Permian Albaillellaria (Radiolaria) from a limestone lens at the Arrow Rocks in the Waipapa Terrane (Northland, New Zealand)

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ABSTRACT
Well-preserved Permian radiolarians are present in a limestone lens at Arrow Rocks in the Whangaroa Area within Waipapa Terrane, New Zealand. This fauna contains eight species of albaillellarians, six species of genus *Follicucullus* and two of *Pseudoalbaillella*, and is Late Middle to Early Late Permian in age. In the Whangaroa Area, basalts are probably as old as Middle Permian, while cherts are mostly Late Permian. Although the radiolarian fauna from Arrow Rocks contains two new species of *Follicucullus*, this fauna can nevertheless be assigned a low-latitude origin. Two new species, *Follicucullus sphaericus* and *Follicucullus whangaroaensis*, are described.

INTRODUCTION
Our knowledge of Permian radiolarians has significantly increased since Ormiston & Babcock (1979) described genus *Follicucullus* from Guadalupian sequences in West Texas. After this pioneering research, taxonomy and biostratigraphy of Permian fauna developed rapidly in the United States, Russia and Japan (e.g., Holdsworth & Jones 1980; Ishiga & Imoto 1980; Takemura & Nakaseko 1981; Ishiga et al. 1982a, b; Nazarov & Ormiston 1986; Ishiga 1986). Most of this work was, however, done in the northern hemisphere, and most Permian radiolarians recorded from the southern hemisphere are from New Zealand.

Permain radiolarians are known from only a few fossil localities in New Zealand, one of which is Red Rocks near Wellington in Torlesse Terrane (Fig. 1), where Grapes et al. (1990) reported Middle Permian radiolarians from bedded chert. The other localities are concentrated within the Whangaroa Area in the northern Waipapa Terrane. Several radiolarian localities of bedded chert and limestone have been reported from this area, geologic age of which ranges from Middle to Late Permian (Caridroit & Ferriere 1988; Adachi 1988; Takemura et al. 1998). We have made geological and biostratigraphic surveys in the Whangaroa Area (1995-1996), and have already reported the occurrence of Permian and Triassic radiolarians from this area. At Arrow Rocks, an almost continuous section from basalt with limestone, bedded chert to siliceous mudstone is exposed. Well-preserved radiolarians are present in a limestone lens within spilitic basalt, the age of which is Middle to Late Permian (Takemura et al. 1998). This fauna includes several albaillellarian species of the genera *Follicucullus* Ormiston & Babcock, 1979 and a
Fig. 1. — Index map of the North Island, New Zealand, showing the distribution of terranes (Aita & Spörli 1992) and the location of the Whangaroa Area, as well as Red Rock near Wellington.
few of *Pseudoalbaillella* Holdsworth & Jones, 1980. We describe albaillellarians of this fauna, including two new species of genus *Follicucullus*.

**GEOLOGICAL SETTING, STRATIGRAPHY AND METHOD**

Basement of New Zealand North Island consists mostly of five lithostratigraphic units, Murihiku, Dun Mountain, Waipapa, Torlesse and Mata River Terranes (Aita & Spörli 1992; Fig. 1). These terranes becomes younger in geological age from west to east, and the latter three, Waipapa, Torlesse and Mata River, are Mesozoic accretionary complexes.

The Whangaroa Area (Figs 1, 2) is situated at about 90 km northwest of Whangarei in Northland. This area belongs to the northern part of Waipapa Terrane, which is composed mostly of terrigenous clastic rocks associated with spilitic basalt, chert and argillites. Geological age of the northern part of this terrane is Permian to Triassic, based on radiolarians and fusulinids (Aita & Spörli 1992; Takemura et al. 1998).

The Waipapa Terrane rocks in the Whangaroa Area consists of massive to thick bedded sandstone (greywacke), spilitic basalt, bedded chert, green siliceous mudstone (argillite) and limestone lenses within basalt (Fig. 2). Prior to this study, more than six localities of Permian fossils were known from chert and limestone in this area. Radiolarian fossils show Middle to Late Permian age from five localities (Caridoit & Ferrière 1988; Adachi 1988; Takemura et al. 1998).

