





locality, USGS 4615, near Zapata Creek, Fresno Co., considered by Arnold and Anderson (1910, p. 70) to be Eocene, is from the Cretaceous conglomerate. UCLA loc. 5523, one mile west of the Sargaser ranch house, sec. 13, T. 23 S., R. 16 E., Garza Peak quad., Kings Co., Calif., has a fauna very similar to CAS loc. 2365, and occurs in a Panoche formation conglomerate.

*C. suciensis* is rare to common at several localities in the Santa Ana Mountains, California. It is present in the upper half of the Holz Shale at CIT loc. 1168 in the *Turritella chicoensis* assemblage (Popenoe, 1942, p. 183) and at six localities in the *T. chicoensis perrini* assemblage of Popenoe (*ibid.*); and in a collection from the Schulz Member conglomerate. As mentioned in the discussion of *C. popenoei*, the *Hoplitoplacenticas vancouverense* zone of Sucia Island may be correlative with beds containing the *T. chicoensis perrini* assemblage of Popenoe, 1942.

Of the species discussed in this paper, *C. suciensis* is the most equilateral and for its size the most inflated *Cymbophora*. It is quite distinctive, the easiest of the eight species to recognize. Specimens that are unusually elongate and less inflated than usual approach *C. stantoni* in shape, but *C. suciensis* has closer spaced, rounder-topped ribs on the selenis and corcelet and a thicker shell. It is most similar to *C. triangulata* under which the differences between the two species are contrasted.

*Cymbophora suciensis* has been found most

abundantly in fine- to very fine-grained sandstones.

## CYMBOPHORA TRIANGULATA (Waring)

Pl. 1, fig. 12; Pl. 2, figs. 7-8; Pl. 3, figs. 11-12; Table 4

*Crassatellites triangulatus* Waring, 1917, p. 59, Pl. 9, fig. 1.

*Crassatellites uwasana* Gabb, Waring, 1917, p. 57, Pl. 8, fig. 10.

*Cymbophora ashburneri* (Gabb) POPENOE, 1937, p. 397, Pl. 49, fig. 1; KEEN, in MOORE, 1969, p. N598, fig. E93, 8; SAUL, 1973, Appendix A and B.

*Cymbophora ashburneri* (Gabb) SHIMER and SHROCK, 1944, p. 431, Pl. 171, fig. 27, not 26 (fig. 26 = *C. ashburneri* (Gabb)).

*Description.*—Shell of average size for the genus, thick, of average inflation, trigonal, longer than high. Beaks prominent, anterior margin straight, sloping steeply, curved abruptly at the anterior angulation; ventral margin smoothly curved, angled at the posterior angulation; posterior margin convexly curved; posterior angulation distinct but rounded. Surface of flank not ribbed but textured by growth lines and marked by impressed growth checks; selenis bounded by distinct depressed line and bend in growth lines, ribbed close to the beak by fine concentric ribs; marginward area of corcelet with coarser concentric ribs near the beak. Resilifer with a slightly raised ventral margin, not extending to the edge of the hinge plate. Hinge of right valve with 3a subpetaloid, close to and at a small angle to the valve margin, 3b longer than 3a, as long as the

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## EXPLANATION OF PLATE 3

All figures natural size.

- Figs. 1-2—*Cymbophora ashburneri* (Gabb). 1, Right valve, part of pallial sinus, hypotype (UCLA 48516). 2, Left valve, selenis and posterior slope, paralectotype (ANSP 4441a), photo by T. Susuki.  
 3-6—*Cymbophora stantoni* (Arnold). 3, Right valve, pallial sinus, hypotype (UCLA 48505); 5, selenis and posterior slope.  
 7-8—*Cymbophora buttensis* Anderson. 7, Left valve, selenis, hypotype (USNM 187735). 8, Right valve, hypotype (UCLA 48541).  
 9-10—*Cymbophora bella* n. sp. 9, Right valve, pallial sinus, paratype (UCLA 48536). 10, Left valve, anterior slope, holotype (UCLA 48533).  
 11-12—*Cymbophora triangulata* (Waring). 11, Right valve, hypotype (UCLA 48523). 12, Left valve, selenis, hypotype (UCLA 40664).  
 13-15—*Cymbophora popenoei* n. sp. 13, Right valve, holotype (UCLA 40665=CIT 3451). 14, Right valve, pallial sinus, paratype (UCLA 48496). 15, Left valve, selenis, paratype (UCLA 48492).

