Fusulines from the Ryukyu Islands, Pt. 3, Iheya-jima 2, Tonaki-jima and Okinawa-jima : Paleontological Study of the Ryukyu Islands-X

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Fusulines from the Ryukyu Islands, Pt. 3, Iheya-jima 2, Tonaki-jima and Okinawa-jima

(Paleontological Study of the Ryukyu Islands-X)

Takeshi ISHIBASHI

Abstract

This paper is Part 3 of a series of papers on fusulines from the Ryukyu Islands. Twenty-one Permian fusuline species of thirteen genera are paleontologically described from Iheya-jima, Tonaki-jima and Okinawa-jima. The fusuline faunas of the Ryukyu Islands are in common with those of Japanese main Islands and China, and only a few species show affinity with species of North America and other regions of the Tethys realm.

Introduction

The study of Paleozoic fusulines in the Ryukyu Islands has been begun by HANZAWA (1933) from the limestone which is distributed at the Motobu Peninsula, Okinawa-jima. The second report on fusulines was of KONISHI (1964) from Tonaki-jima.

I reported some fusulines from Iheya-jima (ISHIBASHI, 1968) and Amami-oshima (ISHIBASHI, 1969), and described them in Parts 1 (1983) and 2 (1984), respectively under the same title. This paper systematically describes Permian fusulines collected from Iheya-jima, Tonaki-jima and Okinawa-jima (Fig. 1).

I would like to express my sincere thanks to Professor Ryuzo TORIYAMA of Fukuoka University for his reading the manuscript and facilities of using his library on fusulines and encouradgement. My deep appreciation extends to Professor Kenji KONISHI of Kanazawa University who kindly offered some specimens of Tonaki-jima.

1. Amami-oshima

The fusulines described and illustrated from the Naon Formation of Amami-oshima are as follows;

Yabeina katoi, Neoschwagerina margaritae, Neoschwagerina craticulifera, Neoschwagerina minoensis, Neoschwagerina sp., *Misellina* sp., *Maklaya* sp., *Presumatrina neoschwagerinoides, Parafusulina* sp., *Nankinella* sp. A and sp. B, *Dunbarula* sp., *Reichelina* sp. A and sp. B, and *Leella grossa.* These fusulines are associated with some small foraminifers and calcareous algae.

The limestone lentils occur in conglomeratic beds in the lower and middle parts of the Naon Formation. The Naon Formation had been considered to

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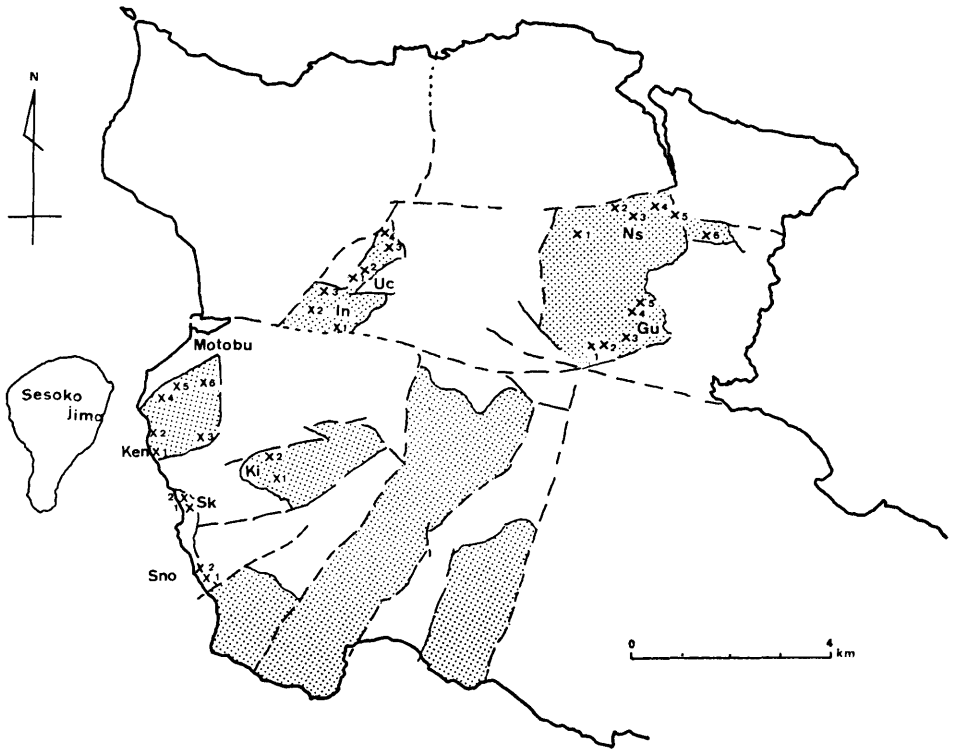


Fig. 1. Map showing main fusuline localities (X) in the Motobu Peninsula of Okinawa-jima. The dotted areas are composed of Permian limestone beds.

be the Permian in age, but it is at present referred to as the Mesozoic on the basis of microfossils (i.e., OSOZAWA, S. *et al.*, 1983).

2. Tonaki-jima

Tonaki-jima is an islet situated about 70 km west of Naha City of Okinawa. KONISHI (1964) studied the geology of the island and tectonic setting in the Ryukyu Islands Arc. The following fusuline species have been illustrated by him at that time; *Yabeina* cf. *globosa* (YABE), *Neoschwagerina* sp., *Schwagerina* (or *Chusenella*? sp., *Schubertella* (or *Chusenella*?) sp., and *Kahlerina* sp. These species were collected from the Nagasakibara limestone lentil of Otake Dolostone Member of the Tonaki Formation. Two species of them are described in this paper.

3. Iheya-jima

The general geology of Iheya-jima was reported by ISHIBASHI (1968) who listed some Carboniferous and Permian fusulines from the Iheya and Maedake Formations. This was the first discovery of the Carboneferous fusulines from the Ryukyu Islands. A half of these fusulines have been described in Pt. 2 (ISHIBASHI, 1984) under the same title as this paper. The fusuline faunas obtained up to the present are as follows;

Iheya Formation

**Nankinella* sp., **Staffella* sp., *Fusulinella* cfr. *itadorigawaensis* ISHII, *Beedeina higoensis* (KANMERA), *Protriticites* sp., **Pseudoschwagerina* sp., *Pseudofusulinella* sp., *Triticites samaricus* RAUSER-CERNOUSOVA, *Hemifusulina*? sp., *Pseudofusulina regularis* (SCHELLWIEN), *Pseudofusulina aganoensis* FUZIMOTO, *Schwagerina* cf. *krotowi* (SCHELLWIEN), *Parafusulina gruperaensis* (THOMPSON and MILLER).

Maedake Formation

Reichelina chichibuensis MORIKAWA, *Rauserella* sp., *Schubertella* sp., *Triticites* sp., *Pseudofusulina* sp., *Pseudofusulina vulgaris* (SCHELLWIEN), *Pseudofusulina* aff. *laevicula* MORIKAWA, *Eoparafusulina* (*Mccloudia*) cfr. *tarda* SKINNER and WILDE, *Parafusulina gruperaensis* (THOMPSON and MILLER), *Parafusulina* cf. *kaerimizuensis* (OZAWA), *Parafusulina* sp., *Nagatoella kobayashii* THOMPSON, *Misellina* (*Misellina*) *claudiae* (DEPRAT), *Maklaya pamirica* (LEVEN), *Neoschwagerina* cfr. *muratai* MORIKAWA, *Neoschwagerina craticulifera* (SCHWAGER), *Neoschwagerina craticulifera occidentalis* KOCHANSKY-DEVIDE, *Yabeina* cfr. *igoi* MORIKAWA and SUZUKI, *Yabeina globosa* (YABE).

The limestone lenses intercalated at three horizons in black slate of the Iheya Formation at Yahei yield fusulines ranging in age from Middle Carboniferous to upper Lower Permian. The limestone lens at loc. 1–4 contains *Fusulinella* cf. *itadorigawaensis* and *Schwagerina* cfr. *krotowi, Parafusulina gruperaensis*. The first species was found in a limestone specimen in association with abundant *Chaetetes*, while the latter two from an oolitic limestone specimen, but these specimens were collected from the same limestone lens. The lenticular limestones and chert and sandstone layers in the Iheya Formation are supposed to be olistoliths on the basis of occurrence of fusulines.

4. Motobu Peninsula, Okinawa-jima

The geology of the Motobu Peninsula has been briefly described by ISHIBASHI (1969). After that FUJITA (1983) mapped the Motobu Peninsula area in detail, and made clear that the Paleozoic and Mesozoic rocks of the area are chaotic deposits comprising blocks of Permian to late Triassic rocks.

The first record of fusulines was made at about 500 m south of Tamagusuku, Nakasone area, Nakijin-son (village) by HANZAWA (1933) who listed the following species; *Neoschwagerina* sp., *Paleofusulina* (= *Pseudofusulina*) sp., *Verbeekina douvillei* (DEPRAT). The present paper deals with 11 species of 7 genera, namely *Boultonia* cfr. *erki* SKINNER, *Chusenella* (*Sosioella*) *kiyoharai* (MORIKAWA), *Pseudofusulina* sp. A, *Verbeekina verbeeki* (GEINITZ), *Presumatrina* cfr. *neoschwagerinoides* (DEPRAT), *Neoschwagerina* cfr. *muratai* MORIKAWA and SUZUKI, *Neoschwagerina craticulifera* (SCHWAGER), *Neoschwagerina margaritae* DEPART, *Yabeina globosa* (YABE), *Sumatrina annae* VOLZ and *Sumatrina longissima* DEPRAT.

* Undescribed in this paper.

Systematic Paleontology

Family Ozawainellidae THOMPSON and FOSTER, 1937

Genus *Reichelina* ERK, 1941

Type-species.—*Reichelina cribroseptata* ERK, 1941

Reichelina chichibuensis MORIKAWA

Pl. 13, Figs. 1–9

1956. *Reichelina chichibuensis*, MORIKAWA; *Sci. Repts., Saitama Univ.*, [B], 2, p. 251–252, pl. 32, figs. 1–11, 13 and 17.

Material.—A considerable number of specimens have been obtained from the limestone breccia of the Maedake Formation. Nine specimens are here illustrated.

Description.—Shell very minute in size with rounded periphery and very obtuse polar extremities and coils tightly in inner three volutions, but expands like flar in outer volution forming a horn-like to shell. One of mature shells (Pl. 13, Fig. 1) of 4½ volutions 0.34 mm in axial length and 1.32 mm in width including flaring lip.

Proloculus very small and spherical with outside diameter of 42 microns in average. Spirotheca very thin, 5 to 7 microns in thickness. Septa thinner than spirotheca with interval of 60–85 microns and gently arcuate anteriorly. Interval considerably wider at uncoiled part. Secondary deposits concentrate on the outer part of spirotheca of coiled shells. Chomata poorly develop and tunnel angle very narrow about 10 degrees.

Remarks.—The present specimens with rather large shells and wider flars are identical with *Reichelina chichibuensis* described by MORIKAWA (1956) from Onagata, Chichibu of Kanto, central Japan in shell-size, thickness of spirotheca and characteristics of last volutions excepting for deposits on spirotheca in Okinawa's specimens. The type-species, *Reichelina cribroseptata,* originally described by ERK (1941) from Turkey, can be distinguished from Okinawa's species in having large shell and a poor development of a horn-like flaring terminus with heavy deposits on the disphanotheca.

Some smaller species belonging to *Reichelina* are reported from Japan, *R. matsushitai* described by NOGAMI (1958) from Atetsu, Hiroshima Prefecture and *R. changhsingensis* by SAKAGAMI (1980) from Akasaka, Gifu Prefecture respectively. These species have smaller shells and higher, slender horn-like volutions, and occur in higher stratigraphic horizon.

Occurrence.—Locality Ihyg. *Reichelina chichibuensis* occurs in the limestone breccias in the uppermost of the Maedake Formation at Yahei, northern part of the Iheya-jima.

Genus *Rauserella* DUNBAR, 1948

Type-species.—*Rauserella erratica* DUNBAR, 1948

Rauserella sp. indet.

Pl. 13, Figs. 12–14

Material.—Three specimens collected from the limestone breccias of the Maedake Formation, Iheya-jima are examined.

Descriptive remarks.—Shell is small in size and irregularly fusiform. Inner volutions are discoidal with short axis of coiling and rounded periphery and outer volutions have subsylindrical and asymmetrical structure to inner volutions.

Chomata are indistinct. Septa are plane throughout shell. Spirotheca is relative thick, 10 microns and is composed of tectum and disphanotheca? The present specimens are apparently similar to species of *Toriyamaia* but differ from the latter in having short axis of coiling perpendicular to outer volutions.

Rauserella sp. reported by MORIKAWA (1956) from Onagata, Kanto is somewhat similar to the present species but the former has large shell and thicker spirotheca. KOBAYASHI (1957) illustrated three species of *Rauserella* from the Ibukiyama limestone, central Japan, one of which, *Rauserella* sp. (Pl. 13, Figs. 15, 16) seemingly has similar characters on shell-size, wall and coiling of inner volution. However he did not give the description for this species.

Occurrence.—Locality Ihmb. The present material was collected from the limestone breccias of the Maedake Formation, Iheya-jima.

Family Schubertellidae SKINNER, 1931

Subfamily Schubertellinae SKINNER, 1931

Genus *Schubertella* STAFF and WEDEKIND, 1910

Type-species.—*Schubertella transitoria* STAFF and WEDEKIND, 1910

Schubertella sp. indet.

Pl. 13, Figs. 10, 11

Material.—One axial (slightly oblique) and a tangential sections are here examined.

Descriptive remarks.—Shell is fusiform and rather large for the genus. It has pointed poles, convex lateral slopes with 1.11 mm in length and 0.68 mm in width (Pl. 13, Fig. 11), giving a form ratio of 1.6. Early volutions are subspherical in form, tightly coiled, and their axis of coiling perpendicular to outer ones. Outer four volutions increase their height abruptly.

Proloculus is unknown at the present material. Spirotheca is thin, about 30 ? microns in average and composed of tectum and diaphanotheca. Septa are unfluted throughout shell. Chomata well develop in third and fourth volutions, those of fourth volution is the highest and nearly reaches to next volution. Tunnel is rather narrow, with tunnel angle of about 22 degrees.

The present specimens closely resemble *Schubertella giraudi* described by LIU *et al.* (1978) from Kueichow, southwest China in having inflated biconical shell, plain septa, high chomata and narrow tunnel angles. The specimens reported under the same specific name by KANMERA (1963) from the Kozaki Formation, southern Kyushu are very similar to Okinawa's specimens in many respects. The holotype of *Sch. giraudi* described by DEPRAT (1915) under the name of *Neofusulinella* is also very similar to the present specimens but the

latter has larger shell and thinner spirotheca. For final identification further material is necessary.

Occurrence.—*Schubertella* sp. was collected from the limestone breccias of the locality Ihyg, Iheya-jima.

Subfamily Boultoninae SKINNER and WILDE, 1954

Genus *Boultonia* LEE, 1927

Type-species.—*Boultonia willsi* LEE, 1927

Boultonia cfr. *erki* SKINNER

Pl. 13, Figs. 15–30

1969. *Boultonia erki* SKINNER, *Univ. Kansas, Paleont. Contr., Pap.* **36**, p. 6–7, pl. 8, figs. 1–10; pl. 9, fig. 1.

Material.—A number of specimens was collected from the Motobu Peninsula, Okinawa-jima. Sixteen specimens are here examined.

