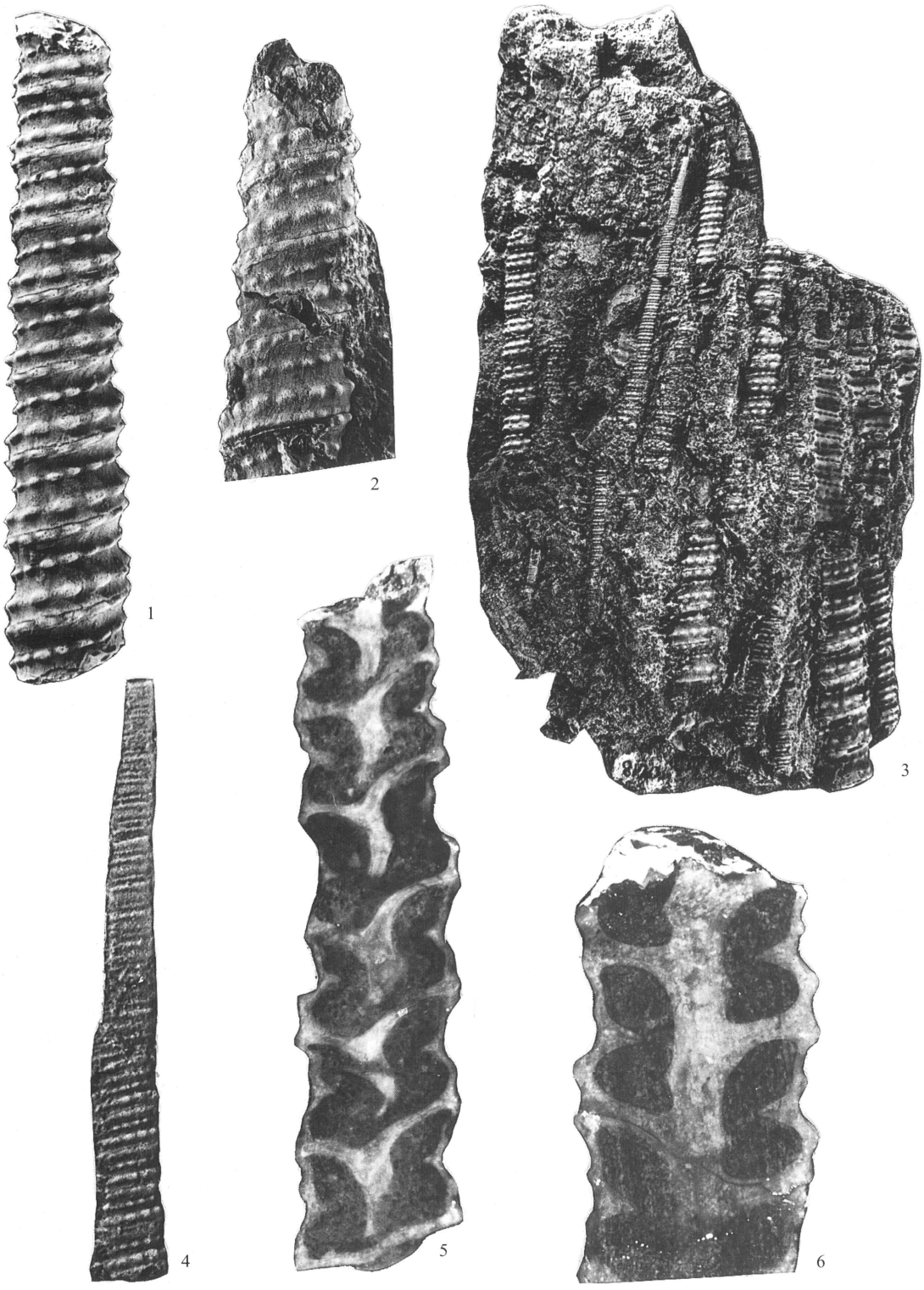


SAUL and SQUIRES, *Nerinella*

this member indicate a fluctuating, moderate to high-energy, lower to upper shoreface palaeoenvironment associated with a fan-delta setting (Cooper *et al.* 1982). A late Turonian age for the member is indicated by the ammonites *Subprionocyclus normalis* (Anderson, 1958) and *Subprionocyclus* cf. *neptuni* (Geinitz, 1849) (Saul 1982). Associated fossils at the type locality of the new species are an undescribed cerithioidian? gastropod and bivalves, including specimens of ribless small pectinids, *Crassatella gamma* Popenoe, 1937, and an impression of *Alleinacin sulcata* (Packard, 1922). This last-named bivalve species is an abundant and characteristic faunal element in the Baker Canyon Member (Popenoe 1937; Squires and Ritterbush 1981).

*Nerinella santana* is much more strongly sculptured than the type species, *N. dupiniana*. *Nerinella santana* is similar to *Nerinella quadralineata* (Stanton, 1947, p. 88, pl. 62, figs 1–2) from north-eastern Texas in the upper part of the Glen Rose Limestone, of early Albian Age (Stephenson *et al.* 1942). *Nerinella santana* differs from *N. quadralineata* in having a wider (5° rather than 3°) pleural angle and fewer spiral cords. Despite its name, *N. quadrilineata* has five to six cords rather than the four of *N. santana*. Both species appear to have one fewer cord than is actually present because the first and last cords are tightly appressed, with only the fine line of the suture between them to indicate that what seems to be one cord is actually two cords.

The exterior of the new species is similar to that of *Nerinea flexuosa* Sowerby (1832, pl. 38, fig. 16; Bronn 1836, p. 563, pl. 6, fig. 19; Goldfuss 1844, p. 47, pl. 177, fig. 7; Zekeli 1852, p. 38, pl. 5, fig. 5; Tiedt 1958, p. 504, text-fig. 11 as *Aptyxiella* (*Acroptyxis*) *flexuosa*) from the Upper Cretaceous of Austria. Internally, the new species differs from *N. flexuosa* by having much weaker columellar folds.

