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EOCENE MACROPALEONTOLOGY OF NORTHERN LOCKWOOD VALLEY, VENTURA COUNTY, CALIFORNIA

Richard L. Squires

Natural History Museum of Los Angeles County • 900 Exposition Boulevard • Los Angeles, California 90007

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Richard L. Squires

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EOCENE MACROPALEONTOLOGY OF NORTHERN LOCKWOOD VALLEY, VENTURA COUNTY, CALIFORNIA

Richard L. Squires[1]

ABSTRACT. The Juncal Formation?, composed mainly of muddy siltstone, crops out in northern Lockwood Valley just south of Mount Pinos, southern California. Forty-six taxa, represented by one solitary coral, one annelid, one scaphopod, 31 gastropods, and 12 bivalves have been recovered. Two new species are described and named: *Coccodentalium emersoni* new species, the first record of *Coccodentalium* in North America and the earliest known record anywhere in the world, and *Arene mcleani* new species, the first recognized Paleogene species of this genus on the West Coast.

Macrofossils are scarce, usually fragmented, and found in lenses in the lower and uppermost parts of the 605-m-thick formation. The amount of postmortem transport was not great, and the macrofossils are inferred to have lived in warm-temperate to subtropical seas along a protected rocky coast that extended into transition-zone depths less than about 60 m. Deposition of the primarily transgressive sequence coincided with the early Eocene sea-level rise (TE1.2 of Vail and Hardenbol, 1979).

The macrofossils indicate an early Eocene age ("Capay Stage") for the entire formation. The molluscan stage range of the following species and subspecies can now be extended to include the "Capay Stage" based on the presence of these species in the formation: *Homalopoma umpquaensis domenginensis, Turritella buwaldana, Turritella uvasana hendoni* s.l., *Xenophora stocki, Galeodea* (*Caliagaleodea*) *californica, Trypanotoma stocki, Olequahia domenginica, Conus caleocius,* and *Glyptoactis* (*Claibornicardia*) *domenginica.*

Geochronologically, the Juncal Formation? in the northern Lockwood Valley area is the same age as the lower Juncal Formation in the Pine Mountain and Whitaker Peak areas; the lower part of the Llajas Formation in the Simi Valley area; and the Maniobra Formation in the Salton Sea area, all in southern California. The Juncal Formation? in the study area is most similar lithostratigraphically to the lower Juncal Formation in the Pine Mountain and Whitaker Peak areas.

INTRODUCTION

The study area covers the thickest and best exposed western and central parts of the Juncal Formation? in northern Lockwood Valley, just south of Mount Pinos (Figs. 1, 2) in southern California. The objective of this report is to provide, for the first time, a study of the molluscan biostratigraphy of these strata. Based on the molluscan fossils, refinements in the geologic age and depositional environments of the formation are possible.

In the course of this study, a new scaphopod and a new gastropod are described, and a cassid gastropod that has affinity to an Anglo-Paris Basin species is discussed. New information on the biogeography and molluscan stage ranges of some of the taxa are presented.

From 1984 through 1986, the geology of the study area was mapped by the author, and about 300 macrofossil specimens were collected from 11 localities (described in the "Localities" section). The geographic location and relative stratigraphic position of each are shown in Figure 2. Macrofossils were found only in the lower and uppermost parts of the Juncal Formation? and are confined to sandstone lenses. Preservation is poor to fair. Every fossiliferous lens that was found was collected to the point that every identifiable specimen was taken. In spite of such concentrated collecting, the yield of specimens was low due to the sparsity of the specimens.

Forty-six taxa, two of which are new species, were identified from the sandstone lenses. Ninety-six percent of the taxa are mollusks. Taxa identified to species or subspecies are one solitary coral, one annelid, one scaphopod, 31 gastropods, and 12 bivalves. All species are illustrated on Figures 4–55. In addition, unidentifiable scaphopod, ostreid, and crab-cheliped fragments were found locally.

The identification of species studied in this report is based on published figures and descriptions, and comparisons with selected type and non-type specimens on deposit at the Natural History Museum of Los Angeles County, the University of California Museum of Paleontology, Berkeley, and California State University, Northridge.

A stratigraphic section was measured parallel to the course of the North Fork of Lockwood Creek (Fig. 2) by means of

1. Department of Geological Sciences, California State University, Northridge, California 91330, and Research Associate, Invertebrate Paleontology, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007.

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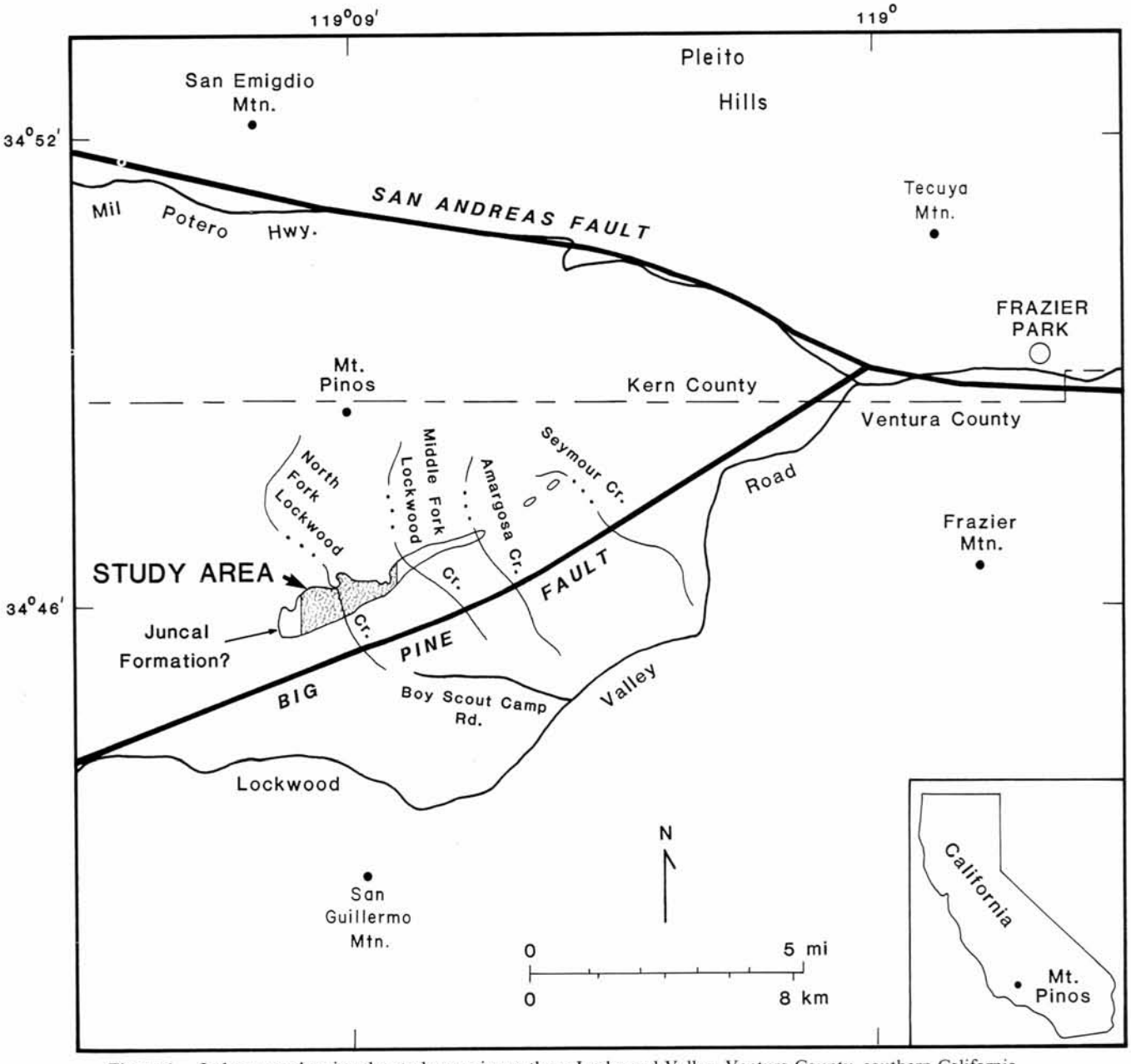


Figure 1. Index map showing the study area in northern Lockwood Valley, Ventura County, southern California.

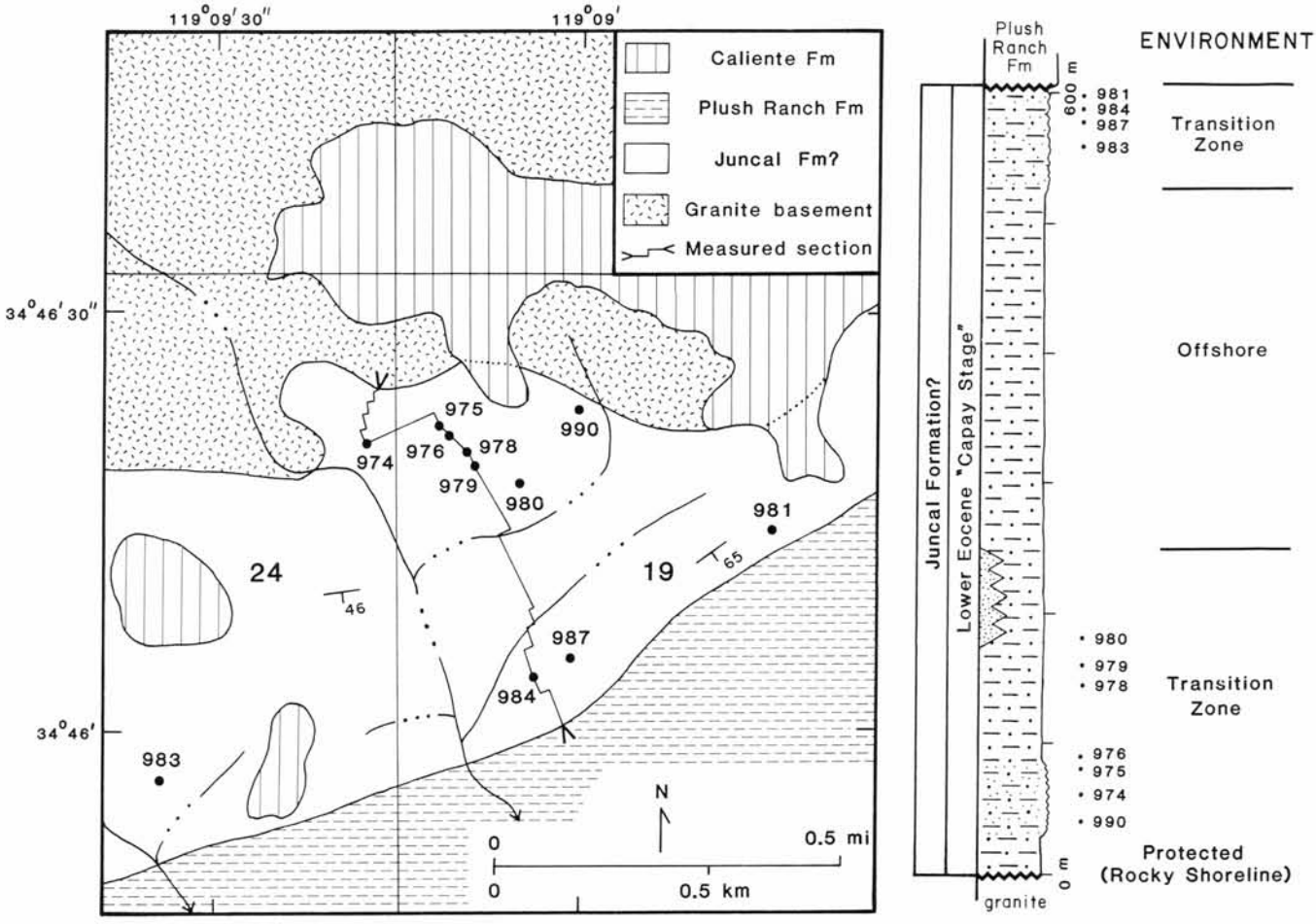
a Jacob's staff and Brunton compass. Eight microfossil samples were taken along the traverse of the measured section at about 75-m intervals, starting at the base of the section. These samples were analyzed for calcareous nannofossils and planktic foraminifera but proved to be barren (M.V. Filewicz, pers. commun., 1987).

STRATIGRAPHY AND DEPOSITIONAL ENVIRONMENTS

The Juncal Formation? in northern Lockwood Valley is 605 m thick and consists predominantly of muddy siltstone with minor amounts of sandstone and scattered lenses with fossils (Fig. 2).

