

Explanation of Figures 19 to 26

All figures  $\times 1$ ; all specimens coated with ammonium chloride.

Figures 19–24. *Confusiscalca? sulfurea* sp. nov. Figures 19, 20: CAS cat. no. 66549.01 from CAS loc. 66549, holotype; Figure 19, aperture; Figure 20, back. Figures 21, 22: LACMIP cat. no. 11544 from UCLA loc. 7233, paratype; Figure 21, apertural side; Figure 22, back. Figures 23, 24: LACMIP cat. no. 11545 from UCLA loc. 4252, paratype; Figure 23, aperture; Figure 24, back.

Figures 25, 26. *Confusiscalca? juvenca* sp. nov. Figures 25, 26: LACMIP cat. no. 11543 from LACMIP loc. 10735, holotype; Figure 25, apertural side; Figure 26, back. Photographs, 19–24 by De Leon; 25, 26 by Susuki.

the superfamily Janthinoidea, Lamarck, 1812, which they place near the end of the Mesogastropoda.

#### Genus *Confusiscalca* de Boury, 1909

Type species: by original designation and monotypy, *Scalaria dupiniana* d'Orbigny, 1842, from Aube, France, of Albian age.

*Confusiscalca* was originally considered to be a subgenus of *Amaea* by DE BOURY (1909). It has continued to be treated as a subgenus by several workers, including STEWART (1927), who placed it as a subgenus of *Epitonium* Röding, 1798, WENZ (1940) as a subgenus of *Amaea* H. & A. Adams, 1853, and DURHAM (1937) as a subgenus of *Opalia* H. & A. Adams, 1853. GARDNER (1876) had included *Scalaria dupiniana* and its allies in *Opalia*, and

the two species described here resemble *Opalia*. *Confusiscalca? juvenca* is as similar to *Opalia* as to *Confusiscalca*.

COSSMANN (1912:73) considered *Confusiscalca* a full genus and characterized it as having axial ribs and varices that do not cross the basal cord, which is visible on the spire supradjacent to the suture. The axial ribs are not always aligned with ribs of adjacent whorls, and they are posteriorly somewhat reflected toward the basal cord. Whorl sides are completely overrun by fine spiral threads. The base is rather flat and circumscribed peripherally by the somewhat projecting basal cord against which the axial ribs abut. The basal disk is ornamented by fine spiral threads and crossed by radiating slightly sinuous growth lines. The aperture has a small posterior canal against the basal cord of the penultimate whorl.

COSSMANN (1912) listed occurrences of species referred to *Confusiscalca* from nearly all continents, but the genus has apparently not been recognized in the Western Interior, Atlantic, and Gulf Coast Cretaceous faunas of the United States. The genus ranges from Neocomian (GARDNER, 1876) through Maastrichtian.

*Confusiscalca? sulfurea* Saul & Popenoe, sp. nov.

(Figures 19–24)

*Opalia (Confusiscalca) mathewsonii* (Gabb)?: DURHAM, 1937: 504, pl. 56, fig. 23.

**Diagnosis:** A medium-sized *Confusiscalca* with axial ribs that extend from suture to basal cord and increase gradually in number, 12 on the fifth whorl and 19 on the 12th whorl; basal cord variably exposed on spire.

**Description:** Shell medium sized, turreted; pleural angle about  $24^\circ$ ; whorls 12, moderately convex, width more than twice height; sutures impressed, not always anterior to the basal cord; basal disk flattened, bordered peripherally by a strong cord and centrally by a low swelling about an indistinct umbilical depression. Whorl sides sculptured by strong, scarcely sigmoid, swollen, round crested axial ribs, overridden by fine spiral threads; ribs just reaching the posterior suture and terminating at the basal cord, nearly aligned with ribs of adjacent whorls, but not confluent, 12 ribs on fifth whorl, 19 ribs on twelfth whorl; rib interspaces round bottomed, about equal in width to the ribs; spiral sculpture of low, spaced, spiral threads of alternating strength; base with fine more closely spaced nearly equal spiral threads; growth line a little prosocline at the suture, broadly barely concave medially. Aperture subquadrate; inner lip narrow, a little thickened.

**Holotype:** CASG cat. no. 66549.01 (= CASG cat. no. 7010, DURHAM, 1937:pl. 56, fig. 23)

**Paratypes:** LACMIP cat. no. 11545 from UCLA loc. 4252, Ashland, Oregon; and 11544 from UCLA loc. 7233, Sulphur Creek, Redding quadrangle, Shasta Co., California.

