INTRODUCTION

Twelve samples from four cores at Site 275 contain a well-preserved Late Cretaceous (latest Campanian) radiolarian assemblage. The intervals sampled, the total abundance of the Radiolaria, and their general state of preservation are indicated in Figure 1.

Site 275 is situated at 50°26.34'S 176°18.99'E on the southeast part of the Campbell Plateau near New Zealand. The Cretaceous sequence at this site can be divided into the following lithologic units: Unit 1—a pale yellow and olive soft, moderately to intensely mottled sandy silt and glauconite-rich radiolarian-diatomaceous ooze (Cores 1 and 2), and Unit 2—a dark gray, stiff, massive glauconite- and nodule-bearing detrital clay silt (Cores 3-5).

The late Campanian assemblage present at Site 275 is significant for the following reasons: (1) It is the first...
Upper Cretaceous radiolarian assemblage figured from the Antarctic region; (2) It is a high-latitude assemblage displaying markedly lower diversity than those from middle or low latitudes (e.g., that of the late Campanian of California). (3) Even with its lower diversity, it can be readily correlated with the upper Campanian of California using the detailed zonation proposed by Pessagno (1974). As indicated by Pessagno (1974), the diversity gradient displayed by Mesozoic Radiolaria does not seem to be nearly as great as that of other microfossil groups such as the Foraminiferida. Hence, the Radiolaria may well serve as a matrix for interrelating zonal schemes proposed for other groups of fossils in high, middle, and low latitudes.

**BIOSTRATIGRAPHY**

At Site 275 the interval from Core 1, Section 1, 140-142 cm to Core 4, Section 2, 140-142 cm is correlative with the latest Campanian *Patulibracchium dickinsoni* Zone of Pessagno (1974) (Figure 2). The interval below Core 4, Section 2, 140-142 cm to Core 5, Section 1, 80-82 cm is tentatively assigned to the *Patulibracchium dickinsoni* Zone.

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**Figure 2.** Range, abundance, and oppel zones of Campanian and Maestrichtian Radiolaria.
TABLE 1
Important Biohorizons in the Upper Cretaceous

| A | First occurrence of Planomalina baxteri (Gandolfi). |
| B | First occurrence of Inoceramus labiatus (Schlotheim), Margiocrinula helvetica (Bolli), Allievium superbum (Squinabol). |
| C | First occurrence of Dictymotreta s.s. Zittel |
| D | First evolutionary appearance of Allievium praegallawayi Pessagno |
| E | Final evolutionary appearance of Allievium superbum (Squinabol). |
| F | First evolutionary appearance of Allievium gallowayi (White). |
| G | Final evolutionary appearance of Allievium praegallawayi Pessagno |
| H | First occurrence of Globotruncana arca (Cushman); first occurrence of Protoceratopsis perplexus Pessagno, and Protoceratopsis kirbyi Pessagno |
| I | First occurrence of Patulibracchium lawsoni Pessagno |
| K | Extinction of Genus Pseudoaulophacus Pessagno and Allievium gallowayi (White); marked decline of Pseudoaulophacidae Riedel |

*From Pessagno, 1974. See also Figure 2.

Discussion

In the California coast ranges the base of the Patulibrachium dickinsoni Zone is defined by the first evolutionary occurrence of *P. dickinsoni* Pessagno (derived from *P. lawsoni* Pessagno). *Patulibrachium taliiferri* Pessagno, *Coniforma antiochensis* Pessagno, and *Sciadiocapsa (?) campbelli* Pessagno make their first appearance at the base of this zone. The top of the *P. dickinsoni* Zone is marked by the extinction of *Phaseliforma* Pessagno, and in particular by the extinction of *Phaseliforma carinata* Pessagno, *P. laxa* Pessagno, and *P. meganosensis* Pessagno. *Orbiculiforma renillaeformis* (Campbell and Clark) makes its first appearance in the upper part of this zone. It should be noted that only one species (*Allievium murphyi* Pessagno) of the Pseudoaulophacidae Riedel is present at this horizon.

