3 RADIOLARIAN SYSTEMATICS AND BIOSTRATIGRAPHY

3.1 INTRODUCTION

Radiolarians belong to the subclass Radiolaria MÜLLER of the Kingdom Protista. They are marine, single celled, holoplanktonic protozoans characterised by the presence of protoplasmic extensions or pseudopodia. The subclass Radiolaria is divided into two orders; Polycystina EHRENBERG 1838 and Acantharia HAECKEL 1862. The former order is of particular interest in this study. Polycystine Radiolaria are distinguished from the Order Acantharia, by possessing an amorphous silica skeleton which has the potential for good preservation in the geological record. The skeleton differs greatly in the different suborders, and these different features, together with the internal microstructure of the central capsule, distinguish many genera. The skeleton of Acantharia is composed of strontium sulphate (Anderson, 1983). Some species of Radiolaria exist as a solitary form, while other species are colonial. In this study solitary species only, have been identified. Solitary forms range in size from 30µm to 2mm in diameter (Anderson, 1983). Radiolarians from the Order Polycystina have been divided into four suborders:

Suborder ALBAILLELLARIA DEFLANDRE 1953;
Suborder NASSELLARIA EHRENBERG 1875;
Suborder SPUMELLARIA EHRENBERG 1875;
Suborder PHAEODARIA HAECKEL 1879.

Only specimens from the suborders of Albaillellaria, Nassellaria and Spumellaria have been identified in this study.

A biostratigraphic study of Radiolaria from the Bentong-Raub suture zone and other localities within Peninsular Malaysia was undertaken with the aim of determining the relative ages of the rocks which formed in the palaeo-ocean (Palaeo-Tethys ocean) that once separated the Sibumasu and Indochina/East Malaya terranes.

3.2 STUDY TECHNIQUES

During this study, 1,289 samples of siliceous sedimentary rocks were collected from seventy-eight localities in Peninsular Malaysia. A list of all localities and grid references is found in Appendix B. Individual samples were collected on the basis of rock type and presence of radiolarian tests visible with the hand lens. The standard method for extraction of Radiolaria from marine siliceous sedimentary rocks using hydrofluoric acid was applied, following the techniques established by Dumitrica (1970) and Pessagno and Newport (1972). The rock samples were broken into small pieces (approximately 3 cm in diameter). These were placed in plastic beakers and covered with 4% HF for approximately 18-24 hours. The acid was then discarded and the samples washed, sieved using 60 and 230 mesh stainless steel screens, and then dried. This process was repeated once and sometimes twice. The dried residue was examined with a binocular microscope and picked over, using a very fine brush. The better preserved radiolarian tests were placed on aluminium stubs using double sided tape and sputter coated with gold. The specimens were then examined and photographed using a JEOL JSM 35 scanning electron microscope at 20 kV. A small number of specimens were photographed with a newly acquired JEOL JSM 5800LV scanning microscope at 15 kV operating in SEI (Secondary Electron Imaging) mode.

Some problems with radiolarian extraction were encountered. Although radiolarian tests were clearly visible in many of the samples collected, often they were recrystallised, and the tests were not able to be extracted. Datable radiolarians were extracted from twenty two localities within Peninsular Malaysia. Many of the samples yielded faunas too poorly preserved for identification and biostratigraphic analysis. Recrystallisation, corrosion of the tests and a microcrystalline silica coating on many specimens contributed to poor preservation. As well, the abundances of the taxa were, in general, extremely low. Age determination using observation of an abundant species would carry more weight than the presence of a single, or a few specimens, as was often the case. Poor preservation due to recrystallisation and dissolution is a major contributing factor to low abundance of species in the study area.

3.3 SYSTEMATIC FRAMEWORK & MORPHOLOGIC TERMINOLOGY

Following is the suprageneric systematic framework adopted in this study. Families are listed in alphabetical order within this framework.

SUBPHYLUM: SARCODINA SCHMARDA 1871
CLASS: ACTINOPODA CALKINS 1909
SUBCLASS: RADIOLARIA MÜLLER 1858
ORDER: POLYCYSTINA EHRENBERG 1838
Suborder: ALBAILLELLARIA DEFLANDRE 1953
SUPERFAMILY: ALBAILLELLACEA CHENG 1986
Family: Albaillellidae DEFLANDRE 1952
Family: Ceratoikiscidae HOLDSWORTH 1969
Family: Holoeciscidae CHENG 1986
SUPERFAMILY: FOLLICUCULLACEA CHENG 1986
Family: Follicucullidae ORMISTON & BABCOCK 1979
Family: Neoalbaillellidae CHENG 1986
Family: Pseudoalbaillellidae CHENG 1986
Suborder: NASSELLARIA EHRENBERG 1875
SUPERFAMILY: CYRTOIDEA HAECKEL 1862
Family: Eptingiidae DUMITRICA 1978
Incertae Nassellaria
Family: Triassocampidae KOZUR & MOSTLER 1981
Suborder: SPUMELLARIA EHRENBERG 1875
Family: Entactiniidae RIEDEL 1967b
Subfamily: Astroentactiniinae NAZAROV & ORMISTON 1985
Subfamily: Entactiniinae RIEDEL 1967b
Family: Hindeosphaeridae KOZUR & MOSTLER 1981
Family: Oertlispongidae KOZUR & MOSTLER 1980
Family: Sepsagonidae KOZUR & MOSTLER 1981
SUPERFAMILY: LATENTIFISTULIDEA NAZAROV & ORMISTON 1983
Family: Latentifistulidae NAZAROV & ORMISTON 1983
Family: Ruzhencevispongidae KOZUR 1980
Family: Tormentidae NAZAROV & ORMISTON 1983

Incertae subordinis (families are listed in alphabetical order)

Family: Archocyrtiidae KOZUR AND MOSTLER 1981
Family: Palaeoscenidiidae RIEDEL 1967b
Family: Popofskyellidae DEFLANDRE 1964
Family: Pylentonemidae DEFLANDRE 1963

The systematic morphologic terminology of selected radiolarian families, representatives of which have been recovered in this study, is provided below. Diagnoses of families, subfamilies and genera are not repeated here, but where appropriate, a reference to the relevant diagnosis is given.

Suborder **ALBAILLELLARIA** DEFLANDRE 1953
emend. Holdsworth 1969a

Systematic morphologic terminology of Suborder Albaillellaria after Holdsworth (1966, 1969a,b), Ormiston and Babcock (1979); Takemura and Nakaseko (1981), Caridroit and De Wever (1986); Cheng (1986), (Braun *et al.*, 1992) and this study.

Apical cone: Conical apical portion of *Pseudoalbaillella* and *Neoalbaillella* species.
Apical spine: A solid spine, conical in cross section, located at the top of the lamellar shell of many *Albaillella* species.
Cavea: The term "cavea" is restricted to the cage like structure in "unshelled" ceratoikiscid species. It describes the cage-like structure produced by numerous pairs of caveal ribs carried by the a-rod. These rods are parallel aligned, closely spaced and never fused together to develop a lamellar shell. The term should not be used to describe the structure of shelled *Albaillella* species.
Caveal ribs: Pairs of apophyses carried by a-rod, bilaterally symmetrically arranged and perpendicular to the plane of the central triangular frame in *Ceratoikiscum* species.
Caveal vane: Perforated lattices borne on the dorsal edges of caveal ribs formed by a number of rows of pores in *Ceratoikiscum* species.
Collar: A narrow convex band which may/may not separate apical and central region in Follicucullidae and Pseudoalbaillellidae species.
Columella (Deflandre, 1952): In shelled albaillellids there are two longitudinal rays or rods that run all the way throughout the interior of the shell and meet at the very apex of the shell forming an apical spine. They may or may not attach to the shell directly and mostly they connect to the shell by a double system of 'trabeculae". These two longitudinal rods are termed columellae.

Crenella: Constrictions (or furrows) between two elevated ridges. The combination of elevated ridges and depressed crenellae form the crenulate lamellar shell of *Albaillella* species.

H-frame: The skeleton of albaillellids outside the lamellar shell is formed by two elongate rods (a-rod and intersector) and connected by a straight or slightly curved transverse bar (b-rod).

Lamellar/lattice shell: Variably shaped conical or elongate shell of Albaillellids. Test wall usually imperforate, with or without oblique banding (crenulations) on the surface. Completely developed pairs of caveal ribs superimposed on the lamellar shell occur only in the genus *Holoeciscus.*

Lateral spines: Spines of *Holoeciscus* species that project perpendicularly from the uncovered portions of b- and intersector rods.

Patagial tissue: *Ceratoikiscum* species develop spongy layers of fibres between extra triangular rods which often envelop rod junctions.

Patagial vane: Triangular and extra triangular portions of the rods in *Ceratoikiscum* species are often linked by an irregular lamellose or spongy disc.

Pseudoabdomen: Weakly inflated to subspherical region beneath apical cone of *Pseudoalbaillella* and *Neoalbaillella* species.

Pseudothorax: Skirt-like expansion of apertural region of *Pseudoalbaillella* and *Neoalbaillella* species.

Sinus: Hollow or groove in test wall of *Follicucullus.*

Stapia: Protruding ventral skeletal frame/uncovered portions of b- and i- rods.

Trabecula: In *Albaillella* species, both dorsal and ventral columellae are usually attached to the inner wall of the lamellar shell by paired lateral apophyses which are slightly or strongly offset and curved.

Superfamily **ALBAILLELLACEA** CHENG 1986

The superfamily Albaillellacea CHENG includes the following families:

Albaillellidae DEFLANDRE 1952
Ceratoikiscidae HOLDSWORTH 1969
Holoeciscidae CHENG 1986

Family **ALBAILLELLIDAE** DEFLANDRE 1952 emend. Holdsworth 1977, emend. Cheng 1986

Type genus: *Albaillella* DEFLANDRE 1952, emend. Cheng 1986

Diagnosis: For diagnosis see Cheng, 1986.

Family Albaillellidae includes the genus *Albaillella* DEFLANDRE.

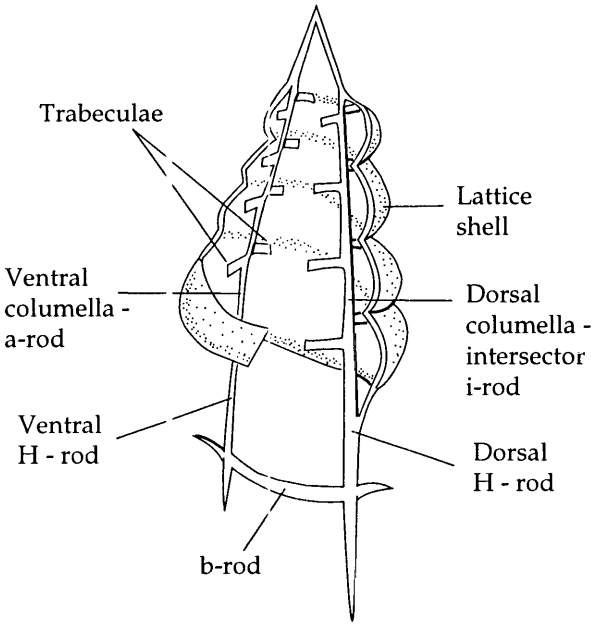

Figure 3.1 Systematic morphologic terminology of family Albaillellidae genus *Albaillella* DEFLANDRE (after Holdsworth 1969b).

Family **CERATOIKISCIDAE** HOLDSWORTH 1969a

Type genus: *Ceratoikiscum* DEFLANDRE 1953

Diagnosis: For diagnosis see Holdsworth, 1969a.

Family Ceratoikiscidae includes the genera *Ceratoikiscum* DEFLANDRE and *Helenifore* NAZAROV & ORMISTON.

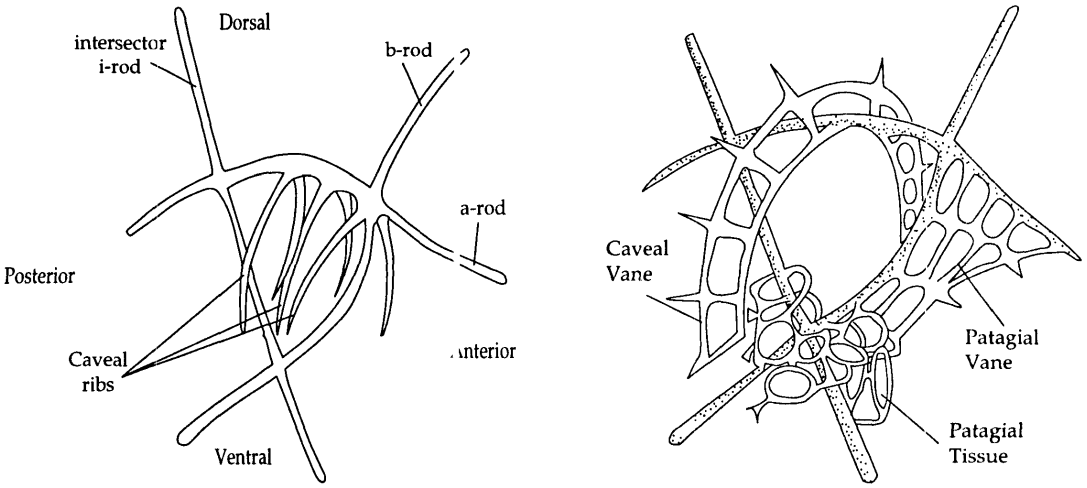

Figure 3.2 Systematic morphologic terminology of family Ceratoikiscidae HOLDSWORTH genus *Ceratoikiscum* DEFLANDRE (after Holdsworth, 1969a).

Family **HOLOECISCIDAE** CHENG 1986

Type genus: *Holoeciscus* FOREMAN 1963

Diagnosis: For diagnosis see Cheng, 1986.

Family Holoeciscidae includes the genus *Holoeciscus* CHENG.

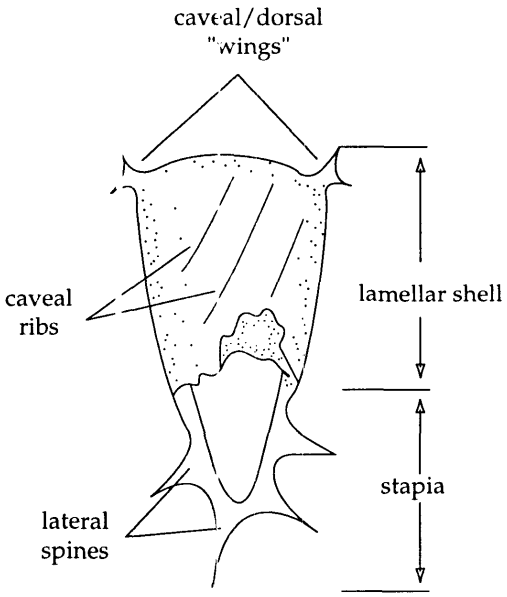

Figure 3.3 Systematic morphologic terminology of family Holoeciscidae CHENG (after Braun *et al.*, 1992).

Suborder **ALBAILLELLARIA** DEFLANDRE 1953
emend. Holdsworth 1969a

Superfamily **Follicucullacea** CHENG 1986

The superfamily Follicucullacea CHENG includes the following families:

Follicucullidae ORMISTON & BABCOCK 1979

Neoalbaillellidae CHENG 1986 (see Remarks: p. 131)

Pseudoalbaillellidae CHENG 1986 (see Remarks: p. 131)

Family **FOLLICUCULLIDAE** ORMISTON & BABCOCK 1979
emend. Kozur 1981

Type genus: *Follicucullus* ORMISTON & BABCOCK 1979

Diagnosis: For diagnosis see Kozur, 1981.

Family Follicucullidae includes the genus *Follicucullus* ORMISTON & BABCOCK.

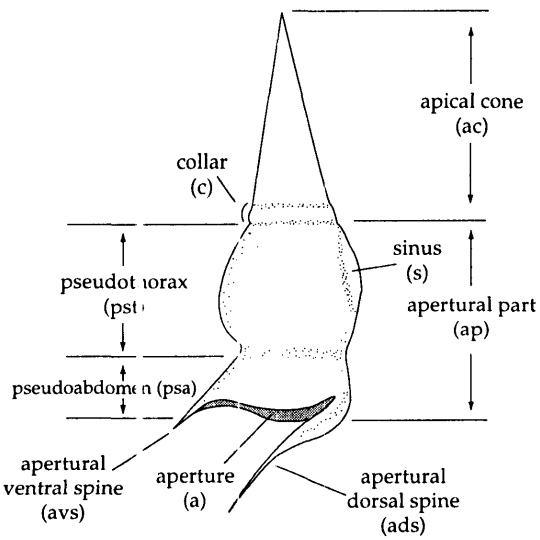

Figure 3.4 Systematic morphologic terminology of family Follicucullidae ORMISTON & BABCOCK (after Caridroit and De Wever, 1986).

Family **NEOALBAILLELLIDAE** CHENG 1986

Type genus: *Neoalbaillella* TAKEMURA & NAKASEKO 1981

Diagnosis: Cheng (1986) named the family Neoalbaillellidae, but did not provide a diagnosis for it.

The family Neoalbaillellidae includes the genus *Neoalbaillella* TAKEMURA & NAKASEKO.

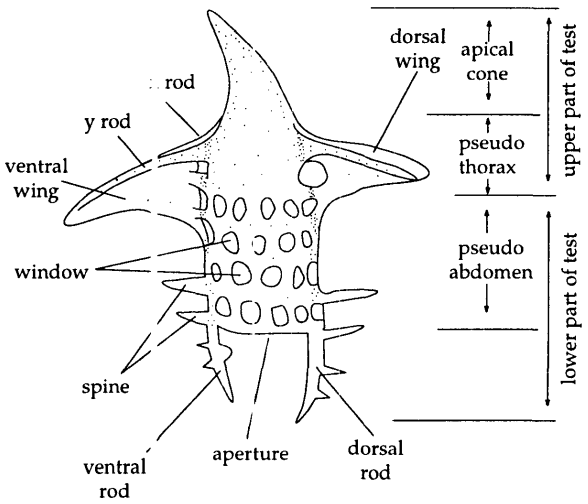

Figure 3.5 Systematic morphologic terminology of family Neoalbaillellidae CHENG (after Takemura and Nakaseko, 1981).

Family **PSEUDOALBAILLELLIDAE** CHENG 1986

Type genus: *Pseudoalbaillella* HOLDSWORTH & JONES 1980a

Diagnosis: Cheng (1986) named the family Pseudoalbaillellidae, but did not provide a diagnosis for it.

The family Pseudoalbaillellidae includes the genus *Pseudoalbaillella* HOLDSWORTH & JONES 1980a

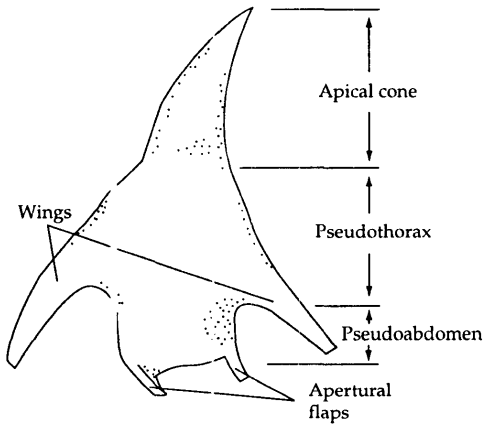

Figure 3.6 Systematic morphologic terminology of family Pseudoalbaillellidae CHENG 1986 (this study).

Suborder **NASSELLARIA** EHRENBERG 1975

Systematic morphologic terminology of the suborder Nassellaria after (Campbell, 1954). All of the following features are not present in all genera.

Abdomen: Third segment of the lattice shell of segmented Nassellarians.
Postabdomina: Joints or segments below the abdomen (third segment) of the Apical horn: Apical horn or apical spine located at the top of the cephalis in some genera.
Cephalis: The first division of Nassellarians with a segmented lattice shell (that nearest the centre or apex of the tripod).
Feet: Radial appendages, may be solid or fenestrated and project from the apex.
Joints: Lattice shell of segmented Nassellarians are divided into segments by strictures (constrictions) of the shell.
Lattice shell: Siliceous conical or helmet shaped structure fixed at the common centre of the tripod.
Sagittal ring: Great circle or ring which reinforces the lattice wall in the medial sagittal plane.
Thorax: Second segment of the lattice shell of segmented Nassellarians.
Tripod: Three divergent rods united at a common centre

Incertae NASSELLARIA

Family **TRIASSOCAMPIDAE** KOZUR & MOSTLER 1981

Type genus: *Triassocampe scalaris* DUMITRICA, KOZUR & MOSTLER 1980
Diagnosis: For diagnosis see Blome, 1984.

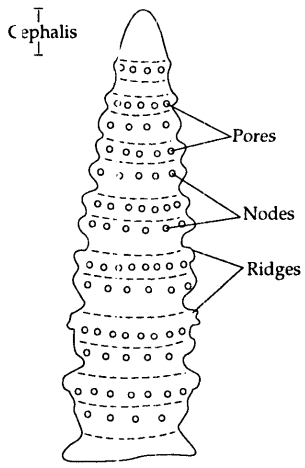

Figure 3.7 Systematic morphologic terminology of family Triassocampidae KOZUR & MOSTLER (Drawn from Yao, 1983 Fig. 2.1).

Suborder **SPUMELLARIA** Ehrenberg 1875

Systematic morphologic terminology of suborder Spumellaria after Campbell (1954).

By-spines: Accessory needle-like spines in some genera.
Cortical shell: Outermost lattice shell.
Lattice shell: Hollow siliceous lattice shell or fenestrated sphere having similar or dissimilar pores.
Main spines: Main spines or principal spines tend to be arranged in opposing pairs.
Medullary shell: Innermost lattice shell.
Pore frames: Smooth or elevated hexagonal or otherwise shaped framework, containing the pores of the lattice shell.
Radial beams: Concentric shells are united and supported by radial beams which have constant numbers or positions in various genera.
Spicules: Spumellarians lacking lattice shells are formed by arrangements of simple, disjointed, needle-like, radiate or otherwise arranged spicules.
Spines: Needle-like, sword-like or bladed (often tribladed and triradiate in axial section) spines commonly evenly distributed and arising from the pore frames, or may be restricted to opposing poles of the shell.

Family **ENTACTINIIDAE** RIEDEL 1967b
emend. Nazarov & Ormiston 1985

Type genus: *Stigmostylosphaera* (RÜST 1892) emend. Foreman 1963. (see Remarks: p. 159)
Diagnosis: For diagnosis see Nazarov and Ormiston, 1985.

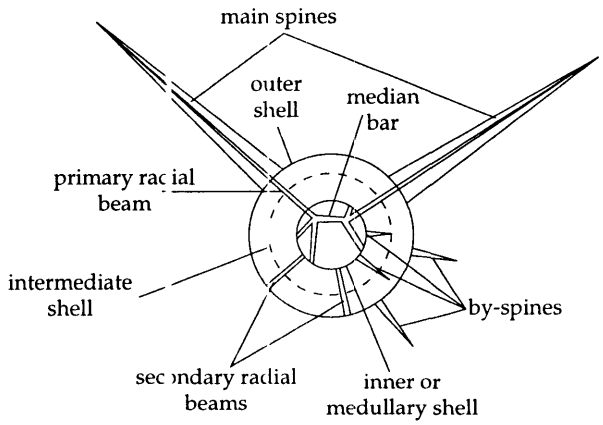

Figure 3.8 Systematic morphological terminology of family Entactiniidae RIEDEL (after Sashida & Tonishi, 1985).

Family **OERTLISPONGIDAE** KOZUR & MOSTLER 1980
(Suborder **Spumellaria** (DUMITRICA, KOZUR & MOSTLER 1980))
(Suborder **Entactinaria** (KOZUR & MOSTLER 1982)

Type genus: *Oertlispongus* DUMITRICA, KOZUR & MOSTLER 1980
Diagnosis: For diagnosis see Dumitrica *et al.*, 1980.

The family Oertlispongidae KOZUR & MOSTLER includes the following genera:

Oertlispongus DUMITRICA, KOZUR & MOSTLER 1980
Baumgartneria DUMITRICA, 1982

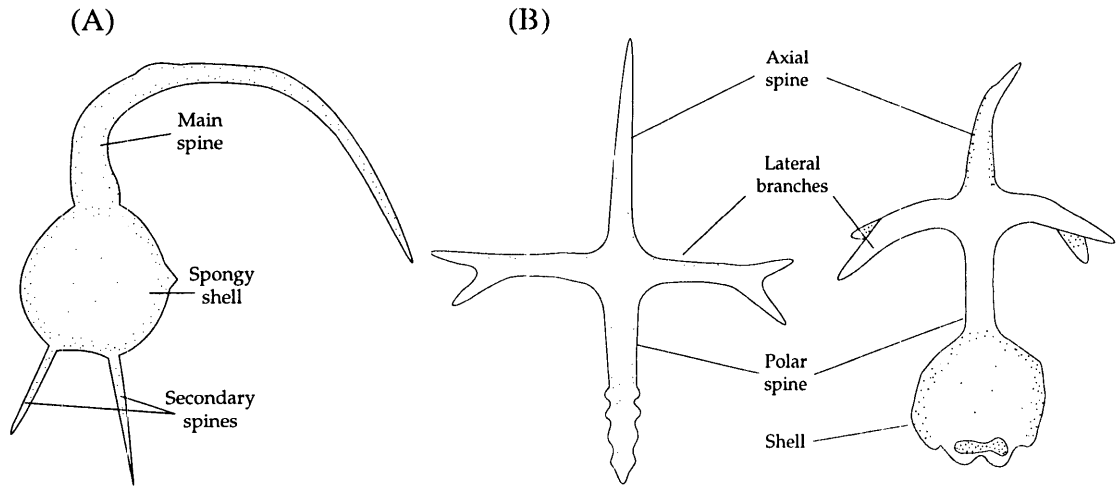

Figure 3.9 Systematic morphologic terminology of family Oertlispongidae KOZUR & MOSTLER (A) genus *Oertlispongus* DUMITRICA, KOZUR & MOSTLER, and (B) genus *Baumgartneria* DUMITRICA (after Kozur and Mostler, 1994).

