Carboniferous Palaeotextulariid Foraminifers from the Akiyoshi Limestone Group, Southwest Japan

By

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with 2 Text-figures and 1 Plate

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ABSTRACT. Nine species of Palaeotextulariidae are described and illustrated from the lower part of the Akiyoshi Limestone group; *Palaeotextularia consobrina*, *P. vulgaris*, *P.* sp. A, *Cribrostomum* sp., *Deckerellina* sp., *Deckerella* sp., *Climacammina antiqua*, *C. volgensis*, *C.* sp. A. The zones below the *Millerella* sp. A zone are characterized with the dominance of *Palaeotextularia*, while the *Millerella* sp. A zone and the overlying ones with higher percentage of *Climacammina*. The progressive change of chamber arrangement, aperture pattern and test size as well as the stratigraphic distribution bear close resemblance to what have been observed in the British Visean and Namurian.

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I. INTRODUCTION

Recently, the smaller foraminifera have been appreciated as important elements in the biostratigraphical study of the Late Palaeozoic formations. CUMMINGS (1958) demonstrated the need of quantitative analysis of faunal assemblages by examining both of thin sections prepared from hard rocks and free specimens extracted from soft rocks. He drew an example from the British Avonian Palaeotextulariidae, and discussed its stratigraphic significance. With regard to the morphogeny of palaeotextulariids[1], he noticed several bioseries characterized by progressive change of chamber arrangement (biserial-uniserial), apertural condition (single-cribrate) and test size (small-large).

The writer has been engaged in studying biostratigraphically the Carboniferous limestone (the lower part of the Akiyoshi Limestone group) developed on the southern slope of the Akiyoshi plateau, Yamaguchi Prefecture, Southwest Japan. As a result, he (OKIMURA, 1966) established the following seven zones on the basis of faunal assemblages of smaller foraminifera together with primitive fusulinaceans.

Fusulinella biconica zone
Profusulinella beppensis zone } ... Fusulinid-bearing bio-micrite (-sparite) to bio-micrudite (-sparrudite)
Pseudostaffella antiqua zone

1) Hereafter, the term "palaeotextulariid" is restricted to the forms referred to the Palaeotextulariidae.

Millerella sp. A zone.....Algal bio-micrite (-sparite) to bio-micrudite (-sparrudite) with biolithite, intrasparrudite and calclithite

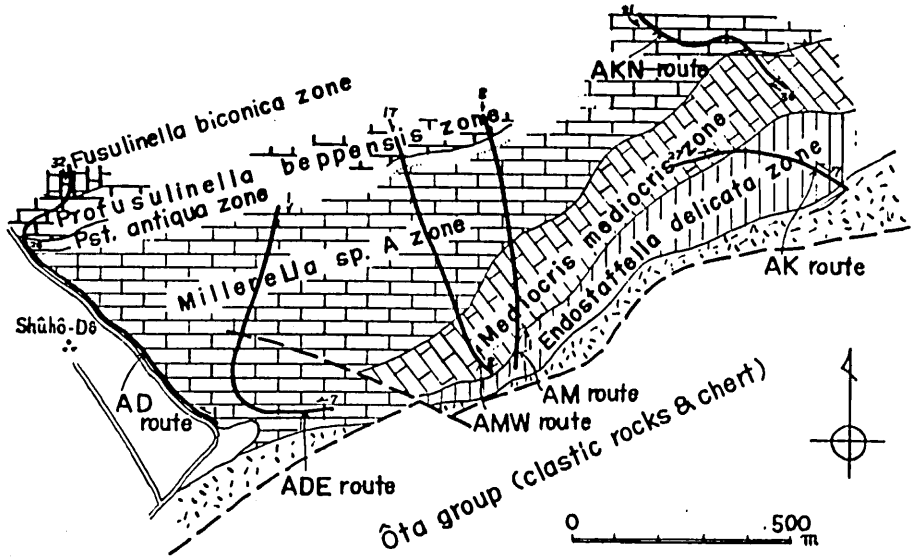
.....Unconformity?.....

Mediocris mediocris zone } ...Oo-sparite to -sparrudite with algal bio-micrudite
Endostaffella delicata zone } (-sparrudite) and tuffaceous shale

Endothyra sp. A zone.....Intra-sparrudite (-micrudite) with "schalstein"

(Rocks enclosed with round brackets are rather rare)

In this paper, nine species of Palaeotextulariidae are described. Regarding the classification of this family the writer follows the proposal of Cummings (1956), and the specific identification is made mainly through the $0/\infty/\infty$ and $A^{+}45°\ B^{+}/\infty$ sections (Cummings, 1958). All the foraminifers of the Akiyoshi Limestone can be examined only by thin sections, because there is not any friable and soft rock. For the quantitative study three sections at right angles to one another have been examined in every locality, and specimens distributed within more than 25 square centimeters in area are counted. One of the purposes of this study was to make clear the stratigraphic distribution as well as the bioseries of Palaeotextulariidae and to use them for biostratigraphic subdivision of the Akiyoshi Carboniferous Limestone.