**Dimensions:** See Table 3.

**Type locality:** CASG loc. 66549, Hagerdorn Ranch, 4 miles (6.4 km) northwest of Montague, Siskiyou Co., California.

**Distribution:** Hornbrook Formation, ?Osburger Gulch Member, near Ashland, Jackson Co., Oregon; Hornbrook Formation, ?Osburger Gulch Member, near Montague, Siskiyou Co.; Redding Formation, Bellavista Sandstone Member, Redding area, Shasta Co., California.

**Geologic age:** Turonian.

**Remarks:** Three species resembling *Confusiscala* have been described from the Pacific Slope Cretaceous faunas. The first of these, "*Scalaria*" *mathewsonii* Gabb, 1864, was referred to *Confusiscala* by STEWART (1927). It is based on a single, poorly preserved specimen consisting of four incomplete, partially exposed whorls, from "near Martinez," Contra Costa Co., California. Deposits "near Martinez" range in age from Albian to Maastrichtian. Preservation of the holotype of "*S.*" *mathewsonii* suggests that it is of Maastrichtian age. In *C.?* *sulfurea* the basal cord is less strong, the whorls are less convex, and the axial ribs are narrower with comparatively wider interspaces. If STEWART's (1927) estimate that *C.?* *mathewsonii* had about 12 axial ribs is correct, *C.?* *sulfurea* has the greater number of ribs.

The second species is *Mesostoma* (?) *newcombii* Whittes, 1903, from the Cedar District Formation of Sucia Island, San Juan Co., Washington. It is Campanian in age and differs from *Confusiscala?* *sulfurea* in its much larger size and relatively shorter whorl height. In *C. newcombii* axial ribs fade toward the posterior suture, creating a whorl profile that is broadest near its base, whereas *C.?* *sulfurea* has longer ribs and a more evenly rounded whorl profile.

The third and even larger species is *Cerithium suciense* Packard, 1922, described from a specimen consisting of two whorls (height 59 mm, diameter 44 mm) probably from the Cedar District Formation on Sucia Island, San Juan Co., Washington (UCB loc. 2209), which is of mid Campanian age. Another and larger specimen consisting of eight whorls (height incomplete 162 mm, diameter 56 mm) is available from that part of the Chatsworth Formation in the Simi Hills yielding *Metaplacenticeras* aff. *M. pacificum* (Smith, 1900). *Confusiscala suciense* is from the *Hoplitoplacenticeras vancouverense* to *Metaplacenticeras pacificum* zones and of mid to late Campanian age. *Confusiscala?* *sulfurea* is much smaller than *C. suciense* and lacks the strong posterior growth line sinus just subjacent to the suture.

The holotype of *Confusiscala?* *sulfurea* was described as being "from the upper Chico beds," reflecting common usage 60 years ago, but the Cretaceous strata near Montague are now referred to as the Hornbrook Formation. Present in the matrix of the holotype are specimens of

Table 3

Measurements (mm) of *Confusiscala?* *sulfurea* sp. nov. and *C.?* *juvenca* sp. nov.

	H	D	Hp	Dp	A	R	Dp/ Hp
<i>C.?</i> <i>sulfurea</i>							
CASG 66549.01	51.3	19.0	8.5	14.4	22°	19	1.7
LACMIP 11544	45.8	14.6†	7.5	9.4†	21°	13	1.2
LACMIP 11545	27.2	12.5	5.6	10.5†	26°	13	1.9
<i>C.?</i> <i>juvenca</i>							
LACMIP 11543	27.4	10.9	5.0	8.9	31°	10	1.8

\* Specimen incomplete; † specimen crushed. Abbreviations decypted in Introduction.

*Turritella hearni* Merriam, 1941, a species of Turonian age that is present in the lower Hornbrook Formation.

*Confusiscala?* *sulfurea* is not a typical *Confusiscala*. Its axial ribs, like those of *C.?* *mathewsonii*, extend from the posterior suture to the basal cord, and it differs from *C. dupiniana* in having longer axial ribs and a more evenly rounded whorl profile.

**Etymology:** The species name *sulfurea* is Latin and refers to the occurrence of this species on Sulphur Creek, Shasta Co., California.

*Confusiscala?* *juvenca* Saul & Popenoe, sp. nov.