Descriptive remarks.—Shell is minute, fusiform with bluntly pointed poles. Mature specimens have three to four volutions but inner volutions can not clearly be observed due to the presence of calcite veins. Proloculus minute, about 97 microns in outside diameter (Pl. 13, Figs. 15). Last volution is tendency to increase its high abruptly.

Spirotheca is thin, consisting of tectum and diaphanotheca. Its thickness is 11 microns in average at fourth volution. Septa are strongly fluted from pole to pole, folds about a half of chamber height. They are irregular in thickness from inner to outer volutions. Chomata well develop and reach a half of distance from tunnel to pole. Tunnel is narrow.

Boultonia erki associated with *Paradunbarula dallyi* was originally described by SKINNER (1969) from the limestone (Zone of *Yabeina*), south-southwest of Ankara, Turkey. Many interveining calcite and secondary deformation make the preservation of the present specimens poor. Although the Okinawa's specimens are closely identical with *B. erki* in essential characteris-

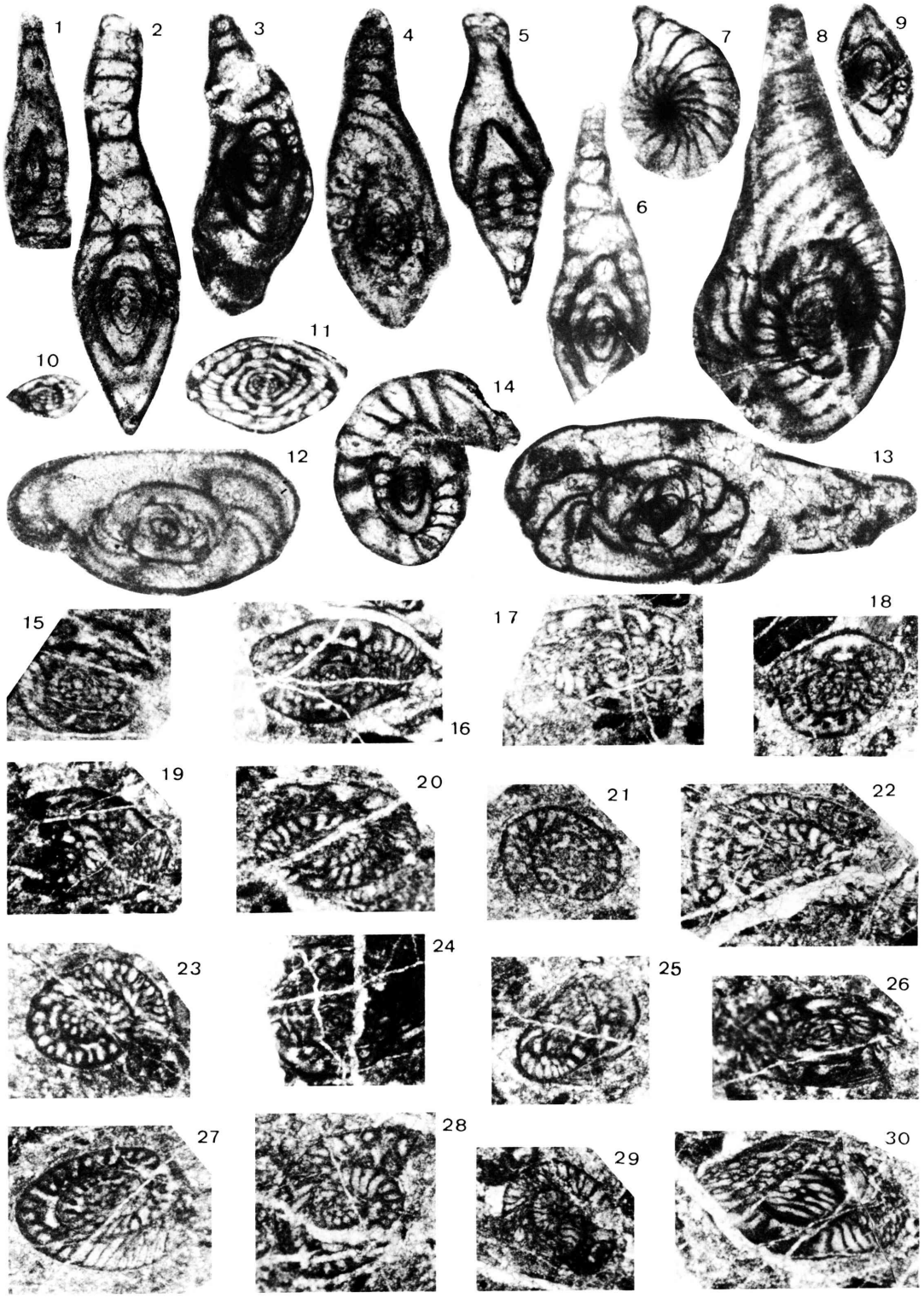
Explanation of Plate 13

Figs. 1–9. *Reichelina chichibuensis* MORIKAWA .....Page 98
1, 3, 5 and 9. Tangential sections (GK. D 20155, 20157, 20159 and 20163): 2 and 6. Axial sections (GK. D 20156 and 20160): 4 and 8. Centered oblique sections (GK. D 20158 and 20162) ×50.

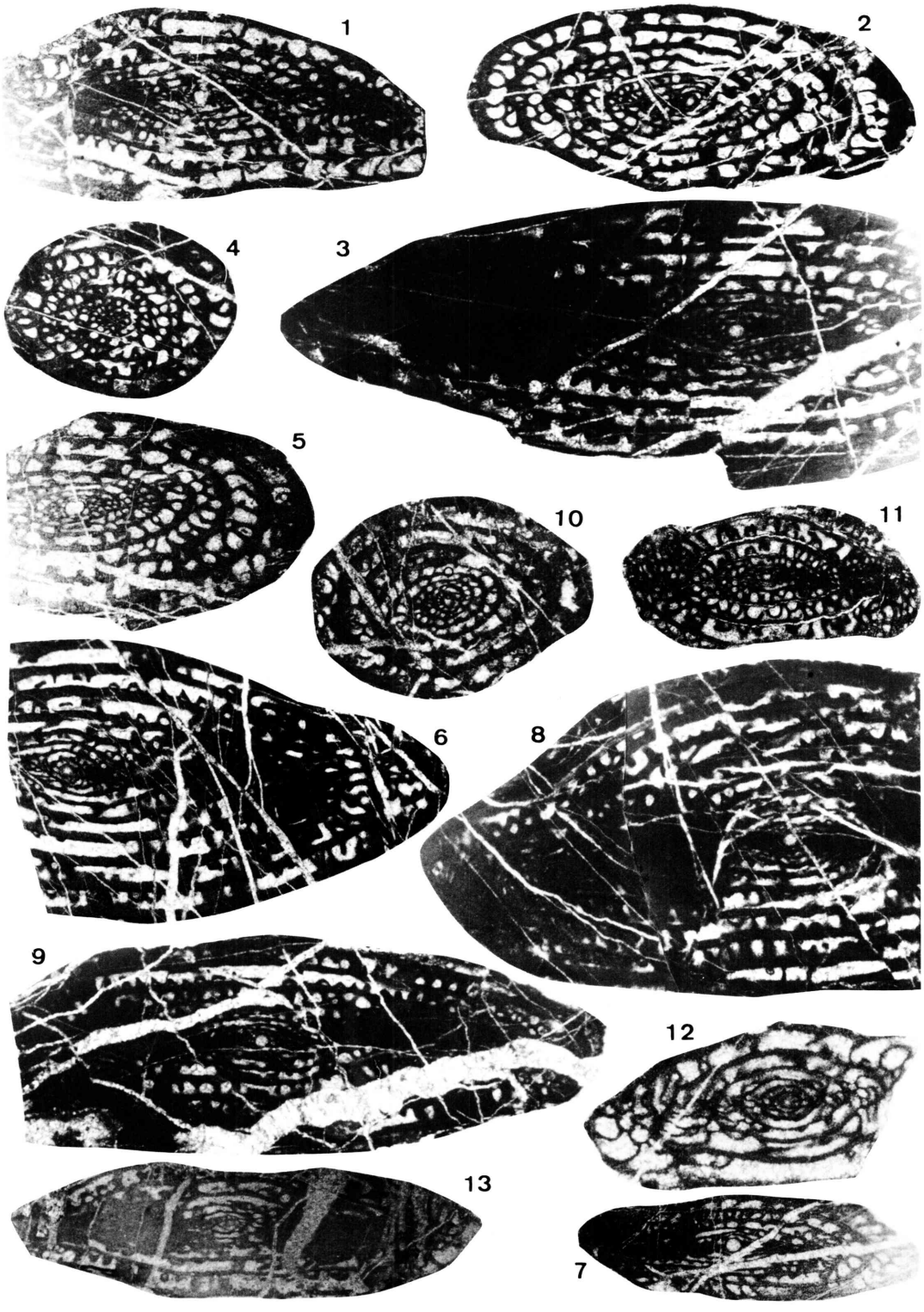
Figs. 10–11. *Schubertella* sp. indet. .....Page 99
10. Oblique section (GK. D 20164): 11. Axial (slightly oblique) section (GK. D 20165) ×20.

Figs. 12–14. *Rauserella* sp. indet. .....Page 98
12 and 13. Axial (slightly oblique) sections (GK. D 20166 and 20167): Sagittal section (GK. D 20168) ×20.

Figs. 15–30. *Boultonia* cfr. *erki* SKINNER .....Page 100
15, 20–24, 25, 27–29. Sagittal (slightly oblique) sections (GK. D 20169, 20174–20178, 20179, 20181–20183): 16–17, 19, 26. Centered oblique sections (GK. D 20170–20171, 20173, 20180): 18. Axial section (GK. D 20172) ×20



T. ISHIBASHI: Okinawa Fusulines



T. ISHIBASHI: Okinawa Fusulines

tics observed in many thin sections, they have larger shell and proloculus. It may probably be referable to the species under consideration.

Occurrence.—The material was collected from the limestone found at locality Uc-1, near Uhudo of the Motobu Peninsula, Okinawa-jima.

Family Schwagerinidae DUNBAR and HENBEST, 1930

Genus *Chusenella* HSU, 1942 emend. CHEN, 1956

(= *Orientoschwagerina* MIKLUKHO-MAKLAY, 1955)

Type-species.—Chusenella ishanensis HSU, 1942

Subgenus *Sosioella* SKINNER and WILDE, 1966

Type-species.—Sosioella sosioensis PASINI, 1964

Chusenella (Sosioella) ? sp. indet.

Pl. 15, Fig. 1

Material.—An axial (slightly tangential) and five oblique sections were obtained from the limestone breccia in dolomitic limestone layer of Tonaki-jima. This material (No. KK63100–100) was collected by Dr. Kenji KONISHI.

Descriptive remarks.—One axial specimen here illustrated has very large shell. Shell is fusiform with more than 12.1 mm in length and 5.95 mm width with gently convex lateral slopes. The inner five volutions tightly coiled, and the following five volutions expand rapidly. Proloculus can not be measured exactly, but a part of its outer portion is found in thin section. It has very small diameter.

Radius vectors of the first to eighth volutions are 90?, 182, 303, 558, 851, 1300, 1767, and 2022? microns, respectively. Spirotheca consists of tectum and alveolar keriotheca. Thickness of spirotheca in the fifth to eighth volutions are 114, 165, 177, and 204 microns, respectively. Septa are plane in inner five volutions and strongly fluting in outer volutions. Septal flutings reach a half to tops of chamber.

Subgenus *Sosioella* of genus *Chusenella* was established by SKINNER and WILDE (1966b), who designated *Chusenella sosioensis* collected from Sicily as the type-species. Although the polar regions of the present specimen has been

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Explanation of Plate 14

All ×10

Figs. 1–10. *Chusenella (Sosioella) kiyoharai* (MORIKAWA) .....Page 102
1, 3, 6, 8 and 9. Axial sections (GK. D 20185, 20187, 20190, 20192 and 20193): 2 and 5. Centered oblique sections (GK. D 20186 and 20189): 4. Oblique section (GK. D 20188): 10. Sagittal section (GK. D 20194)

Fig. 11. *Eoparafusulina (Mccloudia)* cfr. *tarda* SKINNER .....Page 104
Axial section (GK. D 20195)

Fig. 12. *Triticites* sp. indet. .....Page 103
Axial section (GK. D 20196)

Fig. 13. *Pseudofusulina* sp. A .....Page 103
Axial (slightly tangential) section (GK. D 20197)

missing, several important characteristics of *Sosioella* have been observed in the present specimen. These characteristics are partly in common with those of *Chusenella* and *Rugosochusenella*.

It needs more sufficient material to determine the true nature of this species.

Occurrence.—The present specimen occurs in the limestone breccia of the Tonaki Formation, Tonaki-jima.

Chusenella (*Sosioella*) *kiyoharai* (MORIKAWA)
Pl. 14, Figs. 1–10

1960. *Pseudofusulina kiyoharai* MORIKAWA; *Sci. Repts., Saitama Univ.*, [B], 3, p. 286–287, pl. 50, figs. 1–7.
1960. *Pseudofusulina paramotohashii* MORIKAWA; *Ibid.*, p. 284–285, pl. 49, figs. 7–11.

Material.—Ten selected specimens are described and illustrated. All thin sections were made from one hand specimen.

Description.—Shell medium to large fusiform with cylindorical median portion, gently convex, straight or slightly concave lateral slopes, and rounded poles. One of the mature shells (Pl. 14, Fig. 3) has axial length (twice half length) 13.98 mm and width 2.90 mm, giving form ratios 4.82. Expansion of shell slow throughout growth. Inner two or three volutions rather tightly coiled, outer volutions gradually increase height of chamber. Ratios of half length to radius vector are difficult to measure.

Proloculus round to subspherical and small in size, having maximum outside diameter of 255 microns, and ratio of its diameter to width of shell 1:22.

Spirotheca consists of tectum and keriotheca. It is thin in inner two or three volutions and gradually increase thickness in outer volutions. Thickness of spirotheca in the first to sixth volutions in seven specimens averages 23, 30, 36, 57, 78, and 110 microns, respectively. Septa fluted throughout length of shell, though weekly fluted at central part of shell, and septal fluting is irregular in shape and height. Dense deposits fill axial regions in inner five to seven volutions. Tunnel low and rather broad, with tunnel angles of 24, 32, 46 and 46 degrees, respectively in Pl. 14 Fig. 8 (GK. D 20192).

Remarks.—The present species was originally established by MORIKAWA (1960) from the Iwaizaki Limestone as a species of genus *Pseudofusulina*. The Iwaizaki's specimens have the diagonosistic characteristics of subgenus *Sosioella* of *Chusenella* (SKINNER and WILDE, 1966). *"Pseudofusulina" paramotohashi* described by MORIKAWA at the same time is considered to be conspecific with *Chusenella* (*Socioella*) *kiyoharai*. Both are common with each other in the essential characters of septa, spirotheca and height of volution though the former has hexagonal shape probably due to the secondary deformation.

The present specimens are referred to *Chusenella* (*Sosioella*) *kiyoharai*, having the diagonostic characters given by MORIKAWA. Some specimens of *Pseudofusulina norikurensis* (i.e., MORIKAWA and ISOMI, 1961) and *P. ambigua*

(i.e., KOBAYASHI, 1957) are somewhat similar to the present specimens, but they differ from the latter in their larger proloculus and more loosely coiled inner three or four volutions.

