

## PROPEAMUSSIUM SPECIES (BIVALVIA: PROPEAMUSSIIDAE) FROM THE UPPER CRETACEOUS OF SOUTHERN CALIFORNIA

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**ABSTRACT**—*Propeamussium* (*Parvamussium*) *holzense* n. sp. and *Propeamussium* (*Parvamussium*) *robinsonense* n. sp. are described from the Upper Cretaceous Holz Shale Member of the Ladd Formation, Santa Ana Mountains, southern California. These species occur with *Bostrychoceras elongatum* (Whiteaves), *Glyptoxoceras subcompressum* (Forbes), and *Inoceramus orientalis* (Sokolow), which are indicative of a late medial Santonian age (*Bostrychoceras elongatum* Biochron). *Propeamussium* (*Parvamussium*) *cowperi* (Waring), from the Campanian Chatsworth Formation of the Simi Hills, southern California, is also redescribed and reillustrated for comparative purposes.

### INTRODUCTION

THIN SHELLED “mud pectens” belonging to the family Propeamussiidae are relatively common from deeper water mudstones of Cretaceous age in the circum-Pacific area (Waring, 1917; Yabe and Nagao, 1928; Nagao, 1932; Ichikawa and Maeda, 1958; Hayami, 1965; Tamura, 1973, 1976; Tashiro, 1976; Sundberg, 1980, 1982, 1983; Tashiro and Matsuda, 1986). Because of their relative abundance and widespread distribution in this deeper water lithofacies, the Propeamussiidae may have biostratigraphic and paleoecological value. However, there are few adequate descriptions of this group from the Cretaceous of the circum-Pacific area.

Two new species of *Propeamussium* (*Parvamussium*) from southern California are described and the previously named species *Propeamussium* (*Parvamussium*) *cowperi* (Waring, 1917) is redescribed and reillustrated. *Propeamussium* (*Parvamussium*) *holzense* n. sp. and *Propeamussium* (*Parvamussium*) *robinsonense* n. sp. occur in the Upper Cretaceous Holz Shale Member of the Ladd Formation, Santa Ana Mountains, southern California (Figure 1). Sundberg (1980, 1982, 1983) has previously reported the two species as a single taxon, *Propeamussium* (*Propeamussium*) sp. A or *Propeamussium* sp. For comparison purposes, *Propeamussium* (*Parvamussium*) *cowperi*, also found in the Upper Cretaceous of southern California, is redescribed and reillustrated because its original description and illustrations (Waring, 1917) are inadequate.

Measurements for the three taxa are explained in Figure 2 and presented in Tables 1, 2, and 3. The following institutional abbreviations are used: CAS, Department of Geology, California Academy of Sciences, Golden Gate Park, San Francisco, California; CSUF, Department of Geological Sciences, California State University, Fullerton, California; LACMIP, Section of Invertebrate Paleontology, Los Angeles County Museum of Natural History, Los Angeles, California; UCLA, Department of Earth and Space Sciences, University of California, Los Angeles, California (collections presently housed at LACMIP).

### AGE

*Propeamussium* (*Parvamussium*) *holzense* and *Propeamussium* (*Parvamussium*) *robinsonense* occur with *Bostrychoceras elongatum* (Whiteaves), *Glyptoxoceras subcompressum* (Forbes), and/or *Inoceramus orientalis* (Sokolow) in the Plano Trabuco area (UCLA locs. 7057, 7058, 7059, and 7061) and in Silverado Canyon (LACMIP loc. 8087 and CSUF loc. 68), Santa Ana Mountains, southern California. In northern California, these associated taxa are indicative of the *Bostrychoceras elongatum* Biozone of late medial Santonian age (Haggart, 1984), thus in-

dicating a late medial Santonian age for *P.* (*P.*) *holzense* and *P.* (*P.*) *robinsonense*.

*Propeamussium* (*Parvamussium*) *cowperi* occurs at Stanford University locality 2 (Waring, 1917; =CAS 61644). This locality is in the basal portion of the Chatsworth Formation (Waring, 1917; Saul and Anderson, 1981) and is probably late medial Campanian age (Colburn et al., 1981).

### SYSTEMATIC PALEONTOLOGY

Superfamily PECTINACEA Rafinesque, 1815  
 Family PROPEAMUSSIIDAE Abbott, 1954  
 Genus PROPEAMUSSIUM de Gregorio, 1884  
 Subgenus PARVAMUSSIUM Sacco, 1897

*Type species.*—*Pecten duodecim-lamellatus* Bronn, 1831.