Superfamily **LATENTIFISTULIDEA** NAZAROV & ORMISTON 1983a
Family **LATENTIFISTULIDAE** NAZAROV & ORMISTON 1983a

Type genus: *Latentifistula* NAZAROV & ORMISTON 1983
Diagnosis: For diagnosis see Nazarov and Ormiston, 1983.

Family Latentifistulidae includes the following genera -

Latentifistula NAZAROV & ORMISTON 1983a
Latentibifistula NAZAROV & ORMISTON 1983a
Quadriremis NAZAROV & ORMISTON 1985
Quinqueremis NAZAROV & ORMISTON 1983a
Polyfistula NAZAROV & ORMISTON 1985
Triactofenestrella NAZAROV & ORMISTON 1985

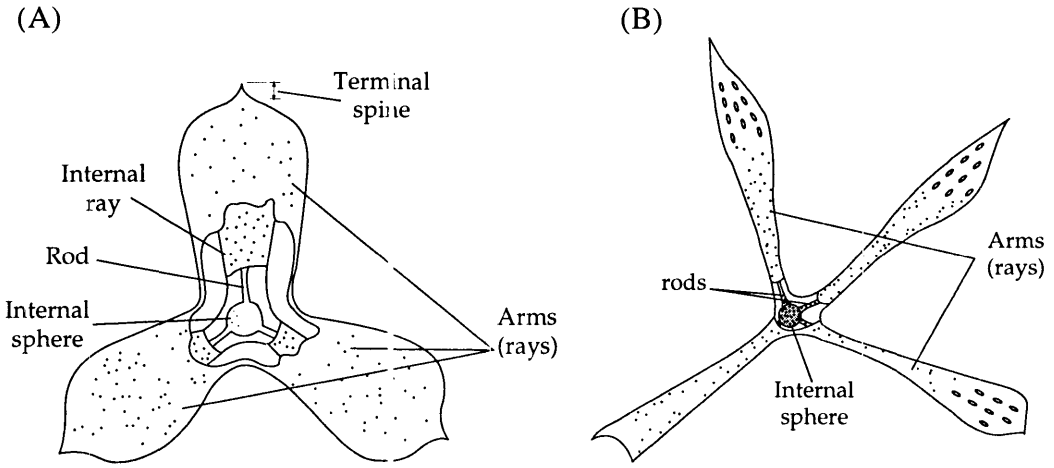

Figure 3.10 Systematic morphologic terminology of family Latentifistulidae KOZUR
(A) genus *Latentibifistula* NAZAROV & ORMISTON, and
(B) genus *Quadriremis* NAZAROV & ORMISTON (after Nazarov and Ormiston, 1983a).

Family **RUZHENCEVISPONGIDAE** KOZUR 1980 emend. NAZAROV & ORMISTON 1983a, 1985.

Type genus: *Ruzhencevispongus* KOZUR 1980, emend. Nazarov 1983

Diagnosis: For diagnosis see Nazarov and Ormiston 1985.

Family RUZHENCEVISPONGIDAE includes the following genera:

Ruzhencevispongus KOZUR

Latentidiota NAZAROV & ORMISTON

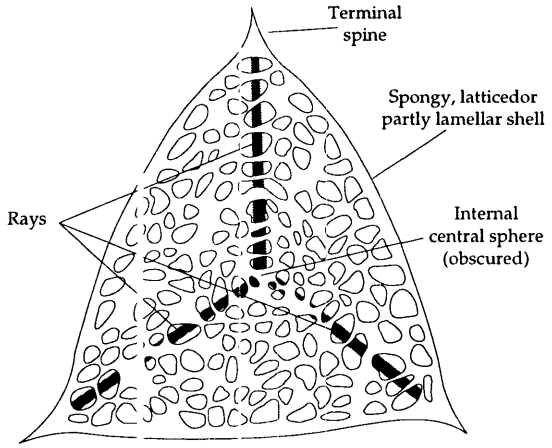

Figure 3.11 Systematic morphologic terminology of family Ruzhencevispongidae KOZUR (after Nazarov and Ormiston, 983a).

Family **TORMENTIDAE** NAZAROV & ORMISTON 1983a

Type genus: *Tormentum* NAZAROV & ORMISTON 1983a

Diagnosis: For diagnosis see Nazarov and Ormiston, 1983a.

Family Tormentidae includes the following genera:

Tormentum NAZAROV & ORMISTON 1983a
Tetratormentum NAZAROV & ORMISTON 1985
Rectotormentum NAZAROV & ORMISTON 1985
Pseudotormentus DE WEVER & CARIDROIT 1984

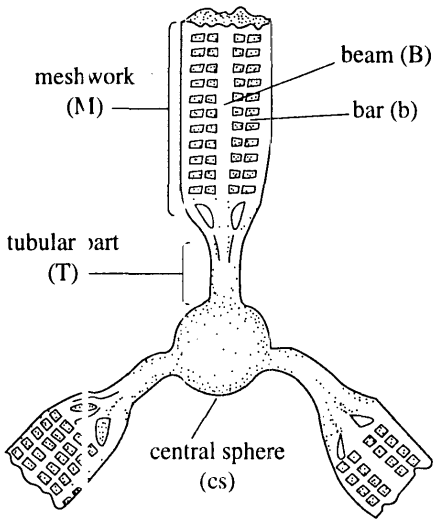

Figure 3.12 Systematic morphologic terminology of family Tormentidae NAZAROV & ORMISTON genus *Pseudotormentus* DE WEVER & CARIDROIT (after Caridroit and De Wever, 1986).

Incertae familiae

Genus ***Triplanospongos*** SASHIDA & TONISHI 1988

Type species: *Triplanospongos musashiensis* SASHIDA & TONISHI 1988

Diagnosis: For diagnosis see Sashida and Tonishi, 1988.

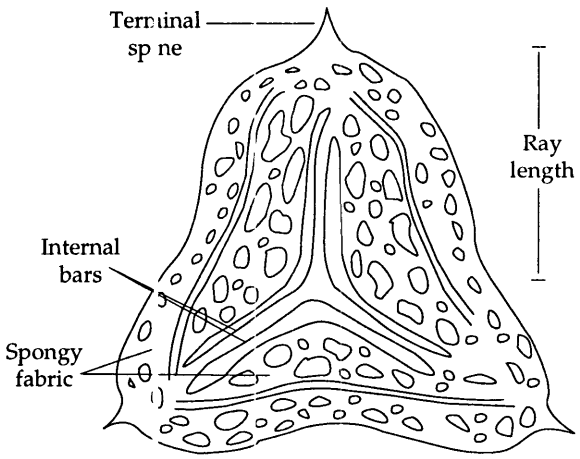

Figure 3.13 Systematic morphologic terminology of genus *Triplanospongos* SASHIDA & TONISHI (after Sashida and Tonishi, 1988).

INCERTAE SUBORDINIS

Family **ARCHOCYRTIIDAE** KOZUR & MOSTLER 1981

emend. Cheng 1986.

Type genus: *Archocyrtium* DEFLANDRE 1972 emend. CHENG 1986.

Diagnosis: For diagnosis see Cheng, 1986.

Family Archodyrtidae includes the genus *Archocyrtium* DEFLANDRE.

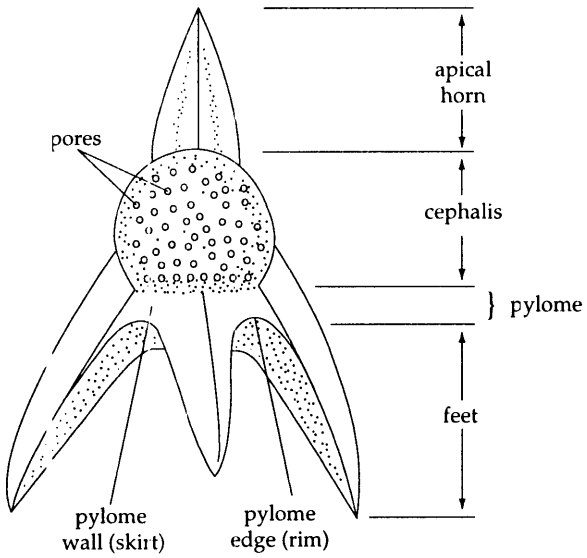

Figure 3.14 Systematic morphologic terminology of family Archocyrtiidae KOZUR & MOSTLER (after Kozur and Mostler, 1981, and Cheng, 1986).

Family **PALAEOSCENIDIIDAE** Riedel 1967b
emend. Holdsworth 1977, Goodbody 1982, Furutani 1983, Goodbody 1986

Type Genus: *Palaeoscenidium* DEFLANDRE 1953 emend. Goodbody 1986.
Diagnosis: For diagnosis see Goodbody, 1986.

Subfamily **PALAEOSCENIDINAE** RIEDEL 1967b
emend. Furutani 1981, 1982, Goodbody 1986

Diagnosis: For diagnosis see Goodbody, 1986.

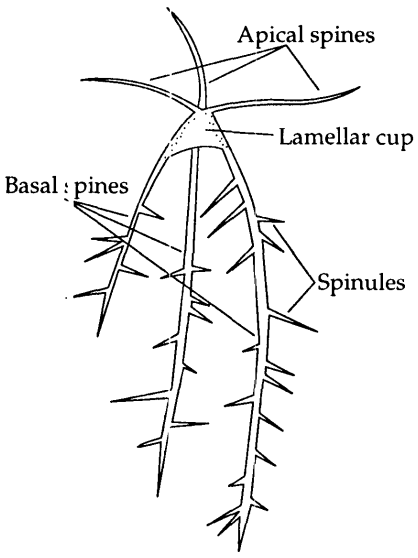

Figure 3.15 Systematic mophologic terminology of family Palaeoscenidiidae RIEDEL (after Foreman, 1963; Goodbody 1986).

Family **POPOFSKYELLIDAE** DEFLANDRE 1964
emend. Cheng. 1986.

Type genus: *Popofskyellum* DEFLANDRE 1964.
Diagnosis: For diagnosis see Cheng, 1986.

Family Popofskyellidae includes the following genera:

Popofskyellum DEFLANDRE 1964.
Kantollum CHENG, 1986.

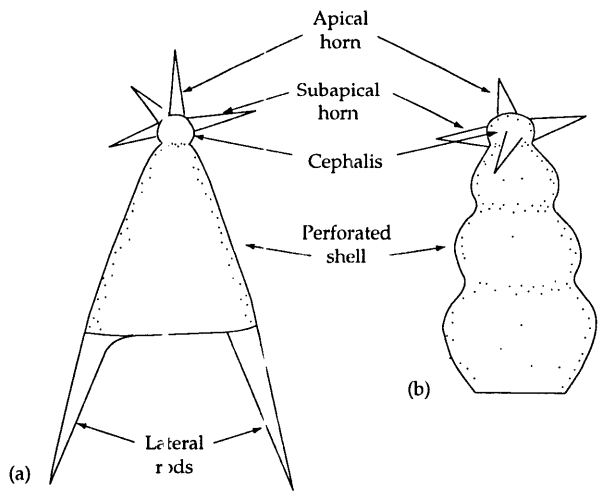

Figure 3.16 Systematic morphologic terminology of family Popofskyellidae DEFLANDRE
(a) genus *Popofskyellum* DEFLANDRE, and
(b) genus *Kantollum* CHENG (after Schwartzapfel, 1990).

Family **PYLENTONEMIDAE** DEFLANDRE 1963
emend. Holdsworth 1977, Holdsworth , Jones and Allison, 1978, Cheng, 1986

Type genus: *Pylentonema* DEFLANDRE 1963

Diagnosis: For diagnosis see Cheng, 1986.

The family Pylentonemidae Deflandre includes the following genera:

Pylentonema DEFLANDRE 1963

Quadrapesus CHENG 1986

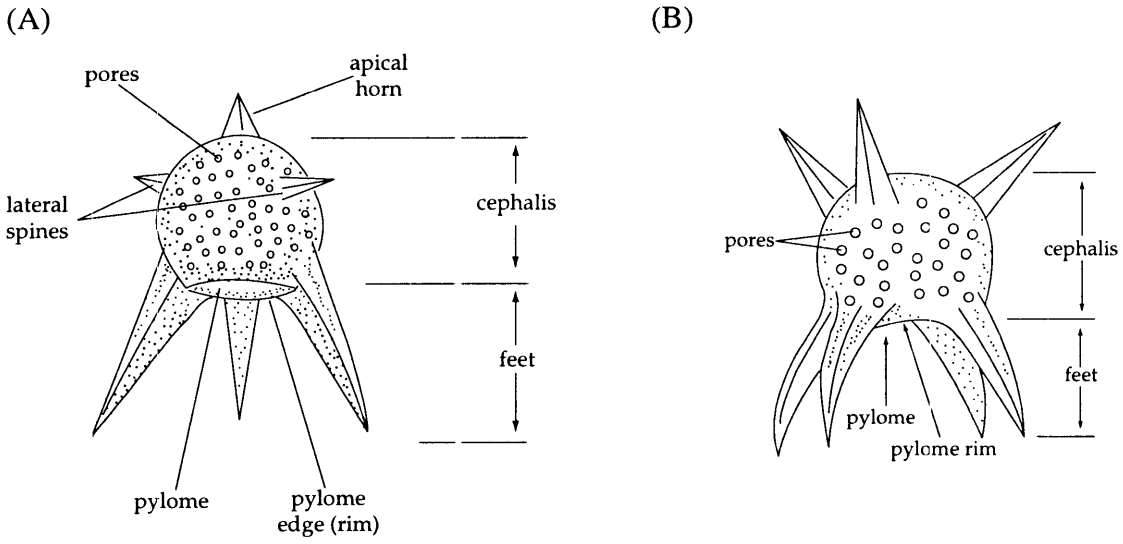

Figure 3.17 Systematic morphologic terminology of family Pylentonemidae DEFLANDRE
(A) genus *Pylentonema* DEFLANDRE, and
(B) genus *Quadrapesus* CHENG (after Schwartzapfel, 1990).

3.4 SYSTEMATIC PALAEONTOLOGY

Radiolarians extracted from cherts within the Bentong-Raub suture zone and other localities in Peninsular Malaysia are described below. The systematic framework and morphologic terminology adopted in this study is defined in Chapter 3.3. All species described are illustrated using scanning electron micrographs. All illustrated specimens are catalogued with Australian Museum AMF numbers and are registered and deposited in the Australian Museum, Sydney. A list of specimens, AMF numbers, SEM stub identification numbers, Scanning Electron photomicrograph negative numbers and Plate reference is found in Appendix F.

Repository numbers and repository locations (if known) of holotype specimens of each species cited in the systematic section of this study, are noted in square brackets under the heading "Holotype". Following is a list of the more commonly indicated repository number prefixes and associated repository locations:

Repository no. [USNM] indicates that the specimen is registered and deposited in the United States National Museum of Natural History, Washington, D.C.;
[KUE] = Department of Earth Sciences, Kyoto University of Education, Japan;
[GIN] = Geological Institute of the Soviet Academy of Sciences, Moscow;
[MTSM] = Institute of Geological Sciences, College of General Education, Osaka University;
[IGUT] = Institute of Geoscience, University of Tskuba, Japan;
[CK/...] = Dipartmento di Geologica e Paleontologia Università di Palermo (Sicily, Italy);
[UCB No FSL] = l'Université Claude-Bernard, Lyon in the collection of the Department des Sciences de la Terre.

All radiolarian species recovered from localities within Peninsular Malaysia are listed below in taxonomic order. These species are then described systematically in the following pages. The faunas recovered in this study are listed in taxonomic order in Table 3.1, Table 3.2, Table 3.3, Table 3.4, and Table 3.5.

Suborder: **ALBAILLELLARIA DEFLANDRE 1953**

Superfamily: ALBAILLELLACEA CHENG 1986

Family: Albaillellidae DEFLANDRE 1952

Albaillella DEFLANDRE 1952

Albaillella asymmetrica ISHIGA & IMOTO 1982b
Albaillella cartalla ORMISTON & LANE, 1976
Albaillella deflandrei GOURMELON 1987a
Albaillella sp. aff. *A. deflandrei* ? GOURMELON 1967a
Albaillella excelsa ISHIGA, KITO & IMOTO 1982a
Albaillella furcata Won 1983
Albaillella levis ISHIGA, KITO & IMOTO 1982a
Albaillella paradoxa DEFLANDRE 1952
Albaillella sinuata ISHIGA & WATASE 1986
Albaillella sp. aff. *A. spinosa* CHENG 1986
Albaillella triangularis ISHIGA, KITO & IMOTO 1982a
Albaillella undulata DEFLANDRE 1952
Albaillella sp. A. aff. *A. undulata* DEFLANDRE 1952
Albaillella sp. B. aff. *A. undulata* DEFLANDRE 1952

Family: Ceratoikiscidae HOLDSWORTH 1969a

Ceratoikiscum DEFLANDRE 1953

Ceratoikiscum berggreni GOURMELON 1987a

Helenifore NAZAROV & ORMISTON 1983a

Helenifore laticlavium NAZAROV & ORMISTON 1983b

Family: Holoeciscidae CHENG 1986

Holoeciscus FOREMAN 1963

Holoeciscus elongatus KIESSLING & TRAGELEHN 1995
Holoeciscus foremanae CHENG 1986

Superfamily: FOLLICUCULLACEA CHENG 1986

Family: Follicucullidae ORMISTON & BABCOCK 1979

Follicucullus ORMISTON & BABCOCK 1979

Follicucullus crunulatus n. sp.
Follicucullus dorsoconvexus (KOZUR 1993)
Follicucullus elongatus n. sp.
Follicucullus monacanthus ISHIGA & IMOTO 1982c
Follicucullus porrectus RUDENKO 1984

Follicucullus scholasticus ORMISTON & BABCOCK 1979

Family: Neoalbaillellidae CHENG 1986

Neoalbaillella TAKEMURA & NAKASEKO 1981

Neoalbaillella ornithoformis TAKEMURA & NAKASEKO 1981

Family: Pseudoalbaillellidae CHENG 1986

Pseudoalbaillella HOLDSWORTH & JONES 1980a

Pseudoalbaillella convexa RUDENKO & PANASENKO 1990

Pseudoalbaillella elegans ISHIGA & IMOTO 1980

Pseudoalbaillella elongata ISHIGA & IMOTO 1980

Pseudoalbaillella fusiformis (HOLDSWORTH & JONES 1980)

Pseudoalbaillella globosa ISHIGA & IMOTO 1982

Pseudoalbaillella sp. cf. *Ps. lomentaria* ISHIGA & IMOTO 1980

Pseudoalbaillella sp. aff. *Ps. longicornis* ISHIGA & IMOTO 1980

Pseudoalbaillella longtanensis SHENG & WANG 1985

Pseudoalbaillella longtanensis ? SHENG & WANG 1985

Pseudoalbaillella ornata ISHIGA & IMOTO 1980

Pseudoalbaillella sakmarensis (KOZUR 1981)

Pseudoalbaillella scalprata HOLDSWORTH & JONES 1980 morphotype *rhombothoracata* ISHIGA 1983

Pseudoalbaillella scalprata HOLDSWORTH & JONES 1980 morphotype *scalprata* ISHIGA 1983

Pseudoalbaillella simplex ISHIGA & IMOTO 1980

Pseudoalbaillella sp. A.

Pseudoalbaillella sp. B.

Suborder: NASSELLARIA EHRENBERG 1875

Family: Eptingiidae DUMITRICA 1978

Eptingium DUMITRICA 1978

Eptingium manfredi manfredi DUMITRICA 1978

Eptingium manfredi robustum KOZUR & MOSTLER 1980

Eptingium nakasekoi KOZUR & MOSTLER 1994

Incertae NASSELLARIA

Family: Triassocampidae KOZUR & MOSTLER 1981

Triassocampe DUMITRICA, KOZUR & MOSTLER 1980

Triassocampe coronata BRAGIN 1991

Triassocampe deweveri (NAKASEKO & NISHIMURA 1979)

Suborder: SPUMELLARIA EHRENBERG 1875

Family: Entactiniidae RIEDEL 1967b

Subfamily: Astroentactiniinae NAZAROV & ORMISTON 1985b

Astroentactinia NAZAROV 1975

Astroentactinia biaciculata NAZAROV 1975

Astroentactinia mirousi GOURMELON 1987a

Astroentactinia spatiosa BRAUN 1990c

Copicyntra NAZAROV & ORMISTON 1985b

?*Copicyntra* sp.

Uberinterna SASHIDA & TONISHI 1988

Uberinterna virgispinosum SASHIDA & TONISHI 1988

Subfamily: Entactiniinae RIEDEL 1967b

Hegleria NAZAROV & ORMISTON 1985b

Hegleria mammilla (SHENG & WANG 1985)

Stigmosphaerostylus (RÜST 1892)

Stigmosphaerostylus sp. cf. *S. itsukaichiensis* (SASHIDA & TONISHI 1985)

Stigmosphaerostylus sp. cf. *S. pycnoclada* (NAZAROV & ORMISTON 1985b)

Stigmosphaerostylus variospina (WON 1983)

Stigmosphaerostylus vulgaris (WON 1983)

Family: Hindeosphaeridae KOZUR & MOSTLER 1981

Pseudostylosphaera KOZUR & MOSTLER, 1981

Pseudostylosphaera compacta (NAKASEKO & NISHIMURA 1979)

Pseudostylosphaera japonica (NAKASEKO & NISHIMURA 1979)

Pseudostylosphaera sp. A
Pseudostylosphaera sp. B

Family: Oertlispongidae KOZUR & MOSTLER 1980
Baumgartneria DUMITRICA 1982
Baumgartneria bifurcata DUMITRICA 1982

Oertlispongus DUMITRICA, KOZUR & MOSTLER 1980
Oertlispongus inaequispinosus DUMITRICA, KOZUR & MOSTLER 1980

Family: Sepsagonidae KOZUR & MOSTLER 1981
Sepsagon DUMITRICA, KOZUR & MOSTLER 1980
Sepsagon ladinicus KOZUR & MOSTLER 1994

Incertae familiae
Meschedea Won 1983
Meschedea permica SASHIDA & TONISHI 1985

Polyetactinia FOREMAN 1963
Polyetactinia polygonia FOREMAN 1963

Superfamily: LATENTIFISTULIDEA NAZAROV & ORMISTON 1983a
Family: Latentifistulidae NAZAROV & ORMISTON 1983a
Ishigaum DE WEVER & CARIDROIT
Ishigaum sp.
Latentifistula NAZAROV & ORMISTON 1983a
Latentifistula sp. aff. *L. crux* NAZAROV & ORMISTON 1983a
Latentifistula impella (ORMISTON & LANE 1976)
Latentifistula patagilaterala NAZAROV & ORMISTON 1985b
Latentifistula turgida (ORMISTON & LANE 1976)
Latentifistula sp. aff. *L. turgida* (ORMISTON & LANE 1976)
Latentibifistula NAZAROV & ORMISTON 1983a

Latentibifistula triacanthophora NAZAROV & ORMISTON 1983a
Latentibifistula sp. A
Latentibifistula sp. B
Latentibifistula sp. C
Latentibifistula sp. D
Polyfistula NAZAROV & ORMISTON 1984
Polyfistula sp.
Quadriremis NAZAROV & ORMISTON 1985b
Quadriremis gliptoacus NAZAROV & ORMISTON 1985b

Latentifistulidae gen. et sp. indet.

Family: Ruzhencevispongidae KOZUR 1980
Ruzhencevispongus KOZUR 1980
Ruzhencevispongus uralicus KOZUR 1980

Family: Tormentidae NAZAROV & ORMISTON 1983
Pseudotormentus DE WEVER & CARIDROIT 1984
Pseudotormentus kamigoriensis DE WEVER & CARIDROIT 1984
Pseudotormentus sp. cf. *Ps. kamigoriensis* DE WEVER & CARIDROIT
Pseudotormentus sp.

Incertae familiae:
Triplanospongos SASHIDA & TONISHI 1988
Triplanospongos musashiensis SASHIDA & TONISHI 1988

INCERTAE SUBORDINIS

Family: Archocyrtiidae KOZUR AND MOSTLER 1981
Archocyrtium DEFLANDRE 1972
Archocyrtium callimorphum ? BRAUN 1989a
Archocyrtium eupectum BRAUN 1989a
Archocyrtium pulchrum BRAUN 1990c
Archocyrtium sp.

Archocyrtium sp. A
Archocyrtium sp. B
Archocyrtium sp. C
Archocyrtium sp. D

Family: Palaeoscenidiidae RIEDEL 1967b
Palaeoscenidium DEFLANDRE 1953
Palaeoscenidium cladophorum DEFLANDRE 1953

Family: Popofskyellidae DEFLANDRE 1964
Popofskyellum DEFLANDRE 1964
Popofskyellum sp. cf. *P. hendricksi* CHENG
Popofskyellum sp.

