

TABLE 11—Dimensions of *Natica conradiana* (Gabb), in mm, \* = incomplete. See Figure 2 for explanation of measurements.

	h	w	s	p	e	w/h	s/h	p/h	e/h	e/p
UCLA 59793	17.8	20.4	3.8	8.6	3.0	1.15	0.21	0.48	0.17	0.35
UCLA 59794	32.2	36.0	9.8	14.5	8.0	1.12	0.3	0.45	0.25	0.55
UCLA 59795	15.5	19.8	3.3	7.8	2.5	1.28	0.21	0.5	0.16	0.32
CAS 61405	18.5	19.4*	3.4	7.9	2.2	1.05	0.18	0.43	0.12	0.28
CAS 61404	27.4	33.5	6.5	13.4	6.4	1.22	0.24	0.49	0.23	0.48

entiate between *N. conradiana* and *N. conradiana vacculae*.

**NATICA CONRADIANA VACCULAE n. subsp.  
Figure 7.3, 7.6, 7.9, 7.10,  
7.12, 7.16**

*Gyrodes conradiana* (Gabb). JONES, SLITER, AND POPENOE, 1978, p. XXII, 10, Pl. 1, figs. 16, 17. Not *?Lunaria* (*Gyrodes?*) *conradiana* Gabb, 1864.

**Description.**—Shell of moderate thickness, medium sized; spire about 25% of total height; suture appressed to moderately incised, at posterior one-third of whorl; shoulder subangulate becoming rounded; whorl profile well rounded; umbilical margin doubly angulate, the inner angulation much the stronger and overhanging the umbilical depression; umbilicus moderately wide, round; umbilical depression made reniform by a funicle against the inner lip; growth line obliquely prosocline, bending across the shoulder to become orthocline, periodically impressed near the suture to form short collabral grooves; aperture moderately oblique, semicircular, rounded anteriorly, angulate posteriorly; outer lip thin; inner lip thickened by funicle, wrapped onto the last whorl at the outer umbilical angulation; spiral sculpture of very fine raised threads somewhat stronger and wider spaced on the shoulder; remnant color marking of zig-zag prosocline stripes.

**Holotype.**—UCLA 59796.

**Paratypes.**—UCLA 59440 from UCLA loc. 4416, Stinking Creek, Redding Quadrangle, Shasta Co.; UCLA 59799 from CIT loc. 1440, Salt Creek, Millville Quadrangle, Shasta Co.; UCLA 59800 from CIT loc. 1446, Woodman Creek, Millville Quadrangle, Shasta Co.; UCLA 59797 from CIT loc. 1195, Stinking Creek, Redding Quadrangle, Shasta Co., California.

**Type locality.**—CIT loc. 1195: Stinking Creek, Shasta Co., California.

**Distribution.**—Bellavista Sandstone and lower Frazier Silt, Redding area, Shasta Co.; Hornbrook Formation, Siskiyou Co., California; ?basal Nanaimo Group, Hamley Point, Sydney Island, British Columbia.

**Age.**—Early and mid Turonian. The Bellavista Sandstone is early Turonian, the lower Frazier Silt mid Turonian on the basis of ammonites (Matsumoto, 1960, p. 7; Jones et al., 1978), but foraminiferal correlations suggest a Cenomanian age for these units (Jones et al., 1978).

**Remarks.**—The major difference between *N. conradiana vacculae* and *N. conradiana* is in the sculpture. *Natica conradiana* typically has spiral grooves rather than fine threads. These spiral grooves are commonly stronger on the shoulder than are the fine threads of *N. conradiana vacculae*. The fine spiral threads are crossed or interrupted by the stronger growth lines to produce a finely dimpled texture on the shell. In the Redding area well-preserved specimens, some of which exhibit color markings but which characteristically have only very fine spiral threads, have been collected from the Bellavista Sandstone; well-preserved specimens from the Melton Sandstone are usually distinctly spirally grooved on the shoulder. *Natica conradiana vacculae* thus appears to indicate an earlier horizon than does *N. conradiana*. Strength of sculpture and extent of whorl covered vary considerably. In all collections some specimens are without any; in some cases the absence appears to be original, in others to result from obliteration.

