

TABLE 7—Measurements in mm of *Anchura nanaimoensis* (Whiteaves). For abbreviations and symbols used, see introduction.

| Specimen | H | Hp | Db | Dp | Dp/Hp | R | PA | S | Ct | Cp | A | Remarks |
|-----------|------|-----|----|-----|-------|---|-----|---|----|----|----|------------------|
| GSC 5763 | 17.0 | — | — | — | — | — | 19° | — | 8 | 3 | — | latex pull |
| GSC 5763a | 17.8 | 4.3 | — | 6.9 | 1.72 | — | 22° | — | 8 | 3 | 14 | 4 spire whorls |
| GSC 5763c | 14.3 | 3.4 | — | — | — | — | 20° | — | 7 | 3 | — | 3.5 spire whorls |

Coast. Although it has both axial and spiral sculpture on the early whorls, the axial ribs are much weaker and finer on the more mature whorls than in *A. callosa*, *A. falciformis*, or *A. phaba*. In addition, its peripheral angulation is stronger, its parietal callus is more protuberant than in the above species, and it has one dominant basal spiral with a subdominant spiral below and a weaker cord above. Its whorl profile differs from that of *A. falciformis* and *A. callosa* in being concave adapical to the median angulation.

The specimen, hypotype LACMIP 11340, upon which the

description of the early whorls is based, is a nearly complete specimen. Although the mature whorls of this specimen are too crushed to photograph well, they allow identification of the species.

Type specimens.—Holotype LACMIP 6465; paratypes LACMIP 6466–6471, IGM 3284; hypotypes LACMIP 11340 from UCLA locality 7235, 11339 from LACMIP locality 8068.

Type locality.—LACMIP 2858, top of south slope, north fork of Ammonite Ravine, Arroyo Santa Catarina, Baja California, Mexico.