Text-Fig. 1. Geological sketch map on the southern slope of the Akiyoshi Limestone Plateau. Thick solid lines show the sampling routes.

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Repository. All specimens described and figured in this paper are kept at the Institute of Geology and Mineralogy, Faculty of Science, Hiroshima University, Japan. Their register-numbers are given in the explanation of plate.

II. SYSTEMATIC DESCRIPTION

Family Palaeotextulariidae CUMMINGS, 1956
Genus *Palaeotextularia* SCHUBERT, 1920

Type-species:- *Palaeotextularia schellwieni* GALLOWAY and RYNIKER, 1930

Palaeotextularia consobrina LIPINA
Pl. XVII, fig. 2.

1948, *Palaeotextularia consobrina* LIPINA, *Akad. Nauk, USSR, Inst. Geol. Nauk, Trudy, Moskow, fasc. 62 (Geol. Ser.* no. 19), p. 201, pl. 10, figs. 2-4.
1957, *Palaeotextularia consobrina*, GOLUBTZOV, *Akad. Nauk, BSSR, Inst. Geol. Nauk*, no. 2, p. 125, pl. 4, fig. 8.
1962, *Palaeotextularia consobrina*, BOGUSH and YUPHEREV, *Akad. Nauk, USSR, Sibir. Otdel., Inst. Geol. Geoph.*, p. 187, pl. 7, fig. 17.

Material:- Two specimens of $0/\infty/\infty$, and three of $A^{+}45°B^{+}/\infty$ or other orientation have been examined. Figured specimen was collected at locality AK-25 of the *Mediocris mediocris* zone.

Description:- Test small, cuneiform, tapering uniformly toward the proloculum, consisting of six pairs of alternating chambers, which are biserially arranged and gradually and regularly increase in size as added; the ratio of breadth to height of chamber 1.0 to 1.2 in the neanic stage, becoming larger in the last and penultimate chambers. Wall moderate in thickness, composed of granular calcareous material, with a discontinuous inner layer showing a "fibrous" structure. Septa long, fairly convex, overlapping. Aperture a single, low opening at the base of domed face of the last chamber.

Dimensions:- Length 0.64 mm. and maximum width 0.40 mm. in the figured specimen (Pl. XVII, fig. 2).

Remarks:- The type-specimens of this species have, after LIPINA (1948, p. 201), a single, granular calcareous wall without the hyaline radial layer, while the specimens at hand have an impersistent inner layer. In every other features, however, the latter agrees with the former, and therefore the writer dares to identify them with each other. As to the generic position, further study may be necessary. As LIPINA stated, this species closely resembles *Textularia eximia* EICHWALD; a complete discrimination between the two is impossible, because the latter is described only from the exteriors. The present species is similar to *Palaeotextularia longiseptata* LIPINA from the middle to upper Visean of USSR, but differs in its convex septa throughout the growth and lesser width of test. It also differs from *P. bella* LIPINA described from the middle Visean (Oka substage) of the Moscow Basin as the latter is goblet-shaped.

Horizon and localities:- The holotype and other figured specimens of LIPINA occurred from the upper part of the Jasnopala substage to the upper part of the Oka substage, Lower Carboniferous on the southern slope of the Moscow Basin. The specimens at hand were obtained from localities AK-19, AK-23, AK-24, AK-25 and AK-27, all of the *Mediocris mediocris* zone of the Akiyoshi Limestone.

Palaeotextularia vulgaris (REITLINGER)
Pl. XVII, fig. 1.

1950, *Textularia vulgaris* REITLINGER, *Akad. Nauk, USSR, Inst. Geol. Nauk, Trudy, Moskow, fasc. 126 (Geol. Ser.* no. 47), p. 53, pl. 9, figs. 13 and 14; pl. 10, fig. 17.

Material:- Five specimens of 0/∞/∞ section and more than seven specimens of $A^{+}45°B^{+}$/∞ section are mainly concerned with the description below. Figured one was found at locality AK-18 of the upper part of the *Endostaffella delicata* zone.

Description:- Test small, considerably tapering in early part, thereafter with subparallel sides, consisting of six pairs of alternating chambers, which increase in size rapidly in nepionic stage and very slowly in later stage. Wall thin, two-layered, with outer granular calcareous and inner "fibrous" layers. Septa long, slightly convex, thickening gradually toward the inner end, overlapping. Aperture a single, very low opening at the base of "antetheca" of the final chamber, on inner margin.

