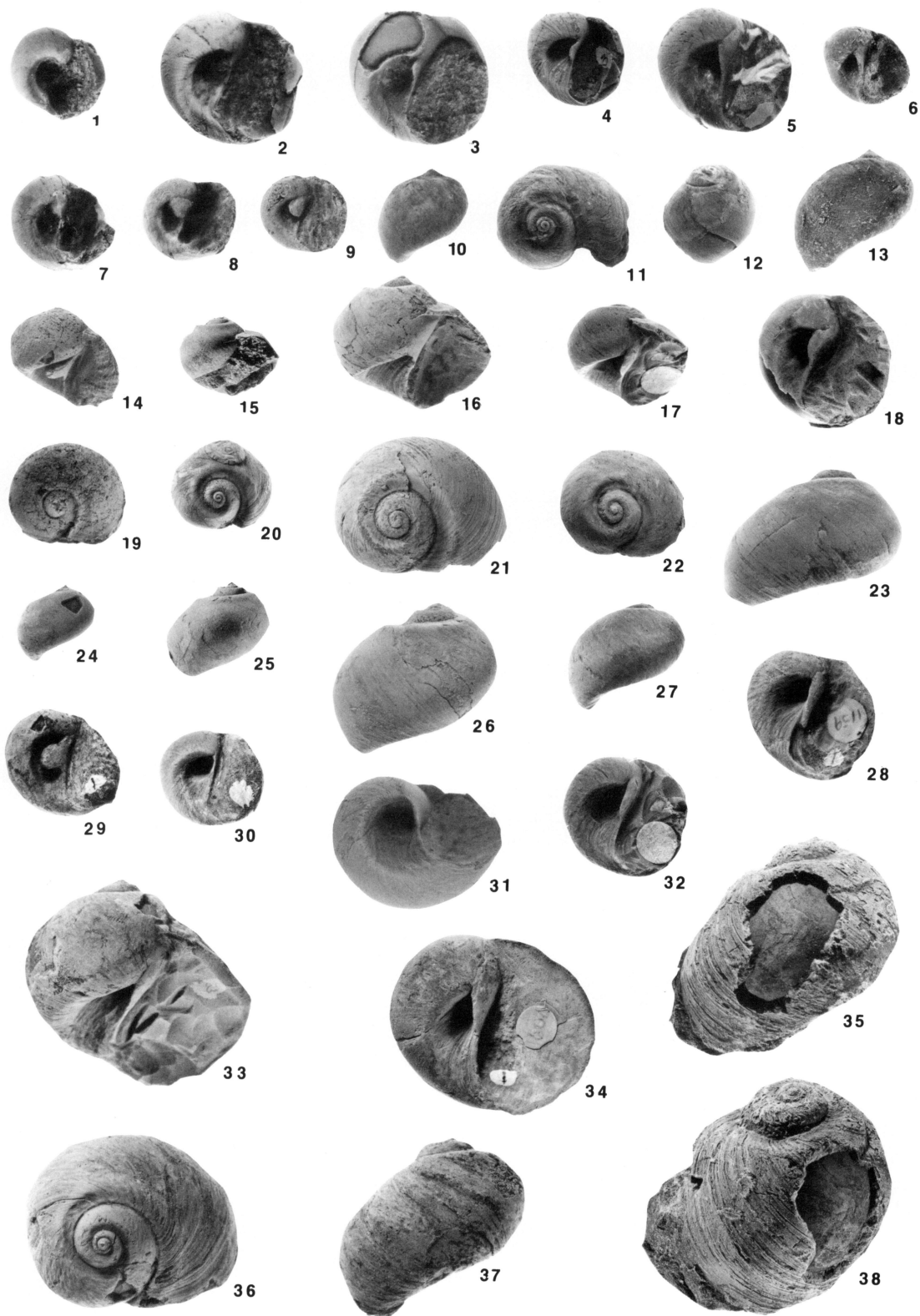




shoulder and slightly higher spire. It differs from *G. (S.) canadensis* in its propensity for developing tongues of callus on the inner lip edge which overhang the umbilicus, its less obliquely expanded whorl, and its more rounded umbilical margin. It differs from *G. (?S.) banites* in its more tabulate shoulder and less well-developed umbilical callus tongue. *Gyrodes (S.) quercus* grades into *G. (S.) canadensis* Whiteaves in the lower Tenmile Member, Chico Formation, on Chico Creek, Butte Co., California.

Included in *G. (S.) quercus* are three forms: 1) *quercus* s.s., specimens of Coniacian and earliest Santonian age which have a short reflected tongue of callus at the adapical end of the free inner lip; 2) form "a", specimens of early to late Santonian age which usually have a simple inner lip; and 3) form "b", specimens of late Santonian age (zone of *Baculites capensis*) which have a narrow reflected tongue of callus usually elongate along the free inner lip. Specimens from CIT 1260, Swede Basin, Redding area, are *quercus* s.s. and suggest a Coniacian or earliest Santonian age. Matsumoto (1960, p. 8, 105) identified *Baculites capensis* from this locality, but the *baculites* taper more rapidly and have a more subtrigonal cross section than *B. capensis* from the upper Musty Buck Member of the Chico Formation on Chico Creek, Butte Co., California. The three forms of *Gyrodes* differ mainly in development of the reflection and callus of the inner lip. The callus is not uni-

formly developed among specimens from a locality. Typical *quercus* is very similar to form "b", but the callus of "b" is usually more elongate along the inner lip and the umbilical depression of form "b" is usually more elongate parallel to the inner lip than is the depression of either *quercus* s.s. or form "a".

Hundreds of specimens of *G. (S.) quercus* are present in the collections, and all three forms are well represented. Specimens of Coniacian age develop a callus tongue when over 6 mm in height (Figure 6.3). The callus tongue starts as a short reflection of the free inner lip adjacent to its onlap of the previous whorl. With shell growth, a narrow sulcus forms between whorl and callus tongue. The sulcus is usually slightly wider in equivalent sized specimens of form "b" than it is in *quercus* s.s. Some specimens from UCLA loc. 3633 at the top of the Musty Buck Member on Chico Creek have the elongate callus of form "b" but lack a sulcus. Their inner lip is a somewhat more strongly reflected version of that of *G. (S.) canadensis*.

