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LATE CRETACEOUS MOLLUSCA OF THE SIMI HILLS: AN INTRODUCTION

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ABSTRACT

Diverse but poorly described molluscan faunas from the eastern and western end of the Simi Hills provide a chronologic framework for the Chatsworth Formation. These faunas indicate an age range of late mid Campanian to early Maestrichtian. Ammonite zones recognized are the late Campanian *Metaplacenticeras pacificum* zone and the early Maestrichtian *Neodesmoceras catarinae* zone. The diversity is at least four times that previously reported. With the possible exception of near littoral assemblages from the massive sandstones at the eastern end of the Simi Hills, all molluscan faunas are normal marine, deep inner sublittoral, shelf assemblages.

INTRODUCTION

Mollusks are by far the most common megafossils in the Chatsworth Formation, and yet, considering the diversity present, relatively few of them have been recorded. The most comprehensive list is that of Popenoe, 1942. His check list indicates the presence of 29 species in the Simi Hills. We find that at least four times that many are present. About half are undescribed, the gastropods being more neglected than the bivalves. Although present, scaphopods have been completely neglected, a tradition we have continued. Cephalopods are less common than the gastropods and much less common and diverse than the bivalves. The greatest concentrations of molluscan fossils are in three areas: Bell Canyon and Dayton Canyon on the eastern end of the Simi Hills and Lang Ranch at the western end of the Simi Hills. Other areas have provided few or poorly preserved fossils. Important information, however, has been added to the study of the Chatsworth Formation by these less impressive fossil localities. Most of the material upon which the following bivalve and gastropod notes are based was collected by or at the instigation of W. P. Popenoe. Bivalve and gastropod data were compiled by L. R. Saul, the cephalopod data by J. M. Alderson.

We attempt in the following notes to inventory the molluscan fauna of the Chatsworth Formation in systematic order, providing, where possible, distributional data and inferences as to geologic age and ecologic habitat. Figure 1 provides geographic and stratigraphic orientation. All of the fossil localities are plotted on the Geologic Map (in pocket). The Campanian-Maestrichtian boundary in these notes is that of Jeletzky, 1970, and is between the *Metaplacenticeras pacificum* and *Neodesmoceras catarinae* zones. In terms of Goudkoff's foraminiferal zones, all mollusks, with the possible exception of those from Bell Canyon localities, are probably from within the E zone. We have not attempted to describe the 100+ species but provide differentiating characters for a few important species.

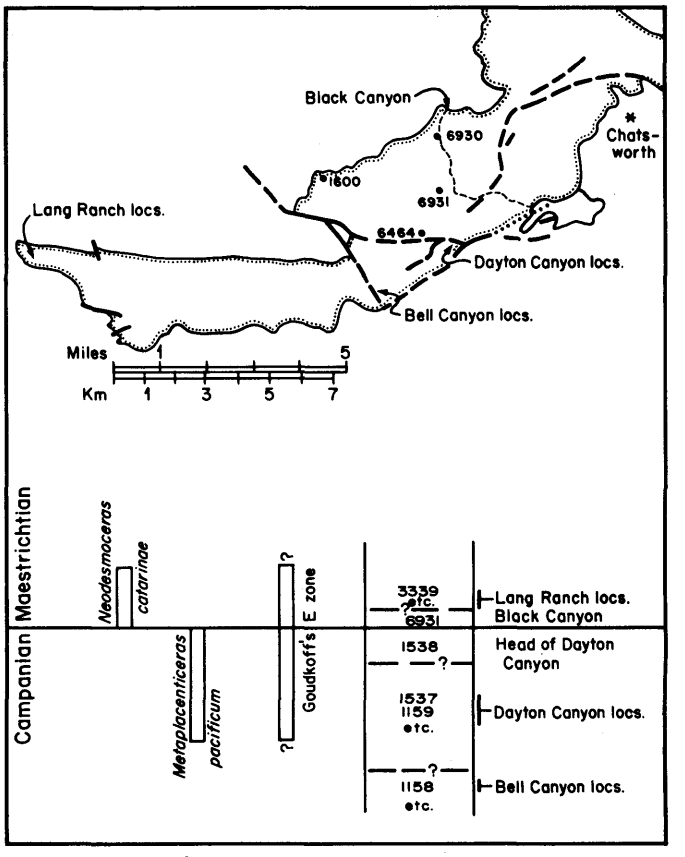


Figure 1. Outline of outcropping Chatsworth Formation from Jennings & Strand (1969) with major areas of fossil localities and some scattered localities plotted. For complete plot of localities see Squires this guidebook, Geologic Map in pocket. Fossil localities plotted on column in inferred stratigraphic order and related to Pacific Coast ammonite and benthic foraminifera zones.

Abbreviations used are: CAS = California Academy of Sciences; CIT = California Institute of Technology; LSJU = Stanford University; UCB = University of California, Berkeley; UCLA = University of California, Los Angeles.

SUMMARY

The molluscan fauna of the Simi Hills includes representatives of at least 25 bivalve families, 22 gastropod families, and 7 ammonite families. Even though the fauna has not been critically studied, it provides a means of dating the strata of the Chats-

in Link, M. H., Squires, R. L., and Colburn, I.P., eds., **Simi Hills Cretaceous Turbidites, Southern California**, Pacific Section, Society Economic Paleontologists and Mineralogists, Fall Field Trip Guidebook, pg. 29-42

worth Formation both as to regional correlation and internal chronology. The oldest known fossiliferous outcrops are of late mid Campanian age, the youngest of early Maestrichtian age based on ammonite zones. Regional correlations suggest that the upper part of Goudkoff's E zone includes the *Neodesmoceras catarinae* zone of Jeletzky. The bivalves and gastropods indicate an inner sublittoral habitat, probably the deeper portion, but still within the photic zone Some of the ammonites suggest deeper water.

BIVALVIA

Bivalve shells make up the bulk of the molluscan fossils, especially in the three areas from which abundant megafossils have been obtained. Most valves are disarticulated.

NUCULOIDA

The order Nuculoida is sparsely represented in the collections from the Chatsworth Formation by a few unidentified nuculanids from Bell and Dayton Canyon localities and the nuculid *Acila (Truncacila)* sp. *Acila (Truncacila)* sp. is found at several Dayton Canyon localities and at UCLA 6937, Black Canyon. There it occurs with *Indogrammatodon?* sp. indet., *Anomia?*, and *Baculites* cf. *B. rex* ANDERSON.

ARCOIDA

At least four arcoid families are represented in the Chatsworth Formation.

PARALLELODONTIDAE are common to abundant at Bell and Dayton Canyon localities and present at UCLA loc. 6937 in Black Canyon where thus far the fossils are too few and too poorly preserved to estimate abundance or identify with certainty. These parallelodontids have been referred to various supra-specific taxa including *Parallelodon*, *Grammatodon*, *Nanonavis*, and *Nemodon*, but they are most similar in sculpture and dentition to *Indogrammatodon*, an Indo-Pacific group said in the Treatise (Moore, 1969, p. N258) to be of Jurassic age. Other members of the group here referred to *Indogrammatodon?* have been found throughout the Cretaceous of the West Coast especially in very fine-grained sediments. Specimens from Bell Canyon are larger than usual for the group and twice the size of specimens from Dayton Canyon. Whether this results from the muddier matrix of the Bell localities or is indicative of specific difference is not now known. Specimens from Bell are referred to *Indogrammatodon?* cf. *I.? whiteavesi* (REINHART, 1937) (pl. 1, fig. 3-4, 6-7) and those from Dayton to *I.?* cf. *I.? vancouverensis* (MEEK, 1858) (pl. 1, fig. 5, 8-9) mainly on the basis of the radial ribbing of the right valve which is more even, and has narrow interspaces in the Bell Canyon forms and has wider interspaces with every fourth or fifth rib slightly stronger in specimens from Dayton Canyon. In both forms the sculpture and shape of the right and left valves differ, with coarser sculpture and a stronger carina on the left valve. The discrepancy of the valves and distinctive pittings of the surface (pl. 1, fig. 3) of many specimens suggest that *Indogrammatodon?* spp. may have been epifaunal forms; their presence in fine-grained sediments throughout California in association with *Acila*, *Inoceramus*, and ammonites suggests that, although not confined to soft substrates inhospitable to most bivalves, they could survive upon them.

CUCULLAEIDAE are prominent in the Bell and Dayton Canyon collections, if only because of their size. Specimens from Bell Canyon are *Cucullaea (Idonearca) youngi* WARING, 1917 (pl. 1, fig. 1). They are high relative to length, have rather narrow beaks, and are ornamented by fine radial ribs with broad interspaces. This is the species present in the Cedar District Formation of Sucia Island, San Juan Co., Washington, Chico Formation of Chico Creek, Butte Co., (=*C. buttensis* ANDERSON, 1958), and in the Holz Shale of the Santa Ana Mts., Orange Co. Based on these occurrences, it is of early and mid Campanian age. Specimens from Dayton Canyon localities are longer relative to height, broad-beaked, and smooth. They are *C.(I.) cordiformis* PACKARD, 1922 (pl. 1, fig. 2). Packard's poorly preserved holotype is apparently from the Pleasants Sandstone of the Santa Ana Mts., Orange Co., where the species is the same one as that of the Dayton Canyon localities. This species has also been found rarely in the Tuna Canyon Formation of the Santa Monica Mts. associated with *Metaplacenticeras* spp. and is of late Campanian age.

