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# New Species of Neritid Gastropods from Cretaceous and Lower Cenozoic Strata of the Pacific Slope of North America

by

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*Abstract.* Ten new species of neritid gastropods are described from the fossil record of the Pacific slope of North America. *Nerita* (*Amphinerita*) *eos* sp. nov., from northern California, is of Early Cretaceous (Hauterivian) age and is the earliest record of *Amphinerita*. *Nerita* (*Amphinerita*) *vacca* sp. nov., from northern California, is of Late Cretaceous (Turonian) age. *Nerita* (*Bajanerita*?) *larix* sp. nov., from Washington, is of middle early Eocene ("Capay") age. *Nerita* (subgenus?) *salsa* sp. nov., from northern California, is of Turonian age.

*Otostoma lucanus* sp. nov., from southern California, is of Turonian age, and *Otostoma?* *atopos* sp. nov., from northern California, is of late Early Cretaceous (Albian) age.

*Corsania* (*Corsania*) *allisoni* sp. nov., from Baja California, Mexico, is of Albian age. *Corsania* (*Januncia*) *rhoga* sp. nov., from northern California, is of early Paleocene age, and *Corsania* (*J.*) *susana* sp. nov., from southern California, is of late Paleocene age. *Corsania* (*J.*) *oraria* sp. nov., a Washington species of middle early Eocene age, is the youngest record of this genus and subgenus and the first record of them in the Eocene of the Pacific coast of North America.

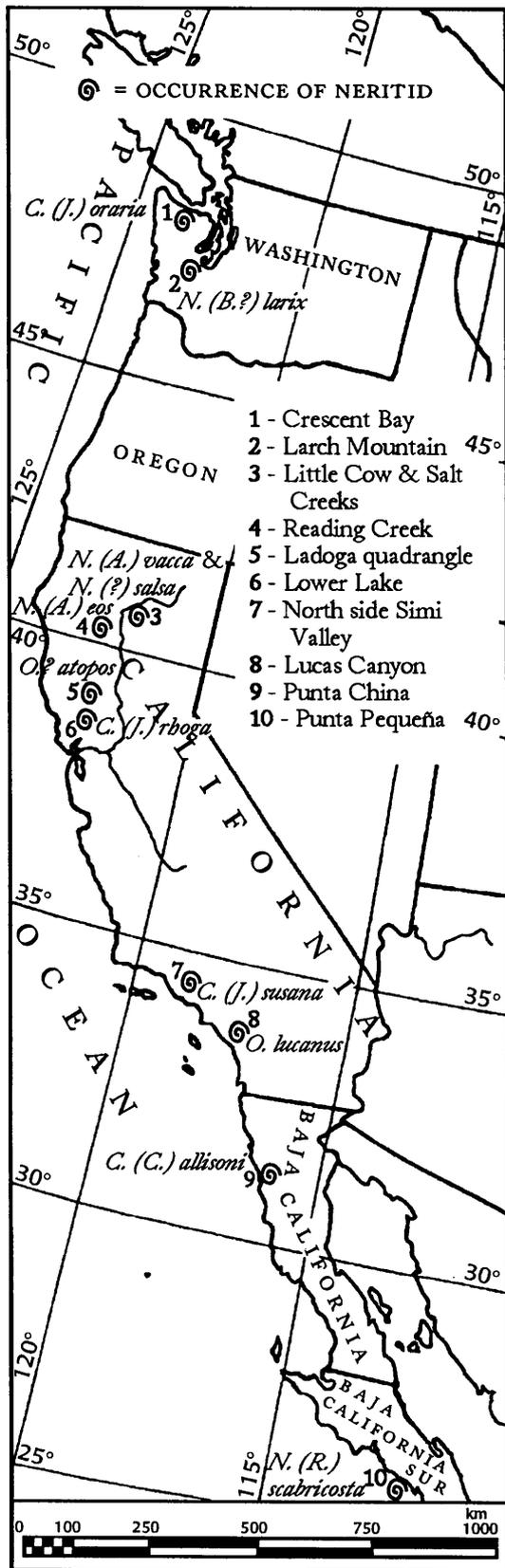
Although neritids are of sufficiently uncommon occurrence north of Baja California to make them of limited biostratigraphic importance, their thermophilic tendencies make them useful in recognizing periods of warmer climate.

## INTRODUCTION

The gastropod family Neritidae has a geologic range from Triassic to Recent (Keen & Cox, 1960; Tracey et al., 1993), but members of this family are uncommon to rare in the rock record. This scarcity is due, in large part, to the preference of these gastropods for living in rocky shoreline habitats, which are usually sites of erosion rather than deposition. In addition, many of the fossil neritid specimens, especially the smooth-shelled ones whose apertures are filled with hardened rock matrix, are overlooked because they resemble naticid gastropods. The apertures of

neritids, however, are quite distinct, but normally require very careful and time-consuming cleaning.

Mesozoic neritids from the Pacific coast of North America are rare for the above reasons. In addition, the record is not continuous because neritids, which are warm-water gastropods, only lived in this area during periods of warm climate. The neritid's discontinuous record parallels that of other thermophilic mollusks, such as the record of the bivalve *Plicatula*, which has been recently studied by Squires & Saul (1997). While examining the extensive collection of Cretaceous and Cenozoic fossils at the Natural History Museum of Los Angeles County, we came across impor-



tant new finds of neritids, as well as undescribed neritids that had been discovered by the late paleontologists W. P. Popenoe and E. C. Allison. These new neritids are the basis of this report. The geographic distribution of each new species is shown in Figure 1, and the geologic range of each is shown in Figure 2. Today, the northernmost record of a neritid on the Pacific coast of North America is *Nerita (Ritena) scabricosta* Lamarck, 1822, which ranges from Punta Pequeña at Bahía San Juanico (26°15'N) on the outer coast of Baja California Sur, Mexico, to Ecuador (Keen, 1971).

