



Figures 40–53. Specimens coated with ammonium chloride. Figures 40–45. *Panzacorbula* Squires & Saul, gen. nov. *pozo* (Dailey & Popenoe, 1966). Figure 40. Holotype LACMIP 8916, LACMIP loc. 23774, left valve, $\times 2.2$. Figure 41. Paratype LACMIP 8918, LACMIP loc. 23774, left-valve interior, $\times 2.1$. Figure 42. Paratype LACMIP 8917, LACMIP loc. 23774, right valve, $\times 2.1$. Figure 43. Hypotype LACMIP 13124, LACMIP loc. 10667, immature right valve, $\times 4.1$. Figure 44. Paratype LACMIP 8917, LACMIP loc. 23774, right-valve interior, $\times 2$. Figure 45. Holotype LACMIP 8916, LACMIP loc. 23774, dorsal view, $\times 2$. Figures 46–49. *Eoursivivas cultriformis* (Gabb, 1864). Figure 46. Hypotype LACMIP 13125, LACMIP loc. 26345, left valve, $\times 2.6$. Figure 47. Hypotype LACMIP 13126, LACMIP loc. 26345, left valve, $\times 5.1$. Figure 48. Lectotype UCMP 11945a, CGS loc. 144, right valve, $\times 5.2$. Figure 49. Hypotype LACMIP 13127, LACMIP loc. 26345, right valve, $\times 2.3$. Figures 50–53. *Caestocorbula cavus* Squires & Saul, sp. nov., UCMP loc. B-5611. Figure 50. Paratype UCMP 155540, left valve, $\times 13.7$. Figures 51–53. Holotype UCMP 155539, $\times 7$. Figure 51. Left valve. Figure 52. Right valve. Figure 53. Dorsal view.

Diagnosis: Same as for genus.

Description: Shell medium (maximum length 21.7 mm); moderately thick. Valves subpyriform to trigonal elongate, inflated (right valve more inflated than left valve), nearly equilateral (left valve very slightly smaller than right valve), sub-inequilateral. Lunule deep; escutcheon less well developed. Anterior and posterior ends rounded. Posterior end of both valves projected, set off by subdued, very low keel on left valve and sharp keel on juvenile right valve; keel becoming obsolete with growth on both valves. Umbones moderately high, at midline of valves or slightly anterior of midline; beaks prosogyrate, just anterior to midline. Left valve nearly smooth on umbo but with very weak to weak, closely spaced ribs toward venter. Right valve with strong, widely spaced wavy ribs, overlapping shinglelike toward umbo, and with deep interspaces. Ribs on both valves gradually becoming obsolete posteriorly, producing smooth posterior slope. Left-valve hinge with thickened lunular margin (which fits into narrow antecardinal socket in right valve), somewhat narrow V-shaped socket, and large spoon-shaped chondrophore with edges delimited by ridges. Chondrophore projecting beyond plane of commissure and aligned at an angle of approximately 45° to it. Pit posteriorly adjoining chondrophore V-shaped, long, narrow, and deep. Right-valve hinge with narrow antecardinal socket; single, large triangular cardinal tooth; adjoining pit trigonal, broad, and deep. Cardinal tooth situated below and slightly anterior to beak to which it is joined by narrow ridge.

Dimensions of holotype: Conjoined valves, 15 mm in height, 21.7 mm in length, 11.2 mm in thickness.

Holotype: LACMIP 8916 (= ex UCLA 40427).

Type locality: LACMIP loc. 23774.

Paratypes: LACMIP 8917 and 8918 (= ex UCLA 40428 and 40429).

Geologic age: Early late Campanian to early late Maastrichtian.

Distribution: LOWER UPPER CAMPANIAN: Jalama Formation, Santa Barbara County, southern California (Figure 1, locale 17). UPPER CAMPANIAN/LOWER MAASTRICHTIAN UNDIFFERENTIATED: Gualala Formation, Anchor Bay Member, Mendocino County, northern California (Figure 1, locale 10); unnamed Cretaceous formation, Pozo district, San Luis Obispo, central California (type locality) (Figure 1, locale 16). LOWER MAASTRICHTIAN: Tesla Formation, near base of lower sandstone member, Corral Hollow, east of Livermore, Alameda County, western edge of San Joaquin Valley, central California (Figure 1, locale 12). UPPER LOWER TO LOWER UPPER MAASTRICHTIAN: Moreno Formation, Tierra Loma Member, Ortigalita Creek, south of Los Banos Reservoir, Merced County, west side of San Joaquin Valley, central California (Figure 1, locale 14).