NOETIIDAE (TRINACRIINAE) is represented solely by *Trinacria cor* POPENOE, 1937, which is present (some places abundantly) at Dayton Canyon and Lang Ranch. That it has not turned up at Bell Canyon localities probably has no time significance as it is present in the upper Chico Formation of Chico Creek, Butte Co., and the Holz Shale of the Santa Ana Mts., Orange Co. These are probably slightly older than the Bell Canyon deposits which are the oldest known in the Chatsworth Formation. The species appears to range in age from Campanian to early Maestrichtian.

GLYCYMERIIDAE from Bell and Dayton Canyon localities and CIT loc. 1538 = UCLA loc. 6464 have flat-topped ribs with very narrow interspaces and are

Plate 1.-- Bivalves from the Chatsworth Formation

[All figures natural size unless otherwise indicated.]

1. *Cucullaea (Idonearca) youngi* WARING, 1917, right valve. UCLA 59204. UCLA loc. 6020, Bell Canyon; late mid Campanian
2. *Cucullaea (Idonearca) cordiformis* PACKARD, 1922, right valve. UCLA 59205. CIT loc. 1159, Dayton Canyon; late Campanian

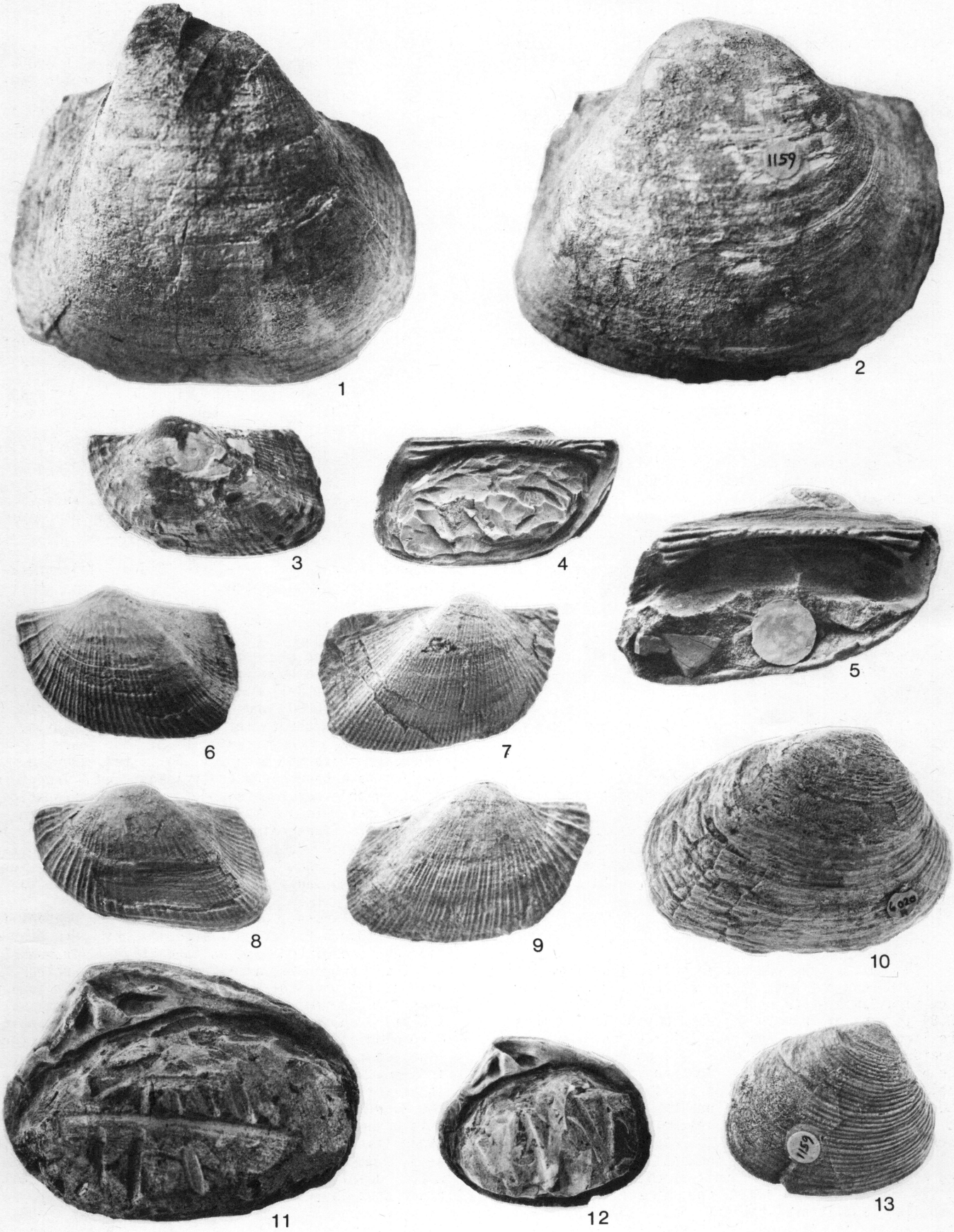
3-4. *Indogrammatodon?* cf. *I.? whiteavesi* (REINHART, 1937), left valve. UCLA 59201. UCLA loc. 6232, Bell Canyon; late mid Campanian

5. *Indogrammatodon?* cf. *I.? vancouverensis* (MEEK, 1858), left valve, x2. UCLA 59203. CIT loc. 1159, Dayton Canyon; late Campanian
6. *Indogrammatodon?* cf. *I.? whiteavesi* (REINHART, 1937), left valve, x1.5. UCLA 59199. CIT loc. 1158, Bell Canyon; late mid Campanian
7. *Indogrammatodon?* cf. *I.? whiteavesi* (REINHART, 1937) right valve, x2. UCLA 59200. CIT loc. 1158, Bell Canyon; late mid Campanian
8. *Indogrammatodon?* cf. *I.? vancouverensis* (MEEK, 1858), left valve, x1.5. UCLA 59203. CIT loc. 1159, Dayton Canyon; late Campanian
9. *Indogrammatodon?* cf. *I.? vancouverensis* (MEEK, 1858), right valve, x2, UCLA 59202. CIT loc. 1159, Dayton Canyon, late Campanian

10-11. *Crassatella (Crassatella)* cf. *C. (C.) conradiana* (GABB, 1864), right valve. UCLA 59206. UCLA loc. 6020A, Bell Canyon; late mid Campanian

12-13. *Crassatella (Crassatella)* cf. *C. (C.) conradiana* (GABB, 1864), right valve. UCLA 59307. CIT loc. 1159, Dayton Canyon; late Campanian

Plate 1



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identified as *Glycymeris (Glycymerita) veatchii* (GABB, 1864). Specimens are abundant at most Bell and Dayton Canyon fossil localities; at some they are mainly large, at others nearly all small (UCLA loc. 6232). Whether this reflects ecologic conditions or results from current sorting is not at present determined. Ribs on *Glycymeris* from Lang Ranch localities and UCLA loc. 1600 are slightly tri- angulate with the sharp central angle highest until the shell reaches a height of about 30 mm. The ribs then become more rounded but remain narrow with respect to the interspaces. These specimens are identified as *Glycymeris (Glycymerita?) banosensis* ANDERSON, 1958, a species described from the Moreno Formation of Los Baños Creek, Merced Co. At its type locality *G. (G.?) banosensis* is probably more nearly of mid Maestrichtian age rather than early Maestrichtian as at Lang Ranch, Ventura Co.

MYTILOIDA

A few mytilids (*MYTILIDAE*), belonging to several genera, are in the collections. They are not a major element in these faunas. One fragment of a *Pinna?* (*PINNIDAE*) has been found at CIT loc. 1537.

PTEROIDA

Except for *INOCERAMIDAE* and *ANOMIIDAE* this order is poorly represented in the Simi Hills Cretaceous rocks. *Inoceramus* is common to abundant in Dayton Canyon localities, but Bell Canyon and Lang Ranch localities are deficient in *INOCERAMIDAE*. Matsumoto (1960, p. 68) identified Dayton Canyon *Inoceramus* as *I.* cf. *I. subundatus* MEEK, 1861. A shell fragment that may have been part of a large *Inoceramus* sp. is from UCLA loc. 6020A; it is thus far the only Bell Canyon inoceramid.

All *ANOMIIDAE* have been ascribed to *Anomia* sp.; specimens are common only from CIT loc. 1537, but this may be an artifact of preservation or preparer's preference.

LIMIIDAE is possibly represented by one incomplete specimen from UCLA loc. 6931.

"Oyster" fragments are referred to *OSTREIDAE* because of their shell texture and amorphous shape. Except for those from UCLA loc. 6932 all were relatively thin-shelled, small forms, not especially indicative of shallow water. Fragments from UCLA loc. 6932, however, are of a thick-shelled type with a strongly angled shape. Such a form suggests a very shallow water habitat.