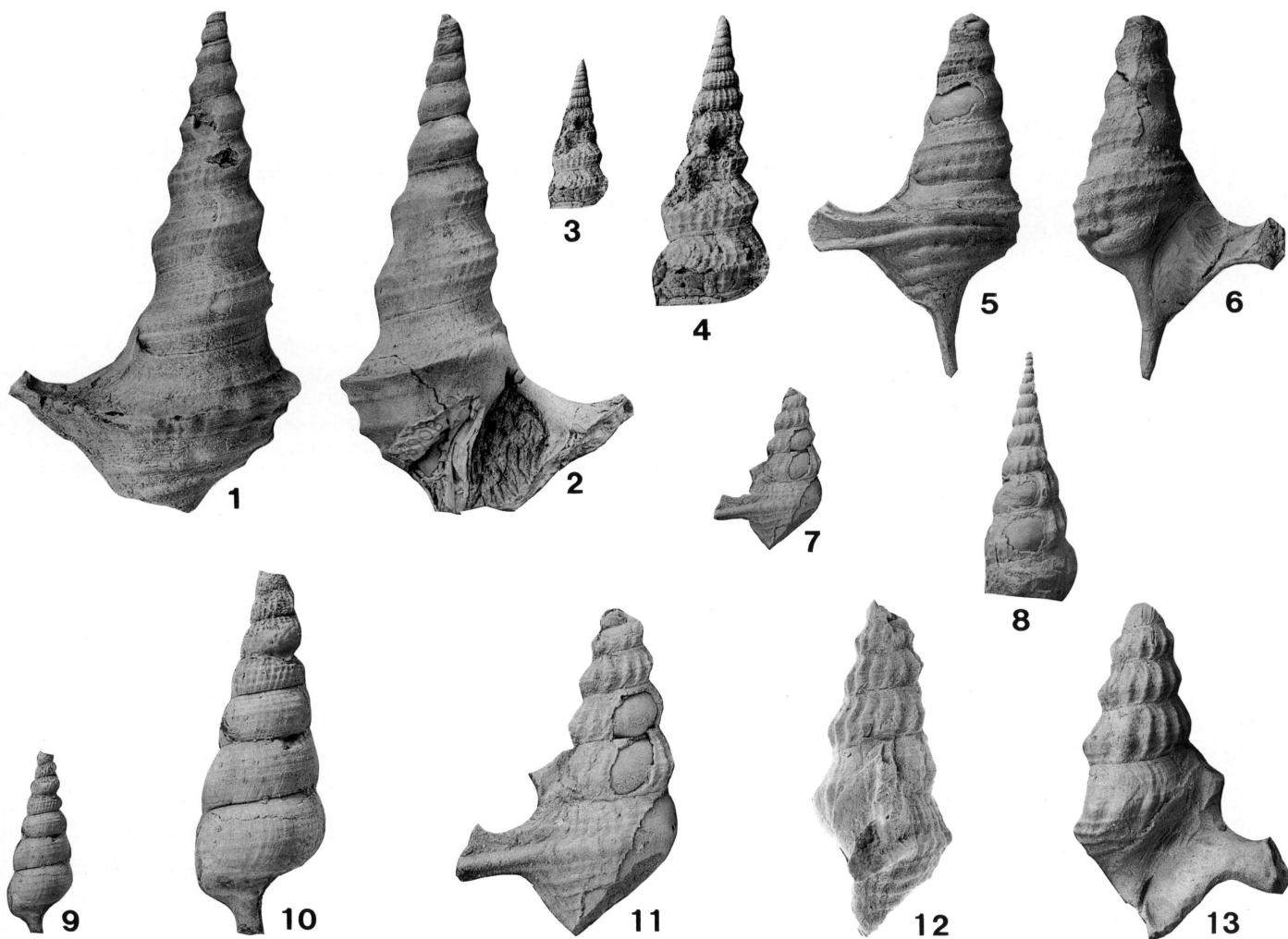


FIGURE 6—1–4, *Anchura gibbera* Webster. 1, 2, Hypotype, abapertural and apertural views, $\times 1$, LACMIP 11339, locality LACMIP 8068; 3, 4, hypotype, abapertural view of juvenile, $\times 1$ and $\times 2$, LACMIP 11340, locality UCLA 7235. 5, 6, *Anchura baptos* new species, holotype, abapertural and apertural views, $\times 1$, USNM 485427, locality M5906. 7, 11–13, *Anchura (Helicaulax?) popenoei* new species, holotype, abapertural, side, and apertural views, $\times 1$ (7), and $\times 2$ (11–13), LACMIP 11342, locality UCLA 5990. 8, *Anchura (Helicaulax) tricosa* Saul and Popenoe, hypotype, side view showing varices, $\times 1.5$, LACMIP 11343, locality CIT 92. 9, 10, *Anchura?* new species, abapertural view, $\times 1$ and $\times 2$, LACMIP 11341, locality CIT 1545.

TABLE 8—Measurements in mm of *Anchura gibbera* Webster. For abbreviations and symbols used, see introduction.

| Specimen | H | Hp | Db | Dp | Dp/Hp | R | PA | S | Ct | Cp | A | Remarks |
|--------------|------|------|------|------|-------|---|------|------|----|----|---|------------------|
| LACMIP 6465 | 70 | 10.8 | — | 16.6 | 1.54 | — | 19° | 16.0 | 4 | 2 | — | body + 4.5 whorl |
| LACMIP 11339 | 70.8 | 11.7 | 31.8 | 18.2 | 1.56 | — | 24° | — | 4 | 2 | — | body + 7 whorls |
| LACMIP 11340 | 62.5 | 10.9 | 22.2 | 16.7 | 1.53 | — | 26°† | — | 4 | 2 | — | body + 7 whorls |

Measured specimens.—See Table 8.

Age.—Late Campanian to early Maastrichtian, *Pachydiscus ootocodensis* (?), *Didymoceras hornbyense*, and *Pachydiscus (Neodesmoceras) catarinae* Zones.

Geographic distribution.—Point Loma Formation, Carlsbad, (UCLA 7235) San Diego County, Calif.; Rosario Formation, Punta San Jose (LACMIP 8068), Arroyo Santa Catarina, Baja California, Mexico.