Dimensions:- Length 0.67 mm. and maximum width 0.36 mm. in the figured specimen (Pl. XVII, fig. 1).

Remarks:- The compound wall structure and a single aperture show that this species does not belong to *Textularia*, but to *Palaeotextularia*, as indicated on CUMMINGS' list (1956, p. 219). This species is similar to *Palaeotextularia angusta* (REITLINGER) from the lower Moscovian of the Moscow Basin and *P. eofragilis* (REITLINGER) from the Bashkirian of the Timan Upland, Komi ASSR, but differs in its more convexed septa, lesser thickening of septal end and less inflated last chamber.

Horizon and localities:- The holotype specimen (0/∞/∞ section) of this species came from the lower Moscovian Kashira formation at Irina Slaboda in the eastern part of the Moscow Basin. In the Akiyoshi Limestone the present species is commonly found from the oolitic limestone of the *Endostaffella delicata* zone. Localities; AK-7, AK-12, AK-13, AK-15, AK-16, AK-17 and AK-18.

Palaeotextularia sp. A
Pl. XVII, fig. 3.

Material:- Two sections oriented nearly 0/∞/∞, six sections of $A^{+}45°B^{+}$/∞ and a few others have been examined. Figured specimen came from locality ADE-4 of the *Millerella* sp. A zone.

Description:- Test moderate in size, convexed cuneiform, tapering throughout, consisting of 7-9 pairs of alternating chambers, which increase uniformly in size as added; the ratio of breadth to height of each chamber 1.2-1.4; last chamber considerably inflated, cribrostomoid. Wall thin, composed of an outer granular calcareous layer with

adventitious material and an inner "fibrous" layer, but the latter indistinct in the nepionic part. Septa relatively long, slightly convex in the early stage and fairly convex in the later stage, spoon-shaped with thickened inner end, overlapping each other through the growth. Aperture a single, very low opening at the base of domed face of the final chamber, but in some specimens apparently cribrate.

Dimensions:- Length 1.08 mm. and maximum width 0.54 mm. in the figured specimen (Pl. XVII, fig. 3).

Comparison and affinities:- Although the exact comparison is difficult by lack of sections oriented due 0/∞/∞, this species differs from the two species described above in its semicircular final chamber. This species resembles *Palaeotextularia angusta* (REITLINGER) and *P. fragilis* (REITLINGER) from the upper Moscovian of Timan Upland, Komi ASSR in the septal feature and arrangement of chambers, but it is larger than the former and smaller than the latter.

Horizon and localities:- The present species was mainly collected from the algal limestone of the *Millerella* sp. A zone. Localities; AD-1, AD-4, AD-8, ADE-2, ADE-4, ADE-7, AMW-11 and AMW-13. It occurred, though rarely, also from localities AK-19 and AK-22 of the *Mediocris mediocris* zone.

Genus *Deckerellina* REITLINGER, 1950

Type-species:- *Deckerellina istiensis* REITLINGER, 1950

Deckerellina sp.
Pl. XVII, fig. 4.

Material:- In the case of thin section study *Deckerellina* may be identified only in 0/∞/∞ section by the granular calcareous wall and the double aperture in the later stage. There are two specimens which satisfy such condition and are undoubtedly referable to this genus. Figured specimen was collected from locality AD-13 of the *Millerella* sp. A zone.

Description:- Test moderate in size, straight or very slightly curved, increasing rapidly in breadth in early stage, thereafter gradually enlarging to become obtuse cuneiform, consisting of seven pairs of alternating chambers, among which those of the earlier five pairs are low and broad and the succeedings are inflated and nearly as high as broad. Septa somewhat convex, overlapping except the last one, spatulate in early part and securiform with a waterdrop-like end in later stage. Wall consisting mainly of granular calcareous material. Two apertures observed on the last chamber, one in the inner part of its terminal face and the other at the base of the face; aperture in the earlier part a single opening at the base of palaeotextularioid chamber.

Dimensions:- Length 0.98 mm. and maximum width 0.56 mm. in the figured specimen (Pl. XVII, fig. 4).

Comparison and affinities:- Owing to the scarcity of material, accurate comparison with other species of this genus is difficult. The present species shows some resemblance to *D. istiensis* REITLINGER described from the Middle Carboniferous of the

Central Russian Platform, but the latter has a larger and slenderer test.

Horizon and localities:- The specimens were collected at localities AK-13 of the *Endostaffella delicata* zone and AD-13 of the upper part of the *Millerella* sp. A zone. AK-13 consists of oolitic limestone, and AD-13 of algal limestone containing pebbles of oolitic limestone.