TRIGONIOIDA

TRIGONIIDAE are present in collections from Bell and Dayton Canyons but, thus far, absent from those from Lang Ranch. *Pterotrigonia evansana* (MEEK, 1858) is present in both Bell and Dayton Canyon beds. The largest specimens are from Bell Canyon, the greater abundance of specimens is from Dayton Canyon. The absence of this species from Lang Ranch is probably not of time significance as it is present in the Jalama Formation, Santa Ynez Mts., Santa Barbara Co., but may instead suggest unstable bottom conditions. Two specimens of *Yaadia robusta* SAUL, 1978 (pl. 2, fig. 11), have been found at CIT loc. 1159, and a juvenile probably of this species was collected at CIT loc. 1538. As *Yaadia* spp. appear to have had a shallow, sublittoral habitat (Saul, 1978, p. 16), its scarcity in the Simi Hills deposits favors the deeper, inner sublittoral, stable shelf interpretation for the fauna in general.

Plate 2.-- Bivalves from the Chatsworth Formation

[All figures natural size unless otherwise indicated.]

1-2. *Crassatella (?)* n. sp. near *C. (?) elongata* ANDERSON, 1958, right valve. UCLA 59208. CIT loc. 1157, Bell Canyon; late mid Campanian

3, 5. *Crassatella (?) elongata* ANDERSON, 1958, right valve. UCLA 59209. CIT loc. 1159, Dayton Canyon; late Campanian

4. *Crassatella (?) elongata* ANDERSON, 1958, left valve. UCLA 59210. CIT loc. 1159, Dayton Canyon; late Campanian

6, 8. *Crassatella (?) lomana* (COOPER, 1894), left valve, UCLA 59080. UCLA loc. 3339, Lang Ranch; early Maestrichtian. 8. x.75; photo by T. Susuki

7. *Cymbophora suciensis* (WHITEAVES, 1879), left valve. UCLA 59211. CIT loc. 1158, Bell Canyon; late mid Campanian

9. *Cymbophora triangulata* (WARING, 1917), left valve. UCLA 59212. CIT loc. 1159, Dayton Canyon; late Campanian

10. *Cymbophora* n. sp., right valve. UCLA 59213. UCLA loc. 3812, Lang Ranch; early Maestrichtian

11. *Yaadia robusta* SAUL, 1978, left valve, x.56. UCLA 38634. CIT loc. 1159, Dayton Canyon; late Campanian

12. *Calva bowersiana* (COOPER, 1894), left valve. UCLA 59214. CIT loc. 1159, Dayton Canyon, late Campanian

VENEROIDA

One species of *ASTARTIDAE*, *Eriphyla veatchii* (GABB, 1864), has been found in the Chatsworth Fm. It is common at Bell Canyon localities CIT loc. 1158 and UCLA loc. 6020, and one doubtfully identified specimen is in the collection from Dayton Canyon, CIT loc. 1537. Characteristics of West Coast *Eriphyla* spp. have not been well delimited, and the species have been haphazardly identified. Therefore stratigraphic occurrence and time ranges of species are not determined. Most occurrences of *Eriphyla* spp. are in fine-grained sediments (it is present in the Holz Shale, Santa Ana Mts., Orange Co.,) and the matrix at CIT loc. 1158 and UCLA loc. 6020 is a very poorly sorted sandstone with a high clay content.

Three lineages of *CRASSATELLIDAE* are present in the Chatsworth Formation (Table 1). All have dentition and crenulated margins suggestive of *Crassatella* but their subgeneric affinities are still unclear. The species have not been well defined. This is not surprising, as in addition to ontogenetic shape and sculpture changes, there is apparently considerable morphologic variation within each species. The three lineages recognized are *lomana*-group, *saulae*-group, and *conradiana*-group. The *conradiana*-group appears to be ancestral to an unnamed species occurring in the Rosario Formation near Carlsbad, San Diego Co. This unnamed species of early Maestrichtian age has a hinge like that of *Crassatella (Crassatella)*, and the *conradiana*-group is referred to *Crassatella (Crassatella)* despite hinge differences in the geologically older species. The species of this lineage, *Crassatella (Crassatella)* cf. *C. (C.) conradiana* (GABB, 1864), from Bell (pl. 1, figs. 10-11) and Dayton

Plate 2

Table 1. Occurrence of *Crassatella* spp. in the Chatsworth Formation

groups	*conradiana*	*saulae*	*lomana*
localities			
Lang Ranch			*lomana*
Dayton Canyon	cf. *conradiana*	*saulae*	*elongata*
Bell Canyon	cf. *conradiana*		n. sp. near *elongata*

Canyon (pl. 1, figs. 12-13) localities is also found in the uppermost Chico Formation on Chico Creek, Butte Co. As beds of late late Campanian age at Bee Canyon, Santa Ana Mountains, yield a probable descendant, *C. (C.)* cf. *C. (C.) conradiana* may be indicative of mid to early late Campanian age. The *saulae*-group is represented by poorly preserved specimens of *C. (?) saulae* DAILEY & POPENOE, 1966, from CIT locs. 1156, 1537, and 1538. At its type locality *C. (?) saulae* is probably of early Maestrichtian age, and these Dayton Canyon occurrences thus suggest a range extension to include late Campanian. The *lomana*-group is represented by three species (see Table 1). *Crassatella (?)* n. sp. near *C. (?) elongata* ANDERSON (pl. 2, figs. 1-2) is from Bell Canyon. Compared to *C. elongata*, it has a longer cardinal tooth 2, and the socket for this tooth approaches nearer to the beak. The species is also present in the Cedar District Formation on Sucia Island, Washington, and in the upper Holz Shale of the Santa Ana Mountains. It is thus probably of ?early and mid Campanian age. *Crassatella (?) elongata* ANDERSON, 1958 (pl. 2, figs. 3-5) is from Dayton Canyon. Anderson based his species on a specimen figured by Waring and said to be from Bell Canyon, but the specimen resembles those from Dayton rather than Bell Canyon. The beak of *C. (?) elongata* is not as anteriorly placed and the shell is not as elongate as that of *C. (?) lomana* (COOPER, 1894). As *C. (?) elongata* occurs with *Metaplacenticeras* spp., it is of late Campanian age. *Crassatella (?) lomana* (COOPER, 1894) (pl. 2, figs. 6, 8) is from Lang Ranch. Despite reported occurrences elsewhere, it has thus far only been found at the type locality, Point Loma, San Diego Co., and Lang Ranch, Ventura Co; at both places it is from the *Neodesmoceras catarinae* zone and associated with *Baculites lomaensis* ANDERSON, 1958. It is, thus, of early Maestrichtian age. Occurrences elsewhere suggest that these three groups may each have slightly different ecologic requirements, the *saulae*-group may have inhabited the shallowest and/or the most turbulent water areas and the *conradiana*-group may have inhabited the deepest and/or quietest water areas. The difference between deepest and shallowest water (if these were the important factors) probably was not great, as it is common for species from two of these groups to occur at the same locality. The *Crassatellas*, then, suggest that the Bell Canyon fauna lived in the deepest, least turbulent water; the Dayton Canyon fauna in the shallowest, most turbulent water; and the Lang Ranch fauna in intermediate conditions.

With the exception of *Protocardia (Pachycardium?)* cf. *P. (P.?) placerensis* (GABB, 1864) at CIT loc. 1159, *CARDIIDAE* are rare in the Simi Hills Cretaceous.

A few specimens representing several genera of *TELLINIDAE* are in the collections. Forms resembling *Linearia*, *Moerella*, and *Paleomoera* are present, and from CIT loc. 1534 one specimen of *Tellina (Tellinella)* n. sp.

Several specimens of *TANCREDIIDAE* from Dayton Canyon and Lang Ranch localities are all identified with greater or lesser degrees of certainty, depending upon preservation, as *Meekia (Mygallia) daileyi* SAUL & POPENOE, 1962. *M. (M.) daileyi* is of late Campanian and early Maestrichtian age (Saul & Popenoe, 1962, p. 311). *Meekia (Mygallia)* spp., and *Tellina (Tellinella)* spp. are common associates of *Yaadia* spp., and all suggest the shallower areas of the inner sublittoral zone.

Assigned to the family *ARCTICIDAE* are *Etea angulata* (PACKARD, 1922), represented by one or two specimens from CIT loc. 1159, and *Tenea inflata* (GABB, 1864). *T. inflata* is rare in collections from Bell Canyon and rare to common in collections from Dayton Canyon. It has a deep, angular, antero-dorsally directed pallial sinus suggestive of the venerids *Dosinia* or *Cyclina* which it also resembles in shape.

Clisocolus dubius (GABB, 1864) may or may not be correctly placed in the family *GLOSSIDAE*, but its shape, etc., suggest that it may have had a life style similar to that of *Glossus*. *C. dubius* is present in Bell and Dayton Canyon collections and in Lang Ranch collections. It was possibly a very shallow burrower into soft, subtidal substrates.

MACTRIDAE are a major element in the fauna of the Simi Hills. One lineage -- *Cymbophora suciensis*-*C. triangulata*-- *C.* n. sp. aff. *C. suciensis* is largely responsible for this. *C. suciensis* (WHITEAVES, 1879) approaching *C. triangulata* (pl. 2, fig. 7) is common in Bell Canyon collections; *C. triangulata* (WARING, 1917) (pl. 2, fig. 9) is common to abundant in Dayton Canyon collections; and *C.* n. sp. aff. *C. suciensis* (pl. 2, fig. 10) is common in Lang Ranch collections. Other species of *Cymbophora* from the Simi Hills are *C. popenoei* SAUL, 1974 -- rare in Bell Canyon collections and most Dayton Canyon collections, but common at CIT locs. 1156, 1159, and 1534; *C. buttensis* ANDERSON, 1958 -- common at CIT 1537; and *C.* cf. *C. stantoni* (ARNOLD, 1908) rare at CIT locs. 1154 and 1159 (see Table 2). *Willimactra* aff. *W. popenoei* SAUL, 1973 is represented by broken valves from UCLA loc. 6232 and CIT locs. 1156 and 1537. Where common to abundant, *Willimactra* and ribbed *Cymbophora* -- e.g., *C. popenoei* -- suggest shallower or more turbulent conditions than does the *Cymbophora suciensis* lineage.

