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NOTES ON PALEOGENE TURRITELLAS, VENERICARDIAS, AND MOLLUSCAN STAGES OF THE SIMI VALLEY AREA, CALIFORNIA

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ABSTRACT

Revision of *Turritella* spp. and *Venericardia* spp. from the Paleogene of the Simi Valley area aids in defining the molluscan faunal sequence present there. This Paleogene section comprises the uppermost part of an unnamed molluscan Stage older than the "Martinez" Stage, the "Martinez" Stage, most of the "Meganos" Stage, probably the uppermost part of the "Capay" Stage, and the "Domengine" Stage. The molluscan faunas provide age information for shallow-water deposits not readily dated by other fossil disciplines.

INTRODUCTION

Range zones of turritellas provide an important means of age determination and correlations of shallow-water Upper Cretaceous and Tertiary marine sedimentary rocks in California. These rocks usually lack planktic foraminifers and often do not have adequate benthic foraminifers for reliable correlation. Nannoplankton are also usually missing from these sediments. It was upon molluscan faunas from such shallow-marine facies that the molluscan stages (Figs. 1 & 2) were based. These stages have been criticized for imprecise biostratigraphic limits and boundaries and improper nomenclature (Givens, 1974, p. 31) at the same time that their existence, sequence, and recognizability have been confirmed. Occasionally some fortunate downslope transport of these shallow-water faunas into areas more favorable to planktic foraminifers and nannoplankton provides direct ties between the different zonations, but usually the correlations between the zonations are not quite that direct. The marine Paleogene section in the vicinity of Simi Valley is rich in turritellas and has at least a small portion of each molluscan stage above the Cretaceous-Tertiary boundary and below the "Transition" Stage. Correlations of Simi Valley area sediments based on planktic foraminifers and nannoplankton with other Early Tertiary West Coast sections are in good agreement with such correlations based on *Turritella* biozones and molluscan stages.

UNNAMED STAGE

The earliest turritellas from the upper Las Virgenes Sandstone and basal Santa Susana Formation in the Simi Hills are below those typical of the "Martinez" molluscan stage. These late *T. peninsularis quaylei* Saul (Pl. 1, fig. 2) suggest the top of an unnamed Stage roughly equivalent to the Danian (Fig. 1). This stage is better represented in the San Francisquito Formation near Warm Springs Mountain, Los Angeles Co., Calif.

"MARTINEZ" STAGE

Above the meagerly represented unnamed Stage *T. peninsularis* ANDERSON & HANNA is the most commonly encountered fossil. *T. peninsularis* occurs widely in California and Baja California (Saul, 1983) but, it has not been tied directly to foraminiferal and nannoplanktic zones. It occurs below *T. i. pachecoensis* which is associated with P4 Zone Foraminifera at the base of the Lodo Formation, south of Panoche Creek, Fresno Co., Calif. In Poison Oak Canyon, Santa Susana Mts., it is found in fossiliferous cobbles in conglomerate lenses above the lowest occurrence of the *Heliolithus kleinpellii* Zone (Poore, 1976) (=CP5 Zone, Okada & Bukry, 1980) and is thus older than P4 = *Planorotalites pseudomenardii* Zone (see Fig. 1). In the Simi Hills, *T. peninsularis* ranges through 200+m of the lower Santa Susana Formation — above *T. p. quaylei* and below *T. infragranulata pachecoensis*. A few meters above *T. infragrannulata pachecoensis* in the Bus Canyon section, Finch (1980) records Foraminifera of the P4 Zone. In the Paleocene section near Martinez, Contra Costa Co., from whence the "Martinez" Stage derives its name, *T. peninsularis* occurs 233m below Foraminifera assigned to the P4 Zone (Schmidt, 1975). *T. infragranulata pachecoensis* STANTON and *T. infragranulata* GABB are found 300m higher in the same Pacheco Syncline section (Saul, 1983, p. 35), and the "Martinez" Stage thus comprises the zones of *T. peninsularis*, *T. i. pachecoensis* and *T. infragranulata*.

Shallow-water mollusks of the *T. infragranulata* Zone are not common in the Simi Valley area. Deposits assignable to this zone are apparently of too deep water to yield more than scrappy shallow-water faunas. The zone is better developed in the Santa Monica Mts. Shallow-water molluscan faunas there suggest that *T. susanaensis* NELSON is actually the apical portion of a *T. infragranulata* GABB and that *T. ?buwaldana subuvasana* NELSON occurs in this zone.

"MEGANOS" STAGE

Heitman (this volume) finds planktic foraminifers indicative of P5 and lower P6 Zones, and Filewicz & Hill (this volume) record CP8 Zone and probable CP9 Zone nannoplankton in the upper Santa Susana Formation. In these deep-water sediments only a few mollusks have been found. An undescribed *Turritella* (Pl. 1, fig. 12) of unknown affinites occurs in these beds. Toward the top of the Santa Susana, microfossils are less abundant and megafossils become more so. In the upper 100m a few thin fossiliferous stringers contain mainly turritellas. These are predominantly *T. andersoni* n. subsp. (Pl. 1, figs. 15-18) and *T. uvasana infera* MERRIAM (pl. 1, fig. 19). Although referred to *T. u. infera*, the specimens from the upper Santa Susana Formation have more rounded whorl profile and heavier ribbing than

in Squires, R.R. and Filewicz, M.V., eds., 1983, **Cenozoic Geology of the Simi Valley Area, Southern California,** Pacific Section, S.E.P.M., Fall Field Trip Volume and Guidebook, p. 71-80.