Basically, this zone can be defined by virtue of the fact that (1) its base occurs above the biohorizon offered by the extinction of *Pseudoaulophacus* Pessagno and the marked decline of the Pseudoaulophacidae and (2) its top occurs at the biohorizon offered by the extinction of *Phaseliforma* Pessagno and the Phaseliformidae Pessagno.

The presence of *Orbiculiforma renillaeformis* (Campbell and Clark) in the interval from Core 1, Section 1, 140-142 cm to Core 2, Section 5, 140-142 cm suggests that samples from this interval are assignable to the upper part of the *P. dickinsoni* Zone.

Associated planktonic foraminifera in the California section indicate that the *Crucella espartoensis* Zone, *Phaseliforma carinata* Subzone, and the *Patulibrachium dickinsoni* Zone are closely correlative with the *G. calcarata* Zonule of Pessagno (1967, 1969b) (see also Pessagno, 1974).

The total abundance of Radiolaria as well as the relative abundance and occurrence of various species are shown in Figure 1. One can easily discern from this figure that even in the samples where radiolarian total abundance is high (e.g., T.A. = 5 at 2/1 and 2/2), species diversity tends to be low. For example, Sample 275-2-1, 140-142 cm contains only 25 species of Radiolaria. Sample NSF 568-B from the *P. dickinsoni* Zone of California (latitude 35°N) contains 70 described and undescribed taxa; this latter sample is also comparable in terms of the total abundance of Radiolaria.

The late Campanian assemblage from the Campbell Plateau shows a great deal of similarity to that described by Lipman (1960) and Kozlova and Gorbovetz (1966) from the western Siberian lowland (latitude 65°N). Both assemblages seem to share species assignable to the Prunobrachidae, n. fam. Members of this family seem to be most abundant at high latitudes and are poorly represented at lower latitudes.

**SYSTEMATIC PALEONTOLOGY**

**Subclass RADIOLARIA**

**Order POLYCYSTIDA**

**Suborder SPUMELLARIINA**

Superfamily SPONGODISCACEA Haeckel, 1882

Subsuperfamily PSEUDAULOPHACILAE Riedel, 1967

Family PHASELIFORMIDAE Pessagno, 1972

Type genus: *Phaseliforma* Pessagno, 1972.

Range: Allievium praegallawayi Zone to Patulibrachium dickinsoni Zone; Coniacian to Campanian.

Occurrence: Upper Cretaceous of California, Russia, and Antarctic region insofar as known.

Genus PHASELIFORMA Pessagno, 1972

Type species: *Phaseliforma carinata* Pessagno, 1972.

Range: Allievium praegallawayi Zone to Patulibrachium dickinsoni Zone; Coniacian to Campanian.

Occurrence: Upper Cretaceous of California, Russia, and Antarctic region.

**Phaseliforma laxa Pessagno**

(Plate 1, Figure 2).

*Phaseliforma laxa* Pessagno, 1972a, p. 276-277, pl. 23, fig. 7-9.

Range: *Crucella espartoensis* Zone, *P. carinata* Subzone; latest Campanian.

Occurrence: Latest Campanian portions of Forbes and "Marsh Creek" formations, Great Valley sequence, California. Site 275 (Figure 1).

**Phaseliforma subcarinata** Pessagno, n. sp.

(Plate 1, Figure 1).

Description: Test bean-shaped; about three quarters as wide as long with a V-shaped indentation along middle of one side. Test compressed posteriorly with angulated periphery. Meshwork with irregular polygonal pore frames with nodes at vertices; pore frames triangular to hexagonal with circular to elliptical pores.

Remarks: *Phaseliforma subcarinata*, n. sp., is closely related to *P. carinata* Pessagno. It differs from *P. carinata* (1) by being nearly three
quaters as wide as long; (2) by having a more perforate periphery; and (3) by having a less angled periphery.

Measurements: Maximum length—holotype (1) 360µ; paratypes (7) 280-420µ. Maximum width—holotype (1) 280µ; paratypes (7) 220-330µ.

Type locality: DSDP Leg 29, Site 275, Core 2, Section 1, 140-142 cm.

Deposition of types: Holotype = USNM 207350; paratypes = USNM 207351.

Range: Patulibrachium dickinsoni Zone to O. renillaeformis Zone; latest Campanian to Maestrichtian.