The strength of the funicle also varies from a slight thickening to a well rounded cord which ends at the inner lip in a semicircular umbilical callus. This callus is nearly midway in the umbilical depression along the inner

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## LOCALITIES

Gyrodiform gastropods from more than 200 localities were studied, but only the localities cited in this paper are listed here. Descriptions for nearly half of the cited numbered localities have been previously published. These are listed briefly with a reference.

- M 175 USGS, S of Logan Ridge, Lodoga Quad., Colusa Co., Calif., probably slumped downhill from Venado Fm. (Turonian) (Saul, 1978, p. 55).
- 446 CAS, Clawson Quarries, 4 miles (6.4 km) S of Ashland, Jackson Co., Oregon. Coll: BSC. Hornbrook Fm. (Turonian).
- 974 CIT, Santa Ana Mts., El Toro Quad., Orange Co., Calif. Williams Fm., Pleasants Sandstone Member (late Campanian, *Metaplacenticeras pacificum* Zone) (Matsumoto, 1960, p. 99).
- 976 CIT, Santa Ana Mts., El Toro Quad., Orange Co., Calif. Williams Fm., Pleasants Sandstone Member (late Campanian, *Metaplacenticeras pacificum* Zone) (Matsumoto, 1960, p. 99).
- 1007 CIT, Oak Run, Millville Quad., Shasta Co., Calif. Member IV (Coniacian) (Matsumoto, 1960, p. 100).
- 1016 CIT, About halfway up slope of W bank of Big Chico Creek, in first ravine flowing into Chico Creek N of bridge S of Mickey's house, 800' N, 700'E of SW cor. sec. 1, T23N, R2E, Paradise Quad., Butte Co., Calif. Coll: Popenoe and Scharf, 1931. Chico Fm., lower Musty Buck Member (Santonian).
- 1017 CIT, About 100' (30.5 m) below lava contact W side Chico Creek, N and a little W of Mickey's house, 1,650' N, 1,300' E of SW cor. sec. 1, T23N, R2E, Paradise Quad., Butte Co., Calif. Coll: Popenoe and Scharf, 1931. Chico Fm., Musty Buck Member (Santonian).
- 1041 CIT, Butte Creek, Paradise Quad., Butte Co., Calif. Chico Fm., Tenmile Member (late early Campanian, *Turritella chicoensis* Zone) (Saul and Popenoe, 1962, p. 328).