Genus *Deckerella* CUSHMAN and WATERS, 1928

Type-species:- *Deckerella clavata* CUSHMAN and WATERS, 1928

Deckerella sp.
Pl. XVII, fig. 5.

Material:- In thin section, this genus may be identified only in an axial section which shows two apertural openings, the double wall structure and the characteristic chamber pattern. Only three specimens satisfying such condition were collected. The figured specimen came from locality AD-28 of the *Profusulinella beppensis* zone.

Description:- Test relatively large, elongate, slightly curved, gradually tapering in early part, thereafter with subparallel sides, consisting of six pairs of overlapping, biserially arranged chambers, followed by four low, broad, uniserial chambers. Wall relatively thick, composed of an outer granular calcareous layer and an incomplete inner calcareous "fibrous" layer. Septa relatively long and somewhat convex in early part, but in later part thick and shortened with septal openings. Aperture in early chambers a single, low opening at the base of the terminal face, on the inner margin; aperture in later chambers double in a central position of the convexed terminal face.

Dimensions:- Concerning the figured specimen (Pl. XVII, fig. 5), length 0.72 mm. and maximum width 0.35 mm. in biserial part, and length 0.93 mm. and maximum width 0.43 mm. in uniserial part.

Comparison and affinities:- This species closely resembles *Deckerella media bashkiricus* MOROZOVA from the Middle Carboniferous of USSR, but the latter has an almost straight test. *D. laheei* CUSHMAN and WATERS from the Pennsylvanian of USA differs from this species in its larger size and longer septa, although they are alike in their chamber arrangement.

Horizon and localities:- The present specimens were obtained at three localities (ADE-4 of the upper part of the *Millerella* sp. A zone, AD-26 of the *Pseudostaffella antiqua* zone and AD-28 of the *Profusulinella beppensis* zone).

Genus *Cribrostomum* MÖLLER, 1879

Type-species:- *Cribrostomum textulariforme* MÖLLER, 1879

Cribrostomum sp.
Pl. XVII, fig. 6.

Material:- Three axial sections and two other sections have been examined. The figured specimen was obtained at locality AK-8, the lower part of the *Endostaffella*

delicata zone.

Description:- Test relatively large, elongate, slightly curved, tapering throughout, consisting of seven pairs of biserially arranged chambers, which increase gradually in size as added; last chamber strongly inflated, asymmetrical to the axis of the test, covering two-thirds of the penultimate pair of chambers. Wall reratively thick, composed of outer granular calcareous main element with adventitious material, and incomplete inner "fibrous" calcareous layer. Aperture cribriform, numbering, in the $0/\infty/\infty$ section, five in the central portion of the inflated terminal face of the final chamber. Septa long except for the last one, somewhat convexed, club-shaped with a thickened end of outer layer.

Dimensions:- Length 1.14 mm. and maximum width 0.64 mm. in the figured specimen (Pl. XVII, fig. 6).

Comparison and affinities:- This species closely resembles *Cribrostomum "eximium* (EICHWALD)" of MÖLLER (1879) and *C. bradyi* MÖLLER in shape, but is distinguished in its higher chambers of later stage and more strongly inflated last chamber. It also differs from other species of the genus in its unusual inflation of the last chamber.

Horizon and localities:- This species is rare in occurrence. Its localities are AK-8, AK-15 of the *Endostaffella delicata* zone, AK-19, AK-23 of the *Mediocris mediocris* zone and AKN-23 (in pebble) of the *Millerella* sp. A zone.

Genus *Climacammina* BRADY, 1873

Type-species:- *Textularia antiqua* BRADY, 1871

Climacammina antiqua (BRADY)

Pl. XVII, figs. 7 and 8.

1876, *Textularia antiqua* BRADY, *Palaeontogr. Soc. London, Monogr.*, vol. 30, pp. 67-69, pl. 2, figs. 1-9.
1930, *Climacammina antiqua*, LEE and CHEN, *Acad. Sinica, Nat. Res. Inst. Geol., Mem.*, no. 9, pp. 102-103, pl. 5, fig. 3.
1956, *Climacammina antiqua*, CUMMINGS, *Micropaleont.*, vol. 2, no. 3, pp. 226-227, pl. 1, figs. 10-11.

Material:- Five axial sections are concerned with the description below. Figured specimens were obtained from locality AD-21 of the *Millerella* sp. A zone.

