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ON SOME PERMIAN FUSULINIDS FROM IWAIZAKI, N.E. JAPAN

by

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(with 1 Text-figure and 4 plates)

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Introduction

A small cape at Iwaizaki, Miyagi Prefecture, N. E. Japan is the type area for the Iwaizaki stage of the middle Permian Kanokura series. A number of investigations have been made as to the geological structure, stratigraphy, biostratigraphy and palaeontology of Iwaizaki, and it has been generally accepted that the cape is mainly made up by almost vertically inclined gray limestones which conformably overlie calcareous sandstones with *Monodiexodina*, and are, in turn, overlain by black slates of the upper Permian Toyoma series with occasional worm tracks like "*Notaculites*."

Recently MORIKAWA (1960) faunistically divided so-called Iwaizaki limestone into three zonules. They are *Parafusulina matsubaishi*, *Pseudofusulina paramotohashii* and *Yabeina shiraiwensis* zonules in ascending order.

The writer found a lens of fusulinid bearing slaty limestone intercalated in black slates at a locality along the Pacific coast about 400 m N.W. from the tip of the cape. This fusulinid horizon is stratigraphically estimated to be about 130 m higher than the hithertoknown fusulinid containing Iwaizaki limestone, and assumes therefore the highest fusulinid horizon in this area.

The following fusulinid species have been identified.

Nankinella sp.

Dunbarula kitakamiensis, sp. nov.

Codonofusiella inuboensis (CHISAKA)

Rauserella pachytheca, sp. nov.

Pseudofusulina chihsiaensis (LEE)

Lepidolina kumaensis KANMERA

Although small in number they are correlatable with fusulinids from the Kuma and corresponding formations in Japan, Russian Maritime region and China. Of

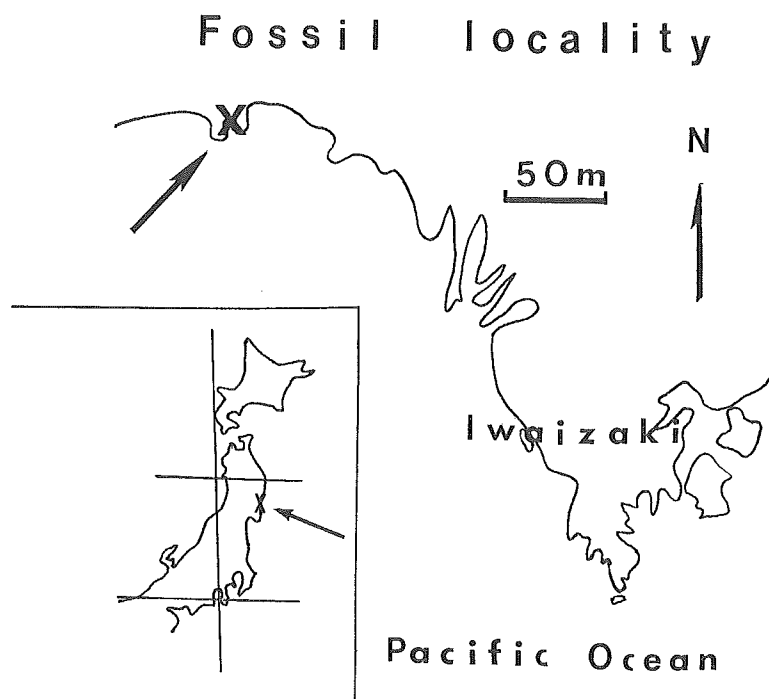


Fig. 1

them *Lepidolina kumaensis* is characteristic.

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Description of species

Family Schubertellidae SKINNER, 1931

Genus *Dunbarula* CIRY, 1948

Dunbarula kitakamiensis sp. nov.

Pl. 8, figs. 1–6.

1954 *Dunbarula?* sp. KANMERA, pp. 7–8, Pl. 3, figs. 8(?), 9–11, 20

Materials: Axial sections, UHR 18989 (Holotype), UHR 18998, UHR 19027, UHR 18991, UHR 19030.

Sagittal sections, UHR 18993, UHR 19022, UHR 18992, UHR 18997, UHR 18998, UHR 19023.

Diagnosis: Minute ellipsoidal shell with weakly fluted septa, and three layered spirotheca with occasional alveolar structure in the outer volutions.

Description:

Many well oriented and finely preserved minute specimens have been obtained.

Shell ellipsoidal in shape with bluntly pointed poles. Five volutions present in mature shell, with the length of 0.8 to 1.2 mm and 0.44 to 0.8 mm in width. Form ratio varies from 1.5 to 2.3, and mostly about 1.8. Two distinct growth stages are recognizable; one of which is endothyroidal younger stage and the other is ellipsoidal older stage. The younger stage is coiled at a large angle to the older stage.