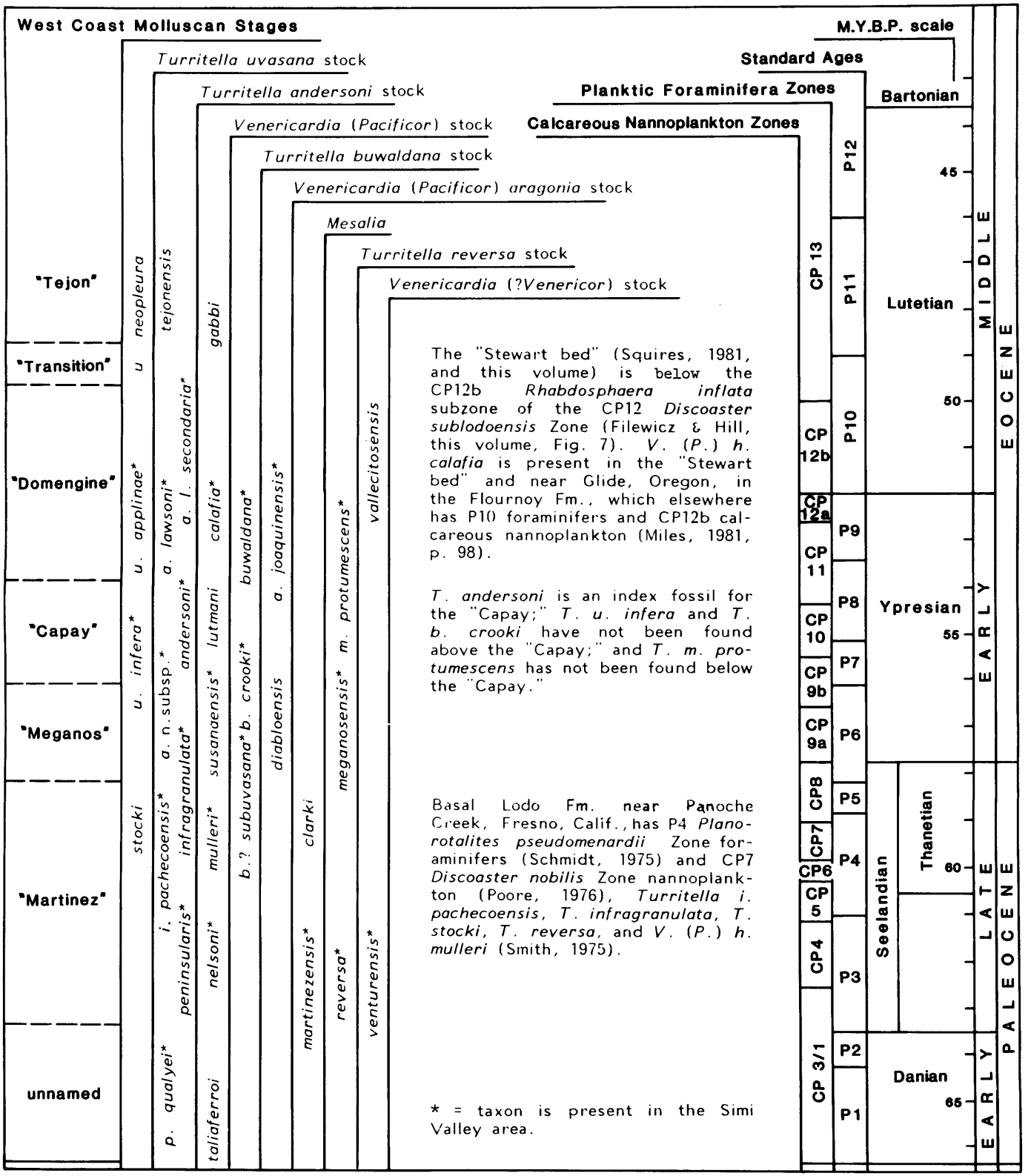


Figure 1. Paleogene West Coast molluscan stages, turritellids and venericardias plotted against M.Y.B.P. scale, standard ages, planktic Foraminifera zones, and calcareous nannofossil zones after Hardenbol & Berggren (1978, p. 219), Okada & Bukry (1980, p. 322) and Berggren, Kent, & Flynn (in press, fig. 3) with m.y. conversion from Dalrymple (1979). With the exception of *Venericardia* (*P.*) *taliaferroi* which is also known from the late Maestrichtian, the initial letter of a specific name indicates its earliest appearance.