16—*Cymbophora bella* (Anderson). 16, Right valve, pallial sinus, hypotype (UCLA 6852).  
 17—*Cymbophora bella* (Anderson). 17, Right valve, pallial sinus, paratype (UCLA 32206) of holotype (UCLA 32206), photo by T. Susuki.

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FIGS. 3-6

— *Cymbophora stantoni* (Arnold). 3, Right valve, pallial sinus, hypotype (UCLA 48507); 4, Right valve, selenis and posterior slope, hypotype (UCLA 48505); 5, Right valve, selenis and posterior slope, paratype (UCLA 48502); 6, Left valve, selenis and posterior slope, paratype (UCLA 48502).

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TABLE 4—Measurements in mm of *Cymbophora triangulata* (Waring)

Cat. no.	H	L	T	H/L	T/L	S	S/L	RH	RW	RW/RH	Remarks
397	32	39	9	.82	.23						crushed
40664	32	42	10	.76	.24			3.5	2.4	.69	
48522								3	2	.67	
48523	27	35	8	.77	.23						
48524	18.5	23	7	.8	.3	13	.57				
48525	32	40	9	.8	.23	20	.5				

H=height of valve; L=length of valve; T=thickness of valve; S=length of pallial sinus; RH=height of resifer; RW=width of resifer.

width of the hinge plate; laterals sturdy, AI and PI ornamented by granulations which coalesce into squiggly lineations, AI with a deep, nearly vertical cusp in dorsal side and a sharp posterior nubbin, AIII shorter. Hinge of left valve with inverted V of 2b scarcely filled, 4b very thin, AII with two nearly vertical cusps on ventral side. Pallial sinus ascending, extending across  $\frac{2}{3}$ ths of the posterior portion of the shell.

*Holotype*.—LSJU cat. no. 397

*Hypotypes*.—UCLA cat. no. 40664 (Popenoe, 1937, pl. 49, fig. 1; Shimer and Shrock, 1944, pl. 171, fig. 27; Keen, in Moore, 1969, fig. E93, 8), CIT loc. 974, Santa Ana Mts.; UCLA cat. no. 48522, CIT loc. 976, Santa Ana Mts.; UCLA cat. no. 48523, UCLA loc. 4207, Santa Ana Mts.; UCLA cat. no. 48524, CIT loc. 976, Santa Ana Mts., UCLA cat. no. 48525, UCLA loc. 6019, Santa Monica Mts.

*Type locality*.—LSJU loc. 3, Chico Area south of the Santa Monica Mts. Extrapolation from Waring's map (1917, p. 51) suggests that this locality is in the vicinity of UCLA loc. 4439, Temescal Canyon, Topanga quad., Los Angeles Co., Calif.

*Age*.—Late Campanian, *Metaplacenticerus pacificum* zone; early Maestrichtian?

*Remarks*.—*Cymbophora triangulata* is usually present in collections from the beds containing *Metaplacenticerus pacificum* of the Santa Monica Mountains and the Simi Hills and the Pleasants Sandstone, Santa Ana Mountains, southern California. The badly crushed specimen figured as *Crassatellites wasana* Gabb by Waring is from Waring's loc. 3 and is probably *Cymbophora triangulata*. Large, poorly preserved specimens probably of this species were found at UCLA 4863, Rosario Formation, San Antonio del Mar, Baja California.

The hinge of *C. triangulata* has exemplified *Cymbophora* dentition since Popenoe figured (1937, Pl. 49, fig. 1, as *C. ashburnerii*) a specimen from the *Metaplacenticerus pacificum*

zone in the Santa Ana Mountains. This figure, reprinted by Shimer and Shrock (1944, Pl. 171, fig. 27), has been used by Keen (in Moore, 1969, fig. E93, 8) to typify the genus *Cymbophora*. However, the hinge of *C. ashburnerii* has more slender, finely granulated laterals, and anterior laterals AI and AII are more obviously colaminar than those of *C. triangulata*; the latter has a smaller resifer with a slightly raised ventral margin. Stephenson (1952, p. 120, 123) and Speden (1970, p. 128) compared hinges of specimens from Texas and South Dakota to Popenoe's figure without realizing that it was not *C. ashburnerii* and did not have laterals striated as in *Spisula*. Based apparently upon his study of "*Cymbophora warrenana*" (Meek and Hayden), Speden suggested that the rugose lateral teeth indicate a relationship of *Cymbophora* to *Spisula*, a relationship likely for the species studied by Speden and Stephenson but unlikely for West Coast *Cymbophora*.