Expansion of the shell uniform and tight. The height of volution from the first to the fifth volution in average of twenty specimens, 0.029, 0.036, 0.051, 0.067 and 0.104 mm respectively.

Proloculus minute, 40 to 50 microns in outside diameter.

Spirotheca composed of tectum, diaphanotheca and lower tectorium in younger stage. On the contrary in the older stage it consists of tectum, dark upper and less dark lower layer which gradually becomes darker towards outward. At the same time, dark upper layer gradually becomes thinner, and at the outermost volution it is scarcely detectable. Moreover in some well preserved specimens, spirotheca shows alveolar structure. (Pl. 8, figs. 1, 2).

Thickness of the spirotheca is very thin, but gradually thickened towards outer volutions. The average thickness of the spirotheca from the first to the fifth volution, 5, 9, 13, 17 and 19 microns, respectively in ten specimens.

Septa weakly fluted near the pole regions in outer volutions only, whereas the mid portion of the septa is almost straight throughout the shell. The number of septa is counted, 8, 10, 13, 16 and 20 respectively from the first to the fifth volution in average of seven specimens.

Chomata seem to be not present in younger stage, while rudimentarily present in older stage.

Septal pores not present.

Tunnel broad, low and about 1/3 of the height of the chamber. The tunnel angle in the third volution is about 30°, and 35° to 48° in the fourth.

Remarks:

By the minute ellipsoidal shell with discoidal immature stage, weakly fluted septa near pole regions and the structure of spirotheca, this species is referable to the genus *Dunbarula*.

In 1954 KANMERA reported *D.?* sp. from the Upper Permian Kuma formation. His specimens are quite identical with mine, although they have slightly small proloculus.

The genotype species, *D. mathiewi* CIRY (1948) has larger cylindrical shell with more volutions, more intensely fluted septa than the present species. *D. mathiewi* has septal pores in septa which are not observable in the latter.

D. nana KOCHANSKY-DEVIDE & RAMOVŠ (1955) and *D. schubertellaeformis* SHENG (1958) are easily distinguished from the present form in shell shape, size, the number of volution, the diameter of proloculus and other characteristics.

Dunbarula palaeofusulinaeformis from Kueichow has advanced characters in many ways than the present form (SHENG 1963). It is noteworthy that *D. palaeofusulinaeformis* occurs at lower horizon than *Palaeofusulina* zone in China and SHENG regards that *D. palaeofusulinaeformis* is the ancestor of *Palaeofusulina*.

The present form closely resembles *Dunbarula laudoni* SKINNER and WILDE (1966), described from northwestern Washington, U.S.A., associated with *Schwagerina royanderssoni* THOMPSON, WHEELER & DANNER, *Yabeina decora* SKINNER & WILDE, and *Y. fusiformis* SKINNER & WILDE. The former is, however, distinguishable from the latter in possessing the following characters; namely the wall structure consisting of 3 layers in inner volutions, tectum and diaphanotheca partly with alveolar structure in outer volutions, the absence of chomata in inner stage, and broader tunnel angle for corresponding volutions.

Genus *Codonofusiella* DUNBAR & SKINNER, 1937

Codonofusiella inuboensis (CHISAKA)

Pl. 8, figs. 7–12.

1960 *Paraboultonia inuboensis* CHISAKA, p. 243, Pl. 1, figs. 1–6.

Materials: Axial sections, UHR 18996, UHR 18989, UHR 19025. Sagittal sections, UHR 18990, UHR 18992, UHR 19021. Tangential sections, UHR 18996, UHR 18997, UHR 19024, UHR 19022.

Description:

Shell minute, fusiform to subcylindrical in shape with $4\frac{1}{2}$ to $5\frac{1}{2}$ volutions in mature specimens. The shell measures 1.06 to 2.2 mm in length and 0.44 to 0.78 mm in width. The uncoiled portion attains as long as 1.51 mm in a sagittal section.

Coiling of the shell is tight in inner volutions, gradually expanding towards outward. Inner endothyroidal, one or two volutions coiled at a large angle to the later volutions. Average height of volution from the first to the fourth volution, 0.021,

0.028, 0.05 and 0.097 mm respectively in seven specimens.

Proloculus minute. Its outside diameter is at most 55 microns.

Spirotheca very thin, composed of tectum and lower dense layer. The upper surface of tectum is commonly covered with layer continuous with septa. In outer few volutions of some specimens, spirotheca consists of tectum and fine keriotheca (Pl. 8, fig. 12). Thickness of the spirotheca of tectum and lower layer gradually increases towards outer volutions and is measured 10 microns in the outermost volution.