Occurrence.—The material was collected from the limestone found at locality In-2, near Inoha Primary School, Motobu-cho, the Motobu Peninsula, and includes *Sumatrina longissima, Verbeekina verbeeki* and *Neoschwagerina craticulifera.*

Genus *Pseudofusulina* DUNBAR and SKINNER, 1931

Type-species.—Pseudofusulina huecoensis DUNBAR and SKINNER, 1931

Pseudofusulina sp. A

Pl. 14, Fig. 13

Material.—One axial (slightly tangential) specimen comes to hand.

Descriptive remarks.—Shell is small, cylindrical fusiform with rounded poles. Only available section is 7.2 mm length and 2.2 mm width, giving form ratio of 3.3. Shell expands slowly and uniformly. Proloculus is not observable. Spirotheca is thin, composed of tectum and keriotheca, with a thickness of 20, 21, 25, 49, 54, 68, and 109 microns, respectively in seven volutions. Septa flute throughout length of shell. Calcite deposits fill axial regions of inner four volutions. Tunnel is low with rather wide angle.

Since only a single section, which is not exactly oriented, has been available for *Pseudofusulina* sp., the specific name is not discussed in detail here. However some allied species have been reported from Japan and China. *Schwagerina japonica* described by MORIKAWA (1955) is somewhat similar to the present species but the former has regular septal fluting and larger proloculus. The microphotographs illustrated in plate XIV, figs. 11–12 by MORIKAWA are discordant to his description and measurements.

The present specimen closely resembles *Pseudofusulina gregaria* LEE reported by CHEN (1934), but the latter has strong septal fluting throughout the shell and more dense axial fillings.

Occurrence.—The material was collected from the limestone layer at locality Sno-1, Shiokawa in the Motobu Peninsula and includes *Yabeina katoi* in the same thin section.

Genus *Triticites* GIRTY, 1904

Type-species.—Miliolites secalius SAY, 1923

Triticites sp. indet.

Pl. 14, Fig. 12

Material.—Only one slightly oblique section is here examined.

Descriptive remarks.—Shell is small, inflated fusiform with gently convex lateral slopes. Axial length (twice half length) and median which are 3.15 mm and 1.21 mm, respectively, giving form ratio of 2.60. Inner three volutions show rather fusiform. Average ratios of half length to radius vector of the first to sixth volutions are 1.55, 1.89, 1.98, 2.22, 2.65 and 2.08, respectively.

A part of proloculus is observed. Shell expands relatively rapidly and radius vectors of the first to sixth volutions are 67, 114, 174, 253, 383, and 583 microns, respectively. Spirotheca is moderate in thickness and is composed of tectum and keriotheca, which gradually increases thickness. Septa flute intensely in axial regions, but no axial fillings developed. Tunnel is low and moderate in width. Chomata are recognized at the first to fourth volutions. Tunnel angels from the first to fourth volutions are 29, 43, 52, and 55 degrees, respectively.

Although the present specimen is very insufficient in number to describe the species, it is somewhat similar to *Triticites haydeni* (OZAWA) reported by TORIYAMA (1958) from the Akiyoshi Limestone. The locality of the type-species originally described by OZAWA (1925) is different from TORIYAMA's locality Akiyoshi Plateau. The present specimen has smaller form ratio and proloculus, and weaker septal fluting. Further study on more sufficient material is necessary before the definite spcific assignment of this form is done.

Occurrence.—*Triticites* sp. was collected from the limestone conglomerate distributing at locality Ihyg, Yahei, Iheya-jima.

Genus *Eoparafusulina* COOGAN, 1960

(= *Alaskanella* SKINNER and WILDE, 1966)

Type-species.—*Fusulina gracilis* MEEK, 1864

Subgenus *Mccloudia* ROSS, 1967

Type-species.—*Eoparafusulina contracta* SKINNER and WILDE, 1965

Eoparafusulina (*Mccloudia*) cfr. *tarda* SKINNER and WILDE

Pl. 14, Fig. 11

1965. *Eoparafusulina tarda* SKINNER and WILDE; *Univ. Kansas Paleont. Contr., Protoza*, art. 6, p. 83, pl. 45, figs. 1–7.

Material.—Only a single axial section was obtained from the limestone breccias of the Maedake Formation.

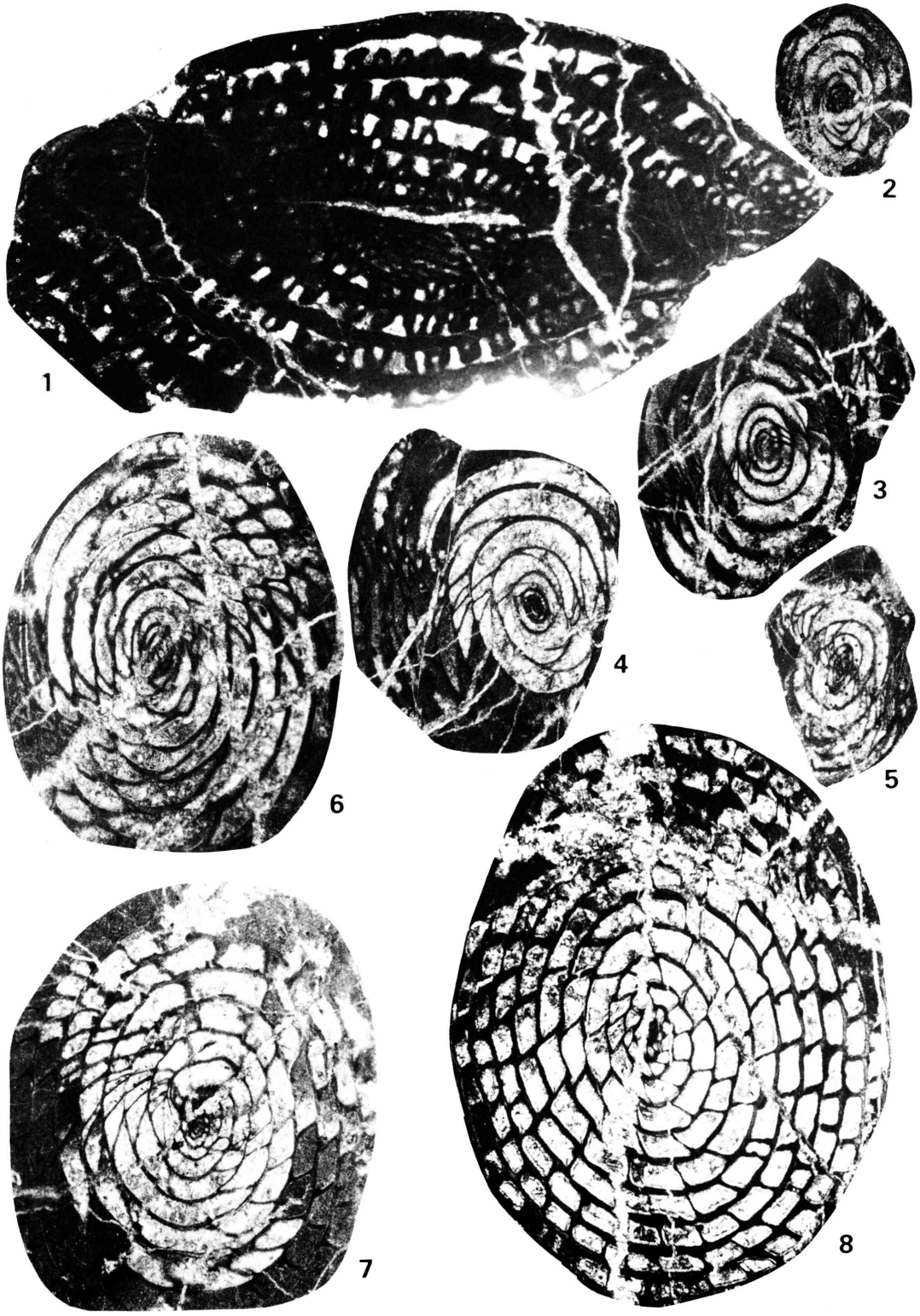
Description.—Shell moderate in size, cylindrical with broadly rounded poles, and a straight axis of coiling. Specimen with five and a half volutions measured 2.0 mm in length and 0.94 mm in width, giving a form ratio of 2.13. Shell fusiform in inner volutions and expands gradually and uniformly in outer ones. Ratios of half length to radius vector 1.23, 2.03, 2.44, 2.19, and 2.07, respectively.

Explanation of Plate 15

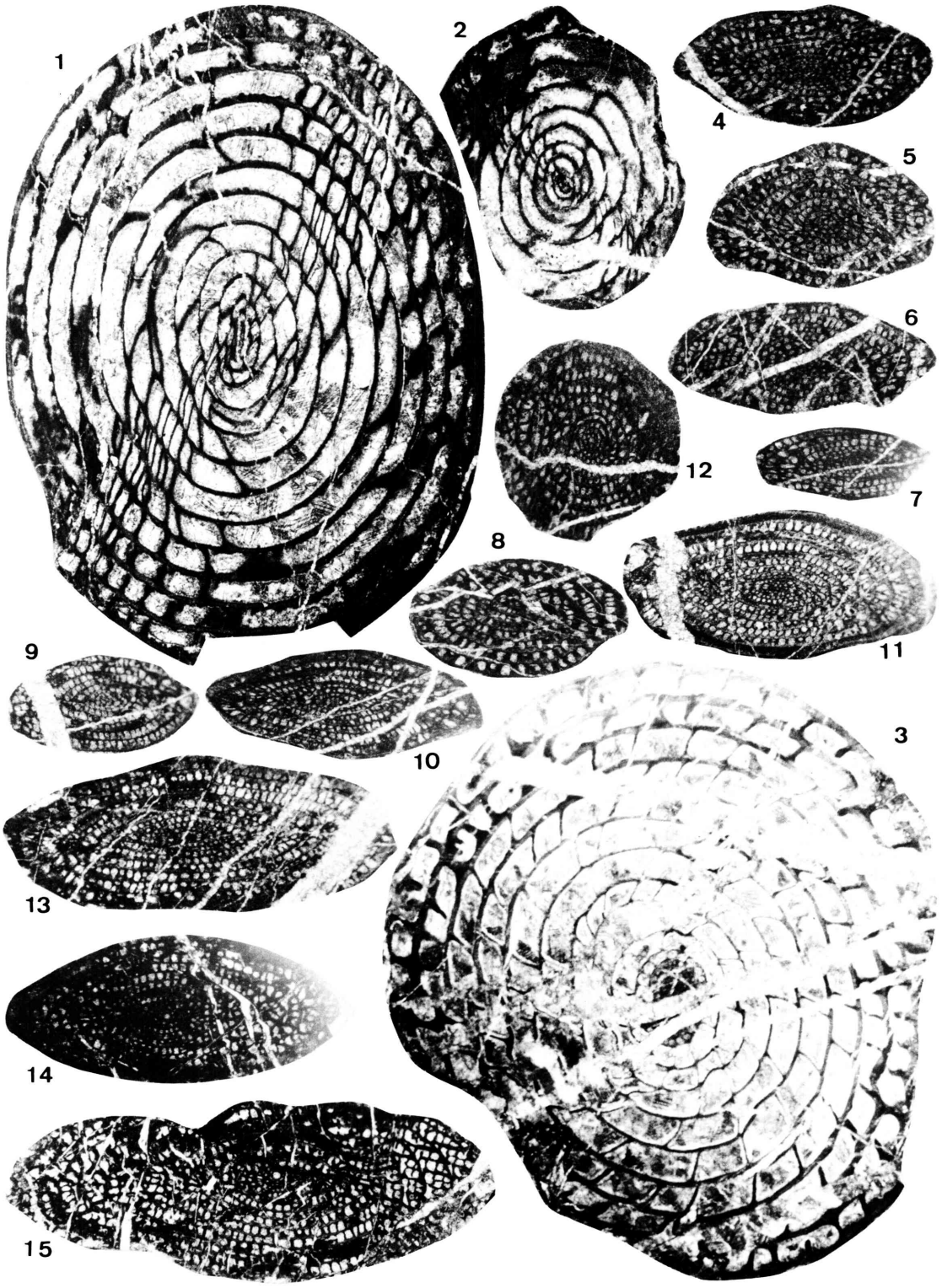
All ×10

Fig. 1. *Chusenella* (*Socioella*) ? sp. indet. .....Page 101
Tangential section (GK. D 20198)

Figs. 2–8. *Verbeekina verbeeki* (GEINITZ) .....Page 105
2–5. Centered oblique sections (GK. D 20199–20202): 6 and 7. Oblique sections (GK. D) 20203–20204): 8. Sagittal section (GK. D 20205). See Pl. 16, Figs. 1–3.



T. ISHIBASHI: Okinawa Fusulines



T. ISHIBASHI: Okinawa Fusulines

Proloculus small, its outside diameter 129 × 168 microns. Radius vectors of the first to fifth volutions 88, 163, 252, 471, and 764 microns, respectively. Spirotheca composed of tectum and alveolar keriotheca. Its thickness 7.5, 21, 22, 42, and 49 microns, respectively in the first to fifth volutions.

Septa strongly and regularly fluted from pole to pole. Tips of fluting reach tops of chamber. Tunnel low and rather broad, with tunnel angles of 17, 26, and 42, respectively in the first to third volutions.

Though the present material is too insufficient in number to make a specific assignment, the important characteristics of shell are observed. The present specimen is almost referable to *Eoparafusulina tarda* described by SKINNER and WILDE from the McCloud Limestone of California in many shell characters. The genus *Eoparafusulina* was established by COOGAN (1960), and later subdivided by ROSS (1967) into two subgenera, *Eoparafusulina* and *Mccloudia*. This species is included in the subgenus *Mccloudia* along with several species of *Eoparafusulina*. Some species such as *Eoparafusulina* (*Mccloudia*) *contracta*, *E.* (*M.*) *ovata* are similar to the present species, but the latter is distinguished from the formers in having larger shell and stronger septal fluting in axial region.

The present specimen resembles *Pseudofusulina* aff. *laevicula* known from the locality Ihmb of the Maedake Formation but the latter has larger shell of subcylindrical fusiform and weaker septal fluting.

Occurrence.—This material occurs in the limestone breccias found at locality Ihyg, Yahei, northern part of Iheya-jima.

Superfamily Verbeekinoidae STAFF and WEDEKIND, 1910

Family Verbeekinidae STAFF and WEDEKIND, 1910

Genus *Verbeekina* STAFF, 1909

Type-species.—*Fusulina verbeeki* GEINITZ, 1876

Verbeekina verbeeki (GEINITZ)

Pl. 15, Figs. 2–8; Pl. 16, Figs. 1–3

1876. *Fusulina verbeeki* GEINITZ, *Palaeontographic*, 22, p. 399, 400.
1912. *Schwagerina verbeeki*, DEPRAT; *Mém. Serv. Géol. l'Indochine*, tome 1, fasc. 3, p. 40–41, text-fig. 24, pl. 1, figs. 7–11.

Explanation of Plate 16

All ×10

Figs. 1–3. *Verbeekina verbeeki* (GEINITZ) .....Page 105
1–2. Oblique sections (GK. D 20206–20207): 3. Sagittal section (GK. D 20208). See Pl. 15, Figs. 2–8.

