CUSHMAN FOUNDATION FOR FORAMINIFERAL RESEARCH

SPECIAL PUBLICATION NO. 28

ATLAS OF CALIFORNIA NEOGENE FORAMINIFERA

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Cushman Foundation Special Publication No. 28
p. 1-271, 1990

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ABSTRACT

This atlas consists of 123 species of foraminifera from the Miocene and Pliocene of California. Each taxon is illustrated with type figures, scanning electron micrographs, and thin-section photomicrographs. Accompanying data on the taxonomy, biostratigraphic range and paleoenvironmental significance of each species provides workers with an efficient means of interpreting the provincial assemblages.

New species described are *Bolivina santanaensis* and *Lagena newportensis*.

INTRODUCTION

Foraminifera are often encountered in petrographic slides of mudstones from the California Neogene, but the lack of a reference for identifying sectioned tests has made it impossible for these observations to yield much information. The original purpose of this atlas was to enable both the micropaleontologist and petrographer to recognize foraminifers in petrographic slides (see pls. 1-3). With this capability, workers can interpret the biostratigraphic age and depositional paleoenvironment of the sediments examined. In order to make this a most versatile reference, the species are illustrated by type figures, scanning electron micrographs (SEMs), and thin section photomicrographs accompanied by their taxonomic, biostratigraphic, and paleoenvironmental data.

The basis for the thin section study is the technique developed by Finger and Armstrong (1984). Approximately 1200 samples from 18 Neogene outcrop sections in the coastal regions of central and southern California were examined during the course of this investigation, yielding 338 foraminiferal assemblages. Geographic locations and stratigraphic intervals of the nine sampled sections referred to in the faunal plate descriptions of this atlas are plotted on the map and chart of Figure 1. Although the Miocene Monterey Formation is heavily emphasized here, several species from the lower Pliocene Fernando Formation (commonly termed "Repetto") also are included.

In selecting 123 taxa, or less than one-third of the total faunal collection eventually made, priority generally was given to those species which are considered important markers for age and/or paleoenvironment. Unfortunately, not all of the regional index species had sufficient recovery during the thin-sectioning phase of this study to be included. Of the selected taxa, more than 1000 illustrations are presented on the 125 faunal plates (pls. 4-128) of this catalog. Each plate consists of both SEMs and thin-section photomicrographs, and is accompanied by a facing page of information on the species illustrated. Two new species, *Bolivina santanensis* and *Lagena newportensis*, are described.

As revealed during the course of this study, there are limitations to the utility of the thin-section aspect of this catalog which the user

should bear in mind. When examining petrographic slides of foraminiferal rocks from the Monterey Formation, it is most likely that many specimens will be observed which cannot be identified. Aside from the likelihood of finding species which are not represented in this catalog, the microscopist is certain to encounter specimens that do not reveal the diagnostic features of their morphologies due to orientation to the sectioned plane or poor preservation. Also, bolivinids and/or globigerinids tend to dominate most of the Monterey assemblages and, thus, are the most likely forms to be found in petrographic slides. This study reveals that many of the bolivinid species can be difficult, if not impossible, to tell apart in thin section, regardless of orientation and preservation. With experience, however, the microscopist will develop the insight necessary to quickly scan the assemblage for those species and specimens that have the greatest potential of accurate identification and interpretive value.

The applicability of this reference is not necessarily limited to the specific fauna illustrated, as most of the genera represented here are common in other Neogene sections around the world. Identifications at the generic level can provide vital information for interpretation and correlation, particularly if the microscopist has a working knowledge of the regional fauna.

COMMENTS

The catalog entries are arranged in alphabetical order by genus and species. With few exceptions, the generic assignments are based on Loeblich and Tappan (1987). Two alphabetical lists assist rapid searches for particular species: Table 1 is arranged by genus-species; Table 2 is arranged by species-genus. The latter index enables workers to get around the confusion between traditional (familiar) generic assignments and those adopted herein.

As noted above, each plate is accompanied by a facing page of information on the illustrated species. A brief explanation of each subheading is provided below:

Type Designation and Reference: The original citation of the taxonomic name (if different from the current name) and the publication in which the species was originally described.

Type Figure(s): Illustration of the type specimen(s), in most cases derived from the publication naming the species. The holotype is usually figured, although many papers do not label the figure as such. For some of the indeterminate species, and species recently described by Finger and Lipps (Finger and others, 1990) for which the holotype is illustrated on the facing plate herein, I have included figures of comparable forms to which they had previously been assigned.

Type Level and Locality: The biostratigraphic age, lithostratigraphic unit, and geographic location of the type specimen(s).

Taxonomic Remarks: For the majority of species, it has been possible for me to compare my specimens with the types deposited in other collections. The following codes indicate that the type specimen(s) was examined and in which collection it is housed: LSJU = Stanford University (Kleinpell's collection); UCMP = University of California Museum of Paleontology; USGS = U.S. Geological Survey (Menlo Park); USNM = U.S. National Museum of Natural History (Cushman Collection). Other comments are provided, such as partial synonymies and the "splitting and lumping" of taxa.

Biostratigraphic Range in California Neogene: Ages of species (and/or their probable synonyms) are indicated according to Kleinpell (1938, table 18) and his revisions (Kleinpell, 1980; Kleinpell and Tipton, 1980). Although it is now realized that most of the Zemorrian is Oligocene (see Finger, 1983), ranges which extend into the Zemorrian are indicated as such because it is the time when some of the important Neogene basins actually originated. Composite ranges compiled from selected regional literature, particularly those publications illustrating the fauna, are also presented and code-referenced (see Appendix). In collating the published data, I also combined total ranges of those species for which I believe there is a strong case for synonymy (as discussed under the respective "Taxonomic Remarks").

Planktic species ranges are listed for the northeastern Pacific (California Current), as determined from DSDP Site 173 off northern California (Ingle, 1973) and DSDP Sites 467, 468, and 469 off central and southern California (Poore, 1981); also listed are their global ranges according to Kennett and Srinivasan (1983).

This study presents a revised range for each species based on my own research data and the regional literature referred to above. Sections in which I found the species are notated as codes readily deciphered from Figure 1. Chronologic correlation follows the framework of Figure 2. I have refrained from using Kleinpell's (1938) zones and the subseries they are supposedly concurrent with because their inconsistency renders them unreliable for regional correlation (see Concluding Remarks).

Paleoecological Significance: Most of the interpretations presented here are based on Ingle (1980, table 1; 1985, tables 4.2-4.5). Data on probable synonyms are indicated appropriately. In determining depositional paleobathymetries in the California Neogene, where downslope displacement is prevalent, the deepest upper depth limits represented in an assemblage are interpreted as minimum depths of deposition. The depth ranges of Ingle's (1980) bathymetric zones/biofacies are as follows:

inner shelf	0-50 m
outer shelf	50-150 m
upper bathyal	150-500 m
upper middle bathyal	500-1,500 m
lower middle bathyal	1,500-2,000 m
lower bathyal	>2,000 m

Low-oxygen zone indicators are those species believed to be tolerant of anaerobic (<0.2 ml/l oxygen) bottom conditions.

Plate-figures: A description of the facing plate follows the above subheadings for each species. For the specimen(s) in each picture, there is information on its sample locality, age, and magnification. Scanning electron micrographs were obtained with the Etec Omniscan® and the Etec Autoscan®, thin-section photomicrographs were taken through a Leitz Laborlux 12® stereomicroscope; attached Polaroid® camera systems were used with all of these instruments.

CONCLUDING REMARKS

In compiling this report, it became increasingly evident that *most* of the benthic foraminifers in the California Neogene are longer ranging than previously documented. In fact, some of the species included in this catalog extend into the Oligocene, while many others inhabit the modern California Borderland. With adequate illustrations relatively rare in the regional literature, it is commonly difficult to assess the correctness of species identifications and their synonymies in various papers. However, species that are repeatedly misidentified should not be considered good index species. What is evident from the biostratigraphic data presented here is that only a select few species from the California Neogene may be true index fossils. Perhaps the major flaw in foraminiferal studies of the California Neogene has been the tendency for workers to rely on individual species as definitive age-markers by correlating them with the composite range chart of Kleinpell (1938) or slightly modified versions thereof.

Kleinpell (1938; see Wornardt, 1972) emphasized that the total assemblage, or congregation, was more important than index fossils in recognizing his chronostratigraphic zones because few of the foraminiferal species are restricted to a single zone, and those that are were geographically or ecologically restricted. Thus, he had reluctance when naming his concurrent range zones (which he referred to as Oppelian zones) according to characteristic species which were usually present in them. Concurrent range zones certainly seem to be a useful and reliable means of correlation on a *local* basis. However, correlating these associations over wide distances and between basins is quite risky, as current knowledge of geography, geomorphology, and ecology dictates that at any given time the Neogene California Borderland must have been characterized by a heterogeneity of depositional environments and biofacies. In the course of this study, I have found it impossible to rely on Kleinpell's zones because most of the species used to identify them are either poorly distinguished from related forms or too wide-

ranging for their occurrences to be significant.

In almost every case, a foraminiferal assemblage recovered from the California Neogene represents a thanatofacies; its composition was determined by the environmental gradient and associated biofacies through which the sediments were transported downslope and finally deposited. Thus, thanatofacies can be extremely useful in determining the depositional history of sediments. Their correlations generally trace paleobathymetries which, although often time-transgressive, are a powerful tool in paleoenvironmental studies. Hence, the six Miocene stages defined by Kleinpell (1938), and later staunchly defended by him (Kleinpell, 1980), are facies-controlled and more or less independent of time (see Crouch and Bukry, 1979; Arnal and others, 1980). The *relative chronologic succession* of these stages reflects the overall structural and ecologic evolution of the California Borderland and the associated changes in the occurrences and relative abundances of foraminiferal species. There can be no doubt that the global cooling trend of the middle Miocene is reflected in the Luisian-Mohnian faunal transition, and that the boundary between these two stages is latitudinally diachronous along the West Coast. The other stages are not as readily distinguished, as they do not define widespread ecological changes.

Two major problems in recognizing the subdivisions of the California Miocene are that Kleinpell (1938, 1980) created stratotypes for his stages and zones and he emphasized numerous taxa which he failed to recognize as ecophenotypes or diagenetically formed variants of other species. On the former point, there is no reason to expect the depositional trends (i.e., faunal mixing, depth of deposition) interpreted for a stratotype section to be widespread throughout the California Borderland. Also, there is recent evidence that abrupt faunal changes in some of the more important reference sections are due to previously undetected hiatuses (e.g., Barron, 1986a, b; Arends and Blake, 1986; DePaolo and Finger, in press). This implies that faunal turnovers across stage and zonal boundaries may be much more gradual than previous studies would have us believe.

From the foregoing comments, it is evident that this catalog is more than just a guide to thin-sectioned foraminifers. Whereas benthic foraminifers often are the most abundant microfossils in the California Neogene, it is critical that workers fully appreciate the limitations of the extracted data before providing their interpretations of age and paleoenvironments. It is hoped that this catalog will serve as a useful reference for identifying and interpreting some of the species that comprise this most important fauna, and that it also will find utility in studies of faunas from other regions and ages.

ACKNOWLEDGEMENTS

Many of the specimens illustrated in this catalog were obtained from samples generously donated by J. H. Lipps (University of California). I am most grateful to G. L. Armstrong (formerly Chevron Oil Field Research Company) for his invaluable assistance throughout the course of this study. I also thank D. Haman (Chevron U.S.A., Inc., Central Region) for encouraging and supporting this research from its inception., K. MacDougall (U.S. Geological Survey, Menlo Park), R. L. Fleisher (Chevron Overseas Petroleum, Inc.), D. B. Wagner (Chevron U. S. A., Inc., Western Region), and M. P. Dumont (formerly Chevron U. S. A., Inc., Western Region) for offering taxonomic opinions, J. C Ingle, Jr. (Stanford University) and M. B. Lagoe (University of Texas, Austin) for reviewing the manuscript and providing constructive comments, and S. J. Culver (Old Dominion University) for editing this monograph and providing advice and assistance on publishing it through the Cushman Foundation.

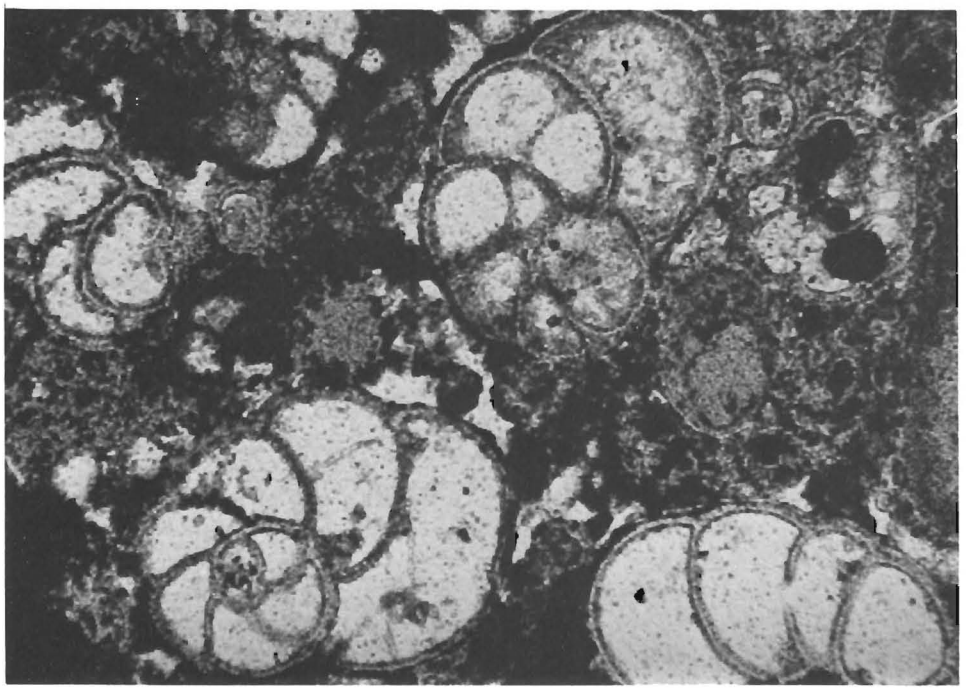


PLATE 1

Photomicrograph of specimens of *Valvulineria robusta* (Kleinpell) in petrographic section, X91, sample locality CRC40661-1, Relizian, Monterey Formation, Rodeo Canyon (Boathouse Beach), Point Arguello area, Santa Barbara County.

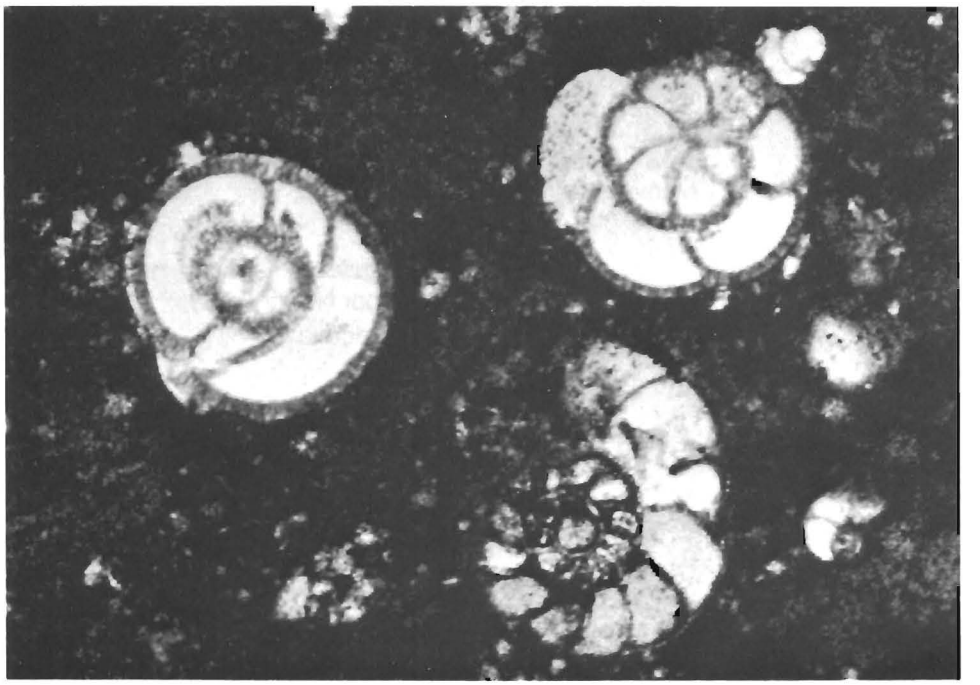


PLATE 2

Photomicrograph of *Pullenia miocenica* Kleinpell (top two specimens) and *Anomalinoides salinasensis* (Kleinpell) in petrographic section, X91, sample locality CRC40471-12, Luisian, Monterey Formation, Lions Head, Santa Maria area, Santa Barbara County.

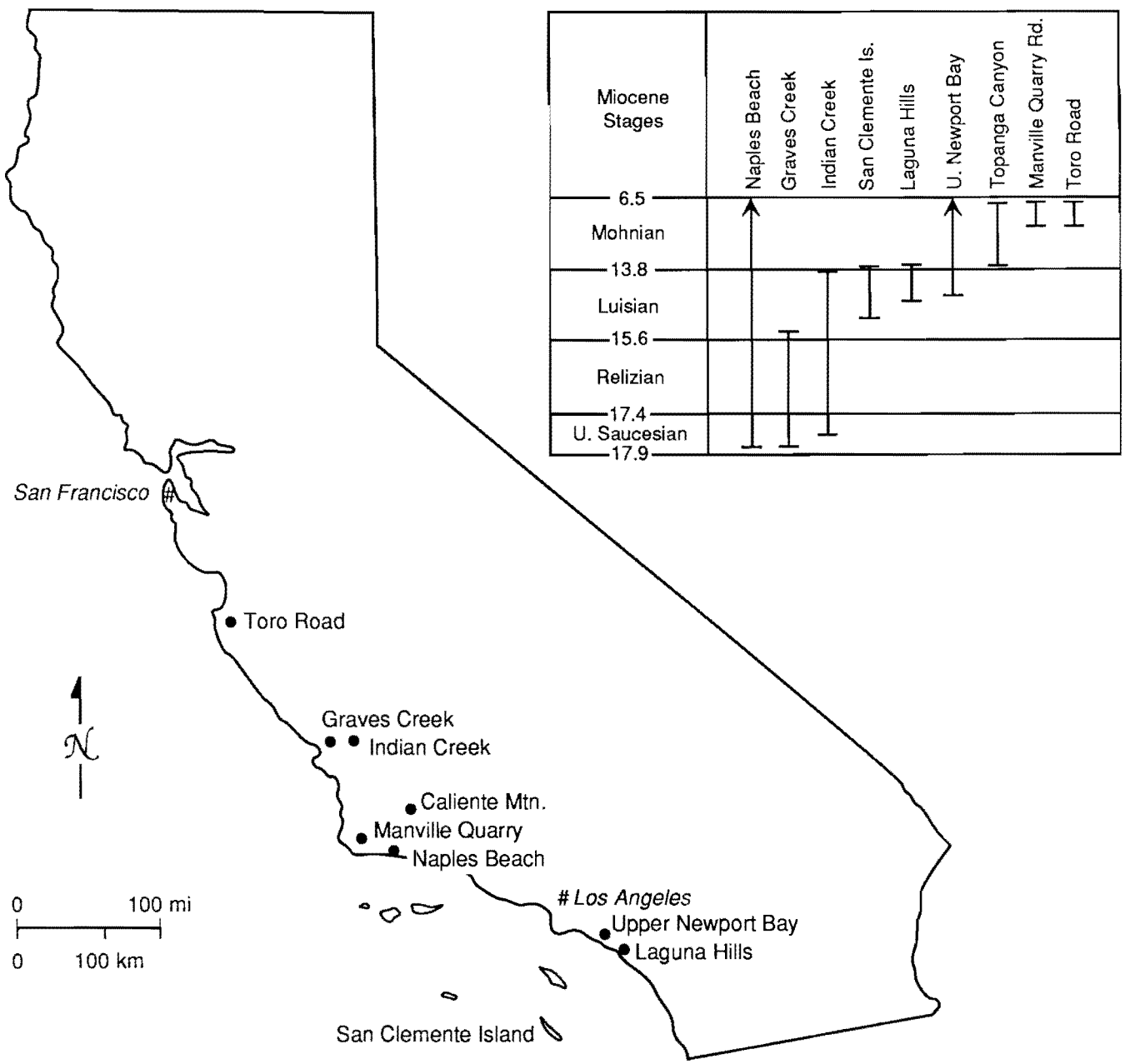


FIGURE 1. Locality map and age intervals of outcrop sections yielding samples examined in the California Neogene study. Stage boundaries are according to Fig. 2.

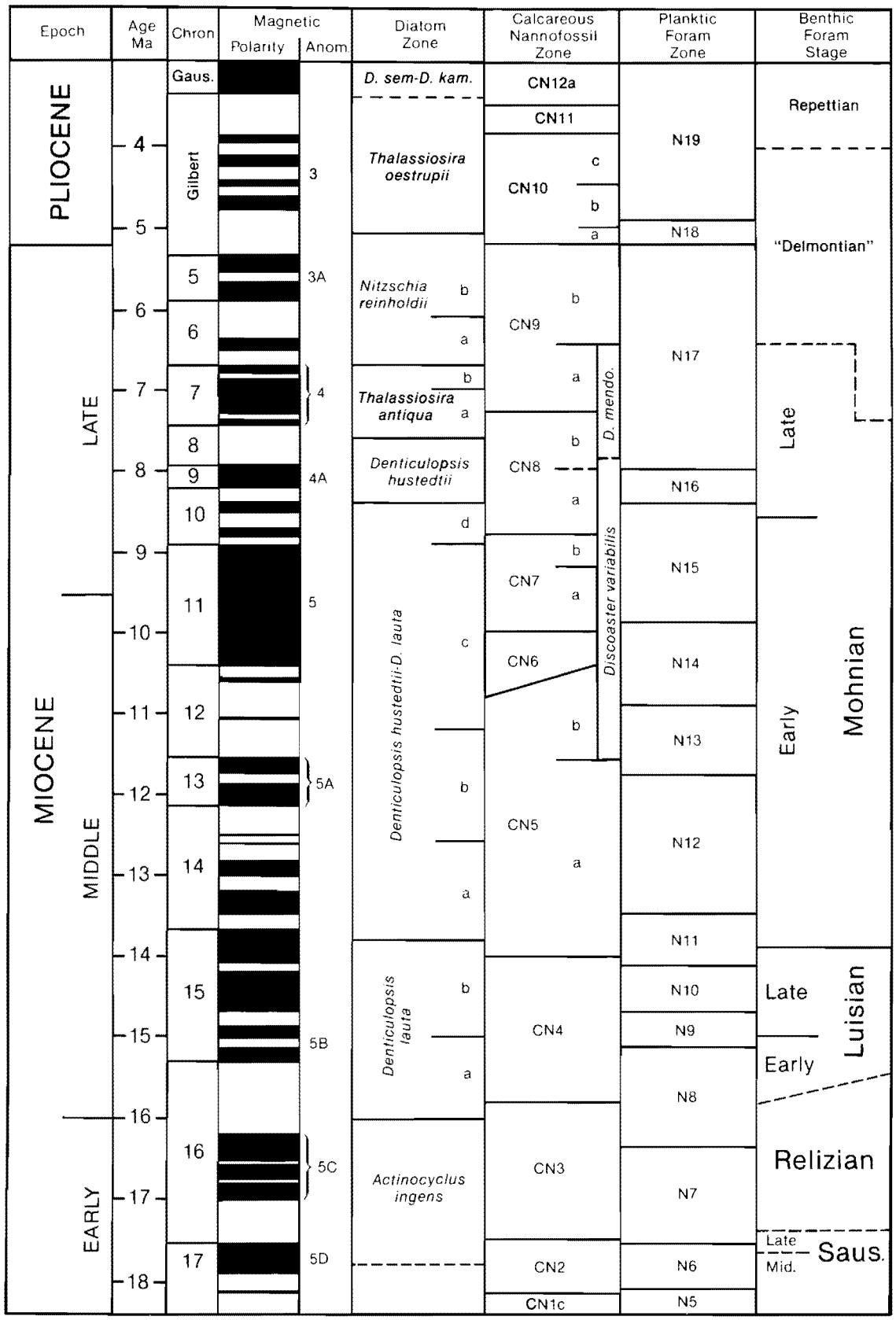


FIGURE 2. Chronostratigraphic correlation chart for the late early Miocene to late Pliocene of California. (Modified from Barron, et al., 1985; Barron 1986 a, b.)

Table 1. SPECIES LIST (genus, species)

Ambitropus evax
Anomalinoides salinasensis
Astrononion goudkoffi
Baggina californica
Bolivina advena
Bolivina advena ornata
Bolivina argentea
Bolivina blakei
Bolivina bramlettei
Bolivina brevior
Bolivina californica
Bolivina churchi
Bolivina foraminata
Bolivina girardensis
Bolivina granti
Bolivina imbricata
Bolivina santanaensis
Bolivina sinuata
Bolivina sulphurensis
Bolivina wissleri
Bolivina woodringi
Buccella oregonensis
Bulimina fossa
Bulimina inflata
Bulimina subacuminata
Bulimina subcalva
Buliminella curta
Buliminella elegantissima
Buliminella semihispida
Buliminella subfusiformis
Cancris baggi
Cassidulinella renulinaformis
Chilostomella ovoidea
Chilostomina pustulosa
Cibicidoides cushmani
Cibicidoides mckannai
Concavella gyroidinaformis
Cyclammina incisa
Dentalina pseudoobliqua
Elphidium granti
Epistominella discorbisoides
Epistominella smithi
Galliherina uvigerinaformis
Gaudryina subglabrata
Glandulina cf. *G. simulans*
Globigerina bulloides
Globigerina pseudociperoensis
Globocassidulina monicana
Globocassidulina neomargareta
Globocassidulina neopulchella
Globorotaloides trema
Gyroidina healdi
Gyroidina rosaformis
Gyroidina cf. *G. rosaformis*
Hansenisca altiformis
Hansenisca multicamerata
Hansenisca rotundimargo
Hanzawaia depaoloi
Holmanella baggi
Holmanella valmonteensis
Hopkinsina magnifica
Islandiella californica
Islandiella carinata
Islandiella modeloensis
Kleinpella californiensis
Lagena newportensis
Lenticulina cf. *L. calcar*
Lenticulina hughesi
Lenticulina luciana
Lenticulina miocenica
Lenticulina reedi
Lenticulina smileyi
Loxostomoides digitata
Marginulinopsis beali
Megastomella capitanensis
Melonis barleeanus
Melonis pompilioides
Neoeponides cf. *N. parantillarum*
Nodogenerina lepidula
Nodogenerina sagrinensis
Nodosaria cf. *N. anomala*
Nodosaria ewaldi
Nodosaria cf. *N. tympaniplectriformis*
Nonionella miocenica
Oridorsalis umbonata
Paracassidulina delicata
Parafrondicularia miocenica
Plectofrondicularia californica
Praeglobobulimina galliheri
Protentella prolixa
Protoglobobulimina pseudotorta
Protoglobobulimina pseudotorta (f. *"pseudoaffinis"*)
Proxifrons advena
Pseudononion costiferum
Pseudononion multicameratum
Pseudononion schencki
Pseudoparrella californica
Pseudoparrella subperuviana
Pullenia inglei
Pullenia miocenica
Rectuvigerina branneri
Rectuvigerina hughesi
Rectuvigerina loeblichi
Rectuvigerina transversa
Siphonodosaria advena
Siphonodosaria montereyana
Siphonodosaria quadrulata
Sphaeroidina chilostomata
Suggrunda kleinpelli
Tenuitellinata angustiumbilicata
Trifarina fluens
Uvigerina hannai
Uvigerina hootsi
Uvigerina "peregrina"
Uvigerina proboscidea
Uvigerina senticosa adiposa
Uvigerina subperegrina
Uvigerinella californica
Valvulineria californica
Valvulineria malagaensis
Valvulineria malagaensis (immature form)
Valvulineria miocenica
Valvulineria miocenica ornata
Valvulineria cf. *V. miocenica ornata*
Valvulineria robusta

Table 2. INDEX OF SPECIES (species, genus)

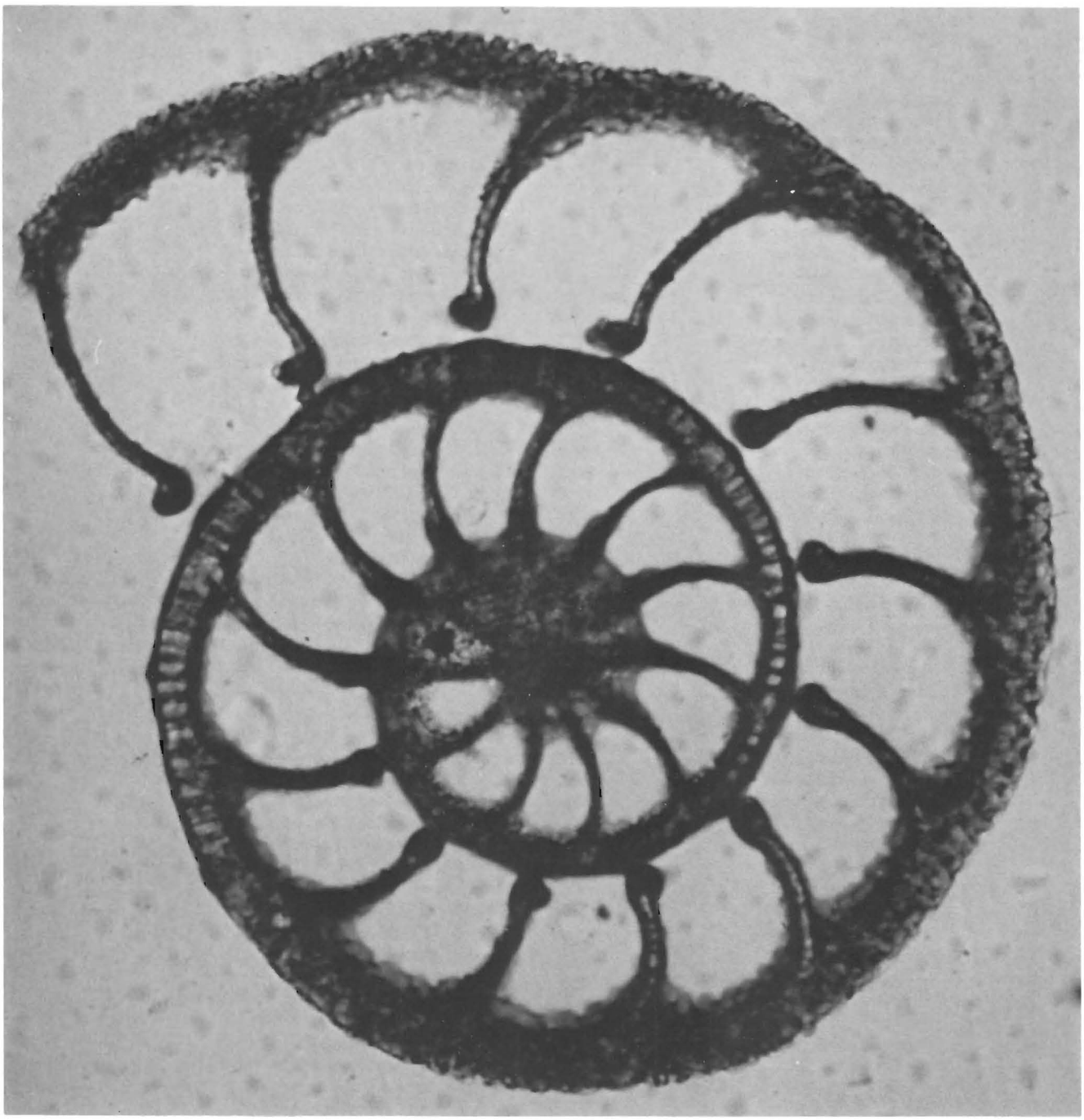


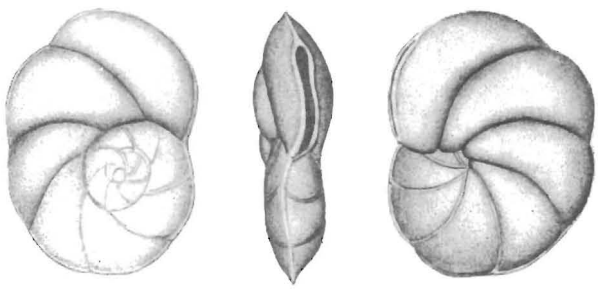
PLATE 3

Thin-section photomicrograph of *Anomalinoides salinasensis* (Kleinpell), X400, sample locality CRC40660-14, Luisian, Monterey Formation, Naples Beach, Santa Barbara County.

FAUNAL ENTRIES AND PLATES

Ambitropus evax
to
Valvulineria robusta

Ambitropus evax (Bandy)



1a 1b 1c

Type Designation and Reference: *Epistominella evax* Bandy, 1953, Jour. Paleont., v. 27, no. 2, p. 179.

Type Figures: *Ibid.*, pl. 23, figs. 1a-c, holotype, X73.

Type Level and Locality: Recent, south side of Cordell Bank, off San Francisco, California.

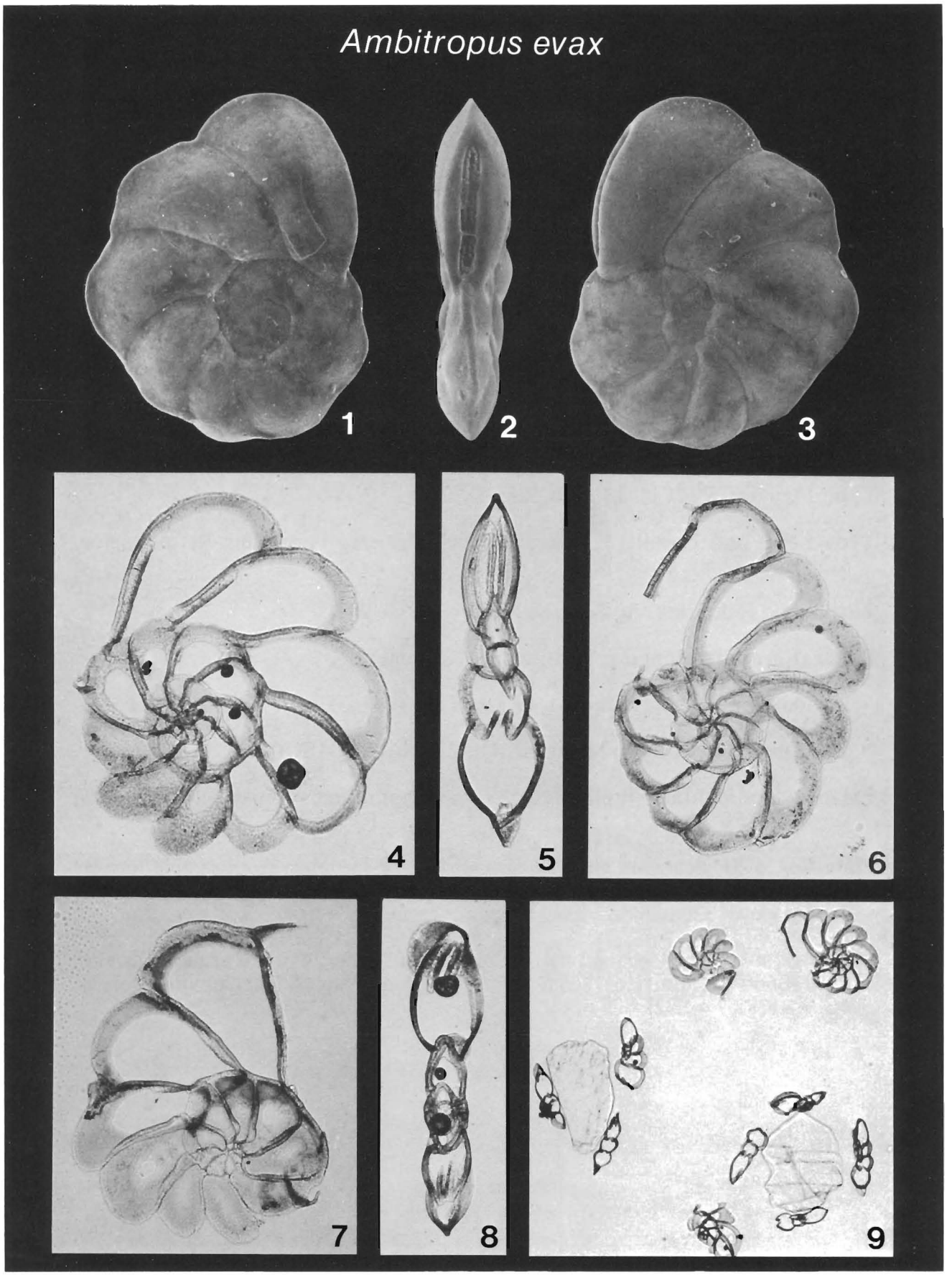
Taxonomic Remarks: Agrees with holotype (USNM237434) and paratypes (USNM237435). This species is the genotype of *Ambitropus*, and it is distinct from the Ecuadorian species *A. thalmanni* (see Lipps, 1965). Its juveniles can be difficult to distinguish from those of *Epistominella pseudosmithi* Arnal (1984), particularly since both species often are in association. Regional synonyms are *Pulvinulinella* sp. (in part?) of Kleinpell (1938), *A. thalmanni* (Stainforth and Stevenson) *sensu* Smith (1960), and *Megastomella kleinpelli* Arnal (1984).

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *Pulvinulinella* sp.: Late Mohnian.
Regional Literature: Luisian to Pliocene, ranges to Holocene (AR76, AR84, CB86, LI65).
This Study: Relizian to Pliocene, ranges to Holocene. (MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, X125: 1, side view; 2, edge view; 3, opposite side view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 33: 4, 5 = X100; 6 = X80; 7, 8 = X100; 9 = X25.


Ambitropus evax
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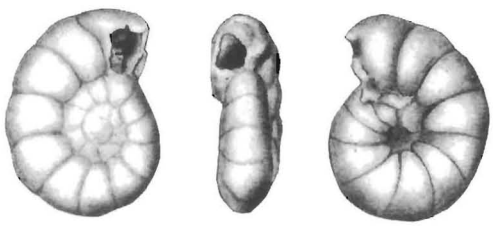
Anomalinoides salinasensis (Kleinpell)



1a 1b 1c

Type Designation and Reference: *Anomalina salinasensis* Kleinpell, 1938, Miocene Stratigraphy of California, p. 347.

Type Figures: *Ibid.*, pl. 13, figs. 1a-c, X46.

Type Level and Locality: Lower Luisian, Monterey Formation, Reliz Canyon, Monterey County, California.

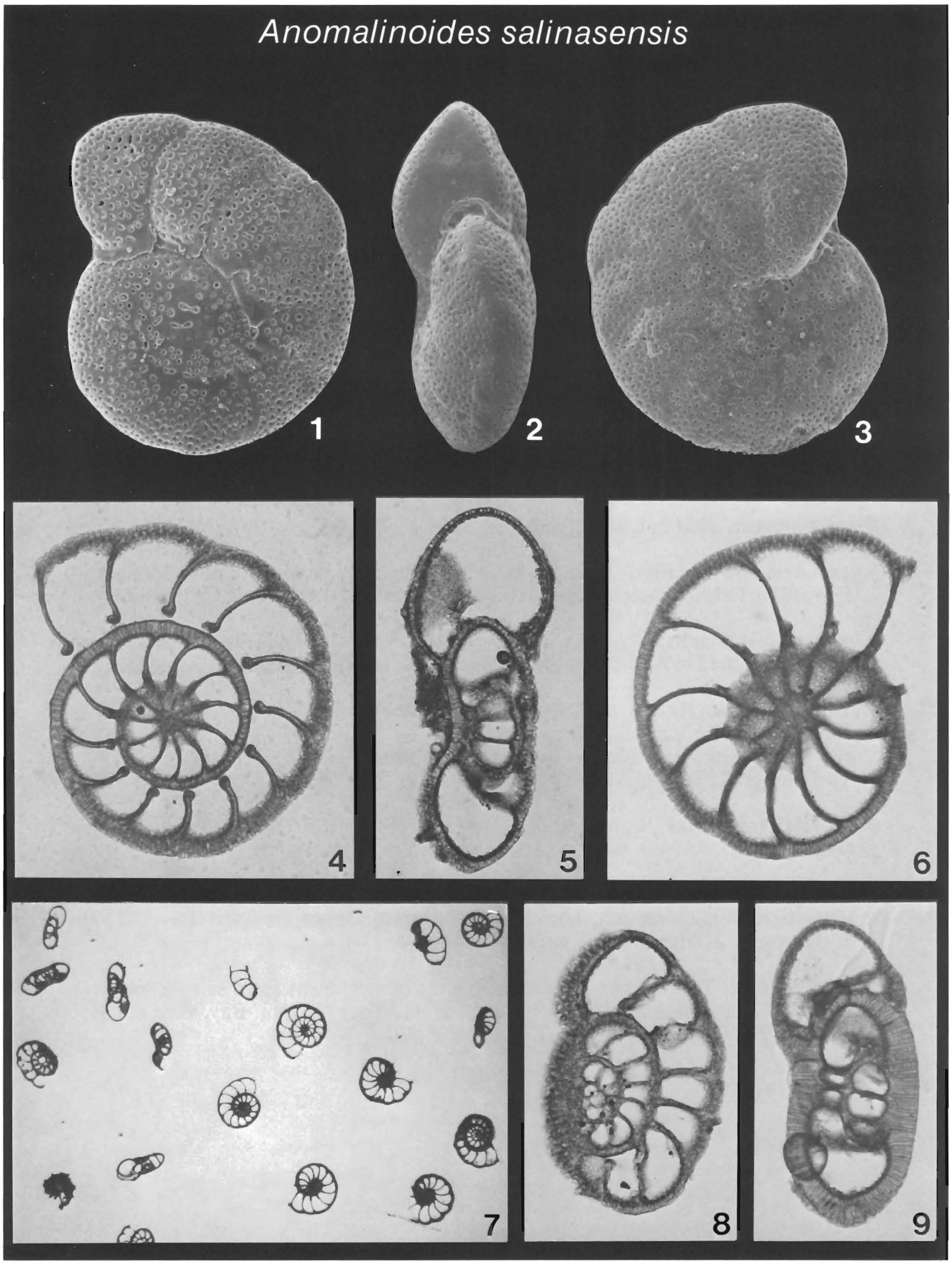
Taxonomic Remarks: Agrees with holotype (LSJU908).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Relizian to late Luisian.
Regional Literature: Saucesian to Mohnian (AR76, BL81, FI90, KL80, PM81, SM60).
This Study: Saucesian to Mohnian. (GC, IC, NA, SCI, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1985).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality GC-15a, Luisian, Monterey Formation, Graves Creek, X123: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40660-14, Luisian, Monterey Formation, Naples Beach, slide no. 5: 4-6 = X128; 7 = X32; 8, 9 = X128.


Anomalinoides salinasensis
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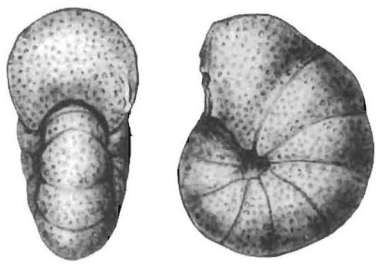
Astrononion goudkoffi (Kleinpell)



5 2

Type Designation and Reference: *Nonion goudkoffi* Kleinpell, 1938, Miocene Stratigraphy of California, p. 231.

Type Figures: *Ibid.*, pl. 20, figs. 2, 5, X125.

Type Level and Locality: Upper Mohnian, Valmonte Diatomite Member, Monterey Formation, Cabrillo Beach, Palos Verdes Hills, Los Angeles County, California

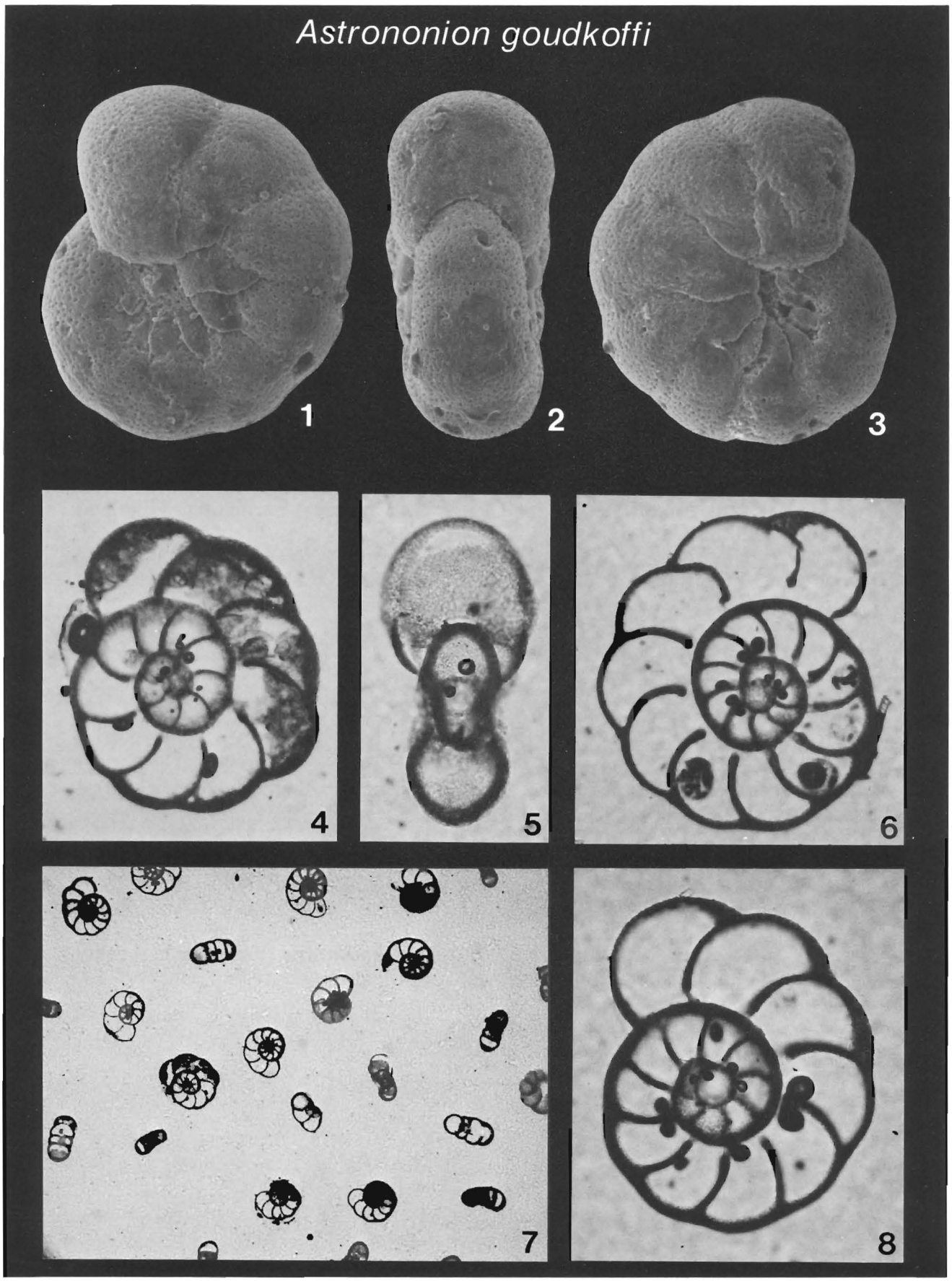
Taxonomic Remarks: Agrees with holotype (USNM497177). This minute species has been referred to *Anomalina* and *Melonis* in the regional literature.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian.
Regional Literature: Mohnian (BE86, KL80, PI56).
This Study: Relizian to Mohnian. (IC, MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = outer shelf/shelf edge (Ingle, 1985).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, X157: 1, side view; 2, edge view; 3, opposite side view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 87: 4 = X160; 5 = X200; 6 = X160; 7 = X32; 8 = X200.


Astrononion goudkoffi
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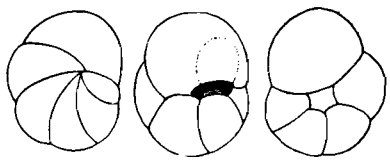
Baggina californica Cushman



Type Reference: Cushman, 1926c, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 64.

Type Figures: *Ibid.*, pl. 9, figs. 8a-c, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

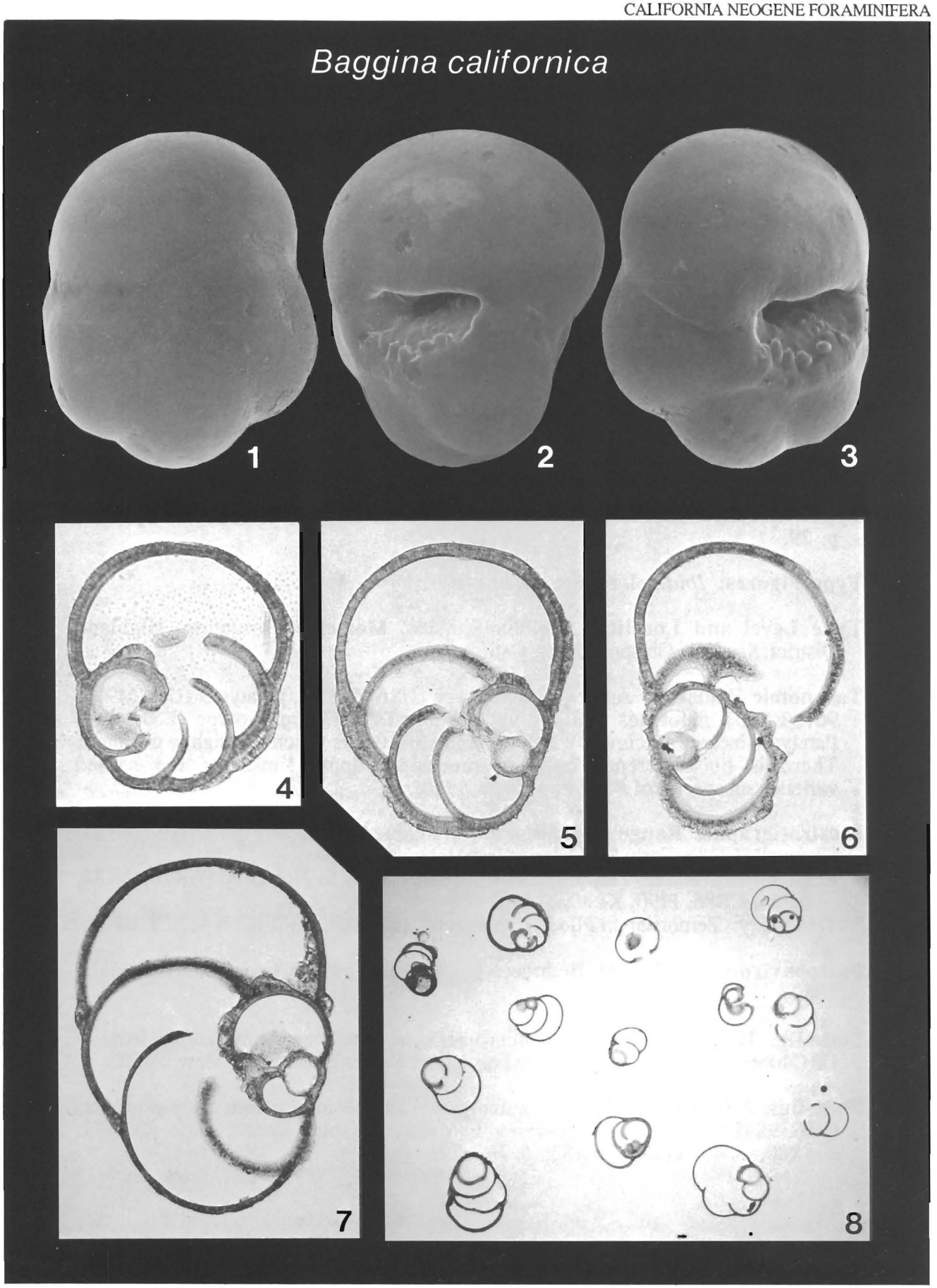
Taxonomic Remarks: Agrees with holotype (USNM5777), paratypes (USNM5778-5782), and topotypes (USGS).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Zemorrian to late Mohnian.
Regional Literature: Zemorrian to Mohnian/Delmontian (AR76, AR84, BL81, FI90, KL80, PM81, SM80, TI73).
This Study: Zemorrian to Mohnian/"Delmontian". (GC, IC, LH, NA, SCI, UNB)

Paleoenvironmental Significance: Upper depth limit = shelf edge/upper bathyal transition (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40660-14, Luisian, Monterey Formation, Naples Beach, X80: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay, slide no. 24: 4-7 = X80; 8 = X20.


Baggina californica
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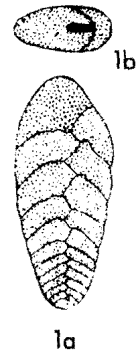
Bolivina advena Cushman



Type Reference: Cushman, 1925c, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 29.

Type Figures: *Ibid.*, pl. 5, figs. 1a, b, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

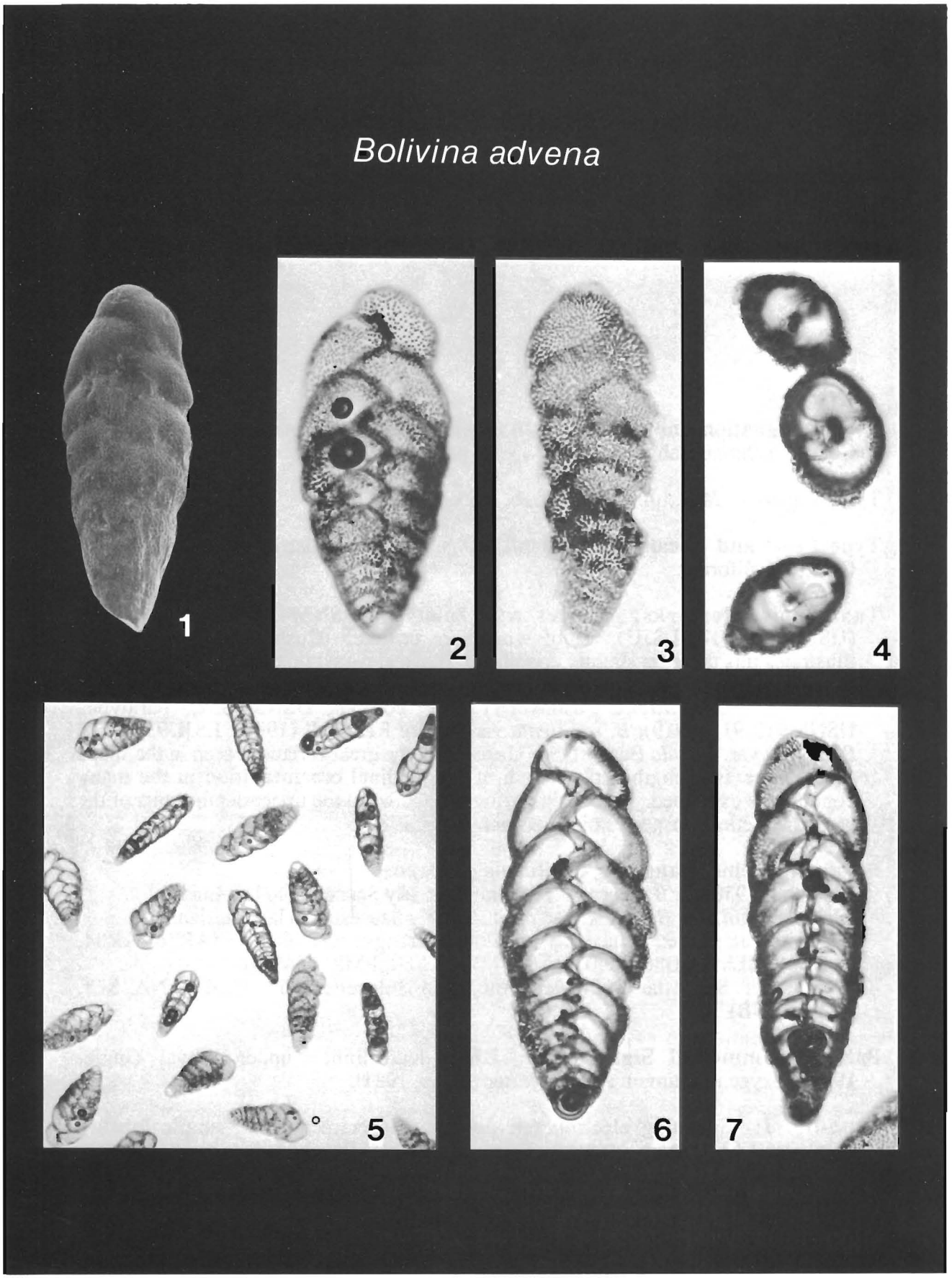
Taxonomic Remarks: Agrees with holotype (USNM4350), paratypes (USNM905-907, LSJU), topotypes (USGS), and Kleinpell's (1938) plesiotype (LSJU670). Paratypes include specimens which are striate and others which are slightly crenulate. There is no difference between the upper depth limits of the named varieties/subspecies of *B. advena* (Ingle, 1980).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Saucesian to late Mohnian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, AR84, BE86, CB86, FI90, KL80, TI73).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, IC, NA, SCI, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40660-8, Saucesian, Monterey Formation, Naples Beach: side view, X100.

Plate-figs. 2-7: Thin-section photomicrographs of specimens from sample locality CRC39842-94, Relizian, Monterey Formation, Naples Beach, slide no. 111: 2 = X80; 3, 4 = X128; 5 = X32; 6, 7 = X128.


Bolivina advena
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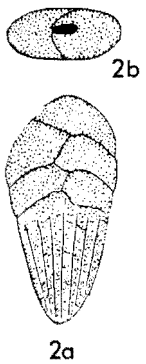
Bolivina advena ornata Cushman



Type Designation and Reference: *Bolivina advena* var. *ornata* Cushman, 1925c, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 29.

Type Figures: *Ibid.*, pl. 5, figs. 2a, b, X65.

Type Level and Locality: Relizian/Luisian, Highland District, San Luis Obispo County, California.

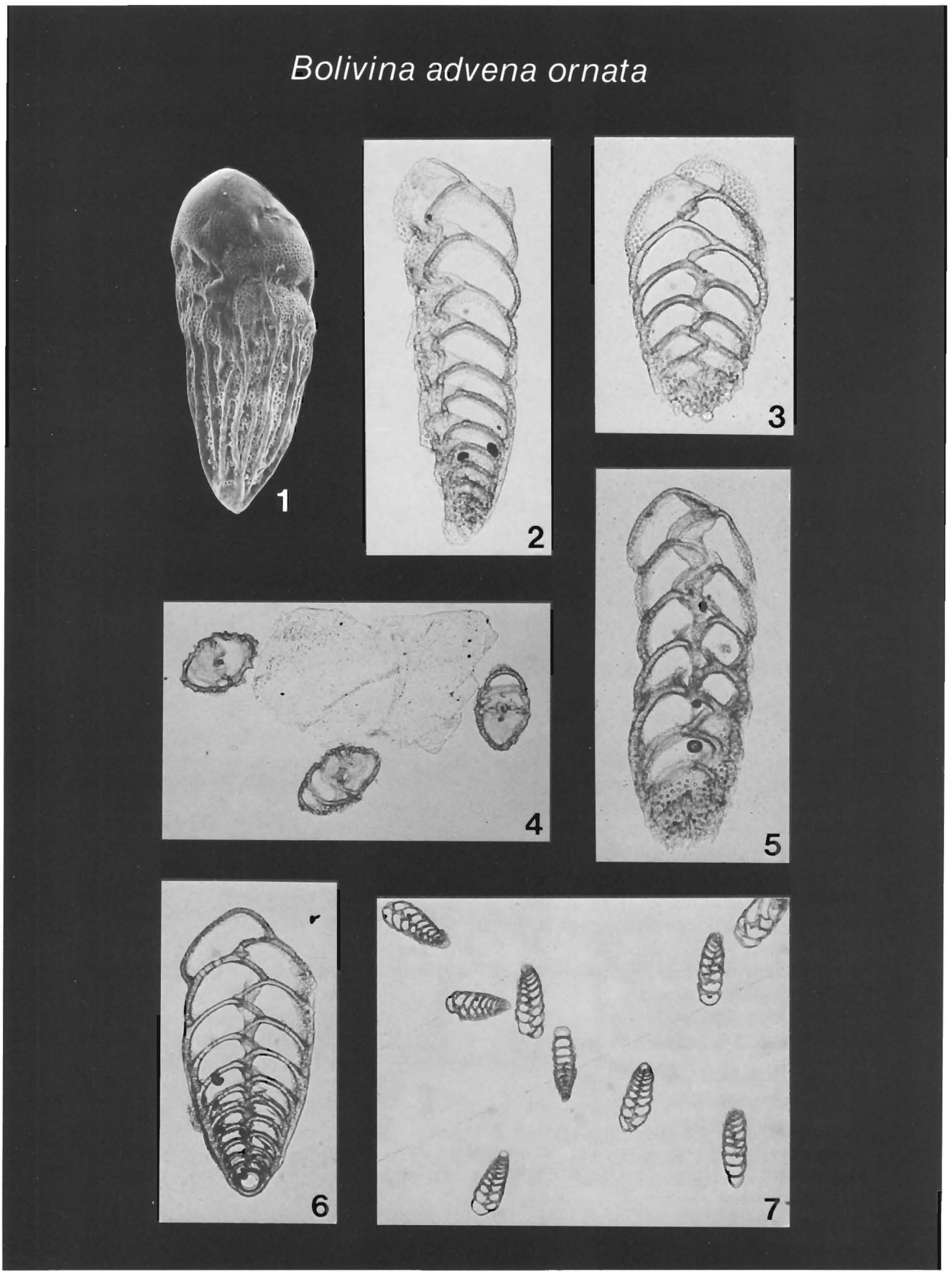
Taxonomic Remarks: Agrees with holotype (USNM4351) and paratypes (USNM908-912, LSJU), all of which are costate. Cushman (1937, pl. 10) illustrates this taxon as slightly crenulate. I have elevated this variety to subspecies because it rarely occurs with *B. advena* s.s., and I have synonymized it with *B. advena* var. *striatella* Cushman (1925c; holotype USNM4352; paratypes USNM913-917, -919), *B. imbricata* var. *inflata* Kleinpell (1938; LSJU937), and *B. advena* var. *acutula* Bandy (1953) because of the great variations seen in the shape of the edge and length and strength of longitudinal ornamentation in the many populations examined. There is no difference between the upper depth limits of the named varieties/subspecies of *B. advena* (Ingle, 1980).

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *B. advena* var. *striatella*: Early Saucesian to late Luisian.
Kleinpell (*ibid.*) for *B. advena* var. *ornata*: Early Saucesian to late Luisian.
Regional Literature: Saucesian to Pliocene, ranges to Holocene (AR76, AR84, BE86, BL81, CB86, FI90, HA80, TI73, KL80, PM81, SM60).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, IC, LH, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980); oxygen-minimum zone indicator (Blake, 1981).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40660-12, Luisian, Monterey Formation, Naples Beach: side view, X102.

Plate-figs. 2-7: Thin-section photomicrographs of specimens from sample locality CRC40267-34, Luisian, Monterey Formation, Upper Newport Bay, slide no. 6: 2, 3 = X128; 4 = X80; 5, 6 = X128; 7 = X32.


Bolivina advena ornata
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Bolivina argentea Cushman

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Type Reference: Cushman, 1926b, Contr. Cushman Lab. Foram. Res., v. 2, pt. 2, no. 29, p. 42.

Type Figure: *Ibid.*, pl. 6, fig. 5, X80.

Type Level and Locality: Pliocene, offshore California.

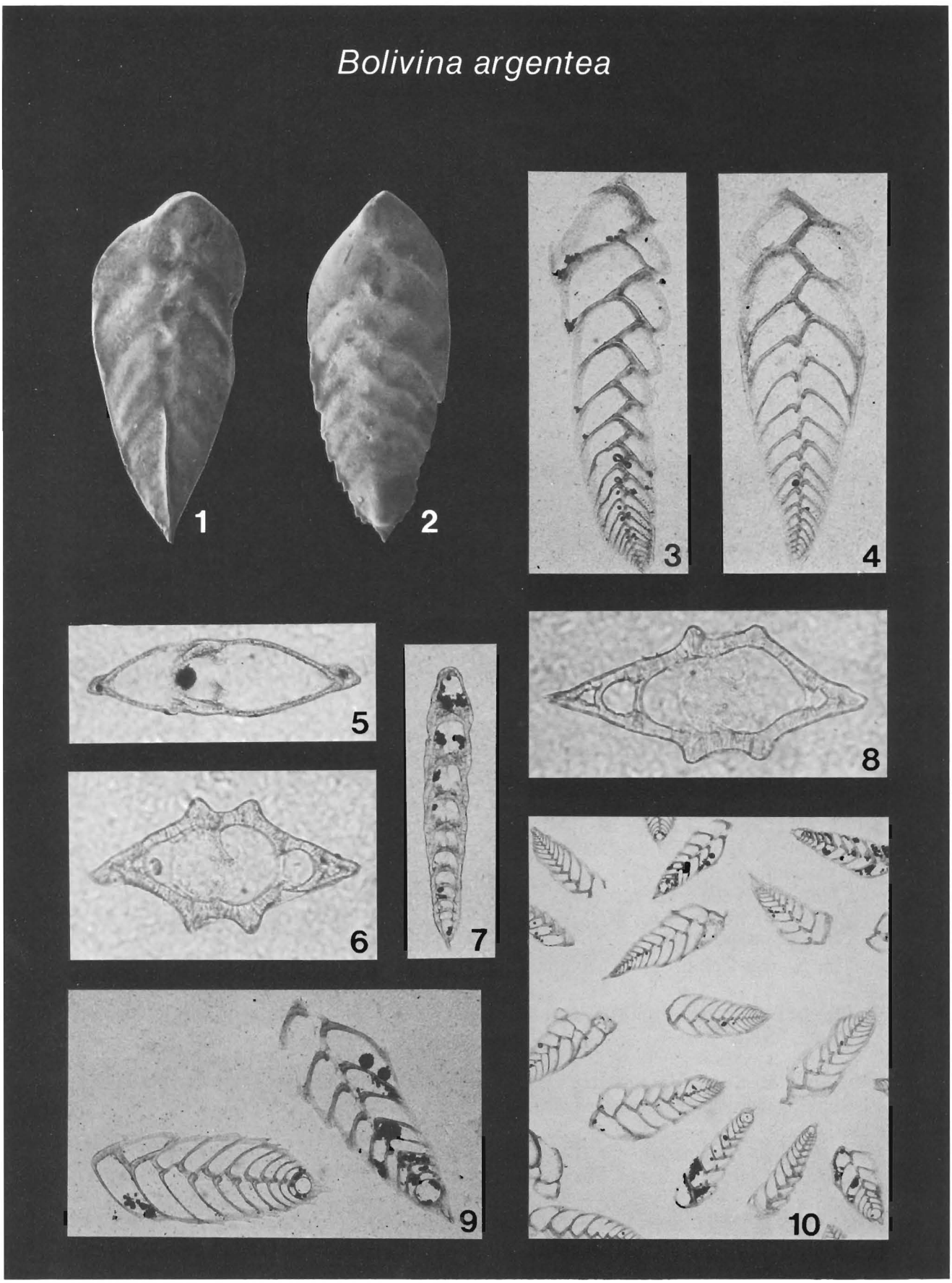
Taxonomic Remarks: Holotype (USNM20281) missing, but recovered specimens agree with type description and topotypes (USGS); paratypes (USNM5573) are not "very much compressed" as noted in holotype description.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not reported.
Regional Literature: Pliocene, ranges to Holocene (CB86, MA52).
This Study: Pliocene, ranges to Holocene. (UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: side views, X103.

Plate-figs. 3-10: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 77: 3, 4 = X80; 5 = X160; 6 = X320; 7 = X80; 8 = X320; 9 = X80; 10 = X32.


Bolivina argentea
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Bolivina blakei Finger and Lipps

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Above Figure: Type figure of *B. floridana* Cushman, 1918a, U.S. Geol. Surv., Bull., no. 676, pl. 10, fig. 4, X60 (Miocene, Choctawhatchee Formation, Florida).

Type Reference: *In* Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 38.

Type Figure: *Ibid.*, pl. 4, fig. 12. (See facing plate-fig. 1.)

Type Level and Locality: Relizian, Sandholdt Member, Monterey Formation, Graves Creek, Atascadero, San Luis Obispo County, California.

Taxonomic Remarks: Commonly cited in California as *B. floridana*. Holotype (USNM325334) of *B. floridana* is less crenulate and narrower than *B. blakei*, and has crenulations more like those on some *B. advena* Cushman (1925c).

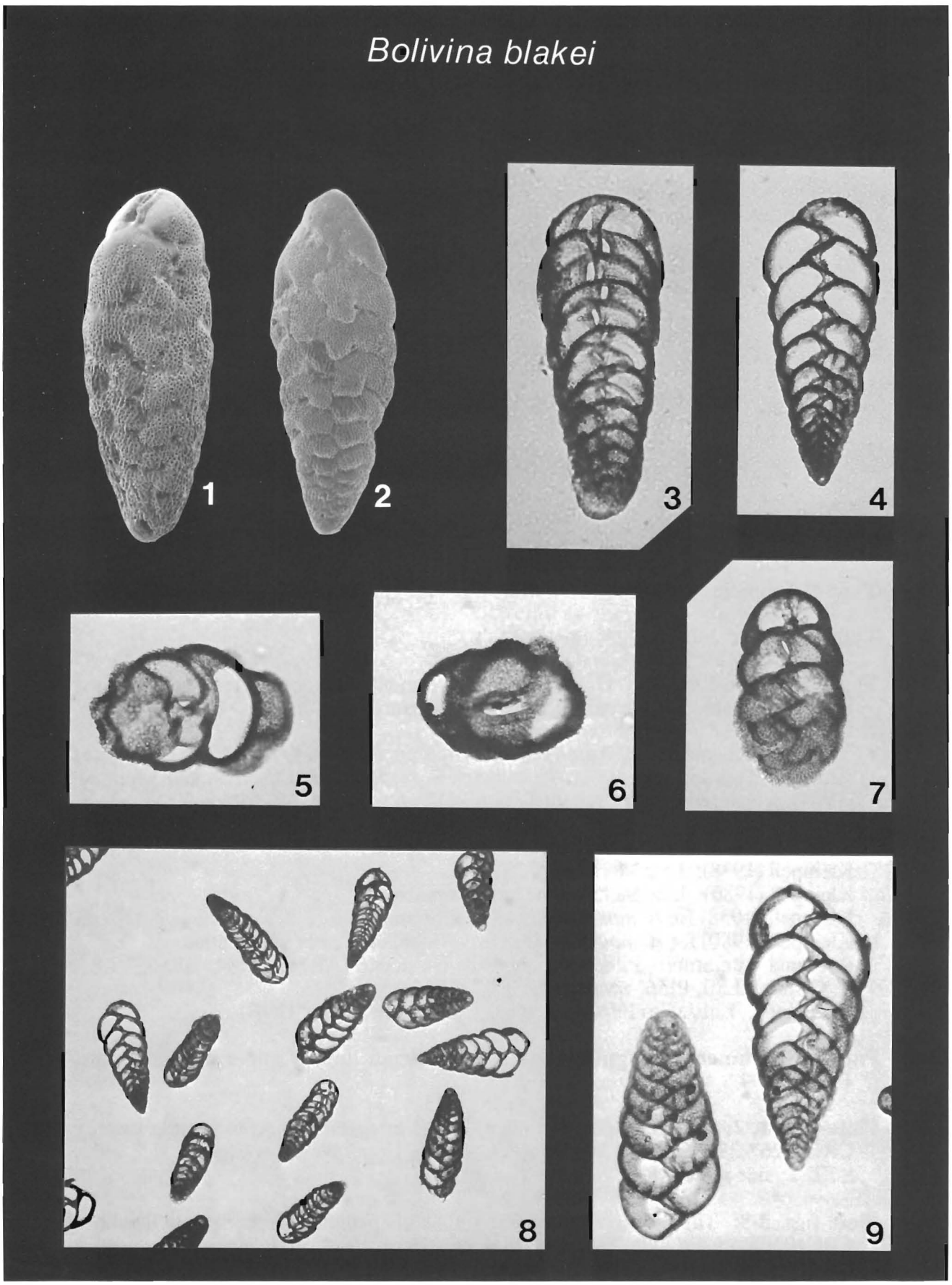
Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *B. floridana*: Early Saucesian(?), Late Saucesian to early Mohnian.
Kleinpell (1980) for *B. floridana*: Early Saucesian to early Mohnian.
Regional Literature for *B. floridana*: Zemorrian to Mohnian/Delmontian (AR76, BL81, FI90, KL80).
This Study: Zemorrian to Mohnian/"Delmontian". (GC, IC, NA, SCI)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of holotype from sample locality GC-3, Relizian, Monterey Formation, Graves Creek: side view, X100.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC39842-103, Relizian, Monterey Formation, Naples Beach: side view, X90.

Plate-figs. 3-9: Thin-section photomicrographs of topotype specimens from sample locality GC-3, Relizian, Monterey Formation, Graves Creek, slide no. 106: 3 = X128; 4 = X80; 5, 6 = X128; 7 = X100; 8 = X32; 9 = X80.


Bolivina blakei
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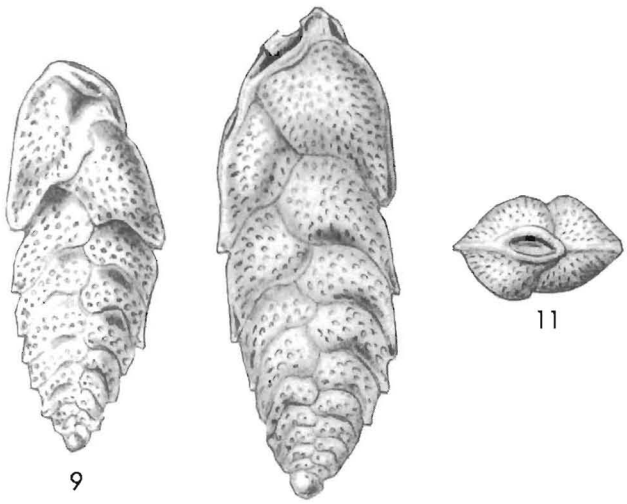
Bolivina bramlettei Kleinpell



Type Reference: Kleinpell, 1938, Miocene Stratigraphy of California, p. 267.

Type Figures: *Ibid.*, pl. 21, figs. 9-11, X75.

Type Level and Locality: Upper Mohnian, Valmonte Diatomite Member, Monterey Formation, Palos Verdes Hills, Los Angeles County, California.

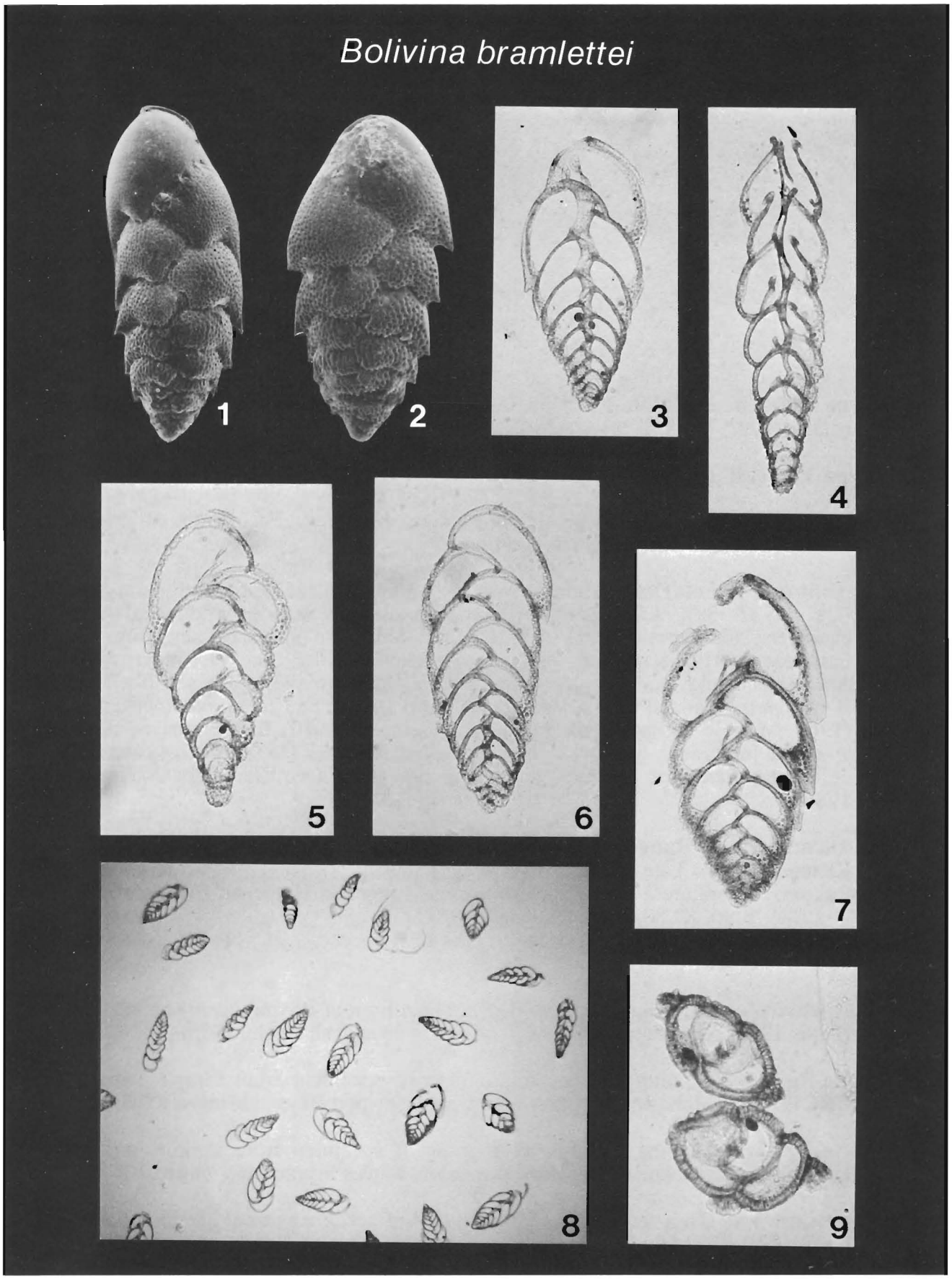
Taxonomic Remarks: Agrees with holotype (USNM497188) and topotypes (USGS). This species may be the same as *B. modeloensis* Cushman and Kleinpell (1934), which represents a relatively rare form.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian.
Kleinpell (1980): Late Mohnian to late Delmontian.
Kleinpell (1938) for *B. modeloensis*: Early Mohnian.
Kleinpell (1980) for *B. modeloensis*: Early Mohnian to early Delmontian.
Regional Literature: Pliocene, ranges to Holocene (AR76, AR84, BE86, BL81, CB86, KL80, PI56, SM60, WH56).
This Study: Luisian to Pliocene, ranges to Holocene. (MQ, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimens from sample locality CRC40267-39, Mohnian, Monterey Formation, Upper Newport Bay: 1, side view, X70; 2, side view, X80.

Plate-figs. 3-9: Thin-section photomicrographs of specimens from sample localities CRC40267-43 and -47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 7: 3-7 = X100; 8 = X20; 9 = X100.


Bolivina bramlettei
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Bolivina brevior Cushman

Type Reference: Cushman, 1925c, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 31.

Type Figures: *Ibid.*, pl. 5, figs. 8a, b, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

Taxonomic Remarks: Agrees with holotype (USNM4356) and paratypes (USNM937-939); LSJU paratypes have crenulations near the midline of later chambers; topotypes (USGS) identified by P. Smith are poor specimens from the San Joaquin Hills and their assignment is questionable. The vast majority of specimens display some degree of crenulation along the midline, as described for *B. vaughani* Natland (1938, Recent, off Long Beach) and *B. guadalupe* Parker (1964, Mohole in Pacific off Mexico). Kleinpell (1980) figures one of these crenulate forms as *B. brevior*. *B. brevior dunlapi* Kleinpell (1938) is a less common striate-crenulate form worthy of taxonomic distinction (see Kleinpell and Tipton, 1980).