Four genera of *VENERIDAE* have been recognized in the Chatsworth Formation. *Calva* is the most widespread. *C. bowersiana* (COOPER, 1894) (pl. 2, fig. 12) is common to very abundant in collections from Bell and Dayton Canyons. Collections from Lang Ranch include very large specimens of *Calva varians* (GABB, 1864) identical to those from the Jalama Formation, Jalama Creek, Santa Barbara Co. Lang Ranch collections also contain *Loxo decore* DAILEY & POPENOE, 1966. Venerid clams with *Loxo*-like sculpture, but as yet unknown hinge structures, are present at CIT locs. 1156 and 1537. *Flaventia lens* (GABB, 1864) is present in most collections from Bell and Dayton Canyons, whereas *Legumen ooides* (GABB, 1864) is present in Dayton Canyon and Lang Ranch localities.

MYOIDA

A few specimens belonging to this order are in

Table 2. Occurrence of Mactridae in collections from the Chatsworth Formation

localities	Bell Canyon	Dayton Canyon 1154 1159	1537	1155 1156 1534	1538	Lang Ranch
species						
Cymbophora n. sp.						X
C. buttensis			X			
C. cf. *C. stantoni*		X				
C. triangulata		X	X	X	X	
C. popenoei	X	X	X	X		
C. suciensis	X					
Willimactra aff. *W. popenoei*	x		x	x		

the collections. *CORBULIDAE* are probably under-represented because of the difficulty in extracting the small valves from the hard matrix. They are common at CIT loc. 1537 but are not identified as to genus or species. A few *Panopea* sp., family *HIATELLIDAE*, have been found; they are not identified as to species. A few pholads resembling *Martesia* have been found; they are not identified as to family.

HIPPURITOIDA

This order is represented by fragments of *Coralliochama orcutti* WHITE, 1885, recovered from a clast in a conglomerate bed. At its type locality, Punta Banda, Baja California, at Gualalla, Mendocino Co., in the Asuncion Formation, Cape San Martin quad., Monterey Co., and in the Rosario Formation near Carlsbad, San Diego Co., *Coralliochama orcutti* is probably of early Maestrichtian age. *C. orcutti* is also reported from beds in the San Rafael Mts., Santa Barbara Co., which are said to underlie the Debris Dam Sandstone. East of Agua Caliente Canyon, LSJU locs. 2794 and 2795 in the Debris Dam Sandstone have *Baculites rex* ANDERSON, and Matsumoto (1960, p. 113) considered them to be of early Maestrichtian or latest Campanian age. Other mollusks from UCLA loc. 6308 (vicinity of LSJU loc. 2794) suggest the late Campanian side of the stage boundary. This may indicate a late Campanian through early Maestrichtian range for *Coralliochama orcutti*, but at present the early Maestrichtian age is better based than is the late Campanian age. As specimens from UCLA loc. 6931 are from a clast in a conglomerate, the conglomerate is somewhat younger in age than the fossils.

PHOLADOMYOIDA

Two specimens from CIT loc. 1537 probably belong to the family *PHOLADOMYIDAE*. In shape they resemble *Periplomya* of the Laternulidae, but instead of a chondrophore and internal ligament, they have an external ligament. This unidentified genus is also present in the Chico Formation of Chico Creek, Butte Co.

GASTROPODA

In general, gastropod species are represented by fewer individuals than are the bivalves.

ARCHAEOGASTROPODA

One specimen of a limpet has been found at CIT loc. 1537. Muscle scars have not been exposed, but externally it resembles members of the family *ACMAEIDAE*.

The family *TROCHIDAE*, subfamily *MARGARITINAE* is represented by two species: *"Margarites" ornatissimus* (GABB, 1864) [=*Solariaxis templetoni* WARING, 1917], common to abundant in collections from Bell and Dayton Canyons, and *"Margarites"* cf. *"M." inornatus* (GABB, 1864), from Lang Ranch. *"M." ornatissimus* has also been found in the Pleasants Sandstone, Santa Ana Mts., and the Chico Formation, Butte Co., and is of Campanian age. *"M." inornatus* occurs in beds of Maestrichtian age near Martinez, Contra Costa Co. Margaritinae tend to be a primitive (Fretter & Graham, 1962, p. 616), cool water group. Several species of Recent Margaritinae found in very shallow water near the northern end of their range are found in deeper water in the southern part (Abbott, 1974, p. 36). Many Recent species are cited in association with algae or kelp (Fretter & Graham, 1962, p. 672). Margaritinae of the Chatsworth Formation suggest the deeper portion of the photic zone.

MESOGASTROPODA

The possible member of the *RISSOIDAE*, *"Mesostoma" suciensis* (WHITEAVES, 1879) is found at Bell and Dayton Canyons and at Lang Ranch Localities. It resembles an unusually large *Turboella*. As with the margarites, rissoids are cited in association with algae or kelp (Fretter & Graham, 1962, p. 684).

TURRITELLIDAE have been collected at some Bell and Dayton Canyon localities and at UCLA loc. 6464= CIT loc. 1538. Only at CIT loc. 1157 are they abundant. In life turritellas are extremely gregarious and live in dense patches -- a patchy distribution in the strata is not surprising. At Bell Canyon localities the turritella is a late form of *Turritella chicoensis* (GABB, 1864) (pl. 3, fig. 1) approaching *T. c. pescaderoensis* in its sculpture and shape, but at Dayton Canyon localities and UCLA loc. 6464, the turritella is *T. c. pescaderoensis* ARNOLD, 1908 (pl. 3, fig. 2). This is the form found in the Pleasants Sandstone of the Santa Ana Mts. and in *Metaplacenticeras*-bearing beds in the Santa Monica Mts., and it is considered to indicate a late Campanian age (SAUL, in press). Turritellas require non-turbulent water and a bottom sufficiently firm that their mucus-lined feeding depressions can stay open (Yonge, 1946, p. 379).

Several undescribed *MATHILDIDAE* are in the collections from Dayton Canyon and Lang Ranch. Both *Mathilda* and *Gegania* appear to be represented. Some Recent species of *Mathilda* are reported from bathyal depths.

A variety of undescribed *EPITONIIDAE* are present in the Chatsworth Formation. Most resemble *Amaea* spp. or *Opalia* spp. A specimen over 18 cm long from CIT loc. 1538 is tentatively identified as *"Cerithium(?)" suciensis* PACKARD, 1922. It does not appear to be a cerithacean but is probably an epitoniid similar to *Confusiscala*. If epitoniids are specialized carnivores (Fretter & Graham, 1962, p. 572), few individuals of diverse species are to be expected.

Species belonging to two lineages of *Lysis* are present in collections from the Chatsworth Formation. This genus, with its curious excavated columellar area, has been placed in the families *Purpuridae, Lamellariidae, Naticidae (Polinicinae)*, and

Fossariidae. *Lysis* spp. from older rocks resemble *Trichotropidae*, but the Campanian and Maestrichtian species resemble *CALYPTRAEIDAE*. The one figured (pl. 3, figs. 3-4) is probably *Lysis duplicosta* GABB, 1864. The columellar area is widely expanded and sunken. *L. diplicosta* is present in collections from Bell and Dayton Canyons. Forms of the other lineage, *L. suciensis* (WHITEAVES, 1879) are present in collections from Bell and Dayton Canyons and the Lang Ranch. The expanded aperture suggests that the living animal was firmly clamped to a hard object.

APORRHAIDAE were diverse in the Cretaceous. Rare specimens representative of four genera, *Anchura*, *Tessarolax*, *Aporrhais?*, and a new genus, are in the collections from Bell and Dayton Canyons; and *"Lispodesthes" rotundus* (WARING, 1917) is abundant at several Lang Ranch localities. The Recent aporrhaid, *Aporrhais pespelicani* is a detrital feeder and thus must move about more frequently than the filter feeding turritellas with which it commonly occurs. It moves with considerable agility in a series of spasmodic jerks as the shell is lifted high off the substrate by elongation of the foot and the shell is then swung forward (Fretter & Graham, 1962, p. 567).

NATICIDAE are difficult to identify, and the following identifications are tentative. *Euspira compressa* (WARING, 1917) is from Dayton Canyon and specimens from Bell Canyon are probably conspecific. This is in part *Euspira shumardiana* GABB of Popenoe, 1942. Poorly preserved specimens from Lang Ranch may also be *P. compressa*. Other poorly preserved specimens from there look more like *Polinices? mercedensis* ANDERSON, 1958. *"Gyrodes" canadensis* WHITEAVES, 1903, is common in some collections from Bell and Dayton Canyons, and *"G."* cf. *"G." expansa* GABB, 1864, is present in Lang Ranch collections. *"G." canadensis* is present in the Cedar District Formation of Sucia Island, Washington, the Chico Formation of Chico Creek, Butte Co., and the Holz Shale and Pleasants Sandstone of the Santa Ana Mts. (Popenoe, 1954, p. 17) and is of Campanian age. *"G." expansa* was based upon specimens from beds of Maestrichtian age near Martinez, Contra Costa Co., and the Lang Ranch specimens resemble Martinez specimens in being less sharply tabulate than *"G." canadensis* and having a slight sulcus abapical to the tabulation. *Ampullina concipio* DAILEY & POPENOE, 1966, occurs at UCLA loc. 1600. It was described from the Jalama Formation on Jalama Creek, Santa Barbara Co., and is considered to be of early Maestrichtian age. Waring's (1917, pl. 9, fig. 9) figure of *Amauropsis oviformis* GABB does not resemble that species.

