



SAUL and SQUIRES, *Aphanoptyx*

of southern Europe, typically carries a Tethyan fauna rich in corals, rudists, and nerineas. Its age is predominantly Barremian to early Aptian, but, in places, ranges into the early Albian (Gignoux 1955; Ager 1980). Pchelintsev (1965) gave the range of *Aphanoptyxis* as Bathonian through Tithonian, but Kollmann (1976) extended the geological range of the genus into the late Albian. *Aphanoptyxis californica* extends the geological range of the genus into the Upper Cretaceous Turonian Stage.

Aphanoptyxis andersoni nom. nov.

Plate 2, figures 1–2

1938 *Nerinea archimedis* Anderson, p. 132, pl. 9, fig. 1 [*non Nerinea archimedi* d'Orbigny, 1842].

1938 *Nerinea* sp. Anderson, p. 132, pl. 9, figs 2–3.

Holotype. CASG 66460.02.

Anderson's hypotypes of Nerinea sp. CASG 66460.03–66460.04 from CASG loc. 66460.

Type locality. CASG 66460 (= CASG 1353 in part), North Fork Cottonwood Creek, Shasta Co., northern California; latitude 40° 28' 12" N, longitude 122° 36' 40" W.

Remarks. *Nerinea archimedis* Anderson is a junior homonym of *Nerinea archimedi* d'Orbigny, 1842, a species from the Lower Cretaceous of Europe. We herein place Anderson's species in *Aphanoptyxis* and rename it as *Aphanoptyxis andersoni* nom. nov. Specimens of *A. andersoni* are rare and none available shows a better cross section than those of Anderson (1938, pl. 9, figs 2–3). Neither CASG 66460.03 or 66460.04 is cut parallel to the columella; both are broken at low angle to the columella giving Anderson an impression of a wider pleural angle than that in CASG 66460.02. In addition to the specimens figured by Anderson (1938), a specimen (CASG 67886.01) from CASG loc. 62583, consisting of the early whorls of this species is figured. It is associated with *Plicatula variata* Gabb, 1864 and *Potamidopsis? grovesi* sp. nov. Of available specimens, only the holotype CASG 66460.02 is of comparable size to *A. californica*, and the others are smaller and less complete. The two species are very similar: *Aphanoptyxis andersoni* differs from *A. californica* in lacking the median spiral cord on the early adult whorls, in having finer nodes, and in having a pleural angle near 14° rather than 18°.

Distribution. Near Ono, Shasta Co., northern California, Budden Canyon Formation, Ogo Member.

Stratigraphical range. Lower Cretaceous, Hauterivian.

Aphanoptyxis californica sp. nov.

Plate 2, figures 3–10

Derivation of name. The species is named for the state of California.

Holotype. LACMIP 7912.

Type locality. LACMIP loc. 10761, Little Cow Creek valley, Shasta County, northern California; latitude 40° 40' 22" N, longitude 122° 8' W.

Paratypes. LACMIP 7913–7915 from LACMIP loc. 10761; 7916–7918 from LACMIP loc. 24649.

Diagnosis. An *Aphanoptyxis* with a noded carina at posterior suture, a low medial spiral cord, and an anterior cord at the angle between whorl side and base; carina more prominent on adult whorls than on juvenile whorls, medial spiral rib obsolete on adult whorls.

Description. Shell medium sized (up to 38.7 mm high), turritid-conical, multi-whorled (about 14 whorls), with an elongate and narrow upper spire. Pleural angle about 18°. Very early whorls (approximately first 13 mm of