Septa narrowly and highly fluted throughout the shell. In some tangential sections cuniculi appears to be feebly developed. Number of the septa 6 to 7 in the first, 11 in the second, 19 to 20 in the third and 28 to 29 in the fourth volution.

Rudimentary chomata present only in the first volution.

Axial fillings are weakly developed.

Remarks :

This form is quite identical with *Paraboultonia inuboensis* CHISAKA (1960), described from Takagami conglomerate developed in Choshi peninsula, Chiba prefecture, Japan. As to the generic assignment, however, the species is better treated as a *Codonofusiella*. As illustrated by himself (Pl. 1, fig. 6), at least some specimens possess uncoiled portion with septa not reached the outer surface of the preceding volution. Moreover, the length of uncoiled outermost volution is variable from specimen to specimen. This variation is well exemplified in my Kitakami specimens. Therefore it is difficult to determine the exact length of flared last volution when specimens are few. The writer also considers that it is not suitable to use the length of the uncoiled flared volution as generic or subgeneric criterion, and that many other characters should also be taken into account in dividing species into generic or subgeneric groups.

Subgenus *Lantschichites* was established by TOUMANSKAYA in 1953 before SKINNER and WILDE proposed a new genus *Paraboultonia*. The writer considers these two subgenera are synonymous. So the latter should be a junior subjective synonym of the former. Morphologically *Lantschichites* stands in between *Boultonia* and *Codonofusiella*. As already mentioned in the above description the present form possesses keriothecal structure in spirotheca in outer volutions. No references on the presence of keriotheca in spirotheca have ever been made in the genus *Codonofusiella*. This fact is important in considering the systematic position of *Codonofusiella*.

Codonofusiella cuniculata KANMERA (1954) somewhat resembles the present form. But the former is provided with no axial fillings and distinct cuniculi.

Cod. japonica was described by MORIKAWA (1960) from the Iwaizaki peninsula,

South Kitakami Mountainland, Japan. The place is the locality from where the present form was also obtained. MORIKAWA's species has longer uncoiled volution, less intensively fluted septa, thinner spirotheca than the present form.

Genus *Rauserella* DUNBAR, 1944

Rauserella pachythea sp. nov.

Pl. 7, figs. 7-9.

Materials ; Axial section, UHR 18989 (Holotype) and some other poorly preserved or ill oriented specimens.

Derivation of the name : The new specific name alludes to the nature of thick spirotheca especially in the outer volutions.

Description :

This species is rare amongst numerous thin sections prepared. The only one axial section has been fortunately obtained. The following description is mainly based on it.

Shell small, cylindrical with rounded pole regions. The shell possessing five volutions is, 3.0 mm long and 1.1 mm wide, having form ratio 2.8. In inner 2 to $2\frac{1}{2}$ volutions the shell is discoidal and tightly coiled ; while in outer volutions shell is thick cylindrical with loose and erratical coiling. Inner volutions coiled askew at a large angle to the later volutions.

The height of volution is about 0.04 mm in the first two volutions, and 0.18 to 0.22 mm in the fourth. Proloculus is measured 0.076 mm in outside diameter.

Spirotheca consists of three layers in inner discoidal volutions ; tectum, upper and lower layers. It is composed of tectum and lower massive homogenous layer in outer volutions. Thickness of the spirotheca gradually increases towards outward ; in inner volutions 12 to 20, and outer 38 microns.

Septa straight throughout volutions. Number of the septa is 5 in the first, and 10 to 12 in the outer volutions.

Chomata absent in all volutions.

Tunnel low and broad in inner volutions.

Remarks :

Not many species of *Rauserella* have been described until present. *Rauserella erratica* DUNBAR (1944), the genotype, is distinguished from the present species by the characters of inner volutions. Namely, the former possesses chomata and discoidal shell without umbilical pole regions, and comparatively sharp angular periphery.

Rauserella minuta MIKLUCHO-MACLAY (1959) is readily distinguishable from the present form in having far smaller shell.

The present species also differs from *R. fujimotoi* KOBAYASHI (1956) in possessing larger shell. Both *R. sp.* from Iwaizaki, South Kitakami Mountainland, Japan, reported by MORIKAWA (1960), and *R. sp.* from the Kuma formation, Kyushu, Japan, described by KANMERA (1954), can not be compared with the present form on account of the absence of well oriented specimens.

As compared above, no previous species of *Rauserella* fit precisely the present form to which the writer here proposes a new species.

Family Schwagerinidae DUNBAR & SKINNER, 1930

Genus *Pseudofusulina* DUNBAR & SKINNER, 1931

Pseudofusulina chihsiaensis (LEE)

Pl. 7, figs. 1-6.