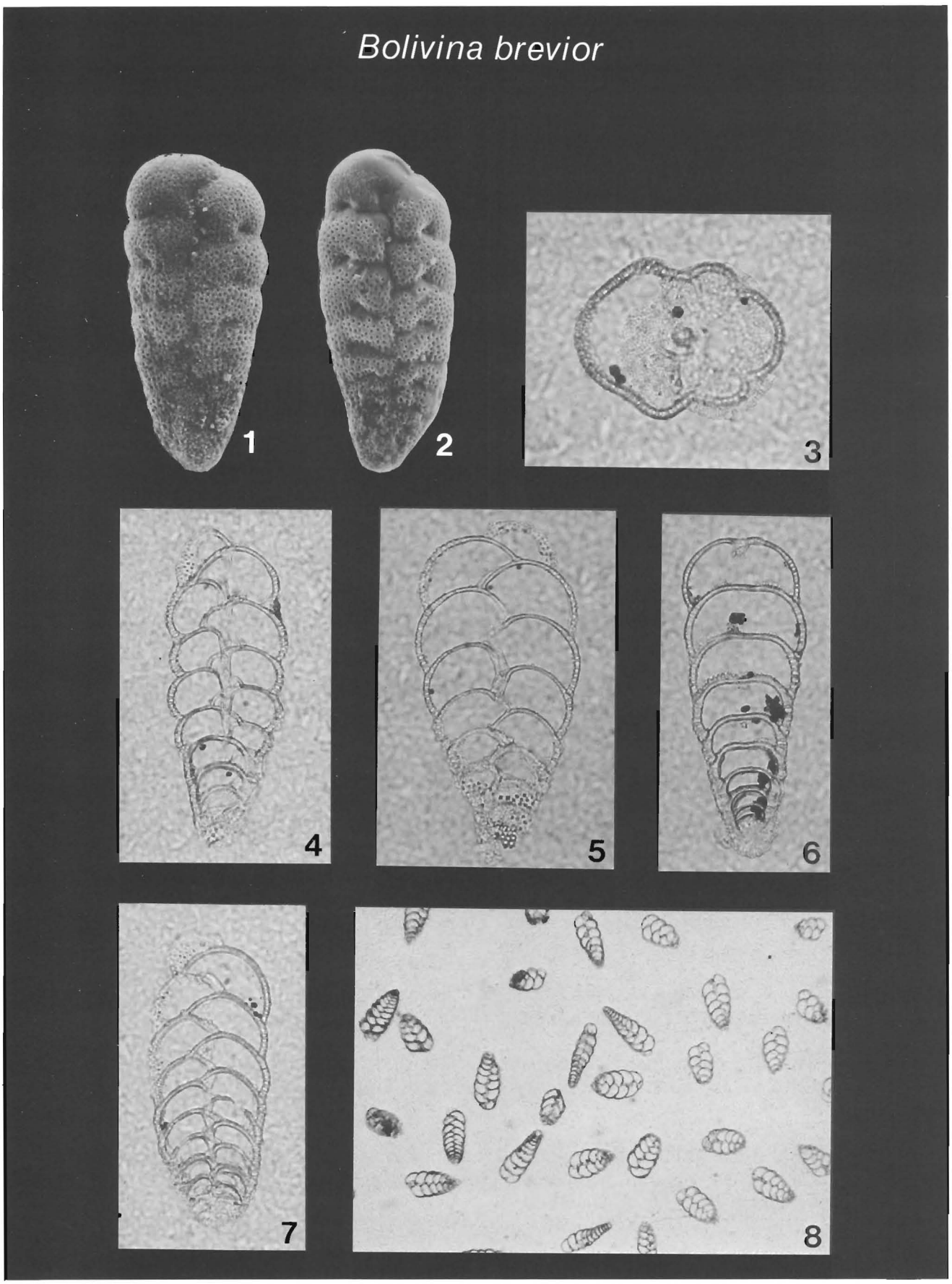
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Saucesian to early Delmontian.
Regional Literature: Saucesian to Pliocene, ranges to Holocene (AR76, BE86, CB86, FI90, KL80, PI56, SB86, SM60, TI73).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, IC, LH, MQ, NA, SCI, TC, TR, UNB)

Paleoenvironmental Significance: Upper depth limit of *B. vaughani* = outer shelf (Ingle, 1980); upper depth limit of *B. brevior* = outer shelf (Ingle, 1985).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-3, Mohnian, Monterey Fm., Upper Newport Bay: side view, X201.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40660-22, Mohnian, Monterey Formation, Naples Beach: side view, X201.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40660-22, Mohnian, Monterey Formation, Naples Beach, slide no. 109: 3 = X320; 4-7 = X200; 8 = X40.


Bolivina brevior
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Bolivina californica Cushman

Type Reference: Cushman, 1925c, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 32.

Type Figures: *Ibid.*, pl. 5, figs. 10a, b, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

Taxonomic Remarks: Agrees with holotype (USNM4358), paratypes (USNM946-948), and topotypes (USGS). The species is quite variable in inflation and in number and strength of striae/costae.

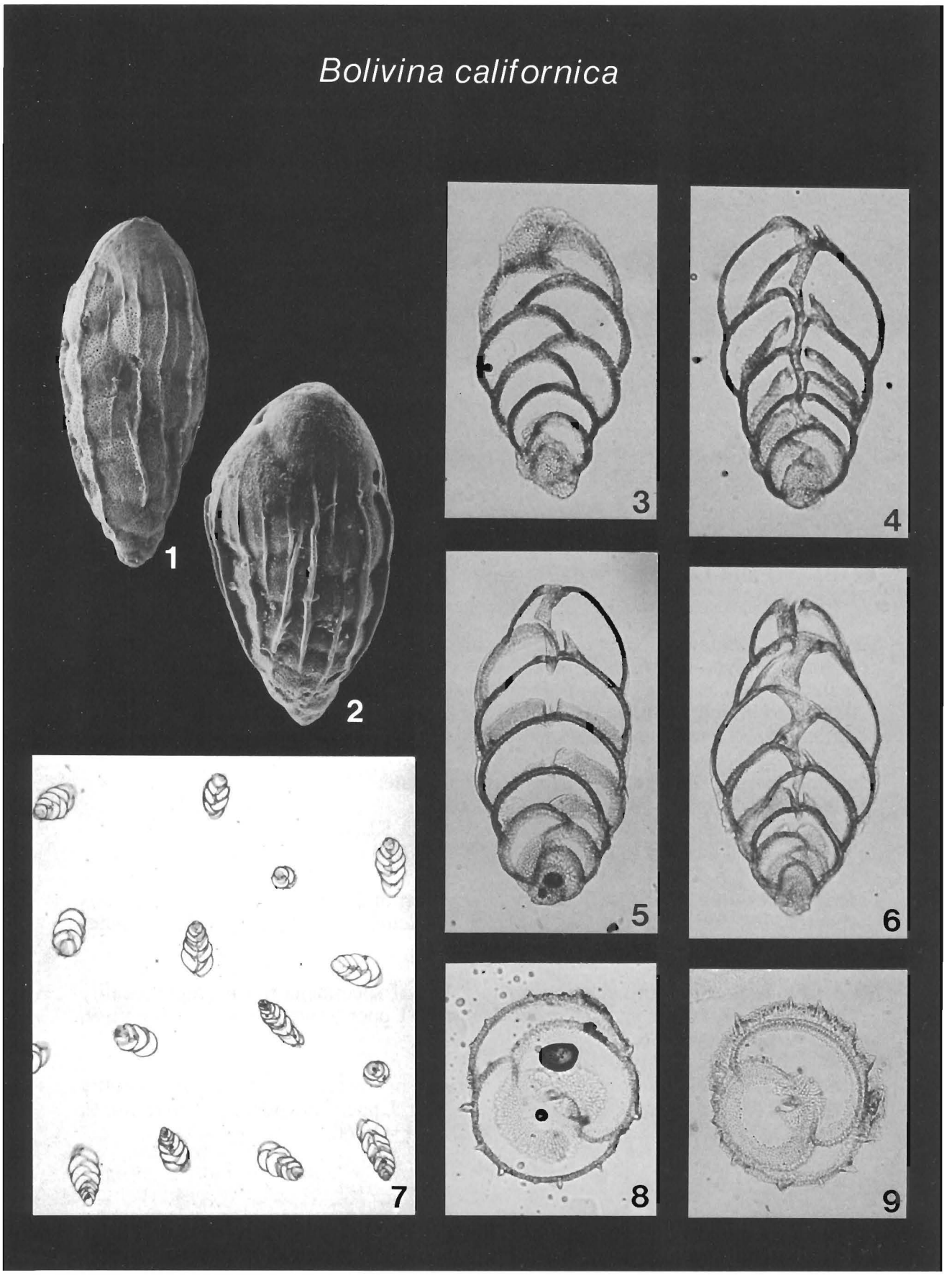
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Saucesian to early Mohnian, late Mohnian(?).
Regional Literature: Saucesian to Mohnian (AR76, AR84, BE86?, BL81, FI90, KL80, PI56, SM60).
This Study: Saucesian to Mohnian. (GC, IC, LH, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality LH-5, Luisian, Monterey Formation, Laguna Hills: side view, X152.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40267-33, Luisian, Monterey Formation, Upper Newport Bay: side view, X152.

Plate-figs. 3-9: Thin-section photomicrographs of specimens from sample locality CRC40267-34, Luisian, Monterey Formation, Upper Newport Bay, slide no. 17: 3-6 = X160; 7 = X32; 8, 9 = X200.


Bolivina californica
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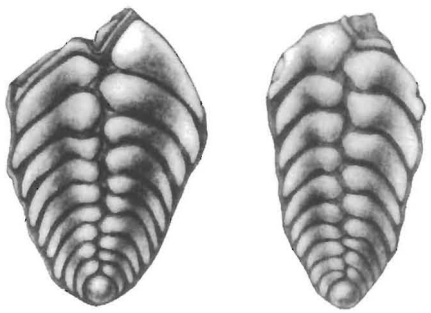
Bolivina churchi Kleinpell and Tipton



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Type Reference: Kleinpell and Tipton, *in* Kleinpell, 1980, Miocene Stratigraphy of California Revisited, p. 72.

Type Figures: *Ibid.*, pl. 9, figs. 11, 12: 11, holotype, X62; 12, cotype, X53.

Type Level and Locality: Basal McClure Shale, Sulphur Canyon, Kings County, California.

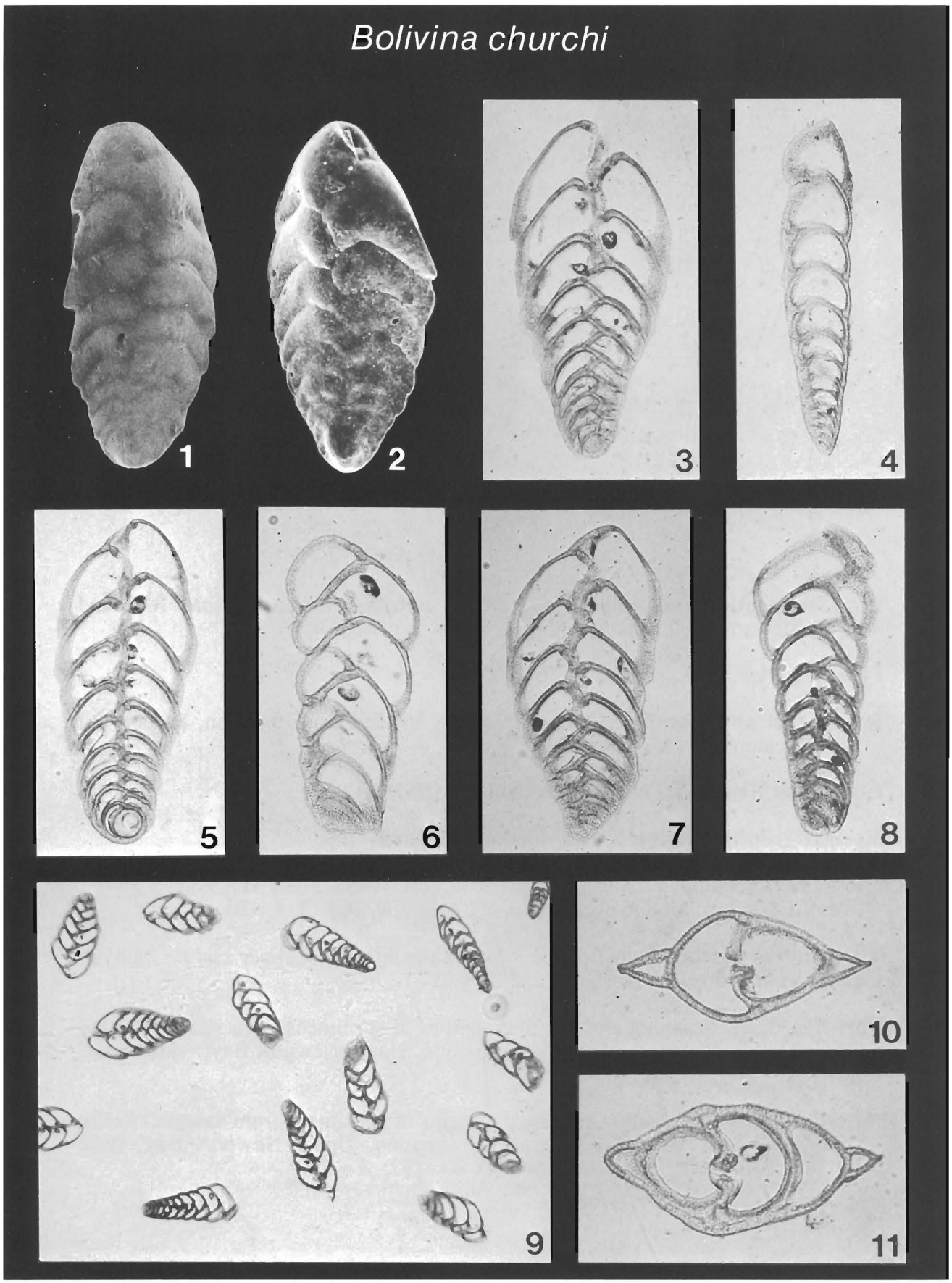
Taxonomic Remarks: Holotype (deposited in Kleinpell's personal collection) not examined. Type-figures do not adequately represent this species, whose populations include specimens that are more slender in shape. There is also much variation in the degree to which the edge of the test is serrated, and this renders it difficult to synonymize it with similar forms recorded in the regional literature.

Biostratigraphic Range in California Neogene:
Kleinpell and Tipton (1980): Early Mohnian.
Regional Literature: Saucesian to Mohnian (FI90, KL80).
This Study: Saucesian to Mohnian. (GC, NA, UNB)

Paleoenvironmental Significance: Upper depth limit not determined for this species, but for a similar morphotype, *B. acuminata* Natland, it is the outer shelf/upper bathyal transition (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimens from sample locality CRC40267-44, Mohnian, Monterey Formation, Upper Newport Bay: 1, side view, X81; 2, side view, X86.

Plate-figs. 3-11: Thin-section photomicrographs of specimens from sample locality CRC40267-44, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 9: 3-7 = X100; 8 = X128; 9 = X32; 10 = X128; 11 = X160.


Bolivina churchi
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Bolivina foraminata R. E. and K. C. Stewart

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Type Designation and Reference: *Bolivina seminuda* var. *foraminata* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 66.

Type Figures: *Ibid.*, pl. 8, figs. 5a, b, X60.

Type Level and Locality: Lower Pliocene, lower Pico Formation, Rincon Oil Field, Ventura County, California.

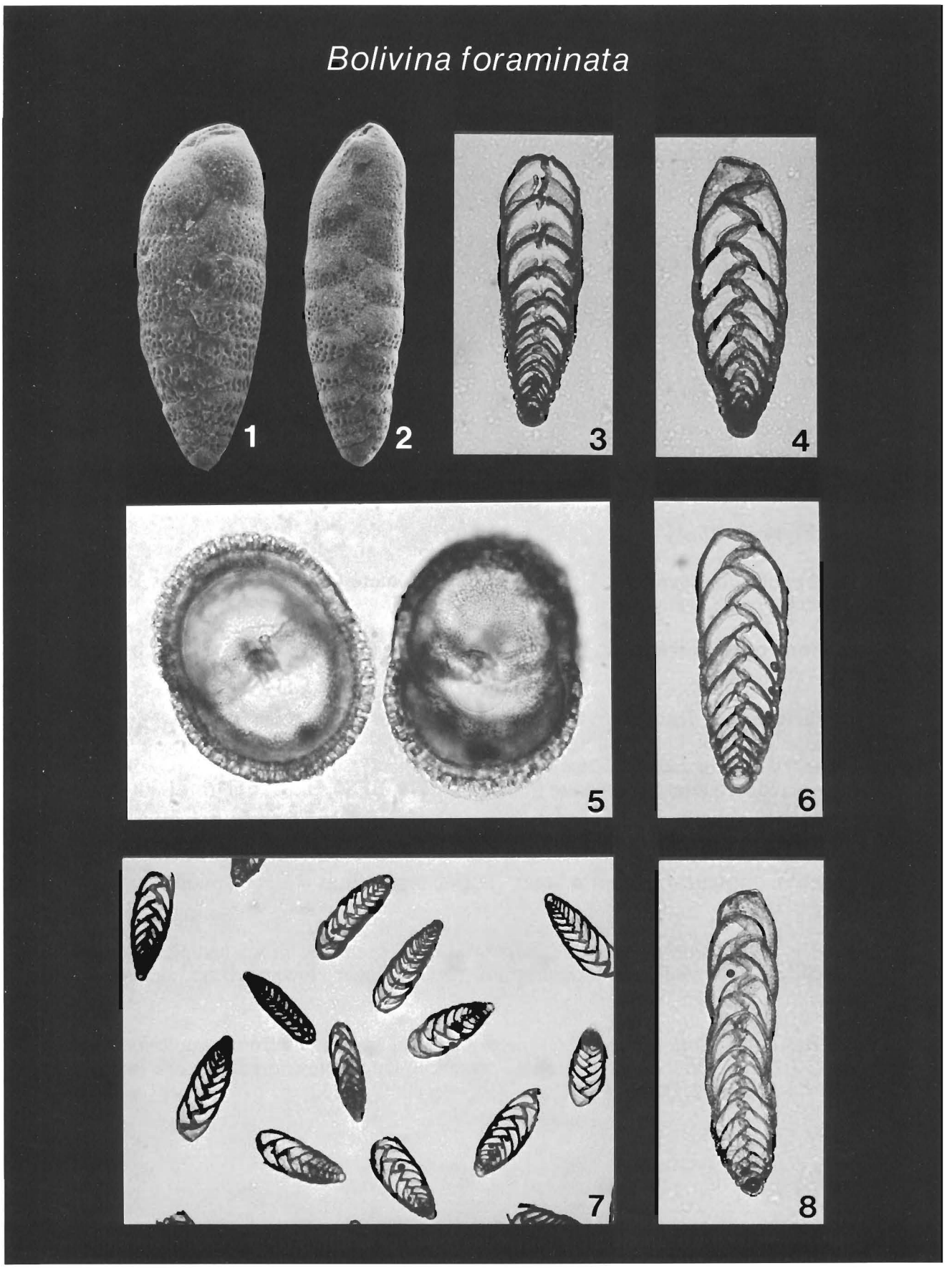
Taxonomic Remarks: Agrees with holotype (USNM12533).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian to late Delmontian.
Regional Literature: Mohnian to Pliocene (KL80, MA52, SB86, WH56).
This Study: Saucesian to Pliocene. (GIC, MQ, NA, TC, TR, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal; oxygen-minimum zone indicator (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimens from sample locality CRC40267-3, Mohnian, Monterey Formation, Upper Newport Bay: side views, X100.

Plate-figs. 3-9: Thin-section photomicrographs of specimens from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 113: 3, 4 = X80; 5 = X160; 6 = X80; 7 = X32; 8 = X80.


Bolivina foraminata
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Bolivina girardensis Rankin

Type Reference: *In* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 17.

Type Figures: *Ibid.*, pl. 3, figs. 7a, b, X60.

Type Level and Locality: Upper Mohnian, Monterey Formation, Naples Beach, Santa Barbara County, California.

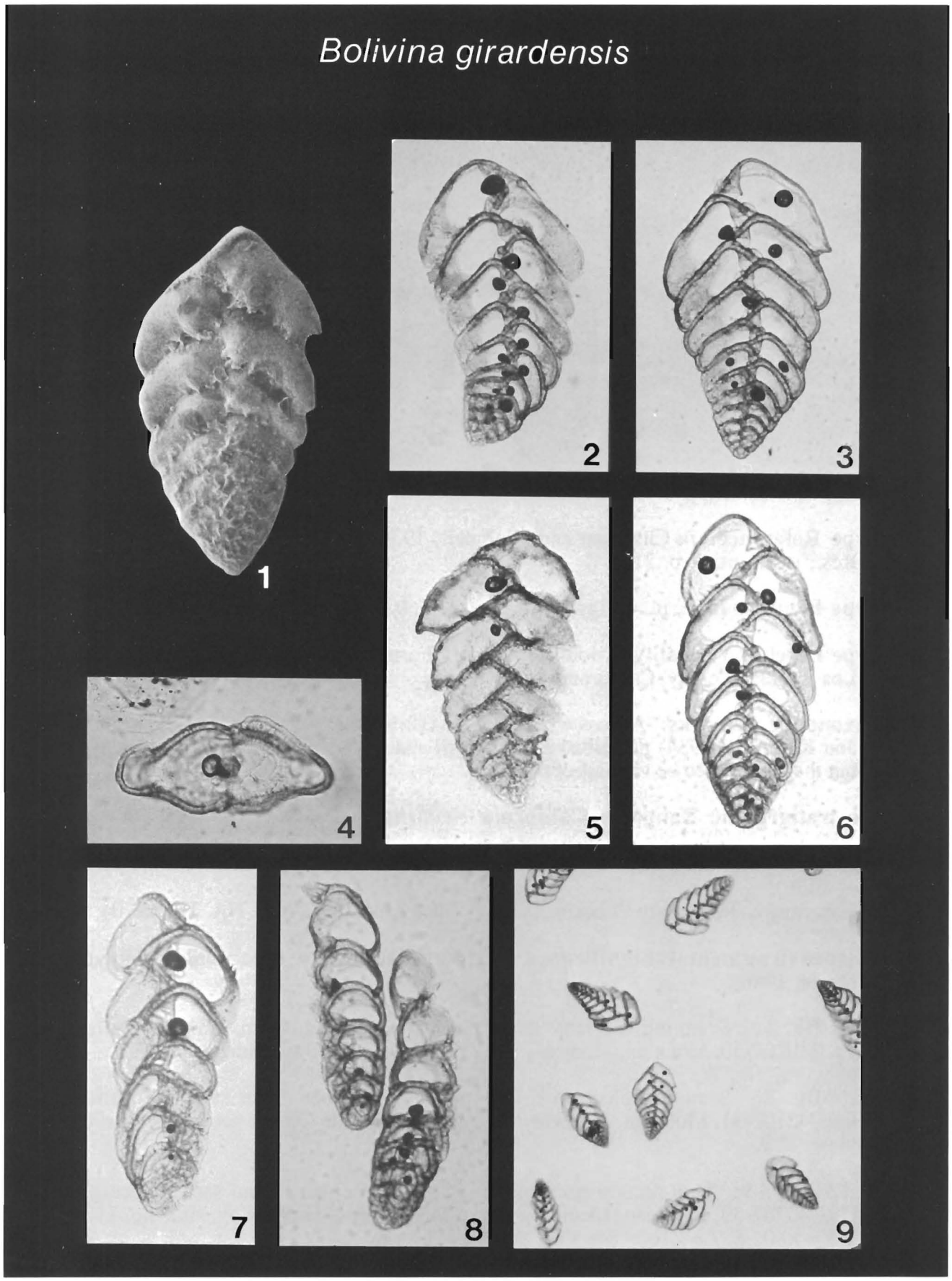
Taxonomic Remarks: Agrees with holotype (USNM20153) and recovered topotypes.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian.
Kleinpell (1980): Late Mohnian to early Delmontian(?).
Regional Literature: Mohnian to Pliocene (AR76, BE86, BL81, CG46, KL80, PI56, SM60).
This Study: Mohnian to Pliocene. (MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-50, Mohnian, Monterey Formation, Upper Newport Bay: side view, X123.

Plate-figs. 2-9: Thin-section photomicrographs of specimens from sample locality CRC40267-50, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 20: 2, 3 = X128; 4, X200; 5, 6 = X128; 7, 8 = X160; 9 = X32.


Bolivina girardensis
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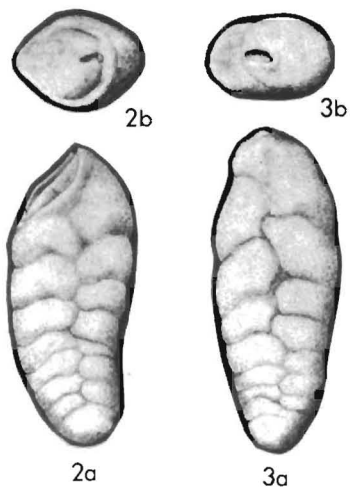
Bolivina granti Rankin



Type Reference: *In* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 21.

Type Figures: *Ibid.*, pl. 4, figs. 2a-3b, X60: 2a, b, holotype; 3a, b, paratype.

Type Level and Locality: Mohnian, Modelo Formation, Santa Monica Mountains, Los Angeles County, California.

Taxonomic Remarks: Agrees with holotype (USNM20192). Rankin (*in* Cushman and Kleinpell, 1934) described *B. goudkoffi* and *B. hootsi* from the same sample, but these appear to be variants of *B. granti*.

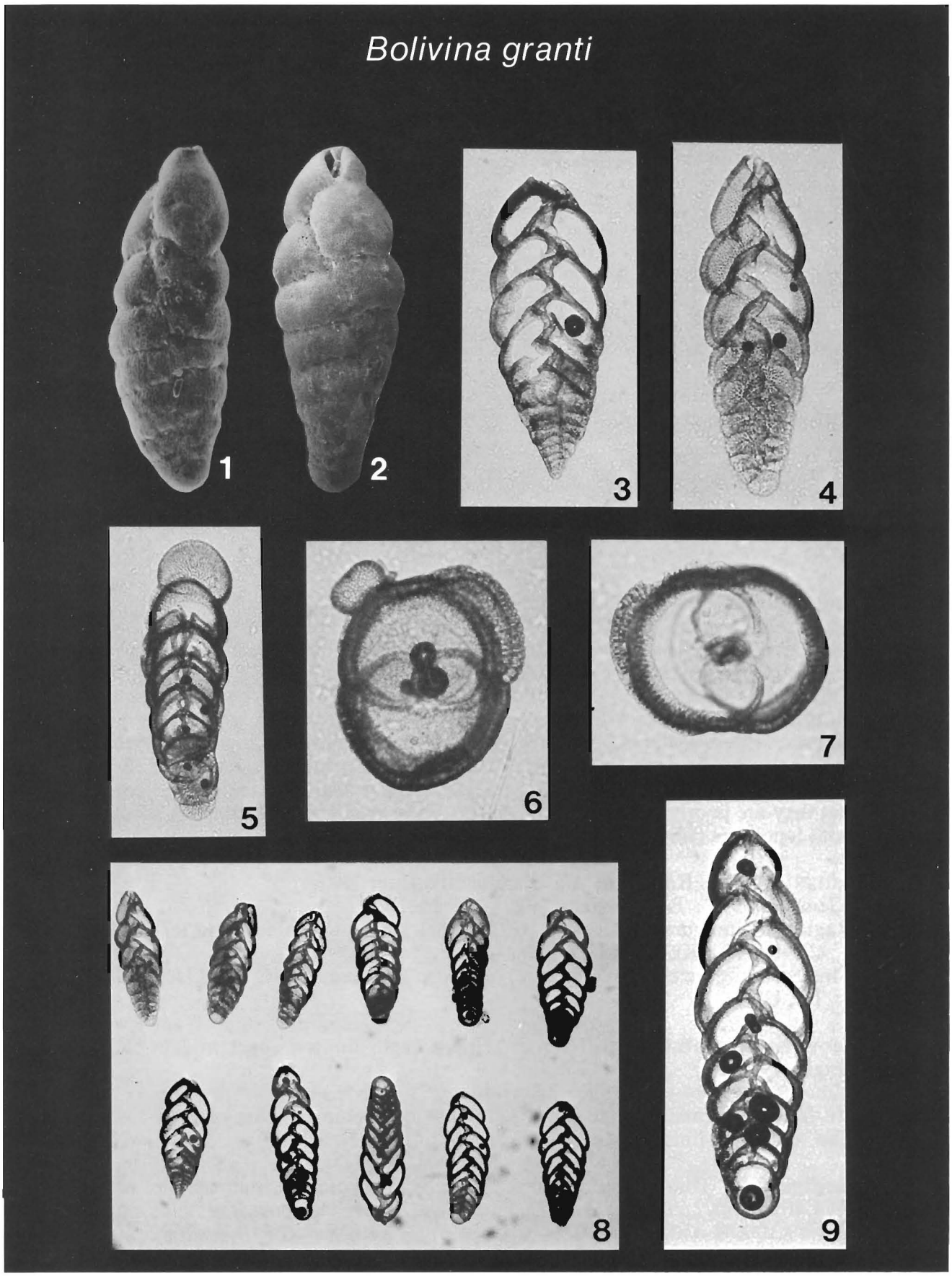
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian.
Regional Literature: Mohnian to Pliocene, ranges to Holocene (CB86, FI90, KL80, PI56).
This Study: Relizian to Pliocene, ranges to Holocene. (GC, MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-50, Mohnian, Monterey Fm., Upper Newport Bay: side view, X77.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC42107-31, Mohnian, Monterey Formation, Manville Quarry access road: side view, X79.

Plate-figs. 3-9: Thin-section photomicrographs of specimens from sample locality CRC40267-50, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 112: 3-5 = X80; 6, 7 = X160; 8 = X32; 9 = X80.


Bolivina granti
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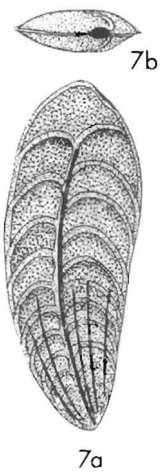
Bolivina imbricata Cushman



Type Reference: Cushman, 1925c, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 31.

Type Figures: *Ibid.*, pl. 5, figs. 7a, b, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

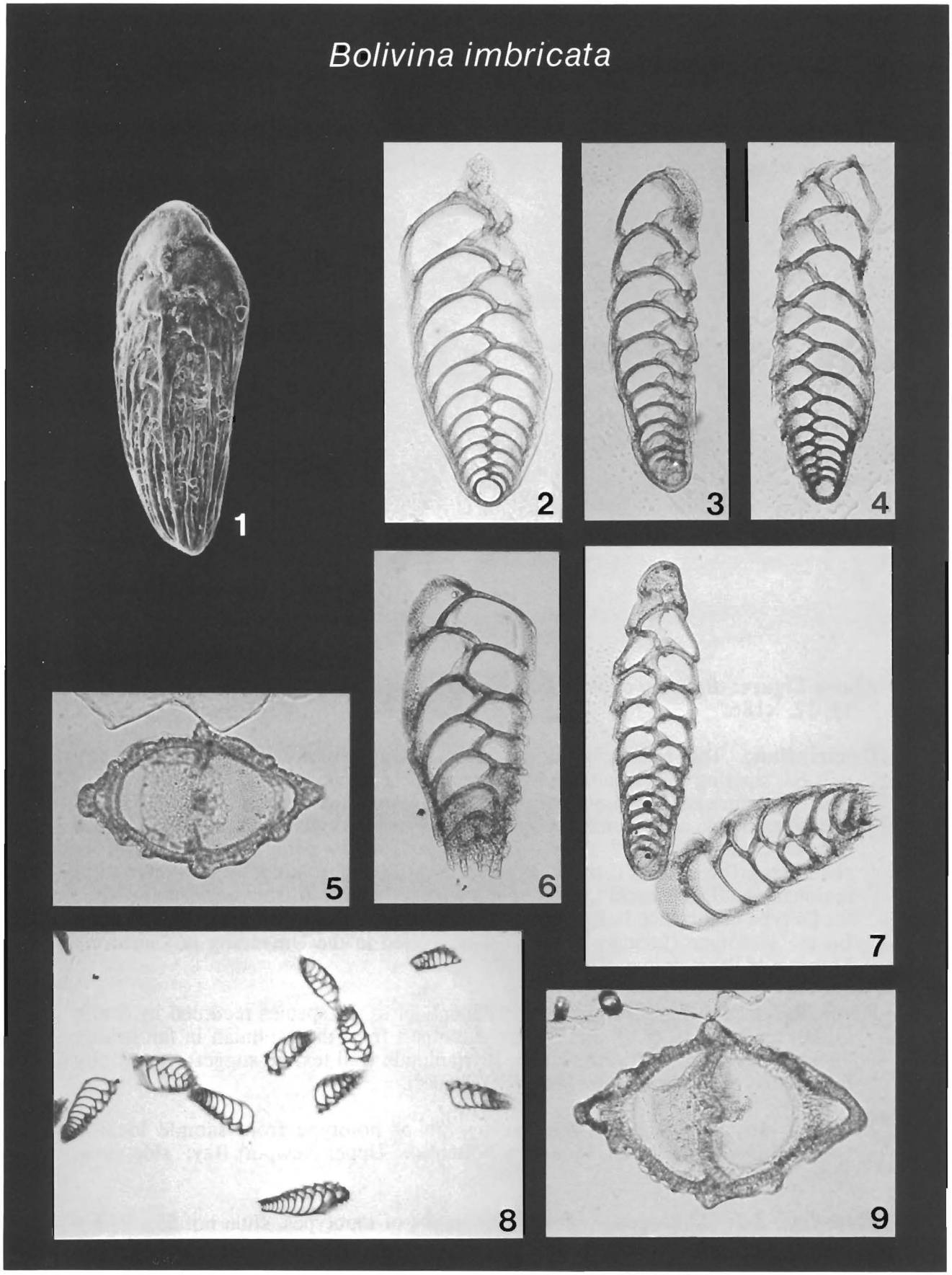
Taxonomic Remarks: Agrees with holotype (USNM4355), which has raised sutures; 15 USNM paratype slides (totalling >15 specimens) show much variation and include a form distinguished from *B. advena ornata* Cushman (1925c) by possessing a median costum. Two LSJU paratypes also have the median costum, but they are poorly preserved specimens with broken apertural ends. Also agrees with topotypes (USGS).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Relizian to late Luisian.
Regional Literature: Saucesian to Pliocene, ranges to Holocene (AR76, AR84, CB86, FI90, KL80, PM81, SM60).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, IC, LH, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-32, Luisian, Monterey Formation, Upper Newport Bay: side view, X87.

Plate-figs. 2-9: Thin-section photomicrographs of specimens from sample locality CRC40267-30, Luisian, Monterey Formation, Upper Newport Bay, slide no. 21: 2, 3 = X100; 4 = X80; 5 = X200; 6 = X100; 7 = X80; 8 = X25; 9 = X200.


Bolivina imbricata
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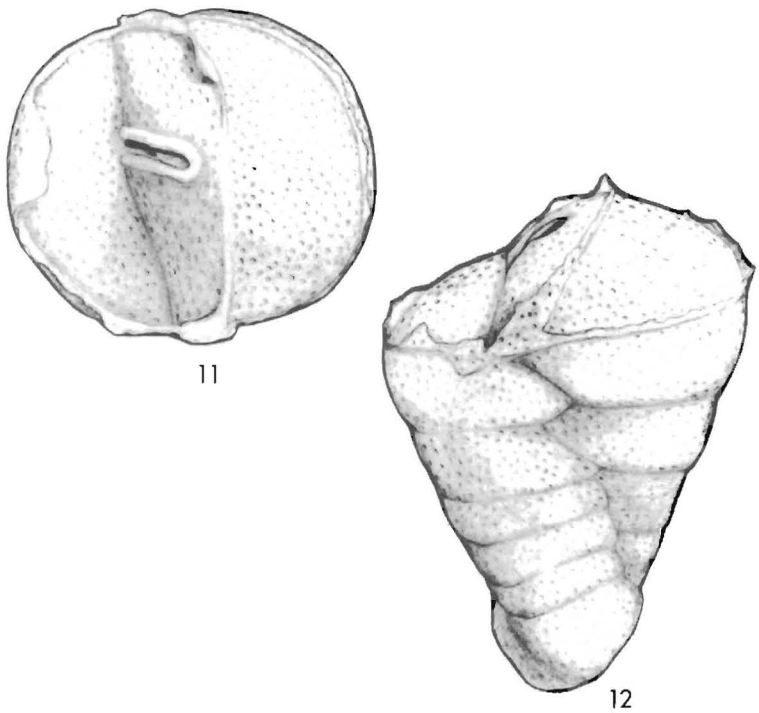
Bolivina santanaensis Finger, n. sp.



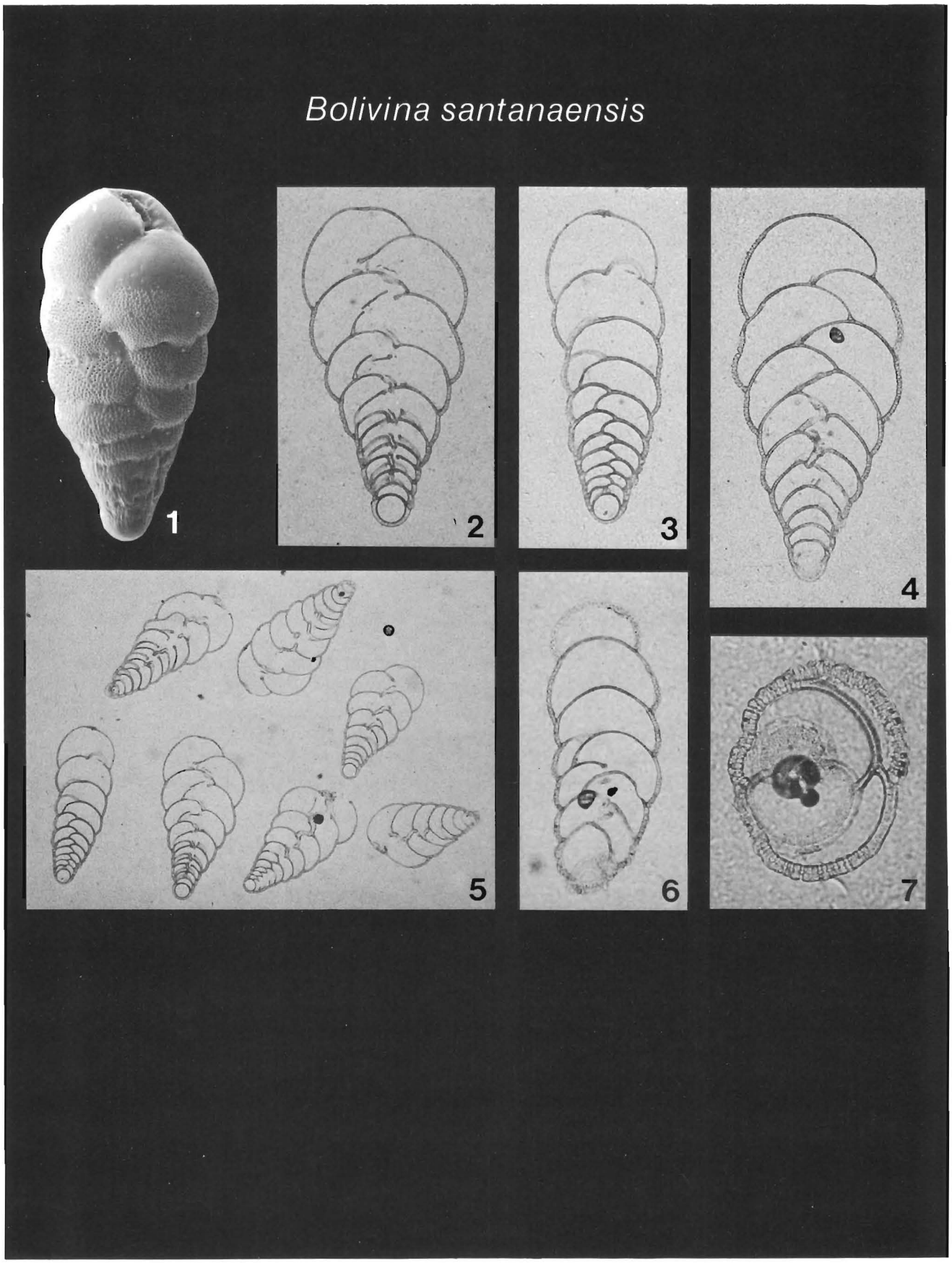
Above Figure: *Bolivina* cf. *B. subhughesi* Kleinpell *sensu* Smith, 1960, pl. 57, figs. 11, 12, X186.

Description: Test relatively large and stout, very slightly compressed, slightly twisted, tapering toward proloculus; chambers about nine pairs, thrice as wide as high. Aperture an elongate slit bordered by a narrow lip. Wall texture "seminude" due to restriction of moderately coarse perforations from glassy smooth upper edges of each chamber as well as the upper surfaces of the penultimate and ultimate chambers. The species is much more robust than *B. foraminata*, often referred to regionally as *B. seminuda* Cushman or a variety thereof. *B. santanaensis* is named for its type occurrence in the Neogene Santa Ana Embayment of the Los Angeles Basin. Holotype (facing plate, fig. 1) deposited in the University of California Museum of Paleontology (UCMP38337).

Remarks: *B. santanaensis* is probably identical to the species recorded by Smith (1960) as *Bolivina* cf. *B. subhughesi* Kleinpell from the Mohnian in the nearby Puente Formation, Santa Ana Hills. Its seminude wall texture suggests an affinity for low-oxygen waters (upper bathyal or deeper).

Plate-fig. 1: Scanning electron micrograph of holotype from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay: side view, X94.

Plate-figs. 2-7: Thin-section photomicrographs of topotypes, slide no. 55: 2, 3 = X64; 4 = X80; 5 = X32; 6 = X80; 7 = X200.


Bolivina santanaensis
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Bolivina sinuata Galloway and Wissler

Type Reference: Galloway and Wissler, 1927, Jour. Paleont., v. 1, p. 71.

Type Figures: *Ibid.*, pl. 11, figs. 9a, b, X41.

Type Level and Locality: Lower Pleistocene, Lomita Marl, San Pedro Formation, Lomita Quarry, Palos Verdes Hills, Los Angeles County, California.

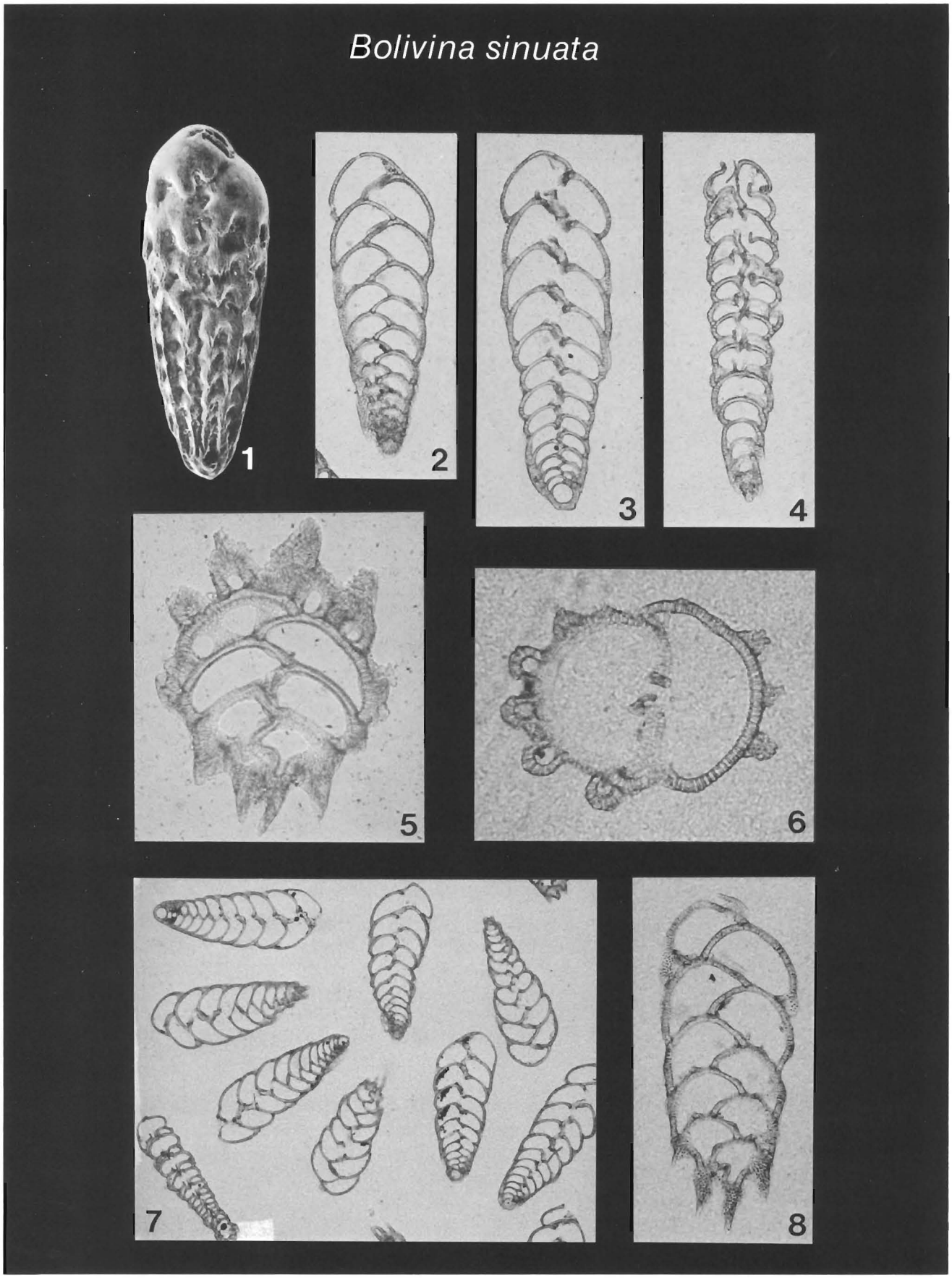
Taxonomic Remarks: Agrees with topotypes; holotype (deposited in Columbia University) not examined. It is distinguished from the Miocene species *B. hughesi* Cushman (1926b) and *B. wissleri* Kleinpell and Tipton (1980) by its arrangement of crenulations into distinct costae.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian to late Delmontian.
Regional Literature: Mohnian to Pliocene, ranges to Holocene (AR76, CB86, GW27, HA80, KL80, MA52, PI56, SM60, WH56).
This Study: Mohnian to Pliocene, ranges to Holocene. (UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1985).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: side view, X78.

Plate-figs. 2-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 76: 2-4 = X64; 5, 6 = X160; 7 = X32; 8 = X80.


Bolivina sinuata
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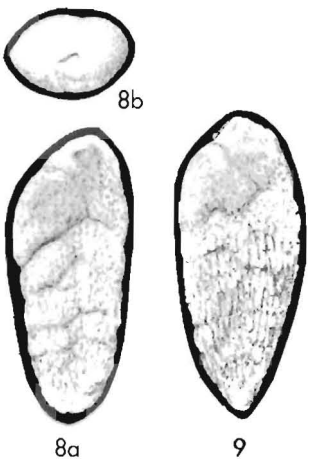
Bolivina sulphurensis Cushman and Adams



Type Designation and Reference: *Bolivina subadvena* var. *sulphurensis* Cushman and Adams, 1935, Contr. Cushman Lab. Foram. Res., v. 11, pt. 1, p. 20.

Type Figures: *Ibid.*, pl. 3, figs. 8a-9, X60: 8a, b, paratype, megalospheric form; 9, holotype, microspheric form.

Type Level and Locality: Upper Pliocene*, Pico Sandstone, Ventura County, California. [*Cited by authors as Late Tertiary]

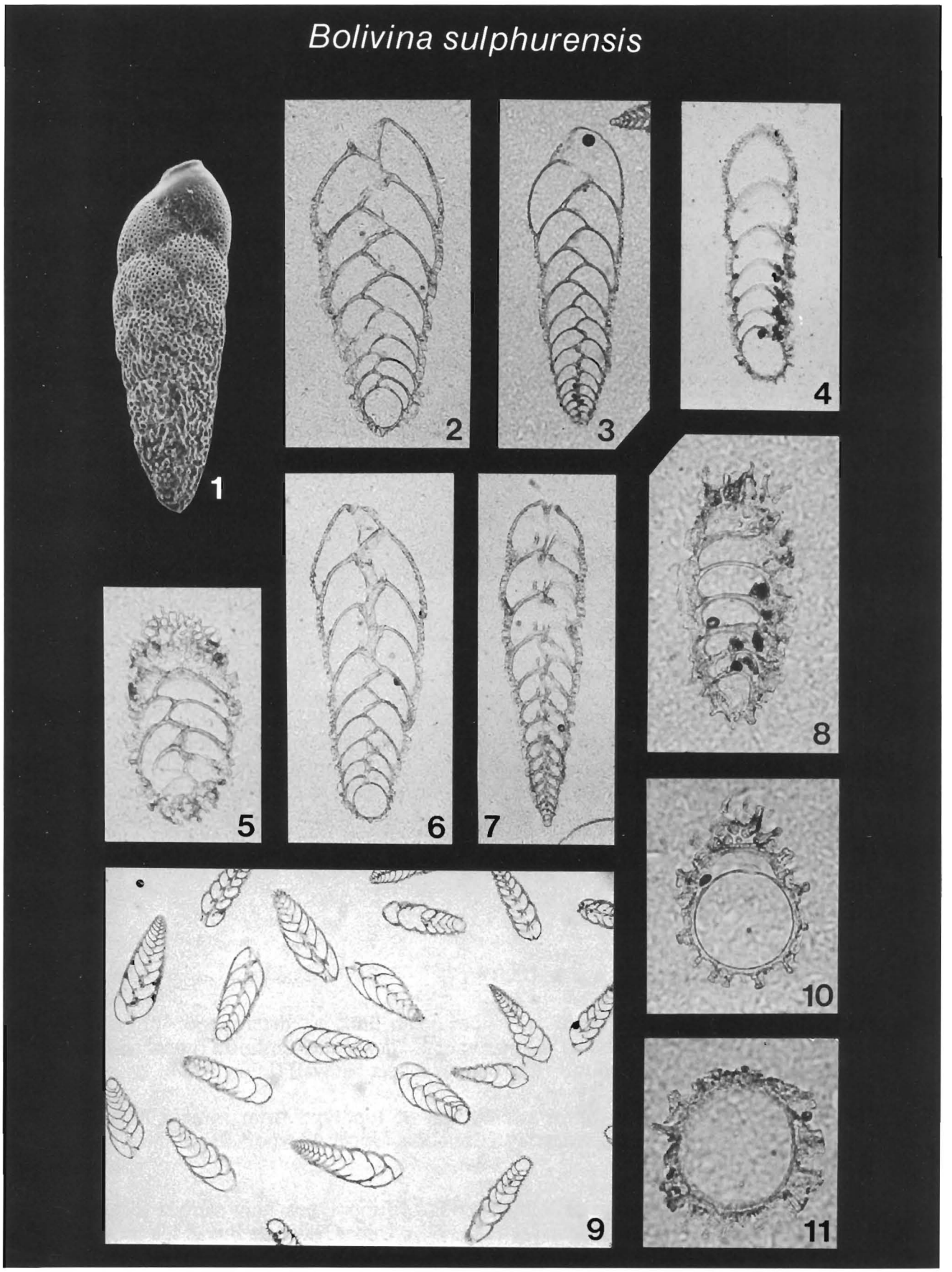
Taxonomic Remarks: Agrees with holotype (USNM21624).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not reported.
Regional Literature: Pliocene, ranges to Holocene (CB86, HA80, MA52, WH56).
This Study: Pliocene, ranges to Holocene. (UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: side view, X89.

Plate-figs. 2-11: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 75: 2 = X128; 3 = X80; 4 = X100; 5 = X160; 6, 7 = X100; 8 = X250; 9 = X32; 10, 11 = X250.


Bolivina sulphurensis
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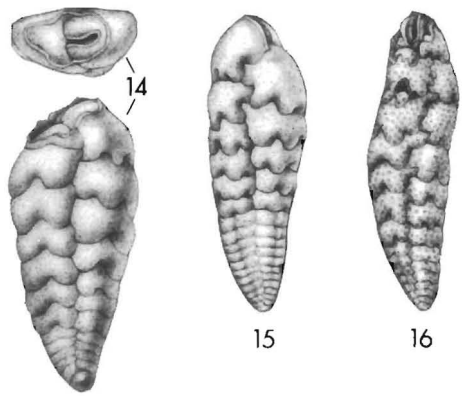
Bolivina wissleri Kleinpell and Tipton



Type Reference: Kleinpell and Tipton, *in* Kleinpell, 1980, Miocene Stratigraphy of California Revisited, p. 74.

Type Figures: *Ibid.*, pl. 8, figs. 14-16: 14, holotype, X56; 15, cotype, X44; 16, hypotype (questionably assigned to species), X29.

Type Level and Locality: Mohnian, Monterey Formation, Upper Newport Bay, Orange County, California.

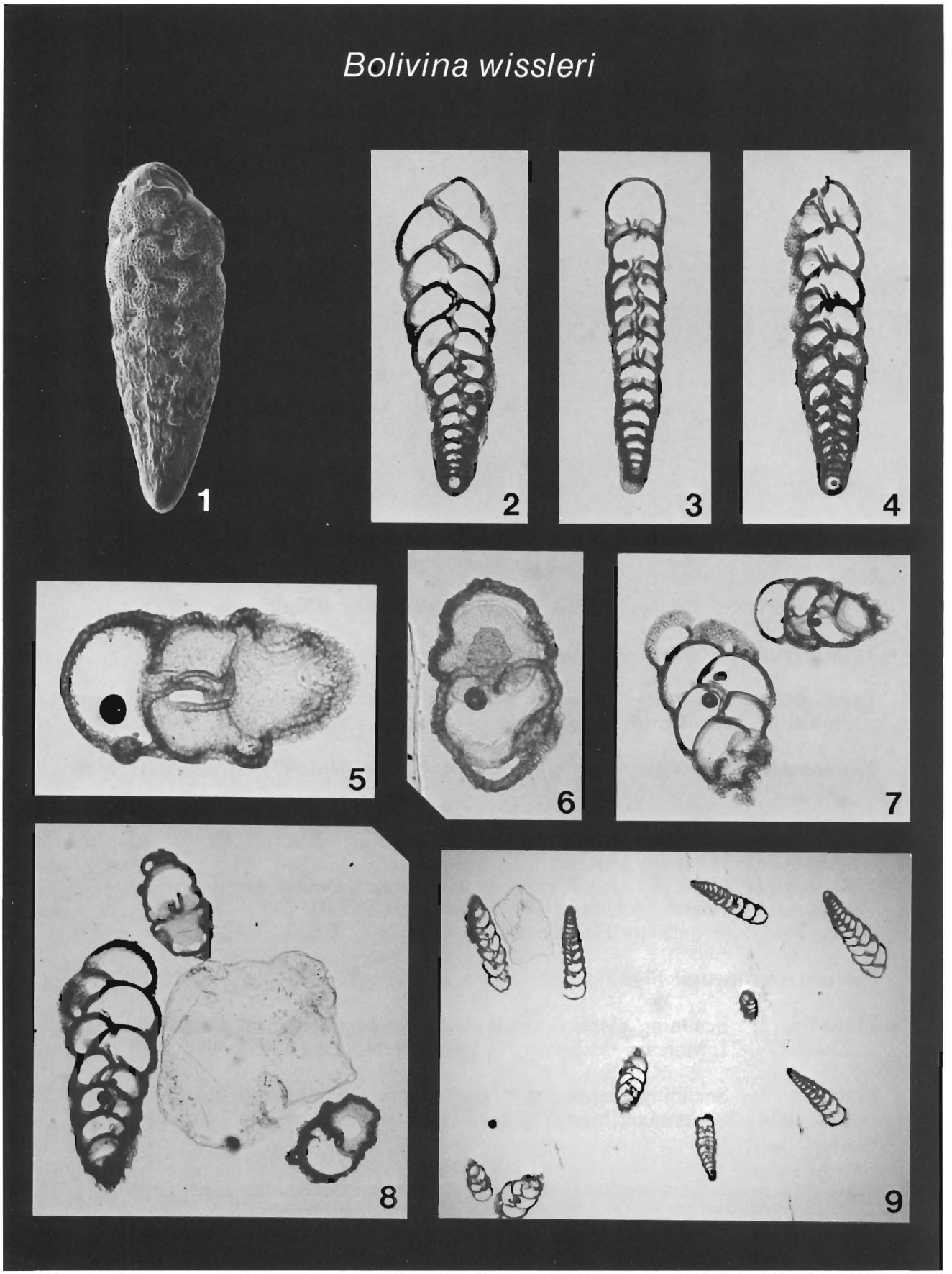
Taxonomic Remarks: Holotype (deposited in Kleinpell's personal collection) not examined, but recovered specimens are topotypes. Kleinpell and Tipton (1980) named this species for the form recognized by Pierce (1956) as *B. hughesi* Cushman (1926b), claiming that Pierce wrongly identified his specimens. However, Pierce was correct in reporting the crenulations on the holotype of *B. hughesi*, as described by Cushman, and noting that the type figure was actually of a different specimen. Its holotype was later figured in Cushman (1937, pl. 14, figs. 7a, b). *B. wissleri* is distinctly different from *B. hughesi*, as it is quite compressed and not twisted.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Kleinpell and Tipton (1980): Mohnian.
Regional Literature: Not recognized.
This Study: Mohnian. (NA, TR, UNB)

Paleoenvironmental Significance: Upper depth limit not determined; probably within range of those for related morphotypes *B. "floridana"* Cushman (upper middle bathyal) and *B. sinuata* Galloway and Wissler (upper bathyal) (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of topotype from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay: side view, X70.

Plate-figs. 2-9: Thin-section photomicrographs of topotypes from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 22: 2-4 = X64; 5, 6 = X160; 7, 8 = X64; 9 = X20.


Bolivina wissleri
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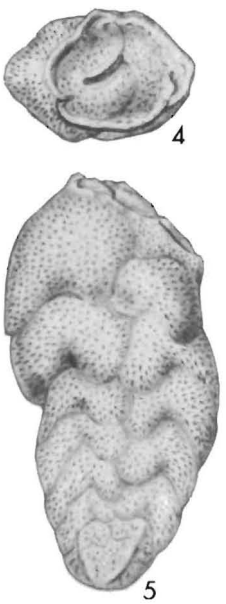
Bolivina woodringi Kleinpell



Type Reference: Kleinpell, 1938, Miocene Stratigraphy of California, p. 285.

Type Figures: *Ibid.*, pl. 21, figs. 4, 5, X75.

Type Level and Locality: Upper Mohnian, Valmonte Diatomite Member, Monterey Formation, Palos Verdes Hills, Los Angeles County, California.

Taxonomic Remarks: Agrees with holotype (USNM497194) and topotypes (USGS).

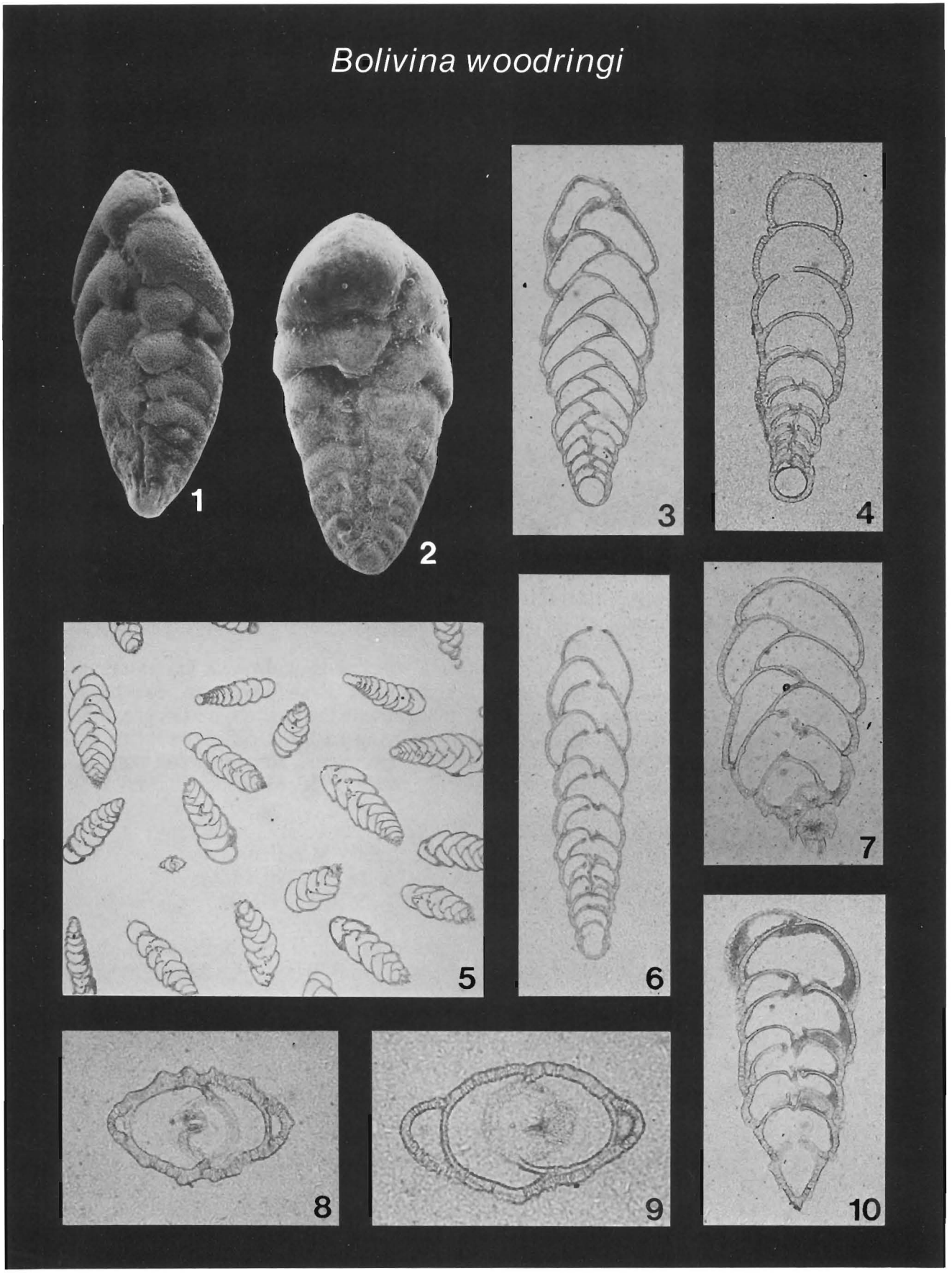
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Mohnian(?), late Mohnian.
Kleinpell (1980): Early Mohnian to late Mohnian, early Delmontian(?).
Regional Literature: Mohnian (BE86, KL80, PI56, SM60).
This Study: Mohnian to "Delmontian"(?). (MQ, NA, SCI, TC, TR?, UNB)

Paleoenvironmental Significance: Upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40660-21, Mohnian, Monterey Formation, Naples Beach: side view, X70.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40267-3, Mohnian, Monterey Formation, Upper Newport Bay: side view, X89.

Plate-figs. 3-10: Thin-section photomicrographs of specimens from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 52: 3 = X64; 4 = X80; 5 = X20; 6 = X64; 7 = X80; 8, 9 = X160; 10 = X100.


Bolivina woodringi
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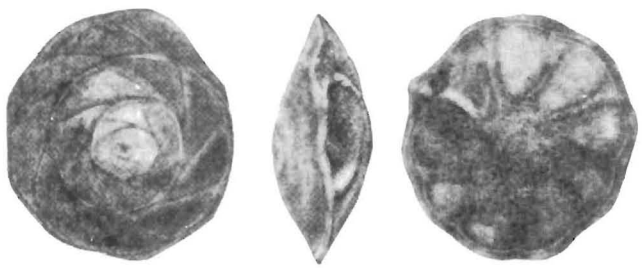
Buccella oregonensis (Cushman, Stewart and Stewart)



4a 4c 4b

Type Designation and Reference: *Eponides mansfieldi* var. *oregonensis* Cushman, Stewart and Stewart, 1948, Oregon Dept. Geol. Min. Indust., Bull., no. 36 (1947), pt. 2, p. 48.

Type Figures: *Ibid.*, pl. 6, figs. 4a-c, holotype, X60.

Type Level and Locality: Middle Miocene, Astoria Formation, Agate Beach, Lincoln County, Oregon.

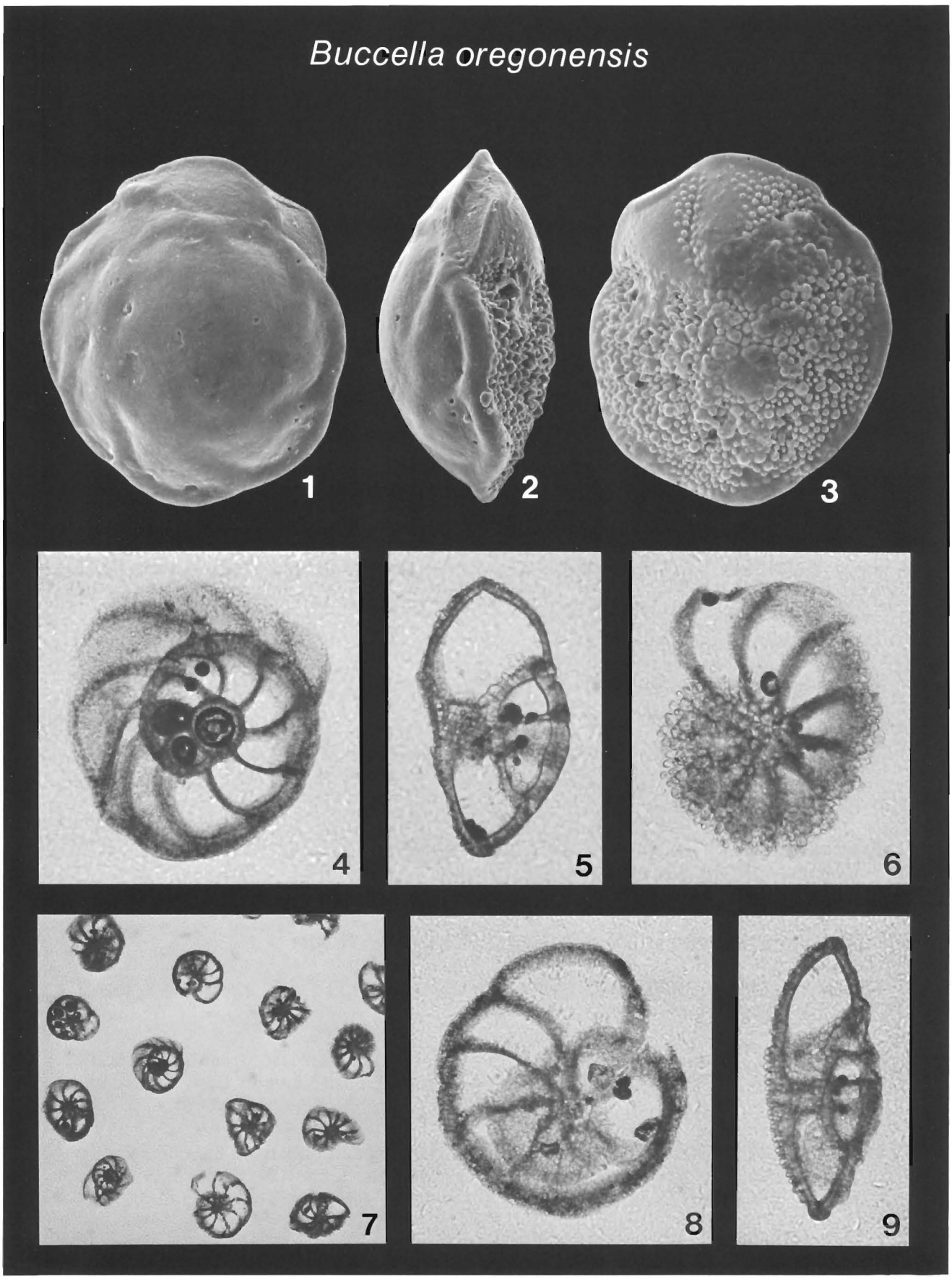
Taxonomic Remarks: Some of the California specimens agree with the holotype (USNM44208), but most are much smaller and more planoconvex, and few have limbate sutures. Because the species is relatively rare in the California Miocene, it is not possible to determine the validity of referring to these different forms as intraspecific variants; perhaps they are immature specimens. Some regional workers have referred to this species as *E. mansfieldi* Cushman (1930, Miocene, Florida).

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *E. mansfieldi*: Late Relizian to early Mohnian.
Regional Literature: Zemorrian to Mohnian (AR76, AR84, FI90, PI56).
This Study: Zemorrian to Mohnian. (GC, LH, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit not determined, but probably the same as that of *B. tenerrima* (Bandy) and *B. frigida* (Cushman), which is inner shelf (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-34, Luisian, Monterey Formation, Upper Newport Bay, X266: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality UCLA-6317, Luisian, Monterey Formation, San Clemente Island, slide no. 118: 4-6 = X160; 7 = X32; 8, 9 = X160.


Buccella oregonensis
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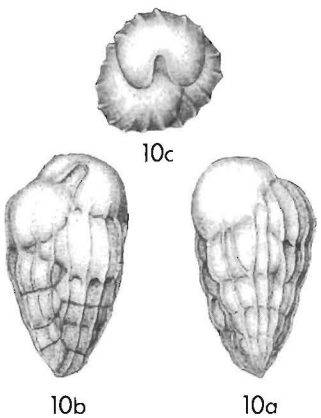
Bulimina fossa Cushman and Parker



Type Reference: Cushman and Parker, 1938, Contr. Cushman Lab. Foram. Res., v. 14, pt. 3, p. 56.

Type Figures: *Ibid.*, pl. 9, figs. 10a-c, holotype, X90.

Type Level and Locality: Pliocene, Pico Formation, Cañada de Aliso, Ventura County, California.

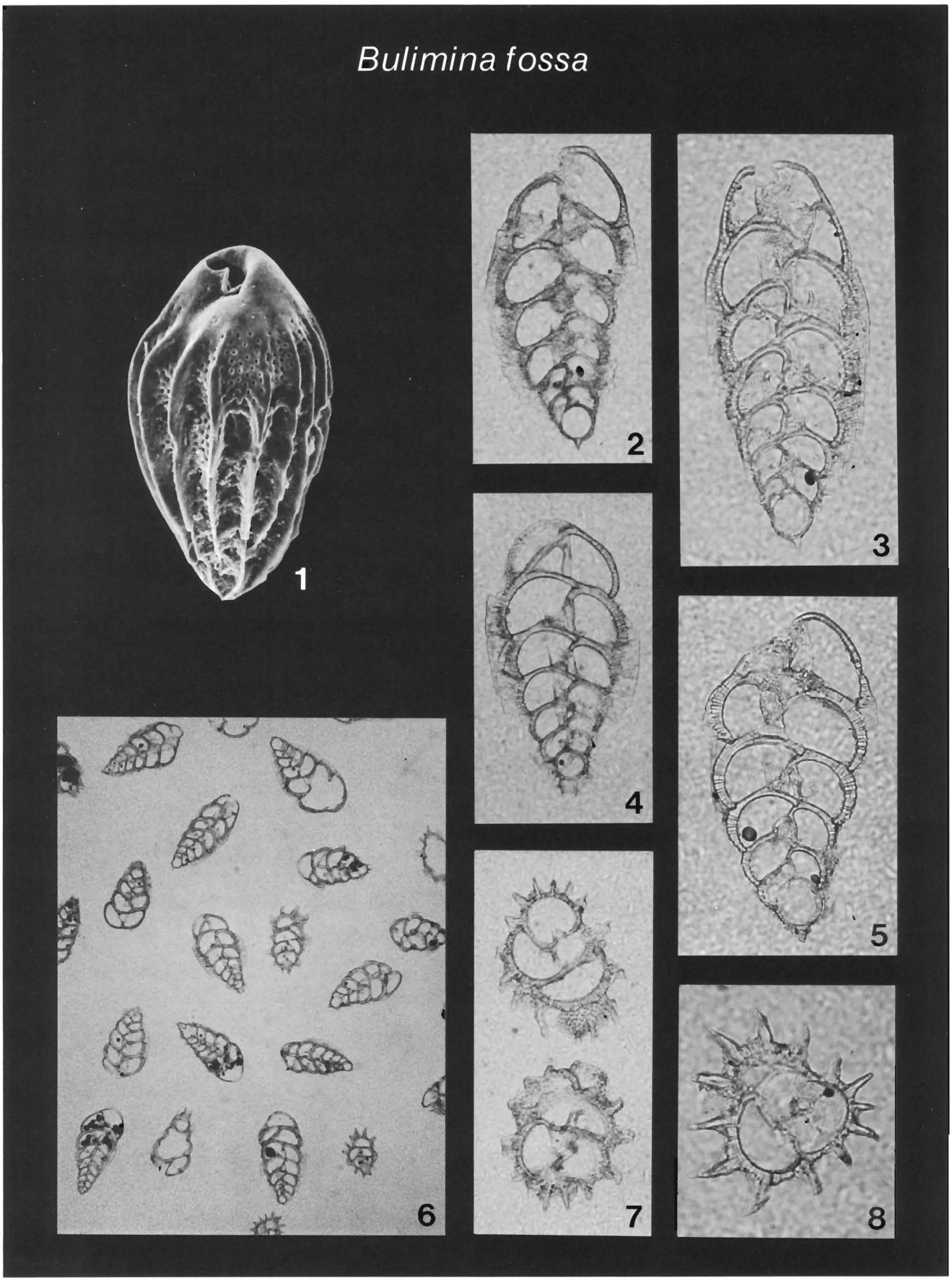
Taxonomic Remarks: Agrees with holotype (USNM24644). Many regional workers have referred this species to *B. rostrata* Brady (1884, Recent, SE Atlantic and Indian Oceans).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Regional Literature: Luisian to Pliocene, ranges to Holocene (AR76, AR84, BE86, BL81, BO81, CB86, CG46, PI56).
This Study: Luisian to Pliocene, ranges to Holocene. (UNB)

Paleoenvironmental Significance: Upper depth limit (of *B. rostrata*) = lower middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: side view, X184.

Plate-figs. 2-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 74: 2 = X160; 3 = X200; 4 = X160; 5 = X200; 6 = X50; 7 = X160; 8 = X320.


Bulimina fossa
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Bulimina inflata Seguenza

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Type Reference: Seguenza, 1862, Accad. Gioenia Sci. Nat. Catania, Atti, Ser. 2, v. 18, p. 109.

Type Figure: *Ibid.*, pl. 1, fig. 10, X38.

Type Level and Locality: Pleistocene, Sicily, Italy (type locality not designated).

Taxonomic Remarks: Holotype (USNM20295) of *B. pagoda* Cushman (1927, Recent, Pacific) has smaller and sharper spines than *B. inflata*. Holotype (USNM12530) of *B. pagoda* var. *hebespinata* R. E. and K. C. Stewart (1930, Pliocene, California) is also distinct from this cosmopolitan species, having rather coarse and blunt spines projecting outward from the test.

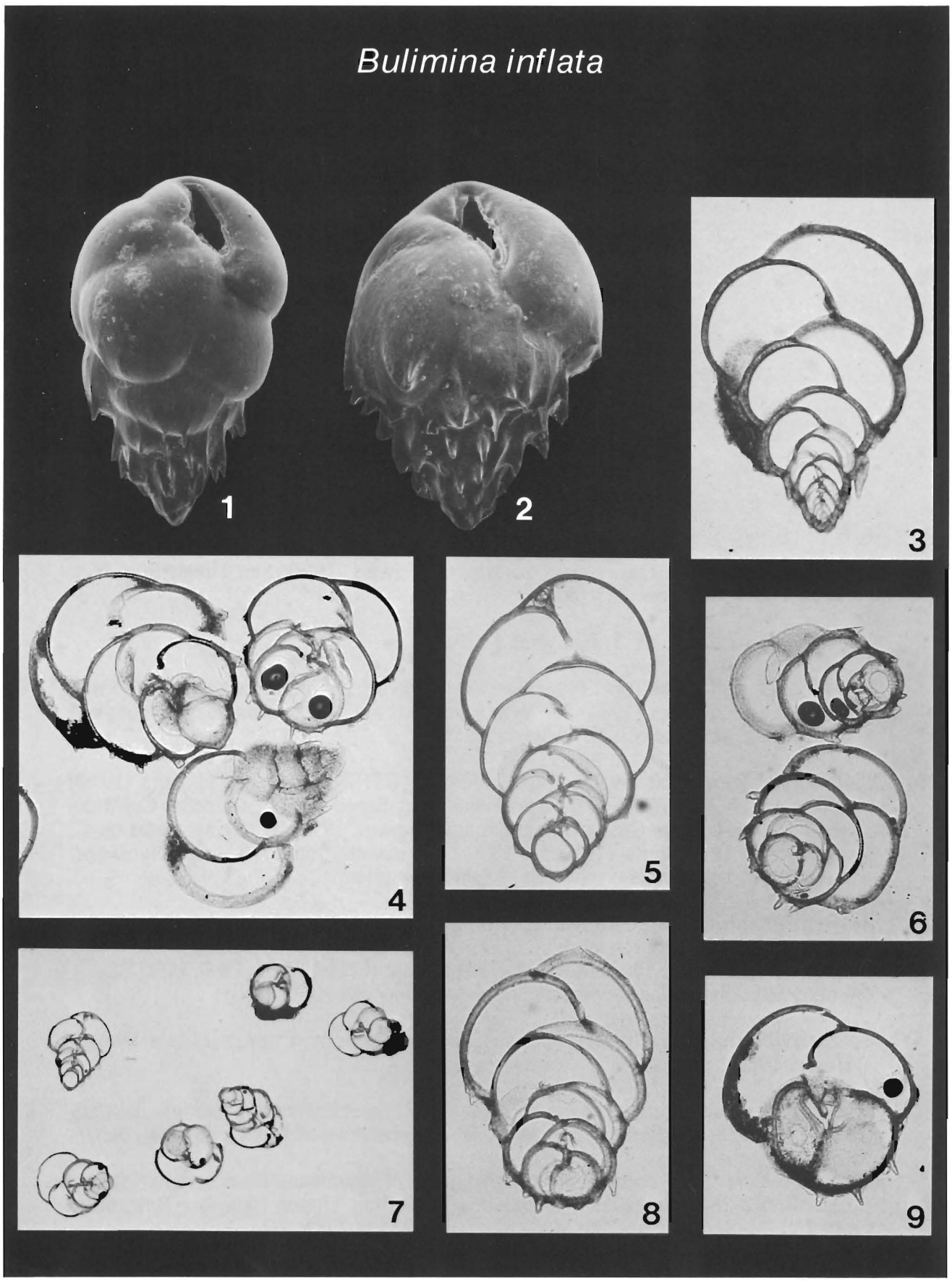
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian to early Delmontian.
Regional Literature: Saucesian to Pliocene, ranges to Holocene (AR76, BE86, BL81, BO81, CB86, CL31, CS30, FI90, KL80, PI56).
This Study: Saucesian to Pliocene, ranges to Holocene. (MQ, NA, SCI, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay: side view, X69.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC42107-15, Mohnian, Monterey Formation, Manville Quarry access road: side view, X139.

Plate-figs. 3-9: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 43: 3-6 = X80; 7 = X32; 8, 9 = X100.


Bulimina inflata
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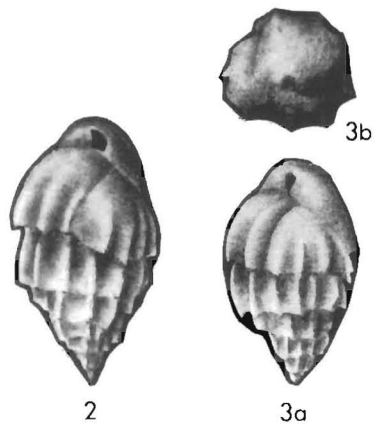
Bulimina subacuminata Cushman and R. E. Stewart



Type Reference: *In* Cushman, Stewart and Stewart, 1930, San Diego Soc. Nat. Hist., Trans., v. 6, no. 2, p. 65.

Type Figures: *Ibid.*, pl. 5, figs. 2-3b, X65.

Type Level and Locality: Pliocene*, Bear River, Humbolt County, California. [*According to Haller (1980), the Bear River beds are Miocene and they do not yield this species nor its associated Pliocene fauna.]