Takemura et al. (1998) report the occurrence of Late Permian Radiolarians including *Albaillella triangularis* Ishiga, Kito & Imoto, 1982 and *Hegleria* sp. in a bedded chert sample (ARR-7) within Unit 2. The horizon of ARR-7 lies about 10 m above that of ARR-1 (Fig. 3). Triassic radiolarians such as *Parentactinia* (Dumitrica, 1978), *Archaesemantis* (Dumitrica, 1978) and forms belonging to genus *Glomeropyle* (Aita & Bragin 1999) are present in siliceous mudstones within Units 6 and 8.
The material treated in this study is a limestone lens (ARR-1) within Unit 1. The unit includes four red, pale red or white limestone layers, 0.7 to 2 m thick, intercalated within basalts, which are usually green grey to green coloured, massive or showing pillow structure, or sometimes are fragmental. ARR-1 is a purple grey coloured, laminated limestone lens, situated at about 24 m above the base horizon. This lens is intercalated just below the uppermost red limestone layer within Unit 1 (24-26 m, Fig. 3).

ARR-1 contains numerous radiolarian shells, but they have been altered by CaCO₃ so that we obtained no or very few residues by extraction using diluted hydrochloric, nitric or acetic acids. As a result of this, it was decided to process the sample using diluted hydrofluoric acid (HF, 1 to 3%) for about 20 hours. We successfully recovered residues including radiolarians by this process, but the preservation was not good enough for determination of species. The same sample was then again processed by diluted nitric acid (HNO₃, 1 to 2%) for up to 24 hours. After this step, we were able to obtain well-preserved radiolarian shells. Although other acids such as hydrofluoric, hydrochloric or acetic acids were tried for the second step after HF, the best preservation was achieved by using nitric acid.

RADIOLARIAN FAUNA FROM ARROW ROCKS AND GEOLOGIC AGE OF BASALT-CHERT SEQUENCE IN THE WHANGAROA AREA

The limestone lens sample (ARR-1) contains well-preserved albaillellarian fauna. The fauna includes six species of genus Follicucullus and two of genus Pseudoalbaillella (Figs 4, 5). Ishiga (1986, 1991) established Permian radiolarian zonation based on the ranges of albaillellarians from mostly bedded chert sequences in Southwest Japan. His zonation is applicable for the ARR-1 fauna, because many albaillellarians from our sample were already included within Ishiga's zonation.

Among these albaillellarians with conical shells investigated by Ishiga (1986, 1991), Pseudoalbaillella fusiformis (Holdsworth & Jones, 1980), P. aff. longicornis of Ishiga et al. (1982a), Follicucullus scholasticus Ormiston & Babcock, 1979 and F. porrectus Rudenko, 1984 (= F. japonicus of Ishiga 1991) are present in our sample ARR-1. Because both Follicucullus monacanthus Ishiga & Imoto, 1982 (Ishiga et al. 1982b) and species of genus Neoalbaillella Takemura & Nakaseko, 1981 are absent in this sample, we correlate this fauna with Follicucullus scholasticus zone of Ishiga (1986).
Fig. 3. — Summarized geologic column of the Arrow Rocks. A, fold zone; B, siliceous mudstone; C, bedded siliceous mudstone and chert; D, alternation of black shale and chert; E, bedded chert; F, tuff; G, limestone; H, spilitic basalt. ARR-1 and ARR-7 are the horizons where Permian radiolarians occurred (Takemura et al. 1998).
Following Ishiga's zonation, the upper limits of the ranges of Pseudoalbaillella fusiformis and P. aff. longicornis are within Follicucullus monacanthus zone or lower. However, occurrences of these two species in ARR-1 are few and they are usually less well preserved than Follicucullus. It is possible that these two species might be reworked, or that the ranges might be longer than that suggested by Ishiga's (1986) zonation.

The fauna in ARR-1 can be also correlated to the Follicucullus japonicus zone of Ishiga (1991) because of the co-occurrence of F. porrectus (= F. japonicus) and F. scholasticus, and because of the absence of F. monacanthus, F. charveti Caridroit & De Wever, 1984, F. bipartitus Caridroit & De Wever, 1984 and Neoalbaillella. According to the correlation of radiolarian zonation with fusulinid and conodont zonations by Ishiga (1986, 1990, 1991), the geologic age of Follicucullus scholasticus zone and F. japonicus zone is in the vicinity of the boundary between Middle and Late Permian.

Besides these species, Kozur (1993) described Cariver dorsoconvexus (herein treated as a species of the genus Follicucullus) from Upper Permian sequence in Sicily, Italy. F. sphaericus n. sp. was figured by Kuwahara (1997) as Follicucullus sp. A, which is present in bedded chert of GA section in Gujo-Hachiman Area, central Japan. These samples are within Neoalbaillella optima and N. ornithiformis zones, indicating a Late Permian age. The ranges of these two species, Follicucullus dorsoconvexus and F. sphaericus n. sp., however, are not clarified yet. Therefore, we regard the geologic age of our sample ARR-1 as Late Middle or Early Late Permian.