- 1931 *Schellkwenia chihsiaensis* LEE, pp. 287-288, Pl. 1, figs. 2, 2a.
 1934 *Pseudofusulina chihsiaensis*, CHEN, pp. 74-75, Pl. IX, figs. 1-8, 12; Pl. X, fig. 18; Pl. XI, fig. 10; Pl. XIV, figs. 11, 12.
 1934 *Psf. chihsiaensis* var. *regularis* CHEN, pp. 75-76, Pl. IX, fig. 10.
 1934 *Psf. chihsiaensis* var. *fragilis* CHEN, pp. 76-77, Pl. IX, fig. 11.
 1934 *Psf. chihsiaensis* var. *brevis* CHEN, pp. 77-78, Pl. IX, fig. 9.
 1934 *Psf. pseudochihsiaensis* CHEN, Pl. IX, fig. 13; Pl. XI, figs. 8, 9.
 1952 *Schwagerina pseudochihsiaensis*, KONISHI, Pl. 14, figs. 9, 10.
 1960 *Parafusulina chihsiaensis*, MORIKAWA, pp. 294-295, Pl. 46, fig. 16; Pl. 52, figs. 1-4.
 non 1962 *Parafusulina chihsiaensis*, CHISAKA, pp. 544, Pl. 7, fig. 5.
 1963 *Schwagerina?* sp. cf. "*Pseudofusulina*" *chihsiaensis* (Lee), KANMERA, pp. 93-94, Pl. 19, fig. 14.
 1965 *Pseudofusulina chihsiaensis*, LEVEN, p. 137, Pl. V, figs. 5-7.
 1966 *Chusenella cheni*, SKINNER & WILDE, pp. 31, Pl. 25, figs. 1-6.
 1967 *Pseudofusulina chihsiaensis*, LEVEN, p. 153, Pl. XIII, figs. 5, 6.
 Materials: Axial sections, UHR 18990, UHR 19021. Sagittal sections, UHR 19022a, UHR 19022b. And many other ill-oriented specimens.

Description:

A few well oriented specimens are at hand. Shell medium in size, fusiform with sharply pointed poles and arcuate axis of coiling.

The external size of full grown shell can not be measured with certainty because of ill-preservation of the materials at hand. The mature shell possesses 8 to 8½ volutions. The shell of six volutions, 4.4 to 5.6 mm long and 1.6 to 1.8 mm

wide. The largest shell in tangential section so far as measured, is 7.5 mm in length and 2.45 mm in width. Form ratio 2.8 to 3.1.

The coiling of the shell relatively tight, but rapidly expanding in the fifth to the seventh volution. The average height of volution from the first to the eighth volution in five specimens, 0.048, 0.062, 0.09, 0.108, 0.136, 0.177, 0.22 and 0.245 mm respectively.

Proloculus attains 0.20 to 0.24 mm in outside diameter. Spirotheca consists of coarse alveoli especially in outer volutions. Thickness of the spirotheca is gradually thickened towards outer volutions, averaging from the first to the seventh volution in four specimens, 13, 23, 28, 38, 48, 58 and 64 microns respectively.

Septa rather regularly and broadly fluted mainly at their lower portions, but almost straight near the tunnel. Cuniculi structure is not observed in tangential sections. The number of septa in inner four volutions, 8 to 22 and in outer volutions 20 to 25.

Chomata not present except the first volution where the trace of them is detectable.

Axial fillings well developed.

Tunnel low and broad.

Remarks :

The present form is quite identical with *Schellwienia chihsiaensis* LEE, which was corrected to *Pseudofusulina chihsiaensis* (LEE) by Chen (1934), from Chihsia limestone, South China. Chihsia form possesses smaller proloculus, especially in the illustrated axial section by LEE (1931) (Pl. 1, fig. 2) than the present form. But other essential characters are all well coincide between Chinese and the present Japanese forms.

In 1934, CHEN described *Pseudofusulina chihsiaensis* with 3 varieties and *Ps. pseudochihsiaensis*. The writer considers that these two species are synonymous and differences are of no specific value, and that to divide *Pseudofusulina chihsiaensis* into 3 varieties is needless.

The present species is also identical with *Parafusulina chihsiaensis*, which MORIKAWA described from Iwaizaki, in every respect.

Schwagerina acris THOMPSON & WHEELER (1942) is somewhat similar to Iwaizaki specimens, but the latter is distinguished from the former in having comparatively small and slightly more elongate shell with more sharply pointed poles, and more tight coiling of the shell.