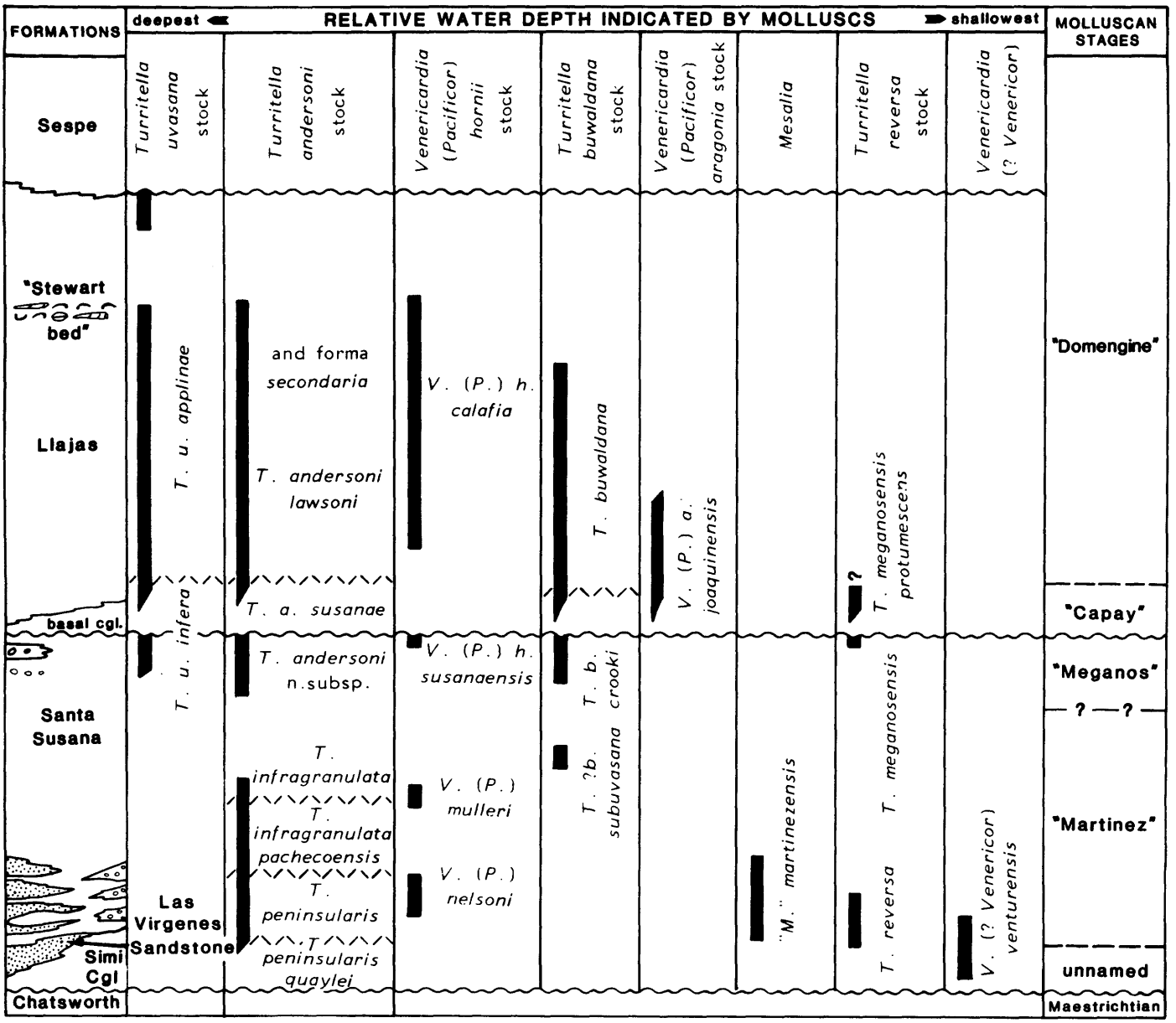


Figure 2. Occurrence of turritellids and venericardias in Simi Valley area Paleogene deposits and the molluscan stages they indicate. Turritellids and venericardias are listed according to the water depth each lineage suggests.

those from the type locality low in the Llajas Formation. *T. buwaldana crooki* is also present especially in the upper 50m of the Santa Susana Formation. Approximately 7.5m below the Llajas Formation is UCB loc. 7000. The Meganos age of the upper 100m of Santa Susana Formation was first proclaimed by Clark (1921) who based this assignment upon the locally abundant fauna from UCB loc. 7000. This fauna includes the shallow-water turritella *T. meganosensis* CLARK & WOODFORD (Pl. 1, fig. 13) and *Venericardia (Pacificor) hornii susanaensis* VERASTEGUI (Pl. 1, fig. 14).

The Meganos D fauna, from which the stage derives its name, does not have any representative of the *T. andersoni* line. Nor, although it has *V. (P.) aragonia diabloensis* VERASTEGUI, does it have a representative of the *V. (P.) hornii* line. It does have *T. meganosensis* CLARK & WOODFORD and specimens of *T. uvasana infera* MERRIAM, similar to those from the Santa Susana Formation. *T. meganosensis* has been referred to the *T. reversa* stock (Merriam, 1941, p. 39). This stock is represented in the "Capay" Stage by *T. m. protumescens* (Pl. 2, fig. 1). The most likely precursor for *T. u. infera* is *T. stocki* MERRIAM which is known only from the *T. i. pachecoensis* Zone. *T. u. infera* is present 50+m below the occurrence of *T. meganosensis*. More common than *T. u. infera* in the upper Santa Susana Formation is *T. andersoni* n. subsp. (Pl. 1, figs. 15-18) which has been collected through the upper 90m of the Santa Susana Formation. Merriam (1941, p. 79) identified these specimens with *T. a. susanae* whose type locality (UCB loc. A-993) is in the "basal" Llajas Formation, at the same time noting that there is a difference in sculpture. Although more than 100 specimens of *T. andersoni* n. subsp. from the Santa Susana Formation have been examined, none has the

sculpture of the Llajas specimens. Some of the Santa Susana specimens are very close to *T. andersoni* DICKERSON, especially some from localities near the Llajas-Santa Susana contact suggesting that the uppermost Santa Susana Formation is late "Meganos" in age. A late "Meganos" age is also suggested by Merriam & Turner (1937, p. 93) in their discussion of *Ficopsis meganosensis* CLARK & WOODFORD.

"CAPAY" STAGE

All occurrences of *T. andersoni* and *V. (P.) hornii lutmani* are considered to be indicative of the restricted "Capay" Stage of Givens (1974, p. 23) which includes the range of the *Turritella uvasana infera* Fauna of Givens and excludes the "Upper Capay Stage" of Clark & Vokes (1936). It is in this restricted sense that "Capay" is used herein. *V. (P.) hornii lutmani* TURNER (Pl. 2, fig. 6) occurs with *T. andersoni* in the Roseburg Formation of Oregon (assigned to Zone P7/8 by Miles, 1981, p. 90) and the lower Juncal Formation of the Pine Mountain area, Ventura Co., California (Givens, 1974, p. 16). In their definition of the "Capay" Stage, Merriam and Turner (1937) included the Llajas beds which carry *T. m. protumescens*. Also present in this fauna are *T. uvasana infera* MERRIAM (Pl. 2, fig. 4) which does not range higher than the "Capay" (Givens, 1974, p. 65) and *T. buwaldana crooki* MERRIAM & TURNER (Pl. 2, figs. 2-3). As restricted by Givens, the "Capay" Stage is equivalent to the zone of *T. andersoni*. *T. a. susanae* MERRIAM (Pl. 2, fig. 5) differs from *T. andersoni* mainly in the strength of the sculpture, but not in the placement of the spirals, and large collections of *T. andersoni* usually have some specimens with sculpture similar to *T. a. susanae*. The "Capay" fauna has been collected from a narrow stratigraphic interval at the base of the interfingering shallow–marine facies (Squires, 1981; this volume) and below the occurrence of *Turritella andersoni lawsoni* DICKERSON.

