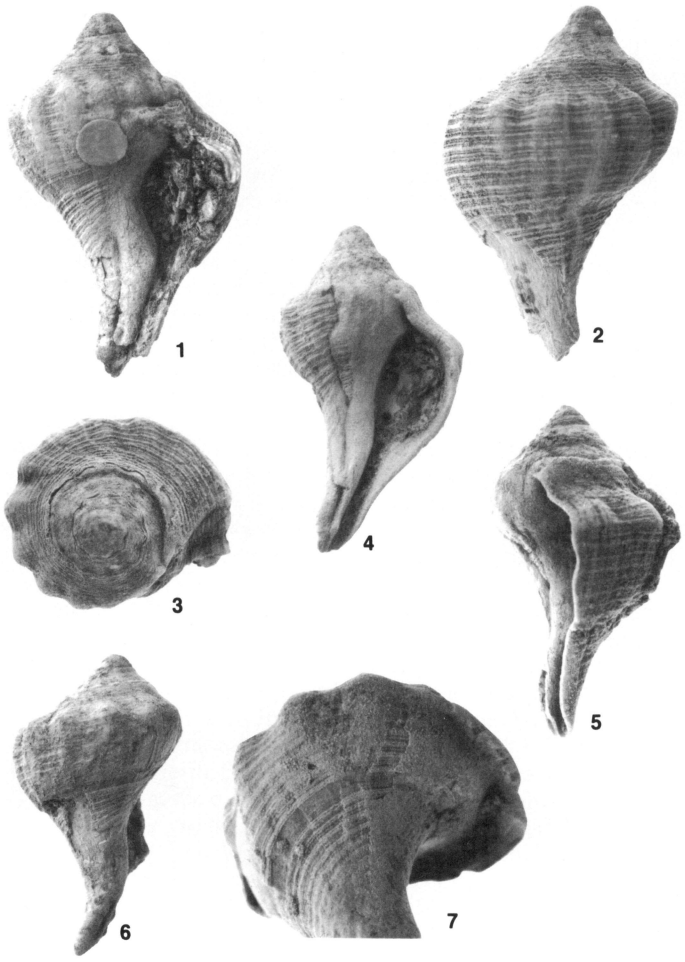

FIGURE 4—*Protobusycon judithae* n. sp., all ×1 unless otherwise indicated. *1–3,* LACMIP cat. no. 7621 from UCLA loc. 6456, holotype; *4, 5,* LACMIP cat. no. 7623 from LACMIP loc. 7044, paratype with body whorl somewhat compressed but apparently complete anterior canal; *6,* LACMIP cat. no. 7622 from UCLA loc. 6456, paratype; *7,* LACMIP cat. no. 7624 from LACMIP loc. 7044, paratype, spiral band on base of whorl near inner lip, ×2.

whorl profile of ?*Pyropsis gabbi* (Stanton, 1896) bears some resemblance to the Northeast Pacific genus *Perse* Clark, 1918, but the fold on the columella of *Perse* is very oblique. ?*Pyropsis gabbi* is remarkably similar in shape and sculpture to *Lupira pyriformis* Stephenson, 1941, and *L. varibilis* (Wade, 1926), of Maastrichtian age from the Gulf Coast Ripley Formation (Sohl, 1964), but *Lupira* has folds on the columella near the mid-point of the inner lip whereas the columellar bend of ?*P. gabbi* is adjacent to the anterior siphon. ?*Pyropsis gabbi* also resembles the melongenid *Pyrifusus crassus* Sohl, 1964, of Maastrichtian age (Sohl, 1964) from the Ripley Formation, but ?*Pyropsis gabbi* has a more widely expanded whorl that is narrower about the periphery, a narrower anterior canal, and a rounder aperture.

