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Artikel: Late Aptian-Early Albian radiolaria of the Windalia radiolarite (type section), Carnarvon Basin, Western Australia

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SCHWEILER. *Eofalciferella condoni* BRUNNSCHWEILER was also newly identified but is considered by Kennedy & Klinger (1979) as nomen dubium; Casey (1961) suggests that *E. condoni* probably belongs in *Sanmartinoceras*. Other specimens of *Aconoceras*, *Toxoceratoides*, *Tropaeum* and *Australiceras* have been collected previously by Dr H. M. Butler, Dr McNamara and G. W. Kendrick from exposures of Windalia Radiolarite in the Carnarvon Basin (collections stored at the W. A. Museum). Ammonite and belemnite biostratigraphy is discussed separately below.

Belemnites

Moulds of belemnite guards occur throughout the section and similar sized morphotypes tend to be found concentrated along bedding horizons that can be tracted laterally along the outcrop. Specific identification is difficult. Typically the guards posses undeflected ventrolateral alveolar grooves identifiable with *Peratobelus* WHITEHOUSE of the Dimitobelidae (Whitehouse 1924, Stevens 1965). Latex moulds show many specimens are cylindriconical in outline with slightly depressed transverse sections, similar to *P. oxys* TENISON-WOODS. Based on the shape of other casts, species comparable with *P. australis* PHILLIPS, and others tentatively identified as *Dimitobelus stimulus* DOYLE and *D. diptychus* MCCOY also occur.

Other fossil groups

Foraminifera recovered from the studied samples and listed in the literature are rare and poorly preserved, and are not biostratigraphically useful. Only few siliceous agglutinated specimens of *Ammodiscus* and *Haplophragmoides* were identified. Rare species of diminutive *Hedbergella* spp. have been recorded only from coeval sediments in offshore petroleum wells (Apthorpe 1979). Rare, poorly preserved ostracods and fish teeth have also been recorded during this, and previous studies but provide little biostratigraphically useful information. Samples processed for calcareous nannoplankton and palynology proved to be barren. Evidence for benthonic dwelling calcareous organisms is rare. Only one bivalve impression was noted at a separate locality (Ellis 1987), however, Brunnschweiler (1959), Johnstone et al. (1958), Condon et al. (1956) and Condon (1968) suggest a more common presence of bivalves. Rare sponge spicules include simple (oxy-)hexactines and microscleres (Rhaxella) (Dr Benita Murchey, pers. comm. 1991). Infaunal burrowing organisms appear to have been common during deposition of the Windalia Radiolarite as is evident from a mottling of the rock color and texture. Distinct bioturbate textures include abundant *Chondrites* and lesser *Thalassinoides*. Some bedding planes are covered by a network of shallow winding and straight furrows, apparently trails of some crawling invertebrate.

5. Systematic palaeontology

Genera and species are listed alphabetically. A synonymy is provided for previously recorded species to clarify the taxonomic designation. Complete descriptions are given only for new species; short remarks are provided for indeterminate or atypical forms.

Information on the stratigraphic ranges and geographic distribution of previously recorded forms is provided under the headings "Range" and "Occurrence". Holotypes and paratypes of type material, and all illustrated material are deposited under the corresponding catalogue C-numbers (listed on plate explanations) with the Museum of Natural History, Basel, Switzerland. A second series of numbers provides reference to the authors photographic collections' records.

Genus *Acaeniotyle* FOREMAN

Acaeniotyle FOREMAN 1973b, p. 258.

Type species. – Acaeniotyle diaphorogona FOREMAN 1973b.

Acaeniotyle diaphorogona FOREMAN
Plate 3, Fig. 10

Acaeniotyle diaphorogona FOREMAN 1973b, p. 258, pl. 2, figs. 2–5; Foreman 1975, p. 607, pl. 2F, figs. 1–4 only; pl. 3, figs. 1, 2; Nakaseko et al., 1979, pl. 4, fig. 9; de Wever & Theibault 1981, p. 582, pl. 2, fig. 7; Schaaf 1981, p. 431, pl. 15, fig. 2; NAKASEKO & Nishimura 1982, p. 141, pl. 1, fig. 12 (refigured from Nakaseko et al., 1979, pl. 4, fig. 9); Ozvoldova & Sykora 1974, p. 261, pl. 1, figs. 1–3; Schaaf 1984, p. 104, pl. D, figs. H (refigured holotype), 1–5 (fig. 3 refigured from Schaaf 1981, pl. 15, fig. 2); Sanfilippo & Riedel 1985, p. 586, text-fig. 4, figs. 1a–b; de Wever et al. 1986, pl. 6, fig. 11; Aita 1987, p. 63, pl. 12, fig. 12; Thurow 1988, p. 396, pl. 9, fig. 8; Tumanda 1989, p. 33, pl. 1, fig. 2; Ozvoldova & Petercakova 1992, pl. 1, figs. 13, 16; Steiger 1992, p. 28, pl. 2, figs. 1, 2; Taketani & Kanie 1992, text-fig. 3-1.
Acaeniotyle sp. cf. *Acaeniotyle diaphorogona* FOREMAN 1975, p. 607, pl. 1F, fig. 1.
Acaeniotyle sp. aff. *A. diaphorogona* FOREMAN 1973b, p. 258, pl. 2, figs. 6, 7; pl. 16, fig. 16; Yao 1984, pl. 3, fig. 24.
cf. *Acaeniotyle diaphorogona* FOREMAN, Baumgartner 1984, p. 753, pl. 1, fig. 1 only; Tumanda 1989, p. 33, pl. 1, fig. 3; Baumgartner 1992, p. 317, pl. 3, fig. 1.
cf. *Acaeniotyle* sp. cf. *Acaeniotyle diaphorogona* FOREMAN, Thurow 1988, p. 386, pl. 6, fig. 4.
aff. *Acaeniotyle* sp. aff. *A. diaphorogona* FOREMAN, Empson-Morin 1981, p. 261, pl. 3, figs. 8a–d.
aff. *Acaeniotyle gedrangta* EMPSON-MORIN 1981, p. 261, pl. 3, figs. 6, 7.

Range. – Oxfordian to Middle Albian (Campanian?).
Occurrence. – Japan, north Pacific, Atlantic and Indian Oceans, southern Europe, Australia.

Acaeniotyle longispina (SQUINABOL)
Plate 3, Figs. 8, 9

Xiphosphaera longispina SQUINABOL 1903, p. 110, pl. 8, fig. 13.
Xiphosphaera fossilis SQUINABOL 1903, p. 110, pl. 8, fig. 14.
Acaeniotyle sp. aff. *A. umbilicata* (RÜST), Foreman 1973b, pl. 1, fig. 15; Foreman 1975, p. 609, pl. 2E, fig. 8.
Xiphosphaera umbilicata RENZ 1974, p. 799, pl. 2, figs. 9–12; pl. 9, fig. 21.
Xiphosphaera sp. cf. *A. umbilicata* (RÜST), Haig & Barnbaum 1978, figs. 3H, I.
Acaeniotyle umbilicata (RÜST), Baumgartner 1992, p. 317, pl. 3, fig. 2.
cf. *Acaeniotyle umbilicata* STEIGER 1992, p. 27, pl. 1, fig. 17 only.

Remarks. – This species differs from *A. umbilicata* (RÜST) by having more mammae which are smaller and more angular.
Range. – Tithonian (?) to middle Cretaceous.
Occurrence. – North Pacific, Atlantic and Indian Oceans, southern Europe, Australia.

Acaeniotyle sp. cf. *A. diaphorogona* FOREMAN
Plate 3, Fig. 25

Remarks. – Positive identification is hindered because the spines are broken. However, at least 3 spine bases can be seen allowing comparison with *A. diaphorogona.*

Acaeniotyle (?) sp. A
Plate 2, Fig. 9

Remarks. – Cortical shell small (about 120 µm in diameter), with irregular angular mammae each with 5–6 small circular to elliptical pores. At least 6 massive triradiate spines project from centre of respective mammae. Remaining mammae with thin circular spines projecting from tips. Internal structure is unclear.

Acaeniotyle (?) sp. B
Plate 2, Fig. 19

Remarks. – This rare form has a cortical shell similar to *Praeconocaryomma prisca*, but differs by possessing an indeterminate number (probably less than 3) of thin triradiate spines. Due to poor preservation only the spine bases can be seen.

Actinommid gen. and sp. indet.
Plate 4, Fig. 4

aff. Actinomid, gen. and sp. indet. FOREMAN 1973b, pl. 1, fig. 1.

Remarks. – Cortical shell spherical to sub-spherical, meshwork coarse, complex with irregular circular-polygonal pores set within irregular polygonal pore frames. Angular nodes at intersections of pore frames. Internal structure not known. The form illustrated by Foreman (1973b) has a similar arrangement of meshwork on the cortical shell, but is larger than the species illustrated here.

Genus ***Actinomma*** HAECKEL

Actinomma HAECKEL 1862, p. 440.

Type species. – *Haliomma trinacrium* HAECKEL 1860.

Actinomma (?) *pleiadesensis* n. sp.
Plate 4, Figs. 5–7

Description. – Thin spherical to sub-spherical test with 3 concentric shells and with about 10 massive, radially arranged, triradiate primary spines. Primary spines generally not preserved but spine bases can be easily distinguished on surface of cortical shell. Cortical shell thin, finely latticed with irregularly arranged small, polygonal pore frames and irregular circular to ovoid pores. Primary spines continuous with massive triradiate beams that connect cortical shell with first medullary shell, and first medullary shell with second medullary shell. Thin circular secondary radial beams also connect cortical shell to first medullary shell at vertices of polygonal pore frames. First medullary shell slightly smaller than cortical shell with large irregular polygonal pores. Second medullary shell subspherical with large elliptical to polygonal pores set in pentagonal and hexagonal pore frames.

Remarks. – *Actinomma* (?) *pleiadesensis* n. sp. differs from *A.* (?) *davisensis* PESSAGNO, *A.* (?) *douglasi* PESSAGNO from *A.* (?) *joaquinensis* PESSAGNO by having a cortical shell which is more finely latticed with irregular pores and by having spines which are more slender.