Abbreviations used are: CIT, California Institute of Technology (collections now stored at LACMIP); CSUN, California State University, Northridge; LACMIP, Natural History Museum of Los Angeles County, Invertebrate Paleontology Section; UCMP, University of California Museum of Paleontology (Berkeley); UCLA, University of California, Los Angeles (collections now stored at LACMIP).

SYSTEMATIC PALEONTOLOGY

Family NERITIDAE Rafinesque, 1815

Subfamily NERITINAE Rafinesque, 1815

Genus *Nerita* Linnaeus, 1758

**Type species:** *Nerita peloronta* Linnaeus, 1758, by subsequent designation (Montfort, 1810); Recent, South Florida, West Indies, and Bermuda.

Subgenus *Amphinerita* Martens, 1887

**Type species:** *Nerita umlaasiana* Krauss, 1848, by subsequent designation (Baker, 1923); Recent, South Africa.

**Discussion:** *Amphinerita* is closely allied to and part of the same clade as subgenus *Linnerita* Vermeij, 1984, and the most diagnostic feature used to distinguish between the two is the type of sculpture on the operculum (Vermeij, 1984). *Amphinerita* differs from most species of *Linnerita* by having an elevated spire, a smooth shell, and a parietal callus that is not transversely wrinkled (Vermeij, 1984). In addition, in our study of modern specimens of these two taxa, we observed that *Linnerita* can have small spiral wrinkles adjacent to the inner lip teeth. *Amphinerita* has a fossil record extending back to the Late Cretaceous (Wenz, 1938; Keen & Cox, 1960), whereas subgenus *Linnerita* has no known fossil record (Vermeij, 1984).

*Amphinerita* has a sharp-edged inner lip with a nearly

Figure 1

Index map for occurrences of new species of neritids from Washington to Baja California.