ANCHURA BAPTOS new species

Figure 6.5, 6.6

Diagnosis.—*Anchura* with axial sculpture reduced to nodes and three to four spiral cords on spire whorls; lower two extend onto shank at wing.

Description.—Shell moderately large, high-spired, drawn out anteriorly into a very narrow, moderately long, backwardly bent rostrum; pleural angle about 28 degrees; whorls angled medially, slightly concave posterior to middle and convex anteriorly; suture appressed. Sculpture on earliest preserved whorl of arcuate axial ribs and three strong spiral cords; medial cord strongest, forming the angulation, posterior cord weakest; axial ribs becoming weaker on more mature whorls, reduced to barely more than nodes on cords by penultimate whorl; ultimate whorl with six cords (three equally spaced, additional cords anterior to three of spire), anterior cord weakest; three cords of spire extended onto shank of wing; posterior cord meeting posterior edge near center of posterior sulcus; median cord forming keel of wing, and anterior cord forming secondary anterior angulation. Outer lip expanded to form wing with short shank. Aperture with broad posterior sulcus and broad anterior sulcus delineated posteriorly by parietal callus pad. Inner lip expanded onto whorl face, developing a spirally elongate, thick callus pad, thickest along fifth cord but overlapping onto fourth and sixth cords.

Remarks.—*Anchura baptos* is based on one incomplete specimen consisting of five whorls, including the body whorl, most of the rostrum, and the shank of the wing. The shank is relatively narrow and lacks secondary spurs. The shell is recrystallized and some surface details such as growth lines have been lost.

In its sculpture, *A. baptos* is most similar to *A. gibbera* and *A. phaba*. It differs from *A. gibbera* in having a wider pleural angle, one less cord on the whorls of the spire, and a lower, more elongate parietal callus pad. It differs from *A. phaba* and geologically older Pacific Slope *Anchura* species in having the axial ribs of the mature whorls reduced to no more than nodes on the cords and in having fewer spiral cords. *Anchura baptos* is the only Pacific Slope species to have two strong cords extending onto the shank and presumably the wing. Four specimens from the San Francisquito Formation on Warm Springs Mountain, Los Angeles County, California, are probably also this species. The specimen from LACMIP 14313 was associated

with *Roudairia squiresi* Kirby and Saul, 1995, and is considered to be of latest Maastrichtian age. LACMIP 14314 is eight meters upsection from LACMIP 14313, and the three specimens from this higher horizon are associated with *Turritella pensularis quaylei* Saul, 1983, and considered to be of early Danian age (Kirby, 1991). The San Francisquito Formation specimens differ from the Dip Creek specimen in having a fourth adapical cord on the spire. This cord is weaker than the other cords and may be variably present.

Type specimen.—Holotype USNM 485427.

Type locality.—USGS locality M5906, east side of Dip Creek, 2300'S, 1000'W of NE corner sec. 30, T25S, R10E, Lime Mountain quadrangle, San Luis Obispo County, California.

Measurements.—See Table 9.

Age.—Latest Maastrichtian, *Turritella pensularis adelaidana* Zone to early Danian *Turritella pensularis quaylei* Zone.

Geographic distribution.—The type locality on Dip Creek, San Luis Obispo County, and two localities [LACMIP 14313 (1 specimen) and 14314 (3 specimens)] near the base of the San Francisquito Formation on Warm Springs Mountain, Los Angeles County, California.

Etymology.—The name *baptos*, Greek, dipped, dyed, refers to the type locality on Dip Creek.

ANCHURA? new species

Figure 6.9, 6.10

Discussion.—A fragment of a high-spired gastropod from the Tierra Loma Shale Member of the Moreno Formation may be an *Anchura*. The specimen consists of about seven whorls, the earliest preserved of which have both fine arcuate axial ribs and spiral cords giving an almost cancellate appearance. The ribs and cords form nodes at their intersections. The axial ribs fade on the fourth whorl leaving about six primary spiral cords plus intermediaries. The cords appear to be fading on the last whorl. The whorl profile is rounded and there is no indication of a keel on any whorl.