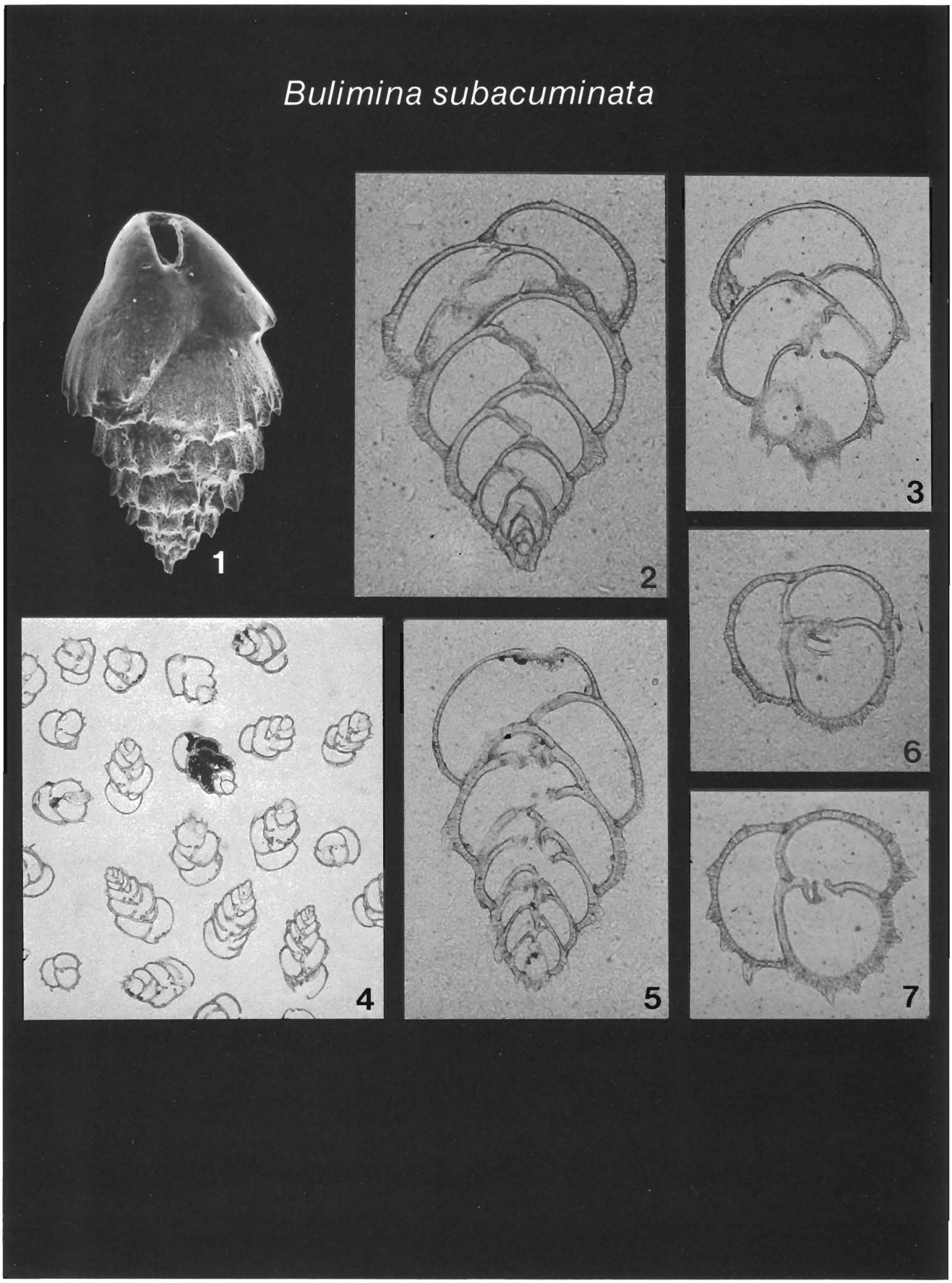
Taxonomic Remarks: Agrees with holotype (USNM12456) and Haller's (1980) hypotype (UCMP47631). The species is distinguished from *B. subcalva* Cushman and K. C. Stewart (*in* Cushman, Stewart and Stewart, 1930) by having costae on all chambers. In Haller's (1980, p. 245, 246) emendation of *B. subacuminata*, however, *B. subcalva* is considered its junior synonym.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not reported.
Regional Literature: Pliocene, ranges to Holocene (CB86, CS30, FI90, MA52).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Fm., Upper Newport Bay: side view, X107.

Plate-figs. 2-7: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 73: 2 = X160; 3 = X128; 4 = X32; 5 = X128; 6, 7 = X160.


Bulimina subacuminata
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Bulimina subcalva Cushman and K. C. Stewart

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Type Reference: *In* Cushman, Stewart and Stewart, 1930, San Diego Soc. Nat. Hist., Trans., v. 6, no. 2, p. 65.

Type Figures: *Ibid.*, pl. 4, figs. 11a, b, X65.

Type Level and Locality: Pliocene*, upper Rio Dell Formation, Scotia Bluffs, Humbolt County, California. [*According to Haller (1980), these beds are Pleistocene and do not yield this species nor its associated Pliocene fauna.]

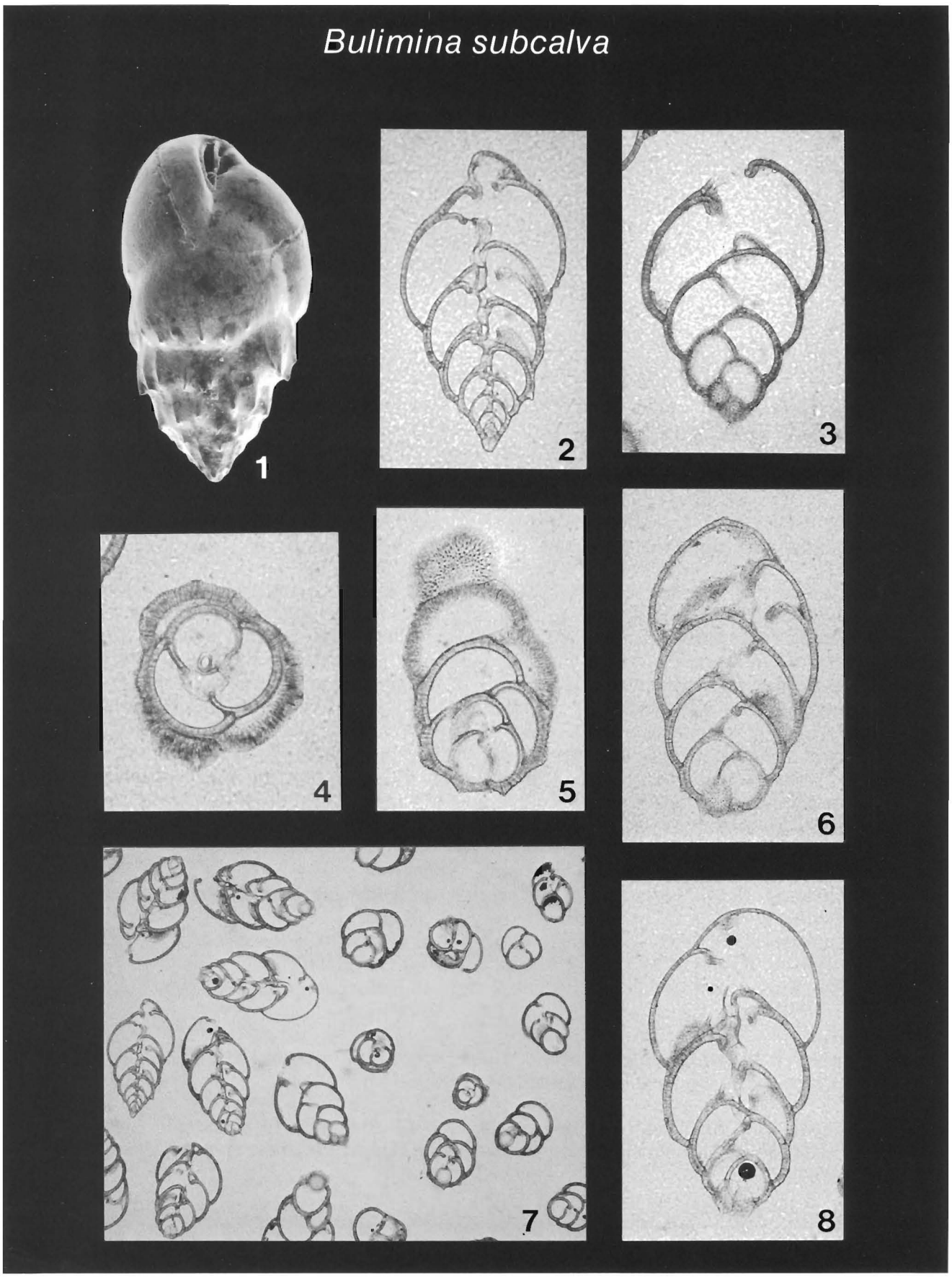
Taxonomic Remarks: Agrees with holotype (USNM12454), which has costae only on lower half of test. Haller (1980, p. 245, 246) synonymizes this species in his emendation of *B. subacuminata* Cushman and R. E. Stewart (*in* Cushman, Stewart and Stewart, 1930); *B. subcalva* resembles two of his *B. subacuminata* hypotypes (UCMP47632 and -47633).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Saucesian(?) to late Relizian(?).
Regional Literature: Saucesian to Pliocene (CG46, CS30, FI90).
This Study: Saucesian to Pliocene. (GC, NA)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Fm., Upper Newport Bay: side view, X74.

Plate-figs. 2-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 72: 2-4 = X80; 5 = X128; 6 = X80; 7 = X32; 8 = X80.


Bulimina subcalva
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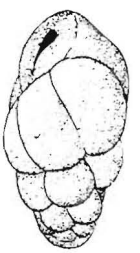
Buliminella curta Cushman



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Type Reference: Cushman, 1925c, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 33.

Type Figure: *Ibid.*, pl. 5, fig. 13, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

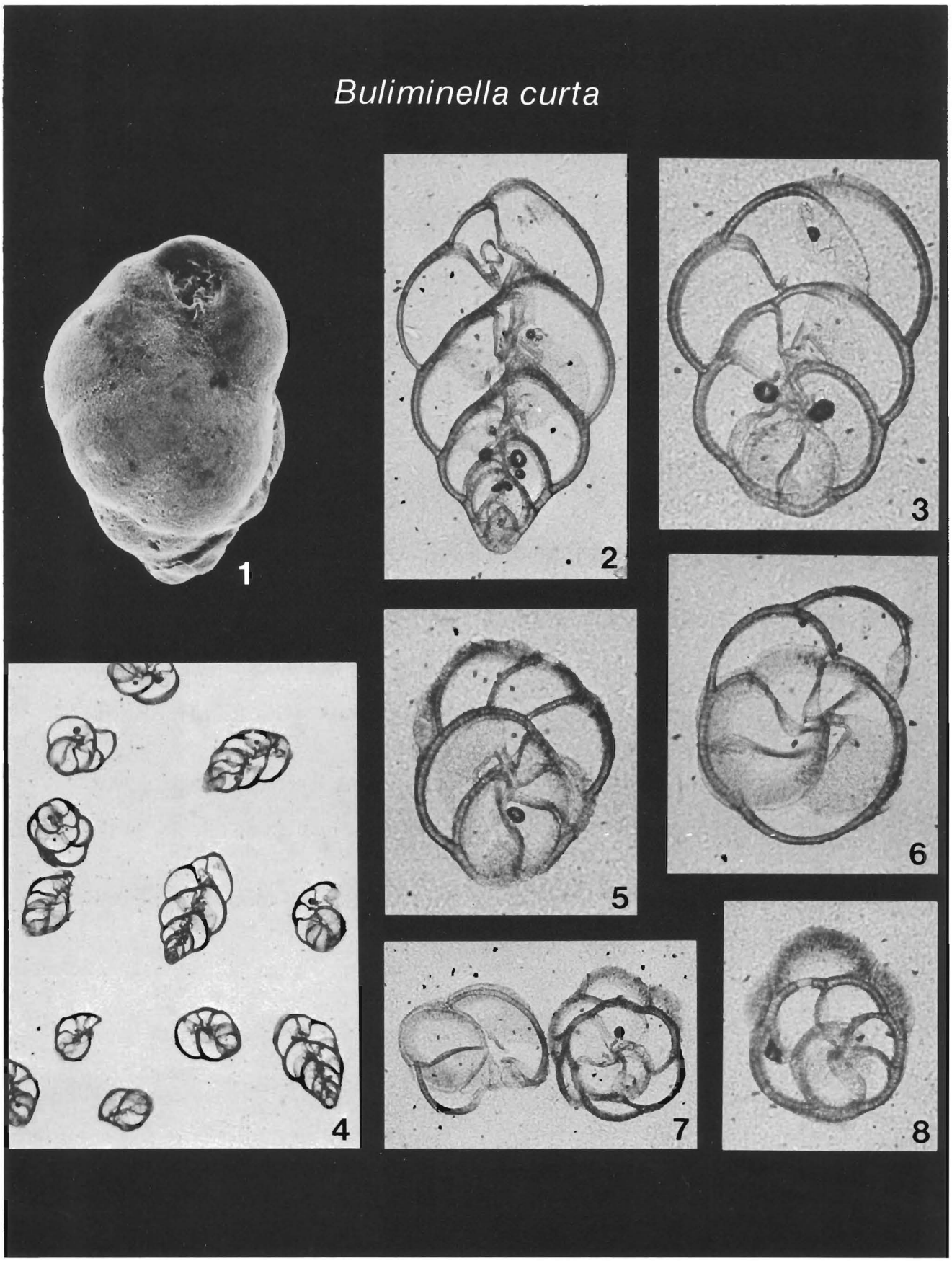
Taxonomic Remarks: Holotype (USNM4361) and Kleinpell's (1938) plesiotype (LSJU667) are not as inflated as these specimens but are intermediate between this stubby form assigned herein to *B. curta* and the more common elongate forms referred to *B. subfusiformis* Cushman. In most assemblages, there is a gradation between these morphotypes, which suggests that they are ecophenotypic variants of a single species. On this matter, it is relevant to note that four related taxa, *B. brevior*, *B. curta*, *B. californica*, and *B. subfusiformis*, were described by Cushman (1925c) from the same locality and possibly from the same sample. The differentiation of *B. curta* in this catalog is based on rare populations comprised solely of this end member of the grade; most of the other morphotypes are assigned to *B. subfusiformis*.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Zemorrian to early Delmontian, late Delmontian(?).
Kleinpell (1980): Early Saucesian to late Delmontian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, BE86, CB86, KL80, MA52, PI56, SB86, SM60, TI73, WH56).
This Study: Zemorrian to Pliocene, ranges to Holocene. (IC, MQ, NA, TC, TR, UNB)

Paleoenvironmental Significance: Upper depth limit = outer shelf (Ingle, 1980); oxygen-minimum zone indicator (Blake, 1981).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-3, Mohnian, Monterey Formation, Upper Newport Bay: oblique side view, X136.

Plate-figs. 2-8: Thin-section photomicrographs of specimens from sample locality CRC41367-2, Mohnian, Monterey Formation, Toro Road, slide no. 45: 2 = X128; 3, 4 = X40; 5, 6 = X160; 7 = X100; 8 = X160.


Buliminella curta
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Buliminella elegantissima (d'Orbigny)

13 14

Type Designation and Reference: *Bulimina elegantissima* d'Orbigny, 1839, Voy. Amér. Mer. Foraminifères, v. 5, pt. 5, p. 51, pl. 7, figs. 13, 14.

Type Figures: *Ibid.*, pl. 7, figs. 13, 14, X40.

Type Level and Locality: Recent, Southeast Pacific.

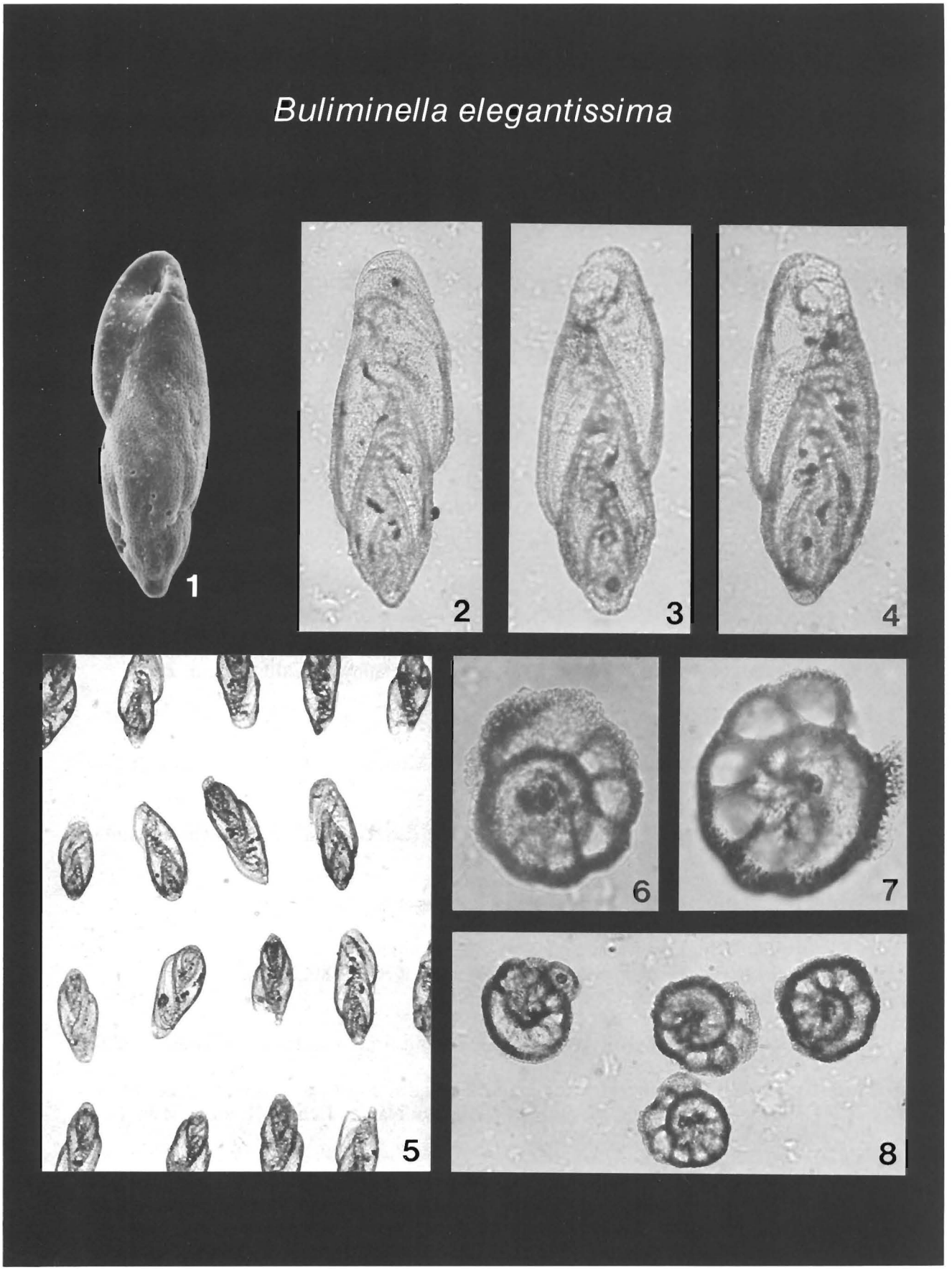
Remarks: This is a long-ranging species which is relatively rare in abundance when present.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Relizian to late Delmontian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, CB86, CS30, FI90, GW27, SB86, SM60).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, IC, LH, NA, SCI, TC, TR, UNB)

Paleoenvironmental Significance: Upper depth limit = inner shelf (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC41367-2, Mohnian, Monterey Formation, Toro Road: side view, X231.

Plate-figs. 2-8: Thin-section photomicrographs of specimens from sample locality CRC41367-2, Mohnian, Monterey Formation, Toro Road, slide no. 100: 2 = X200; 3, 4 = X250; 5 = X80; 6, 7 = X400; 8 = X200.


Buliminella elegantissima
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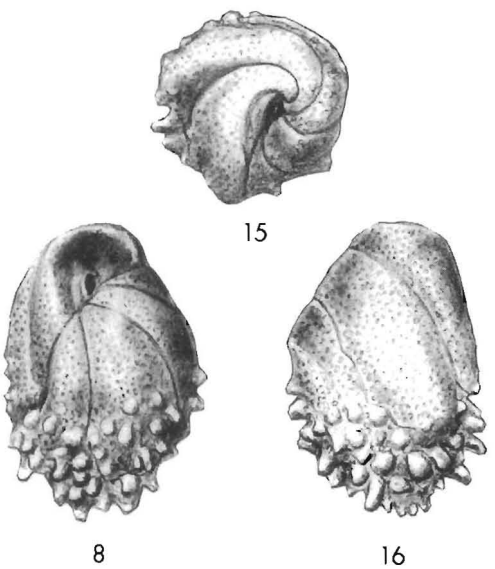
Buliminella semihispida Kleinpell



Type Reference: Kleinpell, 1938, Miocene Stratigraphy of California, p. 250.

Type Figures: *Ibid.*, pl. 20, figs. 8, 15, 16, X50.

Type Level and Locality: Upper Mohnian, Monterey Formation, Naples Beach, Santa Barbara County, California.

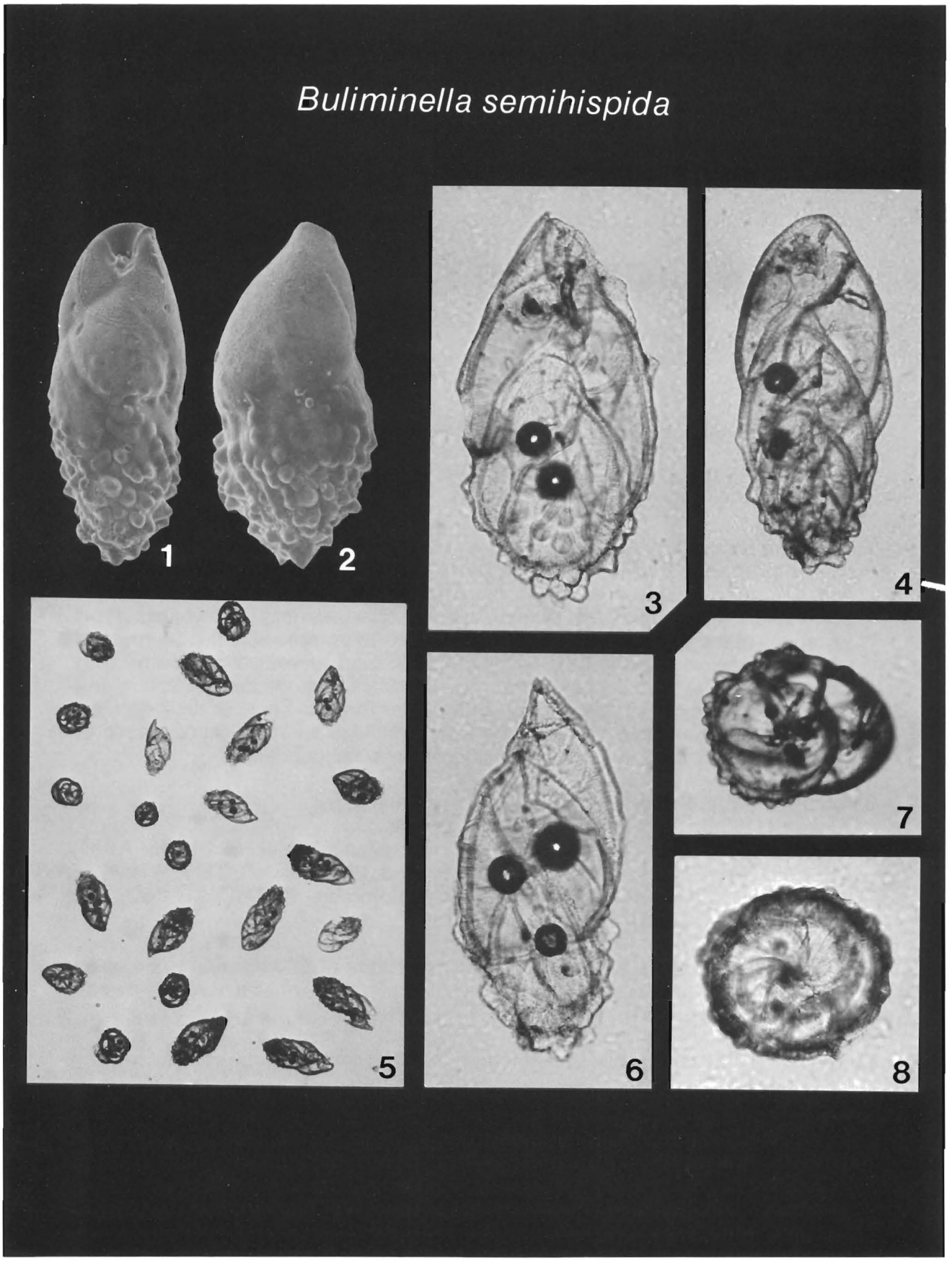
Taxonomic Remarks: Agrees with holotype (LSJU6091). Specimens illustrated here are topotypes.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian.
Kleinpell (1980): Late Mohnian to early Delmontian(?).
Regional Literature: Mohnian to Delmontian (AR76, KL80, PI56).
This Study: Mohnian to "Delmontian". (NA)

Paleoenvironmental Significance: Upper depth limit = outer shelf (Ingle, 1980).

Plate-fig. 1, 2: Scanning electron micrographs of topotypes from sample locality CRC39842-47, Mohnian, Monterey Formation, Naples Beach: 1, side view, X139; 2, side view, X148.

Plate-figs. 3-8: Thin-section photomicrographs of topotypes from sample locality CRC39842-47, Mohnian, Monterey Formation, Naples Beach, slide no. 99: 3 = X200; 4 = X160; 5 = X32; 6 = X200; 7 = X160; 8 = X200.


Buliminella semihispida
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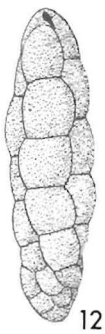
Buliminella subfusiformis Cushman



Type Reference: Cushman, 1925c, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 33, pl. 5, fig. 12.

Type Figure: *Ibid.*, pl. 5, fig. 12, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

Taxonomic Remarks: Agrees with holotype (USNM4360), although holotype has more tightly packed chambers. Kleinpell's (1938) plesiotype (LSJU848) is large with four whorls and looks more like *B. curta*. In most assemblages, there is a grade between these morphotypes, which suggests that they may be ecophenotypic variations of a single species. On this matter, it is relevant to note that four related forms, *B. brevior*, *B. curta*, *B. californica*, and *B. subfusiformis*, were described by Cushman (1925c) from the same locality and possibly from the same sample. Most of the morphotypes can be assigned to *B. subfusiformis*. Some of the larger and slender specimens have the slight neck and rounded aperture characteristic of *Buliminellita*, but these appear to be ecophenotypic variants as well.

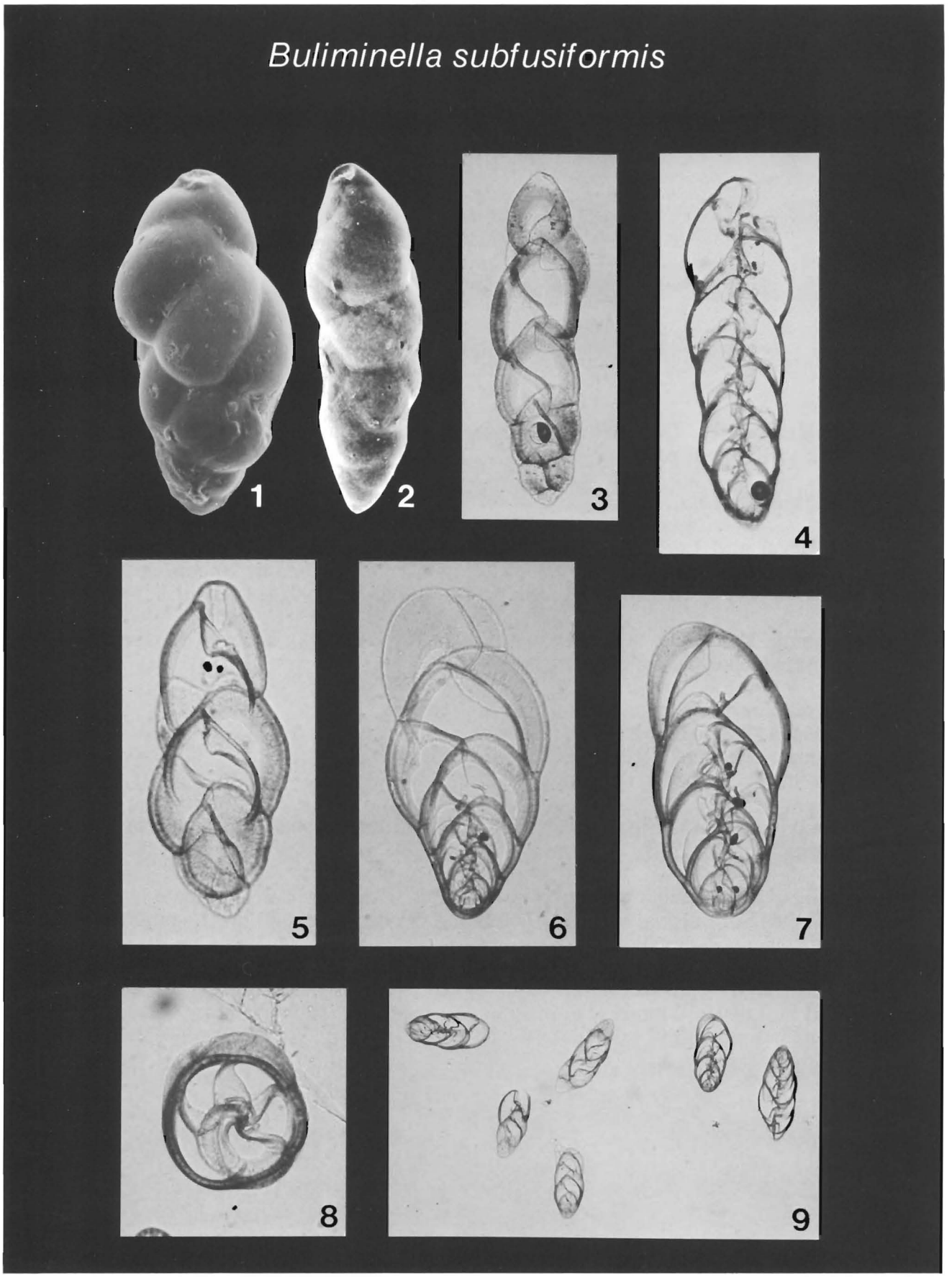
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Zemorrian to early Delmontian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, AR84, BE86, CB86, CL31, FI90, GW27, KL80, PI56, PM81, SM60, TI73, WH56).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, IC, LH, MQ, NA, SCI, TC, TR, UNB)

Paleoenvironmental Significance: Upper depth limit of *B. subfusiformis* = upper bathyal/ oxygen-minimum zone; upper depth limit of *B. californica* and *B. curta* = outer shelf (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40660-6, Saucesian, Monterey Formation, Naples Beach: side view, X172.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40267-36, Mohnian, Monterey Fm., Upper Newport Bay: side view, X88.

Plate-figs. 3-9: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 25: 3 = X100; 4 = X80; 5, 6 = X160; 7 = X128; 8 = X160; 9 = X32.


Buliminella subfusiformis
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Cancris baggi Cushman and Kleinpell

2a 2c 2b

Type Reference: Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 15.

Type Figures: *Ibid.*, pl. 3, figs. 2a-c, X25.

Type Level and Locality: Luisian*, Sandholdt Member, Monterey Formation, Graves Creek, San Luis Obispo County, California. [*Cited by authors as Upper Relizian, later by Graham (1980) and Finger and others (1990) as Luisian]

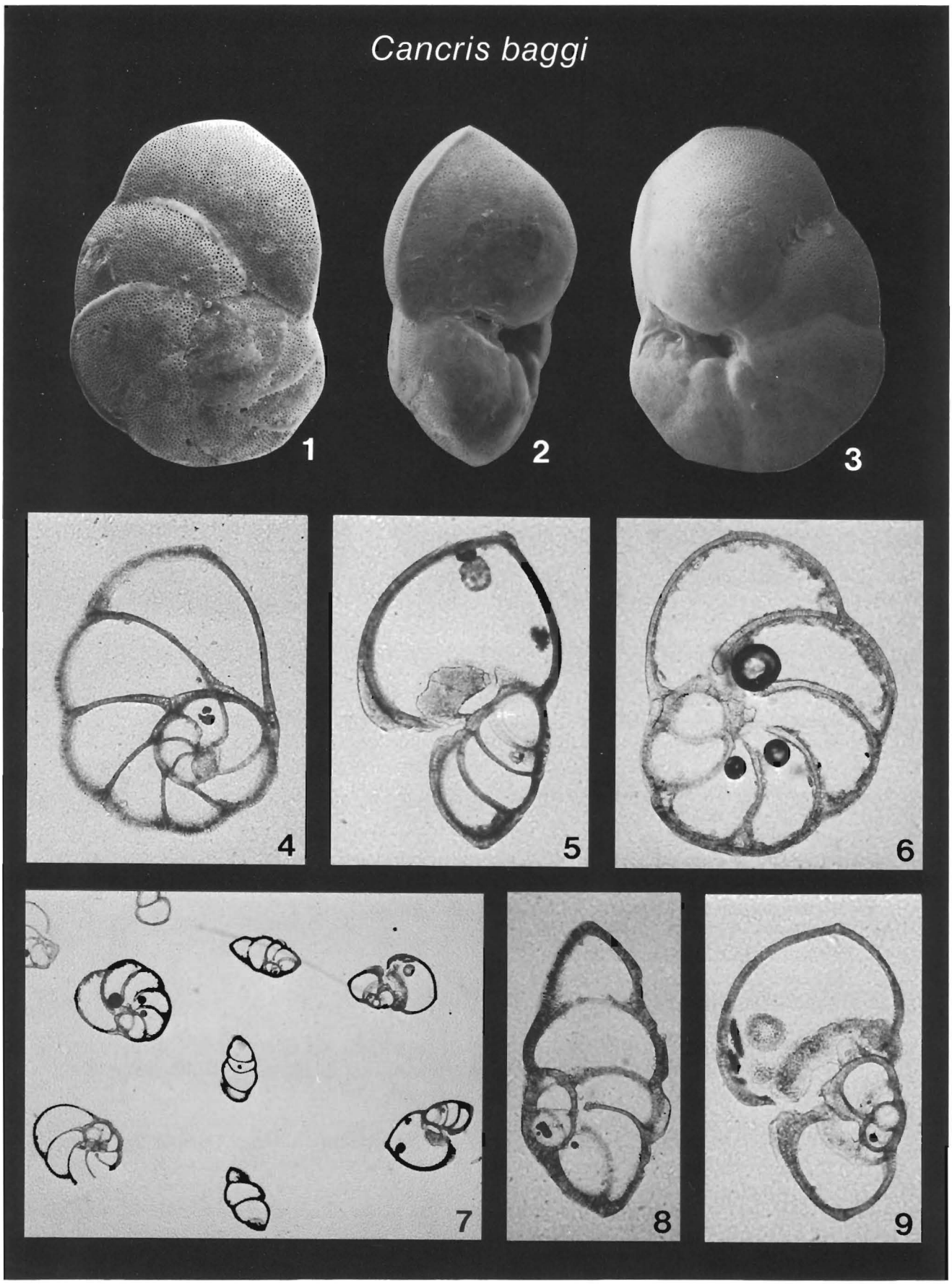
Taxonomic Remarks: Agrees with holotype (USNM20148), although some of the recovered topotypes are slightly more involute.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Relizian.
Regional Literature: Relizian to Luisian (FI90, SM60).
This Study: Saucesian to Luisian. (GC, IC, LH, NA, SCI)

Paleoenvironmental Significance: Upper depth limit = shelf edge/upper bathyal transition (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC39842-3, Luisian, Monterey Formation, Naples Beach, X124: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of topotypes from sample locality GC-15a, Luisian, Monterey Formation, Graves Creek, slide no. 114: 4-6 = X80; 7 = X25; 8 = X100; 9 = X80.


Cancris baggi
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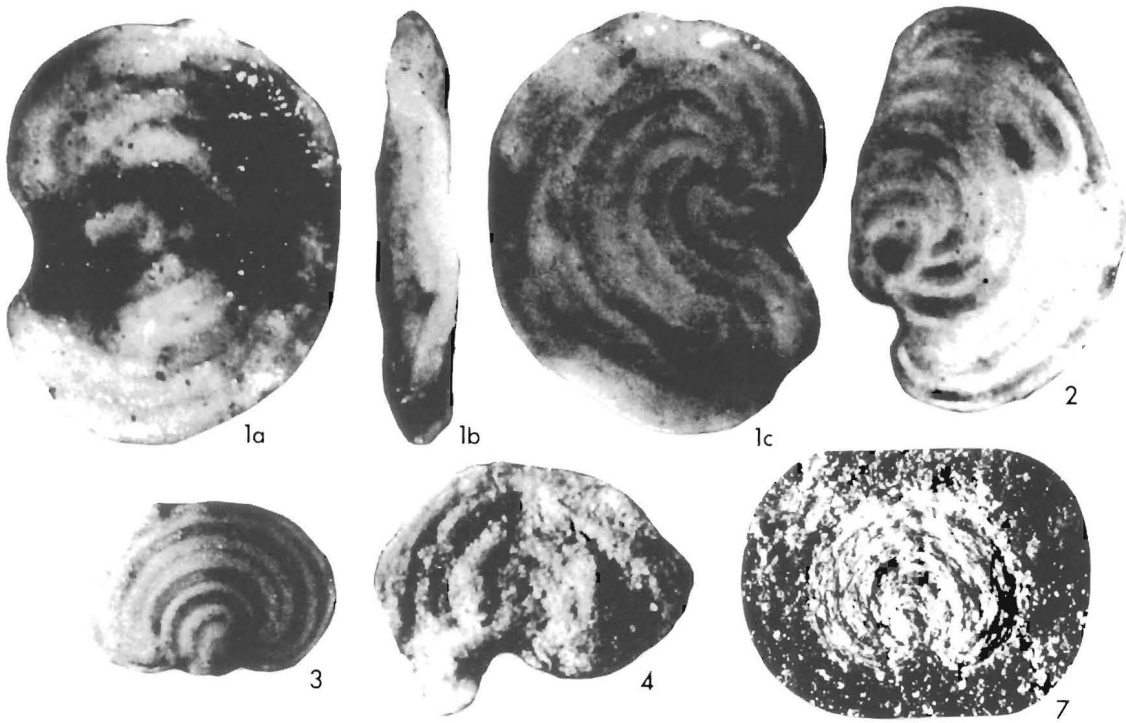
Cassidulinella renulinaformis Natland



Type Reference: Natland, 1940, Jour. Paleont., v. 14, p. 571, pl. 69.

Type Figures: *Ibid.*, pl. 69, figs. 1-4, 7: 1a-c, holotype, X46; 2, paratype, X50; 3, paratype, X50; 4, crushed specimen, X46; 7, paratype (impression), X27.

Type Level and Locality: Mohnian, Monterey Formation, well in Orcutt Field, Santa Barbara County, California.

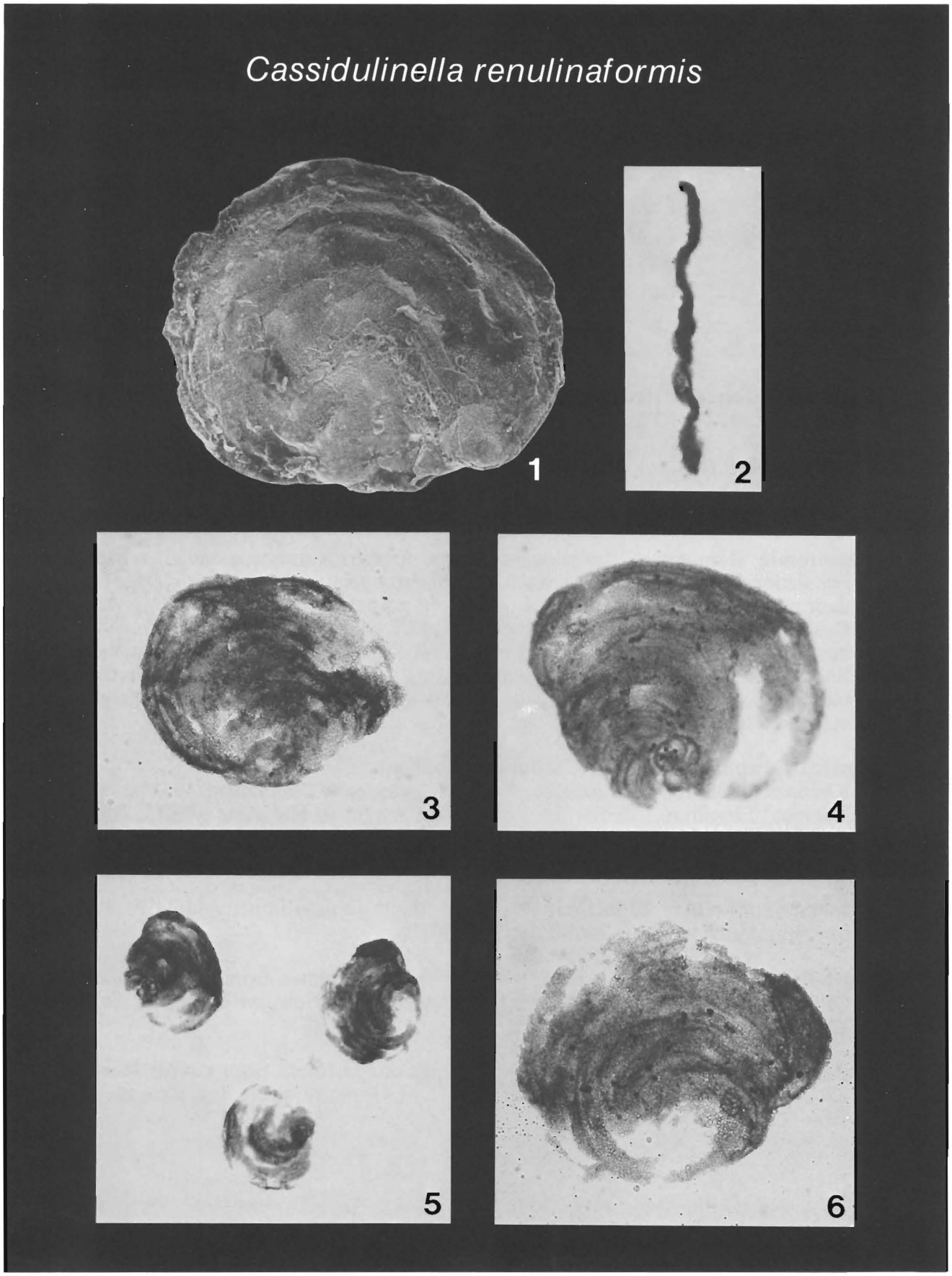
Taxonomic Remarks: Unlike the holotype (USNM546448), the recovered specimens and paratypes (USNM) are diagenetically compressed.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Kleinpell (1980): Late Mohnian.
Regional Literature: Mohnian (AR76, PI56).
This Study: Mohnian. (MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit not determined; its affinity for laminated sediments (Hendrix, 1958) suggests that this species is indicative of a low-oxygen upper-bathyal environment (see Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-3, Mohnian, Monterey Fm., Upper Newport Bay: side view, X91.

Plate-figs. 2-6: Thin-section photomicrographs of specimens from sample locality CRC40267-3, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 12: 2-4 = X80; 5 = X32; 6 = X80.


Cassidulinella renulinaformis
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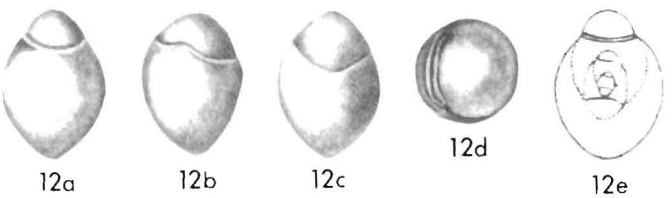
Chilostomella ovoidea Reuss



Type Reference: Reuss, 1850, K. Akad. Wiss. Wien., Math.-Naturw. Cl., Denkschr., v. 1, p. 380.

Type Figures: *Ibid.*, pl. 48, figs. 12a-e, X40.

Type Level and Locality: Tertiary, Austria.

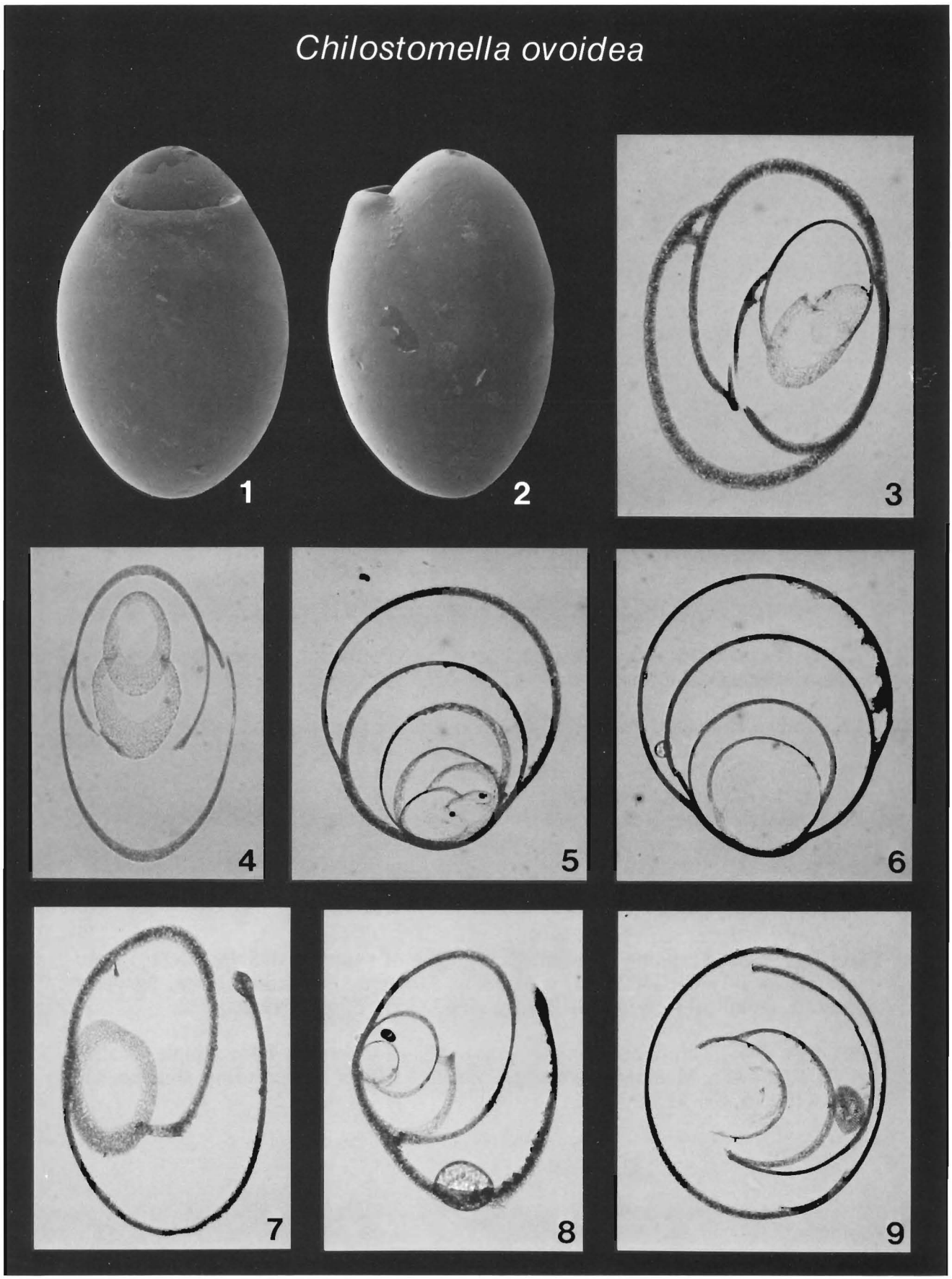
Taxonomic Remarks: The wideness of the aperture varies considerably within populations. As with other species, Mohnian specimens tend to be much larger than their predecessors; hence, some regional workers have referred them to *C. grandis* Cushman (1917, Recent, Philippines). The *C. grandis* holotype (USNM9146), however, is considerably larger and less ovate, and possesses a flange-like truncated lip. Another synonym in the regional literature is *C. czizeki* Reuss (1850, Tertiary, Germany), which is more elongate and has a less enveloping ultimate chamber compared to *C. ovoidea.*

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for cf. *C. ovoidea*: Early Mohnian, early Delmontian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, BE86, CB86, FI90, MA52, WH56).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, IC, LH, NA, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal; oxygen-minimum zone indicator (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay: side views, X100.

Plate-figs. 3-9: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 26: 3-6 = X128; 7-9 = X100.


Chilostomella ovoidea
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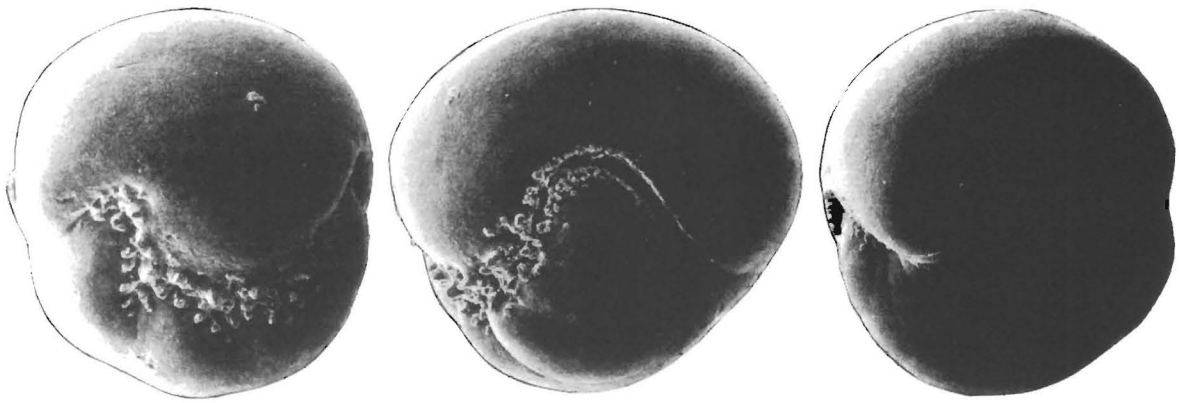
Chilostomina pustulosa Finger and Gaponoff



10 11 12

Type Reference: Finger and Gaponoff, 1986, Jour. Foram. Res., v. 16, no. 1, p. 37, pl. 1, figs. 1-15; pl. 2, figs. 1-12; pl. 3, figs. 1-11.

Type Figures: *Ibid.*, pl. 2, figs. 10-12, holotype, X104.

Type Level and Locality: Mohnian, Monterey Formation, Upper Newport Bay, Orange County, California.

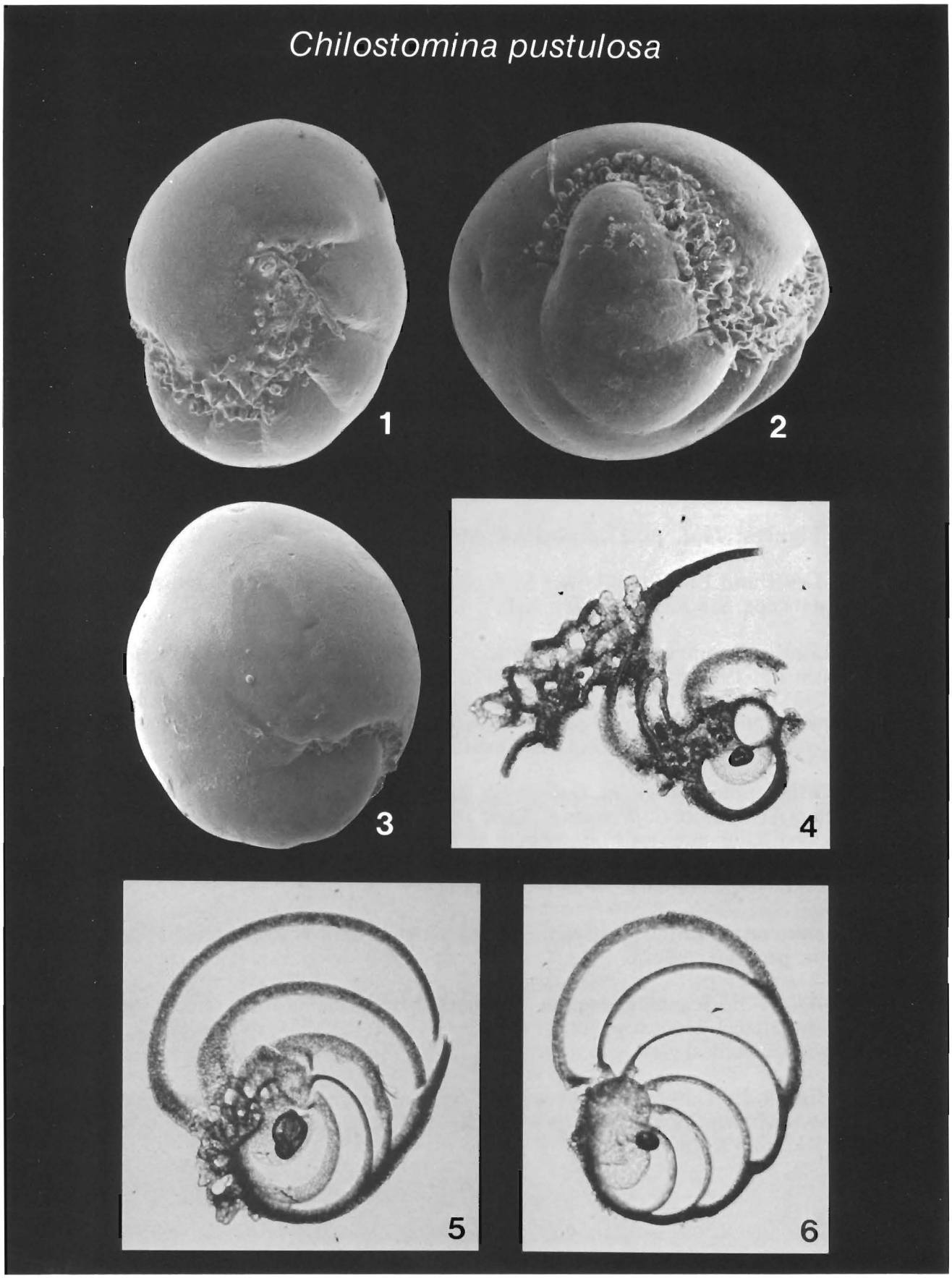
Taxonomic Remarks: Specimens illustrated here are from the type locality.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Regional Literature: Relizian to Mohnian (Finger and Gaponoff, 1986, FI90).
This Study: Saucesian to Mohnian. (GC, MQ, UNB)

Paleoenvironmental Significance: Upper depth limit probably bathyal (see Finger and Gaponoff, 1986).

Plate-figs. 1-3: Scanning electron micrographs of paratype (USNM388213) from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay: 1, umbilical view, X132; 2, edge view, X151; 3, spiral view, X132.

Plate-figs. 4-6: Thin-section photomicrographs of topotypes from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 41: 4 = X100; 5, 6 = X160.


Chilostomina pustulosa
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Cibicidoides cushmani (Barbat and von Estorff)

21a 21b 21c

Type Designation and Reference: *Cibicides floridanus* var. *cushmani* Barbat and von Estorff, 1933, Jour. Paleont., v. 7, no. 2, p. 173.

Type Figures: *Ibid.*, pl. 23, figs. 21a-c, X90.

Type Level and Locality: Lower Miocene, lower Vaqueros Formation, southeast of Maricopa, San Joaquin Valley, Kern County, California.

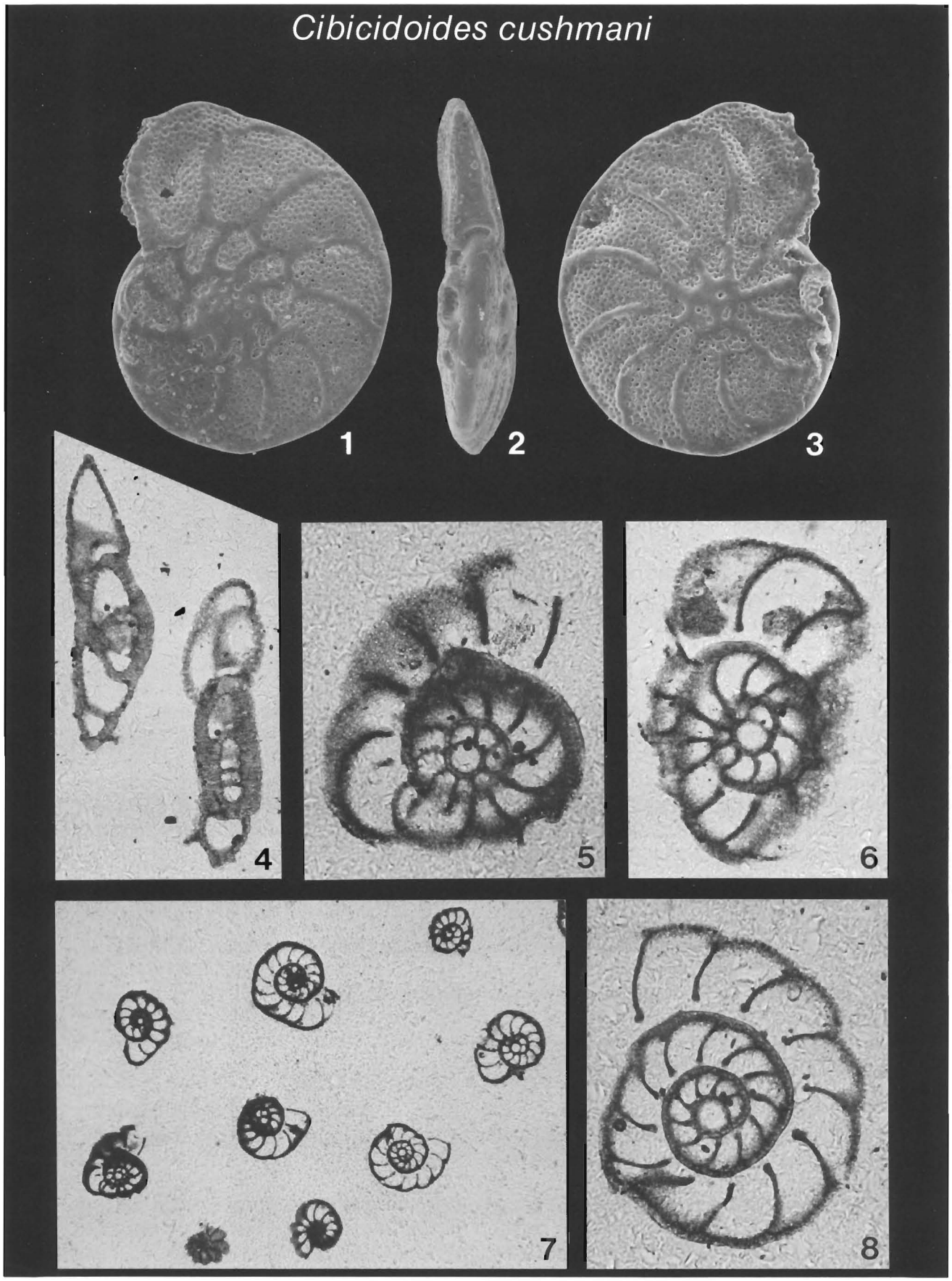
Taxonomic Remarks: This species has been referred to *Cibicides floridanus* (Cushman, 1918a; Miocene, Florida) by most regional workers. The holotype (USNM325327) of that species, however, is distinctly biconvex, with a thickness-to-diameter ratio of 1:3; those specimens recovered herein are much flatter. *Planulina limbata* Natland (1938; Recent, Pacific off Panama) is a junior synonym.

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *C. floridanus*: Early Zemorrian to Late Saucesian.
Regional Literature (for *C. floridanus, P. limbata, and C. cushmani*) Saucesian to Holocene (AR76, CL31, FI90, KL80, NA38, PM81, TI73).
This Study: Zemorrian to Holocene. (GC, NA)

Paleoenvironmental Significance: Upper depth limit = lower middle bathyal (Ingle, personal comm.).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality GC-8, Relizian, Monterey Formation, Graves Creek, X124: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality GC-9, Relizian, Monterey Formation, Graves Creek, slide no. 94: 4-6 = X128; 7 = X32; 8 = X128.


Cibicidoides cushmani
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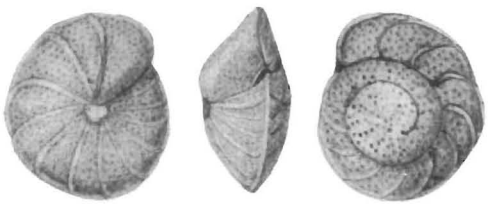
Cibicidoides mckannai (Galloway and Wissler)



5a 5b 5c

6a 6b 6c

Type Designation and Reference: *Cibicides mckannai* Galloway and Wissler, 1927, Jour. Paleont., v. 1, p. 65.

Type Figures: *Ibid.*, pl. 10, figs. 5a-6c: 5a-c, holotype, X50; 6a-c, young specimen, X47.

Type Level and Locality: Lower Pleistocene, lower San Pedro Formation, Lomita Quarry, Palos Verdes Hills, Los Angeles County, California.

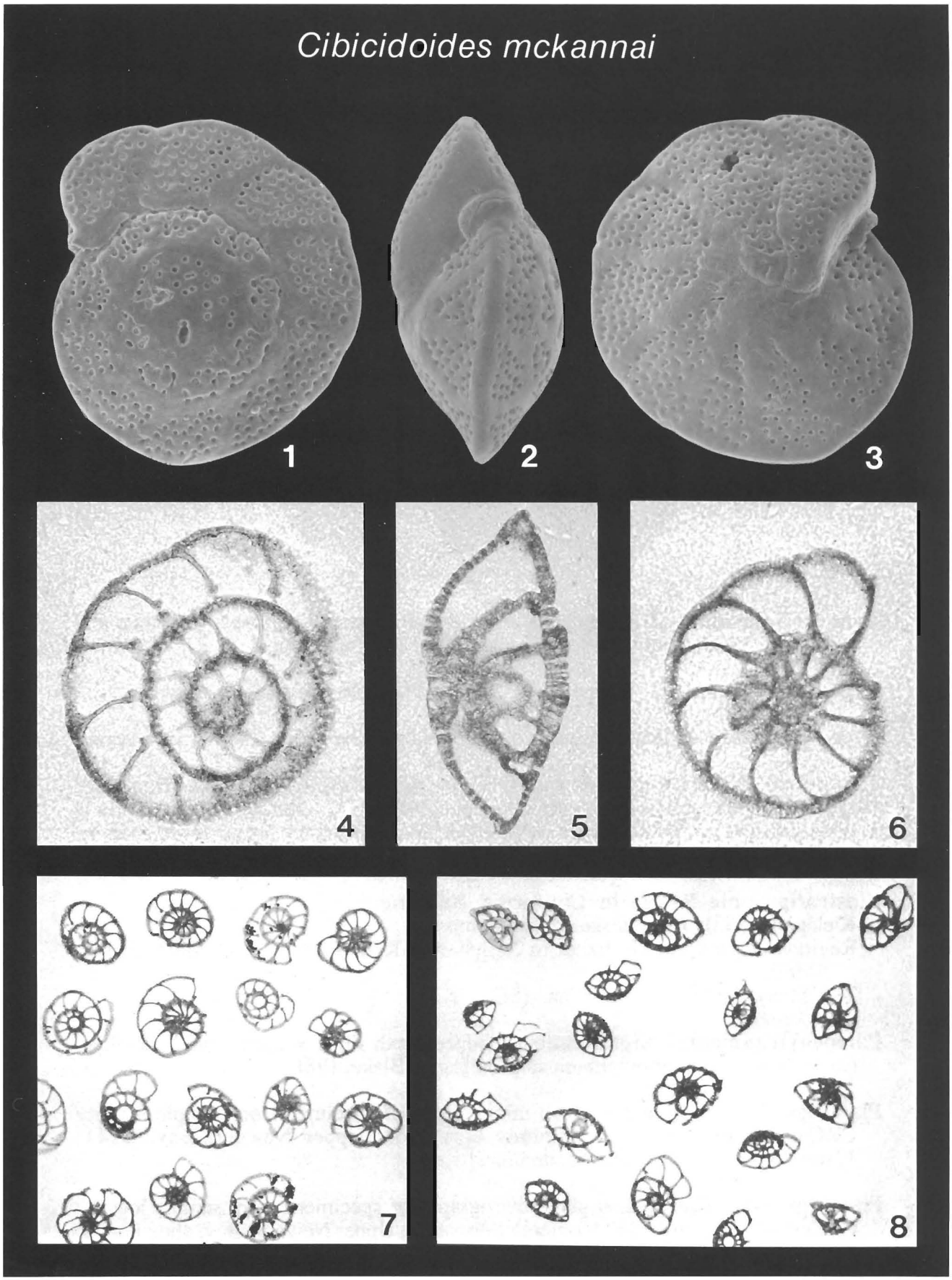
Taxonomic Remarks: Not compared with holotype deposited in Columbia University, but agrees with topotypes (COFRC). The form described as *Cibicides mckannai* var. *suppressus* Martin (1952) is more equally biconvex, but this seems to be a gradational feature within recovered populations.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not reported.
Regional Literature: Luisian to Pliocene, ranges to Holocene (BE86, CB86, GW27, HA80, MA52, WH56).
This Study: Luisian to Pliocene, ranges to Holocene. (UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, X169: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 86: 4-6 = X128; 7, 8 = X32.


Cibicidoides mckannai
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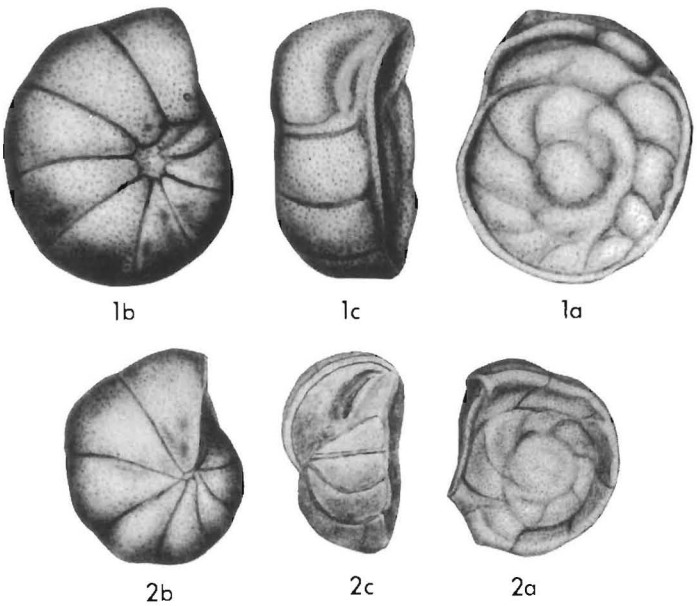
Concavella gyroidinaformis (Cushman and Goudkoff)



Type Designation and Reference: *Pulvinulinella gyroidinaformis* Cushman and Goudkoff, 1938, Contr. Cushman Lab. Foram. Res., v. 14, pt. 1, p. 2.

Type Figures: *Ibid.*, pl. 1, figs. 1a-2c, X115: 1a-c, holotype; 2a-c, paratype.

Type Level and Locality: Upper Mohnian, Shale Hills, Kings County, California.

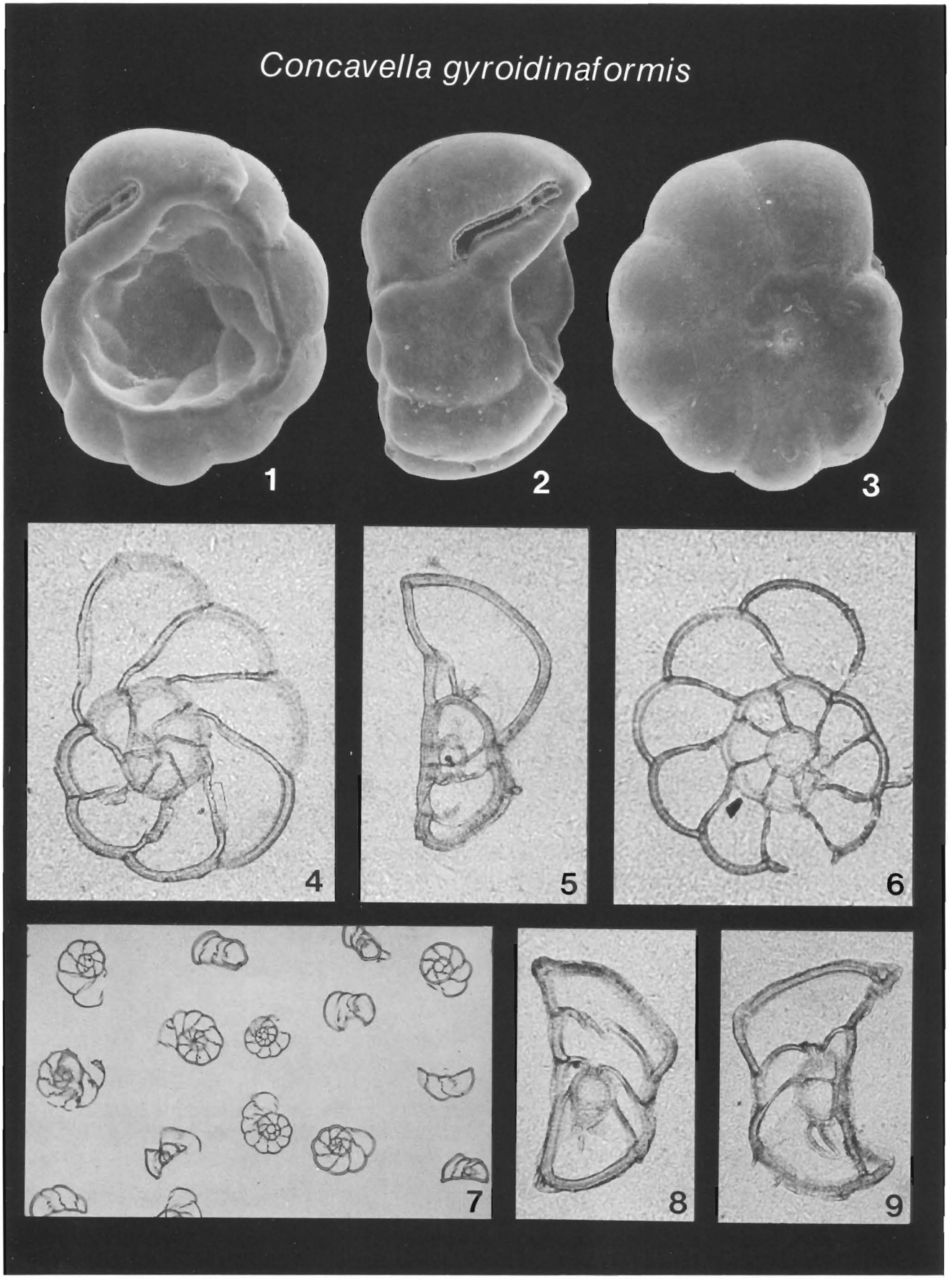
Taxonomic Remarks: Agrees with holotype (USNM24290), although all primary types (USNM) are small (immature) specimens. *C. bandyi* Arnal (1984) is distinguished by its scalloped edges, but this appears to be no more than an ecophenotypic variation.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Luisian to late Mohnian.
Regional Literature: Relizian to Mohnian (AR76, AR84, KL80, LI65, PM81, SM60).
This Study: Relizian to Mohnian. (SCI, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980); oxygen-minimum zone indicator (Blake, 1981).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-39, Mohnian, Monterey Formation, Upper Newport Bay, X141: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-45a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 13: 4-6 = X160; 7 = X32; 8, 9 = X160.


Concavella gyroidinaformis
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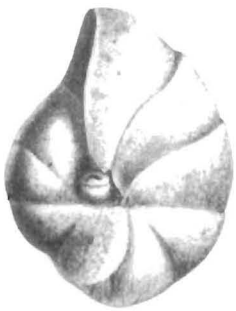
Cyclammina incisa (Stache)



1

Type Designation and Reference: *Haplophragmium incisum* Stache, 1864, *Novara* Exped., Geol. Theil, v. 1, pt. 2, p. 165.

Type Figure: *Ibid.*, pl. 21, fig. 1, X20.

Type Level and Locality: Upper Tertiary, New Zealand.

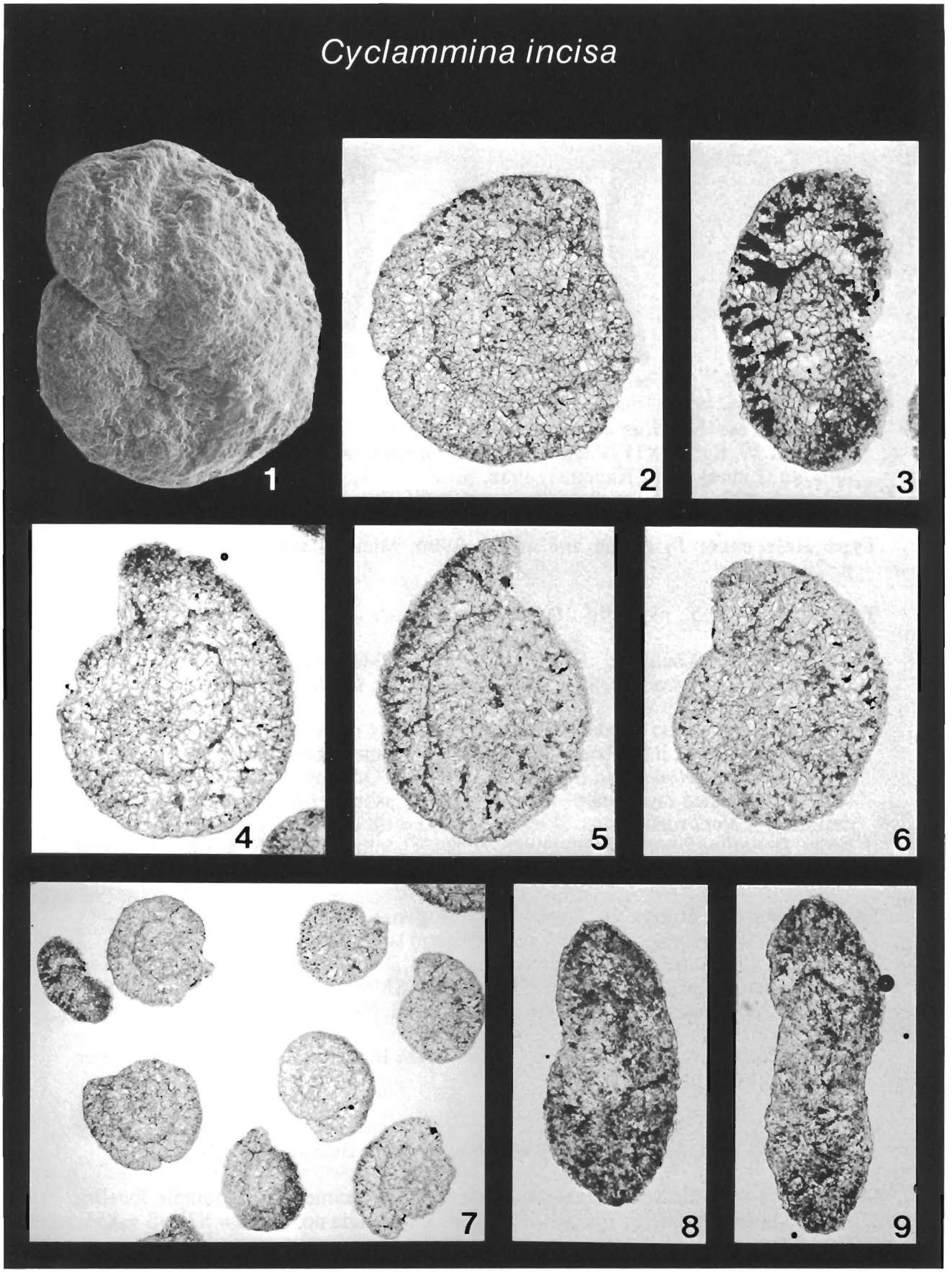
Taxonomic Remarks: The type-figure of this species does not resemble the specimen illustrated here, which is very worn. It was thin-sectioned as an example of an internally complex agglutinated species. Unfortunately, the thin-section slide reveals that infillings of secondary calcite mask the internal structure of these specimens. Identification of the California specimens based on comparison with the type-figure is inconclusive; the nomen is adopted here in accordance with prior regional usage.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Zemorrian to early Saucesian.
Regional Literature: Zemorrian to Mohnian (CL31, TI73).
This Study: Zemorrian to Mohnian. (CM)

Paleoenvironmental Significance: Upper depth limit = lower middle bathyal (Ingle, 1980, table 2).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality FJP-9, Saucesian, Monterey Formation, Caliente Mountain, side view, X73.

Plate-figs. 2-9: Thin-section photomicrographs of specimens from sample locality FJP-9, Saucesian, Monterey Formation, Caliente Mountain, slide no. 98: 2 = X51; 3 = X64; 4 = X40; 5, 6 = X51; 7 = X20; 8, 9 = X64.


Cyclammina incisa
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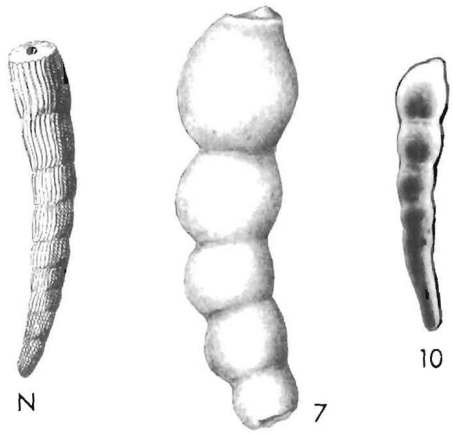
Dentalina pseudoobliqua Finger and Lipps



Above Figures: *Nautilus obliquus* Linné, 1758, type figure, *in* Gualtieri, Testac., v. 19, pl. 19, fig. N, X11 (Recent, probably Adriatic or Mediterranean); *Dentalina obliqua* (Linné) *sensu* Kleinpell, 1938, pl. 11, fig. 7, X40; 10, *D. pseudoobliqua*, holotype, X22.

Type Reference: *In* Finger and others, 1990, Micropaleontology, v. 36, no. 2, p. 26.

Type Figure: *Ibid.*, pl. 1, fig. 10 (shown above).

Type Level and Locality: Relizian, Sandholdt Member, Monterey Formation, Graves Creek, Atascadero, San Luis Obispo County, California.

Taxonomic Remarks: Although this species bears no resemblance to the costate *D. obliqua* (Linné), it has been referred to this binomen often. The junior homonym of *D. obliqua* [= *Nodosaria* (*Dentaline*) *obliqua* d'Orbigny, 1826] has very oblique sutures. A related morphotype is *N. subsoluta* Cushman (1923), but that species is definitely a *Nodosaria* which is more lobulate with chambers longer than they are wide. *Dentalina pseudoobliqua* typically has a nonlobulate early segment followed by a series of subspherical chambers.

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *D. obliqua*: Late Relizian to late Luisian.
Regional Literature (includes *D. obliqua* and *D. pseudoobliqua*): Saucesian to Mohnian (BE86, CB86, FI90, PM81, SB86, SM60).
This Study: Saucesian to Mohnian. (GC, IC, LH, NA, SCI, UNB)

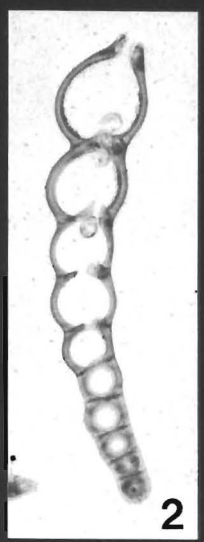
Paleoenvironmental Significance: Upper depth limit for *Dentalina* spp. = upper middle bathyal (Ingle, 1985).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40660-14, Luisian, Monterey Formation, Naples Beach: side view, X80.

Plate-figs. 2-4: Thin-section photomicrographs of specimens from sample locality LH-5, Luisian, Monterey Formation, Laguna Hills, slide no. 23: 2 = X32; 3 = X51; 4 = X20.

