onyms of *C. bisecta,* but we did not attempt to list the voluminous literature citations of *C. bisecta* and its synonyms. The latest lengthy synonymy of *C. bisecta* is given by Honda (1989), but he considered *C. disjuncta,* as well as the Japanese fossils *Conchocele nipponica* (Yabe and Nomura, 1925) [=originally considered to be a variety of *Conchocele bisecta*] and *C. bisecta omaruri* (Oyama and Mizuno, 1958), to be distinct taxa. A useful synonymy of *C. disjuncta* is given in Moore (1988), and a useful abbreviated synonymy of *C. bisecta* is given in Coan et al. (in press).

Smith (1956) commented that *Thyasira folgeri* Wagner & Schilling, 1923, seems to be based on small specimens of the *T.* cf. *T. disjuncta* that they collected from the middle member of the Wagonwheel Formation. Jenkins (1931) also suspected that *T. folgeri* was a juvenile form but thought it should be referred to *T. bisecta.*

Weaver (1942 [1943], plate 34, figures 5, 6) and Moore (1963, plate 23, figure 8, not plate 7, figures 23, 24 = a paratype) figured the holotype (USNM 3518) of *C. bisecta* (Conrad).

Van Winkle (1919) described *Thyasira adoccasa* Van Winkle (1919, pages 25–26, plate 3, figures 15, 16) from the middle? Tertiary of Trinidad in the southeastern Caribbean Sea. She noted that although *Thyasira adoccasa,* a large species with specimens to 12 cm length, resembles *Conchocele bisecta* (Conrad), the latter species does not reach such large size. Coan et al. (in press), however, have reported specimens of *T. bisecta* to 11 cm length. Intermediate stages of the two species are similar, but *Conchocele bisecta* differs from *T. adoccasa* by retaining the prominent fold that extends from the beaks to the posterior margin and by not becoming ovate in shape in the late adult specimens.

Olsson (1931) reported that *Thyasira peruviana* Olsson (1931, pages 148–149, plate 6, figures 3, 5, 7, 8, 9, 12) resembles *Conchocele bisecta.* The stratigraphic position and geologic age of *T. peruviana* are uncertain. The specimens are known only from an isolated exposure, and Olsson (1931) reported that, based on field relations, this exposure seems to belong to the Talara Formation. Marsaglia and Carozzi (1990) considered this formation to be of middle Eocene age. Olsson, however, tentatively assigned *T. peruviana* in the isolated exposure to the Oligocene because some of the molluscan species in the rock resembled Oligocene species. Examination of the type specimens of *T. peruviana* revealed that this species belongs to genus *Conchocele* because the anterior margin is straight, which is a diagnostic feature of this genus (Coan et al., in press). *Conchocele peruviana* is similar to *Conchocele bisecta* but differs in being smaller in size and in having a much wider and more sharply delineated ligamental area.

Goedert et al. (in press) reported a possible occurrence of *Thyasira peruviana* associated with a whale-fall (chemosynthetic) habitat in the Oligocene part of the Pysht Formation, Washington.

The earliest occurrences of *Conchocele bisecta* on the Pacific coast of North America are in the upper Eocene Keasey Formation, northwest Oregon (Campbell and Bottjer, 1993), the upper Eocene Marrowstone Shale, Olympic Peninsula, Washington (Clark, 1925), and the uppermost Eocene middle member of the Wagonwheel Formation, Wagonwheel Mountain (herein).

Elsewhere in the fossil record on the Pacific coast of North America, *C. bisecta* has been found in the lower Oligocene part of the Poul Creek Formation, Gulf of Alaska (Clark, 1932; Addicott et al., 1971; Kanno, 1971b); the upper Oligocene uppermost part of the Lincoln Creek Formation, Knappton, southwestern Washington (Moore, 1984, see discussion of age in Squires and Goedert, 1994); the lower Miocene Clallam Formation, northern Olympic Peninsula, Washington (Addicott, 1976); the middle Miocene Astoria Formation, Astoria, northwestern Oregon (Weaver, 1942 [1943]; Moore, 1963); the Miocene to Pliocene Yakataga Formation, Gulf of Alaska (Kanno, 1971b); the Pliocene Pico Formation, southern California (Waterfall, 1929); the Pliocene Wildcat Group, northern California (Ogle, 1953); the Pleistocene Timms Point Silt, southern California (Arnold, 1903; Woodring et al., 1946); and the Pleistocene San Pedro Sand, southern California (Gabb, 1866). In all of these formations, *Conchocele bisecta* was originally identified as *C. disjuncta* or *Thyasira disjuncta,* except for the Astoria Formation (Weaver, 1942 [1943]; Moore, 1963), the Poul Creek Formation (Clark, 1932), and the Timms Point Silt (Arnold, 1903), where it was originally identified as *T. bisecta.*