Measurements.

measurement of 11 specimens (μm)	Average	Min.	Max.	Holotype:
diameter of cortical shell:	230	200	270	255
diameter of first medullary shell: (single broken specimen)	190			
diameter of second medullary shell: (single broken specimen)	65			

Etymology. – This species is named for the Pleiades Hills on Winning Station.
Holotype. – Basel Museum C-37163 (paratypes registered with C-37162 and C-37164).
Range. – Late Aptian-Early Albian.
Occurrence. – Western Australia.

Genus ***Alievium*** PESSAGNO emend. Foreman

Alievium PESSAGNO 1972, p. 297; emend. FOREMAN 1973, p. 262.

Type species. – *Theodiscus superbus* SQUINABOL 1914.

Alievium (?) sp. A
Plate 2, Fig. 17

Remarks. – This incomplete form is doubtfully assigned with *Alievium* because of its coarse meshwork of bars forming irregular polygons, rather than a meshwork with triangularly arranged bars typical for the Pseudoaulophacidae.

Alievium (?) sp. B
Plate 3, Fig. 15

Alievium sp. B THUROW 1988, p. 397, pl. 5, fig. 16.

Remarks. – This rare form is comparable with the Albian species of THUROW (1988). It is questionably assigned with the genus *Alievium* on the basis of its subspherical latticed shell which is evenly porous with small circular pores set in polygonal pore frames with small spines at vertices. Poor preservation prevents recognition of the characteristic meshwork for this genus.

Genus ***Amphipyndax*** FOREMAN

Amphipyndax FOREMAN 1966, p. 355.

Type species. – *Amphipyndax enessefi* FOREMAN 1966, p. 356, text-figs. 10, 11a–b.

Amphipyndax stocki (CAMPBELL & CLARK)
Plate 4, Fig. 19

Stichocapsa megalocephalia CAMPBELL & CLARK 1944, p. 44, pl. 8, figs. 26, 34.
Stichocapsa (?) *stocki* CAMPBELL & CLARK 1944, p. 44, pl. 8, figs. 31–33.

Dictyomitra uralica GORBOVETS in Kozlova & Gorbovets 1966, p. 116, pl. 6, figs. 6, 7.
Amphipyndax stocki (CAMPBELL & CLARK), Foreman 1968, p. 78, pl. 8, figs. 12a–c; Petrushevskaya & Kozlova 1972, p. 545, pl. 8, figs. 16, 17; Foreman 1973a, p. 78, pl. 430, pl. 13, fig. 5; Moore 1973, p. 827, pl. 11, fig. 6; Riedel & Sanfilippo 1974, p. 775, pl. 11, figs. 1–3, pl. 15, fig. 11; Pessagno 1975, p. 1016, pl. 4, figs. 4–8; Foreman 1978, p. 745, pl. 4, fig. 4; Nakaseko et al. 1979, p. 21, pl. 6, fig. 17–20; pl. 8, fig. 14, Nakaseko & Nishimura 1982, p. 145, pl. 12, fig. 5; Taketani 1982, p. 52, pl. 2, figs. 9a–b; pl. 10, figs. 13, 14; Yao 1984, pl. 5, fig. 25; Suyari 1986, pl. 3, fig. 1; pl. 5, figs. 10, 11; pl. 9, figs. 1, 2; pl. 10, fig. 5; pl. 11, fig. 10; pl. 12, fig. 6 only; pl. 14, fig. 5; pl. 16, fig. 3; pl. 18, fig. 2; pl. 19, figs. 5, 6; Teraoka & Kurimoto 1986, pl. 4, fig. 8; pl. 5, fig. 17; pl. 6, fig. 15; pl. 7, figs. 14, 15; Iwata & Tajika 1989, pl. 1, fig. 8; Tumanda 1989, p. 35, pl. 7, fig. 11; Ozvoldova 1990, p. 140, pl. 2, fig. 3.
Amphipyndax plousios FOREMAN 1968, p. 78, pl. 8, fig. 11; Foreman 1978, p. 745, pl. 4, fig. 5.
Stichomitra cathara FOREMAN, Renz 1974, p. 797, pl. 11, fig. 17.
Amphipyndax mediocris (TAN), Renz 1974, p. 788, pl. 5, figs. 7–9; pl. 12, fig. 3; Schaaf 1981, p. 431, pl. 3, fig. 11; pl. 22, figs. 7a–b; Nakaseko & Nishimura 1982, p. 144, pl. 12, fig. 6; Thurow 1988, p. 397, pl. 4, fig. 5.
Protostichocapsa stocki (CAMPBELL & CLARK), Empson-Morin 1982, p. 516, text-figs. 1A–F; text-figs. 2D–F; pl. 4, figs. 1–12 (figs. 1–3 = lectotype; figs. 5–6 = paralectotype (= pl. 8, fig. 31 of Cambell & Clark 1944)).
Amphipyndax sp. TAKETANI 1982, p. 52, pl. 10, fig. 16.
Amphipyndax sp. A TUMANDA 1989, p. 16, pl. 9, fig. 2.
cf. *Amphipyndax* sp. RIEDEL & SANFILIPPO 1970, p. 505, pl. 3, fig. 11.
cf. *Lithocampe pseudochrysalis* var. a MOORE 1973, p. 828, pl. 8, figs. 4, 5.
cf. *Amphipyndax alamedaensis* (CAMPBELL & CLARK), Nakaseko & Nishimura 1982, p. 144, pl. 17, fig. 6 only.

Remarks. – *Amphipyndax stocki* shows wide variation and is difficult to distinguish from *A. mediocris*. Herein, all forms with a distinct knob-like cephalis and with postabdominal segments with or without slight external strictures are identified with *A. stocki*. This contrasts with the original illustration of *A. mediocris* by Hok (1927) which shows a hemispherical cephalo-thorax that is continuous with the rest of the conical test and is not a knob-like protrusion.
Range. – (Aptian?) Albian to Maastrichtian.
Occurrence. – California, Japan, Roti, western Siberia, Europe, Pacific, Atlantic and Indian Oceans, Western Australia.

Genus ***Angulobracchia*** BAUMGARTNER

Angulobracchia BAUMGARTNER 1980, p. 310.

Type species. – *Paronaella* (?) *purisimaensis* PESSAGNO 1971.

Angulobracchia crassa OZVOLDOVA
Plate 1, Figs. 1, 6

Hagiastrid gen. sp. indet, FOREMAN 1973b, p. 261, pl. 6, figs. 2, 5, 6 only.
Dictyastrum crassum OZVOLDOVA 1979, p. 10, pl. 2, figs. 1, 3.
?*Angulobracchia crassa* OZVOLDOVA, Ozvoldova & Petercakova 1992, p. 315, pl. 2, figs. 3, 4.
Angulobracchia spp. BAUMGARTNER 1992, p. 318, pl. 3, figs. 5, 6.
Angulobracchia media STEIGER 1992, p. 49, pl. 11, figs. 12, 13.
Angulobracchia (?) *media* STEIGER, Baumgartner 1992, p. 318, pl. 3, figs. 4.

Remarks. – Note the variation in interradial angles between the secondary and tertiary rays.
Range. – Tithonian-Albian.
Occurrence. – Europe, Pacific and Indian Oceans; Western Australia.

Genus *Arachnosphaera* HAECKEL

Arachnosphaera HAECKEL 1860, p. 804.

Type species. – *Arachnosphaera oligacantha* HAECKEL 1860.

Arachnosphaera exilis (Hinde)
Plate 4, Figs. 1–3

Lithocyclia exilis HINDE 1893, p. 223, pl. 5, fig. 8; Lloyd 1963, p. 1–2, fig. 1.
Arachnosphaera exilis (HINDE), Lloyd 1966, p. 121, pl. 16, figs. 1, 3–10; pl. 18, figs. 1, 2; Haig & Barnbaum 1978, fig. 3 W.

Range. – Late Aptian to Early Cenomanian (?).
Occurrence. – Australia.

Genus *Archaeocenosphaera* PESSAGNO & YANG

Archaeocenosphaeria PESSAGNO & YANG in Pessagno et al. 1989, p. 203.

Type species. – *Archaeocenosphaera ruesti* PESSAGNO & YANG 1989 in Pessagno et al. 1989.

Archaeocenosphaera euganea (SQUINABOL)
Plate 2, Figs. 14, 16

Cenosphaera euganea SQUINABOL 1903, p. 109, pl. 8, fig. 1.
Archaeo-"Cenosphaera" boria PESSAGNO 1977b, p. 36, pl. 3, figs. 13, 19 (subsequent assignment in Pessagno et al. 1989, p. 203).

Remarks. – This species is assigned with *A. euganea* based on similar test diameter and number of small circular pores present, about 17 of which can be seen across the maximum diameter of the shell in side view.
Range. – Berriasian-middle Cretaceous (?).
Occurrence. – California, Italy, Western Australia.

Genus *Archaeodictyomitra* PESSAGNO

Archaeodictyomitra PESSAGNO 1976, p. 49; emend. Pessagno 1977b, p. 41.

Type species. – *Archaeodictyomitra squinaboli* PESSAGNO 1976.

Archaeodictyomitra vulgaris PESSAGNO
Plate 5, Figs. 7, 14

Lithocampe lipmanae ALIEV 1965, p. 64, pl. 12, figs. 1–3 only.
Archaeodictyomitra vulgaris PESSAGNO 1977b, p. 44, pl. 6, fig. 15; Schaaf 1981, p. 432, pl. 4, fig. 2; Suyari 1986, pl. 2, fig. 5; pl. 11, fig. 5; pl. 19, fig. 10; Teraoka & Kurimoto 1986, pl. 2, fig. 12; pl. 3, fig. 12; Thurow 1988, p. 398, pl. 6, fig. 19; Tumanda 1989, p. 36, pl. 7, fig. 4 only.
Archaeodictyomitra sp. cf. *A. vulgaris* PESSAGNO, Yao 1984, pl. 4, fig. 6.
cf. *Dictyomitra ordinaria* ALIEV 1965, p. 51, pl. 9, fig. 4.
cf. *Dictyomitra ordinaria* var. *elongata* ALIEV 1965, p. 52, pl. 9, fig. 5.
cf. *Dictyomitra mutabila* ALIEV 1965, p. 53, pl. 9, fig. 6 only.
cf. *Dictyomitra* sp. FOREMAN 1973b, pl. 10, fig. 8.

cf. *Archaeodictyomitra vulgaris* PESSAGNO, Steiger 1992, p. 88, pl. 26, fig. 1.
aff. *Lithocampe lipmanae* var. n. ALIEV 1965, p. 65, pl. 12, fig. 8.
aff. *Archaeodictyomitra* sp. cf. *A. vulgaris* PESSAGNO, Thurow 1988, p. 398, pl. 7, fig. 13.