Description:- Test relatively large, elongate, slightly to fairly curved, horn-shaped with conical early part and cylindrical later part, more or less constricted between them. Conical part of test consisting of eleven pairs of biserially arranged overlapping chambers, which increase gradually in size with growth, followed by a single inflated chamber covering some one-third of terminal areas of the preceding two chambers; cylindrical part of test consisting of three broad, low, uniserial chambers. Wall thin, composed of granular calcareous layer with discontinuous inner "fibrous" layer. Aperture of early chambers a single low opening as in the genus *Palaeotextularia*, but in the later part becoming cribriform; in $0/\infty/\infty$ section 3-4 small openings with ingrowth of septal face observable on the central domed area of the uniserial chamber. Septa spatulate to securiform, relatively thin and overlapping in the earlier stage, but in the later part fairly thick.

Dimensions:- One of the figured specimens (Pl. XVII, fig. 8); length 1.29 mm. and maximum width 0.41 mm. in biserial part, and length 1.16 mm. and maximum width 0.56 mm. in uniserial part.

Remarks:- The present species closely resembles *Climacammina magna* Roth and Skinner from the lower Pennsylvanian McCoy formation of Colorado, USA, but the latter is distinguished from the former in its almost straight arrangement of chambers and larger size. This species differs from *C. longissimoides* (Lee and Chen) described from the Middle Carboniferous Huanglung limestone of China in its apertural number which increases gradually with growth of climacamminoid uniserial part. This species also differs from *C. volgensis* Reitlinger described from the Bashkirian of the Central Zawalji, USSR, in the larger test. Harlton's specimens (1927, pl. 4, figs. 3a and b) from the Pennsylvanian Glenn formation of Oklahoma, USA, which has been identified with *C. antiqua*, may belong to other species in that their aperture becomes cribrate only in the last chamber.

Horizon and localities:- The present species has been known from the upper Visean of British Lower Carboniferous and the Huanglung limestone (c_1 horizon, Middle Carboniferous) of China. In the British Carboniferous, according to Cummings (1956), the range of this species is very restricted. The material at hand was collected from localities AD-1, AD-12, AD-21, AD-22 of the *Millerella* sp. A zone and AD-26 of the *Pseudostaffella antiqua* zone.

Climacammina volgensis Reitlinger
Pl. XVII, fig. 9.

1930, *Cribrostomum longissimoides* Lee and Chen, *Acad. Sinica, Nat. Res. Inst. Geol., Mem.*, no. 9, pp. 100-101, pl. 4, fig. 7.
1961, *Climacammina volgensis* Reitlinger, *Akad. Nauk, USSR, Inst. Geol., tom.* 5, p. 238, pl. 3, fig. 3.

Material:- An axial section ($0/\infty/\infty$) and two sections nearly oriented $A^{+}45°B^{+}/\infty$ have been examined. Besides them more than three oblique specimens are referable to this species. Figured specimen came from locality ADE-2 of the *Millerella* sp. A zone.

Description:- Test relatively large, elongate, straight to very slightly curved; tapering early part consisting of eight pairs of biserially arranged chambers, followed by a single asymmetrical cribrostomoid chamber which covers about two-thirds of preceding pair of chambers; cylindrical later part consisting of three broad, low chambers of climacamminoid uniserial arrangement; adjoining part between early and later parts slightly constricted. Wall relatively thin, composed of granular calcareous main element and incomplete inner "fibrous" layer. Aperture in early part a single, low opening as in the genus *Palaeotextularia*; aperture in uniserial part cribriform, represented by short siphonal openings in the central portion of the terminal face of chamber. Septa convex through the growth, overlapping and spatulate in early part, short, thick and securiform in middle and later parts.

Dimensions:- Figured specimen (Pl. XVII, fig. 9); length 0.75 mm. and maximum

width 0.45 mm. in biserial part, and length 0.82 mm. and maximum width 0.62 mm. in uniserial part.

Remarks:- The present species differs slightly from *Climacammina longissimoides* (LEE and CHEN) from the Huanglung limestone (Middle Carboniferous) of China in its shorter test. Among the syntypes of the latter species, however, the specimen illustrated in fig. 7 of pl. 4 (LEE and CHEN, 1930) is smaller than the others (figs. 6 and 8), and it may be referable to *C. volgensis*. *C. longissimoides* recorded by SULEIMANOV (1949) from the lower Permian of Bashkir, USSR, differs from the holotype of the species in its apertural characters and middle cribrostomoid chamber, and may be also assigned to *C. volgensis*.

Horizon and localities:- This species was originally recorded from the Bashkirian of Central Zawalji, USSR. The specimens here described were collected at localities ADE-2, AD-13, AD-21 of the *Millerella* sp. A zone, AD-26 of the *Pseudostaffella antiqua* zone and AD-28 of the *Profusulinella beppensis* zone.

Climacammina sp. A

Pl. XVII, figs. 10 and 11.