Sculpture of the earliest whorls of this specimen is similar to that of young *A. gibbera*, but reduced sculpture from the fourth whorl on is distinctly different from any other Pacific Slope *Anchura* species.

Figured specimen.—LACMIP 11341 from CIT locality 1545 = LACMIP 8147, Laguna Seca section, Merced County, California

Measured specimen.—See Table 10.

Age.—Early late Maastrichtian

Subgenus HELICAULAX Gabb, 1868

Type species.—*Rostellaria ornata* d'Orbigny, 1843, by subsequent designation (Cossmann, 1904), from the Turonian of France.

TABLE 9—Measurements in mm of *Anchura baptos* new species. For abbreviations and symbols used, see introduction.

| Specimen | H | Hp | Db | Dp | Dp/Hp | R | PA | S | Ct | Cp | A | Remarks |
|-------------|------|-----|------|------|-------|------|-----|------|----|----|---|-----------------|
| USNM 485427 | 52.5 | 8.0 | 21.0 | 15.0 | 1.88 | 10.1 | 28° | 11.1 | 3 | 1 | — | body + 4 whorls |

TABLE 10—Measurements in mm of *Anchura?* new species. For abbreviations and symbols used, see introduction.

| Specimen | H | Hp | Db | Dp | Dp/Hp | R | PA | S | Ct | Cp | A | Remarks |
|--------------|------|-----|-----|-----|-------|---|-----|---|----|----|---|---------|
| LACMIP 11341 | 27.8 | 4.9 | 9.6 | 8.7 | 1.78 | — | 18° | — | 6 | — | — | juv. |

Discussion.—In overall shape and type of sculpture, *Helicaulax* resembles *Anchura* but differs in having an additional elongate, reflexed posterior digitation that is adnate to the spire for most of its length (Sohl, 1960, p. 103). Sohl (1960) considered *Anchura* and *Helicaulax* to be closely related. However, Roy (1994) divided 33 aporrhaid genera including *Anchura* and *Helicaulax* into two morphologic groups, placing *Helicaulax* into one group, M1 with multidigitate apertures, and *Anchura* into the other group, M2 with simpler apertures. Saul and Popenoe (1993) included *Anchura (Helicaulax) condoniana* (Anderson, 1902) and *A. (H.) tricosa* Saul and Popenoe, 1993, in *Helicaulax* on the basis of their having an elongate, reflexed posterior digitation adjacent to but not adnate to the spire, straight rostra, and spurs along the shank of the wing. The latter two characteristics do not, however, separate *Helicaulax* from some *Anchura* species, which also display straight rostra and spurs along the shank. Campanian and Maastrichtian faunas of the Gulf Coast contain several species placed in *Anchura* that have short posterior digitations (i.e., *A. chapelvillensis* Dockery, 1993 and *A. corniculata* Dockery, 1993), but none of these digitations approach the length of those of *A. (H.) tricosa*. This prominent digitation gives *A. (H.) tricosa* a multidigitate apertural margin like that of *Helicaulax* and removes it from Roy's M2 group. Roy (1994) listed 25 characteristics that he used in differentiating genera of aporrhaid; six of these separate *Helicaulax* from *Anchura*. All six, however, relate to the posterior digitation. As species having a very short posterior digitation are included in *Anchura*, the distinction depends upon the length of the digitation and the length of its attachment to the spire. Based on these criteria, species such as *A. (H.) tricosa* do not fit neatly into either *Anchura* s. s. or *Helicaulax*. Pending thorough evaluation of the distribution in time and space of these features and their evolutionary significance, *A. (H.) tricosa* is left in *Helicaulax*, which seems, as Sohl (1960) suggested, close to *Anchura* s. s. Although the new species, *Anchura (Helicaulax?) popenoei*, is very similar to *A. (H.) tricosa*, it has a much shorter posterior digitation and, thus, is questionably assigned to *Helicaulax*.