All specimens recognized as *G. (S.) quercus* s.s. are from Members IV and V of the Redding area; *G. (S.) quercus* form "a" are from Member V of the Redding area, the lower Musty Buck Member of the Chico Formation along Chico Creek, and from Mill Creek; *G. (S.) quercus* form "b" are from Members V and VI of the Redding area, the Tenmile Member of the Chico Formation on Mill

←

FIGURE 6—All figures $\times 1$ except as noted. 1–4, *Gyrodes (Sohlella) quercus* n. sp., paratypes from CIT loc. 1007, Coniacian, showing development of the callus tongue; 1, UCLA 59738, $\times 5$; 2, UCLA 59737, $\times 5$; 3, UCLA 59736, $\times 4$; 4, UCLA 59734. 5, 6, 11–13, 15, 25, *Gyrodes (Sohlella) canadensis* Whiteaves "early" form, hypotypes, early Campanian; 5, 6, 11–13, from UCLA loc. 3639; 5, UCLA 59767, $\times 2$; 6, UCLA 59769, $\times 2$; 11, UCLA 59768, $\times 2$; 12, UCLA 59767, $\times 1.5$; 13, UCLA 59769, $\times 3$; 15, 25, ANSP 4254, Gabb's paratype of *G. expansus* probably from Pentz, Butte Co., Calif. 7, *Gyrodes (?Sohlella) banites* n. sp. s.l., hypotype, UCLA 59759 from UCLA loc. 4246, Santonian, $\times 2$. 8–10, 14, 19, 24, 29, *Gyrodes (?Sohlella) banites* n. sp., Santonian; 8–10, 14, 19, 29, from UCLA loc. 3633; 8, 10, paratype, UCLA 59753, $\times 3$; 9, 19, paratype, UCLA 59752; 9, $\times 1.5$; 19, $\times 2$; 14, 29, holotype, UCLA 59751; 24, paratype, UCLA 59755 from UCLA loc. 3627; 7–9, 29, showing development of the callus tongue. 16, 20, 21, 26, 30, 31, *Gyrodes (Sohlella) canadensis* Whiteaves, 1903, Campanian; 16, 21, 26, 31, holotype, CGS 5777 from Sucia Island, Washington, $\times 2$; 20, 30, hypotype, UCLA 59763 from CIT 1041. 17, 18, 22, 23, 27, 28, 32, *Gyrodes (Sohlella) pacificus* n. sp.; 17, 22, 27, 32, holotype, UCLA 59773 from CIT loc. 976, late Campanian; 18, paratype, UCLA 59775 from CIT loc. 974, late Campanian, $\times 2$; 23, paratype, UCLA 59777 from UCLA loc. 7137, early Maastrichtian; 28, paratype, UCLA 59776 from CIT loc. 1159, late Campanian. 33–38, *Gyrodes (Sohlella) expansus* Gabb, 1864, Maastrichtian; 33, 34, 36, 37, hypotypes from CIT loc. 1602; 33, 36, UCLA 59780; 34, UCLA 59779; 37, UCLA 59781; 35, 38, lectotype, ANSP 4245 from Martinez, Contra Costa Co., Calif.

TABLE 5—Dimensions of *Gyrodes* (?*Sohlella*) *banites* n. sp., 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 59760	13.5	16.0	2.8	7.3	1.7	1.19	0.21	0.54	0.13	0.23
UCLA 59761	12.0	13.7	2.7	6.2	2.0	1.14	0.23	0.52	0.17	0.32
UCLA 59758(1)	12.6	15.0	2.7	6.5	2.0	1.19	0.21	0.52	0.16	0.31
UCLA 59758(2)	10.3	11.6	1.7	5.3	1.0	1.13	0.16	0.51	0.1	0.19
UCLA 59762(1)	17.0	19.3	2.6	7.5	2.0*	1.13	0.15	0.44	0.12	0.27
UCLA 59762(2)	14.7	16.4	2.8	7.5	2.4	1.12	0.19	0.51	0.16	0.32
UCLA 59762(3)	10.8	14.3	2.4	6.0	1.8	1.32	0.22	0.56	0.17	0.3
UCLA 59762(4)	11.6	13.4	2.0	5.9	1.9	1.15	0.17	0.51	0.16	0.32
UCLA 59755	10.5	14.4	2.5	6.1	1.9	1.37	0.24	0.58	0.18	0.31
UCLA 59756	12.2	15.5	3.0	6.8	2.3	1.27	0.24	0.56	0.19	0.34
UCLA 59751	15.5	17.8	3.9	7.8	2.8	1.15	0.25	0.5	0.18	0.36
UCLA 59757	14.0	19.3	3.0	7.8	2.5	1.37	0.21	0.56	0.17	0.32

Creek, and the upper Musty Buck Member on Chico Creek. Specimens from the top of the Musty Buck Member on Chico Creek appear transitional to *G. (S.) canadensis*.

In the Chico Creek section *G. (S.) quercus* form "b" ranges through the *B. capensis* Zone to the *B. chicoensis* Zone. Haggart and Ward (1984) and Haggart (1984) infer that the zones of *Bostrychoceras elongatum* and *Inoceramus schmidtii* are missing from between the zones of *Baculites capensis* and *B. chicoensis* in the Chico Formation on Chico Creek. They consider the *Baculites capensis* Zone to be of late early Santonian age rather than late Santonian, as suggested by Matsumoto (1960). That zones may be missing from such shallow water deposits as the Musty Buck Member is not surprising. However, neither *Bostrychoceras elongatum* nor *I. schmidtii* has been found elsewhere in association with such a shallow water molluscan assemblage as occurs in the Musty Buck Member. Both are usually associated with more offshore assemblages. Their absence from Chico Creek may reflect shallow water depth rather than missing strata. *Gyrodes (S.) quercus* form "b" from UCLA 4217 on Clover Creek, Redding area, occurs with a *Perissitys* n. sp. which also occurs near the top of the Musty Buck Member on Chico Creek and with *I. schmidtii* in the Kingsley Cave Member of the Chico Formation on Mill Creek. The beds at UCLA 4217 on Clover Creek are probably correlatives of the Kingsley Cave Member and thus of late Santonian age (sensu Haggart and Ward, 1984, and Haggart, 1984); and the top of the Musty Buck Member and base of the Tenmile Member on Chico Creek are perhaps the shallower water correlative. Along

Chico Creek the *B. elongatum* and *I. schmidtii* Zones may be lacking or very thin—*Baculites chicoensis* has been collected less than 15 m above *B. capensis*. If there are no correlative strata on Chico Creek, the *G. (S.) quercus* record is incomplete and *G. (S.) quercus* form "b" may not be its latest variant.

The species is named for its occurrence in Oak Run: *quercus*, Latin, oak.

GYRODES (?*SOHLELLA*) *BANITES* n. sp.

Figures 5.5, 5.6, 5.8, 5.9, 5.15,
5.19, 5.24, 5.28, 5.29, 6.7–6.10,
6.14, 6.19, 6.24, 6.29

Description.—Shell thin, small, wider than high; spire about 22% of total height; suture appressed, at posterior 1/3 of penultimate whorl; shoulder obscure, sloping, with slight concave band adapically; whorl profile obliquely convexly rounded; umbilical margin roundly biangulate; umbilicus wide, steeply sloping with a narrow funicle; growth line obliquely prosocline with an antispinal flexure at the umbilical angulation; aperture oblique, tear-drop shaped; outer lip thin, projected posteriorly; inner lip thin anteriorly and posteriorly, reflected medially to form an overhanging callus tongue.

Holotype.—UCLA 59751.

Paratypes.—UCLA 59755 from UCLA loc. 3627; UCLA 59756 from UCLA loc. 3628; UCLA 59752–59753 from UCLA loc. 3633; UCLA 59757 from UCLA loc. 3630; all from Chico Creek, Butte Co., California.