The interior of the new species resembles both *Nerinella stantoni* Cragin (1905, p. 98, pl. 21, figs 6–9; Shimer and Shrock 1944, p. 495, pl. 203, figs 9–11) from the Upper Jurassic of Texas and *Nerinea* (*Nerinella*?) *decipiens* Stanton (1947, p. 82, pl. 60, figs 1–3) from the Lower Cretaceous of Texas. Like the new species, these two Texas species have a palatal fold on the medial part of the outer wall surface, but the new species differs by having a weak columellar fold. Externally, the new species differs from *N. stantoni* by having spiral cords that are much stronger, fewer in number (three rather than four), and noded. Externally the new species differs less from *Nerinea* (*Nerinella*?) *decipiens* by having noded spiral cords and stronger spiral cords.

The interior of the new species resembles *Cossmannea imlayi* Sohl, 1965 (pp. D23–D24, pl. 4, figs 1–8) from the Middle Jurassic of central and southern Utah. Internally, *Cossmannea imlayi* has a palatal fold on the medial part of the outer wall surface and a very low, rounded, obscure columellar fold. The palatal fold persists from the earliest whorls, but the columellar fold does not develop until a late growth stage. Externally, the new species differs greatly from *C. imlayi* by having prominent sculpture rather than smooth whorls with a swollen sutural area. Sohl (1965) placed his species in the genus *Cossmannea* with some misgivings because his species lacked the strong columellar fold that is diagnostic of *Cosmannea*. It is possible that Sohl's species belongs in the genus *Nerinella*.

*Nerinella santana* has fewer and much more prominent spiral ribs, noded ribs, a weaker palatal plait, a medial columellar plait, and a thinner outer wall than does *Nerinella maudensis* (Whiteaves).

*Distribution.* All specimens are from a single piece of float consisting of coarse-grained sandstone, probably derived from the Baker Canyon Member of the Ladd Formation, Santa Ana Mountains, Orange County, southern California.

*Stratigraphical range.* Upper Cretaceous (Turonian).