Chusenella leei SKINNER & WILDE (1966) from Twin Lakes, northwestern Washington resembles the present form in shell shape, mode of axial fillings, and character of coiling. But strictly compared, the former differs from the latter in having comparatively large fusiform shell with sharply pointed poles even in inner

volution, inner tightly coiled three volutions, and abruptly expanded later volutions.

SKINNER & WILDE (1966) described *Chusenella cheni*, with the above referred *Chu. leei* from the same place. Their specimens principally identical with Iwaizaki specimens. But the former possesses more tightly coiled inner volutions and comparatively well developed chomata in inner volutions than the latter. But these differences are merely of intra-specific variations as exemplified by CHEN in 1934 with abundant specimens. *Chusenella cheni* SKINNER & WILDE should be included into *Pseudofusulina chihsiaensis*.

Schwagerina longipertica CHEN (1956) differs from *Pseudofusulina chihsiaensis* only in regularly fluted septa. The relation between these two species should be reexamined in future.

In 1952, KONISHI described *Schwagerina pseudochihsiaensis* (CHEN) from Yasuba type Dodo conglomerate. He did not illustrate the axial section, so precise natures of inner volutions and proloculus are unknown. But essential characteristics are quite identical with the Iwaizaki form.

There is another report of *Parafusulina chihsiaensis* from the Kitakami Mountainland besides Iwaizaki by CHISAKA (1962) from Maiya town. His specimen, however, judging from his illustration and description, seems to be not conspecific with Chihsia form. Because the shell of the former is subcylindrical, while that of the latter is fusiform with sharply pointed poles. But further discussion can not be made in detail here, as CHISAKA showed only one illustration. Future investigation is needed by securing more numerous specimens.

Family Verbeekinidae STAFF & WEDEKIND, 1910

Genus *Lepidolina* LEE 1933

Lepidolina kumaensis KANMERA

Pl. 5, figs. 1-9; Pl. 6, fig. 1.

- 1952 cfr. *Sumatrina annae* VOLZ, KONISHI, pp. 159-161, pl. 14, figs. 2-5, 7.
- 1954 *Lepidolina kumaensis* KANMERA, pp. 22-24, Pl. 5, figs. 1-13.
- 1954 *Lepidolina toriyamai* KANMERA, pp. 24-26, Pl. 6, figs. 1-19.
- 1958 *Lepidolina* cfr. *toriyamai*, YANAGIDA, pp. 228, text-fig. 2.
- 1958 *Lepidolina kumaensis*, NOGAMI, pp. 104-105, Pl. 2, figs. 8, 9.
- 1958 *Lepidolina toriyamai maizuruensis* NOGAMI, p. 106, Pl. 2, figs. 1-5.
- 1958 *Lepidolina toriyamai*, NOGAMI, pp. 105-106, Pl. 1, figs. 1, 2.
- 1959 *Lepidolina ussurica* DUTKEVITSCH, MIKLUCHO-MACLAY in ОСНОВЫ палеонтологии. Pl. 11, fig. 9.
- 1960 *Yabeina proboscis*, CHISAKA, pp. 252-253, Pl. 9, figs. 1-3.
- 1962 *Lepidolina kumaensis*, SUYARI, pp. 38-39, Pl. 12, figs. 2-4.
- 1965 *Lepidolina kumaensis*, HASEGAWA, pp. 27-30, Pl. 1, figs. 1-5, Pl. 2.

Description :

Shell medium, subcylindrical to elongate fusiform, with slightly concave lateral slopes and bluntly pointed poles. Outer few volutions are always partly missing in all specimens, so it is difficult to measure the exact size of full grown shell. In some mature specimens twelve volutions are counted but nine to ten are common. In the eighth volution the shell is 3.7 to 5.4 mm long, and 1.26 to 1.56 mm wide. The shell possessing twelve volutions is estimated to be 6.2 to 8.1 mm long and 2.7 to 2.8 mm wide. Form ratio varies from 2.4 to 3.7. The shell is spherical to sub-spherical up to the fourth volution, but it rapidly expands in length, though increase in width remains slow and uniform. From the fifth or the sixth to the outer volutions, the shell is almost the same in shape. Average form ratio of half length to radius vector in the first to the eighth volution in five specimens is 1.2, 1.5, 1.9, 2.4, 2.7, 2.8, 3.0 and 3.2 respectively. Form ratio in some specimens in the ninth and the tenth volution in average is 3.6 and 3.7 respectively.

Proloculus is spherical, relatively large and measures commonly 260 to 300 microns, the largest one being 460 microns in outside diameter.

Heights of the first to the eighth volution averaging eight specimens is 0.042, 0.045, 0.057, 0.059, 0.072, 0.090, 0.099, and 0.112 mm respectively.