Haydenia impressa (GABB, 1864) has been collected at CIT loc. 1159; it has been doubtfully placed in the *CASSIDIDAE* (Stewart, 1927, p. 381).

The family *PERRISSITYIDAE* is included here in the Mesogastropoda, but it may belong in the Neogastropoda. *Perissitys brevirostris* (GABB, 1864) (pl. 3, fig. 5) is common in collections from Bell and Dayton Canyons. It occurs in the upper Chico Formation on Chico Creek, Butte Co., and in the upper Holz Shale and Pleasants Sandstone of the Santa Ana Mts., Orange Co., and is of Campanian age. Its presence at UCLA loc. 6464 indicates that the beds there are of Campanian age. *Cophocara* n. sp. (pl. 3, figs. 6-7) is present in collections from Lang Ranch. The species occurs elsewhere -- Rosario Formation near Santa Catarina Landing, Baja California, and lower "Ragged Valley Shale" along Los Gatos Creek, Fresno Co. -- associated with *Pachydiscus (Neodesmoceras)* cf. *P. (N.) catarinae* and is of early Maestrichtian age. *"Hindsia"* aff. *"H. nodulosa* (WHITEAVES, 1874)" is present at Bell and Dayton Canyons as also is *"Fusus" kingii* GABB, 1864. As they have been collected from the Cedar District Formation on Sucia Island, Washington, they suggest a Campanian age.

NEOGASTROPODA

A number of forms resembling *BUCCINIDAE* are present in the collections; most are undescribed. *"Fulgur" hilgardi* WHITE, 1889, may possibly be a buccinid. It occurs at Bell and Dayton Canyons, in the upper Chico Formation, Chico Creek, Butte Co., and the Holz Shale and Pleasants Sandstone, Santa Ana Mts., and is of Campanian age. Specimens resembling *"Fusus" tumidus* GABB, 1869, are from Bell Canyon; they are probably not that species, are undescribed, and are probably buccinids.

None of the forms resembling *FASCIOLARIIDAE* have been described. *?Graphidula* sp. is found at both Bell and Dayton Canyon localities and *?Anomalofusus* spp. are from Dayton Canyon.

An undescribed ?member of the *MITRIDAE*, *Paleofusimitra* n. sp. (pl. 3, fig. 8) is common at Dayton Canyon, especially at CIT loc. 1159, and present at Bell Canyon. The tall, slender shell is weakly sculptured by subsutural, spiral lirae and incised spirals over the rest of the shell. These spirals are usually nearly obliterated on the mid whorl. There are two oblique folds on the columella, the adapical one much weaker.

VOLUTIDAE are present in collections from Bell and Dayton Canyons and Lang Ranch. *Volutoderma* spp. are the largest gastropods from these localities. Several species are described but for none are the limits of variation well enough known to identify the Simi Hills specimens to species. Two types are recognizable, however: *Volutoderma* aff. *V. averillii* (GABB, 1864) which is more slender and somewhat more strongly sculptured and *Volutoderma* aff. *V. magna* PACKARD, 1922, which has a more expanded body whorl. Despite their overall exterior similarity, the two types have different patterns of columellar folds. More than one species of each type may be represented. Some specimens of *Volutoderma* (if not all) from Bell Canyon are probably *Volutoderma averillii* (GABB, 1864) and some from Dayton Canyon collections are probably *V. magna* PACKARD, 1933.

Some pretty shells from Bell Canyon (UCLA loc. 6232) may belong to the *CANCELLARIIDAE*. They resemble the genus *Caveola*.

Specimens resembling *Amuletum* of the family *TURRIDAE* are also present in Bell Canyon collections.

ENTOMOTAENIATA

Odostomia santana PACKARD, 1922, may belong to the *PYRAMELLIDAE* although it is large for that family. Specimens assigned to this species have been collected from both Bell and Dayton Canyons. In the Santa Ana Mts., Orange Co., it is found in the Pleasants Sandstone.

CEPHALASPIDEA

The family *ACTEONIDAE* is represented by two genera. Specimens identified as *Acteon (Eoacteon) normalis* (COOPER, 1894) are from Lang Ranch. The

species was described from Pt. Loma, San Diego Co., probably from the Rosario Group, *Neodesmoceras catarinae* zone. *Nonacteonina obesa* DAILEY & POPENOE, 1966, is also from Lang Ranch; it was described from the Jalama Formation, Jalama Creek, Santa Barbara Co., and is also of early Maestrichtian age. *Nonacteonina* sp. is present at Dayton Canyon.

The *RINGICULIDAE* is the best represented family of opisthobranchs, at least in terms of numbers of specimens. A new species of *Ringicula* is abundant at UCLA locs. 3812 and 3815, Lang Ranch. Many, but not all, Recent *Ringicula* spp. are from outer sublittoral to bathyal depths. *Biplica* spp. are one of the most common gastropods in the Simi Hills collections. *Biplica obliqua* (GABB, 1864) (pl. 3, figs. 9-10) is present at both Bell and Dayton Canyon localities. Specimens from Bell Canyon are especially large, twice the size of those from Dayton; the significance of this is unknown. *B. obliqua* is widely distributed from British Columbia to Southern California in beds of Campanian age (Popenoe, 1957, p. 435). *Biplica miniplicata* POPENOE, 1957 (pl. 3, figs. 11-12), is abundant at Lang Ranch. In all of its occurrences elsewhere -- Moreno Formation, Merced Co., Deer Valley Formation of Colburn (1964), Contra Costa Co., etc., it is of Maestrichtian age.

The largest *SCAPHANDRIDAE* present in Simi Hills collections are slightly over 1 cm in length. Probable *Mirascapha* n. sp. are from Bell and Dayton Canyons and Lang Ranch. *Ellipsoscapha nortonensis* (ANDERSON, 1958) is present in collections from Dayton Canyon; *E.* cf. *E. nortonensis* (ANDERSON) is in collections from Bell Canyon. At its type locality in Enos Canyon (CAS loc. 1467), Yolo Co., *E. nortonensis* occurs with *Metaplacenticeras pacificum* (SMITH, 1900) and is of late Campanian age.

The family *ACTEOCINIDAE* is probably represented by two undescribed species, *Cylichna* n. sp. and *Cylindrotruncatum* n. sp. from Bell Canyon.

Specimens from Dayton Canyon (CIT loc. 1537) have been referred to *?Cylichnina* n. sp. and possibly to the family *RETUSIDAE*.

CEPHALOPODA

Recent collecting in the Chatsworth Formation has revealed a large and varied cephalopod fauna. At least 14 ammonite genera are represented, of which 10 have not previously been reported. Although Mollusca known from the Chatsworth Formation range in age from mid Campanian to early Maestrichtian, the only diagnostic ammonites presently known are late Campanian and early Maestrichtian forms. The upper Campanian *Metaplacenticeras* beds at Dayton Canyon localities CIT 1159 and 1537 are especially prolific, with a minimum of 12 genera and perhaps 20 species present, representing all 7 ammonite families recognized herein from the Chatsworth Formation. A few poorly preserved nautiloids are present at Dayton Canyon, representing more than one genus; but we have not tried to identify them. In this preliminary discussion, we attempt to add to what is known of the ammonite faunas, reserving critical studies of certain elements thereof for future reports. For earlier reports mentioning ammonites from this area see Smith, 1900; Anderson, 1902, 1958; Waring, 1917; Kew, 1924; Popenoe, 1942, 1955, and 1973; and Matsumoto, 1959a, b.

Plate 3.-- Gastropods and ammonites from the Chatsworth Formation

[All figures natural size unless otherwise indicated.]