Family: Pylentonemidae DEFLANDRE 1963
Pylentonema DEFLANDRE 1963
Pylentonema antiqua DEFLANDRE 1963
Pylentonema mendax (DEFLANDRE 1972)
Quadrapesus CHENG 1986
Quadrapesus sp.

3.4.1 Suborder: Albaillellaria

3.4.1.1 Family: Albaillellidae

Class **ACTINOPODA** CALKINS 1909

Subclass **RADIOLARIA** MÜLLER 1858

Order **POLYCYSTINA** EHRENBERG 1838
emend. Riedel 1967b

Suborder **ALBAILLELLARIA** DEFLANDRE 1953
emend. Holdsworth 1969a

Superfamily **ALBAILLELLACEA** CHENG 1986

Family **Albaillellidae** DEFLANDRE 1952
emend. Holdsworth 1977, emend. Cheng 1986

Subfamily **Albaillellinae** CHENG 1986

Genus ***Albaillella*** DEFLANDRE 1952
emend. Holdsworth 1966, emend. Ormiston and Lane 1976, emend. Won, 1983

Type Species: *Albaillella paradoxa* DEFLANDRE 1952

Diagnosis: For diagnosis see Ormiston and Lane, 1976.

Albaillella asymmetrica ISHIGA & IMOTO 1982b
Plate 3.1a, 3.1b, 3.1c.

1980 *Albaillella* sp. B, ISHIGA & IMOTO; p. 340, Pl. 5, Figs. 6-10.
1981 *Albaillella* sp. B, ISHIGA & IMOTO; Ishiga *et al.*, p. 18
1981 *Albaillella* sp.; Sato *et al.*, P. 1, Fig. 4.
1982b *Albaillella asymmetrica* ISHIGA & IMOTO; Ishiga *et al.*, Pl. 3, Figs. 3-11.
1984 *Albaillella asymmetrica* ISHIGA & IMOTO; Ishiga & Suzuki, p. 201, Pl. 1, Figs. 9, 10, 12-15.
1985 *Albaillella asymmetrica* ISHIGA & IMOTO; Yoshida & Murata, Pl. 1, Figs. 11, 12.
1986 *Albaillella asymmetrica* ISHIGA & IMOTO; Ishiga *et al.*, p. 129, 131, Pl. 1, Figs. 9-15.
1990 *Albaillella asymmetrica* ISHIGA & IMOTO; Ishiga, Pl. 1, Fig. 16.
1992 *Albaillella asymmetrica* ISHIGA & IMOTO; Blome & Reed, p. 362, Figs. 9.1 - 9.5.
1995 *Albaillella asymmetrica* ISHIGA & IMOTO; Naka, Pl. 4, Figs. 3-9; Pl. 5. Figs. 1-5; Pl. 6, Fig. 2.
1995b *Albaillella asymmetrica* ISHIGA & IMOTO; Spiller & Metcalfe, Figs. 5.1, 5.2.
1996 *Albaillella asymmetrica* ISHIGA & IMOTO; Spiller, Pl. 4, Fig. 7.

Holotype: Ishiga *et al.*, 1982b: Pl. 3, Fig. 3. [KUE PR 32-34]

Description: Ishiga *et al.*, (1982b) divide the test of this species into three parts, apical cone, pseudothorax and pseudoabdomen. The apical cone has weak horizontal to oblique segmentations or crenulations, curves slightly toward the ventral side, is distally tapered toward the ventral side and gradually narrows to a spine. The pseudothorax is long, flattened, and shell surface is crenulated horizontally or obliquely, with two asymmetrical, horizontal wings, which are broken in the illustrated specimens. Dorsal and ventral rods run vertically along the inner surface of the shell wall and join at a point within shell apex and extend vertically downward to the apertural rim.

Material: Rare specimens from localities CH13 and CH14 near Pos Blau, Cameron Highlands, and KLK2 near Bt Cinta Manis, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Permian (upper Wolfcampian) *Pseudoalbaillella scalprata* m. *rhombothoracata* zone, Leonardian *Albaillella sinuata* zone, upper Leonardian *Pseudoalbaillella longtanensis* zone and the lower part of the upper Leonardian *Pseudoalbaillella globosa* zone (Ishiga, 1986) - southwest Japan (Ishiga and Imoto, 1980; Ishiga *et al.*, 1982b; Yoshida and Murata, 1985; Naka, 1995); Central Oregon, USA (Blome and Reed, 1992); Bentong-Raub area, Peninsular Malaysia (Spiller and Metcalfe, 1995a).

Albaillella cartalla ORMISTON & LANE 1976

Plate 3.1d, 3.1e, 3.1f.

1976 *Albaillella cartalla* ORMISTON & LANE; p. 171-172; Pl. 5, Fig. 9-15.
1983 *Albaillella cartalla* ORMISTON & LANE; Won, p. 125; Pl. 12, Fig. 1,2; Pl. 14, Fig. 3;
1986 *Albaillella cartalla* ORMISTON & LANE; Nazarov & Ormiston, Pl. 4, Fig. 7.
1990a *Albaillella cartalla* ORMISTON & LANE; Braun, Pl.1, Fig. 3.
1990c *Albaillella cartalla* ORMISTON & LANE; Braun, p. 84, Pl. 2, Figs. 1-3; Pl. 4, Fig. 7, 8.
1991 *Albaillella cartalla* ORMISTON & LANE; Braun & Amon, p. 27, Fig. 3a.
1992 *Albaillella cartalla* ORMISTON & LANE; Aitchison *et al.*, p. 47, Fig. 8J,N-Q.
1993a *Albaillella cartalla* ORMISTON & LANE; Aitchison, p. 361, Pl. 1, Fig. 12.
1993 *Albaillella cartalla* ORMISTON & LANE; Braun & Schmidt-Effing, Pl. II, Fig. 2.
1995a *Albaillella cartalla* ORMISTON & LANE; Spiller & Metcalfe, Figs. 6a, 6b.
1995b *Albaillella cartalla* ORMISTON & LANE; Spiller & Metcalfe, Fig. 4.1, 4.2.
1996b *Albaillella cartalla* ORMISTON & LANE; Feng & Ye, Pl. 2.4, Figs. 1-3.
1996 *Albaillella cartalla* ORMISTON & LANE; Spiller, Pl. 2, Figs. 5, 6.
1996 *Albaillella cartalla* ORMISTON & LANE; Schwartzapfel & Holdsworth, p. 52, Pl. 28, Figs. 1-3, 6, 7, 12, 13, 16; Pl. 28, Figs. 5, 10, 11, 14, 15, 17-19; Pl. 29, Figs.3, 11-13.

Holotype: Ormiston & Lane 1976: Pl. 5, Fig. 10. [USNM 186452]

Description: Specimens recovered in this study are fragmentary with the transverse bar of the H-frame that carry the spines, separated from the test. Shell expands from the apical tip to the position of the lateral "wings", then tapers slightly to aperture. Shell may be traversed by oblique bands, although not all the specimens recovered in this study

displayed this feature. Major rods of the H-frame are generally broken and not preserved. External transverse bar of the H-frame, curved and carrying up to 5 spines.

Material: Rare specimens from localities KLK13 near Genting Sempah and CH6 near Pos Mering, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Carboniferous (Viséan) - Oklahoma, USA (Ormiston and Lane, 1976); *Albaillella cartalla* zone of Rheinischen Schiefergebirges, Germany (Won, 1983; Braun, 1990b; 1990c); Texas area, south Queensland, Australia (Aitchison and Flood, 1990); southwest Yunnan, China (Feng and Ye, 1996b); Bentong-Raub area and Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995a; 1995b; Spiller, 1996).

Albaillella deflandrei GOURMELON 1987a

Plate 3.1g, 3.1h.

1987a	*Albaillella deflandrei* GOURMELON; p. 85, Pl. 11, Fig. 6-8.
1990a	*Albaillella deflandrei* GOURMELON; Braun, p. 356, Fig. 4c.
1990c	*Albaillella deflandrei* GOURMELON; Braun, p. 85, Pl. 4, Fig. 15,16.
1993	*Albaillella deflandrei* GOURMELON; Braun & Schmidt-Effing, p. 373-374; Pl. 1, Fig. 3.
1995a	*Albaillella deflandrei* GOURMELON; Spiller & Metcalfe, Figs. 5g, 5h.
1995b	*Albaillella deflandrei* GOURMELON; Spiller & Metcalfe, Figs. 4.3, 4.4.
1996b	*Albaillella deflandrei* GOURMELON; Feng & Ye, Pl. 2.4, Figs. 6, 7.
1996	*Albaillella deflandrei* GOURMELON; Spiller, Pl. 2, Figs. 3, 4.

Holotype: Gourmelon 1987a: Pl. 11, Fig. 8. [LPB 12851; T/48/3]

Description: Elongate, conical test with strong external columella, which continue below the base of the test, both are bent slightly to the side. The curvature of one vertical external stapia is stronger than the other. The basal part of the test is strongly corrugated. The corrugations continue towards the apical horn, but are less well defined. The basal part of the test is inflated on one side.

Material: Rare specimens from locality KLK4 near Karak, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Upper Tournaisian *Albaillella deflandrei* zone - Rheinisches Schiefergebirge, Germany (Braun, 1990a); southwest Yunnan, China (Feng and Ye, 1996b); Karak area, Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995a; Spiller, 1996).

Albaillella sp. aff. *A. deflandrei* ? GOURMELON 1967a
Plate 3.1i.

Description: Poorly preserved fragmentary specimens have an elongate conical test. The cavea has a strongly corrugated basal part and one side of the basal part of the test is inflated . External columella are not preserved in any of the recovered specimens. The presence of this feature would enable positive identification of the *Albaillella deflandrei* GOURMELON species.
Material: Very rare poorly preserved specimens from locality KK1 near Kuala Kangsar.
Range and occurrence: ? Lower Carboniferous from an isolated exposure of tuffaceous chert near Kuala Kangsar, west Peninsular Malaysia.

Albaillella excelsa ISHIGA, KITO & IMOTO 1982a
Plate 3.1j.

1982a	*Albaillella excelsa* ISHIGA KITO & IMOTO; p. 17, Pl. III, Figs. 5-8.
1986	*Albaillella excelsa* ISHIGA KITO & IMOTO; Ishiga, p. 91, Fig. 1; p.98.
1987	*Albaillella excelsa* ISHIGA KITO & IMOTO; Wu & Zhang, Pl. 1, Fig. 10.
1989	*Albaillella excelsa* ISHIGA KITO & IMOTO; Wu & Li, Pl. 1, Figs. 8-9.
1990	*Albaillella excelsa* ISHIGA KITO & IMOTO; Ishiga, p.286, Fig. 2.
1990	*Albaillella excelsa* ISHIGA KITO & IMOTO; Rudenko & Panasenko, p. 118, Pl. X, Figs. 1-4.
1990	*Albaillella excelsa* ISHIGA KITO & IMOTO; Tumanda *et al.*, Pl. 2, Figs. 22-23.
1992	*Albaillella excelsa* ISHIGA KITO & IMOTO; Kuwahara & Sakamoto, p. 39, Pl. 3. Figs. 1-3.
1993a	*Albaillella excelsa* ISHIGA KITO & IMOTO; Sashida *et al.*, Pl. 1, Figs. 25-27.
1993	*Albaillella excelsa* ISHIGA KITO & IMOTO; Yao *et al.*, Pl. 1, Figs. 2, 4-5, 7, 9.
1994	*Albaillella excelsa* ISHIGA. KITO & IMOTO; Wang *et al.*, p. 184, Pl. 4, Figs. 14, 15.
1995	*Albaillella excelsa* ISHIGA KITO & IMOTO; Sashida *et al.*, p. 52, Figs. 10.5-10.11.
1995b	*Albaillella excelsa* ISHIGA. KITO & IMOTO; Spiller & Metcalfe, Fig. 5.3.
1996a	*Albaillella excelsa* ISHIGA. KITO & IMOTO; Feng & Ye, Pl. 11.1, Fig. 6.
1996b	*Albaillella excelsa* ISHIGA. KITO & IMOTO; Feng & Ye, Pl. 2.2, Fig. 8.

Holotype: Ishiga *et al.,* 1982a: Pl. 3. Fig. 5. [KUE PR 29-2]

Description: Elongate, smooth, conical test. External columella continue a short distance below the base of the test, but these are not preserved in the figured specimens. The apical horn is slightly bent towards the ventral side and one large wing protrudes from the ventral side of the test from a variable point on the middle third of the test. The specimens of this study do not display the weakly crenulated test described by Ishiga *et al.* (1982a).
Material: Rare specimens from localities K5B, K6, K8 and K15 near Pokok Sena, "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.
Range and occurrence: Upper Permian (Guadalupian) - southwest Japan (Ishiga *et al.*, 1982a); central Japan (Kuwahara and Sakamoto, 1992); Busuanga Island, Palawan, Philippines (Tumanda *et al.*, 1990) Western Yunnan, South China (Wu and Zhang, 1987); Guizhou and Guangxi areas, Yangtze Platform of South China (Yao *et al.*, 1993);

Menglian area, southwest Yunnan, South China (Wang *et al.*, 1994; Feng and Ye, 1996a; 1996b); the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Spiller and Metcalfe, 1995b).

Albaillella furcata WON 1983

Plate 3.1k.

1983	*Albaillella furcata* WON; p. 126-127, Fig. 3f; Pl. 12, Fig. 3-5, 7.
?1983	*Albaillella uncus* WON; p. 127-128, Pl. 1., Fig. 16-18, Fig. 3e.
1990	*Albaillella furcata* WON; Aitchison & Flood, Figs. 6G-6I, 6K, 6L, 6O-6R.
1990c	*Albaillella furcata* WON; Braun, p. 86, Pl. 3, Fig. 9.
1993a	*Albaillella furcata* WON; Aitchison, Pl. 1, Fig. 11.
1995b	*Albaillella* sp. aff. *A. furcata* WON; Spiller & Metcalfe, Fig. 4.5.
1996	*Albaillella furcata* WON; Spiller, Pl. 2, Fig. 9.
1996	*Albaillella furcata* WON; Schwartzapfel & Holdsworth, p. 54, Pl. 30, Figs. 1, 2, 5, 9, 10, 13, 15.

Holotype: Won 1983: Pl. 12. Fig. 5. [Pr. 9704-S 31/6]

Description: Fragmentary specimen with a broad, elongate test. Shell is bilaterally symmetrical, weakly crenulated and flattens towards the apical part. Apical spine exhibits characteristic bifurcation. Dorsal and ventral wing-like appendages protrude from the centre of the segmented lamellar test, but are incomplete. The external stapia are not preserved.

Remarks: *Albaillella furcata* WON is similar to *Albaillella rockensis* CHENG in having a bifurcated apical spine, but differs in the width of the lamellar shell below the wing projection. The width of the lamellar shell in *Albaillella rockensis* is dramatically reduced below the wing projection. The specimen illustrated in this study, although fragmentary, does not show any reduction in width of the lamellar shell.

Material: Rare specimens from locality CH6 near Pos Mering, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Carboniferous (Viséan) - Rheinischen Schiefergebirges, Germany (Won, 1983; Braun, 1990a; 1990b); the Anaiwan terrane, Armidale, NSW, Australia (Aitchison and Flood, 1990); Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995b; Spiller, 1996).

Albaillella levis ISHIGA, KITO & IMOTO 1982a

Plate 3.1l, 3.2a.

1982a	*Albaillella levis* ISHIGA, KITO & IMOTO; p. 17, Pl. 3, Figs. 1-4.
1982	*Albaillella levis* ISHIGA, KITO & IMOTO; Kojima, Pl. 3.5, 3.5.
1985	*Albaillella levis* ISHIGA, KITO & IMOTO; Sashida & Tonishi, Pl. 7, Figs. 5-6.

1985 *Albaillella levis* ISHIGA, KITO & IMOTO; Yoshida & Murata, Pl. II, Figs. 11, 12.
1989 *Albaillella levis* ISHIGA, KITO & IMOTO; Wu & Li, Pl. 1, Fig. 10.
1990 *Albaillella levis* ISHIGA, KITO & IMOTO; Ishiga, Pl. 1, Fig. 7
1990 *Albaillella levis* ISHIGA, KITO & IMOTO; Tumanda *et al.*, Pl. 2, Fig. 24.
1990 *Albaillella levis* ISHIGA, KITO & IMOTO; Rudenko & Panasenko, p. 119, Pl. X, Figs. 5-9.
1990 *Albaillella levis* ISHIGA. KITO & IMOTO; Noble & Renne, p. 389, Pl. I, Figs. 12-15.
1992 *Albaillella levis* ISHIGA, KITO & IMOTO; Kuwahara & Sakamoto, p. 40, Pl. 3, Figs. 8-9, 12.
1993a *Albaillella levis* ISHIGA, KITO & IMOTO; Sashida *et al.*, Pl. 1, Figs. 20, 22-24.
1993 *Albaillella levis* ISHIGA, KITO & IMOTO; Takemura & Yamakita, Pl. 1, Fig. 4.
1993 *Albaillella levis* ISHIGA, KITO & IMOTO; Yao *et al.*, Pl. 1, Fig. 8.
1994 *Albaillella levis* ISHIGA, KITO & IMOTO; Wang *et al.*, p. 184, Pl. 4, Figs. 11-13
1995 *Albaillella levis* ISHIGA, KITO & IMOTO; Blome & Reed, p. 58, Pl. 1 Fig. 3.
1995b *Albaillella levis* ISHIGA, KITO & IMOTO; Spiller & Metcalfe, Fig. 5.4.
1995 *Albaillella levis* ISHIGA, KITO & IMOTO; Sashida *et al.*, Figs. 10.16, 10.17, 10.21.
1996a *Albaillella levis* ISHIGA, KITO & IMOTO; Feng & Ye, Pl. 11.1, Fig. 5.
1996b *Albaillella levis* ISHIGA, KITO & IMOTO; Feng & Ye, Pl. 2.2, Fig. 9.

Holotype: Ishiga *et al.* 1982a: Pl. 3 Fig. 1. [KUE PR 33-26]

Description: Conical, smooth test without constrictions or transverse bands. The apical part of the test is bent towards the ventral side. The dorsal side of the test curved ventrally and the ventral side is curved to a lesser degree. A large wing protrudes from the mid to lower third of the ventral side of the test. Dorsal and ventral rods of the H-frame persist beneath the shell wall and extend downward from the apertural rim, although the external columella are broken in the figured specimens.

Material: Rare specimens from localities K2, K5B, K6, K8, K9, and K15 from the "Lower Chert Member" of the Semanggol Formation, near Pokok Sena, northwest Peninsular Malaysia.

Range and occurrence: Upper Permian (Guadalupian) of southwest Japan (Ishiga *et al.*, 1982a; Yoshida and Murata, 1985); central Japan (Kuwahara and Sakamoto, 1992); Busuanga Island, Palawan, Philippines (Tumanda *et al.*, 1990); Western Yunnan, South China (Wu and Zhang, 1987); Eastern Klamath Mountains, California, USA (Noble and Renne, 1990); Guizhou and Guangxi areas, Yangtze Platform of South China (Yao *et al.*, 1993); Menglian area, southwest Yunnan, South China (Wang *et al.*, 1994); southwest Yunnan, China (Feng and Ye, 1996a; 1996b); the "Lower Chert Member" of the Semanggol Formation of northwest Peninsular Malaysia (Sashida *et al.* 1993a; 1995; Spiller and Metcalfe, 1995b);

Albaillella paradoxa DEFLANDRE 1952

Plate 3.2b, 3.2c.

1952 *Albaillella paradoxa* DEFLANDRE; p. 872-874, Figs. 1-3, 9.
1953 *Albaillella paradoxa* DEFLANDRE; Deflandre, p. 408, Fig. 307b.
1969b *Albaillella paradoxa* DEFLANDRE; Holdsworth, Pl. 1, Figs. 10a, 12a.
1973 *Albaillella paradoxa* DEFLANDRE; Holdsworth, p. 127, Pl. 1, Figs. 12, 15.
1984 *Albaillella paradoxa* DEFLANDRE; Sandberg & Gutschick, Pl. 8, Figs, M, N.

1985 *Albaillella paradoxa* DEFLANDRE; Gourmelon, p. 1263, Pl. 2, Fig. 20.
1986 *Albaillella paradoxa* DEFLANDRE; Gourmelon, p. 191, Pl. 3, Fig. 5, Pl. 4, Fig. 4.
1987a *Albaillella paradoxa* DEFLANDRE; Gourmelon, p. 84, Pl. 11, Figs. 1-5.
1988 *Albaillella paradoxa* DEFLANDRE; Braun & Schmidt-Effing, p. 649, Figs. 16, 17.
1988a *Albaillella paradoxa* DEFLANDRE; Aitchison, Fig. 1a.
1988b *Albaillella paradoxa* DEFLANDRE; Aitchison, Fig. 2.12.
1988c *Albaillella paradoxa* DEFLANDRE; Aitchison, Fig. 9G; Figs. 10R-T.
1989b *Albaillella paradoxa* DEFLANDRE; Braun, p. 362-363, Pl. 3, Fig. 3.
1989 *Albaillella paradoxa* DEFLANDRE; Giese & Schmidt-Effing, p. 72, Pl. 1, Fig. 6.
1990 *Albaillella paradoxa* DEFLANDRE; Aitchison, Fig. 5U.
1990 *Albaillella paradoxa* DEFLANDRE; Aitchison & Flood, Fig. 4R-4T.
1990a *Albaillella paradoxa* DEFLANDRE; Braun, Pl. 1, Fig. 1.
1990c *Albaillella paradoxa* DEFLANDRE; Braun, p. 90-91, Pl. 2, Figs. 9-13; Pl. 4 Figs. 13, 14.
1993a *Albaillella paradoxa* DEFLANDRE; Aitchison, Pl. 1, Fig. 8.
1993 *Albaillella paradoxa* DEFLANDRE; Braun & Schmidt-Effing, Pl. I, Fig. 6.
1995b *Albaillella paradoxa* DEFLANDRE; Spiller & Metcalfe, Fig. 4.6.
1996 *Albaillella paradoxa* DEFLANDRE; Spiller, Pl. 1, Fig. 16.

Holotype: Deflandre 1952: p. 873, Fig. 2.

Description: Elongate, conical, imperforate lamellar test. The forms recovered in this study are unwinged and display a simple elongate H-frame structure. Faint oblique banding is observed on the lamellar shell. Dorsal and ventral columella are joined by a very short transverse bar.

Material: Rare specimens from locality NS2 near Kuala Pilah, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Carboniferous (Viséan) of the Montagne Noire, France (Deflandre, 1952; 1953; Gourmelon 1987b); Baltimani Formation, Turkey (Holdsworth, 1973); upper Tournaisian Upper *typicus* conodont zone of Utah, USA (Sandberg and Gutschick, 1984); Frankenwald, Germany (Braun & Schmidt-Effing, 1988; Braun, 1989b); upper Tournaisian *Albaillella deflandrei* zone of the Kuala Pilah area, Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995b; Spiller, 1996).

Albaillella sinuata ISHIGA & WATASE 1986

Plate 3.2d.

1982b *Albaillella* sp. D; Ishiga *et al.*, p. 276, Pl. 4, Figs. 1-7.
1982c *Albaillella* sp. D; Ishiga *et al.*, Pl. 1, Figs. 17, 18.
1984 *Albaillella* sp. D; Ishiga & Suzuki, Pl. 1, Figs. 1-11.
1986 *Albaillella sinuata* ISHIGA & WATASE; Ishiga *et al.*, p. 126, Pl. 1, Figs. 1-8.
1990 *Albaillella sinuata* ISHIGA & WATASE; Ishiga, Pl. 1 Fig. 15.
1992 *Albaillella sinuata* ISHIGA & WATASE; Blome & Reed, p. 362, Figs. 9.6 - 9.9.
1993c *Albaillella sinuata* ISHIGA & WATASE; Sashida *et al.*, Fig. 6:7.
1993 *Albaillella sinuata* ISHIGA & WATASE; Takemura & Yamakita, Pl. 1, Fig. 7
1994 *Albaillella sinuata* ISHIGA & WATASE; Wang *et al.*, p. 184, Pl. 2, Figs, 13-14.
1995b *Albaillella* sp. cf. *A sinuata* ISHIGA & WATASE; Spiller & Metcalfe, Fig. 5.5.
1996 *Albaillella* sp. cf. *A. sinuata* ISHIGA & WATASE; Spiller, Pl. 4, Fig. 1.

Holotype: Ishiga *et al.*, 1986: Pl. 1, Fig. 1. [KUE PR 58-47]

Description: Horizontal to oblique, undulose, conical shell. Crenulations increase slightly in width and height towards the aperture. Not all rods and spines characteristic of this species are preserved in the figured specimens.

Remarks: All specimens recovered from locality KLK2 near Bt Cinta Manis are poorly preserved.

Material: Rare specimens from locality KLK2, Bt. Cinta Manis, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Leonardian *Albaillella sinuata* zone and lowermost *Pseudoalbaillella longtanensis* zone (Ishiga, 1990) from the Muikaichi area, Shimane Prefecture, southwest Japan (Ishiga *et al.*, 1986); Mino-Tamba Belt, southwest Japan (Ishiga *et al.*, 1982b; 1982c); Qinzhou (Guangxi) and Menglian (Yunnan) South China (Wang *et al.*, 1994); "Fang chert", north Thailand (Sashida *et al.*, 1993b); Bt. Cinta Manis, Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995b; Spiller, 1996).

Albaillella sp. aff. *A. spinosa* CHENG 1986

Plate 3.2e.