Compare:-

1930, *Cribrostomum maximum* LEE and CHEN, *Acad. Sinica, Nat. Res. Inst. Geol., Mem.*, no. 9, pp. 99-100, pl. 4, figs. 4-5.

1937, *Cribrostomum maximum*, LEE, *Geol. Soc. China, Bull.*, vol. 16, pp. 72-73, pl. 1, fig. 13.

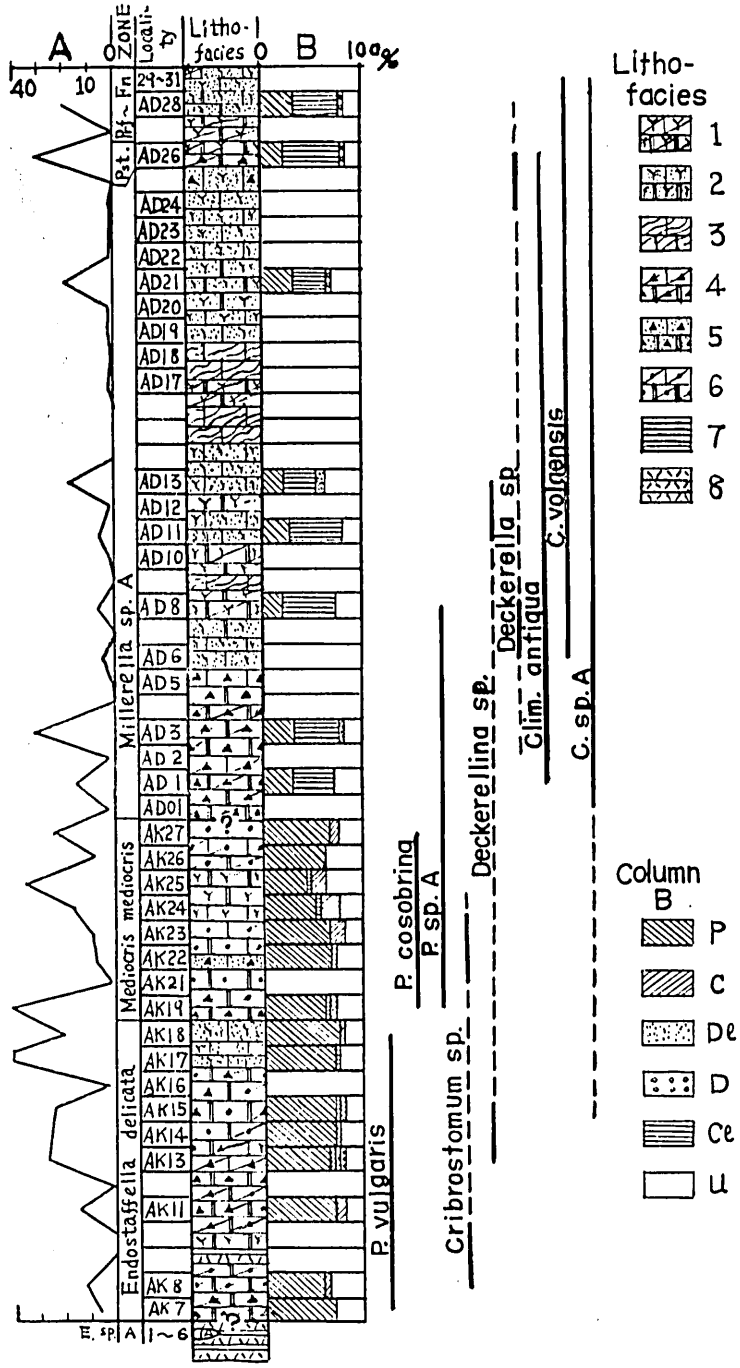
Material:- Axial section of this species has not been obtained yet. More than five $\frac{1}{2}/\frac{1}{2}/\frac{3}{4}$ and other oblique sections are concerned with the description below.

Description:- Test large, slightly curved, short cuneiform in $\frac{1}{2}/\frac{1}{2}/\frac{3}{4}$ section; early part consisting of biserial chambers and later part of uniserial ones. Wall composed of outer granular calcareous main element and discontinuous inner "fibrous" layer. Septa fairly thick, convex, with septal piller in the uniserial part. Aperture in uniserial chambers cribrate, consisting probably of more than five irregularly arranged vestibular siphons situated in the central portion of domed face of chamber; aperture in early chambers not clear.

Dimensions:- Length 1.75 mm. and maximum width 0.80 mm. in $\frac{1}{2}/\frac{1}{2}/\frac{3}{4}$ section, in one of the figured specimen (Pl. XVII, fig. 10).