Remarks. – Included here are all forms with a uniform broad conical outline lacking pronounced constrictions between segments, and with about 20 widely spaced continuous costae per segment.
Range. – Albian; Late Aptian herein.
Occurrence. – California, Europe, central Pacific and North Atlantic Oceans, Western Australia.

Archaeodictyomitra sliteri PESSAGNO
Plate 5, Fig. 15

Dictyomitra costata (SQUINABOL), Petrushevskaya & Kozlova 1972, p. 550, pl. 2, fig. 3.
Dictyomitra sp. A FOREMAN 1975, p. 615, pl. 2G, fig. 18; not pl. 1G, fig. 7; not pl. 2G, figs. 19, 20.
Dictyomitra sp. cf. *Dictyomitra* sp. A FOREMAN (1975), Haig & Barnbaum 1978, fig. 40.
Archaeodictyomitra sliteri PESSAGNO 1977b, p. 43, pl. 6, figs. 3, 4, 22, 23, 27; de Wever & Thiébault 1981, p. 585, pl. 1, fig. 19; Suyari 1986, pl. 2, fig. 7; pl. 13; Teraoka & Kurimoto 1986, pl. 3, fig. 13 only; Tumanda 1989, p. 36, pl. 7, fig. 2; Marcucci et al. 1991, text-figs. 3n–o; (not Steiger 1992, p. 88, pl. 26, fig. 2).
Dictyomitra sp. A TAKETANI 1982, p. 59, pl. 4, figs. 5a–b.
Archaeodictyomitra aff. *A. sliteri* PESSAGNO, Suyari 1986, pl. 2, fig. 8.

Remarks. – Included here are all forms with a slender outline, conical proximally becoming cylindrical distally; with about 20 moderately massive closely spaced continuous costae on postabdominal chambers; with or without slight constrictions.
Range. – Albian to Cenomanian; Late Aptian herein.
Occurrence. – California, Europe, Pacific and North Atlantic Oceans, Australia.

Genus ***Archaeospongoprunum*** PESSAGNO

Archaeospongoprunum PESSAGNO 1973, p. 57.

Type species. – *Archaeospongoprunum venadoensis* PESSAGNO 1973.

Archaeospongoprunum carrierensis PESSAGNO
Plate 3, Figs. 3, 4

Archaeospongoprunum carrierensis PESSAGNO 1977b, p. 29, pl. 1, figs. 6, 7, 9.

Range. – Albian; Late Aptian in this study.
Occurrence. – California, Western Australia.

Archaeospongoprunum diversispina (SQUINABOL)
Plate 3, Fig. 11

Spongoprunum diversispina SQUINABOL 1904, p. 199, pl. 4, fig. 2; Renz 1974, p. 796, pl. 10, fig. 18.
Archaeospongoprunum sp. cf. *A. tehamaensis* PESSAGNO, Thurow 1988, p. 398, pl. 6, fig. 1.

Range. – Middle Cretaceous; Late Aptian in this study.
Occurrence. – Southern Europe, Indian Ocean, Western Australia.

Archaeospongoprunum klingi PESSAGNO
Plate 3, Fig. 7

Archaeospongoprunum klingi PESSAGNO 1977b, p. 29, pl. 2, figs. 21, 23, 24.

Range. – Albian; Late Aptian in this study.
Occurrence. – California, Western Australia.

Archaeospongoprunum sp. cf. *A. praelongum* PESSAGNO
Plate 3, Fig. 6

cf. *Archaeospongoprunum praelongum* PESSAGNO 1977b, p. 30, pl. 2, figs. 4, 13, 18, 19.

Remarks. – Only poorly preserved specimens were observed restricting accurate identification.

Archaeospongoprunum sp. cf. *A. tehamaensis* PESSAGNO
Plate 3, Fig. 5

Spongoprunum sp. aff. *Cyphantus probus* (RÜST), Renz 1974, p. 796, pl. 2, figs. 19–22; pl. 10, fig. 19.
Archaeospongoprunum tehamaensis PESSAGNO, Schaaf 1981, p. 432, pl. 7, fig. 3 only; pl. 10, figs. 7a–b; Schaaf 1984, pl. Hauterivian, fig. 11 only (refigured from Schaaf 1981, pl. 7, fig. 3); (not Pessagno 1973, p. 65, pl. 9, figs. 2, 3; not Pessagno 1976, p. 33, pl. 1, fig. 1; not Pessagno 1977b, p. 30, pl. 2, figs. 3, 9).
Archaeospongoprunum sp. A PESSAGNO 1977b, p. 30, pl. 2, fig. 2.
cf. *Spongoprunum minimum* SQUINABOL 1903, p. 118, pl. 10, fig. 26.

Remarks. – This form is similar to *A. tehamaensis* in that they both possess tetraradiate polar spines which are straight and without torsion. It differs from *A. tehamaensis sensu stricto* by having polar spines which are more slender. *Archaeospongoprunum* sp. cf. *A. tehamaensis* appears to be restricted to the Hauterivian to Albian and may be ancestral to *A. tehamaensis.*

Archaeospongoprunum sp.
Plate 3, Fig. 2

aff. *Archaeospongoprunum* sp. A HAIG & BARNBAUM 1978, fig. 3D.

Remarks. – Test as with genus, elongate, cylindrical with two distinct lobes at each end. Polar spines both triradiate in axial section; torsion of spines not evident due to specimens being incomplete.

Genus ***Artocapsa*** HAECKEL

Artocapsa HAECKEL 1887, p. 438.

Type species. – *Artocapsa fusiformis* HAECKEL 1887.

Artocapsa ultima TAN
Plate 4, Figs. 14, 15

Artocapsa ultima TAN, Hok 1927, p. 74, pl. 16, fig. 143; Renz 1974, p. 788, pl. 6, fig. 24; pl. 11, fig. 13.
Artocapsa livermorensis CAMPBELL & CLARK 1944, p. 45, pl. 8, figs. 19, 21, 27.
?*Stichomitra livermorensis* (CAMPBELL & CLARK), Foreman 1968, p. 76, pl. 8, fig. 2b only.
aff. *Stichomitra* (?) sp. B THUROW 1988, p. 406, pl. 4, fig. 22.

Remarks. – The species illustrated here generally agree with the description for *A. ultima* (and for ?*S. livermorensis* FOREMAN 1968, p. 76). They differ by being more slender with distinct strictures separating post-thoracic segments and by having lateral spines on the final postabdominal chambers.
Range. – Middle Cretaceous to Campanian; Late Aptian in this study.
Occurrence. – Roti, California, Indian and Atlantic Oceans, Western Australia.

Genus ***Crucella*** PESSAGNO

Crucella PESSAGNO 1971, p. 52.

Type species. – *Crucella messinae* PESSAGNO 1971.

Crucella messinae PESSAGNO
Plate 2, Figs. 1–4

Crucella messinae PESSAGNO 1971, p. 56, pl. 6, figs. 1–3; Foreman 1975, p. 612, pl. 1 D, figs. 8, 9; pl. 5, fig. 2; Pessagno 1976, p. 32, pl. 1, fig. 4 (refigured holotype of Pessagno 1971, pl. 6, fig. 1); Pessagno 1977b, p. 27, pl. 1, figs. 3, 4, 13; Taketani 1982, p. 50, pl. 9, fig. 17; Thurow 1988, p. 399, pl. 5, fig. 22; Koutsoukos & Hart 1990, p. 54, pl. 2, figs. 7, 8.
cf. *Crucella espartonensis* PESSAGNO, Renz 1974, pl. 1, fig. 12 only.
cf. *Crucella* sp. B. THUROW 1988, p. 399, pl. 2, fig. 15.

Remarks. – Note increased development of patagium with progressively larger specimens. The transmitted light form illustrated by Renz (1974) appears to lack a lacuna characteristic for *C. espartonensis*, it is tentatively assigned to *C. messinae* herein.
Range. – Approximately Aptian to Late Cenomanian.
Occurrence. – Southern Europe, North Atlantic, Pacific and Indian Oceans, Western Australia.

Crucella sp.
Plate 2, Fig. 8

Remarks. – This rare form possess a central lacuna somewhat similar to *C. espartoensis*.

Genus ***Cyrtocalpis*** HAECKEL

Cyrtocalpis HAECKEL 1860, p. 835.

Type species. – *Cyrtocalpis amphora* HAECKEL 1862.

Cyrtocalpis operosa TAN
Plate 5, Figs. 19, 25

Cyrtocalpis operosa TAN 1927, p. 40, pl. 7, fig. 27; Riedel & Sanfilippo 1974, p. 778, pl. 4, figs. 1–3; pl. 14, fig. 10.
?*Cyrtocalpis operosa* TAN, Renz 1974, p. 778, pl. 4, figs. 15, 16; pl. 12, fig. 8.
Cyrtocalpis sp. aff. *C. operosa* TAN, Foreman 1978, p. 746, pl. 5, fig. 6.
cf. *Cyrtocalpis operosa* TAN, Yao 1979, p. 25, pl. 1, figs. 1–9.

Range. – Valanginian to middle Cretaceous.
Occurrence. – Roti, Atlantic and Indian Oceans, Western Australia.

Genus *Dicanthocapsa* SQUINABOL

Dicanthocapsa SQUINABOL 1903, p. 133; emend. Dumitrica 1970, p. 61.

Type species. – *Dicanthocapsa euganea* SQUINABOL 1903.

Dicanthocapsa sp. cf. *D. ancus* (FOREMAN)
Plate 5, Fig. 20

Dicanthocapsa cf. *ancus* (FOREMAN), Dumitrica 1970, p. 64, pl. 6, figs. 35a–b; pl. 7, fig. 40; pl. 20, fig. 125; Nakaseko & Nishimura 1982, p. 149, pl. 5, fig. 5.
Theocapsomma sp. FOREMAN 1971, p. 1681, pl. 5, figs. 8, 9 only.
Dicanthocapsa sp. B RENZ 1974, p. 790, pl. 11, fig. 18.
cf. *Theocapsomma* sp. RIEDEL & SANFILIPPO 1970, p. 505, pl. 3, fig. 1.
cf. *Dicanthocapsa* sp. PETRUSHEVSKAYA & KOZLOVA 1972, p. 790, pl. 7, fig. 4 only.
cf. *Dicanthocapsa* sp. TERAOKA & KURIMOTO 1986, pl. 5, figs. 6–7.