Hypotypes.—UCLA 59758–59759 from UCLA loc. 4246, Oak Run Valley, Shasta Co.; UCLA 59760–59761 from CIT loc. 1246, Clover Creek Valley, Shasta Co.; UCLA

59762 from CIT loc. 1017, Chico Creek, Butte Co., California.

Type locality.—UCLA loc. 3633: Chico Creek, Paradise Quadrangle, Butte Co., California.

Distribution.—Upper Member V, east of Redding, Shasta Co.; upper Musty Buck and basal Tenmile Members of the Chico Formation on Chico Creek, Butte Co., California.

Age.—Santonian, from *Baculites boulei* through *Baculites capensis* Zones, and earliest Campanian.

Remarks.—Typical *G. (?S.) banites* is a common form through a narrow stratigraphic interval from 488 m (1,600 feet) to 536 m (1,760 feet) above the base of the Chico Formation on Chico Creek. The subspecies is also recognized near Redding, in Member V at CIT loc. 1246 and UCLA loc. 4246 and as low as CIT loc. 1017 on Chico Creek at 448 m (1,470 feet) above the base of the Chico Formation (Matsumoto, 1960, p. 15; Saul, 1983, p. 12), but none of these early Santonian specimens has as well developed an umbilical callus as do those from the *Baculites capensis* Zone.

Gyrodes (?S.) *banites* differs from *G. quercus* with which it occurs in having a large reflected, medially placed, tongue-like callus which overhangs the umbilicus, and in usually having a less well-developed tabulation at the suture. The callus is reminiscent of that of *Neverita* or *Hypterita*, but *G. (?S.) banites* is not as flattened or widely expanded as *N. josephina* (Risso, 1826) or *H. helicoides* (Gray, 1825). The growth line of *G. (?S.) banites* resembles that of *N. helicoides* in being prosocline at the suture rather than that of *N. josephina* which is nearly orthocline to the suture. *Gyrodes* (?S.) *banites* resembles *Banis siniformis* Stephenson (1941, p. 279, Pl. 50, figs. 14–16) from the Nacatoch Sand of the Navarro Group of Texas but has a rounder whorl profile, narrower more abruptly depressed umbilical depression, and a more adapically placed callus tongue. The callus tongue of *G. (?S.) banites* starts as a reflection of the free inner lip at its onlap of the previous whorl (Figure 6.7). The rounded callus tongue overlaps onto the previous whorl until the shell exceeds 7 mm in height (Figure 6.8), then, with further shell growth, becomes free of the previous whorl and overhangs the um-

bilicus. This growth of the callus tongue is similar to that of the smaller, less well-developed callus of *G. (S.) quercus*. *Banis* is characterized as having a thick reflected inner lip (Stephenson, 1941, p. 279), but the inner lip of *G. (?S.) banites* is thin except at the umbilical callus. This callus resembles that of *Hypterita*—a thin lobe suspended anteriorly from a pillar-like funicle (Marincovich, 1977, p. 296)—more than it does the more anteriorly placed, knob-like callus of *Banis siniformis* Stephenson. It differs from that of *Hypterita* in having a flat to convex surface rather than a concave surface.

In assigning *G. (?S.) banites* tentatively to *Sohlella*, we have considered the similarity of callus formation, the welt at the suture and the slight concavity and obscure shoulder tabulation, the path of the growth line, and the well-defined umbilical depression to indicate closer relationship to species of *Sohlella*—especially to *G. (S.) quercus*—than to *Banis*, *Hypterita*, or *Neverita*. Marincovich (1977, p. 215) considered that Ampullospirinae (in which he included Gyrodinae) do not have a distinct and compact umbilical callus, and, as previously mentioned, Conrad (1860), Cossmann (1925), and Sohl (1960), among others, have indicated the absence of umbilical callus in *Gyrodes*. A small umbilical callus is developed in *G. (S.) quercus* s.s. and *G. (S.) quercus* form “b”. Development in gyrodifform naticids of this structure, previously considered diagnostic of placement in another subfamily, further complicates classification within the family Naticidae (Wrigley, 1949).

The species is named for its resemblance to *Banis*; *banis* + *ites*, Greek, having the nature of, like.

GYRODES (SOHLELLA) CANADENSIS

Whiteaves, 1903

Figures 5.31–5.33, 6.5, 6.6,
6.11–6.13, 6.15, 6.16, 6.20,
6.21, 6.25, 6.26, 6.30, 6.31

Gyrodes expansa GABB, 1864, p. 108 [in part], Pl. 19, fig. 62c [only]; STEWART, 1927, p. 328 [in part], Pl. 22, fig. 3 [only].

Gyrodes excavata Michelin. WHITEAVES, 1879, p. 124, Pl. 16, figs. 2–2a [non *G. excavata* (Michelin)].

Gyrodes (*Conradiana*? Gabb, var.) *Canadensis* WHITEAVES, 1903, p. 365 [new name for above].

TABLE 6—Dimensions of *Gyrodes (Sohlella) canadensis* Whiteaves, 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 59767	9.7*	11.5	2.0	5.4	1.6	1.19	0.21	0.56	0.16	0.3
UCLA 59768	8.9	10.2	2.4	4.6	1.4	1.15	0.27	0.52	0.16	0.3
UCLA 59769	6.8	7.7	1.5	3.4	1.1	1.13	0.22	0.5	0.16	0.32
UCLA 59770	23.7	27.0	5.8	10.7	5.8	1.14	0.24	0.45	0.24	0.54
UCLA 59771	18.9	22.1	4.0	8.9	3.0	1.17	0.21	0.47	0.16	0.34
UCLA 59772(1)	18.7	20.3*	3.9	9.0	3.2	1.09	0.21	0.48	0.17	0.36
UCLA 59772(2)	12.7*	14.4	2.8*	6.6	1.8	1.13	0.22	0.52	0.14	0.27
UCLA 59763	14.3	16	3.2	7.0	2.0	1.12	0.22	0.49	0.14	0.29
UCLA 59764	14.0	16.2	2.8	7.0	2.6	1.16	0.2	0.5	0.19	0.37
UCLA 59765	17.0	19.0	3.6	7.8	2.4	1.12	0.21	0.46	0.14	0.31
UCLA 59766	14.0	15.6	3.0	7.9	2.3	1.11	0.21	0.56	0.16	0.29

Not *Gyrodes canadensis* Whiteaves. WARING, 1917, p. 66, Pl. 9, fig. 7 = *G. (S.) pacificus* n. sp.

Not *Gyrodes expansus canadensis* Whiteaves. POPENOE, 1954, p. 17, fig. 4(9) = *G. (S.) pacificus* n. sp.

Description.—Shell thin, small to medium sized, spire about 22% of total height; suture appressed, at posterior one-third of penultimate whorl; shoulder sharply tabulate with concave band adapically and broad slightly concave zone abapically; whorl profile roundly inflated abapical to the concave zone; umbilical margin roundly biangulate; umbilicus comma-form, sides sloping; growth line obliquely prosocline with antispinal flexure at the umbilical angulation; aperture oblique, tear-drop shaped; outer lip thin, projected posteriorly; inner lip thin, wrapped onto the last whorl at the outer umbilical angulation.