### *Nerinella maudensis* (Whiteaves, 1884)

1884 *Nerinaea maudensis* Whiteaves, p. 214, pl. 27, figs 2, 2a–2d.

*Remarks.* Whiteaves' description and figures suggest that his placement of this species in *Nerinella* is correct. Whiteaves (1884) reported *Nerinaea maudensis* from brittle and very friable shale at the east end of Maude Island, opposite Leading Island in Skidegate Inlet, Queen Charlotte Islands,

western British Columbia. On the geological map of McLearn (1949), this imprecise locality could plot in either the Yakoun Formation or the Haida Formation. Bolton (1965) listed the type specimens as being of Early Cretaceous age and from the Haida Formation. Haggart (1992) considered the Yakoun Formation to be of Mid Jurassic, Bajocian age, and the Haida Formation to range from the Early Cretaceous to the Late Cretaceous (Albian to mid Turonian). Other than Bolton's (1965) catalogue of the type specimens, we have seen no further report of the occurrence of this species, although Whiteaves (1884) said that it was not uncommon. According to J. W. Haggart (pers. comm.) the 'brittle and very friable shale' is probably the Haida Formation, and the species may be of Albian age.

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## APPENDIX

### *Cited fossil localities*

The localities are listed in groups corresponding to the following (arranged north to south) geographical areas in California: Hornbrook, Cottonwood Creek, Little Cow Creek valley, Bear Creek, Chico Creek, and Santa Ana Mountains.

Hornbrook

LACMIP 27228. SW 1/4, SW 1/4 Sec. 33, T47N, R7 [or 6?]N, U.S. Geological Survey, 15-minute, Hornbrook Quadrangle, 1955, Shasta Valley, Siskiyou County, northern California. Collector: M. Gaona, June, 1984. Hornbrook Formation, Osburger Gulch Sandstone Member. Age: Late Cretaceous, Turonian.

Cottonwood Creek

U.S. Geological Survey, 15-minute Ono Quadrangle, 1952, Shasta County, northern California. Budden Canyon Formation, Ogo Member. Age: Early Cretaceous, Hauterivian.

CASG 62606. In stream bottom of the North Fork of Cottonwood Creek, downstream from the Ono Bridge and stratigraphically below the section exposed in first large bluff (north side of creek) downstream from the bridge. Locality is 59·7 m (196 ft) stratigraphically above the mouth of Rector Creek.

CASG 62583. Downstream from the base of section of first bluff described above and 24 m (80 ft) stratigraphically above the base of section exposed in this bluff.

Little Cow Creek Valley

U.S. Geological Survey, 15-minute, Millville Quadrangle, 1953, Shasta County, northern California. Redding Formation, Bellavista Sandstone Member. Age: Late Cretaceous, Turonian.

LACMIP 10761 [= CIT 1439]. Upper part of Bellavista Sandstone Member, north side of Little Cow Creek, near north-east corner SW 1/4 Sec. 31, T33N, R2W, latitude 40° 40′ 22″ N, longitude 122° 8′ W. Collector: W. P. Popenoe, March 19, 1940.

LACMIP 10780 [= CIT 1193]. Thin conglomerate beds interbedded with massive drab sandstone cropping out on east side of Stinking Creek Valley, estimated as 7·5 m stratigraphically above Triassic-Cretaceous contact, 2353 m (7720 ft) N70° 20′ W from south-east corner Sec. 6, T32N, R3W. Collectors: W. P. Popenoe and Ahlroth, June, 21, 1936.

LACMIP 10784 [= CIT 1009]. Near base of Bellavista Sandstone member, sandstone cropping out on a small hill on the east bank of Willow Creek about 0·40 km (0·25 mi.) above its confluence with Salt Creek and about 91 m (300 ft) east of the creek channel, NE 1/4, NE 1/4 Sec. 34, T33N, R3W. Collectors: W. P. Popenoe and Scharf, August 11, 1931.