"DOMENGINE" STAGE

Turritella andersoni lawsoni DICKERSON and its variant *T. a. l. secondaria* MERRIAM ranges from just above the interval of interfingering between the coastal alluvial-fan facies to the "Stewart bed" of the Llajas Formation (Squires, 1981; this volume). It, *T. u. applinae* MERRIAM, *T. buwaldana* DICKERSON, and *Venericardia (P.) hornii calafia* STEWART are indicative of the "Domengine" Stage (Givens, 1974; Givens & Kennedy, 1979). Filewicz and Hill (this volume) find CP12 Zone calcareous nannoplankton above and below the Llajas "Stewart bed" of Squires (1981; this volume). CP12 is correlated with upper P9 and lower P10 (Okada & Bukry, 1980; Berggren, et al., in press) (Fig. 1). *V. (P.) hornii calafia* is present in the Flournoy Formation near Glide, Oregon, which Miles (1981) indicates is also P10. It is also probably present — based on *V. (P.) oregonensis* VERASTEQUI (Pl. 2, fig. 9), which appears to be an immature *V. (P.) h. calafia* — in the underlying Lookingglass Formation. The type Domengine has *T. a. lawsoni*, and Poore (1976) finds *Discoaster sublodoensis* = CP12 Zone in the Domengine Formation. Vokes (1939, p. 70) tentatively recognized *V. (P.) h. calafia* from the Domengine near Griswolds. In the San Diego area, the Ardath Shale yields *T. a. lawsoni* and *T. u. applinae* (Pl. 2, fig. 19) and has foraminifers correlative with P10/11 and calcareous nannoplankton of the CP12 Zone. *T. a. lawsoni* has been collected from near the base of the Mount Soledad Formation (Givens & Kennedy, 1979, p. 83), the probably deltaic deposits of which underly the deeper-water Ardath Shale. The "Capay"-"Domengine" Stage boundary thus lies near the P8-9 boundary (probably within P8) and not as indicated by Miles (1981, p. 100) near the P9-10 boun-

PLATE 1

Figs. 1-2. Turritellids of the unnamed Stage.

1. *Turritella peninsularis quaylei* SAUL, 1983, late form; x2; UCLA 58888; UCLA loc. 3111.
2. *Mesalia martinezensis* (GABB, 1869), x1; UCLA 59360; UCLA loc. 3111, Calabasas Quad., Simi Hills; top of Las Virgenes Sandstone. This species is also present in the "Martinez" Stage.

Figs. 3-11. Turritellas and venericardias of the "Martinez" Stage.

3-4. *Turritella peninsularis* ANDERSON & HANNA, 1935; x1; 5. UCLA 58907; UCLA loc. 2333, Pinyon Ridge, Valyermo Quad.; San Francisquito Fm. 6. UCLA 49512; UCLA loc. 2687, Calabasas Quad., Simi Hills; lower Santa Susana Fm. Photo by T. Susuki.

3. *Turritella reversa* WARING, 1917; x1; UCLA 58932; UCLA loc. 6547, Poison Oak Canyon, Santa Susana Quad.; fossiliferous cobble in Santa Susana Fm.

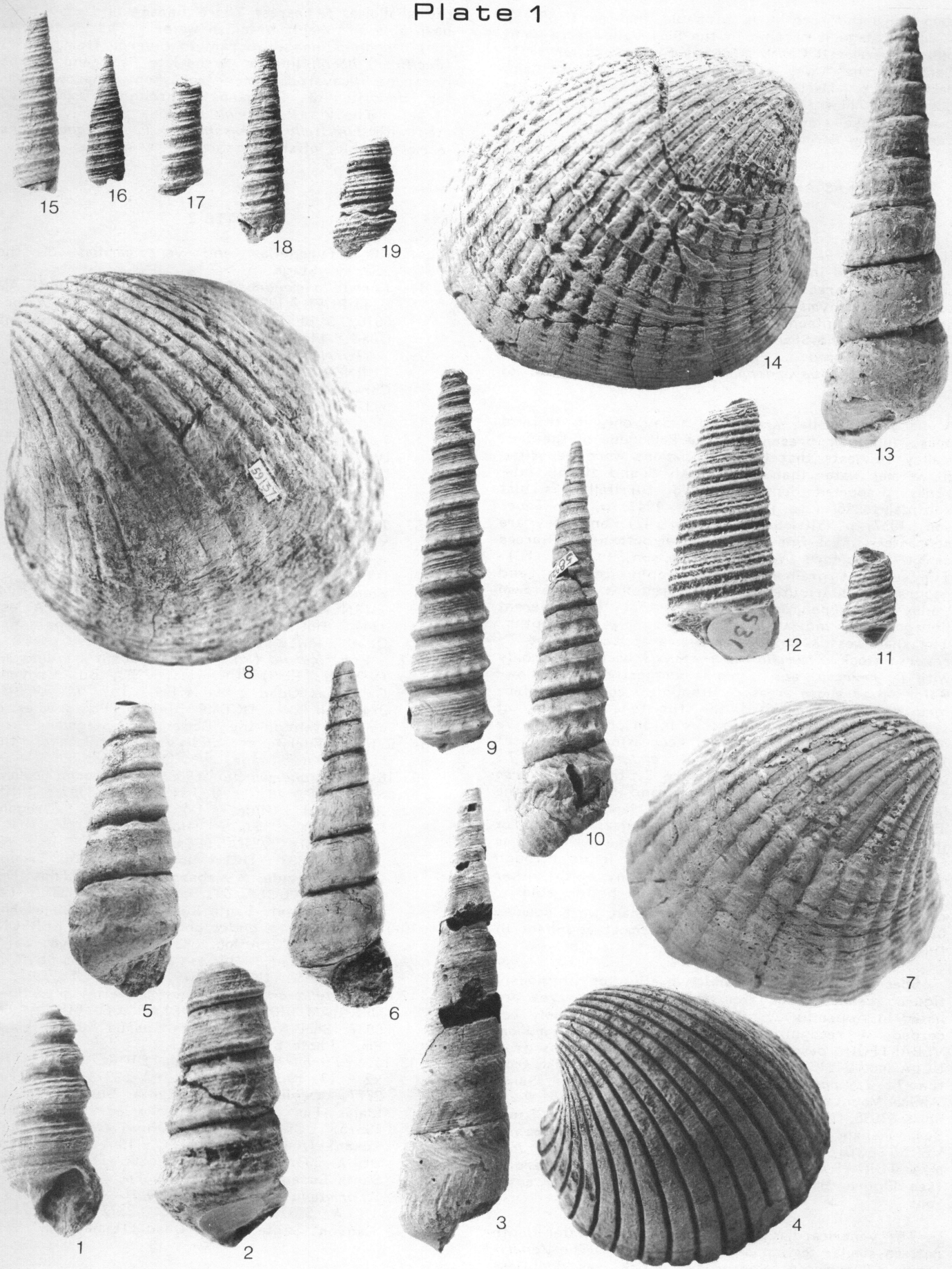
4. *Venericardia (Venericor?) venturensis* WARING, 1915; x.75; 59362; UCLA loc. 2689, Calabasas Quad.; Simi Hills; basal Santa Susana Fm. Fm. This species is also present in the unnamed Stage preceeding the "Martinez".