Comparison and affinities:- This species closely resembles *Climacammina maxima* (LEE and CHEN) from the e_1, Ma and Md horizons of the Huanglung limestone (Middle Carboniferous) of China, and the M_1 horizon of the Carboniferous of the Donetz Basin. However, precise comparison between them is difficult owing to the lack of well-oriented sections.

Horizon and localities:- The present material was collected from the algal limestone of the *Millerella* sp. A zone (localities; AD-1, AD-13, AD-21, ADE-4 and AY-K). It occurred very rarely from the *Mediocris mediocris* zone (locality; AY-F) and the *Pseudostaffella antiqua* zone (locality; AD-26).



Text-Fig. 2. Chart showing the distribution of Palaeotextulariidae in the section along AK and AD routes (vertical scale generalized). Column A shows the total number of specimens and column B shows the percentage of genera within the family. Lithofacies; 1. biosparite-rudite, 2. biomicrite-rudite, 3. biolithite, 4. intrasparite-rudite, 5. intramicrite-rudite, 6. oosparite-rudite, 7. chert, 8. "schalstein"; Column B; P. *Palaeotextularia*, C. *Cribrostomum*, Dl. *Deckerellina*, D. *Deckerella*, Cl. *Climacammina*, U. Palaeotextulariids undetermined.

III. Notes on the Stratigraphic Distribution of Palaeotextulariidae

The Akiyoshi Carboniferous Limestone is subdivided into seven zones, as stated in the preceding chapter. The representative litho- and bio-stratigraphic successions of its lower part (the zones below the *Millerella* sp. A zone) and upper part (the *Millerella* sp. A zone and the overlying ones) are obtained in the AK and AD sections, respectively. The palaeotextulariid foraminifers are commonly collected throughout the Limestone except for the lowest zone, and their quantitative distribution in these two sections is roughly illustrated in Text-Fig. 2.

There is a significant difference in faunal assemblage between the *Mediocris mediocris* zone and the *Millerella* sp. A zone. In the lower part the smaller foraminifers such as Palaeotextulariidae and Endothyridae are dominant, and within Palaeotextulariidae *Palaeotextularia* exceeds about 50% in number of individuals, being accompanied with *Cribrostomum*. On the other hand, in the upper part the fusulinacean foraminifers become important elements and *Climacammina* is a main component within Palaeotextulariidae. Although there are a number of individuals of palaeotextulariids in the basal part of *Millerella* sp. A zone, it is highly probable that most of them are included in pebbles derived from the underlying zone; a disconformity is presumed there.

The lower half of the Akiyoshi Carboniferous Limestone is characterized with bio- and oo-sparite, while the upper half with biomicrite and algal limestone. Therefore, it appears that the above-mentioned faunal change is affected by lithology of limestone. However, the stratigraphic distribution of Palaeotextulariidae in the Akiyoshi Carboniferous Limestone is harmonic with that in other limestones of the same age in the Inner Zone of Southwest Japan, such as the Taishaku Limestone and the Atetsu Limestone (Okimura, 1966). Moreover, a similar distribution has been reported by Cummings (1956, p. 236) in the British Lower Carboniferous and Namurian.

With regard to the morphogenetic change of Palaeotextulariidae, the test becomes gradually larger and individuals having uniserial chambers and multiple apertures increase in number from the lower zone towards the upper zone. Such progressive change has also been known in the Visean of the British South West Province (Cummings, 1958, pp. 15–17).

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Explanation of Plate XVII

Palaeotextularia vulgaris (Reitlinger)

Fig. 1. 0/∞/∞ section (YOAK18-2) from loc. AK-18 of the *Endostaffella delicata* zone. ×60

Palaeotextularia consobrina Lipina

Fig. 2. 0/∞/∞ section (YOAK25-2) from loc. AK-25 of the *Mediocris mediocris* zone. ×60

Palaeotextularia sp. A

Fig. 3. Nearly 0/∞/∞ section (YOADE4-1) from loc. ADE-4 of the *Millerella* sp. A zone. ×50

Deckerellina sp.

Fig. 4. 0/∞/∞ section (YOAD13-1) from loc. AD-13 of the *Millerella* sp. A zone. ×50

Deckerella sp.

Fig. 5. Nearly 0/∞/∞ section (YOAD28-1) from loc. AD-28 of the *Profusulinella beppensis* zone. ×65

Cribrostomum sp.