Takemura et al. (1998) reported Permian radiolarians from a limestone lens (MAH-5) at the west end of Mahinepua Peninsula (Fig. 2). MAH-5 contains Follicucullus porrectus Rudenko and Pseudoalbaillella (?) sp. They correlated this sample with the F. monacanthus zone of Ishiga (1986), and with the F. japonicus zone of Ishiga (1991), because of the absence of other species of Follicucullus. The geologic age of this sample is also near the Middle/Late Permian boundary.

Recently Leven & Grant-Mackie (1997) described fusulinids from some limestone lenses within spilitic basalt at Wherowhero Point (Fig. 2). These fusulinids include Lepidolina shiraiwensis Ozawa, 1925, Neoschwagerina margaritae Deprat, 1913 and Yabeina globosa (Yabe, 1906), and the fauna was correlated with the Yabeina-Lepidolina zone. Leven & Grant-Mackie (1997) regard the geologic age of these fusulinids as Midian, and most samples probably as Early Midian. The Midian stage corresponds to the Capitanian and late Wordian in North America (Leven & Grant-Mackie, 1997) and Ishiga (1990) correlated the fusulinid Yabeina-Lepidolina zone with the radiolarian Follicucullus monacanthus and F. scholasticus zones.

Thus, the three limestone samples within spilitic basalts from northern New Zealand show similar geologic ages. Bedded cherts are sometimes associated with these basalts and are characteristic of ocean floor sedimentary sequences. Indeed, at Arrow Rocks, bedded cherts conformably overlie spilitic basalt (Fig. 3). The ages of these cherts are reported from three localities in the Whangaroa Area (Caridroit & Ferriere 1988; Adachi 1988; Takemura et al. 1998) to be about Late Permian. Therefore, the age of ocean floor sequence represented by basalt and chert in the Whangaroa Area is Middle to Late Permian.

The radiolarian fauna from Arrow Rocks contains two new species of Follicucullus, F. sphaericus n. sp. and F. whangaroensis n. sp. The former was already figured by Kuwahara (1997) from Japan, but the latter has not been reported yet. These two species are common elements within this fauna, and they may reflect a significant faunal difference in albaillellarian distribution between New Zealand and northern hemisphere regions.

Leven & Grant-Mackie (1997), however, also maintained that the fusulinid fauna from Wherowhero Point showed a clear affinity with those in the eastern Paleotethys and Panthalassa region, and that these limestone blocks had been moved from the original site of deposition. Because the radiolarian-bearing limestones which we describe herein show similar geologic age as these fusulinid limestones, and because they all occur within a restricted area, the radiolarian fauna from these samples must originate from near the region where the fusulinids were deposited. Therefore, the radiolarian fauna from Arrow Rocks is also near the region where the fusulinids were deposited.
Rocks originated in a low-latitude area of Middle to Late Permian time.

SYSTEMATIC DESCRIPTION

The following description was made by the first author, Takemura A. The type specimens are deposited at Hyogo University of Teacher Education.

Subclass RADIOLARIA Müller, 1838
Order POLYCYSTINA Ehrenberg, 1838
emend. Riedel, 1967
Suborder ALBAILELLARIA Deflandre, 1953
emend. Holdsworth, 1969
Family ALBAILELLIDAE Deflandre, 1952
emend. Holdsworth, 1977

REMARKS

Cheng (1986) classified Albaillellaria into two groups, Albaillellacea and Follicucullacea, based on the presence of a cross-bar. This criterion is, however, applicable only for very well-preserved specimens, and we cannot observe such fragile parts in most Permian samples.


Genus Follicucullus
Ormiston & Babcock, 1979


Most Permian taxonomic works followed the original definition of Genus Follicucullus made by Ormiston & Babcock (1979). Only Kozur & Mostler (1989) and Kozur (1993) divided this group, with descriptions of three new genera. However, their division are so minute that we cannot use them to assign a genus to poorly preserved specimens. Therefore, for this paper, the author regards these three genera as junior synonyms of the genus Follicucullus.