- 1042 CIT, N bank of Rancheria Gulch, about 1.5 mi (2.4 km) W of Henley, 210' S, 800' E of NW cor. sec. 30, T47N, R6W, Hornbrook Quad., Siskiyou Co., Calif. Coll: Popenoe and Findlay, 1933. Hornbrook Fm., Osburger Gulch Sandstone Member (late Turonian, *Subprionocyclus neptuni* Zone).
- 1158 CIT, SE slope of Simi Hills, N bank Bell Canyon, 500' (152.4 m) S, 9,000' (2743.2 m) W of NE cor. sec. 4, T1N, R17W, Calabasas Quad., Ventura Co., Calif. Coll: Popenoe, 1935. Chatsworth Fm. (?mid Campanian, *Turritella chicoensis* Zone).
- 1159 CIT, Crest of spur between forks of Dayton Canyon, Simi Hills, about 400' (121.9 m) E of Los Angeles-Ventura Co. line, 400' (121.9 m) N, 2,350' (238.7 m) W of SE cor. sec. 28, T2N, R17W, Calabasas Quad., Los Angeles Co., Calif. Coll: Durbin and Popenoe, 1935. Chatsworth Fm. (late Campanian, *Metaplacenticeras pacificum* Zone).
- 1195 CIT, Bed of Stinking Cr., 2,600' (792.5 m) N, 1,100 (335.3 m) E of SE cor. sec. 6, T32N, R3W, Redding Quad., Shasta Co., Calif. Coll: Popenoe and Ahlroth, 1936. Bellavista Sandstone (early Turonian).
- 1246 CIT, Clover Creek valley, Millville Quad., Shasta Co., Calif. Member V or VI (early Santonian) (Matsumoto, 1960, p. 104).
- 1260 CIT, Swede Basin, Millville Quad., Shasta Co., Calif. Member IV, lower part (Coniacian or earliest Santonian) (Matsumoto, 1960, p. 8, 105).
- 1264 CIT, Little Cow Creek, Millville Quad., Shasta Co., Calif. Melton Sandstone (late Turonian, *Subprionocyclus neptuni* Zone) (Matsumoto, 1960, p. 105).
- 1313 CIT, Left bank of Chico Creek, 5.6 mi (9.0 km) upstream from Ten-mile House, and approx. 20' (6.2 m) above stream bed in road cut, approx. 1,200' (365.8 m) N, 1,750' (533.4 m) E of SW cor. sec. 12, T23N, R2E, Paradise Quad., Butte Co., Calif. Chico Fm., Musty Buck Member (Santonian).
- 1346 CAS, Mouth of Hulen Creek, Shasta Co., California, where it enters Cottonwood Creek. Coll: F. M. Anderson. Budden Canyon Fm., Bald Hills Member (late Albian).
- 1346A CAS, 1 mile (1.6 km) above mouth of Hulin Creek, basal Chico Zone, Shasta Co., California. Budden Canyon Fm., Bald Hills Member (late Albian).
- 1346 CIT, Little Cow Creek, Millville Quad., Shasta Co., Calif. Melton Sandstone (late Turonian, *Subprionocyclus normalis* Zone) (Matsumoto, 1960, p. 106).
- 1396 CIT, Sucia Island, Orcas Island Quad., San Juan Co., Washington. Cedar District Fm. (mid Campanian, *Hoplitoplacenticeras vancouverense* Zone) (Saul, 1974, p. 1093).
- 1400 CIT, Sucia Island, Orcas Island Quad., San Juan Co., Washington. Cedar District Fm. (mid Campanian, *Hoplitoplacenticeras vancouverense* Zone) (Matsumoto, 1960, p. 107).
- 1440 CIT, Redding area, Millville Quad., Shasta Co., Calif. Bellavista Sandstone (?early Turonian) (Saul, 1974, p. 1093).
- 1444 CIT, S side Woodman Creek, approx. 2,400' (731.5 m) S of NE cor. sec. 35, T33N, R3W, Millville Quad., Shasta Co., Calif. Coll: Popenoe, 1940. Bellavista Sandstone (early Turonian).
- 1446 CIT, near top of N slope of hillside SE of Alturas-Redding highway, S side Woodman Creek, 2,250' (746.8 m) S, 500' (152.4 m) W of NE cor. sec. 35, T33N, R3W, Millville Quad., Shasta Co., Calif. Coll: Popenoe, 1940. Bellavista Sandstone (early Turonian) (Matsumoto, 1960, p. 107).