Age.—Critical study of *Anchura (Helicaulax)* is needed in order to exclude forms improperly assigned to the subgenus. Sohl (1960) considered *Helicaulax* to be restricted to the Late Cretaceous, but Roy (1994, figures 5, 6) listed it from the Aptian through Maastrichtian stages. On the Pacific Slope, *A. (Helicaulax)* has been identified from strata of Turonian and, if our tentative assignment of *A. (Helicaulax?) popenoei* is correct, Coniacian age.

ANCHURA (HELICAULAX?) POPENOEI new species

Figure 6.7, 6.11–6.13

Diagnosis.—A relatively small *Anchura* with short posterior digitation at its base adjacent to the spire, but not otherwise adnate; sculpture dominantly axial with about 18 slightly curved ribs; about six cords on spire, third and fourth spiral cords

coalesced on body whorl, forming angulation and continuing onto extended outer lip.

Description.—Shell medium-sized, high-spired; pleural angle about 22 degrees; whorl profile slightly angulate just anterior to middle on spire and strongly angulate on last whorl; five whorls preserved in holotype; suture appressed; protoconch unknown; varices randomly present but not obvious; growth line anti-spirally concave on spire. Mature sculpture of slightly arched axial ribs, forming nodes at the periphery, 18 on penultimate whorl, axial ribs weakening on body whorl but persisting as nodes on carina; spiral cords strongest anterior to angulation on ultimate whorl, about six cords showing on spire whorls, third and fourth cords strongest, coalescing and forming noded keel on ultimate whorl and extending onto shank as carina, about six cords anterior of keel on ultimate whorl with second and third strongest. Outer lip expanded, forming narrow shanked wing with additional short posterior digit adjacent to spire.

Remarks.—*Anchura (Helicaulax?) popenoei* is described from one specimen lacking protoconch, rostrum, and outermost portion of wing. Because the wing is broken, the length of the shank is undetermined. The posteriorward extension at the break is probably, considering the position of the carina, part of a secondary spur rather than the inception of the posterior arm. The earliest preserved whorl has many fine equal spiral cordlets, but on the next whorl five cords have begun to dominate the spiral sculpture. It is considerably smaller than *A. (H.) condoniana* Anderson, 1902, and has more convex whorls that are more strongly angulate; its sculpture is less strongly beaded, and its axial ribs are noticeably more arcuate than those of *A. (H.) condoniana*. In whorl profile, shape and beading of ribs, and possession of varices *A. (H.) popenoei* is most similar to *A. (Helicaulax) tricosa* Saul and Popenoe, 1993. On the spire, *A. (H.) popenoei* has two cords posterior to the carina rather than three and only about two anterior to the carina. Strength of cords, nodding, and axial ribs also resemble those of *A. callosa* and *A. falciformis*, but *A. (H.) popenoei* is smaller, less high spired, has fewer spiral cords, and the shank to the outer lip is narrower.

Anchura (Helicaulax?) popenoei is questionably included in *Helicaulax* because of its short posterior digitation that is adjacent to the spire at its base. Dockery (1993) includes species with similarly small posterior digitations in *Anchura*, but *A. (H.) popenoei* bears so great a resemblance to *A. (H.) tricosa* that it is included in the same supraspecific taxon.

Type specimens.—Holotype LACMIP 11342.

Type locality.—UCLA 5990, sandstone cropping out in bed of small NW-flowing gully tributary to French Creek, near south end of Swede Basin, 300'S, 1800'E of NW corner sec. 9, T33N, R2W, Millville quadrangle, Shasta County, California. Collector: W. P. Popenoe, 1/1/1959.

Measured specimens.—See Table 11.

Age.—Coniacian

TABLE 11—Measurements in mm of *Anchura (Helicaulax?) popenoei* new species. For abbreviations and symbols used, see introduction.

| Specimen | H | Hp | Db | Dp | Dp/Hp | R | PA | S | Ct | Cp | A | Remarks |
|--------------|------|-----|------|-----|-------|---|-----|-----|----|----|----|-----------------|
| LACMIP 11342 | 24.3 | 4.2 | 10.8 | 8.2 | 2.0 | — | 22° | 6.0 | 6 | 2 | 18 | body + 4 whorls |