*Diagnosis.*—*Propeamussium* with a byssal notch present throughout ontogeny.

*Description.*—Valves small, thin, nearly equally convex; exterior of right valve covered with submarginal lirae; exterior of left valve commonly covered with radial costae; anterior auricle of right valve with byssal notch present throughout ontogeny and, in some shells, with radial costellae; lacks lateral gape; maximum internal rib height (RH) on left valve approximately 50–100 percent of shell height. (Modified from Hertlein, 1969, p. N350–N351.)

*Discussion.*—*Propeamussium* (sensu stricto) and *Parvamussium* have been considered subgenera of *Propeamussium* (Hertlein, 1969) or as separate genera (Tamura, 1973; Moore, 1984). *Propeamussium* (sensu lato) species from the Upper Cretaceous of southern California illustrate a mixture of morphological characteristics used by Hertlein, Tamura, and Moore to differentiate *Propeamussium* from *Parvamussium*. Modern species of *Parvamussium* are presently recognized based on the persistence of a byssal notch throughout ontogeny, whereas in *Propeamussium* (sensu stricto) the byssal notch disappears in later growth stages (Waller, personal commun.). This single character difference between *Propeamussium* (sensu stricto) and *Parvamussium* is here considered minor. Thus, the two taxa are here considered subgenera of *Propeamussium*.

Tamura (1973) considered all Mesozoic species of *Propeamussium* (sensu lato) as belonging to the genus (subgenus) *Parvamussium*. The species from southern California support Tamura's hypothesis. Other reported Mesozoic species of *Propeamussium* (sensu lato) are assumed to belong to the subgenus *Parvamussium*, although published illustrations of some species are not adequate for determining if the byssal notch is present throughout ontogeny.

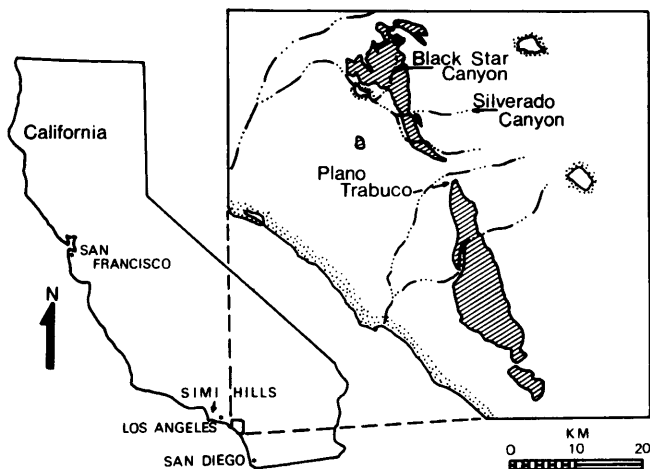


FIGURE 1—Location map showing the Simi Hills and (in the enlarged area) the Upper Cretaceous outcrop belt in the Santa Ana Mountains.

Right valves of *Propeamussium* (sensu lato) have an outer shell layer composed of columnar prismatic calcite and inner layers of foliated calcite and crossed lamellar aragonite (Waller, 1972, 1984). In the right valve, the stronger foliated calcite and crossed lamellar aragonite shell layer terminate at the same location as the internal ribs (which are foliated calcite) (Waller, 1972). This termination leaves the weaker, more fragile, prismatic calcite layer unsupported along the ventral margin of the right valve. As a result, the fragile ventral margin of the right valve is commonly broken off and/or not preserved. A few of the fossil specimens described here show this thin prismatic calcite layer (Figure 3.10). Left valves do not have the outer shell layer composed of columnar prismatic calcite. In these valves, the inner layer of foliated calcite extends to the valve edge (Waller, 1972, 1984).

The internal ribs in *Propeamussium* have different relative lengths in right and left valves (Waller, personal commun.). All rib height/height ratios (RH/H) mentioned in the following descriptions refer to left valves only. The height of the internal ribs in the right valve is not discussed due to the fragile ventral margin as discussed above. The internal ribs are considered primary if they begin in the umbonal region and secondary if they begin at some distance away from the umbonal region.

**PROPEAMUSSIUM (PARVAMUSSIUM) HOLZENSE n. sp.**  
Figures 3, 4

**Diagnosis.**—*Propeamussium* (*Parvamussium*) with a posteriorly ovate to subcircular valve outline; well-developed to moderately well-developed byssal notch on right anterior auricle; 6–9 radial costellae on right anterior auricle; 11–15 internal ribs on right valve (10–15 primary and 0–3 secondary); 9–15 on left valve (9–15 primary and 0–3 secondary); hinge line straight.