Occurrence: Site 275 (Figure 1). Moreno Grande Formation, Marca Shale, and upper part of Marsh Creek Formation; Great Valley sequence, California coast ranges.

Family PRUNOBRACHIDAE Pessagno, 1973

Type genus: Prunobrachium Kozlova, 1966

Description: Test elongate, elliptoidal to cylindrical, usually lobate with tubular structures termed brachiopyles at each pole. Spongy meshwork markedly concentric in center of test; less concentric elsewhere. Test with or without a pseudopatagium.

Remarks: On first glance, the Prunobrachidae, n. fam., seem related to either the Sponguridae Haeckel or the Hagiastriadae Riedel. However, it was found that the Prunobrachidae differ from the Sponguridae (1) by having well-developed concentric meshwork in a spherical mass only in the center of their tests; (2) by possessing brachiopyles at their poles (3) by often developing a pseudopatagium (see Prunobrachium); and (4) by lacking solid polar spines. The term brachiopyles was first used by Pessagno (1971, p. 75) for the cylindrical, porous, spongous tube associated with the Hagiastriidae Riedel (i.e., the Patulibrachinaceae Pessagno). Although the presence of brachiopyles with the Prunobrachidae could suggest a relationship with the Hagiastriidae, the general structure of the remainder of the test negates this conclusion. The Hagiastriidae (see Pessagno, 1971, p. 19) possess tests with spongy meshwork arranged in parallel to subparallel layers axially, and with individual layers comprised of pore frames arranged linearly or sublinearly.

Range: Upper Cretaceous.

Occurrence: Antarctic Region, Russia; rare in California.

Genus PRUNOBRACHIUM Kozlova, 1966

Type species: Prunobrachium crassum (Lipman, 1960).

Emended definition: Test elongate, basically elliptoidal to cylindrical, usually lobate with brachiopyles at each pole. Spongy meshwork arranged in two distinct major layers (Plate 2, Figures 1, 2); parallel to the long axis of test; outer layer termed pseudopatagium.

Remarks: Prunobrachium is perhaps most similar to Spongurus Haeckel (Sponguridae); it differs from Spongurus, however, by possessing (1) brachiopyles at its poles; (2) a test consisting of two distinct major layers; and (3) meshwork which is markedly less concentric in character.

The outer layer of the test of Prunobrachium is termed the pseudopatagium. It differs from a true patagium by having its meshwork arranged in a crudely concentric fashion.

Range: Upper Cretaceous; latest Campanian. Upper part of Patulibrachium dickinsoni Zone to Patulibrachium dickinsoni Zone.

Occurrence: Antarctic Region, western Siberian lowland, eastern slope of the Urals, and Great Valley sequence of California.

Prunobrachium? auklandensis Pessagno, n. sp.

(Plate 1, Figure 8)

Description: Test elongate bilobate with long central constriction separating two terminal lobes. Brachiopyles fragile, not preserved in their entirety. Pore frames ranging in shape from triangular to polygonal.

Remarks: P. auklandensis, n. sp., differs from P. incisum Kozlova by being bilobate and more elongate in character. This species is questionably assigned to Prunobrachium because it lacks a pseudopatagium.

Measurements: Length exclusive of brachiopyles—holotype (1) 275µ; paratypes (2) 470, 480µ. Maximum width in center—holotype (1) 70µ; paratypes (2) 70, 80µ.

Type locality: DSDP Leg 29, Site 275, Core 2, Section 1, 140-142 cm.
UPPER CRETACEOUS RADIOLARIA

Subfamily PATULIBRACCHINAE Pessagno, 1971


Range: Mesozoic.

Occurrence: Worldwide

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**Patulibrachium** sp. 1

(Plate 2, Figure 6)

Remarks: This form is characterized by the linearly arranged square to rectangular pore frames of its rays and by the rather massive patagium. Due to the massive nature of the patagium, it is usually preserved and tends to impart a triangular shape to the test.

Range and occurrence: *Patulibrachium dickinsoni* Zone; latest Campanian at Site 275 (Figure 1).

Genus PARONAELLA Pessagno, 1971

Type species: *Paronaella solaneonsis* Pessagno, 1971.