- 1532 CIT, Salt Creek, Millville Quad., Shasta Co., Calif. Frazier Silt (?late Turonian) (Matsumoto, 1960, p. 107).
- 1602 CIT, NW side of crest of ridge just W of prominent bend in road, highway between Martinez and Crockett, approx. 1.8 mi (2.9 km) N 75°W of shore end of ferry pier at Martinez and S of Benicia city wharf, Benicia Quad., Contra Costa Co., Calif. Coll: Popenoe, 1944. Great Valley Sequence (?mid Maastrichtian).
- 2326 UCLA, Crest of spur S of Santiago Truck trail and Harding Canyon, 600' S, 175' W of NW cor. sec. 32 and E edge of topo sheet, T5S, R7W, El Toro Quad., Santa Ana Mts., Orange Co., Calif. Coll: Popenoe, 1946. Williams Fm., Pleasants Sandstone Member (late Campanian, *Turritella chicoensis pescaderoensis* Zone).
- 2582 UCLA, Western base of 1st hill W of Barclay Ranch rd, approx. 1,600' (487.7 m) S, 600' (182.9 m) W of NE cor. sec. 23, T2N, R18W, Calabasas Quad., Simi Hills, Ventura Co., Calif. Coll: Murphy, 1950. Lower Santa Susana Fm. (early "Martinez" ≈ early Selanian, *Turritella peninsularis* Zone).
- 2697 LSJU, (Waring loc. 4, in part) Simi Hills, 3 mi (4.8 km) ENE of Simi Peak, near head of E fork of Las Virgenes Canyon, Camulos Quad., Ventura Co., Calif. Lower Santa Susana Fm. (early "Martinez" ≈ early Selanian, *Turritella peninsularis* Zone).
- 2874 UCLA, 4,780' (1452.9 m) N, 25.5°E of the confluence of Huling Creek and N fork of Cottonwood Creek on E fork of Huling Creek, on S limb of hairpin meander, Ono Quad., Shasta Co., Calif. Coll: M. A. Murphy, summers 1951-1953. Budden Canyon Fm., Chocabilly Member (Early Albian, *Leconteites lecontei* Zone).
- 3154 UCLA, First small rise S of hill 2,150' S of the road, 12,690' (3,869.9 m) S, 28.5°E of NW cor. Calabasas (1929) Quad., Simi Hills, Ventura Co., Calif. Coll: Fantozzi, 1953. Lower Santa Susana Fm. (early "Martinez" ≈ early Selanian, *Turritella peninsularis* Zone).
- 3382 UCLA, 2 ft (0.62 m) thick ledge of graywacke above siltstone along N side of Clear Creek, 2,000' (609.6 m) ESE of Reading Bar, 2 mi (3.2 km) SSW of Centerville at junct. of Ono-Redding and Horsetown-Centerville rds., SW $\frac{1}{4}$  sec. 36, T31N, R6W, Anderson Quad., Shasta Co., Calif. Coll: Murphy and Rodda, 1955. Budden Canyon Fm., upper Aiken Member (mid Albian, *Oxytropidoceras packardi* Zone).
- 3464 UCLA, W of the Gas Point Rd., Ono Quad., Shasta Co., Calif. Budden Canyon Fm., Bald Hills Member (Cenomanian) (Murphy and Rodda, 1960, p. 856).
- 3465 UCLA, North Fork of Cottonwood Cr., Ono Quad., Shasta Co., Calif. Budden Canyon Fm., Bald Hills Member (Cenomanian) (Murphy and Rodda, 1960, p. 856).
- 3625 UCLA, First ravine to S of Mickey's Place on W side of Chico Creek about 100' (30.5 m) below fork in ravine, 800' (243.8 m) N, 900' (274.3 m) E of SW cor. sec. 1, T23N, R2E, Paradise Quad., Butte Co., Calif. Coll: L. R. and R. B. Saul, 1952. Chico Fm., Musty Buck Member (early Santonian).
- 3627 UCLA, Chico Creek, Paradise Quad., Butte Co., Calif. Chico Fm., Musty Buck Member (Santonian, *Baculites capensis* Zone) (Matsumoto, 1960, p. 156).
- 3628 UCLA, E bank Chico Creek approx. 100' (30.5 m)