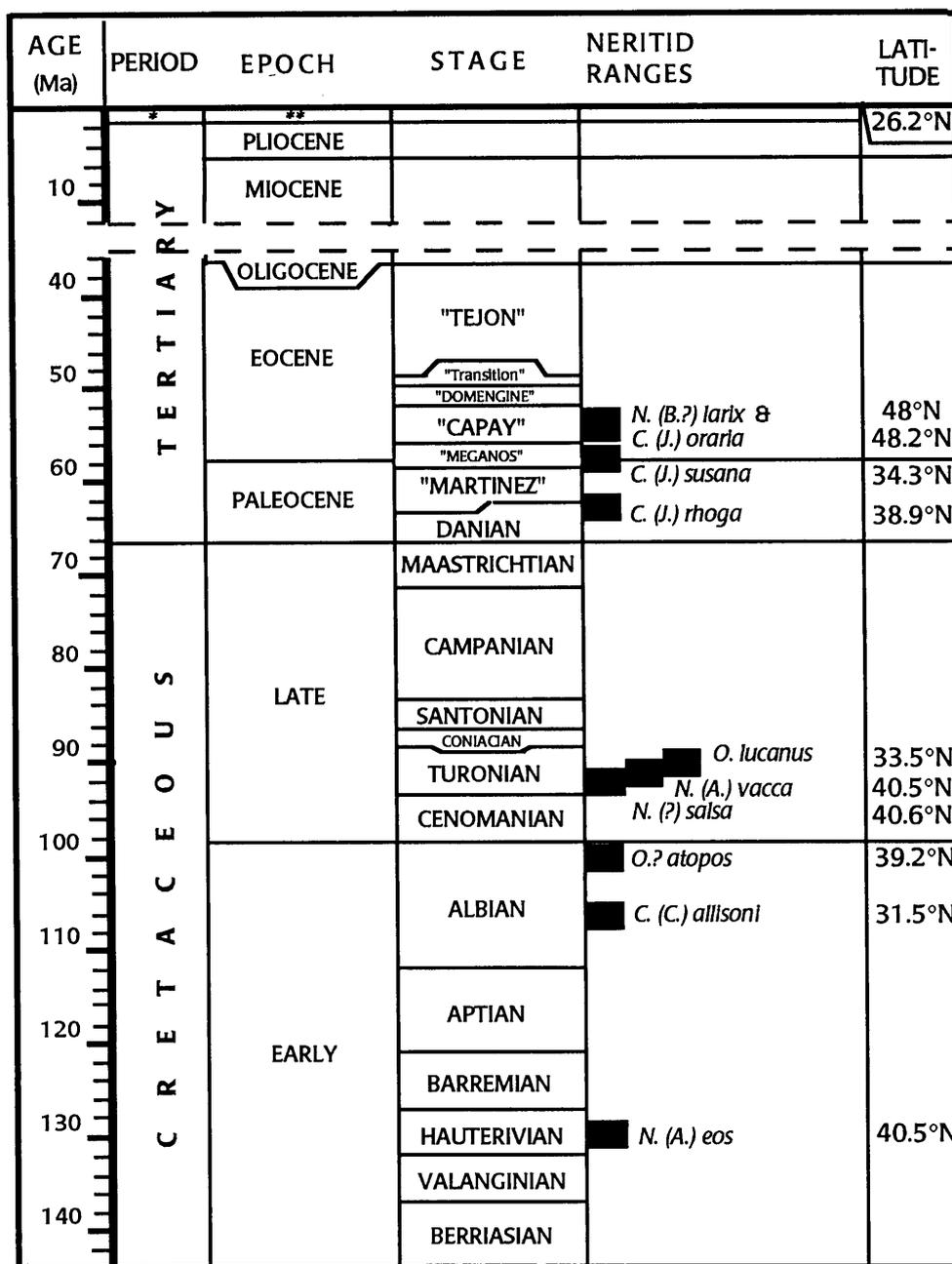


Figure 2

Time ranges of the new species of neritids. \* = Quaternary; \*\* = Pleistocene.

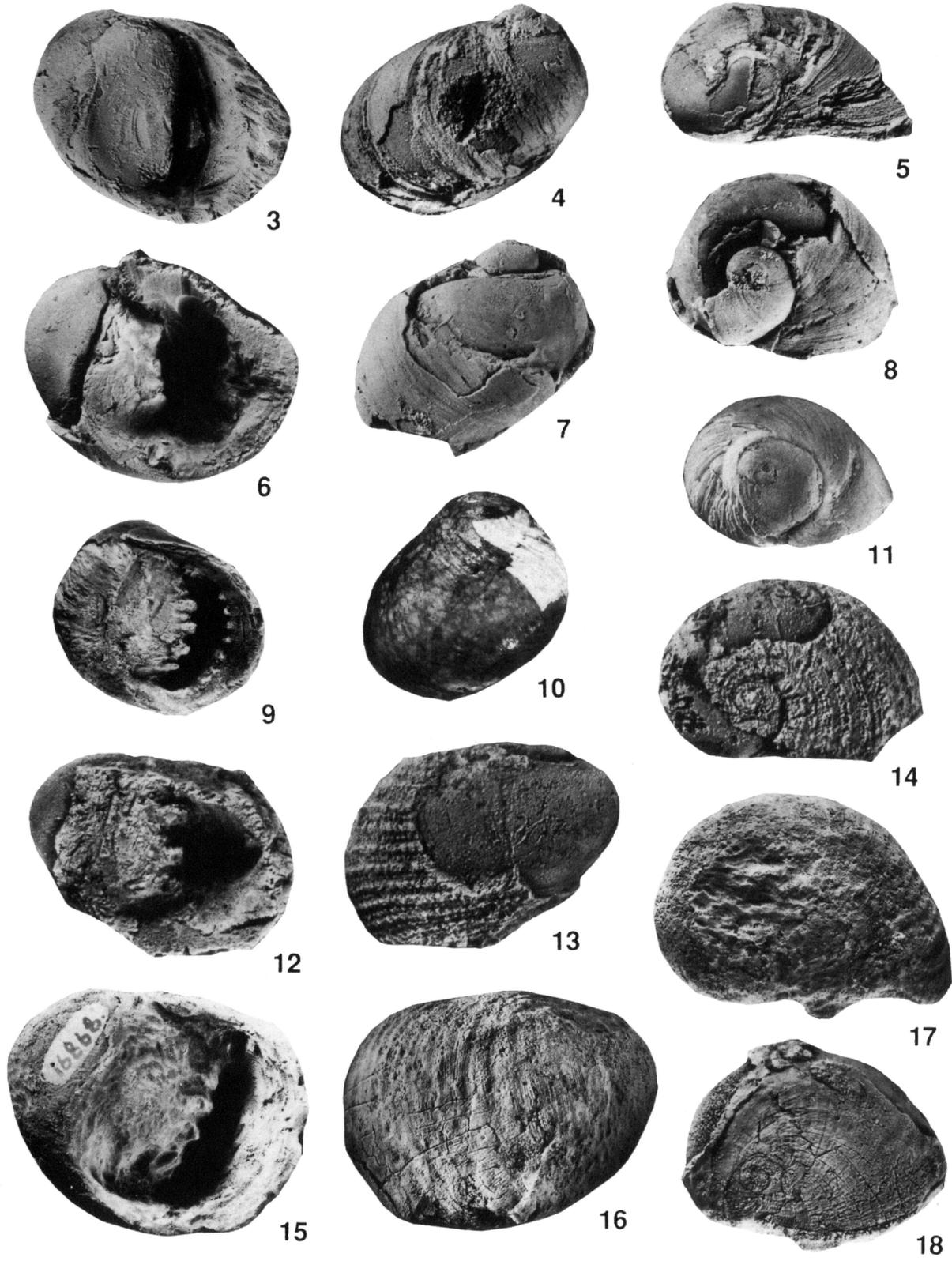
straight trend; its edge is commonly somewhat concave and finely toothed medially.

*Nerita (Amphinerita) eos* Saul & Squires, sp. nov.

(Figures 3-5)

**Diagnosis:** An *Amphinerita* with broad, flat, and smooth deck and smooth inner lip.

**Description:** Shell small, obliquely ovate, globose, broader than high, thin-shelled, consisting of 2½ whorls; spire moderately elevated; body whorl rapidly expanding with rounded shoulder. Body whorl relatively smooth, except for some irregularly spaced growth rugae, especially near outer lip. Growth lines closely spaced and prosocline. Aperture moderately large, sub-ovate. Deck wide, smooth, and flat. Posterior end of deck with shallow but prominent



groove. Trend of inner lip very slightly sinuous, nondentate.