Remarks. – This species differs from those illustrated by Foreman (1971) and Renz (1974) by having a more inflated abdomen. Its poor preservation and scarcity prevents accurate identification.

Genus *Gongylothorax* FOREMAN emend. Dumitrica

Gongylothorax FOREMAN 1968, p. 19; emend. DUMITRICA 1970, p. 56.

Type species. – *Gongylothorax verbeeki* (TAN), Foreman 1968.

Gongylothorax cephalocrypta (TAN)
Plate 4, Fig. 16

Dicolocapsa cephalocrypta TAN 1927, p. 44, pl. 8, fig. 42.
Dicolocapsa exquisita TAN 1927, p. 44, pl. 8, fig. 43.
Gongylothorax verbeeki (TAN), Haig & Barnbaum 1978, text-fig. 4V; Schaaf 1981, p. 434, pl. 1, figs. 1a, b; pl. 9, figs. 9a, b; Tumanda 1989, p. 37, pl. 8, fig. 18; (not Foreman 1968, p. 20, pl. 2, figs. 8a–c; not Dumitrica 1970, p. 57, pl. 1, figs. 6a–b; pl. 2, figs. 7–10; not Foreman 1973a, p. 429, pl. 13, fig. 4; not Wu & Li 1982, p. 66, pl. 1, fig. 10).
cf. *Dicolocapsa verbeeki* TAN 1927, p. 44, pl. 8, figs. 40, 41.
cf. *Gongylothorax favosus* DUMITRICA 1970, p. 56, pl. 1, figs. 1a–c, 2; Matsuoka 1986, pl. 2, fig. 5; (not Wu & Li 1982, pl. 1, figs. 8, 9).
aff. *Dicolocapsa* aff. *abbreviata* NEVIANI, Heitzer 1930, p. 394, pl. 28, fig. 40.

Remarks: This rare form compares well with the original description and illustration for *G.* (= *Dicolocapsa*) *cephalocrypta*. It is placed with *Gongylothorax sensu* DUMITRICA on the basis of its poreless cephalis being partly encased in an inflated thorax and in possessing a restricted aperture. A relatively large, simple sutural pore is located on the upper surface near the cephalis. Foreman (1968, p. 20) remarked that *G. cephalocrypta* lacked angular pore frames. However, Tan (1927, p. 44) clearly describes the thorax having a "... rugged upper surface ...". This is evident in his illustration and is interpreted here as the polygonal nature of the pore frames surrounding depressed pores. *Gongylothorax cephalocrypta* differs from both *G. verbeeki* and to *G. favosus sensu stricto* (1) in the elongate ovoid shape of the thoracic segment; (2) the size of the poreframes on the thorax, and (3) in the characteristics of the sutural pore. Species with spherical thoracic segments and assignable with *G. verbeeki* or with *G. favosus* have not been observed in

our samples. *G. favosus* possesses a narrow circular sutural pore; and in *G. verbeeki* a large simple sutural pore develops only in younger (Campanian-Maastrichtian) species. Future work will clarify whether the specific criteria used here are valid. However, it is probable that *G. favosus* is ancestral to *G. cephalocrypta* (with the development of an elongate thoracic segment and large simple sutural pore in the Aptian-Albian), and separately (?) to *G. verbeeki* (with the development of smaller poreframes (?) and modification of the sutural pore).
Range. – (Upper Calovian-Oxfordian?) Late Barremian-middle Cretaceous.
Occurrence. – Japan, Tibet, Roti, southern Europe, central Pacific Ocean, Australia.

Genus ***Haliomma*** PESSAGNO

Haliomma EHRENBERG 1838, p. 128.

Type species. – *Haliomma aequoreum* EHRENBERG 1844.

Haliomma sp.
Plate 2, Figs. 10, 13

aff. *Haliomma minor* CAMPBELL & CLARK, Renz 1974, p. 793, pl. 9, fig. 8.
Actinomma sp. LING & LAZARUS 1990, p. 355, pl. 1, fig. 3; pl. 4, fig. 7.

Remarks. – Spherical to sub-spherical with 2 concentrically arranged lattice shells. Cortical shell latticed with large circular to elliptical pores set in thick irregular polygonal pore frames. About 6 thin triradiate spines radially arranged, and continuous with massive triradiate radial beams connecting cortical shell with medullary shell. First medullary shell with large polygonal pore frames and pores.

Genus ***Hemicryptocapsa*** TAN

Hemicryptocapsa TAN 1927, p. 50.

Type species. – *Hemicryptocapsa capita* TAN 1927.

Hemicryptocapsa sp. cf. *H. simplex* DUMITRICA
Plate 4, Figs. 21, 23

cf. *Hemicryptocapsa simplex* DUMITRICA 1970, p. 74, pl. 16, figs. 104a–b; pl. 21, figs. 142–148 (?).

Remarks. – *Hemicryptocapsa* sp. cf. *H. simplex* differs from *H. simplex* by having a less encased thorax. It shows similarities with the late Jurassic *Williriedellum caparthicum* DUMITRICA; it is possible that these three forms are closely related.

Genus ***Histiastrum*** EHRENBERG

Histiastrum EHRENBERG 1847a, p. 386.

Type series. – *Histiastrum quaternarium* Ehrenberg 1875, subsequent designation Haeckel 1887.

Histiastrum aster LIPMAN
Plate 3, Fig. 21

Histiastrum aster LIPMAN 1952, p. 35, pl. 2, figs. 6, 7; Lipman 1962, p. 300, pl. 2, fig. 5; Kozlova & Gorbovets 1966, p. 84, pl. 3, fig. 9; Schaaf 1981, p. 435, pl. 8, fig. 1; pl. 11, fig. 5; Schaaf 1984, pl. Albien, fig. 2 (refigured from Schaaf 1981, pl. 8, fig. 1).

Range. – Hauterivian-Campanian.
Occurrence. – Siberia, Pacific and Indian Oceans, Western Australia.

Genus ***Holocryptocanium*** DUMITRICA

Holocryptocanium DUMITRICA 1970, p. 75.

Type species. – *Holocryptocanium tuberculatum* DUMITRICA 1970.

Holocryptocanium barbui barbui DUMITRICA
Plate 4, Fig. 24

Holocryptocanium barbui DUMITRICA 1970, p. 76, pl. 17, figs. 105a–108a; pl. 21, fig. 136; Petrushevskaya & Kozlova 1972, pl. 1, fig. 3; Foreman 1975, p. 618, pl. 1 F, fig. 9; pl. 6, fig. 13; Schaaf 1981, p. 435, pl. 2, figs. 1a, b; pl. 10, figs. 6a, b; Taketani 1982, p. 67, pl. 7, figs. 1a–b; [?]pl. 13, figs. 18, 19, 21; Baumgartner 1984, p. 768, pl. 4, fig. 14; Yao 1984, pl. 5, fig. 1; Sanfilippo & Riedel 1985, p. 614, text-fig. 12, figs. 2a–c; Teraoka & Kurimoto 1986, pl. 2, fig. 1; pl. 4, fig. 1.
Holocryptocanium japonicum NAKASEKO & NISHIMURA in Nakaseko et al. 1979, p. 23, pl. 5, figs. 8, 10; Taketani 1982, p. 67, pl. 7, figs. 2a, b, 3; pl. 13, fig. 21.
Holocryptocanium barbui japonicum NAKASEKO & NISHIMURA, Nakaseko & Nishimura 1982, p. 154, pl. 3, figs. 5–7; pl. 14, fig. 10; Suyari 1986, pl. 9, fig. 9; Suyari & Kuwano 1986, pl. 3, fig. 4.
Holocryptocanium sp. SCHAAF 1981, pl. 2, fig. 8; Suyari 1986, pl. 4, fig. 9.
Holocryptocanium barbui barbui DUMITRICA, Baumgartner 1992, p. 321, pl. 7, fig. 4.

Range. – (Tithonian?) Late Berriasian-Cenomanian.
Occurrence. – Southern Europe, North Atlantic, Pacific and Indian Oceans, Western Australia.

Genus ***Mesosaturnalis*** KOZUR & MOSTLER emend. de Wever

Mesosaturnalis KOZUR & MOSTLER 1981, p. 57; emend. DE WEVER 1984, p. 17.

Type species. – *Palaeosaturnalis levis* DONOFRIO & MOSTLER 1978.

Mesosaturnalis sp.
Plate 3, Fig. 12

aff. *Spongosaturnalis* sp. aff. *Saturnalis polymorphus* (SQUINABOL), Renz 1974, p. 797, pl. 2, fig. 5; pl. 9, fig. 22 (refigured pl. 2, fig. 5).

Remarks. – Saturnalids are rarely recovered from the Windalia Radiolarite, mainly as a result of their fragile nature and breakage during sediment lithification. Tentative comparison with Renz's (1974) specimens is based on similar shape of the ring structure and because her material was recovered from a relatively nearby locality in the eastern Indian Ocean. However, without more complete specimens specific assignment is not possible.

Genus *Mita* PESSAGNO

Mita PESSAGNO 1977b, p. 44.

Type species. – *Mita magnifica* PESSAGNO 1977.

Mita sp.
Plate 5, Fig. 13

Mita sp. B PESSAGNO 1977b, p. 45, pl. 7, fig. 6.
Mita sp. A THUROW 1988, p. 402, pl. 3, fig. 1.
aff. *Archaeodictyomitra squinaboli* PESSAGNO, Suyari 1986, pl. 2, fig. 3 only.

Remarks. – This species shows some similarities with *Archaeodictyomitra squinaboli.* Further comparison is not made here due to the scarcity of *Mita* sp., its smaller size and poor state of preservation.

Genus *Napora* PESSAGNO

Napora PESSAGNO 1977a, p. 94.

Type species. – *Napora bukryi* PESSAGNO 1977a.