- S of northernmost H<sub>8</sub> fence, 800' (243.8 m) S, 1,000' (304.8 m) E of NW cor. sec. 13, T23N, R2E, Paradise Quad., Butte Co., Calif. Coll: L. R. and R. B. Saul, 1952. Chico Fm., Musty Buck Member (Santonian, *Baculites capensis* Zone).
- 3630 UCLA, W side Chico Creek valley about  $\frac{1}{3}$  mi (0.54 km) up deep ravine and  $\frac{2}{3}$  mi (1.1 km) S of Mickey's Place, approx. elev. 1,160' (353.6 m), 1,750' (533.4 m) S, 200' (61.0 m) E of NW cor. sec. 12, T23N, R2E, Paradise Quad., Butte Co., Calif. Coll: L. R. and R. B. Saul, 1952. Chico Fm., basal Tenmile Member (?late Santonian or earliest Campanian).
- 3633 UCLA, Chico Creek, Paradise Quad., Butte Co., Calif. Chico Fm., near top of Musty Buck Member (Santonian, *Baculites capensis* Zone) (Matsumoto, 1960, p. 15, 156).
- 3639 UCLA, Chico Creek, Paradise Quad., Butte Co., Calif. Chico Fm., Tenmile Member (early Campanian, *Turritella chicoensis holzana* Zone) (Saul, 1983, p. 121).
- 3778 UCLA, Huling Creek, Ono Quad., Shasta Co., Calif. Budden Canyon Fm., Bald Hills Member (late Albian) (Murphy and Rodda, 1960, p. 857).
- 4081 UCLA, S of Pentz, Cherokee Quad., Butte Co., Calif. Chico Fm., ?Musty Buck Member (early Campanian) (Saul and Popenoe, 1962, p. 328).
- 4106 UCLA, N of Clover Creek, Millville Quad., Shasta Co., Calif. Member VI (early Santonian) (Popenoe, 1983, p. 765).
- 4127 UCLA, Hard ss. slabs in bed of Clover Cr., 700' (213.4 m) N, 1,200' (365.8 m) W of SE cor. sec. 22, T32N, R2W, Millville Quad., Shasta Co., Calif. Coll: Popenoe and Dailey, 1959. Member VI (late Santonian).
- 4246 UCLA, SE side Oak Run Valley, in ss. below thick cgl. 1,800' (548.6 m) N, 1,700' (518.2 m) E of SW cor. sec. 15, T32N, R2W, Millville Quad., Shasta Co., Calif. Coll: Popenoe, 1959. Member V (early Santonian).
- 4340 UCLA, SE of Pentz, Cherokee Quad., Butte Co., Calif. Chico Fm., ?Musty Buck Member (early Campanian) (Saul and Popenoe, 1962, p. 329).
- 4416 UCLA (=CIT 1195), Stinking Creek, Redding Quad., Shasta Co., Calif. Bellavista Sandstone (Turonian) (Matsumoto, 1960, p. 104).
- 4669 UCLA, Camp Creek drainage, ss. cropping out in field about  $\frac{1}{4}$  mi. (0.4 km) N of road from Suplee to Paulina, and in center of SW $\frac{1}{4}$  sec. 23, T17S, R25E, Dayville Quad., Crook Co., Oregon. Coll: Imlay and Popenoe, 1959. (Cenomanian.)
- 5902 UCLA, In gullies tributary to Oil Canyon at its source, just west of center of sec. 7, T19S, R15E, Joaquin Rocks Quad., Fresno Co., Calif. Coll: Popenoe, 1949. Panoche Fm., "Ragged Valley Shale" (early Maastrichtian).
- 6337 UCLA, W side Cottonwood Creek, Hancock Ranch, 2,000' (609.6 m) S, 3,750' (1,143 m) E of NW cor. sec. 6, T24S, R16E, Cholame Valley Quad., Monterey Co., Calif. Coll: Alderson, 1976. Panoche Fm. (early Maastrichtian).
- 6342 UCLA, W side San Joaquin Valley, cgl. reef bed cropping out on NW slope of Los Baños Cr., about 3,200' (975.4 m) N, 1,800' (548.6 m) W of SE cor. sec. 12, T11S, R9E, Ortigalita Peak Quad., Merced Co., Calif. Coll: Stewart and Popenoe, 1944. Panoche Fm., "Quinto B" beds (early Maastrichtian).
- 6465 UCLA, "Rob's loc." S-facing slope of E-flowing gulch just above 4 on map, 2,375' (723.9 m) S, 2,375' (723.9 m) E of NW cor. sec. 4, T20N, R14E, N of Los Gatos Creek, Coalinga Quad., Fresno Co., Calif. Coll: L. R., R. B., R. B., and R. L. Saul, 1972. Panoche Fm., "Ragged Valley Shale" (early Maastrichtian).
- 6534 UCLA, S side short cul de sac having prominent bare vertical outcrop on N side, W side Arroyo Santa Catarina, almost opposite road into Arroyo, approx. 8.1 km N, 4.2 km E of mouth of stream NW side Arroyo Santa Catarina, N 19°W of S tip Punta Canoas, Baja Calif., Mexico. Coll: L. R. and R. L. Saul and W. P. Popenoe, 1968. Rosario Fm. (early Maastrichtian).
- 7006 UCLA, Wave-cut shelf on S side Sucia Island, sec. 25, T38N, R2W, Orcas Island Quad., San Juan Co., Washington. Coll: L. R. and R. B. Saul, 1958. Cedar District Fm. (Campanian).
- 31918 CAS, Thompson Cr., 1,200' (365.8 m) N, 600' (182.9 m) W of SE cor. sec. 20, T8N, R2W, Monticello Dam Quad., Yolo Co., Calif. Coll: Kennett, 1943. Just above base of Yolo Shale (Turonian).
- 85511 CGS, Hamley Point, Sydney Island, lat. 48°36'05"N, long. 123°16'05"W, British Columbia, Canada. Coll: Muller, 1970. Nanaimo Group, near base (Turonian).