**Dimensions of holotype:** Height 7.5 mm, width 11.4 mm.

**Holotype:** LACMIP 7880.

**Type locality:** LACMIP loc. 26600, latitude 40°35'30"N, longitude 122°54'28"W.

**Distribution:** Budden Canyon Formation, Ogo Member, Trinity Alps, Trinity County, northern California (LACMIP loc. 26600).

**Geologic age:** Early Cretaceous (Hauterivian).

**Discussion:** Only a single specimen was found. It is complete and shows overall good preservation. The apertural area is well preserved. The shell is missing on the spire, and the sutural area between the spire and body whorl is poorly preserved. The teleoconch exterior is somewhat weathered.

The new species most closely resembles *Nerita ovooides* Geinitz (1871–1875:pl. 57, fig. 4a, b) from strata in Germany that Gignoux (1950:421) correlated to the early Late Cretaceous (Cenomanian). The new species differs from *N. ovooides* by having a slightly more elevated spire, a longer inner lip, and a straighter abapical side of the deck.

The new species superficially resembles *Neritina incompta* White (1879:308–309, pl. 7, figs. 6–6c) from Upper? Cretaceous rocks in Wyoming. The exact age of these rocks is uncertain (Erickson, 1974:162). The new species differs from *N. incompta* by having a much wider deck area.

For a comparison of *N. (A.) eos* with *N. (A.) vacca* sp. nov., see "Discussion" under the latter.

The operculum of the new species is not known, as is the case for most extinct neritids, but the new species is assigned to subgenus *Amphinerita* based on the presence of a moderately elevated spire, a smooth shell, and a parietal callus without axial wrinkles. There are growth rugae on the body whorl of *N. (A.) eos*, but they are quite unlike the close-spaced, regularly spaced, and rather broad

axial wrinkles on the living species *N. (Linnerita) antiquata* Recluz, 1853, which has the best developed axial wrinkles of any species of *Linnerita*.

Associated fauna at the type locality of *N. (A.) eos* includes the shallow-marine bivalves *Yaadia* and *Pholadomya*. A Hauterivian age is indicated by ammonites found nearby along Reading Creek (Imlay, 1960).

The new species is the earliest record of *Amphinerita*. Previously, this subgenus was only known from the Late Cretaceous (Wenz, 1938). The new species is the earliest record of genus *Nerita* from the west coast of North America and, as far as we know, the earliest record of this genus anywhere in the world.

*Nerita (Amphinerita) eorex* Vokes (1939:180–181, pl. 22, figs. 24, 26, 29) from shallow-marine rocks in the middle Eocene Domengine Formation of central California (Vokes, 1939; Kappeler et al., 1984, table 2) is the only previously reported *Amphinerita* from the fossil record of the Pacific coast of North America. Vokes's species has five subequal, relatively large teeth (strength decreasing posteriorly) and a very low spire, and is not an *Amphinerita*. His species, as well as *Nerita* cf. *N. (Amphinerita) eorex* Vokes of Squires (1984:16, fig. 6a) from the middle lower Eocene ("Capay Stage") part of the Llajas Formation in Simi Valley, southern California, are judged by us to be juvenile stages (less than 10 mm high) of *Velates perversus* (Gmelin, 1791), a nearly cosmopolitan species that is also found in "Capay Stage" and possibly "Domengine Stage" strata of southern California and Baja California Sur, Mexico (Woods & Saul, 1986; Squires, 1987; Squires & Demetron, 1992). The growth stages of *V. perversus* involve a change from tightly coiled juvenile whorls with a globose-naticiform shape, a subangulate shoulder, fewer teeth, and a much thinner callus on the inner lip to reduced-coiled adult whorls with a very extensive callus and a patelliform shape (Woods & Saul, 1986; Squires, 1987; Savazzi, 1992). These features are like those observed on *N. (A.) eorex* and *N. cf. N. (A.) eorex*. *Velates perversus* is very similar to *V. californicus* Vokes (1935:384–385, pl. 26, figs. 3–8). The juvenile stage of *V. perversus* differs from *V. californicus* in

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#### Explanation of Figures 3 to 18

Specimens are coated with ammonium chloride, unless otherwise stated. Figures 3–5. *Nerita (Amphinerita) eos* Saul & Squires, sp. nov., holotype LACMIP 7880, LACMIP loc. 26600, height 7.5 mm, width 11.4 mm, ×5. Figure 3: apertural view. Figure 4: abapertural view. Figure 5: apical view. Figures 6–8. *Nerita (Amphinerita) vacca* Saul & Squires, sp. nov. Figure 6: paratype LACMIP 7882, LACMIP loc. 10751, apertural view, height 10 mm, ×3.8. Figures 7–8: holotype LACMIP 7881, height 11.6 mm, width 12.5 mm, ×3.1. Figure 7: abapertural view. Figure 8: apical view. Figures 9–11. *Nerita (Bajanerita?) larix* Saul & Squires, sp. nov., holotype LACMIP 7883, CSUN loc. 1563, height 9 mm, width 10.3 mm, ×3.8. Figure 9: apertural view. Figure 10: abapertural view, uncoated. Figure 11: apical view. Figures 12–14. *Nerita (subgenus?) salsa* Saul & Squires, sp. nov. Figures 12–13: holotype LACMIP 7884, LACMIP loc. 10773, height 6 mm, ×5.6. Figure 12: apertural view. Figure 13: abapertural view. Figure 14: paratype LACMIP 7885, LACMIP loc. 10760, apical view, width 5 mm, ×9. Figures 15–18. *Otostoma lucanus* Saul & Squires, sp. nov. Figures 15–17: holotype LACMIP 7886, LACMIP loc. 16868, height 23.3 mm, width 30.3 mm, ×1.7. Figure 15: apertural view. Figure 16: abapertural view. Figure 17: apical view. Figure 18: paratype LACMIP 7887, apical view, width 18 mm, ×2.4.