The author generally follows the specific division of Follicucullus established by Ishiga (1991), who lumped forms of this genus into six species from Permian sediments in Japan. They are F. monacanthus Ishiga & Imoto, 1982 (Ishiga et al. 1982b), F. ventricosus Ormiston & Babcock, 1979, F. charveti Caridroit & De Wever, 1984, F. scholasticus Ormiston & Babcock, 1979, F. porrectus Rudenko, 1984 (= F. japonicus Ishiga, 1991) and F. bipartitus Caridroit & De Wever, 1984. Other than these forms, three species F. dorsocellus (Kozur, 1993), F. sphaericus n. sp. and F. whangaroaensis n. sp. were distinguished in the sample ARR-1.

Follicucullus scholasticus
Ormiston & Babcock, 1979
(Fig. 4A, B)

Follicucullus scholasticus Ormiston & Babcock, 1979: 333-334, pl. 1, figs 1-5.


REMARKS

Ishiga (1984) proposed two morphotypes within this species. F. scholasticus morphotype I has simple conical shell without undulation and it resembles forms described by Ormiston & Babcock (1979) under the name of this species (Ishiga 1985). In this paper, the author follows Ishiga's taxonomy and F. scholasticus is used for forms with simple conical shell without undulation.

Kozur & Mostler (1989) proposed a new genus Ishigaconus for Follicucullus forms without shell undulation. However, the distinction of this species and F. porrectus is sometimes difficult because...
Fig. 4. — A, Follicucullus scholasticus Ormiston & Babcock, 1979; B, Follicucullus scholasticus Ormiston & Babcock, 1979; C, Follicucullus porrectus Rudenko, 1984; D, Follicucullus porrectus Rudenko, 1984; E, Follicucullus ventricosus Ormiston & Babcock, 1979; F, Follicucullus ventricosus Ormiston & Babcock, 1979; G, Follicucullus dorsoconvexus (Kozur, 1993); H, Follicucullus dorsoconvexus (Kozur, 1993); I, Pseudoalbaillella fusiformis (Holdsworth & Jones, 1980); J, Pseudoalbaillella aff. longicornis Ishiga & Imoto, 1980. Scale bars: 100 μm.
the undulation or tripartite division of shells is often unclear.

**Follicucullus porrectus**
Rudenko, 1984
(Fig. 4C, D)

**Follicucullus porrectus** Rudenko, 1984 – Beljanskij, Nikitina & Rudenko 1984, pl. 8, figs 3, 10.
**Follicucullus scholasticus**Ormiston & Babcock morphotype II – Ishiga 1984: 430, 431, pl. 1, figs 1-8.
**Follicucullus japonicus** Ishiga, 1991: 108-111, pl. 1, figs 1-22, pl. 2, fig. 1.

**REMARKS**
In this paper, the author uses this species name for intermediate forms between *F. scholasticus* and *F. ventricosus*. There are much variations of shell shapes within this species from sample ARR-1, same as described by Ishiga (1991). Such variations seem to be continuous from simple conical shape of *F. scholasticus* to clearly tripartite *F. ventricosus* with inflated spherical pseudothorax. Therefore, it is sometimes difficult to distinguish this species from the other two species.

**Follicucullus ventricosus**
Ormiston & Babcock, 1979
(Fig. 4E, F)

**Follicucullus ventricosus**Ormiston & Babcock, 1979: 332-333, pl. 1, figs 6-14.

**REMARKS**
Ishiga (1991) made a comparison between *F. porrectus* (= *F. japonicus*) and *F. ventricosus* under the description of the former species. He used the width/length ratio (W/L) of shells, strongly inflated pseudothorax and existence of groove (sinus) on pseudothorax as criteria to distinguish these two species. *F. ventricosus* of the present study has strongly inflated and subspherical pseudothorax and a distinctly tripartite conical shell. However, there is usually no groove on the dorsal side of pseudothorax as seen in *F. dorsoconvexus*. The author tentatively include tripartite forms without grooves on subspherical pseudothorax within *F. ventricosus* in this paper. The difference between this species and *F. porrectus* is only the degree of inflation of the pseudothorax, and the variation between them seems to be continuous.

**Follicucullus dorsoconvexus**
(Kozur, 1993)
(Fig. 4G, H)

**Cariver dorsoconvexus** Kozur, 1993: 109, pl. 1, figs 15-17, 19.

**REMARKS**
Kozur (1993) proposed a new genus *Cariver* for *Follicucullus* species with curved shell and aperture perpendicular to the shell axis. If we adopt such minute generic division, we can assign genera only for well-preserved specimens. *F. dorsoconvexus* resembles to *F. ventricosus*. Both two species have tripartite shell with inflated pseudoabdomen and sinus on the dorsal side of the shell. The aperture is sometimes not exactly perpendicular to the shell axis, because the dorsal side of the shell wall becomes shorter (Fig. 4G).