7. *Venericardia (Pacificor) nelsoni* VERASTEGUI, 1953; x.75; UCBMP 32804; UCB loc. 3765, Calabasas Quad., Simi Hills; lower Santa Susana Fm. [Holotype of *V. (P.) transversaria* VERASTEGUI, 1953].
8. *Venericardia (Pacificor) mulleri* VERASTEGUI, 1953; x.75; UCLA 59137; Garapito Creek, Santa Monica Mts.; Coal Canyon Fm.
9. *Turritella infragranulata* GABB, 1864; x.75; UCLA 58931; UCLA loc. 6572, Garapito Creek, Santa Monica Mts.; Coal Canyon Fm.
10. *Turritella infragranulata pachecoensis* STANTON, 1896; x.75; UCLA 58920; UCLA loc. 6583, Encino Reservoir, Santa Monica Mts.; Coal Canyon Fm.
11. *Turritella ?buwaldana subuvasana* NELSON, 1925; x2; UCLA 59361; UCLA loc. 3172, Calabasas Quad., Simi Hills; Santa Susana Fm.

Figs. 12-19. Turritellas and venericardias of the "Meganos" Stage.

12. *Turritella* n. sp.; x2; UCLA 59363; CIT loc. 531, Santa Susana Quad.; Santa Susana Fm., 242m below Llajas Fm.
13. *Turritella meganosensis* CLARK & WOODFORD, 1927; x1; UCBMP 37430; UCB loc. 7000, N of Las Llajas Canyon, Santa Susana Quad.; Santa Susana Fm., 7.5m below Llajas Fm.
14. *Venericardia (Pacificor) hornii susanaensis* VERASTEGUI, 1953; x.75; UCBMP 37431; UCB loc. 7000, N of Las Llajas Canyon Santa Susana Quad.; Santa Susana Fm., 7.5m below Llajas Fm.
15-18. *Turritella andersoni* n. subsp.; x1; "Oil Seep Canyon" = Chivo Canyon, Santa Susana Quad.; Santa Susana Fm., approx. 34m below basal Llajas Fm. 15. UCLA 59364. 16. UCLA 59367. 17. UCLA 59366. 18. UCLA 59365.
19. *Turritella uvasana infera* MERRIAM, 1941; x1; UCBMP 37429; UCB loc. 7000, N of Las Llajas Canyon, Santa Susana Quad.; Santa Susana Fm., 7.5m below Llajas Fm.

Plate 1



dary. Furthermore it is probable that most of the "Capay" Stage is missing in the Simi Valley area, and only uppermost "Capay" (sensu Givens) is present. Certainly the lower Llajas has yielded no mollusks restricted to "Martinez" or "Meganos" stages as suggested by Miles (1981, p. 100), but mollusks indicative of these stages have been recovered from the Santa Susana Formation.

TURRITELLAS AND VENERICARDIAS OF THE SIMI VALLEY AREA

Species, subspecies, and varieties of *Turritella* figured from Paleogene deposits of the Simi Valley area are listed in Appendix 1. Some of these I consider to be unrecognizable, e.g., *T. hannai* NELSON; some are synonyms; and at least two are as yet undescribed. Seventeen taxa (see Figure 2) occur in the Paleogene of the Simi Valley area, and the recognized forms are figured on Plates 1-2. Of the stocks indicated, the *T. buwaldana* stock is most in need of further study.

Large turritellas are found today only in tropical seas, and their presence in the Paleogene of the Simi Valley suggests that these formations were deposited in warmer water than is presently found at this latitude. Reported depth range of turritellas is just subtidal to 150m (e.g., Merriam, 1941, p. 14; Thorson, 1957, p. 510; Saul, 1983, p. 42), and they are characteristic of fine-grained level-bottom shelf areas of low turbulence (Yonge & Thompson, 1976, p. 88). The sediment grain size, stratigraphic position, and geographic distribution of the turritellas in the Simi Valley Paleocene rocks suggests that the different lineages are indicative of different water depths. The shallowest living of these was apparently the *T. reversa* stock. *Mesalia martinezensis* occurs commonly with *T. reversa*, and it too is suggestive of shallow-water, near-shore areas. Although a complex of factors doubtless delimited the turritella habitats, it seems possible to list the stocks in an order reflective of increasing water depth and decreasing turbulence: *T. reversa*, *T. buwaldana*, *T. andersoni*, and *T. uvasana*. As indicated in Figure 2, the *T. reversa* stock is represented at the base and the top of the Santa Susana and the base of the Llajas Formations. The *T. buwaldana* stock is present near the top of the Santa Susana Formation and in the lower Llajas Formation. The *T. andersoni* stock is found through more of the Simi Valley section than any of the other stocks. Its species may have been better able to cope with softer, muddier bottoms than were species of the *T. uvasana* stock which are most abundant in fine-grained, clean-sand deposits.