Range: Mesozoic.

Occurrence: Worldwide.

Paronaella (?) sp. 2

(Plate 2, Figure 7)

Remarks: This distinctive form should probably be placed in a new genus. It may have developed from *Paronaella* via formation of a thick patagium between the rays.

Range and occurrence: *Patulibrachium dickinsoni* Zone; latest Campanian at Site 275 (Figure 1).

Paronaella (?) sp. 3

(Plate 2, Figure 8)

Remarks: See comments under *Paronaella* (?) sp. 2.

Range and occurrence: *Patulibrachium dickinsoni* Zone; latest Campanian at Site 275 (Figure 1).

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**Spumellarina Incertae Sedis at Supergeneric Level**

Genus PERITIVATOR Pessagno, 1974

Type species: *Peritivator labyrinthi* Pessagno, 1974.

Range: *Crucella espartoensis* Zone: *Phaseliforma carinata* Subzone to *Orbiculiforma renillaformis* Zone; latest Campanian to Maestrichtian.

Occurrence: Campanian and Maestrichtian of California; Site 275.

Peritivator labyrinthi Pessagno

(Plate 2, Figures 9, 10)

**Remarks:** See comments under *Peritivator labyrinthi*.

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**SUBFAMILY PATULIBRACCHINAE Pessagno, 1971**


Range: Mesozoic.

Occurrence: Worldwide

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**Staurodicyta nemeshi** Haeckel, 1885

Type species: *Staurodicyta beneckeii* Rüst, 1885.

Range and occurrence: *Staurodicyta nemeshi* upper part of *Phaseliforma carinata* Subzone to *Oribiculiforma renillaformis* Zone, latest Campanian to Maestrichtian.

Occurrence: Marca Shale, upper part of Marsh Creek Formation, Great Valley sequence, California coast ranges, Site 275 (Figure 1).

Genus SPONGOSATURNINUS Campbell and Clark, 1944

Type species: *Spongosaturninus ellipticus* Campbell and Clark.

Range and occurrence: Jurassic to Cretaceous; worldwide.
Spongostaurusinus sp. 1
(Plate 2, Figure 12)
Range and occurrence: Patulibrachium dickinsoni Zone (latest Campanian) at Site 275 (Figure 1).

Spongostaurusinus sp. 2
(Plate 2, Figure 13)
Range and occurrence: Patulibrachium dickinsoni Zone (latest Campanian) at Site 275 (Figure 1).

Suborder NASSELLARINA Ehrenberg, 1875
Superfamily CYRTOIDEA Haeckel, 1862
Subsuperfamily EUCYRTIDIAE Ehrenberg, 1847
Family NEOSCIADIOCAPSIDAE Pessagno, 1969a
Type genus: Neosciadiocapsa Pessagno, 1969a.
Range: Jurassic to Tertiary.
Occurrence: Worldwide.

Genus NEOSCIADIOCAPSA Pessagno, 1969a
Type species: Neosciadiocapsa diaboloensis Pessagno, 1969a.
Range: Either Crucella esparronensis Zone to Patulibrachium dickinsoni Zone insofar as known.
Occurrence: Leg 29, Site 275. Great Valley sequence, California coast ranges.

Neosciadiocapsa jenkinsi Pessagno, n. sp.
(Plate 3, Figures 1-12)
Description: Test lacking well-developed collar stricture. Cephalis with small irregularly shaped and disposed pores. Horn long, massive; triradiate in axial section proximally with one or two apical pores situated in each of three grooves at base of horn; remainder of horn circular in axial section and covered by fine, longitudinal striations. Thorax with well-developed uniformly shaped, hexagonal pore frames proximally; pore frames increasing in size distally and becoming more variable in shape, often varying from hexagonal to rectangular on thoracic skirt. Proximal (conical) portion of thorax having pore frames covered by secondary epithelial material and three radiating spinose ridges. Volum partially developed; coarsely perforate like that of N. diaboloensis.
Remarks: N. jenkinsi Pessagno, n. sp., differs from N. diaboloensis Pessagno (1969) by displaying a horn which is triradiate only at its base; (2) by having a test of lower relief; (3) by displaying three radially arranged spinose ridges on the proximal part of the thorax; and (4) by having a broader thoracic skirt.