Dentalina pseudoobliqua


1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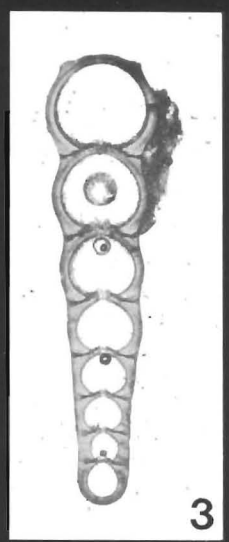
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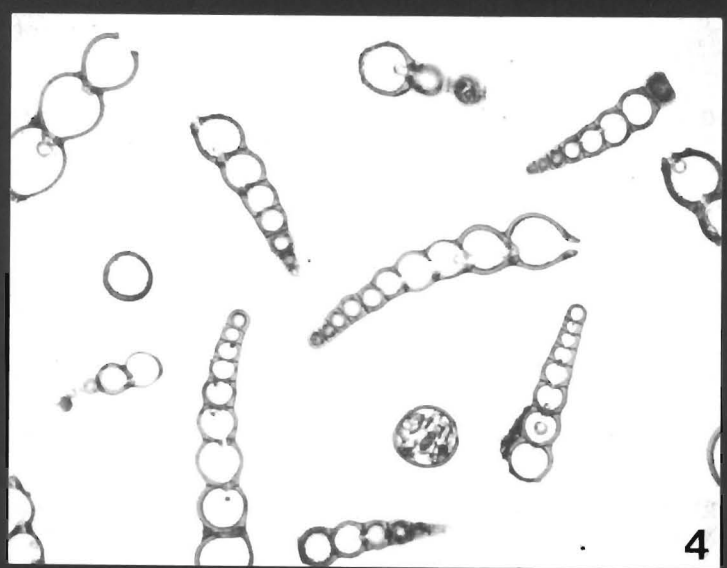
4

Elphidium granti Kleinpell

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11

Type Reference: Kleinpell, 1938, Miocene Stratigraphy of California, p. 238.

Type Figures: *Ibid.*, pl. 19, figs. 1, 11, X125.

Type Level and Locality: Lower Mohnian, Altamira Shale Member, Monterey Formation, Palos Verdes Hills, Los Angeles County, California.

Taxonomic Remarks: Agrees with holotype (USNM497178).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Saucesian to late Relizian, early Mohnian.
Regional Literature: Saucesian to Pliocene (AR76, FI90, HA80, PI56).
This Study: Saucesian to Pliocene. (GC, IC, LH, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = inner shelf (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality MAR-254, Luisian, Monterey Formation, Laguna Hills: side view, X111.

Plate-figs. 2-5: Thin-section photomicrographs of specimens from sample locality UCLA-6317, Luisian, Monterey Formation, San Clemente Island, slide no. 103: 2, 3 = X100; 4 = X25; 5 = X100.

Elphidium granti


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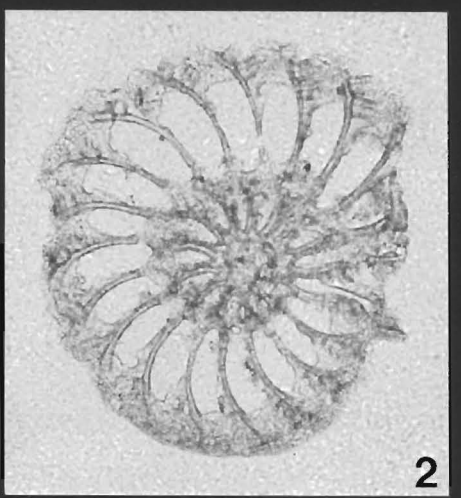
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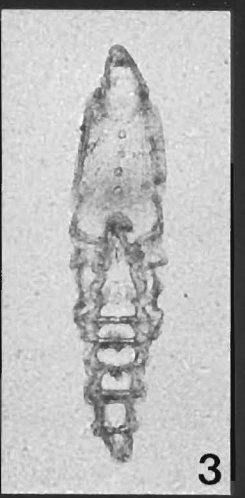
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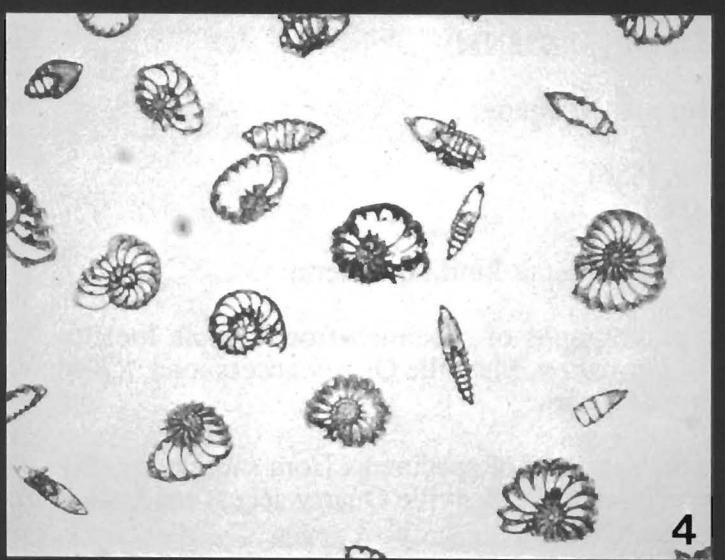
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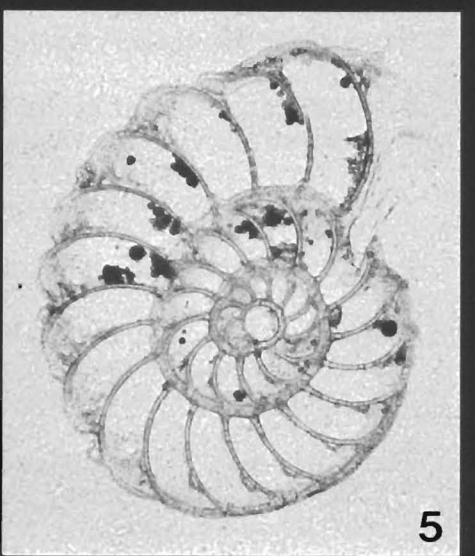
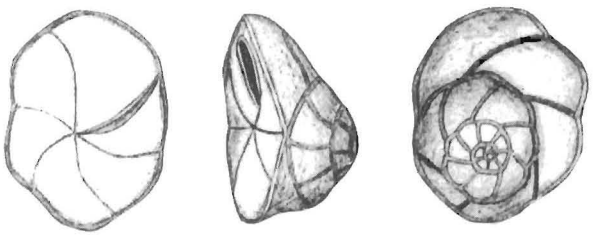

5

Epistominella discorbisoides Pierce



13a 13b 13c

Type Reference: Pierce, 1956, Jour. Paleont., v. 30, no. 6, p. 1304.

Type Figures: *Ibid.*, pl. 139, figs. 13a-c, holotype, X78.

Type Level and Locality: Mohnian, Modelo Formation, Benedict Canyon, Los Angeles County, California.

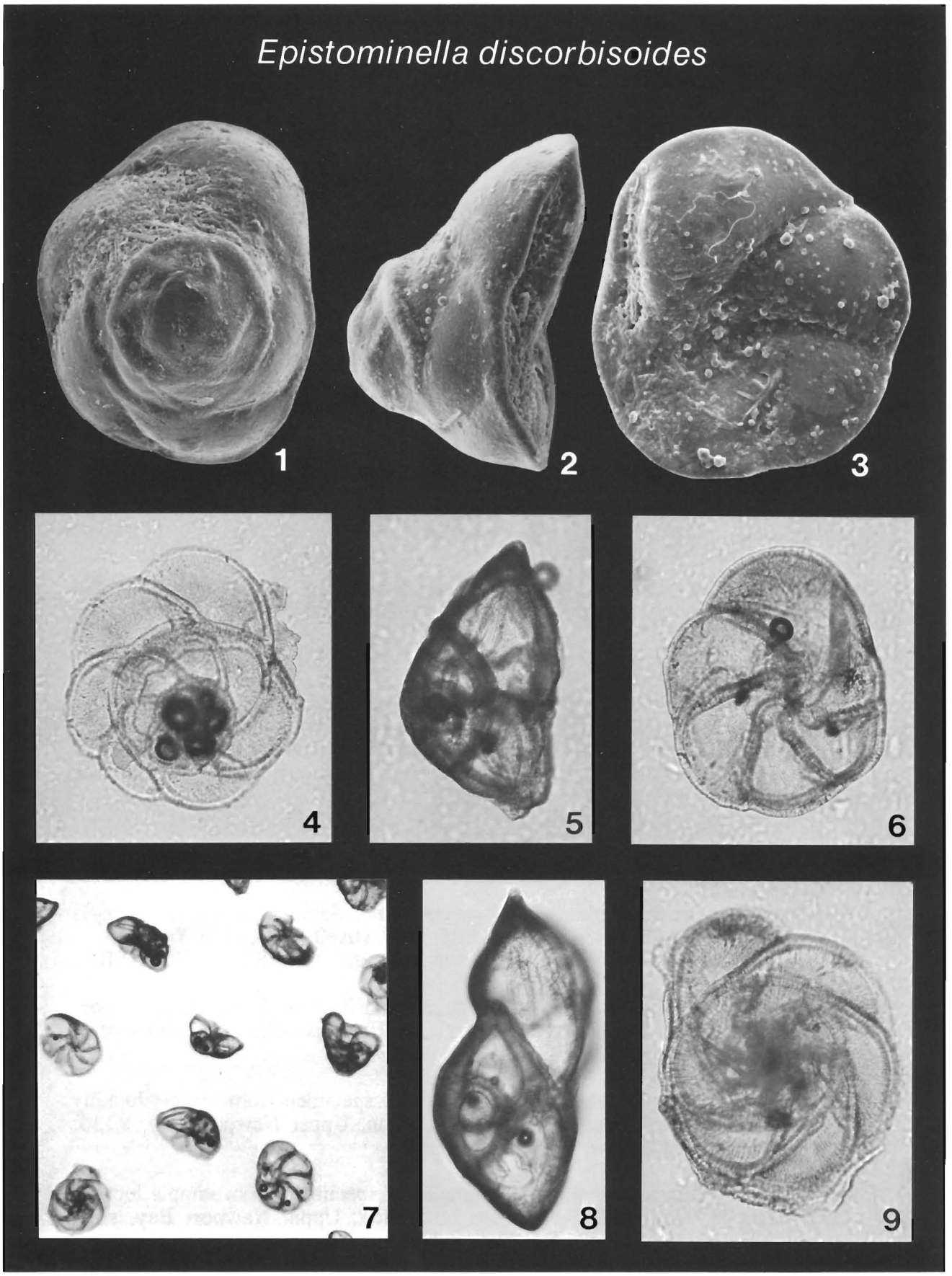
Taxonomic Remarks: Agrees with holotype (USNM).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Regional Literature: Mohnian (LI65, PI56).
This Study: Mohnian. (MQ, NA, TC)

Paleoenvironmental Significance: Upper depth limit not determined.

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC42107-11, Mohnian, Monterey Formation, Manville Quarry access road, X201: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC42107-11, Mohnian, Monterey Formation, Manville Quarry access road, slide no. 110: 4-6 = X200; 7 = X51; 8, 9 = X200.


Epistominella discorbisoides
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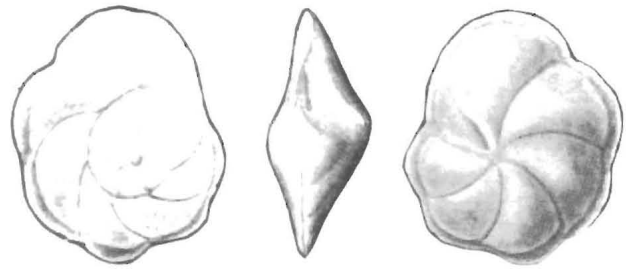
Epistominella smithi (R. E. and K. C. Stewart)



4a 4c 4b

Type Designation and Reference: *Pulvinulinella smithi* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 70.

Type Figures: *Ibid.*, pl. 9, figs. 4a-c, X85.

Type Level and Locality: Upper Pliocene*, upper Pico Formation, Dent Mud Plant, Ventura County, California. [*Cited by authors as lower Pliocene).

Taxonomic Remarks: Agrees with holotype (USNM12545). This species has often been referred to *E. pacifica* (= *Pulvinulinella pacifica* Cushman, 1927, Recent, Pacific; USNM20301), which is more planoconvex and has a round nonlobulate periphery and narrow keel; the two morphotypes may intergrade, however. *E. pseudosmithi* Arnal (1984) is similar to *E. smithi* in planoconvexity, but it has a much narrower keel and a more rounded periphery; it is probably the immature form of *E. smithi*.

Biostratigraphic Range in California Neogene:

Kleinpell (1938) for *Pulvinulinella pacifica*: Early Relizian to early Delmontian, late Delmontian(?).

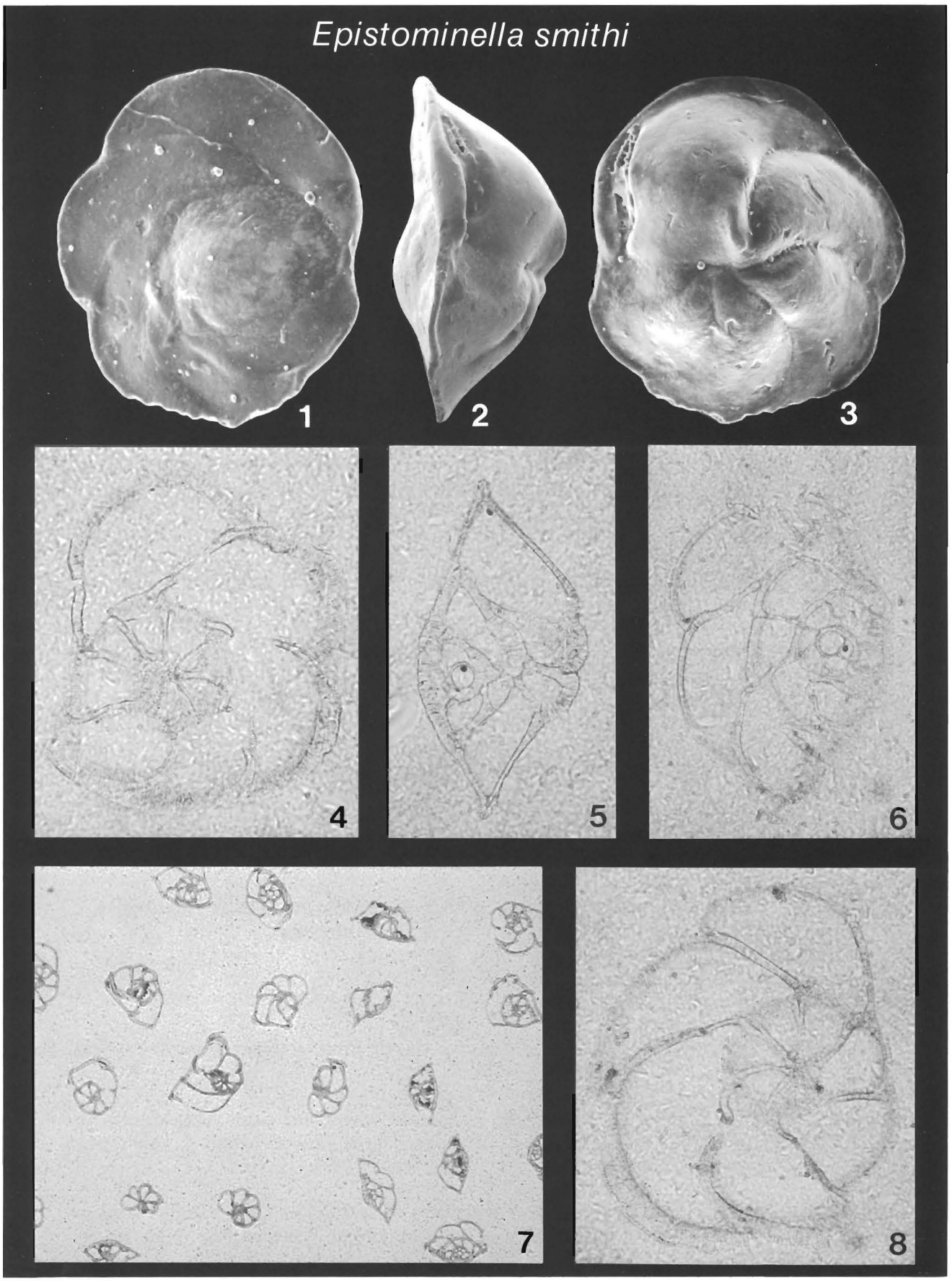
Regional Literature for *E. smithi and E. pseudosmithi*: Saucesian to Pliocene, ranges to Holocene (AR76, AR84, BE86, CB86, FI90, HA80, LI65, PI56, WH56).

This Study: Saucesian to Pliocene, ranges to Holocene. (GC, IC, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit of *E. pacifica* = upper bathyal/upper middle bathyal transition (Ingle, 1980); *E. pacifica* is referred to as an oxygen-minimum zone indicator (Blake, 1981).

Plate-figs. 1-3: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, X136: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 85: 4-6 = X200; 7 = X40; 8 = X200.


Epistominella smithi
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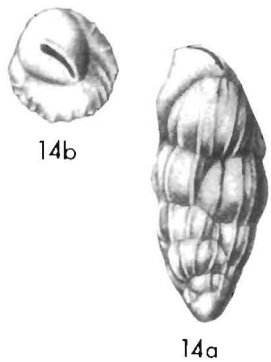
Galliherina uvigerinaformis (Cushman and Kleinpell)



Type Designation and Reference: *Bulimina uvigerinaformis* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 5.

Type Figures: *Ibid.*, pl. 1, figs. 14a, b, X35.

Type Level and Locality: Lower Mohnian, Monterey Formation, Naples Beach, Santa Barbara County, California.

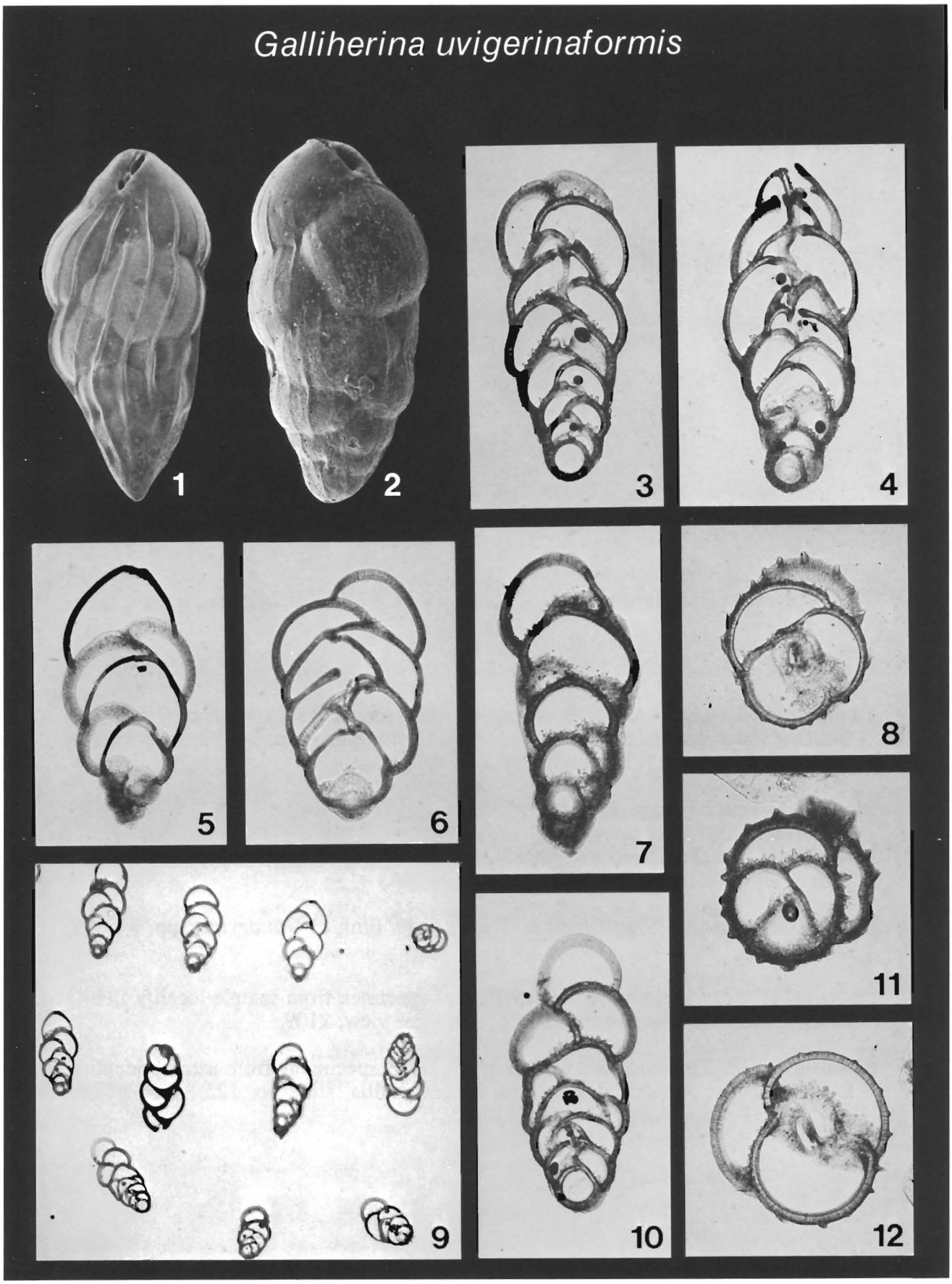
Taxonomic Remarks: Recovered specimens include topotypes from Naples Beach and agree with holotype (USNM20124). Plate-figure 2 is of a topotype specimen of the form referred to *G. uvigerinaformis doanei* Kleinpell and Tipton (1980); neither this variety, nor that referred to *G. uvigerinaformis warreni* Kleinpell and Tipton (1980), warrant the rank of subspecies, as both appear to be ecophenotypic gradations of the species. *G. delreyensis* (Cushman and Galliher, 1934) may also be synonymous.

Biostratigraphic Range in California:
Kleinpell (1938): Early Mohnian.
Kleinpell (1980): Early to late Mohnian.
Kleinpell (1980) for *G. uvigerinaformis doanei*: Late Mohnian to early Delmontian.
Kleinpell (*ibid.*) for *G. uvigerinaformis warreni*: Late Mohnian.
Kleinpell (1938) for *G. delreyensis*: Early Delmontian.
Regional Literature: Mohnian (AR76, KL80, PI56, SM60).
This Study: Mohnian to "Delmontian". (NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1985).

Plate-figs. 1, 2: Scanning electron micrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay: 1, side view, X82; 2, side view, X66.

Plate-figs. 3-12: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 2: 3-8 = X80; 9 = X20; 10 = X64; 11, 12 = X80.


Galliherina uvigerinaformis
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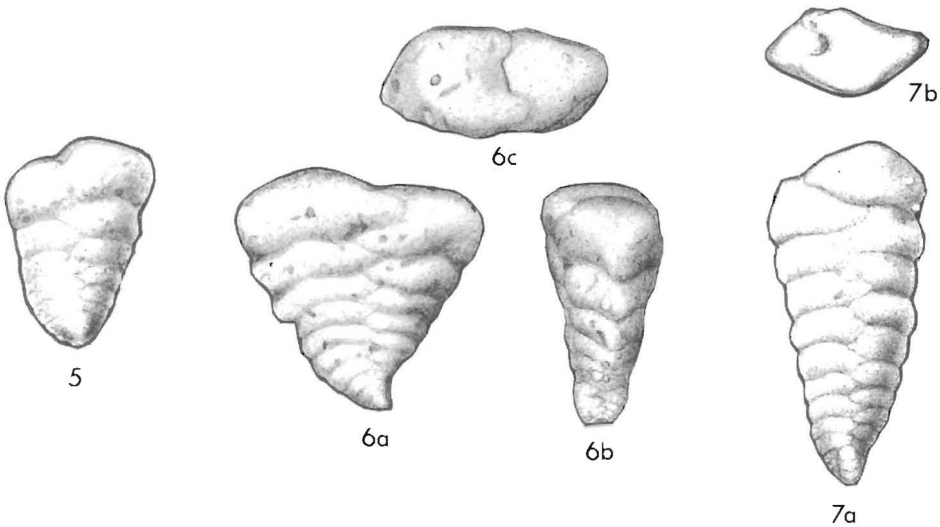
Gaudryina subglabrata Cushman and McCulloch



Type Reference: Cushman and McCulloch, 1939, Allan Hancock Pac. Exped., v. 6, no. 1, p. 92.

Type Figures: *Ibid.*, pl. 8, figs. 5-7b: 5, X50; 6a-c, holotype, X50; 7, X40.

Taxonomic Remarks: Although Kleinpell (1938) recorded six species of *Gaudryina* from the lower Saucesian, none resemble this form. The genus has been reported in the regional literature from the Zemorrian to the Mohnian.

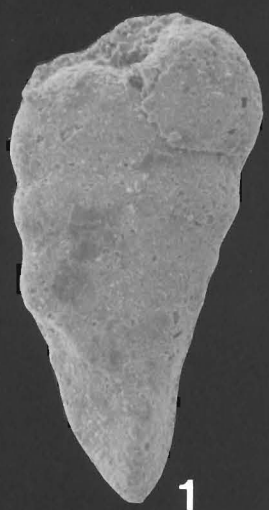
Biostratigraphic Range in California:
Kleinpell (1938): Not recognized.
Regional Literature: Holocene (CB86).
This Study: Saucesian to Holocene. (IC, LH, NA)

Paleoenvironmental Significance: Upper depth limit of *Gaudryina* spp. = outer shelf (Ingle, 1985).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality LH-4, Luisian, Monterey Formation, Laguna Hills: side view, X109.

Plate-figs. 2-6: Thin-section photomicrographs of specimens from sample locality LH-4, Luisian, Monterey Formation, Laguna Hills, slide no. 125: 2 = X128; 3 = X100; 4 = X32; 5 = X128; 6 = X160.

Gaudryina subglabrata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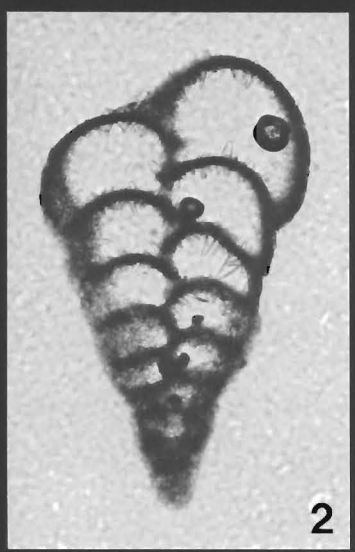
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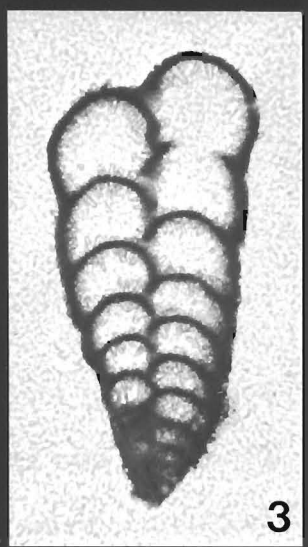
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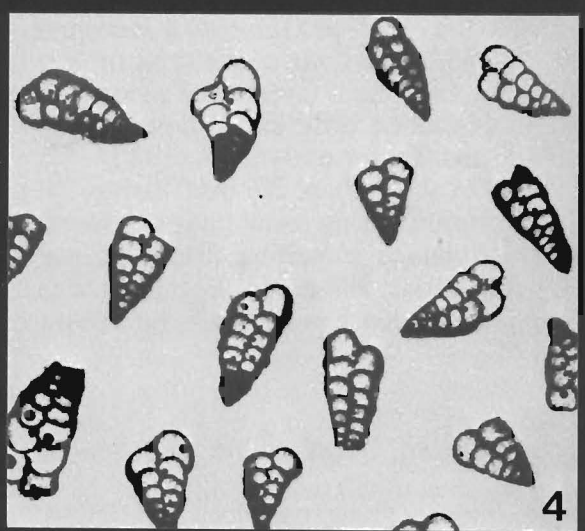
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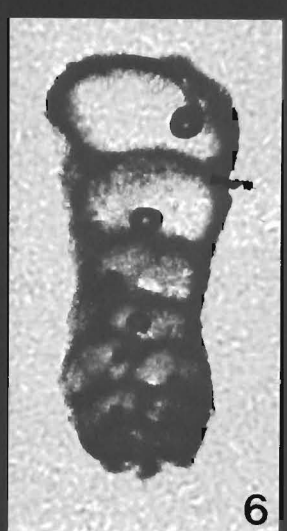
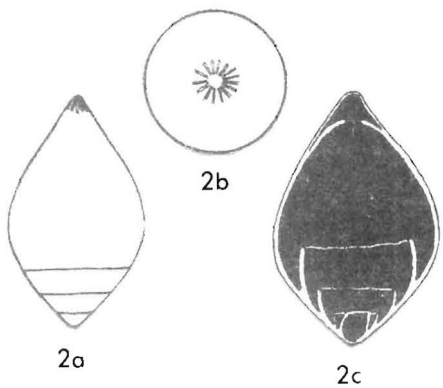

6

Glandulina cf. *G. simulans* Silvestri



Type Designation and Reference: *Glandulina simulans* Silvestri, 1903, R. Accad. Sci. Torino, Atti, v. 38 (1902-03), p. 211.

Type Figures: *Ibid.*, pl.-figs. 2a-c, magnification not indicated.

Type Level and Locality: Tertiary, Italy.

Taxonomic Remarks: Silvestri's type-figures are of a form devoid of an apical spine, but with an overall shape and internal structure similar to the California species. The California species is often referred to the genotype *Glandulina laevigata* [= *Nodosaria* (*Glanduline*) *laevigata* d'Orbigny, 1826], but one of the type-figures for that species is a lateral cross section displaying an internal layering of successive chamber walls; the internal test structure is described differently, however, in Cushman (1948), Loeblich and Tappan (1964), and Taylor and others (1985). Of possible significance is the observation by Taylor et al. (*ibid.*, p. 20) that "internally, the distal wall of earlier chambers undergoes resorption during some stage of growth or at the time of reproduction". Because *G. simulans* is neither discussed nor synonymized in any of these forementioned publications, and the California species can be readily distinguished by its apical spine, both are considered here to be distinct species from *G. laevigata*.

Biostratigraphic Range in California:

Kleinpell (1938) for *G. laevigata*: Early Zemorrian, questionable occurrences thereafter to late Delmontian.

Regional Literature for *G. laevigata*: Luisian to Pliocene, ranges to Holocene (BE86, CB86, CS30, MA52, WH56).

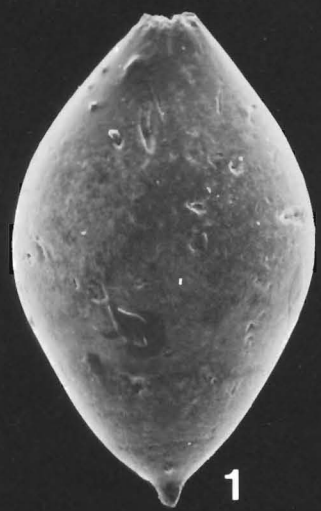
This Study: Zemorrian to Pliocene, ranges to Holocene. (UNB)

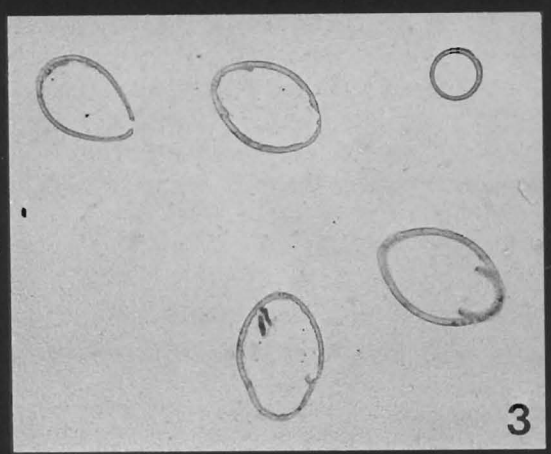
Paleoenvironmental Significance: Upper depth limit of *G. laevigata* = upper middle bathyal (Ingle, 1980).

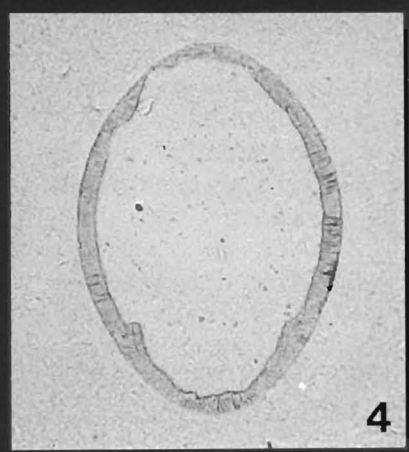
Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Fm., Upper Newport Bay: side view, X78.

Plate-figs. 2-4: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 83: 2 = X128; 3 = X40; 4 = X128.

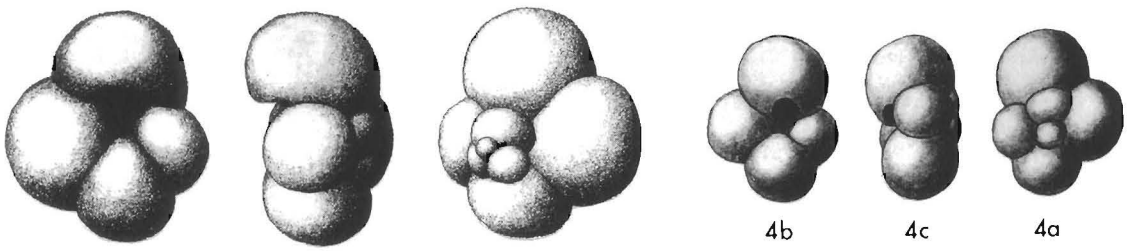
Glandulina cf. *G. simulans*







Globigerina bulloides d'Orbigny



Type Reference: d'Orbigny, 1826, Ann. Sci. Nat., sér. 1, v. 7, p. 277; modèles no. 17 and 76.

Type Figure: Not given. Figures above from Banner and Blow, 1960, pl. 1: 1a-c, lectotype (specimen collected by d'Orbigny from Adriatic), X45; 4a-c, modèle no. 76, half natural size.

Type Level and Locality: Recent, Adriatic Sea, near Rimini, Italy.

Taxonomic Remarks: Agrees with figures of lectotype and d'Orbigny's modèle no. 76 in Banner and Blow (1960) and with Kleinpell's hypotype (LSJU839). Lipps (1964, p. 116-117) splits the California Miocene plexus into *G. bulloides*, *G. quadrilatera* Galloway and Wissler, and *G. dubia* Egger, noting that they all may be variants of a single species. Kennett and Srinivasan (1983, p. 36) consider *G. quadrilatera* as a phenotypic variant of *G. bulloides*. In the present study, specimens with four chambers in their outer whorl are assigned to *G. bulloides*, while those with four and a half to five chambers are assigned to *G. pseudociperoensis* Blow. Early Neogene populations tend to be transitional between *G. praebulloides* Blow and *G. bulloides*.

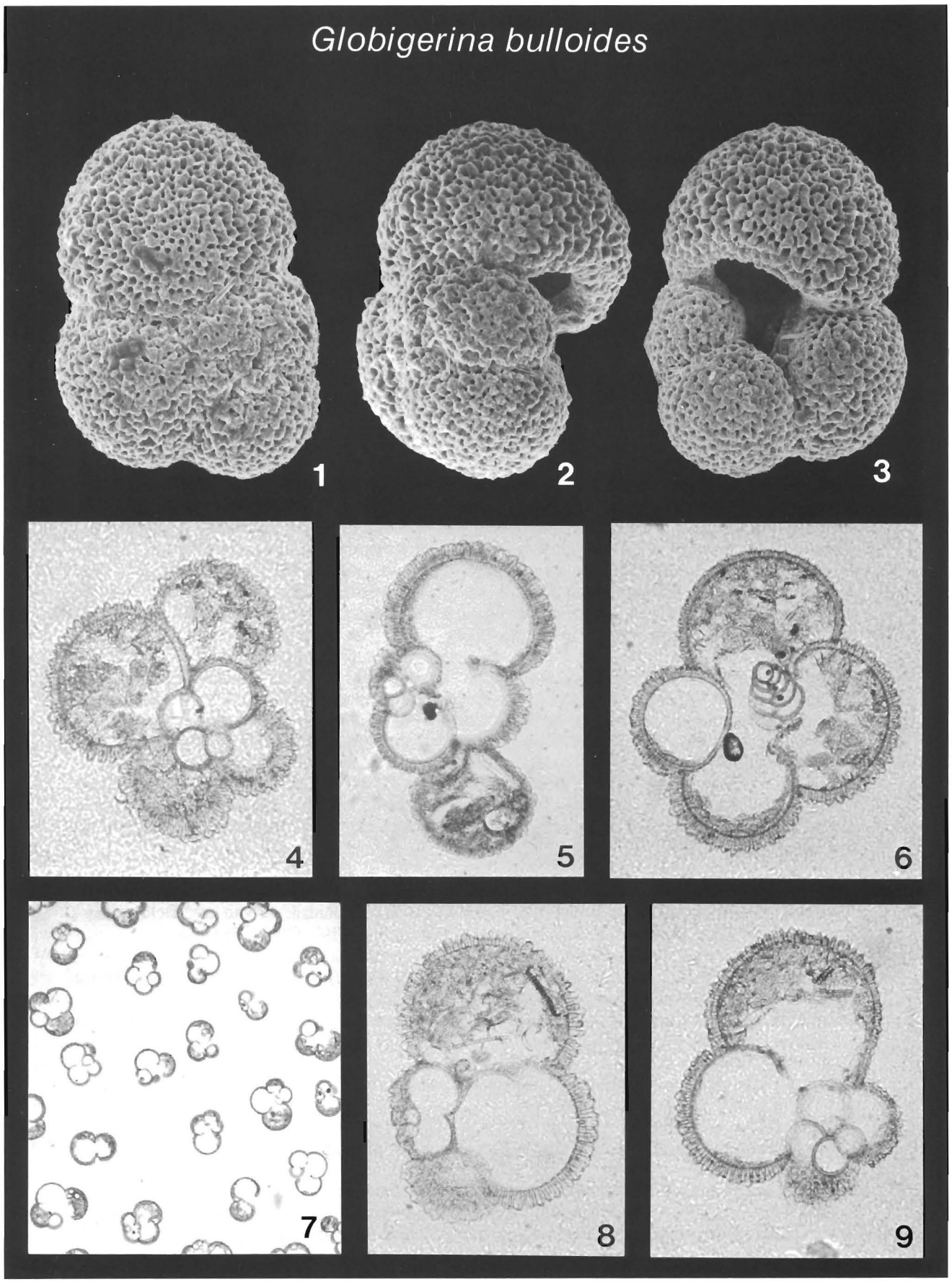
Biostratigraphic Range:

Kleinpell (1938): Early Zemorrian to early Delmontian, late Delmontian(?).
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (BE86, CG46, FI90, GW27, PM81, SM60, TI73).
Ingle (1973; DSDP Site 173): Zones N9 to N23.
Poore (1981; DSDP Sites 467-469): Zones 9/10 to N23.
Kennett and Srinivasan (1983, p. 36): Zones N9 to N23.
This Study for *G. bulloides* plexus: Zemorrian to Pliocene (Zones P17? to N21), ranges to Holocene (Zone N23). (GC, IC, LH, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Distributed in temperate waters, declines towards tropics (Kennett and Srinivasan, 1983, p. 36).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-3, Mohnian, Monterey Formation, Upper Newport Bay, X177: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 61: 4-6 = X160; 7 = X25; 8, 9 = X160.


Globigerina bulloides
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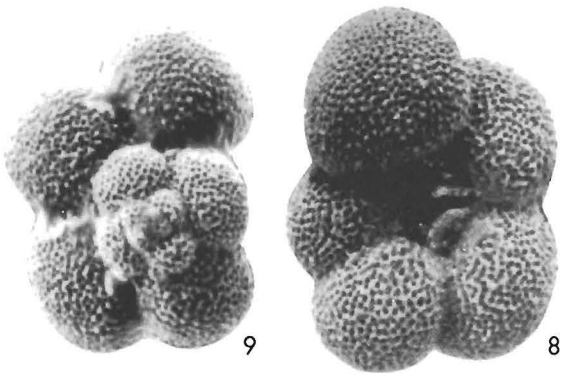
Globigerina pseudociperoensis Blow



Type Designation and Reference: *Globigerina praebulloides pseudociperoensis* Blow *in* Brönnimann and Renz (eds.), 1969, Proc. First Int. Conf. Plankt. Microfossils, v. 1, p. 381, 382.

Type Figures: *Ibid.*, pl. 17, figs. 8, 9, holotype, X120 and X112 respectively.

Type Level and Locality: Middle Miocene, Zone N11, lower Palembang Fm., Central Sumatra.

Taxonomic Remarks: This planktic species has been referred to by several names in the regional literature. The problematic plexus consists of four species described as biostratigraphically distinct: *G. ciperoensis* (Oligocene), *G. pseudociperoensis* (early and middle Miocene), *G. concinna* (late Miocene), and *G. umbilicata* (Pliocene). *G. pseudociperoensis* differs morphologically from *G. ciperoensis* by its less closely appressed chambers, wider aperture, more rapidly opening and higher spire, and four (vs. five) chambers in its penultimate whorl. The chambers of *G. concinna* increase more rapidly than these other two species. *G. umbilicata* is distinguished from the others by its larger size, more open umbilicus, and flatter spire. Poore (1981) identifies *G. pseudociperoensis* in the lower Miocene and *G. umbilicata* Orr and Zaitzeff in the Pliocene of his DSDP material, but his figured specimens look similar and he did not record any of these or related morphotypes in the intermediate interval. The species differences are indistinct in the morphologically variable and biostratigraphically intermediate populations characteristic of the California Neogene, but the *G. pseudociperoensis* morphotype is most typical. Lipps (1964, p. 116-117) splits the California Miocene plexus into *G. bulloides* d'Orbigny, *G. quadrilatera* Galloway and Wissler, and *G. dubia* Egger, noting that they all may be variants of a single species - his *G. dubia* is the same form as that figured here.

Biostratigraphic Range:

Kleinpell (1938): *G. dubia*: Late Relizian; *G. quadrilatera*: Late Mohnian, early to late? Delmontian.

Regional Literature: Saucesian to Pliocene, ranges to Holocene (FI90, GW27, PM81).

Kennett and Srinivasan (1983): No entries for *G. pseudociperoensis* and *G. dubia*.

Ingle (1973; DSDP Site 173): *G. concinna*: Zones N4 to N17; *G. bulloides quadrilatera*: Zones N9 to N23; *G. bulloides umbilicata*: Zones N15 to N22.

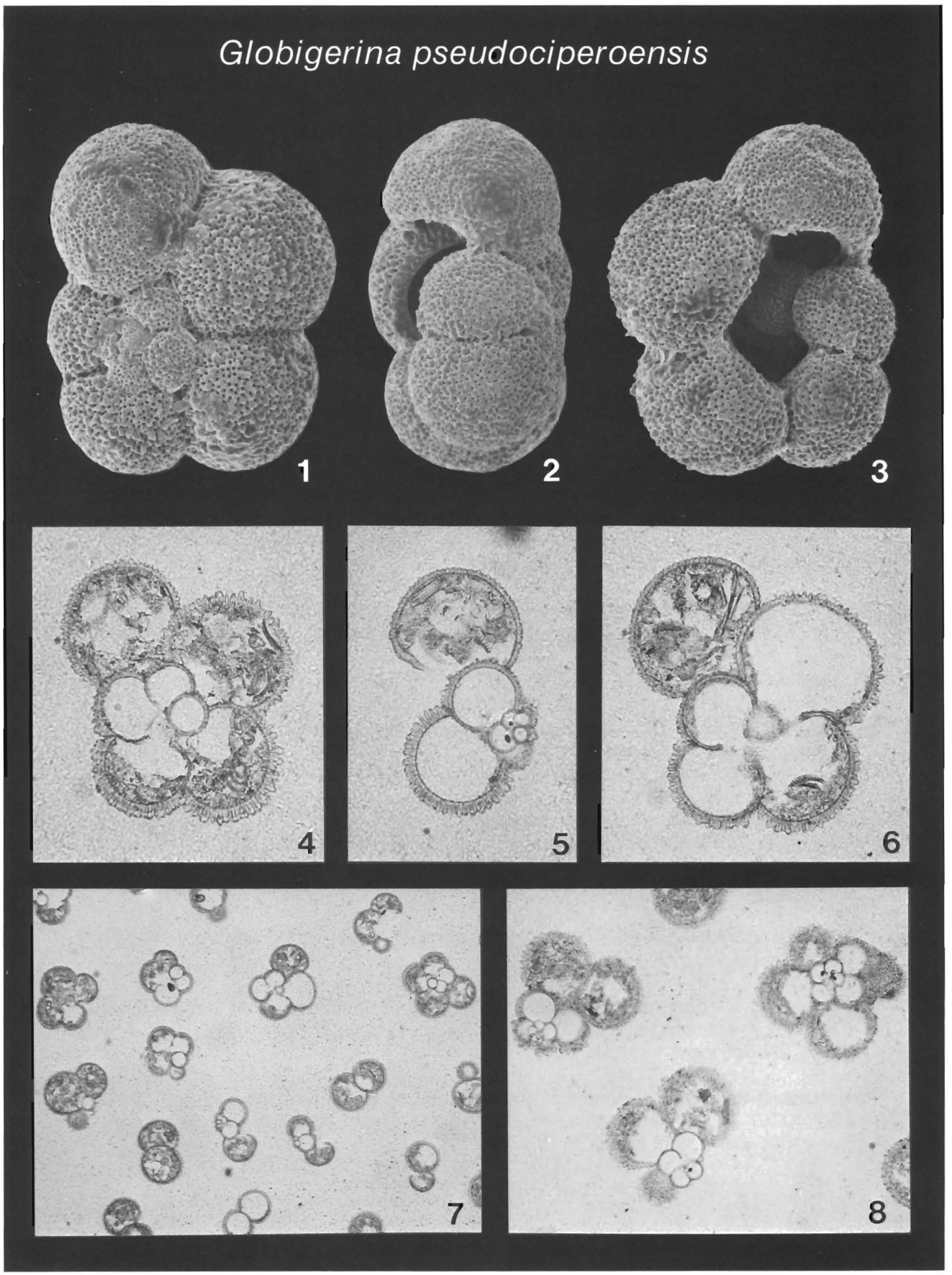
Poore (1981): *G. pseudociperoensis*, DSDP Site 468: indeterminate interval from Zone N9/N10 to indeterminate interval between Zones N14 and N19. *G. umbilicata*, DSDP Sites 468 & 469: Zones N19 to N23.

This Study (for plexus): Saucesian to Pliocene (Zones N6 to N21), ranges to Holocene (Zone N23). (GC, IC, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Distributed in tropical to temperate waters.

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-34, Luisian, Monterey Fm., U. Newport Bay, X130: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality CRC40267-50a, Mohnian, Monterey Fm., Upper Newport Bay, slide no. 56: 4-6 = X128; 7 = X32; 8 = X80.


Globigerina pseudociperoensis
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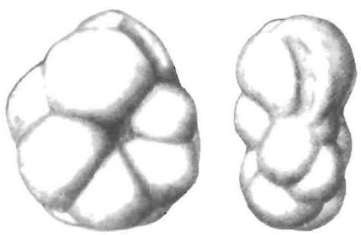
Globocassidulina monicana (Cushman and Kleinpell)



4a 4b

Type Designation and Reference: *Cassidulina monicana* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 16.

Type Figures: *Ibid.*, pl. 3, figs. 4a, b, X60.

Type Level and Locality: Lowest Mohnian, road from Girard to Mohn Spring, Santa Monica Mountains, Los Angeles County, California.

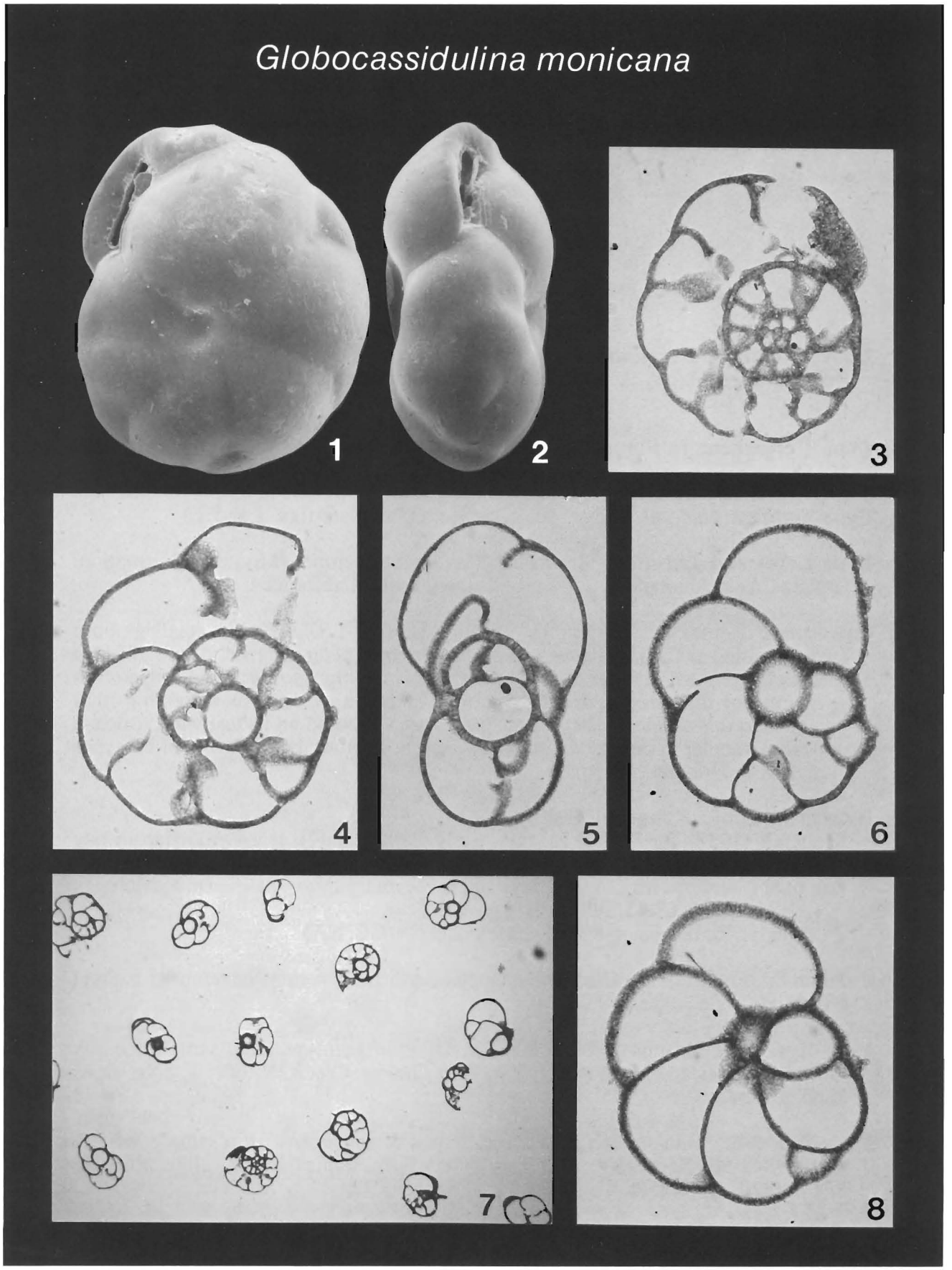
Taxonomic Remarks: The holotype (USNM20151) is an aberrant form in which the lobulation is exaggerated; such specimens are relatively rare in populations of this species. The specimen illustrated here in plate-figs. 1 and 2 is more typical of the species. Generic assignment is based on its test wall, which is optically granular in polarized light, and aperture type (see Nomura, 1983a).

Biostratigraphic Range in California:
Kleinpell (1938): Early Mohnian.
Regional Literature: Luisian to Mohnian (AR76, AR84, KL80).
This Study: Luisian to Mohnian. (MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = shelf edge/upper bathyal transition (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, X75: 1, side view; 2, edge view.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-38, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 29: 3 = X100; 4-6 = X80; 7 = X20; 8 = X80.


Globocassidulina monicana
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Globocassidulina neomargareta Finger and Lipps

52

Above Figure: *Cassidulina margareta* Karrer, 1877, Austria. K. K. Geol. Reichsanst., Abh., v. 9, pl. 16b, fig. 52, magnification not indicated (Miocene, Austria).

Type Reference: *In* Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 40.

Type Figures: *Ibid.*, pl. 8, figs. 26, 27. (See facing plate-figs. 1 and 2.)

Type Level and Locality: Saucesian, Sandholdt Member, Monterey Formation, Graves Creek, Atascadero, San Luis Obispo County, California.

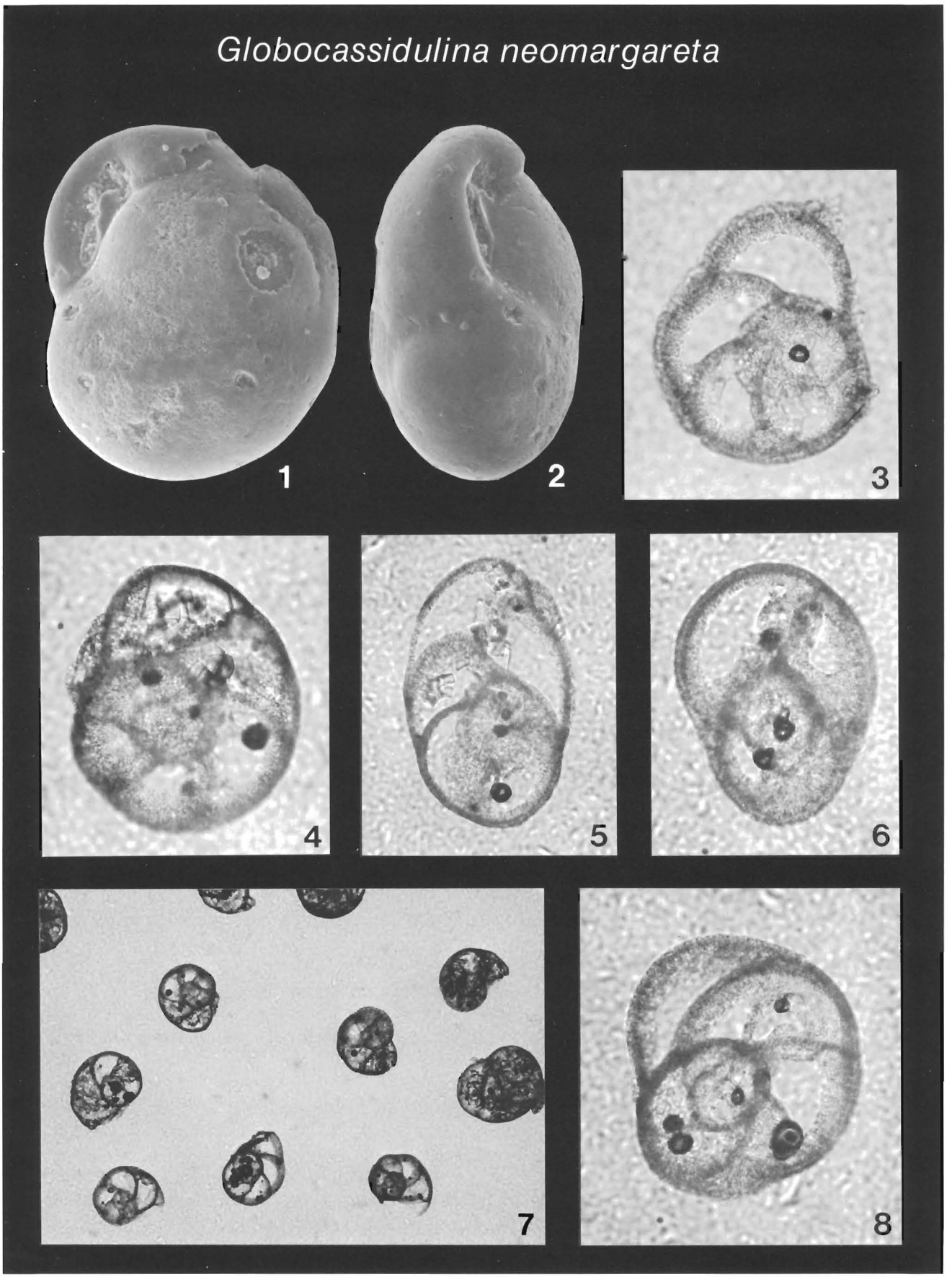
Taxonomic Remarks: Kleinpell's (1938) plesiotype LSJU679 is a small globose form identified as *Cassidulina margareta* (?), a nomen often assigned to the California species. The most distinguishable feature of *G. neomargareta* is the shape of its aperture, but this may have been ignored by some workers in assigning other juveniles to this species. The generic assignment is based on its test wall, which is optically granular in polarized light; however, its aperture is unlike any of the types classified by Nomura (1983a).

Biostratigraphic Range in California:
Kleinpell (1938) for *C. margareta*: Early Zemorrian(?), late Zemorrian to late Relizian.
Regional Literature for *C. margareta* and *G. neomargareta*: Saucesian to Mohnian (AR76, BE86, CL31, FI90, TI73).
This Study: Zemorrian to Relizian, Mohnian(?). (GC, NA)

Paleoenvironmental Significance: Upper depth limit = shelf edge/upper bathyal transition (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of holotype from sample locality GC-13, Saucesian, Monterey Formation, Graves Creek, X266: 1, side view; 2, edge view.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC39842-90, Saucesian, Monterey Formation, Naples Beach, slide no. 126: 3, 4 = X320; 5 = X250; 6 = X320; 7 = X80; 8 = X320.


Globocassidulina neomargareta
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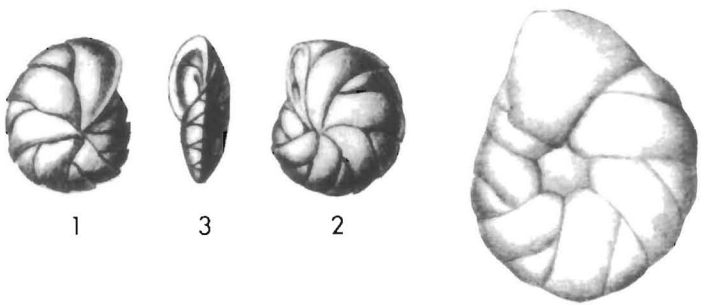
Globocassidulina neopulchella Finger and Lipps



Above Figures: Type figure of *Cassidulina pulchella* d'Orbigny, 1839, pl. 8, figs. 1-3, X64 (Recent, off Peru); and figure of *C. pulchella* d'Orbigny *sensu* Kleinpell, 1938, pl. 11, fig. 9, X40.

Type Reference: *In* Finger and others, Micropaleontology, v. 36, no. 1, p. 40.

Type Figures: *Ibid.*, pl. 8, figs. 22-25. (See facing plate-figs. 1 and 2.)

Type Level and Locality: Relizian, Sandholdt Member, Monterey Formation, Graves Creek, Atascadero, San Luis Obispo County, California.

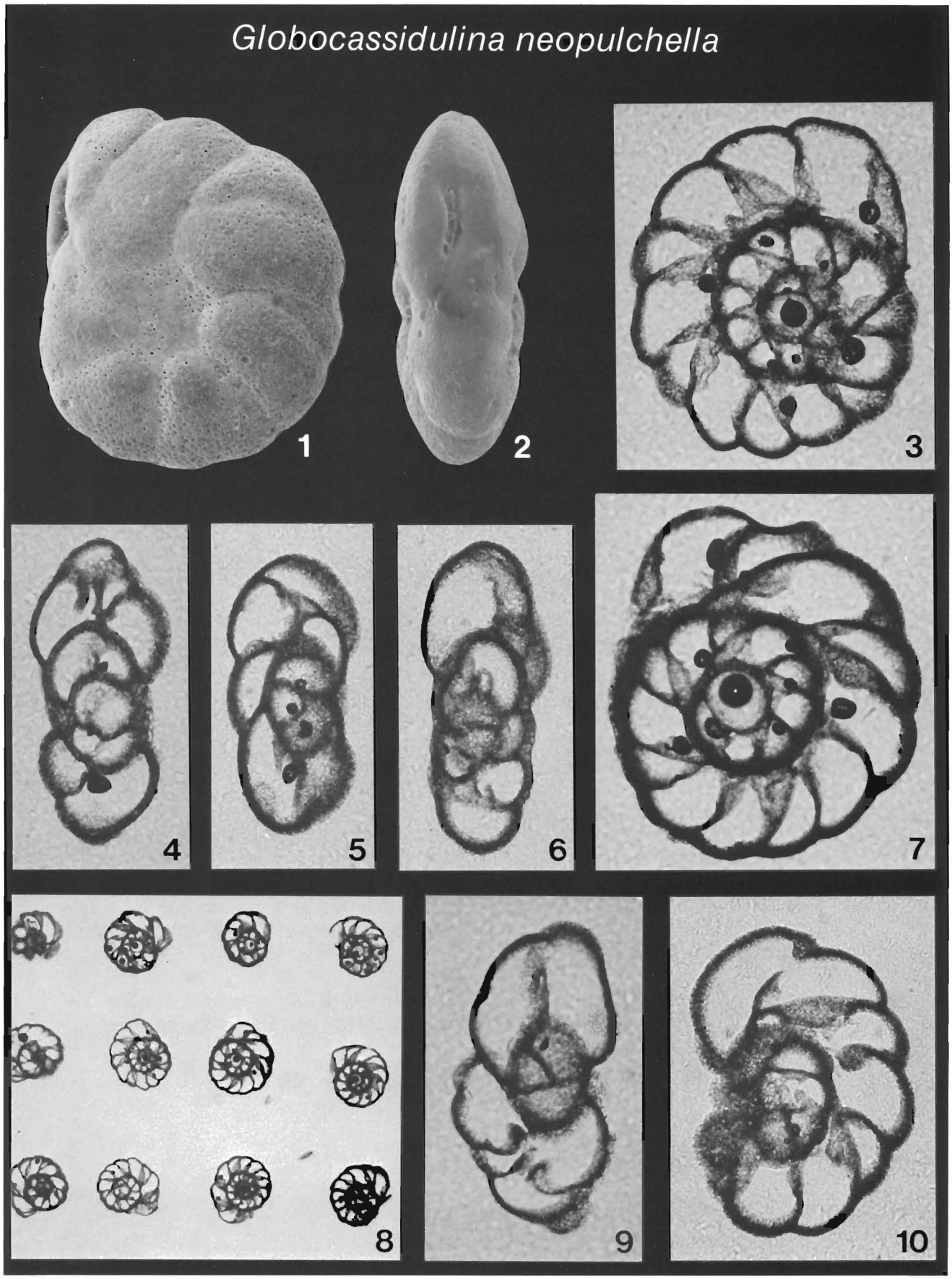
Taxonomic Remarks: A specimen slide of this species in Kleinpell's (LSJU) collection is identified as *Cassidulina panzana* Kleinpell (1938). However, a plesiotype for his 1938 publication refers to the same form as *C. pulchella* d'Orbigny. *G. neopulchella* is distinctly different from both of these species, most notably by its relatively coarsely perforated surface; also, its peripheral edge ranges from subangular to subrounded. Generic assignment is based on its test wall, which is optically granular in polarized light, and aperture type (see Nomura, 1983a).

Biostratigraphic Range in California:
Kleinpell (1938) for *Cassidulina pulchella*: Late Zemorrian(?), early Relizian to early Mohnian.
Regional Literature: Relizian (FI90).
This Study: Relizian; Zemorrian to Mohnian range uncertain. (GC)

Paleoenvironmental Significance: Upper depth limit for *C. pulchella* = upper bathyal (Ingle, 1985).

Plate-figs. 1, 2: Scanning electron micrographs of holotype from sample locality GC-1, Relizian, Monterey Formation, Graves Creek, X174: 1, side view; 2, edge view.

Plate-figs. 3-10: Thin-section photomicrographs of topotypes from sample locality GC-1, Relizian, Monterey Formation, Graves Creek, slide no. 115: 3-7 = X160; 8 = X32; 9, 10 = X160.


Globocassidulina neopulchella
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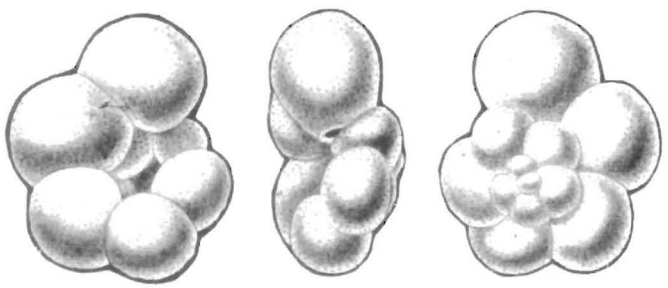
Globorotaloides trema Lipps



3b 3c 3a

Type Reference: Lipps, 1964, Tulane Stud. Geol., v. 2, no. 4, p. 128.

Type Figures: *Ibid.*, pl. 4, figs. 3a-c, holotype, X190.

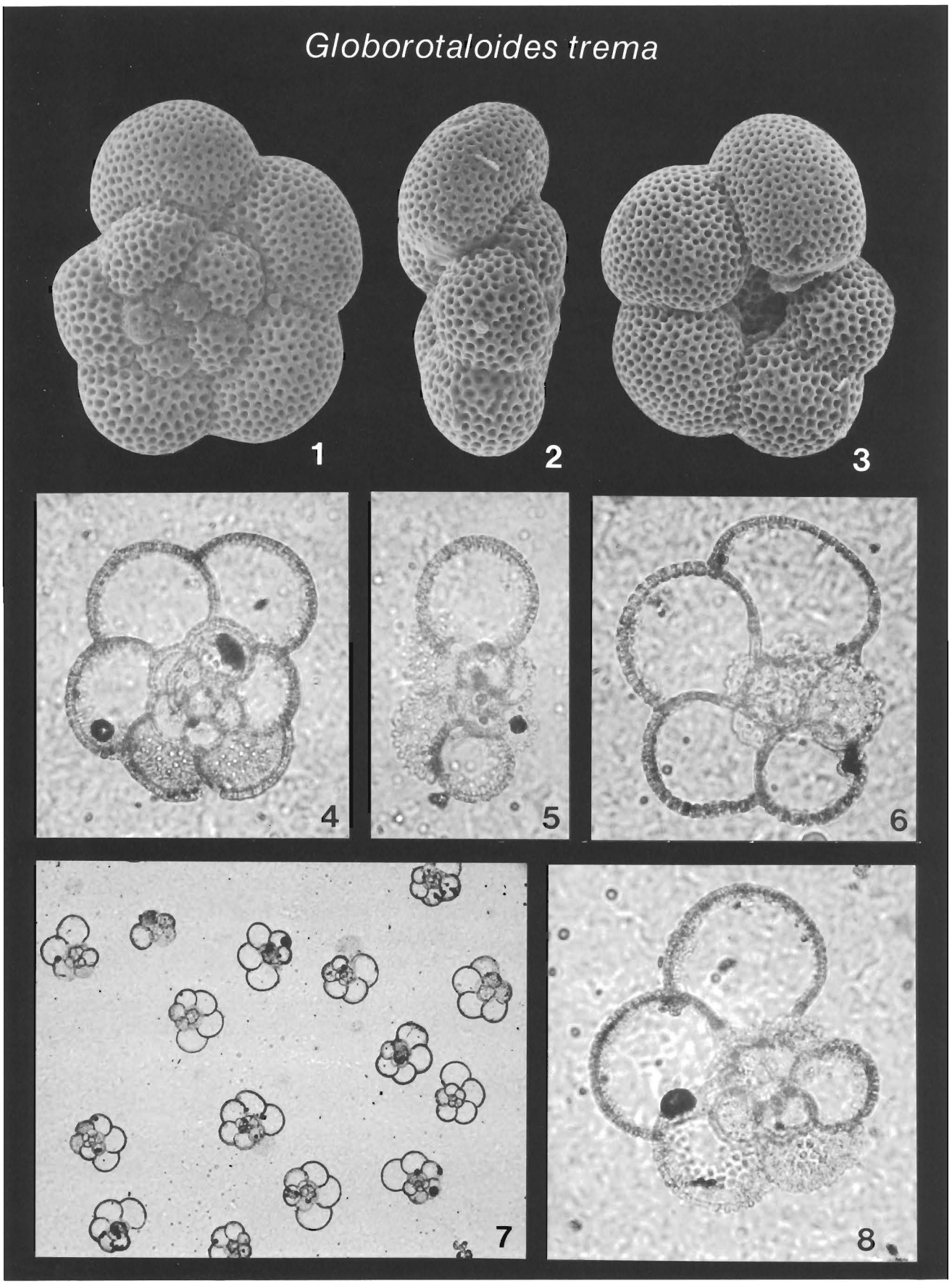
Type Level and Locality: Luisian, Monterey Formation, Upper Newport Bay, Orange County, California.

Taxonomic Remarks: Recovered specimens are topotypes which agree with paratype (USNM).

Biostratigraphic Range:
Kleinpell (1938): Not recognized.
Regional Literature: Luisian to Mohnian (BE86, LI64).
Ingle (1973; DSDP Site 173): Zone N5/6 to N12.
Kennett and Srinivasan (1983): No entry.
This Study: Luisian to Mohnian (Zones N10 to N14); the DSDP range correlates with the Saucesian-Mohnian interval. (MQ, NA, UNB)

Plate-figs. 1-3: Scanning electron micrographs of topotype from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay, X420: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of topotypes from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay, slide no. 95: 4-6 = X400; 7 = X80; 8 = X400.


Globorotaloides trema
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Gyroidina healdi (R. E. and K. C. Stewart)

Type Designation and Reference: *Eponides healdi* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 70.

Type Figures: *Ibid.*, pl. 8, figs. 8a-c, X60.

Type Level and Locality: Lower Pliocene, lower Pico Formation, well in Rincon Oil Field, Ventura County, California.

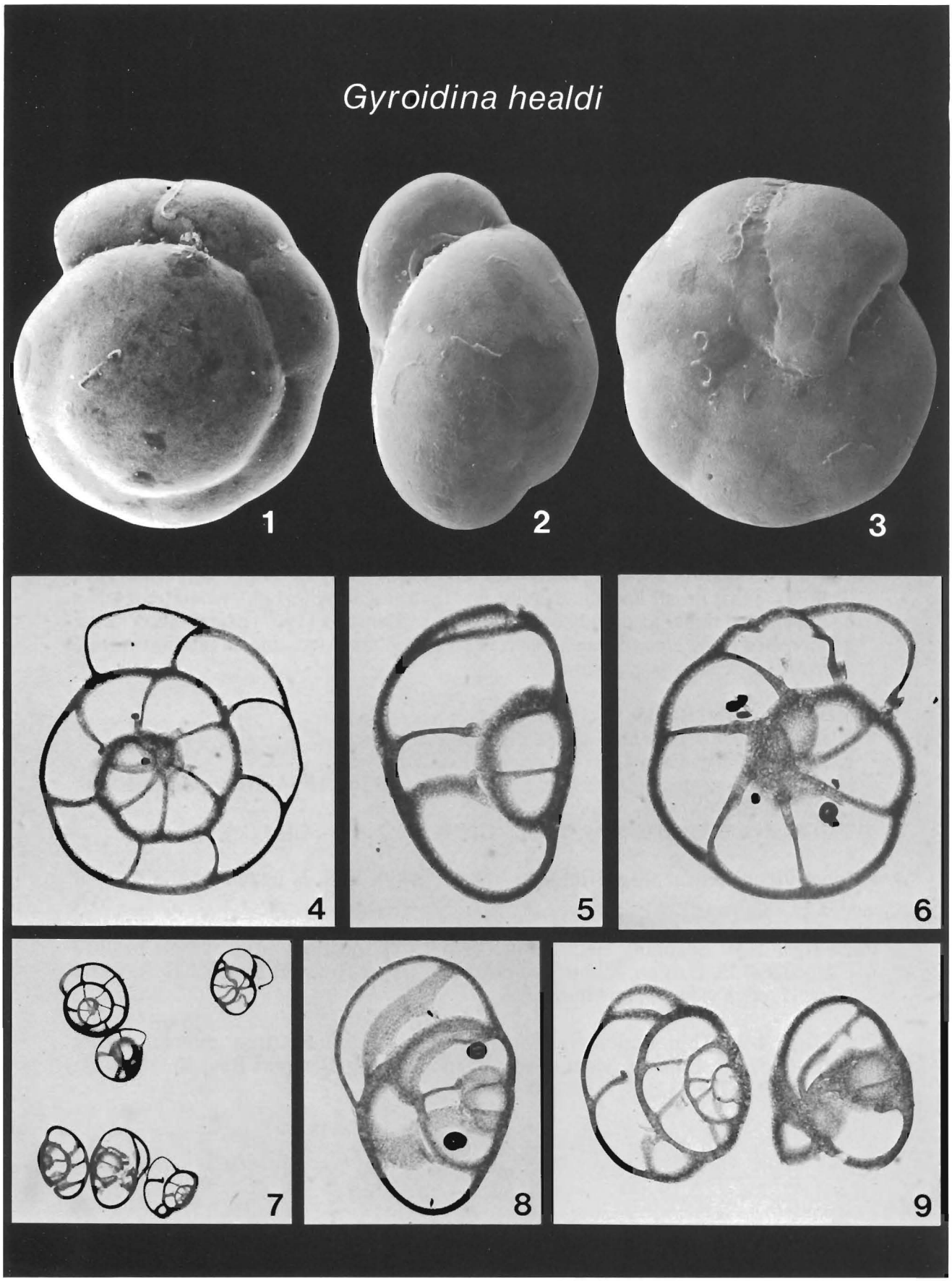
Taxonomic Remarks: Agrees with holotype (USNM12541). Hansen's (1967) examination of the genotype of *Gyroidina* revealed that it has a closed umbilicus and an interiomarginal aperture, as seen in *G. healdi.*

Biostratigraphic Range in California:
Kleinpell (1938): Late Mohnian to early Delmontian.
Kleinpell (1980): Early Mohnian to early Delmontian.
Regional Literature: Zemorrian to Delmontian (BE86, FI90, KL80, PI56).
This Study: Zemorrian to Pliocene. (GC, MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1985).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-39, Mohnian, Monterey Formation, Upper Newport Bay, X140: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 44: 4-6 = X128; 7 = X32; 8 = X128; 9 = X180.


Gyroidina healdi
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Gyroidina rosaformis (Cushman and Kleinpell)

18a 18c 18b

Type Designation and Reference: *Eponides rosaformis* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10; pt. 1, p. 14.

Type Figures: *Ibid.*, pl. 2, figs. 18a-c, X60.

Type Level and Locality: Miocene, Chico-Martinez Creek, Kern County, California.

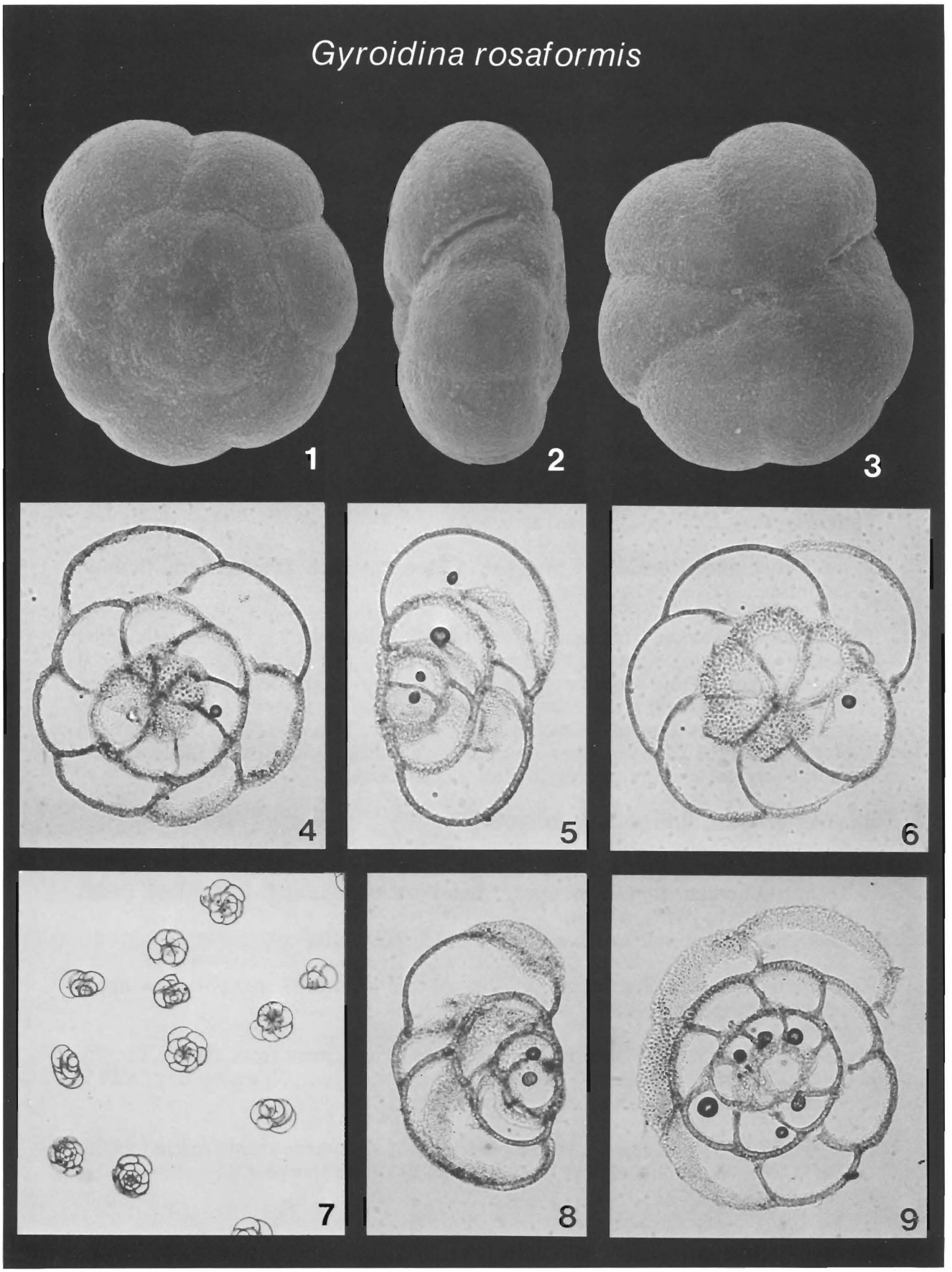
Taxonomic Remarks: Agrees with holotype (USNM20145) and topotypes (USGS). This small species usually has its ultimate whorl characterized by six chambers and radial to slightly oblique sutures. Hansen's (1967) examination of the genotype of *Gyroidina* revealed that it has a closed umbilicus and an interiomarginal aperture, as seen in *G. rosaformis*.

Biostratigraphic Range in California:
Kleinpell (1938): Late Luisian to early Mohnian.
Kleinpell (1980): Early Luisian to early Mohnian.
Regional Literature: Zemorrian to Mohnian (AR76, AR84, BE86, FI90, KL80, PM81, SB86).
This Study: Zemorrian to Mohnian. (GC, IC, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1985).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay, X206: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay, slide no. 27: 4-6 = X200; 7 = X32; 8, 9 = X200.


Gyroidina rosaformis
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Gyroidina cf. *G. rosaformis* (Cushman and Kleinpell)

18a 18c 18b

Type Designation and Reference: *Eponides rosaformis* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 14.

Type Figures: *Ibid.*, pl. 2, figs. 18a-c, X60.

Type Level and Locality: Miocene, Chico-Martinez Creek, Kern County, California.