Holotype.—CGS 5777.

Paratype.—CGS 5777b.

Hypotypes.—"Early" form: ANSP 4254 (smaller specimen figured by Gabb), probably from Chico Fm., near Pentz, Butte Co.; UCLA 59767–59769, "deformed" specimens from UCLA loc. 3639, Chico Fm., Tenmile Member, Chico Creek, Butte Co.; UCLA 59770–59771, from UCLA loc. 4340, Chico Fm., Musty Buck Member, near Pentz, Butte Co.; UCLA 59772, from UCLA loc. 4081, Chico Fm., ?Musty Buck Member, near Pentz, Butte Co., California; typical form: UCLA 59763, from CIT loc. 1041, Chico Fm., Tenmile Member, Butte Creek, Butte Co., California; UCLA 59763 from UCLA loc. 7006, UCLA 59765 from CIT loc. 1400, and UCLA 59766 from CIT loc. 1396, Cedar District Formation, Sucia Island, San Juan Co., Washington.

Type locality.—Sucia Island, San Juan Co., Washington.

Distribution.—Cedar District Formation of the Nanaimo Basin, Vancouver Island, British Columbia, and Sucia Island, San Juan Co., Washington; Chico Formation at Tuscan Springs, Tehama Co., Tenmile Member of the Chico Formation on Butte Creek, and Musty Buck Member of the Chico Formation near Pentz, Butte Co.; ?Pigeon Point Formation near Bolsa Point, San Mateo Co.; lower Chatsworth Formation in Bell Canyon, Simi Hills, Ventura Co.; upper Holz Shale Member of the Ladd Formation in the Santa Ana Mountains, Orange Co., California.

Age.—Early through mid Campanian, late *Submortonicer* *chicoensis* Zone and *Hoplitoplacenticer* *vancouverense* Zone.

Remarks.—*Gyrodes (S.) canadensis* is one of the most widely distributed and common species of *Sohlella*. It has been frequently misidentified as *G. expansus* Gabb from which it differs in usually having the tabulation slightly concave and clearly marked by an angulation, and in having a sharper umbilical angulation that is sharper in youth and subrounded in maturity. Specimens included in *G. (S.) canadensis* are of two forms. An "early" form characterized by a strongly concave zone abapical to the shoulder (Figure 5.33) occurs from 545 m (1,790 feet) to 872 m (2,860 feet) above the base of the Chico Formation, or roughly through the lower half of the Tenmile Member. Numerous small specimens (under 14 mm high) from this stratigraphic interval develop a strong spiral antisinus to the growth line abapical to the shoulder (Figure 6.11, 6.12); they also have a subrounded umbilical angulation, and the anterior half of the outer lip has a broad sinus.

TABLE 7—Dimensions of *Gyrodes (Sohlella) pacificus* n. sp., 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 59773	15.8	19.3*	2.8	7.8	1.9	1.22	0.18	0.49	0.12	0.24
UCLA 59774	18.5*	23.0	4.0*	8.8	3.3	1.24	0.22	0.48	0.18	0.37
UCLA 59775	10.6	12.5	1.9	5.6	1.8	1.18	0.18	0.53	0.17	0.32
UCLA 28714	16.0	19.7	3.6	7.0	2.5	1.23	0.22	0.44	0.16	0.36
UCLA 59776	14.6	20.9	3.1	7.7	2.4	1.43	0.21	0.53	0.16	0.31

The aspect is of deformity caused by an injury, infection, or other environmental factor. The "condition" was not limited to Chico Creek, Butte Co.; similar, "deformed" specimens occur on Butte Creek and at Pentz in the Chico Formation and in the upper Holz Shale of the Ladd Formation in the Santa Ana Mountains, Orange Co., California. All localities at which such specimens are common are of early Campanian age from the earlier part of the *Baculites chicoensis* and *Submortonicer as chicoensis* Zones, and the *Turritella chicoensis holzana* Zone.

The change from the "early" form to typical *G. (S.) canadensis* with a less pronounced concave zone anterior to the shoulder is gradual. Specimens from the *Hoplitoplacenticer as vancouverense* Zone on Sucia Island have very little concavity and are similar to specimens from Bell Canyon, Simi Hills, Ventura Co., California. The stratigraphic position of the type specimens is unknown. They may have been collected from the *Hoplitoplacenticer as vancouverense* beds, but the concavity to their whorls suggests that they were collected from lower strata.

GYRODES (SOHLELLA) PACIFICUS n. sp.

Figure 6.17, 6.18, 6.22,
6.23, 6.27, 6.28, 6.32

Gyrodes canadensis Whiteaves. WARING, 1917, p. 66, Pl. 9, fig. 7.

Gyrodes expansus canadensis Whiteaves. POPENOE, 1954, p. 17, fig. 4(9).

Description.—Shell thin, medium sized, wider than high, surface strongly textured by growth lines, especially in larger individuals; spire 20% of total height; suture appressed, near posterior third of penultimate whorl; shoulder roundly tabulate with broad slightly concave zone abapically; whorl profile roundly inflated abapical to the concave zone; umbilical margin roundly biangulate; umbilicus comma-form; sides sloping; growth line

obliquely prosocline with antispiral sinus within the umbilicus; aperture oblique, tear-drop shaped; outer lip thin, projected posteriorly; inner lip thin anteriorly, a little reflected and slightly thickened posteriorly, wrapped onto the last whorl just posterior to the umbilical angulation.

Holotype.—UCLA 59773.

Paratypes.—UCLA 59774 from CIT loc. 976, UCLA 59775 from CIT loc. 974, and UCLA 28714 from UCLA loc. 2326, Santa Ana Mountains., Orange Co., California; UCLA 59776 from CIT loc. 1159, Simi Hills, Los Angeles Co., California; UCLA 59777 from UCLA loc. 7137, Punta Banda, Baja California, Mexico.

Type locality.—CIT loc. 976: Old Pleasants Ranch, Williams Canyon, 800' S, 600' W of NE cor. sec. 19, T5S, R7W, El Toro Quadrangle, Santa Ana Mountains., Orange Co., California.

Distribution.—Panoche Formation at top of Marlif Member in Panoche Hills, Fresno Co.; Chatsworth Formation of Lang Ranch area, Simi Hills, Ventura Co., and of Dayton Canyon, Simi Hills, Los Angeles and Ventura Counties; Jalama Formation of the Santa Ynez Mountains, Santa Barbara Co.; upper Tuna Canyon Formation of the Santa Monica Mountains, Los Angeles Co.; Pleasants Sandstone Member of the Williams Formation in the Santa Ana Mountains, Orange Co.; Rosario Formation of San Diego area, California; and Rosario Formation of northern Baja California, Mexico.

Age.—Late Campanian, zone of *Metapla-centricer as pacificum*, and early Maastrichtian.