Description: A single, poorly preserved specimen with elongate, lamellar shell imperforate, and well-crenulated. Apical spine is not preserved. Lamellar shell flattened and conical in overall shape. Poorly preserved spines appear to originate from the columellae rods and project beyond the shell wall. Several short spines occur on the exterior side of the curved transverse bar.

Remarks: This species co-occurs with *Albaillella cartalla* ORMISTON & LANE, *Albaillella furcata* WON, *Latentifistula turgida* (ORMISTON & LANE) and *Latentifistula impella* (ORMISTON & LANE).

Material: Rare specimens from locality CH6 near Pos Mering, Cameron Highlands.

Range and occurrence: The upper part of the Lower Carboniferous (Viséan) *Albaillella cartalla* zone of Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995b).

Albaillella triangularis ISHIGA, KITO & IMOTO 1982a

Plate 3.2f.

1980 *Albaillella* sp. C; Ishiga & Imoto, Pl. 5, Figs. 11-16
1981 Albaillellidae gen. et sp. indet.; Takemura & Nakaseko, Pl. 2, Fig. 9.
1982a *Albaillella triangularis* ISHIGA, KITO & IMOTO; p. 17, Pl. 2, Figs. 8-11.
1982c *Albaillella triangularis* ISHIGA, KITO & IMOTO; Ishiga *et al.*, Pl. 2, Figs. 17, 18.
1982 *Albaillella* sp. C ISHIGA & IMOTO; Nishizono *et al.*, Pl. 2.6.

1985 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Ishiga, p. 181, Pl. 2, Figs. 13-19.
1985 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Yoshida & Murata, Pl. II, figs. 9, 10.
1986 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Caridroit & De Wever, p. 58-59, Pl. 1, Fig. 1-5.
1986 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Ishiga & Miyamoto, Pl. 64, Fig. 13.
1989 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Wu & Li, Pl. 1, Fig. 14.
1990 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Ishiga, Pl. 1, Fig. 8.
1990 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Rudenko & Panasenko, p. 120, Pl. X, Figs. 10, 11.
1990 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Tumanda *et al.*, Pl. 2, Fig. 18.
1991 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Kuwahara *et al.*, Fig. 4.1.
1992 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Kuwahara & Sakamoto, p. 41, Pl. 3, Figs. 5, 6.
1992 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Sugiyama, Fig. 4.5.
1993 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Takemura & Yamakita, Pl. 1, Fig. 5.
1993 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Yao *et al.*, Pl. 1, Fig. 3.
1993a *Albaillella triangularis* ISHIGA, KITO & IMOTO; Sashida *et al.*, Pl. 1, Figs. 15-17, 19, 21.
1994 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Wang *et al.*, p. 185, Pl. 4, Figs. 9, 10.
1995 *Albaillella triangularis* ISHIGA, KITO & IMOTO; Sashida *et al.*, p. 51, Figs. 10.18-10.20.

Holotype: Ishiga *et al.*, 1982a, Pl 2, Fig. 8. [KUE PR 26-10]

Description: Conical, smooth test with horizontal to oblique constrictions or transverse bands. The apical part of the test is bent towards the ventral side. The dorsal side of the test curved ventrally and the ventral side is curved to a lesser degree. A large prong-like wing protrudes from the mid to lower third of the ventral side of the test. Dorsal and ventral rods of the H-frame are present beneath the shell wall and extend downward from the apertural rim, but they are broken in the figured specimens.

Material: Rare specimens from localities K5B and K8 near Pokok Sena, from the "Lower Chert Member" of the Semanggol Formation northwest Peninsular Malaysia.

Range and occurrence: Upper Permian (Guadalupian to ?Dzhulfian) from Japan (Takemura and Nakaseko, 1979; Ishiga *et al.*, 1982a; Ishiga *et al.*, 1982c; Yoshida and Murata, 1985; Caridroit and De Wever, 1986); South China (Wu and Li, 1989; Yao, *et al.*, 1993; Wang *et al.*, 1994); Philippines (Tumanda *et al.*, 1990); "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (this study).

Albaillella undulata DEFLANDRE 1952

Plate 3.2g, 3.2h.

1952 *Albaillella undulata* DEFLANDRE; Albaillella nov. gen. Figs. 8-9.
1960 *Albaillella undulata* DEFLANDRE; Deflandre, Pl. 1, Fig. 24.
1966 *Albaillella undulata* DEFLANDRE, Holdsworth, p. 321-323.
1973 *Albaillella undulata* DEFLANDRE; Holdsworth, Pl. 1, Fig. 13.
1985 *Albaillella undulata* DEFLANDRE; Gourmelon, Pl. 2. Fig. 21.
1987a *Albaillella ladarezensis* DEFLANDRE; Gourmelon, p. 88-90, Pl. 11, Fig. 9-11.
1990 *Albaillella undulata* DEFLANDRE; Aitchison & Flood, Figs. 5A-5G.
1990a *Albaillella ladarezensis* GOURMELON = *A. undulata* DEFLANDRE; Braun, p. 354; p. 356, Fig. 4b.
1990c *Albaillella undulata* DEFLANDRE; Braun, p. 93, Pl. 4, Figs. 9, 10.

1992 *Albaillella undulata* DEFLANDRE; Aitchison *et al.*, p. 45, Fig. 8A.
1993a *Albaillella undulata* DEFLANDRE; Aitchison, p. 360, Pl. 1, Fig. 9.
1994 *Albaillella* sp.; Wu *et al.*, Pl. 1, Fig. 10.
1995a *Albaillella undulata* DEFLANDRE; Spiller & Metcalfe, Fig. 5f.
1995b *Albaillella undulata* DEFLANDRE; Spiller & Metcalfe, Fig. 4.9.
1996 *Albaillella undulata* DEFLANDRE; Spiller, Pl. 2, Figs. 1, 2.

Holotype: Deflandre, 1952: p. 873, Fig. 8.

Description: Elongate pointed conical cavea with distinct crenulate lamellar structure. The dorsal and ventral columella are carried internally and project only a short distance from the basal aperture. The b-rod or transverse bar is not preserved in the figured specimens.

Material: Rare specimens from locality KLK4 near Karak and very rare specimens from locality NS2 near Kuala Pilah, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Carboniferous (Tournaisian) from the Montagne Noire, France (Deflandre, 1952; Gourmelon, 1985; 1987a); Derbyshire, England (Holdsworth, 1966); Turkey (Holdsworth 1973); Germany (Braun, 1990a; 1990c); Anaiwan terrane, New England orogen, eastern Australia (Aitchison & Flood, 1990); southern Guangxi, China (Wu *et al.* 1994); Kuala Pilah, Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995a; 1995b; Spiller, 1996).

Albaillella sp. A. aff. *A. undulata* DEFLANDRE
Plate 3.2i, 3.2j, 3.2k.

1995b *Albaillella* sp. aff. *A. undulata* DEFLANDRE; Spiller & Metcalfe, Fig. 4.8.
1996b *Albaillella* cf. *undulata* DEFLANDRE; Feng & Ye, Pl. 2.3, Fig. 10.
1996 *Albaillella* sp. aff. *A. undulata* DEFLANDRE; Spiller, Pl. 2. Figs. 11, 12.

Description: Pointed conical cavea with obliquely crenellated caveal wall. Rows of poorly preserved pores occur on the oblique ridges of the cavea, parallel to the crenellae. The dorsal and ventral columella are carried on the external wall of the cavea. The columella projections are extremely long, straight and strong. The b-rod or transverse bar, if present, is not preserved in the figured specimens.

Remarks: Only fragmentary specimens have been extracted and no specimens exhibit the apical cone or the full extent of the extremely long dorsal and ventral columella, or the presence of a transverse bar or b-rod. This specimen is similar to *Albaillella undulata* DEFLANDRE by the presence of a pointed, conical, crenellated cavea supported by dorsal and ventral columella. It differs from *Albaillella undulata* DEFLANDRE by the presence of an obliquely crenellated test and the presence of externally carried columella that project a

long distance beyond the caveal aperture. The species co-occurs with *Albaillella cartalla* ORMISTON & LANE and *Albaillella* sp. cf. *A. spinosa* CHENG.

Material: Rare fragmentary specimens from locality CH6 near Pos Mering, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Carboniferous *Albaillella indensis* zone of southwest Yunnan, China (Feng and Ye, 1996b); Upper part of the Lower Carboniferous (Viséan) *Albaillella cartalla* zone of Braun, 1990, due to the presence of *Albaillella cartalla* and *Albaillella* sp. aff. *A. spinosa.* from the Cameron Highlands area, Bentong-Raub suture zone, Peninsular Malaysia (this study).

Albaillella sp. B. aff. *A. undulata* DEFLANDRE

Plate 3.21.

1995b *Albaillella* sp. aff. *Albaillella undulata* DEFLANDRE; Spiller & Metcalfe, Fig. 4.7.

Description: Pointed conical cavea with strong horizontal crenellae on the cavea wall. The dorsal and ventral columella are carried on the internal wall of the cavea. The columella project below the base of the aperture. The b-rod or transverse bar, if present, is not preserved in the extracted specimens.

Remarks: This specimen is similar to *Albaillella undulata* DEFLANDRE by the presence of a pointed conical cavea with horizontal crenellae and by the presence of columella carried internally. It differs from *Albaillella undulata* DEFLANDRE by the presence of very strong horizontal crenellations and tight constrictions between them. The species co-occurs with *Albaillella cartalla* ORMISTON & LANE and *Albaillella* sp. cf. *A. spinosa* CHENG.

Material: Rare fragmentary specimens from locality CH6 near Pos Mering, Bentong-Raub suture zone, Cameron Highlands, Peninsular Malaysia.

Range and occurrence: Upper part of the Lower Carboniferous (Viséan) *Albaillella cartalla* zone of Braun, 1990c, due to the presence of *Albaillella cartalla* ORMISTON & LANE and *Albaillella* sp. aff. *A. spinosa* CHENG from the Cameron Highlands area, Bentong-Raub suture zone, Peninsular Malaysia (this study).

3.4.1.2 *Family: Ceratoikiscidae*

Family **Ceratoikiscidae** HOLDSWORTH, 1969a

Genus ***Ceratoikiscum*** DEFLANDRE 1953

Type Species: *Ceratoikiscum avimexpectans* DEFLANDRE.

Diagnosis: For diagnosis see Deflandre 1953.

Ceratoikiscum berggreni GOURMELON 1987a

Plate 3.3a, 3.3b, 3.3c.

1987a	*Ceratoikiscum berggreni* GOURMELON; p. 96-98, Pl. 13, Fig. 7-8.
1990c	*Ceratoikiscum berggreni* GOURMELON; Braun, p. 95, Pl. 5, Fig. 4, 5; Pl. 6, Fig. 8, 9.
1993	*Ceratoikiscum berggreni* GOURMELON; Braun & Schmidt Effing, p. 374, Pl. 1, Fig. 5.
1995a	*Ceratoikiscum* sp.; Spiller & Metcalfe, Fig. 5k.
1995b	*Ceratoikiscum berggreni* GOURMELON; Spiller & Metcalfe, Figs. 4.15.
1996	*Ceratoikiscum* sp.; Spiller, Pl. 1, Fig. 9.

Holotype: Gourmelon 1987a: Pl. 3, Fig. 7. [LPB 12819; P 50/3]

Description: A ring-like (circular) skeleton with at least three pairs of widely projecting, prickly (thorny) cavea rib-pairs. The patagium is poorly developed. The projecting caveal-ribs, in conjunction with the long external prickles, give the skeleton a rather spiky appearance. The number of caveal rib pairs cannot be determined due to the poor preservation.

Material: Rare specimens from thin bedded chert at locality NS2, Kuala Pilah, Bentong-Raub suture zone.

Range and occurrence: Upper Tournaisian from the Montagne Noire and central Pyrenes, France (Gourmelon, 1987a); upper Tournaisian *Albaillella deflandrei* zone Kuala Pilah area, Peninsular Malaysia (this study).

Genus ***Helenifore*** NAZAROV & ORMISTON 1983b

Type species: *Helenifore laticlavium* NAZAROV & ORMISTON 1983b

Diagnosis: For diagnosis see Nazarov & Ormiston, 1983b.

Helenifore laticlavium NAZAROV & ORMISTON 1983b

Plate 3.3d.

1983b *Helenifore laticlavium* NAZAROV & ORMISTON; p. 464-466, Pl. 2, Figs. 8, 11, 13, 14.
1988b *Helenifore laticlavium* NAZAROV & ORMISTON; Aitchison, p. 794, Fig. 2.8.
1988 *Helenifore laticlavium* NAZAROV & ORMISTON; Ishiga *et al.*, Fig. 2g.
1988 *Helenifore* ? cf. *laticlavium* NAZAROV & ORMISTON; Schmidt-Effing, p. 36, Table 1, Fig. 1.
1993a *Helenifore laticlavium* NAZAROV & ORMISTON; Aitchison, Pl.1, Fig.1.
1993b *Helenifore laticlavium* NAZAROV & ORMISTON; Aitchison, p. 112, Pl. 2, Figs. 11, 12.
1993c *Helenifore laticlavium* NAZAROV & ORMISTON; Sashida *et al.*, Figs. 4.24-4.26.

Holotype: Nazarov & Ormiston 1983b: Pl. 2, Fig. 8. [USNM 360222]

Description: Ceratoikiscid with a flat ring of platy fabric, usually with two well-expressed, denticulate spines. The spines are flat, short, acute at the tip. There are two other spines, usually poorly expressed; one is shorter and also acute. The platy fabric which unites all elements of the skeleton rarely has a small opening.

Material: Rare specimens from locality T3A near Raub, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Upper Devonian (Frasnian) of Western Australia (Nazarov and Ormiston, 1983b; Aitchison, 1993b), New South Wales (Aitchison, 1988b; Ishiga *et al.*, 1988) and Southern Urals (Nazarov and Ormiston, 1983b); Upper Devonian (Famennian) of North America (Foreman, 1963) and Frankenwalds, Germany (Schmidt-Effing, 1988); Lower Carboniferous (Viséan) of Turkey (Holdsworth, 1973); Pak Chom-Loei area, Thailand (Sashida *et al.*, 1993c); Upper Devonian (Famennian) of the Bentong-Raub suture zone, Peninsular Malaysia (this study).

3.4.1.3 Family: Holoeciscidae

Family **Holoeciscidae** CHENG 1986

Genus ***Holoeciscus*** FOREMAN 1963

Type species: *Holoeciscus auceps* FOREMAN 1963

Diagnosis: For diagnosis see Foreman, 1963.

Holoeciscus elongatus KIESSLING & TRAGELEHN 1994

Plate 3.3e, 3.3f, 3.3g.

1994n.nud "*Holoeciscus longus*"; Schwartzapfel, p. 184, Pl. 12, Figs. 3-6, 13-20.
1994 *Holoeciscus elongatus* KIESSLING & TRAGELEHN; p. 230, Pl. 1, Fig. 14-17.
1996 *Holoeciscus longus* n.sp., Schwartzapfel & Holdsworth, p. 126, Pl. 12, Figs. 3-6, 18-20.

Holotype: Kiessling and Tragelehn, 1994: Pl. 1, Figs. 14-15.

Description: Lamellar shell (cavea) rectangular in lateral view, covering the upper and two thirds of the lower triangular rods. Subcircular basal aperture. Lamellar shell subcylindrical with elongated appearance, width to height ratio approximately 1:3. Three to four pairs of caveal ribs. Cavea with small ovate pores following the caveal ribs. Protruding ventral skeletal frame (stapia) spinose. Dorsal "wings" very weakly developed. Blade-like protruding spines on the ventral portion of the test, perpendicular to the skeletal plane.

Remarks: *H. elongatus* KIESSLING & TRAGELEHN differs from *H. foremanae* CHENG in having a longer, more slender lamellar shell. The lamellar shell covers a greater proportion of both i.t. and b.t. spines.

Material: Rare specimens from localities KLK1 and KLK5 near Genting Sempah, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Upper Devonian (Famennian) from the Frankenwalds, Northern Bavaria, Germany (Kiessling and Tragelehn, 1994); Criner Hills, Oklahoma, USA (Schwartzapfel, 1994; Schwartzapfel and Holdsworth, 1996); Bentong-Raub suture zone, Peninsular Malaysia (this study).

Holoeciscus foremanae CHENG 1986

Plate 3.3h.

1986	*Holoeciscus foremanae* CHENG; p. 232, Pl. 5, Figs. 4-6, 9, 10, 14, 18.
1988b	*Holoeciscus foremanae* CHENG; Aitchison p. 794, Fig. 2(1).
1988c	*Holoeciscus foremanae* CHENG; Aitchison, Figs. 4A, B.
1988	*Holoeciscus foremanae* CHENG; Ishiga *et al.*, Fig. 2c.
1989	*Holoeciscus foremanae* CHENG; Aitchison, p. 179,Pl. 6.5A, B.
1990	*Holoeciscus foremanae* CHENG; Aitchison, p. 370, Figs. 4A, B.
1990b	*Holoeciscus foremanae* CHENG; Braun, p. 9-10, Pl. 1, Figs. 1-3.
1990	*Holoeciscus foremanae* CHENG; Schwartzapfel, p. 183, Pl. 20, Figs. 1-4, 7-9.
1991	*Holoeciscus foremanae* CHENG; Wang, Pl. II, Fig. 8.
1993a	*Holoeciscus foremanae* CHENG; Aitchison, Pl. 1, Fig. 4.
1995a	*Holoeciscus foremanae* CHENG; Spiller & Metcalfe, Fig. 5a.
1995b	*Holoeciscus foremanae* CHENG; Spiller & Metcalfe, Fig. 3.1.
1996	*Holoeciscus foremanae* CHENG; Spiller, Pl. 1, Fig. 4.
1996	*Holoeciscus foremanae* CHENG; Schwartzapfel & Holdsworth, p. 125, Pl. 20, Figs. 1-4, 7-9.

Holotype: Cheng 1986: Pl. 5, Fig 9. [USNM 405520]

Description: Lamellar shell rectangular in lateral view, covering upper and two thirds of the lower triangular rods and a circular basal aperture. Five to six pairs of caveal ribs, obliquely arranged, traceable along the surface of the lamellar shell; Two pairs of caveal ribs extend beyond the lamellar shell periphery, forming a protruding pair of spines which

are perpendicular to the plane of symmetry. A row of pores surround caveal ribs linearly, but are not visible in the figured specimens due to poor preservation.

Material: Rare specimens from float sample at locality KLK1 near Genting Sempah, more abundant specimens from locality KLK5 near Bentong, and very rare specimens from locality NS2 near Kuala Pilah.

Range and occurrence: Upper Devonian (Famennian) from the Ouachita Mountains, Oklahoma and Arkansas (Cheng, 1986); New England Orogen, eastern Australia (Aitchison, 1988b; 1988c; 1989; 1990); Germany (Braun, 1990b; Schwartzapfel, 1990), Xinjiang, China (Wang, 1991) and Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995a; 1995b).

3.4.1.4 Family: Follicucullidae

Suborder **ALBAILLELLARIA** DEFLANDRE 1953
emend. HOLDSWORTH 1969

Superfamily **FOLLICUCULLACAE** CHENG 1986

Remarks: Cheng (1986) erected two superfamilies; Albaillellacea and Follicucullacea. The superfamily FOLLICUCULLACEA was said to include the following families (Cheng, 1986):

Follicucullidae ORMISTON & BABCOCK (1979),
Neoalbaillellidae TAKEMURA & NAKASEKO (1981), and
Pseudoalbaillellidae n. fam (Cheng, 1986; p. 45) / Pseudoalbaillellidae HOLDSWORTH & JONES (1980) (Cheng 1986; p. 49).

As shown above, the Family Neoalbaillellidae was attributed to Takemura and Nakaseko (1981) by Cheng (1986). Takemura and Nakaseko (1981) did not erect a family Neoalbaillellidae, but established the genus *Neoalbaillella* TAKEMURA & NAKASEKO. Therefore, in the present study, the family Neoalbaillellidae is attributed to Cheng, 1986, although a diagnosis does not exist.

In addition, the family Pseudoalbaillellidae was not erected by Holdsworth and Jones (1980a). The authors named a new genus *Pseudoalbaillella* HOLDSWORTH & JONES 1980a. Cheng (1986) first named the family Pseudoalbaillellidae, and in the present study the family Pseudoalbaillellidae is attributed to him, although a diagnosis for the family does not exist.

Family **Follicucullidae** ORMISTON & BABCOCK 1979
emend. KOZUR 1981

Genus ***Follicucullus*** ORMISTON AND BABCOCK 1979

Type Species: *Follicucullus ventricosus* ORMISTON & BABCOCK, 1979
Diagnosis: For diagnosis see Ormiston and Babcock, 1979

Follicucullus crenulatus sp. nov.
Plate 3.3i, 3.3j, 3.3k, 3.3l.

Holotype: AMF.99137, Plate 3.3i.
Paratypes: AMF.99136, Plate 3.3j; AMF.99138, Plate 3.3k.

Name: Drawn from the Latin *crenulatus*, meaning crenulated.
Diagnosis: *Follicucullus* ORMISTON & BABCOCK possessing a horizontally crenulated pseudothorax and pseudoabdomen
Description: Test elongate. Apical horn slightly curved. Pseudothorax and pseudoabdomen are horizontally crenulated, most having three crenulations in total. The degree of crenulation varies between specimens. Some possess weak crenulation while others have pronounced crenulation of the test. Also the degree of crenulation within a single specimen varies. The first crenulation is very weak. The size of the crenulations increases in the second and third crenulation.
Measurements: Average of three specimens. Measurements are in microns.

	1	2	3	Av.
Length of test	333	294	250	292
Length of apical horn	193	173	145	170
Length of apertural part	126	122	110	119

Material: Few moderately preserved specimens from locality K1 of the "Lower Chert Member" of the Semanggol Formation, near Pokok Sena, northwest Peninsular Malaysia.
Range and occurrence: Upper Permian (Guadalupian) of northwest Peninsular Malaysia (this study).

Follicucullus dorsoconvexus (KOZUR 1993)
Plate 3.4a, 3.4b, 3.4c.

1984 *Follicucullus* cf. *ventricosus* ORMISTON & BABCOCK; Belyanskii *et al.*, Pl. 8, Fig. 1.
1993 *Cariver dorsoconvexus* KOZUR; Pl. 1, Figs. 15-17, 19.
1995b *Cariver dorsoconvexus* KOZUR; Spiller & Metcalfe, Fig. 5.6.

Holotype: Kozur 1994, Pl. 1 Fig. 16. [CK/111-64]

Description: Apical horn long, straight or slightly curved. Pseudothorax large and inflated, inclined towards the dorsal side. The dorsal margin is strongly convex and displays a long, shallow groove down the centre of the pseudothorax. The ventral margin is also convex and also displays a broad, deep groove. The pseudoabdomen is long, strongly curved towards the ventral side. The dorsal margin of the pseudoabdomen is convex, while the ventral margin is straight to slightly concave. The aperture is situated on the ventral side, perpendicularly (or nearly so) to the test axis. The base of the dorsal margin of the pseudoabdomen is straight, perpendicular to the test axis. A small, poorly preserved, curved ventral flap can be seen on better preserved specimens.
Material: Numerous well preserved specimens from locality K1 of the "Lower Chert Member" of the Semanggol Formation, near Pokok Sena, northwest Peninsular Malaysia.
Range and occurrence: Dzhulfian of Sosio Valley, Western Sicily (Italy) (Kozur, 1993); Upper Permian (Guadalupian) of northwest Peninsular Malaysia (Spiller and Metcalfe, 1995b).

Follicucullus elongatus sp. nov.
Plate 3.4d, 3.4e, 3.4f.

Holotype: AMF.99143, Plate 3.4c.
Paratypes: AMF.99144, Plate 3.4e; AMF.99145, Plate 3.4f.

Name: Drawn from the Latin *elongatus*, meaning elongated.
Diagnosis: *Follicucullus* ORMISTON & BABCOCK possessing an elongated, slender, apical horn and apertural part.
Description: The test is clearly separated into two distinct parts (apical horn and apertural part). Apical horn is elongate, slender, straight to slightly curved. Pseudothorax weakly inflated. Pseudothorax and pseudoabdomen also elongate and slender. The remains of a poorly preserved apertural flap is visible in some specimens.
Remarks: This species resembles *Follicucullus scholasticus* ORMISTON & BABCOCK but differs in having a much more elongate and slender test with a very definite division

between the apical horn and apertural part, or the upper and lower part of the test. This species also resembles *Follicucullus bipartitus* CARIDROIT & DE WEVER, but differs in having the apical horn region much more slender and elongate than the lower part of the test, and a straight to very slightly inclined test. This species also resembles *Follicucullus furca* CARIDROIT & DE WEVER, but differs in having the apical horn region much more slender and elongate than the lower part of the test.

Measurements: Average of three specimens. Measurements are in microns.

	1	2	3	Av.
Length of test	462	453	335	417
Diameter of apertural part	53	53	48	51
Length of apical horn	249	204	191	215
Length of apertural part	204	240	-	222

Material: Numerous specimens from locality K1 of the "Lower Chert Member" of the Semanggol Formation, near Pokok Sena, northwest Peninsular Malaysia.

Range and occurrence: Upper Permian (Guadalupian) *Follicucullus scholasticus* zone of northwest Peninsular Malaysia (this study).

Follicucullus monacanthus ISHIGA & IMOTO 1982c

Plate 3.4g.