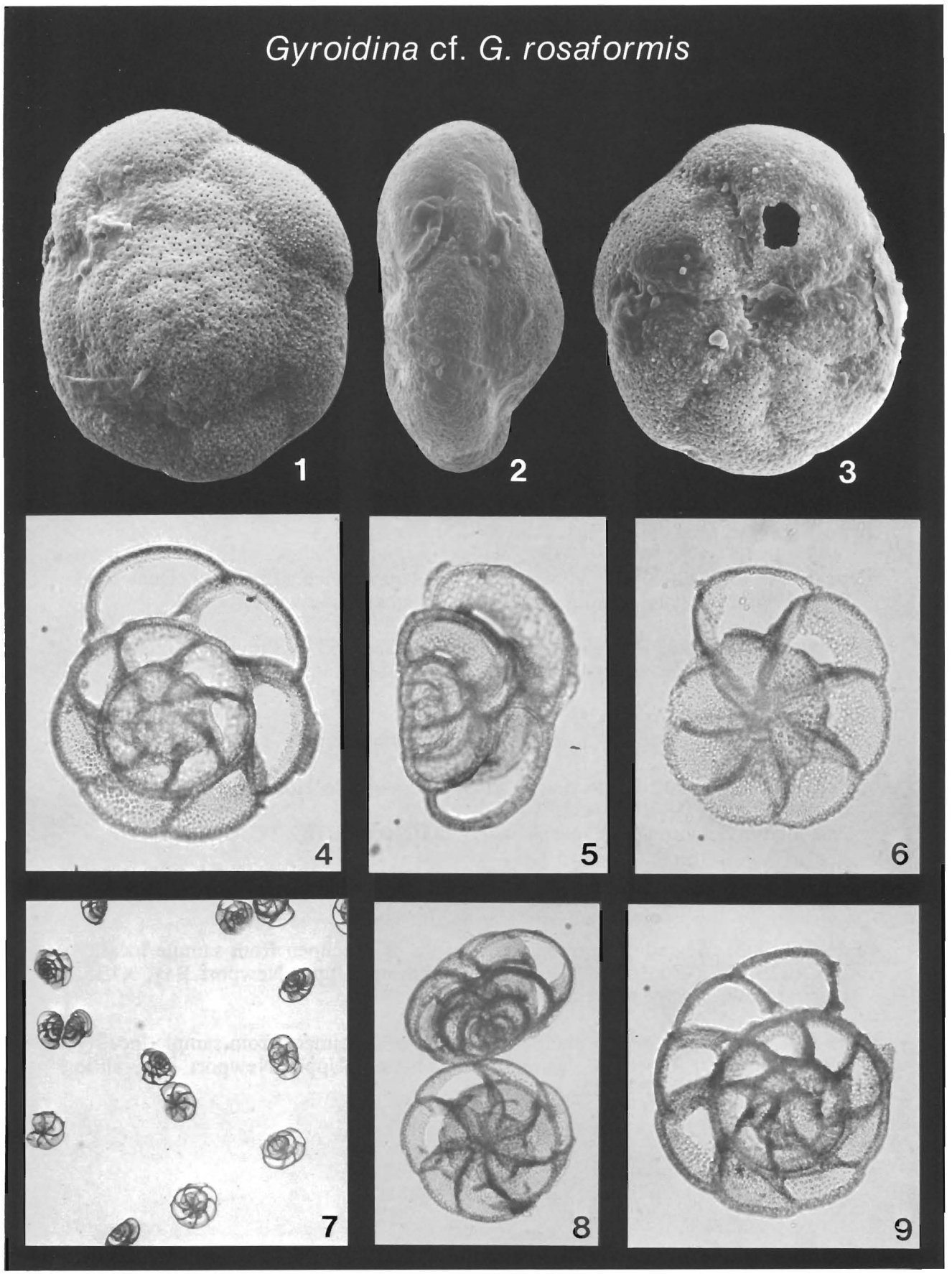
Taxonomic Remarks: This form differs from *G. rosaformis* s.s. by generally being smaller and having eight chambers in the last whorl and oblique spiral sutures. It may be the immature form, but the two morphotypes often occur independently of each other. The fact that this form is a constituent of many assemblages suggests that previous workers lumped the two as *G. rosaformis*. Hansen's (1967) examination of the genotype of *Gyroidina* revealed that it has a closed umbilicus and an interiomarginal aperture, as seen in *G.* cf. *G. rosaformis*.

Biostratigraphic Range in California:
Kleinpell (1938) for *G. rosaformis*: Late Luisian to early Mohnian.
Kleinpell (1980) for *G. rosaformis*: Early Luisian to early Mohnian.
Regional Literature for *G. rosaformis*: Zemorrian to Mohnian (AR76, AR84, BE86, FI90, KL80, PM81, SB86).
This Study: Zemorrian to Mohnian. (NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit of *G. rosaformis* = upper middle bathyal (Ingle, 1985)

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, X275: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 28: 4-6 = X250; 7 = X40; 8 = X160; 9 = X250.


Gyroidina cf. G. rosaformis
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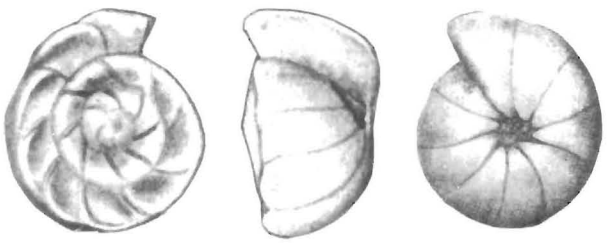
Hansenisca altiformis (R. E. and K. C. Stewart)



2a 2c 2b

Type Designation and Reference: *Gyroidina soldanii* var. *altiformis* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 67.

Type Figures: *Ibid.*, pl. 9, figs. 2a-c, X40.

Type Level and Locality: Upper Pliocene*, upper Pico Formation, Dent Mud Plant, Ventura County, California. [*Cited by authors as Lower Pliocene]

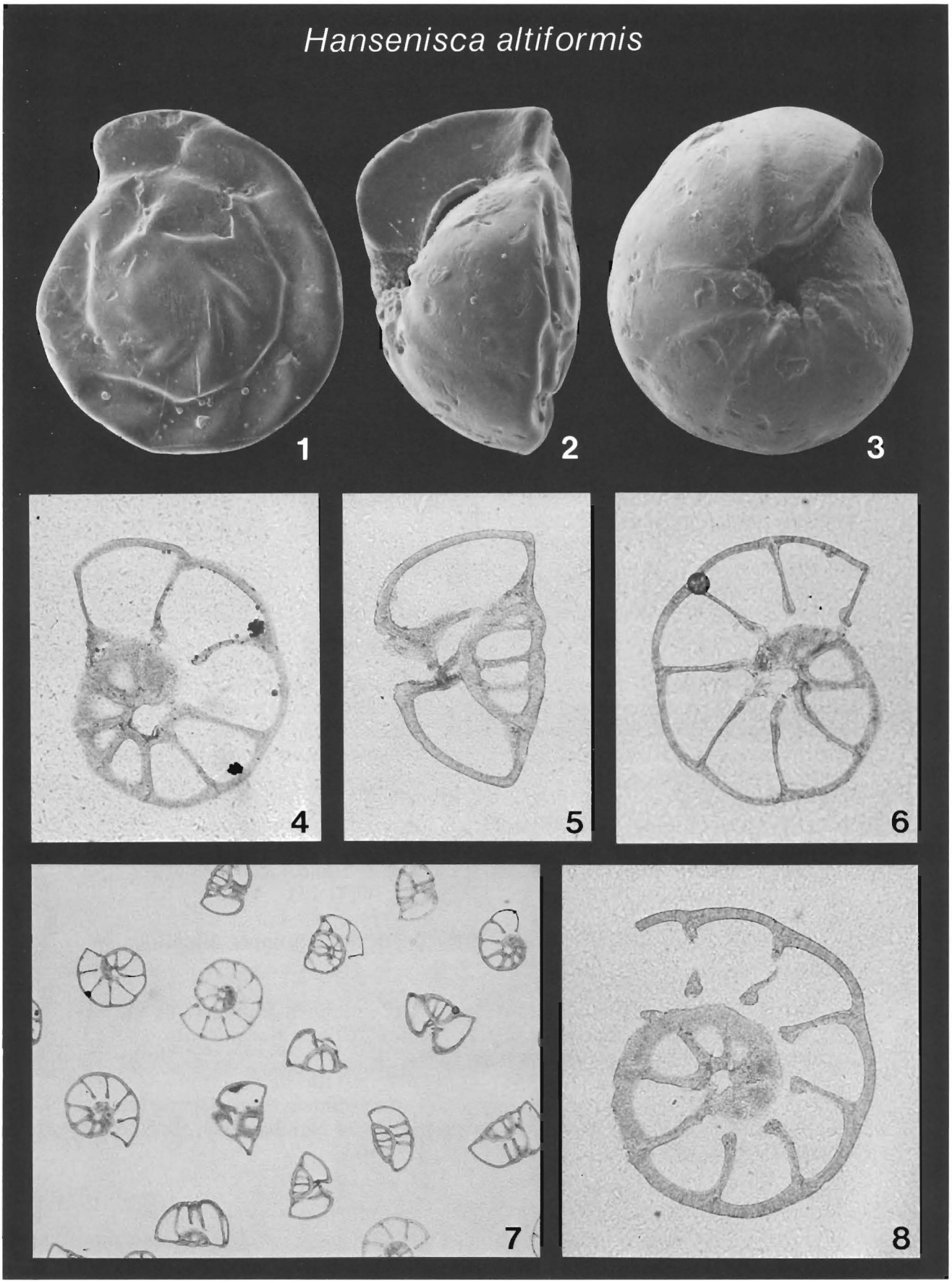
Taxonomic Remarks: Agrees with holotype (USNM12537). Previously referred to *Gyroidina* throughout regional literature.

Biostratigraphic Range in California:
Kleinpell (1938) for *G. soldanii*: Early Zemorrian to early Relizian, late Delmontian(?).
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, BE86, CB86, CL31, HA80, MA52, WH56).
This Study: Zemorrian to Pliocene, ranges to Holocene. (IC, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, X135: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 84: 4-6 = X128; 7 = X32; 8 = X128.


Hansenisca altiformis
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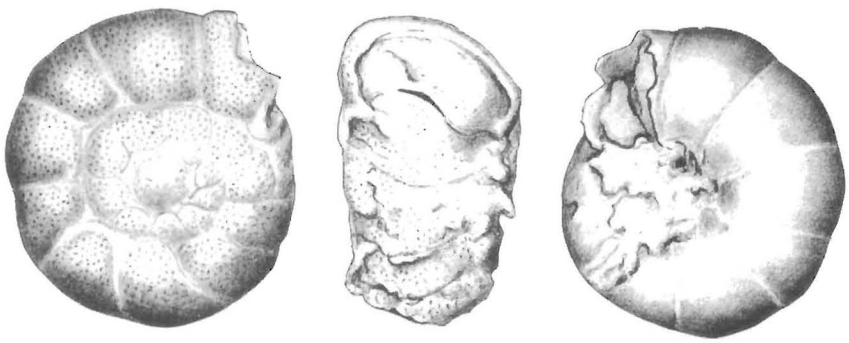
Hansenisca multicamerata (Kleinpell)



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Type Designation and Reference: *Eponides multicameratus* Kleinpell, 1938, Miocene Stratigraphy of California, p. 320.

Type Figures: *Ibid.*, pl. 19, figs. 2, 3, 7, X125.

Type Level and Locality: Lower Mohnian, Altamira Shale Member, Monterey Formation, Palos Verdes Hills, Los Angeles County, California.

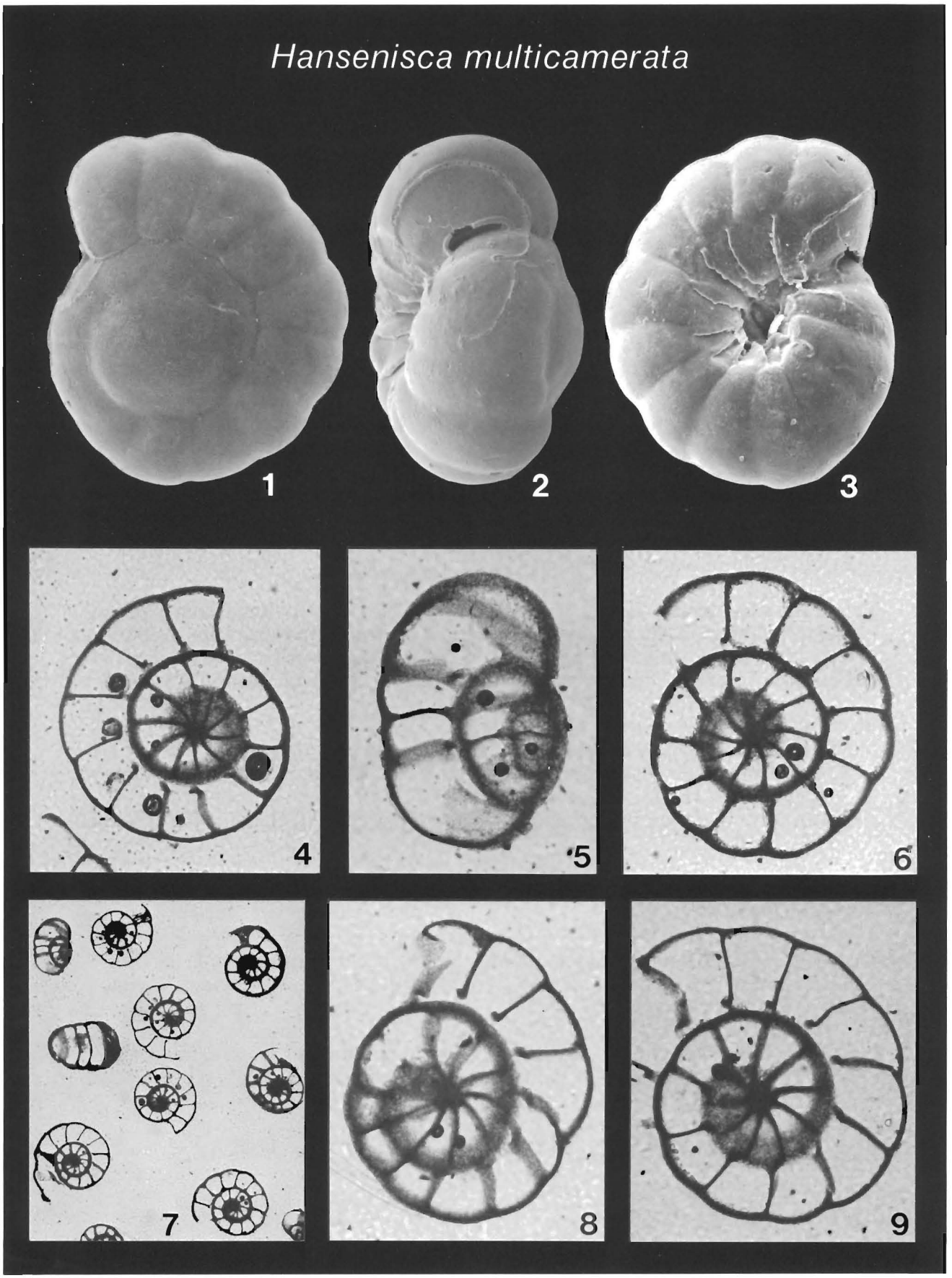
Taxonomic Remarks: Holotype (USNM497208) is small and broken (as illustrated in type figure). A more typical specimen is illustrated here as plate-figs. 1-3. The species has been referred to *Eponides* and *Gyroidina* in the regional literature. *H. multicamerata* is differentiated from *H. rotundimargo* by its longer chambers and rounded peripheral edge.

Biostratigraphic Range in California:
Kleinpell (1938): Early Luisian to early Delmontian.
Regional Literature: Relizian to "Delmontian" (AR76, BE86, PI56).
This Study: Relizian to "Delmontian". (MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1985).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, X137: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 93: 4 = X128; 5 = X160; 6 = X128; 7 = X32; 8, 9 = X160.


Hansenisca multicamerata
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Hansenisca rotundimargo (R. E. and K. C. Stewart)

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Type Designation and Reference: *Gyroidina soldanii* var. *rotundimargo* R. E. and K. C. Stewart, 1930, Jour. Paleont., v. 4, no. 1, p. 68.

Type Figures: *Ibid.*, pl. 9, figs. 3a-c, X60.

Type Level and Locality: Lower Pliocene, lower Pico Formation, well in Rincon Field, Ventura County, California.

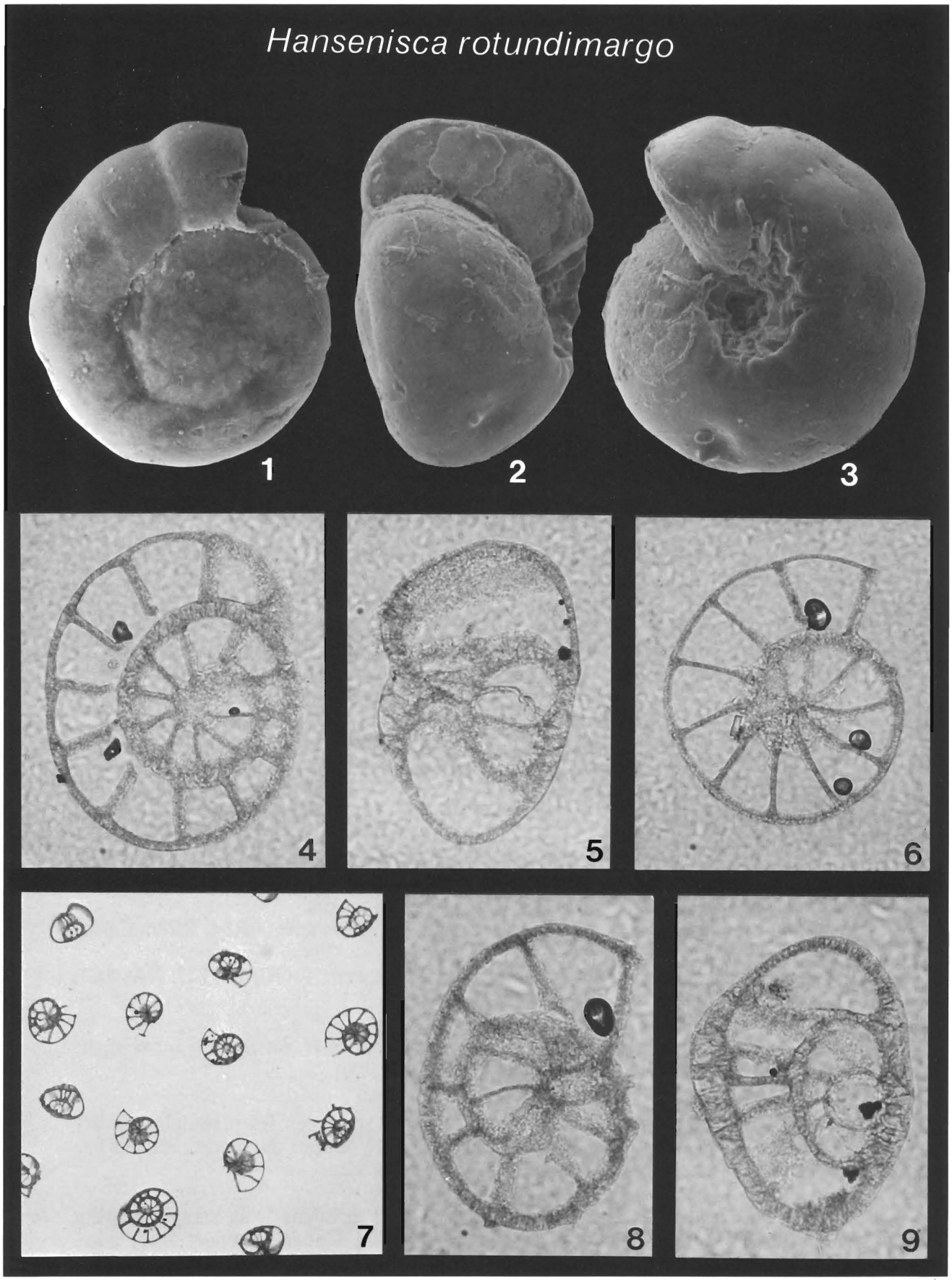
Taxonomic Remarks: Agrees with holotype (USNM12540). Referred to *Eponides* and *Gyroidina* in the regional literature. This form often has been referred to *Gyroidina multilocula* (= *G. soldanii* var. *multilocula* Coryell and Mossman, 1942, Pliocene of Panama), but that species has a flat spiral side with flush sutures.

Biostratigraphic Range in California:
Kleinpell (1938): Early Mohnian to early Delmontian.
Regional Literature: Luisian to Pliocene, ranges to Holocene (AR76, AR84, BE86, CB86, FI90, HA80, PI56, PM81, SM60, WH56).
This Study: Relizian to Pliocene, ranges to Holocene. (GC, LH, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1985).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality LH-7, Luisian, Monterey Formation, Laguna Hills, X175: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC39842-6, Luisian, Monterey Formation, Naples Beach, slide no. 60: 4 = X250; 5 = X320; 6 = X250; 7 = X51; 8, 9 = X320.


Hansenisca rotundimargo
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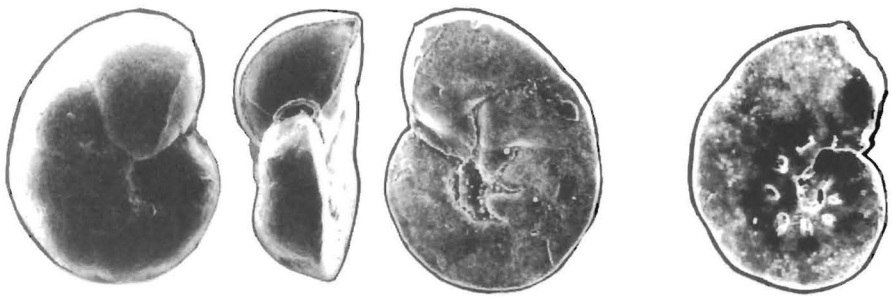
Hanzawaia depaoloi Finger and Lipps



15 16 17 18

Type Reference: *In* Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 44.

Type Figures: *Ibid.*, pl. 8, figs. 15-18: 15-17, holotype, X67; 18, X148.

Type Level and Locality: Relizian, Sandholdt Member, Monterey Formation, Graves Creek, Atascadero, San Luis Obispo County, California.

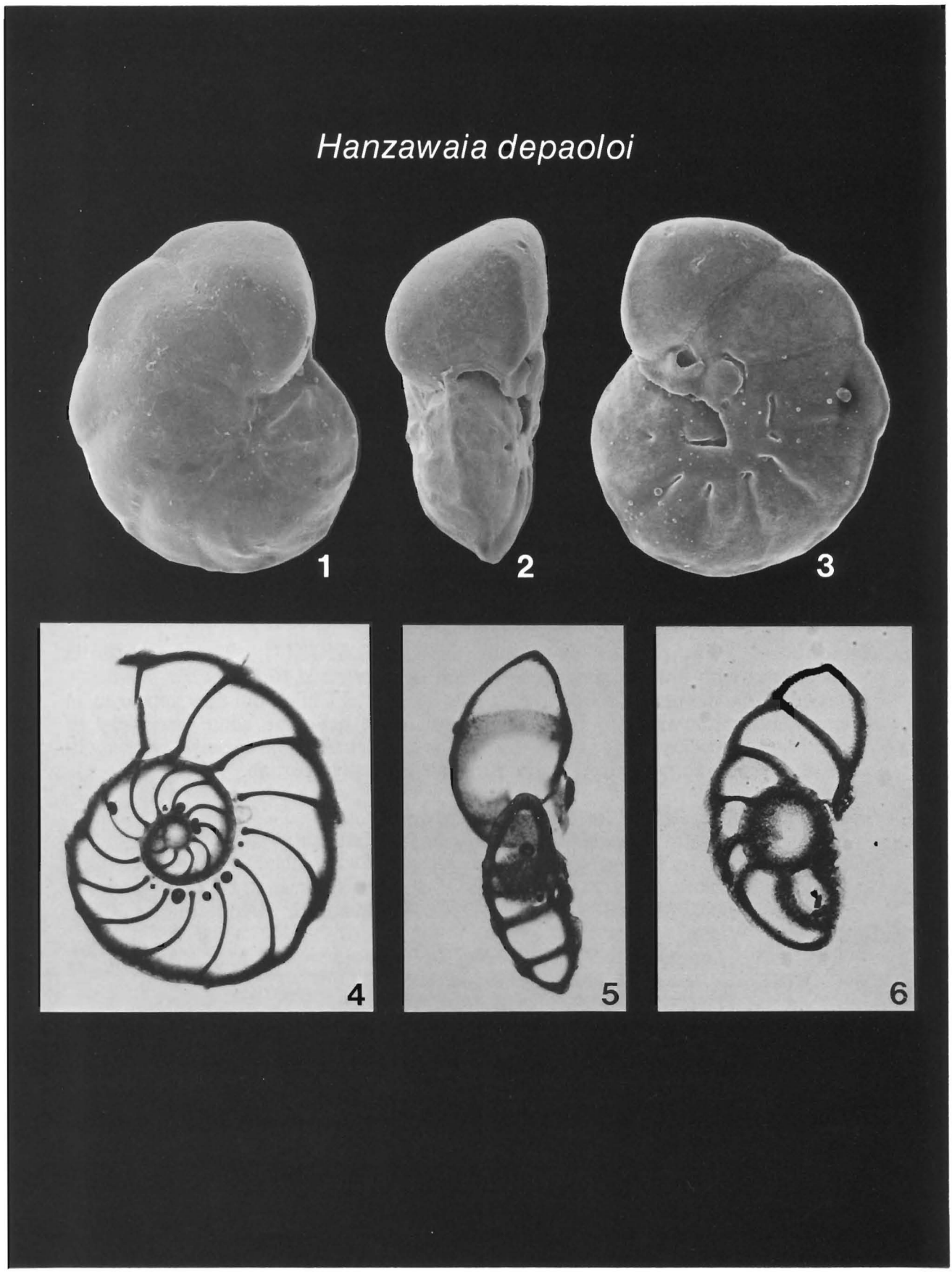
Taxonomic Remarks: Holotype (USNM325335) of *H. basiloba* is similar to *H. illingi* (= *Truncatulina illingi*, Nuttall, 1928, middle Tertiary, Trinidad), but neither of these species bear much resemblance to this California form which they have often been assigned to. This species has also been referred to by regional workers as *Cibicides americana* (= *Truncatulina americana* Cushman, 1918a, Miocene, South Carolina), but that species, which may be a *Cibicidina*, is definitely not the *Hanzawaia* shown here. *H. depaoloi* varies greatly in sutural thickening and coalescense of umbilical flaps.

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for cf. *Cibicides basiloba*: Questionable occurrences from late Relizian to late Luisian.
Kleinpell (*ibid.*) for *Cibicides illingi*: Early to late Mohnian.
Regional Literature: Relizian to Pliocene, ranges to Holocene (AR84, BE86, CB86, FI90, KL80, PI56, SM60).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, IC, LH, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit of *H. basiloba* = inner shelf; upper depth limit of *H. illingi* = outer shelf (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-46a, Mohnian, Monterey Formation, Upper Newport Bay, X85: 1, convex side view; 2, edge view; 3, flattened side view.

Plate-figs. 4-6: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 31: 4 = X64; 5 = X80; 6 = X100.


Hanzawaia depaoloi
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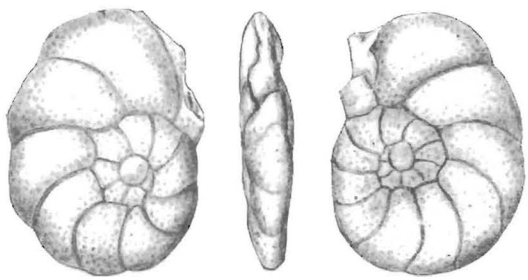
Holmanella baggi (Kleinpell)



14a 14b 14c

Type Designation and Reference: *Planulina baggi* Kleinpell, 1938, Miocene Stratigraphy of California, p. 349.

Type Figures: *Ibid.*, pl. 8, figs. 14a-c, X40.

Type Level and Locality: Upper Saucesian, Monterey Formation, Reliz Canyon, Monterey County, California.

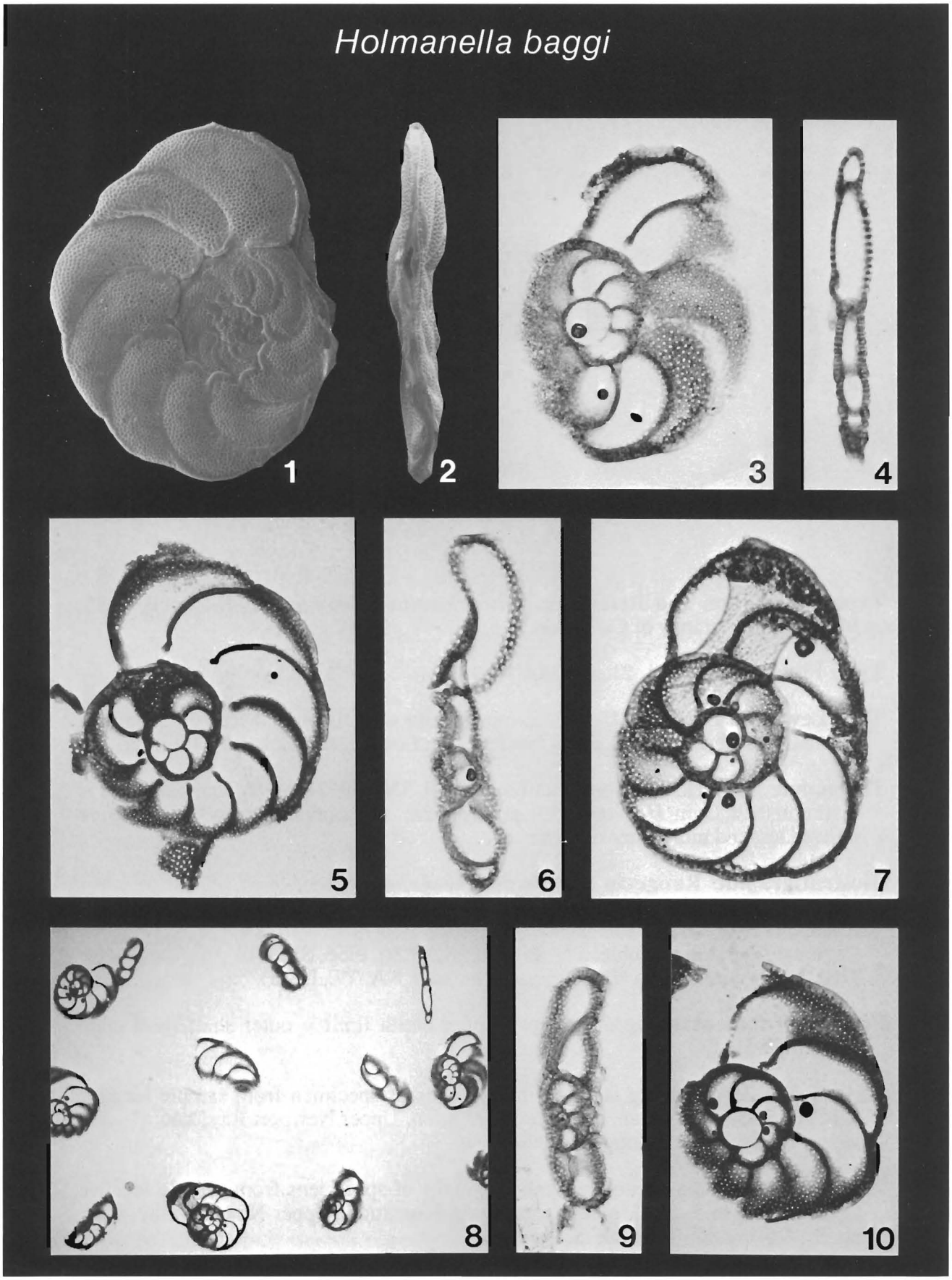
Taxonomic Remarks: Agrees with holotype (LSJU947). Those California specimens with limbate sutures often have been referred to *Planulina ornata* (= *Truncatulina ornata* d'Orbigny, 1839, Recent, coastal Chile), but they appear to be ecophenotypic variants of *H. baggi*, and none have the acute periphery of d'Orbigny's species. *H. baggi* is distinguished from *H. valmonteensis* (Kleinpell, 1938; see next entry) by its flatter test and less extensive aperture.

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *P. baggi*: Late Saucesian, late Relizian.
Kleinpell (*ibid.*) for *P. ornata*: Late Luisian to early Delmontian, late Delmontian(?).
Regional Literature (includes *P. baggi* and *P. ornata*): Relizian to Pliocene, ranges to Holocene (BE86, CB86, CG46, CS30, FI90, KL80, HA80, MA52, PI56, SM60, WH56).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit of both *P. baggi* and *P. ornata* = outer shelf (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, X52: 1, side view; 2, edge view.

Plate-figs. 3-10: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 34: 3, 4 = X80; 5 = X64; 6, 7 = X80; 8 = X20; 9 = X80; 10 = X64.


Holmanella baggi
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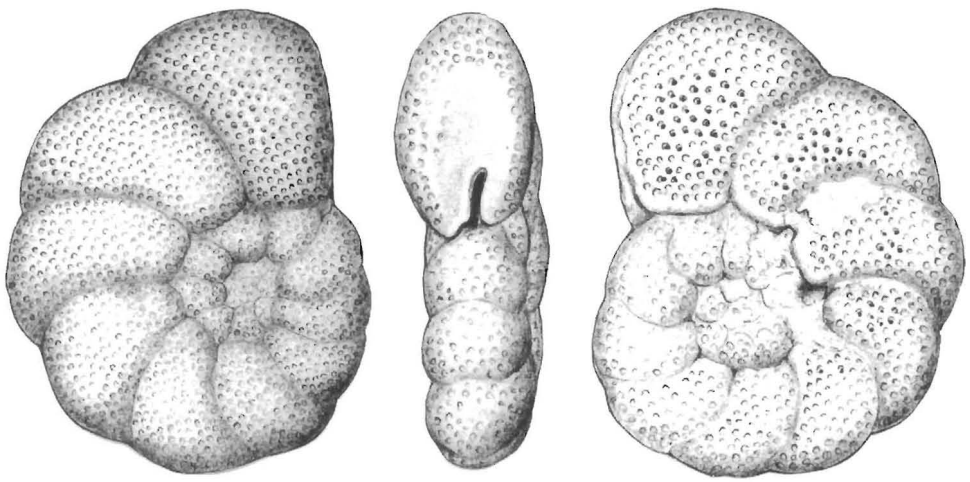
Holmanella valmonteensis (Kleinpell)



14 15 16

Type Designation and Reference: *Discorbinella valmonteensis* Kleinpell, 1938, Miocene Stratigraphy of California, p. 350.

Type Figures: *Ibid.*, pl. 21, figs. 14-16, X65.

Type Level and Locality: Upper Mohnian, Valmonte Diatomite Member, Monterey Formation, Cabrillo Beach, Palos Verdes Hills, Los Angeles County, California.

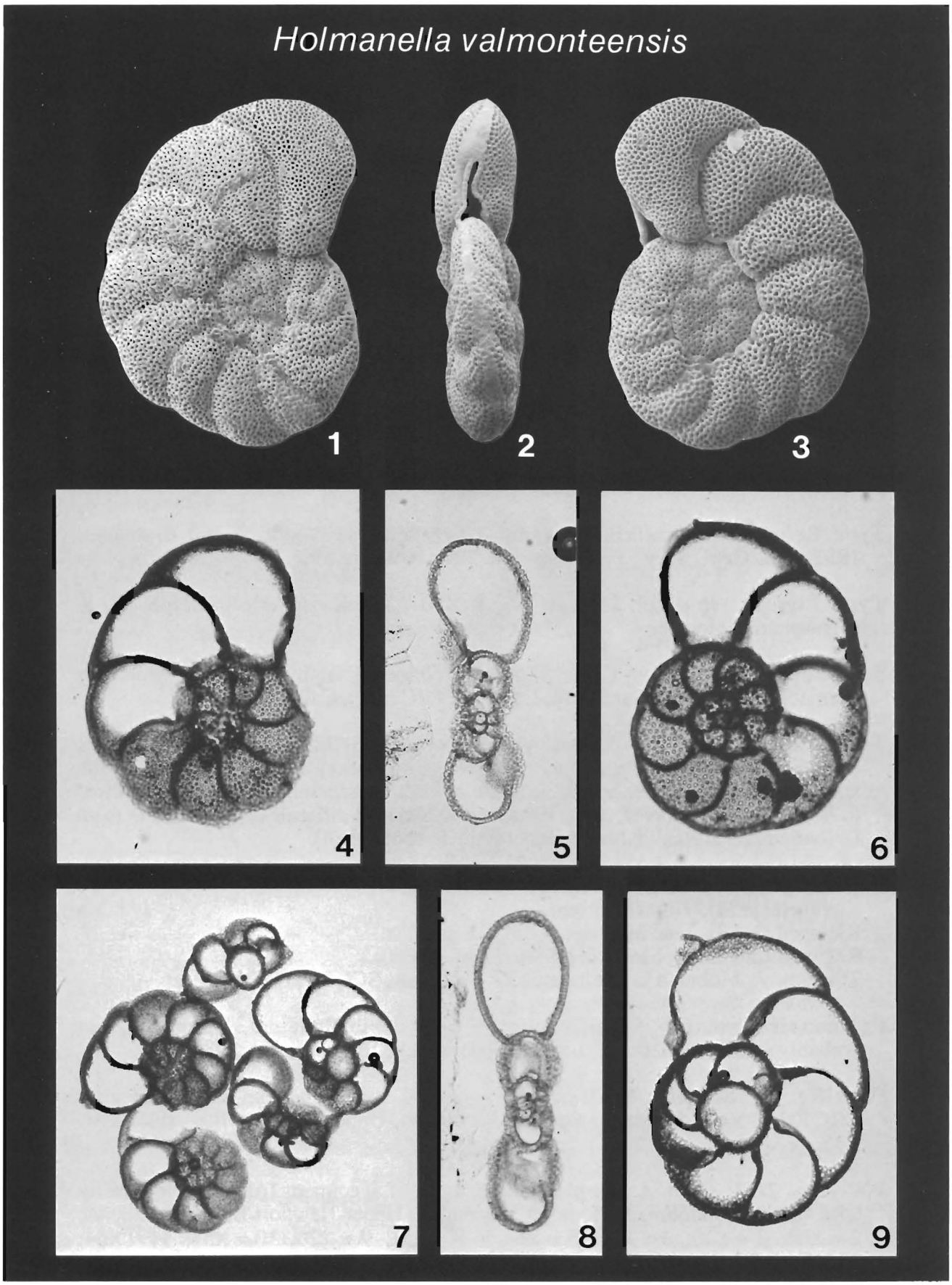
Taxonomic Remarks: Agrees with holotype (USNM497214). *H. valmonteensis* is distinguished from *H. baggi* (Kleinpell, 1938; see previous entry) by its more inflated test and more extensive aperture.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian.
Kleinpell (1980): Late Mohnian to early Delmontian(?).
Regional Literature: Mohnian (AR76, BE86, KL80, PI56, SM60).
This Study: Mohnian to "Delmontian"(?). (MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = outer shelf/shelf edge (Ingle, 1985).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, X66: 1, side view; 2, edge view; 3, opposite side view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-3 and -50, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 8: 4-6 = X80; 7 = X50; 8, 9 = X80.


Holmanella valmonteensis
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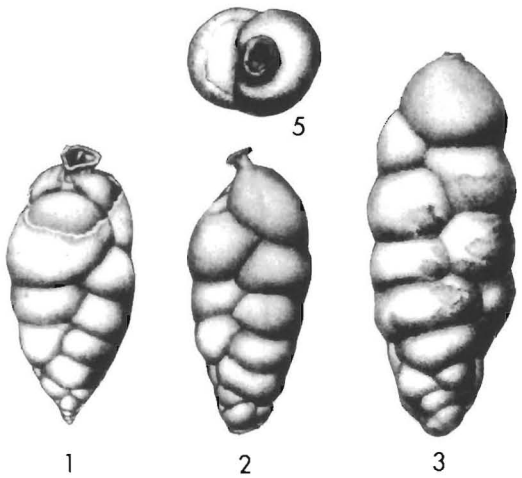
Hopkinsina magnifica Bramlette



Type Reference: *Hopkinsina magnifica* Bramlette, *in* Woodring and Bramlette, 1951, U.S. Geol. Surv., Prof. Pap., no. 222 (1950), p. 59.

Type Figures: *Ibid.*, pl. 22, figs. 1-3, 5, X10: 1, microspheric paratype; 2, 5, megaspheric holotype.

Type Level and Locality: Upper Miocene, Valmonte Diatomite Member, Monterey Formation, Peck Park, San Pedro, Los Angeles County, California.

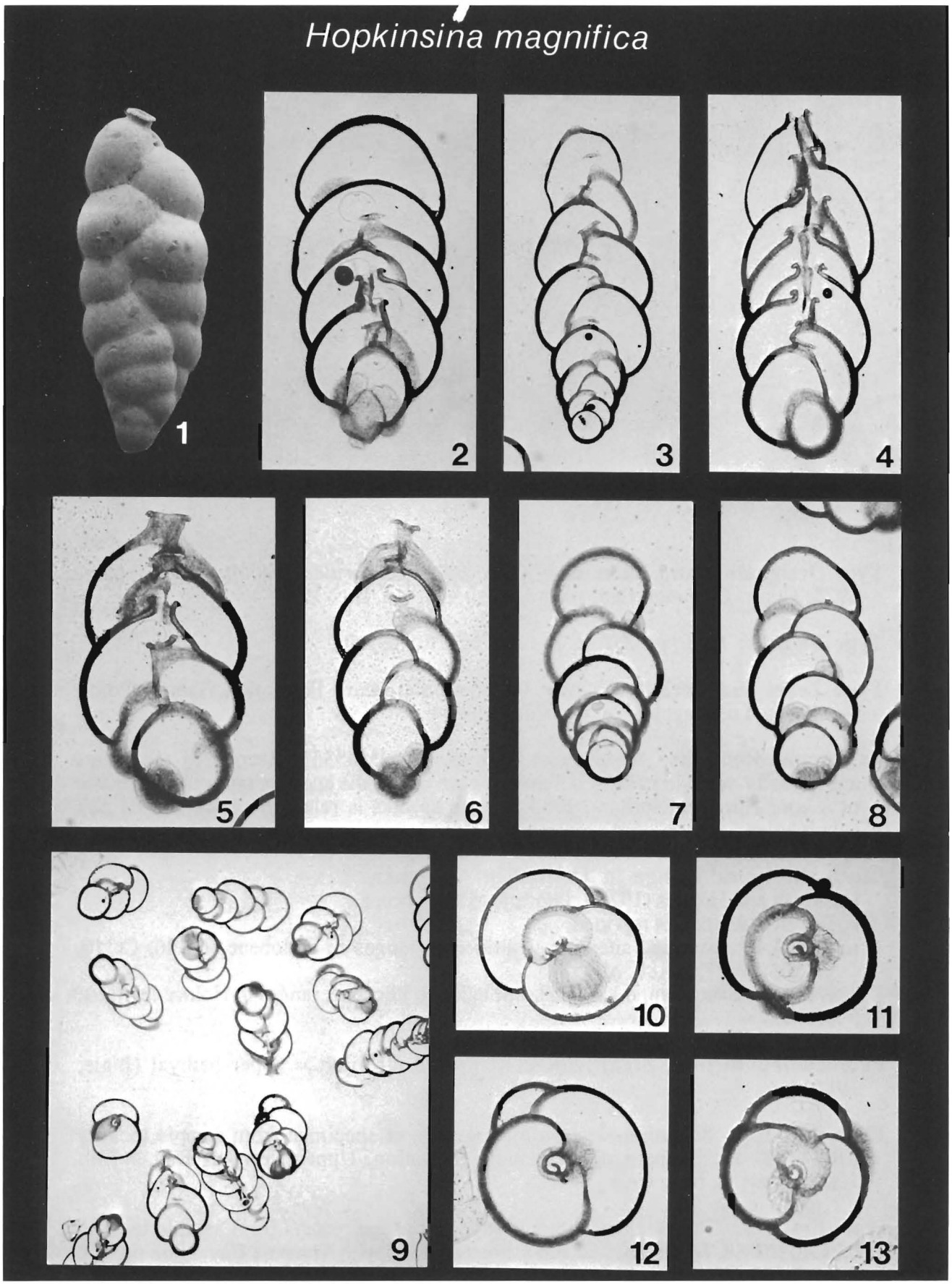
Taxonomic Remarks: Agrees with holotype (USNM560226) and topotypes (USGS). Although many *Uvigerina* develop a tendency toward biseriality in the latest whorls, this species becomes distinctly biserial early on; hence, its assignment to *Hopkinsina*. However, immature specimens can be difficult to differentiate from *Uvigerina hootsi* Rankin (*in* Cushman and Kleinpell, 1934).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Kleinpell (1980): Late Mohnian to early Delmontian.
Regional Literature: Mohnian (BE86, KL80, SM60).
This Study: Mohnian to "Delmontian". (MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit not determined, but probably similar to that of *U. hootsi* = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, side view, X45.

Plate-figs. 2-13: Thin-section photomicrographs of specimens from sample locality CRC40267-50, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 40: 2 = X64; 3 = X40; 4 = X51; 5 = X64; 6-8 = X51; 9 = X20; 10 = X51; 11 = X64; 12, 13 = X80.


Hopkinsina magnifica
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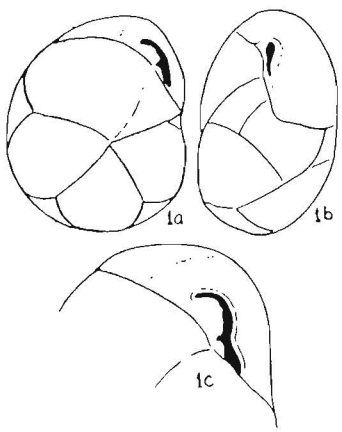
Islandiella californica (Cushman and Hughes)



Type Designation and Reference: *Cassidulina californica* Cushman and Hughes, 1925, Contr. Cushman Lab. Foram. Res., v. 1, no. 1, p. 12.

Type Figures: *Ibid.*, pl. 2, figs. 1a-c: a, b, X30; c, X50.

Type Level and Locality: Upper Pliocene, San Pedro Formation, Timms Point, San Pedro, Los Angeles County, California.

Taxonomic Remarks: Agrees with holotype (USNM4336). Recovered specimens are optically radial in polarized light and have one of the aperture types characteristic of *Islandiella* (see Nomura, 1983a). The species is relatively thick-walled and subglobular.

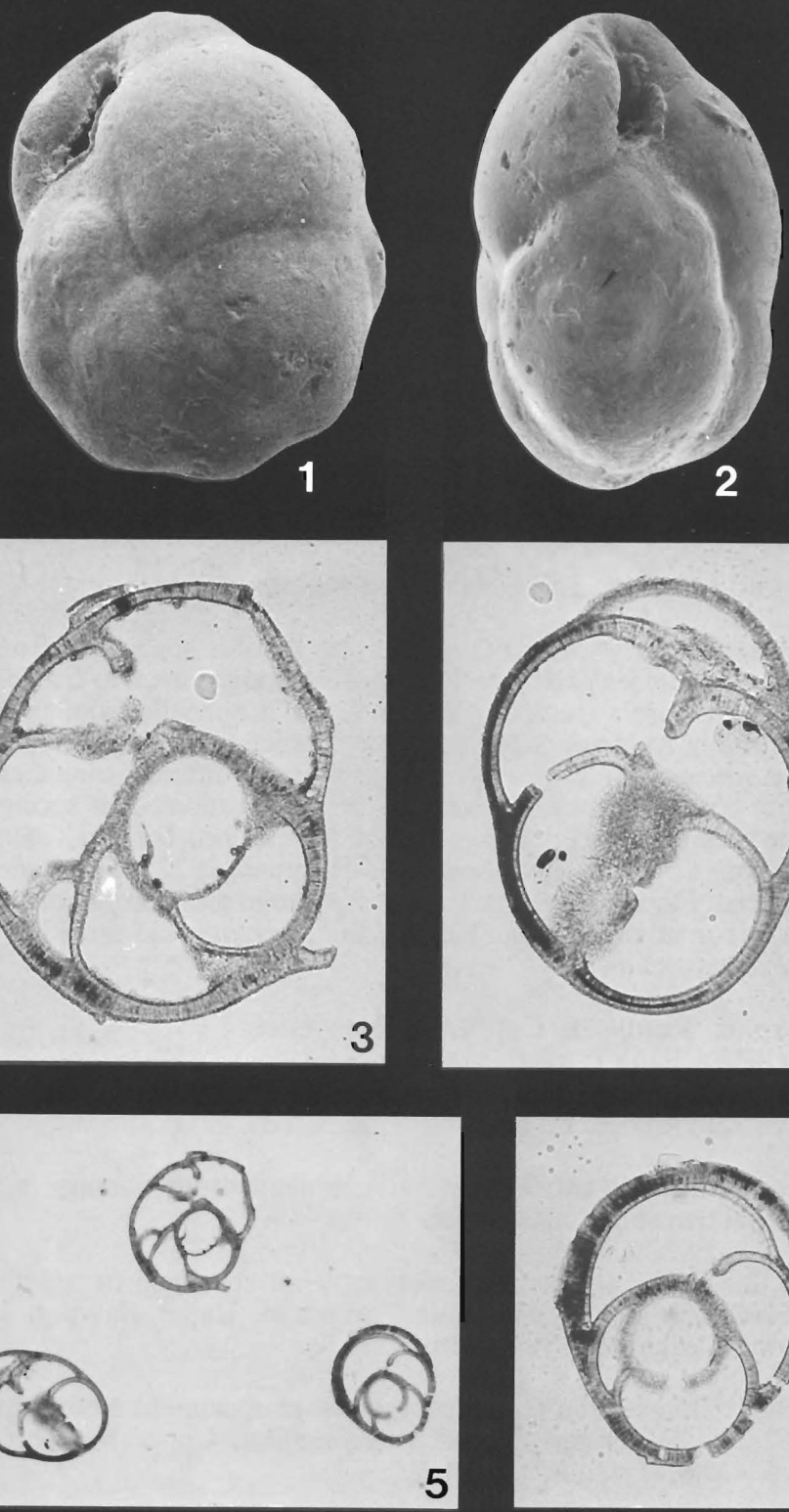
Biostratigraphic Range in California Neogene:
Cushman and Hughes (1925): Pliocene to Pleistocene.
Kleinpell (1938): Not reported.
Regional Literature: Saucesian to Pliocene, ranges to Holocene (CB86, CG46, CS30, GW27, HA80, MA52).
This Study: Saucesian to Luisian?; Mohnian to Pliocene, ranges to Holocene. (NA, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, X130: 1, side view; 2, edge view.

Plate-figs. 3-6: Thin-section photomicrographs of specimens from sample locality CRC40267-38, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 30: 3, 4 = X100; 5 = X32; 6 = X80.

Islandiella californica



Islandiella carinata (Silvestri)

10a 10c 10b

Type Designation and Reference: *Cassidulina laevigata* var. *carinata* Silvestri, 1896, Accad. Pont. Nuovi Lincei, Mem., v. 12, p. 104.

Type Figures: *Ibid.*, pl. 2, figs. 10a-c, X50.

Type Level and Locality: Lower Pliocene localities in Italy.

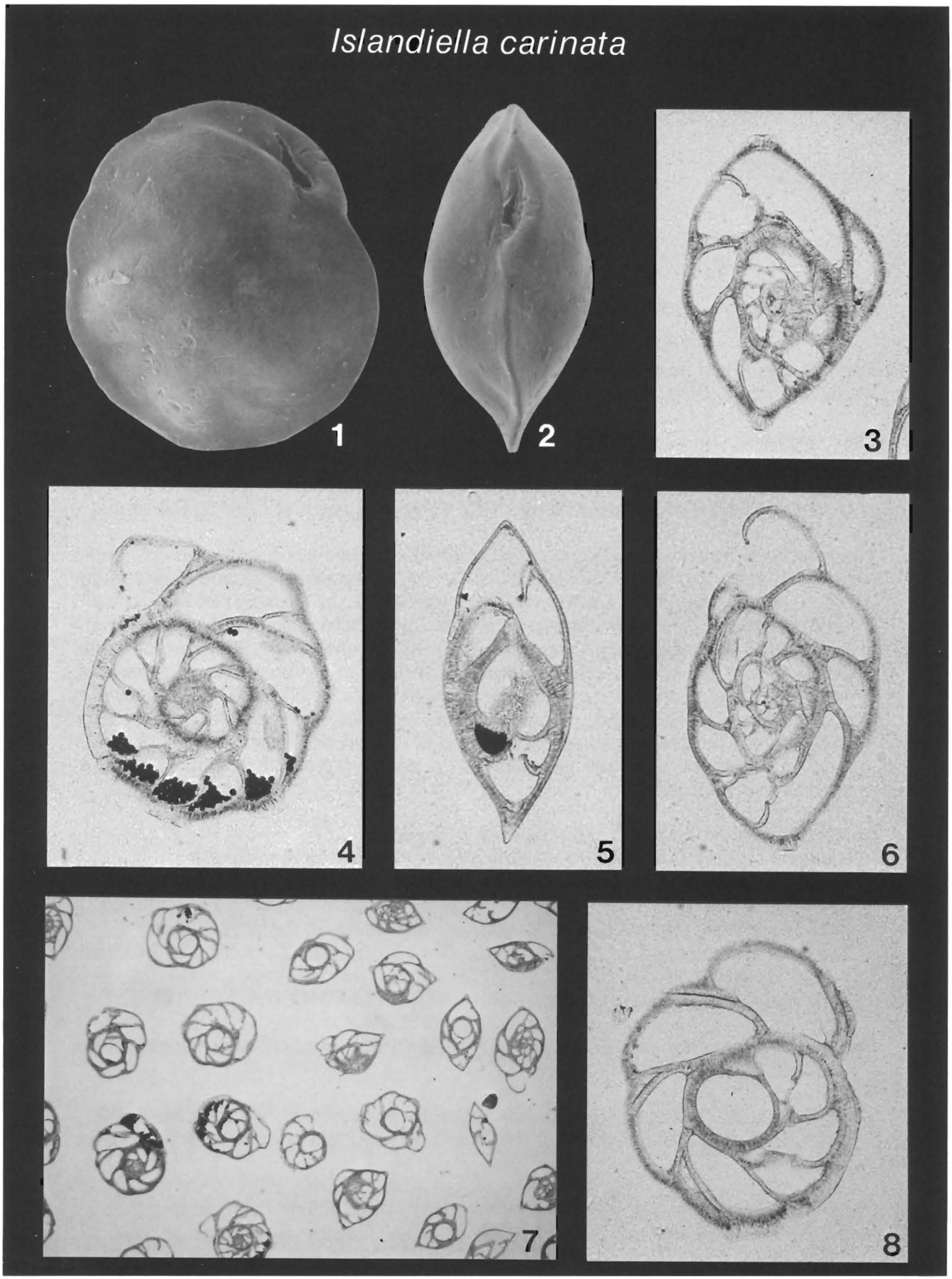
Taxonomic Remarks: Nomura (1983b) notes that his specimens from Japan are optically granular under polarized light; thus, he assigns them to *Globocassidulina.* Although the California species looks identical, it is optically radial under polarized light. According to Nomura (1983a), this characteristic and its type of aperture affiliate this species with *Islandiella.* If the critieria for differentiating these genera are valid, one or both of us may be wrong in the identification of the species. Analysis of topotype specimens could help to resolve this. *C. neocarinata* Thalmann (1950, nom. subst. pro *C. laevigata* var. *carinata* Cushman, 1922), a similar morphotype from the Recent Florida Keys, has been referred to in the literature on the California fauna, but it is smaller and less lobulate than *I. carinata*, and should be assigned to the genus *Paracassidulina.*

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Zemorrian to early Mohnian.
Regional Literature: Luisian to Pliocene (BE86, FI90, HA80).
This Study: Zemorrian to Pliocene. (GC, IC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal/upper middle bathyal transition (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-47a, Mohnian, Fernando Formation, Upper Newport Bay, X130: 1, side view; 2, edge view.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 71: 3-6 = X80; 7 = X20; 8 = X80.


Islandiella carinata
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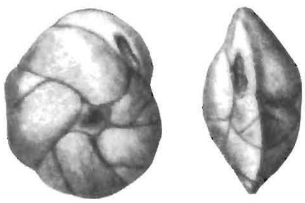
Islandiella modeloensis (Rankin)



12a 12b

Type Designation and Reference: *Cassidulina modeloensis* Rankin, *in* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 23.

Type Figures: *Ibid.*, pl. 3, figs. 12a, b, X50.

Type Level and Locality: Upper Mohnian, Modelo Formation, on road from Girard to Mohn Spring, Santa Monica Mountains, Los Angeles County, California.

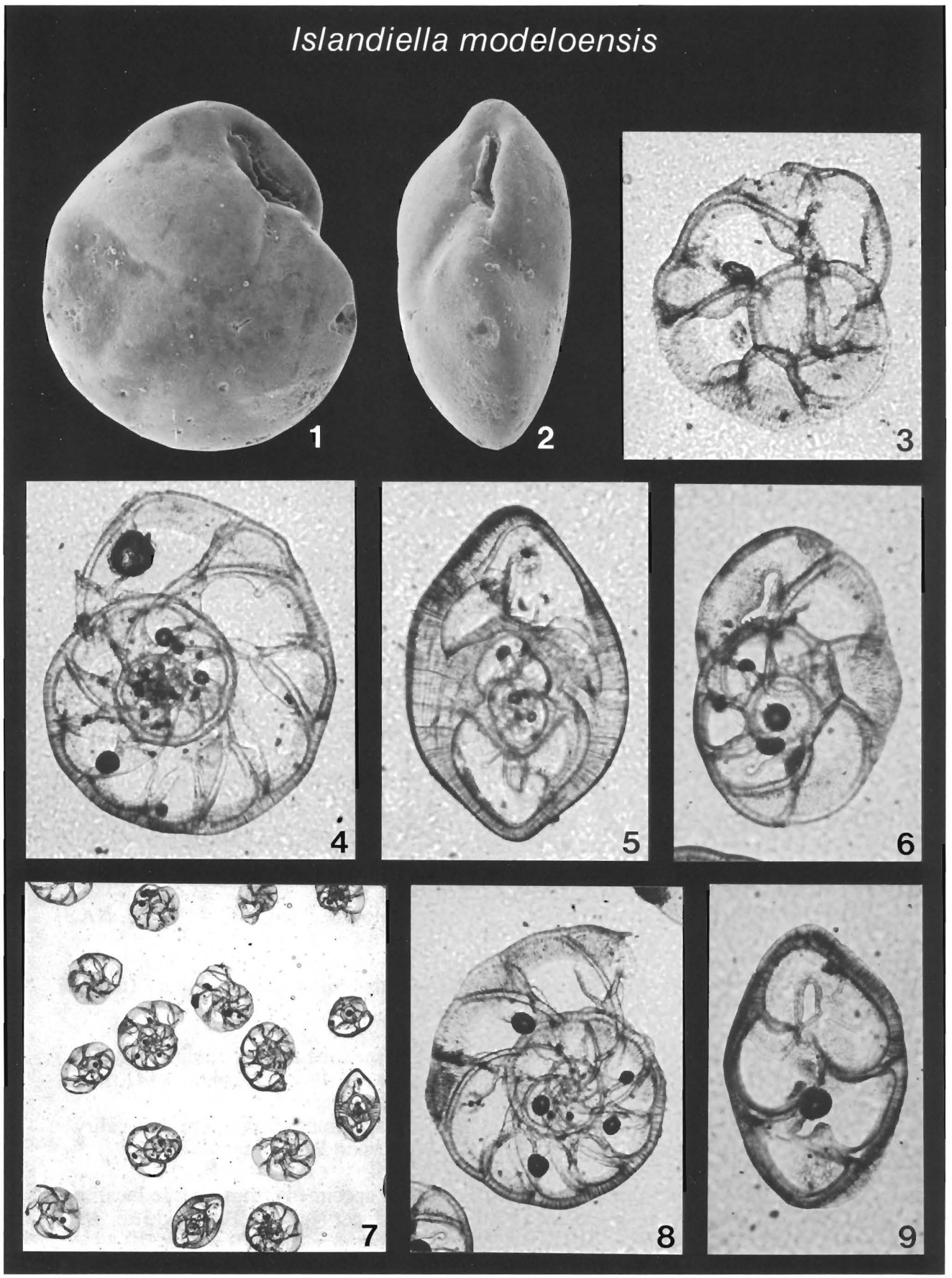
Taxonomic Remarks: Although only a minority of recovered specimens resemble the holotype (USNM20158), which has a very acute periphery and a prominent umbo, the species plexus seems to be quite variable in the thickness of the test wall, visible portion of the umbo, and angling of the peripheral edge. Such variations are seen within assemblages, and suggest that they are of a single population. In his description of the species, Rankin noted, "This species is variable in its periphery, sometimes keeled and varying to a serrate edge.". Kleinpell (1980) illustrates two end-members of this grade. I suspect that most of the specimens referred to *C. panzana* Kleinpell are also within this grade. Recovered specimens are optically radial in polarized light and have one of the aperture types that Nomura (1983a) restricts to *Islandiella*.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian to early Delmontian, late Delmontian(?).
Kleinpell (*ibid.*) for *C. panzana*: Late Saucesian to late Luisian.
Kleinpell (1980): Early Mohnian* to early Delmontian, late Delmontian(?). [*Species also referred to as having its first appearance in the late Mohnian]
Regional Literature (for *C. panzana* and *C. californica*): Zemorrian to Mohnian (AR76, AR84, BE86, FI90, KL80, PI56).
This Study: Zemorrian to "Delmontian". (GC, IC, LH, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = shelf edge/upper bathyal transition (Ingle, 1980)

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality GC-3, Relizian, Monterey Formation, Graves Creek, X119: 1, side view; 2, edge view.

Plate-figs. 3-9: Thin-section photomicrographs of specimens from sample locality CRC39842-6, Luisian, Monterey Formation, Naples Beach, slide no. 38: 3-6 = X160; 7 = X32; 8 = X128; 9 = X160.


Islandiella modeloensis
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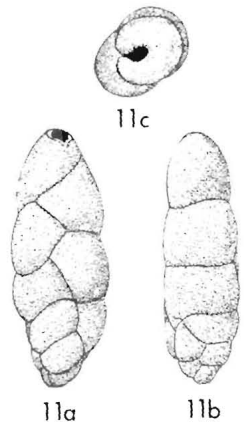
Kleinpella californiensis (Cushman)



Type Designation and Reference: *Virgulina californiensis* Cushman, 1925c, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 32.

Type Figures: *Ibid.*, pl. 5, figs. 11a-c, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

Taxonomic Remarks: Agrees with holotype (USNM4359) and topotypes (USGS). Large specimens, such as that illustrated in plate-fig. 2, have been referred to *V. californiensis* var. *grandis* Cushman and Kleinpell (1934; USNM20125), but size is gradational within this species. The genus *Kleinpella* was recently erected by Finger and Lipps *in* Finger and others (1990), with this species as its genotype.

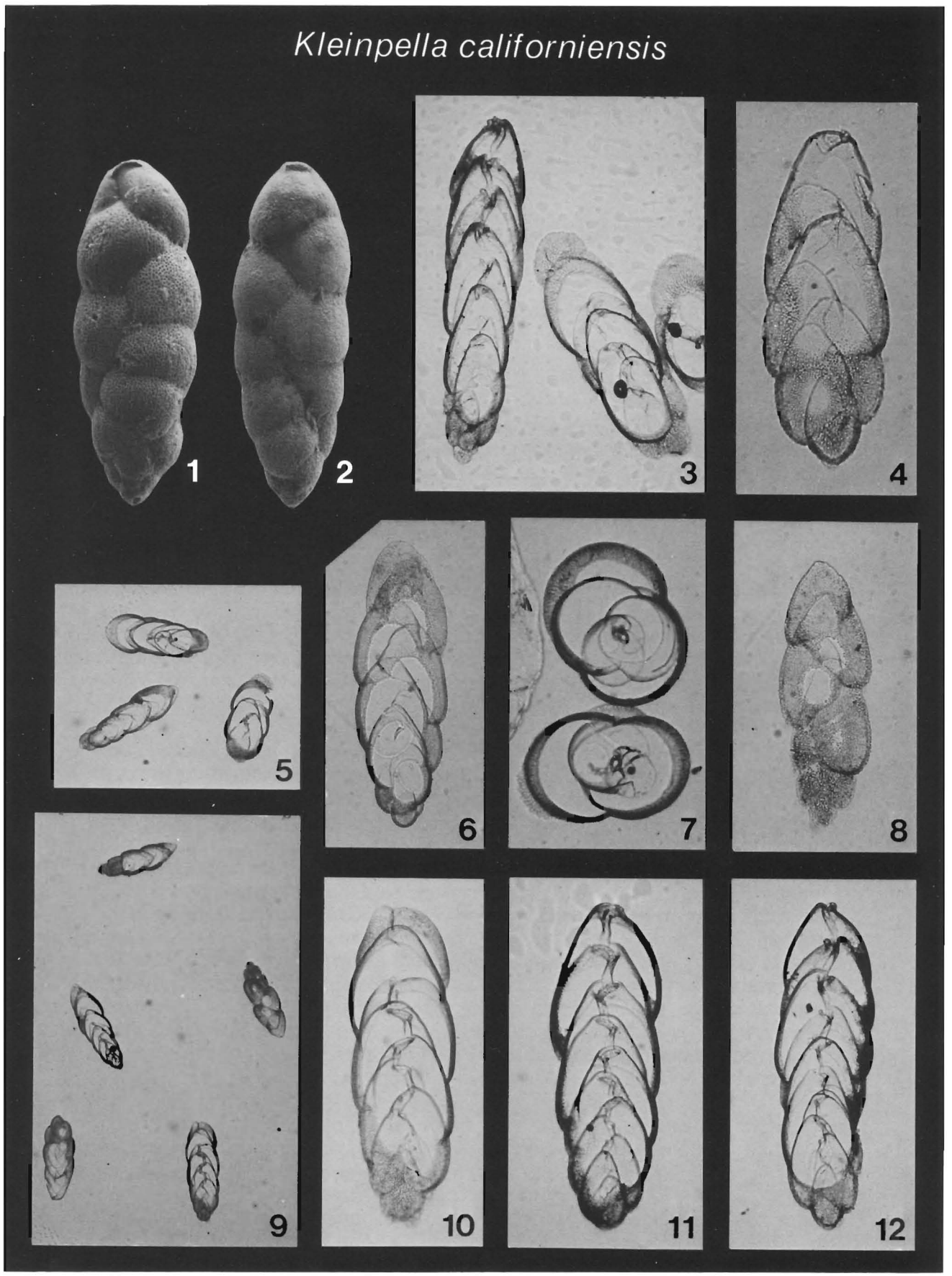
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Saucesian to early Delmontian.
Regional Literature: Saucesian to Pliocene, ranges to Holocene (AR76, AR84, BE86, CB86, CL31, FI90, KL80, PI56, SM60, TI73).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, IC, LH, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980); low-oxygen zone indicator (Ingle, 1985).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-29, Luisian, Monterey Fm., Upper Newport Bay: side view, X141.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40267-3, Mohnian, Monterey Fm., Upper Newport Bay: side view, X59.

Plate-figs. 3-12: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 36: 3 = X100; 4 = X128; 5 = X40; 6 = X100; 7 = X160; 8 = X100; 9 = X32; 10-12 = X100.


Kleinpella californiensis
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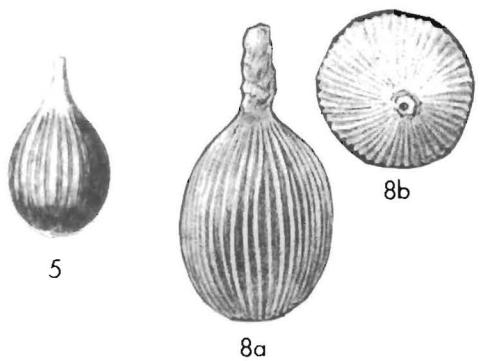
Lagena newportensis Finger, n. sp.



Above Figures: Type figure of *Serpula (Lagena) sulcata* Walker and Jacob, 1798, pl. 14, fig. 5, magnification not indicated; type figure of *Lagena dorseyae* McLean, 1956, pl. 39, figs. 8a, b, X64.

Type Level and Locality: "Repettian", Lower Pliocene, lower Fernando Formation, Upper Newport Bay, Orange County, California.

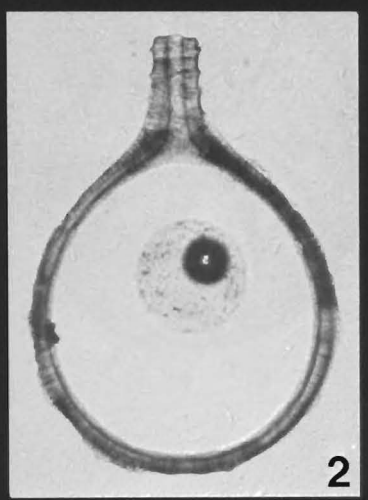
Description: Unilocular test globular with elongate neck; chamber ornamented with approximately 20 longitudinal costae extending from basal perimeter to lower part of neck, neck ornamented with fine costae arranged in longitudinally compressed hexagons forming a honeycomb-like pattern. The species derives its name from its type locality. Holotype (facing plate, fig. 1) deposited in the University of California Museum of Paleontology (UCMP38338).

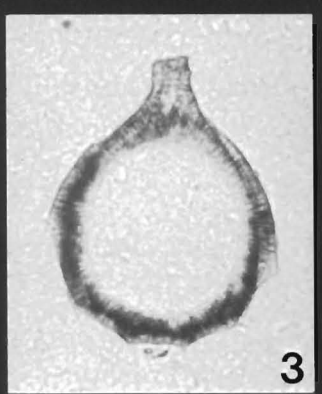
Remarks: In California, lagenids are generally more common in the Pliocene than in the Miocene. Several striate/costate species have been documented in the regional literature, while others remain undescribed and unfigured. However, the California Neogene taxa have often been referred to widely (geographically and geologically) disparate species that are obviously not the same. For example, Kleinpell (1938) assigned his plesiotype LSJU662, which looks like *Oolina borealis* Loeblich and Tappan (1954; Recent, Northeast Pacific), to *L. acuticosta* Reuss (1862), a Maastrichtian species described from The Netherlands. Other erroneously assigned names appropriate only as informal morphodescriptors include *L. costata* (Egger), *L. striata* (d'Orbigny), and *L. sulcata* Walker and Jacob (shown above). The species most closely resembles *L. dorseyae* McLean (1956; Upper Miocene, Virginia), also illustrated above, but has fewer costae and more distinct neck ornamentation. *L. newportensis* is known only from the Pliocene. Although its paleoenvironmental significance has not been determined, the genus generally inhabits the neritic zone (Murray, 1973).

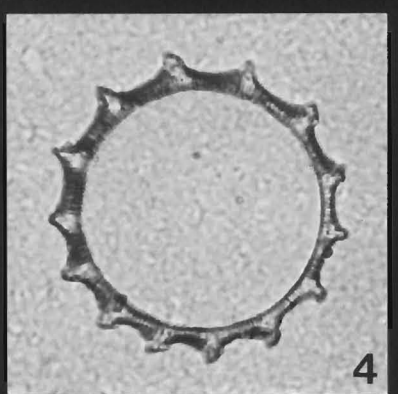
Plate-fig. 1: Scanning electron micrograph of holotype from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: side view, X194.

Plate-figs. 2-4: Thin-section photomicrographs of topotypes from sample locality CRC40267-28a, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 127: 2, 3 = X160; 4 = X200.

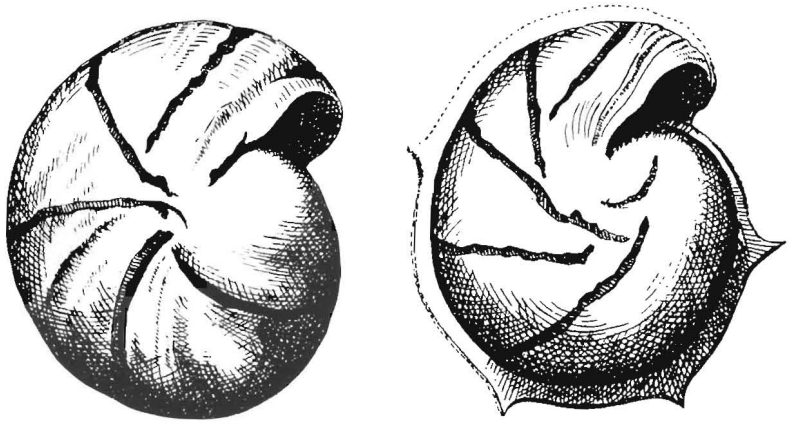
Lagena newportensis







Lenticulina cf. *L. calcar* (Linné)



B C

Type Reference: *Nautilus calcar* Linné, 1758, *Systema Naturae*, ed. 10, v. 1, p. 709.

Type Figures: *Nautilus minimus* etc. Gualtieri, Testac., v. 19, figs. B, C, magnification not indicated.

Type Level and Locality: Recent, Adriatic Sea.

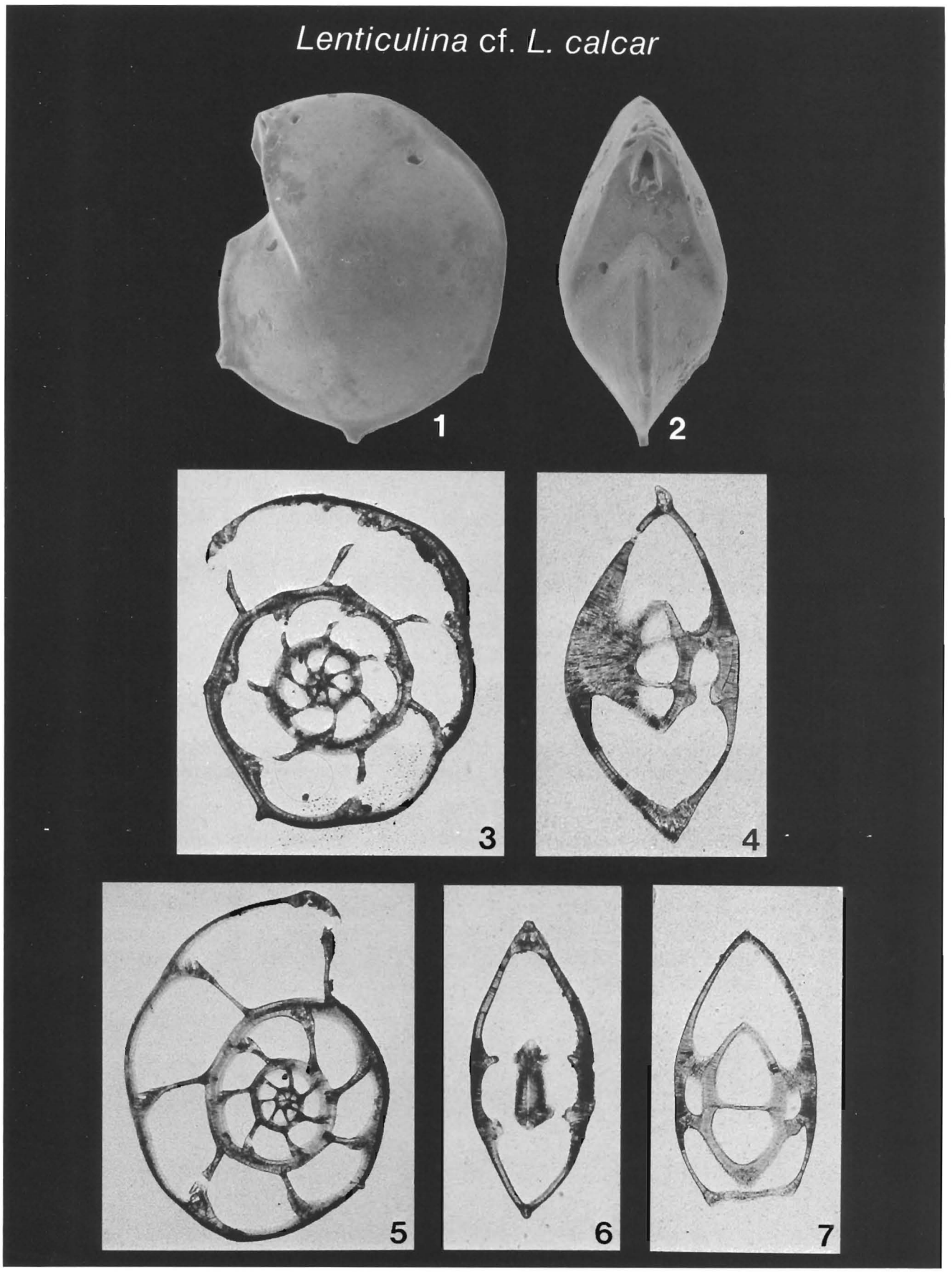
Taxonomic Remarks: Not all of the recovered specimens display peripheral spines, a feature not seen on any of the *Lenticulina* species illustrated in the regional literature. However, Bandy and Arnal (1969) recorded *Lenticulina calcar* (Linné); their unfigured species may be the same shown here. The California specimens have more angular and less prominent keels than that of figure C above.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Regional Literature for *L. calcar*: Zemorrian to Luisian (CL31).
This Study: Zemorrian(?), Saucesian to Mohnian. (UNB)

Paleoenvironmental Significance: Not determined, although the upper depth limit of other *Lenticulina* species = upper middle bathyal (Ingle, 1985).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, X85: 1, side view; 2, edge view.

Plate-figs. 3-7: Thin-section photomicrographs of specimens from sample localities CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 58: 3 = X51; 4 = X80; 5 = X51; 6 = X64; 7 = X80.


Lenticulina cf. L. calcar
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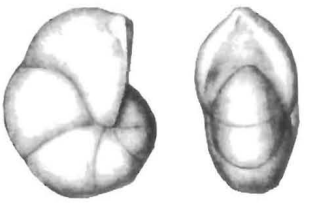
Lenticulina hughesi (Kleinpell)



18a 18b

Type Designation and Reference: *Robulus hughesi* Kleinpell, 1938, Miocene Stratigraphy of California, p. 198.

Type Figures: *Ibid.*, pl. 7, figs. 18a, b, X42.

Type Level and Locality: Upper Saucesian, Monterey Formation, Reliz Canyon, Monterey County, California.

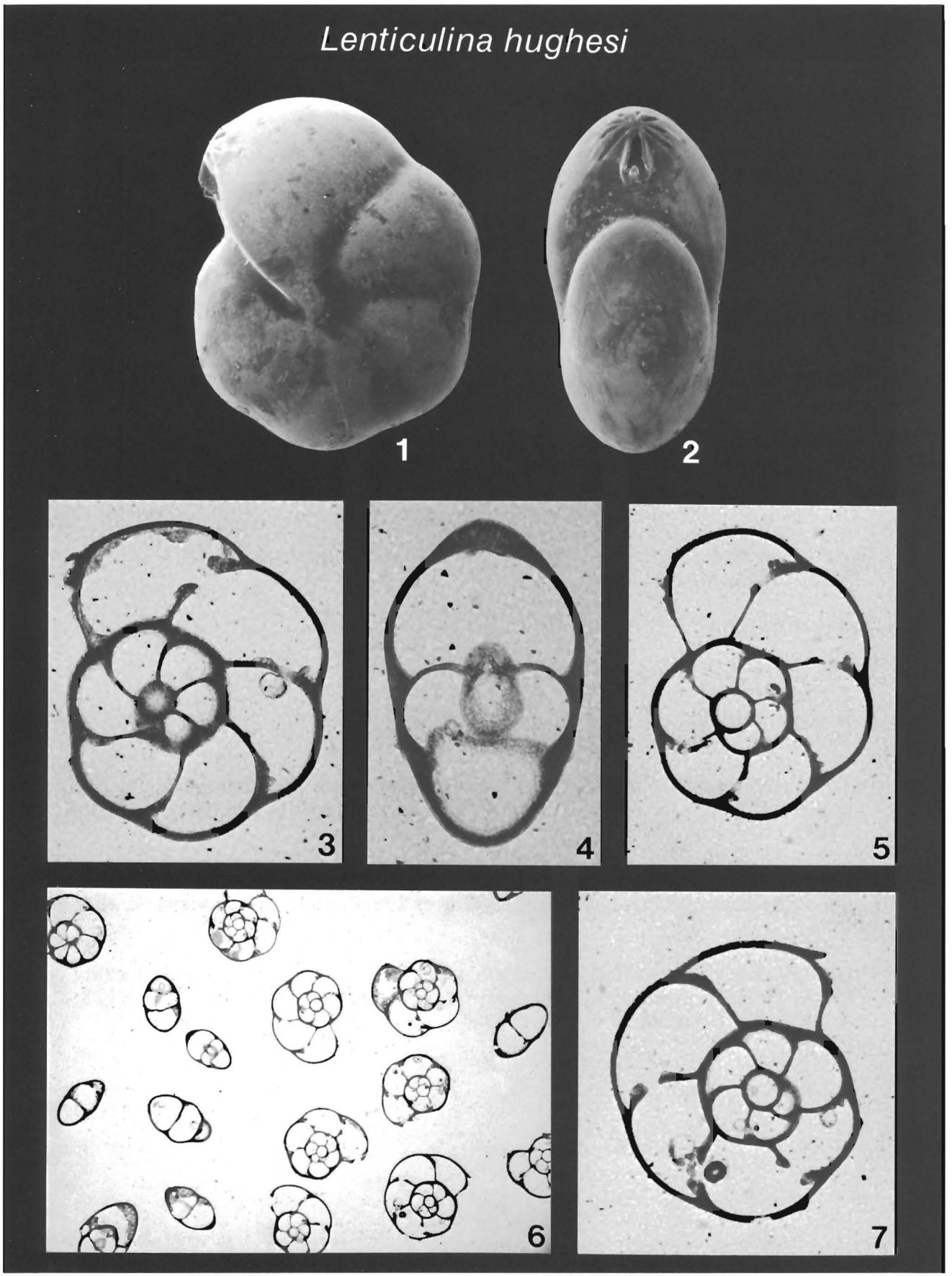
Taxonomic Remarks: Agrees with holotype (LSJU663).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Saucesian to late Relizian, early Luisian(?).
Regional Literature: Relizian to Luisian (AR84, FI90).
This Study: Saucesian to Luisian. (GC)

Paleoenvironmental Significance: Upper depth limit not determined for this species, although for other *Lenticulina* species it is upper middle bathyal (Ingle, 1985).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality GC-3, Relizian, Monterey Formation, Graves Creek, X75: 1, side view; 2, edge view.