Discussion: This study of Dailey and Popenoe's species is based on 124 specimens (including the type material): 96 right valves, 25 left valves, and three pairs of conjoined valves. Only one specimen (right valve) has a predatory drill hole. There can be some variation in the strength of the ribs. At UCMP locs. D-8149 and D-8174, near the base of the lower sandstone member of the Tesla Formation, some right valves have weaker ribs than normal.

The overall shell shape and lunule depth of *Panzacorbula pozo* is remarkably similar to *Indocorbula basseae* (Singh & Rai, 1980:79, pl. 1, fig. 6a; Fürsich et al., 2000: 142, pl. 17, figs. 14, 15, pl. 18, figs. 8, 9) from Middle Jurassic strata of western India. *Panzacorbula pozo* differs from the Indian species by having an inclined, spoon-shaped chondrophore (rather than a flattish one) and valves with significantly discrepant sculpture. Both valves of *I. basseae* have coarse ribs.

Panzacorbula pozo strongly resembles *Caryocorbula? ovisana* Stephenson (1952:129, pl. 32, figs. 9–15) from Cenomanian strata of Texas, but *P. pozo* differs by having a less trigonal shape and a weaker keel on both valves. In addition, on the left valve of *P. pozo*, the socket that accommodates the right-valve cardinal tooth is much narrower and V-shaped, rather than wide-oval.

Panzacorbula pozo resembles somewhat *Excorbula parkyi*, but *P. pozo* differs by having a subpyriform shape, lunule, ribs on the left valve, ribs on the immature part of the right valve, and much stronger ribs on the mature part of the right valve.

Genus *Eoursivivas* Ota, 1964

Type species: *Corbula matsumotoi* Hase, 1960, by original designation; Early Cretaceous (Valanginian to Hauterivian), Japan.

Diagnosis: Shell medium, very elongate to subpyriform. Sculpture consisting of subdued, irregular bands. Keel weak to moderately well developed, with groove between it and posterior dorsal margin.

Discussion: *Eoursivivas* Ota, 1964, was previously known only from Lower Cretaceous (Valanginian to Hauterivian) strata of Japan. *Eoursivivas cultriformis* is the first record of this genus in the Western Hemisphere and its youngest record.

Eoursivivas cultriformis (Gabb, 1864)

(Figures 46–49)

Corbula cultriformis Gabb, 1864:149, pl. 22, figs. 122.

Corbula (Anisorhynchus) cultriformis (Gabb). Dall, 1898: 840.

Corbula cultriformis Gabb. Stewart, 1930:289.

Diagnosis: An *Eoursivivas* with subdued irregular com-

marginal bands. Keel low. Posterior slope slightly concave.

Description: Shell medium (maximum 20 mm in length). Valves very elongate, nearly equivalved, and inequilateral. Anterior end rounded. Posterior end considerably elongate, somewhat oblong. Anterior dorsal margin somewhat steeper than posterior dorsal margin. Posterior slope slightly concave and set off by low keel, situated very near valve edge. Posterior dorsal margin somewhat prominent on some specimens, thereby producing second keel. Umbones moderately low, slightly anterior of midline of valves; beaks approximately 39% of the distance from the anterior end. Lunule and escutcheon absent. Sculpture on both valves consisting of rather weakly developed commarginal ribs, occurring as irregular bands. Left-valve hinge with projecting chondrophore.

Dimensions of lectotype: Right valve, 4.9 mm in height, 9 mm in length.

Lectotype: UCMP 11945a [= CGS 144], designated here.

Type locality: Exact location unknown, Martinez, Contra Costa County, northern California.

Geologic age: Late early to early late Maastrichtian.

Distribution: UPPER LOWER TO LOWER UPPER MAASTRICHTIAN: Moreno Formation, Tierra Loma Member, Ortigalita Creek, south of Los Banos Creek Reservoir, Merced County, west side of San Joaquin Valley, central California (Figure 1, locale 14). MAASTRICHTIAN UNDIFFERENTIATED: Great Valley Series, near Martinez, northern California (type locality) (Figure 1, locale 11).