1980 *Follicucullus* sp. A ISHIGA & IMOTO; Pl. 4., Figs, 11-15.
1982b *Follicucullus* sp. B ISHIGA & IMOTO; Ishiga *et al.*, Pl. 4, Figs, 18-20.
1982b *Follicucullus monacanthus* ISHIGA & IMOTO; Ishiga *et al.*, Pl. 4, Figs. 15-17, 21-23.
1982c *Follicucullus* sp. A ISHIGA & IMOTO; Ishiga *et al.*, Pl. 2, Figs. 5-7.
1983 *Follicucullus monacanthus* ISHIGA & IMOTO; Suyari, *et al.*, Pl. 4, Figs. 1, 2.
1984 *Follicucullus monacanthus* ISHIGA & IMOTO; Isozaki, p. 31, Fig. 2; 7-9.
1984 *Follicucullus monacanthus* ISHIGA & IMOTO; Tazawa, *et al.*, p. 265, Fig. 2; 3-6.
1984 *Follicucullus monacanthus* ISHIGA & IMOTO; Ishiga, pl. 1, Figs, 9-12.
1985 *Follicucullus monacanthus* ISHIGA & IMOTO; Naka & Ishiga, Pl. 1, Figs. 8-11.
1985 *Follicucullus monacanthus* ISHIGA & IMOTO; Yoshida & Murata, Pl. II, Figs. 3, 4.
1986 *Follicucullus monacanthus* ISHIGA & IMOTO; Ishiga *et al.*, p. 128, Pl. 2, 4-11, Fig. 3.
1986 *Follicucullus monacanthus* ISHIGA & IMOTO; Ishiga, Figs. 1, 2, p. 97.
1990 *Follicucullus monacanthus* ISHIGA & IMOTO; Ishiga, Pl. 1; Fig. 13.
1990 *Follicucullus monacanthus* ISHIGA & IMOTO; Yamashita & Ishiga, Pl. 1, Fig. 1.
1991 *Follicucullus monacanthus* ISHIGA & IMOTO; Wang, Pl. III, Fig. 4.
1992 *Follicucullus monacanthus* ISHIGA & IMOTO; Blome & Reed, p. 364, Figs. 9.14 - 9.15.
1992 *Follicucullus monacanthus* ISHIGA & IMOTO; Sugiyama, Fig. 4.3.
1993 *Parafollicucullus monacanthus* (ISHIGA & IMOTO); Kozur, p. 106, Pl. 1, Fig. 23.
1993a *Follicucullus monacanthus* ISHIGA & IMOTO; Sashida *et al.*, Pl. 2, Figs. 1, 2.
1993c *Follicucullus monacanthus* ISHIGA & IMOTO; Sashida *et al.*, Figs. 6.12, 6.13.
1993 *Follicucullus monacanthus* ISHIGA & IMOTO; Takemura & Yamakita, Pl. 1, Fig. 8.
1994 *Follicucullus monacanthus* ISHIGA & IMOTO; Wang *et al.*, p. 187, Pl. 2, Figs. 19-21.
1994 *Follicucullus monacanthus* ISHIGA & IMOTO; Wu *et al.*, Pl. II, Fig. 18.

1995 *Follicucullus monacanthus* ISHIGA & IMOTO; Naka, p. 228, Pl. 1, Figs. 1-2, 7-10, 12; Pl. 2, Figs. 4-5, 10-11; Pl. 3, Figs. 3-6.
1995 *Follicucullus monacanthus* ISHIGA & IMOTO; Sashida *et al.*, p. 53, Figs. 10.12-10.15.
1996 *Follicucullus monacanthus* ISHIGA & IMOTO; Mankinen *et al.*, Figs. 4.9, 4.10.

Holotype: Ishiga *et al.*, 1982b: Pl. 4, Fig. 15. [KUE PR 35-15]

Description: Poorly preserved specimen with unsegmented, conical apical cone. Pseudothorax small, with a triangular, blade-like wing extending from the dorsal side. Pseudoabdomen is inflated.

Material: Rare specimens from locality K2, northwest Peninsular Malaysia.

Range and occurrence: Upper Permian (upper Guadalupian to lower Leonardian) of the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Sashida *et al.*, 1993a; 1993c; 1995; this study); Kuhfeng Formation, Anhui, China (Wang, 1991); southwest Japan (Ishiga *et al.*, 1982b; 1982c); Sambosan zone, Oita Prefecture, Kyushu, southwest Japan (Yoshida and Murata, 1985); Grindstone Terrane, Central Oregon, USA (Blome and Reed, 1992); western Sicily (Kozur, 1993); Upper Permian (Guadalupian *Follicucullus porrectus* zone) of the North Folk terrane, Klamath Mountains, California (Mankinen *et al.*, 1996)

Follicucullus porrectus RUDENKO 1984

Plate 3.4h, 3.4i.

1980 *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga & Imoto, p. 340, Pl. 4, Figs. 5-7.
1980 *Follicucullus* sp. cf. *F. ventricosus* ORMISTON & BABCOCK; Ishiga & Imoto, Pl. 4, Fig. 20.
1982 *Follicucullus ventricosus* ORMISTON & BABCOCK; Kojima, Pl. 3.2.
1982a *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga *et al.*, Pl. 3, Fig. 9.
1982c *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga *et al.*, Pl. 2, Figs. 8-10.
1984 *Follicucullus porrectus* RUDENKO; Belyanskii *et al.*, p. 55-56, Pl. 8, Figs. 3, 10.
1984 *Follicucullus scholasticus* ORMISTON & BABCOCK; Belyanskii *et al.*, p. 54, Pl. 8, Figs. 4, 5.
1984 *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga, Pl. 1 Figs. 2-6, 7 (?), 8.
1985 *Follicucullus scholasticus* ORMISTON & BABCOCK m. I ISHIGA; Ishiga, Pl. 1, Figs. 22-28; Pl. 2, Figs. 1-4.
1985 *Follicucullus scholasticus* ORMISTON & BABCOCK; Sashida & Tonishi, Pl. 7, Figs. 1, 3.
1986 *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga & Miyamoto, p. 330-331, Pl. 64, Figs. 9-11.
1986 *Follicucullus scholasticus* ORMISTON & BABCOCK m. I Ishiga; Ishiga *et al.*, p. 129, Pl. 2, Figs. 12-19.
1987 *Follicucullus scholasticus* ORMISTON & BABCOCK m. II ISHIGA; Pillai & Ishiga, Pl. I, Figs. 9, 10.
1989 *Follicucullus ventricosus* ORMISTON & BABCOCK; Wu & Li, Pl. 1, Fig. 15.
1990 *Follicucullus scholasticus* ORMISTON & BABCOCK m. II ISHIGA; Ishiga, Pl. 1, Fig. 11.
1990 *Follicucullus scholasticus* ORMISTON & BABCOCK; Murchey, Pl. 1, Fig. 3.
1991 *Follicucullus japonicus* ISHIGA; Ishiga, p. 108-111, Pl. 1, Figs. 1-22; Pl. 2, Fig. 1.
1991 *Follicucullus ventricosus* ORMISTON & BABCOCK; Liu *et al.*, Pl. 1, Fig. 3.
1991 *Follicucullus scholasticus* ORMISTON & BABCOCK; Liu *et al.*, Pl. 1, Figs. 4, 5.
1992 *Follicucullus scholasticus* ORMISTON & BABCOCK m. II ISHIGA; Blome & Reed, p. 364, Fig. 9.17.
1992 *Follicucullus scholasticus* ORMISTON & BABCOCK; Sugiyama, Fig. 4.1.

1993 *Follicucullus porrectus* RUDENKO; Kozur, p. 105, Pl. 1, Figs. 7-11.
1993a *Follicucullus scholasticus* ORMISTON & BABCOCK; Sashida *et al.*, Pl. 1, Figs. 5-9.
1994 *Follicucullus scholasticus* ORMISTON & BABCOCK m. II ISHIGA; Wang, *et al.*, p. 188, Pl. 3, Figs. 8-10.
1994 *Follicucullus scholasticus* ORMISTON & BABCOCK m. II ISHIGA; Wu *et al.*, Pl. II, Fig. 20.
1995a *Follicucullus scholasticus* ORMISTON & BABCOCK m. II ISHIGA; Spiller & Metcalfe, Fig. 6h.
1995b *Follicucullus porrectus* RUDENKO; Spiller & Metcalfe. Fig. 5.8.
1996a *Follicucullus scholasticus* ORMISTON & BABCOCK m. I ISHIGA; Feng & Ye, Pl. 11.1, Figs. 8, 9.
1996 *Follicucullus japonicus* Ishiga var. A; Mankinen *et al.*, Figs. 4.3, 4.4.
1996 *Follicucullus japonicus* Ishiga; Mankinen *et al.*, Figs. 4.5-4.7, 4.16.

Holotype: Belyanskii *et al.*, 1984, Pl. 8, Fig. 10. [30/533; Museum PPHO "Premorheolohei"]

Description: Test long, slender, conical. The outer test has an undulose appearance and is subdivided into apical cone, pseudothorax and pseudoabdomen. Apical cone long, unsegmented, straight or slightly curved, sometimes oblique. Pseudothorax, narrow, but distinctly broader than remaining test. Pseudoabdomen gently inflated, situated slightly obliquely to the pseudothorax.

Remarks: This species is presently known by three names in the literature, two of which are in common, but incorrect, usage - *Follicucullus scholasticus* ORMISTON & BABCOCK m. II ISHIGA and *Follicucullus japonicus* ISHIGA. Rudenko, in Belyanskii *et al.* (1984) named this species *Follicucullus porrectus* RUDENKO. Ishiga (1991) later named the species *Follicucullus japonicus* ISHIGA. Following the rules of Zoological Nomenclature the first used name is the senior synonym and this name has priority. Therefore the taxon should retain the name *Follicucullus porrectus* RUDENKO. *Follicucullus porrectus* RUDENKO differs from *Follicucullus scholasticus* ORMISTON & BABCOCK in having a conical shell that is weakly differentiated into apical cone, gently inflated pseudothorax and pseudothorax without wings, and pseudoabdomen with small flaps. *Follicucullus porrectus* RUDENKO differs from *Follicucullus ventricosus* ORMISTON & BABCOCK in having a more strongly inflated pseudothorax producing a more distinct division of apical cone, pseudothorax and pseudoabdomen.

Material: Rare specimens from localities K1, K2, and K9 near Pokok Sena, from the "Lower Chert Member" of the Semanggol Formation of northwest Peninsular Malaysia.

Range and occurrence: Upper Permian (Guadalupian) from southwest Japan (Ishiga and Imoto, 1980; Ishiga *et al.*, 1982a; 1982c); Grindstone Terrane, Central Oregon, USA (Blome and Reed, 1992); Primorye region (Russian Far East) (Belyanskii *et al.*, 1984); Oman and Sicily (Kozur, 1993), the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Sashida *et al.*, 1993a; Spiller and Metcalfe, 1995a); Upper Permian (Guadalupian *Follicucullus porrectus* zone) of the North Folk terrane, Klamath Mountains, California (Mankinen *et al.*, 1996).

Follicucullus scholasticus ORMISTON & BABCOCK 1979

Plate 3.4j.

1979 *Follicucullus scholasticus* ORMISTON & BABCOCK; p. 333, Pl. 1, Figs. 1-5.
1980 *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga & Imoto, p. 340, Pl. 4, Figs. 8-10.
1982 *Follicucullus scholasticus* ORMISTON & BABCOCK; Kojima, Pl. 3.4.
1982b *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga *et al.*, Pl. 4, Figs. 13, 14.
1984 *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga, Pl. 7, Figs. 1, 3.
1984 *Follicucullus scholasticus* ORMISTON & BABCOCK; Belyanskii *et al.*, p. 54, Pl. VIII, Fig. 4, 5.
1985 *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga, p. 180, Pl. 1, Figs. 15-21.
1985 *Follicucullus scholasticus* ORMISTON & BABCOCK; Sashida & Tonishi, Pl. 7, Figs.,1, 3.
1986 *Follicucullus scholasticus* ORMISTON & BABCOCK; Caridroit & De Wever, p. 72, Pl. II, 17-19, Fig. 15.
1986 *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga & Miyamoto, p. 330, Pl. 64, Figs, 9-11.
1986 *Follicucullus scholasticus* ORMISTON & BABCOCK m. II ISHIGA; Ishiga *et al.*, Pl. II, Figs. 20-23.
1986 *Follicucullus scholasticus* ORMISTON & BABCOCK; Nazarov & Ormiston, Pl. VII, Fig. 2.
1987 *Follicucullus scholasticus* ORMISTON & BABCOCK m. I ISHIGA; Pillai & Ishiga, Pl. I, Figs. 11-15.
1989 *Follicucullus scholasticus* ORMISTON & BABCOCK; Wu & Li, Pl. 1, Figs. 5, 6.
1989 *Ishigaconus scholasticus* ORMISTON & BABCOCK; Kozur & Mostler, p. 181-182.
1990 *Follicucullus scholasticus* ORMISTON & BABCOCK; Ishiga, Figs, 2-3, Pl. 1; 11.
1990 *Follicucullus scholasticus* ORMISTON & BABCOCK; Tumanda *et al.*, Pl. 1, Fig. 1.
1992 *Follicucullus scholasticus* ORMISTON & BABCOCK m. I ISHIGA; Blome & Reed, p. 364, Fig. 9.16.
1993 *Ishigaconus scholasticus* (ORMISTON & BABCOCK); Kozur, p. 108, Pl. 1, figs. 1-3; Pl. 3, Figs, 9, 11.
1993a *Follicucullus scholasticus* ORMISTON & BABCOCK; Sashida *et al.*, Pl. 1, Fig. 4.
1994 *Follicucullus scholasticus* ORMISTON & BABCOCK m. I ISHIGA; Wang, *et al.*, p. 188, Pl 3, Figs. 6-7.
1994 *Follicucullus scholasticus* ORMISTON & BABCOCK m. I ISHIGA; Wu *et al.*, Pl. II, Fig. 15.
1995a *Follicucullus scholasticus* ORMISTON & BABCOCK m. I ISHIGA; Spiller & Metcalfe, Fig. 6g.
1995b *Follicucullus scholasticus* ORMISTON & BABCOCK m. I. ISHIGA; Spiller & Metcalfe, Fig. 5.7.
1996a *Follicucullus scholasticus* ORMISTON & BABCOCK m. I ISHIGA; Feng & Ye, Pl. 11.1, Fig.7.
1996b *Follicucullus scholasticus* ORMISTON & BABCOCK m. I ISHIGA; Feng & Ye, Pl. 2.2, Figs. 12, 13, 15.
1996 *Follicucullus scholasticus* ORMISTON & BABCOCK; Mankinen *et al.*, Figs. 4.3, 4.4.

Holotype: Ormiston & Babcock 1979: Pl. 1, Figs. 1, 2. [USNM 250552]

Description: Test long and straight to gently curved, cone expanding slightly from the apex. Minimal differentiation of shell from straight, narrow apical region, to very slightly inflated central region and slightly flared apertural region. Aperture is elliptical in outline. Apertural flaps are not preserved in the extracted specimens.

Remarks: *Follicucullus scholasticus* ORMISTON & BABCOCK differs from *Follicucullus porrectus* RUDENKO in having a much straighter, more weakly differentiated test.

Material: Rare specimens from localities K1, K2 and K9 near Pokok Sena, from the "Lower Chert Member" of the Semanggol Formation, Northwest Peninsular Malaysia

Range and occurrence: Upper Permian (Guadalupian) from southwest Japan (Ishiga and Imoto, 1980; Ishiga *et al.*, 1982b, Caridroit and De Wever, 1986); central Japan (Sashida

and Tonishi, 1985); Grindstone Terrane, Central Oregon, USA (Blome and Reed, 1992); Delaware Basin, West Texas (Ormiston and Babcock, 1979); Primorye region (Russian Far East) (Belyanskii *et al.*, 1984); Philippines (Tumanda *et al*, 1990); Sicily (Kozur, 1993); Changning-Menglian ophiolite belt of the Menglian area, western Yunnan (Wu and Li, 1989); Lancang area, southwest Yunnan, China (Feng and Ye, 1996a; 1996b); Qinzhou-Yulin area southern Guangxi, China (Wu *et al.*, 1994); the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Sashida *et al.*, 1993a; Spiller and Metcalfe, 1995a; 1995b); Upper Permian (Guadalupian *Follicucullus porrectus* zone) of the North Fork terrane, Klamath Mountains, California (Mankinen *et al.*, 1996).

3.4.1.5 Family: Neoalbaillellidae

Family **Neoalbaillellidae** CHENG 1986

Genus ***Neoalbaillella*** TAKEMURA & NAKASEKO 1981

Type Species: *Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO 1981

Diagnosis: For diagnosis see Takemura and Nakaseko, 1981.

Neoalbaillella ornithoformis TAKEMURA & NAKASEKO 1981

Plate 3.41.

1981	*Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO; p. 211, Pl. 33, Figs. 1-6, Text-fig. 2.
1982a	*Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO; Ishiga *et al.*, Pl. 1, Figs. 6-8; Pl. 2, Fig. 1.
1982c	*Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO; Ishiga *et al.*, Pl. 2, Figs. 14, 16.
1982	*Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO; Nishizono *et al.*, Pl. 2, Fig. 7.
1985	*Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO; Sashida & Tonishi, Pl. 7, Fig. 8-9.
1990	*Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO; Ishiga, Pl. 1, Fig. 5.
1990	*Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO; Tumanda *et al.*, Pl. 2, Fig. 21
1993a	*Neoalbaillella* cfr. *ornithoformis* TAKEMURA & NAKASEKO; Sashida *et al.*, Pl. 1, Figs. 28-30.
1994	*Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO; Wang *et al.*, p. 186, Pl. 4, Figs. 6-8.
1995	*Neoalbaillella* cfr. *ornithoformis* TAKEMURA & NAKASEKO; Sashida *et al.*, Figs. 10.1-10.4.
1996a	*Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO; Feng & Ye, Pl. 11.1, Fig. 14.
1996b	*Neoalbaillella ornithoformis* TAKEMURA & NAKASEKO; Feng & Ye, Pl. 2.2, Fig. 3.

Holotype: Takemura & Nakaseko 1981: Pl. 33, Fig. 1. [ATPMTB-1103-1]

Description: Poorly preserved specimen. Upper part of the test is imperforate with robust apical cone slightly bent. Wings are not preserved. Pseudothorax and pseudoabdomen cylindrical. Pseudoabdomen displays four transverse rows of windows. Dorsal and ventral rods are not preserved.

Material: Rare specimens from locality K9 near Pokok Sena, "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.

Range and occurrence: Uppermost Permian (Uppermost Guadalupian to lowest Dzhulfian) *Neoalbaillella ornithoformis* Zone of Ishiga (1986). Southwest Japan (Takemura and Nakaseko, 1981; Ishiga *et al.*, 1982a; Nishizono *et al.*, 1982); central Japan (Sashida and Tonishi, 1985); Philippines (Tumanda, 1990), Lancang area, southwest Yunnan, China (Feng and Fang, 1996a; 1996b); "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Sashida *et al.*, 1995; Sashida *et al.*, 1993a; this study).

3.4.1.6 Family: Pseudoalbaillellidae

Family **Pseudoalbaillellidae** CHENG 1986

Genus ***Pseudoalbaillella*** HOLDSWORTH & JONES 1980a

Type species: *Pseudoalbaillella scalpratu* HOLDSWORTH & JONES 1980a

Diagnosis: For diagnosis see Holdsworth and Jones, 1980a

Pseudoalbaillella convexa RUDENKO & PANASENKO 1990
Plate 3.5a.

1990 *Pseudoalbaillella convexa* RUDENKO & PANASENKO; p. 184, Pl. 18, Figs. 6, 7.
1993 *Parafollicucullus convexus* (RUDENKO & PANASENKO); Kozur, p. 106, Pl. 1, Fig. 20.
1995b *Pseudoalbaillella convexa* RUDENKO & PANASENKO; Spiller & Metcalfe, Fig. 5.9.

Holotype: Rudenko and Panasenko: 1990: Pl. 18, Fig. 7. [974/897 Museum PO "Premorheolohei"]

Description: Apical cone long and slightly curved. Pseudothorax small, globular with two short wings. Pseudoabdomen consists of a long, narrow neck without a ring-like, short segment, followed by a bottle-like, short segment, that is considerably broader than the neck.

Remarks: This species co-exists with *Follicucullus dorsoconvexus* (Kozur).

Material: Rare specimens from locality K1 near Pokok Sena, from the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.

Range and occurrence: Upper Permian (Guadalupian) of the Primorye region (Russian Far East) (Rudenko and Panasenko, 1990); Sosio Valley area, Western Sicily, Italy (Kozur, 1993) and the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (this study).

Pseudoalbaillella elegans ISHIGA & IMOTO 1980

Plate 3.5b.

1980	*Pseudoalbaillella elegans*	SHIGA & IMOTO; p. 337, Pl. 1 Figs. 9-12.
1982c	*Pseudoalbaillella elegans*	SHIGA & IMOTO; Ishiga *et al.*, Pl. 1, Figs. 2, 3.
1985	*Pseudoalbaillella elegans*	SHIGA & IMOTO; Ling *et al.*, Fig. 3J.
1987	*Pseudoalbaillella elegans*	SHIGA & IMOTO; Ling & Forsythe, Pl.1, Fig. 9.
1990	*Pseudoalbaillella elegans*	SHIGA & IMOTO; Ishiga, Pl. 2, Fig. 12.
1993c	*Pseudoalbaillella elegans*	SHIGA & IMOTO; Sashida *et al.*, Figs. 6.2-6.4.
1995	*Pseudoalbaillella elegans*	SHIGA & IMOTO; Sashida, p. 39, Fig. 5.7, 5.9, 5.10.

Holotype: Ishiga and Imoto 1980 Pl. 1, Fig. 9. [KUE PR 4-14]

Description: Apical cone is conical and unsegmented. Pseudoabdomen is long, unsegmented and weakly inflated.

Material: Very rare, moderately preserved specimens from locality KLK31.

Range & Occurrence: Lower Permian (Wolfcampian) from Tamba district, southwest Japan (Ishiga and Imoto, 1980); southernmost Chile ; "Fang Chert" of Thailand (Sashida *et al.*, 1993c) and the Lower Permian (Wolfcampian) from the Bentong-Raub area, Peninsular Malaysia (this study).

Pseudoalbaillella elongata ISHIGA & IMOTO 1980

Plate 3.5c, 3.5d.

1980	*Pseudoalbaillella elongata*	ISHIGA & IMOTO; p. 339, Pl. 4, Figs. 1-4.
1982c	*Pseudoalbaillella elongata*	ISHIGA & IMOTO; Ishiga, *et al.*, Pl. 1, Figs, 15-16.
1995b	*Pseudoalbaillella elongata*	ISHIGA & IMOTO; Spiller & Metcalfe, Fig. 5.10.
1996	*Pseudoalbaillella elongata*	ISHIGA & IMOTO; Spiller, Pl. 4, Fig. 3, 4.

Holotype: Ishiga and Imoto 1980, Pl. 4, Fig. 1. [KUE PR 8-36]

Description: Apical cone without segmentation. Pseudothorax small, with minor inflation. Dorsal and ventral conical wings that project from the pseudothorax, are broken

in all specimens recovered in this study. Cylindrical pseudoabdomen long, slender and without segmentation. Dorsal and ventral flaps are not preserved.

Remarks: Pseudoalbaillella elongata has previously only been recovered from the upper Wolfcampian *Pseudoalbaillella scalprata* m. *rhombothoracata* zone. This study has extended the range of *Pseudoalbaillella elongata* from the upper Wolfcampian *Ps. rhombothoracata* zone to the Leonardian *Albaillella sinuata* zone.

Material: Rare specimens from locality KLK2 Cinta Manis, Bentong-Raub suture zone, Peninsular Malaysia. Specimens are associated with *Albaillella sinuata* ISHIGA & WATASE and *Pseudoalbaillella scalprata* HOLDSWORTH & JONES m. *rhombothoracata* Ishiga.

Range and occurrence: Lower Permian (upper Wolfcampian) of southwest Japan (Ishiga and Imoto, 1980; Ishiga *et al.*, 1982c); lower Leonardian *Albaillella sinuata* zone of the Bentong-Raub suture zone, Peninsular Malaysia (Spiller, 1996; Spiller and Metcalfe, 1995b; this study).

Pseudoalbaillella fusiformis (HOLDSWORTH & JONES 1980)
emend. Cornell & Simpson, 1985.
Plate 3.5e, 3.5f.

1980a	*Parafollicucullus fusiformis* HOLDSWORTH & JONES; p. 285, Fig. 1D, 1E.
1982b	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Ishiga *et al.*, Pl. 4, Figs. 10-12.
1982c	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Ishiga *et al.*, Pl. 2, Figs. 1, 2.
1983	*Parafollicucullus fusiformis* HOLDSWORTH & JONES; Wakita, Pl. 4, Fig. 11.
1985	*Pseudoalbaillella nanjingensis* SHENG & WANG; Sheng & Wang, Pl. 1, Figs, 1-5. 7-10.
1985	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Yoshida & Murata, Pl. 1, Fig. 14.
1986	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Ishiga *et al.*, p. 127, Pl. 1, Figs. 16-18.
1990	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Ishiga, Pl. 1, Fig. 12.
1990	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Murchey, Pl. 1, Fig. 4.
1990	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Tumanda *et al.*, Pl. 1, Figs. 2, 3.
1991	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Wang, Pl. III, Fig. 3.
1992	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Blome & Reed, p. 365, Figs, 9.21-9.23, 10.1-10.4.
1994	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Wang *et al.*, Pl. 2, Figs. 5,6.
1994	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Wu *et al.*, Pl. II, Fig. 14.
1995	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Blome *et al.*, Pl. 8.1, Figs. 3-6, 11.
1995b	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Spiller & Metcalfe, Fig. 5.13.
1996a	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Feng & Ye, Pl. 11.1, Fig. 2.
1996b	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Feng & Ye, Pl. 2.2, Fig. 16.
1996	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Mankinen *et al.*, Fig.4.1, 4.8.
1996	*Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES); Spiller, Pl. 4, Fig. 9, 10.