The Juncal Formation? represents a transgressive sequence that was coincident in time with a major early Eocene global sea-level rise, the TE1.2 event of Vail and Hardenbol (1979) (Fig. 3). The uppermost part of the formation may reflect a localized regressive event, perhaps associated with uplift. The early Eocene was also the warmest interval of the Cenozoic, and a circum-tropical current contributed to widespread dispersal of marine organisms (Squires, 1984, 1987).

The formation unconformably overlies pre-Tertiary granite. The contact is exposed at the base of the measured section shown in Figure 2. The uppermost 20 cm of the granite is crumbly as if it had been weathered, as opposed to the unweathered granite directly beneath. The contact is an ero-



BASE MAP FROM SAWMILL MTN., CA, 7.5-MINUTE QUADRANGLE, 1943.

Figure 2. Geologic map of the study area, North Fork of Lockwood Creek, with CSUN macrofossil localities and measured-section traverse in the Juncal Formation?. Accompanying columnar section of this formation shows inferred depositional environments, West Coast provincial molluscan stage, and stratigraphic position of each macrofossil locality.

sional surface with about 10 cm of relief and is overlain by a 15-cm-thick mudstone layer that contains scattered fine to medium, angular quartz grains. This layer grades upward into siltstone. The Juncal Formation? is unconformably overlain by the Oligocene/lower Miocene nonmarine Plush Ranch Formation. Locally, the Eocene outcrops are covered by fan conglomerate deposits of the middle Miocene Caliente Formation.

The vertical distribution of rock types and fossiliferous lenses, and the inferred depositional environments, are shown in Figure 2. The interbedded muddy siltstone, very fine sandstone, and a few lenses of fine to coarse sandstone in the lower 250 m and the upper 100 m of the formation are similar to modern transition-zone deposits reported by Reineck and Singh (1975) and similar to Eocene transition-zone deposits reported by Squires and Yamashiro (1986) and Squires (1987). The lenses of sandstone represent storm-lag accumulations. When present, the fossil fragments are near the bottom of the lenses, which may also contain granite clasts, up to 4 cm in diameter. The granite clasts are less angular in the upper part of the formation. Although the transported fossils are disarticulated and consist mainly of small fragments, the distance of postmortem transport was not great because delicate morphologic parts of the mollusks do not show much evidence of abrasion. The fossils are interpreted as indigenous death assemblages, and, although transported, they are in the same environment in which they lived.

Squires (1984) tabulated the bathymetry and water temperature of extant molluscan genera found in the Eocene Llajas Formation, Simi Valley, southern California. Thirty-eight percent of these genera are the same as those found in the Juncal Formation?. These genera are *Architectonica, Calyptraea, Conus, Cypraea, Galeodea, Lyria, Olivella, Sinum, Turritella, Xenophora, Acila* (*Truncacila*), *Callista* (*Costacallista*), *Corbula* (*Caryocorbula*), *Glycymeris, Nemocardium,* and *Pitar* (*Lamelliconcha*). Based on the tabulated data by Squires (1984), these extant genera would most commonly occur today in warm-temperate to tropical seas between 14- and 58-m depths. This range was calculated by averaging the lowest and highest, most frequently reported depth ranges of

the genera. Additional extant genera in these deposits also support this depth range: *Arene*, in the eastern Pacific today, is most common intertidally on rocks and is confined to tropical waters (Keen, 1971); *Bittium* is common in sublittoral tropical to boreal waters near rocks or on soft bottoms (Keen, 1971; McLean, 1978); *Barbatia* is byssally attached and although commonly found in intertidal tropical waters it may live in waters as deep as 65 m (Keen, 1971; Abbott and Dance, 1982); and *Parvamussium* lives today in waters between 18- and 632-m depths (Grau, 1959).

Homalopoma is mostly found intertidally among rocks (Abbott and Dance, 1982), and its presence in the formation is in keeping with an inferred, protected rocky coast environment. Such an environment would account for the absence of coarse nearshore deposits at the base of the formation. Only muddy siltstone could accumulate if the protected rocky coastline extended into transition-zone depths. A similar paleoenvironment was found by Roush (1986) for a part of the Eocene Domengine Formation north of Coalinga, California.

Benthic foraminiferal data reinforce the molluscan paleoenvironmental data. Three of the fossiliferous lenses (CSUN locs. 974, 976, and 980) in the lower part of the formation contain the benthic foraminifera *Quinqueloculina*, which, according to Murray (1973), lives today mainly in temperate and tropical waters in 0- to 40-m depths. The extinct benthic foraminifera *Pseudophragmina* (*Proporocyclina*) is rare in two of the fossiliferous lenses (CSUN locs. 974, 976) in the lower part of the formation. According to Vaughan (1945), nearly all recorded species of American Discocyclinidae were confined to tropical, subtropical, and south-temperate latitudes. The depth of water of such foraminifera ranged from near tide level to perhaps 100 m.

Thin beds of very laminated fine sandstone alternating with bioturbated fine sandstone are exposed between 180 and 250 m above the base of the formation, along the western bank of the North Fork of Lockwood Creek in the east-central portion of section 24 (at the strike and 46° dip symbol shown on Fig. 2). These strata are very similar to modern lower shoreface deposits reported by Howard and Reineck (1972), as well as by Kumar and Sanders (1976), and to Eocene lower shoreface deposits reported by Squires (1981, 1983, 1984).

The middle part of the formation consists almost entirely of siltstone with less than one percent sandstone. No macrofossils, microfossils, or sedimentary structures were found. A slightly deeper, more seaward environment than the transition zone is inferred for these sediments, based on their gradational nature with the underlying and overlying transition-zone deposits.

AGE

The Juncal Formation? in northern Lockwood Valley is early Eocene ("Capay Stage") in age (Fig. 3). This age assignment is based mainly on mollusks, and to a lesser degree, on benthic foraminifera.

Clark and Vokes (1936) informally proposed five molluscan provincial Eocene stages: Meganos, Capay, Domengine, Transition, and Tejon. They recognized two faunal zones in their Capay Stage. Givens (1974) showed that their upper faunal zone of the "Capay" should be considered part of the "Domengine Stage," and he restricted the use of the "Capay Stage" to their lower faunal zone. It is in this restricted sense that the "Capay Stage" is used herein. Saul (1983) and Squires (1984, 1987) regarded the restricted "Capay Stage" of Givens (1974) as early Eocene.

Prior to this study, the age of the Juncal Formation? was regarded as middle Eocene ("Domengine Stage") by Kirkpatrick (1958) or as early Eocene ("Capay Stage") by Carman (1964) and Dibblee (1982). Kirkpatrick's age assignment was based on misidentified specimens of *Turritella andersoni lawsoni*. He did not mention at which of his localities they were present. His localities were made along a single traverse from north to south essentially along the present author's measured section (Fig. 2). Kirkpatrick mislocated his position at the start of his traverse because his localities Y-1 through Y-6 plot in granitic basement rock.

Carman's (1964) and Dibblee's (1982) age assignments were based on the presence of *Turritella andersoni* from a single locality (equivalent to CSUN loc. 974) from the lower part of the formation.

Squires and Wilson (1987) preliminarily reported the age of the Juncal Formation? to be early Eocene ("Capay Stage"). This age assignment was based on the mollusks that are documented in this report.

Evidence for a "Capay" age for the lower 180 m of the Juncal Formation? is the joint presence of taxa whose stratigraphic ranges elsewhere on the West Coast (California, Oregon, and Washington) overlap only within the "Capay Stage." *Amaurellina caleocia, Architectonica* (*Stellaxis*) *cognata, Bittium? dumblei, Cylichnina tantilla, Ectinochilus* (*Macilentos*) *macilentus, Eocernina hannibali, Ficopsis remondii crescentensis, Callista* (*Costacallista*) *hornii vokesi, Corbula* (*Caryocorbula*) *dickersoni, Glycymeris* (*Glycymerita*) *sagittata*, and *Pitar* (*Lamelliconcha*) *joaquinensis* have their lowest stratigraphic position in the "Capay Stage" (Turner, 1938; Vokes, 1939; Givens, 1974; Squires, 1984, 1987). *Turritella andersoni* has its highest stratigraphic position in the "Capay Stage" (Merriam, 1941; Saul, 1983; Squires, 1984, 1987).

Evidence for a "Capay" age for the uppermost 100 m of the Juncal Formation? is also the joint presence of taxa whose stratigraphic ranges elsewhere on the West Coast overlap only within the "Capay Stage." *Turritella andersoni* is associated with *Rotularia* (*Rotularia*) *tejonense, Architectonica* (*Stellaxis*) *cognata, Clavilithes tabulatus, Conus remondii, Cylichnina tantilla, Ectinochilus* (*Macilentos*) *macilentus, Eocernina hannibali, Ficopsis remondii crescentensis, Lyria andersoni, Paraseraphs erraticus, Sinum obliquum, Pachycrommium clarki, Glycymeris* (*Glycymerita*) *sagittata*, and *Pitar* (*Lamelliconcha*) *joaquinensis*, which have their lowest stratigraphic position in the "Capay Stage" (Turner, 1938; Vokes, 1939; Givens, 1974; Squires, 1984, 1987). The uppermost 100 m also contains *Apiotoma californiana*, which is confined to the "Capay Stage" in the Whitaker Peak area, southern

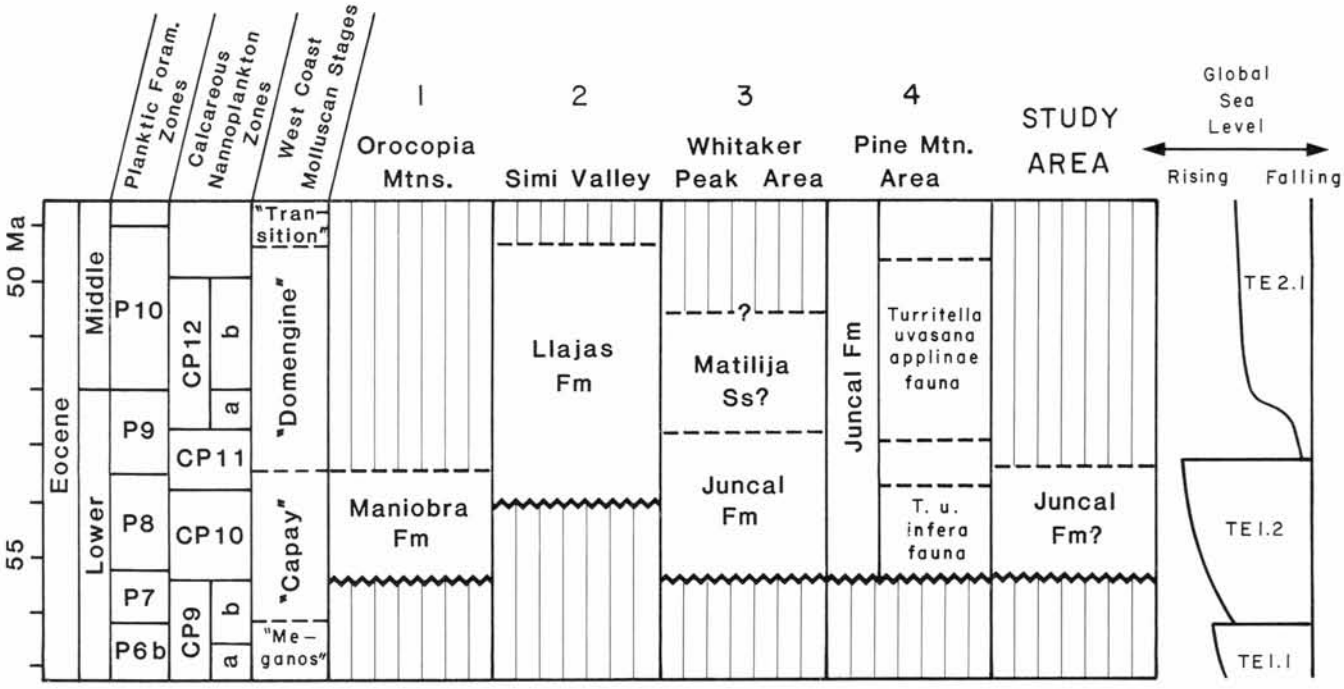


Figure 3. Correlation of the Juncal Formation?, northern Lockwood Valley, with I) mega-annum (millions of years) scale (Ma), series, subseries, standard planktic foraminifera zones, calcareous nannoplankton zones (all after Berggren et al., 1985); West Coast provincial molluscan stages (after Saul, 1983); and global sea-level changes relative to planktic foraminifera zones (from Vail and Hardenbol, 1979); and II) selected southern California Eocene formations with sources of information: 1) Squires and Advocate, 1986; Squires, unpublished data. 2) Squires, 1984. 3) Squires, 1987. 4) Givens, 1974.