1. *Turritella chicoensis* GABB, 1864, x.75. UCLA 58748. CIT loc. 1157, Bell Canyon; late mid Campanian
2. *Turritella chicoensis pescaderoensis* ARNOLD, 1908. UCLA 59215. CIT loc. 1159, Dayton Canyon; late Campanian
3-4. *Lysis duplicosta* GABB, 1864. UCLA 59216. UCLA loc. 6020A, Bell Canyon; late mid Campanian
5. *Perissitys brevirostris* (GABB, 1864), x.75. UCLA 28715. CIT loc. 1158, Bell Canyon, late mid Campanian. Photo by T. Susuki
6-7. *Cophocara* n. sp. UCLA 59217. UCLA loc. 3814, Lang Ranch; early Maestrichtian. 6. x1.5. 7. x1.75
8. *Paleofusimitra* n. sp. UCLA 59218. CIT loc. 1159, Dayton Canyon; late Campanian
9-10. *Biplica obliqua* (GABB, 1864), x1.5. UCLA 27753. CIT loc. 1158, Bell Canyon; late mid Campanian. Photos by A. C. Daley
11. *Biplica miniplicata* POPENOE, 1957, x1.5. UCLA 59219. UCLA loc. 3815, Lang Ranch; early Maestrichtian
12. *Biplica miniplicata* POPENOE, 1957, x1.87. UCLA 27755. UCLA loc. 3339, Lang Ranch; early Maestrichtian. Photo by A. C. Daley
13. *Pachydiscus (Neodesmoceras) catarinae* (ANDERSON & HANNA, 1935). UCLA 28718. Lang Ranch area; early Maestrichtian. Photo by T. Susuki
14. *Metaplacenticeras* sp. UCLA 46038. CIT loc. 1537, Dayton Canyon; late Campanian
15. *Metaplacenticeras* sp. UCLA 59220. CIT loc. 1537, Dayton Canyon; late Campanian
16. *Hauericeras transitionale* WARING, 1917. HOLOTYPE, CAS 390. "Bell Canyon", but probably Santa Monica Mountains

AMMONOIDEA

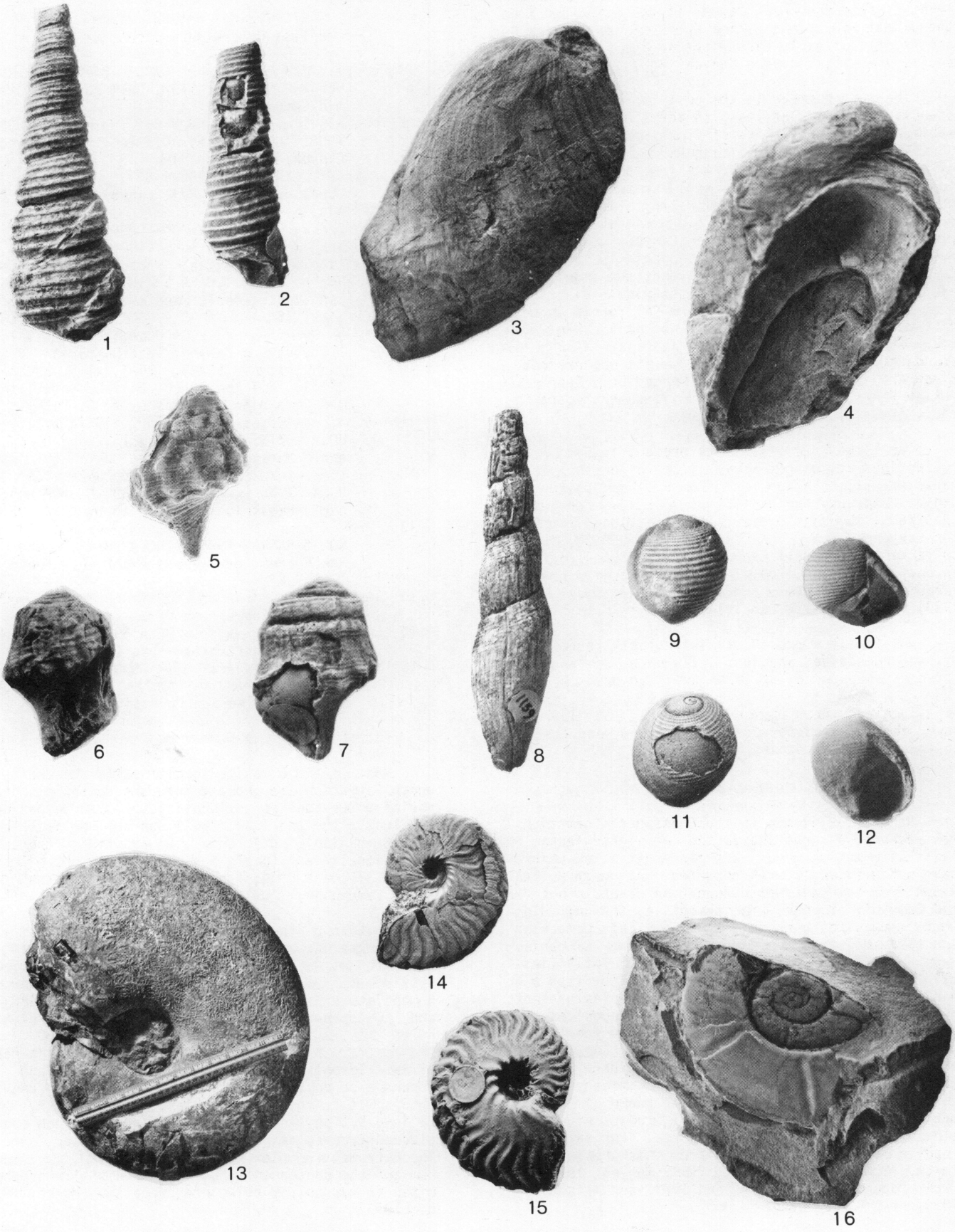
Most of the ammonite localities in the Chatsworth Formation are grouped into the following catagories: "Dayton Canyon localities" (late Campanian): CIT locs. 1159 and 1537; "Bell Canyon localities" (mid Campanian): CIT locs. 1157 and 1158; "Lang Ranch localities" (early Maestrichtian): UCLA locs. 3339, 3813, and 6936; locality of John Alderson (late Campanian): JA-33.

Members of the persistent ammonite family *PHYLLOCERATIDAE* are represented in the Chatsworth Formation at Dayton Canyon by *Hypophylloceras (Neophylloceras) ramosum* (MEEK) (we follow the generic nomenclature used by Matsumoto and Morozumi, 1980), and *Phyllopachyceras* cf. *P. forbesianum* (D'ORBIGNY).

H. (N.) ramosum is common in California in beds of late Turonian through late Campanian age, and occurs also on Vancouver Island and in Japan (Jones, 1963). It is found in a variety of sedimentary facies, but phylloceratids have generally been considered free-swimming, relatively deep water forms. The extremely complex septal sutures of *H. (N.) ramosum* and the consequently strengthened shell have been cited in support of this interpretation (Moore, 1957, p. L121).

Phyllopachyceras forbesianum is widespread in

Plate 3



the Indo-Pacific realm (Jones, 1963, p. 25), and has been reported from the west side of the Sacramento Valley, California (Matsumoto, 1959a). Comparable specimens are now known from the Diablo Range at LSJU loc. 2227, Monterey Co., occurring there with *Baculites rex*. The present specimens are immature, but are comparable to *P. forbesianum*.

Only one representative of the family *DESMOCERATIDAE* is definitely known from the Chatsworth Formation: *Desmophyllites diphylloides* (FORBES). This smooth, constricted, involute ammonite is common at CIT loc. 1159 and occurs there in approximately a .6 to 1 ratio with *Metaplacenticeras* spp. It is widespread in the Indo-Pacific region, and ranges through the Campanian, and into the Maestrichtian in some areas (Matsumoto, 1959b). It is very common in the late Campanian of California, occurring virtually everywhere *Metaplacenticeras* is abundant. One specimen was found by one of us (L. S.) in a calcareous concretion at Bell Canyon (UCLA loc. 6929).

Waring, 1917, described a new species, *Hauericeras transitionale* from his loc. 2, Bell Canyon, but the holotype (pl. 3, fig. 16) probably did not come from Bell Canyon, as the matrix appears foreign to the area, but may have instead come from the Tuna Canyon Formation (Yerkes and Campbell, 1979) of the Santa Monica Mountains, where Waring and the Stanford field party of 1910 also collected. A *Hauericeras* was recently found by one of us (J. A.) in a unit of very similar lithology in Temescal Canyon, Santa Monica Mountains, near Waring's loc. 3, in shales near the top of the local section. According to Waring's original description (p. 69), "*H. transitionale* is confined to the upper shales of the Chico formation". This statement would seem to exclude it from his loc. 2 in Bell Canyon which appears at the base of the Cretaceous section on his geologic map, p. 51. Based on the stratigraphic position of the shale unit in Temescal Canyon, *H. transitionale* is at least as young as late Campanian, and possibly younger.

PACHYDISCIDAE from the Chatsworth Formation include *Pachydiscus (Neodesmoceras* aff. *P. (N.) catarinae* (ANDERSON & HANNA) from the Lang Ranch, and *Anapachydiscus* cf. *A. arrialoorensis* STOLICZKA, *Pachydiscus* cf. *P. neevesi* WHITEAVES, and other juvenile or fragmentary specimens referred to *Anapachydiscus* sp. and *Pachydiscus* sp., all from Dayton Canyon.

P. (Neodesmoceras) catarinae and closely related, if not identical, forms are known from the Rosario Formation of Baja California and adjacent California, and from the "Ragged Valley Shale" near Coalinga, Fresno Co., California. The *P. (N.) catarinae* zone is superjacent to the latest Campanian zone of *Metaplacenticeras pacificum* in the scheme of Jeletzky, 1970, and is therefore of early Maestrichtian age.

Forms similar to *A. arrialoorensis*, present here at CIT loc. 1159, occur in beds of late Campanian and early Maestrichtian age in California (Matsumoto, 1959b, Saul, 1979). A large *Anapachydiscus* sp. was found by W. P. Popenoe at UCLA loc. 5473 near Dayton Canyon. Fragments of large pachydiscids up to 30 cm long are known from CIT loc. 1159.

Specific identification of the other pachydiscids is difficult, partly because some are juveniles (Hancock and Kennedy, 1981). Others probably represent new species, but are fragmentary.