growth) nearly flat-sided, later whorls concave, with deepest part medially. Protoconch unknown. Sculpture at diameter 0.5 mm to 2.3 mm of four noded spiral cords, each with numerous nodes; sutural cord finely noded, at suture; posterior cord strongest, most coarsely noded; medial cord weaker and more finely noded; basal cord barely as strong as posterior cord, nodes stronger than on medial and smaller than on posterior cord; sculpture at diameter 2.3 mm to 4.8 mm of coarsely noded posterior cord; medial cord becomes band of collabral (opisthocline) riblets; basal cord barely visible, nearly overlapped by succeeding whorl; sculpture at greater diameters becoming obsolete, basal cord overlapped by suture; posterior cord protruding on adult whorls. Base of body whorl slightly convex with faint spirals, a slight depression adjacent to anterior carina followed by spiral row of low nodes. Aperture small, wider than high; columella short and rising to form sharp rim bordering posterior side of anterior canal. Anterior canal strongly twisted, almost at right angle to columella, and well defined by strongly raised borders. Outer lip unknown. Whorls without interior plaits, except for a single parietal plait on posterior portion of body whorl. Whorl interiors with posterior constriction, resembling a gutter. Interior of columella complexly layered. Growth lines indistinct, opisthocline? across whorl flank and especially on anterior slope of posterior carina, looping? sharply forward across posterior carina.

Dimensions of holotype. Height 38.7 mm, diameter 12 mm.

Remarks. Specimens are moderately numerous, and preservation is poor to moderately good. Many of them are weathered and abraded. The shell surface tends to peel, and growth lines are obscure except on the base. Nearly all of the specimens are missing the early whorls. The holotype has the greatest height of any specimen found. A fragment from LACMIP loc. 10780 has the greatest diameter (15.5 mm) of any specimen found. An inferred complete specimen of the new species is estimated to be approximately 45 mm high and approximately 16 mm wide. A whorl with diameter of 11.3 mm is 4.6 mm high, giving a ratio of 2.5.

The sculpture changes from early to later whorls. Uppermost whorls have a noded spiral thread next to the posterior suture, a noded spiral cord forming a posterior carina, a less angulate noded spiral cord on the medial part of the whorl, and a noded spiral thread next to the anterior suture. Nodes on the medial cord of these early whorls start out as beads, then change into opisthocline, short, axial ribs at a diameter of about 3–5 mm. Middle spire whorls have a swollen noded spiral carina next to the posterior suture and a fading band of riblets on the medial part of the whorl. The spiral cord next to the anterior suture becomes a low unmoded swelling. Later whorls have an unnoded, much projecting, tabulate carina next to the posterior suture and the rest of the whorl is smooth, concave-sided, with a slight spiral swelling next to the anterior suture.

In the Hornbrook area, Siskiyou Co., ten specimens of the new species were collected at a single locality in Shasta Valley, LACMIP loc. 27228, from the Osburger Gulch Sandstone Member of the Hornbrook Formation. Nilsen (1984) reported the age of this member in Shasta Valley as Turonian, based on abundant molluscan fossils, including ammonites, bivalves, and gastropods, and he considered that this member was deposited under high-energy, shallow-marine conditions. The Osburger Gulch Sandstone Member specimens of *A. californica* are poorly preserved but show the prominent spiral carina next to the posterior suture.

In Little Cow Creek valley, Shasta Co., the new species was found at four localities in the Bellavista Sandstone Member of the Redding Formation: LACMIP 10761, 10780, 10784, and 24649. These localities are also plotted on a generalized geological map in Jones *et al.* (1978, fig. 5). The age of this member is Turonian, based on ammonites (Jones *et al.* 1978; Haggart 1986). Haggart (1986) inferred that the depositional environment of the member was inner to middle shelf. Specimens are most abundant at LACMIP loc. 24649 [= UCLA loc. 4649 of Jones *et al.* 1978], where about 100 were collected, including some upper spire fragments. The specimens were in a coquina, faunally dominated by the new species. About 40 specimens, including some upper spire fragments, were collected at LACMIP loc. 10784 [= CIT loc. 1009 of Jones *et al.* 1978]. Of these specimens, about one-half are small fragments. Nearly all of the larger specimens are abraded. Their sculpture is much reduced, and the whorls are flat sided with only low spiral bands. This locality is stratigraphically the lowest of four localities, and the specimens were subjected to abrasion caused

by agitated-water conditions associated with deposition of the basal part of the member. Sixteen specimens were collected at LACMIP 10761 [= CIT loc. 1439 of Jones *et al.* 1978]. This locality is stratigraphically the highest of four localities and represents the deepest water and least agitated-water conditions of the member. Specimens from this locality were subjected to the least amount of abrasion. They are the best preserved specimens of *A. californica* available. Only four specimens were collected at LACMIP loc. 10780 [= CIT loc. 1193 of Jones *et al.* 1978]. They are badly corroded, but one moderately well preserved specimen shows some abrasion.