(Figures 25, 26)

**Diagnosis:** An *Opalia*-like epitioid with 10 to 12 strong, shouldered axial ribs per whorl and a strong basal disk; whorls overlain with fine cancellate sculpture produced by fine spiral threads and growth lines.

**Description:** Shell of medium size, turreted; pleural angle about 30°; whorls eight or nine in number, moderately convex, width about twice height; sutures deeply impressed; basal disk flattened, a little concave, bordered peripherally by a thick and rounded cord; no umbilicus. Whorl sides sculptured; axial sculpture of 10 to 12 nearly straight, slightly oblique, swollen, round-crested ribs, shouldered at the posterior suture, abruptly terminating at the basal cord, and nearly or quite in alignment with the ribs of adjacent whorls, but not confluent; rib interspaces round bottomed, equal in width to the ribs; spiral sculpture of low, faint, rather widely spaced spiral threads alternating with finer spiral threads and crossed by growth lines producing an overall finely cancellate appearance, extending over the basal disk; growth line with a shallow (about equal to 1/2 the axial rib thickness) but well-marked sinus at the shoulder. Aperture probably almost quadrate with a spoutlike extension at its inner anterior border and a posterior notch at the shoulder; inner lip thin, narrow, reflected onto base; outer lip unknown.

**Holotype:** LACMIP cat. no. 11543.

**Dimensions:** See Table 3.

**Type locality:** LACMIP loc. 10735 (= CIT loc. 1212), Little Cow Creek, 2 miles (3.2 km) NE of Frazier Corners, Shasta Co., California.

**Distribution:** Redding Formation, Frazier Siltstone Member, Redding area, Shasta Co., California.

**Geologic age:** Turonian.

**Remarks:** *Confusiscala? juvenca* differs from *C.? sulfurea* in having strongly shouldered and straighter axial ribs, fewer, more irregular spirals on its basal disk, a posterior growth line sinus, and the suture posterior to the basal cord so that the basal cord does not show on the spire. In *C.? juvenca* the growth line has a posterior notch like that of *C. suciensis*, but the ribs are much straighter and longer, extending from the shoulder to the basal cord without diminished strength.

*Confusiscala? juvenca* has many of the characteristics of the genus *Opalia* (type species *Opalia australis* (Lamarck, 1822)), but differs in at least two respects: *C.? juvenca* has a well-marked but shallow posterior sinus to the growth line at the shoulder, and *C.? juvenca* apparently lacks the spiral bands of punctations of *Opalia*. Although the holotype of *C.? juvenca* appears well preserved, recrystallization and mineralization of the specimen may have obscured some details, and such details as punctations could be obscured. This species is geologically older and more strongly shouldered than the Maastrichtian, Gulf Coast species assigned to *Opalia* by SOHL (1964).

**Etymology:** The species name *juvenca* is Latin, meaning young, and refers to the occurrence of this species in the Little Cow Creek drainage.

Order NEOGASTROPODA Thiele, 1929

Superfamily MURICACEA Rafinesque, 1815

Family SARGANIDAE Stephenson, 1923

STEPHENSON (1923) proposed the new family Sarganidae to contain *Sargana* Stephenson, 1923, distinguishing it from Muricidae on the basis of the columellar folds and the flattened spire. SOHL (1964:173) and WENZ (1941:1082) have placed *Sargana* in the subfamily Rapaninae of the family Muricidae, but PONDER & WARÉN (1988) included Rapaninae in the Thaidinae and recognize Sarganinae. The placement of *Sargana* and of Sarganinae in Muricidae is questioned by GARVIE (1991), who quotes uncompleted work on protoconchs by Klaus Bandel as indicating that *Sargana* is a close relative of *Trichotropis*, and this placement was abrogated by GARVIE (1992), who places *Sargana* without attribution or mention of morphological criteria in the Cancellariidae. The spiny shell of *Sargana* does not resemble that of *Trichotropis*. In several features—pyriform shape, flattened protoconch, complex spiny sculpture—*Sargana* resembles *Pyropsis* Conrad, 1860, which

STEPHENSON (1941) placed in the Pyropsidae. SOHL (1964) considered the separation of the Pyropsidae as a family too drastic and left it in the Vasidae H. & A. Adams, 1853, but SAUL (1988) included *Pyropsis* in Tudicidae Cossmann, 1901, placing it in the superfamily Muricacea. In shape and placement of the posterior siphonal notch, the aperture of *Sargana* resembles that of tudicids more than it does that of muricines. The aperture does not resemble that of trichotropids, and unlike the many muricines that have a posterior outer lip sinus at the shoulder rather than against the body whorl, the Sarganidae have a well-developed posterior sinus against the body whorl. The aperture of *Sargana* also differs from that of cancellariids in forming a narrow, constricted anterior canal that is abruptly confined posteriorly, whereas in cancellariids the anterior canal is typically broad and not confined at its apertural junction.