that *V. perversus* has a subangulate shoulder rather than a rounded one. In addition, the adult stage of *V. perversus* has dentition expressed only as projections (in some cases bifurcating) of the inner lip edge, whereas *V. californicus* has much stronger and better developed dentition (Woods & Saul, 1986). *Nerita (A.) eorex* and *N. cf. N. (A.) eorex* have a subangulate shoulder like *V. perversus*. Saul (1983a) reported *V. californicus* from the lower Eocene part of the "Meganos Stage" of the upper 100 m of the Santa Susana Formation on the south side of Simi Valley, southern California. Squires (1991) tentatively identified this species from the same rocks and corroborated the age, based on calcareous nannofossil data.

**Etymology:** The species name is derived from *eos*, Greek, meaning dawn or early.

*Nerita (Amphinerita) vacca* Saul & Squires, sp. nov.

(Figures 6–8)

**Diagnosis:** An *Amphinerita* with three small teeth on inner lip and posterior portion of inner lip prominently bulged.

**Description:** Shell small (up to 11.6 mm high), obliquely ovate, globose, thick shelled, two whorls; spire moderately elevated; body whorl rapidly expanding with rounded shoulder. Body whorl smooth. Growth lines prosocline. Aperture moderately large, sub-circular. Deck callus smooth. Inner lip with three small teeth; trend of inner lip straight on anterior half, posterior portion prominently semi-triangular and protruding. Outer lip thickened and showing tendency to be flared. Interior of outer lip smooth.

**Dimensions of holotype:** Height 11.6 mm, width 12.5 mm.

**Holotype:** LACMIP 7881.

**Type locality:** LACMIP loc. 10751, latitude 40°38'47"N, longitude 122°12'30"W.

**Paratype:** LACMIP 7882; height 10 mm (incomplete), width 12.6 mm; same locality as holotype.

**Distribution:** Redding Formation, Melton Sandstone Member, Little Cow Creek valley, Shasta County, northern California (LACMIP loc. 10751).

**Geologic age:** Late Cretaceous (Turonian).

**Discussion:** Two specimens were found. Only the holotype has the spire preserved. Both specimens are missing shell on the body whorl, and both have incomplete outer lips.

The new species most closely resembles *Nerita (Amphinerita) picea* Récluz, 1841, an extant species that has been reported (Kay, 1979) as the dominant nerite along shorelines in the Hawaiian Islands. The new species differs from *N. (A.) picea* by not having any fine spiral ribs. The operculum of the new species is not known, but the new species is assigned to subgenus *Amphinerita* rather than to the closely allied subgenus *Linnerita*, based on the presence

of a more elevated spire, a smooth shell, and no transverse wrinkles on the deck area near the inner lip teeth.

The new species differs from *Nerita (Amphinerita) eos* by having teeth on the inner lip and a bulging, semi-triangular area on the posterior portion of the inner lip.

The new species was found in strata that were correlated to the Turonian Stage by Jones et al. (1978). The locality (LACMIP 10751 = CIT 1265) of the new species is part of a series of CIT localities plotted on a generalized geologic map and included in a megafaunal list within the report by Jones et al. (1978). They did not report the new species.

**Etymology:** The species is named for its type locality in Little Cow Creek valley, Latin, *vacca* meaning cow.

#### Subgenus *Bajanerita* Squires, 1993

**Type species:** *Nerita (Bajanerita) californiensis* (White, 1885), by original designation; Late Cretaceous, Baja California, Mexico.

**Discussion:** *Bajanerita* has an inner lip with a convex trend, and this is one of the main distinguishing features of this subgenus. The new species described below has this feature and also the following features of *Bajanerita*: elevated spire, smooth body whorl, many equal-sized teeth on the interior of the outer lip, and a divaricate color pattern. The new species, however, has certain characteristics that are not known for *Bajanerita*. These are the following: four teeth on the inner lip, narrow teeth on the inner lip, a swollen callus, and a thickened outer lip. The new species might belong to *Bajanerita* or belong to a closely allied new subgenus. We are very hesitant to name a new subgenus based on a single specimen.

*Nerita (Bajanerita?) larix* Saul & Squires, sp. nov.

(Figures 9–11)

**Diagnosis:** A moderately high-spined shell with four, narrow teeth on the inner lip, a thickly swollen callus, and a thickened outer lip.

**Description:** Shell small (up to 9 mm high), sub-rhomboid, convex, consisting of approximately 2½ whorls; spire elevated, blunt body whorl rapidly expanding, early whorls nearly hidden by body whorl; suture between spire and body whorl impressed. Body whorl smooth. Growth lines prosocline, especially near suture. Color pattern intricately divaricate. Aperture moderately large, sub-circular; apertural opening narrow. Deck callus swollen and smooth. Trend of inner lip convex; inner lip with four equal teeth, narrow and widely spaced. Outer lip thickened, with about seven small, equal-sized teeth on its inner margin.