This species is named for Dr. D. Graham Jenkins, University of Canterbury, in honor of his many contributions to New Zealand stratigraphy.
Measurements: A-A — holotype (1) 470µ; paratypes (10) 460 to 560µ.
B-B — see Pessagno, 1969a, p. 381) holotype (1) 450µ; paratypes (10) 410 to 500µ.
Type locality: DSDP Leg 29, Site 275, Core 2, Section 1, 140-142 cm.
Deposition of types: Holotype = USNM 207362; paratypes = USNM 207363.
Range: Patulibrachium dickinsoni Zone insofar as known; latest Campanian.
Occurrence: Site 275 (Figure 1).

Genus MICROSCIADIOCAPSA Pessagno, 1969a
Type species: Microsciadiocapsa monticellensis Pessagno, 1969.
Range and occurrence: Upper Cretaceous of California insofar as known.

Microsciadiocapsa (?) sp.
(Plate 4, Figures 1-3)
Range and occurrence: Patulibrachium dickinsoni Zone at Site 275 (Figure 1).

Family AMPHIPYNDACIDAE Riedel, 1967
Type genus: Amphipyndax Foreman, 1968.
Range: Cretaceous. Albion to Maastrichtian insofar as known.
Occurrence: Worldwide.

Amphipyndax stocki (Campbell and Clark), emend. Foreman, 1968
(Plate 4, Figures 3-5)
Stichocapsa (?) stocki Campbell and Clark, 1944, p. 44, pl. 8, fig. 31-33.
Stichocapsa megac月薪phalina Campbell and Clark, 1944, p. 44, pl. 8, fig. 26, 34.
Amphipyndax stocki (Campbell and Clark), Foreman, 1968, p. 78, pl. 8, fig. 12 a-c; Foreman, 1970, p. 430, pl. 13, fig. 5; Petrusheskaya and Kozlova, 1972, p. 545, pl. 8, fig. 16, 17.
Remarks: Foreman (1968, p. 79) noted the presence of hexagonally distributed nodes surrounding the pores of this species. Scanning electron micrographs of Leg 29 specimens demonstrate the presence of such nodes, but indicate that they are situated at the vertices of hexagonally arranged pore frames. Two forms seem to be present here: one with a spherical, papillose cephalothoracic region and the other with a smooth cephalothoracic region.
Range: Patulibrachium dickinsoni Zone to Orbiculiforma renillaforme Zone; latest Campanian to Maastrichtian.
Occurrence: Moreno Grande Formation; upper part of Marsh Creek Formation; occurrence at Site 275 (Figure 1).

Amphipyndax sp.
(Plate 4, Figure 8)
Range and occurrence: Site 275 (Figure 1).

Family ARTOSTROBIIDAE Riedel, 1967
Type genus: Artostrobus Haeckel, 1887, designated herein.
Remarks: Riedel (1967) never designated a type genus for this family.
Range: Cretaceous to Tertiary.
Occurrence: Worldwide.

Genus THEOCAMPE Haeckel, emend. Burma, 1959
Type species: Dictyomitra ehrenbergi Zittel, 1876
Range: Paleozoic to Recent.
Occurrence: Worldwide.

Theocampe sp. aff. T. altamontensis (Campbell and Clark)
(Plate 4, Figure 10)
Tricolocampe (Tricolocampra) altamontensis Campbell and Clark, p. 33, pl. 7, fig. 24-26.
Remarks: The specimen figured herein differs from T. altamontensis s.s. by showing irregularly distributed pore frames on the distal part of the abdomen. The character of the remainder of the test is quite similar to that of T. altamontensis.
Range and occurrence: Patulibrachium dickinsoni Zone; latest Campanian at Site 275 (Figure 1).

Family ARCHAEODICTYOMITRIDAE Pessagno, 1974
Type genus: Archaeodictyomitra Pessagno, 1974.
Range: Jurassic to Cretaceous.
Occurrence: Worldwide.