Figs. 4–10. *Presumatrina* cfr. *neoschwagerinoides* (DEPRAT) .....Page 118
4–6 and 8. Oblique sections (GK. D 20209–20211 and 20213): 7 and 10. Slightly tangential sections (GK. D 20212 and 20215): 9. Tangential section (GK.D 20214)

Figs. 11–15. *Neoschwagerina* cfr. *muratai* MORIKAWA and SUZUKI ....Page 107
11 and 13. Tangential sections (GK.D 20216 and 20218): 12. Sagittal section (GK. D 20217): 14–15. Axial sections (GK. D 20219–20220)

1925. *Verbeekina verbeeki*, OZAWA; *Jour. Coll. Sci. Imp. Univ. Tokyo*, **45**, art. 6, p. 48–51, pl. 10, figs. 6.
1933. *Verbeekina douvillei*, HANZAWA; *Japan. Jour. Geol. Geogr.*, **10**, (3–4), pl. 7, fig. 1.
1934. *Verbeekina verbeeki*, CHEN; *Palaeont. Sinica*, [B], **4**, fasc. 2, p. 101–102, pl. 16, fig. 1.
1936. *Verbeekina verbeeki*, THOMPSON; *Jour. Palaeont.* **10** (3), p. 197–200, pl. 24, figs. 1–8.
1936. *Verbeekina verbeeki*, HUZIMOTO; *Sci. Repts. Tokyo Bunrika Daigaku*, [C], **1**, (2), p. 101–104, pl. 9, fig. 8; pl. 21, figs. 1–3.
1955. *Verbeekina verbeeki*, KOCHANSKY-DEVIDÉ and RAMOVS. *Sloenska Akad. Znanosti in Umetn. Akad. Sci. Art. Slovenia*, Cl. 4, Razurave Dissert., p. 389, 416, pl. 4, figs. 1–3.
1956. *Verbeekina verbeeki*, CHEN; *Palaeont. Sinica*, [New B], (6), p. 47, 48, pl. 9, figs. 5, 6; Pl. 13, figs. 1, 2.
1957. *Verbeekina verbeeki*, MIKLUKHO-MAKLAY; *Uchenye Zapiski, Lgu*, (225), p. 113–114, pl. 3, fig. 2.
1957. *Verbeekina verbeeki*, KOBAYASHI; *Sci. Repts. Tokyo Kyoiku Daigaku*, [C], (48), p. 301–302, pl. 9, figs. 5–7.
1958. *Verbeekina verbeeki*, TORIYAMA; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], **7**, p. 205–208, pl. 37, figs. 1–6; pl. 38, figs. 1–6.
1961. *Verbeekina verbeeki*, NOGAMI; *Mem. Coll. Sci. Univ. Kyoto*, [B], **28**, (2), art. 3, p. 167–169, pl. 2, figs. 1–4.
1963. *Verbeekina verbeeki*, SHENG; *Palaeont. Sinica*, [new, B], (10), p. 215–216, pl. 26, figs. 1–5.
1964. *Verbeekina verbeeki*, IGO; *Japan. Jour. Geol. Geogr.*, **35**, (1), p. 62–63, pl. 2, fig. 1.
1964. *Verbeekina verbeeki*, ISHII and NOGAMI; *Jour. Geosci. Osaka City Univ.*, **8**, art. 2, p. 24, pl. 8, figs. 4–6.
1965. *Verbeekina verbeeki* forma A, PITAKPAVIAN; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], **17**, (1), p. 53–54, pl. 6, fig. 5.
1967. *Verbeekina verbeeki*, LEVEN; *Acad. Sci. USSR, Geol. Inst., Transact.*, **167**, p. 205, pl. 28, fig. 1.
1975. *Verbeekina verbeeki*, TORIYAMA; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], **23**, (1), p. 66–68, pl. 14, fig. 12.

Material.—A number of specimens was collected from the limestone of the Motobu Peninsula. Some selected sections are described here.

Description.—Shell rather large and globular in form with straight axis of coiling. Mature specimen of 12 or 13 volutions attains more than 10 mm in length and 10 mm in width. Shell coils tightly in the first to third volutions, and expands rapidly and uniformly in outer volutions. Proloculus very minute. Radius vector of the first to seventh volutions in one specimen (Pl. 15, Fig. 3), 120, 282, 533, 894, 1321, 1823, and 2332 microns, respectively.

Spirotheca thin in inner volutions, and increases thickness in outer four or five volutions, averaging 16, 16, 18, 25, 31, 31, 44, 49, 50, 72, 110, and 123 microns, respectively in the fourth to sixteenth volutions. Parachomata not present in inner volutions and appear in the outrer ones. Its height very low, less than one-fifth or one-sixth of chamber.

Remarks.—This species is one of the best known Permian fusulines. According to OZAWA (1925, p. 51), both *V. douvillei* and *V. pseudoverbeeki* described by DEPRAT (1913) are conspecific with this species. The synonym list

of the species is selected one because this species has been reported by many previous workers from various places in the Tethys regions. *Verbeekina douvillei* collected by HANZAWA (1933) from southern locality of Tamagusuku, the Motobu Peninsula is probably assigned to this species, though only a single oblique section has been illustrated. The present specimens have been collected from several localities, including Hanzawa's locality, of the Motobu Peninsula.

In the present specimens collected from locality In-1, the outer volutions have been replaced by the micritic calcite cements during the diagenesis. The important characteristics observed in the present spcimens are quite in accordance with those of the specimens described by the previous authors.

Occurrence.—The material was collected from several localities in the Motobu Peninsula. *Verbeekina verbeeki* is associated with *Neoschwagerina craticulfera* and *Sumatrina longissima.*

Family Neoschwagerinidae DUNBAR and CONDRA, 1928

Subfamily Neoschwagerininae DUNBAR and CONDRA, 1928

Genus *Neoschwagerina* YABE, 1903

Type-species.—*Schwagerina craticulifera* SCHWAGER, 1883

Neoschwagerina cfr. *muratai* MORIKAWA and SUZUKI

Pl. 16, Figs. 11–15

1961. *Neoschwagerina muratai* MORIKAWA and SUZUKI; *Sci. Repts., Saitama Univ.*, [B], 4, (1), p. 54, 55, pl. 6, fig. 3.

1961. *Neoschwagerina okuboi* MORIKAWA and SUZUKI; *Ibid.*, p. 55–56, pl. 6, fig. 4; pl. 17, figs. 1–8.

1963. *Neoschwagerina muratai*, HANZAWA and MURATA; *Sci. Repts., Tohoku Univ.*,[2nd.], 35, (1), table 2, pl. 4, figs. 1, 2; pl. 16, fig. 4; pl. 19, figs. 2, 5, 6.

Material.—Four axial (slightly tangential) sections and one sagittal section are examined.

Descriptive remarks.—Shell is moderate in size, fusiform with bruntly rounded poles, convex lateral slopes and a straight axis of coiling. One of mature shell has more than ten volutions and is 5.2 mm in half length and 2.0 mm in width. Ratios of half length to radius vector of the first to tenth volutions in three specimens average 1.38, 1.38, 1.48, 1.55, 1.58, 1.68, 1.82, 2.14, 2.18, and 2.25, respectively.

Proloculus is small and spherical with outside diameter 147 to 153 microns in three specimens. Shell coils tightly in two or three volutions, and expands slowly and uniformly in outer volutions. Radius vectors of the first to tenth volutions in one specimen (Pl. 16, Fig. 14) are 98, 178, 259, 343, 455, 570, 700, 836, 979, and 1176 microns, respectively. Spirotheca is very thin and is composed of tectum and very fine alveolar keriotheca, and is 15, 16, 19, 22, 26, 26, 27, 32, 41, and 44 microns in thickness in the first to tenth volutions of the same specimen.

Primary transverse septula are thin and present throughout shell. No secondary transverse septula are observed in most part of shell. Axial septula

are the same a stransverse ones in thickness. No secondary axial septula are present. Parachomata are very high and narrow, having two-thirds of chamber height, and come into contact with lower ends of primary transverse septula.

Neoschwagerina muratai was *described by* MORIKAWA and SUZUKI (1961) from the Akasaka Limestone, along with some allied species such as *N. okuboi*, *N. akasakensis*, and *N. shimensis*. HANZAWA and MURATA (1963) considered that *N. okuboi* was conspecific with *N. muratai*. The present specimens may probably be identified with *N. muratai* MORIKAWA and SUZKI in essential characters, but the former is so insufficient in number for specific identification. I hold the identification until more sufficient mature specimens become available.

Occurrence.—*Neoschwagerina* cfr. *muratai* was collected from the limestone conglomerate of Yahei, locality Ihyg, Iheya-jima and limestone of locality Uc-3 of the Motobu Peninsula, Okinawa-jima.

Neoschwagerina craticulifera (SCHWAGER)
Pl. 17, Figs. 1–12

1883. *Schwagerina craticulifera* SCHWAGER; RICHTHOFEN's China, vol. IV, p. 140, pl. 18, figs. 15–25.
1906. *Neoschwagerina craticulifera*, YABE; *Jour. Coll. Sci. Imp. Univ. Tokyo*, **21**, art. 5, p. 3, pl. 1, fig. 3 (non. fig. 4).
1914. *Neoschwagerina craticulifera*, DEPRAT; *Mém. Serv. Géol. l'Indochine*, **3**, (1), p. 24–26, pl. 7, figs. 4–8.
1925. *Neoschwagerina craticulifera*, OZAWA; *Jour. Coll. Sci. Imp. Univ. Tokyo*, **45**, art. 6, p. 54–55, pl. 2, fig. 8c; pl. 11, fig. 4.
1927. *Neoschwagerina craticulifera*, OZAWA; *Jour. Fac. Sci. Imp. Univ. Tokyo*, sec. II, **2**, pt. 3, p. 154–156, pl. 40, figs. 1–7, 10, 11a.
1933. *Neoschwagerina craticulifera*, LEE; *Mem. Nat. Res. Inst. Geol.* **14**, pl. 5, fig. 1.
1935. *Neoschwagerina craticulifera*, GUBLER; *Mém. Soc. Géeol. France*, (26), p. 103–106. text-fig. 45.
1936. *Neoschwagerina craticulifera*, HUZIMOTO; *Sci. Repts. Tokyo Bunrika Daigaku*, sec. C, **1**, (2), p. 112–113, pl. 22, figs. 6–9; pl. 23, figs. 6, 7.
1942. *Neoschwagerina craticulifera*, TORIYAMA; *Japan. Jour. Geol. Geogr.*, **18**, (4), p. 244–245, pl. 24, fig. 13.
1944. *Neoschwagerina craticulifera*, TORIYAMA; *Ibid.*, **19**, (1–4), p. 81–82, pl. 6, fig. 26.
1947. *Neoschwagerina craticulifera*, TORIYAMA; *Ibid.*, **20**, (2–4), p. 76–77, pl. 17, figs. 4–7.
1956. *Neoschwagerina craticulifera*, CHEN; *Palaeontologia Sinica*, [new, B], (6), p. 56–57, pl. 12, figs. 10–12.
1956. *Neoschwagerina craticulifera*, SHENG; *Acta Pal. Sinica*, p. 219–220, pl. 5, figs. 1–3.
1957. *Neoschwagerina craticulifera*, KOBAYASHI; *Sci. Repts., Tokyo Kyoiku Daigaku*, sec. C, **5**, (48), p. 303–305, pl. 9, figs. 8–13.
1957. *Noeschwagerina craticulifera*, MIKLUCHO-MACLAY, *Uchenye Zapiski Lgu Ser. Geol. Nauk*, **9**, p. 125–126, 129, pl. 6, figs. 1–2.
1958. *Neoschwagerina craticulifera*, SAKAGAMI; *Jour. Hokkaido Gakugei Univ.*, **9**, (2), p. 91, pl. 4, figs. 5–6.
1958. *Neoschwagerina craticulifera*, TORIYAMA; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], **7**, p. 215–220, pl. 40, fig. 1–22, (fig. 10, copied from DEPRAT

1914, pl. 7, fig. 4); pl. 41, figs. 1–5.

1959. *Neoschwagerina craticulifera*, HONJO; *Jour. Fac. Sci., Hokkaido Univ.*, [4], **10**, (1), p. 142–146, pl. 3, figs. 6, 8, 9; pl. 6, figs. 5, 6.

1960. *Neoschwagerina craticulifera*, KANUMA; *Bull. Tokyo Gakugei Univ.*, **11**, p. 68–69, pl. 13, figs. 1, 2.

1961. *Neoschwagerina craticulifera*, NOGAMI; *Mem. Coll. Sci., Kyoto Univ.*, [B], **28**, p. 171–174, pl. 1, figs. 13–16.

1961. *Neoschwagerina craticulifera*, MORIKAWA and SUZUKI; *Sci. Repts. Saitama Univ.*, [B], **4**, (1), p. 59–60, pl. 7, fig. 3; pl. 21, figs. 4, 5.

1961. *Neoschwagerina craticulifera*, SADA; *Jour. Sci., Hiroshima Univ.*, [C], (1), p. 120–122, pl. 13, figs. 1–6; Pl. 14, fig. 5b.

1962. *Neoschwagerina craticulifera*, SUYARI; *Jour. Gakugei, Tokushima Univ.*, [Nat. Sci.], **12**, p. 35, pl. 11, figs. 3, 4.

1963. *Neoschwagerina craticulifera*, SHENG; *Palaeontologia Sinica*, [New, B], (149), p. 233–234, pl. 32, figs. 9–17.

1967. *Neoschwagerina craticulifera*, LEVEN; *Acad. Sci. USSR, Geol. Inst., Transact.* (167), p. 191, pl. 33, fig. 3.

1975. *Neoschwagerina craticulifera*, SHENG and SUN; *Fusulinids from Quinghai*, p. 51, pl. 13, fig. 10.

1979. *Neoschwagerina craticulifera*, TORIYAMA and KANMERA; *Geol. Palaeont. Southeast Asia*, **20**, p. 74, pl. 12, figs. 11–18.

1982. *Neoschwagerina craticulifera*, ZHANG; *Strat. and Palaeont. in W. Sichuan and E. Xizang, China*, Pt. 2, p. 208, pl. 30, fig. 8.

1983. *Neoschwagerina craticulifera*, ISHIBASHI; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], **25**, (1), pl. 13, figs. 10–12.

Material.—A number of thin sections was obtained from Okinawa-jima and Iheya-jima, ten of which are examined here.

Descriptive remarks.—Since the establishment of *Neoschwagerina craticulifera* by SCHWAGER (1983), this species has been one of the best known species in the Permian neoschwagerinids, and described by many previous authors from the Tethys regions. It is, therefore, unnecessary to add further description excepting for giving the following comments. In the Motobu Peninsula of Okinawa-jima, *Neoschwagerina craticulifera* usually occurs in the massive limestone and limestone breccias. Although the specimens from the massive limestone (Pl. 17, Figs. 2 and 3) were secondarily deformed those from limestone breccia of the Maedake Formation in Iheya-jima are considerably well preserved and are associated with *Misellina claudiae, Nagatoella kobayashii* and *Neoschwagerina margaritae.*

Neoschwagerina sp. reported by HANZAWA (1933) from Paleozoic limestone of the Motobu Peninsula is probably referable to *N. craticulifera.* I found this species along with *Verbeekina verbeeki* from the same locality. This species from Amami-oshima was illustrated by microphotographs without any description (ISHIBASHI, 1983).

Occurrence.—*Neoschwagerina craticulifera* was collected at the locality Ihmb in Iheya-jima, at many localities in the Motobu Peninsula of Okinawa-jima and at the locality 10 in Amami-oshima, Ryukyu Islands.