Napora dumitricai PESSAGNO
Plate 2, Figs. 5, 6

Tripilidium (?) sp. A FOREMAN 1973b, p. 265, pl. 10, figs. 13–15.
Tripilidium (?) sp. C FOREMAN 1973b, p. 265, pl. 10, fig. 19.
Napora (= *Ultranapora*) *dumitricai* PESSAGNO 1977b, p. 38, pl. 5, figs. 7, 16, 17, 21.
cf. *Tripilidium obliquum* HINDE 1900, p. 26, pl. 2, fig. 9.
cf. *Dictyophimus obliquum* (HINDE), Renz 1974, p. 791, pl. 5, fig. 17; pl. 11, fig. 1.

Remarks. – Note flanging at the top of the (broken) polar spine indicating the base of subsidiary spines in figure 6. Foreman (1973) records this species from the Valanginian-Early Hauterivian. Pessagno (1977b) regarded the range of this species from his Californian assemblages to be Middle-Late Albian and explained the conclusions of Foreman (1973) to result from reworking or downhole contamination. The presence of *N. dumitricai* in the Windalia assemblage indicates the range of this form must extend into at least the Late Aptian.
Range. – (Valanginian?) Middle-Late Albian; Late Aptian herein.
Occurrence. – Borneo, Pacific and eastern Indian Oceans, Western Australia.

Napora sp. cf. *N. durhami* PESSAGNO
Plate 2, Fig. 7

Tripilidium (?) sp. B FOREMAN 1973b, p. 265, pl. 10, figs. 16–18.
cf. ?*Tricalpis ellyae* TAN, Renz 1974, p. 798, pl. 5, figs. 18, 19; pl. 11, fig. 10 (refigured pl. 5, fig. 18).
cf. *Dictyophimus* sp. A HAIG & BARNBAUM 1978, fig. 4d only.
cf. *Napora* (= *Ultranapora*) *durhami* PESSAGNO 1977b, p. 38, pl. 5, figs. 7, 16, 17, 21; de Wever & Thiébault 1981, p. 594; pl. 2, fig. 5; Thurow 1988, p. 402, pl. 5, fig. 3; Ling & Lazarus 1990, p. 356, pl. 3, fig. 15; pl. 5, fig. 1.

Nassellariina gen. and sp. indet.
Plate 4, Fig. 20

Remarks. – Test with 5–6 segments, conical becoming ovoid distally, without aperture. Cephalis spherical, imperforate. The cephalis is questionably slightly encased by the thorax. Thorax trapezoidal, partly porous with simple circular thoracic opening. Abdomen trapezoidal with large simple sutural pore. First and second postabdominal chambers trapezoidal, increasing gradually in width; final postabdominal chamber truncate spherical, decreasing in width rapidly. Abdomen and postabdominal chambers with coarse circular-elliptical pores set in polygonal (dominantly hexagonal) pore frames. This rare species could not be assigned to any meaningful generic classification due to the number of segments or to the presence of the large sutural pore or both.

Genus ***Orbiculiforma*** PESSAGNO

Orbiculiforma PESSAGNO 1973, p. 71.

Type species. – *Orbiculiforma quadrata* PESSAGNO 1973.

Orbiculiforma depressa WU
Plate 1, Fig. 21

Orbiculiforma depressa WU 1986, p. 355, pl. 1, figs. 3, 6, 9, 22.

Range. – Early Cenomanian; Late Aptian-Early Albian herein.
Occurrence. – Tibet, Western Australia.

Orbiculiforma mclaughlini PESSAGNO
Plate 1, Fig. 20

Orbiculiforma mclaughlini PESSSAGNO 1977a, p. 74, pl. 4, figs. 4–7.
cf. *Spongodiscus* sp. cf. *S. americanus* KOZLOVA, Renz 1974, p. 796, pl. 3, fig. 12; pl. 10, fig. 6.
cf. *Orbiculiforma* sp. A PESSAGNO 1977b, p. 28, pl. 1, fig. 19.

Range. – Late Kimmeridgian-Early Tithonian; Late Aptian – Early Albian herein.
Occurrence. – California, Western Australia.

Orbiculiforma sp.
Plate 1, Fig. 19

Orbiculiforma spp. BAUMGARTNER 1992, pl. 7, fig. 11 only.
cf. Spongodiscid, gen. & sp. indet. FOREMAN 1971, pl. 5, fig. 2 only.
cf. *Orbiculiforma railensis* PESSAGNO, Baumgartner 1992, pl. 7, figs. 9, 10.

Remarks. – This species is characterized by a polygonal test with a thin periphery and coarser meshwork. Central cavity moderately deep with a raised central area, and having 9–10 (possibly more?) spines. It is similar to the forms illustrated by Baumgartner (1992) which differ only by having more numerous spines which are bladed and not spongy.

Genus ***Paronaella*** PESSAGNO sensu BAUMGARTNER

Paronaella PESSAGNO 1971, p. 46; emend. BAUMGARTNER 1980, p. 300.

Type species. – *Paronaella solanoensis* PESSAGNO 1971.

Paronaella (?) *diastimusphere* n. sp.
Plate 1, Figs. 9, 11, 15

Description. – Test with three rays, primary ray often slightly longer, with two prominent lateral spines and one central spine at ray tips. Distinctive large disc-shaped central area (not patagium) with irregular tetragonal, pentagonal and hexagonal pore frames. Rays elliptical in axial section; pore frames rectangular or slightly polygonal with linear arrangement. Inter-radial angles generally equal (not considered to be diagnostic). This form is tentatively assigned as *Paronaella* until further internal examination is undertaken positively identifying the lack of a bracchiopyle.
Remarks. – *Paronaella* (?) *diastimusphere* n. sp. differs from all other species of *Paronaella* by its large disc-shaped central area.
Measurements.

measurement of 15 specimens (µm)	Average	Min.	Max.	Holotype:
length of rays:	225	190	255	AX: 230 BX: 195 CX: 215
width of rays:	100	75	125	105
diameter of central area:	240	190	365	255

Etymology. – Greek. *diastam*, space + *sphaira*, sphere – with reference to the saucer shape of the central area.
Holotype. – Basel Museum C-37099 (paratypes registered with C-37100 and C-37101).
Range. – Late Aptian-Early Albian.
Occurrence. – Western Australia.

Paronaella sp.
Plate 1, Fig. 2

Remarks. – Distinctive but rare form with inflated ray tips and with open inter-radial angle between second and tertiary rays. Ray structure of *Paronaella* sp. resembles that of *P. petroleumensis* PESSAGNO, however, the scarcity and poor preservation does not permit accurate comparison.

Paronaella (?) sp.
Plate 1, Fig. 3

Remarks. – Only a few specimens observed; poor preservation restricts accurate identification.

Paronaella spp.
Plate 1, Figs. 5, 10, 13

Remarks. – Includes all forms with ray tips moderately to greatly inflated and with a central spine flanked by 2 or more lateral spines.

Genus *Patellula* Kozlova emend. Empson-Morin

Patellula Kozlova in Petrushevskaya & Kozlova 1972, p. 527; emend. Empson-Morin 1981, p. 257.

Type species. – *Stylospongia planoconvexa* Pessagno 1963.

Patellula sp.
Plate 3, Fig. 20

Patellula planoconvexa (Pessagno), Schaaf 1981, p. 436, pl. 8, fig. 9.

Remarks. – This species compares well with the Albian form illustrated by Schaaf (1981). It differs, however, from the type species of *P. planoconvexa* (Pessagno) by being biconvex with a tholus-type structure on both sides of the test.

Genus *Patulibracchium* Pessagno

Patulibracchium Pessagno 1971, p. 26.

Type species. – *Patulibracchium davisi* Pessagno 1971.

Patulibracchium sp.
Plate 1, Figs. 4, 8

?Spongodiscid, gen. & sp. indet. Foreman 1971, p. 1681, pl. 5, fig. 4 only.

Remarks. – Distinctive three-ray test with bracchiopyle; pore frames irregular and spongy in central area, becoming more aligned and polygonal on distal half of each arm. Ray tips with large cylindrical central spine, flanked by two stout triangular spines. With or without patagium.

Patulibracchium (?) sp.
Plate 1, Figs. 7, 12, 16, 17

Rhopalodictyum sp. Renz 1974, pl. 3, figs. 10, 11; pl. 10, fig. 2.
cf. *Euchitonia novalensis* Squinabol 1914, p. 277, pl. 21, fig. 7.

Remarks. – This form has a characteristic raised triangular-shaped central area. A bracchiopyle could not be positively identified and it is questionably assigned as *Patulibracchium.*
Range. – Aptian-Senonian (?).
Occurrence. – Southern Europe (?), Indian Ocean, Western Australia.

Genus *Praeconocaryomma* Pessagno

Praeconocaryomma Pessagno 1976, p. 40.

Type species. – *Praeconocaryomma universa* Pessagno 1976.

Praeconocaryomma excelsa n. sp.
Plate 3, Figs. 22–24

aff. *Cenosphaera disseminata* Rüst 1885, p. 16, pl. 27, fig. 4.
aff. *Astrophacus* sp. A Hinde 1893, p. 223, pl. 5, figs. 4 (?), 5.

Description. – Test spherical to ellipsoidal. Cortical shell with numerous large prominent mammae, radially arranged, and rising perpendicularly. Tops and distal third of mammae imperforate; tops flattened, rectangular to hexagonal in outline. Base of mammae with large elongate pores, separated by vertical circular bars that project into intermammary areas and irregularly bifurcate and trifircate linking up with rays of neighbouring mammae. With broken specimens, bars thicker and flattened under mammae and continuous. Small nodes present at ray bi-, trifurcations. Intermammary areas with irregular small polygonal pores. First medullary shell approximately one third the diameter of the cortical shell, with small polygonal pore frames with subcircular to polygonal pores; connected to cortical shell by 6–10 (?) thick, bladed radial beams. Structure of second and third medullary shell unknown.

Remarks. – *Praeconocaryomma excelsa* n. sp. is grossly similar with *P. immodica* PESSAGNO & POISSON (1979) from the Jurassic. It differs form *P. immodica*, (1) by possessing considerably more mammae (approximately 60 mammae can be seen in lateral view on well preserved specimens compared with about 35 mammae for *P. immodica*); (2) by possessing mammae that are, on average, thinner (avg. 20 μm, range 17–29 μm for *P. excelsa*, compared with avg. 35 μm, range 25–40 μm, for *P. immodica*); (3) by having mammae that are more closely spaced and with rays that rise more vertically; (4) by having a first medullary shell with coarse polygonal pore frames rather than a triangular meshwork; and (5) by having a first medullary shell connected to the cortical shell by only 6–10 massive radial beams.