The family *PLACENTICERATIDAE* is represented by abundant specimens of *Metaplacenticeras* Spath, a widespread genus in the North Pacific realm, known from Alaska to Baja California and also from Japan The zone of *M. pacificum* forms the highest Campanian zone in the scheme of Jeletzky, 1970. Figures 14 and 15 (pl. 3) show two typical specimens from Dayton Canyon which differ in strength of ornament and in breadth The genus has been found abundantly in the Santa Ana and Santa Monica Mountains, but the large, compressed, finely ribbed forms with tricarinate venter, common in the former areas seem to be absent from the Dayton Canyon beds, while stouter forms are more common in the latter area. The significance of this difference is still unclear, but may reflect a difference in age rather than facies, as possibly transitional forms have been found near the top of the Dayton Canyon section, at loc. JA-33, 100 m NW of the Los Angeles-Ventura Co. line, in sandstone beds stratigraphically above those of CIT loc. 1537. No smooth intergrading series of variants, as found, for example, in *Neogastroplites* by Reeside and Cobban (1960 in the Mowry Shale of the Western Interior, is yet known to exist in the present species.

Discovery of *Metaplacenticeras* spp. in the middle part of the "Alcalde Shale" in Post (loc. JA-67) and Cooper (loc. JA-54 = UCLA loc. 6371) Canyons of the Coalinga area, Fresno Co., in 1977 by one of us (J.A.) and Mr. David Melton, confirms Almgren's (1972) interpretation of the age of that unit, and provides a tie to the upper Campanian Dayton Canyon beds of the Chatsworth Formation.

This family *TETRAGONITIDAE* is represented in the lower part of the Chatsworth Formation at Dayton Canyon by the following forms: *Tetragonites* cf. *T. (Saghalinites) henleyense* (ANDERSON), *Pseudophyllites indra* (FORBES), and *Gaudryceras* cf. *G. denmanense* (WHITEAVES).

The first species is recorded by Anderson (1958) from the Hornbrook Formation near Henley, California, occuring there with *Metaplacenticeras* spp. The juvenile specimens from Dayton Canyon compare fairly well with Anderson's species.

Pseudophyllites indra is known from Alaska, British Columbia, France, Madagascar, So. India, Australia, Antarctica, and Brazil. The remarkable distribution of this species has recently been discussed by Kennedy and Cobban, 1976. It is known in California from UCLA loc. 2415, Bee Canyon, Santa Ana Mts. (coll. L. Saul), from the Covelo area, Mendocino Co. at UCB loc. A-6598, from the Diablo Range at LSJU loc. 2227, Monterey Co. and from the Tuna Canyon Formation, Santa Monica Mountains, with *Metaplacenticeras* spp. Its combination of *Nautilus*-like shell form and complex sutures suggest a possible relatively deep water habitat.

Gaudryceras cf. *G. denmanense* is known from LSJU loc. 2709, Yolo Co., west side of the Sacramento Valley, with *Metaplacenticeras* spp. (Matsumoto, 1959b). Similar forms occur at CIT loc. 1159 and CIT loc. 1535.

At least 5 species of *Baculites (BACULITIDAE)* are now known from the Chatsworth Formation. Those occurring with *Neodesmoceras* at Lang Ranch are *Baculites occidentalis* MEEK and *B. lomaensis* ANDERSON. Both are found in the "Ragged Valley Shale" of the Coalinga area, Fresno Co., while *B. lomaensis* is also known from Pt. Loma, San Diego Co. *B. occidentalis*

is present at several localities on the west side of the San Joaquin Valley (Matsumoto, 1959a).

Occurring with *Metaplacenticeras* spp. in the Dayton Canyon area are abundant *Baculites inornatus* MEEK and one specimen of *B. anceps pacificus* MATSUMOTO & OBATA (at CIT loc. 824). *B. inornatus* also occurs in Bell Canyon with *Desmophyllites* and *Nostoceras?* sp., in beds of mid Campanian age.

Crushed, but septate specimens probably referable to *B. rex* ANDERSON are present in silty shale near the top of the Chatsworth Formation, and therefore probably date these beds as Maestrichtian. Specimens questionably referred to *B. rex* are known from CIT loc. 1538 (UCLA loc. 6464).

In addition, crushed, unidentifiable baculites are present in the following areas: 1) in siltstone underlying the massive sandstone at Dayton Canyon (stratigraphically above *Metaplacenticeras* beds), 2) in silty shale beds along the Box Canyon Road, and 3) in silty shale at Santa Susana Pass. It is hoped that these areas will eventually yield better specimens, and thereby provide a sound basis on which to draw the Campanian-Maestrichtian boundary in the Chatsworth Formation.

Presently known members of this -- *NOSTOCERATIDAE* -- family of heteromorphic ammonites from the Chatsworth Formation are all fragmentary, but include *Nostoceras (?)* sp., *Solenoceras (?)* sp., and *Neocrioceras (?)* sp. *Nostoceras (?)* from Lang Ranch consists of part of the helical portion of a shell comparable with this genus. Another fragmentary specimen from Bell Canyon may be part of the retroversal hook of a *Nostoceras* sp.

Solenoceras (?) sp. from CIT loc. 1159 are unusual small forms which probably represent a new species. The more complete specimens show two slightly separated, parallel arms connected by a curved part which alone bears a double row of nodes. The affinites of this species are not clear, but it may be related to *Pseudoxybeloceras* Wright & Matsumoto (Peter Ward, personal communication, 1981; see also Ward & Mallory, 1977).

Neocrioceras (?) sp. from CIT loc. 1159 is another unusual heteromorph species represented by small fragments of a quadrituberculate, open-coiled form with flared ribs. This genus has not previously been reported from California.

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We could not have compiled this inventory without the collections of W. P. Popenoe. His careful geographic and stratigraphic locality data have made it possible to sort out and arrange chronologically, similar faunas of different ages. We will miss his encouragement and many invaluable discussions. We would also like to thank Mr. David Melton for his assistance in collecting ammonite specimens.

REFERENCES CITED

Abbott, R. T., 1974, American seashells [2nd ed.]. Van Nostrand Reinhold Co., New York, Cincinnati, Toronto, London, Melbourne, 663 p., 24 pl.

Almgren, A. A., 1972, Age and correlation of the Alcalde Shale Formation -- an alternative interpretation. In Steinert, R. E. [ed.], Cretaceous of the Coalinga area. Soc. Econ. Paleont. Mineral., Pacific Sec., Guidebook fall field trip, p. 59-65.

Anderson, F. M., 1902, Cretaceous deposits of the Pacific Coast. Calif. Acad. Sci., Proc. (3), v. 2, p. 1-154, pl. 1-12.

_____ 1958, Upper Cretaceous of the Pacific Coast. Geol. Soc. America, Mem. 71, 378 p., 75 pl.

Arnold, Ralph, 1908, Descriptions of new Cretaceous and Tertiary fossils from the Santa Cruz Mountains, California. U. S. Nat. Mus. Proc. v. 34, no. 1617, p. 345-390, pl. 31-37.

Colburn, I. P., 1964, The Mesozoic stratigraphy in the vicinity of Mount Diablo, California. Geol. Soc. Sacramento, Guide Book and Field Trip, Mount Diablo Area, p. 9-22, chart.

Cooper, J. G., 1894, Catalogue of Californian fossils, (Pt. 2-5). Calif. State Min. Bur., Bull. 4, 65 p., 6 pl.

Dailey, D. H., & Popenoe, W. P., 1966, Mollusca from the Upper Cretaceous Jalama Formation, Santa Barbara County, California. Univ. Calif. Publ. Geol. Sci., v. 65, 41 p., 6 pl., 3 text-fig.

Fretter, Vera & Graham, Alastair, 1962, British prosobranch molluscs. Ray Society, London. 755 p., 317 fig.

Gabb, W. M., 1864, Description of the Cretaceous fossils. Calif. Geol. Survey, Paleontology, v. 1, p. 57-243, 1864, pl. 9-32. 1865.

_____, 1866-1869, Cretaceous and Tertiary fossils. Calif. Geol. Survey, Paleontology, v. 2, sec. 1, 1866, p. 1-38; sec. 1 pt. 2-3, sec. 2, 1869, p. 39-299, pl. 1-36.

Hancock, J. M., & Kennedy, W. J., 1981, Upper Cretaceous ammonite stratigraphy: some current problems. In House, M. R., & Senior, J. R. [eds.], The Ammonoidea. Systematics Assoc. Spec. v. 18, p. 531-553.

Jennings, C. W. & Strand, R. B., [comp.], 1969, Los Angeles sheet, geologic map of California. Calif. Div. Mines & Geol.

Jones, D. L., 1963, Upper Cretaceous (Campanian and Maestrichtian) ammonites from southern Alaska. U.S. Geol. Survey, Prof. Paper 432, iv, 53 p., 41 pl., 25 text-fig., 2 tab.

Kennedy, W. J., & Cobban W. A., 1976, Aspects of ammonite biology, biogeography, and biostratigraphy. Palaeont. Assn. London, Spec. Papers Palaeontology 17, 94 p, 11 pl. 24 text-fig., 5 tab.

Kew, W. S. W., 1924, Geology and oil resources of a part of Los Angeles and Ventura Counties, California. U. S. Geol Surv. Bull. 753, 202 p., 17 pl.

Matsumoto, Tatsuro, 1959a, Upper Cretaceous ammonites of California, Pt. I. Kyushu Univ., Fac. Sci. Mem. Ser. D, Geology, v. 8 (4), p. 91-171, pl. 30-45, 85 text-fig.