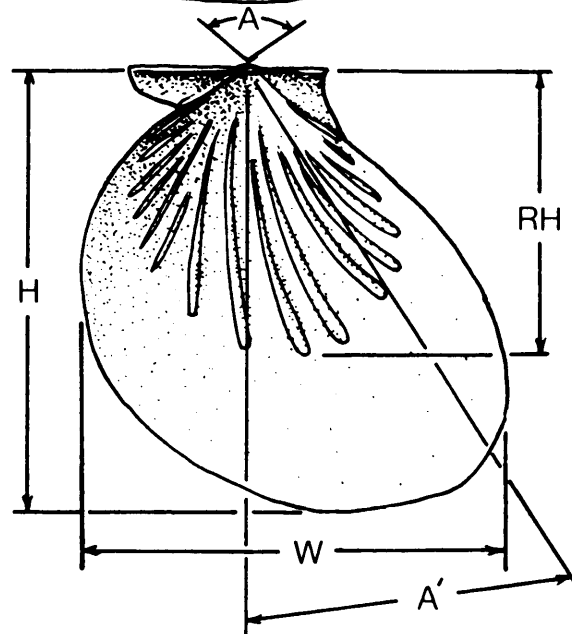
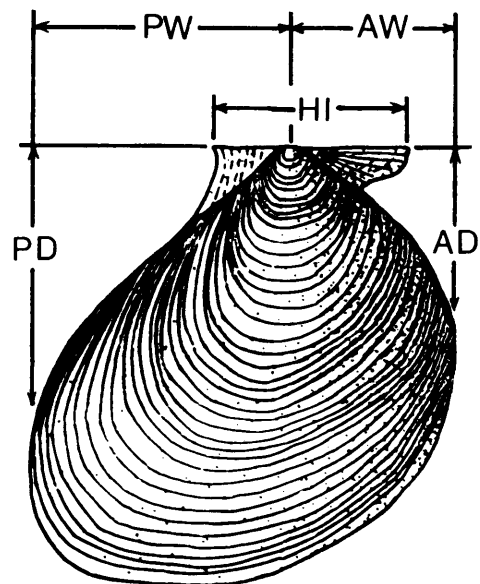


FIGURE 2—Measurements used for *Propeamussium* (*Parvamussium*) *holzense* n. sp., *Propeamussium* (*Parvamussium*) *robinsonense* n. sp., and *Propeamussium* (*Parvamussium*) *cowperi* (Waring). External right valve at top; internal right valve at bottom. A, umbonal angle; A', angle of maximum distance from umbo; H, height; HI, hinge line length; RH, maximum height of ribs; W, width; AD, anterior distance from umbo to maximum anterior width; AW, maximum anterior width from umbo; PD, posterior distance from umbo to maximum posterior width; PW, posterior width from umbo.

FIGURE 3—*Propeamussium* (*Parvamussium*) *holzense* n. sp. from the Santa Ana Mountains. All specimens coated with ammonium chloride sublimate or magnesium ribbon smoke. 1, 4, latex cast of holotype (LACMIP 7231); 1, right valve exterior, posterior auricle broken,  $\times 2.9$ ; 4, close-up of holotype anterior auricle,  $\times 12.9$ ; 2, 3, 5, latex cast of paratype (LACMIP 7219); 2, left valve exterior,  $\times 1.6$ ; 3, left valve interior,  $\times 1.6$ ; 5, close up of hinge line,  $\times 5.6$ ; 6, paratype (LACMIP 7238), latex cast of left valve interior,  $\times 1.5$ ; 7, 8, latex cast of paratype (LACMIP 7228); 7, exterior right valve with posterior auricle missing and left valve interior,  $\times 1.5$ ; 8, left valve exterior with auricles missing and right valve interior,  $\times 1.5$ ; 9, paratype (LACMIP 7232), articulated specimen, right valve up with prismatic calcite fringe missing, posteriorly ovate specimen,  $\times 1.8$ ; 10, latex cast of paratype (LACMIP 7241), right valve exterior with prismatic calcite fringe preserved,  $\times 3.0$ ; 11, 12, latex cast of paratype (LACMIP 7220); 11, left valve exterior with hinge area missing,  $\times 1.5$ ; 12, left valve interior, short rib section near ventral margin probably broken off from posterior side of umbonal region,  $\times 1.5$ ; 13, paratype (LACMIP 7216), left valve exterior with auricles missing,  $\times 1.8$ . 14, latex cast of paratype (LACMIP 7221), left valve exterior,  $\times 3.8$ .