Discussion: This study of Gabb's species is based on 35 specimens (including Gabb's syntypes): 22 right valves and 13 left valves. No conjoined valves were detected. Only one specimen (right valve) has a predatory drill hole. Most of the specimens are weathered, and on those with severe weathering, the growth bands become riblike.

Stewart (1930:289) reported that the type material of this species should be at UCMP, and that one of these specimens is UCMP specimen 11945a. Our search of this collection resulted in the detection of two cabinets containing Gabb's material formerly stored under the auspices of the old California Geological Survey (CGS) collection. A box labelled "CGS no. 144, original material," contains seven specimens of *Corbula cultriformis*, and one of these is labelled 11945a. All of these specimens are poorly preserved internal molds, external molds, or have retained only a portion of their shell. Because Gabb did not designate a holotype, we select specimen 11945a, which has some of its shell intact (Figure 48), to serve as the lectotype.

Eoursivivas cultriformis is most similar to *Eoursivivas*

matsumotoi (Hase, 1960:332, pl. 39, figs. 5–21; Ota, 1964:155–157, pl. 21, figs. 1–11, text fig. 4; Hayami, 1975:146, pl. 10, figs. 7, 8; Tashiro, 1992:pl. 74, fig. 2) from Lower Cretaceous (Valanginian to Hauterivian) strata of Japan. *Eoursivivas cultriformis* differs from *E. matsumotoi* by having a slightly better developed keel and a slightly concave posterior slope.

Subfamily CAESTOCORBULINAE Vokes, 1945

Genus *Caestocorbula* sensu lato Vincent, 1910

Type species: *Corbula henckeliusiana* Nyst, 1836, by original designation; Eocene, Belgium.

Diagnosis: Shell small to moderate, subtrigonal, moderately inflated, and inequivalved. Left valve usually much smaller, less inflated, less rostrate, and with generally weaker commarginal ribs than on right valve. Accessory siphonal plate of left valve rectangular, with faint median groove, and fitting into rostrum of right valve. Left valve lacking all trace of posterior elongation. Left-valve hinge with projecting chondrophore. Right valve produced posteriorly into a prominent rostral "snout." Right cardinal tooth relatively large and heavy. Pallial sinus extremely well developed (Vokes, 1944, 1945; Keen, 1969).

Discussion: Vokes (1945) provided taxonomic details and a detailed description of the genus.

Caestocorbula (*Caestocorbula*) Vincent, 1910, is very similar to *Caestocorbula* (*Parmicorbula*) Vokes, 1944. Fossil specimens of *Caestocorbula* are virtually indistinguishable from *Parmicorbula*, unless their accessory siphonal plate posterior to the right valve is preserved; however, the siphonal plate is rarely found on fossil specimens. For both of the new species described below, no information is known about the accessory siphonal plates; hence, *Caestocorbula* sensu lato is used.

The earliest records of *Caestocorbula* sensu stricto are *Caestocorbula morinoi* Tashiro & Kozai, 1991, from either Lower Cretaceous (Valanginian or Barremian) strata in Japan, and *Caestocorbula antiqua* Kozai, 1987, from Lower Cretaceous (either upper Hauterivian or Barremian) strata in Japan. The earliest record of *Parmicorbula* is *Parmicorbula neaeroides* (Blanckenhorn, 1890) from Aptian (undifferentiated) rocks in Lebanon and Syria (Vokes, 1944, 1945; Keen, 1969). Tashiro & Kozai (1991) tentatively reported *Parmicorbula* from lower Aptian strata in Japan. According to Keen (1969), *Caestocorbula* and *Parmicorbula* both went extinct in the Eocene.

Caestocorbula cavus Squires & Saul, sp. nov.

(Figures 50–53)

Diagnosis: Small *Caestocorbula* with both valves ovate. Commarginal ribs on left valve uniformly very weak, those on right valve uniformly weak.

Description: Shell small (maximum length 9 mm), longer than high. Valves ovate, slightly inflated, and inequilateral. Left valve smaller than right valve. Anterior end rounded. Posterior dorsal part of left valve deeply indented and concave, passing into short rostrum. Posterior slope of left valve with very low to obscure keel. Posterior end of right valve with projected rostral "snout." Umbones central. Sculpture on left valve consisting of moderately closely spaced, uniformly very weak commarginal ribs. Sculpture on right valve consisting of moderately closely spaced, uniformly weak ribs, becoming slightly more widely spaced ventrally.