Neoschwagerina margaritae DEPRAT
Pl. 17, Figs. 13–14; Pl. 18, Figs. 1–10

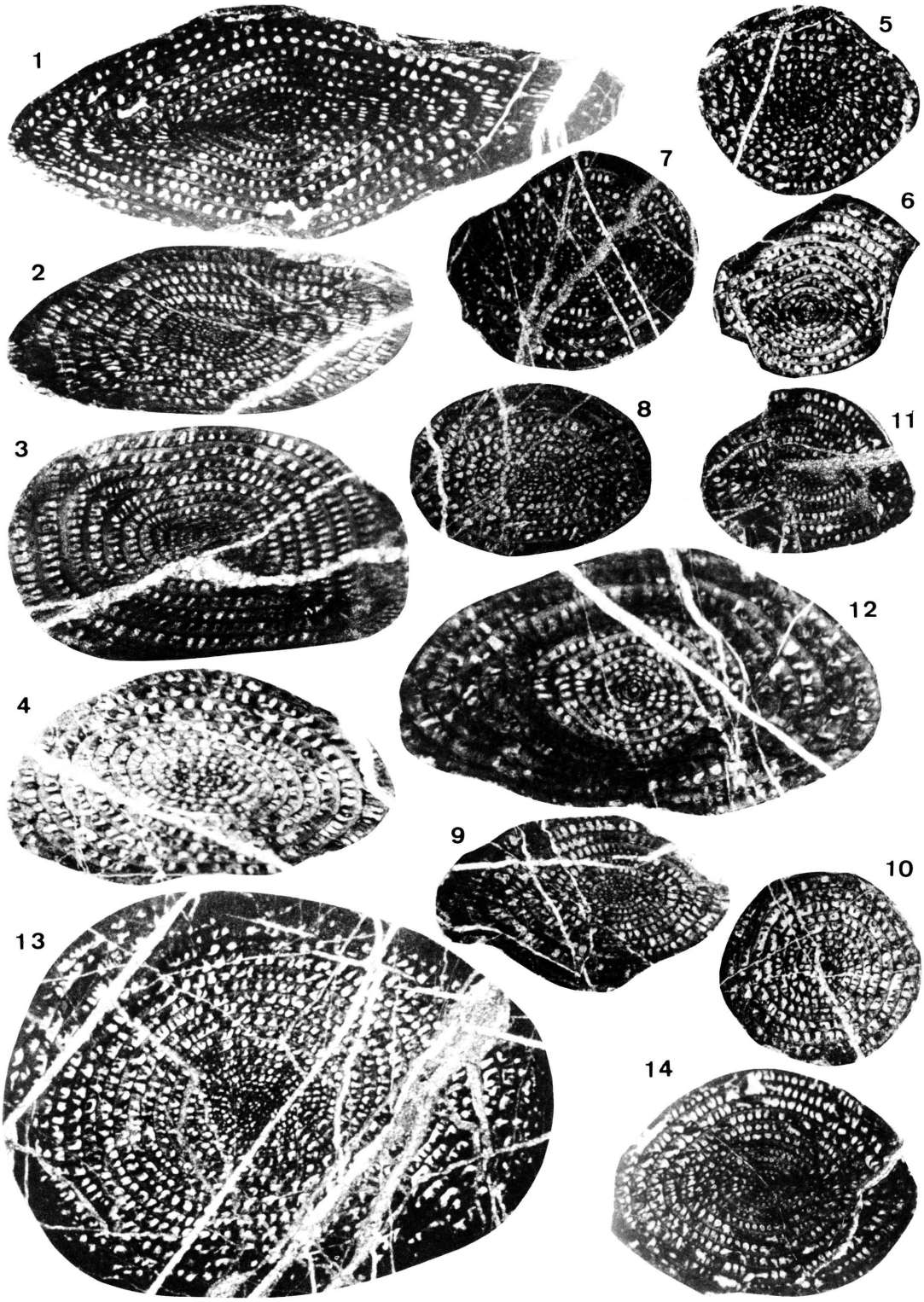
1913. *Neoachwagerina (Neoschwagerina) margaritae* DEPRAT; *Mém. Serv. Géol. l'Indochine*, **II**, (1), p. 58–60, pl. 8, fig. 10; pl. 9, figs. 1–3.
1914. *Neoschwagerina (N.) margaritae*, DEPRAT; *Ibid.*, **III**, (1), p. 28–29, pl. 7, fig. 3.
1924. *Neoschwagerina margaritae*, COLANI; *Ibid.*, **XI**, (1), p. 1, 22–123, 153–154, pl. 24, figs. 1–7, 9.
1925. *Neoschwagerina margaritae*, OZAWA; *Jour. Coll. Sci. Imp. Univ. Tokyo*, **45**, art. 6, p. 58, pl. 11, figs. 1, 3.
1927. *Neoschwagerina margaritae*, OZAWA; *Ibid.*, sec. 2, **2**, pt. 3, p. 158–159, pl. 42, figs. 5, 7.
1935. *Neoschwagerina margaritae*, GUBLER; *Soc. Géol. France, Mém.*, [New], **11**, (4), p. 106–108, pl. 7, figs. 1, 4, 6; pl. 8, fig. 4.
1936. *Neoschwagerina margaritae*, HUZIMOTO; *Sci. Repts. Tokyo Kyoiku Daigaku*, sec. C, **1**, (2), p. 117–118, pl. 22, figs. 16–17; pl. 24, figs. 1–4.
1956. *Neoschwagerina margaritae*, CHEN; *Palaeontologia Sinica*, [New, B], (6), pl. 10, figs. 1–3.
1957. *Neoschwagerina margaritae*, KOBAYASHI; *Sci. Repts. Tokyo Kyoiku Daigaku*, sec. C, **5**, (49), p. 306–308, pl. 10, figs. 3–6.
1958. *Neoschwagerina margaritae*, SAKAGAMI; *Jour. Hokkaido Gakugei Univ.*, [2], **9**, (2), p. 93–94, pl. 4, figs. 11–13.
1958. *Neoschwagerina* cf. *margaritae*, NOGAMI; *Mem. Coll. Sci., Univ. Kyoto*, [B], **25**, (2), art. 4, p. 101, pl. 1, fig. 7.
1959. *Neoschwagerina margaritae*, NOGAMI; *Ibid.*, [B], **26**, (2), art. 1, p. 75–76, pl. 1, fig. 21.
1961. *Neoschwagerina margaritae*, NOGAMI; *Ibid.*, [B], **28**, (2), art. 3, p. 177–180, pl. 4, figs. 1–5.
1961. *Neoschwagerina margaritae*, MORIKAWA and SUZUKI; *Sci. Repts. Saitama Univ.*, [B], **4**, (1), p. 60–61, pl. 7, fig. 4; pl. 12, figs. 16–18.
1961. *Neoschwagerina margaritae*, KAWANO; *Bull. Fac. Educ., Yamaguchi Univ.*, [Math. Sci.], **11**, spec. no., p. 108–111, pl. 11, figs. 6–9; pl. 12, figs. 1–11.
1961. *Neoschwagerina margaritae*, SADA; *Jour. Sci., Hiroshima Univ.*, [C], **4**, (1), p. 125–126, pl. 13, fig. 9.
1962. *Neoschwagerina margaritae*, ISHIZAKI; *Sci. Repts., Tohoku Univ.*, [2nd], **34**, (2), p. 177–178, pl. 12, figs. 9–13.
1963. *Neoschwagerina margaritae*, HANZAWA and MURATA; *Sci. Repts., Tohoku Univ.*, [2nd], **35**, (1), pl. 6, figs. 5, 6; pl. 8, figs. 5, 6; pl. 13, fig. 4; pl. 14, figs. 1, 3–5; pl. 15, figs. 1–3, 5; pl. 16, figs. 1–3, 8, 9; pl. 18, figs. 1–3, 6.

Explanation of Plate 17

All ×10 except Fig. 12. (×20)

Figs. 1–12. *Neoschwagerina craticulifera* (SCHWAGER) .....Page 108
1–2 and 11. Tangential sections (GK. D 20221–20222, 20231): 3, 6, 9 and 12. Axial sections (GK. D 20223, 20226, 20229 and 20223): 4 and 8. Centered oblique sections (GK. D 20224 and 20228): 5, 7 and 10. Oblique sections (GK. D 20225, 20227 and 20230)

Figs. 13–14. *Neoschwagerina margaritae* DEPRAT .....Page 110
13. Centered oblique section (GK. D 20233): 14. Axial section (GK. D 20234) See also Pl 18, Figs. 1–10.



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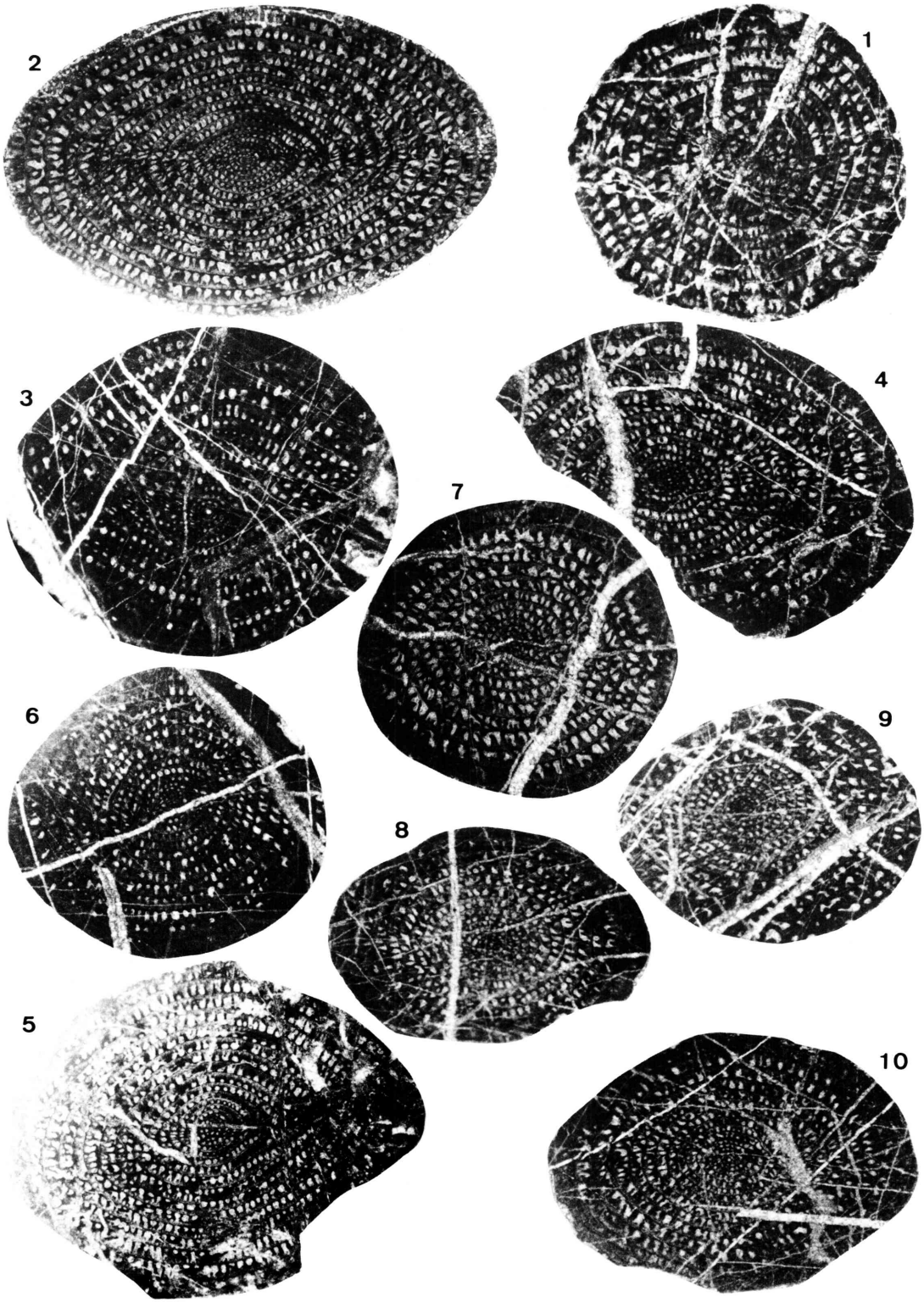

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1963. *Neoschwagerina margaritae*, SADA; *Geol. Rept., Hiroshima Univ.*, (12), p. 542–551, pl. 58, figs. 1–12.
1967. *Neoschwagerina margaritae*, LEVEN; *Acad. Sci. USSR, Geol. Inst. Transact.*, **167**, p. 192–193, pl. 33, fig. 8; pl. 34, fig. 1.
1977. *Neoschwagerina margaritae*, LIN et al.; *Palaeont. Atlas of central south China*, **2**, p. 92, pl. 29, fig. 2.
1981. *Neoschwagerina margaritate*, WANG et al.; *Palaeontology of Xizang, book 3*, p. 67, pl. 17, figs. 1, 4, 7.
1982. *Neoschwagerina margaritae*, ZHANG; *Strati. Palaeont. in W. Sichuan and E. Xizang, China*, pt. 2, p. 208, pl. 34, fig. 4.
1983. *Neoschwagerina margaritae*, ISHIBASHI; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], **25**, (1), pl. 13, figs. 2–8.

Material.—Plenty of specimens were collected from Iheya-jima and the Motobu Peninsula of Okinawa-jima. Each four of axial, sagittal and centered oblique sections are examined here.

Remarks.—*Neoschwagerina margaritae* was originally established by Deprat from Lang-nac, Indochina. This species has been known widely from many localities of Main Islands of Japan and China, and described in detail by the previous workers. SADA (1963), particularly, made a detailed comparison, between this species and allied species reported from Japan and China.

The present specimens are fairly variable in characters of shell form, septa and transverse septula. One axial section (Pl. 18, Fig. 1) has fusiform in inner volutions and oval shape in outer ones. The specimens collected from the locality Ihmb in Iheya-jima have been secondarily filled with micritic calcite in outer volutions, it is, therefore, difficult to get detailed information about a shape of shell and presence of secondary transverse septula in them. The important characteristics are prserved in the specimens of the Motobu Peninsula.

Occurrence.—*N. margaritae* occurs in many localities of the Motobu Peninsula, two localities Ihy and Ihmb at Iheya-jima, and locality 10 at Amami-oshima, Ryukyu Islands.

Neoschwagerina craticulifera occidentalis KOCHANSKY-DEVIDÉ and RAMOVS
Pl. 19, Figs. 4–9; Pl. 21, Figs. 4–8

1955. *Neoschwagerina craticulifera occidentalis* KOCHANSKY-DEVIDÉ and RAMOVS; *Slovenska Akad.* **4**, (Hist. Nat.), p. 418–419, pl. 7, figs. 1–6.

Material.—Four axial and two sagittal sections come to hand.

Description.—Shell moderate in size, inflated fusiform with straight axis

Explanation of Plate 18

All ×10

Figs. 1–10. *Neoschwagerina margaritae* DEPRAT .....Page 110
1 and 7. Sagittal (slightly oblique) sections (GK. D 20235 and 20241): 2–5. Axial sections (GK. D 20236–20239): 6, 8 and 10. Centered oblique sections (GK. D 20240, 20242 and 20244): 9. Oblique section (GK. D 20243) See also Pl. 17, Figs. 13–14.

of coiling, convex lateral slopes and bluntly rounded poles. The largest shell attains axial length more than 7.2 mm. Other mature shells of nine to ten volutions have axial length from 5.3 to 4.3 mm and median width from 4.2 to 2.7 mm, with form ratio of 1.26 to 1.58. Ratios of half length to radius vector in the first to fifteenth volutions in a specimen (Pl. 21, Fig. 6), 1.78, 1.59, 1.68, 1.76, 1.82, 1.72, 1.51, 1.59, 1.58, 1.57, 1.55, 1.50, 1.45, 1.39, and 1.35, respectively.