?*Pyropsis gabbi* differs from *Protobusycon judithae* n. sp. in having a very strong subsutural welt, stronger axial ribs that arise more abruptly about the periphery, no spiral band about the base of the whorl, and apparently no fasciole on the anterior siphonal neck. It differs from ?*Heteroterma acrita* in having a lower spire, stronger spiral ribbing on the periphery but a smoother siphonal neck, and a slightly stronger bend to the columella. Both ?*Pyropsis gabbi* and ?*Heteroterma acrita* resemble "*Heteroterma*" *zelandica* Marshall, 1917 (p. 453, Pl. 35, figs. 20, 21; Finlay and Marwick, 1937, p. 84, Pl. X, figs. 8–10), from the Wangaloan of New Zealand and "*H.*" *praecursor* (Wilckens, 1907, p. 21, Pl. 3, figs. 14, 15) from the Maastrichtian of Chile. ?*Pyropsis gabbi* has a lower spire, a smaller aperture that is more abruptly constricted anteriorly, a heavier inner lip, and a somewhat stronger swelling or angulation to the columella. ?*Pyropsis gabbi* differs from *Tudiclana simulator* Finlay and Marwick, 1937 (p. 70, Pl. IX, figs. 4–6), in lacking an obvious plait on the columella, in probably having a shorter canal, in having the whorls more enveloping and a strong subsutural welt, a thicker inner lip, a more biangulate whorl profile, and stronger axial ribs and weaker spiral ribs.

Family MELONGENIDAE Fischer, 1884
Genus PROTOBUSYCON Wade, 1917

Type-species.—By original designation, *Busycon (Protobusycon) cretaceum* Wade, 1917, p. 295.

PROTOBUSYCON JUDITHAE n. sp.
Figure 4.1–4.7

?*Heteroterma gabbi* Stanton. DICKERSON, 1914, p. 151, Pl. 17, fig. 1; CLARK, 1929, Pl. 2, fig. 2.

Heteroterma striata Stanton. SMITH, 1975, p. 479, Pl. II, figs. 19, 20; ?ZINSMEISTER, 1983a, p. 70, Pl. 4, fig. 8; ?ZINSMEISTER, 1983b, p. 1299, fig. 3L–N; not *Heteroterma striata* Stanton, 1896.

Diagnosis.—A *Protobusycon* with low, evenly tapered spire, low rounded nodes on shoulder; spiral band broad and shallow.

Description.—Shell of moderate size, pyriform, low spired, strongly shouldered; spire profile concave, flank broadly convexly rounded from shoulder to whorl base, shallowly concave from base to anterior siphon; base of whorl with shallow spiral band; suture lapping over shoulder; anterior siphon of moderate length, with well-developed fasciole, bent at angle of about 30° to columella; growth line strongly opisthocline across ramp, broadly sinused across flank, antisinused on spiral band, and thence nearly straight to siphonal fasciole.

Overall sculpture graded sets of fine spiral ribs crossing growth lines to produce finely but roughly textured surface; shoulder with broad collabral swellings dying out both anteriorly and posteriorly.

Aperture ovoid, with small posterior notch at inner–outer lip juncture; inner lip clearly demarked, thickened, of moderate width.

Types.—Holotype, LACMIP 7612; paratypes, LACMIP 7622 from UCLA loc. 6456, 7623, 7624 from LACMIP loc. 7044, LSJU 10245 from CAS loc. 61666 (Smith, 1975, Pl. II, fig. 19), and UCBMP 14209 from UCB loc. A-6717 (Smith, 1975, Pl. II, fig. 20); hypotypes, UCBMP 11733 from UCB loc. 1540 (Dickerson, 1914, Pl. 17, fig. 1; Clark 1929, Pl. 2, fig. 2), UCLA 59294 from UCLA loc. 3117 (Zinsmeister, 1983a, Pl. 4, fig. 8; 1983b, fig. 3L), and 59295 from UCLA loc. 3114 (Zinsmeister, 1983b, fig. 3M, N).

Type locality.—UCLA 6456, at the confluence of Silver and Panoche Creek, Fresno Co. (3), California.