The increase in the number of prominent mammae and complexitity of the intermammary areas suggest that *P. excelsa* is a continuation of the Jurassic *P. parvimamma* lineage group discussed by Pessagno & Poisson (1979, p. 57–59). However, the first medullary shell of species in the *P. parvimamma* lineage group is distinctly different from that of *P. excelsa* making any direct relationship unlikely.

Measurements.

measurement of 22 specimens (μm)	Average	Min.	Max.	Holotype:
diameter of cortical shell	250	210	270	235
height of mammae	20	15	30	20
diameter of first medullary: (2 specimens)	60			

Etymology. – Latin excellsus-a-um, rise, with reference to the raised mammae.
Holotype. – Basel Museum C-37154 (paratypes registered with C-37155 and C-37156).
Range. – Late Aptian-Early Albian.
Occurrence. – Western Australia.

Praeconocaryomma lipmanae PESSAGNO
Plate 2, Fig. 18

Praeconocaryomma lipmanae PESSAGNO 1976, p. 41, pl. 4, figs. 12, 13; Taketani 1982, p. 47, pl. 9, fig. 3.
Conocaryomma lipmanae (PESSAGNO), Thurow 1988, p. 590, pl. 5, fig. 9.

Range. – Late Albian to Turonian; late Aptian in this study.
Occurrence. – Japan, California, north Atlantic Ocean, Western Australia.

Praeconocaryomma prisca PESSAGNO
Plate 3, Figs. 16, 17

Praeconocaryomma prisca PESSAGNO 1977b, p. 33–34, pl. 3, fig. 20.

Range. – Valanginian; Late Aptian – Early Albian in this study.
Occurrence. – California, Western Australia.

Genus ***Protoxiphotractus*** PESSAGNO

Protoxiphotractus PESSAGNO 1973, p. 81.

Type species. – *Protoxiphotractus perplexus* PESSAGNO 1973.

Protoxiphotractus (?) *rugosa* TAN
Plate 3, Fig. 1

Ellipsoxiphus rugosa TAN 1927, p. 37, pl. 6, fig. 12.

Remarks. – This rare form is tentatively assigned with *Protoxiphotractus* on the basis of its subspherical latticed cortical shell with coarse polygonal meshwork and two short polar spines which tend to be elliptical in axial section towards their tips. It displays similarities with *Acaeniotyle starka* Empson-Morin but lacks a strongly nodose surface and spine bases. Internal structure of test unknown.
Range. – Middle Cretaceous; Late Aptian in this study.
Occurrence. – Roti, Western Australia.

Genus ***Pseudodictyomitra*** PESSAGNO

Pseudodictyomitra PESSAGNO 1977b, p. 50.

Type species. – *Pseudodictyomitra pentacolaensis* PESSAGNO 1977b.

Pseudodictyomitra lodogaensis PESSAGNO
Plate 4, Figs. 18, 19

Pseudodictyomitra lodogaensis PESSAGNO 1977b, p. 50, pl. 8, figs. 4, 21, 28; Nakaseko & Nishimura 1982, p. 159, pl. 9, fig. 5; Taketani & Kanie 1992, text-fig. 5.1; (not Schaaf 1981, p. 437, pl. 3, fig. 5; not Yao 1984, pl. 5, fig. 14; not Thurow 1988, p. 405, pl. 3, fig. 12).
Dictyomitra sp. C HAIG & BARNBAUM 1978, fig. 4I.
Pseudodictyomitra vestalensis PESSAGNO, Thurow 1988, p. 405, pl. 8, fig. 15.
Dictyomitra ex. gr. *multicostata* ZITTEL, Koutsoukos & Hart 1990, p. 53, pl. 1, figs. 4, 5 (6, 7?).
Pseudodictyomitra pentacolaensis PESSAGNO, Ling & Lazarus 1990, P. 405, pl. 2, figs. 11, 12; pl. 4, figs. 5–7.
cf. *Zifondium* (?) sp. YAO 1984, pl. 4, fig. 5.

Range. – Aptian to Cenomanian.
Occurrence. – California, Japan, Brazil, central Pacific and North Atlantic Oceans, Weddell Sea, Australia.

Genus *Spongatractus* HAECKEL

Spongatractus HAECKEL 1887, p. 350.

Type species. – *Spongosphaera pachystyla* EHRENBERG 1873.
Remarks. – Included with *Spongatractus* are all forms with a thick ellipsoidal spongy cortical shell and a single medullary shell, and with a single spine at each of the 2 poles. The synonymy of *Spongotractus* HAECKEL with *Spongosphaera* EHRENBERG as suggested by Cambell (1954, D74) is not followed here.

Spongatractus biconstrictus RÜST
Plate 4, Fig. 9

Ellipsoxiphus biconstrictus RÜST 1898, p. 16, pl. 5, fig. 8.
cf. *Spongodruppa cocos* RÜST, Tumanda 1989, p. 35, pl. 7, fig. 9.

Remarks. – Rüst (1898) described *S. biconstrictus* having a smooth surface of irregularly dispersed middle-sized pores. We interpret this as suggesting a spongy cortical shell, analogous with the specimens illustrated herein, despite his illustration presenting a cortical shell with coarse pores. *Spongatractus biconstrictus* differs from Tumanda's (1989) *S. cocos* by possessing spines at each of the poles.
Range. – Late Jurassic-Early Cretaceous; late Aptian-Early Albian in this study.
Occurrence. – Southern Europe, Japan (?), Western Australia.

Spongatractus sp. cf. *S. biconstrictus* RÜST
Plate 4, Fig. 10

cf. ?*Spongodruppa cocos* RÜST, Schaaf 1981, p. 439, pl. 6, fig. 13; pl. 15, figs. 4a, b.
cf. *Spongodruppa cocos* RÜST, Schaaf 1984, pl. Albien, fig. 3 (refigured from Schaaf 1981, pl. 6, fig. 13).

Remarks. – *Spongotractus* sp. A is more inflated than *S. biconstrictus*. Internal structure is identicle to Schaafs (1981, 1984) *S. cocos* but it differs by possessing polar spines.

Genus *Spongodiscus* EHRENBERG

Spongodiscus EHRENBERG 1854, p. 246.

Type species. – *Spongodiscus resurgens* EHRENBERG 1854.

Spongodiscus renillaeformis CAMPBELL & CLARK
Plate 1, Figs. 14, 18

Spongodiscus renillaeformis CAMPBELL & CLARK 1944, p. 18, pl. 6, figs. 5, 6, 8, 10; Schaaf 1981, p. 438, pl. 8, fig. 4 only; pl. 13, fig. 9; pl. 15, fig. 1; Schaaf 1984, p. 160, pl. Albien, fig. 1 (refigured Schaaf 1981, p. 438, pl. 8, fig. 4).
Spongodiscus impressus LIPMAN in Kozlova & Gorbovets 1966, p. 87, pl. 4, figs. 8, 9.
aff. *Orbiculiforma* spp. BAUMGARTNER 1992, pl. 7, fig. 12 only.

Remarks. – Note the large variation in size between specimens.
Range. – Albian-Lower Cenomanian (Campanian?); Late Aptian-Early Albian herein.
Occurrence. – Southern Europe, eastern Indian Ocean, Western Australia.

Genus *Spongopyle* DREYER

Spongopyle DREYER 1889, p. 42.

Type species. – *Spongopyle setosa* DREYER 1889, subsequent designation Campbell 1954.
Remarks. – There are several species of *Cyrtocalpis* described by Rüst (1885) which conform with *Spongopyle* as used here, however, no reference is made to their internal structure making any accurate comparison impossible.

Spongopyle ecleptos RENZ
Plate 2, Fig. 21

Spongopyle ecleptos RENZ 1974, p. 796, pl. 3, figs. 2–6; pl. 10, fig. 14; Schaaf 1981, p. 439, pl. 17, figs. 2a–b, 9.
Spongopyle insolita KOZLOVA group, Riedel & Sanfilippo 1974, p. 780, pl. 2, fig. 10 only.
aff. *Cyrtocalpis minima* RÜST 1885, p. 302, pl. 25, fig. 6.

Remarks. – This species shows no internal structure. In reflected light it can be distinguished from *S. stauromorphos* by its flattened central area and flared pylome, the latter species has a more inflated central region.
Range. – Late Jurassic to Campanian.
Occurrence. – Eastern Indian Ocean, Western Australia.

Spongopyle galeata RENZ
Plate 4, Fig. 8

Spongopyle galeata RENZ 1974, p. 796, pl. 10, fig. 8.

Remarks. – *Spongopyle galeata* is easily identified by its large size and no internal structure (compare with *S. ecleptos* and *S.* sp. cf. *S.* sp. cf. *S. insolita*).
Range. – Middle Cretaceous; Late Aptian in this study.
Occurrence. – Eastern Indian Ocean, Western Australia.

Spongopyle stauromorphos RENZ
Plate 2, Fig. 11

Spongopyle stauromorphos RENZ 1974, p. 796, pl. 3, figs. 1a–b; pl. 10, fig. 9.
Spongopyle sp. SCHAAF 1981, pl. 17, figs. 1a–b.

Remarks. – Internal examination shows a central area with about 6 narrow concentric rings conforming with the original description.
Range. – Barremian (?) to middle Cretaceous.
Occurrence. – Central Pacific and eastern Indian Ocean, Western Australia.

Spongopyle sp. cf. *S. insolita* KOZLOVA
Plate 2, Fig. 20

cf. *Spongopyle insolita* KOZLOVA in Kozlova & Gorbovets 1966, p. 91, pl. 4, figs. 11a–b; Riedel & Sanfilippo 1970, p. 505, pl. 2, fig. 2; Petrushevskaya & Kozlova 1972, pl. 5, fig. 10; Renz 1974, p. 796, pl. 3, figs. 7–8; pl. 10, fig. 10.
cf. *Spongopyle insolita* KOZLOVA group, Riedel & Sanfilippo 1974, p. 780, pl. 2, fig. 7–9, 11 only; pl. 14, fig. 4.

Remarks. – This species is only tentatively compared with *S. insolita* as internal examination shows a central area with about 6–7 narrow concentric rings rather than about

4–5 rings which are wide apart. It differs from *S. stauromorphos* by being considerably smaller and by lacking spines.