Holotype: Holdsworth and Jones, 1980: Fig. 1D. [USNM 305133]

Description: Sharply curved apical cone without segmentation. Pseudothorax subglobular in shape. Strong dorsal and ventral wings emerge from pseudothorax, but are

broken in the figured specimens. Pseudoabdomen barrel shaped with three segments. The pseudothoracic wings are reported to extend downwards and connect with the horizontal bi-spines of the abdominal apertural flaps. This feature is broken in all specimens recovered in this study, but the remains of a horizontal bi-spine is visible on one specimen.

Material: Rare specimens from locality CH14 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Upper Wolfcampian to lower Guadalupian of Alaska (Holdsworth & Jones, 198a); southwest Japan (Ishiga *et al.*, 1982b; Ishiga *et al.*, 1982c) central Japan (Wakita, 1983); Sambosan zone, Oita Prefecture, Kyushu, southwest Japan (Yoshida and Murata, 1985); Longtan, Nanjing, China (Sheng and Wang, 1985); Busuanga Island, Palawan, Philippines (Tumanda *et al.*, 1990); Battle Mountain, Nevada, North America (Murchey, 1990); Grindstone Terrane, central Oregon, USA (Blome and Reed, 1992); Qinzhou area, Guangxi (Wu *et al.*, 1994); Changning-Menglian area, Yunnan, South China (Wang *et al.*, 1994; Feng and Ye, 1996a; 1996b); Upper Permian (Guadalupian *Follicucullus porrectus* zone) of the North Folk terrane, Klamath Mountains, California (Mankinen *et al.*, 1996), Leonardian of Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995b; Spiller, 1996).

Pseudoalbaillella globosa ISHIGA & IMOTO 1982b

Plate 3.5g.

1982c *Pseudoalbaillella* sp. B, ISHIGA & IMOTO; Pl. 2, Figs. 3-4.
1982b *Pseudoalbaillella globosa* ISHIGA & IMOTO; Ishiga *et al.*, p. 275, Pl. 1, Figs. 1-8.
1986 *Pseudoalbaillella globosa* ISHIGA & IMOTO; Ishiga *et al.*, Pl. 2, Figs. 1-3.
1990 *Pseudoalbaillella globosa* ISHIGA & IMOTO; Ishiga, Pl. 1, Fig. 14.
1992 *Pseudoalbaillella globosa* ISHIGA & IMOTO; Sugiyama, Fig. 4.4.

Holotype: Ishiga *et al.*, 1982b: Pl. 1 Fig. 1. [KUE PR 34-1]

Description: Fragmentary specimens with a globular, strongly inflated pseudothorax. Pseudoabdomen is segmented with two segments preserved, but the base of the pseudoabdomen is not preserved. Dorsal and ventral wings are not preserved

Material: Very rare specimens from locality CH14 near Pos Blau, Cameron Highlands area, Peninsular Malaysia.

Remarks: The specimens extracted in this study co-exist with *Pseudoalbaillella longtanensis* SHENG & WANG. The coexistence of these two species suggests that the sample was taken from the boundary of the *Pseudoalbaillella longtanensis* zone and the *Pseudoalbaillella globosa* zone.

Range and occurrence: Upper Leonardian to Guadalupian of southwest Japan (Ishiga *et al.*, 1982b; 1986; Ishiga, 1990); central Japan (Sugiyama, 1992) and Upper Leonardian to

lower Guadalupian of Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia (this study).

Pseudoalbaillella sp. cf. *Ps. lomentaria* ISHIGA & IMOTO 1980
Plate 3.5h.

1996 *Pseudoalbaillella* sp. cf. *Ps. lomentaria* ISHIGA & IMOTO; Spiller. Pl. 3, Fig. 4.

Description: Segmented test with overall cylindrical shape of even diameter. Unsegmented to weakly segmented or apical cone. Pseudothorax inflated to the same diameter as the segmented or crenulated pseudoabdomen. Apertural rim is curved with remnants of flaps extending vertically downward.

Remarks: This species is similar to *Ps. lomentaria*, but differs in having a more weakly inflated pseudothorax and less pronounced constrictions between the pseudothorax and pseudoabdomen, and also between adjacent crenellae.

Material: Rare specimens from locality CH14 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Permian (Wolfcampian) *Pseudoalbaillella lomentaria* zone of Cameron Highlands area, Peninsular Malaysia (Spiller, 1996; this study).

Pseudoalbaillella sp. aff. *Ps. longicornis* ISHIGA & IMOTO 1980
Plate 3.5i, 3.5j.

1982a *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Ishiga *et al.*, Pl. 3, Fig. 11.
1982b *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Ishiga *et al.*, p. 275, Pl. 2, Figs. 1-7.
1984 *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Ishiga, Pl. 1, Figs, 13, 14.
1986 *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Ishiga *et al.*, Pl. II, Figs. 24-26.
1989 *Pseudoalbaillella* sp. cf. *Ps longicornis* ISHIGA & IMOTO; Wu & Li, Pl. 1, Fig. 15.
1990 *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Tumanda *et al.*, Pl. 1, Fig. 4.
1990 *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Yamashita & Ishiga, Pl. 1, Fig. 4, 5.
1992 *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Blome & Reed, p. 366, Figs. 10.9 - 10.12.
1994 *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Wang *et al.*, p. 181, Pl. 2, Figs. 7, 8.
1994 *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Wu *et al.*, Pl. II, Fig. 13.
1995 *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Blome *et al.*, Pl. 8.1, Figs. 7, 8, 14-16.
1995 *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Naka, Pl. 1, Fig. 13; Pl. 5, Figs. 8-10.
1995b *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Spiller & Metcalfe, Fig. 5.15.
1996 *Pseudoalbaillella* sp. aff. *Ps. longicornis* ISHIGA & IMOTO; Spiller, Pl. 4, Fig. 8.

Description: Apical cone robust and slightly curved. Some specimens possess a very weakly segmented apical cone. Pseudothorax spherical with two horizontal, robust and slightly flattened, blade-like wings curving downwards with a well preserved serrated edge along the top of one wing. Pseudoabdomen very short and slightly flared; a weak constriction is present between the pseudothorax and the pseudoabdomen and no apertural flaps are preserved.

Remarks: It has been observed that *P. fusiformis* has a tendency to break apart below the small post-pseudothoracic segment, with the resulting upper portion closely resembling forms identified as *P.* sp. aff. *P. longicornis* ISHIGA & IMOTO (Blome and Reed, 1992). This, together with the long age range of the species reduces the biostratigraphic potential of *P. fusiformis.*

Material: Rare specimens from locality CH14 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Leonardian to lower Guadalupian; worldwide.

Pseudoalbaillella longtanensis SHENG & WANG 1985

Plate 3.5k.

1982b	*Pseudoalbaillella* sp. C; Ishiga *et al.*, Pl. 4, Figs. 8, 9.
1982c	*Pseudoalbaillella* sp. C; Ishiga *et al.*, pl. 1, Fig. 19.
1985	*Pseudoalbaillella longtanensis* SHENG & WANG; Sheng & Wang, p. 178, Pl. 2, Figs. 3, 4.
1986	*Pseudoalbaillella* sp. C; Ishiga, Watase & Naka, Pl. 1, Fig. 19.
1990	*Pseudoalbaillella longtanensis* SHENG & WANG; Ishiga, Pl. 1 Fig. 18.
1991	*Pseudoalbaillella longtanensis* SHENG & WANG; Wang, Pl. 3, Fig. 2.
1994	*Pseudoalbaillella longtanensis* SHENG & WANG; Wang *et al.*, p. 182, Pl. 2, Figs. 3, 4.
1995b	*Pseudoalbaillella longtanensis* SHENG & WANG; Spiller & Metcalfe, Fig. 5.14.
1996	*Pseudoalbaillella longtanensis* SHENG & WANG; Spiller, Pl. 4, Figs. 11, 12.

Holotype: Sheng and Wang 1985: Pl. 1, Fig. 4. [R0014]

Description: Apical cone is straight to slightly curved with a spherical, two-winged pseudothorax and an elongated, conical, four segmented pseudoabdomen. The first segment of the pseudoabdomen is smaller than the others in width.

Material: Rare specimens from locality CH14 near Pos Blau, Cameron Highlands, Peninsular Malaysia.

Range and occurrence: Lower Permian (Leonardian) of southwest Japan (Ishiga *et al.*, 1982b; Ishiga *et al.*, 1982c; Ishiga *et al.*, 1986); Longtan, Nanjing, South China (Sheng and Wang, 1985); Bentong-Raub suture zone of Peninsular Malaysia (Spiller and Metcalfe, 1995b; Spiller, 1996).

Pseudoalbaillella longtanensis ? SHENG & WANG 1985
Plate 3.5l.

Description: Very poorly preserved specimen with straight to slightly curved apical cone. Pseudothorax spherical and bears two wings. Pseudoabdomen is segmented with the first segment smaller in diameter than others.

Material: Very rare poorly preserved specimens from locality K1 near Pokok Sena, "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.

Range and occurrence: The range of *Pseudoalbaillella longtanensis* SHENG & WANG is upper Leonardian. This specimen has only tentatively been assigned to *Ps. longtanensis* SHENG & WANG and therefore the range of this species also tentatively given as upper Leonardian.

Pseudoalbaillella ornata ISHIGA & IMOTO 1980
Plate 3.6a, 3.6b.

1980	*Pseudoalbaillella ornata* ISHIGA & IMOTO; p. 339, Fig. 5; Pl. 3, Figs. 3-8.
1981	*Pseudoalbaillella ornata* ISHIGA & IMOTO; Ishiga *et al.*, p. 18, Fig. 2.
1982c	*Pseudoalbaillella ornata* ISHIGA & IMOTO; Ishiga *et al.*, Pl. 1, Figs. 9, 10.
1986	*Pseudoalbaillella ornata* ISHIGA & IMOTO; Ishiga, p. 90, Fig. 1; p. 94.
1990	*Pseudoalbaillella ornata* ISHIGA & IMOTO; Ishiga, Pl. 2, Fig. 7.
1995b	*Pseudoalbaillella ornata* ISHIGA & IMOTO; Spiller & Metcalfe, Figs. 5.16, 5.17.
1996	*Pseudoalbaillella ornata* ISHIGA & IMOTO; Spiller, Pl. 3, Figs. 1, 2.

Holotype: Ishiga and Imoto, 1980: Pl. 3, Fig. 3. [KUE PR 13-5]

Description: Apical cone strong and slightly curved, without segmentation. Pseudothorax barrel-shaped with 2 wings which transform into spine extensions. The spines are not preserved in the specimens recovered in this study. Wings form an angle of approximately 40° to the lateral sides of the pseudothorax. Pseudoabdomen cylindrical and slightly lobate with a ring-like swell ornamented with a single row of sinuses. A pair of sinuses is found on either the dorsal or ventral side, below the ring like swell. Apertural flaps are not preserved.

Material: Rare specimens from locality CH13 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Permian (Wolfcampian) of the Tamba district of southwest Japan (Ishiga and Imoto, 1980) and the Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995b; Spiller, 1996).

Pseudoalbaillella sakmarensis (KOZUR 1981)

Plate 3.6c, 3.6d.

1980 *Pseudoalbaillella* sp. A. Ishiga, Kito & Imoto; p. 32, Pl. 2, Figs. 16-19; Pl. 3, Figs. 1-2.
1981 *Parafollicucullus sakmarensis* KOZUR; Kozur, p. 266, Pl. 1, Figs. 1-3.
1982c *Pseudoalbaillella sakmarensis* (KOZUR); Ishiga *et al.*, Pl. 1, Fig. 8.
1982 *Pseudoalbaillella sakmarensis* (KOZUR); Kojima, Pl. 4.3, 4.5-4.6.
1982 *Pseudoalbaillella* sp. A ISHIGA & IMOTO; Nishizono *et al.*, Pl. 2.2.
1985 *Pseudoalbaillella sakmarensis* (KOZUR); Yoshida & Murata, Pl. 1, Figs.4, 5.
1989 *Pseudoalbaillella* cf. *sakmarensis* (KOZUR); Wu & Li, Pl. 1, Fig. 17.
1990 *Pseudoalbaillella sakmarensis* (KOZUR); Ishiga, Pl. 2, Fig. 8.
1992 *Pseudoalbaillella sakmarensis* (KOZUR); Kuwahara, Pl. 2, Fig.13.
1994 *Pseudoalbaillella sakmarensis* (KOZUR); Wang *et al.*, p. 182, Pl. 1, Figs. 9-11.
1995b *Pseudoalbaillella sakmarensis* (KOZUR); Spiller & Metcalfe, Fig. 5.18.
1996b *Pseudoalbaillella sakmarensis* (KOZUR); Feng & Ye, Pl. 2.3, Fig. 2.
1996 *Pseudoalbaillella sakmarensis* (KOZUR); Spiller, Pl. 3, Fig. 3.

Holotype: Kozur, 1981: Pl. 1, Fig. 1. [KO 1979 11-1]

Description: Apical cone has weak segmentation. Pseudothorax spherical with dorsal and ventral unsymmetrical wings but the dorsal wing is not preserved in the specimens recovered in this study. Pseudoabdomen is long, unsegmented and curves strongly downward. A blade-like ridge runs down the test from the top of the pseudoabdomen on the dorsal side. Two spine-like flaps extend from aperture rim. A sinus is visible on the ventral side above the apertural flaps.

Material: Rare specimens from locality CH13 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Permian (Wolfcampian) of the Tamba district, southwest Japan (Ishiga and Imoto, 1980); Sambosan zone, Oita Prefecture, Kyushu, southwest Japan (Yoshida and Murata, 1985); Lower Permian Kungurian stage of the Southern Urals (Kozur, 1980); Lower Permian (Wolfcampian) of Quizhou (Guangxi) and Menglian (Yunnan) South China (Wang *et al.*, 1994; Feng and Ye, 1996b); Wolfcampian of the Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia (Spiller and Metcalfe, 1995b; Spiller, 1996).

Pseudoalbaillella scalprata HOLDSWORTH & JONES 1980

morphotype *rhombothoracata* ISHIGA 1983

Plate 3.6e, 3.6f.

1980 *Pseudoalbaillella rhombothoracata* ISHIGA & IMOTO; Ishiga & Imoto, p. 339, Pl. 3, Figs. 9-12.
1982c *Pseudoalbaillella rhombothoracata* ISHIGA & IMOTO; Ishiga *et al.*, Pl. 1, Fig. 14.
1983 *Pseudoalbaillella scalprata* m. *rhombothoracata* ISHIGA; Ishiga, p. 3-4, Pl. 3, Figs. 1-12.
1985 *Pseudoalbaillella rhombothoracata* ISHIGA & IMOTO; Yoshida & Murata, Pl. 1, Fig. 10.
1990 *Pseudoalbaillella scalprata* m. *rhombothoracata* ISHIGA; Ishiga, Pl. 2, Fig. 4.
1991 *Pseudoalbaillella rhombothoracata* ISHIGA & IMOTO; Liu *et al.*, Pl. 1, Figs. 11-13.

1994 *Pseudoalbaillella scalprata* m. *rhombothoracata* ISHIGA; Wang *et al.*, p. 368, Fig. 10.18.
1994 *Pseudoalbaillella scalprata* m. *rhombothoracata* ISHIGA; Wu *et al.*, Pl. II, Fig. 10.
1996b *Pseudoalbaillella scalprata* m. *rhombothoracata* ISHIGA; Feng & Ye, Pl. 2.3, Figs. 3, 5.
1996 *Pseudoalbaillella scalprata* m. *rhombothoracata* ISHIGA; Spiller, Pl. 4, Fig. 2.

Holotype: Ishiga and Imoto, 1980: Pl. 3, Fig. 9.

Description: Apical cone non-segmented and slightly curved. Pseudothorax moderately inflated and generally rhombohedral in shape. Two wings emerge from pseudothorax, but these are broken in all specimens recovered in this study. Pseudoabdomen is longer than that of *Pseudoalbaillella scalprata* m. *scalprata*.

Material: Rare specimens from locality KLK2 near Bukit Cinta Manis and locality CH13 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia

Range and occurrence: Lower Permian (Wolfcampian) of southwest Japan (Ishiga *et al.*, 1982c; Ishiga, 1983); Sambosan zone, Oita Prefecture, Kyushu, southwest Japan (Yoshida and Murata, 1985); the Changning-Menglian belt of South China (Liu *et al.*; 1991; Wang *et al.*, 1994; Feng and Ye, 1996b); Bentong-Raub suture zone, Peninsular Malaysia (Spiller, 1996).

Pseudoalbaillella scalprata HOLDSWORTH & JONES 1980
morphotype *scalprata* ISHIGA 1983
Plate 3.6g, 3.6h.

1982c *Pseudoalbaillella scalprata* HOLDSWORTH & JONES; Ishiga *et al.*, Pl. 1, Figs. 11, 12.
1983 *Pseudoalbaillella scalprata* m. *rhombothoracata* ISHIGA; Ishiga, p. 2-3, Pl. 1, Figs. 1-18.
1985 *Pseudoalbaillella scalprata* HOLDSWORTH & JONES; Cornell and Simpson, Pl. 1, Fig. 5.
1985 *Pseudoalbaillella scalprata* HOLDSWORTH & JONES; Yoshida & Murata, Pl. 1, Figs. 8, 9.
1990 *Pseudoalbaillella scalprata* m. *rhombothoracata* ISHIGA; Ishiga, Pl. 2, Fig. 6.
1990 *Pseudoalbaillella scalprata* HOLDSWORTH & JONES; Murchey, Pl. 1, Fig. 5.
1991 *Pseudoalbaillella scalprata* HOLDSWORTH & JONES; Liu *et al.*, Pl. 1, Figs. 7,8.
1992 *Pseudoalbaillella scalprata* m. *scalprata* ISHIGA; Blome & Reed, p. 368, Figs. 10.19 - 10.21.
1994 *Pseudoalbaillella scalprata* HOLDSWORTH & JONES; Wang *et al.*, p. 182, Pl. 1, 20-22.
1994 *Pseudoalbaillella scalprata* m. *scalprata* ISHIGA; Wu *et al.*, Pl. II, Fig. 11.
1995b *Pseudoalbaillella scalprata* m. *scalprata* ISHIGA; Spiller & Metcalfe, Figs. 5.19, 5.20.
1996a *Pseudoalbaillella scalprata* m. *scalprata* ISHIGA; Feng & Ye, Pl. 11.1, Fig. 1.
1996b *Pseudoalbaillella scalprata* m. *scalprata* ISHIGA; Feng & Ye, Pl. 2.3, Fig. 1.
1996 *Pseudoalbaillella scalprata* m. *scalprata* ISHIGA; Spiller, Pl. 3, Figs. 6, 7.

Holotype: Holdsworth and Jones, 1980: Fig. 1A. [USNM 305131a]

Description: Unsegmented or weakly segmented apical cone, strong and curved, generally longer than pseudothorax. Pseudothorax is round and moderately inflated. Wings pronounced, bladelike, slightly flattened arise from the pseudothorax. Pseudoabdomen unconstricted and very short, about one-third length of pseudothorax with a dorsal and ventral flap extending vertically downwards.

Material: Rare specimens from locality CH13 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Permian (Wolfcampian) of southwest Japan (Ishiga *et al.*, 1982c; Ishiga, 1983); West Texas (Cornell and Simpson, 1985); Sambosan zone, Oita Prefecture, Kyushu, southwest Japan (Yoshida and Murata, 1985); Havallah sequence Nevada (Murchey, 1990); the Changning-Menglian belt of South China (Liu *et al.*; 1991; Wang *et al.*, 1994; Feng and Ye, 1996a; 1996b); Grindstone Terrane, Central Oregon (Blome and Reed, 1992); Bentong-Raub suture zone, Peninsular Malaysia (Spiller, 1996).

Pseudoalbaillella simplex ISHIGA & IMOTO 1980

Plate 3.6i.

1980	*Pseudoalbaillella simplex*	SHIGA & IMOTO; p. 337, Pl. 1, Figs. 13-18.
1982	*Pseudoalbaillella simplex*	SHIGA & IMOTO; Hattori & Yoshimura, Pl. 1.2.
1985	*Pseudoalbaillella simplex*	SHIGA & IMOTO; Ling *et al.*, Figs. 3L, LM.
1985	*Pseudoalbaillella simplex*	SHIGA & IMOTO; Yoshida & Murata, Pl. 1, Fig. 1.
1987	*Pseudoalbaillella simplex*	SHIGA & IMOTO; Ling & Forsythe, Pl. 1, Figs. 10, 11.
1990	*Pseudoalbaillella simplex*	SHIGA & IMOTO; Ishiga, Pl. 2, Fig. 3.
1992	*Pseudoalbaillella simplex*	SHIGA & IMOTO; Kuwahara, Pl. 2, Figs. 10-11.
1995	*Pseudoalbaillella simplex*	SHIGA & IMOTO; Sashida, p. 39, Figs. 5.1-5.6.

Holotype: Ishiga and Imoto 1980 Pl. 1, Fig. 13. [KUE PR 5-7]

Description: Slightly curved, unsegmented apical cone. Weakly inflated pseudothorax with small wings. Pseudoabdomen is also weakly inflated with constriction between pseudothorax and pseudoabdomen weakly defined. Apertural flaps are not preserved in specimens extracted in this study.

Material: Rare specimens from locality KLK31 near Bentong, Bentong-Raub suture zone, Peninsular Malaysia.

Range & Occurrence: Lower Permian (Wolfcampian) of the Tamba district, southwest Japan (Ishiga and Imoto, 1980); southernmost Chile (Ling *et al.*, 1985; Ling & Forsythe, 1987); Sambosan zone, Oita Prefecture, Kyushu, southwest Japan (Yoshida and Murata, 1985); Chichibu belt, Miyagawa area Mie Prefecture, Japan (Kuwahara, 1992); central Japan (Sashida, 1995); and the Bentong-Raub suture zone of Peninsular Malaysia (this study).

Pseudoalbaillella sp. A

Plate 3.6j, 3.6k.

1996 *Pseudoalbaillella* sp. cf. *P. elegans* ISHIGA & IMOTO; Spiller. Pl. 4, Figs. 4, 5.

Description: Test elongate. Unsegmented apical cone. Pseudothorax moderately inflated with two lateral wings which are broken in all specimens. Pseudoabdomen is long, unsegmented and gently inflated. Lower part of pseudoabdomen (apertural margin) curves strongly to the ventral side.

Remarks: This species resembles *Pseudoalbaillella elegans* ISHIGA & IMOTO in having an elongate test, a small, winged pseudothorax and a long, unsegmented pseudoabdomen which curves at the apertural margin. This specimen has a more strongly inflated pseudoabdomen and strong curvature of the apertural margin to the ventral side. Some illustrations of *Pseudoalbaillella elegans* ISHIGA & IMOTO also display a flattened appearance (Ishiga, 1990: Pl. 2, Fig.12) as well as a strong depression along the length of the pseudoabdomen. These features are not evident in the specimens recovered in this study.

This species also resembles an illustration of *Pseudoalbaillella ishigai* WANG (Wang *et al.*, 1994: Pl. 2, Fig. 2). Wang *et al.* (1994) describe a new species *Pseudoalbaillella ishigai* WANG from their *Pseudoalbaillella ishigai* Zone. This zone is correlative with the *Pseudoalbaillella longtanensis* zone of Ishiga (1990). It is said to include *Pseudoalbaillella ishigai* WANG, *Albaillella sinuata* ISHIGA & WATASE, *Pseudoalbaillella scalprata* HOLDSWORTH & JONES m. *rhombothoracata* ISHIGA and other species. This assemblage is similar to the fauna associated with *Pseudoalbaillella* sp. A in this study. The description of *Pseudoalbaillella ishigai* WANG (Wang *et al.*, 1994: p. 181) refers to a pseudoabdomen consisting of five segments. This feature does not appear to be visible in one of the specimens (Pl. 2, Fig. 2) illustrated by Wang *et al.* (1994). The specimen recovered in the present study also does not have a segmented pseudoabdomen.

Material: Rare specimens from locality KLK2 Cinta Manis, Bentong-Raub area, Peninsular Malaysia.

Range and occurrence: Leonardian *Albaillella sinuata* zone from Bentong-Raub area, Peninsular Malaysia (Spiller, 1996 this study).

Pseudoalbaillella sp. B

Plate 3.6l.

1996 *Pseudoalbaillella* sp.; Spiller, Pl. 3, Fig. 5.

Description: Apical cone long and unsegmented to weakly segmented. Pseudothorax weakly inflated, bearing two lateral wings that are broken in the extracted specimens. Pseudoabdomen is cylindrical and without segmentation. Apertural region is not preserved.

Material: Rare specimens from locality CH13 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.
Range and occurrence: Lower Permian (Wolfcampian) *Pseudoalbaillella lomentaria* zone of Ishiga (1982c; 1990).