California, the only other place it has been found (Squires, 1987).

The molluscan stage range of certain species can be extended into the "Capay Stage" based on their presence in the Juncal Formation? in Lockwood Valley. These taxa include *Homalopoma umpquaensis domenginensis, Xenophora stocki, Galeodea* (*Caliagaleodea*) *californica, Trypanotoma stocki, Olequahia domenginica,* and *Conus caleocius,* which were formerly reported (Clark, 1929, 1942; Vokes, 1939; Stewart, 1946; Givens, 1974; Givens and Kennedy, 1979; Squires, 1984, 1987) as confined to the "Domengine Stage"; *Turritella uvasana bendoni* s.l., which was formerly reported (Turner, 1938; Merriam, 1941; Weaver, 1943) only from the middle Eocene Tyee Formation in southwestern Oregon; *Glyptoactis* (*Claibornicardia*) *domenginica,* which was formerly reported (Vokes, 1939; Verastegui, 1953; Givens, 1974; Givens and Kennedy, 1979; Squires, 1984, 1987) as present only in the "Domengine" and "Transition" "Stages"; and *Turritella buwaldana,* which was formerly reported (Merriam, 1941; Squires, 1984, 1987) as ranging stratigraphically from upper "Meganos"?, "Capay"?, and "Domengine" through "Tejon." The definite "Capay Stage" presence of *T. buwaldana* is significant because this is a very common and widely distributed species in the Eocene of the West Coast.

The geologic age range of the benthic foraminifer *Quinqueloculina triangularis,* which is in the lower 180 m of the formation at localities 974, 976, and 980, is too long to allow precise age determination. This species ranges from late Paleocene through early Eocene (Ynezian through Ulatisian stages) (Mallory, 1959; Poore, 1980).

CORRELATION

Suggested time correlations of the northern Lockwood Valley Eocene section with various representative fossiliferous Eocene sections in southern California are shown in Figure 3.

The Eocene section in northern Lockwood Valley is most similar lithostratigraphically to the lower Juncal Formation in the Pine Mountain and Whitaker Peak areas to the south and southeast. The similarities are a predominantly siltstone lithology of early Eocene age ("Capay Stage") and of shallow-marine origin, unconformably overlying granitic basement.

In the northern Lockwood Valley area, the siltstone rests directly on granitic basement. According to Givens (1974), the mudstone facies of the lower Juncal Formation in upper Hot Springs Canyon, Pine Mountain area, is also in direct contact with the granitic basement. Similarly, the siltstone in the lower Juncal Formation in the Whitaker Peak area locally is separated from the granitic basement by only a meter or so of nearshore sandstone. Based on these similarities, the Eocene section in the study area is tentatively assigned to the Juncal Formation.

The Paleogene Pattiway Formation in the Cuyama Badlands–Caliente Range area, 30 km to the northwest of the study area, resembles the Lockwood Valley section in being overlain by the Caliente Formation. However, there are im-

portant differences. The Lockwood Valley section is distinguished from the Pattiway Formation by 1) much finer grained texture overall with no sandstone/conglomerate upper part (see Sierveld, 1957); 2) presence of macrofossils (none has been reported in the Pattiway Formation); and 3) presence of the overlying Plush Ranch Formation rather than the Simmler Formation. The age of the Pattiway Formation also is uncertain. Based on benthic foraminifera from a well drilled in its lower part in the Caliente Range, it is questionably assigned to the Paleocene (Hill et al., 1958).

SYSTEMATIC MATERIALS

Systematic arrangement of the generic and higher taxonomic categories follows that of Wells (1956) for the coral; Clark (1969) for the annelid; Palmer (1974) for the scaphopods; Cox et al. (1969) and Vokes (1980) for the bivalves; and generally Wenz (1938–1944) for the gastropods.

The figured specimens are on deposit in the Natural History Museum of Los Angeles County, Invertebrate Paleontology Section (LACMIP). Additional unfigured specimens are deposited at the University of California Museum of Paleontology, Berkeley (UCMP) or in the Department of Geological Sciences, paleontology collection, California State University, Northridge (CSUN).

The original author and reference are given for each species or subspecies. Also included are molluscan stage range, geographic distribution, local occurrence, and remarks. The molluscan stages are for the West Coast (California, Oregon, and Washington), and they are from Clark and Vokes (1936) and Weaver et al. (1944), with refinements made by Givens (1974) and Saul (1983). The stage names are provisional, hence they are placed in quotation marks. New stage ranges that are the result of this study are mentioned under the "Remarks" for each species or subspecies. Authors of familial, generic, and subgeneric names, type species, synonymies, and primary type material of nearly all these species or subspecies can be found in Givens (1974) and Squires (1984, 1987). For those few taxa that are not included therein, synonymies and primary type material are given in this present report.

Abbreviations used for catalog and/or locality numbers are:

CSUN: California State University, Northridge.
LACMIP: Natural History Museum of Los Angeles County, Invertebrate Paleontology Section.
UCMP: University of California Museum of Paleontology, Berkeley.

SYSTEMATICS

Phylum Coelenterata

Class Anthozoa

Order Scleractinia

Family Caryophylliidae

Trochocyathus (*Platycyathus*) *grahami* (Durham, 1943)

Figure 4

Platycyathus grahami Durham, 1943:200–201, pl. 32, figs. 12, 14.

Primary Type Material. UCMP holotype 30097, "Martinez? Stage," NW ¼, sec. 8, T 15 S, R 12 E, Chounet Ranch 7.5-minute quadrangle (= Tierra Loma quadrangle), Fresno County, California.

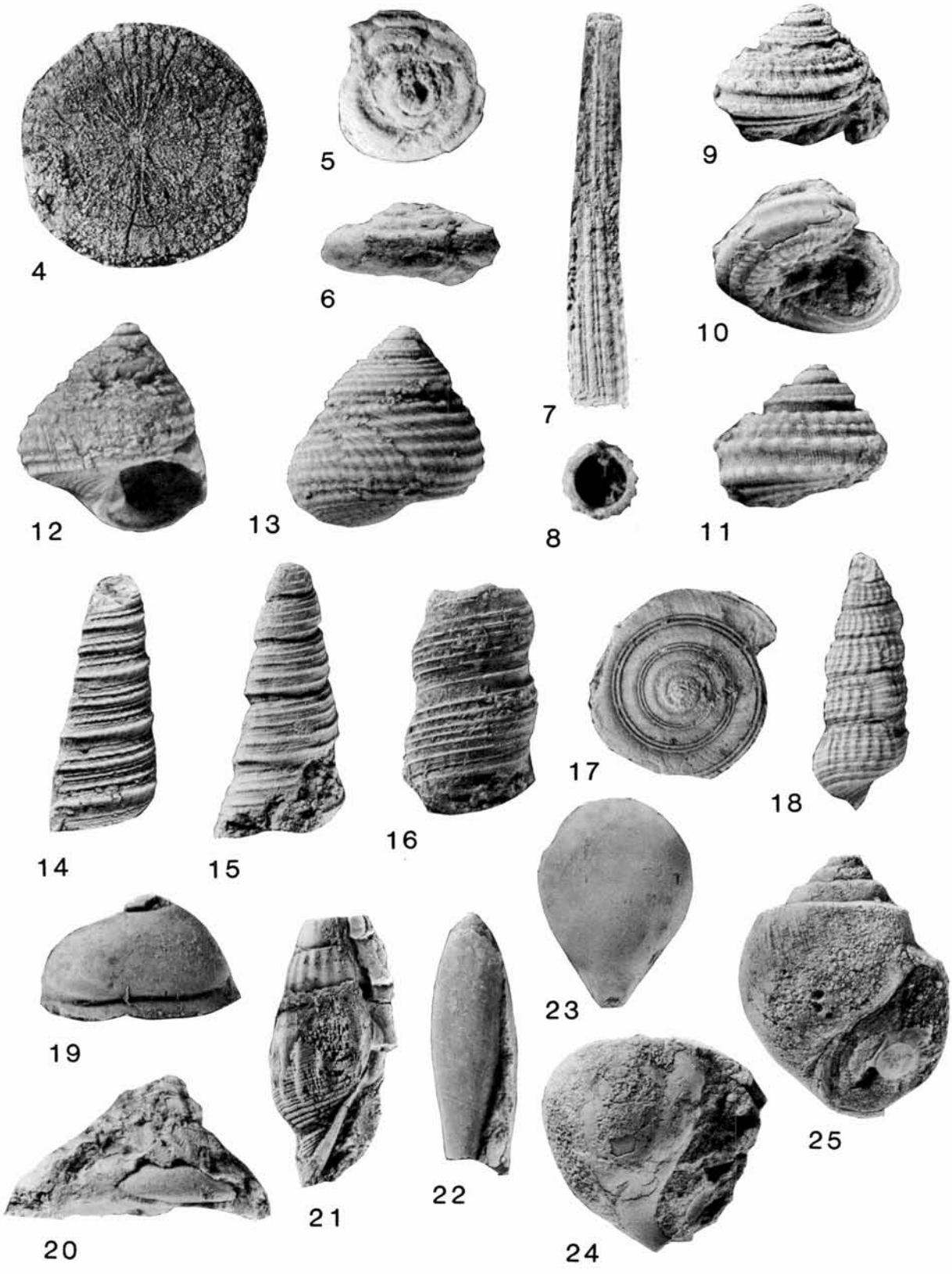
Molluscan Stage Range. "Martinez"?, "Meganos"?, "Capay."

Geographic Distribution. Northern Lockwood Valley through north-central California.

Local Occurrence. CSUN locality 987.

→

Figures 4–25. Northern Lockwood Valley Eocene solitary coral, annelid, scaphopod, archaeogastropods, and mesogastropods. **Fig. 4–8.** Solitary coral, annelid, and scaphopod. **4.** *Trochocyathus* (*Platycyathus*) *grahami* (Durham, 1943), dorsal view, ×2.6, greatest diameter 16 mm, LACMIP hypotype 768, CSUN locality 987. **5–6.** *Rotularia* (*Rotularia*) *tejonense* (Arnold, 1910), LACMIP hypotype 7689, CSUN locality 984. **5.** Umbilical view, ×4.3, greatest diameter 6 mm. **6.** Side view, ×5.2, height 2.5 mm. **7–8.** *Coccodentalium emersoni* new species, LACMIP holotype 7690, CSUN locality 979. **7.** Longitudinal view, ×4.1, length 16 mm. **8.** Oral view, ×6.5, diameter 2 mm. **Fig. 9–13.** Archaeogastropods. **9–11.** *Arene mcleani,* new species, CSUN localaity 983. **9.** Apertural view, ×8, height 3 mm, width 3 mm, LACMIP paratype 7692. **10.** Oblique umbilical view, ×6.8, height 3.5 mm, width 4.5 mm, LACMIP holotype 7691. **11.** Abapertural view, ×6, height 4 mm, width 5 mm, LACMIP paratype 7693. **12–13.** *Homalopoma umpquaensis domenginensis* Vokes, 1939, ×4.8, height 7.5 mm, width 6.5 mm, LACMIP hypotype 7694, CSUN locality 979. **12.** Apertural view. **13.** Abapertural view. **Figs. 14–25.** Mesogastropods. **14.** *Turritella andersoni* Dickerson, 1916, side view, ×4.3, height 10 mm, width 4 mm, LACMIP hypotype 7695, CSUN locality 979. **15.** *Turritella buwaldana* Dickerson, 1916, abapertural view, ×4.7, height 10 mm, width 5 mm, LACMIP hypotype 7696, CSUN locality 981. **16.** *Turritella uvasana hendoni* s.l. Merriam, 1941, apertural view, ×2.4, height 16 mm, width 10 mm, LACMIP hypotype 7697, CSUN locality 987. **17.** *Architectonica* (*Stellaxis*) *cognata* Gabb, 1864, dorsal view, ×2.3, greatest diameter 14.5 mm, LACMIP hypotype 7698, CSUN locality 983. **18.** *Bittium*? *dumblei* (Dickerson, 1916), abapertural view, ×2, height 22 mm, width 4 mm, LACMIP hypotype 7699, CSUN locality 979. **19.** *Calyptraea diegoana* (Conrad, 1855), side view, ×2.7, height 8 mm, width 14 mm, LACMIP hypotype 7700, CSUN locality 983. **20.** *Xenophora stocki* Dickerson, 1916, abapertural view, ×4.5, height 5.5 mm, width 9 mm, LACMIP hypotype 7701, CSUN locality 979. **21.** *Ectinochilus* (*Macilentos*) *macilentus* (White, 1889), apertural view, ×1.7, height 27 mm, width 12 mm, LACMIP hypotype 7702, CSUN locality 987. **22.** *Paraseraphs erraticus* (Cooper, 1894), apertural view, ×2.3, height 19.5 mm, width 4.5 mm, LACMIP 7703, CSUN locality 981. **23.** *Cypraea* species indeterminate, abapertural view, ×1.5, height 24 mm, width 17 mm, LACMIP hypotype 7704, CSUN locality 984. **24.** *Eocernina hannibali* (Dickerson, 1914), apertural view, ×1.1, height 35 mm, width 33 mm, LACMIP hypotype 7705, CSUN locality 984. **25.** *Pachycrommium clarki* (Stewart, 1927), apertural view, ×1, height 44 mm, width 33 mm, LACMIP hypotype 7706, CSUN locality 987.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Remarks. Only a single large specimen (greatest diameter 16 mm) was found, and it is a deeply weathered disk-shaped corallum.