Genus ***Spongotripus*** HAECKEL

Spongotripus HAECKEL 1881, p. 461.

Type species. – *Spongotripus regularis* HAECKEL 1887.

Spongotripus sp. cf. *Tripodictya triacummata* LIPMAN
Plate 3, Fig. 19

Spongotripus sp. cf. *Tripodictya triacummata* LIPMAN, Renz 1974, p. 797, pl. 10, fig. 3.
cf. *Tripodictya triacummata* LIPMAN 1952, p. 33, pl. 2, fig. 2.
cf. *Spongotripus* sp. PETRUSHEVSKAYA & KOZLOVA 1972, p. 528, pl. 21, fig. 2.

Remarks. – This rare form compares well with the early Cretaceous specimens from Renz (1974), but lacks triradiate spines allowing only tentative comparison. *Spongotripus* sp., although similar, is Eocene in age.

Genus ***Staurocyclia*** HAECKEL

Staurocyclia (= *Coccostaurus*) HAECKEL 1881, p. 458.

Type species. – *Staurocyclia* (= *Coccostaurus*) *cruciata* HAECKEL 1881.

aff. *Staurocyclia martini* RÜST
Plate 3, Fig. 18

Spongodiscid 1 gen. and sp. indet. RENZ 1974, p. 796, pl. 3, fig. 9; pl. 10, fig. 4.
aff. *Staurocyclia martini* RÜST 1898, p. 21, pl. 6, fig. 11; Schaaf 1981, p. 439, pl. 11, figs. 2a, b; Thurow 1988, p. 406, pl. 10, fig. 8.

Remarks. – This form is questionably assigned to *S. martini* as it lacks the circular arrangement of nodes (tholus?) in the central area.
Range. – Barremian-Early Aptian; Late Aptian this study.
Occurrence. – Southern Europe, north Atlantic and central Pacific Ocean, Western Australia.

Genus ***Stichocapsa*** HAECKEL

Stichocapsa HAECKEL 1881, p. 439.

Type species. – *Stichocapsa jaspidea* RÜST 1885.
Remarks. – Many species belonging with *Stichocapsa* have previously been included with *Stichomitra* Cayeux. However, the designation of *S. costata* as a type species for *Stichomitra* by Chediya 1959 (reference not available to the author) made this genus synonymous with *Dictyomitra* (as indicated by Campbell 1954, D 140; Petrushevskaya & Kozlova 1972, p. 545 and later by Sanfilippo & Riedel 1985, p. 622). Pessagno (1976, p. 54) improperly indicated *S. jaspidea* as a type species for *Stichomitra* in the sense of

the description for the genus made by Foreman (1968, p. 71). *Stichomitra sensu* FOREMAN (1968) is regarded as a junior synonym for *Stichocapsa.*

Stichocapsa sp.
Plate 4, Fig. 12

cf. *Stichocapsa* sp. PETRUSHEVSKAYA & KOZLOVA 1972, pl. 8, figs. 6, 7 (?).
cf. *Lithostrobus litus* FOREMAN 1978, p. 747, pl. 4, fig. 12.
cf. *Amphipyndax conicus* NAKASEKO & NISHIMURA, Suyari 1986, pl. 3, fig. 2 only.
cf. *Stichomitra* (?) sp. A THUROW 1988, p. 406, pl. 1, fig. 17.
cf. *Amphipyndax* sp. B TUMANDA 1989, p. 16, pl. 9, fig. 6.

Genus ***Stylosphaera*** EHRENBERG

Stylosphaera EHRENBERG 1847b, p. 54.

Type species. – *Stylosphaera hispida* EHRENBERG 1854, subsequent designation Frizzell in Frizzell & Middour 1951.

Stylosphaera pusillus CAMPBELL & CLARK emend. Foreman
Plate 3, Fig. 13

Stylosphaera (*Stylospharella*) *pusilla* CAMPBELL & CLARK 1944, p. 5, pl. 1, figs. 2, 4, 5.
Stylosphaera pusilla CAMPBELL & CLARK, Renz 1974, p. 798, pl. 9, fig. 20 only.
Druppatractus sp. A FOREMAN 1977, pl. 1, fig. 3.
Ellipsoxiphus pusilla (CAMPBELL & CLARK), Foreman 1978, p. 743, pl. 2, figs. 9, 10, 17.
Praestylosphaera sp. aff. *P. pusillus* (CAMPBELL & CLARK), Empson-Morin 1981, p. 262, pl. 4, fig. 6.
Lithatractus pusillus (CAMPBELL & CLARK), Taketani 1982, p. 48, pl. 1, figs. 8a, b; pl. 9, figs. 5, 6; Iwata & Tajika 1989, pl. 3, fig. 3; Baumgartner 1992, p. 321, not illustrated.

Remarks. – Foreman (1978) emended the original description to include forms with smooth or bladed spines. Internal observation indicates the presence of a single medullary shell indicating that assingment with *Stylosphaera* is appropriate.
Range. – Early Barremian-Early Campanian.
Occurrence. – California, southern Europe, Japan, Pacific, Atlantic and Indian Oceans, Western Australia.

Stylosphaera sp. cf. *S. hastatus* (CAMPBELL & CLARK)
Plate 3, Fig. 14

Sphaerostylus (*Sphaerostylantha*) *hastatus* CAMPBELL & CLARK 1944, p. 5, pl. 1, figs. 1, 6.
Ellipsoxiphus hastatus (CAMPBELL & CLARK), Foreman 1978, p. 742, pl. 2, fig. 13.
Praestylosphaera hastata (CAMPBELL & CLARK), Empson-Morin 1981, p. 262, pl. 4, figs. 4, 5a–c.

Remarks. – This species is tentatively compared with *Stylosphaera hastata* CAMPBELL & CLARK based on its relatively large spherical cortical shell composed of uniform circular pores set in polygonal pore frames.

Genus *Triactoma* RÜST emend. Pessagno et al.

Triactoma RÜST 1885, p. 289; emend. Pessagno et al. 1989, p. 205.

Type species. – *Triactoma tithonianum* RÜST 1885 (subsequent designation by Campbell 1954).

Triactoma sp.
Plate 2, Figs. 12, 15

Remarks. – Sub-spherical to spherical cortical shell with large hexagonal pore frames and circular pores. Although the spines are not preserved in our specimens, three radially arranged massive triradiate spine bases symmetrically arranged on test are present. This rare form is present in most of the samples examined from the Windalia Radiolarite type section.

Genus *Tricolocapsa* HAECKEL

Tricolocapsa HAECKEL 1887, p. 436.

Type species. – *Tricolocapsa theophrasti* HAECKEL 1887, subsequent designation Cambell 1954.

Tricolocapsa antiqua (SQUINABOL)
Plate 4, Figs. 17, 22

Theocorys antiqua SQUINABOL 1903, p. 135, pl. 8, fig. 25; Riedel & Sanfilippo 1974, p. 781, pl. 10, fig. 9 only; Haig & Barnbaum 1978, fig. 4F; Kozlova in Basov et al. 1979, fig. 4; Schaaf 1981, p. 440, pl. 24, figs. 10a, b; Sanfilippo & Riedel 1985, p. 623–624, text-fig. 14, figs. 6a–b, d only.
Theocorys oblonga SQUINABOL 1904, p. 226, pl. 9, fig. 3.
Theocorys sp. aff. *T. antiqua* SQUINABOL, Renz 1974, p. 798, pl. 6, figs. 4–7; pl. 11, fig. 4.
Theocorys sp. 1 LING & LAZARUS 1990, p. 357, pl. 3, fig. 8; pl. 4, fig. 9.
Tricolocapsa sp. LING & LAZARUS 1990, p. 357, pl. 4, fig. 10.
cf. *Tricolocapsa parvipora* TAN 1927, p. 48, pl. 9, fig. 59.
cf. *Tricolocapsa parvipora* var. a TAN 1927, p. 49, pl. 9, fig. 60.

Remarks. – Only forms with 3 segments, a conical to spindle shaped test with a constricted aperture, and generally with a longitudinal arrangement of small, closely spaced pores (often between plicae) are included with *T. antiqua* here. This species was initially assigned with *Theocorys*, however, it bears little resemblance to this genus which is characterized by having large pores and with a third segment being wide open terminally. Reassignement of this species to *Tricolocapsa* is more appropriate, although a basal cover plate over the aperture is generally not preserved (see, however, *Tricolocapsa* sp. Ling & Lazarus 1990, p. 357, pl. 4, fig. 10). It is not clear whether Tan's (1927) species of *T. parvipora* possesses a constricted aperture. Forms with 4 segments initially included with *T. antiqua* (e.g. Riedel & Sanfilippo 1974, pl. 10, figs. 10, 11 and Sanfilippo & Riedel 1985, p. 623–624, text-fig. 14, fig. 6c) appear to conform with *Stichocapsa naradaniensis* YAO (1979).
Range. – Aptian to Santonian.
Occurrence. – Southern Europe, Atlantic, Indian and Pacific Oceans, Weddell Sea, Roti (?), Australia.

Tricolocapsa sp.
Plate 4, Fig. 11

Theocorys antiqua (SQUINABOL), Sanfilippo & Riedel 1985, p. 623–624, text-fig. 14, fig. 6d only.
cf. *Dicolocapsa radiata* HEITZER 1930, p. 395, pl. 28, figs. 44a–b.
cf. *Tricolocapsa plicarum* YAO 1979, p. 32, pl. 4, figs. 1–11.
aff. *Heliocapsa gutta* HEITZER 1930, p. 392, pl. 28, fig. 30.

Remarks. – This rare form differs from *T. antiqua* by the more spherical shape of its abdomen. It compares well with *T. plicarum*, but differs by lacking a characteristic robust basal cover plate.

Genus *Windalia* ELLIS n. gen.

Type species. – *Amphipyndax* (?) *pyrgodes* RENZ 1974, p. 788, pl. 12, fig. 1.