**Dimensions of holotype:** Height 9 mm, width 10.3 mm.

**Holotype:** LACMIP 7883.

**Type locality:** CSUN 1563 [= LACMIP loc. 16655], latitude 47°59'03"N, longitude 123°8'12"W.

**Distribution:** Upper part of Crescent Formation, Larch Mountain, Black Hills, Thurston County, southwestern Washington (CSUN loc. 1563).

**Geologic age:** Middle early Eocene ("Capay Stage").

**Discussion:** Only the holotype is known, but it is well preserved.

The new species resembles *Nerita vokesi* Durham (1944: 156, pl. 17, figs. 11, 12) from UCMP loc. A-1802 in the Quimper Formation, Discovery Bay, Jefferson County, Washington. Durham (1944:117) assigned the beds at this locality to his *Molopophorus stephensoni* Zone. Armentrout (1975) assigned this zone to the uppermost Eocene part of his Galvinian Molluscan Stage. The new species differs from *N. vokesi* in the following features: an inner lip with a convex rather than a straight trend, larger shell size, a more? elevated spire, and, apparently, a convex callus. Although Durham (1944) reported that *N. vokesi* has a sharp and smooth outer lip, these features are not observable on the type specimens. The only type specimen that shows the aperture is a worn-down specimen that is essentially only a cross section of the aperture. We have not been able to locate any other specimens of this species that fully show all the details of the spire, the aperture, and the callus. Until such specimens are found, the subgenus assignment of *N. vokesi* cannot be positively determined.

As mentioned above, the new species has some of the characteristics of subgenus *Bajanerita*, which is known only as the species *N. (B.) californiensis* (White, 1885:pl. 5, figs. 7, 8; Squires, 1993, fig. 2.1-2.8). Although *N. (B.) californiensis* has been reported (Squires, 1993) from the Upper Cretaceous (upper Campanian to lower Maastrichtian) Rosario Formation at Punta Banda, Baja California, Mexico, our study of the LACMIP collection revealed that this species is also present at LACMIP loc. 24137 in the Upper Cretaceous Jalama Formation, Santa Barbara County, southern California. Dailey & Popenoe (1966) assigned the age of this formation to the late Campanian, or possibly early Maastrichtian. The new species differs from *N. (B.) californiensis* by having a slightly higher spire, four rather than three inner lip teeth, narrower inner lip teeth, a thicker callus, fewer outer lip teeth, and a thickened outer lip.

**Etymology:** The species is named for Larch Mountain; from *larix*, Latin, meaning larch.

#### *Nerita* (subgenus?)

**Discussion:** The new species described below has the main morphologic characteristics listed in Keen & Cox (1960) that generally apply to genus *Nerita*; namely, a sturdy shell, spirally ribbed, and a well-developed inner lip deck area. The new species, however, does not match with any of the descriptions of the known subgenera of *Nerita*. We are hesitant to name a new subgenus to accommodate the new

species because it has somewhat poor preservation, especially of the outer lip and callus areas.

*Nerita* (subgenus?) *salsa* Saul & Squires, sp. nov.

(Figures 12-14)

**Diagnosis:** A *Nerita* with barely elevated to flat spire, noded spiral ribs, adult inner lip with three squarish teeth, and a smooth callus.

**Description:** Shell small (up to 6 mm high), neritiform, thin-shelled, consisting of approximately two whorls; spire lowly elevated to flat; body whorl rapidly expanding with a tabulate shoulder. Body whorl covered with evenly spaced and noded primary spiral ribs, becoming slightly coarser toward base of whorl. Interspaces with a single, noded secondary spiral rib. Aperture moderately large, subquadrate. Deck callus moderately thick and smooth. Trend of inner lip straight; inner lip on juvenile specimens (< 4 mm height) with one tooth, located posteriorly; inner lip on larger specimens with three, slightly subequal squarish and widely spaced teeth; posteriormost tooth the most projecting. Outer lip thickened, at least anteriorly.

**Dimensions of holotype:** Height 6 mm, width 7 mm.

**Holotype:** LACMIP 7884.

**Type locality:** LACMIP loc. 10773, latitude 40°40'52"N, longitude 122°11'50"W.

**Paratype:** LACMIP 7885, height 4 mm, width 5 mm, LACMIP loc. 10760.

**Distribution:** Redding Formation, Bellavista Sandstone Member, Shasta County, northern California (LACMIP locs. 10760 and 10773).

**Geologic age:** Late Cretaceous (Turonian).

**Discussion:** Five specimens were found. Four are from LACMIP loc. 10773, but only two of these show moderately good preservation. A single specimen was found at LACMIP loc. 10760, and it is poorly preserved. Only the holotype shows the inner lip well, but the posterior portion of the aperture is poorly preserved. None of the specimens has the outer lip intact, except the paratype, which has only the anteriormost part present. Shell is missing on the spire area of most of the specimens.

The new species is unlike any known neritid species.

The new species was found in strata that were correlated to the Turonian Stage by Jones et al. (1978). The two localities (LACMIP 10760 = CIT 1438; LACMIP 10773 = CIT 1217) where the new species is present are part of a series of CIT localities plotted on a generalized geologic map and included in a megafaunal list within the report by Jones et al. (1978). They did not report the new species.