The new species is very close to *A. andersoni* from the Lower Cretaceous (Hauterivian Stage) of Cottonwood Creek, Shasta Co., northern California. In addition to differences mentioned under *A. andersoni*, *Aphanoptyxis californica* differs from *A. andersoni* in the following features: carina stronger and more strongly noded, and medial spiral rib stronger on early adult whorls. The two species are so similar that slightly weathered specimens of the two are indistinguishable.

Aphanoptyxis californica closely resembles *Aphanoptyxis excavata* (Brongniart 1822, pl. 9, fig. 10; Kollman 1976, pp. 173–174, pl. 2, figs 13–16; pl. 3, figs 17–19) from the Lower Cretaceous (middle Albian) of Poland and Lower Cretaceous (upper Albian) of France and England (Kollmann 1976). *Aphanoptyxis californica* differs from *A. excavata* in having whorls that are wider than high, a noded posterior carina, and, on the early whorls a medial spiral cord or band of riblets.

The new species also resembles *Aphanoptyxis* aff. *sturi* (Stolickza) Kollmann (1982, p. 351, pl. 2, fig. 35; pl. 4, fig. 56) from the Upper Cretaceous (Cenomanian) of Romania and Greece and Upper Cretaceous (Turonian) of Bulgaria (Kollmann 1982). Although poor preservation makes comparison with *Aphanoptyxis* aff. *sturi* difficult, *Aphanoptyxis californica* differs by having a medial spiral cord or riblets on the early whorls and a less heavily noded carina on the adult whorls.

The new species resembles *Aphanoptyxis bladonensis* Arkell (1931, pp. 618–619, pl. 50, figs 8–13) from the upper Great Oolite in England of Middle Jurassic, Bathonian age (Gignoux 1955; Harland *et al.* 1990), *aspidoidea* zone (M. J. Barker, pers. comm.). The new species differs from *A. bladonensis* by having a medial spiral cord or riblets on the early whorls and a projecting carina on the much more concave adult whorls.

Aphanoptyxis californica also somewhat resembles *Macrocerithium tramitense* Cragin, 1893 (p. 222; Stephenson 1952, p. 160, pl. 37, figs 23–29) from the Upper Cretaceous (Cenomanian) Lewisville Member of the Woodbine Formation in north-eastern Texas. The genus *Macrocerithium* is known solely from this species, which has been reported only from Texas. *Macrocerithium tramitense*, whose growth lines are very similar to those of *A. californica*, might be a nereinid. A study of the interior of *M. tramitense* or recovery of a protoconch, both presently unknown, should greatly assist in its classification. The new species differs from *M. tramitense* in the following features: spiral cords on upper spire more strongly noded, no fine intermediate spiral riblets on upper spire, broader pleural angle, sides of adult whorls concave, spiral carina next to the posterior suture on adult whorls much more heavily noded and more projecting, posterior part of twisted anterior canal much stronger. The adult whorls of *M. tramitense* have subdued sculpture which may result from abrasion. In fact, Stephenson (1952) noted that most of the specimens of *M. tramitense* are corroded. If the abraded adult specimens of the new species from LACMIP loc. 10784 are compared with *M. tramitense*, then the adult whorls of the two species show a greater similarity, in that they both have a low spiral rib next to the positive suture and they both have flattish whorls. Also like *A. californica*, *M. tramitense* is found abundant in shallow-marine coquinas that are faunally dominated by it.