Archaeodictyomitra (?) regina (Campbell and Clark)
(Plate 4, Figures 11, 12)
Lithonitra (Lithonitrita) regina Campbell and Clark, 1944, p. 41, pl. 8, fig. 30, 38, 40.
Dictyomitra regina (Campbell and Clark). Foreman, 1968, p. 68-69, pl. 8, fig. 5a-c.
Remarks: This species is questionably assigned to Archaeodictyomitra. Like Archaeodictyomitra, it lacks well-developed strictures. However, it seems to lack relict pores; all of its pores appear to be primary in nature. Furthermore, its test seems to be more cylindrical in shape and lacks well-developed partitions between the test joints.
Range: Crucella esparronensis Zone, Phaseiliforma carinata Subzone to Orbiculiforma renillaforme Zone; latest Campanian to Maastrichtian.

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Occurrence: Upper part of the Forbes and Marsh Creek formations; Moreno Grande Formation; Marca Shale. Site 275 (Figure 1).

Archaeodictyomitra sp.
(Plate 5, Figure 4)

Range and occurrence: Patulibrachium dickinsoni Zone at Site 275 (Figure 1).

Genus DICTYOMITRA Zittel, 1876, emend. Pessagno, 1974
Type species: Dicytomitra multicostata Zittel, 1876. Lectotype designated by Pessagno, 1974.
Range: Turonian to Maastrichtian.
Occurrence: Worldwide.

Dicytomitra densicostata Pessagno
(Plate 5, Figures 1-3)

Dictyomitra densicostata Pessagno, 1974, pl. 14, fig. 10-14, 16.
Range: Alveium praegallowayi Zone, Orbiculiforma vacansis Subzone to Patulibrachium dickinsoni Zone.
Occurrence: Sites, Funks, Forbes, and Marsh Creek formations; Great Valley sequence, California coast ranges. Site 275 (Figure 1).

Nassellariania Incertae Sedis at Suprageneric Level

Type species: Cornutella clathrata Ehrenberg, 1884.
Range and occurrence: Jurassic to Recent; worldwide.

Cornutella californica Campbell and Clark
(Plate 5, Figure 13)

Cornutella californica Campbell and Clark, 1944, p. 22-23, pl. 7, fig. 42; Foreman, 1968, p. 21-22, pl. 3, fig. 1a-c.
Range: Crucella esparteraensis Zone, Phaselliforma carinata Subzone to Orbiculiforma renillaeformis Zone insofar as known; late Campanian to Maastrichtian.
Occurrence: Upper part of Forbes and Marsh Creek formations; Marca Shale, Moreno Grande Formation in Great Valley sequence, California coast ranges. Campanian and Maastrichtian of South Atlantic, Trinidad.

Genus CINCLOPYRAMIS Haeckel, 1881
Type species: C. cribellum Haeckel, 1887.
Range: Upper Cretaceous to Recent.
Occurrence: Worldwide.

Cinclopyramis sp.
(Plate 5, Figures 11, 12)

Range and occurrence: Site 275 (Figure 1).

Genus GLOPHOPHAENA Ehrenberg, 1847
Type species: Lophophnea galena Ehrenberg, 1854.
Range and occurrence: Not fully established.

Lophophnea (?) polycyris (Campbell and Clark), emend. Foreman, 1968
(Plate 5, Figures 9, 10)

Sethococcus (Phlebarachnium) polycyris Campbell and Clark, 1944, p. 27, pl. 7, fig. 39, 40, 45, 48, 50, 51.
Lithomelissa (Sethomelissa) armata Campbell and Clark, 1944, p. 26, pl. 7, fig. 44, 47.
Lophophnea (?) polycyris (Campbell and Clark). Foreman, 1968, p. 23, pl. 3, fig. 3a-c.
Range: Patulibrachium dickinsoni Zone to Orbiculiforma renillaeformis Zone; latest Campanian to Maastrichtian.
Occurrence: Marca Shale, Moreno Grande Formation in Great Valley sequence, California coast ranges.

Genus LITHOMELISSA Ehrenberg, 1847
Type species: Lithomelissa tartari Ehrenberg, 1854.
Range and occurrence: Not established.

Lithomelissa (?) sp.
(Plate 5, Figure 8)

Range and occurrence: Patulibrachium dickinsoni Zone; latest Campanian. Site 275 (Figure 1).