Species, subspecies, and varieties of previously figured venericardias from the Simi Valley area are listed in Appendix 2. Of the 10 taxa previously recorded, I recognize 4 and add *V.* (*P.*) *mulleri* VERASTEGUI based on unphotogenic specimens from UCLA loc. 3121. A more suitable specimen, also from the *T. i. pachecoensis* Zone but from the Santa Monica Mountains, is figured (Pl. 1, fig. 8). Turner's (1938, p. 50) *V. hornii lutmani* from the "Santa Susana shale" is undoubtedly *V.* (*P.*) *h. susanaensis* VERASTEGUI (Pl. 1, fig. 14), and *V.* (*P.*) *h. lutmani* TURNER has not been found. Six venericardias (see Figure 2) are present in the Simi Valley environs.

The venericardias also appear to fit a water-depth pattern similar to that of the turritellas. The *Venericardia* (*?Venericor*) *venturensis* stock was doubtless the shallowest, nearest shore lineage and may have been able to inhabit brackish water. The *V.* (*Pacificor*) *aragonia* lineage appears to diverge from the *V.* (*Pacificor*) *hornii* lineage in the late Paleocene. Thus it can be recovered from nearer shore, shallower water deposits of "Meganos" through "Domengine" Stages. The *V.* (*P.*) *hornii* stock is typically associated with *Turritella andersoni* and *T. uvasana* stocks in more stable, offshore habitats.

PLATE 2

Figs. 1-8. Turritellas and venericardias of the "Capay" Stage.

1. *Turritella meganosensis protumescens* MERRIAM & TURNER, 1937; x1; UCLA 59371; UCLA loc. 6616, S of Las Llajas Canyon, Santa Susana Quad.; Llajas Fm.

2-3. *Turritella buwaldana crooki* MERRIAM & TURNER, 1937; x2; UCLA loc. 6615, Chivo Canyon, Santa Susana Llajas Fm. 2. UCLA 59372. 3. UCLA 59373. This subspecies is also present in the "Meganos" Stage.

4. *Turritella uvasana infera* MERRIAM, 1941; x2; UCLA 59359; UCLA loc. 6616, S of Las Llajas Canyon, Santa Susana Quad.; Llajas Fm. This subspecies is also present in the "Meganos" Stage.

5. *Turritella andersoni susanae* MERRIAM, 1941; x1.75; UCBMP 15295, Holotype; UCB loc. A-993, Las Llajas Canyon, Santa Susana Quad.; Llajas Fm. Photo by T. Susuki.

6. *Venericardia* (*Pacificor*) *hornii lutmani* TURNER, 1938; x.75; UCLA 59381; UCLA loc. 4244, Hot Springs Canyon, Topatopa Mts. Quad.; lower Juncal Fm.

7-8. *Venericardia* (*Pacificor*) *aragonia joaquinensis* (VOKES, 1939); UCB loc. 7193, Bus Canyon, Calabasas Quad.; Llajas Fm. 7. x.75; UCBMP 37432. 8. x1; UCBMP 37433; This species is also present in the "Domengine" Stage.

Figs. 9-18. Turritellas and venericardias of the "Domengine" Stage.

9, 16-17. *Venericardia* (*Pacificor*) *hornii calafia* STEWART, 1930. 9. x1; LSJU 8099; Little River at Glide, Douglas Co., Oregon; Lookingglass Fm. [Holotype of *V.* (*P.*) *oregonensis* VERASTEGUI, 1953]. 16. x1; UCLA 59383; UCLA loc. 7071, Bus-Trough Canyon divide, Calabasas Quad.; Llajas Fm. 17. x.75; UCLA 59378; UCLA loc. 2312, Las Llajas Canyon, Santa Susana Quad.; Llajas Fm.

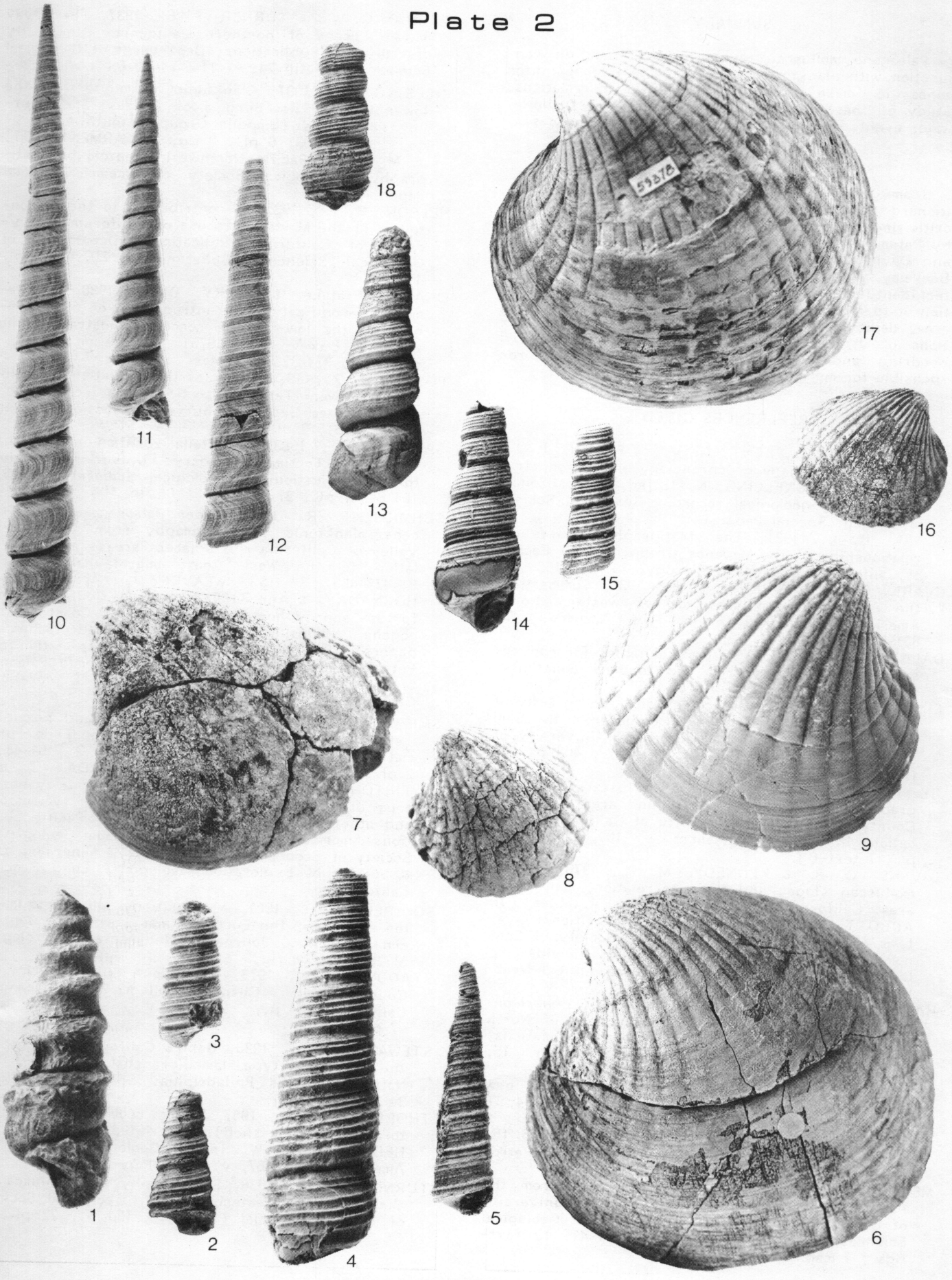
10-11. *Turritella andersoni lawsoni* DICKERSON, 1916; x1; UCLA loc. 5837, Simi Arroyo, Santa Susana Quad.; Llajas Fm. Photos by T. Susuki. 10. UCLA 59379. 11. UCLA 59397.