Proloculus small and spherical with outside diameter of 98 microns in average in four specimens. Shell expands slowly in inner two or three volutions and uniformly in outer ones. Radius vectors of the first to twelfth volutions in three specimens average 72, 118, 220, 248, 345, 458, 591, 640, 879, 1041, 1229, and 1436 microns, respectively.

Spirotheca consists of tectum and finely keriotheca. Average thickness in the first to twelfth volutions in three specimens 9, 12, 17, 21, 23, 23, 24, 32, 36, 26, 28, and 30 microns, respectively. Septa are irregular and not uniform in shape, and extend down a half of distance of chamber height. Axial septula first appear in the second or third volution, considerably short and primitive in development. Primary transverse septula are slender and occur throughout shell except in the first or second volution. They extend usually to the top of parachomata across chamber, but occasionally do not reach parachomata in outer volutions. Secondary transverse septula not present. Parachomata low and rather thin.

Remarks.—This subspecies of *N. craticulifera* was established by KOCHANSKY-DEVIDÉ and RAMOVS (1955) from Jugoslavia, but MORIKAWA and SUZUKI (1961) considered that this subspecies was synonymous with *Neoschwagerina margaritae* DEPRAT.

Neoschwagerina glintzbockeli and *N. tebagaensis* described by SKINNER (1969) from Turkey as new species are very similar to *N. craticulifera occidentalis* from Jugoslavia and Okinawa in essential characters. As it is very difficult for me to separate them from each other species, the minor differences such as shell size and numbers of axial septula should be regarded as individual variation.

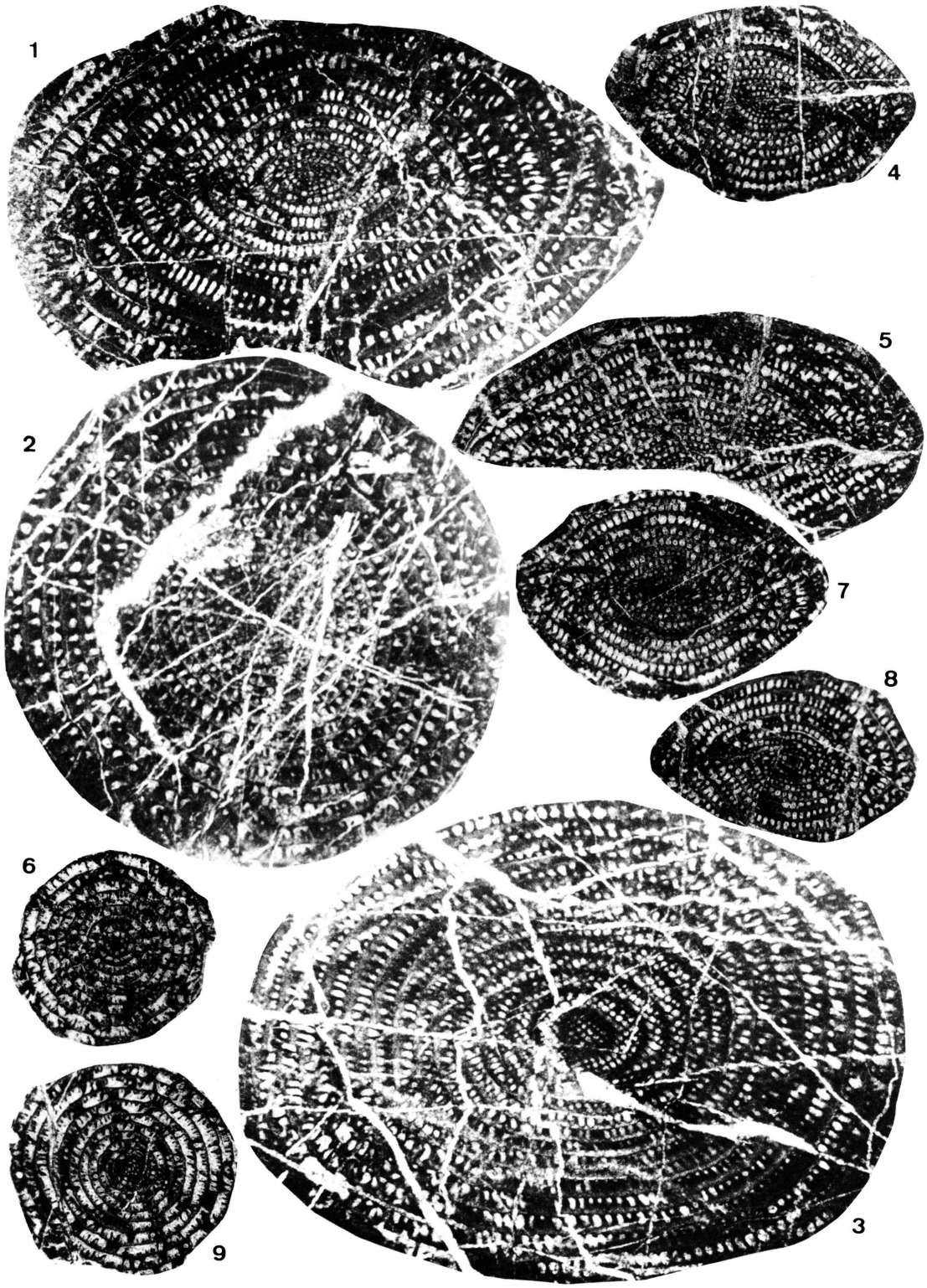
As the present specimens are referable to any of these species of *Neoschwagerina* mentioned above, here I tentatively use the specific name of *craticulifera occidentalis*. These species should be revised as a new species on the basis of more detailed comparison in future.

Explanation of Plate 19

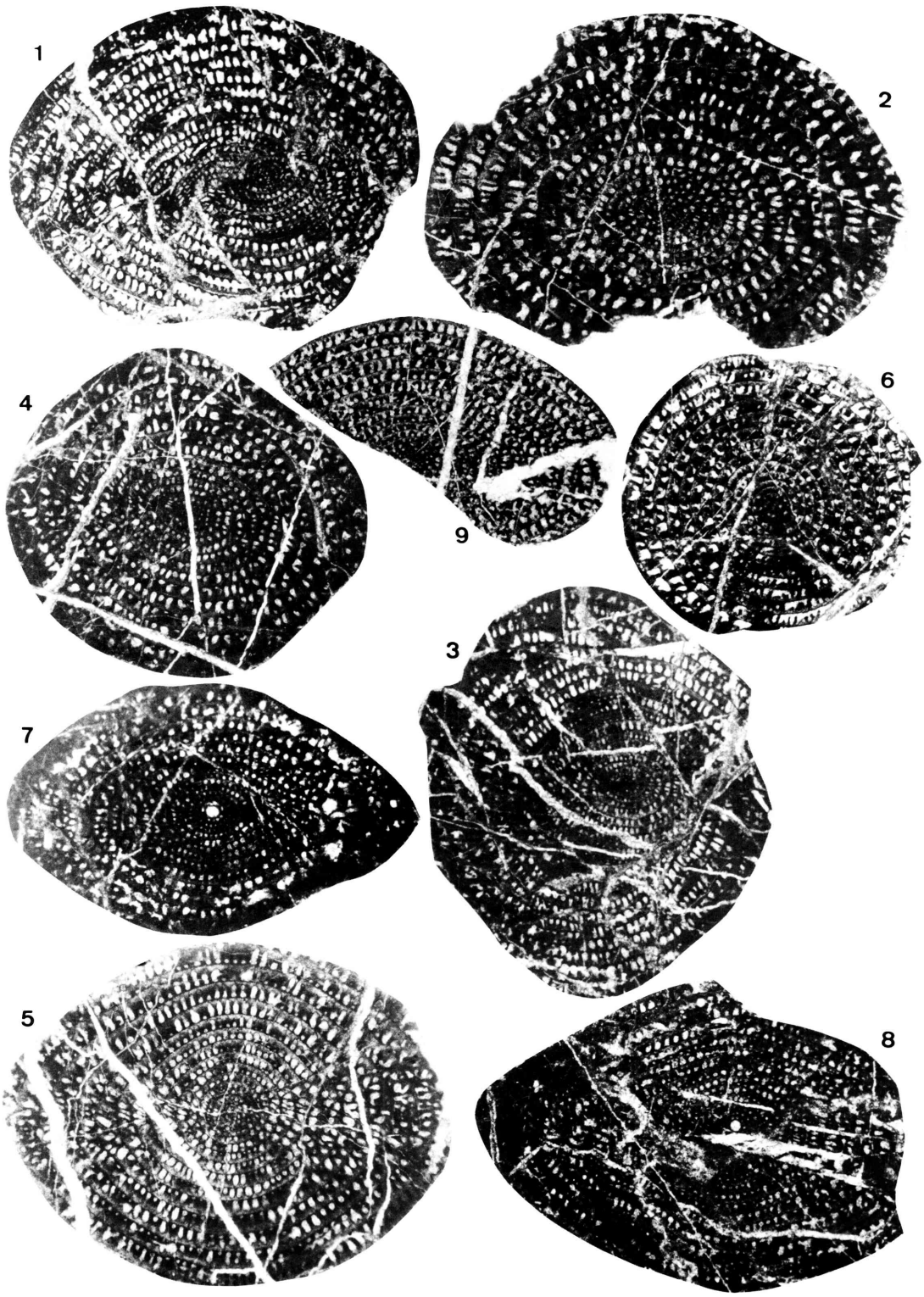
All ×10

Figs. 1–3. *Yabeina katoi* (OZAWA) ..... Page 113
1. Axial section (GK. D 20245): 2. Sagittal section (GK. D 20246): Tangential section (GK. D 20247)

Figs. 4–9. *Neoschwagerina craticulifera occidentalis* KOCHANSKY-DEVIDÉ and RAMOVS ..... Page 111
4–5 and 7. Axial sections (GK. D 20248–20249 and 20251): 6 and 9. Sagittal sections (GK. D 20250 and 20253): 8. Tangential section (GK. D 20252) See also Pl. 21, Figs. 4–8.



T. ISHIBASHI: Okinawa Fusulines



T. ISHIBASHI: Okinawa Fusulines

Occurrence.—The material is obtained from lenticular limestone at locality Ihmb and from limestone conglomerate bed at locality Ihyg, in Iheya-jima.

Genus *Yabeina* DEPRAT, 1914

Type-species.—*Neoschwagerina* (*Yabeina*) *inouyei* DEPRAT, 1914 (= *Neoschwagerina globosa* YABE, 1906)

Yabeina katoi (OZAWA)

Pl. 19, Figs. 1–3

1927. *Neoschwagerina* (*Neoschwagerina*) *katoi* OZAWA; *Jour. Fac. Sci., Imp. Univ. Tokyo*, sec. 2, 2, pt. 3, p. 159, pl. 41, fig. 1; pl. 42, fig. 3; pl. 43, figs. 1a, 2a, 3, 5. (non pl. 41, fig. 10; pl. 42, fig. 6)
1936. *Neoschwagerina katoi*, HUZIMOTO; *Sci. Repts., Tokyo Bunrika Daigaku*, sect. C, 1, (2), p. 118–119, pl. 24, figs. 5–8.
1956. *Yabeina* cf. *Yabeina katoi*, YAMAGIWA; *Trans. Proc. Palaeont. Soc. Japan*, [N. S.], (23), p. 240–241, pl. 34, fig. 16.
1957. *Yaeina* cf. *Yabeina katoi*, KOBAYASHI; *Sci. Repts., Tokyo Kyoiku Daigaku*, sect. C, 5, (48), p. 308–309, pl. 10, fig. 7.
1960. *Yabeina katoi*, CHISAKA; *Jour. Coll. Arts Sci., Chiba Univ.*, 3, (2), p. 251–252, pl. 8, fig. 6.
1961. *Yabeina katoi*, MORIKAWA and SUZUKI; *Sci. Repts., Saitama Univ.*, [B], 4, (1), p. 68–69, pl. 10, fig. 1; pl. 21, figs. 2–3.
1961. *Yabeina katoi*, SADA; *Jour. Sci., Hiroshima Univ.*, [C], 4, (1), pl. 14, fig. 3.
1963. *Neoschwagerina katoi*, HANZAWA and MURATA; *Sci. Repts., Tohoku Univ.*, [2nd], 35, (1), pl. 10, figs. 1–2; pl. 11, figs. 1–2.
1983. *Yabeina katoi*, ISHIBASHI; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], 25, (1), pl. 13, fig. 1.

Material.—Eight specimens come to hand, three of which, each one of axial, tangential and sagittal sections, are examined.

Description.—Shell large in size, inflated fusiform with gently convex lateral slops, straight axis of coiling and bluntly pointed poles. A mature shell of sixteen volutions 11.2 + mm in length and 7 + mm in width, giving form ratio of 1.6. Ratios of half length to radius vector of the first to sixteenth volutions 1.97, 1.73, 1.58, 1.64, 1.60, 1.66, 1.47, 1.52, 1.49, 1.52, 1.45, 1.42, 1.42, 1.38, 1.41, and 1.52, respectively.

Proloculus very small, spherical, with an outside diameter of 50 microns in one specimen. Shell coils tightly in inner three or four volutions and it

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Explanation of Plate 20

All ×10

Figs. 1–6. *Yabeina globosa* (YABE) ..... Page 114
1, 3 and 5. Axial sections (GK. D 20260, 20262 and 20264): 2. Centered section GK. D 20261): 4. Oblique section (GK. D 20263): 6. Sagittal section (GK. D 20265)

Figs. 7–9. *Yabeina packardi* THOMPSON and WHEELER ..... Page 115
7–8. Axial sections (GK. D 20267–20268): 9. Oblique section (GK. D 20269)
See also Pl. 21, Figs. 1–3.

expands uniformly in outer ones. Chambers increase gradually its height. Radius vectors of the first to fifteenth volution of axial specimen 82, 177, 269, 364, 495, 675, 901, 1094, 1398, 1619, 1927, 2264, 2584, 2993, and 3268 microns, respectively.

Spirotheca thin in inner volutions but not clearly observed in most parts of outer volutions owing to secondary deposits at lower part of keriotheca. Septa rather thin, and composed of extension of tectum and keriotheca. Basal part of septa solidified by dark dense materials. Axial septula develop throughout shell and not equal in length. Primary transverse septa thin, and their lower tips attain to tops of parachomata, but few of them extend down a half of height of chambers in outer volutions. Secondary transverse septula not develop throughout shell.

Remarks.—*Yabeina katoi* was originally described by OZAWA (1927) from the Akasaka Limestone as a species of *Neoschwagerina*. The microphotograph of sagittal section illustrated by OZAWA (1927, pl. 41; fig. 10) is quite the same as a sagittal microphotograph of *Neoschwagerina margaritae*, illustrated in pl. 43, fig. 5.

The present specimens quite agree with OZAWA's specimens in important characteristics, such as size of mature shell, thin transverse septula in inner volutions, small proloculus and absence of secondary transverse septula throughout shell. The present species has been known from several localities in Japan. This species has been illustrated by ISHIBASHI (1983) from Amami-oshima.