Vaughan and Wells (1943) and Wells (1956) included *Platycyathus* as a subgenus of *Trochocyathus.*

Platycyathus? sp. Durham (1942:92) from the upper Oligocene Blakeley Formation, Kitsap County, Washington, is the only other species of this subgenus recognized from the West Coast Tertiary.

Previously, *Platycyathus* had not been reported as ranging stratigraphically into the "Capay Stage."

Phylum Annelida

Class Polychaeta

Order Sabellida

Family Serpulidae

Rotularia (*Rotularia*) *tejonense* (Arnold, 1910)

Figures 5, 6

Spiroglyphus? *tejonensis* Arnold, 1910:51, pl. 4, fig. 18.
Not *Spiroglyphus*? *tejonensis* Arnold. Dickerson, 1916:pl. 37, figs. 5a–b.

Molluscan Stage Range. "Capay" through "Transition."

Geographic Distribution. Simi Valley, southern California through central California.

Local Occurrence. CSUN localities 975(?), 984.

Remarks. Only two specimens were found, and preservation is poor. The figured specimen shows remnants of the external sculpture with its diagnostic raised carina adjacent to the suture on the dorsal and umbilical sides of the tube as well as the tricarinate lateral portion of the tube.

An examination of all the figured specimens listed in Keen and Bentson (1944) for *R.* (*R.*) *tejonensis* revealed that UCMP hypotype 11814, figured by Dickerson (1916:pl. 37, figs. 5a–b) without locality data, is not a *Rotularia.* It is a partial internal mold of *Vitrinella,* based on its low-rounded shape, prominent umbilicus, and large aperture. The shell remnants on the posterior portion of the body whorl show only fine growth lines and no carinae.

Rotularia (*R.*) *tejonense* is closely allied to *R.* (*R.*) *capayensis* Merriam and Turner (1937:106, pl. 5, figs. 10–11) from the lower Eocene Capay Formation in Capay Valley, northern California. *Rotularia* (*R.*) *tejonense* differs from the holotype of *R.* (*R.*) *capayensis* in having a raised carina adjacent to the suture on the dorsal and umbilical sides of the tube. On the holotype of *R.* (*R.*) *capayensis,* there is a carina adjacent to the suture on the dorsal side (the umbilical side is buried in matrix), but it varies from being only slightly raised to slightly sunken below the level of the carina on the periphery of the tube. In addition, although the holotype of *R.* (*R.*) *capayensis* has a tricarinate lateral portion on most of its tube, there are four carinae on the dorsal lateral portion of the tube. It is possible that *R.* (*R.*) *tejonense* and *R.* (*R.*) *capayensis* are the same species, but more specimens of *R.* (*R.*) *capayensis* are needed in order to make this determination. The paratype (UCMP 33699) of *R.* (*R.*) *capayensis* is difficult to use for comparative studies because it is subhelical and irregularly twisted.

Rotularia (*R.*) *tejonense* is markedly different from *R.* (*R.*) *tinajaensis* Hanna and Hertlein (1941:170, figs. 62-5, 62-12) from lower? or middle? Eocene strata in the Devils Den area, Kern County, California. *Rotularia* (*R.*) *tinajaensis* has a very laterally extended thin keel on the tube. There is a raised area on the slope of both sides of this keel, but these raised areas are not extended laterally like the keel. *Rotularia* (*R.*) *tinajaensis* has a tricarinate keel in the broad sense, but the lateral portion of the tube is dominated by the extended keel.

Phylum Mollusca

Class Scaphopoda

Order Dentalioida

Family Dentaliidae

***Coccodentalium emersoni* new species**

Figures 7, 8

Diagnosis. Interspaces between noded longitudinal primary ribs with only one unnoded secondary rib of uniform size.

Comparison. *Coccodentalium emersoni* new species is most similar to *Coccodentalium radula* (Schröter, 1784:530; Sacco, 1897:111, pl. 10, figs. 7–15; Emerson, 1962:pl. 77, fig. 6) from upper Miocene (Tortonian Stage) deposits of the Liguria-Piedmont basin, northern Italy (Sacco, 1897:111; Pilsbry and Sharp, 1897–1898:xxxii; Davies, 1975:table 1). *Coccodentalium emersoni* new species differs from *C. radula,* the type species of *Coccodentalium,* in the following features: secondary ribs in interspaces between the longitudinal primary ribs more constant in strength and uniform in size and not tending to become like primary ribs; secondary ribs not noded; and no tertiary ribs in interspaces. These comparisons were based on two specimens of *C. radula* from UCMP locality B-1840 (upper Miocene, type Tortonian, northern Italy).

Coccodentalium emersoni new species resembles *Dentalium callioglyptum* Pilsbry and Sharp (1897:466, 468, pl. 10, figs. 10, 12; pl. 11, fig. 21) and *D. tryoni* Pilsbry and Sharp (1897:468–469, pl. 10, figs. 5, 9; pl. 1, fig. 22) from upper Oligocene deposits of San Domingo, West Indies. The San Domingo species, however, have many more longitudinal ribs (44 to 65 in *D. callioglyptum* and 33 to 66 in *D. tryoni*) and the ribs and nodes are not as coarse as in *C. emersoni* new species.

Description. Small in size (total length unknown, but partial length 16 mm, greatest diameter 2 mm), slightly curved but untwisted, tubular shell open at both ends, tapering posteriorly (diameter 1 mm), circular in cross section. Tube wall thickens posteriorly. Tube sculptured with 12 straight longitudinal ribs crossed by circular lamellae that form nodes at the intersections, producing a cancellate pattern. Inter-

spaces between longitudinal ribs with a single unnoded secondary rib.

Primary Type Material. LACMIP holotype 7690, Juncal Formation?, northern Lockwood Valley, CSUN locality 979.

Type Locality. CSUN locality 979.

Molluscan Stage Range. "Capay."

Geographic Distribution. Northern Lockwood Valley, southern California.

Local Occurrence. CSUN locality 979.

Remarks. Only a single specimen was found, but it shows fairly good preservation. The specimen is slightly crushed near the middle of the shell.

Palmer (1974) elevated *Coccodentalium* to the full generic level. Ludbrook (1960) reported *Coccodentalium* as ranging from the middle Eocene (Europe and East Indies) through Recent (East Indies). Emerson (1962) reported it as ranging from Eocene through Recent, but in his text-figure 2 he showed it only as an Eocene taxon. Pilsbry and Sharp (1897–1898) considered *Coccodentalium* as ranging from the late Miocene through Recent and probably originating from *Dentalium callioglyptum*.

Coccodentalium emersoni new species is the first report of *Coccodentalium* in North America, and the earliest known report of *Coccodentalium* anywhere in the world.

Etymology. This species is named for Dr. William K. Emerson, Curator of Mollusks, American Museum of Natural History, in recognition of his valuable work on scaphopods.

Class Gastropoda

Order Archaeogastropoda

Family Liotiidae

Arene mcleani new species

Figures 9–11

Diagnosis. Moderately elevated spire, strongly beaded (almost noded) bicostate body whorl, and two (rarely three) weaker spiral ribs posterior to the bicostate spiral ribs.

Comparison. *Arene mcleani* new species is similar to *Arene tricostata* (Conrad, 1835:50, pl. 17, fig. 10; Palmer, 1937:37–38, pl. 4, figs. 5, 8, 12; pl. 78, fig. 7; Palmer and Brann, 1965: 398–399; Dockery, 1980:75, pl. 30, figs. 2A–C, 3) from middle Eocene formations in the Atlantic–Gulf Coastal Plain area (Palmer and Brann, 1966; Dockery, 1980). *Arene mcleani* new species differs from *A. tricostata* in the following features: more strongly angulated whorl profile, bicostate rather than tricostate body whorl, two (rarely three) rather than one spiral ribs posterior to the bicostate ribs on the body whorl, more strongly beaded (almost noded) spiral ribs on the body whorl, and no spiral riblets in interspaces between spiral ribs on base of body whorl.

Description. Shell very small in size (height 4 mm), conical-turbiniform, four angulate whorls with tabulate shoulder and sunken suture. Interior nacreous. Protoconch naticiform, smooth (two whorls). Antepenultimate whorl with two spiral riblets crossed by numerous collabral riblets, posteriormost spiral riblet minutely beaded. Penultimate whorls with three beaded spiral ribs, anteriormost rib most prominent, and all crossed by growth lines. Posterior half of body whorl with four (rarely five), beaded spiral ribs; the two anteriormost of these ribs form carinae. One to two minutely beaded spiral riblets may be in interspaces between the carinae, as well as between the posteriormost carina and the spiral rib posterior to it. Base of body whorl somewhat flattened with three beaded spiral ribs; the anteriormost rib borders the umbilicus. Spiral ribs on body whorl crossed by growth lines, which on well-preserved specimens are fairly strongly developed. Aperture circular. Outer lip thick with a low varix. Columellar lip and outer lip not in same plane. Umbilicus plugged with matrix.

Primary Type Material. LACMIP holotype 7691, LACMIP paratypes 7692 and 7693, Juncal Formation?, northern Lockwood Valley, CSUN locality 983.

Type Locality. CSUN locality 983.

Molluscan Stage Range. "Capay."

Geographic Distribution. Northern Lockwood Valley, southern California.

Local Occurrence. CSUN localities 974 and 983.

Remarks. Fourteen specimens were found at locality 983. Six are internal molds, five are fragments of body whorls, and three are well preserved. A single fragment of a body whorl was found at locality 974.

Arene tricostata (Conrad) was assigned to *Solariella* by Palmer (1937) and Dockery (1980). Dall (1892), however, had assigned the species to *Liotia*, which is in the same family as *Arene* and very closely related to *Arene*. Palmer (1937) maintained that Conrad's species lacked the distinctive thickened outer lip of *Liotia*. In Dockery (1980:pl. 30, fig. 3), one of the illustrated specimens of this species, however, does show the thickened outer lip. Based on this specimen, it would seem that Dall (1892) was correct, but due to the lack of well-developed collabral costae on Conrad's species it still should be assigned to *Arene* rather than *Liotia*.

Keen and Johnson (1960) reported *Arene* as ranging from Miocene through Recent. McLean (pers. commun., 1987), who is presently working on a much-needed worldwide review of *Arene* with an emphasis on modern species, has recognized a few Late Mesozoic and Paleogene species. *Arene mcleani* new species is the first recognized Paleogene report of this genus on the West Coast.

Arene mcleani new species may also be present in the Capay Formation at its type section in Smith Canyon, near Capay, northern California. Two specimens that closely resemble *A. mcleani* new species from UCMP locality A-1313 have three beaded spiral ribs on the penultimate whorl and four beaded spiral ribs on the posterior half of the body whorl, but the critically important apertural areas on both specimens are not preserved. These two specimens are undoubtedly the ones that Bentson (1941:528, pl. 11, fig. 3) referred to as *Solariella* new species A from the type section of the Capay Formation. A label in the box that contains these two specimens refers to them as "n. sp. A" and the description in her dissertation generally agrees with their morphology. A one-day visit to UCMP locality A-1313 did not reveal any more

specimens, but future collecting in "Capay Stage" strata in northern California may prove that *A. mcleani* new species ranged that far north.

Etymology. The species is named for Dr. James H. McLean, Curator of Malacology, Natural History Museum of Los Angeles County, in recognition of his important contributions to the study of archaeogastropods.

Family Turbinidae

Homalopoma umpquaensis domenginensis Vokes, 1939

Figures 12, 13

Homalopoma umpquaensis domenginensis Vokes, 1939:179–180, pl. 22, fig. 27.

Primary Type Material. UCMP holotype 15872, Domengine Formation, UCMP locality 672.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. Northern Lockwood Valley through central California.

Local Occurrence. CSUN locality 979.