The new species resembles the figures of *Cerithium depressum* (Zekeli 1852, p. 116, pl. 24, figs 6–7) from the Rondobach part of the Gosau Group, north-eastern Alps, west-central Austria. Summesberger (1985) assigned this part of the Gosau Group to the Upper Cretaceous (Santonian). *Aphanoptyxis californica* has a narrower pleural angle, a flatter whorl profile, and a weaker less noded medial spiral rib on the later whorls.

Distribution. Northern California: Hornbrook Formation, Osburger Gulch Sandstone Member, just south of the California–Oregon border, Siskiyou County (LACMIP loc. 27228); and Redding Formation, Bellavista

Sandstone Member, Little Cow Creek valley, Shasta County (LACMIP locs 10761, 10780, 10784, 24649).

Stratigraphical range. Upper Cretaceous (Turonian).

Genus *NERINELLA* Sharpe, 1850

(= *Nerinoidea* Wenz, 1940; *non Nerinella* Nardo, 1847 (ICZN Opinion 316; 1954))

Type species. *Nerinea dupiniana* d'Orbigny, 1842, by original designation; Lower Cretaceous (Hauterivian), France.

Diagnosis. Slender, acicular multiwhorled nerineids of moderately large length but small diameter, with concave whorl profile, protruding sutural ridges (suture between two spiral ribs), and granulate spiral costae. Interior with one palatal plait, one or two columellar plaits, and a weak or absent parietal plait. No umbilicus.

Remarks. Wenz (1940) provided the new name *Nerinoidea* for *Nerinella* Sharpe, 1850 *non* Nardo, 1847, and he considered *Nerinoidea* to be a subgenus of *Aptyxiella* Fischer, 1885. Kase (1984) recognized *Nerinoidea* Wenz as a distinct genus. Cox (1951) applied for an ICZN ruling that would conserve *Nerinella* Sharpe, 1850. *Nerinella* Sharpe, 1850 was subsequently placed on the *Official List of Generic Names in Zoology*, and its type species *Nerinea dupiniana* d'Orbigny, 1843 was placed on the *Official List of Specific Names in Zoology* (ICZN 1954). *Nerinella* is, in general, longer and more slender than *Nerinea*. According to Abbass (1963), on some specimens of *Nerinella*, the columellar and parietal folds virtually disappear. The geological range of *Nerinella* is lowermost Jurassic (Hettangian) to uppermost Cretaceous (Maastrichtian) (Wenz 1940).

Three Pacific Slope species are here included in *Nerinella*.

Nerinella parallela (Anderson and Hanna, 1935)

- 1934 [?]*Nerinella* sp. Nagao, p. 251, pl. 38, figs 8–10.
 1935 *Turritella parallela* Anderson and Hanna, p. 26, pl. 9, figs 1–3.
non 1942 '*Turritella* sp. cf. *T. parallela*' Anderson and Hanna; Popenoe, p. 179 [= *Turritella hearni* Merriam, 1941].
 1955 *Aptyxiella* (*Endiatricheus*) *parallela* (Anderson and Hanna); Allison, p. 426, pl. 43, figs 8–9.
 1958 *Nerinea parallela* (Anderson and Hanna); Anderson, p. 155.

Remarks. As indicated by Allison (1955), who collected this species near Punta China from several localities in the Alisitos Formation from both the lower and upper members, the recorded locality information (Burckhardt 1930, p. 259) is misleading, and the species has not subsequently been found in the 'Catarina' = Rosario Formation. Although Anderson and Hanna (1935) gave the age as 'Late Cretaceous', and the locality as '2 miles east of Puerto Catarina' [= Santa Catarina Landing], Baja California, the species has not been recovered from rocks of Late Cretaceous age nor from outcrops within 2 miles of Santa Catarina Landing. Their material was probably from the Alisitos Formation, which crops out more than 3.2 km (2 miles) north, south, and east of Santa Catarina Landing, Baja California, Mexico, and is of Early Cretaceous, Aptian–Albian age.