**Etymology:** The species is named for Salt Creek; from *salsus*, Latin, meaning salted.

Genus *Otostoma* d'Archiac, 1859

**Type species:** *Nerita rugosa* Hoeninghaus, 1830, by indication (Douvillé, 1904); see Squires & Saul (1993) for a thorough discussion of the complex history of the type species of *Otostoma*; Late Cretaceous (Maastrichtian), Netherlands.

*Otostoma lucanus* Saul & Squires, sp. nov.

(Figures 15–18)

**Diagnosis:** A medium-sized, thick-shelled *Otostoma* with moderately wide-spaced, coarse axial ribs on body whorl shoulder and five squarish teeth on inner lip.

**Description:** Shell medium (up to 23.3 mm high), globose, thick-shelled, consisting of two to three whorls; spire flat; body whorl rapidly expanding with rounded shoulder. Body whorl with numerous, coarse axial ribs, obsolete? toward the base of whorl; axial ribs moderately wide-spaced with ribs narrower than the interspaces. Aperture large, sub-circular. Deck wide and smooth; deck callus present in medial and parietal areas. Inner lip with five coarse, squarish teeth, becoming smaller anteriorly. Outer lip thickened.

**Dimensions of holotype:** Height 23.3 mm, width 30.3 mm.

**Holotype:** LACMIP 7886.

**Type locality:** LACMIP loc. 16868, latitude 33°33'N, longitude 117°31'29"W.

**Paratype:** LACMIP 7887, height 12.2 mm, width 18 mm, same locality as holotype.

**Distribution:** Ladd Formation, Baker Canyon Member, Orange County, southern California (LACMIP loc. 16868).

**Geologic age:** Late Cretaceous (Turonian).

**Discussion:** Two specimens were found. Although the holotype is a worn specimen with a poorly preserved spire, the aperture is well preserved. The paratype is poorly preserved, except for the spire area.

The new species is most similar to *Otostoma ponticum* Archiac (1859:figs. 2, 2a, 3; Noetling, 1898:54–55, pl. 14, figs. 3, 3a, 3A, 4, 4a, 4A) from Upper Cretaceous rocks of Turkey and western Pakistan. The new species differs from *O. ponticum* by having wider spaced and coarser axial ribs and no tendency for cancellate ornamentation.

Although *Otostoma* is best known from the Old World Tethyan region, it achieved cosmopolitan warm-water distribution. Its earliest appearance is clouded, in part because the bounds of the genus have been drawn differently by various workers. Keen & Cox's (1960) report of *Otostoma* from rocks of Late Jurassic age reflected their inclusion of *Lysoma* White, 1883, in *Otostoma*. Sohl (1965) adamantly considered *Lysoma*, which has a non-dentate inner lip, clearly distinct from *Otostoma* with its dentate

inner lip. Kase's (1984) report of *Otostoma* from strata of late Aptian age in Japan reflected his inclusion in *Otostoma* of the roughly sculptured species herein assigned to *Corsonia*. Undoubted *Otostoma* of Albian age from Texas, *O. marcouana* (Cragin, 1895) and *O. elpasensis* (Stanton, 1947), have been discussed by Stanton (1947); and *Otostoma* species of Albian age have been reported from Tunisia (Thomas & Peron, 1889) and Portugal (Choffat, 1902). Squires (1995) reported the youngest record of *Otostoma* to be late early to early middle Eocene and from southern California (see below).

The only other confirmed Cretaceous record of *Otostoma* from the Pacific coast of North America is *Otostoma aethes* Squires & Saul (1993:figs. 2–4) from uppermost Cretaceous or possibly lowermost Paleocene strata on the south side of Lake Nacimiento, San Luis Obispo County, California. The new species differs from *O. aethes* by having a circular aperture rather than a quadrate one, five rather than seven teeth on the inner lip, axial ribs, and no indication of spiral ribs.

The youngest record of *Otostoma* is *Otostoma bisculptata* (Hanna, 1927:pl. 57, figs. 4, 7; Squires, 1995: figs. 2–6) from upper lower to lower middle Eocene ("Domengine Stage") of southern California. The new species differs from *O. bisculptata* by having fewer and more widely spaced axial ribs and coarser axial ribs. The inner lip of *O. bisculptata* is not known.

The type locality of the new species is equivalent to locality 7 of Stevenson (1948), which plots in the Baker Canyon Member of the Ladd Formation on the geologic map by Morton & Miller (1973). Associated megafauna at this locality includes the following: the bivalves *Glycymeris pacificus* (Anderson, 1902), *Ostrea* sp., *Alleinacin* [*As-tarte*] *sulcata* (Packard, 1922), *Lima* (*Limatula*) cf. *L. (L.) suciensis* Whiteaves, 1903, unidentified rudistids, and the gastropod *Anchura* (*Helicaulax*) *tricolor*? Saul & Popenoe, 1993. Based on comparison to paleontologic work by Saul (1982), this fauna is of Turonian age and of shallow-water origin. Furthermore, the presence of *Otostoma* and rudists indicates subtropical, warm-water conditions, which are known to be especially associated with these types of mollusks (Kauffman & Sohl, 1974; Sohl, 1987).

**Etymology:** The species is named for Lucas Canyon.

*Otostoma? atopos* Saul & Squires, sp. nov.  
(Figures 19–21)

**Diagnosis:** Small, globose, low-spired, body whorl without axial ridges; deck area broad, flat, and smooth; inner lip with six moderately prominent teeth.