Tentative reports of *Conchocele bisecta* (originally identified as *Thyasira* cf. *T. disjuncta*) in the fossil record on the Pacific coast of North America are: the Oligocene Kultieth Formation [formerly referred to as the Katella Formation (Louie Marincovich, personal comm.)], Katella district, southeastern Gulf of Alaska (Miller, 1975); the upper Oligocene Blakeley Formation, Olympic Peninsula, Washington (Tegland, 1933; Durham, 1944); the upper Oligocene to lower Miocene Pysht Formation (formerly referred to as the upper member of the Twin River Formation, see Snavely et al., 1977), Olympic Peninsula, Washington (Durham, 1944); the Oligocene? to Miocene Redwood Formation, Katella district, southeastern Gulf of Alaska (Miller, 1975); and the upper lower to lower middle Miocene Topsy Formation, Lituya district, southeastern Gulf of Alaska (Marincovich, 1979).

The earliest records of *Conchocele bisecta* on the Pacific coast of North America are synchronous with the earliest occurrence of this species in Japan. The first appearance of *C. bisecta* in Japan is in late Eocene to early Oligocene Poronai Formation (Kanno, 1971a). Various authors have reported *C. bisecta* from the Eocene Tighil Series on the west coast of Kamchatka and use Krishtofovich (1936) as their source, but she assigned the Tighil Series (= lower part of the Whitish series) to the middle Miocene.

Material.—Seven adult and 10 juvenile specimens at CSUN loc. 1580; nineteen juvenile specimens at CSUN loc. 1581. Of *bisecta*: holotype USNM 3518, Miocene, Astoria, Oregon. Of *disjuncta*: lectotype MCZ 15017, selected by Stewart (1930), Pleistocene, Deadman's Island [now destroyed], San Pedro, Los Angeles County, southern California.

Occurrence.—Upper Eocene to Recent. Fossil: Alaska, Washington, Oregon, and central and southern California, western Kamchatka, Sakhalin, Japan (all discussed herein), Korea (Yoon, 1976), and Spitzbergen (Durham and MacNeil, 1967). Living: Pribilof Island, Bering Sea (57°N) to northern California (40.8°N); Sea of Okhotsk to Sea of Japan (Coan et al., in press), and Gulf of Darian, Colombia, Caribbean Sea (Boss, 1967).

Family VESICOMYIDAE Dall & Simpson, 1901
Genus VESICOMYA Dall, 1886

Type species.—*Callocardia atlantica* Smith, 1885, by original designation, Recent, northeastern Atlantic.

Subgenus VESICOMYA s.s.
Vesicomya (*Vesicomya*) aff. *V.* (*V.*) *tschudi* Olsson, 1931
Figure 4.9–4.12

Petricola n. sp. ARNOLD AND JOHNSON, 1910, p. 41.
Petricola (?) sp. SMITH, 1956, p. 77.

Discussion.—At locality CSUN 1580, nearly all of the specimens are articulated and range from 1.1 to 2.15 cm in height and 2.1 to 3.2 cm in length. At locality CSUN 1581, most of

the specimens are articulated and range from 1 to 2 cm in height and 1.7 to 2.8 cm in length.

The only sculpture on the valves is strongly defined growth lines. There are well-defined and steep, strongly curved umbones and the dorsal anterior area adjacent to the umbones is steep for a distance before it projects anteriorly. Dentition is not observable. The escutcheon is beveled and deep. The lunule is distinct, heart-shaped, and circumscribed by an impressed isocardioform line (Figure 4.12). The presence of a lunule is important in assigning the specimens to *Vesicomya* (*Vesicomya*) rather than to the *Vesicomya* (*Calyptogena*) Dall, 1891. *Calyptogena* does not have a lunule (Coan et al., in press).

The specimens show very close affinity to *Vesicomya* (*Vesicomya*) *tschudi* (Olsson, 1931, pages 150–151, plate 4, figures 6, 8) from the upper Oligocene Heath Formation, northwestern Peru, South America. The Wagonwheel Formation specimens are smaller and have (except for rare specimens) lower umbones than *V.* (*V.*) *tschudi*. Although poor preservation prevents the determination of whether or not the lunule of *V.* (*V.*) *tschudi* is circumscribed by an impressed isocardioform line, we assign the Peruvian species to *Vesicomya* s.s. because of the morphologic similarity to the material from the Wagonwheel Formation.

We are reluctant to assign the Wagonwheel Formation specimens to a new species because the specimens are not that well preserved, show no interior features, and the differences they show when compared to the Peruvian species might be due only to growth stage.

Olsson (1931) also reported "*Vesicomya*? *tschudi*" from an isolated cherty limestone exposure of Oligocene? age in the Lomitos Formation, northwestern Peru, but he did not figure the bivalve. He also reported that the exposure might belong in the Talara Formation, which Marsaglia and Carozzi (1990) assigned to the middle Eocene.