Remarks.—*Gyrodes (S.) pacificus* is similar to *G. (S.) canadensis* with which it has been confused, but it has a more rounded shoulder and a wider umbilicus. The whorl is more expanded anteriorly and the inner lip is slightly thickened posteriorly. The concave

TABLE 8—Dimensions of *Gyrodes (Sohlella) expansus* 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 59778	17.0	21.4	3.9	8.4	2.9	1.26	0.23	0.49	0.17	0.34
UCLA 59779	27.5	30.8	5.7	13.2	5.6	1.12	0.21	0.48	0.2	0.42
UCLA 59780	33.0	33.9	7.6	14.5	5.2	1.03	0.23	0.44	0.16	0.36
UCLA 59781	28.8	31.6	7.7	13.8	5.8	1.1	0.27	0.48	0.2	0.42

zone to the whorl profile is especially similar to that of "early" *G. (S.) canadensis* from which *G. (S.) pacificus* can be distinguished by its thickening of the inner lip. Specimens from Chatsworth Formation outcrops in Bell Canyon (e.g., CIT loc. 1158; Saul and Anderson, 1981; Squires, 1981) have the narrower umbilicus of *G. (S.) canadensis*, but some have the more strongly reflected inner lip of *G. (S.) pacificus*. They appear to be intermediate between *G. (S.) canadensis* and *G. (S.) pacificus*.

Gyrodes (S.) pacificus differs from *G. (S.) expansus* in having a more angulate tabulation with a more noticeably concave zone to the whorl abapical to the tabulation and a wider umbilicus. With *G. (S.) pacificus* of typical whorl profile from the Rosario Formation of northern Baja California, Mexico, are specimens having a broader shoulder and a less concave zone. Their whorl profile thus is similar to that of *G. (S.) expansus*.

The species is abundant in the Chatsworth Formation at Dayton Canyon, near the Ventura-Los Angeles Co. line where it is associated with *Metaplacenticeras* sp. cf. *M. pacificum*. The largest specimens, however, are from the Rosario Formation in northern Baja California, Mexico, and are of early Maastrichtian age.

The species is named for its occurrence with *Metaplacenticeras pacificum*.

GYRODES (SOHLELLA) EXPANSUS Gabb, 1864 Figure 6.33–6.38

Gyrodes expansa GABB, 1864, p. 108 [in part], Pl. 19, fig. 62a–b [only; not fig. 62c = *G. canadensis* Whiteaves]; GRABAU AND SHIMER, 1909, p. 721, fig. 1048; STEWART, 1927, p. 328 [in part], Pl. 22, figs. 1, 1a [only; not fig. 3 = *G. canadensis* Whiteaves]; SHIMER AND SHROCK, 1944, p. 483, Pl. 198, figs. 21, 22; ANDERSON, 1958, p. 149 [in part; Maastrichtian specimens only].

Description.—Shell thick for the subgenus, medium to moderately large sized, surface strongly textured by growth lines especially in large individuals; spire about 24% of total height; suture appressed, at posterior third of penultimate whorl; shoulder roundly tabulate; whorl profile flattened abapical to the tabulation, then roundly inflated; umbilical margin roundly subangulate; umbilicus steeply sloping; growth line obliquely prosocline with antispiral flexure within the umbilicus; aperture broadly tear-drop shaped; outer lip thin, projected posteriorly; inner lip thin anteriorly, thickened posteriorly, wrapping onto the last whorl at the umbilical angulation.

Lectotype.—ANSP 4245.

Hypotypes.—UCLA 59778 from UCLA 6342, Ortigalita Peak Quadrangle, Merced Co.; UCLA 59779–59781 from CIT loc. 1602, near Martinez, Contra Costa Co., California.

TABLE 9—Dimensions of *Gyrodes (Hypterita) robsauli* n. sp., 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 59782	14.7	15.6	2.7	7.9	2.2	1.06	0.18	0.54	0.15	0.28
UCLA 59783	12.5	16.8	2.4	7.0	1.8	1.34	0.19	0.56	0.14	0.26
UCLA 59784	12.3*	14.3	2.4	6.9	1.6	1.16	0.2	0.56	0.13	0.23
UCLA 59787	12.9	15.7	3.5	6.9	2.6	1.22	0.27	0.53	0.2	0.38
UCLA 59788	16.2	19.0	3.4	7.0	2.5	1.17	0.21	0.43	0.15	0.35
UCLA 59789	7.8	8.8	2.0	4.0	0.9	1.13	0.26	0.51	0.12	0.22
UCLA 59786	17.2	20.0	4.8	8.9	2.9	1.16	0.28	0.52	0.17	0.32
UCLA 59790	15.1*	21.7	3.6*	7.2	2.5	1.44	0.24	0.48	0.17	0.35

Type locality.—Vicinity of Martinez, Contra Costa Co., California.

Distribution.—Upper Great Valley Series in the vicinity of Martinez, Contra Costa Co., Tierra Loma and "Quinto B" Members of the Moreno Formation in the eastern foothills of the Diablo Range, Merced Co., California.

Age.—Middle to ?late Maastrichtian.

Remarks.—*Gyrodes* (*S.*) *expansus* has a narrower umbilicus, more broadly and roundly tabulated spire, and rounder umbilical angulation than *G.* (*S.*) *pacificus*. The average size of *G.* (*S.*) *expansus* is greater than that of any other West Coast Cretaceous species assigned to *Sohlella*. Specimen size is similar to that of *G. dowelli*, *G. onensis*, *Natica conradiana*, and *N. conradiana vacculae*; large *G.* (*S.*) *expansus* are smaller than the largest specimens of *G.* (?*G.*) *robustus* Waring. *Gyrodes* (*S.*) *expansus* differs from *G.* (?*G.*) *robustus* in having a more obliquely inflated whorl, a less clearly delimited tabulation, and a more rounded umbilical angulation.

Subgenus HYPTERITA Woodring, 1957

Type species.—*Natica helicoides* Gray, 1825, by original designation, Woodring (1957, p. 92).

Discussion.—*Hypterita* was proposed as a subgenus of *Neverita* by Woodring, but Keen (1971, p. 478) placed the type species in *Polinices* s.s. Marincovich (1977, p. 296) recognized the subgenus *Hypterita*, but it left it in *Polinices*. In addition to its characteristic and peculiar, thin, overhanging umbilical callus perched on the pillar-like funicle (Woodring, 1957, p. 92; Marincovich, 1977, p. 296), the type-species has a strong flexure to the growth line at the anterior edge of the flank (Figure 4.24). This flexure marks the outer (abaxial) side of a strong antispiral sinus. The flexure and sinus are typical of *Gyrodes* but not of *Polinices* or *Neverita*. Additionally, the growth line of *Hypterita* like that of *Gyrodes* is strongly prosocline. Assignment of *G.* (*H.*) *robsauli* n. sp. to this subgenus considerably extends the geologic range of *Hypterita*. Woodring assigned only two species to *Hypterita*—"Neverita" *helicoides*, a Holocene species which Woodring recognized from the Gatun Formation, and "*N.*" *nereidis* Maury,

1917, from the Cercado Formation. He considered both these fossil occurrences to be Miocene in age.