**Description:** Shell small (up to 7 mm high), subquadrate, broader than high, thin-shelled, consisting of 2½ whorls; spire moderately elevated; body whorl rapidly expanding with tabulate shoulder. Suture between spire and body whorl impressed? Body whorl with closely spaced growth rugae in vicinity of aperture; growth lines prosocline. Ap-

erture moderately large, quadrate. Deck wide, smooth, and flat, except near inner lip area. Inner lip with six moderately strong teeth. Teeth equidistant, except for more closely spaced anteriormost one. Teeth approximately same strength, except for slightly weaker posteriormost one and somewhat shorter anteriormost one. Outer lip thin.

**Dimensions of holotype:** Height 7 mm, width 10.4 mm.

**Holotype:** LACMIP 7888.

**Type locality:** LACMIP loc. 24369, latitude 39°16'N, longitude 122°20'15"W.

**Distribution:** Reworked clasts in the Late Cretaceous Venado Formation, Colusa County, northern California (LACMIP loc. 24369).

**Geologic age:** Late Early Cretaceous (late Albian-early Cenomanian).

**Discussion:** Only a single, small, possibly immature specimen was found. It is complete and shows overall good preservation, with excellent preservation of the apertural area. The shell is missing on the spire and on the area adjacent to the inner lip callus. The sutural area between the spire and body whorl is poorly preserved.

The sculpture of the inner lip of the new species closely resembles that found on species of *Otostoma*. For example, the inner lip of *Otostoma equinum* (Bezançon, 1870) (Cossman & Pissarro, 1910:pl. 6, fig. 40-2) from the Eocene of the Paris Basin, France, is close to that of the new species, except that the most anterior inner lip tooth of the new species is not markedly smaller than the other five teeth. The new species cannot be positively assigned to genus *Otostoma* because the new species shows no evidence of axial sculpture, a feature that is diagnostic of *Otostoma*. The presence of growth rugae on the body whorl in the vicinity of the aperture of the new species might be the barest suggestion of axial ribbing, but poor preservation prevents positive determination.

The new species differs from *Otostoma lucanus* sp. nov. by being much smaller, having an elevated spire, six rather than five teeth on the inner lip, and having no definite evidence of axial ribs.

The new species was found at LACMIP loc. 24369 in reworked clasts contained within younger rocks. Brown & Rich (1960, 1967) studied the stratigraphy of the area in the vicinity of the type locality and reported that the clasts, which are Early Cretaceous (late Albian-early Cenomanian) in age, were redeposited during the Late Cretaceous as part of a submarine-slump. The type locality of the new species plots in map unit 8b of Brown & Rich (1961). Ingersoll & Dickinson (1981) correlated this unit with submarine-fan rocks of the lower Turonian Venado Formation. Fauna associated with the new species in the slump block are the shallow-marine bivalves *Idonearca truncata* Gabb, 1964, and "*Trigonia*," as well as the shallow-marine gastropods *Euspira mariana* Murphy & Rodda, 1960, and

*Turritella petersoni* Merriam, 1941. The bivalve *Idonearca truncata* is indicative of late Albian or earliest Cenomanian age. For a thorough discussion of the age of the megafauna of this unit, see Saul (1978).

**Etymology:** The species name is derived from *atopos*, Greek, meaning out-of-place.

#### Genus *Corsania* Vidal, 1917

**Type species:** *Corsania douvillei* Vidal, 1917, by original designation; late Early Cretaceous (Aptian), Cors, Lérída, Spain.

#### Subgenus *Corsania* s.s.

*Corsania* (*Corsania*) ***allisoni*** Saul & Squires, sp. nov.

(Figures 22-24)

?*Semineritina apparatus* (Cragin) of Allison, 1955:414, pl. 40, fig. 18.

*Otostoma* (*Lyosoma*) *japonica* (Nagao, 1934). Allison, 1955: 414, pl. 40, figs. 11, 12.

*Corsania japonica* (Nagao) of Allison. Woods & Saul, 1986: 640, fig. 5.7.

?*Otostoma japonicum* (Nagao) of Buitrón, 1986:20, 22, pl. 1, fig. 1.

**Diagnosis:** A *Corsania* having a lowly elevated spire with axial ribs, a concave upper body whorl bordered by tuberculate angulations, and noded spiral ribs on remaining part of body whorl.

**Description:** Shell medium (up to 15.6 mm high), broader than high, consisting of 2½ whorls; spire lowly elevated; body whorl rapidly expanding. Penultimate whorl with approximately 12 closely spaced and prominent axial ribs. Body whorl large and separated from penultimate one by a shallowly grooved suture. Ramp broad, bordered posteriorly by a raised and noded spiral angulation. Ramp concave with one to two faintly noded, spiral threads. Periphery of body whorl strongly angulate and tuberculate. Below periphery, medial part of body whorl concave and ornamented by three noded and regularly spaced spiral ribs. Anterior border of concave area delimited by a swollen spiral band with nodes. Anteriormost region of body whorl with one to two weakly spiral ribs. Aperture subcircular. Deck area strongly swollen and smooth with a thin deck callus. Inner lip with six small but distinct teeth, the middle four the strongest. Teeth extend only a short distance onto deck. Outer lip thickened, at least posteriorly. Growth lamellae distinct, consisting of numerous procline lines.

**Dimensions of holotype:** Height 15.6 mm, width 18.8 mm.

**Holotype:** UCMP 33409.

**Type locality:** UCMP loc. A-8317, latitude 31°31'18"N, longitude 116°39'10"W.