Remarks. Only a single specimen was found, but it shows good preservation, especially in the interior of the aperture. The apertural details of this subspecies are illustrated for the first time in Figure 12.

The specimen from the northern Lockwood Valley is better preserved in the apertural region and shows a more mature growth stage than that of the holotype. Supplementary comments on the morphology of this subspecies, therefore, are given below. Over the surface of the teleoconch, the spiral ribs and their interspaces are crossed by oblique lines. These growth lines are not in the same plane as the columella. Where the spiral ribs are crossed by these growth lines, minute nodes are present. The spiral rib anterior to the suture (i.e., the first rib) and the fifth, sixth, and eighth ribs tend to be slightly stronger than the others, but the strength of development of each is variable. There are nine (rather than six) secondary spiral ribs on the base of the body whorl, and these ribs are also noded. There is a large node at the flared base of the columella and a swollen, elongated area next to it that tapers in the direction of the outer lip (Fig. 12).

Previously, this subspecies had not been reported as ranging stratigraphically into the "Capay Stage" or geographically as far south as northern Lockwood Valley.

Order Mesogastropoda

Family Turritellidae

Turritella andersoni Dickerson, 1916

Figure 14

Turritella andersoni Dickerson, 1916:501–502, pl. 42, figs. 9a–b.

Molluscan Stage Range. "Meganos"?, "Capay."

Geographic Distribution. Orocopia Mountains, southern California through southwestern Oregon. Weaver (1937:29) reported *T. andersoni* (no specimens listed or illustrated) from Victoria, British Columbia.

Local Occurrence. CSUN localities 976, 978(?), 979, 983, 987, 984.

Remarks. Fourteen specimens were found at locality 987 and at locality 979; four specimens were found at locality 984. At the other localities only single specimens were found. Preservation is generally good, with excellent preservation at localities 979 and 987. Most specimens are upper spire fragments usually less than 20 mm in height, especially at locality 979. At locality 987, a few fragments of mature whorls are up to 30 mm in height.

The specimens show the characteristic whorl profile that is shallowly concave medially between a strong anterior spiral rib and two weaker, closely spaced and noded posterior primary spiral ribs. A third, noded but even weaker primary spiral rib is present medially between the anterior and posterior primaries. A secondary rib is present between this medial primary and the anteriormost of the two posterior primaries. Tertiary threads are present between the various primary ribs.

The report of *T. andersoni* in the northern Orocopia Mountains in southern California is based on work in progress in the lower Eocene Maniobra Formation, in Riverside County.

Turritella buwaldana Dickerson, 1916

Figure 15

Turritella buwaldana Dickerson, 1916:500–501, pl. 42, figs. 7a–b.

Molluscan Stage Range. Upper "Meganos"?, "Capay" through "Tejon."

Geographic Distribution. San Diego, California through southwestern Oregon.

Local Occurrence. CSUN localities 974, 978, 979, 980, 983, 987(?), 984(?), 981.

Remarks. Seventeen specimens were found at locality 979, six specimens were found at locality 981, and three were found at locality 983. At the other localities only one or two specimens were found. Preservation is generally good. Specimens are upper spire fragments usually less than 15 mm in height.

The specimens have five primary spiral ribs on flat-sided whorls. There can be up to three tertiary spiral ribs in the interspaces. The posterior three primary ribs can be minutely noded, and they are not as strong as the other two primary ribs. Usually, the posteriormost primary rib is the weakest, except on specimens from locality 979 where the posterior three primary ribs are of equal strength. This variability in sculpture is not unusual for this species. Merriam (1941:86–87) mentioned similar variability in his discussion of *T. buwaldana*.

Previously, this species had not been reported with certainty as ranging stratigraphically into the "Capay Stage."

Turritella uvasana hendoni s.l. Merriam, 1941

Figure 16

Turritella uvasana Conrad. Dickerson, 1914:115. Arnold and Hannibal, 1913:572.

Turritella uvasana hendoni Merriam, 1941:91–93, pl. 17, figs. 1–9. Turner, 1938:84, pl. 21, figs. 7, 12–16. Weaver, 1943: 366–367, pl. 74, figs. 1, 6.

Turritella uvasana hendoni var. A Turner, 1938:84, pl. 22, figs. 11, 14. Weaver, 1943:367, pl. 74, fig. 2.

Turritella uvasana hendoni var. B Turner, 1938:85, pl. 22, figs. 7, 10, 12–13. Weaver, 1943:367, pl. 74, fig. 21.

Primary Type Material. UCMP holotype 33298, UCMP paratypes 33290–33293, upper Umpqua Formation, UCMP locality A-662.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. Northern Lockwood Valley, southern California through southwestern Oregon.

Local Occurrence. CSUN localities 984(?), 987.

Remarks. Three specimens were found at locality 987, and a single specimen was found at locality 984. The specimens are fragments of mature whorls up to 15 mm in height, and preservation is poor except for the figured specimen (Fig. 16). The specimens have convex whorls with seven equal-strength, primary spiral ribs and tertiary threads in the interspaces. The posterior rib is set apart form the others by a wide space.

Turner's (1938) usage of "variety" in this taxon is to be regarded as of infrasubspecific rank because it is a variety of a subspecies. Infrasubspecific categories are excluded from the provisions of the International Code of Zoological Nomenclature (1985, Art. 45c).

Merriam (1941) reported that this subspecies shows the greatest variability in morphology of all the members of the *T. uvasana* group. The variant referred to as "variety A" by Turner (1938) and Weaver (1943) from the middle Eocene Tyee Formation, southwestern Oregon, is closest in form to the specimens from the northern Lockwood Valley area. Merriam (1941:93) noted that this particular variant may warrant a separate subspecies designation.

Previously, *T. uvasana hendoni* had not been reported geographically as far south as southern California, and the variant referred to as "variety A" by Turner (1938) and Weaver (1943) had not been reported ranging stratigraphically into the "Capay Stage."

Family Architectonicidae

Architectonica (*Stellaxis*) *cognata* Gabb, 1864

Figure 17

Architectonica cognata Gabb, 1864:117, pl. 20, figs. 72, 72a, 72c; not 72b, 72d, and 72e as stated.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. San Diego, California through southwestern Oregon.

Local Occurrence. CSUN localities 979, 983, 984.

Remarks. Only three specimens were found with diameters ranging from 13 to 19 mm. Preservation is generally good.

Family Cerithiidae

Bittium? *dumblei* (Dickerson, 1916)

Figure 18

Cerithiopsis alternata Gabb, 1864:116, pl. 21, figs. 114–114a.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. Simi Valley, southern California through central California.

Local Occurrence. CSUN locality 979.

Remarks. Only a single specimen was found, but the sculpture is well preserved. Typically in this species, there is only one fine spiral thread between the four primary spiral ribs. On this particular specimen, the number of fine spiral threads between the posterior two primary ribs increases with maturity, from one to three. There are two varices per whorl.

Family Calyptraeidae

Calyptraea diegoana (Conrad, 1855)

Figure 19

Trochita diegoana Conrad, 1855:7, 17; 1857:327, pl. 5, fig. 42.

Molluscan Stage Range. "Martinez" through lower Oligocene.

Geographic Distribution. San Diego, California through Washington.

Local Occurrence. CSUN localities 979, 981, 983, 984.

Remarks. Three specimens were found at locality 981, but only single specimens were found at the other localities.

Family Xenophoridae

Xenophora stocki Dickerson, 1916

Figure 20

Xenophora stocki Dickerson, 1916:502–503, pl. 37, figs. 4a–b.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. San Diego through northern Lockwood Valley, southern California.

Local Occurrence. CSUN localities 974, 979, 984.

Remarks. Poorly preserved, single specimens were found at each locality. The specimen at locality 979 has the best preservation (Fig. 20) and shows the medially shouldered whorls with the elongate, wavy nodes that are characteristic of this species. The specimen also shows imprints of other shells that were once attached to its shell. Previously, this species was known only to attach pebbles to its shell, but the

Lockwood Valley specimen at locality 979 shows that shells were attached. A reexamination of *X. stocki* specimens from the "Stewart bed" of the Llajas Formation, Simi Valley, southern California (Squires, 1984) also revealed imprints of shells that had been attached.

The Lockwood Valley specimens also show remnants of many closely spaced, fine spiral ribs on the flat base of the body whorl. These ribs, which tend to be wavy, are previously unreported for this species, as is the elliptical aperture preserved on the specimen from locality 979. Future better material may prove that the Lockwood Valley specimens represent a new species.

Previously, this species had not been reported as ranging stratigraphically into the "Capay Stage."

Family Strombidae

Ectinochilus (*Macilentos*) *macilentus* (White, 1889)

Figure 21

Rimella macilenta White, 1889:19, pl. 3, figs. 10–12.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. San Diego through central California.

Local Occurrence. CSUN localities 975, 979, 980, 981, 983, 984, 987.

Remarks. Ten specimens each were found at localities 979, 983, and 984; five specimens each were found at localities 981 and 987. At localities 975 and 980, only single specimens were found. Preservation is good and the collabral costae and spiral ribs do not show much sign of abrasion, although the fragile outer lip is missing in nearly every specimen.

Family Seraphsidae

Paraseraphs erraticus (Cooper, 1894)

Figure 22

Tornatina erratica Cooper, 1894:47, pl. 2, fig. 35.

Molluscan Stage Range. "Capay" through "Transition."

Geographic Distribution. San Diego through central California.

Local Occurrence. CSUN locality 981.

Remarks. Only four specimens were found, all of which are internal molds of fragments.

Family Cypraeidae

Cypraea species indeterminate

Figure 23

Local Occurrence. CSUN locality 984.

Remarks. Only a single specimen was found. Three-fourths of the shell is missing along both sides of the aperture, and the extreme apical portion is broken off. Specific identification is not possible but, based on shell features that are present, the specimen resembles *Cypraea castacensis* Stewart (1927:370, pl. 28, fig. 10) from "Domengine Stage" strata in southern and central California (Squires, 1984:fig. 7b).

Family Naticidae

Eocernina hannibali (Dickerson, 1914)

Figure 24

Natica hannibali Dickerson, 1914:119, pl. 12, figs. 5a–b.

Molluscan Stage Range. "Capay" through "Transition."

Geographic Distribution. San Diego, California through southwestern Oregon.

Local Occurrence. CSUN localities 974(?), 978, 984.

Remarks. Four specimens were found at locality 984, three at locality 974, and one at locality 978. Except at locality 974, preservation is good with the characteristic massive parietal and umbilical calluses present.

Pachycrommium clarki (Stewart, 1927)

(Figure 25)

Amaurellina (*Euspirocrommium*) *clarki* Stewart, 1927:336–339, pl. 26, figs. 8–9 [new name, in part, for *Amauropsis alveata* (Conrad, 1855), preoccupied and misidentified].

Pachycrommium clarki (Stewart). Marincovich, 1977:238–241, pl. 20, figs. 4–10.

Molluscan Stage Range. "Capay" through "Tejon."

Geographic Distribution. San Diego, California through northern Washington.

Local Occurrence. CSUN localities 981, 983, 984, 987.

Remarks. Twelve specimens each were found at localities 981 and 987, eight specimens each were found at localities 984 and 987, and three were found at locality 983. At locality 981, there is a partial growth series with specimen heights ranging from 14 through 30 mm. At locality 987, there is a more complete growth series with specimen heights ranging from 11 through 45 mm. The largest specimens were found at locality 983 with specimen heights of 55 mm (incomplete). Specimens of *P. clarki* are the largest of all the macrofossils in the studied fauna. Preservation is fair with many fragmental specimens.

Amaurellina caleocia Vokes, 1939

Figure 26

Amaurellina caleocia Vokes, 1939:172–173, pl. 22, figs. 4–6 [new name, in part, for *Amauropsis alveata* (Conrad) of Dickerson, 1916, preoccupied and misidentified]. Marincovich, 1977:241–243, pl. 20, figs. 11–13; pl. 21, figs. 1–2.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. Orocopia Mountains, southern California through central California.

Local Occurrence. CSUN locality 979.

Remarks. Only a single specimen was found. Although a

portion of the shell is missing, enough is present to show the characteristic minute spiral sculpture.

Sinum obliquum (Gabb, 1864)

Figure 27

Naticina obliqua Gabb, 1864:109, pl. 21, fig. 112.

Molluscan Stage Range. "Capay" through lower Oligocene.

Geographic Distribution. San Diego, California through southwestern Washington.

Local Occurrence. CSUN locality 983.

Remarks. Only a single specimen was found, and it shows the distinctive spiral sculpture.