*C. triangulata* is similar to *C. suciensis* (Text-fig. 4), but *C. triangulata* is the more elongate species (Text-fig. 3) and looks less equant; sculpture on the selenis is less persistent, only the third of the selenis near the beak being ribbed rather than most of the selenis as in *C. suciensis*; the pallial sinus is a little longer; and average sized specimens are larger with large specimens being at least double the size of large *C. suciensis*. *C. triangulata* is easily distinguished from *C. butensis* and *C. stantoni* in lacking the double fold on the corcelet and in having an abruptly sloping anterior margin. *C. triangulata* is more inflated and less elongate than *C. ashburnerii*.

*Cymbophora triangulata*, like *C. suciensis*, is most abundant in fine grained sandstone.

#### CYMBOPHORA GABBIANA (Anderson)

Pl. 1, figs. 16–18; Pl. 2, fig. 10; Pl. 3, figs. 16–17; Table 5

*Maetra gabbiana* Anderson, 1902, p. 74, Pl. 7, fig. 156.

species of <i>Cymbophora</i>	lateral teeth thickness	granulations	concentric ribbing	clearly demarked selenis	ascending or horizontal pallial sinus	characteristics in common
<i>C. ashburnerii</i>						} 5 } } 3
<i>C. stantoni</i>						
<i>C. buttensis</i>						
<i>C. triangulata</i>						} 4
<i>C. suciensis</i>						} 5 } } 4
<i>C. popenoei</i>						} 5 } } 4
<i>C. gabbiana</i>						} 5 } } 3
<i>C. bella</i>						} 5 } } 3

  

	Thin lateral teeth		Straight extension of ventral side of pallial sinus would lie <u>ventral</u> to anterior adductor muscle scar
	Thick lateral teeth		Straight extension of ventral side of pallial sinus would <u>intercept</u> or lie <u>dorsal</u> to anterior adductor muscle scar
	Fine granulations		
	Coarse granulations		

TEXT-FIG. 4—Tabulation of occurrence of relatively stable characteristics in eight species of *Cymbophora*. Each of the three pairs with five characteristics in common consists of a geologically older and younger species (Text-fig. 7). Pictograph considers only strong concentric ribbing of flank as some fine concentric ribbing of anterior and posterior slopes is omnipresent.

*Spisula* (*Cymbophora*) *gabbiana* (Anderson)  
 PACKARD, 1916, p. 299 (in part), Pl. 27, fig. 2  
 (repeat of Anderson).  
*Cymbophora gabbiana* (Anderson) ANDERSON, 1958,  
 p. 144.  
*Cymbophora* sp., SAUL, 1973, appendix A and B.

*Description.*—Shell of average size for the genus, very thick, of average inflation, an isosceles triangle in outline with the ventral side longest. Beaks prominent; anterior margin steeply sloping, straight or slightly concave, abruptly curved at the anterior angulation to the ventral margin; ventral margin smoothly arched, angled at the posterior angulation; posterior margin convexly curved; posterior angulation well-marked by broad, roughened welt. Surface of flank ornamented by well-developed, round-topped concentric ribs which are equal in width to the round-bottomed interspaces; selenis ornamented with regular concentric ribs fanning from beneath the beak, ribs stopping at impressed line bound-

ing the selenis, each rib rather regularly replaced by two ribs on the flank; marginward area of corcelet ornamented with coarser concentric ribs fanning from the beak to the posterior side of the broad welt-like, roughened posterior angulation.

Resilifer with a slightly raised ventral margin, not extending to the edge of the hinge plate. Hinge of right valve with 3a subpetaloid, at a small angle to the valve margin, 3b nearly twice as long as 3a, as long as the width of the hinge plate; laterals sturdy, AI and PI ornamented by granulations which tend to coalesce into squiggly lineations, AI with slightly bimodally curved profile and a shallow beakward slanting groove on the dorsal side, AIII nearly as long as AI. Hinge of left valve with inverted V of 2b nearly filled, 4b sturdier than usual in *Cymbophora*, AII short and stout with a steep nubbed posterior end, PII nearly twice as long as AII. Pallial sinus high, broad, ascending, extending