LACMIP 24649 [= UCLA 4649]. Gritty sandstone cropping out on east bank of Stinking Creek, 122 m (400 ft) west and 305 m (1000 ft) south of north-east corner Sec. 1, T32N, R4W. Collector: W. P. Popenoe, May 19, 1961.

Bear Creek

U.S. Geological Survey, 15-minute, Whitmore Quadrangle, 1956, Shasta County, northern California. Redding Formation, Bear Creek Sandstone Member. Age: Late Cretaceous, Coniacian.

LACMIP 10905. Massive sandstone in bed of Bear Creek, approximately 305 m (1000 ft) due west of the south-east cor. Sec. 6, T31N, R1E, U.S. Geological Survey, 15-minute, Whitmore Quadrangle, 1956, Shasta County, northern California. Collectors: W. P. Popenoe and W. M. Tovell, September 10, 1941.

LACMIP 15758. (P 63–36) Along Ponderosa Way east of Di Hill, descending into Snow Creek, 0·32 km (0·2 mi.) south-east of road fork, 450 m east, 480 m south of north-west corner Sec. 18, T31N, R1E, Whitmore 15′ Quadrangle, Shasta Co., northern California. Collector: W. P. Popenoe, August 17, 1936.

LACMIP 15761 [= UCMP M7244]. Shell bed in fine-grained sandstone on both banks of Bear Creek, 270 m north, 245 m east of south-west corner Sec. 5, T31N, R1E, Whitmore Quadrangle, Shasta Co., northern California. Collector: Jim Haggart, December 1, 1983.

LACMIP 15797. (Continental Oil HS2) Southeast slope Blue Mtn, North Fork Bear Creek, SE 1/4 Sec. 6, T31N, R1E, Whitmore Quadrangle, Shasta Co., California.

LACMIP 15944. North side of North Fork Bear Creek, spoil pile of Alberta-Bakersfield pipeline, about on section line and almost at south-east corner Sec. 6, T31N, R1E, Whitmore Quadrangle, Shasta Co., California. Collectors: L. R. Saul, R. B. Saul, and Lanny Fisk, June 23, 1993.

Chico Creek

U.S. Geological Survey, 15-minute, Paradise Quadrangle, 1953, Butte County, northern California. Chico Formation, Musty Buck Member. Age: Late Cretaceous, Santonian. Collectors: L. R. Saul and R. B. Saul, August, 1952.

LACMIP 23621. Micaceous grey sandstone cropping out in upper part of meadow east of Chico Creek County Road, 625 m (2050 ft) south and 701 m (2300 ft) west of north-east corner Sec. 12, T23N, R2E. Age: early Santonian.

LACMIP 23622. Coarse-grained grey sandstone containing black pebbles, about 268 m (880 ft) above west side of Chico Creek, 244 m (800 ft) north, 427 m (1400 ft) east of south-west corner Sec. 1, T23N, R2E. Age: early Santonian.

LACMIP 23625. East bank of Chico Creek, 91 m (300 ft) north of right-angle bend in Chico Creek, 610 m (2000 ft) north, 290 m (950 ft) east of south-west corner Sec. 12, T23N, R2E. Age: late Santonian.

Santa Ana Mountains

U.S. Geological Survey, 15-minute, Santiago Peak Quadrangle, 1954, Orange County, southern California, Ladd Formation, Baker Canyon Member. Age: Late Cretaceous, Turonian.

LACMIP 8170 [= CIT loc. 1828]. Creek at road junction, Aliso Creek, Trabuco Oaks, Santa Ana Mountains, Orange County, southern California. Collector: C. R. Stauffer.

## NOTE ADDED IN PROOF

Illustrations of heterostrophic protoconchs of two species of nerineids are in KOWALKE, V. T. and BANDEL, K. 1996. Systematik and Paläoökologie der Küstenschnecken der nordalpinen Brandenberg-Gosau (Oberconiac/Untersanton) mit einem Vergleich zur Gastropodenfauna des Maastrichts des Trempbeckens (Südpyrenäen, Spanien). *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie*, **36**, 15–71, pls 1–10.