There is some confusion regarding the spelling of *tschudi* by Olsson. In the description of the species, he used the name *tschudi,* but in the caption to the illustrated figures and in the text of his paper he used the name *tscudi.* Utilizing the "Principle of the First Reviewer" (Article 24c of Ride et al., 1985), we formally choose the spelling *tschudi* because that is the name used by Olsson in his systematic section.

Vesicomya (*Vesicomya*) *tschudi* is similar to *Vesicomya* (*Vesicomya*) *ramondi* Olsson (1931, pages 151–152, plate 4, figure 3), which is also from the upper Oligocene Heath Formation, northwestern Peru, South America. *Vesicomya* (*Vesicomya*) *tschudi* differs by having a less elongate shell.

The geologic history of *Vesicomya* s.s. is inadequately known, mainly due to the few reports of specimens in the fossil record. In addition, there are difficulties in the systematics of vesicomyids (Boss and Turner, 1980), and it is likely that *Vesicomya* s.s. has been assigned to other genera.

The earliest record of *Vesicomya* is *Vesicomya* s.s. of the Wagonwheel Formation. It was previously known from rocks only as old as late Oligocene (Olsson, 1931; Beets, 1943), although Goedert and Campbell (1995) reported a single valve of *Vesicomya* (?) from an early Oligocene cold-seep limestone in the Makah Formation, Olympic Peninsula.

The only other lower Tertiary species of *Vesicomya* s.s. that we know of is *V.* (*V.*) *alberdine* Beets, 1943, from the upper Oligocene of Celebes, Indonesia. Boss (1968) believed it to be closely related, if not a synonym, of the modern *V.* (*V.*) *ticaonica* Dall, 1908, from the Philippine Islands. The Wagonwheel Formation specimens differ from *V.* (*V.*) *alberdine* in having less inflated valves and umbones located much less anteriorly.

Presently, *V.* (*V.*) *lepta* (Dall, 1896, page 17; 1908, page 416, plate 18, figures 13, 14) and *V.* (*V.*) *sternsii* (Dall, 1895, page 693, figures 1a, 1b) are the only two species of *Vesicomya* s.s. living off the west coast of the United States (Coan et al., in press). Both have a convex rather than a straight dorsal anterior area adjacent to the umbones in comparison to the species from the Wagonwheel Formation. In addition, *V.* (*V.*) *sternsii* has a shallower escutcheon.

Material.—Twenty specimens at locality CSUN 1580; 28 specimens at locality CSUN 1581.

Occurrence.—Upper Eocene: Wagonwheel Mountain, central California.

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APPENDIX

LOCALITIES

CSUN 1580. At elevation of 760 ft at north end of top of small hill, latitude 35°42′13″N, longitude 119°59′30″W, 152 m (500 ft) N, and 69 m (225 ft) W of the SE corner of section 35, T25N, R18E, U. S. Geological Survey, 7.5–minute, Emigrant Hill Quadrangle, 1953 (photorevised, 1973), northwest Kern County, central California. Middle siltstone member of the Wagonwheel Formation. Age: Latest Eocene. Collectors: R. L. Squires and M. P. Gring, June, 1994. = LACMIP loc. 16886

CSUN 1581. At elevation of 730 ft at top of small hill, latitude 35°42′N, longitude 119°59′W, 312 m (1,025 ft) N, and 168 m (550 ft) W of the SE corner of section 35, T25N, R18E, U. S. Geological Survey, 7.5-minute, Emigrant Hill Quadrangle, 1953 (photorevised, 1973), northwest Kern County, central California. Middle member of the Wagonwheel Formation. Age: Latest Eocene. Collectors: R. L. Squires and M. P. Gring, June, 1994. = LACMIP loc. 16887

UCMP 3195. From small hogback which joins cliff S of Devil's Kitchen and N of locality, SE corner of section 31, T10N, R21W, U. S. Geological Survey, 7.5-minute, Eagle Rest Peak Quadrangle, 1942, Kern

County, southern California. Middle mudstone member of the San Emigdio Formation. Age: Late Eocene. Collectors: C. M. Wagner and K. H. Schilling, *circa* 1920.

UCMP B-7027. In a gray siltstone in Coyote Canyon, approximately 549 m (1,800 ft) S, and 610 m (2,000 ft) E of the SW corner of section 23, T5N, R33W, U. S. Geological Survey, 7.5-minute, Sacate Quadrangle, 1953, Santa Barbara County, southern California. Upper part of Gaviota Sandstone. Age: Late Eocene. Collector: D. R. Forbes, June, 1948 (Weaver and Kleinpell, 1963:226, figure 6).

UWBM 705. On S shore of Mystery Bay on Marrowstone Island, NE side of Olympic Peninsula, section 32, T30N, R1E, U. S. Geological Survey, 7.5-minute Norland Quadrangle, 1953 (photorevised, 1973), Jefferson County, Washington. Marrowstone Shale. Age: Late Eocene. Collector: H. Hannibal, circa 1915.