Description. – Test conical, elongate, lobate outline, multicyrtoid. Cephalis small, conical, imperforate, separated from thorax by single row of elliptical pores set between poorly developed ridges. Small apical horn may or may not be present. Thorax trapezoidal to campanulate in outline, small, sparsely perforate with weakly developed ridges. Cephalothorax conical, sometimes cylindrical. Abdomen trapezoidal, separated from thorax by irregular row or rows of elliptical pores within weakly developed ridges. Variable number of postabdominal chambers (segments) but no less than 6, trapezoidal to cylindrical in outline; generally increasing rapidly in width but only slightly in height as added. Final 2 to 4 postabdominal chambers increasing in height slowly or not at all, and moderately to rapidly decreasing in width, terminating in a rarely preserved narrow extension with a small aperture. Abdomen and postabdominal chambers separated externally by prominent longitudinal or inclined ridges; internally by an imperforate septal plate with large circular aperture. Septal plate fused with internal side of ridges, approximately midway, such that there is no external expression. Externally, each segment has a single transverse row of circular pores, set within hexagonal pore frames staggered with respect to ridges, generally forming at, or below constriction of the external wall (note that the constriction is not a stricture and does not mark the joint between successive segments). When viewed internally, each segment has 3 rows of circular pores, hexagonally arranged as with the genus *Parvicingula* PESSAGNO and *Amphipyndax* FOREMAN. Generally, on the final few segments test construction is more complex with flattening of diagonally aligned ridges and fusion of septal plate with outer surface, giving this portion of the test a smooth perforate appearance of several rows of hexagonally arranged elliptical to circular pores set within polygonal pore frames.
Remarks. – The characteristic arrangement of ridges and circular pores distinguishes *Windalia* n. gen. from other nassellaria. Haig & Barnbaum (1978) identified similar specimens as *Lithostrobus* Büschilli. However, *Lithostrobus* generally has a test wall composed of quincuncially arranged circular to elliptical pores, which on some forms coalesce to form shallow nodes at the junctions of the intervening pore bars, quite distinct from the forms illustrated herein. Renz (1974) placed species of *Windalia* with *Amphipyndax* (?). However, *Windalia* differs from *Amphipyndax* in lacking a large knob-like cephalis and by possessing prominent ridges at joints and not strictures. With *Parvicingula* PESSAGNO, the fusion between ridges and the internal septal plate at successive joints

is continuous to the external surface where it is expressed as an circumferential ridge, not observed with *Windalia*. *Windalia* differs further from *Parvicingula* by having segments generally with only a single row of circular pores between ridges rather than several rows with distinct pores. It differs from *Foremanina* EMPSON-MORIN by having more prominent ridges, and by having only one pore row between ridges at each segment rather than 2–5 rows of distinct pores.

To date, *Windalia* has been observed only in Lower Cretaceous sediments in the southern hemisphere. In all these sediments it is generally common, particularly in and around Australasia. Its exclusion from the Tethyan region suggests that the genus is endemic to the southern hemisphere and probably developed in the extensive Australian epeirc seas and/or associated with unique ocean circulation in the juvenile Indian and Antarctic Oceans.

Etymology. – Named for the type locality of the Windalia Radiolarite at Windalia Hill.

Range. – Barremian to Albian.

Occurrence. – Weddell Sea (ODP Leg 119 Site 693A), Indian Ocean (ODP Leg 123, Site 765; DSDP Leg 25, Site 249; DSDP Leg 27, Site 259, Site 260, Site 261), Australia (Carnarvon and Surat Basins).

Windalia epiplatys (RENZ) emend.
Plate 5, Figs. 22–24

Amphipyndax (?) *epiplatys* RENZ 1974, p. 788, pl. 5, figs. 1–3; pl. 12, fig. 2 (refigured pl. 5, fig. 1).

Diagnosis. – Test as with genus. Distinct elongate, cylindrical-slightly conical test. Cephalis hemispherical with very small horn at tip. Thorax cylindrical, about as wide as cephalis, slightly porous. Cephalothorax forming prominent cylindrical, knob-like tip. Abdomen trapezoidal, about twice as wide as cephalothorax. First and 2nd postabdominal chambers trapezoidal without constrictions, increasing in width rapidly such that 2nd segment is about twice to three times as wide as abdomen. Next 2 postabdominal segments cylindrical to subcylindrical, increasing in width very slowly, slight constriction may be present within 4th segment. Cephalothorax, abdomen and first 4 postabdominal segments with complex, irregularly developed ridges and elliptical pores, together forming campanulate outline. Next 4 segments subcylindrical to trapezoidal, increasing in width very slowly, with well developed ridges at joints and prominent constriction at single row of circular pores within each segment (as for genus). Ninth segment cylindrical with flattened ridges (without constriction) giving test a smooth perforate appearance. Tenth segment tapering distally rapidly, also with flattened ridges. Remaining 1 or 2 postabdominal segments not preserved on specimens but probably constricting rapidly to small circular aperture or terminal tube.

Remarks. – Definition provided by Renz (1974) does not describe in sufficient detail test structure nor allow for the possession of a terminal extension. The complex shape of *Windalia epiplatys* is characteristic for this species and distinguishes it from all other forms of *Windalia*.

Range. – Late Aptian to middle Cretaceous (?).

Occurrence. – Indian Ocean, Australia.

Windalia pyrgodes (Renz) emend.
Plate 5, Figs. 1–3, 5, 21, 26

Amphipyndax (?) *pyrgodes* Renz 1974, p. 788, pl. 5, figs. 4–6, pl. 12, fig. 1 (refigured pl. 5, fig. 5).
Lithostrobus sp. C Haig & Barnbaum 1978, figs. 4k, l.
aff. *Stichomitra* sp. 1 Ling & Lazarus 1990, p. 356, pl. 2, figs. 15, 16; pl. 5, fig. 11.
cf. parvicingulid sp. B Baumgartner 1992, pl. 8, fig. 12.

Diagnosis. – Test as with genus. Slender, conical, with prominent stricture within successive postabdominal chambers; cephalothorax broadly conical with small, stout horn (generally not preserved). Consisting of at least 10 postabdominal chambers, trapezoidal in outline; first 7–8 segments increase in height slowly and moderately rapidly in width as added; final 2–3 postabdominal chambers with flattened ridges at joints, increasing in height slowly but constricting rapidly (inverted bell-shaped), terminating in long tubular extension as for genus.
Remarks. – Definition provided by Renz (1974) does not describe in sufficient detail test structure nor allow for the possession of a terminal extension. Distinction with *Lithostrobus* as with genus. Distinction between *Windalia pyrgodes* and *Windalia* sp. A is given under the latter species. The specimen *Stichomitra* sp. 1 illustrated by Ling & Lazarus (1990) is incomplete.
Range. – Barremian (?) to middle Cretaceous (?).
Occurrence. – Indian Ocean, Australia.

Windalia sp. A
Plate 4, Figs. 8–10, 12

Remarks. – *Windalia* sp. A differs from *W. pyrgodes* (1) by the biconical shape of its test, and (2) with the widest point of the test at the joint after the 6th–7th segment rather than being the 7th–8th segment.
Range. – Late Aptian to Early Albian.
Occurrence. – Western Australia.

Windalia sp. B
Plate 5, Figs. 4, 6, 11

Remarks. – *Windalia* sp. B differs from *W. pyrgodes* and *W.* sp. A (1) by having a distal portion of the test which is cylindrical, and (2) by having a constriction at the 6th and 7th segments which separate the cylindrical distal portion from a conical proximal portion of the test.
Range. – Late Aptian to Early Albian.
Occurrence. – Western Australia.

Windalia sp. C
Plate 5, Fig. 17

cf. parvicingulid sp. D Baumgartner 1992, pl. 8, figs. 9–11.

Remarks. – Test as with genus. Elongate form, conical proximally and cylindrical distally with at least 11 postabdominal segments.
Range. – Aptian-Early Albian.
Occurrence. – Indian Ocean, Western Australia.

Windalia sp. D
Plate 5, Figs. 16, 18

Remarks. – *Windalia* sp. D is characterized by having a greatly inflated spindle-shaped test.
Range. – Late Aptian to Early Albian.
Occurrence. – Western Australia.

Note. – Due to moderate and poor sample preservation and because samples exist over a narrow time range (latest Aptian to Early Albian), it is unclear whether *Windalia* sp. A, sp. B, sp. C and sp. D are distinct species or whether they are heteromorphs of *Windalia pyrgodes*. These forms are left under open nomenclature until a larger database can be assembled fully documenting their relationships.

Genus ***Xitus*** PESSAGNO

Xitus PESSAGNO 1977b, p. 55.

Type species. – *Xitus plenus* PESSAGNO 1977b.

Xitus vermiculatus (RENZ)
Plate 4, Figs. 12, 13

Eucyrtidium vermiculatum RENZ 1974, p. 792, pl. 8, figs. 17–19; pl. 11, fig. 22 (refigured pl. 8, fig. 17).
Xitus spineus PESSAGNO 1977b, p. 56, pl. 10, figs. 3, 12, 16, 20.
Xitus vermiculatus (RENZ), Schaaf 1981, p. 441, pl. 19, figs. 6a–b.
Xitus sp. cf. *X. spicularius* (ALIEV), Schaaf 1981, p. 441, pl. 4, fig. 12.
Novixitus tuberculatus WU & LI 1982, p. 69, pl. 2, fig. 6.
Parvicingula (?) sp. THUROW 1988, p. 403, pl. 6, fig. 10.
Pseudodictyomitra sp. A TUMANDA 1989, pl. 8, fig. 10.
cf. *Xitus* sp. indet. SCHAAF 1981, pl. 21, figs. 10a–b.
aff. *Dictyomitra* sp. FOREMAN 1975, p. 615, pl. 1H, fig. 5; pl. 2H, fig. 2.

Range. – Berriasian (?) to middle Cretaceous.
Occurrence. – California, Japan, Tibet, Pacific and Indian Oceans, Western Australia.

6. Discussion: Age and correlation

At present, ammonites offer the most reliable age determination of the type section. The most common forms identified from the Windalia Radiolarite at Winning Station are *Tropaeum* and *Australiceras*, which are widely distributed only in Aptian-Albian strata (Whitehouse 1927; Day 1969, 1974). Day (1969, 1974) further showed that if Australian species of these genera are the same age as their northern European and Madagascan analogues, which have been accurately dated by their association with hoplitids, then only Late Aptian-Early Abbian time is represented by their ranges. Other age-diagnostic ammonite genera (*Aconoceras, Toxoceratoides* and *Sanmartinoceras*) and the belemnite genus *Peratobelus* recorded from the type section are consistent with a Late Aptian-Early Albian age. Although little published data is publicly available, the preceeding Muderong Shale and succeeding Gearle Siltstone have been dated with palynomorphs,