Dimensions.—Holotype, height 47 mm, diameter 31.9 mm, height of spire 10 mm.

Distribution.—"Martinez" 1.6 km (1 mi) south of Stewartville, Contra Costa Co. (2); basal Lodo Formation on Panoche Creek, Fresno Co. (3); lower Santa Susana Formation, Simi Hills, Ventura Co. (5), California.

Geologic age.—Paleocene, Thanetian, zones of *Turritella infragranulata* and *T. i. pachecoensis.*

Remarks.—The species is common in the basal Lodo Formation along Panoche Creek east of Silver Creek, Tumey Hills,

Fresno County (3). Compared to the larger specimens from the vicinity of the type locality, the smaller specimens have a relatively higher spire, more prominent collabral ribs, and the strongest rib of the graded sets of spiral ribs stronger. From youth to maturity the suture progressively overlaps more of the posterior angulation so that the posterior ends of the collabral ribs show clearly on the early whorls but on some large specimens those of the penultimate whorl are completely overlapped. Specimens from the "Martinez" south of Stewartville (2) (*Heteroterma gabbi* Stanton of Dickerson, 1914), the Santa Susana Formation in the Simi Hills (5) (*Heteroterma striata* Stanton of Zinsmeister, 1983a, 1983b), and the Coal Canyon Formation in the Santa Monica Mountains, Los Angeles County, California, are smaller than the largest of the Panoche Creek specimens and are higher spired and more strongly sculptured than most Panoche Creek specimens. These differences may ultimately prove to be indicative of more than intraspecific variation.

Protobusycon judithae differs from *Pyropsis striata* (Stanton, 1896), with which it has been confused, in lacking the two rows of strong nodes, having a spiral band about the body whorl, having a growth line that is prosocline but not sinused on the ramp, and in its overall sculpture of strongly textured sets of spiral riblets rather than more distant subequal riblets. ?*Pyropsis gabbi* (Stanton, 1896) has a lower spire, stronger posterior and anterior angulations, and lacks the spiral band about the body whorl.

Protobusycon judithae differs from the two Maastrichtian Gulf Coast species of the Ripley Formation, *P. cretaceum* (Wade, 1917) and the slightly younger *P. binodosum* Sohl, 1964, in having a concavely sloped spire, lower more rounded nodes on the shoulder, a broader, shallower spiral band, and a more strongly bent anterior siphonal canal. *Protobusycon judithae* additionally differs from *P. binodosum* Sohl in lacking the second row of nodes.

Etymology.—The species is named for Judith Terry Smith in recognition of her work on the molluscan fauna of the Lodo Formation.

ACKNOWLEDGMENTS

Essential comparative material was loaned by P. U. Rodda, California Academy of Sciences, San Francisco, J. T. Smith, U.S. Geological Survey, Menlo Park, D. R. Lindberg, University of California, Berkeley, M. A. Murphy and M. Kooser, University of California, Riverside, T. A. Demeré, San Diego Society of Natural History, and F. J. Collier and J. W. M. Thompson, U.S. National Museum. The Koll Construction Company is commended for allowing San Diego Society of Natural History personnel to make a salvage collection of beautifully preserved fossils from the Carlsbad Research Park site. Line drawings were drafted by W. S. Griswold, Natural History Museum of Los Angeles County. Photos of the holotype of *Rapana joseana* are by R. Meier, Natural History Museum of Los Angeles County. The paper has benefited greatly from the criticisms of K. E. Campbell, D. H. Geary, G. L. Kennedy, R. B. Saul, R. L. Squires, E. C. Wilson, and W. J. Zinsmeister.

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ACCEPTED 19 MAY 1988

APPENDIX

LOCALITIES CITED

With the exception of type localities, for which complete descriptions are given, previously published localities are abbreviated and referenced. Numbers in parentheses key the localities to Figure 1.