3.4.2 Suborder: Nassellaria

3.4.2.1 Family: Eptingiidae

Suborder **NASSELLARIA** EHRENBERG 1875

Superfamily **CYRTIODEA** HAECKEL 1862

Family **EPTINGIIDAE** DUMITRICA 1978
(Suborder **Nassellaria** (DUMITRICA 1978))
(Suborder **Entactinaria** (KOZUR & MOSTLER 1982))

Remarks: Dumitrica (1978) assigned the Family Eptingiidae to the suborder Nassellaria. Kozur and Mostler (1982) erected a new suborder Entactinaria in which they placed many families and genera that were said to possess skeletal elements common to both Nassellaria and Spumellaria. This suborder is not universally accepted by radiolarian biostratigraphers. It is never used by Palaeozoic radiolarian biostratigraphers and rarely by Mesozoic biostratigraphers. As some genera that have been placed in the suborder Entactinaria (see Kozur and Mostler, 1982) are found in both Palaeozoic and Mesozoic strata (e.g. genera representative of the families Entactiniidae RIEDEL 1967b and Palaeoscenidiidae RIEDEL 1967b), the use or otherwise of this suborder causes confusion at higher taxonomic levels. It is beyond the scope of this study to resolve the problems of taxonomic hierarchy. In this study I have placed the various families affected by the designation of suborder Entactinaria in the suborder in which they were originally placed. Other suborder designations are indicated in parentheses where appropriate.

Genus *Eptingium* DUMITRICA 1978

Type Species: *Eptingium manfredi* DUMITRICA 1978
Diagnosis: For diagnosis see Blome, 1984.

Eptingium manfredi manfredi DUMITRICA 1978
Plate 3.7a, 3.7b.

1978 *Eptingium manfredi* DUMITRICA; p. 33, Pl. III, Figs. 3, 4; Pl. IV , Figs. 6, 7.
1980 *Eptingium manfredi manfredi* ; Dumitrica *et al.*, p. 19, Pl. 3, Figs. 1-3; Pl. 6, Figs. 5-7.
1993a *Eptingium manfredi* DUMITRICA; Sashida *et al.*, Pl. 2, Figs. 20, 21.
1993d *Eptingium manfredi* DUMITRICA; Sashida *et al.*, Figs, 6.1, 6.2.
1994 *Eptingium manfredi* DUMITRICA; Basir Jasin, Pl. 1, Fig. 7.
1994 *Eptingium manfredi manfredi* DUMITRICA; Kozur, p. 42, Pl. 1, Fig. 3.
1995b *Eptingium manfredi manfredi* DUMITRICA; Spiller & Metcalfe, Fig. 6.14.

Holotype: Dumitrica, 1978: Pl. 3 Fig. 4.

Description: Cephalis is subtriangular with three stout horns or spines which are distributed at unequal angles within the same plane around the cephalis. Horns are triradiate in axial section and may display varying degrees of torsion. The distal ends of the horns taper gently.

Remarks: This subspecies differs from *Eptingium manfredi robustum* KOZUR & MOSTLER by the gently tapering distal ends of the horns.

Material: Rare specimens from locality K3 at Bt. Tembaga, "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.

Range and occurrence: Lower Ladinian - Eastern Carpathians, Romania (Dumitrica, 1978); Lower Ladinian from northwest Peninsular Malaysia (this study).

Eptingium manfredi robustum KOZUR & MOSTLER 1980
Plate 3.7c.

1980 *Eptingium manfredi robustum* KOZUR & MOSTLER: Dumitrica, Kozur & Mostler, p. 20, Pl. 6, Figs. 1-4, 8.
1994 *Eptingium manfredi robustum* KOZUR & MOSTLER: Kozur & Mostler, p. 42, Pl. 1, Figs. 1, 2.
1996b *Eptingium manfredi* DUMITRICA; Feng & Ye, Pl. 2.1, Fig. 3.

Holotype: Dumitrica, Kozur and Mostler, 1980: Pl. 6, Figs.1, 4.

Description: Cephalis is subtriangular with three very stout horns or spines which are distributed at unequal angles within the same plane around the cephalis. Horns are triradiate in axial section, may display varying degrees of torsion. The distal end of the horns is blunt.

Remarks: This subspecies differs from *Eptingium manfredi manfredi* DUMITRICA by the bluntness of the distal ends of the horns.

Material: Rare specimens from locality K3 at Bt Tembaga, "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.

Range and occurrence: Lower and middle Ladinian of the European Tethys (Dumitrica *et al.*, 1980; Kozur and Mostler, 1994); southwest Yunnan (Feng and Ye, 1996b) and Lower Ladinian of the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (this study).

Eptingium nakasekoi KOZUR & MOSTLER 1994
Plate 3.7d.

1979 *Triplocyclia* cf. *acythus* DEWEVER; Nakaseko & Nishimura, p. 72-73, Pl. 4, Figs. 1-3.
1994 *Eptingium nakasekoi* KOZUR & MOSTLER; p. 43, Pl. 1, Fig. 5.

Holotype: Kozur and Mostler, 1994: Pl. 1, Fig. 5. [Ko/Mo 1980 I-138]

Description: Cortical shell is sub-triangular in shape. Three triradiate spines with high, narrow ridges and broad deep grooves are located on the same plane around the shell. Spines taper to needle-like structures at the distal ends.
Material: Rare specimens from locality K3 at Bt Tembaga, "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.
Range and occurrence: Middle Triassic (Anisian) from Balaton Highland, Hungary (Kozur & Mostler, 1994); "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (this study).

3.4.3 Incertae Nassellaria

3.4.3.1 Family: Triassocampidae

Family **TRIASSOCAMPIDAE** KOZUR & MOSTLER 1981

Genus *Triassocampe* DUMITRICA, KOZUR & MOSTLER 1980
emend. Blome, 1984

Type Species: *Triassocampe scalaris* DUMITRICA, KOZUR & MOSTLER 1980
Diagnosis: For diagnosis see Blome, 1984.

Triassocampe coronata BRAGIN 1991

Plate 3.7e, 3.7f.

1982	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Nishizono *et al.*, Pl. 3, Fig. 13.
1987	*Triassocampe* sp. A; Kojima & Mizutani, p. 265, Fig. 3.1.
1991	*Triassocampe coronata* BRAGIN; p. 99, Pl. 1, Fig. 15.
1992	*Triassocampe coronata* BRAGIN, Sugiyama, p. 1198, Fig. 11.5, 11.6.
1995b	*Triassocampe* sp.; Spiller & Metcalfe, Fig. 6.1.
1996b	*Triassocampe coronata* BRAGIN; Feng & Ye, Pl. 2.1, Fig. 6.

Holotype: Bragin, 1991: Pl. 1, Fig. 15. [4738-28-1-17]

Description: Cephalis dome shaped and imperforated. Test is barrel shaped and multisegmented with segments increasing in width slightly towards the distal end of the test. Each of the segments displays developed ridges with a single row of small pores circumferentially arranged beneath each circumferential ridge. The ridge gradually becomes more pronounced along the long axis of growth.

Remarks: *Triassocampe coronata* BRAGIN differs from *Triassocampe deweveri* (NAKASEKO & NISHIMURA) in having a well developed imperforate dome shaped cephalis and a single row of pores arranged below each circumferential ridge.

Material: Rare specimens from locality K1 near Pokok Sena, "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.

Range and occurrence: Middle Triassic (middle Anisian) *Triassocampe coronata* zone of the Russian far east (Bragin, 1991); Mt. Kinkazan, Gifu Prefecture, central Japan (Sugiyama, 1992) and Kuma, Kyushu, Japan (Nishizono *et al*, 1982); southwest Yunnan, China (Feng and Ye, 1996b); Middle Triassic (Anisian) of the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (this study).

Triassocampe deweveri (NAKASEKO & NISHIMURA 1979)

Plate 3.7g, 3.7h, 3.7i, 3.7j, 3.7k, 3.7l.

1979	*Dictyomitrella deweveri* NAKASEKO & NISHIMURA; p. 77, Pl. 10, Figs. 8, 9.
1979	*Dictyomitrella* sp. A; De Wever *et al.*, p. 90, Pl. 5, Figs. 12, 16.
1982	*Triassocampe* sp. A; Mizutani & Koike, p. 128, Pl. 4, Figs. 3-5.
1982	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Hattori & Yoshimura, Pl. 1.4.
1982	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Mizutani *et al.*, p. 55, 56, Pl. 4.1.
1982	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Yao *et al.*, Pl. 1.1.
1982	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Yao, p. 64, Pl. 1, Figs. 1-3.
1983	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Yao, Fig. 2.1.
1984	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Ishida, p. 26, Pl. 1, Figs. 10-12.
1986	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Mizutani *et al.*, Fig. 2.4.
1987	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Kojima & Mizutani, p. 265, Figs. 3.2, 3.3.
1989	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Kojima, Pl. 1.3.
1990	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Yao, Pl. 1, Fig. 1.
1993a	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Sashida *et al.*, Pl. 2, Figs. 8-12.
1993d	*Triassocampe deweveri* (NAKASEKO & NISHIMURA); Sashida *et al.*, Figs. 5.3-5.7.

1994 *Triassocampe deweveri* (NAKASEKO & NISHIMURA); Basir Jasin, Pl. 1, Fig. 10.
1994 *Triassocampe deweveri* (NAKASEKO & NISHIMURA); Kozur & Mostler. p. 140-141, Pl. 42, Fig. 1; Pl. 44, Fig. 14; Pl. 45, Fig. 6.
1995b *Triassocampe deweveri* (NAKASEKO & NISHIMURA); Spiller & Metcalfe, Fig. 6.2 - 6.4.
1996b *Triassocampe deweveri* (NAKASEKO & NISHIMURA); Feng & Ye, Pl. 2.1, Figs. 1, 2.

Holotype: Nakaseko and Nishimura, 1979: Pl. 10, Fig. 9. [MTTK 1707-4]

Description: Shell conical and multisegmented, without apical horn. Cephalis subangular to dome-shaped. Test long, barrel shaped and multisegmented with segments increasing in width slightly towards the distal end of the test. Each of the segments displays developed ridges with a row of small knobs circumferentially arranged. The ridge gradually becomes more pronounced along the long axis of growth. There are eight or more segments.
Material: More commonly occurring species from locality K1 near Pokok Sena, from the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.
Range and occurrence: Triassic of Central and Southwest Japan (Nakaseko and Nishimura, 1979); Triassic of Greece (De Wever *et al.*, 1979); Middle Triassic of the Nadanhada Range, northeast China (Kojima and Mizutani, 1987); Middle Triassic (lower Ladinian) from the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Basir Jasin, 1994; Spiller and Metcalfe, 1995b; this study); Middle Triassic, (lower Ladinian) from the Sosio Valley, Italy (Kozur and Mostler, 1994); Central Japan (Hattori and Yoshimura, 1982; Sashida *et al.*, 1993d); southwest Yunnan, China (Feng and Ye, 1996b); Middle Triassic (lower Ladinian) from the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Basir Jasin, 1994); Spiller and Metcalfe, 1995b; this study).

3.4.4 Suborder: Spumellaria

Suborder **SPUMELLARIA** EHRENBERG 1875

Remarks: Based on the symmetry of the skeleton, spumellarians can be divided into spherical and stauraxon types (Nazarov and Ormiston, 1984). Nazarov and Ormiston (1984) refer to two superfamilies which incorporate all spherical and stauraxon radiolarians - Entactinoidea Riedel (1967) and Latentifistulidea Nazarov and Ormiston (1983a). Nazarov and Ormiston (1984) have emended the superfamily Entactinoidea. A study of the literature has revealed that Riedel (1967b; 1967a) did not erect a superfamily Entactinoidea. The superfamily designation is therefore not referred to in this study and all spherical spumellarians are listed by family in alphabetical order.

3.4.4.1 Family: Entactiniidae

Family **Entactiniidae** RIEDEL 1967b
(Family Tripocosphaeridae Vinassa de Regny, 1898
emend Kozur & Mostler, 1981)

(Suborder **Spumellaria** (Ehrenberg 1875))
(Suborder **Entactinaria** (Kozur & Mostler 1982))

Subfamily **Astroentactiniinae** NAZAROV & ORMISTON 1985

Genus ***Astroentactinia*** NAZAROV 1975

Type species: *Astroentactinia stellata* NAZAROV 1975
Diagnosis: For diagnosis see Nazarov, 1975.

Astroentactinia biaciculata NAZAROV 1975
Plate 3.8a, 3.8b, 3.8c, 3.8d, 3.8e.

1975	*Astroentactinia biaciculata* NAZAROV; p. 84-85, Pl. 8, Fig. 8; Pl. 10, Figs. 6-7.
1987a	*Astroentactinia biaciculata* NAZAROV; Gourmelon, p. 69-70, Pl. 8, Figs. 1-5.
1988	*Astroentactinia biaciculata* NAZAROV; Braun & Schmidt-Effing, p. 653, Fig. 18.
1988	*Astroentactinia biaciculata* NAZAROV; Nazarov, Pl. 13, Fig. 3.
1988	*Astroentactinia biaciculata* NAZAROV; Schmidt-Effing, p. 34, Pl. 1, Fig. 8; Pl. 2, Fig. 3.
1989b	*Astroentactinia biaciculata* NAZAROV; Braun, p. 370, Pl. 2, Fig. 2.
1990b	*Astroentactinia biaciculata* NAZAROV; Braun, p. 13, Pl. 2, Fig. 8.
1990c	*Astroentactinia biaciculata* NAZAROV; Braun, p. 100, Pl. 8, Fig. 8, 9; Pl. 12, Fig. 3.
1993	*Astroentactinia biaciculata* NAZAROV; Braun & Schmidt-Effing, Pl. I, Fig. 2.
1994	*Astroentactinia biaciculata* NAZAROV; Kiessling & Tragelehn, p. 235, Pl. 4, Fig. 6.

Holotype: See Nazarov, 1975. [4046-12-1]

Description: Spherical shell with spherical to irregular shaped pores. Shell carries numerous smooth, needle-like spines, circular in cross-section.
Material: Moderately well preserved specimens from locality NS2, near Kuala Pilah, Bentong-Raub suture zone, Peninsular Malaysia.
Range and occurrence: Upper Devonian (Frasnian) of the Gogo Formation, Canning Basin, Western Australia (Nazarov *et al.*, 1982); Lower Carboniferous (Tournaisian) of the Montagne Noire and Central Pyrenes (Gourmelon, 1987a); Lower Carboniferous (Tournaisian) of Germany (Braun & Schmidt-Effing, 1988; Braun, 1989b; 1990b); Lower Carboniferous (Tournaisian) of Peninsular Malaysia (this study).

Astroentactinia? mirousi GOURMELON 1986

Plate 3.8f.

1984	*Acanthosphaera* sp.; Sandberg & Gutschick;Pl. 5, Fig. X; Pl. 6, Figs. E, G, Q.
1986	*Astroentactinia? mirousi* GOURMELON; Gourmelon, p. 184-185, Pl. 3, Figs. 6, 7.
1987a	*Astroentactinia mirousi* GOURMELON; Gourmelon, p. 70-71, Pl. 8, Fig. 6-7.
1988	*Astroentactinia? mirousi* GOURMELON; Braun & Schmidt-Effing, p. 653, Fig. 19.
1989b	*Astroentactinia? mirousi* GOURMELON; Braun, p. 370-372, Pl. 2, Fig. 1; Pl. 4, Fig. 3.
1990b	*Astroentactinia? mirousi* GOURMELON; Braun, Pl. II, Fig. 2.
1990c	*Astroentactinia? mirousi* GOURMELON; Braun, p. 102, Pl. 9, Fig. 7, 8.

Holotype: Gourmelon, 1986; Pl. 3, Fig. 6. [LPB 12883; M45]

Description: Test spherical with more than 12 poorly preserved long spines with a circular cross-section. Test is covered with a silica coating and the pores and pore frames are not visible.

Material: Rare specimens from locality NS2 near Kuala Pilah, Bentong-Raub suture zone, northwest Peninsular Malaysia.

Range and occurrence: Lower Carboniferous (Tournaisian) of France (Gourmelon, 1987a), Lower Carboniferous (Tournaisian) of Germany (Braun and Schmidt-Effing, 1988; Braun, 1989b; 1990b); Lower Carboniferous (Tournaisian) of the Bentong-Raub suture zone, Peninsular Malaysia (his study).

Astroentactinia spatiosa BRAUN 1990c

Plate 3.8g.

1990c	*Astroentactinia spatiosa* BRAUN 1990; p. 104, Pl. 7, Fig. 1; Pl. 12, Figs. 4,5.

Holotype: Braun, 1990a: Pl. 7, Fig. 1.

Description: Small spherical shell with relatively large pores. Numerous (at least eleven) strong triradiate spines, all of which are broken.

Material: Rare specimens from locality NS2 near Kuala Pilah, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Carboniferous (Tournaisian) of Germany (Braun, 1990c) and the Bentong-Raub suture zone, Peninsular Malaysia (this study).

Genus *Copicyntra* NAZAROV & ORMISTON 1985

Type species: *Copicyntra acilaxa* Nazarov & Ormiston 1985

Diagnosis: For diagnosis see Nazarov & Ormiston, 1985b.

?*Copicyntra* sp.

Plate 3.8h.

1996 *Copicyntra* sp.; Spiller, Pl. 3, Fig. 13.

Description: Spherical test possessing a spongy wall. Small thornlike external spines project from the pore frames. Internal structure not visible.

Remarks: The specimen bears external resemblance to the genus *Copicyntra* NAZAROV & ORMISTON. *Copicyntra* NAZAROV & ORMISTON is described as "Astroentactiniinae with a spongy outer layer and porous inner sphere. Among them (between them ?) are developed 8-13, rarely more, thin concentric shells, which are nested" (Nazarov & Ormiston, 1985). The genus is distinguished from other spongy spherical polycystines by the development of multiple intercalated shells between the outer spongy layer and the porous inner sphere. These diagnostic internal features are not visible in the extracted specimens.

Material: Rare specimens from locality CH13 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Permian (Wolfcampian) of the Bentong-Raub suture zone, Peninsular Malaysia (Spiller, 1996; this study).

Genus *Uberinterna* SASHIDA & TONISHI 1988

Type species: *Uberinterna virgispinosun* SASHIDA & TONISHI 1988.

Diagnosis: For diagnosis see Sashida & Tonishi, 1988.

Uberinterna virgispinosum SASHIDA & TONISHI 1988

Plate 3.8i.

1988 *Uberinterna virgispinosum* SASHIDA & TONISHI; p. 531-532, Fig. 2; Figs. 8.7-8.12.

Holotype: Sashida and Tonishi, 1988; Fig. 8.7. [IGUT-KS3496]

Description: Poorly preserved specimens with thick outer spongy shell and an inner shell which comprises several concentric shells. Thick radial beams that join the inner spheres to the outer spongy shell are visible. External spines are not preserved.

Remarks: This species bears some resemblance to the *Copicyntra* species, but differs in having thick radial cross-beams that join the outer spongy shell to the internal spheres.

Material: Very rare specimens from locality K8 - Bt Nyan, near Pokok Sena, from the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.

Range and occurrence: Upper Permian of the Unazawa Formation of Kashiwara, Itsukaichi town, Tokyo Prefecture, central Japan (Sashida and Tonishi, 1988); "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Sashida and Tonishi, 1988; Spiller and Metcalfe, 1996).

Subfamily **Entactiniinae** RIEDEL 1967b
emend. Nazarov 1975

Genus ***Hegleria*** NAZAROV & ORMISTON 1985b

Type species: *Hegleria mammifera* NAZAROV & ORMISTON 1985b

Diagnosis: For diagnosis see Nazarov & Ormiston, 1985b.

Hegleria mammilla (SHENG & WANG 1985)
Plate 3.8j

1985	*Phaenicosphaera mammilla* SHENG & WANG; p. 179, Pl. 3, Figs. 1-8.
1985b	*Hegleria mammifera* NAZAROV & ORMISTON; p. 22, Pl. 6, Figs.3-5.
1990	*Hegleria mammifera* NAZAROV & ORMISTON; Noble & Renne, Pl. 1, Figs. 9, 10.
1991	*Hegleria mammifera* NAZAROV & ORMISTON; Wang, Pl. III, Fig. 5-7.
1992	*Hegleria mammilla* (SHENG & WANG); Blome & Reed, p. 369, Figs. 11.10, 11.12, 11.13.
1994	*Hegleria mammilla* (SHENG & WANG); Wang *et al.*, p. 189-190, Pl. 2, Figs. 17, 18.
1996a	*Hegleria mammilla* (SHENG & WANG); Feng & Ye, Pl. 11.2, Fig. 1.
1996b	*Hegleria mammilla* (SHENG & WANG); Feng & Ye, Pl. 2.2, Fig. 11.
1996	*Hegleria mammilla* (SHENG & WANG); Mankinen *et al.*, Fig. 4.20.

Holotype: Sheng & Wang 1985: Pl. 3, Fig. 2. [R0024]

Description: Shell body consisting of a spherical lattice cortical shell. Inner or medullary shell is not visible in the illustrated specimens. Cone-like tubercles termed "mammae" by Pessagno (1976) protrude from the cortical shell and lack radial spines.

Material: Rare specimens from localities CH13 and CH14 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Upper Permian Kufeng Formation, Longtan, Nanjing China (Sheng and Wang, 1985); Permian of Guangxi, China (Wang, 1991); upper Permian of southwest Yunnan, China (Feng and Ye, 1996b); Lower Permian (Wolfcampian) to Upper Permian (Guadalupian) of the Grindstone Terrane, Central Oregon, USA (Blome and Reed, 1992); Upper Permian (Guadalupian *Follicucullus porrectus* zone) of the North Folk terrane, Klamath Mountains, California (Mankinen *et al.*, 1996); Lower Permian (Wolfcampian) and (Leonardian) of Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia (this study).

Genus ***Stigmosphaerostylus*** (RÜST 1892),
emend. Foreman 1963

Type species: *Stigmosphaerostylus notalilis* RÜST 1892

Diagnosis: For diagnosis see Foreman, 1963.

Remarks: Aitchison and Stratford (*in press*) propose that the Genus *Entactinia*, introduced by Foreman (1963), is a junior synonym for the validly described genus *Stigmosphaerostylus* RÜST. The genus name *Stigmosphaerostylus* RÜST has priority and subsequently all species previously known under the genus name of *Entactinia* FOREMAN are now placed under the name *Stigmosphaerostylus* (RÜST) which was later emended by Foreman (1963).

Stigmosphaerostylus sp. cf. *S. itsukaichiensis* (SASHIDA & TONISHI 1985)
Plate 3.8k, 3.8l, Plate 3.9a

Description: Fragmentary specimens with small lattice shell bearing long, bladed spines which are triradiate in axial section. Rare main spines display minor torsion. Thorn-like by-spines which arise from pore-frame junctions are very poorly preserved or no longer visible. Internal spicule is not visible in specimens recovered in this study.

Remarks: This species is similar to *Stigmosphaerostylus itsukaichiensis* (SASHIDA & TONISHI) in having a small lattice shell with long triradiate main spines. It differs from *Stigmosphaerostylus itsukaichiensis* (SASHIDA & TONISHI) by having fewer main spines and not exhibiting thorn-like by-spines arising from pore-frame junctions as in the specimens described by Sashida and Tonishi (1985).

Material: Rare specimens from locality CH13 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Permian (Wolfcampian) from the Bentong-Raub suture zone, Peninsular Malaysia (this study).

Stigmosphaerostylus sp. cf *S. pycnoclada* (NAZAROV & ORMISTON 1985)
Plate 3.9b, 3.9c

1996 *Entactinia* sp. cf. *E. pycnoclada* NAZAROV & ORMISTON; Spiller, Pl. 3, Fig. 16.

Description: Shell small, spherical, with long, massive triradiate spines. Main spines have small, short apophyses perpendicular to the main spine.

Remarks: All specimens are fragmentary and poorly preserved.

Material: Rare specimens from locality CH13 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Lower Permian (Wolfcampian) of the Bentong-Raub suture zone, Peninsular Malaysia (this study).

Stigmosphaerostylus variospina (WON 1983)

Plate 3.9d, 3.9e, 3.9f

1976	*Trilonche cimelia* ORMISTON & LANE; p. 167-168, Pl. 2, Fig. 9-10
1983	*Palaeoxyphostylus variospina* WON; 156-157, Pl. 8, Fig. 1-4. 6-22.
1986	*Entactinia variospina* (WON); Gourmelon, p. 183-184, Pl. 4, Fig. 1.
1987a	*Entactinia variospina* (WON); Gourmelon, p. 49-50, Pl. 3, Fig. 6-11.
1988	*Entactinia variospina* (Won); Braun & Schmidt-Effing, p. 654-655, Fig. 21.
1989b	*Entactinia variospina* (WON); Braun, p. 368, Pl. 2, Fig. 3-4; Pl. 4, Fig. 5.
1990a	*Entactinia variospina* (WON); Braun, Pl. I, Fig. 4.
1990c	*Entactinia variospina* (WON); Braun, p. 109, Pl. 7, Fig. 4-6.
1990	*Palaeoxyphostylus variospina* WON; Murchey, Pl. 1, Fig. 9.
1991	*Entactinia variospina* (WON); Braun & Amon, p. 30, Fig. 3j, k.
1993	*Entactinia variospina* (WON); Sashida *et al.*, Figs. 4.1-4.4, 4.13, 4.14.
1994	*Entactinia variospina* (WON); Wu *et al.*, Pl. 1, Fig. 6.
1995a	*Entactinia variospina* (WON); Spiller & Metcalfe, Fig. 6c, 6d.
1995b	*Entactinia variospina* (WON); Spiller & Metcalfe, Fig. 4.16.
1996	*Entactinia variospina* (WON); Spiller, Pl. 2, Figs. 7, 8.