Genus DIACANTHOCAPS A Squinabol, emend. Dumitrice, 1970
Type species: DIACANTHOCAPS euganea Squinabol, 1903.
Range: Cenomanian to Maastrichtian.
Occurrence: Worldwide.

DIACANTHOCAPS amphiura (Campbell and Clark), emend. Foreman, 1968
(Plate 5, Figures 5-7)

Theocapsa (Theocapsomma) corrata Campbell and Clark, 1944, p. 35, pl. 7, fig. 37, 38.
Theocapsomma amphora Campbell and Clark. Foreman, 1968, p. 31, pl. 4, fig. 9a-c.
Remarks: The specimen figured here is quite similar to that illustrated by Foreman (1968, pl. 4, fig. 9c). Foreman's photomicrographs indicate the presence of hexagonal pore frames and circular pores. The specimen from Site 275 shows a tabular aperture at the base of the abdomen: it is most likely better preserved than the California specimens figured in the literature.
Range: Patulibrachium dickinsoni Zone to Orbiculiforma renillaeformis Zone; latest Campanian to Maastrichtian.
Occurrence: Marca Shale, Moreno Grande Formation in the Great Valley sequence of the California coast ranges. Site 275 (Figure 1).

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REFERENCES


PLATE 1

All figures are scanning electron micrographs of late Campanian Radiolaria. Scale on all photos except Figures 10 and 12 = 100µ; scale on Figures 10 and 12 = 28µ and 24µ, respectively.

Figure 1  Phaseliforma subcarinata Pessagno, n. sp.; Holotype (USNM 207359); Sample 29-275-2-1, 140-142 cm.

Figure 2  Phaseliforma laxa Pessagno; Sample 29-275-2-1, 140-142 cm.

Figure 3  Orbiculiforma australis Pessagno, n. sp.; Holotype (USNM 203352); Sample 29-275-2-1, 140-142 cm.

Figure 4  Orbiculiforma australis Pessagno, n. sp.; Paratype (USNM 207353); Sample 29-275-2-1, 140-142 cm.

Figure 5  Orbiculiforma campbellensis Pessagno, n. sp.; Holotype (USNM 207354); Sample 29-275-1-3, 140-142 cm.

Figure 6  Orbiculiforma campbellensis Pessagno, n. sp.; Paratype (USNM 207355); Sample 29-275-1-3, 140-142 cm.

Figure 7  Orbiculiforma renillaeformis (Campbell and Clark); Sample 29-275-2-1, 140-142 cm.

Figure 8  Prunobrachium (?) aucklandensis Pessagno, n. sp.; Holotype (USNM 207356); Sample 29-275-2-1, 140-142 cm.

Figures 9-12  Prunobrachium kenneiti Pessagno, n. sp.; Sample 29-275-2-1, 140-142 cm. 9, 10. Holotype (USNM 207360). 11, 12. Paratype (USNM 207361). Note tubular structures (bracchiopyles) at either end of test. One bracchiopyle tends to be greater in diameter than the other; 140-142 cm.

Figures 13, 14  Prunobrachium sibericum (Lipman); Sample 29-275-2-2, 140-142 cm.
PLATE 2

All figures except 1 and 2 are scanning electron micrographs; Figures 1 and 2 are light photomicrographs; late Campanian Radiolaria. Scale on all figures except 9, 10, 12, and 13 = 100µ; scale on Figures 9, 10, 12, and 13 = 44, 32, 66, and 72µ, respectively.

Figures 1, 2  *Prunobrachium kennetti* Pessagno, n. sp.; Sample 29-275-2-1, 140-142 cm.
   1. Longitudinal section cut in plane through center of test. Note markedly concentric layering of central part of test and division of test into two major layers; outer layer termed the pseudopatagium.
   2. Axial section through center of test; central portion with markedly concentric layering; pseudopatagium with crudely concentric layering.

Figures 3-5  *Prunobrachium longum* Pessagno, n. sp.; Sample 29-275-2-2, 140-142 cm.
   3, 4. Holotype (USNM 207358).
   5. Paratype (USNM 207359).