Hypterita may possibly derive from *Sohlella* by way of *G.* (?*S.*) *banites*, but *G.* (?*S.*) *banites* is closer to *Sohlella* than to *Hypterita*, and forms intermediate between *banites* and *G.* (*H.*) *robsauli* are not yet known.

GYRODES (HYPTERITA) ROBSAULI n. sp.

Figure 4.11–4.14, 4.16–4.19,
4.21–4.23

Description.—Shell thin, small to medium sized; spire about 23% of total height; suture appressed, near posterior three-tenths of penultimate whorl; shoulder obscure, with slight concave band adapically; whorl profile evenly convexly rounded; umbilical margin sharply biangulate in juveniles, obscurely biangulate in adults, outer angle stronger; umbilicus moderately wide, steeply sloping with a narrow funicle; growth line obliquely prosocline with an antispiral sinus within the umbilical depression; aperture oblique, subovoid; outer lip thin, projected posteriorly; inner lip wrapped onto the penultimate whorl at or just outside the outer umbilical angulation, thin anteriorly and posteriorly, reflected medially to form a small, thin, overhanging callus tongue with a concave surface.

Holotype.—UCLA 59782.

Paratypes.—UCLA 59783–59784 from UCLA loc. 5902, Anticline Ridge, Fresno Co.; UCLA 59786 from UCLA loc. 6465, Los Gatos Creek, Fresno Co.; UCLA 59790 from UCLA loc. 6337, Hancock Ranch, Monterey Co., California; and UCLA 59787–59789 from UCLA loc. 6534, Arroyo Santa Catarina, Baja California, Mexico.

Type locality.—UCLA 5902: Anticline Ridge, Joaquin Rocks Quadrangle, Fresno Co., California.

Distribution.—Garzas Sand in the Orestimba Quadrangle, Stanislaus Co.; Tierra Loma Shale member of Moreno Formation in the Ortigalita Peak Quadrangle, Merced Co.; "Ragged Valley Shale"? = Uhalde Shale of Panoche Group, north of Coalinga, Fresno Co.; Panoche Group on Hancock Ranch, Monterey Co., California; Rosario Formation at Arroyo Santa Catarina, Baja California, Mexico.

Age.—Early Maastrichtian, *Pachydiscus*

(*Neodesmoceras*) *catarinae* Zone, and mid Maastrichtian, *Baculites columna* Zone.

Remarks.—*Gyrodes* (*H.*) *robsauli* is based upon about 50 specimens, most of which are small. Half are from UCLA loc. 6534 on the west side of Arroyo Santa Catarina, Baja California, Mexico. Two poorly preserved specimens from mid Maastrichtian localities in the Ortigalita Peak Quadrangle are probably this species, as are specimens from the Garzas Sand along Orestimba Creek, Stanislaus Co., California.

The umbilical callus of *G. (H.) robsauli* resembles that of *Hyperita*. It is thin, perched atop a pillar-like funicle, and has a concave surface. *Gyrodes* (*H.*) *helicoideus* (Gray, 1825) is a much larger, more widely expanded shell, and its basal antispiral sinus overlaps slightly onto the flank rather than being confined to the umbilical depression. The surface of *G. (H.) robsauli* is strongly textured by growth lines as is that of *G. (H.) helicoideus*. Only the specimen of *G. (H.) robsauli* from Hancock Ranch (Figure 4.19) has a shell surface well enough preserved to show microscopic spiral stria similar to those of *G. (H.) helicoideus* (Figure 4.20). Juvenile *G. (H.) robsauli* have a strongly biangulate umbilicus. The inner angulation is early subdued, and the outer angulation migrates flankward but never achieves the position of the growth-line flexure of *G. (H.) helicoideus*.

Gyrodes (*H.*) *robsauli* resembles *G. (?Sohl-ella)* *banites* in having a tongue of callus overhanging the umbilicus, but in none of the available specimens is the callus tongue as large as on typical *G. (?S.) banites*. The whorl profile of *G. (H.) robsauli* differs from that of all *Sohlella* in being evenly rather than obliquely convex and in having the anterior lip concavely curved rather than straight. The umbilical angulations and shoulder tabulation of *G. (H.) robsauli* are stronger than are those of *G. (?S.) banites*. The inception of the callus tongue is earlier in *G. (?S.) banites*, and its development is similar to that in *G. (S.) quercus*. In juvenile *G. (H.) robsauli*, however, the inner lip is wrapped onto the previous whorl between the outer and inner umbilical angulations (Figure 4.14) and migrates outward (Figure 4.12, 4.13).

The species is named for Robert L. Saul who braved tall, dry herbs and cacti to help collect specimens.

?Group of *GYRODES AMERICANUS*

(Wade, 1926) Sohl, 1960

GYRODES s.l. *ONENSIS* n. sp.

Figure 4.3, 4.4, 4.6, 4.9,
4.10, 4.15

Natica (*Gyrodes*) *conradiana* (Gabb). ANDERSON, 1958, p. 149, Pl. 21, figs. 2, 3 [not ?*Lunatia* (*Gyrodes*?) *conradiana* Gabb, 1864].

Ampullina avellana (Gabb). ANDERSON, 1958, p. 151, Pl. 4, figs. 2, 4 [not *Lunatia avellana* Gabb, 1864].

Description.—Shell moderately thick, medium sized, globular, wider than high; spire about 22% of total height; suture appressed on early whorls, becoming incised, near posterior third of penultimate whorl; shoulder slightly tabulate on early whorls, becoming rounded; whorl profile well rounded; umbilical margin angulate on early whorls, becoming subrounded; umbilicus moderately wide, round, steeply sloping; growth line obliquely prosocline with a small posterior antispiral sinus at the shoulder and a broad anterior antispiral sinus just within the umbilicus; aperture moderately oblique, semicircular, rounded anteriorly and angulate posteriorly; outer lip thin; inner lip thin, slightly reflected posteriorly, wrapped onto the last whorl at the outer umbilical angulation.

Holotype.—CAS 10646.

Paratypes.—CAS 10647 from CAS loc. 1346A; CAS 10776 (hypotype of *Ampullina avellana* of Anderson attached to holotype of *Pervinqueria sylvana* Anderson = *Mortoniceras gainesana* (Anderson, 1958) fide Murphy and Rodda, 1960, p. 855) from CAS loc. 1346; UCLA 59791 and 59802 from UCLA loc. 3778, Huling Creek, Tehama Co., California.