**Follicucullus sphaericus**
Takemura, n. sp.
(Figs 5A-F, 6)

**Follicucullus** sp. A. – Kuwahara 1997, pl. 2, fig. 8.
**Follicucullus** (?) sp. – Takemura et al. 1998, pl. 1, fig. 13.

**TYPES.** — Holotype HUTE-R-4024 (Fig. 5A), paratypes HUTE-R-4025 (Fig. 5B) and HUTE-R-4026 (Fig. 5D).

**ETYMOLOGY.** — The species name was derived from the characteristic shape of this species.

**MEASUREMENTS.** — Length of shell, 260-350 μm; length of upper conical part, 120-180 μm; width of shell, 160-250 μm; width of the base of upper conical part, 50-110 μm; measured in 28 specimens.

**DESCRIPTION**
Imperforate and smooth shell composed of two parts, upper conical part and lower part with flattened hemispherical shape. The upper conical part slender, and straight or sometimes slightly curved dorsally. The lower portion of this cone often slightly inflated. The inflated and curved lower part large with smooth surface and
Fig. 5. — A, *Follicucullus sphaericus* n. sp., right lateral view, holotype (HUTE-R-4024); B, *Follicucullus sphaericus* n. sp., left lateral view, paratype (HUTE-R-4025); C, *Follicucullus sphaericus* n. sp., a broken specimen showing the inner surface of the inflated lower part, a hook-shaped trace of the inner wall can be observed; D, *Follicucullus sphaericus* n. sp., right lateral view, paratype (HUTE-R-4026); E, F, *Follicucullus sphaericus* n. sp., apertural view of partly broken specimen, a tube-like ventral spine arises upward from the edge of bended wall; G, *Follicucullus whangaroaensis* n. sp., right lateral view, holotype (HUTE-R-4027); H, *Follicucullus whangaroaensis* n. sp., left lateral view, paratype (HUTE-R-4028); I, *Follicucullus whangaroaensis* n. sp., ventral view, paratype (HUTE-R-4029). Scale bar: A, B, D, E, G-I, 100 μm; C, 83 μm; F, 20 μm.
Fig. 6. — Schematic diagram of *Follicucullus sphaericus* n. sp. The inflated lower part of the shell is so strongly curved that the aperture opens upward. Within the inflated lower part, the shell wall of ventral side is curved and turned upward. Then, both dorsal and ventral spines also extend upward.

showing a semicircular shape in lateral view. Two apertures present on the lower part. A large aperture situated at the ventral side of the upper conical part and opening upward. This large aperture subelliptical in shape and tapering distally from the upper part. One more small aperture opening at the distal end of the shell in well-preserved specimens. This small aperture teardrop-shaped and opening toward the ventral side of the shell, with small dorsal spine or flap originating the lower end of this aperture. Inside the shell wall of the inflated and curved lower part, the ventral side of the shell wall of conical part strongly curved and turned upward. Tube-like ventral spine extending upward from the center of the turned end of the wall.

**REMARKS**

In the broken specimen (Fig. 5C), the trace of the shell wall could be observed on the inner surface of the lower inflated part of the shell. The trace is smoothly continuous from the upper conical part and somewhat inflated within the lower part, which resembles the inflated pseudothorax of *F. porrectus* or *F. ventricosus*. Then, the trace is curved strongly and turned upward. From the turned end of this wall, cylindrical tube-like spine is arises upward inside the shell wall (Figs 5E, F, 6). This skeleton is homologous with a ventral spine or flap of other *Follicucullus* species. A small dorsal flap also exists below the small aperture on the distal part of the lower shell.

The upper conical part often shows slight inflation on its lower portion similar to the pseudothorax of *F. porrectus* or *F. ventricosus*. Therefore, the upper conical part of *F. sphaericus* n. sp. is homologous either with the apical corn alone or with both apical cone and upper pseudothorax of the other *Follicucullus* species. The lower shell
Permian Radiolarians from Arrow Rocks, New Zealand

The shape of this new species was formed by the strong bending and inflating of the pseudothorax and pseudoabdomen of the other species like *F. porrectus* or *F. dorsoconvexus.*

*F. sphaericus* n. sp. differs from all the other species of *Follicucullus* in its flattened hemispherical and curved shell shape, its aperture opening upward, and both ventral and dorsal flaps arising upward. The characteristic shape of this species resembles that of *Pseudoalbaillella buliosa* Ishiga (Ishiga 1982: 335, pl. 1, figs 8-13, 16, 17). The strongly inflated and curved pseudoabdomen of *P. buliosa* is quite similar to the lower part of *F. sphaericus* n. sp., except for a small flap of the former species. *F. sphaericus* n. sp. does not have pseudothorax and wings observed in *Pseudoalbaillella.* *P. buliosa* ranges from Late Carboniferous to Early Permian in age, and there should be no direct phylogenetic relationship between these two species.