12. *Turritella andersoni lawsoni* forma *secondaria* MERRIAM, 1941; x1; UCLA 59380; UCLA loc. 5837, Simi Arroyo, Santa Susana Quad.; Llajas Fm. Photo by T. Susuki.

13-15. *Turritella buwaldana* DICKERSON, 1916; x2. 13. typical form; UCLA 59374; UCLA loc. 2777, Devil Canyon, Santa Susana Quad.; Llajas Fm. 14. round-whorled form; UCLA 59375; UCLA loc. 586, Chivo Canyon, Santa Susana Quad.; Llajas Fm. 15. slender form; UCLA 59376; UCLA loc. 586, Chivo Canyon, Santa Susana Quad., Llajas Fm.

18. *Turritella uvasana applinae* HANNA, 1927; x1; UCLA 59377; UCLA loc. 2312, Las Llajas Canyon, Santa Susana Quad.; Llajas Fm.

Plate 2



SUMMARY

Paleogene molluscan faunas can be used in conjunction with planktic foraminiferal and nannoplankton zones to make possible finer-scale correlations. Study of these faunas helps delineate the shallower water events of transgressive-regressive sequences.

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APPENDIX 1

Paleogene *Turritella* spp. of the Simi Valley area figured by previous workers, revised where necessary, and Stage or Zone of occurrence indicated.

andersoni DICKERSON
WARING, 1917, p. 99, pl. 15, fig. 18. SEE *andersoni lawsoni* DICKERSON

andersoni lawsoni DICKERSON
MERRIAM, 1941, p. 77, pl. 9, fig. 5-7.
"Domengine" Stage, upper P8 to P10

andersoni lawsoni secondaria MERRIAM
MERRIAM, 1941, p. 78, pl. 9, fig. 9.
"Domengine" Stage

andersoni susanae MERRIAM
MERRIAM, 1941, p. 79, pl. 11, fig. 6. May be *andersoni* DICKERSON
"Capay" Stage

buwaldana DICKERSON
MERRIAM, 1941, p. 87, pl. 22, fig. 1-6, 13.
"Domengine" Stage

?*buwaldana subuvasana* NELSON
this paper, pl. 1, fig. 11.
"Martinez" Stage, possibly P4-5

hannai NELSON
NELSON, 1925, p. 422, pl. 56, fig. 3-4; MERRIAM, 1941, p. 73, pl. 41, fig. 5-6. Possibly a juvenile *infragranulata pachecoensis* STANTON

infragranulata GABB
WARING, 1917, p. 99, pl. 15, fig. 20 (but the specimen is probably from the Santa Monica Mts.)
"Martinez" Stage, P4/5

infragranulata pachecoensis STANTON
SAUL, 1983, p. 95, pl. 7, fig. 2, text-fig. 21, A2.
"Martinez" Stage, P4

meganosensis CLARK & WOODFORD
MERRIAM, 1941, p. 75, pl. 8, fig. 9.
"Meganos" Stage, P6

meganosensis protumescens MERRIAM & TURNER
MERRIAM & TURNER, 1937, p. 104, pl. 6, fig. 8; MERRIAM, 1941, p. 75, pl. 8, fig. 1-2, 5-6.
"Capay" Stage

pachecoensis STANTON
WARING, 1917, p. 88, pl. 12, fig. 20; MERRIAM, 1941, p. 69 (in part). SEE *infragranulata pachecoensis* STANTON
STADUM, 1973, p. 25, pl. 3, fig. 5. SEE *peninsularis* ANDERSON & HANNA

pachecoensis renodata MERRIAM
MERRIAM, 1941, p. 69, pl. 4, fig. 7-8. SEE *peninsularis* ANDERSON & HANNA

pachecoensis waringi MERRIAM
MERRIAM, 1941, p. 69, pl. 7, fig. 5. See *infragranulata* GABB (this specimen probably from the Santa Monica Mountains)

peninsularis ANDERSON & HANNA
SAUL, 1983, p. 92, pl. 6, fig. 17, 19, 21-23, text-fig. 21, B2-5.
"Martinez" Stage, P3

peninsularis quaylei SAUL
SAUL, 1983, p. 89, pl. 6, figs. 13, 16, text-fig. 21, C1, C4.
Unnamed Stage = ?Danian