Occurrence.—*Yabeina katoi* was collected from the limestone of locality Sno-1, Shiokawa and locality Uc-2 near Ufudo in the Motobu Peninsula, Okinawa-jima and in the limestone pebbles of Naon Formation, Amami-oshima, Ryukyu Islands.

Yabeina globosa (YABE)

Pl. 20, Figs. 1–6

1906. *Neoschwagerina globosa* YABE; *Jour. Coll. Sci., Imp. Univ. Tokyo*, **21**, art. 5, p. 4, pl. 1, fig. 4; pl. 3, fig. 1.
1912. *Neoschwagerina* (*Neoschwagerina*) *globosa*, DEPRAT; *Mém. Surv. Géeol. l'Indochine*, **1**, (3), p. 51–53, pl. 2, fig. 10.
1927. *Neoschwagerina globosa*, OZAWA; *Jour. Coll. Sci., Imp. Univ. Tokyo*, sect. 2, **2**, pt. 3, p. 159–160, pl. 41, figs. 2, 9; pl. 42, figs. 1, 2, 4, (non 6); pl. 43, figs. 1b, 4.
1936. *Yabeina globosa*, HUZIMOTO; *Sci. Repts., Tokyo Bunrika Daigaku*, sect. C, **1**, (2), p. 119–120, pl. 24, figs. 9; pl. 25, figs. 1–4.
1957. *Yabeina globosa*, KANMERA; *Mem. Fac. Sc., Kyushu Univ.*, [D, Geol.], **6**, (1), pl. 20, figs. 5–6.
1961. *Yabeina globosa*, MORIKAWA and SUZUKI; *Sci. Repts., Saitama Univ.*, [B], **4**, (1), p. 67, pl. 10, fig. 2; pl. 16, fig. 8; pl. 21, fig. 1.
1962. *Yabeina globosa*, SUYARI; *Jour. Gakugei, Tokushima Univ.*, [Nat. Sci.], **12**, p. 37–38, pl. 12, fig. 1.
1963. *Yabeina globosa*, HANZAWA and MURATA; *Sci. Repts., Tohoku Univ.*, [2nd.], **35**, (1), pl. 9, figs. 1–2; pl. 12, figs. 1–2.
1964. *Yabeina globosa*, ISHII and NAGAMI; *Jour. Geosci., Osaka City Univ.*, **8**, art. 2, pl. 1, figs. 1–3; pl. 2, figs. 1–3.

Material.—Six selected specimens are examined here.

Descriptive remarks.—*Yabeina globose* is one of the best known species of the upper Middle Permiam in Japan. The type-species, *Neoschwagerina (Yabeina) inouyei* DEPRAT, has been considered to be a synonym of *Yabeina globosa* (OZAWA, 1927, p. 160) by most of Japanese authors but MORIKAWA and SUZUKI (1961), and foreign authors have been described them as a different species. This confusion may be caused by poor illustration given by YABE (1906) when he established *Neoschwagerina globosa* from the Akasaka Limestone.

The present specimens have shell of 7.2 to 7.5 mm in length and 5.5 to 5.8 mm in width, giving form ratios of 1.30 to 1.29. Proloculus is very small. Secondary transverse septula well develop throughout shell volutions. Spirotheca is rather thick.

Neoschwagerina globosa race *punica* described by SKINNER and WILDE (1967) from Tunisia and *Yabeina punica* described by DOUVILLÉ (1934) resemble *Yabeina globosa* in many respects, but the former has larger form ratio, thinner spirotheca and less secondary transverse septula.

Occurrence.—The material is collected from locality Ihmb in Iheya-jima and locality Ken-4, Kenken in the Motobu Peninsula, Okinawa-jima.

Yabeina packardi THOMPSON and WHEELER
Pl. 20, Figs. 7–9; Pl. 21, Figs. 1–3

1942. *Yabeina packardi* THOMPSON and WHEELER; *Jour. Palaeont.*, **16**, (6), p. 710, pl. 106, fig. 4; pl. 107, figs. 2–4; pl. 108, fig. 4.
1948. *Yabeina packardi*, THOMPSON; *Univ. Kansas Palaeont. Contr.*, Protozoa, art. 1, pl. 21, fig. 1.

Material.—Five specimens, three axial, each one of tangential and centered oblique sections are here examined.

Description.—Shell moderate in size and fusiform with gently convex lateral slopes and bluntly rounded poles. Mature shells of thirteen or fourteen volutions 8.0 to 6.9 mm in length and 5.5 to 4.7 mm in width, with form ratio of 1.58. Ratios of half length to radius vector of the first to tenth volutions 1.70, 2.12, 2.16, 2.18, 2.12, 2.32, 2.69, 2.64, 2.59, and 2.53, respectively, in one specimen illustrated as Pl. 20, Fig. 8.

Proloculus rather small and almost spherical. Outside diameter of proloculus 240, 206, and 180 microns, respectively, averaging 209 microns in three specimens. Shell tightly coils in inner three or four volutions and expands slowly but uniformly in outer volutions. Average radius vectors of the first to eleventh volutions in two specimens 168, 242, 352, 460, 581, 708, 823, 994, 1159, 1335, and 1519 microns, respectively.

Spirotheca thin and fine alveolar keriotheca, having average thickness of the first to eigth volutions in two specimens 25, 28, 35, 35, 28, 35, 22, and 22, respectively. Septa consist of tectum and downward extension of keriotheca. Axial septula present throughout shell with irregular length and profile. Primary transverse septula occur throughout shell. Secondary ones very short in length and appear in fourth or fifth volutions. Parachomata mostly join

with primary transverse septula, sometimes make protrusions on surface of spirotheca.

Remarks.—*Yabeina packardi*, described by THOMPSON and WHEELER (1942) from Oregon, North America, resembles *Y. globosa* in shell size, characters of septa and transverse septula, but differs from the latter in having larger form ratio, slender septa and poor development of secondary transverse septula.

YAMAGIWA and Ishii (1958) reported *Yabeina packardi shimensis* from central Japan. This species has been described as *Neoschwagerina shimensis* by MORIKAWA and SUZUKI (1961) based on material of the Akasaka Limestone. The Okinawa' specimens are referable to *Yabeina packardi* described from Oregon.

Occurrence.—The present specimens were obtained from the limestone pebbles in conglomerate in the uppermost bed of Maedake Formation, locality Ihyg, Iheya-jima.

Yabeina cfr. *igoi* MORIKAWA and SUZUKI
Pl. 21, Fig. 10

1927. *Neoschwagerina globosa*, YABE; *Jour. Coll. Sci. Imp. Univ. Tokyo*, sect. 2, 2, pt. 3, pl. 42, fig. 6.
1961. *Yabeina igoi* MORIKAWA and SUZUKI; *Sci. Repts., Saitama Univ.*, [B], 4, (1), p. 64–65, pl. 9, fig. 3; pl. 20, figs. 1–9.

Material.—Only a single axial section is examined here. No sagittal section comes to hand at present.

Descriptive remarks.—The present specimen is insufficient in number to fix the specific characters exactly, but it preserves several essential characters. Shell is mederate in size, elongate fusiform with slightly concave lateral slopes and narrowly pointed poles. Shell has eleven volutions with half length of about 3.8 mm and half diameter of 1.68 mm. Its ratio makes 2.3. Proloculus is moderate in size though it is secondarily deformed (356 × 231 microns).

Spirotheca is rather thin and gradually increases its thickness towards outer volutions. Primary transverse septula are slender and mostly attain to

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Explanation of Plate 21

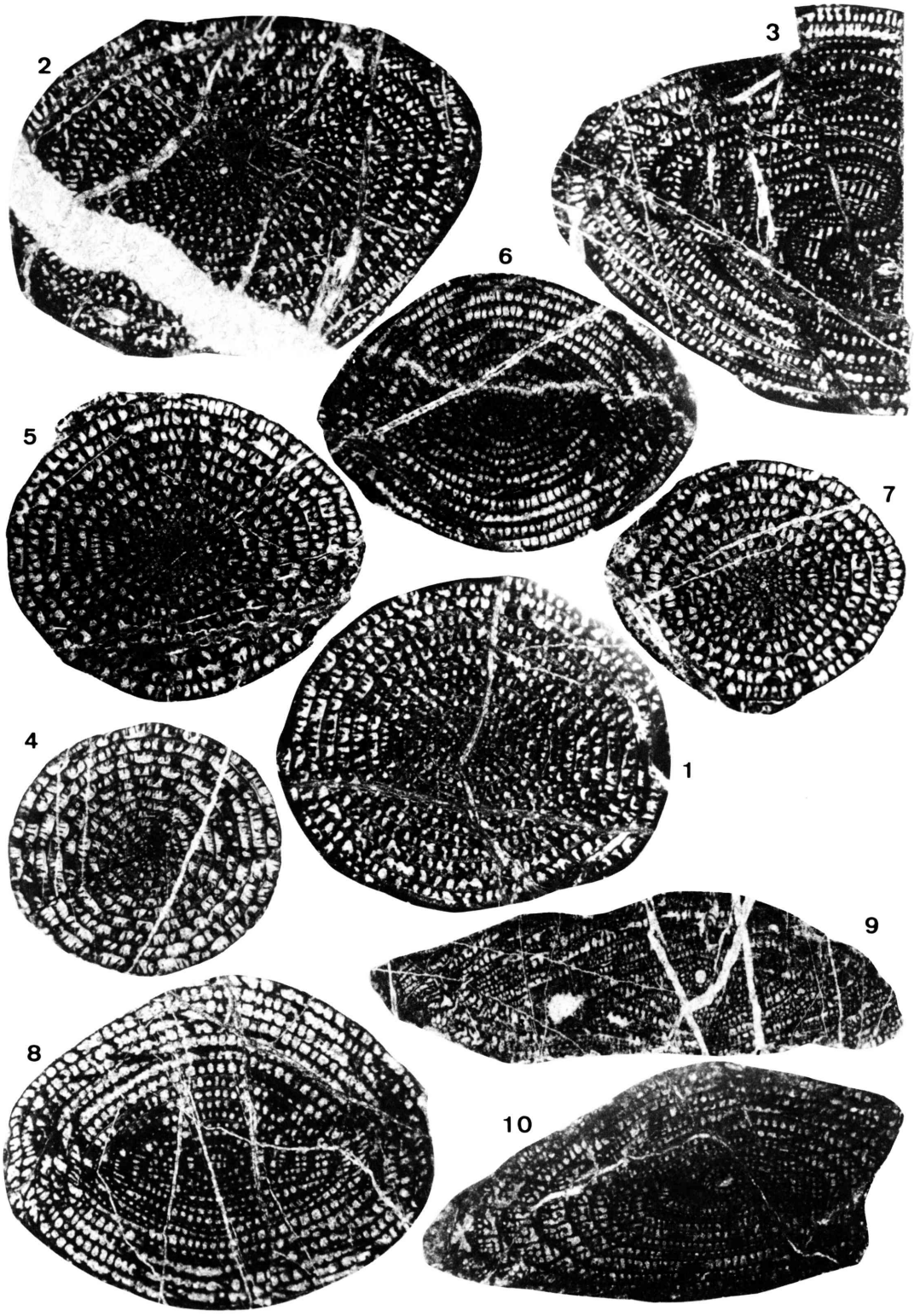
All ×10

Figs. 1–3. *Yabeina packardi* THOMPSON and WHEELER ..... Page 115
1–2. Centered oblique sections (GK. D 20270–20271): 3. Tangential section (GK. D 20272) See also Pl. 20, Figs. 7–9.

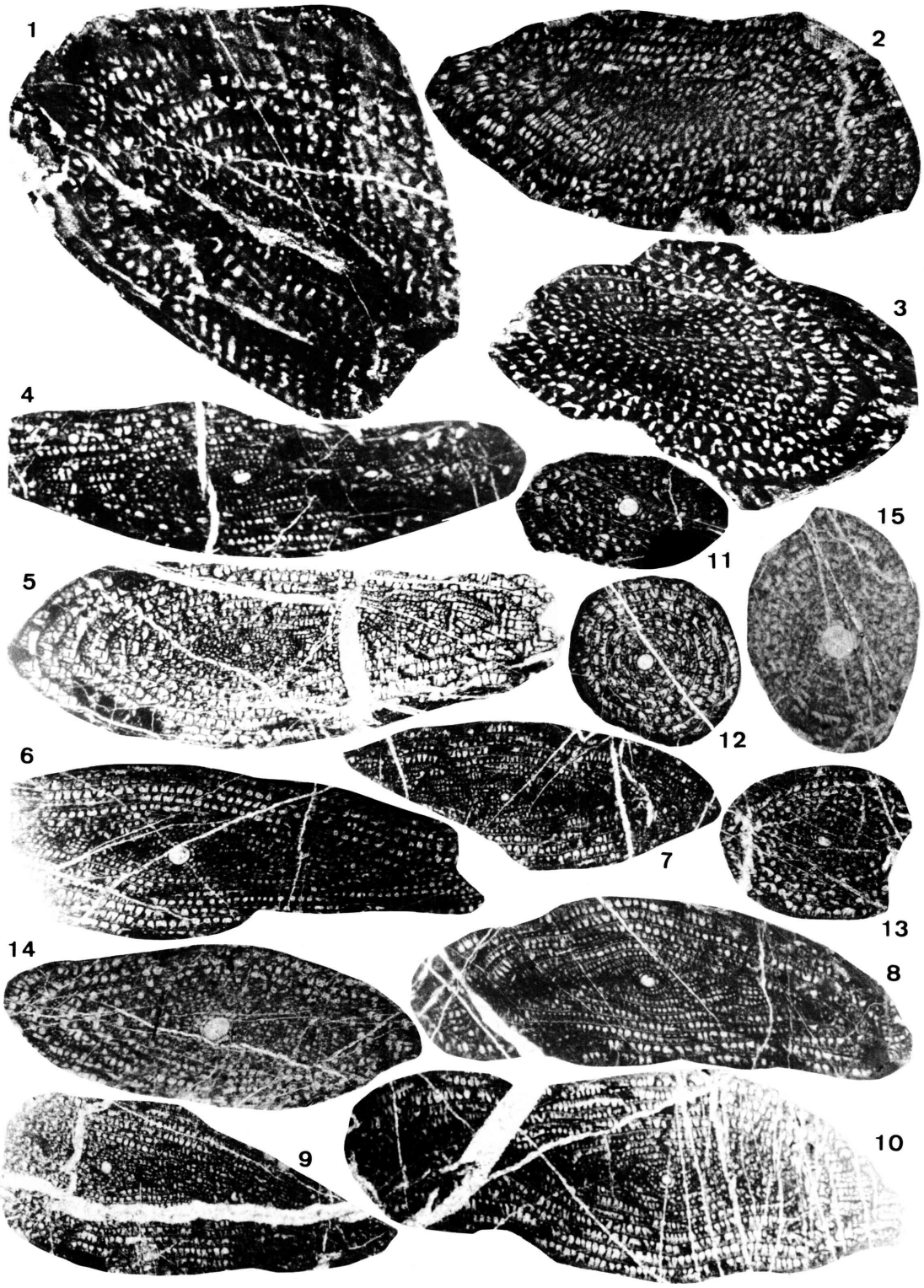
Figs. 4–8...*Neoschwagerina craticulifera occidentalis* KOCHANSKY-DEVIDE and RAMOVS ..... Page 111
4. Sagittal section (GK. D 20254): 5. Oblique section (GK. D 20256): 6, Axial section (GK. D 20257): 7. Centered oblique section (GK. D 20258): 8. Tangential section (GK. D 20259) See also Pl. 19, Figs. 4–9.