Holotype: Won, 1980: Pl. 8, Fig. 1. [Pr. 9704-S 32/4]

Description: Spherical lattice shell with two to six broad triradiate spines with deep grooves. Spines are of unequal length and the angle between spines also variable. Wall of the test is thick and the pore frames appear raised. Pores are of spherical to irregular shape and relatively large. Bi-spines are not observed.

Material: Rare specimens from localities KLK13 near Genting Sempah and NS2 near Kuala Pilah, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Sycamore Limestone, Oklahoma, North America (Ormiston & Lane, 1976); Lower Carboniferous (Viséan) of Schiefergebirges (Germany); Lower Carboniferous (Tournaisian) of the Montagne Noire and Central Pyrenes (Gourmelon, 1986; Gourmelon, 1987a); Lower Carboniferous *Albaillella indensis* Zone of the Frankenwalds, Germany (Braun and Schmidt-Effing, 1988; Braun, 1989b); Quinzhou-Yulin area southern Guangxi, China (Wu *et al.*, 1994); Lower Carboniferous (Tournaisian and Viséan) of Peninsular Malaysia (Spiller and Metcalfe, 1995a; Spiller, 1996)

Stigmosphaerostylus vulgaris (WON 1983)

Plate 3.9g

1960 n. nud.	*Hexastylus ferox* DEFLANDRE; Pl. 1, Fig. 12.

1963	*Entactinia herculea* FOREMAN; Foreman, Pl. 1, Fig. 3c, d.
1983	*Entactinia? vulgaris* WON Won, p. 144, Pl. 4, Fig. 1-3.
1986	*Entactinia vulgaris* WON; Gourmelon, p. 184, Pl. 2, Fig. 4.
1987a	*Entactinia vulgaris* WON; Gourmelon, p. 50, Pl. 4, Fig. 1-6.
1989	*Entactinia vulgaris* WON; Giese & Schmidt-Effing, p. 74, Pl. 2, Figs. 4, 9.
1993	*Entactinia vulgaris* WON; Braun & Schmidt-Effing, Pl. I, Fig. 8.

Holotype: Won, 1980: Pl. 4, Fig. 1. [Pr 0705-S 1/27]

Description: *Stigmosphaerostylus* (RÜST) with spherical lattice test. Pores are rounded to irregularly rounded with delicate bi-spines on the pore junctions on the lattice test. Six major spines are long, straight and triradiate in cross-section.

Material: Rare specimens from locality NS2, near Kuala Pilah, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Upper Devonian (Famennian) of the Huron member of the Ohio shale, North America (Foreman, 1963); Lower Carboniferous (Tournaisian and Viséan) of the Montagne Noire and Central Pyrenees, France (Gourmelon, 1986; 1987a); Lower Carboniferous (Tournaisian) of Peninsular Malaysia (this study).

3.4.4.2 Family: Hindeosphaeridae

Family **HINDEOSPHAERIDAE** KOZUR & MOSTLER 1981
(Suborder **Spumellaria** (Kozur & Mostler, 1981))
(Suborder **Entactinaria** (Kozur & Mostler, 1982)

Genus *Pseudostylosphaera* KOZUR & MOSTLER 1981

Type species: *Pseudostylosphaera gracilis* KOZUR & MOSTLER 1981

Diagnosis: For diagnosis see Kozur and Mostler, 1981.

Pseudostylosphaera compacta (NAKASEKO & NISHIMURA 1979)
Plate 3.9h, 3.9i.

1979	*Archaeospongoprunum compactum* NAKASEKO & NISHIMURA; p. 68, Pl. 1, Figs. 3, 7.
1982	*Archaeospongoprunum compactum* NAKASEKO & NISHIMURA; Hattori & Yoshimura, Pl. 1.5.
1982	*Archaeospongoprunum compactum* NAKASEKO & NISHIMURA; Mizutani & Koike, Pl. 3.1.
1982	*Archaeospongoprunum compactum* NAKASEKO & NISHIMURA; Kido, Pl. 1.2.
1994	*Pseudostylosphaera compacta* (NAKASEKO & NISHIMURA); Basir Jasin, Pl. 1, Fig. 2
1995b	*Pseudostylosphaera japonica* (NAKASEKO & NISHIMURA); Spiller & Metcalfe, Figs. 6.5, 6.6.

Holotype: Nakaseko and Nishimura, 1979: Pl. 1, Fig. 7. [MTSM 802-1]

Description: Shell spherical with straight, elongate polar spines. Spongy shell surface is obscured by microcrystalline silica coating. Polar spines are triradiate in axial section with three longitudinally arranged sharp grooves alternating with three longitudinally arranged strong ridges which are broadest at the base and taper off toward the distal ends.

Remarks: This species differs from *Pseudostylosphaera japonica* (NAKASEKO & NISHIMURA) by having longer and more slender polar spines.

Material: Rare specimens from locality K3, Bt Tembaga, "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.

Range and occurrence: Sambosan Group of southwest Japan and the Chichibu Group of central Japan (Takemura and Nakaseko, 1979); (upper Anisian to Ladinian) from the Nadanhada Range, northeast China (Mizutani and Koike, 1987); Middle Triassic (Anisian - Ladinian boundary) of the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Spiller and Metcalfe, 1995b).

Pseudostylosphaera japonica (NAKASEKO & NISHIMURA 1979)
Plate 3.9j, 3.9k, 3.9l.

1979	*Archaeospongoprunum japonicum* NAKASEKO & NISHIMURA; p. 67-68, Pl. 1, Figs. 2, 4, 9.
1982	*Archaeospongoprunum japonicum* NAKASEKO & NISHIMURA; Mizutani & Koike, Pl. 3, Fig. 3.
1982	*Archaeospongoprunum japonicum* NAKASEKO & NISHIMURA; Yao, Pl. 1, Fig. 21.
1987	*Pseudostylosphaera japonica* (NAKASEKO & NISHIMURA); Kojima & Mizutani, p. 261, Fig. 2.1.
1989	*Pseudostylosphaera japonica* (NAKASEKO & NISHIMURA); Kojima, Pl. 1.1.
1991	*"Stylosphaera" japonica* (NAKASEKO & NISHIMURA); Bragin, p. 91, Pl. 1, Figs. 11, 13?.
1993d	*Pseudostylosphaera japonica* (NAKASEKO & NISHIMURA); Sashida *et al.*, p. 89-90, Fig. 7.9.
1994	*Pseudostylosphaera japonica* (NAKASEKO & NISHIMURA); Basir Jasin, Pl. 1, Fig. 3.
1995b	*Pseudostylosphaera compacta* (NAKASEKO & NISHIMURA); Spiller & Metcalfe, Fig. 6.12.

Holotype: Nakaseko and Nishimura, 1979: Pl.1, Fig. 2. [MTSM 802-3]

Description: Globular shell, bearing two opposite polar spines; shell surface obscured by microcrystalline silica coating. Polar spines equal in length and breadth, moderately long, massive, triradiate in axial section having three longitudinally arranged ridges alternating with three longitudinally arranged deep grooves, width of spines increases slightly toward a distal direction and decreases near the terminus.

Material: Rare specimens from locality K3, from the "Lower Chert Member" of the Semanggol Formation, near Pokok Sena, northwest Peninsular Malaysia.

Range and occurrence: Middle Triassic (upper Anisian to Ladinian) - Nadanhada Range, Northeast China (Kojima and Mizutani, 1987; Kojima, 1989); Middle Triassic (Anisian - Ladinian boundary) of the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Spiller and Metcalfe, 1995b).

Pseudostylosphaera sp. A

Plate 3.10a.

Description: Shell elliptical with a constriction around the centre, bearing two opposite polar spines. Shell surface is obscured by microcrystalline silica coating. Polar spines unequal in length and breadth, moderately long, slender, triradiate in axial section having three longitudinally arranged ridges alternating with three deep grooves, width of spines increases slightly distally and decreases near the terminus.

Material: Rare specimens from locality K3, from the "Lower Chert Member" of the Semanggol Formation, near Pokok Sena, northwest Peninsular Malaysia.

Range and occurrence: Middle Triassic (Anisian - Ladinian boundary) of the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (this study).

Pseudostylosphaera sp. B

Plate 3.10b.

Description: Elliptical shell, bearing two opposite polar spines; shell surface obscured by microcrystalline silica coating. Polar spines unequal in length and breadth, moderately long and robust. Spines triradiate in axial section having three longitudinally arranged ridges alternating with three deep grooves. Width of spines increases slightly toward a distal direction and decreases near the terminus.

Material: Rare specimens from locality K3, from the "Lower Chert Member" of the Semanggol Formation, near Pokok Sena, northwest Peninsular Malaysia.

Range and occurrence: Middle Triassic (Anisian - Ladinian boundary) of the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (this study).

3.4.4.3 *Family: Oertlispongidae*

Family **OERTLISPONGIDAE** KOZUR & MOSTLER 1980
(Suborder **Spumellaria** (Dumitrica, Kozur & Mostler, 1980))
(Suborder **Entactinaria** (Kozur & Mostler, 1982)

Genus ***Baumgartneria*** DUMITRICA 1982

Type species: *Baumgartneria retrospina* DUMITRICA 1982
Diagnosis: For diagnosis see Dumitrica, 1982.

Baumgartneria bifurcata DUMITRICA 1982
Plate 3.10c.

1982 *Baumgartneria bifurcata* DUMITRICA; p. 71, Pl. 10, Figs. 3, 4.
1994 *Baumgartneria bifurcata* DUMITRICA; Kozur & Mostler, p. 64, Pl. 13, Figs. 3, 5, 6, 10.
1995b *Baumgartneria* sp. cf. *B. bifurcata* DUMITRICA; Spiller & Metcalfe, Fig. 6.9.

Holotype: Dumitrica, 1982; Pl. X Fig. 3, [Rc4, I.G.G. no. 102.692].

Description: Cross-shaped radial spine, with branched needle-like lateral branches which bifurcate at the distal ends. Spherical spongy shell is not preserved.
Remarks: Kozur and Mostler (1994) show the first appearance of *Baumgartneria* species at the Anisian - Ladinian boundary. The presence of this species is valuable in constraining the relative age of Middle Triassic radiolarian faunas.
Material: Rare specimens from locality K3, Bt Tembaga from the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.
Range and occurrence: Middle Triassic (Anisian - Ladinian boundary) of Eastern Carpathians (Dumitrica, 1982), lower Ladinian part of the "Lower Chert Member" of the Semanggol Formation of northwest Peninsular Malaysia (Spiller and Metcalfe, 1995b). Southern Alps and Sosio Valley (Italy), Dinarides (Yugoslavia), Eastern Carpathians (Romania), Balaton Highland and Darnohegy area (Hungary) (Kozur and Mostler, 1994), "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Spiller and Metcalfe, 1995b).

Genus ***Oertlispongus*** DUMITRICA, KOZUR & MOSTLER 1980

Type Species: *Oertlispongus inaequispinosus* Dumitrica, Kozur & Mostler 1980

Diagnosis: For diagnosis see Dumitrica, Kozur and Mostler, 1980.

Oertlispongus inaequispinosus DUMITRICA, KOZUR & MOSTLER 1980

Plate 3.10d, 3.11e.

1980	*Oertlispongus inaequispinosus* DUMITRICA, KOZUR & MOSTLER; p. 5, Pl. 10, Fig. 7.
1982	*Oertlispongus inaequispinosus* DUMITRICA, KOZUR & MOSTLER; Dumitrica, p. 64-65, Pl. 1, Figs. 2, 4, 6, 7, 9.
1993	*Oertlispongus* sp.; Sashida *et al.*, Fig. 6.14.
1994	*Oertlispongus inaequispinosus* DUMITRICA, KOZUR & MOSTLER; Kozur & Mostler, p. 59, Pl. 10, Figs. 1-4?, 5-7, 11, 3; Pl. 11, Figs. 2, 6, 7, 9, 11; Pl. 47, Figs. 6, 7.
1995b	*Oertlispongus* sp.; Spiller & Metcalfe Figs. 6.10, 6.11.

Holotype: Dumitrica *et al.*, 1980: Pl. 10, Fig. 7.

Description: Fragmentary specimen of *Oertlispongus inaequispinosus* DUMITRICA, KOZUR & MOSTLER consists of fragments of the curved, unbladed polar spine. Spherical spongy shell of the species has not been recognised.

Remarks: The conical shape and curvature of the spine fragments resemble the main polar spine of the type species *Oertlispongus inaequispinosus* DUMITRICA, KOZUR & MOSTLER. Dumitrica *et al.* (1980) remark that the spine element is commonly the only element that is preserved during the fossilisation process as the spongy shell is generally completely removed by selective dissolution.

Kozur and Mostler (1994) show the first appearance of *Oertlispongus* species at the Anisian - Ladinian boundary. The presence of this species is valuable in constraining the relative age of Middle Triassic radiolarian faunas.

Kozur and Mostler (1994) have named *Oertlispongus* as an important stratigraphic marker within this zone. The genus occurs with the oldest Ladinian conodonts *Neogondolella mesotriassica* (KOZUR & MOSTLER) (Kozur and Mostler, 1994). Coexisting radiolarians species include *Oertlispongus* spp., *Baumgartneria bifurcata* DUMITRICA, *Eptingium manfredi manfredi* DUMITRICA and *Triassocampe deweveri* (NAKASEKO & NISHIMURA) which are characteristic of the Ladinian conodont *Neogondolella mesotriassica* Zone of lower to middle Ladinian age.

Material: Rare specimens from locality K3, Bt. Tembaga, northwest Peninsular Malaysia.

Range and occurrence: Middle Triassic (Anisian - Ladinian boundary) of the Eastern Carpathians (Dumitrica, 1980); lower Ladinian of the Southern Alps, Italy (Dumitrica *et al.*, 1982); Middle Triassic (Anisian - Ladinian boundary of the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (Spiller and Metcalfe, 1995b).

3.4.4.4 *Family: Sepsagonidae*

Family **SEPSAGONIDAE** KOZUR & MOSTLER 1981
(Suborder **Entactinaria** (Kozur & Mostler, 1982))
(Suborder **Spumellaria** (Dumitrica, Kozur & Mostler, 1980))

Genus *Sepsagon* DUMITRICA, KOZUR & MOSTLER 1980

Type Species: *Sepsagon longispinosum* (KOZUR & MOSTLER 1979)
Diagnosis: For diagnosis see Dumitrica, Kozur and Mostler, 1980.

Sepsagon ladinicus KOZUR & MOSTLER 1994
Plate 3.10f.

1980 *Sepsagon longispinosus* (KOZUR & MOSTLER); Dumitrica, Kozur & Mostler, p. 15, Pl. 5, Figs.1,2, 5, 6; Pl. 15, Fig. 1
1994 *Sepsagon ladinicus* KOZUR & MOSTLER; p. 48-49, Pl. 4, Figs. 5-9.

Holotype: Kozur & Mostler, 1994: Pl. 4, Fig. 9 [Ko/Mo 1980/I-555]

Description: Poorly preserved fragmentary specimen. Only part of the cortical shell is preserved and its overall shape is unable to be determined. Two long, slender triradiate spines are preserved. Spines are thicker near the shell junction and gradually taper towards the distal end. The microcrystalline silica coating on the test has obliterated the pore structure of the cortical shell.
Material: Rare specimens from locality K3, Bt. Tembaga, "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.
Range and occurrence: Middle Triassic (lower Ladinian) of the Val di Creme section near Recoaro, Italy (Kozur and Mostler, 1994) and the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (this study).

3.4.4.5 *Incertae familiae A*

Incertae familiae

Genus ***Meschedea*** WON 1983

Type species: *Meschedea pyramispinosa* WON 1983
Diagnosis: For diagnosis see Won, 1983.

Meschedea permica SASHIDA & TONISHI 1985
Plate 3.10g.

1985 *Meschedea permica* SASHIDA & TONISHI; p. 15, Pl. 4, Figs. 10-12; Pl. 5, Figs. 1-3.

Holotype: Sashida and Tonishi, 1985: Pl. 4, Fig. 10. [IGUT 7020]

Description: Outer shell is spherical with round or oval pores. Spines are short and sturdy with deep, wide grooves near the junction of the cortical shell. Spines narrow to a point at the distal end. Internal structure is not visible in the specimen recovered in this study.
Remarks: Sashida and Tonishi (1985) recovered this species from Upper Permian (Guadalupian) bedded chert from Itsukaichi, central Japan. This study recovered the species from the Wolfcampian *Pseudoalbaillella lomentaria* zone of Ishiga (1990) where it was in coexistence with *Ps. sakmarensis* (KOZUR) and *Ps. scalprata* HOLDSWORTH & JONES m. *scalprata* ISHIGA.
Material: Single specimen recovered from locality CH13 from the Cameron Highlands near Pos Blau, Bentong-Raub suture zone, Peninsular Malaysia.
Range and occurrence: Upper Permian (Guadalupian) from Itsukaichi, central Japan (Sashida and Tonishi, 1985) and the Lower Permian (Wolfcampian) from Cameron Highlands near Pos Blau, Bentong-Raub suture zone, Peninsular Malaysia (this study).

Genus ***Polyentactinia*** FOREMAN 1963

Type species: *Polyentactinia craticulata* FOREMAN 1963
Diagnosis: For diagnosis see Foreman, 1963.

Polyentactinia polygonia FOREMAN 1963
Plate 3.10h, 3.10i, 3.10j.

1963 *Polyentactinia polygonia* FOREMAN; p. 281, Pl. 5, Figs. 1a-c.
1984 "delicate polygonal-strutted form"; Sandberg & Gutschick, Pl. 8, Fig. W.
1985 *Polyentactinia polygonia* FOREMAN; Gourmelon, Table 2, Fig. 6.
1987a *Polyentactinia polygonia* FOREMAN; Gourmelon, p. 79, Table 10, Figs. 1-6.
1988 *Polyentactinia polygonia* FOREMAN; Braun & Schmidt-Effing, p. 657, Fig. 23.
1990c *Polyentactinia polygonia* FOREMAN; Braun, p. 131, Pl. 14, Figs. 1-3, 9.
1993 *Polyentactinia polygonia* FOREMAN; Braun & Schmidt-Effing, Pl. III, Fig. 1.
1996 *Polyentactinia polygonia* FOREMAN; Spiller, Pl. 1, Fig. 12.

Holotype: Foreman, 1963: Plate 5, Fig, 1b. [USNM 640454]

Description: Fragmentary specimens displaying a very loose meshwork resulting from straight spinules that arise from a six- to eight rayed double spicule. The spinules arise at various distances along each ray, their branches are few and straight or only slightly curved.
Remarks: Foreman (1963) remarks that this species is distinguished by the variable number of rays on the double spicule, and the loose, angular meshwork.
Material: Rare specimens from locality NS2 near Kuala Pilah, Bentong-Raub suture zone, Peninsular Malaysia.
Range and occurrence: Upper Devonian (Famennian) from the Huron member of the Ohio shale (Foreman, 1963); Lower Carboniferous (Tournaisian) of the Woodford Formation of Utah, USA (Sandberg and Gutschick, 1984), the Montagne Noire and Central Pyrenes, France (Gourmelon, 1985; 1987a); Lower Carboniferous "Jackadgery" assemblage from the Anaiwan terrane, Eastern Australia (Aitchison, 1988c); upper Tournaisian *Albaillella indensis* zone of the Frankenwalds, Germany (Braun and Schmidt-Effing, 1993); upper *Albaillella indensis* zone (lower Viséan) of the Rheinischen Schiefergebirges (Braun, 1990c); Lower Carboniferous (upper Tournaisian) *Albaillella deflandrei* zone of Peninsular Malaysia (Spiller, 1996; this study).

3.4.4.6 Family: Latentifistulidae

Superfamily **LATENTIFISTULIDEA** NAZAROV & ORMISTON 1983a
Family **LATENTIFISTULIDAE** NAZAROV & ORMISTON 1983a

Genus ***Ishigaum*** DE WEVER & CARIDROIT

Type species: *Ishigaum trifustis* DE WEVER & CARIDROIT 1984.

Diagnosis: For diagnosis see De Wever and Caridroit, 1984.

Ishigaum sp.
Plate 3.10k, 3.10l.

Description: Poorly preserved, fragmentary specimens. Small triradiate shell with hollow rays of equal length diverging at angles of 120°. Small dome-like expansion at the ray junction. Rays are narrow at the junction and expand gradually. Ray arms are covered with platy fabric and become more spongy towards the distal ends. Distal ends are club shaped and bear a terminal spine which is not preserved in the illustrated specimens.
Material: Rare specimens from locality K15 Kg. Larit near Pokok Sena, from the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia.
Range and occurrence: Upper Permian (Guadalupian) from the "Lower Chert Member" of the Semanggol Formation, northwest Peninsular Malaysia (this study).

Genus ***Latentifistula*** NAZAROV & ORMISTON 1983a

Type species: *Latentifistula crux* NAZAROV & ORMISTON 1983a
Diagnosis: For diagnosis see Nazarov & Ormiston, 1983a.

Latentifistula sp. aff. *L. crux* NAZAROV & ORMISTON 1983a
Plate 3.11a, 3.11b.

1992 *Latentifistula* sp. aff. *L. crux* NAZAROV & ORMISTON; Blome & Reed, p. 375 Pl. 13.2-13.5.

Description: The general appearance of the test resembles *L. crux*. Shell spongy with short thick rays arranged at an angle of approximately 120°. The terminations of the arms are much more inflated than *L. crux*. Terminal spines not preserved.
Remarks: Blome and Reed (1992) report that *L.* sp. aff. *L. crux* NAZAROV & ORMISTON occurs with both Lower Permian faunas including *Albaillella asymmetrica* ISHIGA & IMOTO, *Pseudoalbaillella fusiformis* (HOLDSWORTH & JONES), and Upper Permian faunas including *Follicucullus scholasticus* ORMISTON & BABCOCK m. II ISHIGA and *Follicucullus monacanthus* ISHIGA & IMOTO. In the present study *L.* sp. aff. *L. crux* NAZAROV & ORMISTON coexists with Lower Permian (Wolfcampian and Leonardian) faunas.
As noted by Blome and Reed (1992) there appears to be a wide variety of forms of this species.
Material: Few specimens from localities CH13 and CH14 near Pos Blau, Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia.

Range and occurrence: Upper Permian (Guadalupian) of the Grindstone Terrane, central Oregon, USA (Blome and Reed, 1992); Lower Permian (Wolfcampian and Leonardian) of the Cameron Highlands, Bentong-Raub suture zone, Peninsular Malaysia (this study).

Latentifistula impella (ORMISTON & LANE 1976)
Plate 3.11c, 3.11d, 3.11e, 3.11f.

1976 *Paronaella impella* ORMISTON & LANE; p. 169, Pl. 3, Figs. 1-5.
1983a *Latentifistula impella* (ORMISTON & LANE); Nazarov & Ormiston, Pl. 1, Fig. 10, 11.
1983 *Scharfenbergia impella* (ORMISTON & LANE); Won, p. 160, Pl. 9, Fig. 9.
1985a *Latentifistula impella* (ORMISTON & LANE); Nazarov & Ormiston, Pl. 1, Fig. 9.
1990 *Latentifistula impella* (ORMISTON & LANE); Aitchison & Flood, Figs. 7E-7H
1990c *Latentifistula impella* (ORMISTON & LANE); Braun, p. 117, Pl. 15, Fig. 6.
1990 *Scharfenbergia impella* (ORMISTON & LANE); Murchey, Pl. 1, Fig. 35.
1992 *Scharfenbergia impella* (ORMISTON & LANE); Aitchison *et al.*, Fig. 8H, I.
1996 *Latentifistula impella* (ORMISTON & LANE); Spiller, Pl. 2, Fig. 10.

Holotype: Ormiston & Lane, 1976: Pl. 3, Fig. 1. [USNM 186431]

Description: Triradiate test. Arms are wide at the junction and emerge from a circular central part. The arms narrow and then widen towards the terminus. Each arm bears a terminal spine.

Remarks: *Latentifistula impella* (ORMISTON & LANE) from the Sycamore Limestone of Oklahoma is the oldest (upper Tournaisian to lower Viséan) known representative of the Palaeozoic stauraxons (Nazarov and Ormiston, 1985a). Based on associated conodonts, its first appearance has been placed in the lower *Gnathodus taxanus* zone of the North American Osagean Stage. However recent studies indicate that the first appearance of *Latentifistula impella* (ORMISTON & LANE) occurs in the lower Viséan (see p. 8-10, Aitchison and Flood, 1990). In the study of radiolarian faunas from Peninsular Malaysia *Latentifistula impella* (ORMISTON & LANE) has only been found associated with Viséan faunas.

Material: Rare specimens from locality KLK13 near Genting Sempah, and localities CH6 and CH7 near Pos Mering, Cameron Highlands.

Range and occurrence: Lower Carboniferous (Tournaisian) of the Sycamore Limestone, Arbuckle Mountains, Oklahoma, USA (Ormiston and Lane, 1976; Nazarov and Ormiston, 1983a, Nazarov and Ormiston, 1985a); Lower Carboniferous of the Rheinischen Schiefergebirges, Germany (Won 1983); ?Viséan of the Texas beds, Anaiwan Terrane, New England Orogen, eastern Australia (Aitchison and Flood, 1990); Viséan *Albaillella cartalla* zone of Germany (Braun, 1990c); Havallah sequence, near Battle Mountain, Nevada, USA (Murchey, 1990); Viséan of the Bentong-Raub suture zone of Peninsular Malaysia (Spiller, 1996; this study).