Natica (*Naticarius*) *uvasana* Gabb, 1864

Figure 28

Natica uvasana Gabb, 1864:212, pl. 32, fig. 277. Dickerson, 1916:pl. 38, fig. 8. Anderson and Hanna, 1925:116–117, pl. 9, figs. 3–4. Stewart, 1927:322–323, pl. 30, fig. 14.

Natica (*Natica*) *uvasana* Gabb. Weaver and Kleinpell, 1963: 187, pl. 24, figs. 12–13. Givens, 1974:77, pl. 7, fig. 18; pl. 8, fig. 1.

Natica (*Naticarius*) *uvasana* Gabb. Marincovich, 1975:172–173, figs. 20–22; 1977:390–392, pl. 39, figs. 5–8.

Primary Type Material. ANSP lectotype 4233, designated by Stewart (1927:322), Tejon Formation, near Fort Tejon, Kern County, California.

Molluscan Stage Range. "Capay" through "Tejon."

Geographic Distribution. San Diego to Point Conception area, California, and Fort Tejon area, California.

Local Occurrence. CSUN locality 987.

Remarks. Only a single specimen was found. Although this well-preserved specimen is a juvenile (height 5 mm) and is the smallest illustrated specimen of this species, it shows the characteristic low spire, globose body whorl, and very distinctive robust umbilical callus with the sharply raised funicle.

The height of an average specimen of this species is 10 mm (Marincovich, 1977). There is variation in the openness of the umbilicus in the illustrated specimens of this species. Small specimens (less than 10 mm in height) have a slit-like umbilicus, whereas larger specimens have a much more open umbilical area.

Previously, *N.* (*N.*) *uvasana* had not been reported as ranging stratigraphically into the "Capay Stage." It is the earliest Cenozoic representative of the subfamily Naticinae Forbes on the West Coast.

Family Cassidae

Galeodea (*Caliagaleodea*) *californica* Clark, 1942

Figure 29

Galeodea (*Caliagaleodea*) *californica* Clark, 1942:118–119, pl. 19, figs. 15–19. Squires, 1984:26, fig. 7j.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. San Diego through northern Lockwood Valley, California.

Local Occurrence. CSUN locality 987.

Remarks. Only a single specimen was found, and it is an internal mold with only a few traces of shell left.

The Lockwood Valley specimen seemingly has less of a flattish ramp area between the suture and the body-whorl shoulder than is typical for this species, but this is due to the internal mold preservation. The specimen shows a secondary spiral rib between each of the primary ribs on the posterior region of the body whorl. This particular feature, however, is variable in this species, as noted by Clark (1942:119) who mentioned that the fairly heavy spiral ribs alternate somewhat irregularly in a tertiary, secondary, and primary series. Three of the 14 topotypes of *G.* (*C.*) *californica* mentioned in Squires (1984:26) also show a secondary spiral rib between the primary spiral ribs on the body whorl.

Previously, this species had not been reported as ranging stratigraphically into the "Capay Stage" or geographically as far north as the northern Lockwood Valley.

Galeodea aff. *G. nodosa carinata* (Deshayes, 1835)

Figures 30, 31

Local Occurrence. CSUN locality 983.

Remarks. Only a single specimen was found, and it is well preserved. The specimen has affinity to *Galeodea nodosa carinata* (Deshayes, 1835:633–634, pl. 85, figs. 8–9 only; 1866:475–476; Wrigley, 1934:120–121) from middle Eocene strata (Lutetian Stage), Paris Basin, France. The morphologic similarities include the shell profile, tabulate shoulder on the whorls, raised and flat-sided spire whorls, four carinae on the body whorl, tendency for a fifth but very weak carina in the neck region, numerous very fine spiral lirae covering the shell, and a thick outer lip.

Comparison of the Lockwood Valley specimen to three specimens of *G. nodosa carinata* from the UCMP Cloetz collection, UCMP locality B-7148 (Parnes, Oise region, Paris Basin), revealed that *G.* aff. *G. nodosa carinata* differs somewhat from *G. nodosa carinata* in the following features: slightly thicker outer lip and parietal callus, nine nodes rather than 12 to 15 nodes on the body-whorl shoulder, a tendency for these nodes to become spinose, and an absence of nodes on the carina just anterior to the shoulder of the body whorl.

Galeodea aff. *G. nodosa carinata* is unlike any reported species or subspecies of *Galeodea* in the Tertiary of the West Coast. The only other galeodeas that are present in the "Capay Stage" of the West Coast are *G.* (*Gomphopages*) *meganosensis* Vokes (1939:151–152, pl. 19, fig. 18; Clark and Woodford, 1927:113, pl. 19, fig. 21; Squires, 1987, fig. 49), *G.* (*Gomphopages*) *sutterensis* Dickerson (1916:492, pl. 40, figs. 1a–b; Schenck, 1926:84, pl. 15, figs. 1–2; Turner, 1938: 92, pl. 18, fig. 19; Vokes, 1939:150–151, pl. 19, fig. 15; Weaver, 1943:402, pl. 78, figs. 6–7; Givens, 1974:78, pl. 8, fig. 4),

and *G.* cf. *G. gallica* Wrigley (Squires and Advocate, 1986: 857–858, figs. 2.7–2.8). The first species has two nodose carinae on the body whorl, and the other two have three. The Lockwood Valley specimen, however, does resemble *G.* (*Gomphopages*) *meganosensis* and *G.* (*Gomphopages*) *sutterensis* in the spinose development of the nodes on the shoulder of the body whorl.

More specimens of *G.* aff. *G. nodosa carinata* are needed to confirm the constancy of the nodose character. More specimens may show that it grades into *G. nodosa carinata* or may show that it is, in fact, a new species.

Family Bursidae

Olequahia domenginica (Vokes, 1939)

Figure 32

Ranella domenginica Vokes, 1939:147–148, pl. 19, figs. 6, 20.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. San Diego through central California.

Local Occurrence. CSUN localities 981, 984.

Remarks. Two specimens were found at locality 981, and a single specimen at locality 984. All are internal molds, but they show the diagnostic spiral ribbing that covers the shell, the medially angulate spire whorls with prominent axial ribbing, the biangulate body whorl with nodes only on the posteriormost angulation, and the thickened outer lip.

Previously, this species had not been reported as ranging stratigraphically into the "Capay Stage."

Family Ficidae

Ficopsis remondii crescentensis Weaver and Palmer, 1922

Figure 33

Ficopsis remondii (Gabb) var. *crescentensis* Weaver and Palmer, 1922:39–40, pl. 11, fig. 14 (new name for *Ficopsis angulatus* Weaver, 1905, preoccupied).

Molluscan Stage Range. "Capay" through "Transition."

Geographic Distribution. San Diego, California through northwestern Washington.

Local Occurrence. CSUN localities 979, 981, 983.

Remarks. Single specimens were found at each locality. Preservation is good, and the specimens show the diagnostic tricarination of the body whorl and the cancellate sculpture.

Order Neogastropoda

Family Fasciolariidae

Clavilithes tabulatus (Dickerson, 1913)

Figure 34

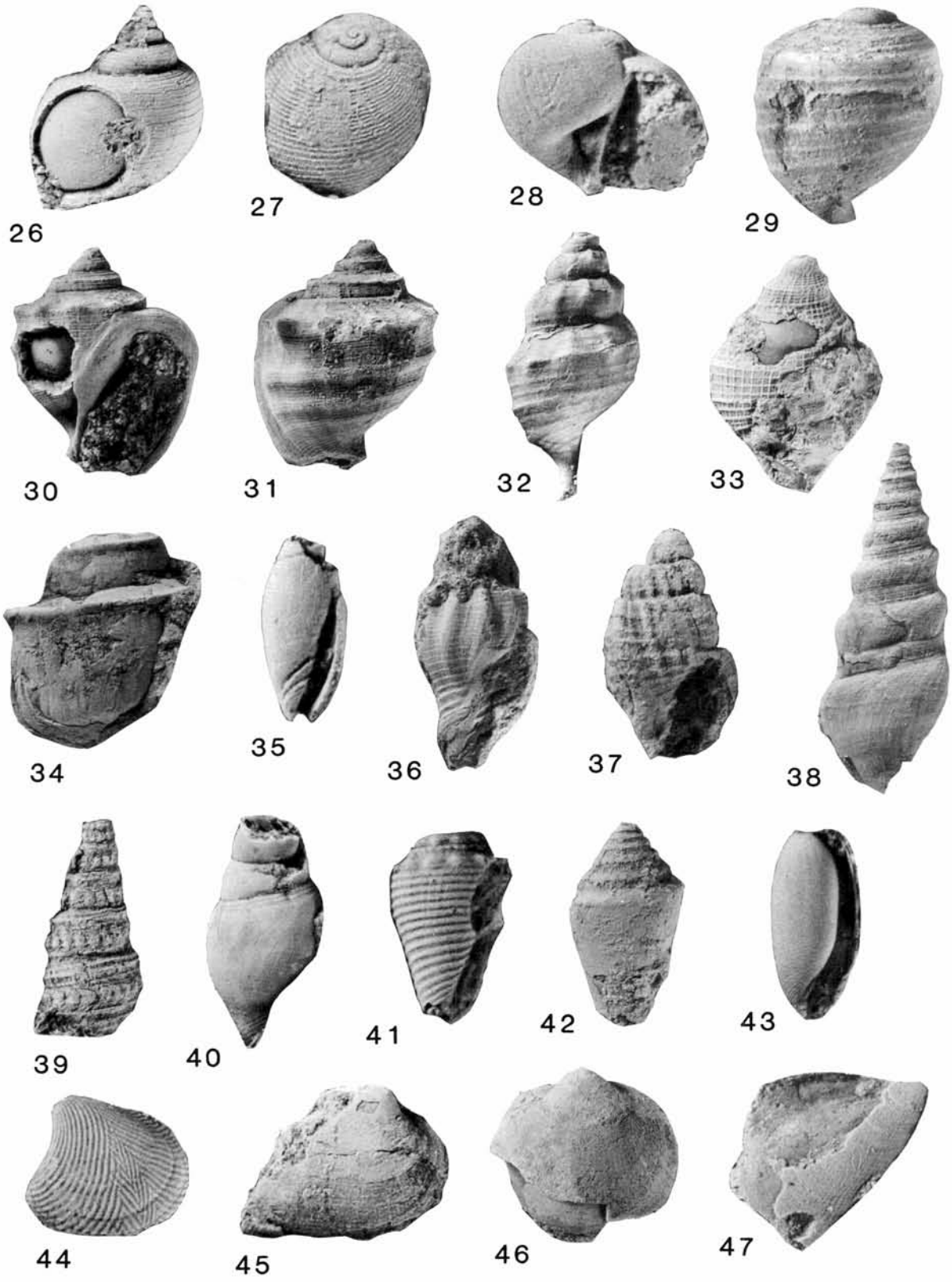
Clavella tabulata Dickerson, 1913:283, pl. 12, fig. 7.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. Orocopia Mountains, southern California through central California.