Plate-figs. 3-7: Thin-section photomicrographs of specimens from sample locality GC-3, Relizian, Monterey Formation, Graves Creek, slide no. 48: 3, 4 = X80; 5 = X64; 6 = X20; 7 = X64.


Lenticulina hughesi
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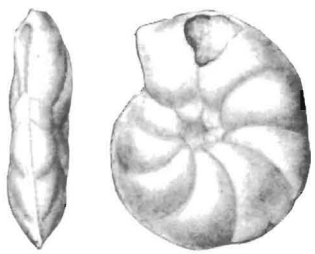
Lenticulina luciana (Kleinpell)



25b 25a

Type Designation and Reference: *Planularia luciana* Kleinpell, 1938, Miocene Stratigraphy of California, p. 207.

Type Figures: *Ibid.*, pl. 9, figs. 25a, b, X42.

Type Level and Locality: Lower Luisian, Monterey Formation, Reliz Canyon, Monterey County, California.

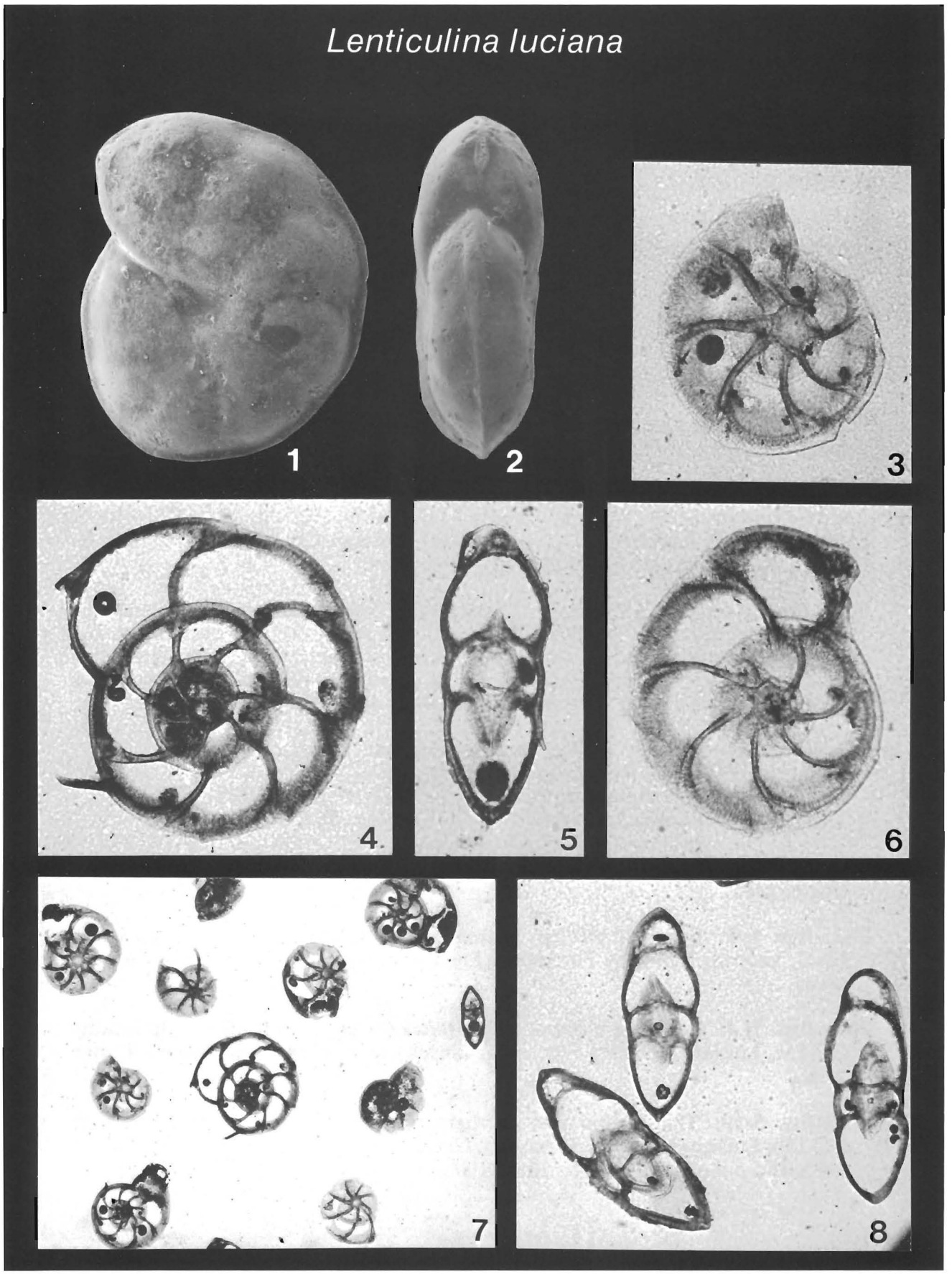
Taxonomic Remarks: Agrees with holotype (LSJU841).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Saucesian to late Relizian.
Regional Literature: Relizian to Luisian (FI90, SM60).
This Study: Saucesian to Luisian. (GC, IC)

Paleoenvironmental Significance: Upper depth limit not determined for this species, although for other *Lenticulina* species it is upper middle bathyal (Ingle, 1985).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality GC-2, Relizian, Monterey Formation, Graves Creek, X94: 1, side view; 2, edge view.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality GC-9, Relizian, Monterey Formation, Graves Creek, slide no. 47: 3 = X128; 4, 5 = X100; 6 = X128; 7 = X32; 8 = X80.


Lenticulina luciana
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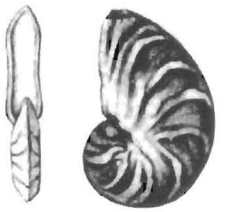
Lenticulina miocenica (Chapman)



1a 1

Type Designation and Reference: *Cristellaria miocenica* Chapman, 1900, Calif. Acad. Sci., Proc., Ser. 3, v. 1 (1897-1904), no. 8, p. 250.

Type Figures: *Ibid.*, pl. 30, figs. 1, 1a, X30.

Type Level and Locality: Miocene?*, well in Santa Clara County, California. [*Most likely from the Miocene Monterey Formation]

Taxonomic Remarks: Depository of holotype not determined, but it is probably the California Academy of Sciences. The test of this species is quite compressed and most specimens have limbate sutures; there is an ontogenetic trend toward elongation of both chambers and test. Regional workers often have referred to this species as *Robulus miocenicus*, and denoted the limbate form as a variety.

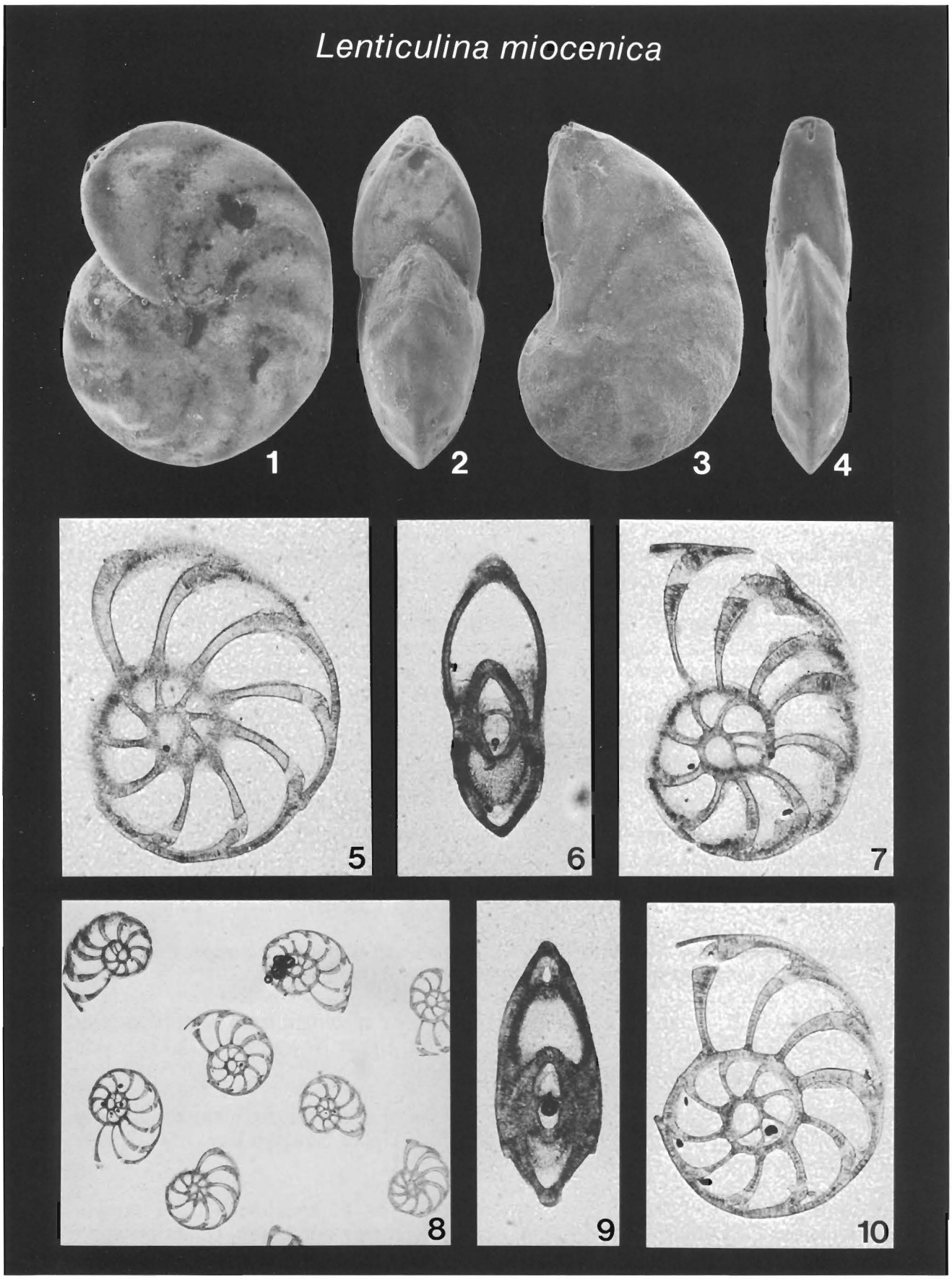
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Relizian to late Luisian.
Regional Literature: Saucesian to Luisian (AR84, FI90, KL80, PM81, SM60).
This Study: Saucesian to Luisian. (GC, IC, LH, NA, SCI, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1985).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality LH-7, Luisian, Monterey Formation, Laguna Hills, X106: 1, side view; 2, edge view.

Plate-figs. 3, 4: Scanning electron micrographs of specimen from sample locality GC-15b, Luisian, Monterey Formation, Graves Creek, X114: 3, side view; 4, edge view.

Plate-figs. 5-10: Thin-section photomicrographs of specimens from sample locality GC-15b, Luisian, Monterey Formation, Graves Creek, slide no. 105: 5, 6 = X128; 7 = X100; 8 = X32; 9 = X128; 10 = X100.


Lenticulina miocenica
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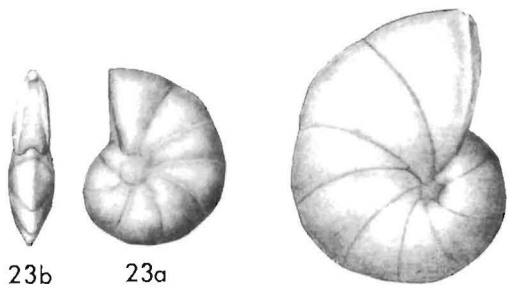
Lenticulina reedi (Kleinpell)



Type Designation and Reference: *Robulus reedi* Kleinpell, 1938, Miocene Stratigraphy of California, p. 201.

Type Figures: *Ibid.*, pl. 7, figs. 23a, b, X42; pl. 8, fig. 5, X90.

Type Level and Locality: Upper Saucesian, Monterey Formation, Reliz Canyon, Monterey Formation, California.

Taxonomic Remarks: The holotype (LSJU660) is poorly preserved (it may be an internal mold); it is slightly flattened and umbonate, with nine chambers that only slightly increase progressively in size, slightly curved-inward sutures, and an acute periphery (possibly with a very slight keel). The identification of recovered specimens is based on the paratype (LSJU931), whose central region is depressed, and not umbonate. Populations of this species exhibit considerable ontogenetic variation, as later chambers tend to be more elongate, lobulate, and noncarinate than earlier ones.

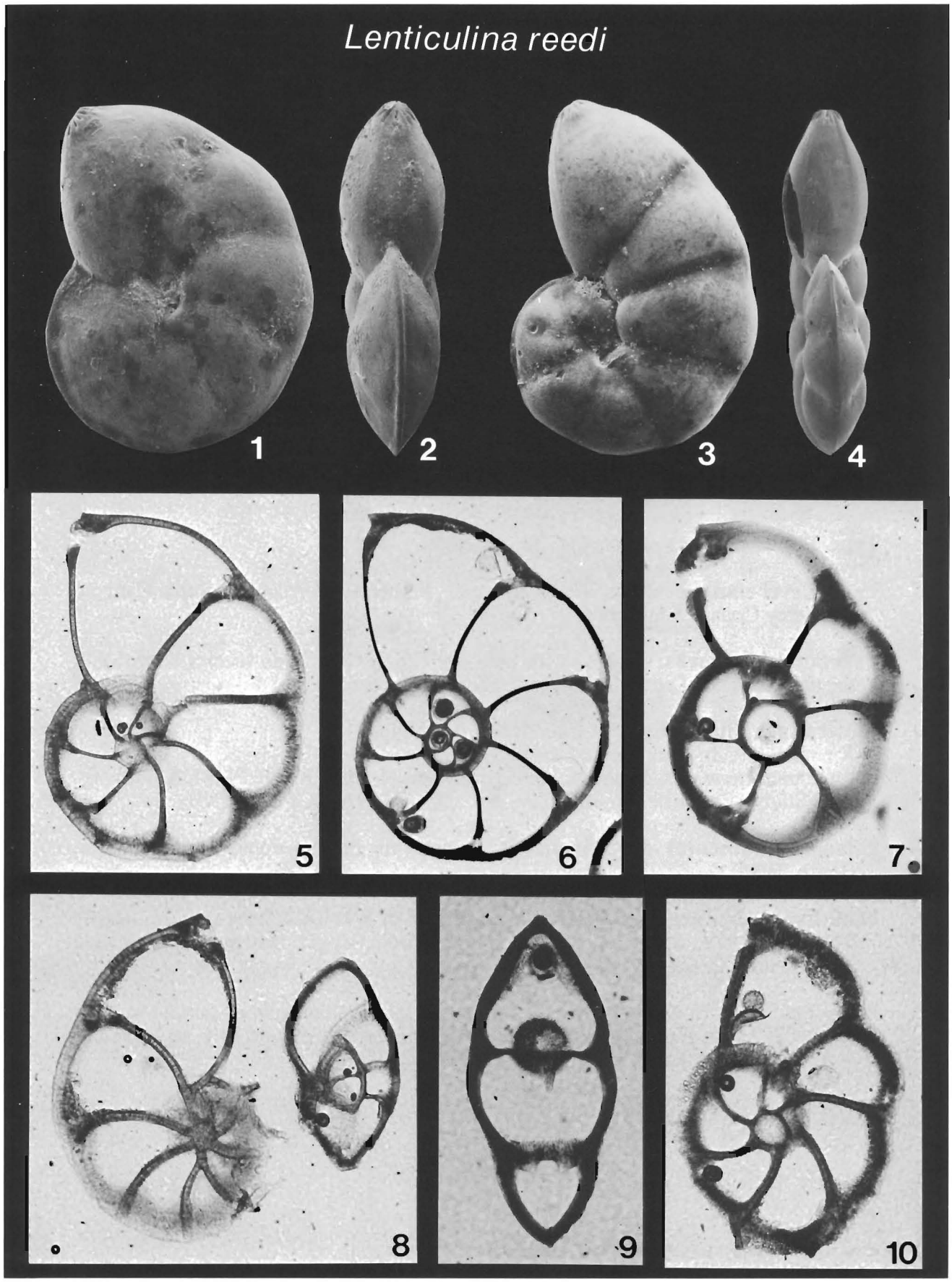
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Saucesian to late Relizian.
Regional Literature: Relizian to Luisian (FI90, PM81).
This Study: Saucesian to Mohnian. (GC, NA, SCI, UNB)

Paleoenvironmental Significance: Not determined, although the upper depth limit of other *Lenticulina* species is upper middle bathyal (Ingle, 1985).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-38, Mohnian, Monterey Formation, Upper Newport Bay, X72: 1, side view; 2, edge view.

Plate-figs. 3, 4: Scanning electron micrographs of specimen from sample locality CRC40267-39, Mohnian, Monterey Formation, Upper Newport Bay, X50: 3, side view; 4, edge view.

Plate-figs. 5-10: Thin-section photomicrographs of specimens from sample localities CRC40267-38 and -39, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 49: 5 = X80; 6 = X64; 7, 8 = X80; 9 = X128; 10 = X100.


Lenticulina reedi
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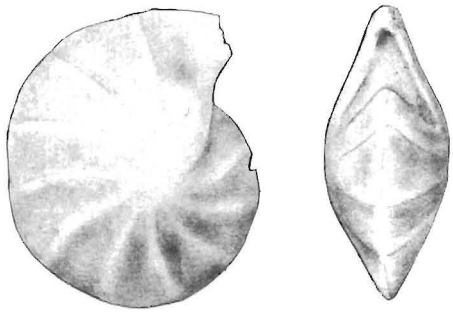
Lenticulina smileyi (Kleinpell)



14a 14b

Type Designation and Reference: *Robulus smileyi* Kleinpell, 1938, Miocene Stratigraphy of California, p. 202.

Type Figures: *Ibid.*, pl. 15, figs. 14a, b, X50.

Type Level and Locality: Upper Luisian, Monterey Formation, Reliz Canyon, Monterey County, California.

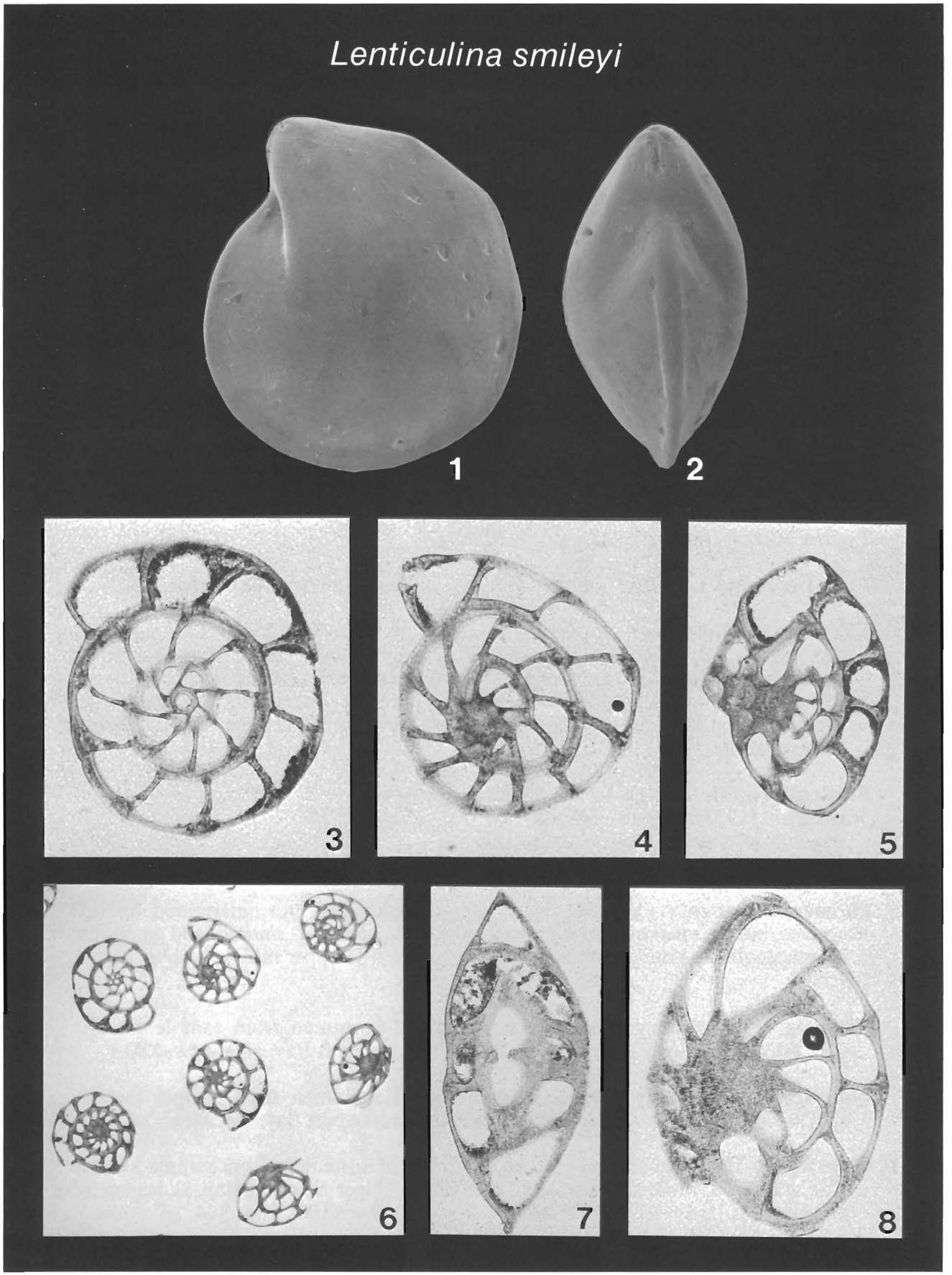
Taxonomic Remarks: Agrees with holotype (LSJU910). This species is probably the most common *Lenticulina* in the California Miocene.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Relizian to late Luisian.
Regional Literature: Zemorrian to Mohnian (AR84, FI90, KL80, PM81, SM60).
This Study: Zemorrian to Mohnian. (GC, IC, LH, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1985).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, X124: 1, side view; 2, edge view.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 50: 3-5 = X64; 6 = X20; 7, 8 = X80.


Lenticulina smileyi
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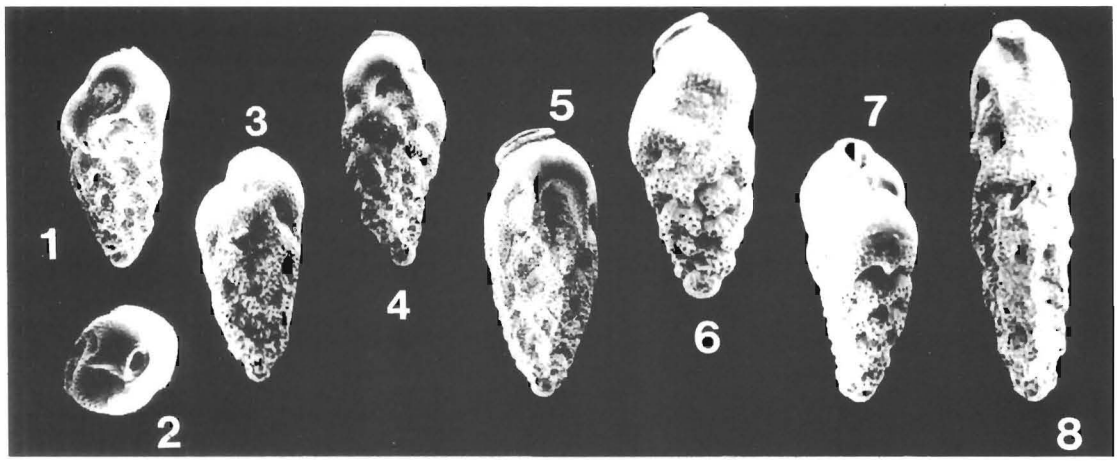
Loxostomoides digitata (Arnal)



Type Designation and Reference: *Bolivina digitata* Arnal, 1984, Jour. Foram. Res., v. 14, no. 1, p. 3.

Type Figures: *Ibid.*, pl. 1, figs. 1-8, X72.

Type Level and Locality: Lower Mohnian, offshore southern California.

Taxonomic Remarks: Agrees with holotype (USNM330501) and paratypes (USNM330502, -376433, -376434). This may be the same species that Smith (1960, pl. 57, figs. 13-14) referred to as *Bolivina* cf. *B. rhomboidalis* (Millett). Although the majority of specimens recovered are biserial throughout, larger specimens become uniserial; hence, this species is assigned to the genus *Loxostomoides*.

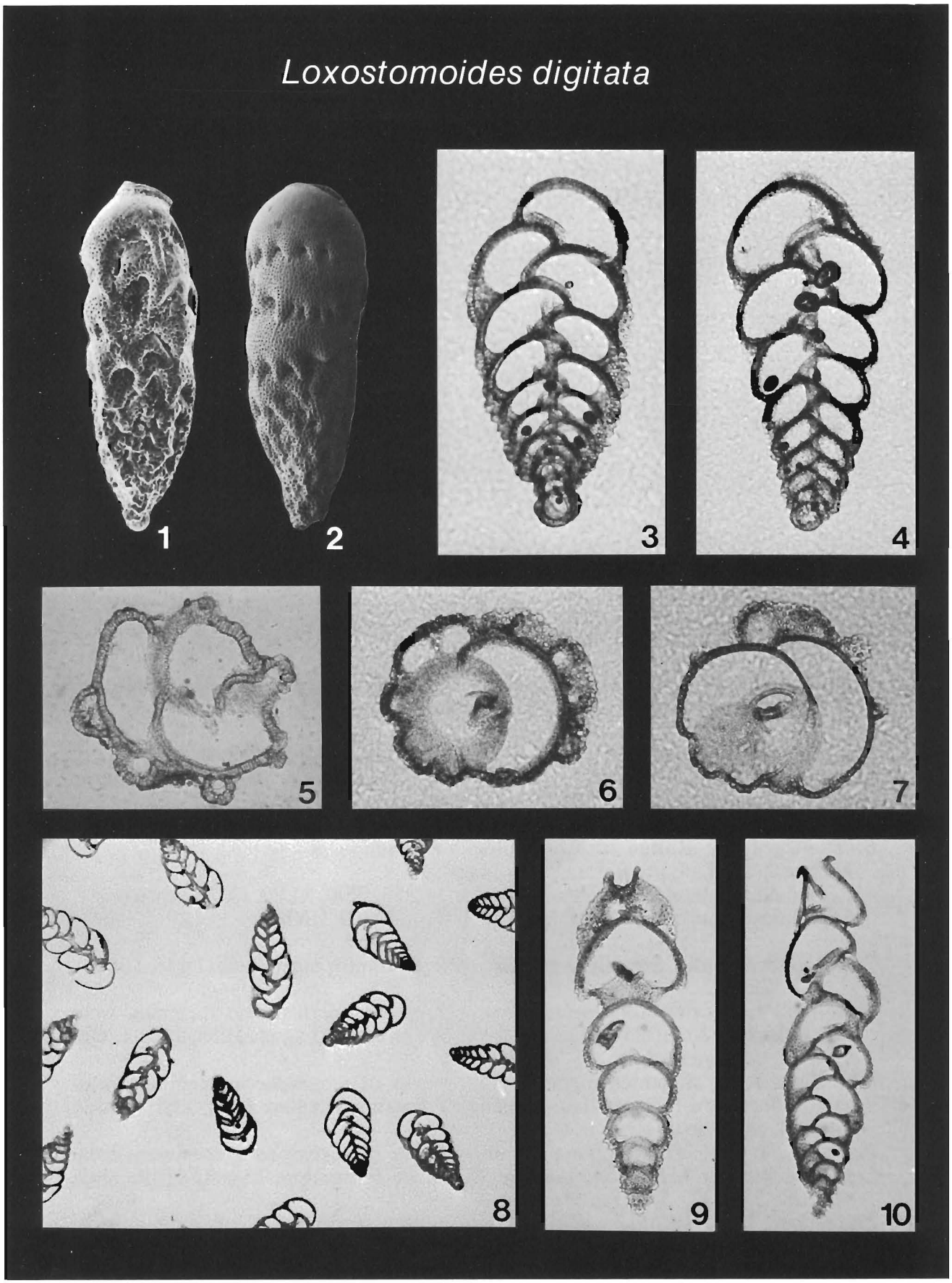
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Regional Literature: Early Mohnian (AR84).
This Study: Luisian to Mohnian. (SCI, UNB)

Paleoenvironmental Significance: Upper depth limit not determined for this species, but for other crenulate bolivinids (e.g., *B. blakei*, *B. sinuata*) and somewhat morphologically similar forms of *Rectuvigerina* it is upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-38, Mohnian, Monterey Fm., Upper Newport Bay: side view, X80.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40267-45a, Mohnian, Monterey Fm., Upper Newport Bay: side view, X63.

Plate-figs. 3-10: Thin-section photomicrographs of specimens from sample locality CRC40267-38, Mohnian, Monterey Formation, Upper Newport Bay, slides no. 16 and no. 120: 3, 4 = X128; 5-7 = X160; 8 = X32; 9 = X100; 10 = X64.


Loxostomoides digitata
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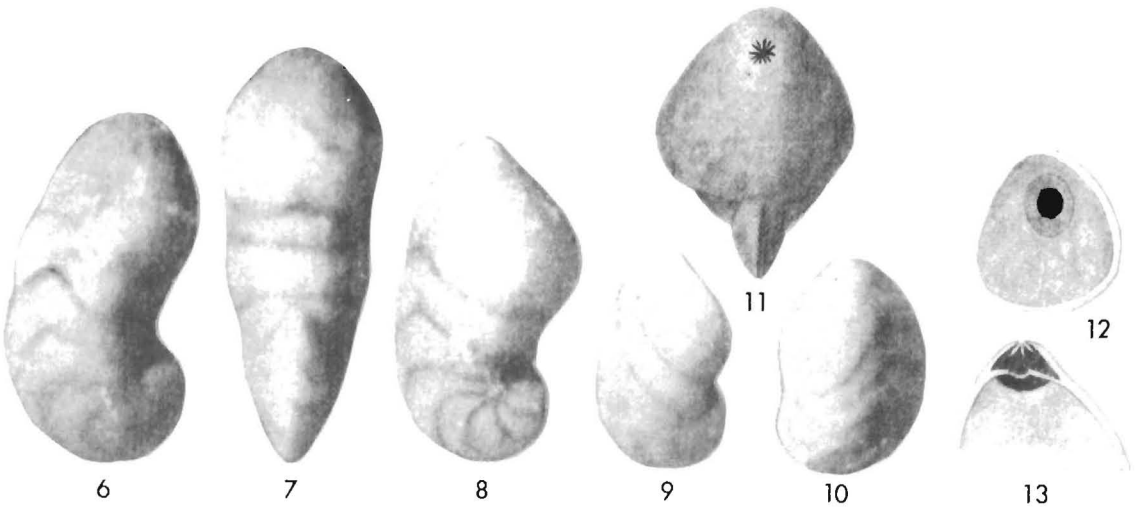
Marginulinopsis beali (Cushman)



Type Designation and Reference: *Cristellaria beali* Cushman, 1925b, Contr. Cushman Lab. Foram. Res., v. 1, no. 1, p. 25.

Type Figures: *Ibid.*, pl. 4, figs. 6-13, X35.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

Taxonomic Remarks: Agrees with holotype (USNM4342) and topotypes (USGS). Previous generic assignments have been to *Cristellaria*, *Hemicristellaria*, *Saracenaria*, and *Marginulina*.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Relizian to late Luisian.
Regional Literature: Saucesian to Mohnian (AR84, FI90, KL80, PM81, SM60).
This Study: Saucesian to Mohnian. (GC, IC, LH, SCI, UNB)

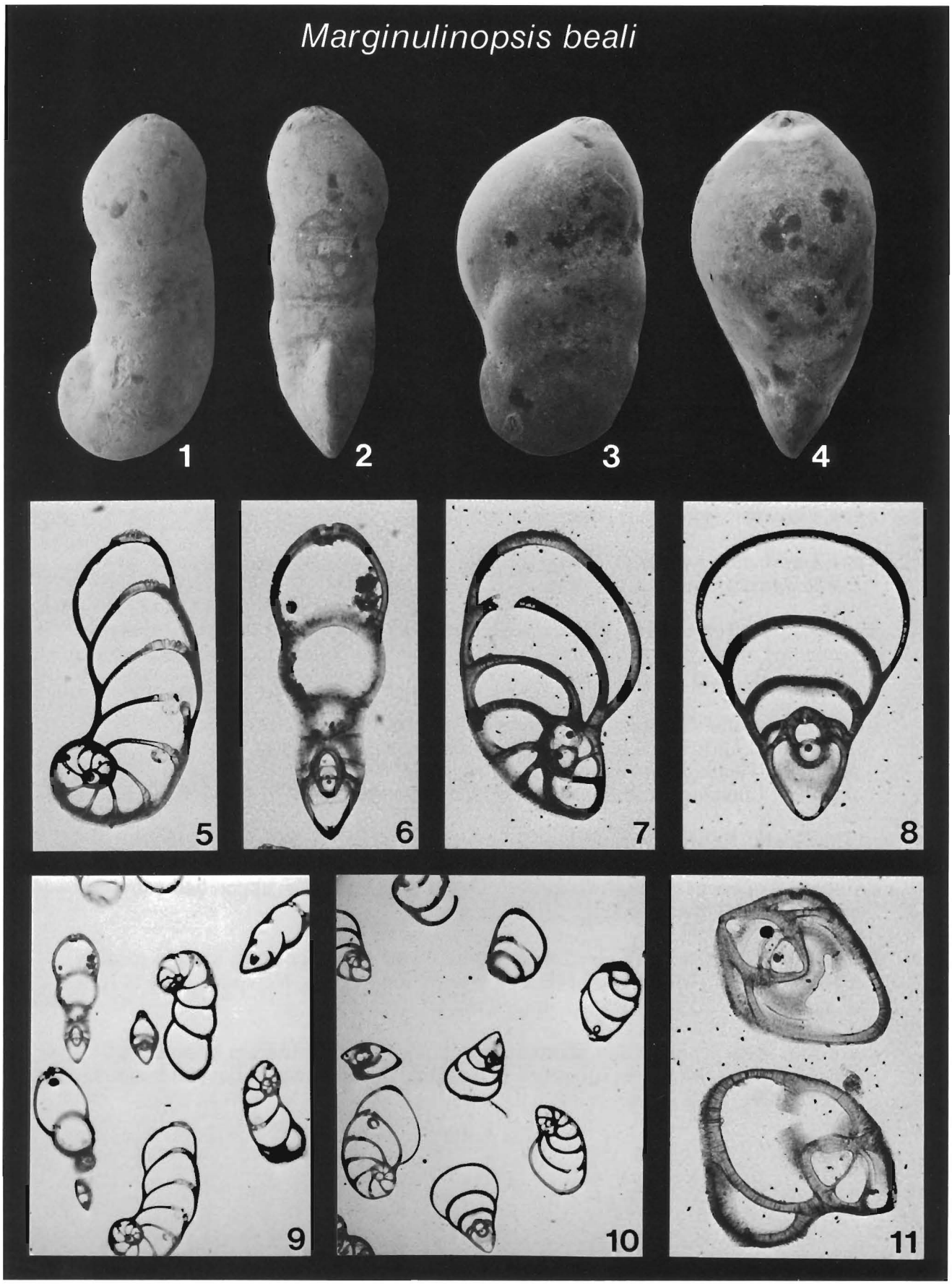
Paleoenvironmental Significance: Upper depth limit = outer shelf (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of microspheric specimen from sample locality MAR-254, Luisian, Monterey Formation, Laguna Hills, X53: 1, side view; 2, edge view.

Plate-figs. 3, 4: Scanning electron micrographs of megaspheric specimen from sample locality LH-7, Luisian, Monterey Formation, Laguna Hills, X62: 3, side view; 4, edge view.

Plate-figs. 5, 6, 9: Thin-section photomicrographs of microspheric specimens from sample locality MAR-254, Luisian, Monterey Formation, Laguna Hills, slide no. 108: 5 = X32; 6 = X51; 9 = X20.

Plate-figs. 7, 8, 10, 11: Thin-section photomicrographs of megaspheric specimens from sample locality LH-5, Luisian, Monterey Formation, Laguna Hills, slide no. 107: 7, 8 = X64; 10 = X20; 11 = X80.


Marginulinopsis beali
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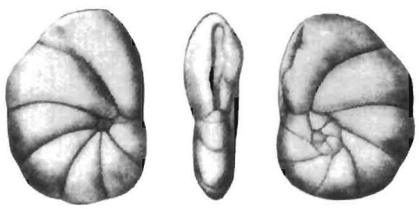
Megastomella capitanensis (Cushman and Kleinpell)



3b 3c 3a

Type Designation and Reference: *Pulvinulinella capitanensis* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 16.

Type Figures: *Ibid.*, pl. 3, figs. 3a-c, X50.

Type Level and Locality: Basal Mohnian, Monterey Formation, Naples Beach, Santa Barbara County, California.

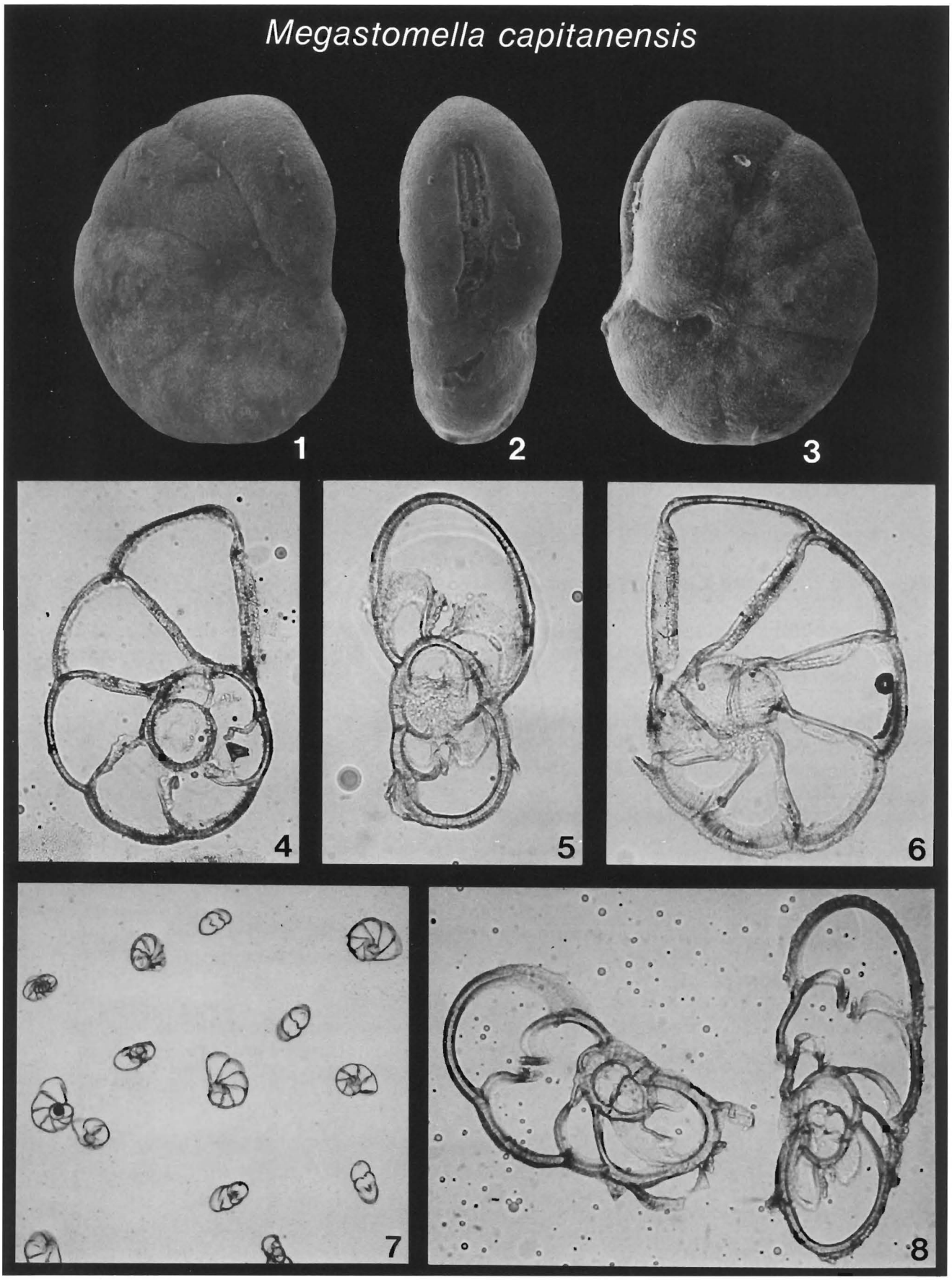
Taxonomic Remarks: Agrees with holotype (USNM20149) and topotypes recovered in this study and those housed in the USGS collection. The species often has been assigned to *Epistominella.*

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Luisian to early Mohnian, late Mohnian(?).
Kleinpell (1980): Early Mohnian to late Mohnian.
Regional Literature: Luisian to Mohnian/"Delmontian" (AR76, AR84, FI90, KL80, LI65).
This Study: Relizian to Mohnian/"Delmontian". (GC, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal/upper middle bathyal transition (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-44, Mohnian, Monterey Formation, Upper Newport Bay, X162: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality CRC40267-43, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 32: 4-6 = X200; 7 = X32; 8 = X160.


Megastomella capitanensis
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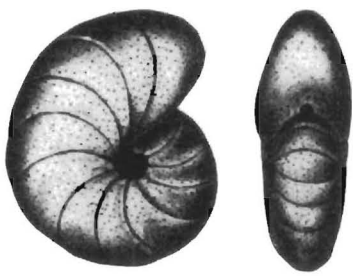
Melonis barleeanus (Williamson)



68 69

Type Designation and Reference: *Nonionina barleeana* Williamson, 1858, On the Recent Foraminifera of Great Britain, p. 32.

Type Figures: *Ibid.*, pl. 3, figs. 68, 69, X52.

Type Level and Locality: Recent, British Isles.

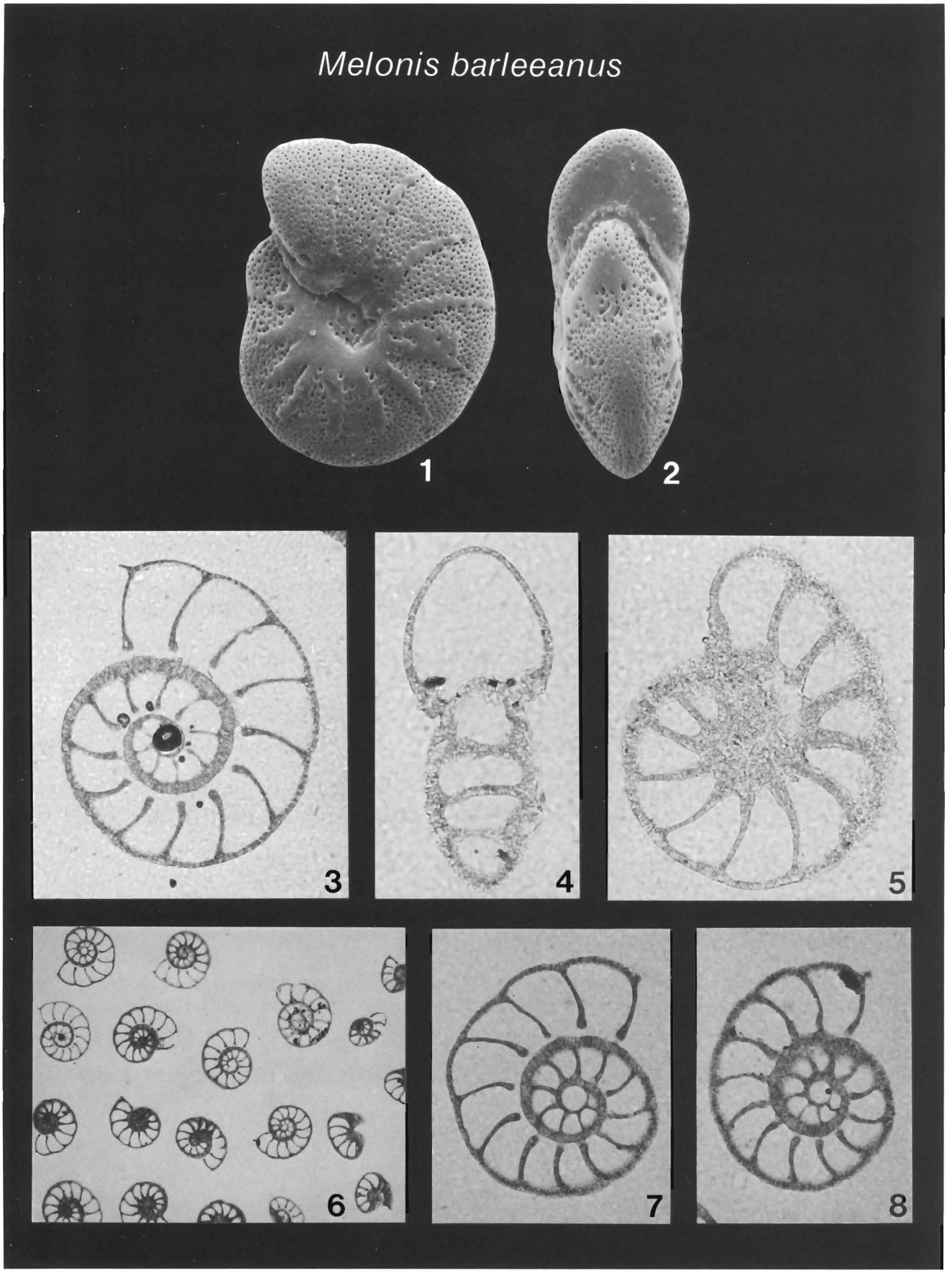
Taxonomic Remarks: This species resembles *Nonion affinis* (Reuss) *sensu* Kleinpell (1938; early Zemorrian), but is most readily distinguished by its more extensive aperture.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not reported.
Regional Literature: Luisian to Pliocene, ranges to Holocene (AR76, BE85, CB86, HA80).
This Study: Luisian to Pliocene, ranges to Holocene. (UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal/lower middle bathyal transition (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, X134: 1, side view; 2, edge view.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 79: 3 = X160; 4, 5 = X200; 6 = X32; 7, 8 = X128.


Melonis barleeanus
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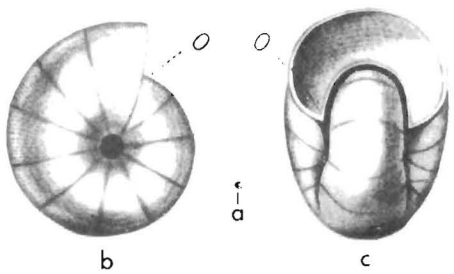
Melonis pompilioides (Fichtel and Moll)



Type Designation and Reference: *Nautilus pompilioides* Fichtel and Moll, 1798, Testacea Microscopica, p. 31.

Type Figures: *Ibid.*, pl. 2, figs. a-c, magnifications not calculated.

Type Level and Locality: Not designated; given as fossil and Recent, Italy.

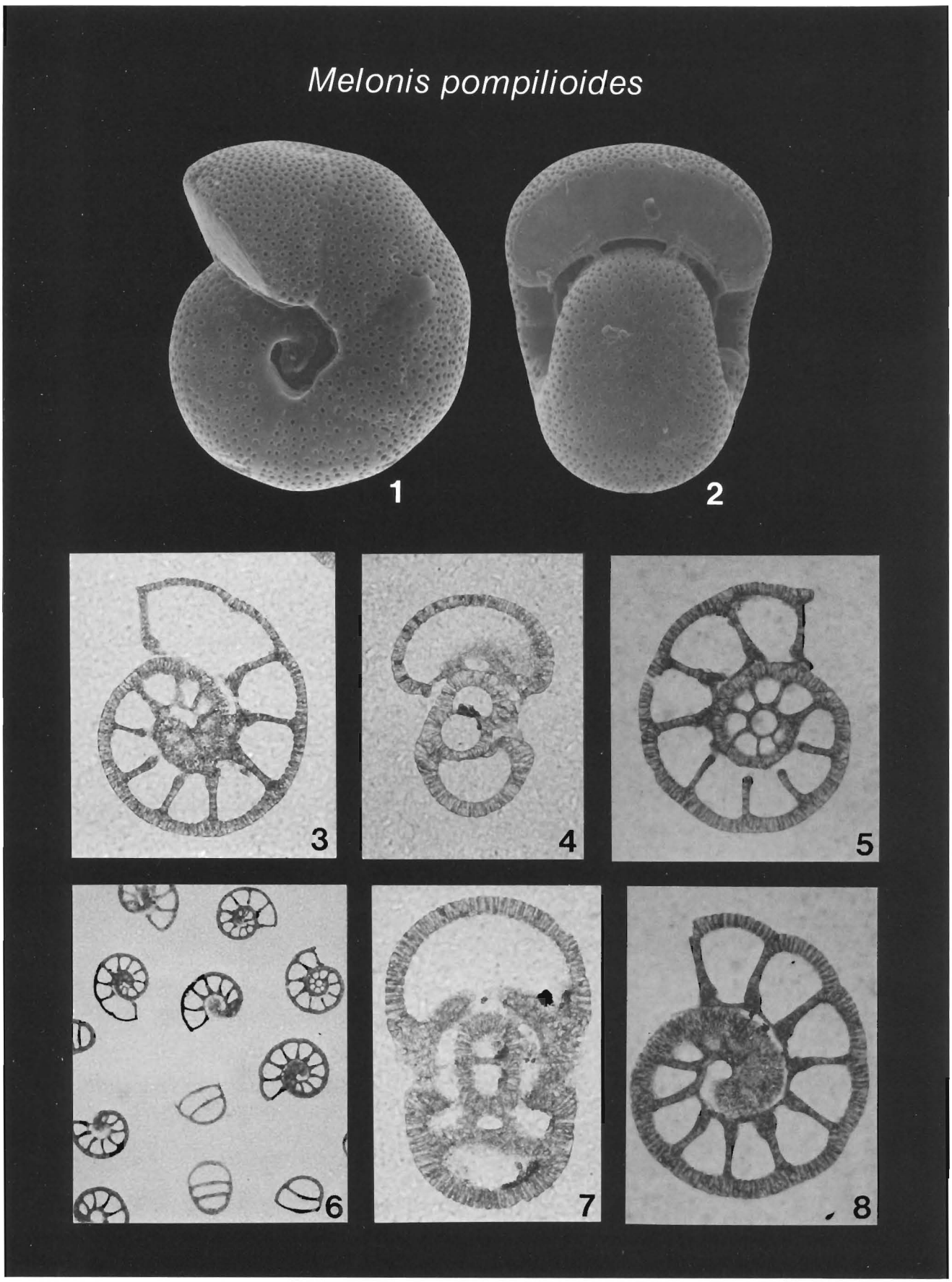
Taxonomic Remarks: Voloshinova (1958) differentiated four inflated species of *Melonis*: *M. pompilioides*, *M. soldanii* (d'Orbigny), *M. melo* (d'Orbigny), and *M. sphaeroides*, n. sp.. Hasegawa (1984) performed a biometric analysis on this group, which led him to synonymize the first three species and retain the latter. In comparison to *M. pompiloides*, *M. sphaeroides* is smaller and increases more rapidly in width, and it has fewer chambers in the final whorl, coarser wall perforation, and a smaller umbilicus.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not reported.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, AR84, BL81, BO81, CB86, HA80, MA52, WH56).
This Study: Zemorrian to Pliocene, ranges to Holocene. (UNB)

Paleoenvironmental Significance: Upper depth limit = lower middle bathyal (Ingle, personal comm.).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, X158: 1, side view; 2, edge view.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 78: 3 = X128; 4 = X160; 5 = X128; 6 = X32; 7 = X160; 8 = X128.


Melonis pompilioides
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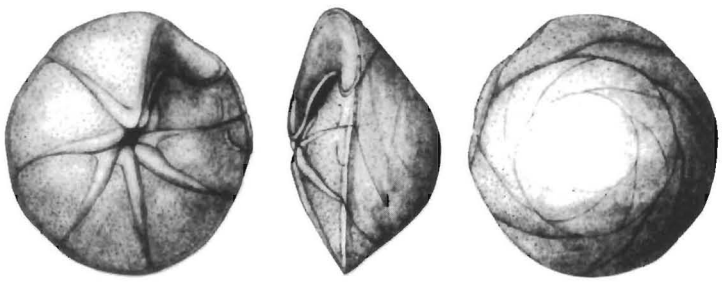
Neoeponides cf. *N. parantillarum* (Galloway and Heminway)



1b 1c 1a

Type Designation and Reference: *Eponides parantillarum* Galloway and Heminway, 1941, New York Acad. Sci., Sci. Surv., Porto Rico and Virgin Islands, v. 3, pt. 4, p. 374.

Type Figures: *Ibid.*, pl. 18, figs. 1a-c, holotype, X37.

Type Level and Locality: Lower Miocene, Quebradillas Formation, south of Hatillo, Puerto Rico.

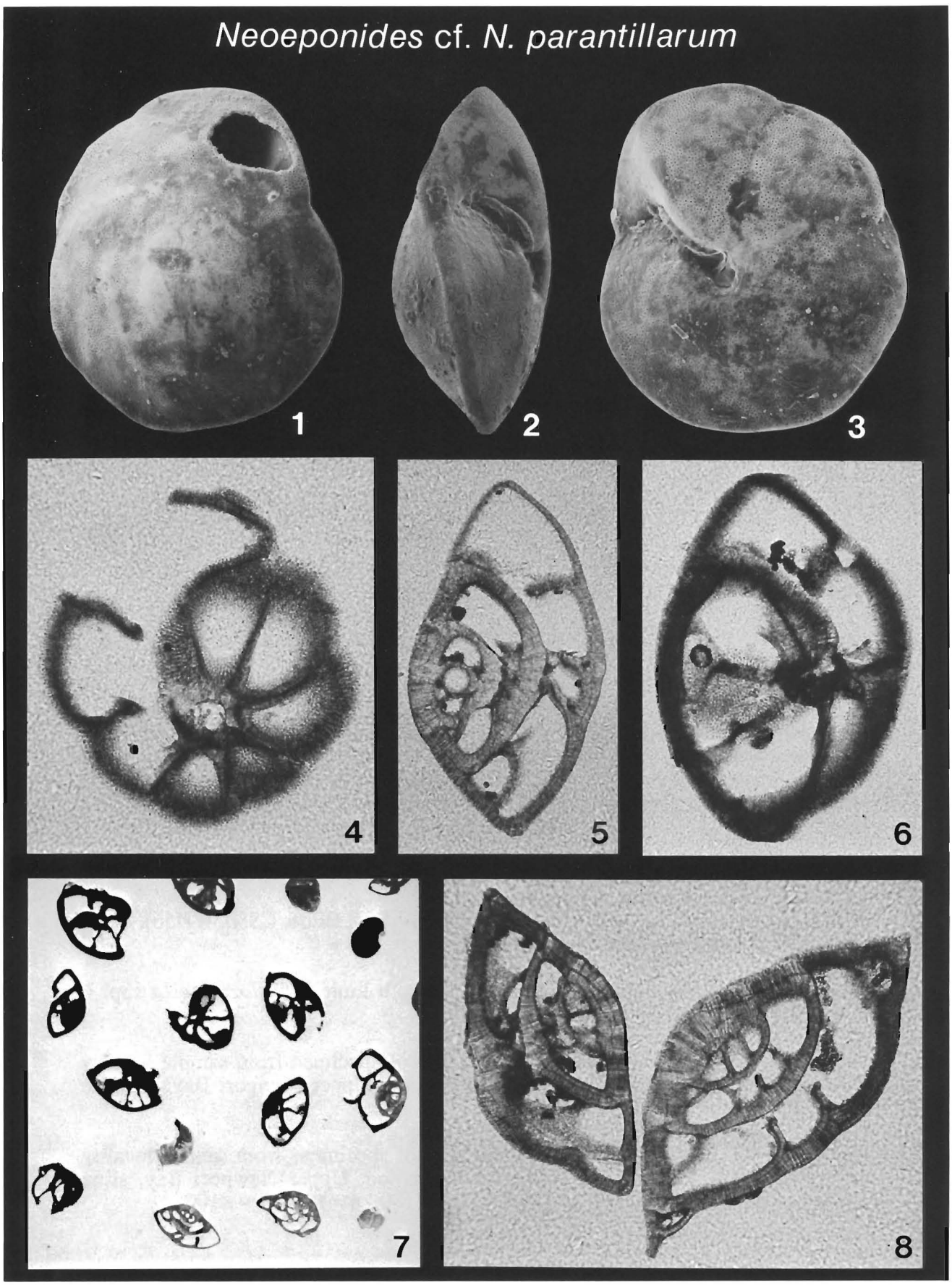
Taxonomic Remarks: The California Miocene species differs from *N. parantillarum* by its lower spire and lack of thickened umbilical sutures.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized, although *Eponides frizzelli* Kleinpell (1938) is a very similar form that he reported from the early Zemorrian.
Regional Literature: Pliocene (CS30).
This Study: Luisian to Pliocene. (LH, NA, SCI)

Paleoenvironmental Significance: Upper depth limit not determined for this species, but it is probably shelf.

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-35a, Luisian, Monterey Formation, Upper Newport Bay, X107: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality UCLA-6317, Luisian, Monterey Formation, San Clemente Island, slide no. 104: 4-6 = X100; 7 = X20; 8 = X100.


Neoeponides cf. N. parantillarum
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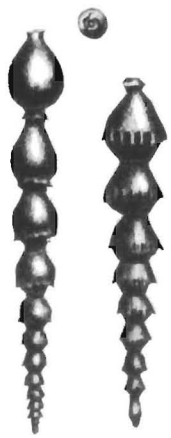
Nodogenerina lepidula (Schwager)



27 28

Type Designation and Reference: *Nodosaria lepidula* Schwager, 1866, *Novara* Exped. 1857-1859, Geol. Theil., v. 2, pt. 2, p. 210.

Type Figures: *Ibid.*, pl. 3, pl. 5, figs. 27, 28, magnifications not given.

Type Level and Locality: Upper Tertiary, India.

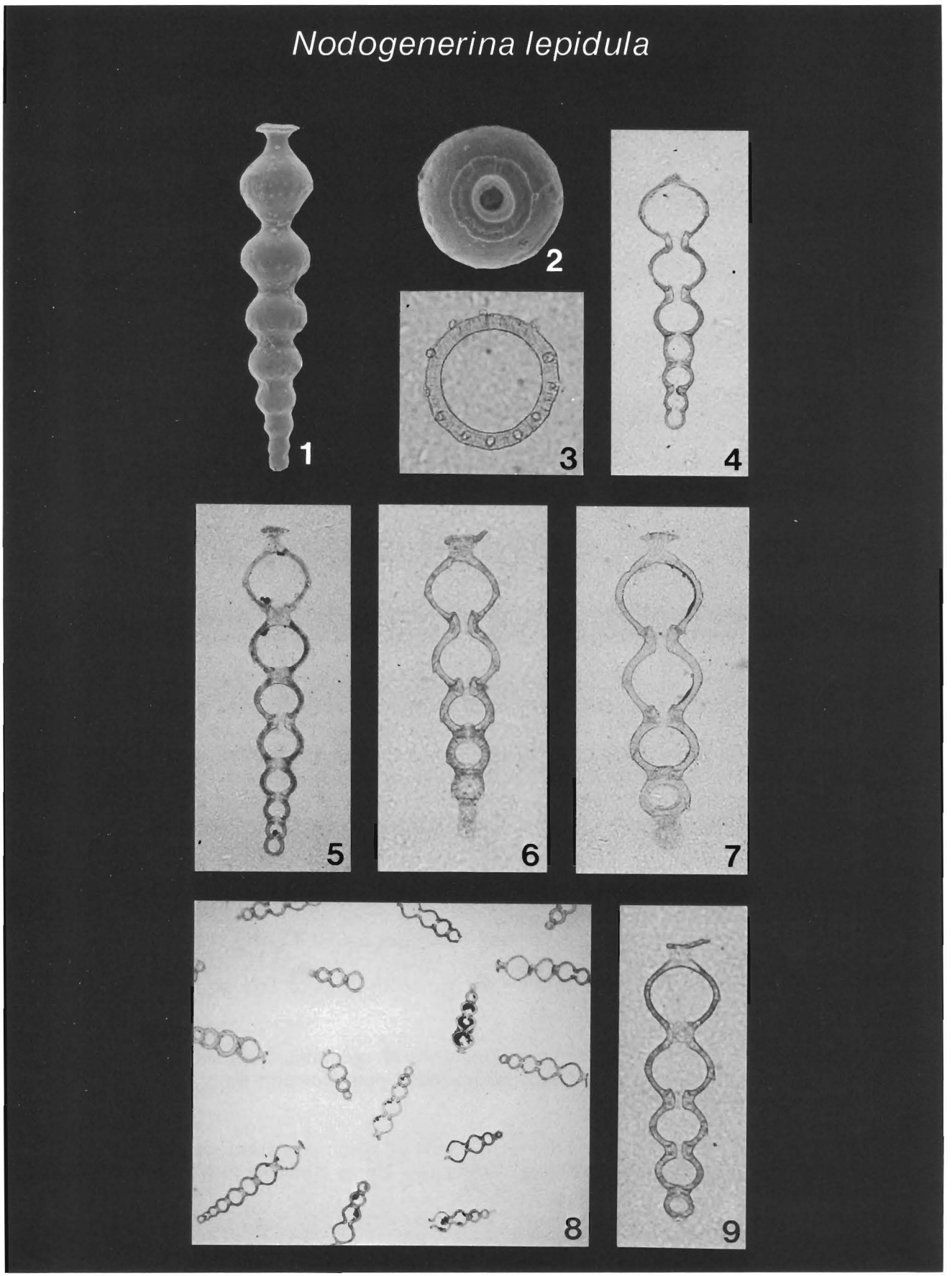
Taxonomic Remarks: This species is distinguished from other regional Nodogenerinas by its chambers, which have their maximum width at midline where they are fringed with small blunt spines. The bell shape and ornamentation of the chambers distinguishes the genus from *Stilostomella*, to which it has often been assigned.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not reported.
Regional Literature: Luisian to Pliocene (AR76, AR84, BE86, CS30, WH56).
This Study: Luisian to Pliocene. (UNB)

Paleoenvironmental Significance: Upper depth limit of *Stilostomella* spp. = lower middle bathyal (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: 1, side view, X90; 2, apertural view, X160.

Plate-figs. 3-9: Thin-section photomicrographs of specimens from sample locality CRC40267-28a, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 67: 3 = X200; 4 = X100; 5 = X80; 6, 7 = X100; 8 = X32; 9 = X100.


Nodogenerina lepidula
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Nodogenerina sagrinensis (Bagg)

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Type Designation and Reference: *Nodosaria sagrinensis* Bagg, 1912, U.S. Geol. Surv., Bull., no. 513, p. 58.

Type Figures: *Ibid.*, pl. 16, fig. 4, X60.

Type Level and Locality: Lower Pleistocene*, San Pedro Formation*, Timms Point, San Pedro, Los Angeles County, California. [*Cited by author as Pliocene, San Diego Formation]

Taxonomic Remarks: Superficially similar to *Siphonodosaria advena* (Cushman and Laiming, 1931), but differs in having its chambers widest at the base rather than at the center, the basal margin of chambers fringed with small blunt spines, and in lacking a crenulate apertural lip. The bell shape and ornamentation of the chambers distinguishes the genus from *Stilostomella*, to which it has often been assigned. *Nodosaria koina* var. *hughesi* Cushman (1926c) may be a variant of this species.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not reported.
Regional Literature: Saucesian to Luisian (FI90).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, MQ, NA, SCI, UNB)

Paleoenvironmental Significance: Upper depth limit of *Stilostomella* spp. = lower middle bathyal (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-38, Mohnian, Monterey Formation, Upper Newport Bay: 1, side view, X57; 2, apertural view, X146.

Plate-figs. 3-7: Thin-section photomicrographs of specimens from sample locality CRC40267-45a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 66: 3, 4 = X100; 5 = X32; 6 = X80; 7 = X100.

Nodogenerina sagrinensis


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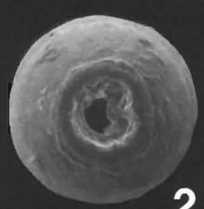
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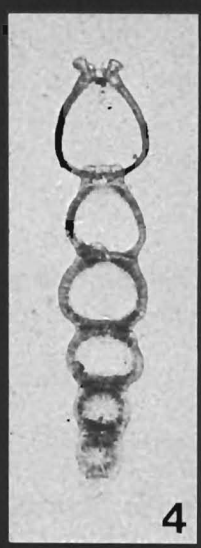
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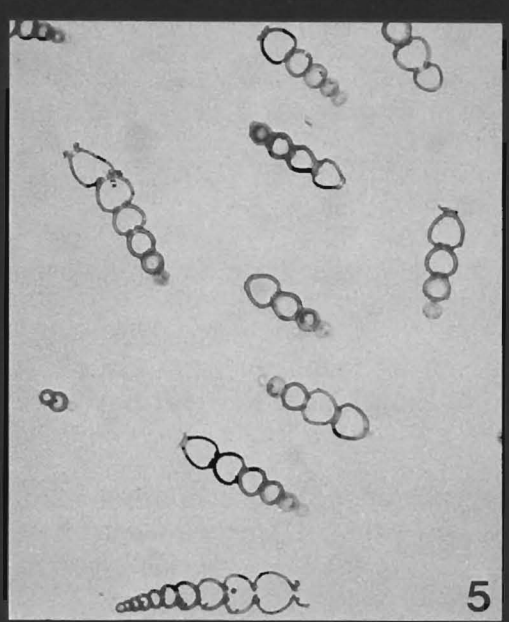
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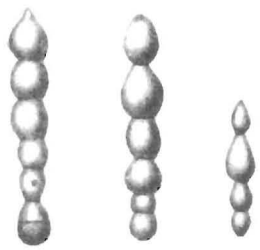
Nodosaria cf. *N. anomala* Reuss



Type Designation and Reference: *Nodosaria* (*Nodosaria*) *anomala* Reuss, 1866, K. Akad. Wiss. Wien, Math.-Naturw. Cl., Denkschr., v. 25, pt. 1, p. 129.

Type Figures: *Ibid.*, pl. 1, figs. 20-22, magnifications not given.

Type Level and Locality: Middle Oligocene, Germany.

Taxonomic Remarks: This form superficially resembles the European species named by Reuss, but differs in being more consistent in chamber shape and generally having fewer chambers comprising the test.

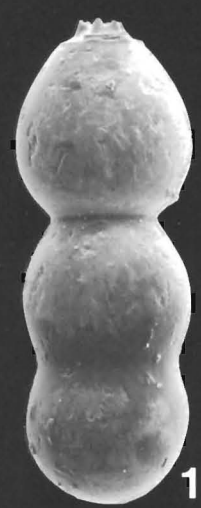
Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *N. anomala*: Early Zemorrian to early Saucesian, late Saucesian(?).
Regional Literature: Zemorrian to Pliocene (MA52).
This Study: Zemorrian to Pliocene. (SCI, UNB)

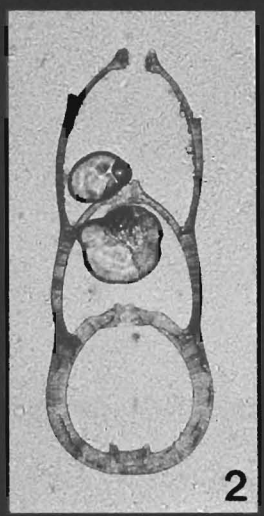
Paleoenvironmental Significance: Upper depth limit for this species not determined, but its associated fauna suggests that it is bathyal.

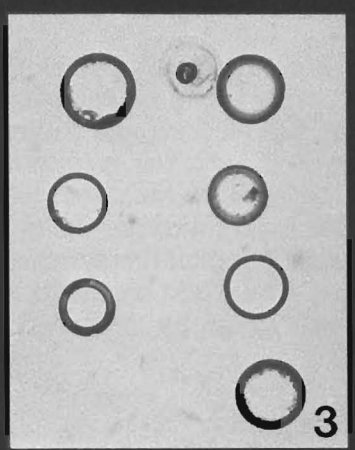
Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: side view, X67.

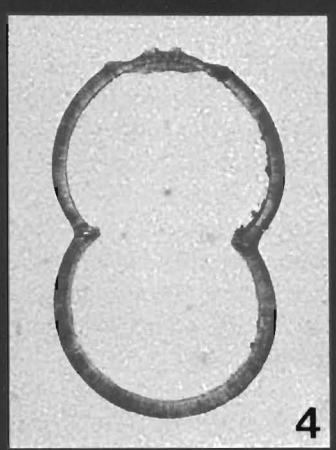
Plate-figs. 2-4: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 116: 2 = X80; 3 = X32; 4 = X80.

Nodosaria cf. *N. anomala*









Nodosaria ewaldi Reuss

2a 2b

Type Reference: Reuss, 1851, Deutsch. Geol. Ges., Zeitschr., v. 3, p. 58.

Type Figures: *Ibid.*, pl. 3, figs. 2a, b, X15.

Type Level and Locality: Eocene, Germany.

Taxonomic Remarks: There are several comparable species described in the literature: *Orthoceras farcimen* Soldani (1798) is not an available name; *N. elongata* d'Orbigny (*in* Fornasini, 1902, nom. subst. pro *N. farcimen* Silvestri (1872, nom. subst. pro *N. ovicula* d'Orbigny, 1826) and *N. gracilis* Neugeboren (1852) are synonymous. *N. longiscata* d'Orbigny (1846), *D. trichostoma* Reuss (1851), and *N. roemeri* Neugeboren (1852) all look somewhat different from this species, yet these names have probably been applied in the regional literature to segments of the form shown here. Partial specimens lacking the earliest chambers are distinguished from those of *N.* cf. *N. tympaniplectriformis* Reuss by their more cylindrical (vs. fusiform) chambers.

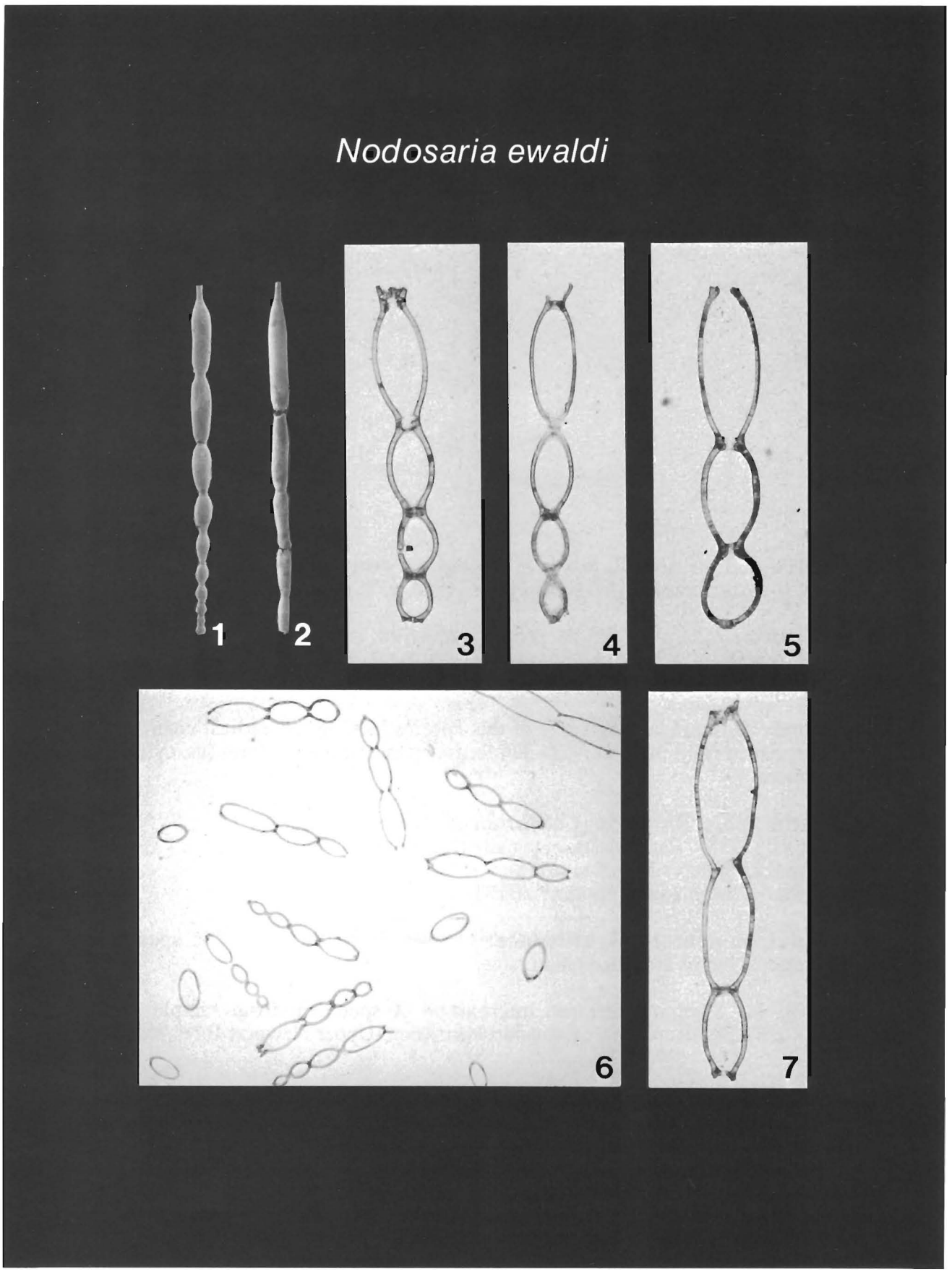
Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *N. longiscata*: Early Zemorrian to late Luisian, Mohnian(?).
Regional Literature: Zemorrian to Pliocene (AR84, BE86, FI90, MA52).
This Study: Zemorrian to Pliocene. (GC, IC, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit for this species not determined, but its associated fauna suggests that it is bathyal.

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay: side view, X24.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40267-35a, Luisian, Monterey Fm., Upper Newport Bay: side view, X34.

Plate-figs. 3-7: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 69: 3-5 = X64; 6 = X25; 7 = X64.


Nodosaria ewaldi
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Nodosaria cf. *N. tympaniplectriformis* Schwager

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Type Designation and Reference: *Nodosaria tympaniplectriformis* Schwager, 1866, *Novara* Exped. 1857-1859, Geol. Theil., v. 2, pt. 2, p. 215.

Type Figure: *Ibid.*, pl. 5, fig. 34, magnification not indicated.

Type Level and Locality: Upper Tertiary, India.

Taxonomic Remarks: Segments of this species lacking the earliest chambers are distinguished from those of *N. ewaldi* Reuss by their more fusiform (vs. cylindrical) chambers.

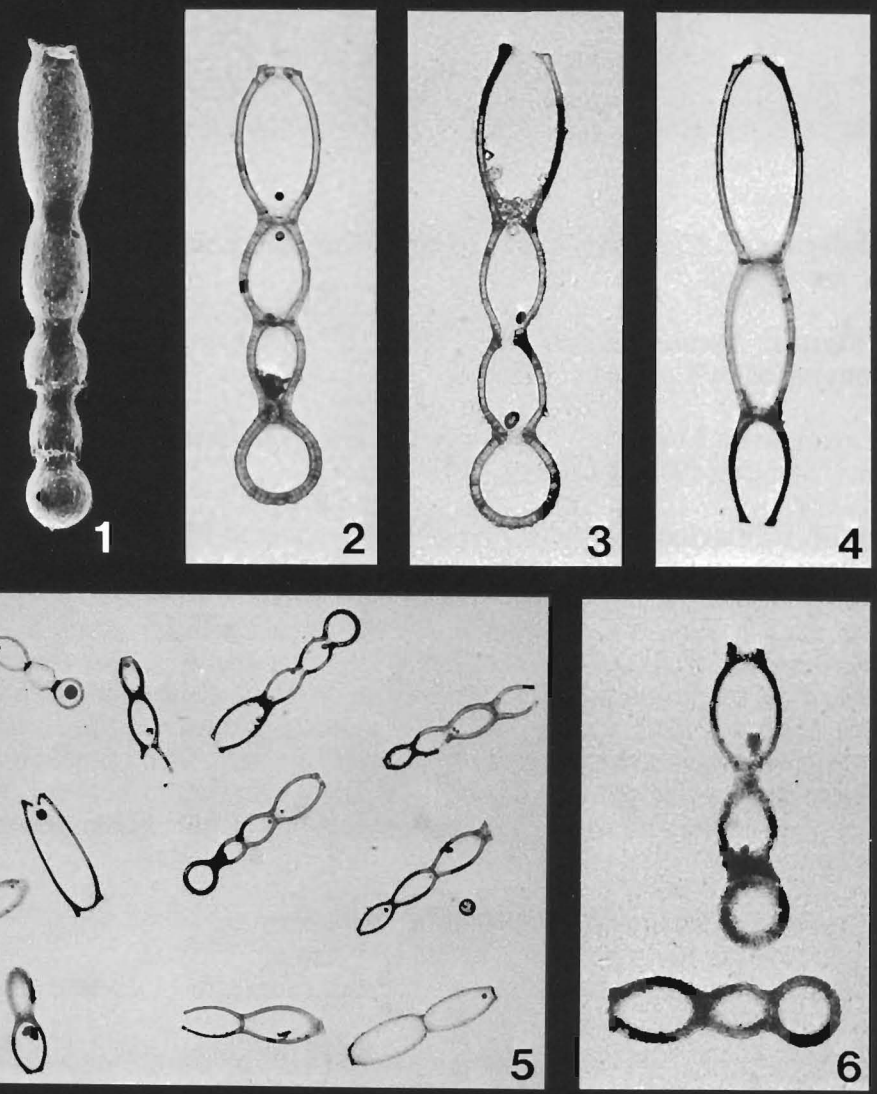
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Mohnian to early Delmontian.
Regional Literature: Mohnian (PI56).
This Study: Mohnian to Pliocene. (UNB)

Paleoenvironmental Significance: Upper depth limit for this species not determined, but its associated fauna suggests that it is bathyal.

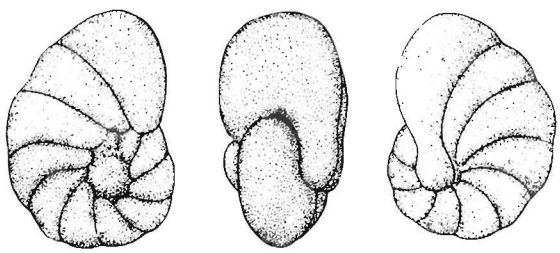
Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: side view, X70.

Plate-figs. 2-6: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 70: 2, 3 = X80; 4 = X64; 5 = X32; 6 = X80.

Nodosaria cf. *N. tympaniplectriformis*



Nonionella miocenica Cushman



Type Reference: Cushman, 1926c, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 64, not figured.