Fig. 9. *Sumatrina longissima* (DEPRAT) ..... Page 120
9. Centered oblique section (GK. D 20277) See also Pl. 10, Figs. 4–13.

Fig. 10. *Yabeina* cfr. *igoi* MORIKAWA and SUZUKI ..... Page 116
10. Axial (slightly oblique) section (GK. D 20273)



T. ISHIBASHI: Okinawa Fusulines



T. ISHIBASHI: Okinawa Fusulines

tops of parachomata. Secondary transverse septula present in the fourth to thirteenth volutions. Each septulum is short and thin, and presents between primary transverse septula. Parachomata extend half as high as height of chamber.

The present specimen is closely referable to *Yabeina igoi* reported by MORIKAWA and SUZUKI (1961) from the Akasaka Limestone, but the former has larger form ratio and thicker spirotheca. The present specimen is somewhat similar to the holotype of *Yabeina proboscis* described by CHEN (1956, pl. 13, fig. 8) from the Maokou limestone, southwestern province of China in shell size and form ratio but the former has thicker spirotheca and transverse septula. LIN *et al.* (1977) described the same species and illustrated fine axial microphoto (p. 94, pl. 30, fig. 1) from the same limestone, but it has very large shell (14.39 mm in length), large form ratio of 3.6 and large proloculus. It may be assignable to the group of *Lepidolina toriyamai* KANMERA.

Occurrence.—The material was collected from the limestone pebble in conglomerate bed of the Maedake Formation, Iheya-jima, locality Ihyg.

Yabeina sp. indet.
Pl. 22, Figs. 1–3

1964. *Yabeina* cfr. *globosa*, KONISHI; *Sci. Repts., Kanazawa Univ.*, 9, (2), pl. 3, figs. 4–5.

Material.—Three specimens are examined here, which were made from the hand specimens (KK63100–100) collected by Dr. K. KONISHI from Tonaki-jima, Ryukyu Islands. Two tangential and one oblique sections are examined.

Descriptive remarks.—*Yabeina* cfr. *globosa* was illustrated by KONISHI (1964) from Tonaki-jima. The present specimens are easily assignable to a species of genus *Yabina* by its shell size and development of secondary transverse septula. Since the present material is not sufficient in number and it is possible to get more material from the same locality, the specific identification is not adviserable at present.

Occurrence.—The specimens were obtained from the Nagasakibara limestone lentil of the Otake Dolostone Member, Tonaki-jima. Almost all fusulinids are secondarily deformed. This species is associated with *Chusenella* (*Sosioella*) ? sp. Some fusulines were illustrated by KONISHI (1964).

Explanation of Plate 22

All ×10

Figs. 1–3. *Yabeina* sp. indet. ..... Page 117
1–2. Tangential sections (GK. D 20274–20275): 3. Oblique section (GK. D 20276)

Figs. 4–13. *Sumatrina longissima* (DEPRAT) ..... Page 120
4 and 6–9. Axial sections (GK. D 20278 and 20280–20283): 5 and 10. Centered oblique sections (GK. D 20279 and 20284): 11–13. Sagittal sections (GK. D 20285–20289) See also Pl. 21, Fig. 9.

Figs. 14–15. *Sumatrina annae* VOLZ ..... Page 119
14. Axial section (GK. D 20290): 15. Sagittal section (GK. D 20291)

Subfamily Sumatrininae SILVESTRI, 1933, emend. KANMERA, 1957

Genus *Presumatrina* TOUMANSKAYA, 1950

Type-species.—Doliolina schellwieni DEPRAT, 1913

Presumatrina cfr. *neoschwagerinoides* (DEPRAT)

Pl. 16, Figs. 4–10

1913. *Doliolina neoschwagerinoides* DEPRAT; *Mém. Serv. Géol. l'Indochine*, tome 2, fasc. 1, p. 52–53, pl. 10, figs. 1–7.
1924. *Doliolina* cfr. *neoschwagerinoides*, COLANI; *Mém. Surv. l'Indochine*, tome 11, fasc. 1, p. 115, pl. 20, fig. 4.
1963. *Cancellina neoschwagerinoides*, SHENG; *Palaeont. Sinica*, [new, B], (10), p. 232, pl. 34, figs. 7–8 and 10–12.
1975. *Cancellina neoschwagerinoides*, TORIYAMA; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], **23**, (1), p. 87, pl. 17, figs. 14–23.
1982. *Cancellina neoschwagerinoides*, ZHANG; *Stratigr. Palaeont. W. Sichuan. E. Xizang, China*, pt. 2, p. 204, pl. 28, figs. 12, 14–15; pl. 29, figs. 6, 10, 12–13, 15; pl. 31, fig. 12; pl. 32, fig. 9.
1983. *Presumatrina neoschwagerinoides*, ISHIBASHI; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], **25**, (1), pl. 13, fig. 14.

Material.—Seven specimens come to hand.

Descriptive remarks.—Shell is small and fusiform with straight axis of coiling, gently convex lateral slopes and narrowly rounded poles. Half length of shell ranges from 2.02 to 1.61 mm and half width is 0.77 to 0.54 mm. Number of volution is usually nine at the maximum. Proloculus is not observed in the present specimens. Spirotheca is moderately thin and consists of tectum and thin keriotheca, with average thickness of 12, 15, 15, 18, 19, 20, and 20 microns, respectively, in the first to seventh volutions (Pl. 16, Fig. 9).

Septa are thin and irregular inlength. Primary transverse septula well develop from the first volution to outer ones, their lower ends join with tops of parachomata. Secondary transverse septula are very short and sporadically observed in most parts of outer volutions of mature individuals.

Although well-centered axial and sagittal sections are not available in the Okinawa's material, there is no doubt on the generic assignment of the present specimens to the genus *Presumatrina*. The lectotype of *Presumatrina neoschwagerinoides* designated by TORIYAMA (1975) is somewhat similar to the present specimens in size of shell, characters of transverse septula, parachomata and spirotheca, but the former has considerably a large proloculus. It is assumed that the present specimens have not such a large proloculus though the exactly oriented axial sections is not available at present.

The present specimens have important characteristics almost the same to those of *Presumatrina neoschwagerinoides* illustrated by ISHIBASHI (1983) from Amami-oshima along with *Leella grossa* and some Permian fusulines. They are probably referable to *P. neoschwagerinoides*.

Occurrence.—The material is collected from locality Uc-4, near Ufudo, the Motobu Peninsula of Okinawa-jima.

Genus *Sumatrina* VOLZ, 1904

Type-species.—Sumatrina annae VOLZ, 1904

Sumatrina annae VOLZ

Pl. 22, Figs. 14–15

1906. *Sumatrina annae* VOLZ; *Geol. Palaeont. Abhandl.* Bd. 6, H. 2, p. 98–100, text-figs. 27–31.
1906. *Neoschwagerina annae*, YABE; *Jour. Coll. Sci. Imp. Univ. Tokyo*, **21**, art. 5, pl. 2, fig. 4.
1906. *Sumatrina annae*, DOUVILLÉ; Bull. Géol. France, 4e, tome 6, pl. 18, fig. 3.
1912. *Neoschwagerina (Sumatrina) annae*, DEPRAT; *Mém. Serv. Géol. l'Indochine*, 1, fasc. 3, p. 56–57, pl. 5, figs. 1–3, text-figs. 30a–h.
1924. *Sumstrina annae*, COLANI; *Ibid.*, **11**, fasc. 1, p. 150–152, pl. 20, fig. 20; pl. 21, figs. 1–8, 10–13, 16–28.
1925. *Sumatrina annae*, OZAWA; *Jour. Coll. Sci. Imp. Univ. Tokyo*, **45**, art. 6, p. 64, pl. 1, figs. 1b, 2b; pl. 10, fig. 8.
1935. *Sumatrina annae*, GUBLER; *Soc. Géol. France, Mém.*, [Nova], 2, fasc. 4, (26), p. 127–130, pl. 5, figs. 8, 11.
1937. *Sumatrina annae*, THOMPSON and FOSTER; *Jour. Palaeont.*, **11**, (2), p. 143–144, pl. 23, fig. 13.
1951. *Sumatrina annae*, THOMPSON; *Contr. Cushman Found. Foram. Research*, **2**, pl. 9, figs. 4–5.
1954. *Sumatrina annae*, HANZAWA; *Japan. Jour. Geol. Geogr.*, **24**, p. 7–13, pl. 2, fig. 4; pl. 3, figs. 1–8.
1956. *Sumatrina annae*, CHEN; *Palaeont. Sinica*, [New B], **6**, p. 69–70, pl. 7, figs. 7–8.
1958. *Sumatrina annae*, TORIYAMA; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], 7, p. 258–261, pl. 48, figs. 26–33.
1961. *Sumatrina annae*, NOGAMI; *Mem. Coll. Sci., Kyoto Univ.*, [B], **28**, p. 194–197, pl. 2, figs. 10–13.
1961. *Sumatrina annae*, KAWANO; *Bull. Fac. Educ., Yamaguchi Univ.*, **11**, p. 120–123, figs. 12–24.
1963. *Sumatrina annae*, SHENG; *Palaeont. Sinica*, [New, B], **10**, p. 245–246, pl. 36, figs. 1–11.
1964. *Sumatrina anne*, IGO; *Japan. Jour. Geol. Geogr.*, **35**, (1), 63–64, pl. 2, figs. 2–3.
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1977. *Sumatrina annae*, LIN et al.; *Palaeont. atlas middlesouth China*, pt. 2, p. 96, pl. 30, fig. 5.
1978. *Sumatrina annae*, LIU et al.; *Palaeont. atlas southwest, China*, Kueichow 2, p. 96, pl. 24, fig. 3.
1981. *Sumatrina* cf. *annae*, WANG et al.; *Palaeont. Xizang*, p. 96, pl. 17, figs. 7–8, 10.
1982. *Sumatrina annae*, ZHANG; *Strat. Palaeont. W. Sichuan and E. Xizang, China*, pt. 2, p. 210–211, pl. 27, fig. 3; pl. 29, fig. 4.

Material.—Each one of axial and sagittal sections are here examined. The limestone abundant in *Sumatrina annae* is semicrystallized.

Descriptive remarks.—Sumatrina annae is one of the best known species of Middle Permian fusulines, and has been reported from many regions of

Tethyan realm including Main Islands of Japan, China, and Indochina. The present specimens well agree with the description and figures given by the many previous workers. Some brief description on the present material is given as below.

The present specimens have axial length (twice half length) of 6.72 mm and width of 2.62 mm, and form ratio of 2.56. Shell is cylindrical in form with eleven volutions. The inner two volutions are subspherical in shape and axis rapidly extends from the third volution. Ratios of half length to radius vectors of the first to ninth volutions are 0.97, 1.24, 1.49, 1.85, 2.04, 2.19, 2.43, 2.55, and 2.67, respectively.

Proloculus is spherical (499 microns) and ellipsoidal (451 × 343 microns) in shape. Radius vectors of the first to ninth volutions are 275, 323, 380, 450, 543, 643, 744, 864, and 1001 microns, respectively. Spirotheca is seemingly thin but its thickness is difficult to measure because of recrystallization.

Occurrence.—Locality In-2, Inoha, Motobu-cho, Okinawa-jima. The material is collected by only one locality and is associated with *Sumatrina longissima* and *Pseudofusulina* sp.

Sumatrina longissima (DEPRAT)
Pl. 22, Fig. 4–13

1914. *Neoschwagerina* (*Sumatrina*) *longissima* DEPRAT; *Mém. Serv. Géol. l'Indochine*, **3**, (1), p. 36–37, pl. 5, figs. 1–6, text-fig. 8.
1935. *Sumatrina longissima*, GUBLER; *Mém. Soc. Géol. l'Indochine*, p. 130–132, pl. 5, figs. 1–2, 5–6, 12, 18; pl. 6, fig. 6; pl. 7, fig. 9.
1956. *Sumatrina longissima*, CHEN; *Palaeont. Sinica*, [New B], (6), p. 70–71, pl. 3, figs. 4–6.
1956. *Sumatrina longissima*, SHENG, *Acta Palaeont. Sinica*, **4**, (2), p. 221, pl. 6, fig. 4.
1958. *Sumatrina* cf. *S. longissima*, KOCHANSKY-DEVIDÉ, *Geol. Vjesnik*, **11**, p. 73–74, pl. 5, fig. 10.
1958. *Sumatrina longissima*, TORIYAMA; *Mem. Fac. Sci., Kyushu Univ.*, [D, Geol.], **7**, p. 255–257, pl. 48, figs. 18–25.
1961. *Sumatrina longissima*, NOGAMI; *Mem. Coll. Sci., Univ. Kyoto*, [B], **28**, (2), art. 3, p. 197–199, pl. 2, figs. 5–9.
1961. *Sumatrina* cf. *S. longissima*, KAWANO; *Bull. Fac. Educ., Yamaguchi Univ.*, [Math. Sci.], **11**, p. 123–124, pl. 15, fig. 25.
1963. *Sumatrina longissima*, SHENG; *Palaeont. Sinica*, [New, B], **10**, p. 246–247, pl. 36, figs. 18–19.
1967. *Sumatrina longissima*, LEVEN; *Acad. Sci. USSR, Geol. Inst. Transact.*, (167), p. 201, pl. 37, fig. 8.
1977. *Sumatrina longissima*, LIN et al.; *Palaeont. atlas of middlesouth China*, pt. 2, p. 96, pl. 30, fig. 6.
1978. *Sumatrina longissima*, LIU et al.; *Palaeont. atlas of southwest of China*, Kueichow 2, p. 95, pl. 23, fig. 6.

Material.—A number of sections were obtained, twelve specimens of which are examined here.

Description.—Shell moderate in size and elongate cylindrical in shape, with slightly convex lateral slopes, straight axis of coiling and bluntly rounded poles.

Well preserved axial section (Pl. 22, Fig. 8) 5.8 mm in length and 2.5 mm in width, giving form ratio of 2.32. Shell subspherical in the first and second volutions and expands very rapidly towards both poles.

Proloculus moderate in size, spherical to ellipsoidal in shape with outside diameter of 156 to 228 microns, averaging 221 microns for eight specimens. Shell coils tightly in inner three or four volutions and loosely expands in outer volutions. Average radius vectors of the first to tenth volutions of five specimens 144, 201, 273, 363, 454, 568, 700, 850, 1018, and 1183 microns, respectively.

Spirotheca considerably thin and composed of only a single layer of tectum? Septa not uniform in shape and in length and bend anteriorly at angle of 20 to 30 degrees. Axial septula present throughout shell and their number varies according to chamber.

Primary transverse septula slender and their tips extend down to tops of parachomata. Secondary transverse septula septula occur clearly from fifth volution, and very short with pendant-shape.

Remarks.—*Sumatrina longissima* is one of the well-known species in the Middle Permian fusulines in Japan, China and Southeast Asia, and has been described in detail by the previous workers as listed in the synonym list.

The Okinawa's specimens are agreeable with those described from the Akiyoshi Limestone (TORIYAMA, 1958), Cambodge (DEPRAT, 1914) and South China (CHEN, 1956) in essential characteristics. *Sumatrina longissima* was collected from two adjacent localities in the Motobu Peninsula, In-1 and In-2, in the latter of which *Sumatrina annae* is found together.

Occurrence.—The specimens were collected from the limestone lentil at locality In-1, Inoha, the Motobu Peninsula of Okinawa-jima.

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[The references in Parts 1 (1983) and 2 (1984) are not repeated here]

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