(2) 1540 UCB: S of Stewartville 1–2 km (1 mi), Mt. Diablo quad., Contra Costa Co., Calif. "Martinez" Formation. Paleocene, early Selandian. (Dickerson, 1914, p. 153.)

(4) 1595 UCLA: North side of Warm Springs Mountain, Warm Springs Mtn. quad., Los Angeles Co., Calif. San Francisquito Fm. Paleocene, ?Danian. (Saul, 1983, p. 113.)

(5) 2307 UCLA: E side near crest of spur W of W branch of Meier Canyon, 2.9 km (1.8 mi) SW of 961 B.M., Santa Susana, 1,061 m (3,500 ft) SE of hill 1480 in sec. 13, T2N, R17W, Santa Susana quad., Simi Hills, Calabasas quad., Ventura Co., Calif. Coll: W. P. Popenoe, 1/9/1946. Lower Santa Susana Fm. Paleocene, ?late Danian or early Selandian.

(5) 2330 UCLA: Nose of spur on NW side Meier Canyon, approx. 1,136 m (3,750 ft) S50°E of 1473 hill, SE¼, SE¼, sec. 12, T2N, R18W, Santa Susana quad., Ventura Co., Calif. Coll: W. P. Popenoe, 4/3/1946. Lower Santa Susana Fm. Early Selandian.

(5) 3111 UCLA: Head of Las Virgenes Canyon, Calabasas quad., Simi Hills, Ventura Co., Calif. Las Virgenes Sandstone, upper part. Paleocene, ?late Danian. (Saul, 1983, p. 119.)

(5) 3114 UCLA: 152 m (500 ft) S. of hill 2150, on crest of gently sloping ridge in very coarse to medium-grained, brown sandstone, 23 m (75 ft) below overlying shale and south of the road, 3,760 m (12,408 ft) S25°E of NW corner of Calabasas (1929) quad., Simi Hills, Ventura Co., Calif. Coll: J. H. Fantozzi, 6/23/1953. Lower Santa Susana Fm. Paleocene, early Selandian.

(5) 3117 UCLA: E (0.4″) of hill 2150 on small hill S of the road 4,000 m (13,200 ft) S34.5°E of NW cor. Calabasas (1929) quad., Simi Hills, Ventura Co., Calif. Coll: J. H. Fantozzi, 8/29/1953. Lower Santa Susana Fm. Paleocene, early Thanetian.

(6) 3392 SDSNH: Carlsbad area, N of Palomar Airport, roadcut along W side of College Blvd. at survey station 86 + 50, elevation 163′, approx. 424 m (1,400 ft) S of intersection with El Camino Real. Fossils collected from single 0.3 m (1 ft) thick horizon approximately 2.4 m (8 ft) below road level. Invertebrate fossils associated with a partial dinosaur skeleton; oyster and *Spondylus* sp. shells attached to dinosaur bones. Lat. 33°08′21″N; long. 117°17′02″W. San Luis Rey quad., San Diego Co., Calif. Coll: SDSNH field party, May 1987. Point Loma Formation. Cretaceous, early Maastrichtian.

(6) 3405 SDSNH: Carlsbad area, N of Palomar Airport, excavation for College Blvd. road bed between survey stations 84 and 92, approx. 242–485 m (800–1,600 ft) S of intersection with El Camino Real, between elevations 150–240 ft. Section consists of gently dipping (3–5°SW) sequence of blue-gray, massive to crudely bedded, bioturbated, fossiliferous mudstone. Fossils collected through an 18.2 m (60 ft) section of unweathered strata. This is a general locality for the entire cut which extended laterally for some 182 m (600 ft) and vertically for 27.3 m (90 ft). Several stratigraphic horizons were sampled separately and given individual locality numbers (e.g., SDSNH 3392). Lat. 33°08′21″N; long. 117°17′02″W. San Luis Rey quad., San Diego Co., Calif. Coll: B. O. Riney, M. A. Roeder, R. Q. Gutzler, April–May 1987. Point Loma Formation. Cretaceous, early Maastrichtian.