Spirotheca very thin, composed of tectum, fine keriotheca and lower tectorium. Under low magnification, it seems as if no keriotheca is present. But under 200 to 400 times magnification keriotheca is surely detected throughout volutions, although it is often ambiguous in the first volution, because of extreme thinness of the spirotheca. Average thickness of the spirotheca of the first to the tenth volution is 7.0, 7.6, 7.7, 7.7, 8.0, 8.0, 8.0, 8.8, 9.3 and 9.0 microns respectively.

Number of the septa is counted 8 to 10 in the first, 10 to 11 in the second, 10 to 14 in the third, 12 to 14, in the fourth, 13 to 16 in the fifth and sixth, about 16 in the seventh and the eighth volution.

A number of regularly spaced, slender, primary transverse septula occur throughout volutions. They resemble the transverse septula of *Gifuella*.

Beneath the primary transverse septula parachomata occur and the top of which is usually combined with each corresponding primary transverse septulum.

Initial axial septula appear at the second volution, rarely at the third or the first and become distinct from the third volution onward. In outer few volutions four to five axial septula present. Small secondary transverse septula begin to appear in the third or the fourth volution. In outer few volutions, they show pendant shape, like that of the secondary transverse septula of genus *Sumatrina*. One or two secondary transverse septula are seen between each adjacent primary transverse septulum in outer volutions, being $\frac{1}{2}$ to $\frac{2}{3}$ the height of the chamber.

Foramina circular to subcircular in cross section, measuring 20 to 30 microns in diameter, and open between two adjacent primary transverse septula.

Remarks:

Lepidolina kumaensis was first described by KANMERA from the Kuma formation in 1954. He also described *Lepidolina toriyamai* with this species which is distinguished from the former by slender form, rather tightly coiled shell, and smaller proloculus. But, as already stated by HASEGAWA in 1965, these differences are not essential. Following HASEGAWA the writer would like to regard them as conspecific. In fact, Iwaizaki specimens reveal considerable variation in shell shape as shown in form ratios, and the size of proloculus, while other characters remain essentially the same. Therefore the writer felt difficulty in dividing them into groups.

Iwaizaki specimens have close similarity to *Lepidolina kumaensis*, and especially to *L. toriyamai* in important characters; namely in elongate shell shape, relatively large proloculus for the size of their shell, expansion of the shell, thickness of the spirotheca, and the characters of transverse septula. But compared with the present specimens, Kuma specimens have more volutions, larger shells, fewer septa, and much more developed axial septula. Concerning to the axial septula, Kuma specimens have three or four axial septula in the third to fourth or sixth volution, and four to nine in outer volutions. On the contrary, the present specimens have only five axial septula even in the eleventh volution.

NOGAMI (1958) also described *L. kumaensis*, *L. toriyamai* and *L. toriyamai maizuruensis*, from the Maizuru Zone, Central Japan. Iwaizaki specimens agree with them, but differ in having smaller shell with fewer volutions, more numerous septa and ill-developed axial septula than the latter.

SUYARI's (1962) specimens obtained from Shikoku are mostly identical with the present specimens in many respects. Only the difference lies in larger proloculus and slightly more rapid expansion in inner few volutions of the former.

Recently HASEGAWA (1965) described in detail *L. kumaensis* and *L. sp.* found in Ohtani conglomerate, and he remarked on *Yabeina* and *Lepidolina*, dividing them into two bioseries, namely *Neoschwagerina-Yabeina* and *Gifuella*-"*Lepidolina*" bioseries. His specimens, the writer examined, show larger shell with more volutions, larger proloculus, more rapid expansion of the shell with fewer septa, and well developed axial septula than the present specimens. Nevertheless, the shape of the shell, extreme thinness of the spirotheca and the characters of the transverse septula which possess the affinity with *Gifuella*, are very well agree with each other.

CHISAKA (1960) reported *Yabeina proboscis* CHEN from the Takagami Conglomerate, Choshi peninsula, Chiba prefecture. Choshi specimens well resemble Iwaizaki specimens, but with much thicker spirotheca, slightly larger shell and proloculus.

In 1962, CHISAKA also described the same species from Maiya town, south Kitakami Mountainland. Judging from his illustrations and measurements, they are similar to the Iwaizaki specimens. But more precise description is desired for

Maiya specimens to make more detailed comparison possible.

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PLATE 5 AND EXPLANATION

Explanation of Plate 5

All figures are $\times 20$.

Lepidolina kumaensis KANMERA.

Figs. 1, 2, 5, 7 & 8. Axial sections.

1. UHR 18993, 2. UHR 18984, 5. UHR 18985,
7. UHR 18983, 8. UHR 18989.

Figs. 3, 6. Oblique axial sections.