Allison (1955) considered *Nerinea quadrilineata* Stanton, 1947, of Aptian to late Albian age, from the Edwards Limestone and Glen Rose Limestone, south-west of Forth Worth, Texas, to be a synonym of *A. (E.) parallela*. In overall shape, type of sculpture, and internal structures, *N. quadrilineata* appears to be a *Nerinella*, but judging from Stanton's figures, it differs from *N. parallela* in having a more concave whorl profile, the spiral ribs weaker, more widely spaced, more finely beaded, and of more nearly equal strength, and a well developed sutural ridge.

Nerinella parallela has a straighter whorl profile, coarser sculpture, and a narrower pleural angle than *Nerinella maudensis* (Whiteaves, 1884). If *N. maudensis* is of Albian age, then *N. parallela* is the earliest known *Nerinella* from the Pacific coast of North America.

Beaded ribs and a narrow pleural angle make *Nerinella parallela* more similar to *N. santana* than to *N. maudensis*. *Nerinella parallela* lacks the strong sutural ridge of *N. santana* and has more, less strongly beaded spiral ribs.

Distribution. Baja California, Mexico.

Stratigraphical range. Aptian–Albian.

Nerinella santana sp. nov.

Plate 3, figures 1–6

Derivation of name. The species is named for the Santa Ana Mountains.

Holotype. LACMIP 7919.

Type locality. LACMIP loc. 8170, Santa Ana Mountains, Orange County, southern California; near latitude 33° 30' N, longitude 117° 30' W.

Paratypes. LACMIP 7920–7923, all from the same locality.

Diagnosis. A *Nerinella* with four noded spiral cords bearing ten or eleven nodes; interior with a strong palatal plait and a medial columellar plait.

Description. Shell elongate, length in excess of 80 mm at 5 mm diameter, multiwhorled, whorls wider than high (height of whorls about 60 per cent. of diameter), incremental angle of whorl sides extremely small, pleural angle about 5°. Very early whorls nearly flat sided, later whorls concave, with deepest part medially. Protoconch unknown. Aperture unknown. Sculpture of four noded spiral cords, each with ten or eleven nodes: anterior (first) cord forming basal keel of whorl, slightly weaker than second cord; second cord near anterior quarter line, strongest, bearing largest nodes; third cord near posterior quarter line, weakest with finest nodes; fourth cord at suture, tightly appressed to first (basal) cord, commonly slightly stronger than the first cord. Interior with a strong palatal plait near mid whorl, a medial columellar plait, and possibly an anterior columella plait. Columella moderately thick.

Dimensions of holotype. Height 43.9 mm, diameter 8.7 mm.

Remarks. Although occurrences are rare, specimens are locally abundant, and preservation is good. The specimens are in a single block of sandstone and show preferred orientation (Pl. 3, fig. 3). The longest specimen, height 76.9 mm, is incomplete both apically and basally and has a maximum diameter of 5.4 mm. The specimen with the greatest diameter, 10.5 mm, is also broken apically and basally, but its diameter indicates that this very slender species would have exceeded 150 mm in height.

The hand specimen containing the new species was collected as float, but the lithology – coarse-grained, very micaceous quartz sandstone – indicates that the stratigraphical horizon is probably a sandstone in the Baker Canyon Member of the Ladd Formation. The sedimentological details of

EXPLANATION OF PLATE 3

Figs 1–6. *Nerinella santana* sp. nov.; LACMIP loc. 8170; Santa Ana Mountains, California. 1, LACMIP 7919, holotype; abapertural view; $\times 2.4$. 2, LACMIP 7920, paratype; $\times 2.2$. 3–4, LACMIP 7921, paratype; 3, hand specimen showing preferred orientation of specimens; $\times 0.93$; 4, apical area of specimen shown in upper middle part of figure 3; $\times 4.8$. 5, LACMIP 7922, paratype; interior view; $\times 4.4$; 6, LACMIP 7923, paratype; interior view; $\times 5.7$.

All specimens, except those in figures 5–6, coated with ammonium chloride.