*Praesargana* Saul & Popenoe, gen. nov.

Type species: *Trophon condoni* White, 1889.

**Diagnosis:** Small, very low-spired sarganids with moderate, laciniate anterior siphon, and a shallow umbilical depression bounded by a roughened fasciole. Outer lip bearing a tubercle opposite the spiral fold of the inner lip. Siphonal canal short and bent to the left.

**Discussion:** *Praesargana* lacks the deep spiral sulcus at the base of the body whorl of *Sargana*. It has finer, more regular, and nodular rather than spinose sculpture; a smaller and shallower umbilical depression; and a shorter, straighter and more open siphonal canal than *Sargana*.

The resemblance of *Praesargana* to *Sargana* suggests inclusion of *Praesargana* in the Sarganinae. The protoconch of *Praesargana* is paucispiral, consisting of but two rapidly expanding flattened, carinate whorls. Because the shells are recrystallized and entombed in tenacious, well-cemented matrix, any fine sculpture is as yet unknown. In shell form and sculpture *Praesargana* does not resemble *Trichotropis*. Although its anterior siphonal canal is broader than that of *Sargana*, the anterior canal of *Praesargana* is abruptly confined posteriorly and much narrower than that of cancellariids.

The generic name is compounded of *Sargana*, derived from the Greek *sargane*, meaning braid, plait, basket, and the Latin prefix *Prae*, meaning before, and is of feminine gender.

*Praesargana condoni* (White, 1889)

(Figures 27–37)

*Trophon condoni* WHITE, 1889:21, pl. 3, figs. 4–5; ANDERSON, 1958:168; JONES, SLITER & POPENOE, 1978:xxii.9, pl. 1, figs. 8–9.

**Diagnosis:** As for the genus.

**Description:** Shell small; spire very low; whorls rapidly expanding, roundly shouldered and convex posteriorly, be-

coming concave on the short broad siphonal neck; anterior end of siphon rounded and lacinate; suture appressed; ramp slightly concave; umbilical depression shallow, narrow, bounded by a roughened fasciole. Protoconch paucispiral, consisting of about two rapidly expanding, carinate whorls surrounding an apical dimple. Sculpture of about 12 strong, evenly spaced, rough, round-topped spiral cords crossed by about 20 nearly straight, collabral ribs, producing a coarse cancellate appearance, strong at the whorl shoulder, diminishing anteriorly, scarcely evident on the basal fourth of the last whorl. Aperture broadly subovate, its two lips, meeting by the thickening of each as the shell approaches maturity, extend back upon the ultimate volution; apertural callus at posterior juncture of inner and outer lips bearing a shallow siphonal groove extending spireward to the shoulder of the penultimate whorl; aperture sharply constricted at its passage into anterior canal by a projecting tubercle on the inner margin of the outer lip, opposing a similarly placed spiral fold on the inner lip; siphonal canal short, narrow, slotlike and strongly bent to the left, margins parallel.

**Syntypes:** USNM cat. no. 20122 (2 specimens).

**Hypotypes:** LACMIP cat. no. 10807 (= UCLA cat. no. 58443) from LACMIP loc. 10735 (= CIT loc. 1212), Little Cow Creek, 2 miles (3.2 km) northeast of Frazier Corners, Shasta Co.; LACMIP cat. no. 11546 from UCLA loc. 5422, Rancheria Gulch, Siskiyou Co.; LACMIP cat. no. 11585 from LACMIP loc. 10735 (= CIT loc. 1212), Little Cow Creek, Shasta Co.; LACMIP cat. no. 11586 from UCLA loc. 4214, Little Cow Creek, Shasta Co., California.