3. UHR 18987, 6. UHR 18981

Figs. 4, 9. Sagittal sections.

4. UHR 18993, 9. UHR 19034.

All specimens are from the locality along the Pacific coast about 400m N. W. from the tip of Cape Iwaizaki, Kesenuma City, Miyagi Prefecture, N. E. Japan.

Plate 5

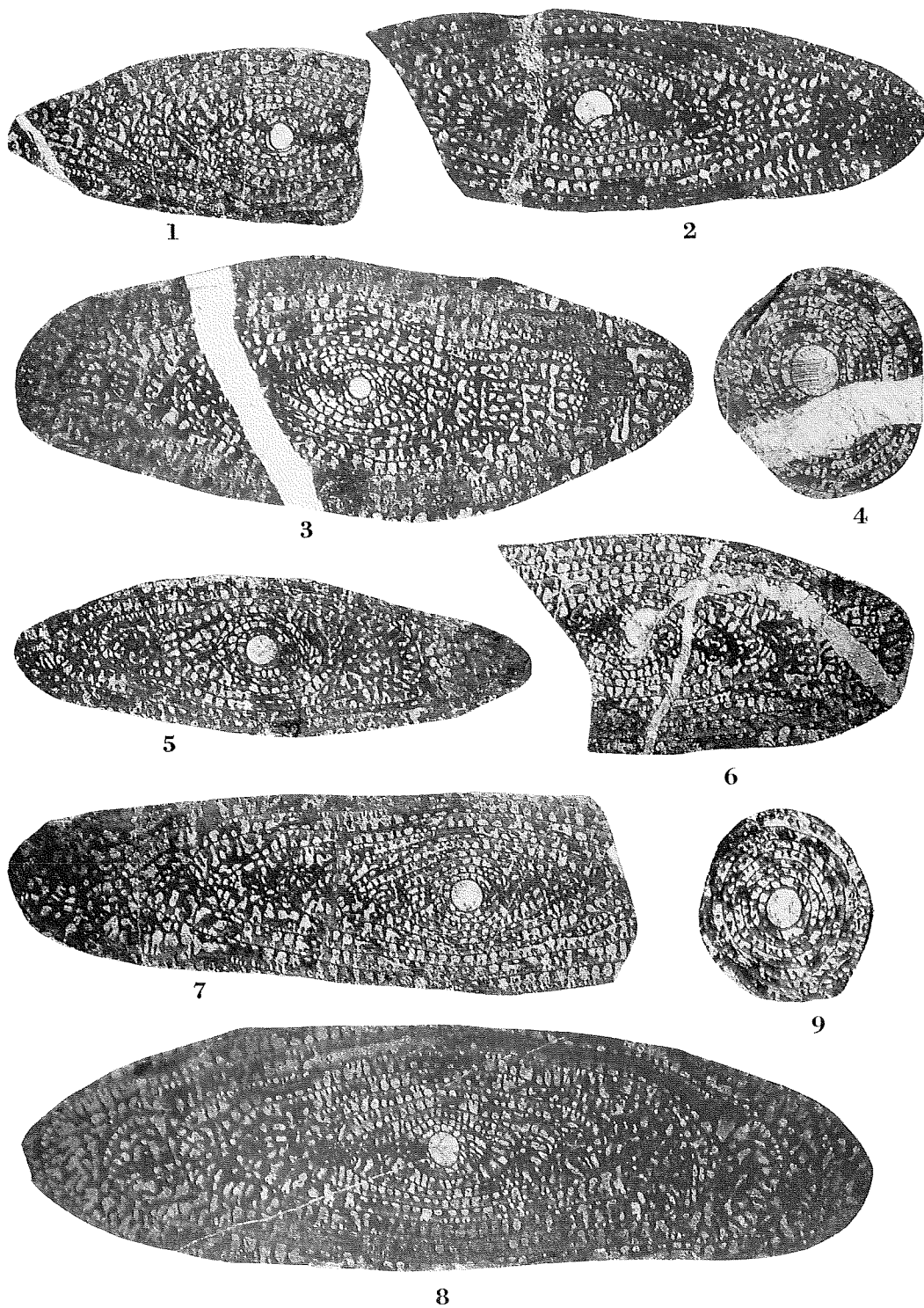


PLATE 6 AND EXPLANATION

Explanation of Plate 6

Lepidolina kumaensis KANMERA

Enlarged part of pl. 5, fig. 8. \times 154. UHR 18989.

Plate 6



PLATE 7 AND EXPLANATION

Explanation of Plate 7

All figures except figs. 2 and 9 are $\times 20$. Fig. 2 is $\times 10$ and Fig. 9 is $\times 50$.