Type locality.—CAS loc. 1346A. In the California Academy of Sciences locality book CAS loc. 1346 = mouth of Huling Creek, Shasta Co., California, where it enters Cottonwood Creek, and CAS loc. 1346A = 1 mile (1.6 km) above the mouth of Huling Creek, Basal Chico Zone. But Anderson (1958) describes these localities as above (various distances) and below the mouth of Huling Creek on Cottonwood Creek or on Huling Creek. Murphy and Rodda (1960, p. 856) found *Mortoniceras gainesiana* (Anderson, 1958) only in the nodular limestone clasts from the lowest conglomerate unit of the Bald Hills

TABLE 10—Dimensions of *Gyrodes* s.l. *onensis* n. sp., 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
CAS 10646	38.0*	46.7	9.8	18.8	8.0	1.23	0.26	0.49	0.21	0.43
CAS 10647	21.4	24.0	3.6	10.4	2.6	1.12	0.17	0.49	0.12	0.25

Member exposed on the North Fork of Cottonwood Creek, Shasta Co., California. They collected two specimens of *G. onensis* at UCLA loc. 3778 in the Bald Hills Member (5 feet above the basal conglomerate) on Huling Creek. Murphy (personal commun.) places CIT loc. 1345 in the lowest conglomerate and CIT 1346A probably in the conglomeratic sandstone just downstream of East Fork of Huling Creek.

Distribution.—Chickabally? and lower Bald Hills Members of the Budden Canyon Formation, Ono area, Tehama and Shasta Counties; below the base of the Venado Formation, near Sites, Colusa Co., California.

Age.—?Early Albian to ?early Cenomanian.

Remarks.—Only eight specimens are identified as *G. onensis*. The holotype is the specimen figured by Anderson (1958, Pl. 21, fig. 2), and is probably of late Albian age. A broken specimen lacking much of its shell, from the early Albian *Leconteites lecontei* Zone (UCLA loc. 2874), is probably this species, as is one from the mid Albian *Oxytropidoceras packardii* Zone (UCLA loc. 3382) that is small for the species and somewhat crushed. A slightly smaller and more broken specimen from below the base of the Venado Formation near Sites, Colusa Co., California, has the well rounded whorls and slightly tabulate spire of this species. It bears California State Mining Bureau number 12787, and if collected with the California State Mining Bureau specimen of *Yaadia leana* (Gabb, 1864) numbered 12784 is probably of Cenomanian age (Saul, 1978, p. 38). Two paratypes are from the basal Bald Hills Member of the Budden Canyon Formation on Huling Creek (UCLA loc. 3778) and are of late Albian age (Murphy and Rodda, 1960; Murphy et al., 1969).

Gyrodes onensis resembles *Natica conradi* and *N. conradi* *vacculae* in size and globular shape, but lacks a funicle in the umbilicus. Its growth line is more like that of

Gyrodes s.s., as is its shallowly sloping umbilicus. Of the three groups defined by Sohl (1960), *G. onensis* is most similar to that of *G. americanus* (Wade, 1926). It resembles *G. depressus* Meek (1876, p. 159) and *G. depressus* Meek of Stanton (1893, p. 135) from the Western Interior Turonian but appears to have a lower spire.

The species is named for its occurrence in the Ono area west of Redding, Shasta Co., California.

GYRODES s.l. sp.

Discussion.—Four small specimens from CIT loc. 1346, Little Cow Creek, Redding area, Shasta Co., California, have umbilical characteristics of this group. These immature specimens from the Turonian Melton Sandstone have a slightly more expanded whorl than does *G. onensis*. The material is inadequate to serve as the basis of a new taxon.

Subfamily NATICINAE Forbes, 1838

Discussion.—Naticinae differ from other naticids in possessing calcareous rather than corneous opercula (Wenz, 1941; Cernohorsky, 1971; Marincovich, 1977; and others), but opercula are unknown for most fossil naticids. Wenz mentions the presence of strong color markings as characteristic of the subfamily, but cool water Naticinae lack such markings.

Genus NATICA Scopoli, 1777

Type species.—*Nerita vitellus* Linnaeus, 1758, by subsequent designation Anton, 1839, p. 31.

Discussion.—The genus *Natica* has a calcareous operculum. It has been subdivided into a number of subgenera, largely upon opercular characteristics. We have no opercula associated with the specimens we propose to include in *Natica*, and must consider them *Natica* s.l. despite the short collabral grooves on the shoulder of *Natica conradi* *vacculae*, which suggest *Naticarius* Dumaril.

These forms have been previously called *Gyrodos allisoni* Murphy and Rodda, *G. conradiana* (Gabb), and *G. siskiyouensis* Anderson. The funicle and the color markings present on well-preserved specimens of "*G.*" *conradiana* [= "*G.*" *siskiyouensis*] and *N. conradiana vacculae* n. subsp. suggest the inclusion of these forms in *Natica*. The pattern of these markings is similar to those of several Recent tropical *Natica* spp., e.g., *N. marochiensis* Gmelin, 1791, *N. gaultieriana* Recluz, 1844, and especially *N. chemnitzii* Pfeiffer, 1840. The umbilicus of these Cretaceous forms is unusually wide for *Natica*, but the shell is slightly thicker than that of most West Coast *Gyrodos*, and they lack the strong antispiral sinus to the growth line within the umbilical depression so characteristic of *Gyrodos*.

Gyrodos allisoni is included with *G. conradiana* and *G. conradiana vacculae* because its umbilicus resembles theirs in having the inner angulation strong and overhanging the very steeply sloping umbilical walls, and its growth line lacks the antispiral sinus within the umbilical depression.

?NATICA ALLISONI
(Murphy and Rodda, 1960)
Figure 7.1, 7.2, 7.5

Gyrodos allisoni MURPHY AND RODDA, 1960, p. 842, Pl. 101, figs. 19, 20.

Holotype.—UCLA 28629.

Paratype.—UCLA 28639.

Hypotype.—UCLA 59792 from UCLA loc. 4669: Camp Creek, Crook Co., Oregon.

Dimensions of hypotype.—In mm, * incomplete; h, 20.5*; w, 20.5; s, 6*; p, 8.9; e, 4.7; w/h, 1.0; s/h, 0.29; p/h, 0.43; e/h, 0.23; e/p, 0.53 (see Figure 2 for explanation of measurements).

Type locality.—UCLA loc. 3464: near the Gas Point Road, 1,900' S, 1,600' E of NW cor. sec. 16, T30N, R6W, Ono Quadrangle, Shasta Co., California.

Distribution.—Budden Canyon Formation, Bald Hills Member, Shasta Co., California; Camp Creek, Dayville Quadrangle, Crook Co., Oregon.

Age.—Cenomanian.

Remarks.—?Natica *allisoni* does not belong to any of Sohl's three groups of *Gyrodos* nor can it be placed in *Sohlella* or *Hypterita*.

Its umbilical characteristics differ from those of all five of these *Gyrodos* groups; its growth line lacks the gyroline antispiral sinus within the umbilical depression and is not as strongly prosocline on the flank. Although small to medium sized specimens have a doubly angulate umbilicus, as described by Murphy and Rodda (1960, p. 842), the outer angulation becomes rounded on specimens larger than any studied by Murphy and Rodda. The inner angulation remains strong and forms a slightly overhanging rim to the very steeply sloping umbilicus. Except for the absence of a funicle this umbilicus resembles that of *N. conradiana* and *N. conradiana vacculae*. Although we agree with Wrigley (1949) and Marincovich (1977) that umbilical characteristics are important in making generic assignments, some of these characteristics are inconstant; the funicle is variably present in *N. conradiana vacculae* (Figure 7.9, 7.10). The growth line of ?*N. allisoni* is similar to that of *N. conradiana* and *N. conradiana vacculae*. The shoulder tabulation of ?*N. allisoni* becomes rounded on larger specimens and the suture changes from appressed to depressed. The striations on the shoulder resemble those of *Natica conradiana* and *N. conradiana vacculae* n. subsp., but these two have a wider umbilicus and more expanded whorl, in addition to an umbilical plug.