_____, 1959b, Upper Cretaceous ammonites of California, Pt. II. Kyushu Univ., Fac. Sci., Mem. Ser. D, Geology, Spec. v. 1, 172 p, pl. 1-41, 80 text-fig.

_____, 1960, Upper Cretaceous ammonites of California, Pt. III. Kyushu Univ. Fac. Sci. Mem., Ser. D, Geology, Sp. V. 2, 204 p., 2 pl., 20 text-fig.

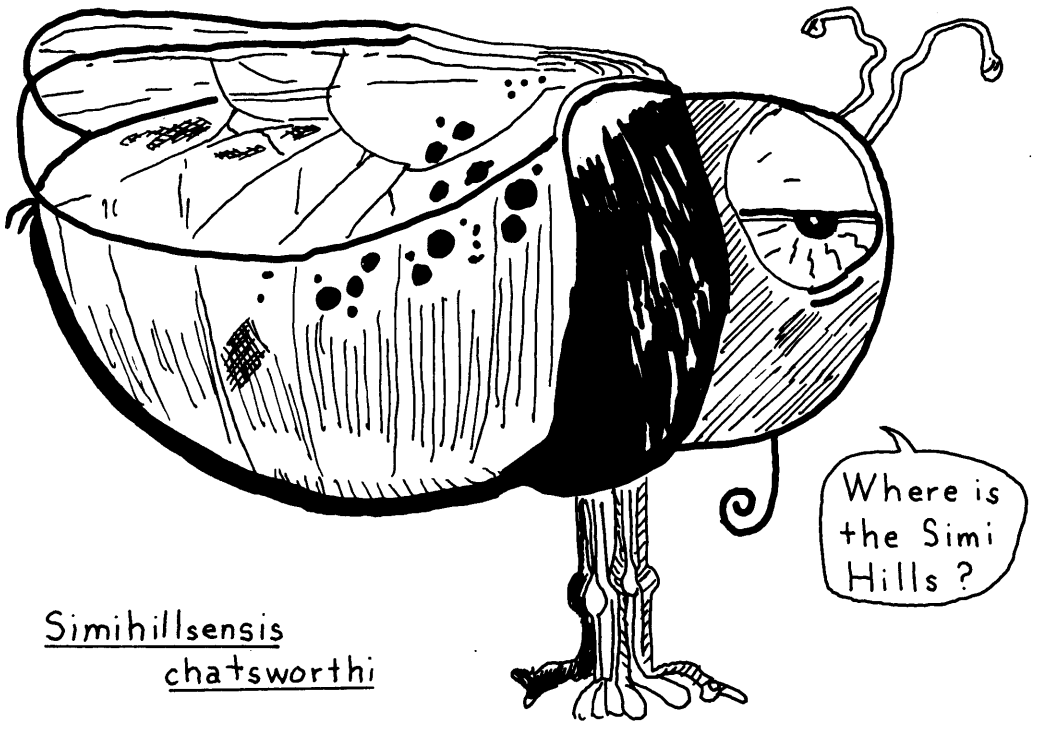
Matsumoto, T., & Morozumi, Y., 1980, Late Cretaceous ammonites from the Izumi Mountains, southwest Japan. Osaka Mus. Nat. Hist., Bull. 33, p. 1-31, pl. 1-16.

Meek, F. B., 1858, Descriptions of new organic remains from the Cretaceous rocks of Vancouver's Island. Albany Inst., Trans. v. 4, p. 37-49.

Moore, R. C. [ed.], 1957, Treatise on invertebrate paleontology. Lawrence, Kansas: Kansas Univ. Press & Geol. Soc. Amer., Pt. L, Mollusca 4, Cephalopoda, Ammonoidea: 490 p., 558 fig.

_____, 1969, Treatise on invertebrate paleontology. Pt. N, Mollusca 6, Bivalvia: Lawrence, Kansas,

Kansas Univ. Press and Geol. Soc. America, 952 p.
Muller, J. E. & Jeletzky, J. A., 1970, Geology of the Upper Cretaceous Nanaimo Group, Vancouver Island and Gulf Islands, British Columbia. Canada Geol. Surv., Paper 69-25, v., 77 p., 3 tab., 11 fig.
Packard, E. L., 1922, New species from the Cretaceous of the Santa Ana Mountains, California. Univ. Calif. Publ., Dept. Geol. Sci., Bull., v.13, p. 413-462, pls. 24-38.
Popenoe, W. P., 1937, Upper Cretaceous Mollusca from Southern California. Jour. Paleontology, v.11, p. 379-402, pl. 45-49.
_____, 1942, Upper Cretaceous formations and faunas of Southern California. Amer. Assoc. Petrol. Geol., Bull., v. 26, p. 162-187, 4 text-fig.
_____, 1954, Mesozoic formations and faunas, Southern California and Northern Baja California. Calif. Div. Mines Bull. 170, Chapter III, Historical Geology, p. 15-21, fig. 1-4.
_____, 1955, Cretaceous of Simi Hills, southern California (abs.). Geol. Soc. America, Bull. v. 66, 1659-1660.
_____, 1957, The Cretaceous gastropod genus Biplica. Univ. Calif. Publ. Geol. Sci., v. 30, p. 425-454, pl. 50-51, 1 text-fig.
_____, 1973, Southern California Cretaceous formations and faunas with especial reference to the Simi Hills and Santa Monica Mountains. In Fritsche, A. E. [ed.], Cretaceous stratigraphy of the Santa Monica Mountains and Simi Hills, Southern California. Soc. Econ. Paleont. & Mineral., Pacific Sec. Geol. Guidebook 1973 Fall Field trip, p. 15-29, 4 pls. 2 text-fig.
Reeside, J. B., Jr. & Cobban, W. A., 1960, Studies of the Mowry Shale (Cretaceous) and contemporary formations in the United States and Canada. U.S. Geol. Surv., Prof. Paper 355, 126 p., 58 pl.
Reinhart, P. W., 1937, Cretaceous and Tertiary pelecypods of the Pacific Slope incorrectly assigned to the family Arcidae. Jour. Paleontology, v. 11, p. 169-180, pl. 27.
Saul, L. R., 1973, Evidence for the origin of the Mactridae (Bivalvia) in the Cretaceous. Univ. Calif. Publ. Geol. Sci., v. 97, 59 p., 3 pl., 8 text-fig.
_____, 1974, Described or figured West Coast species of Cymbophora. Jour. Paleontology, v. 48, p. 1068-1095, 3 pls., 7 text-fig.
_____, 1978, The north Pacific Cretaceous trigoniid genus Yaadia. Univ. Calif. Publ. Geol. Sci., v. 119, 65 p., 12 pls., 20 text-fig., 12 tab.
_____, 1979, A hollow spined Anapachydiscus peninsularis with possible mososaur bit impressions. Los Angeles Co., Nat. Hist. Mus., Cont. Sci. 304, 8 p., 7 fig., 1 tab.
_____, In press. Turritella zonation across the Cretaceous-Tertiary Boundary. Univ. Calif. Publ. Geol. Sci.
Saul, L. R., & Popenoe, W. P., 1962, Meekia, enigmatic Cretaceous pelecypod genus. Univ. Calif. Pub. Geol. Sci., v. 40, p. 289-344, 6 pls, 4 text-fig.
Smith, J. P., 1900, The development and phylogeny of Placenticeras. Calif. Acad. Sci. Proc., ser. 3, v. 1, p. 181-240, pl. 24-28.
Stewart, R. B., 1927, Gabb's California fossil type gastropods. Acad. Nat. Sci. Phila., Proc., v. 78, 1926, p. 287-447, pl. 20-32.
Ward, P. D., & Mallory, V. S., 1977, Taxonomy and evolution of the lytoceratid genus Pseudoxybeloceras and relationship to the genus Solenoceras. Jour. Paleontology, v. 51, p. 606-618, 3 pl., 3 text-fig.
Waring, C. A., 1917, Stratigraphic and faunal relations of the Martinez to the Chico and Tejon of Southern California. Calif. Acad. Sci., Proc., (4), v. 7, p. 41-124, pl. 7-16.
White, C. A., 1885, On the Mesozoic and Cenozoic paleontology of California. U.S. Geol. Survey, Bull. 15, p. 1-33.
_____, 1889, On invertebrate fossils from the Pacific Coast. U.S. Geol. Surv., Bull. 51, 102 p., 14 pl.
Whiteaves, J. F., 1874, Notes on the Cretaceous fossils collected by Mr. James Richardson at Vancouver and the adjacent islands. Canada Geol. Survey, Rept. Progress 1873-1874, p. 260-268, pl.
_____, 1876-1903, Mesozoic Fossils. Canada Geol. Surv., v. 1, p. 1-415, pl. 1-51.
Yerkes, R. F., & Campbell, R. H., 1979, Stratigraphic nomenclature of the central Santa Monica Mountains, Los Angeles County, California. With a section on Age of the Conejo Volcanics by D. L. Turner & R. H. Campbell, U.S. Geol. Survey, Bull. 1457-E, 31 p., 3 pl., 5 fig.
Yonge, C. M., 1946, On the habits of Turritella communis Risso. Journ. Marine Biol. Assoc., v. 26, p. 377-380, 1 fig.



Simihillsensis chatsworthi