Above Figure: *Nonionina auris* (d'Orbigny) in Cushman, 1926a, pl. 13, figs. 4a-c. [Synonymized by Cushman (1926c)]

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

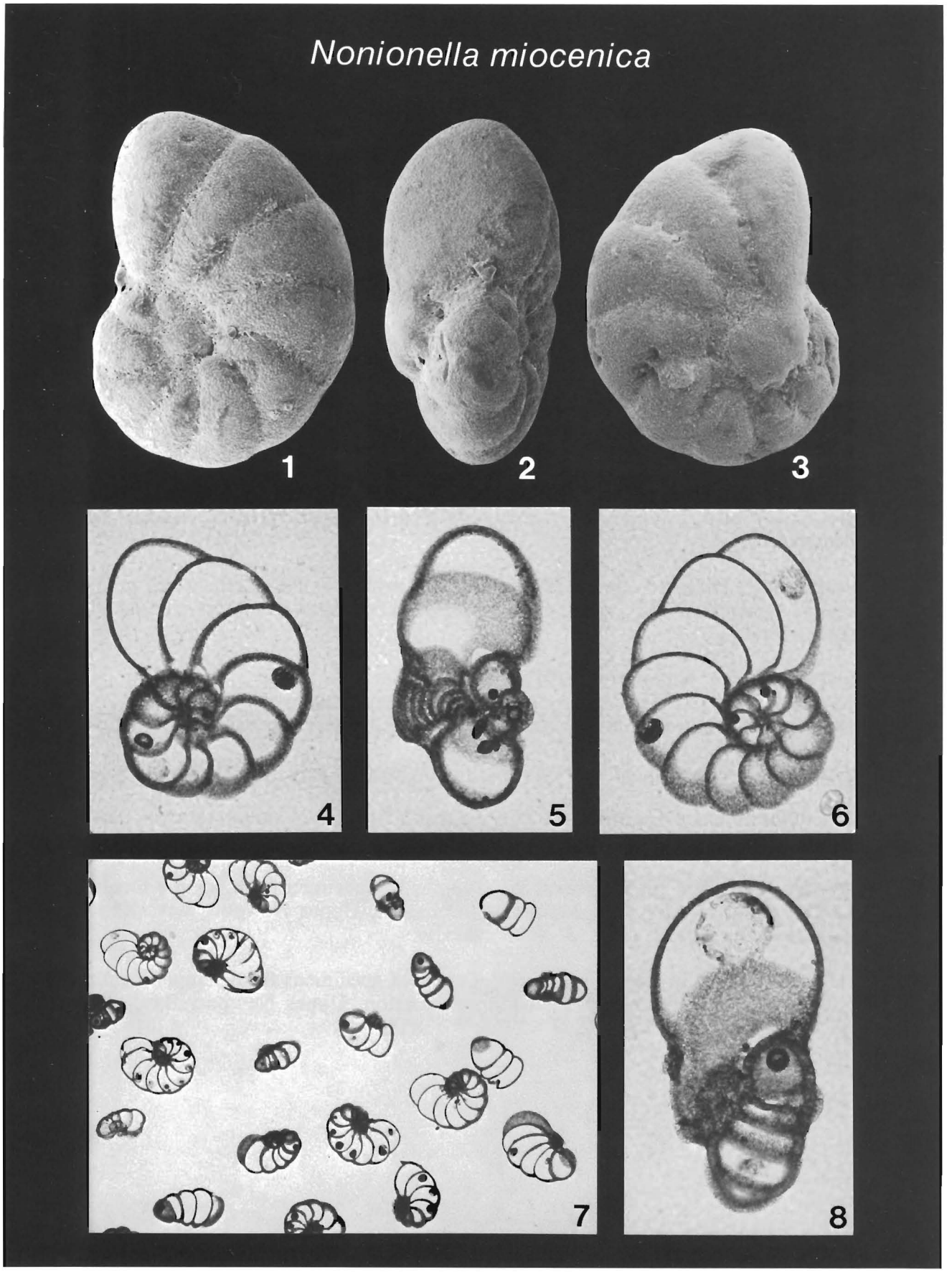
Taxonomic Remarks: The vast majority of recovered forms are small (immature) specimens which agree with the holotype (USNM4370) and topotypes (USGS) and match *Nonionina auris* (d'Orbigny) *sensu* Cushman (1925c, pl. 7, figs. 3a-c; 1926a, pl. 13, figs. 4a-c). Pierce (1956) named similar small specimens *N. davanaensis* (USNM), which is probably the same species. The variant illustrated here matches the holotype of *N. miocenica* var. *stella* Cushman and Moyer (1930; Recent, off San Pedro; USNM13953). Cushman and Moyer (*ibid.*) noted that the features of the lobe seem to be "only a varietal character". The value in differentiating this variety is questionable, as there is a direct correlation between size and the development of the stellate lobe, suggesting that this form is a later ontogenetic stage of the species.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Saucesian to late Delmontian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (BE86, CB86, CS30, HA80, PI56, SM60, WH56).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, IC, LH, MQ, NA, SCI, TC, TR, UNB)

Paleoenvironmental Significance: Upper depth limit = inner shelf (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality MAR-254, Luisian, Monterey Formation, Laguna Hills, X112: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality MAR-254, Luisian, Monterey Formation, Laguna Hills, slide no. 97: 4-6 = X128; 7 = X32; 8 = X128.


Nonionella miocenica
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Oridorsalis umbonata (Reuss)

35b 35c 35a

Type Designation and Reference: *Rotalina umbonata* Reuss, 1851, Deutsch. Geol. Ges., Zeitschr., v. 3, p. 75.

Type Figures: *Ibid.*, pl. 5, figs. 35a-c, magnification not indicated.

Type Level and Locality: Eocene localities in Germany (type locality not designated).

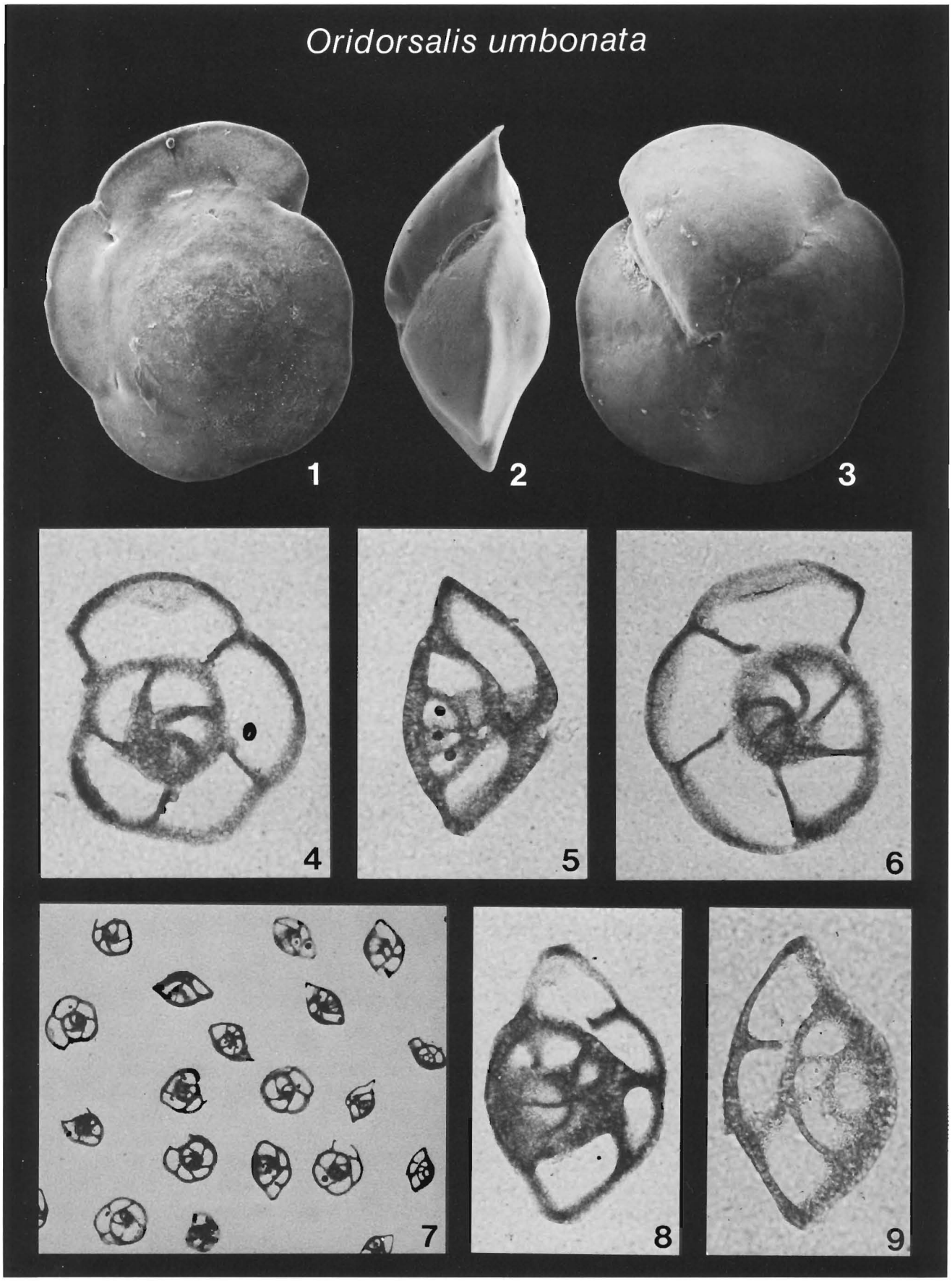
Taxonomic Remarks: As its minute secondary apertures on the spiral sutures are not readily apparent on all specimens, this species could easily be mistaken for *Gyroidina tenera* (Brady).

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *Eponides umbonatus*: Early Zemorrian to early Saucesian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, BE86, CB86, HA80, FI90, TI73).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, TC, UNB)

Paleoenvironmental Significance: Upper depth limit (for *E. umbonatus*) = upper middle bathyal (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, X156: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 63: 4-6 = X160; 7 = X32; 8 = X160; 9 = X200.


Oridorsalis umbonata
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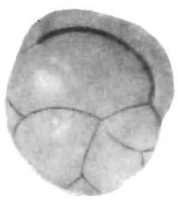
Paracassidulina delicata (Cushman)



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Type Designation and Reference: *Cassidulina delicata* Cushman, 1927, Scripps Inst. Oceanogr., Bull., Tech. Ser., v. 1, p. 168.

Type Figure: *Ibid.*, pl. 6, fig. 5, X50.

Type Level and Locality: Recent, off Panama, Pacific Ocean.

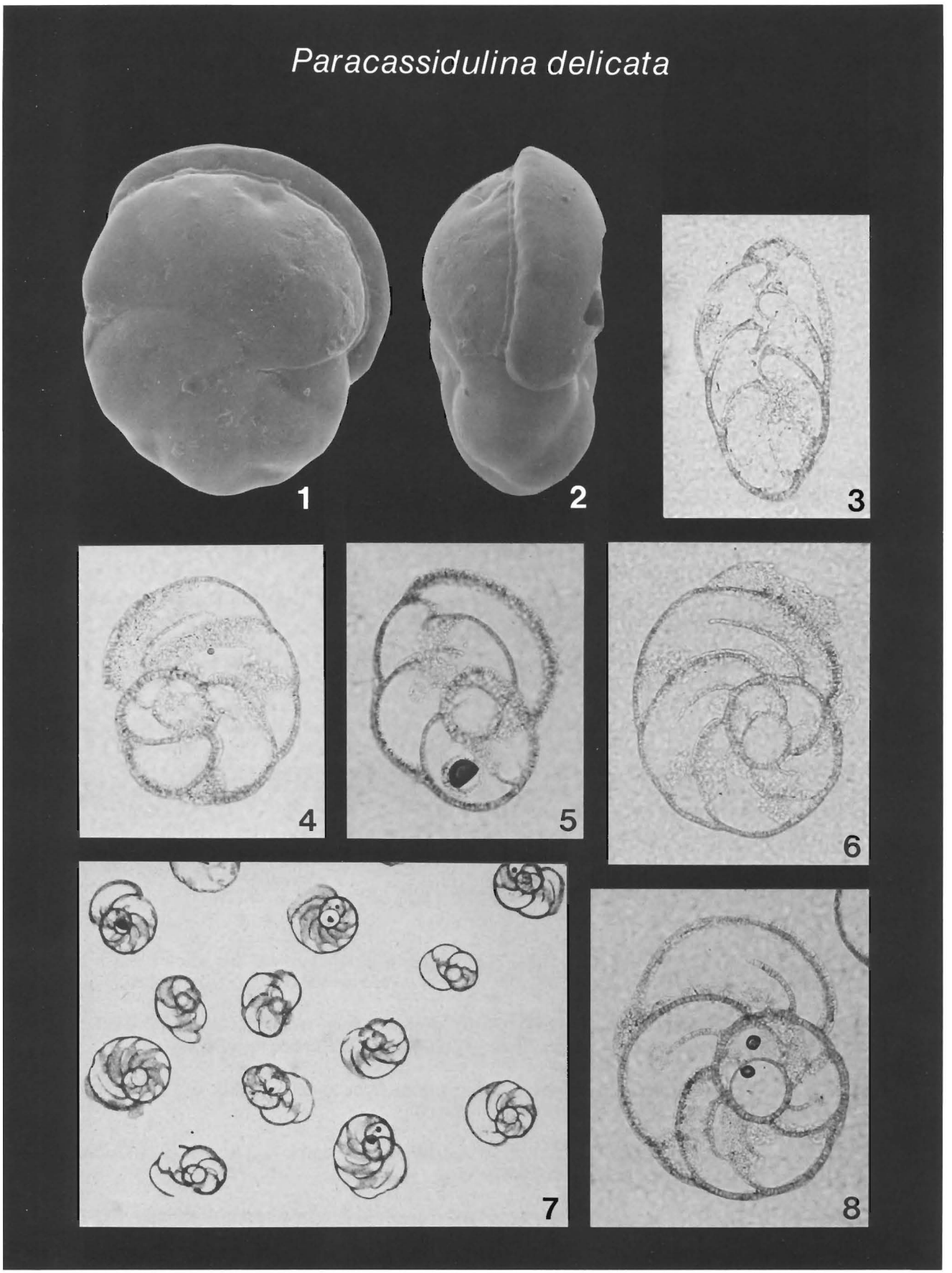
Taxonomic Remarks: Agrees with holotype (USNM20304). Specimens which are comparatively immature to that illustrated in plate-figs. 1 and 2 often have been referred to *C. cushmani* R. E. and K. C. Stewart (1930, Pliocene, Ventura County; USNM12543), but the two species appear to be synonymous (Nomura, 1983b). The generic assignment is based on its wall structure, which is optically granular under polarized light, and aperture type (see Nomura, 1983a). Nomura (1983a) erected the genus *Takayanagia* for similar species that were optically radial under polarized light. He designated *C. delicata* as its genotype on the basis of specimens identified from the Boso Peninsula of Japan, but these appear to be different from the East Pacific species. The Japanese species should be properly identified and designated as the genotype, as the genus is considered to be monospecific.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Delmontian, late Delmontian(?).
Regional Literature: Mohnian to Pliocene, ranges to Holocene (AR76, BE86, CB86, FI90, KL80, HA80, MA52, PI56, SM60, WH56).
This Study: Relizian to Pliocene, ranges to Holocene. (GC, MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal/upper middle bathyal transition (Ingle, 1980); oxygen-minimum zone indicator (Blake, 1981).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, X167: 1, side view; 2, edge view.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 57: 3-6 = X200; 7 = X64; 8 = X200.


Paracassidulina delicata
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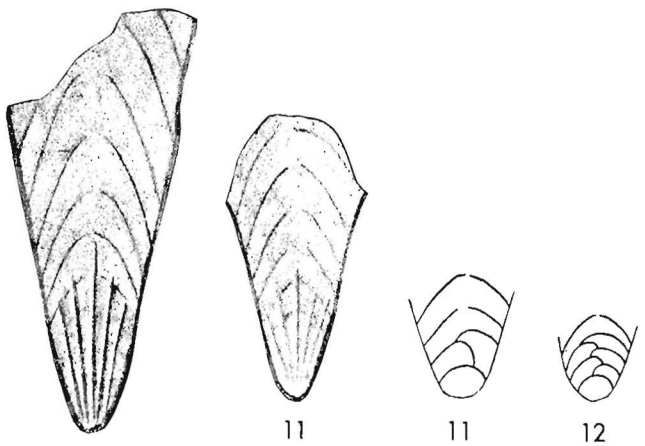
Parafrondicularia miocenica (Cushman)



Type Designation and Reference: *Plectofrondicularia miocenica* Cushman, 1926c, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 58.

Type Figures: *Ibid.*, pl. 7, figs. 10, 11, X65; pl. 8, figs. 11, 12, sections, magnifications not given.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

Taxonomic Remarks: Most of the recovered specimens tend to be more costate and narrower than the holotype of *Plectofrondicularia miocenica* (USNM5701), which approaches *Proxifrons advena* in shape; instead, they agree more closely with the holotype (USNM14460) and Kleinpell's plesiotype (LSJU) of *Plectofrondicularia miocenica* var. *directa* Cushman and Laiming (1931, Zemorrian/Saucesian, Los Sauces Creek, Ventura County). Because this variety appears to be a gradational form, it is not distinguished here from the species *sensu stricto*.

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *Plectofrondicularia miocenica* s.s.: Early Zemorrian to late Relizian.
Kleinpell (*ibid.*) for *Plectofrondicularia miocenica* var. *directa*: Early Saucesian(?), late Saucesian to early Relizian.
Regional Literature: Zemorrian to Pliocene (AR76, CL31, FI90, KL80, HA80, TI73).
This Study: Zemorrian to Pliocene. (GC, IC, NA)

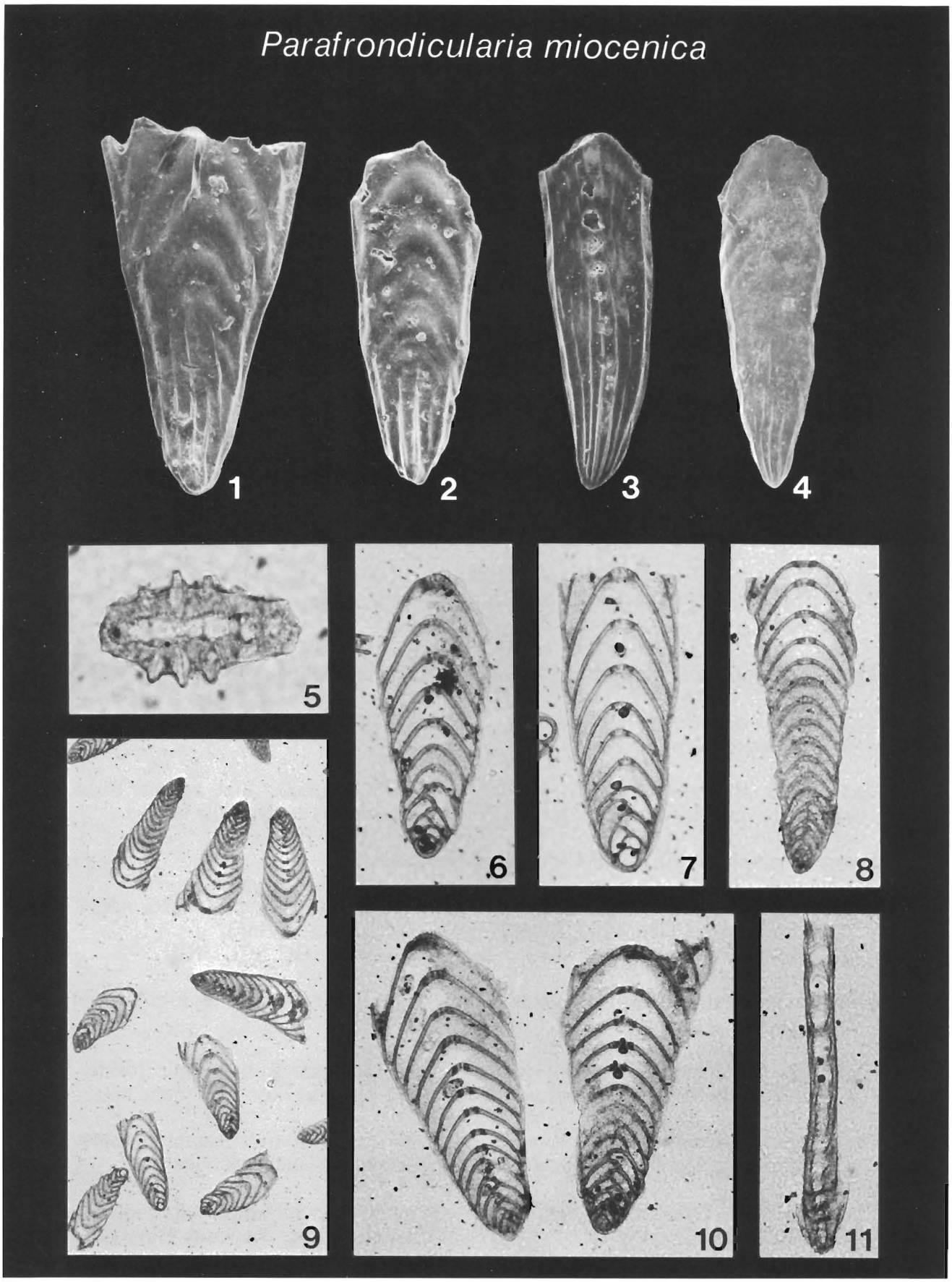
Paleoenvironmental Significance: Upper depth limit not determined for this species, but it is probably the same as that of *Plectofrondicularia* = lower middle bathyal (Ingle, personal comm.).

Plate-figs. 1, 2: Scanning electron micrographs of specimens from sample locality CRC40660-3, Saucesian, Monterey Formation, Naples Beach: 1, side view, X82; 2, side view, X94.

Plate-fig. 3: Scanning electron micrograph of specimen from sample locality GC-3, Relizian, Monterey Formation, Graves Creek: side view, X80.

Plate-fig. 4: Scanning electron micrograph of specimen from sample locality GC-9, Relizian, Monterey Formation, Graves Creek: side view, X61.

Plate-figs. 5-11: Thin-section photomicrographs of specimens from sample locality GC-4, Relizian, Monterey Formation, Graves Creek, slide no. 42: 5 = X320; 6, 7 = X100; 8 = X80; 9 = X32; 10 = X80; 11 = X128.


Parafrondicularia miocenica
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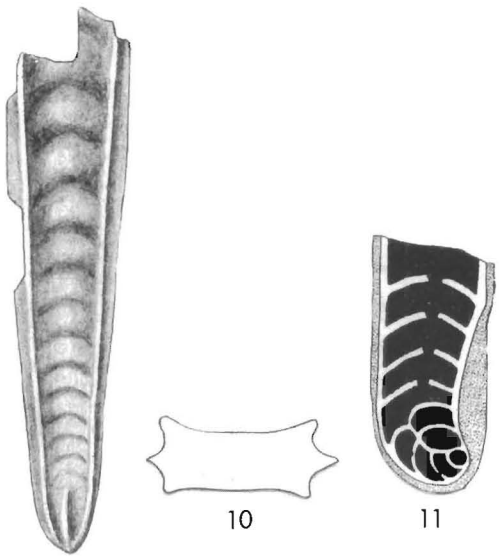
Plectofrondicularia californica Cushman and R. E. Stewart



Type Reference: Cushman and R. E. Stewart, 1926, Contr. Cushman Lab. Foram. Res., v. 2, pt. 2, no. 28, p. 39.

Type Figures: *Ibid.*, pl. 6, figs. 9-11: 9, 10, X50; 11, section, X75.

Type Level and Locality: Pliocene, well in Torrance, Los Angeles County, California.

Taxonomic Remarks: Agrees with holotype (USNM5562). Size appears to be extremely variable within this species; Neogene specimens are typically broken.

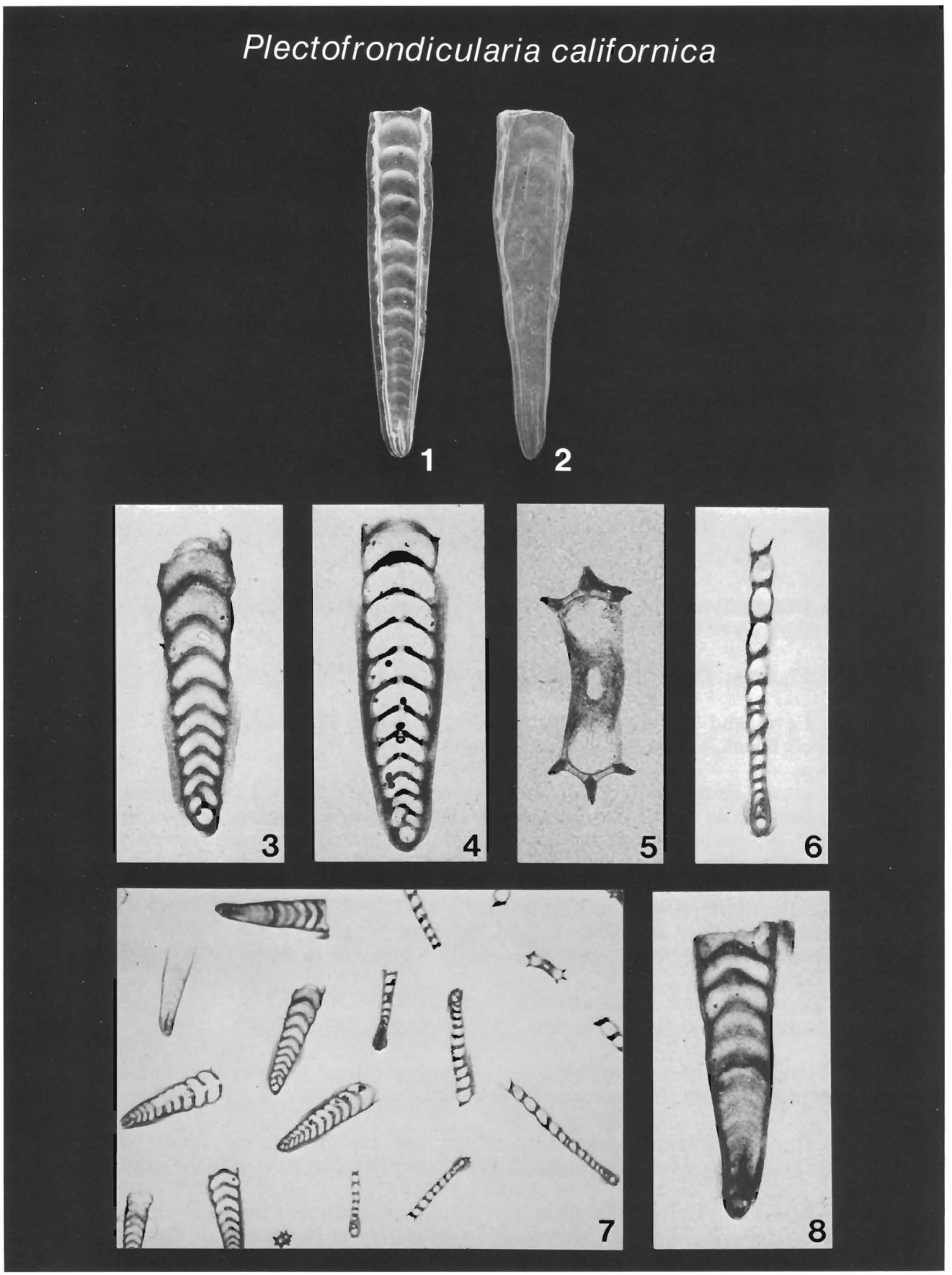
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Zemorrian to late Luisian, late Delmontian(?).
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, AR84, BE86, CB86, CG46, FI90, HA80, KL80, MA52, TI73, WH56).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, SCI, UNB)

Paleoenvironmental Significance: Upper depth limit = lower middle bathyal (Ingle, personal comm.).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Fm., Upper Newport Bay: side view, X30.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC42984-21, Mohnian, Monterey Fm., San Clemente Island: side view, X42.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 64: 3, 4 = X64; 5 = X128; 6 = X51; 7 = X25; 8 = X64.


Plectofrondicularia californica
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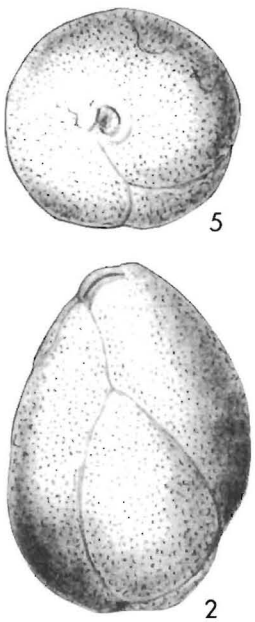
Praeglobobulimina galliheri (Kleinpell)



Type Designation and Reference: *Bulimina galliheri* Kleinpell, 1938, Miocene Stratigraphy of California, p. 253.

Type Figures: *Ibid.*, pl. 17, figs. 2, 5, X50.

Type Level and Locality: Upper Luisian, Monterey Formation, road cut east of Pebble Beach, Monterey County, California.

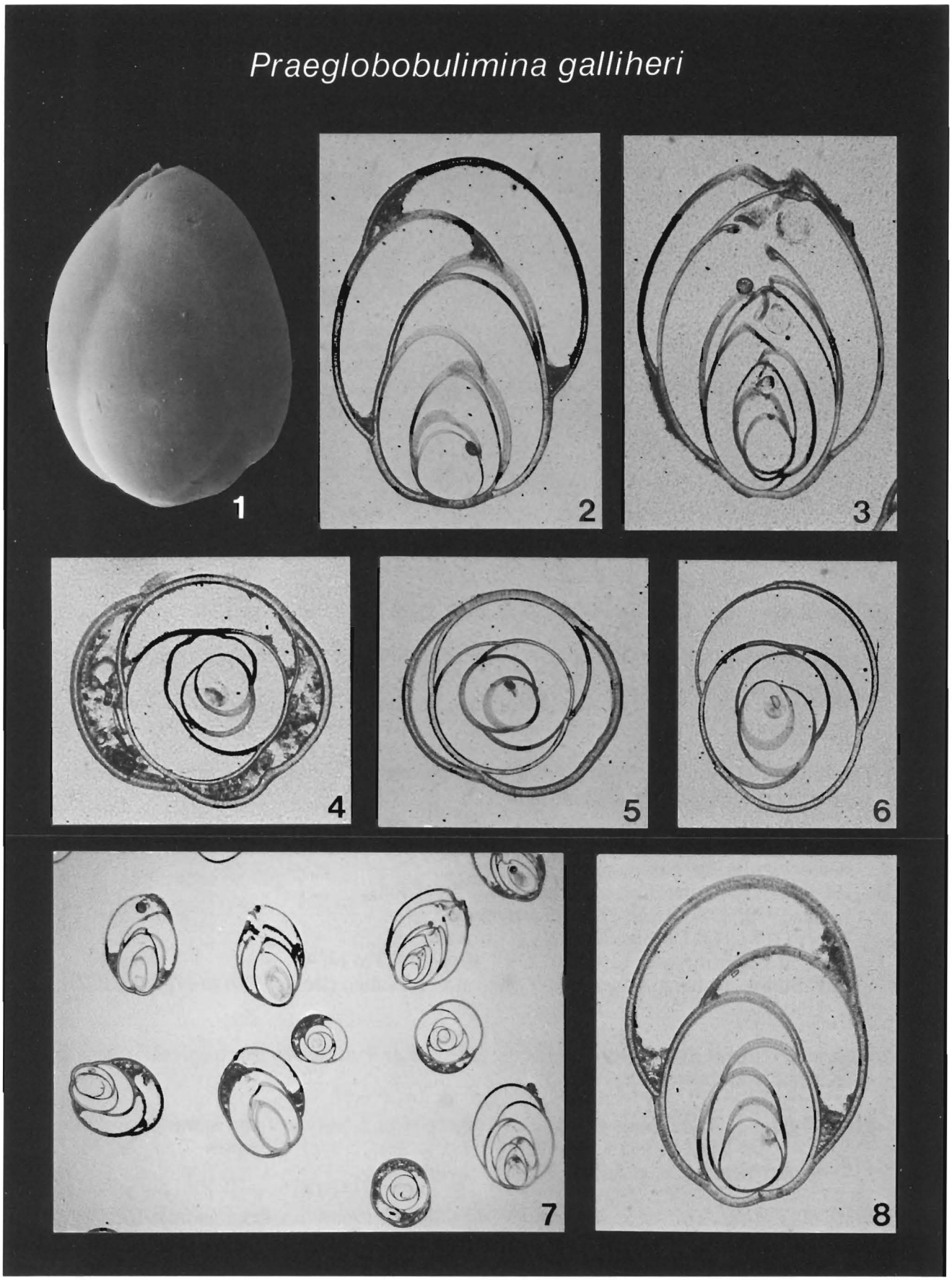
Taxonomic Remarks: Agrees with holotype (LSJU6092). Synonymous with *Globobulimina pacifica* var. *curtata* White (1956, Lower Pliocene, Capistrano Fm.), which is probably an immature form. Broken and juvenile specimens probably have been referred to by other regional workers as *G. pacifica* Cushman.

Biostratigraphic Range in California:
Kleinpell (1938): Late Luisian to early Mohnian.
Kleinpell (1938) for *G. pacifica*: Early Saucesian to early Delmontian, late Delmontian(?).
Regional Literature: Saucesian to Pliocene (PI56, WH56).
This Study: Saucesian to Pliocene. (MQ, NA, SCI, TR, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal; oxygen-minimum zone indicator (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-50a, Mohnian, Monterey Fm., Upper Newport Bay: side view, X73.

Plate-figs. 2-8: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 89: 2-6 = X64; 7 = X20; 8 = X64.


Praeglobobulimina galliheri
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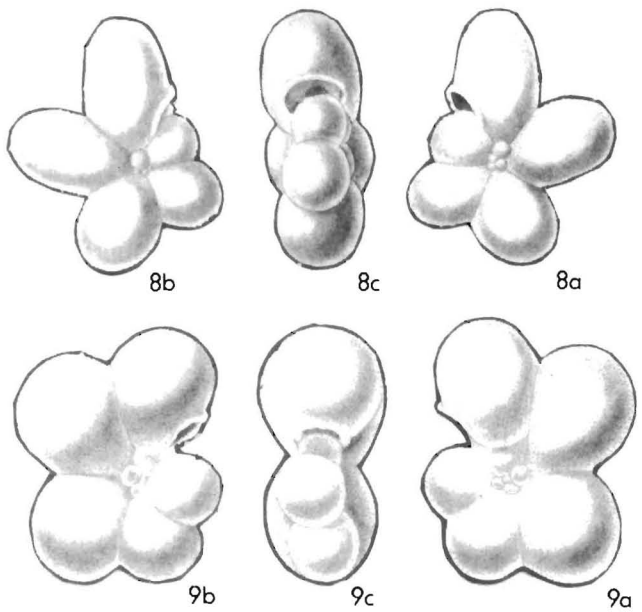
Protentella prolixa Lipps



Type Reference: Lipps, 1964, Tulane Stud. Geol., v. 2, no. 4, p. 124.

Type Figures: *Ibid.*, pl. 2, figs. 8a-9c: 8a-c, holotype, X95; 9a-c, paratype, X135.

Type Level and Locality: Upper Luisian, Monterey Formation, Upper Newport Bay, Orange County, California.

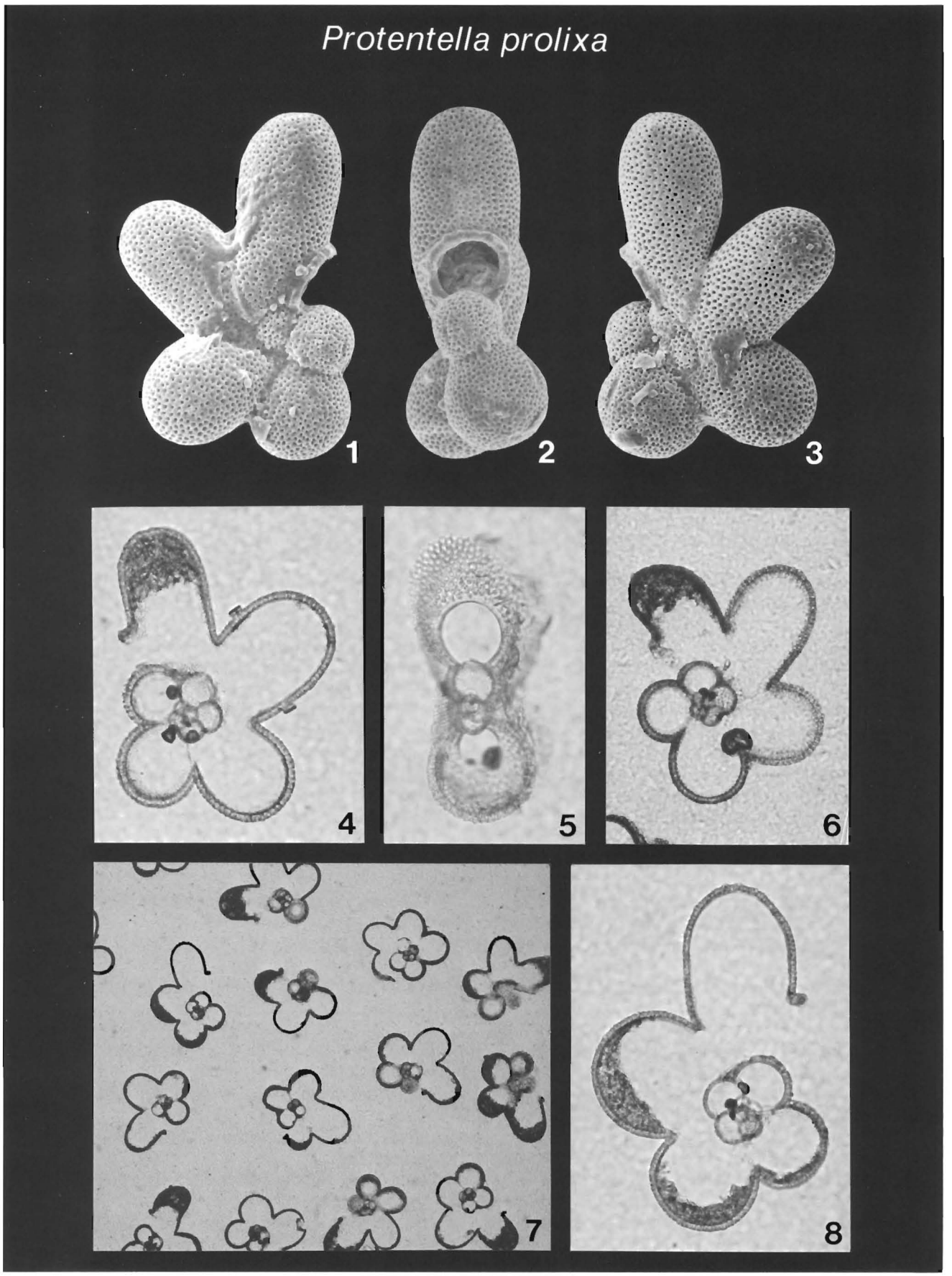
Taxonomic Remarks: Specimens illustrated here are topotypes which agree with holotype (USNM) and paratypes (USNM).

Biostratigraphic Range:
Kleinpell (1938): Not recognized.
Regional Literature: Relizian?, Luisian (FI90, LI64).
Ingle (1973; DSDP Site 173): Not reported.
Poore (1981; DSDP Sites 467-469): Not reported.
Kennett and Srinivasan (1983, p. 222): Zones N12 to N14.
This Study: Relizian (Zone N7)?, Luisian to Mohnian (Zones N10 to N14). (GC?, UNB)

Paleoenvironmental Significance: Distributed in warm subtropical waters. (Kennett and Srinivasan, 1983, p. 222)

Plate-figs. 1-3: Scanning electron micrographs of topotype from sample locality CRC40267-35a, Luisian, Monterey Formation, Upper Newport Bay, X205: 1, dextral view; 2, edge view; 3, sinistral view.

Plate-figs. 4-8: Thin-section photomicrographs of topotypes from sample locality CRC40267-35a, Luisian, Monterey Formation, Upper Newport Bay, slide no. 121: 4 = X200; 5 = X250; 6 = X160; 7 = X64; 8 = X200.


Protentella prolixa
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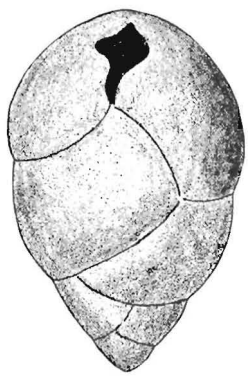
Protoglobobulimina pseudotorta (Cushman)



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Type Designation and Reference: *Bulimina pseudotorta* Cushman, 1926c, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 55.

Type Figure: *Ibid.*, pl. 7, fig. 3, X65.

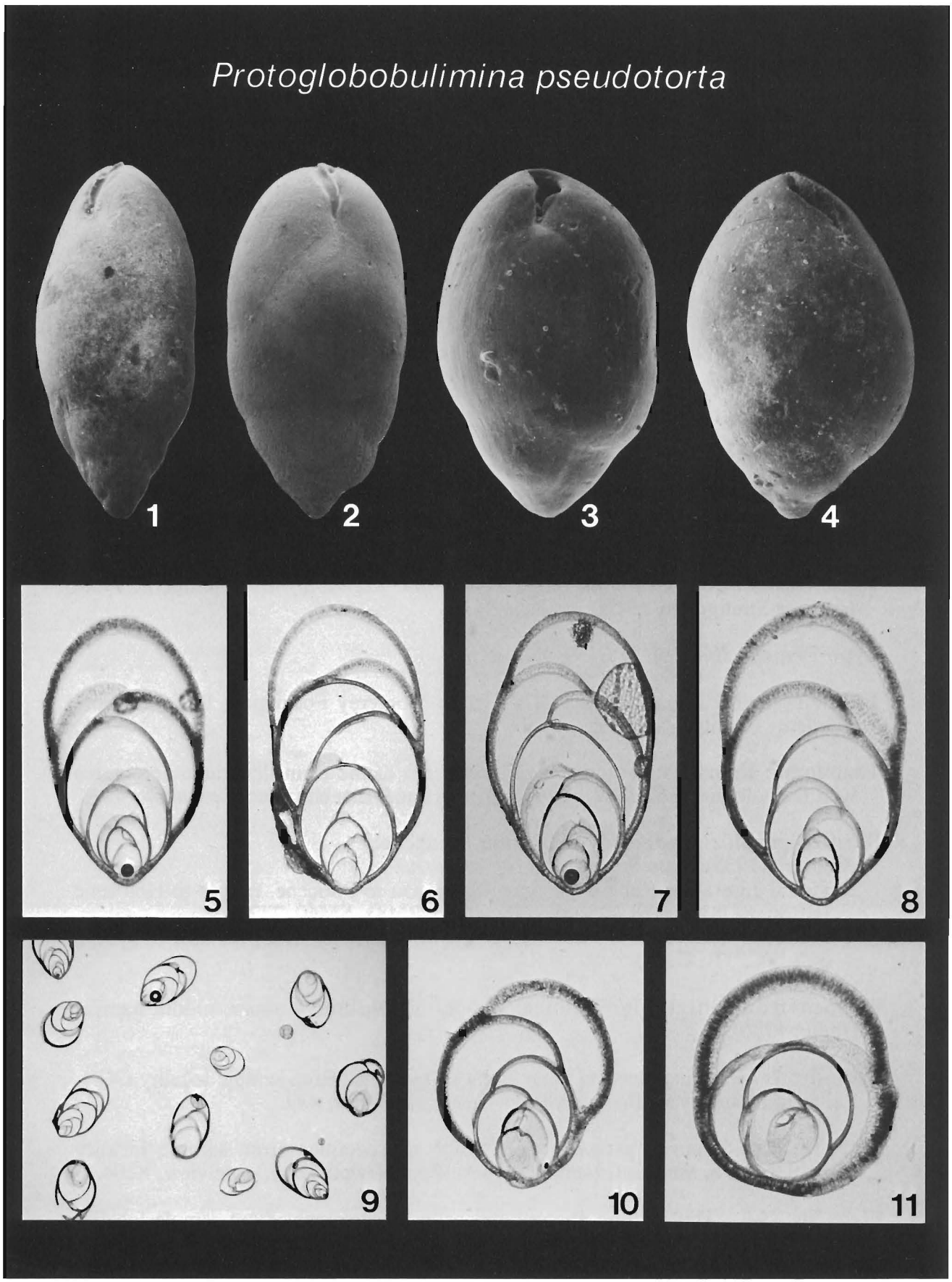
Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

Taxonomic Remarks: Microspheric specimens of the form illustrated here agree with the holotype (USNM5703). However, the species appears to be extremely variable in the degree of test envelopment by the last whorl, and it is impossible to separate the morphotypes of a large population into discrete groups. *Bulimina pseudoaffinis* Kleinpell (1938, lower Relizian, Reliz Canyon, Monterey County), a morphotype that is more lobulate and less-enveloped by its later chambers (see second entry under *P. pseudotorta*), is probably an ecophenotypic variant of this species and it is placed in synonymy here. Regional workers have referred more slender specimens to *B. ovata* d'Orbigny (1846) and *B. ovula* d'Orbigny (1839), but these morphotypes, which are very rare in the California Miocene, are considered to be intraspecific variants or immature forms of *P. pseudotorta.*

Biostratigraphic Range in California Neogene:
Kleinpell (1938, 1980): Late Relizian to late Luisian.
Regional Literature (for the plexus): Zemorrian to Pliocene, ranges to Holocene (BE86, BO81, CB86, FI90, KL80, MA52, PM81, SM60).
This Study: Zemorrian to Pliocene, to Holocene. (GC, IC, LH, MQ, NA, SCI, TC, TR, UNB)

Paleoenvironmental Significance: Upper depth limit of *B. pseudoaffinis* = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-34, Luisian, Monterey Formation, Upper Newport Bay: side view, X115.
Plate-fig. 2: Scanning electron micrograph of specimen from sample locality IC-115, Luisian, Monterey Formation, Indian Creek: side view, X90.
Plate-fig. 3: Scanning electron micrograph of specimen from sample locality CRC40267-30, Luisian, Monterey Formation, Upper Newport Bay: side view, X62.
Plate-fig. 4: Scanning electron micrograph of specimen from sample locality LH-7, Luisian, Monterey Formation, Laguna Hills: side view, X73.
Plate-figs. 5-11: Thin-section photomicrographs of specimens from sample loc. CRC40267-30, Luisian, Monterey Fm., UNB, slide no. 35: 5, 8, 10 = X100; 6, 7 = X80; 9 = X20; 11 = X128.


Protoglobobulimina pseudotorta
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Protoglobobulimina pseudotorta (Cushman) (forma *"pseudoaffinis"*)

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Note: The following historical data is based on that recorded for *Bulimina pseudoaffinis* Kleinpell, which here is considered a junior synonym of *Protoglobobulimina pseudotorta.* (See previous entry for historical data on *P. pseudotorta.*)

Type Designation and Reference: *Bulimina pseudoaffinis* Kleinpell, 1938, Miocene Stratigraphy of California, p. 257.

Type Figure: *Ibid.*, pl. 9, fig. 9, X42.

Type Level and Locality: Lower Relizian, Monterey Formation, Reliz Canyon, Monterey County, California.

Taxonomic Remarks: Macrospheric specimens of the form illustrated here agree with the holotype (LSJU849). See comments under first entry for *P. pseudotorta.*

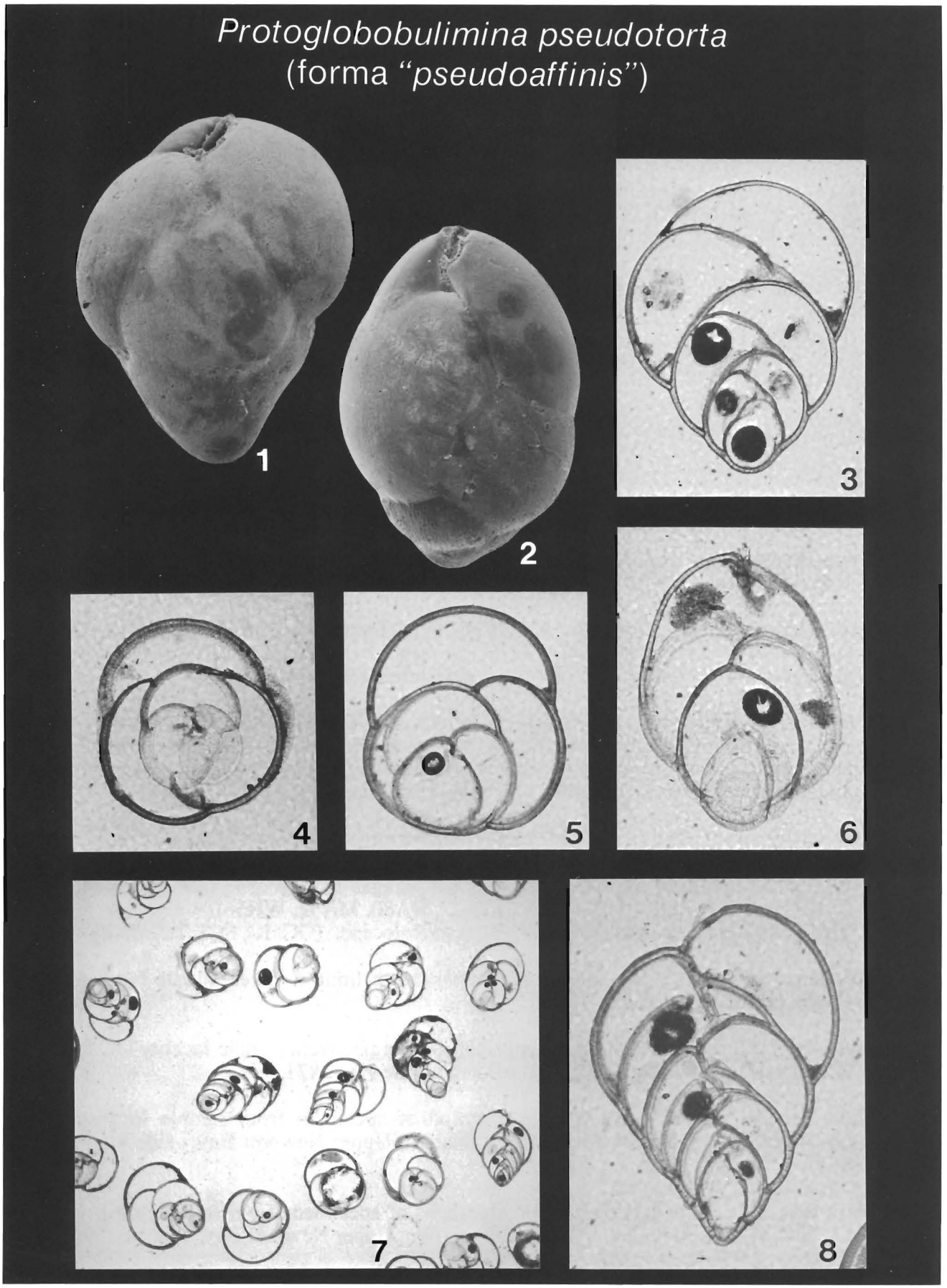
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Saucesian to late Relizian.
Regional Literature (for the plexus): Saucesian to Pliocene, ranges to Holocene (BE86, BO81, CB86, FI90, KL80, MA52, PM81, SM60, TI73).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, IC, LH, MQ, NA, SCI, TC, TR, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality GC-1, Relizian, Monterey Formation, Graves Creek: side view, X89.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40267-47a, Mohnian, Monterey Fm., Upper Newport Bay: side view, X104.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality GC-9, Relizian, Monterey Formation, Graves Creek, slide no. 90: 3-5 = X100; 6 = X128; 7 = X32; 8 = X128.


Protoglobobulimina pseudotorta
(forma "pseudoaffinis")
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Proxifrons advena (Cushman)

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Type Designation and Reference: *Frondicularia advena* Cushman, 1923, U.S. Nat. Mus., Bull., no. 104, p. 141.

Type Figures: *Ibid.*, pl. 20, figs. 1, 2, X30: 1, microspheric; 2, megaspheric.

Type Level and Locality: Recent, offshore northeastern United States.

Taxonomic Remarks: Agrees with holotype (USNM17526). Among those recovered from California, the Miocene specimens tend to lack the distinct biserial early portion, which is more evident in the Pliocene specimens. The species has been assigned to both *Frondicularia* and *Plectrofrondicularia.*

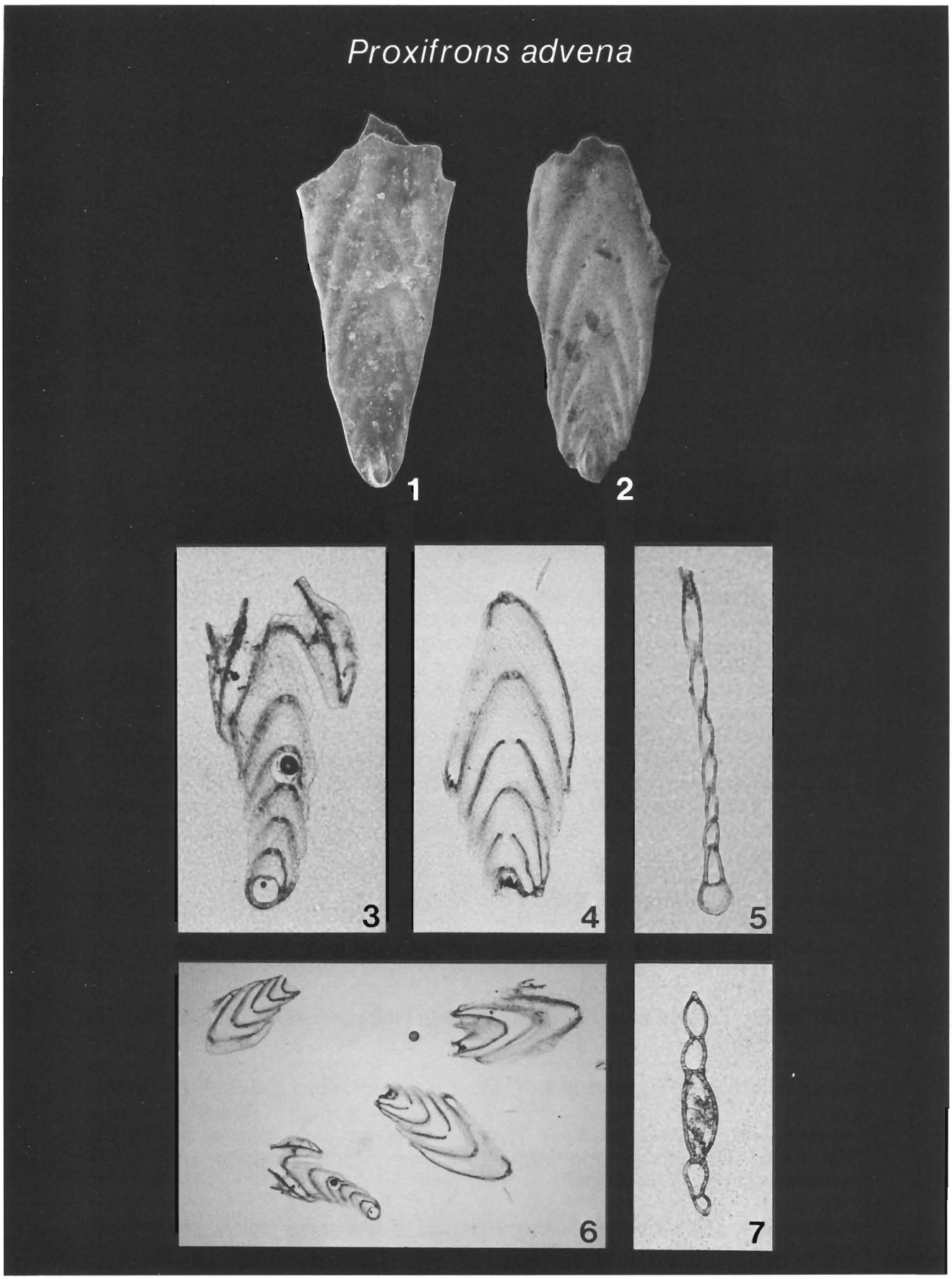
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Relizian to early Delmontian, late Delmontian(?).
Regional Literature: Saucesian to Pliocene, ranges to Holocene (AR76, AR84, BE86, BL81, BO81, CB86, FI90, GW27, HA80, MA52, WH56).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, IC, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = lower middle bathyal (Ingle, personal comm.).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality GC-8, Relizian, Monterey Formation, Graves Creek: side view, X71.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40267-44, Mohnian, Monterey Formation, Upper Newport Bay: side view, X73.

Plate-figs. 3-7: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 59: 3 = X64; 4 = X51; 5 = X80; 6 = X25; 7 = X100.


Proxifrons advena
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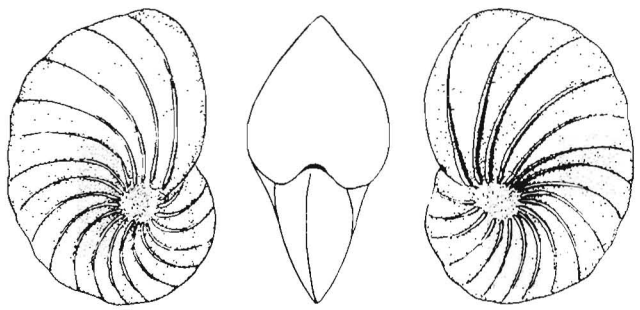
Pseudononion costiferum (Cushman)



Type Designation and Reference: *Nonionina costifera* Cushman, 1926a, Contr. Cushman Lab. Foram. Res., v. 1, pt. 4, p. 90.

Type Figures: *Ibid.*, pl. 13, figs. 2a-c, X45.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

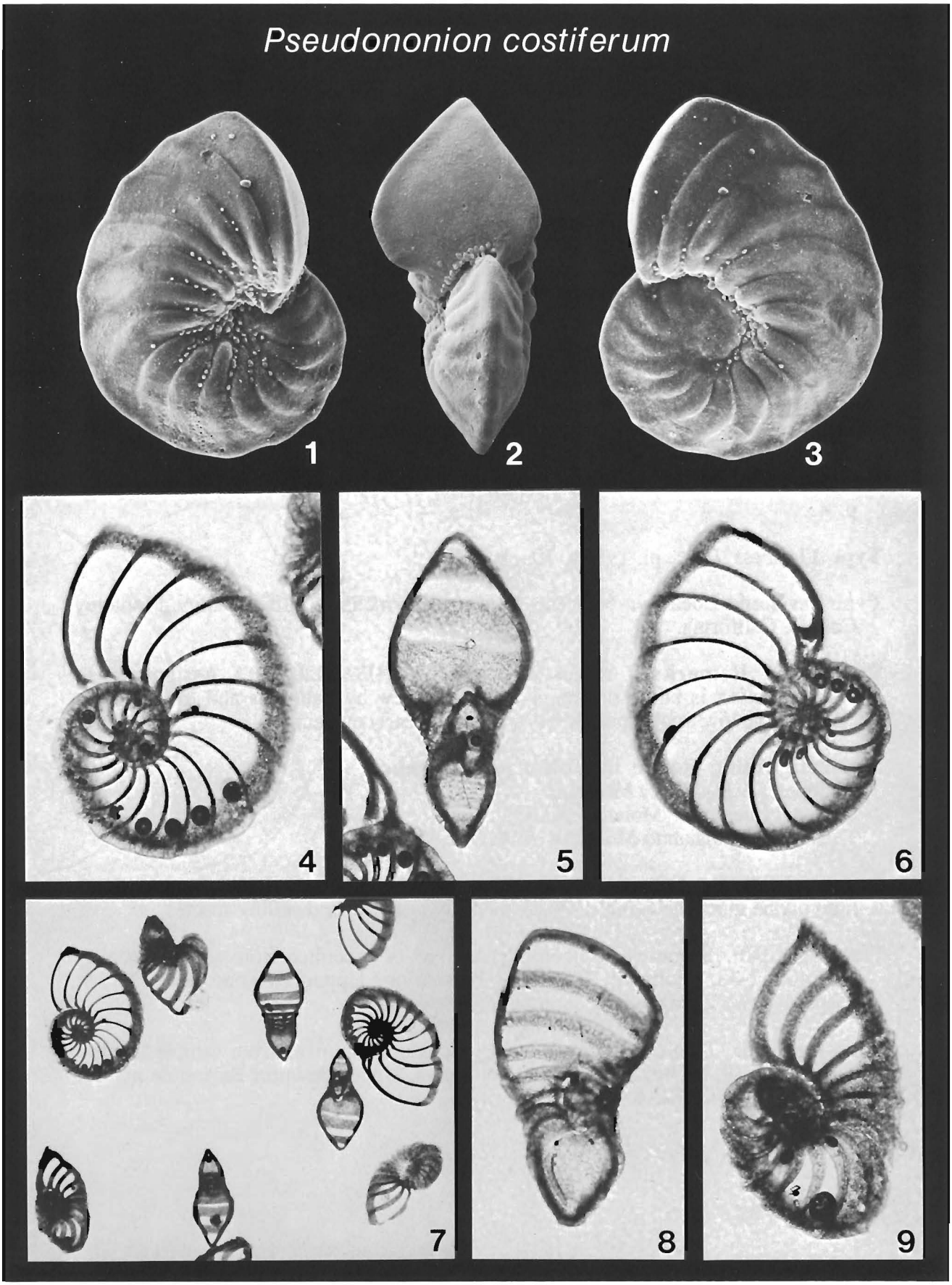
Taxonomic Remarks: Agrees with holotype (USNM4368) and topotypes (USGS, assigned to *Nonion*). The degree of sutural thickening is attributed to ontogenetic and ecophenotypic variation, as well as preservation; thus, the taxonomic splitting by Kleinpell (1980, see plates therein) seems to be unwarranted. Some regional workers have placed this species in *Florilus*, but the present assignment to *Pseudononion* is based on the taxonomic review of these genera by Saunders and Müller-Merz (1982). Because later chambers tend to be broken off most specimens (including the holotype), and this is not easily discerned with the stereomicroscope, the species has been referred to planispiral genera (e.g., see Loeblich and Tappan 1964, fig. 612-6a, b and 1987, pl. 691, figs. 3 & 4). However, the asymmetry of a low trochospire is evident in complete specimens, especially when viewed on apertural edge.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Saucesian to late Luisian.
Kleinpell (1980) for *Nonion costiferum* s.l.: Early Mohnian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, CL31, FI90, HA80, KL80, PM81, SM60, TI73).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, IC, LH, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = inner shelf (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-33, Luisian, Monterey Formation, Upper Newport Bay, X148: 1, umbilical view; 2, edge view; 3, spiral view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-36, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 10: 4 = X80; 5 = X100; 6 = X80; 7 = X32; 8 = X80; 9 = X100.


Pseudononion costiferum
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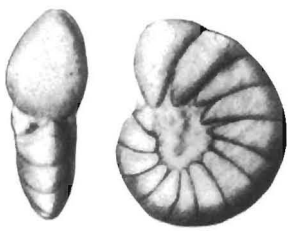
Pseudononion multicameratum (Cushman and Kleinpell)



10b 10a

Type Designation and Reference: *Nonion pizarrensis* var. *multicameratum* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 4.

Type Figures: *Ibid.*, pl. 1, figs. 10a, b, X35.

Type Level and Locality: Miocene, Monterey Formation, Carmel Valley, Monterey County, California.

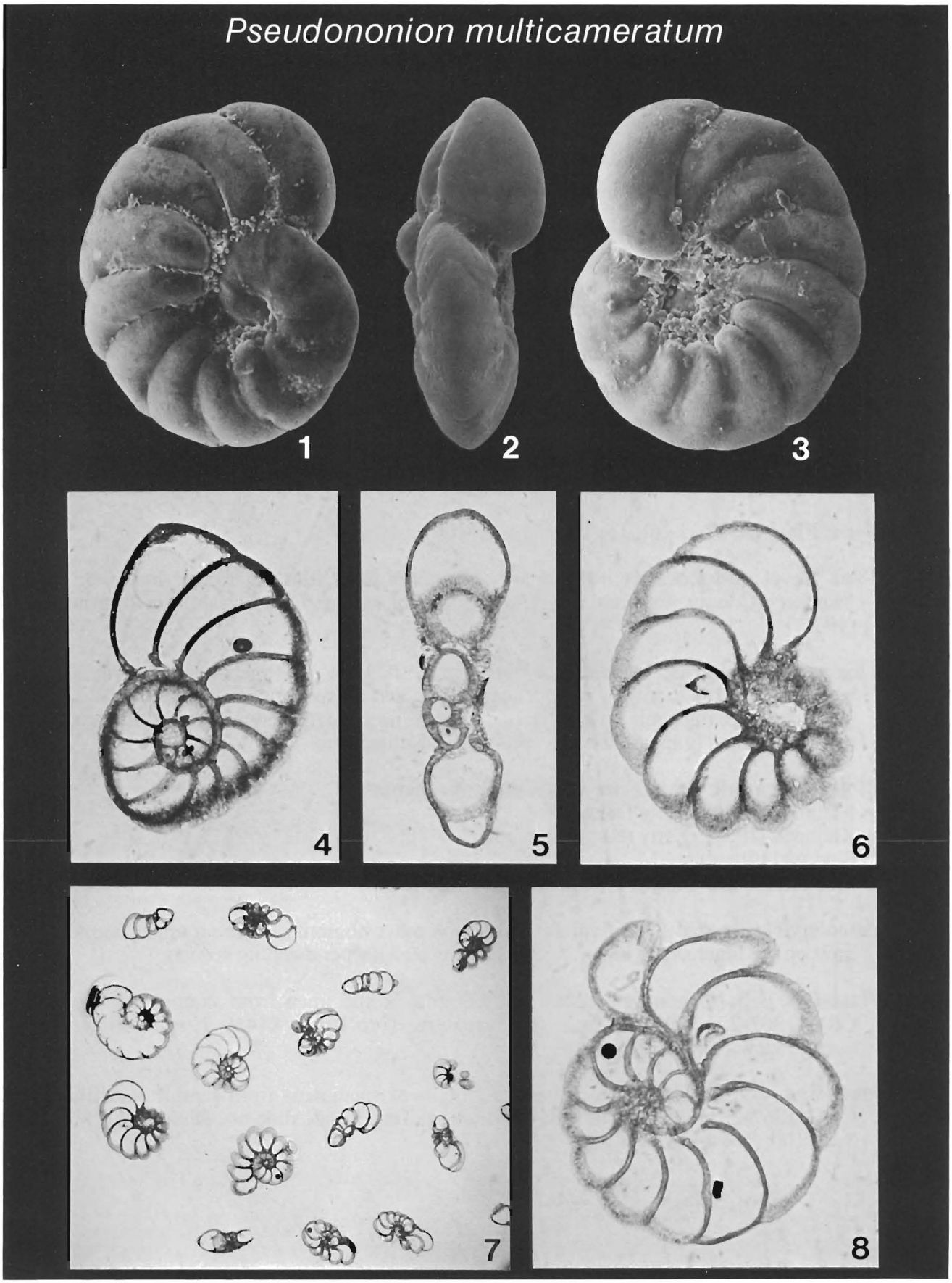
Taxonomic Remarks: Agrees with holotype (USNM20120). Assignment to *Pseudononion* is based on the taxonomic review by Saunders and Müller-Merz (1982). The low trochospire of this species is clearly evident.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Mohnian.
Regional Literature: Mohnian (KL80).
This Study: Luisian to Mohnian. (NA, SCI, UNB)

Paleoenvironmental Significance: Although other nonionids have an upper depth limit on the inner shelf (Ingle, 1980), this may be a deeper dwelling species.

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-38, Mohnian, Monterey Formation, Upper Newport Bay, X134: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality CRC40267-39, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 14: 4-6 = X128; 7 = X32; 8 = X160.


Pseudononion multicameratum
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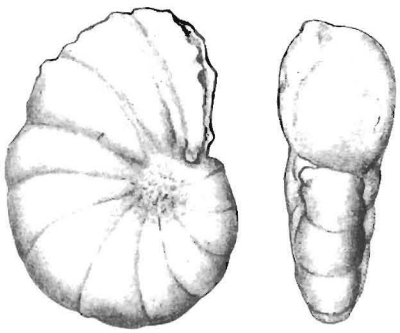
Pseudononion schencki (Kleinpell)



11a 11b

Type Designation and Reference: *Nonion schencki* Kleinpell, 1938, Miocene Stratigraphy of California, p. 235.

Type Figures: *Ibid.*, pl. 16, figs. 11a, b, X60.

Type Level and Locality: Mohnian*, Monterey Formation, diatomite quarry in Monterey County, California. [*Cited by author as type Delmontian; see Barron (1976)]

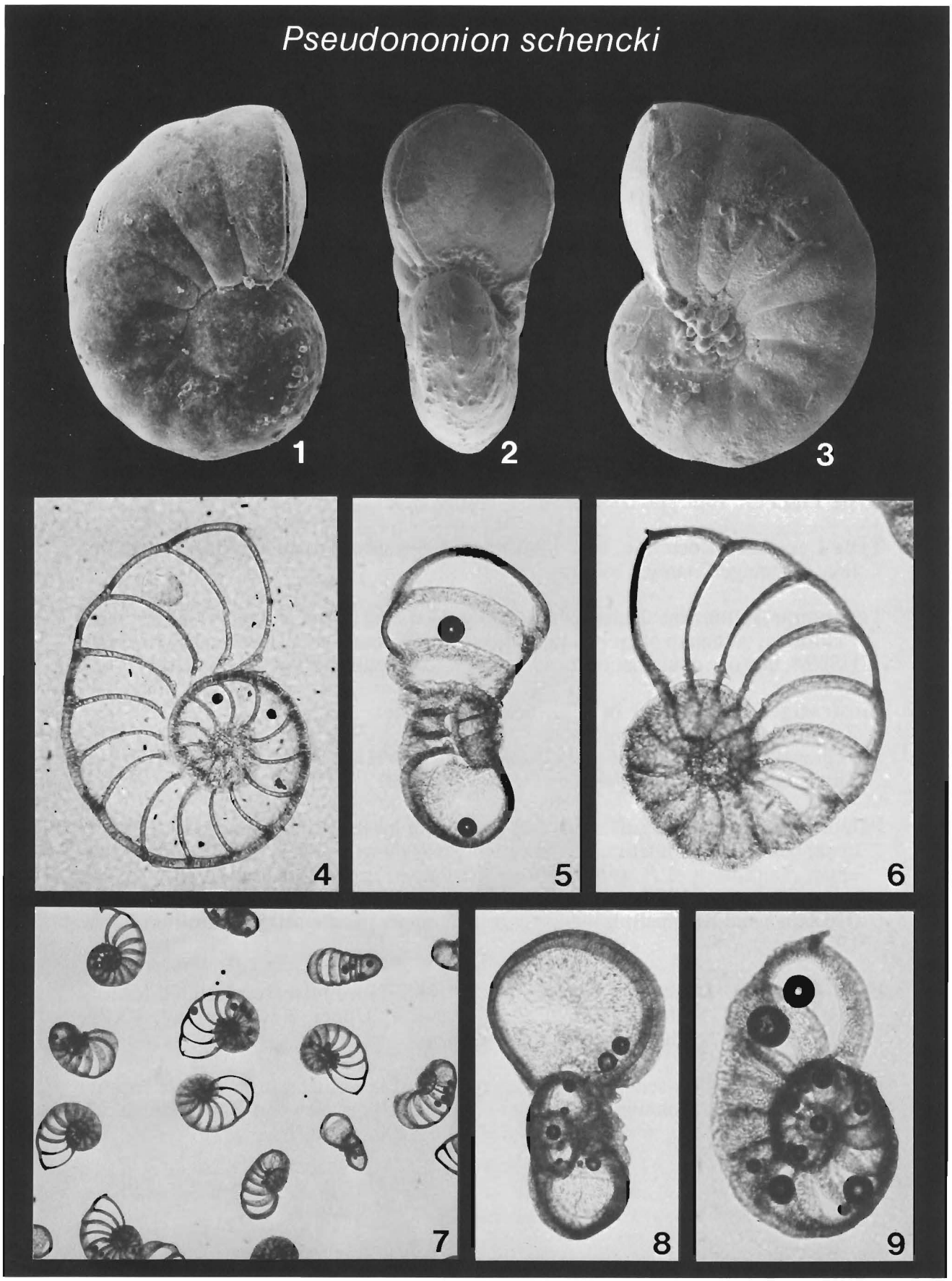
Taxonomic Remarks: Agrees with holotype (LSJU926). The specimens illustrated here are from the topotype area. The holotype and all specimens recovered in this study are missing their later chambers, suggesting greater asymmetry of its low trochospire than is apparent in the specimen illustrated here.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Delmontian.
Kleinpell (1980): Early to late Delmontian.
Regional Literature: Mohnian (KL80, SB86).
This Study: Mohnian to "Delmontian". (TC?, TR)

Paleoenvironmental Significance: Although other nonionids have an upper depth limit on the inner shelf (Ingle, 1980), this may be a deeper dwelling species.

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC41367-2, Mohnian, Monterey Formation, Toro Road, X146: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC41367-2, Mohnian, Monterey Formation, Toro Road, slide no. 88: 4 = X128; 5 = X100; 6 = X128; 7 = X32; 8, 9 = X128.


Pseudononion schencki
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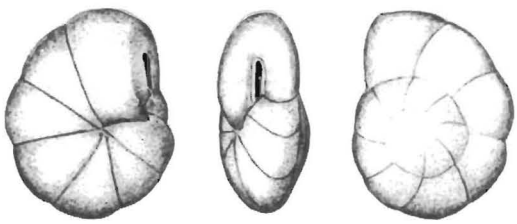
Pseudoparrella californica (White)



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Type Designation and Reference: *Epistominella pontoni* var. *californica* White, 1956, Jour. Paleont., v. 30, no. 2, p. 257.

Type Figures: *Ibid.*, pl. 31, figs. 9a-c, holotype, X120.

Type Level and Locality: Upper Miocene, Capistrano Formation, near Capistrano Beach, Orange County, California.

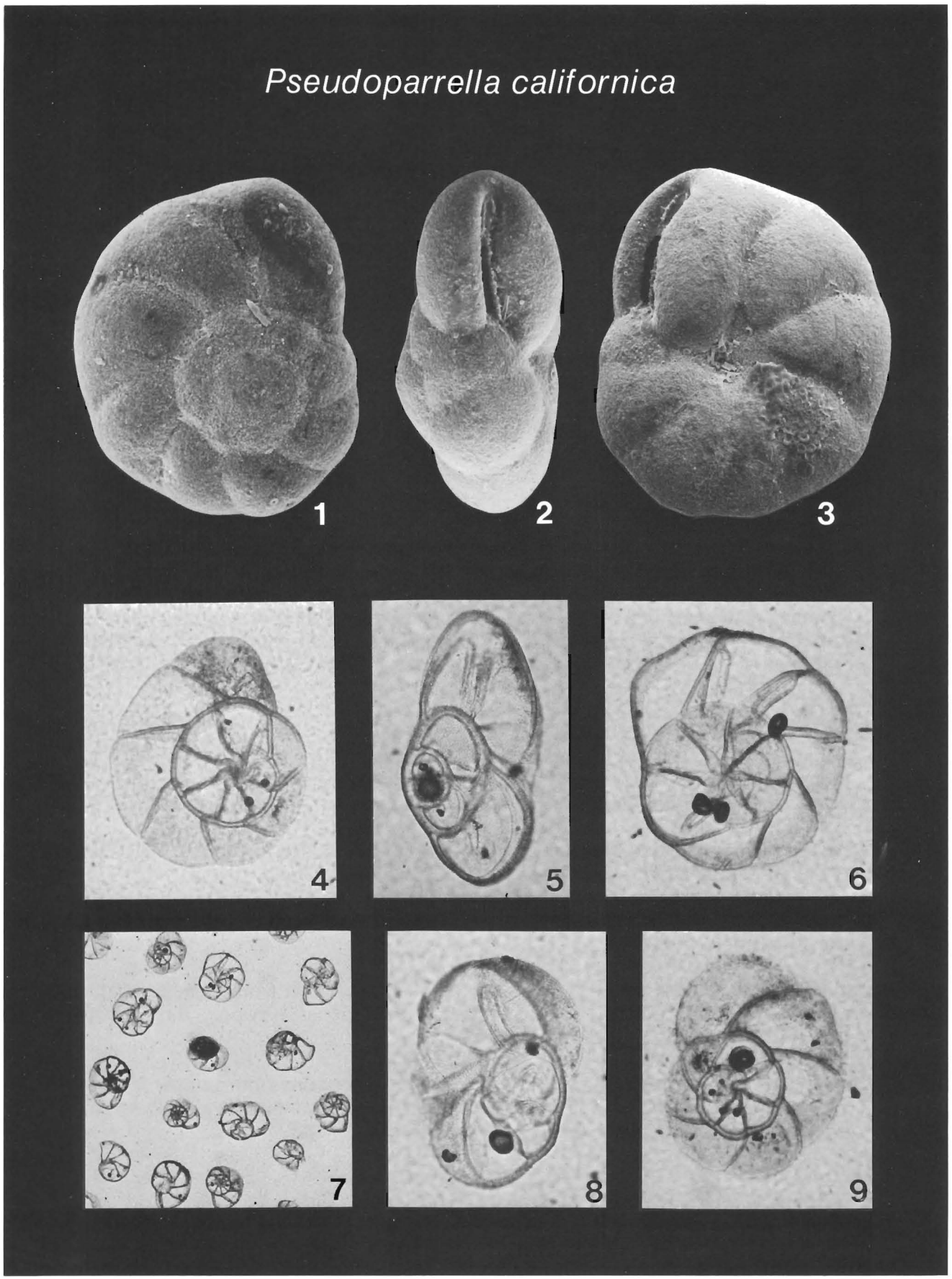
Taxonomic Remarks: Holotype originally deposited in the University of Southern California; although other holotypes from White's study were later transferred to the USNM, this one could not be located. Generic assignment is based on Lipps (1965).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Regional Literature: Mohnian to Pliocene (LI65, WH56).
This Study: Mohnian to Pliocene. (NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit not determined, but possibly upper bathyal if its "intermediate" morphology is directly related to paleodepth, as the upper depth limit of *P. subperuviana* (Cushman) is the outer shelf/upper bathyal transition (Ingle, 1980) and the upper depth limit of *Megastomella capitanensis* (Cushman and Kleinpell) is the upper bathyal/upper middle bathyal transition (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-3, Mohnian, Monterey Formation, Upper Newport Bay, X195: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 92: 4 = X160; 5 = X200; 6 = X160; 7 = X32; 8 = X200; 9 = X160.


Pseudoparrella californica
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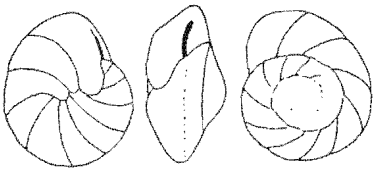
Pseudoparrella subperuviana (Cushman)



Type Designation and Reference: *Pulvinulinella subperuviana* Cushman, 1926c, Cushman Lab. Foram. Res., Contr., v. 2, pt. 3, p. 63.

Type Figures: *Ibid.*, pl. 9, figs. 9a-c, X100.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

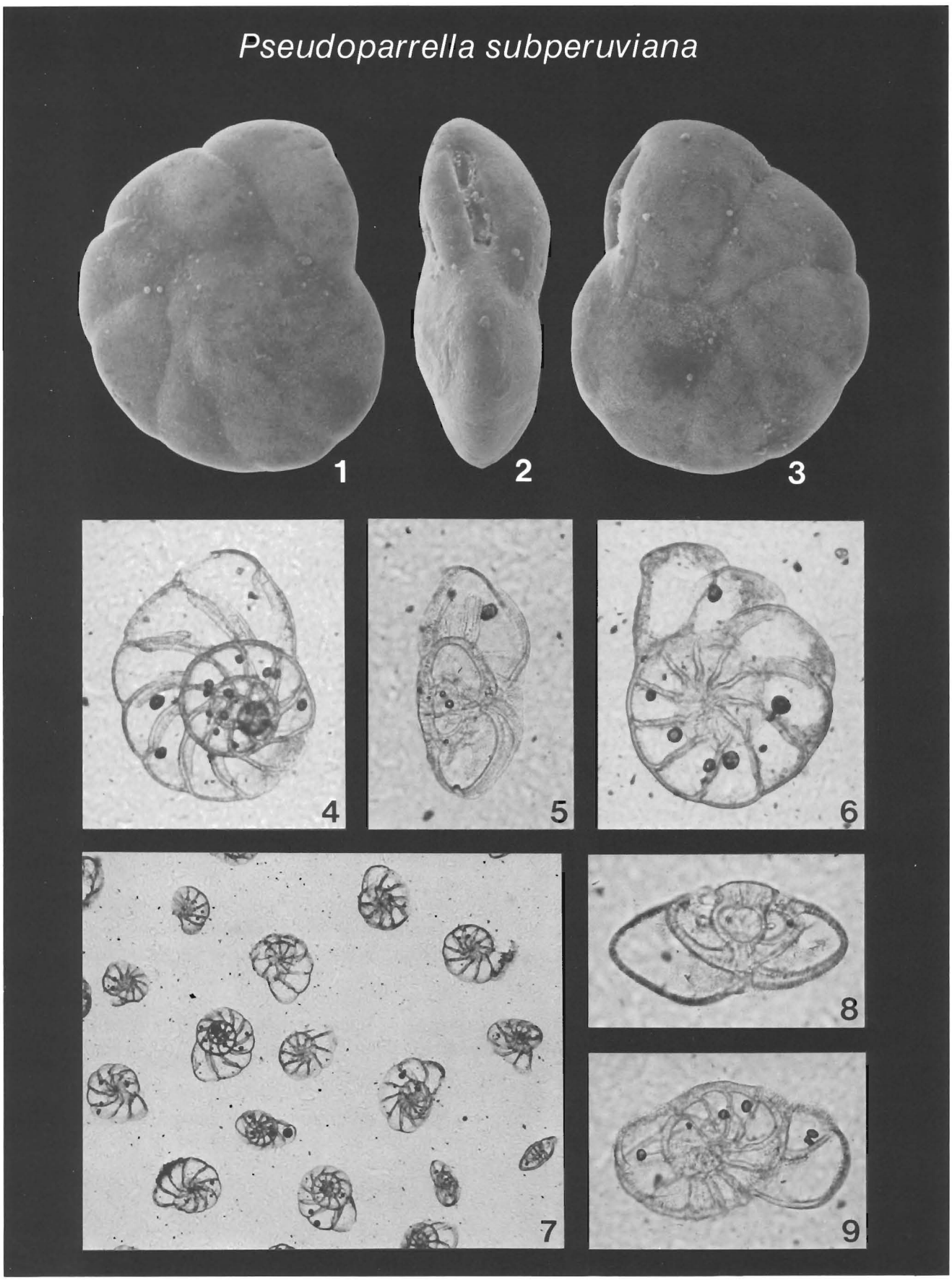
Taxonomic Remarks: Most of the recovered specimens differ from the holotype (USNM5825) which has thick sutures and a pronounced spire, but agree with topotypes (USGS, assigned to *Epistominella*). Spire height, peripheral angle, and chamber shape vary within and among populations of this species. Specimens in some populations approach *Megastomella*. Lipps (1965) considers *P. relizensis* (Kleinpell, 1938) and *P. bradyana* (Cushman, 1927) as junior synonyms of *P. subperuviana*.