reversa WARING
WARING, 1917, p. 88, pl. 12, fig. 15; MERRIAM, 1941, p. 74, pl. 7, figs. 7-11; SAUL, 1983, p. 91, pl. 6, fig. 24, text-fig. 21, B1.
"Martinez" Stage, P3

simiensis WARING
WARING, 1917, p. 88, pl. 14, fig. 15. SEE *infragranulata pachecoensis* STANTON

subuvasana NELSON
NELSON, 1925, p. 423, pl. 56, figs. 5-7; MERRIAM, 1941, p. 74, pl. 41, fig. 1-3. See ?*buwaldana subuvasana* NELSON

susanaensis NELSON
NELSON, 1925, p. 423, pl. 56, fig. 1-2; MERRIAM, 1941, p. 73, pl. 41, fig. 4, 10. Probably a juvenile *infragranulata* STANTON

uvasana CONRAD
WARING, 1917, p. 100, pl. 15, fig. 13. SEE *uvasana applinae* HANNA

uvasana applinae HANNA
this paper, pl. 2, fig. 18.
"Domengine' Stage

uvasana etheringtoni MERRIAM
MERRIAM, 1941, p. 94, pl. 15, fig. 12-15. SEE *uvasana applinae* HANNA

uvasana infera MERRIAM
MERRIAM, 1941, p. 90, pl. 40, fig. 2-4.
"Meganos-Capay" Stages, P6 to lower P8

APPENDIX 2

Venericardia spp. of the Simi Valley area figured by previous workers, revised where necessary, and Stage or Zone of occurrence indicated. Verastegui (1953) placed 2 species *simiana* and *venturaensis* in the subgenus *Venericor*; 4 — *calafia, nelsoni, susanaensis*, and *transversaria* — in *Pacificor*; and 3 — *alisoensis, joaquinensis*, and *schencki* — in *Leuroactis*. I leave *venturensis* in ?*Venericor* and assign the rest to *Pacificor*.

alisoensis VERASTEGUI
VERASTEGUI, 1953, p. 52 (446), pl. 10 (49), fig. 1-3. SEE *aragonia joaquinensis* (VOKES)

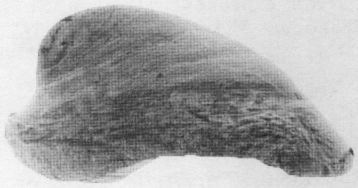
aragonia joaquinensis (VOKES)
this paper, pl. 2, fig. 7-8.
upper "Capay" and "Domengine" Stages

calafia STEWART
VERASTEGUI, 1953, p. 28 (422), pl. 16 (55), fig. 1-3; pl. 17 (56), fig. 1-2. SEE *hornii calafia* STEWART

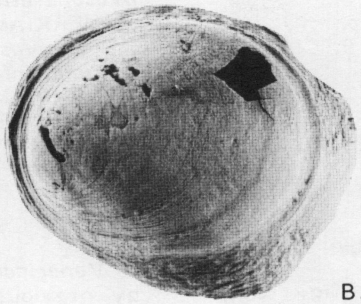
hornii calafia STEWART
STEWART, 1930, p. 168, pl. 11, fig. 2.
"Domengine" Stage, upper P8 to P10

ionensis WARING
HANNA, 1925, p. 284, pl. 42, fig. 1-2. SEE *aragonia joaquinensis* (VOKES)

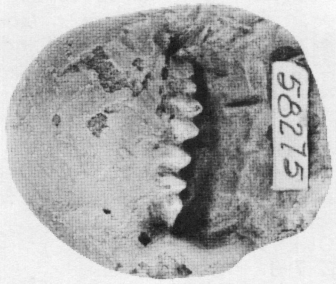
joaquinensis (VOKES)
VERASTEGUI, 1953, p. 60 (454), pl. 12 (25), fig. 4-6. SEE *aragonia joaquinensis* (VOKES)
nelsoni VERASTEGUI
VERASTEGUI, 1953, p. 21 (415), pl. 2 (41), fig. 1, 5; pl. 3 (42), fig. 5.
"Martinez" Stage, probably P3
planicosta venturensis WARING
WARING in MCLAUGHLIN, 1915, pl. 1, fig. 12; WARING, 1917, p. 80, pl. 11, fig. 6-9. SEE *venturensis* WARING
schencki VERASTEGUI
VERASTEGUI, 1953, p. 50 (444), pl. 4 (43), fig. 6-8. SEE *aragonia joaquinensis* (VOKES)
simiana VERASTEGUI
VERASTEGUI, 1953, p. 47 (441), pl. 4 (43), fig. 1-4. SEE *venturensis* WARING
susanaensis VERASTEGUI
VERASTEGUI, 1953, p. 22 (416), pl. 5 (44), figs. 1-4. SEE *hornii susanaensis* VERASTEGUI
"Meganos" Stage, probably P6.
transversaria VERASTEGUI
VERASTEGUI, 1953, p. 37 (431), pl. 2 (41), fig. 3-5. SEE *nelsoni* VERASTEGUI
venturensis WARING
HANNA, 1925, p. 284, pl. 42, fig. 1-2; VERASTEGUI, 1953, p. 45 (439), pl. 3 (420), fig. 1-4; pl. 4 (43). fig. 5.
uppermost "Unnamed" (=?Danian) and "Martinez" Stages, possibly P2-P3



C. spiral view



B. abapertural view



A. apertural view

Velates californicus VOKES, 1935
PALEOCENE, "Meganos" Stage: upper Santa Susana Formation
UCLA 58275 from UCLA loc. 3173, southwest of Runkle Canyon, Calabasas Quad., Ventura Co., California

errata

Plate 1

Fig. 1. *Mesalia martinezensis* (GABB, 1869)

Fig. 2. *Turritella peninsularis quaylei* SAUL, 1983

Fig. 3. *Turritella reversa* WARING, 1917

Fig. 4. *Venericardia (Venericor?) venturensis* WARING, 1915

Fig. 5-6. *Turritella peninsularis* ANDERSON & HANNA, 1935

p. 78, 2nd column, 3rd line of Smith reference

mation of Fresno County, California. P. 464-483,