Pseudofusulina chihhsiaensis (LEE)

Figs. 1, 3. Incomplete axial sections.

1. UHR 18986, UHR 18990

Figs. 5, 6. Sagittal sections

5. UHR 19022a, 6. UHR 19022b

Fig. 2. Oblique tangential section. UHR 18994

Fig. 4. Oblique section. UHR 18986

Rauserella pachythea CHOI, sp. nov.

Fig. 7. Axial section of an immature specimen (Paratype). UHR 18993

Fig. 8. Parallel section (Paratype). UHR 18981.

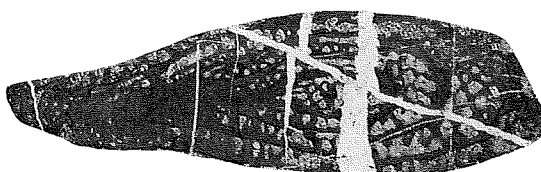
Fig. 9. Axial section of holotype. UHR 18989.

LOC: Produced at the point along the Pacific coast about 400m N. W. from the tip of Cape Iwaizaki, Kesennuma City, Miyagi Prefecture, Japan.

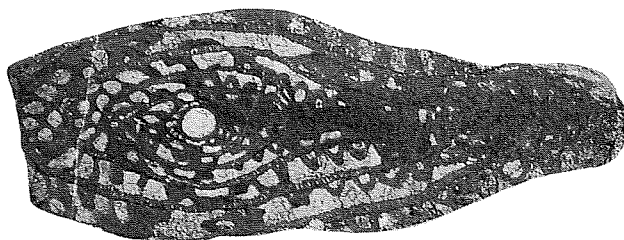
Plate 7



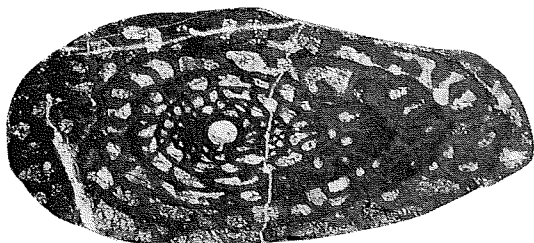
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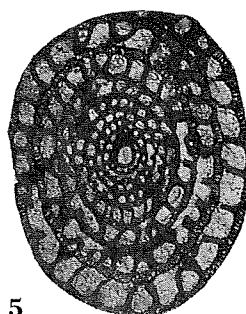
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3



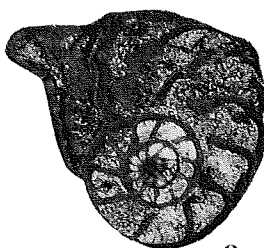
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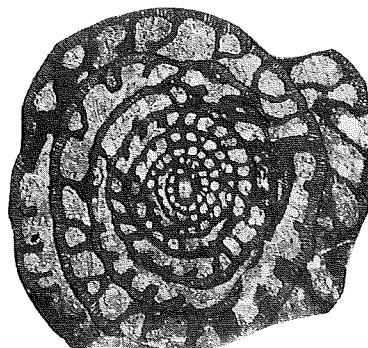
5



7



8



6



9

PLATE 8 AND EXPLANATION

Explanation of Plate 8

Dunbarula kitakamiensis CHOI, sp. nov.

- Fig. 1.** Ill-oriented section which shows the presence of keriotheca in the outer volutions. UHR 18997 \times 100
- Fig. 2.** Sagittal section of a paratype showing the keriothecal structure in the spirotheca of the outer volutions. UHR 18997 \times 100
- Fig. 3.** Slightly oblique axial section of a paratype. UHR 18993 \times 50
- Fig. 5.** Sagittal Section of a paratype. UHR 18993 \times 20
- Fig. 6.** Holotype \times 20. Fig. 4. is the enlarged photograph of fig. 6. \times 100. UHR 18989.

Codonofusiella inuboensis (CHISAKA)

- Figs. 9, 11.** Axial sections. 9. UHR 18996 \times 40, 11. UHR 18989 \times 20.
- Figs. 7, 8.** Parallel sections. 7. UHR 18992 \times 20, 8. UHR 18990 \times 20.
- Fig. 10.** Tangential section. UHR 18997 \times 20
- Fig. 12.** Enlarged portion of the tangential section of a paratype showing the distinct alveolar structure in the spirotheca. UHR 19030 \times 286
- LOC: Produced at the point along the Pacific coast about 400m N. W. from the tip of Cape Iwaizaki, Kesenuma City, Miyagi Prefecture, Japan.

Plate 8