NATICA CONRADIANA (Gabb, 1864)
Figure 7.4, 7.7, 7.8, 7.11,
7.13–7.15, 7.17–7.19

?*Lunatia* (*Gyrodos*?) *conradiana* GABB, 1864, p. 107, Pl. 29, fig. 219.

Gyrodos conradiana (Gabb). GRABAU AND SHIMER, 1909, p. 721; STEWART, 1927, p. 329, Pl. 22, fig. 2; SHIMER AND SHROCK, 1944, p. 483; SCHENCK AND KEEN, 1940, p. 26, Pl. 18, fig. 10; ANDERSON, 1958, p. 149 [in part, not Pl. 21, figs. 2, 3 = *G. onensis* n. sp.].

Gyrodos siskiyouensis ANDERSON, 1902, p. 76, Pl. 8, figs. 167, 168; ANDERSON, 1958, p. 150, Pl. 21, figs. 6, 7.

Not *Gyrodos conradiana* (Gabb). JONES, SLITER, AND POPENOE, 1978, p. XXII. 10, Pl. 1, figs. 16, 17 = *N. conradiana vacculae* n. subsp.

Description.—Shell of average thickness, medium sized to large; spire about 23% of total height; suture appressed becoming moderately incised, at posterior two-fifths of whorl; shoulder rounded; whorl profile well



FIGURE 7 — All figures $\times 1$ except as noted. 1, 2, 5, ?*Natica allisoni* (Murphy and Rodda, 1960), hypotype, UCLA 59792 from UCLA loc. 4669, Cenomanian. 3, 6, 9, 10, 12, 16, *Natica conradiana vacculae* n. subsp., Turonian; 3, 6, 12, holotype, UCLA 59796 from CIT loc. 1195; 3, $\times 2$; 9, paratype, UCLA 59800 from CIT loc. 1446; 10, paratype, UCLA 59799 from CIT loc. 1440; 16, paratype, UCLA 59801 from UCLA loc. 4416, relict color markings. 4, 7, 8, 11, 13, 17–19, *Natica conradiana* (Gabb, 1864), Turonian; 4, 7, 8, 11, 13, 17–19, hypotypes; 17, showing spiral sculpture, $\times 2$; 4, 7, 18, from CAS loc. 446; 4, CAS 61405, $\times 2$; 7, 18, CAS 61404; 8, 19, UCLA 59794 from CIT loc. 1532; 11, 13, 17, UCLA 59793 from CIT loc. 1264; 14, 15, lectotype, ANSP 4255 from San Luis Gonzaga Ranch, Merced Co., Calif.

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 somewhat prosocline, bending across the shoulder to become orthocline; 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 incised lines strongest on the shoulder; remnant color markings of zig-zag prosocline stripes.

Lectotype (here designated). — ANSP 4255. Gabb's original material of *Natica conradiana* consisted of two incomplete specimens from San Luis Gonzaga Ranch in Pacheco Pass, Merced Co., California. He designated neither as holotype. The larger of these two syntypes (UCBMP 31411; height, incomplete, 38.8 mm) was listed as "type material" by Merriam (1895) and was erroneously referred to as the holotype by Stewart (1927). It is essentially a steinkern and could not have provided Gabb with the growth lines or whorl shape present in his drawing, and it is noticeably larger than Gabb's drawing which is said to be "natural size." As this specimen cannot have been the sole basis for Gabb's illustration, there was no reason to consider it the holotype. Its lack of shell renders it of little use as a reference for precise identification of species, and it would be a poor choice for lectotype. Furthermore, although Stewart designated other lectotypes in the same paper, he indicated this one as holotype, suggesting that he mistakenly believed it to be such, and was not designating it as lectotype.

The smaller specimen (ANSP 4255; height, incomplete, 35.3 mm) was figured by Stewart (1927; reprinted by Schenck and Keen, 1940). Although considered poorly preserved by Stewart, it is much the better of the two specimens, retaining enough of the shell to indicate the whorl profile, path of the growth line, and presence of striations on the shoulder. The cleaned umbilicus has a funicle. Additionally, this specimen is as close in size to Gabb's drawing as can be expected considering Gabb's propensity for idealization and reconstruction. Gabb must have relied heavily

on this specimen for his drawing; but, as the umbilical area and inner lip were covered by matrix, he presumably based his open umbilicus on that of the steinkern (UCBMP 31411). As neither of Gabb's specimens can be considered to be the holotype as discussed above, and neither has previously been chosen as lectotype, the more complete specimen (ANSP 4255) is designated as lectotype.

Lectoparatype. — UCBMP 31411.

Hypotypes. — UCLA 59793 from CIT loc. 1264; UCLA 59794 from CIT loc. 1532; UCLA 59795 from CIT loc. 1042; CAS 61404–61405 from CAS loc. 446; and CAS 41 (=holotype of *Gyrodontes siskiyouensis* Anderson).

Type locality. — San Luis Gonzaga Ranch, Pacheco Pass, Merced Co., California; of *G. siskiyouensis*, 4 miles southwest of Ashland, Jackson Co., Oregon.

Distribution. — Panoche Formation, Diablo Range; Hornbrook Formation, Siskiyou Co.; upper Frazier Silt and Melton Sandstone, Shasta Co., California; Hornbrook Formation, Jackson Co., Oregon.

Age. — Late Turonian, with *Subprionocyclus neptuni* (Geinitz) and *S. normalis* (Anderson).

Remarks. — Gabb's specimens are not well-preserved, but indications of spiral sculpture on the shoulder and the strong funicle of the lectotype suggest that it and *G. siskiyouensis* Anderson are conspecific. It has a diameter of 35+ mm and is larger than most of the specimens from the Hornbrook Formation. Fewer specimens of *N. conradiana* than of the subspecies *N. conradiana vacuolae* were available for study. The largest collections of this species are from Siskiyou Co., California, and Jackson Co., Oregon. Both specimens upon which relict color markings can be discerned are from Rancheria Gulch, Hornbrook Quadrangle, Siskiyou Co., California. A specimen (Figure 7.7) from 4 miles (6.4 km) south of Ashland, Oregon, appears never to have had spiral grooves. It also lacks a well-defined funicle (Figure 7.18). Sculpture on a specimen (Figure 7.8) from Salt Creek, Millville Quadrangle, Shasta Co., California, has been virtually obliterated by endolith burrows, but the specimen has the most nearly complete outer lip available. In the absence of the spiral sculpture it is difficult to differ-