(5) 3760 UCB: Simi Hills, Ventura Co., Calif. Santa Susana Fm. Paleocene, ?late Danian–early Selandian. (Nelson, 1925, p. 438).

(5) 3776 UCB: Simi Hills, Ventura Co., Calif. Santa Susana Fm., Paleocene, ?late Danian–early Selandian. (Nelson, 1925, p. 440).

(2) 4189 USGS: 1–2 km (1 mi) north of Pacheco, Concord quad., Contra Costa Co., Calif. Coll: T. W. Stanton, Sept. 1894. Upper Vine Hill Sandstone. Paleocene, Thanetian, *Turritella infragranulata* Zone.

(1) 4192 USGS: Herndon Creek, about 1–2 km (1 mi) SE of Lower Lake, Lake Co., Calif. Coll: T. W. Stanton, Sept. 1894. "Martinez" Fm. Paleocene, early Selandian, *Turritella peninsularis* Zone.

(7) 5431 UCLA: S side Punta San Jose, Baja California, Mexico. Rosario Fm. Cretaceous, early Maastrichtian. (Popenoe and Saul, 1987, p. 36.)

(3) 6456 UCLA: Sandstone and some interbedded shale abrupt hill slope S side road, S side Panoche Creek about 1.2 km (0.75 mi) E of Silver Creek, 1,045 m (3,450 ft) S, 152 m (500 ft) E of NW cor. sec. 21, T15S, R12E, Tumey Hills quad., Tumey Hills, Fresno Co., Calif. Coll: L. R. Saul, 6/10/77. Basal Lodo Fm. Paleocene, early Thanetian.

(8) 6534 UCLA: NW side Arroyo Santa Catarina, Baja California, Mexico. Rosario Fm., buff silts below gritty sands with fossils, cobble cgl. above. Cretaceous, early Maastrichtian. (Popenoe and Saul, 1987, p. 37.)

(5) 6670 UCR: E side Meier Canyon, Calabasas quad., Simi Hills, Ventura Co., Calif. Santa Susana Fm. Paleocene, early "Martinez," probably = early Selandian. (Popenoe and Saul, 1987, p. 37.)

(3) 7044 LACMIP: Fresh roadcut E bank of Silver Creek 0.4 km (0.25

mi) S of junction with Panoche Creek, Tumey Hills quad., Fresno Co., Calif. Coll: C. E. Weaver, 1949. Basal Lodo Fm. Paleocene, early Thanetian.

(1) 7051 LACMIP: 61 m (200 ft) S of west bank Herndon Creek along gully tributary to Herndon Creek about 364 m (1,200 ft) S of Lower Lake–Monticello Hwy, 1.2 km (0.75 mi) E of Lower Lake, Lake Co., Calif. Coll: W. P. Popenoe, 5/12/44. "Martinez" Formation. Paleocene, ?Early Selandian.

(3) A-9717 UCB: E side Panoche Pass Road about 0.4 km (0.25 mi) S of confluence Panoche and Silver Creeks, Tumey Hills quad., Fresno Co., California. Basal Lodo Formation. Paleocene, early Thanetian. (Smith, 1975, p. 480.)

(2) 10488 LACMIP (=Weaver 2080): Pasture land E of Pacheco Road and S of Gum Tree Hill, 848 m (2,800 ft) S60°E from intersection of Pacheco Rd and Santa Fe Railway at overpass in E limb of Pacheco syncline, Contra Costa Co., Calif. Upper Vine Hill Sandstone. Paleocene, Thanetian. (Weaver, 1953, p. 93.)

(3) 61666 CAS (=LSJU 2073): Juncture of Panoche and Silver Creeks, Tumey Hills Quad., Fresno Co., Calif. Basal 9.1 m (30 ft) of Lodo Fm. Paleocene, early Thanetian. (Smith, 1975, p. 465.)