Fig. 6. Nearly 0/∞/∞ section (YOAK8-1) from loc. AK-8 of the *Endostaffella delicata* zone. ×70

Climacammina antiqua (Brady)

Fig. 7. Nearly $\frac{1}{2}/\frac{1}{2}^{-}/\infty$ section (YOAD21-1) from loc. AD-21 of the *Millerella* sp. A zone. ×60

Fig. 8. 0/∞/∞ section (YOAD21-2) from loc. AD-21 of the *Millerella* sp. A zone. ×40

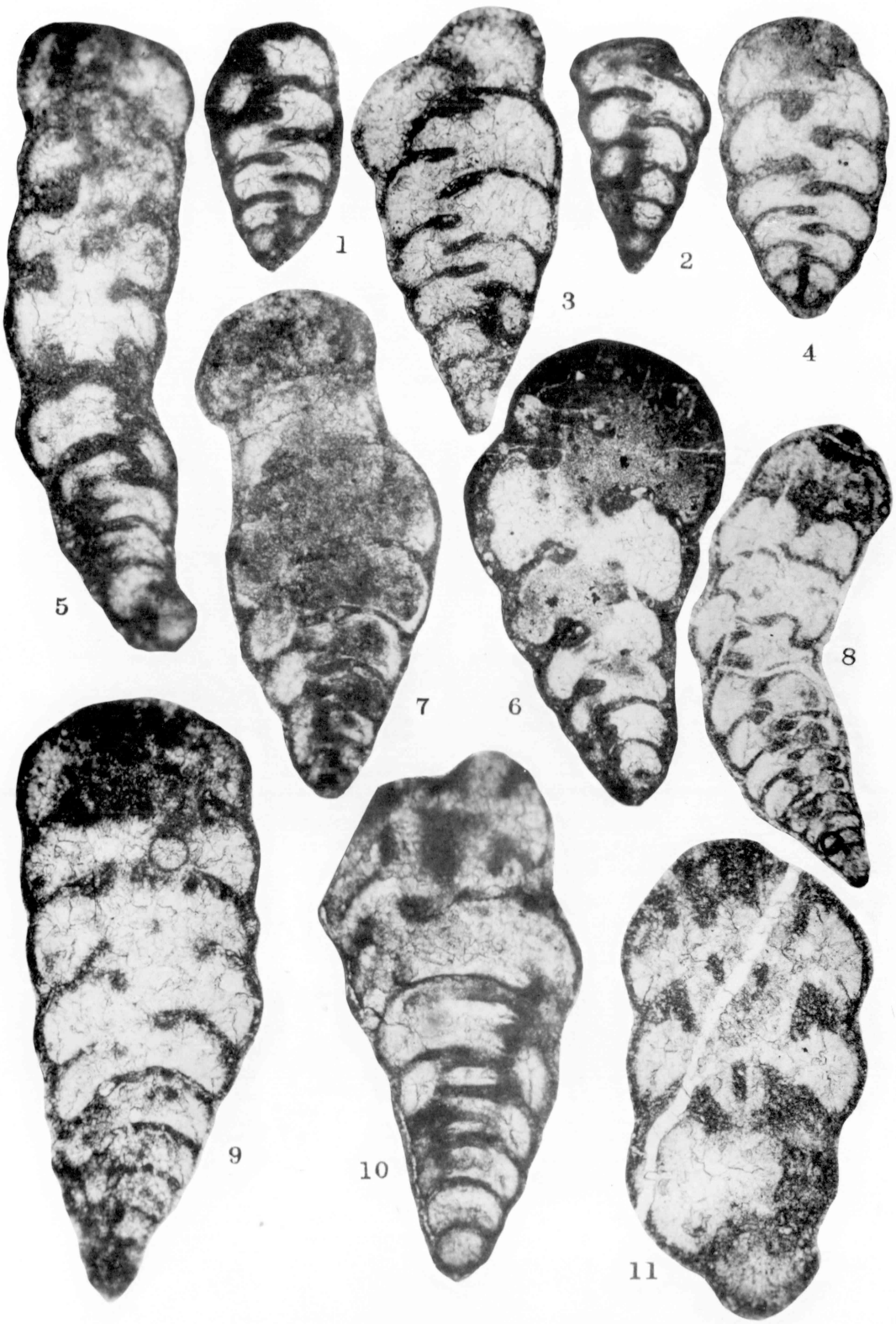
Climacammina volgensis Reitlinger

Fig. 9. 0/∞/∞ section (YOADE2-1) from loc. ADE-2 of the *Millerella* sp. A zone. ×60

Climacammina sp. A

Fig. 10. $A^{+}45°B^{+}/\infty$ section (YOAD26-1) from loc. AD-26 of the *Pseudostaffella antiqua* zone. ×50

Fig. 11. $\frac{1}{2}/\frac{1}{2}/\frac{3}{4}$ section (YOAD1-1) from loc. AD-1 of the *Millerella* sp. A zone. ×50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