→

Figures 26–47. Northern Lockwood Valley Eocene mesogastropods, neogastropods, cephalaspid, and bivalves. **Figs. 26–32.** Mesogastropods. **26.** *Amaurellina caleocia* Vokes, 1939, abapertural view, ×4.9, height 7 mm, width 6 mm, LACMIP hypotype 7707, CSUN locality 979. **27.** *Sinum obliquum* (Gabb, 1864), oblique side view, ×7, width 4 mm, LACMIP hypotype 7708, CSUN locality 983. **28.** *Natica* (*Naticarius*) *uvasana* Gabb, 1864, apertural view, ×6, height 5 mm, width 5.5 mm, LACMIP hypotype 7709, CSUN locality 987. **29.** *Galeodea* (*Caliagaleodea*) *californica* Clark, 1942, abapertural view, ×1.6, height 22 mm, width 17 mm, LACMIP hypotype 7710, CSUN locality 987. **30–31.** *Galeodea* aff. *G. nodosa carinata* (Deshayes, 1835), ×1.5, height 25 mm, width 20 mm, LACMIP hypotype 7711, CSUN locality 983. **30.** Apertural view. **31.** Abapertural view. **32.** *Olequahia domenginica* (Vokes, 1939), abapertural view, ×2.8, height 16.5 mm, width 10 mm, LACMIP hypotype 7712, CSUN locality 981. **33.** *Ficopsis remondii crescentensis* Weaver and Palmer, 1922, side view, ×4, height 10 mm, width 6 mm, LACMIP hypotype 7713, CSUN locality 983. **Figs. 34–43.** Neogastropods. **34.** *Clavilithes tabulatus* (Dickerson, 1913), apertural view, ×1.2, height 30 mm, width 27 mm, LACMIP hypotype 7714, CSUN locality 984. **35.** *Olivella mathewsonii* Gabb, 1864, apertural view, ×5.6, height 5.5 mm, width 2.5 mm, LACMIP hypotype 7715, CSUN locality 987. **36.** *Lyria andersoni* Waring, 1917, apertural view, ×1.9, height 22.5 mm, width 10 mm, LACMIP hypotype 7716, CSUN locality 981. **37.** *Bonellitia* (*Admetula*) *paucivariata* (Gabb, 1864), apertural view, ×6.3, height 6 mm, width 3.5 mm, LACMIP hypotype 7717, CSUN locality 981. **38.** *Apiotoma californiana* Squires, 1987, abapertural view, ×1.1, height 53 mm, width 20 mm, LACMIP hypotype 7718, CSUN locality 983. **39.** *Trypanotoma stocki* (Dickerson, 1916), apertural? view, ×5.7, height 6.5 mm, width 3.5 mm, LACMIP hypotype 7719, CSUN locality 975. **40.** *Cryptoconus cooperi* (Dickerson, 1916), side view, ×1.8, height 22 mm, width 9 mm, LACMIP hypotype 7720, CSUN locality 975. **41.** *Conus caleocius* Vokes, 1939, apertural view, ×5.8, height 5.5 mm, width 3.5 mm, LACMIP hypotype 7721, CSUN locality 979. **42.** *Conus remondii* Gabb, 1864, abapertural view, ×3.2, height 11 mm, width 5.5 mm, LACMIP hypotype 7722, CSUN locality 984. **Fig. 43.** Cephalaspid. **43.** *Cylichnina tantilla* (Anderson and Hanna, 1925), apertural view, ×4, height 8 mm, width 3.5 mm, LACMIP hypotype 7723, CSUN locality 984. **Figs. 44–47.** Bivalves. **44.** *Acila* (*Truncacila*) *decisa* (Conrad, 1855), right valve showing rare secondary bifurcation of divaricate radial ribbing, ×3.7, length 7.5 mm, height 7 mm, LACMIP hypotype 7724, CSUN locality 979. **45.** *Barbatia* cf. *B.* (*Cucullaearca*) *cliffensis* Hanna, 1927, partial right valve, ×3.5, length 10 mm, height 7 mm, LACMIP hypotype 7725, CSUN locality 981. **46.** *Glycymeris* (*Glycymerita*) *sagittata* (Gabb, 1864), right? valve, ×1.5, length 21 mm, height 18 mm, LACMIP hypotype 7726, CSUN locality 981. **47.** *Brachidontes* (*Brachidontes*) *cowlitzensis* (Weaver and Palmer, 1922), right valve, ×8, length 4.5 mm, height 3.5 mm, LACMIP hypotype 7727, CSUN locality 979.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Local Occurrence. CSUN localities 979, 984, 987.

Remarks. Single specimens were found at each locality. At localities 979 and 987, the specimens are fragments of the upper spire and show collabral costae and spiral ribbing. The specimen from locality 984 is a large fragment that shows the swollen carina along the diagnostic tabulate shoulder of the penultimate and body whorls.

Family Olividae

Olivella mathewsonii Gabb, 1864

Figure 35

Olivella mathewsonii Gabb, 1864:100, pl. 18, fig. 53.

Molluscan Stage Range. Lower "Martinez" through "Tejon."

Geographic Distribution. Simi Valley, southern California through northwestern Washington.

Local Occurrence. CSUN locality 987.

Remarks. Only a single specimen was found. It shows the two main columellar folds with a weaker third columellar fold posterior to the other two. All three columellar fold regions have secondary spiral ribbing. According to Gabb (1864), this species may possess two or three columellar folds.

Family Volutidae

Lyria andersoni Waring, 1917

Figure 36

Lyria andersoni Waring, 1917:97, pl. 15, fig. 12.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. Simi Valley, southern California through southwestern Oregon.

Local Occurrence. CSUN locality 981.

Remarks. Two specimens were found. Preservation is fair, and the body whorl of the best preserved specimen (Fig. 36) shows the diagnostic eight collabral ribs and three columellar folds. Waring (1917) observed that this species may have either three or four columellar folds.

Family Cancellariidae

Bonellitia (*Admetula*) *paucivaricata* (Gabb, 1864)

Figure 37

Tritonium paucivaricatum Gabb, 1864:95, pl. 28, figs. 209–209a.

Molluscan Stage Range. "Meganos"?, "Capay" through "Tejon."

Geographic Distribution. Simi Valley, southern California through southwestern Washington.

Local Occurrence. CSUN locality 981.

Remarks. A single specimen was found, and it shows the diagnostic cancellate sculpture, varices, thickened outer lip, and three columellar folds.

Family Turridae

Apiotoma californiana Squires, 1987

Figure 38

Apiotoma californiana Squires, 1987:48–49, fig. 74.

Molluscan Stage Range. "Capay."

Geographic Distribution. Whitaker Peak area and northern Lockwood Valley, southern California.

Local Occurrence. CSUN localities 983, 987.

Remarks. Two specimens were found at locality 983, and a single specimen was found at locality 987. Preservation is good, and the specimens possess the diagnostic angulate whorls with the posterior half nearly straight sided. Spiral ribs cover the whorls, but tend to become obsolete along the base of the body whorl. The angulation in the Lockwood Valley specimens is slightly rounded in comparison to the rather sharp angulation in the holotype. This slight difference is due to an artifact of preservation.

Previously, this species had been known from only a single specimen from the "Capay Stage" part of the Juncal Formation, Whitaker Peak area, southern California.

Trypanotoma stocki (Dickerson, 1916)

Figure 39

Turris stocki Dickerson, 1916:449–500, pl. 42, fig. 5.

Gemmula stocki (Dickerson). Clark, 1929:pl. 11, fig. 3. Anderson and Hanna, 1925:93.

Trypanotoma stocki (Dickerson). Vokes, 1939:120, pl. 17, fig. 14.

Domenginella claytonensis (Gabb). Squires, 1984:37–38, fig. 9k. [Misidentification.]

Primary Type Material. UCMP holotype 11821, Domengine Formation, UCMP locality 672.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. Simi Valley, southern California through central California.

Local Occurrence. CSUN locality 975.

Remarks. Only a single specimen was found. Although only the spire is present, it shows the diagnostic nodose carina near the middle of each whorl and the prominent spiral rib posterior to this carina.

The presence of *T. stocki* in the Juncal Formation?, northern Lockwood Valley, extends the molluscan stage range of this species into the "Capay Stage" proper. Previously, this species had not been reported as ranging stratigraphically any lower than the uppermost "Capay Stage" (Squires, 1984).

Trypanotoma stocki is the only species of this genus on the West Coast. According to Wenz (1943:1414), *Trypanotoma* is a North American genus restricted to the Eocene. The point of origin was most likely in Alabama because *T. carlottae* (Harris) is present there in the Bashi Member of the Hatchetigbee Formation (Palmer and Brann, 1966:967).

Siesser et al. (1985:fig. 2) assigned the Bashi Marl Member to the latest Paleocene through earliest Eocene.

Cryptoconus cooperi (Dickerson, 1916)

Figure 40

Drillia cooperi Dickerson, 1916:491, pl. 40, figs. 6a–b.

Molluscan Stage Range. "Meganos" through "Domengine."

Geographic Distribution. Whitaker Peak area, southern California through southwestern Oregon.

Local Occurrence. CSUN localities 975, 979, 983, 984, 987.

Remarks. Only single fragmentary specimens were found at each locality. Preservation is fair and accounts for the mostly smooth whorls. Most of the specimens, however, do have the distinctive two or three spiral ribs near the suture in the posterior anal band region.

Family Conidae

Conus caleocius Vokes, 1939

Figure 41

Conus caleocius Vokes, 1939:127–129, pl. 18, figs. 1, 7.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. Simi Valley, southern California through central California.

Local Occurrence. CSUN localities 978, 979.

Remarks. Single specimens were found at each locality. Preservation is fair. Although the best preserved specimen (Fig. 41) is incomplete, it shows the diagnostic strong spiral ribs over the entire body whorl, noded body-whorl shoulder, and a row of small nodes immediately anterior to the suture.

Previously, this distinctive species had not been reported as ranging stratigraphically into the "Capay Stage."

Conus remondii Gabb, 1864

Figure 42

Conus remondii Gabb, 1864:122, pl. 20, fig. 79.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. San Diego through central California.

Local Occurrence. CSUN localities 984, 987(?).

Remarks. Single specimens were found at each locality. Preservation is poor, but the specimen from locality 984 shows the diagnostic high spire, noded body-whorl shoulder, and spiral ribs on the anterior portion of the body whorl.

Order Cephalaspidea

Family Cylichnidae

Cylichnina tantilla (Anderson and Hanna, 1925)

Figure 43

Cylichnella tantilla Anderson and Hanna, 1925:140, pl. 7, figs. 4, 8–9.

Molluscan Stage Range. "Capay" through "Tejon."

Geographic Distribution. Simi Valley, southern California through western Washington.

Local Occurrence. CSUN localities 974, 975, 978, 979, 981, 983, 984, 987.

Remarks. Seven specimens were found at localities 984 and 987. At the other localities, only one or two specimens were found. Preservation is fair, but most specimens show the fine spiral ribbing.

Class Bivalvia

Order Nuculoida

Family Nuculidae

Acila (*Truncacila*) *decisa* (Conrad, 1855)

Figure 44

Nucula decisa Conrad, 1855:11–12; 1857:pl. 3, fig. 19.

Molluscan Stage Range. "Martinez" through upper Eocene (*Turritella schencki delaguerrae* Zone of Kleinpell and Weaver, 1963).

Geographic Distribution. San Diego, California through Kamchatka, U.S.S.R.

Local Occurrence. CSUN localities 974, 979, 983.

Remarks. Two specimens were found at each locality, and the specimens are fairly well preserved single valves. All show the characteristic divaricate radial ribbing; the specimen illustrated in Figure 44 shows rare secondary bifurcation of this ribbing.

Order Arcoida

Family Arcidae

Barbatia cf. *B.* (*Cucullaearca*) *cliffensis* Hanna, 1927

Figure 45

Local Occurrence. CSUN localities 981, 987(?).

Remarks. Only single specimens were found at each locality, and the specimens are poorly preserved, incomplete, single valves. The largest fragment (Fig. 45) is a partial internal mold and has a subcentral beak.

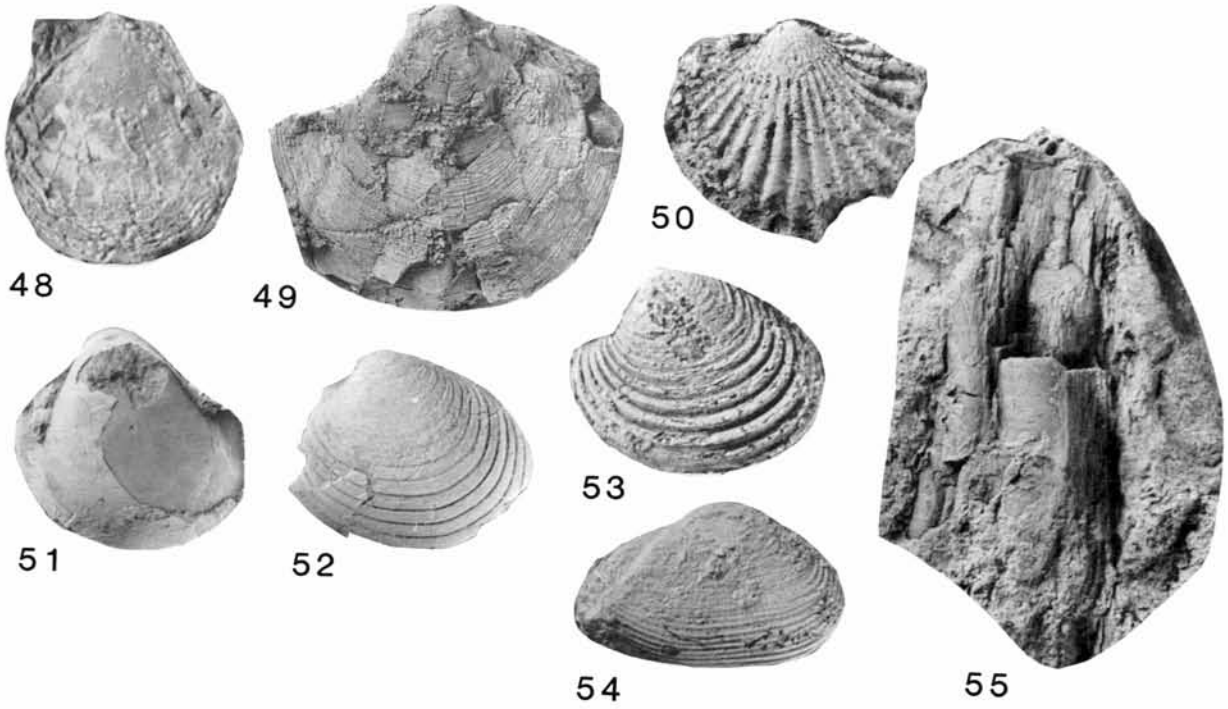
The specimens most closely resemble *B.* (*C.*) *cliffensis* Hanna (1927:272, pl. 26, figs. 1–6; Reinhart, 1943:32–33, pl. 1, figs. 5–7; Moore, 1983:34–35, pl. 5, figs. 9, 12; Squires, 1987: 55, fig. 89) from "Capay" through "Domengine Stage" strata, southern California.