*F. sphaericus* n. sp. should be evolved from the other *Follicucullus* species like *F. porrectus* or *F. dorsoconvexus.*

### Follicucullus whangaroaensis

**Takemura, n. sp.**

(Fig. 5G-I)

*Follicucullus* sp. – Takemura et al. 1998, pl. 1, fig. 14.

**TYPES.** — Holotype HUTE-R-4027 (Fig. 5G), paratype HUTE-R-4028 (Fig. 5H) and HUTE-R-4029 (Fig. 5I).

**ETYMOLOGY.** — The species name is after Whangaroa Area in Northland, New Zealand, where Arrow Rocks is located.

**MEASUREMENTS.** — Length of shell, 240-330 μm; length of apical cone, 130-180 μm; width of shell, 70-110 μm; width of the base of apical cone, 60-70 μm; measured in 12 specimens.

**DESCRIPTION**

Imperforate conical shell slightly curved ventrally, and undulated at the lower part with two distinct inflated rings. Apical cone with smooth surface and with a length more than half of the total shell. Apical cone slightly flattened laterally and curved ventrally. In some specimens, vague ring-like inflation observed at the lowest part of apical cone. The lower part of the shell distinctly undulated in dorsal or ventral view. Two rings inflated laterally between apical cone and apertural region, with circular shape in transverse section. Distinct furrows existing between the two rings, and between the lower ring and inflated apertural region. In dorsal or ventral view, shell distinctly undulated because of these rings and furrows. A vague furrow may divide apical cone and the upper ring. These furrows not present or becoming weak at the dorsal and ventral sides of this ring region. The outline of the shell not undulated distinctly in lateral view. The apertural region, the lowermost part of conical shell, inflated like rings. Two small spines or flaps, dorsal and ventral ones, arising obliquely downward.

**REMARKS**

*F. whangaroaensis* n. sp. differs from the other species of *Follicucullus* by its banded lower shell. This kind of rings has never been observed in the other *Follicucullus* species. The author included this new species within genus *Follicucullus* because of the similarity of its shell shape to other *Follicucullus,* such as *F. scholasticus* or *F. porrectus.* The ring region of this species may correspond with inflated pseudothorax of the other species. Similar structure to this undulated shell with rings was observed in the pseudoabdomen of *Pseudoalbaillella globosa* Ishiga & Imoto (Ishiga et al. 1982b). *P. globosa* has one ring and inflated apertural region below the spherical pseudothorax with two wings. The author considers that there is no direct phylogenetic relationship between these two species.

### Genus Pseudoalbaillella

Holdsworth & Jones, 1980


**TYPE SPECIES.** — *Pseudoalbaillella scalprata* Holdsworth & Jones, 1980.

**REMARKS**

Ishiga & Imoto (1980), Ishiga (1982) and Ishiga et al. (1982a, b) assigned this genus for Late...
Palaeozoic albaillellarians with conical, usually imperforate and tripartite shells and with two wings on the inflated pseudoabdomen. The author follows their taxonomy of this genus.

**Pseudoalbaillella fusiformis**
(Holdsworth & Jones, 1980)
(Fig. 41)

*Parafollicucullus fusiformis* Holdsworth & Jones, 1980: 285, figs D, E.


**REMARKS**
Most specimens of this species extracted from ARR-1 are more or less broken. The preservation of this species seems to be worse than that of *Follicucullus*.

Holdsworth & Jones (1980) described this species as *Parafollicucullus fusiformis* and they regarded the existence of a ring-like prepseudoabdominal segment as a criterion of this genus. However, some specimens from ARR-1 have no ring on their pseudoabdomen.

**Pseudoalbaillella aff. longicornis**
Ishiga & Imoto, 1980
(Fig. 4J)


**REMARKS**
Most specimens of this form are broken and their preservation is usually poor. The total shape and size of this form is almost same as the upper half of *P. fusiformis*.

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