Figure 6  *Patulibrachium* sp.; Sample 29-275-2-1, 140-142 cm.

Figure 7  *Paronaella* (?) sp. 2; Sample 29-275-2-1, 140-142 cm.

Figure 8  *Paronaella* (?) sp. 3; Sample 29-275-2-1, 140-142 cm.

Figures 9, 10  *Peritiviator labyrinthi* Pessagno; Sample 29-275-2-1, 140-142 cm.

Figure 11  *Staurodictya* (?) *fresnoensis* Foreman; Sample 29-275-2-1, 140-142 cm.

Figure 12  *Spongosaturninus* sp. 1; Sample 29-275-2-1, 140-142 cm.

Figure 13  *Spongosaturninus* sp. 2; Sample 29-275-2-5, 140-142 cm.
PLATE 3

All figures are scanning electron micrographs of Campanian Radiolaria. Scale = 100μ unless otherwise noted.

Figures 1-3 *Neosciadiocapsa jenkinsi* Pessagno, n. sp.; Holotype (USNM 207362); Sample 29-275-2-1, 140-142 cm. Scale on Figure 3 = 44μ.

Figures 4-10 *Neosciadiocapsa jenkinsi* Pessagno, n. sp.; Paratypes (USNM 207363); Sample 29-275-2-1, 140-142 cm. Note prominent grooves and apical pores at base of horn and 3 spinose ridges radiating downwards from horn (Figures 8-10). Scale on Figure 7 = 66μ; scale on Figure 10 = 22μ.

Figures 11, 12 *Neosciadiocapsa jenkinsi* Pessagno, n. sp. Note triradiate nature of proximal portion of horn and presence of apical pores. Sample 29-275-1-3, 140-142 cm. Scale = 20μ.
PLATE 4

All figures are scanning electron micrographs of late Campanian Radiolaria.

Figures 1-3 *Microsciadiocapsa (?)* sp.; Sample 29-275-1-3, 140-142 cm.
1, 2. Scale = 100µ.
3. Scale = 40µ.

Figures 4, 5 *Amphipydax stocki* (Campbell and Clark) s.s.
Note bulbous cephalothorax covered with papillae (see descriptions of this species by Campbell and Clark, 1944; Foreman, 1968). Sample 29-275-2-5, 140-142 cm.
4. Scale = 100µ.
5. Scale = 20µ.

Figures 6-8 *Amphipyndax stocki* (Campbell and Clark) s.l.
Note less bulbous, smooth cephalothorax. This form should probably be treated as a new species or a new subspecies of *A. stocki*. Sample 29-275-2-1, 140-142 cm. Scales = 50, 24, and 50µ, respectively.

Figure 9 *Amphipyndax* sp.; Sample 29-275-2-1, 140-142 cm.
Scale = 50µ.

Figure 10 *Theocampe* sp. aff. *T. altamontensis* (Campbell and

Figures 11, 12 *Archaeodictyomitra (?) regina* (Campbell and Clark); Sample 29-275-2-5, 140-142 cm. Scale = 100 and 66µ, respectively.
PLATE 5

All figures are scanning electron micrographs of late Campanian Radiolaria.

Figures 1-3  *Dictyomitra densicostata* Pessagno; Sample 29-275-2-5, 140-142 cm; scale = 80, 26, and 66µ, respectively.

Figure 4  *Archaeodictyomitra* sp.; Sample 29-275-2-5, 140-142 cm; scale = 56µ.

Figures 5-7  *Diacanthocapsa amphora* (Campbell and Clark); Sample 29-275-2-5, 140-142 cm; scale = 40, 50, and 24µ, respectively.

Figure 8  *Lithomelissa (?) sp.*; Sample 29-275-2-5, 140-142 cm; scale = 50µ.

Figures 9, 10  *Lophaphaena (?) polycyrtis* (Campbell and Clark); Sample 29-275-2-5, 140-142 cm; scale = 100 and 50µ, respectively.

Figures 11, 12  *Cinclopyramis* sp.; Sample 29-275-2-1, 140-142 cm; scale = 50µ each.

Figure 13  *Comutella californica* Campbell and Clark; Sample 29-275-2-1, 140-142 cm; scale = 40 µ.