Family Glycymerididae

Glycymeris (*Glycymerita*) *sagittata* (Gabb, 1864)

Figure 46

Axinacea (*Limopsis*?) *sagittata* Gabb, 1864:197–198, pl. 31, figs. 267–267a.



Figures 48–55. Northern Lockwood Valley Eocene bivalves. **48.** *Parvamussium* sp., internal mold of right? valve, ×11.3, length 3 mm, height 3 mm, LACMIP hypotype 7728, CSUN locality 983. **49.** *Claibornites diegoensis* (Dickerson, 1916), right valve, ×1, length 42 mm, height 41 mm, LACMIP hypotype 7729, CSUN locality 987. **50.** *Glyptoactis* (*Claibornicardia*) *domenginica* (Vokes, 1939), right valve, ×4.7, length 7 mm, height 6 mm, LACMIP hypotype 7730, CSUN locality 978. **51.** *Nemocardium linteum* (Conrad, 1865), mostly internal mold, right valve, ×1.7, length 18 mm, width 17 mm, LACMIP hypotype 7731, CSUN locality 981. **52.** *Pitar* (*Lamelliconcha*) *joaquinensis* Vokes, 1939, left valve, ×3.3, length 10 mm, height 8 mm, LACMIP hypotype 7732, CSUN locality 974. **53.** *Callista* (*Costacallista*) *hornii vokesi* Squires, 1987, left valve, ×4.6, length 7 mm, height 6 mm, LACMIP hypotype 7733, CSUN locality 978. **54.** *Corbula* (*Caryocorbula*) *parilis* Gabb, 1864, right valve, ×3.6, length 10 mm, height 6 mm, LACMIP hypotype 7734, CSUN locality 974. **55.** Teredinidae, genus et species indeterminate, in fossilized wood, ×2, length 34 mm, LACMIP hypotype 7735, CSUN locality 987.

Molluscan Stage Range. "Capay" through "Tejon," Oligocene?.

Geographic Distribution. San Diego, California through southwestern Oregon.

Local Occurrence. CSUN localities 974, 975(?), 976, 978, 981, 983, 987.

Remarks. Three specimens were found at locality 981, and one or two specimens were found at each of the other localities. Preservation is moderately good. Only disarticulated valves were found at all the localities.

Order Mytiloida

Family Mytilidae

Brachidontes (*Brachidontes*) *cowlitzensis* (Weaver and Palmer, 1922)

Figure 47

Modiolus (*Brachydontes*) *cowlitzensis* Weaver and Palmer, 1922:16–17, pl. 9, fig. 19 (new name for *Modiola ornata* Gabb, 1864, preoccupied).

Molluscan Stage Range. "Meganos" through lower Oligocene (*Turritella variata lorenzana* Zone of Kleinpell and Weaver, 1963).

Geographic Distribution. San Diego, California through Gulf of Alaska.

Local Occurrence. CSUN locality 979.

Remarks. Only one specimen was found, and it is partly an internal mold of a single valve. It shows the high umbonal fold characteristic of this species.

Order Pterioida

Family Propeamussiidae

Parvamussium sp.

Figure 48

Local Occurrence. CSUN locality 983.

Remarks. A single specimen was found, and it is an internal mold of a single right? valve. Only one of the auricles is present. The interior of the valve shows nine and possibly 10 radial ribs that extend almost to the ventral margin of the valves.

Parvamussium is characterized by internal ribs that extend to, or almost to, the ventral margin (Moore, 1984). There are three Paleogene species of *Parvamussium* in the northeast Pacific, and they all have 10 to 12 interior ribs (Moore, 1984).

Due to the absence of exterior sculpture, specific identification is not possible for the specimen from locality 983.

Order Veneroida

Family Lucinidae

Claibornites diegoensis (Dickerson, 1916)

Figure 49

Lucina diegoensis Dickerson, 1916:484, pl. 37, figs. 1a–b.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. San Diego through northern Lockwood Valley, southern California.

Local Occurrence. CSUN locality 987.

Remarks. A single right valve was found; it is crushed and its dorsal anterior portion is missing. The specimen shows the diagnostic orbicular shape, central beak, fairly strong very closely spaced commarginal ribbing, and the feeble umbonal groove in the dorsal posterior region.

Previously, this species had not been reported geographically as far north as northern Lockwood Valley.

Family Carditidae

Glyptoactis (*Claibornicardia*) *domenginica* (Vokes, 1939)

Figure 50

Venericardia (*Glyptoactis*?) *domenginica* Vokes, 1939:66, pl. 5, figs. 7–9.

Molluscan Stage Range. "Capay" through "Transition."

Geographic Distribution. San Diego through Mt. Diablo, northern California.

Local Occurrence. CSUN localities 978, 979.

Remarks. Two single valves were found at locality 978, and one valve was found at locality 979. Preservation is good, and the specimens show the diagnostic 16 to 17 noded tripartite ribs that are finer and closer together on the posterior portion of the valve. The tripartite nature of the ribs also becomes less apparent posteriorly.

This species is more typical of the subgenus *Claibornicardia* Stenzel and Kraus (*in* Stenzel et al., 1957) than of the subgenus *Glyptoactis* Stewart (1930). Heaslip (1968:98, 110) compared these two subgenera and reported that only *Claibornicardia* had spinose ribs, and that it lacked the diagnostic "tooth" that *Glyptoactis* had above the intersection of the lunule and the anterior point of the left posterior cardinal tooth. *Glyptoactis* (*Claibornicardia*) *domenginica* has spinose radial ribs and lacks the diagnostic "tooth."

Previously, this species had not been reported as ranging stratigraphically into the "Capay Stage."

Family Cardiidae

Nemocardium linteum (Conrad, 1855)

Figure 51

Cardium linteum Conrad, 1855:3, 9; 1857:pl. 2, fig. 1.

Molluscan Stage Range. "Martinez" through "Tejon."

Geographic Distribution. San Diego, California through southwestern Oregon.

Local Occurrence. CSUN localities 981, 983.

Remarks. Two single valves were found at locality 983, and a single valve was found at locality 981. All the specimens are partial internal molds with remnants of exterior shell. They show the diagnostic inflated valves, prominent central beaks, and minute radial ribs.

Family Veneridae

Pitar (*Lamelliconcha*) *joaquinensis* Vokes, 1939

Figure 52

Pitar (*Lamelliconcha*) *joaquinensis* Vokes, 1939:85–86, pl. 13, figs. 9–12.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. Simi Valley, southern California through central California.

Local Occurrence. CSUN localities 974, 975, 976, 978, 979, 980, 981, 983, 984.

Remarks. Six single valves were found at each of the localities 979, 981, and 983. One or two single valves were found at each of the other localities. Preservation is good, and the specimens show the diagnostic flat-topped, wide commarginal ribs with linear interspaces. These flat-topped commarginal ribs are covered by numerous minute growth lines.

Callista (*Costacallista*) *hornii vokesi* Squires, 1987

Figure 53

Callista (*Costacallista*) *hornii vokesi* Squires, 1987:69–70, figs. 120–121.

Molluscan Stage Range. "Capay" through "Domengine."

Geographic Distribution. Simi Valley, southern California through central California.

Local Occurrence. CSUN localities 978, 981.

Remarks. A valve was found at each locality. Preservation is good, and the specimens show the diagnostic thin, vertical-sided commarginal ribs separated by flat-bottomed interspaces twice as wide as the thin commarginal ribs.

Order Myoida

Family Corbulidae

Corbula (*Caryocorbula*) *parilis* Gabb, 1864

Figure 54

Corbula parilis Gabb, 1864:150, pl. 29, figs. 239–239a.

Molluscan Stage Range. "Capay" through "Transition."

Geographic Distribution. San Diego, California through southwestern Oregon.

Local Occurrence. CSUN locality 974.

Remarks. One valve was found. Preservation is fair, and the specimen faintly shows the diagnostic cancellate sculpture. The commarginal ribs also extend onto the sloping posterior region of the shell.

Family Teredinidae

Genus et Species Indeterminate

Figure 55

Local Occurrence. CSUN locality 987.

Remarks. A small piece of fossilized wood with three calcareously lined burrows was found. Generic determination is uncertain because the character of the pallets is used to define subfamilial and generic groups in the Teredinidae, and these are rarely preserved. The only known pallets from a West Coast early Tertiary teredinid belong to a species of *Bankia* (subfamily Bankiinae Turner) (Durham and Zullo, 1961; Kennedy et al., 1980).

LOCALITIES

CSUN macrofossil localities collected by the author in the course of this study are listed first. Localities of other institutions mentioned in this report follow in alphabetical order.

All CSUN localities are in the Juncal Formation? in northern Lockwood Valley, Ventura County, southern California. They are in the United States Geological Survey 7.5-minute (1:24,000 scale) topographic quadrangle of Sawmill Mountain, California, 1943. Abbreviations used are feet (ft.), meters (m), township (T), range (R), north (N), south (S), east (E), and west (W). Distances are given in both English and metric units, but map-contour elevations are given in English units only.

The general location, relative stratigraphic position, provincial molluscan stage, and interpreted paleoenvironment of deposition of each CSUN locality are shown in Figure 2.

CSUN MACROFOSSIL LOCALITIES

974. At elevation of 6015 ft. on west side of trail, 1400 ft. (427 m) south and 250 ft. (76 m) west of NE corner of section 24, T 8 N, R 21 W.

975. At elevation of 6180 ft. on north side of steep hill, 1200 ft. (366 m) south and 350 ft. (107 m) east of NW corner of section 19, T 8 N, R 21 W.

976. At elevation of 6225 ft. at top of steep hill, 1200 ft. (396 m) south and 380 ft. (116 m) east of NW corner of section 19, T 8 N, R 21 W.

978. At elevation of 6200 ft. at a prominent bed on top of small ridge, 1400 ft. (427 m) south and 540 ft. (165 m) east of NW corner of section 19, T 8 N, R 21 W.

979. At elevation of 6170 ft. on top of small ridge and continuing westward along strike of prominent bed into small canyon, 1500 ft. (457 m) south and 600 ft. (183 m) east of NW corner of section 19, T 8 N, R 21 W.

980. At elevation of 6115 ft. on west side of small ridge, 1620 ft. (494 m) south and 925 ft. (282 m) east of NW corner of section 19, T 8 N, R 21 W.

981. At elevation of 6350 ft. on south side of narrow ridge, 2000 ft. (610 m) south and 2850 ft. (869 m) east of NW corner of section 19, T 8 N, R 21 W.

983. At elevation of 6125 ft. on south side of small ridge, 1400 ft. (427 m) north and 1850 ft. (564 m) west of SE corner of section 24, T 8 N, R 21 W.

984. At elevation of 6025 ft. on north side of ridge, 3200 ft. (976 m) south and 1150 ft. (351 m) east of NW corner of section 19, T 8 N, R 21 W.

987. At elevation of 6075 ft. on top of ridge, 3000 ft. (914 m) south and 1315 ft. (952 m) east of NW corner of section 19, T 8 N, R 21 W.

990. At elevation of 6185 ft. along east side of hill, 1050 ft. (320 m) south and 1380 ft. (421 m) east of NW corner of section 19, T 8 N, R 21 W.

UCMP LOCALITIES

672. Massive sandstone forming southern portion of crest of Parson's Peak, SE ¼ of the NW ¼ of section 24, T 18 S, R 14 E, Coalinga quadrangle, Fresno County, California.

A-662. On east bank of Little River between the highway bridge and the first bend of the stream east of the junction with the North Umpqua River, center of section 19, T 26 S, R 3 W, Douglas County, Oregon.

A-1313. West side of Capay Valley west of Tancred Station, south-central part of section 28, T 11 N, R 3 W, Yolo County, California.

B-1840. Santa Agata fossili, northern Italy. Type Tortonian.

B-7148. Parnes (Oise), Paris Basin, France. Lutetian Stage.

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