Dimensions of holotype: Conjoined valves, 4 mm in height, 6 mm in length, 1.8 mm in thickness.

Holotype: UCMP 155539.

Type locality: UCMP B-5611, 31°28'N, 116°36'30"W.

Paratype: UCMP 155540.

Geologic age: Late Aptian.

Distribution: Alisitos Formation, upper member, Arroyo de la Cueva, just southeast of Punta China, northwestern Baja California, Mexico (Figure 1, locale 21).

Discussion: This new species is based on 13 specimens: nine right valves, three pairs of conjoined valves, and one left valve. All are from the type locality, and they are somewhat poorly preserved. Some seem to have been distorted by crushing. The adult left valve of this species is not well known. The best preserved left valve is that of a very early juvenile (Figure 50). The left valve of the holotype is an adult but is poorly preserved (Figures 51–53).

The new species is assigned to *Caestocorbula* based on the projected rostral "snout" of the right valve apparently extending farther than the short rostrum on the left valve.

Caestocorbula cavus is most similar to *Caestocorbula* (s. l.) *ohitai* Kozai (1987:329–330, fig. 3–12–20) from Cenomanian strata of Japan. The new species differs from *C. ohitai* by having an ovate left valve and ribbing that does not curve dorsally on the anterior part of the left valve.

Etymology: The species is named for its occurrence in Arroyo de la Cueva (Spanish for cave), Baja California, Mexico; Latin, *cavus* meaning cave.

Caestocorbula attina Squires & Saul, sp. nov.

(Figures 54–57)

Diagnosis: Very small *Caestocorbula* with left valve triangular, right valve subtriangular. Commarginal ribs on left valve very weak, irregularly spaced; those on right valve very weak to weak, prominent, and with deep interspaces; ribs on right valve becoming stronger ventrally.

Description: Shell very small (maximum length 5.5 mm), higher than long. Left valve smaller and less inflated than right valve. Left valve triangular, lowly inflated, umbones at midline of valves. Right valve subtriangular, prominently inflated; anterior margin broadly rounded; posterior end produced into "spout-like" rostration. Posterior slope of right valve nearly vertical and set off by straight keel, causing wrinkles in adjacent ornament. Umbo of right valve broadly rounded and low, at midline of valve; beak prosogyrate. Left valve smooth on umbo, sculpture consisting of very weak commarginal ribs, irregularly spaced. Right-valve sculpture prominent, consisting of very weak to weak commarginal ribs, becoming stronger toward ventral margin; interspaces consistently deep.

Dimensions of holotype: Right valve, 4.5 mm in height, 5.5 mm in length.

Holotype: LACMIP 13128.

Type locality: LACMIP loc. 25526, 35°54'48"N, 120°09'05"W.

Paratypes: LACMIP 13129 and CAS 69098.02.

Geologic age: Cenomanian.

Distribution: LOWER CENOMANIAN: Unnamed strata near Dayville, Grant County, Oregon (Figure 1, locale 2). UPPER CENOMANIAN/LOWER TURONIAN: Panoche Formation at Reef Ridge, Kings County, central California (type locality) (Figure 1, locale 15). CENOMANIAN UNDIFFERENTIATED: Budden Canyon Formation, Bald Hills (upper part), Bald Hills near Ono, Shasta County, northern California (Figure 1, locale 4).

Discussion: This new species is based on 36 specimens: 28 right valves, six left valves, and two pairs of conjoined valves. All but three of the specimens are from the type locality, where preservation is good, although some specimens found there are fragments. Although the specimens are slightly larger at LACMIP loc. 9936 in Grant County, Oregon, the preservation there is poor. This latter locality is discussed by Squires & Saul (2002).

The new species is similar to *Caestocorbula henckeli* (Nyst, 1836:4, pl. 1, figs. 8a,b; Vokes, 1994:pl. 1, figs. 1–3; Vokes, 1945:20–21, pl. 4, figs. 1–4; Keen, 1969:fig. 158,6), the type species of the genus, but the new species differs by having a greater height to length ratio and coarser sculpture.

The right valve of the new species is very similar to *Caestocorbula? allisoni* sp. nov., but the new species differs from *C. ? allisoni* by having a left valve that is nearly triangular, less inflated, much smaller than the right valve, and with much weaker commarginal ribs.

Etymology: The species is named for its occurrence in the Reef Ridge area; Latin, *attina* meaning stonewall.