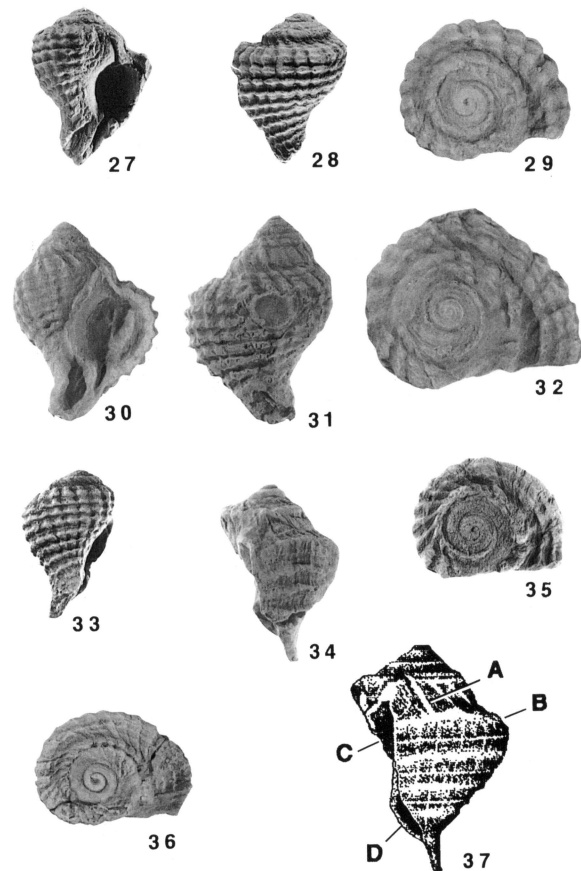
**Dimensions:** See Table 4.

**Type locality:** "Chico Group, Little Cow Creek Valley, about eighteen miles [29 km] east of Redding, Shasta County" (WHITE, 1889).

**Distribution:** Hornbrook Formation, Osburger Gulch Sandstone Member, Rancheria Gulch, Siskiyou Co.; common in sandstone lenses near middle of Frazier Silt Member of Redding Formation, Redding area, Shasta Co., California; reported from "Turonian of Putah Creek, near the Napa-Yolo County line" (ANDERSON, 1958:168).

**Geologic age:** Turonian.

**Remarks:** *Praesargana condoni* resembles *Sargana stantoni* (Weller, 1907), type species of *Sargana* from Maastrichtian of Gulf and Atlantic coasts, and *S. geversi* (Rennie, 1930) from Senonian of Pondoland, but *P. condoni* lacks their basal constriction. Its sculpture is less spiny than that of *S. stantoni*, and its protoconch is not as strongly carinate. It has more spiral cords on the ramp than *S. geversi* and fewer than *S. stantoni*. It also resembles "*Rapana*" *tuberculosa* Stoliczka (1868) from the Trichinopoly beds of South India, but differs from this species in its more abruptly constricted last whorl at the beginning of the siphonal



Explanation of Figures 27 to 37

All specimens coated with ammonium chloride; unless otherwise indicated figures are  $\times 1$ .

Figures 27–37. *Praesargana condoni* (White, 1889). Figures 27–29, 33: LACMIP cat. no. 10807 from LACMIP loc. 10735, hypotype; Figure 27, aperture; Figure 28, back; Figure 29, apical view,  $\times 1.5$ ; Figure 33, left side. Figures 30–32: LACMIP cat. no. 11546 from UCLA loc. 5422, hypotype, specimen with rounded shoulder and higher spire; Figure 30, aperture; Figure 31, back; Figure 32, apical view,  $\times 1.5$ . Figures 34, 36, 37: LACMIP cat. no. 11586 from UCLA loc. 4214, hypotype; Figure 34, right side, showing bulging portion of last whorl; Figure 36, apical view, higher spired specimen than 11585 (Figure 35) and 10807 (Figures 27–29, 33). Figure 37, computer scan of Figure 34 enhanced through use of Canvas 3.0 to show position of present aperture edge, varix, and former position of posterior canal,  $\times 1.33$ ; A, varix with posterior sinus; B, shoulder; C, aperture, D, umbilical fasciole. Figure 35, LACMIP cat. no. 11585 from LACMIP loc. 10735, hypotype, apical view, showing suppression of axial ribbing and some bulging of whorl on last third of body whorl,  $\times 1.5$ . Photographs 27, 28 by Susuki; 29–36 by De Leon.

canal. *Praesargana condoni* is geologically older than these three species of *Sargana*.

*Praesargana condoni* is morphologically variable. The strength of the spiral cords varies from even to irregular with four commonly stronger, the shoulder cord and three alternate anterior cords (Figures 34, 37). The shoulder is