Biostratigraphic Range in California Neogene:
Kleinpell (1938, 1980): Late Saucesian to late Luisian.
Kleinpell (*ibid.*) for *P. relizensis*: Late Saucesian to late Luisian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, BE86, CL31, FI90, HA80, LI65, MA52, PI56, SB86, SM60, WH56).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, IC, LH, MQ, NA, SCI, TC, TR, UNB)

Paleoenvironmental Significance: Upper depth limit = shelf edge/upper bathyal transition (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, X200: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 91: 4 = X160; 5 = X200; 6 = X160; 7 = X32; 8 = X250; 9 = X200.


Pseudoparrella subperuviana
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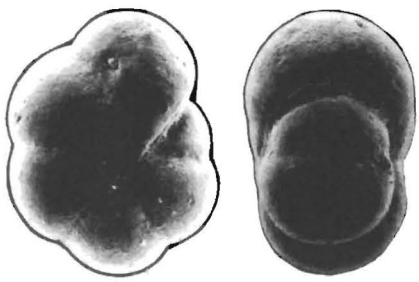
Pullenia inglei Finger and Lipps



31 32

Type Reference: *In* Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 43.

Type Figures: *Ibid.*, pl. 9, figs. 31, 32, X73.

Type Level and Locality: Relizian, Sandholdt Member, Monterey Formation, Graves Creek, Atascadero, San Luis Obsipo County, California.

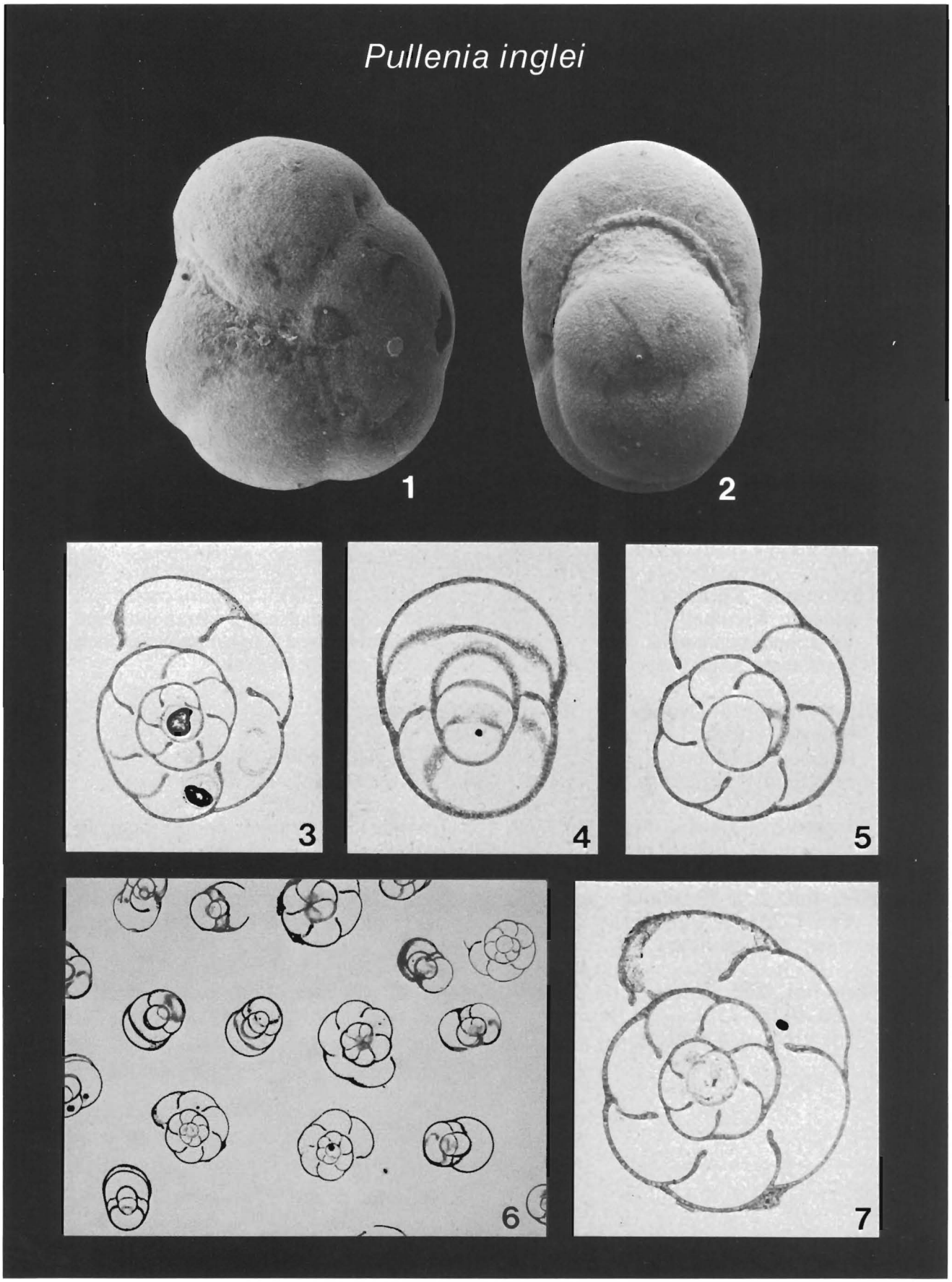
Taxonomic Remarks: Ingle (1985) identifies this form from the late Miocene section along the Manville Quarry access road as *P. miocenica*, whereas his and other workers' previous studies more often refer to it as *P.* cf. *P. miocenica*. This form is not as globose as *P. miocenica* s.s., and its last whorl is initially much narrower. Although *P. inglei* is relatively rare in Luisian assemblages often characterized by common *P. miocenica* s.s., it becomes the predominant form in the Mohnian and may represent an evolutionary trend related to cooling temperatures.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Regional Literature: Relizian to Mohnian (FI90, PI56).
This Study: Relizian to Mohnian. (MQ, NA, TC, UNB)

Paleoenvironmental Significance: Not determined, but possibly has the same upper depth limit as *P. miocenica* = upper middle bathyal/lower middle bathyal transition (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay, X127: 1, side view; 2, edge view.

Plate-figs. 3-7: Thin-section photomicrographs of specimens from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay, slide no. 54: 3 = X100; 4, 5 = X128; 6 = X32; 7 = X128.


Pullenia inglei
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Pullenia miocenica Kleinpell

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Type Reference: Kleinpell, 1938, Miocene Stratigraphy of California, p. 338.

Type Figure: *Ibid.*, pl. 14, fig. 6, X60.

Type Level and Locality: Lower Luisian, Monterey Formation, Reliz Canyon, Monterey County, California.

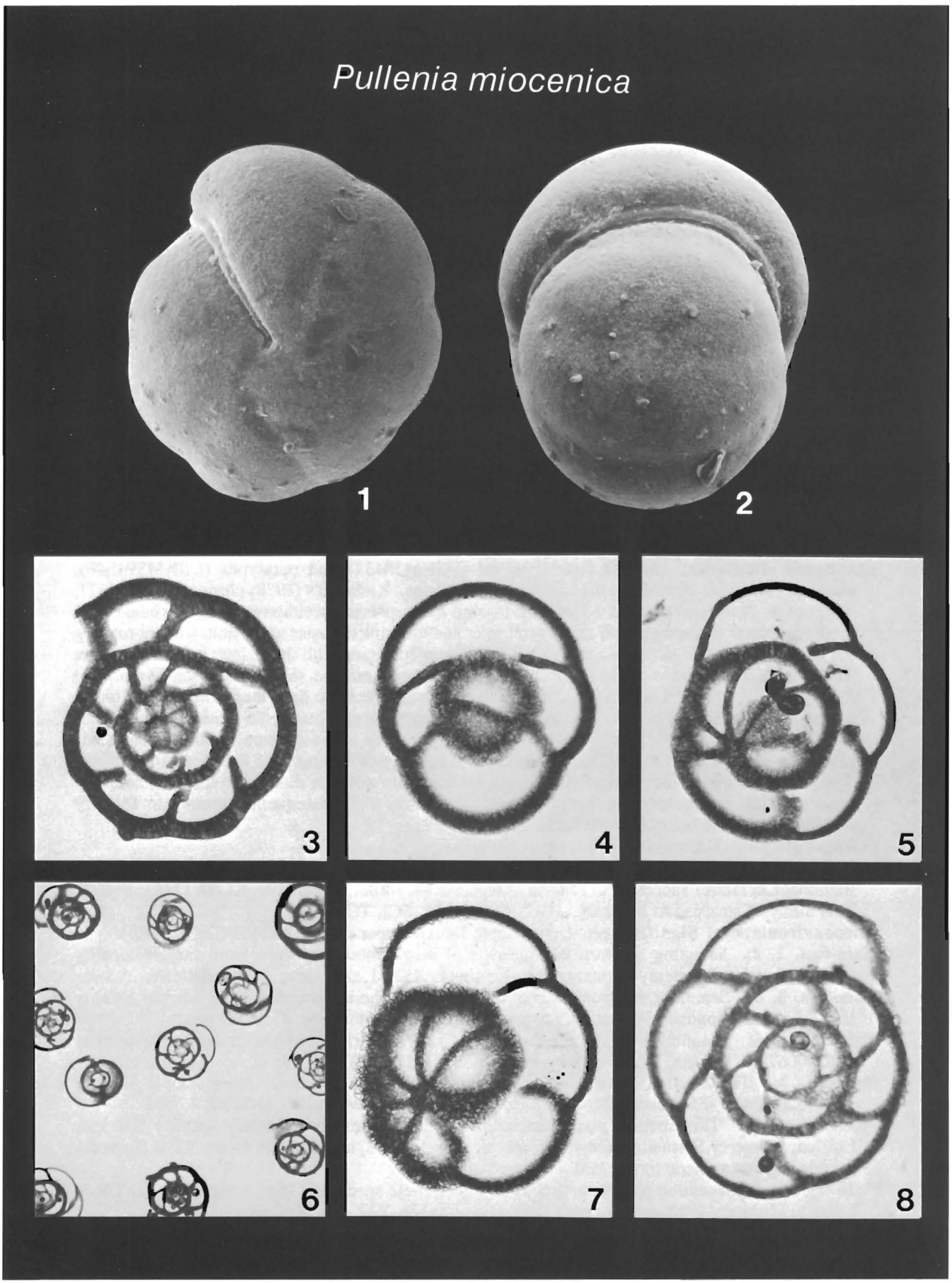
Taxonomic Remarks: Agrees with holotype (LSJU5792). *P. miocenica* var. *globula* Kleinpell (1938) is not differentiated here because the intrapopulation variation is continuous. Many species include similarly robust ecophenotypes in their populations as they range across the middle Miocene cooling interval.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Relizian to late Luisian.
Regional Literature: Zemorrian to Luisian (AR76, AR84, FI90, PM81, SM60).
This Study: Zemorrian to Mohnian. (GC, IC, LH, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal/lower middle bathyal transition (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay, X140: 1, side view; 2, edge view.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay, slide no. 11: 3 = X160; 4, 5 = X100; 6 = X40; 7 = X100; 8 = X160.


Pullenia miocenica
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Rectuvigerina branneri (Bagg)

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Type Designation and Reference: *Sagrina branneri* Bagg, 1905, U.S. Geol. Surv., Bull., no. 268, p. 40.

Type Figure: *Ibid.*, pl. 7, fig. 4, X23.

Type Level and Locality: Luisian*, Sandholdt Member, Monterey Formation, Graves Creek, San Luis Obispo County, California. [*Cited by Kleinpell (1938) as Relizian, later by Graham (1980) and Finger and others (1990) as Luisian]

Taxonomic Remarks: Agrees with holotype (USNM50432) and paratypes (USNM394548), although somewhat variable in size and number of costae. Kleinpell's (1938) plesiotype (LSJU677, assigned to *Siphogenerina*) is a long and tapered megaspheric specimen with approximately 16 moderate costae (6 strong costae and several finer and incomplete costae are visible without rotating it); Kleinpell's (1938) table specimen (LSJU) is a poor specimen with thick, low, indistinct costae. Topotypes (USGS) have many thick costae; some specimens are short, others tending toward *R. hughesi*. *R. branneri* was the first species of *Rectuvigerina* to be described from the California Miocene, and it should probably reign as senior synonym over most of the other costate species (e.g., those of Cushman, 1925a) named from this region. Due to the extreme variation seen in this plexus, it is impossible to consistently split the morphotypes into most of the species described. Type descriptions of the various species do not take into account dimorphic (microspheric vs. megaspheric), ontogenetic, or ecophenotypic variation, and subsequent attempts to identify specimens often are frustrating and futile.

Biostratigraphic Range in California Neogene:

Kleinpell (1938): Late Saucesian to early Luisian.

Regional Literature: Saucesian to Luisian (AR76, AR84, BE86, BL81, FI90, KL80, PM81, SM60).

This Study: Saucesian to Mohnian. (GC, IC, LH, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of megaspheric topotype from sample locality GC-15a, Luisian, Monterey Formation, Graves Creek, X52: 1, side view; 2, aboral view.

Plate-figs. 3, 4: Scanning electron micrographs of megaspheric specimen from sample locality LH-7, Luisian, Monterey Formation, Laguna Hills, X43: 3, side view; 4, aboral view.

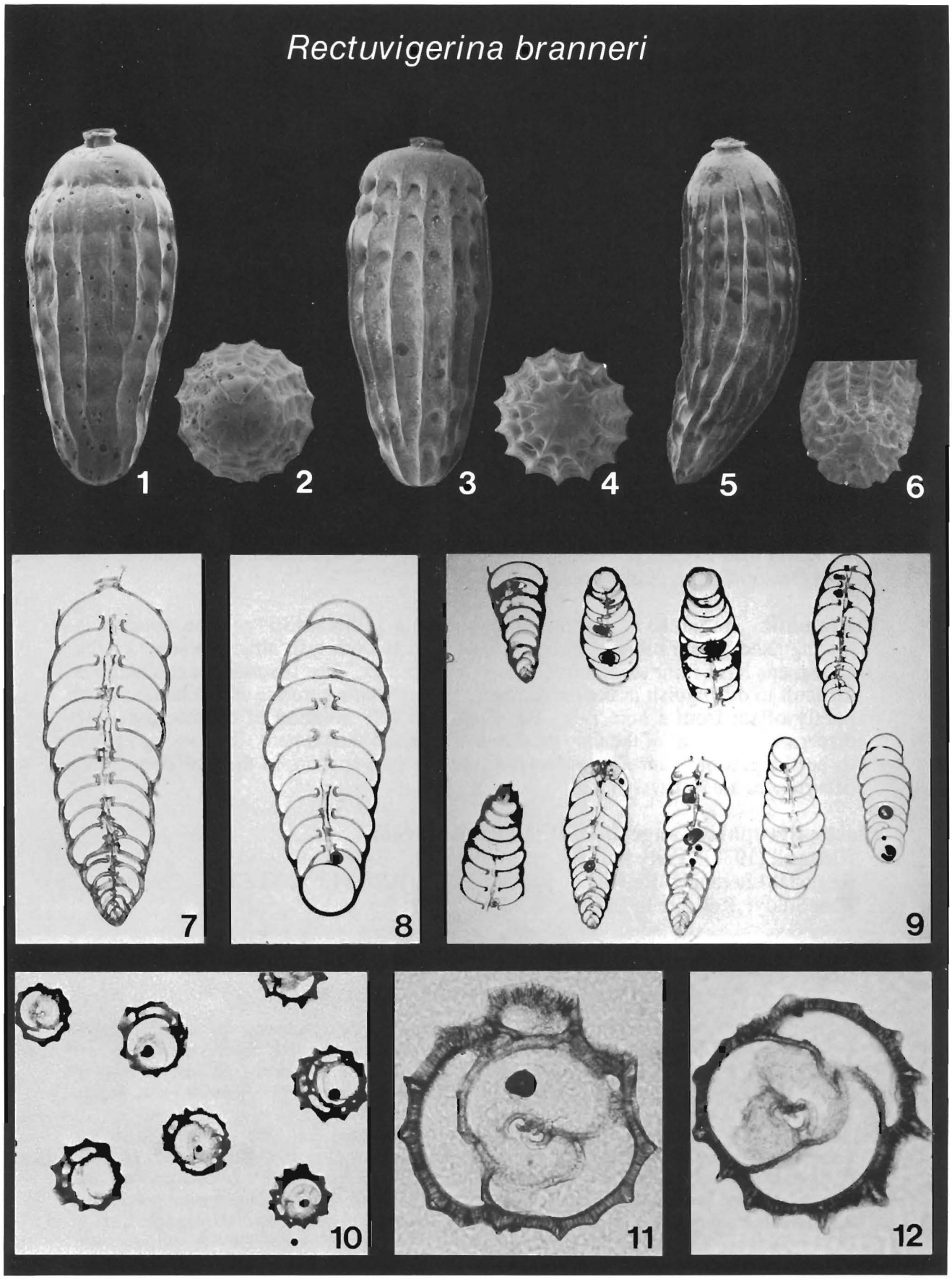
Plate-figs. 5, 6: Scanning electron micrographs of microspheric specimen from sample locality CRC40267-35, Luisian, Monterey Fm., Upper Newport Bay, X33: 5, side view; 6, aboral view.

Plate-fig. 7: Thin-section photomicrograph of microspheric specimen from sample locality CRC40267-34 or -35, Luisian, Monterey Formation, Upper Newport Bay, slide no. 4, X40.

Plate-figs. 8, 9: Thin-section photomicrographs of topotypes from sample locality GC-15a, Luisian, Monterey Formation, Graves Creek, slide no. 137: 8, megaspheric form; X40; 9, microspheric and megaspheric forms, X20.

Plate-fig. 10: Thin-section photomicrograph of megaspheric specimens from sample locality LH-5, Luisian, Monterey Formation, Laguna Hills, slide no. 128, X32.

Plate-figs. 11, 12: Thin-section photomicrographs of microspheric topotypes from sample locality GC-15a, Luisian, Monterey Formation, Graves Creek, slide no. 139, X160.


Rectuvigerina branneri
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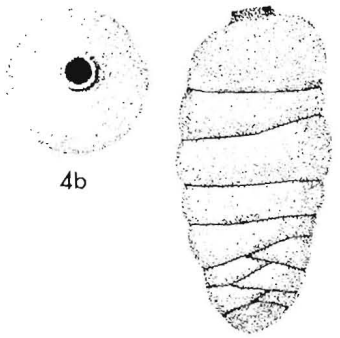
Rectuvigerina hughesi (Cushman)



Type Designation and Reference: *Siphogenerina hughesi* Cushman, 1925d, Contr. Cushman Lab. Foram. Res., v. 1, pt. 2, p. 36.

Type Figures: *Ibid.*, pl. 7, figs. 4a, b, X35.

Type Level and Locality: Relizian, near Chimney Rock, Monterey Formation, San Luis Obispo County, California.

Taxonomic Remarks: Agrees with holotype (USNM4364). The species is distinguished from other *Rectuvigerina* by its smooth test, although some of the specimens have faint striae on the earliest chambers. The triserial neantic stage is difficult to distinguish in the megaspheric generation, where the early chambers are barely offset from a uniseries. However, the 120° rotation of chambers can be discerned in several of the thin-sectioned specimens shown here. This species tends to be the predominant *Rectuvigerina* when it first appears in the Relizian; later occurrences are relatively rare.

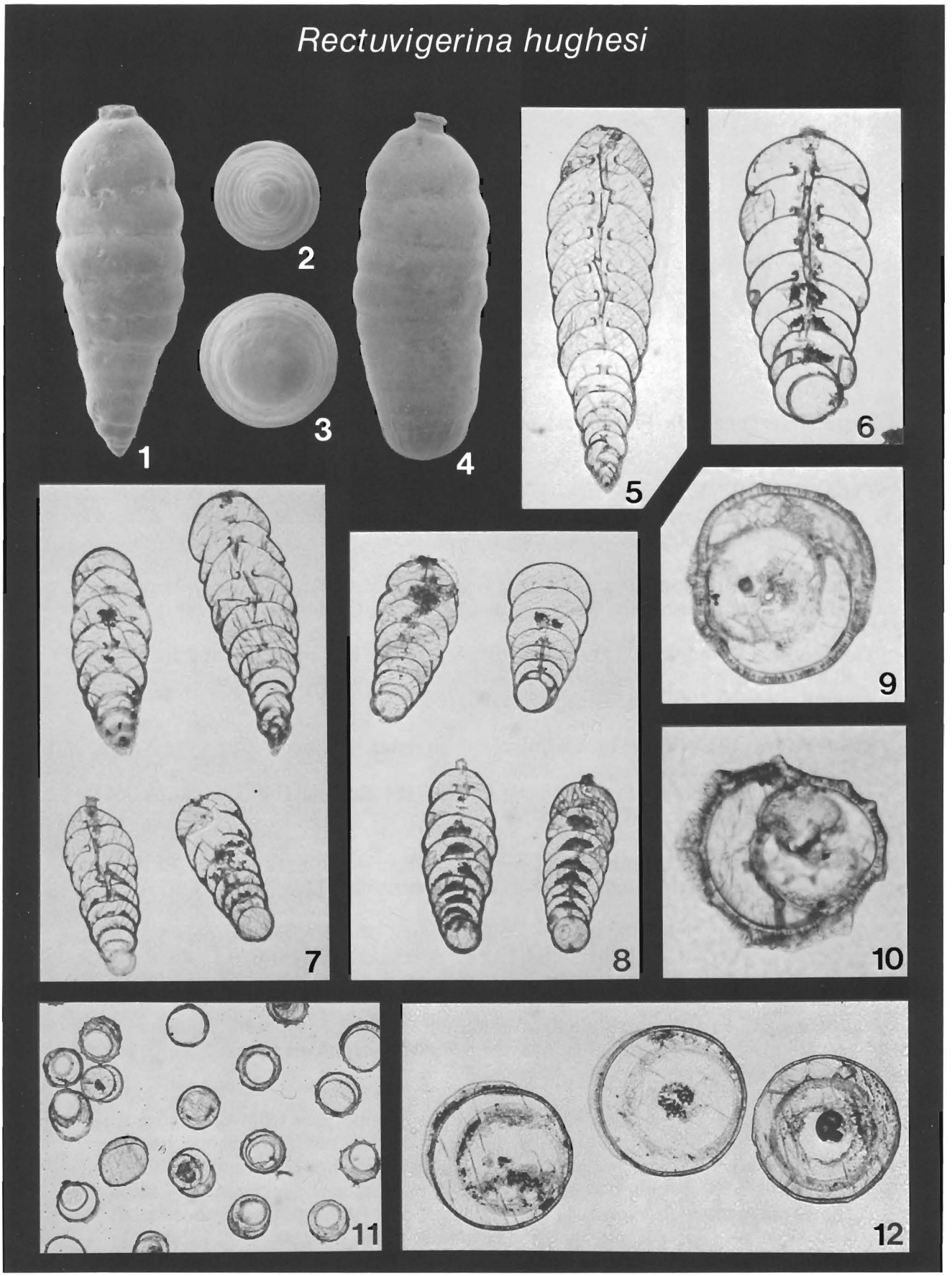
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Relizian.
Regional Literature: Relizian to Luisian (AR76, AR84, FI90, KL80).
This Study: Relizian to Luisian. (GC, IC, SCI)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of microspheric specimen from sample locality GC-4, Relizian, Monterey Formation, Graves Creek, X52: 1, side view; 2, aboral view.

Plate-figs. 3, 4: Scanning electron micrographs of megaspheric specimen from sample locality CRC42984-21, Luisian, Monterey Formation, San Clemente Island, X52: 3, aboral view; 4, side view.

Plate-figs. 5-12: Thin-section photomicrographs of specimens from the Relizian, Monterey Formation, Graves Creek: 5, microspheric specimen, X40, sample locality GC-12, slide no. 136; 6, megaspheric specimen, X64, sample locality GC-4, slide no. 143; 7, microspheric and megaspheric specimens, X32, sample locality GC-12, slide no. 136; 8, megaspheric specimens, X32, sample locality GC-12, slide no. 141; 9, 10, microspheric specimens, X160, sample locality GC-12, slide no. 135; 11, megaspheric specimens, X32, sample locality GC-12, slide no. 140; 12, megaspheric specimens, X80, sample locality GC-12, slide no. 136.


Rectuvigerina hughesi
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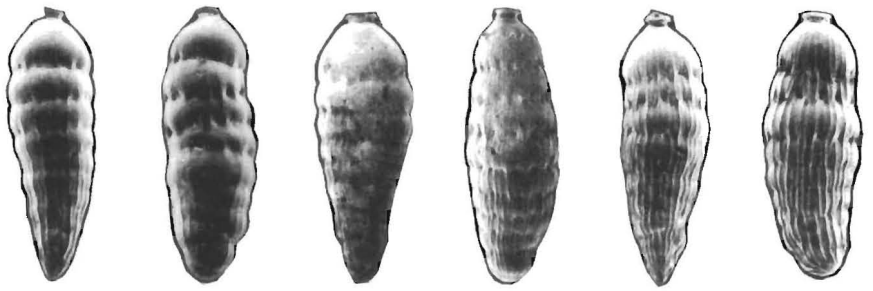
Rectuvigerina loeblichi Finger and Lipps



Type Reference: *In* Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 40.

Type Figures: *Ibid.*, pl. 4, figs. 37-42: 37, microspheric, X39; 38, megaspheric, X28; 39, microspheric paratype, X28; 40, megaspheric paratype, X28, 41, microspheric holotype, X34; 42, megaspheric, X39.

Type Level and Locality: Relizian, Sandholdt Member, Monterey Formation, Graves Creek, Atascadero, San Luis Obispo County, California.

Taxonomic Remarks: This faintly striate species had been referred to, but not illustrated, as an unnamed variety of *Siphogenerina hughesi* Cushman by Woodring and Bramlette (1951) and Kleinpell (1980, p. 33).

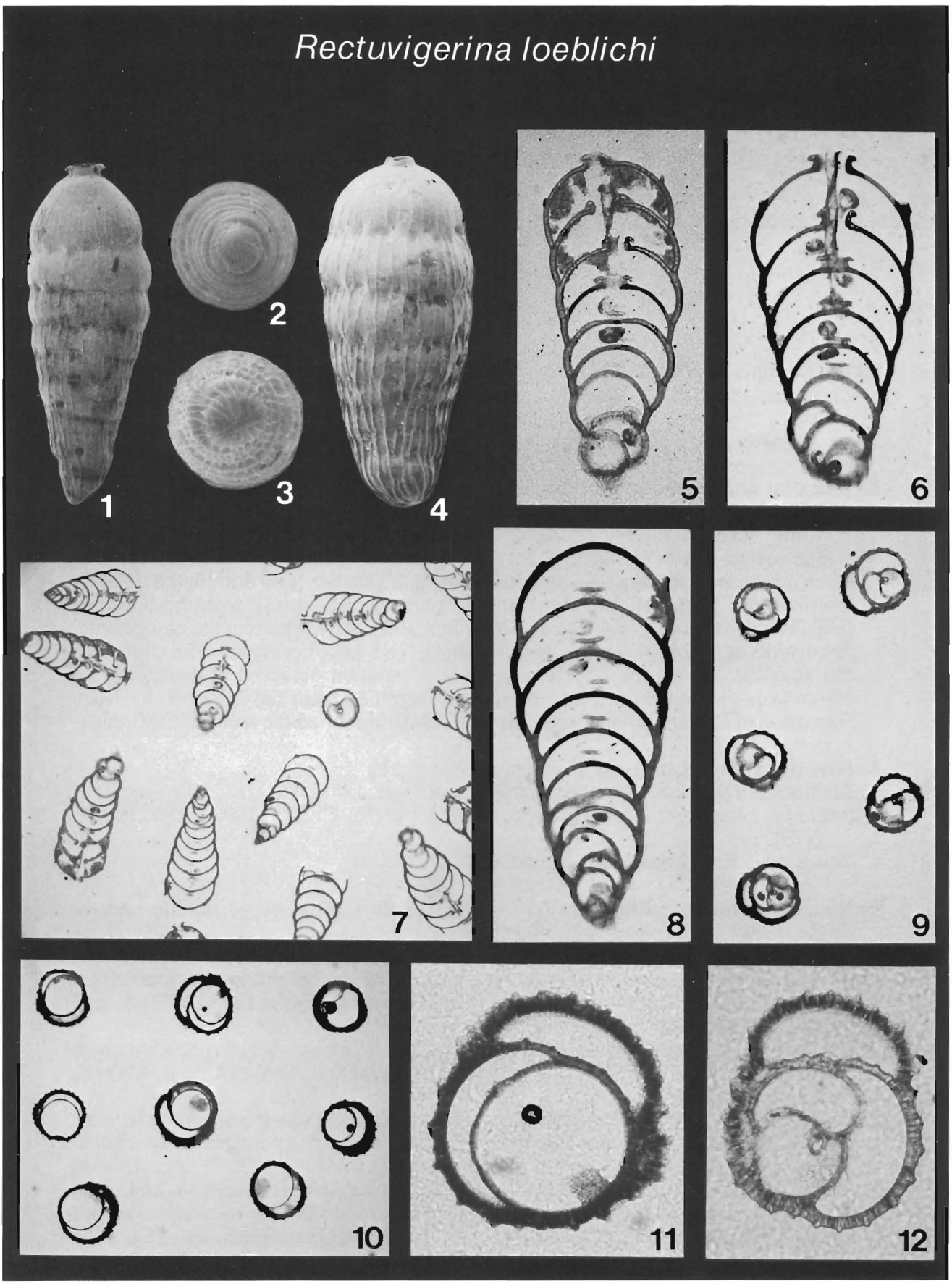
Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *S. hughesi*: Early Relizian.
Regional Literature for *S. hughesi* and *R. loeblichi*: Relizian (FI90, KL80, WB51).
This Study: Relizian. (GC, IC, SCI)

Paleoenvironmental Significance: Probable upper depth limit = outer shelf/upper bathyal transition (see Ingle, 1980, p. 173, footnote no. 6).

Plate-figs. 1, 2: Scanning electron micrographs of microspheric paratype from sample locality GC-3, Relizian, Monterey Formation, Graves Creek, X52: 1, side view; 2, aboral view.

Plate-figs. 3, 4: Scanning electron micrographs of megaspheric topotype from sample locality GC-3, Relizian, Monterey Formation, Graves Creek, X56: 3, aboral view; 4, side view.

Plate-figs. 5-12: Thin-section photomicrographs of topotypes from sample locality GC-3, Relizian, Monterey Formation, Graves Creek: 5, megaspheric specimen, X51, slide no. 18; 6, megaspheric specimen, X64, slide no. 18; 7, microspheric and megaspheric specimens, X20, slide no. 18; 8, microspheric specimen, X64, slide no. 18; 9, microspheric specimens, X51, slide no. 131; 10, megaspheric specimens, X40, slide no. 130; 11, microspheric specimen, X160, slide no. 130; 12, microspheric specimen, X160, slide no. 131.


Rectuvigerina loeblichi
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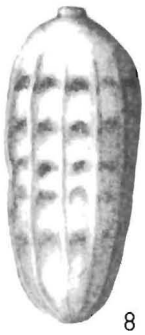
Rectuvigerina transversa (Cushman)



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Type Designation and Reference: *Siphogenerina raphanus* var. *transversus* Cushman, 1918b, U.S. Nat. Mus., Bull., no. 103, p. 64.

Type Figure: *Ibid.*, pl. 22, fig. 8, X35.

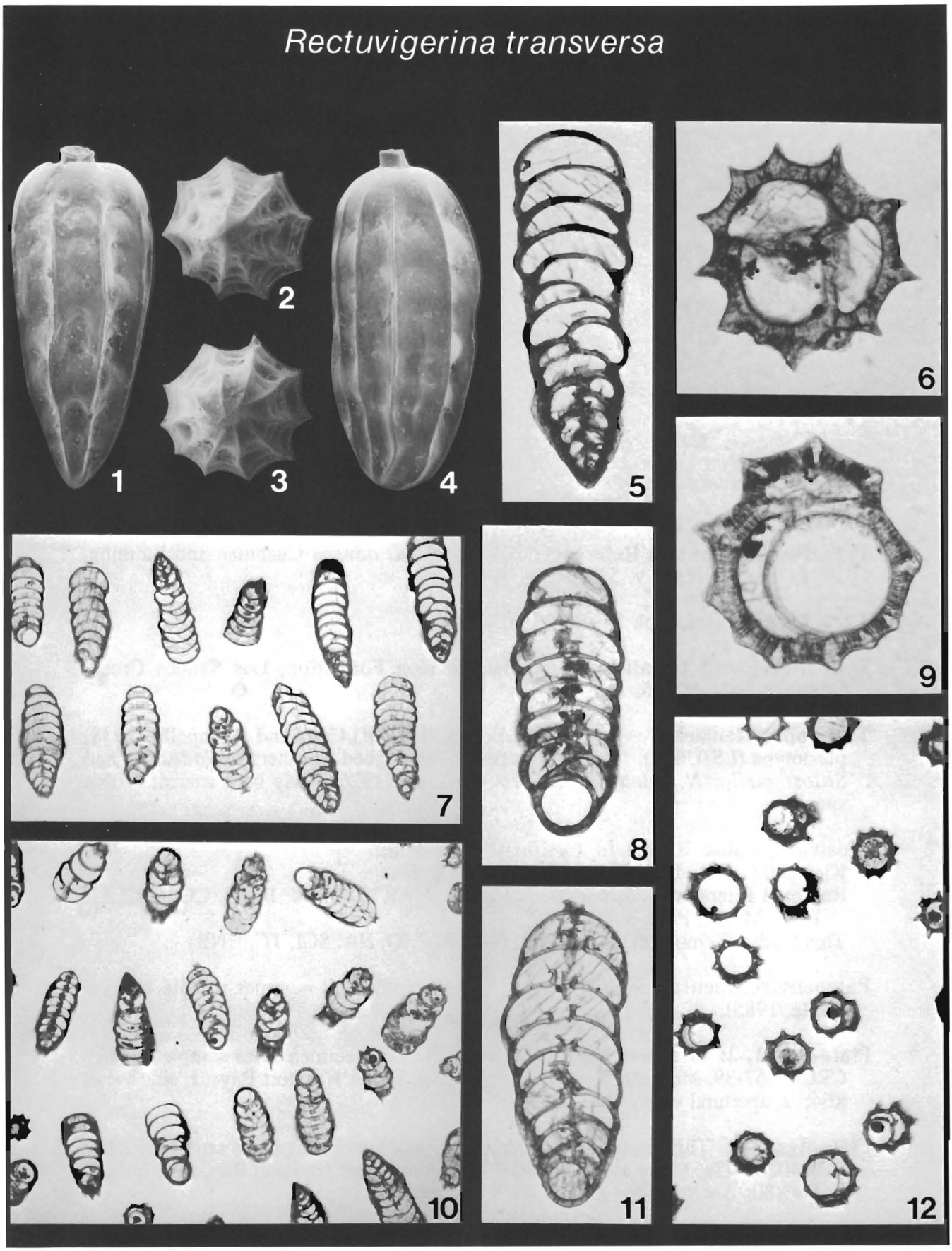
Type Level and Locality: Oligocene, lower Culebra Fm., Panama Canal Zone.

Taxonomic Remarks: The species is characterized by its relatively small size and bladed costae, few in number. Most of the Saucesian associations of *Rectuvigerina*, when compared to those in the Relizian and Luisian, are dominated by this morphotype. Some of the recovered specimens agree closely with the holotype (USNM324646), but a single specimen cannot adequately represent the ontogenetic, dimorphic (microspheric vs. megaspheric), and ecophenotypic variation that characterizes this taxon. The intrapopulation variation observed in the California Miocene is also evident in material that I examined from the Miocene La Boca Formation of Panama [Blacut and Kleinpell (1969) identified the species in this unit].

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Zemorrian to late Saucesian.
Regional Literature: Zemorrian to Luisian (AR76, CL31, FI90, KL80, PM81, TI73).
This Study: Zemorrian to Luisian. (GC, NA)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-figs. 1, 2: Scanning electron micrographs of microspheric specimen from sample locality GC-14, Saucesian, Monterey Formation, Graves Creek, X70: 1, side view; 2, aboral view.
Plate-figs. 3, 4: Scanning electron micrographs of megaspheric specimen from sample locality GC-14, Saucesian, Monterey Formation, Graves Creek, X70: 3, aboral view; 4, side view.
Plate-figs. 5-12: Thin-section photomicrographs of specimens from sample locality GC-14, Saucesian, Monterey Formation, Graves Creek: 5, microspheric specimen, X64, slide no. 19; 6, microspheric specimen, X160, slide no. 133; 7, microspheric and megaspheric specimens, X20, slide no. 19; 8, megaspheric specimen, X64, slide no. 19; 9, megaspheric specimen, X160, slide no. 132; 10, microspheric and megaspheric specimens, X20, slide no. 19; 11, megaspheric specimen, X64, slide no. 19; 12, megaspheric specimens, X40, slide no. 132.


Rectuvigerina transversa
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Siphonodosaria advena (Cushman and Laiming)

19b

19a

Type Designation and Reference: *Nodogenerina advena* Cushman and Laiming, 1931, Jour. Paleont., v. 5, no. 2, p. 106.

Type Figures: *Ibid.*, pl. 11, figs. 19a, b, X70.

Type Level and Locality: Saucesian, Rincon Formation, Los Sauces Creek, Ventura County, California.

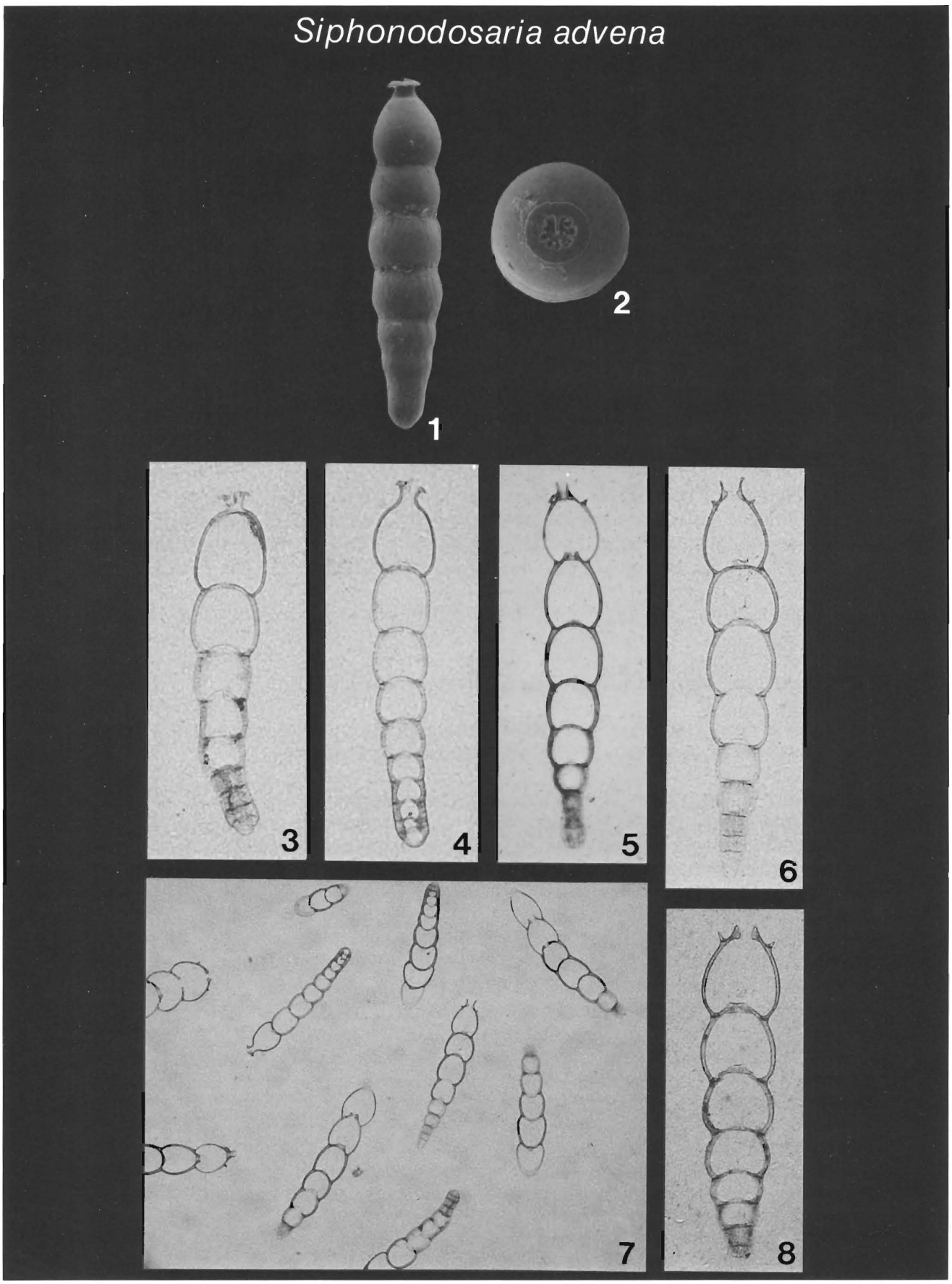
Taxonomic Remarks: Agrees with holotype (USNM14397) and Kleinpell's (1938) plesiotype (LSJU844). This species has been assigned by others to *Nodosaria* and *Stilostomella*. *N. koina* var. *hughesi* Cushman (1926c) may be a variant of this species.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Zemorrian to late Mohnian.
Regional Literature: Zemorrian to Pliocene (AR76, AR84, BE86, CG46, CL31, FI90, MA52, PI56, WH56).
This Study: Zemorrian to Pliocene. (GC, IC, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1985).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-39, Mohnian, Monterey Formation, Upper Newport Bay: 1, side view, X64; 2, apertural view, X127.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 65: 3, 4 = X80; 5 = X64; 6 = X80; 7 = X32; 8 = X80.


Siphonodosaria advena
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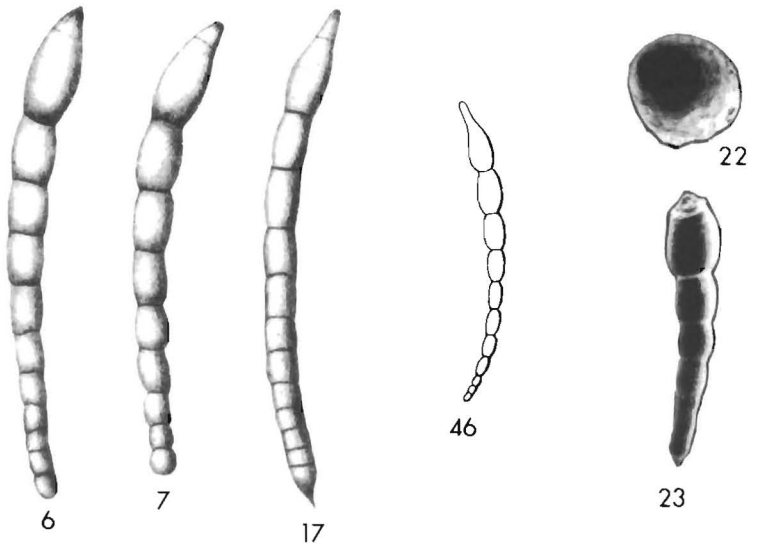
Siphonodosaria montereyana Finger and Lipps



Above Figures: Type figures of *Dentalina reussi* Neugeboren, 1856, pl. 3, figs. 6, 7, 17, magnifications not indicated; *Nodosaria* (*Dentaline*) *communis* d'Orbigny, 1826 *sensu* Parker, Jones, and Brady, 1871, pl. 9, fig. 46, magnification not indicated; 22, 23, *Siphonodosaria montereyana*, holotype: 22, X79; 23, X31.

Type Description: *In* Finger and others, 1990, Micropaleontology, v. 36, no. 1, p. 42.

Type Figures: *Ibid.*, pl. 1, figs. 22, 23 (shown above).

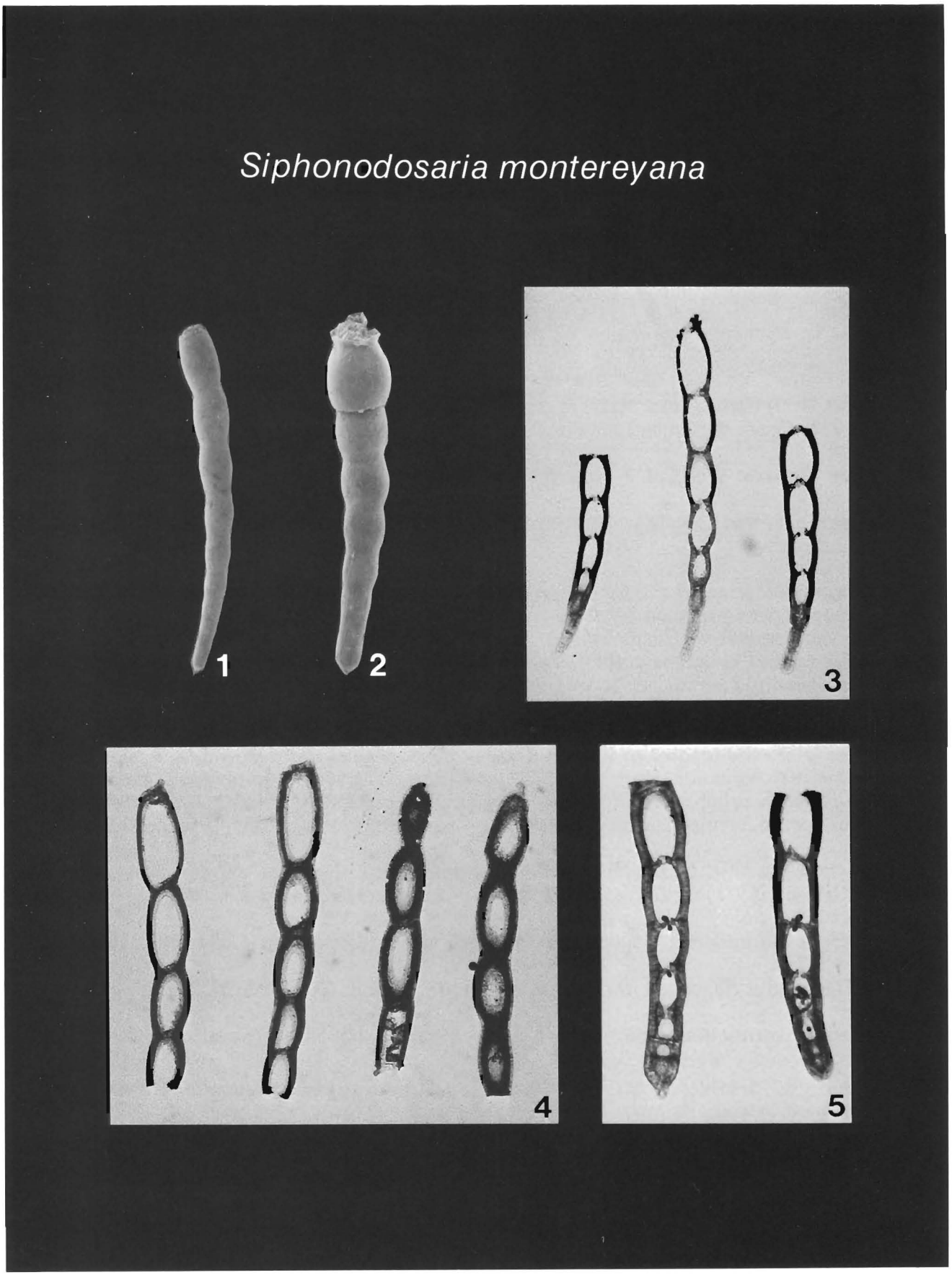
Type Level and Locality: Relizian, Sandholdt Member, Monterey Formation, Graves Creek, Atascadero, San Luis Obispo County, California.

Taxonomic Remarks: This common species resembles *Nodosaria communis* d'Orbigny (1826, Recent, Adriatic Sea) and *Dentalina reussi* Neugeboren (1856, Neogene, Rumania), but its generic assignment is distinguished by its apertural structure and presence of an apical spine. Abraded apertures appear like those of *Nodogenerina* and *Stilostomella*.

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for cf. *D. communis*: Early Zemorrian to early Luisian.
Regional Literature: Saucesian-Relizian (FI90).
This Study: Zemorrian to Pliocene. (GC, NA, SCI, UNB)

Paleoenvironmental Significance: Upper depth limit of *D. communis* = upper middle bathyal; upper depth limit of *Stilostomella* spp. = lower middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-38, Mohnian, Monterey Formation, Upper Newport Bay: side view, X32.
Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay: side view, X42.
Plate-figs. 3-5: Thin-section photomicrographs of specimens from sample locality CRC40267-38, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 117: 3, 4 = X32; 5 = X51.


Siphonodosaria montereyana
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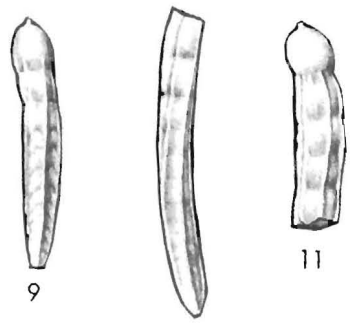
Siphonodosaria quadrulata (Cushman and Parker)



Type Designation and Reference: *Dentalina quadrulata* Cushman and Parker, 1931, Contr. Cushman Lab. Foram. Res., v. 7, pt. 1, no. 99, p. 3.

Type Figures: *Ibid.*, pl. 1, figs. 9-11, X35; 9, holotype.

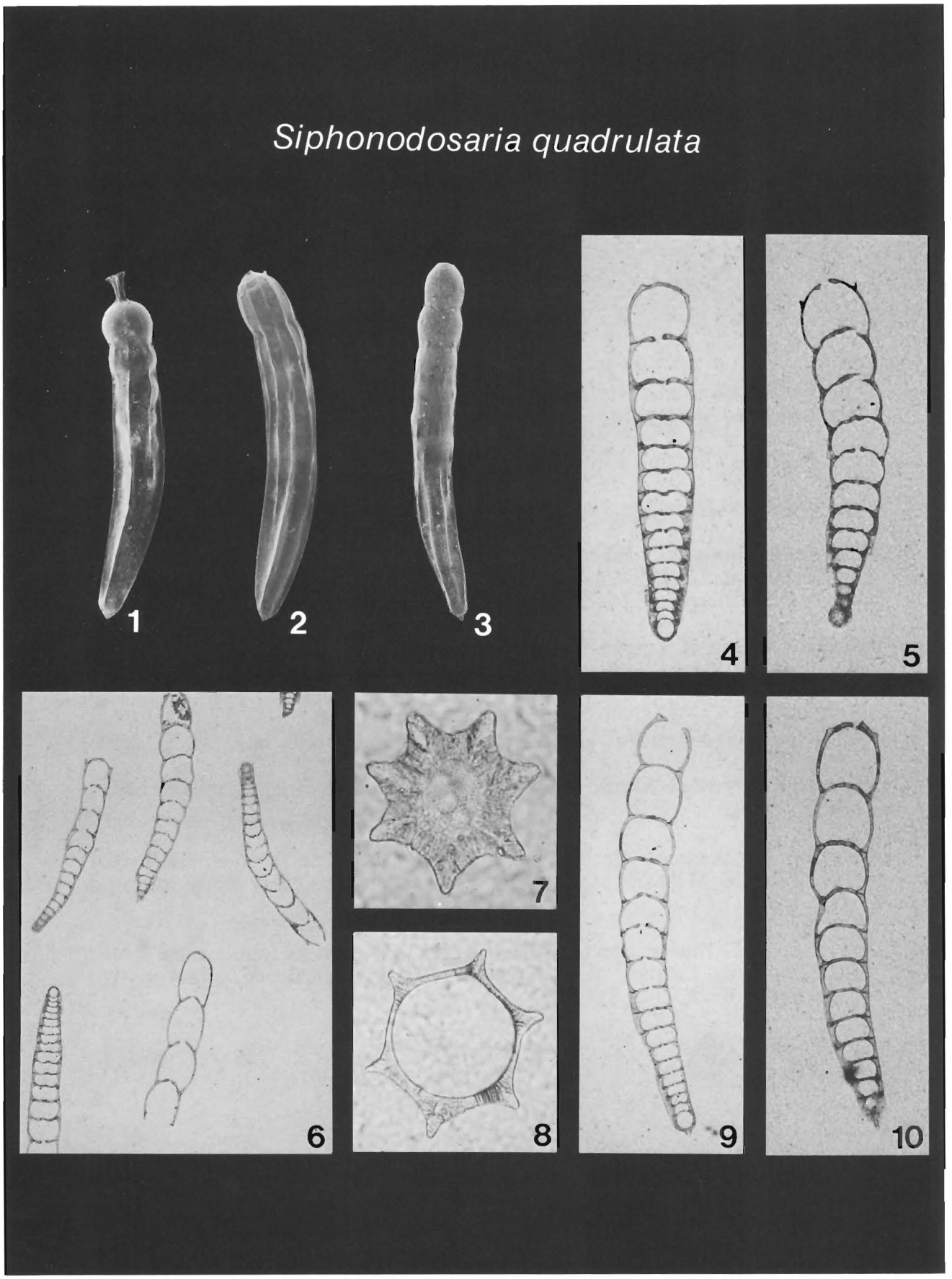
Type Level and Locality: Miocene, east side of San Joaquin Valley, Kern County, California.

Taxonomic Remarks: Agrees with holotype (USNM14516). Authorship of the species was assumed by Cushman and Laiming (1931), but their publication postdates that of Cushman and Parker. *D. barnesi* Rankin (*in* Cushman and Kleinpell, 1934) apparently was described from a lower portion of a *D. quadrulata* test bearing nine costae; type figures of *D. quadrulata* vary from four to about nine costae, which is the range observed in my recovered specimens. *D. hancocki* Cushman and McCulloch (1950) is based on Recent specimens with more chambers, the later ones tending to lose the costae. Thus, both *D. barnesi* and *D. hancocki* appear to be junior synonyms of *D. quadrulata*. The species is assigned herein to *Siphonodosaria* because it possesses a crenulated apertural lip; the fragile structure of the apertural region is rarely preserved on fossil specimens after sample processing.

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *D. quadrulata*: Early Saucesian to late Saucesian.
Kleinpell (*ibid.*) for *D. barnesi*: Late Luisian to late Mohnian.
Regional Literature: Saucesian to Pliocene, ranges to Holocene (CL31, FI90, PI56, TI73).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, NA, SCI, UNB)

Paleoenvironmental Significance: Not determined, but probably middle bathyal.

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay: side view, X63.
Plate-fig. 2: Scanning electron micrograph of specimen from sample locality GC-3, Relizian, Monterey Formation, Graves Creek: side view, X60.
Plate-fig. 3: Scanning electron micrograph of specimen from sample locality GC-9, Relizian, Monterey Formation, Graves Creek: side view, X42.
Plate-figs. 4-10: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 68: 4, 5 = X64; 6 = X20; 7, 8 = X200; 9, X51; 10 = X64.


Siphonodosaria quadrulata
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Sphaeroidina chilostomata Galloway and Morrey

1a 1b

Type Designation and Reference: *Sphaeroidina bulloides* var. *chilostomata* Galloway and Morrey, 1924, Bull. Amer. Paleont., v. 15, no. 55, p. 32.

Type Figures: *Ibid.*, pl. 5, figs. 1a, b, X46.

Type Level and Locality: "Probably Upper Eocene", Manta, Ecuador.

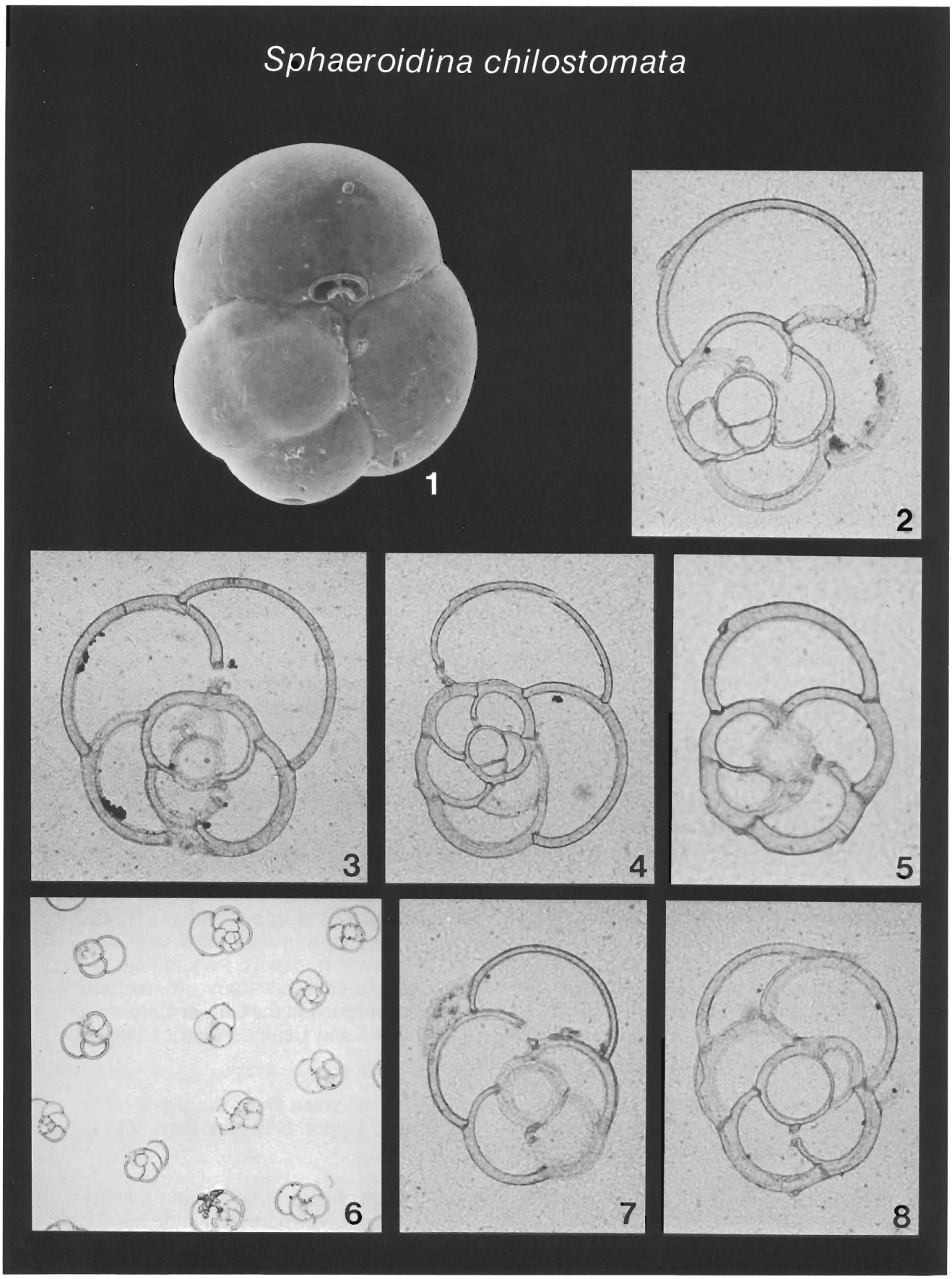
Taxonomic Remarks: Referred to by Martin (1952), but other regional workers have called it *S. bulloides* d'Orbigny (1826). *S. bulloides* has a distinct tooth, whereas *S. chilostomata* has a curved and lipped aperture.

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *S. bulloides*: Early Zemorrian to early Delmontian.
Regional Literature: Saucesian to Pliocene, ranges to Holocene (CB86, CS30, PI56, TI73).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC42107-18, Mohnian, Monterey Formation, Manville Quarry access road: side view, X166.

Plate-figs. 2-8: Thin-section photomicrographs of specimens from sample locality CRC39842-30, Luisian, Monterey Formation, Naples Beach, slide no. 101: 2-5 = X160; 6 = X32; 7, 8 = X160.


Sphaeroidina chilostomata
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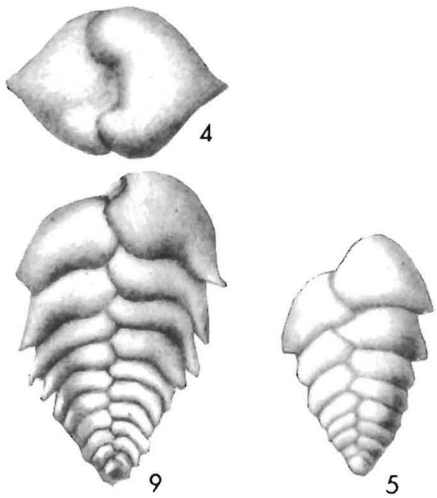
Suggrunda kleinpelli Bramlette



Type Reference: *In* Woodring and Bramlette, 1951, U.S. Geol. Surv., Prof. Pap., no. 222 (1950), p. 59.

Type Figures: *Ibid.*, pl. 23, figs. 4, 5, 9, X100; 4, 9, holotype.

Type Level and Locality: Lower Mohnian, Monterey Formation, Purisima Hills, Santa Barbara County, California.

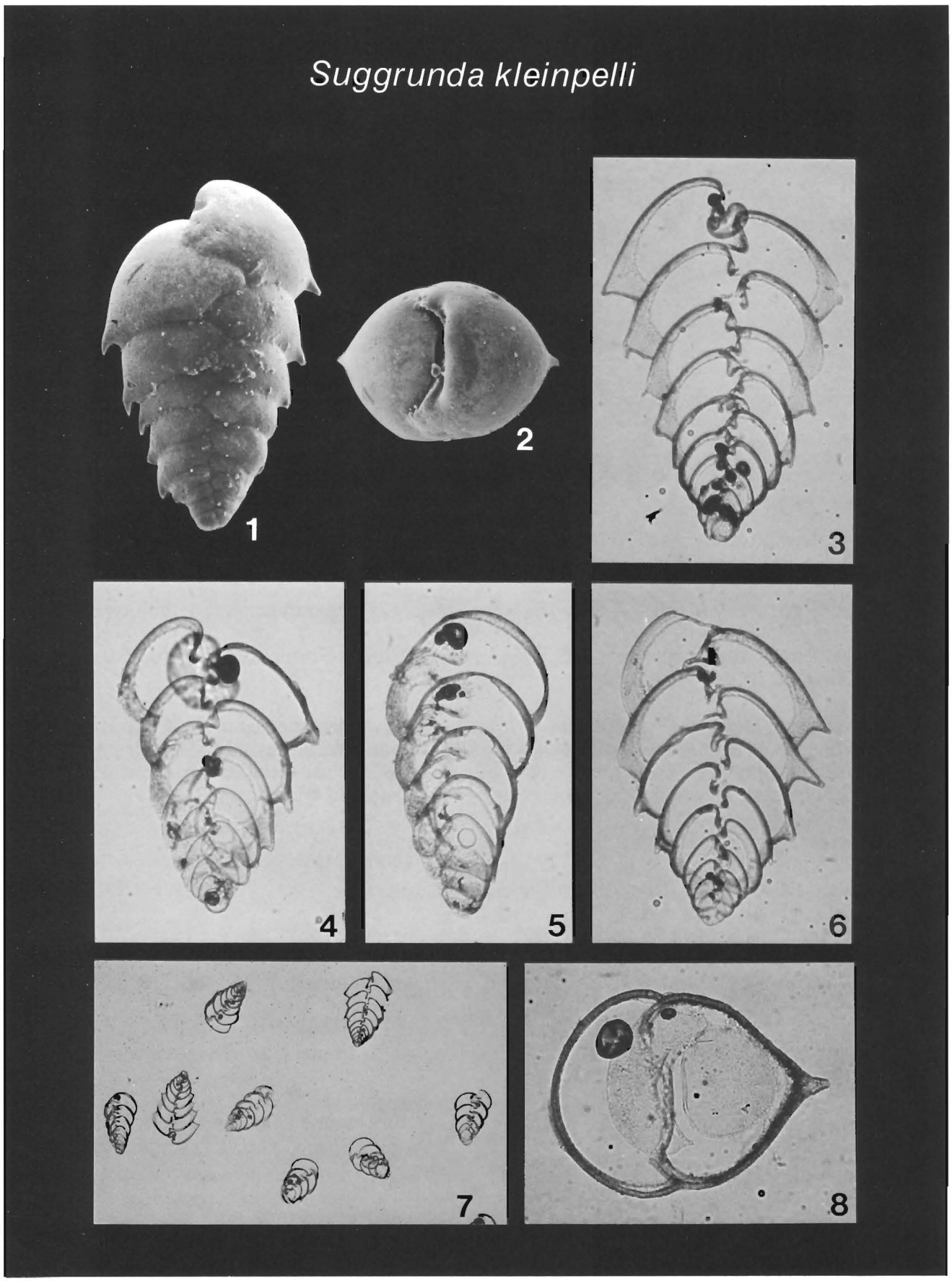
Taxonomic Remarks: Agrees with holotype (USNM560217), which is also similar to that of *S. eckisi* Natland (1950; USNM560206). *S. inflata* Finger and Lipps (*in* Finger and others, 1990) has rounded lateral edges without spines.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Regional Literature: Relizian to Pliocene, ranges to Holocene (AR76, AR84, BE86, CB86, FI90, PI56, SB86, SM60, WB51).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, IC, LH, MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980); Ingle (1980) interprets this species as an oxygen-minimum zone indicator. Although Douglas (1981) found that post-mortem transport invalidated the interpretation of *Suggrunda* as a low-oxygen indicator in his study off southern California, its affinity for low-oxygen waters is uncontested in the Gulf of California (Ingle and Keller, 1980) and off northern California and Central America (Ingle, personal comm.).

Plate-figs. 1, 2: Scanning electron micrographs of specimen from sample locality CRC40267-45a, Mohnian, Monterey Formation, Upper Newport Bay, X171: 1, side view; 2, apertural view.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-45a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 37: 3-6, 8 = X160; 7 = X32.


Suggrunda kleinpelli
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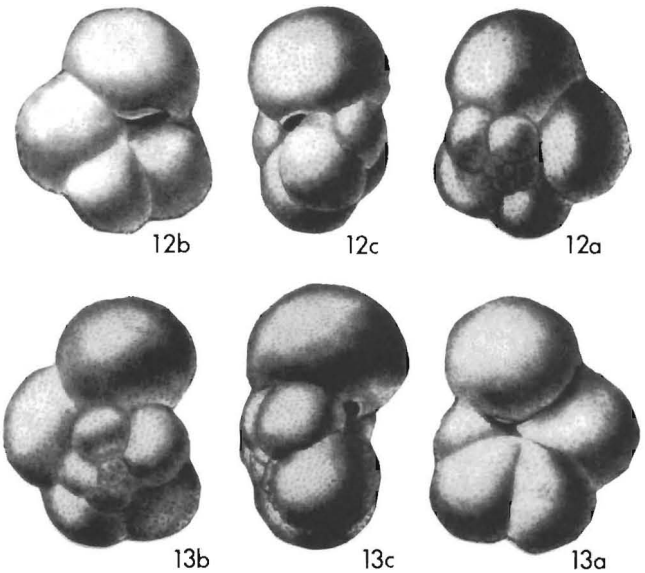
Tenuitellinata angustiumbilicata (Bolli)



Type Designation and Reference: *Globigerina ciperoensis angustiumbilicata* Bolli, 1957, U.S. Nat. Mus., Bull., no. 215, p. 109.

Type Figures: *Ibid.*, pl. 22, figs. 12a-13c, X150: 12a-c, paratype; 13a-c, holotype.

Type Level and Locality: Oligocene, lower Cipero Formation, Cipero Coast, Trinidad, British West Indies.

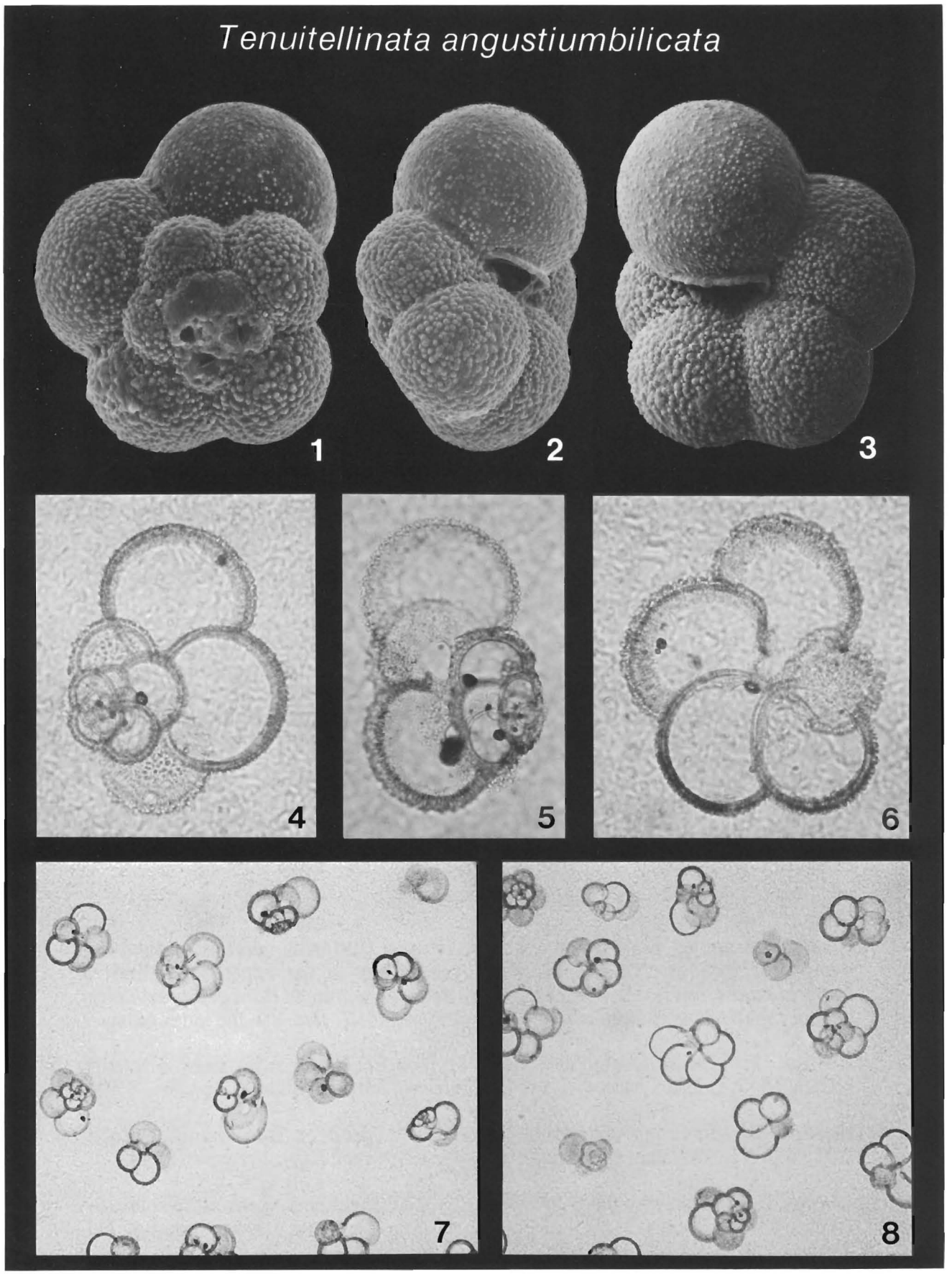
Taxonomic Remarks: Lipps (1964) identified this minute species in the California Miocene as *Eoglobigerina minutissima* (Bolli), but that species has a significantly different aperture. The microperforate test wall of *T. angustiumbilicata* is atypical of *Globigerina*, to which it has most often been assigned (Li Qianyu, 1987).

Biostratigraphic Range:
Regional Literature: Relizian to Luisian (BE86, FI90, PM81).
Ingle (1973; Site 173): Zones N3/4 to N13/14.
Poore (1981; Sites 467 & 468): Zones N9/10 to N21.
Kennett and Srinivasan (1983, p. 31): Zones N19 to N20.
This Study: Saucesian to Pliocene, Zones N6 to N21; the species ranges from below P18/19 to N5 in low latitudes (Bolli and Saunders, 1985). (GC, IC, LH, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Distributed in tropical to temperate waters (Kennett and Srinivasan, 1983, p. 31).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC39842-9, Luisian, Monterey Formation, Naples Beach, X460: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay, slide no. 96: 4-6 = X320; 7, 8 = X80.


Tenuitellinata angustiumbilicata
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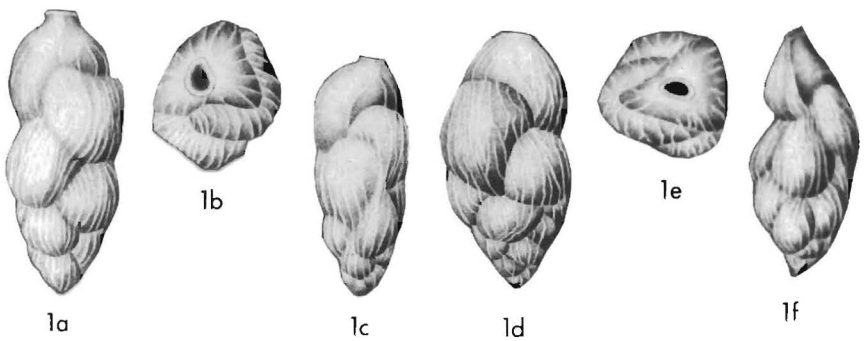
Trifarina fluens (Todd)



Type Designation and Reference: *Angulogerina fluens* Todd, *in* Cushman and McCulloch, 1948, Allan Hancock Pac. Exped., v. 6, no. 5, p. 288.

Type Figures: *Ibid.*, pl. 36, figs. 1a-f, X55: 1a, b, holotype; 1c, paratype; 1d-f, variants.

Type Level and Locality: Recent, Wrangell, Alaska; species also recorded by authors from Gulf of California and off Peru.

Taxonomic Remarks: Paratypes (USNM46853) differ from recovered specimens, but the species seems to be quite variable. All specimens are subtriangular in apertural view and ornamentation is highly variable, ranging from nearly smooth to distinctly costate. It may be synonymous with *Uvigerina hughesi* Galloway and Wissler (1927, Pliocene, California) and/or *Angulogerina occidentalis* Cushman (1923, Recent, West Indies).

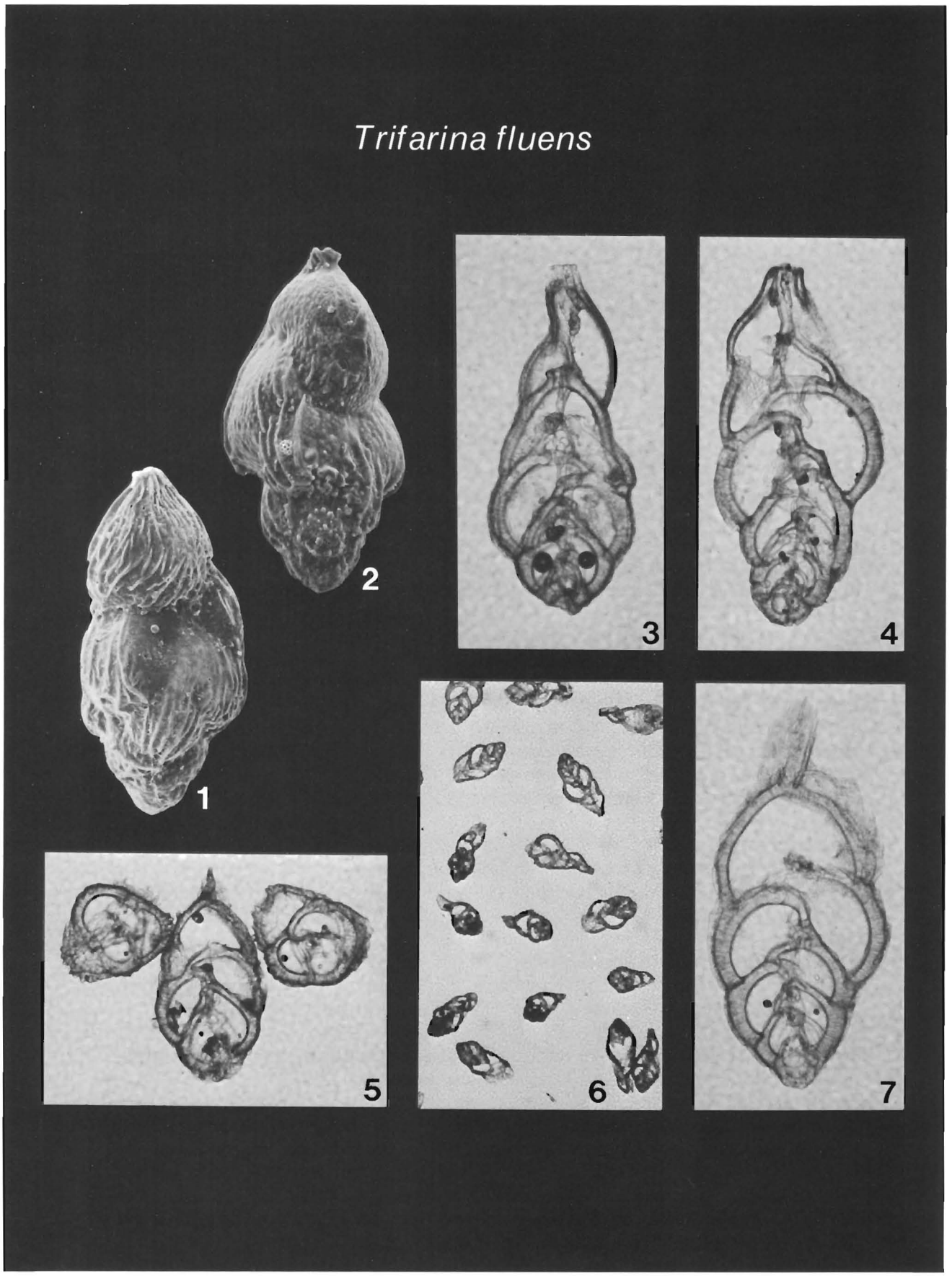
Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *A. occidentalis*: Late Zemorrian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, CB86, PI56).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, IC, SCI, UNB)

Paleoenvironmental Significance: There is some confusion here, as Ingle (1980) designated the outer shelf/upper bathyal transition as the upper depth limit of *T. occidentalis*, but he later (Ingle, 1985) lists the upper depth limit of *Trifarina* spp. as inner shelf. It would probably be correct to include *T. fluens* in the latter group.

Plate-figs. 1: Scanning electron micrograph of specimen from sample locality UCLA-6317, Luisian, Monterey Formation, San Clemente Island, side view, X138.

Plate-figs. 2: Scanning electron micrograph of specimen from sample locality CRC40267-1, Mohnian, Monterey Fm., Upper Newport Bay, side view, X194.

Plate-figs. 3-7: Thin-section photomicrographs of specimens from sample locality UCLA-6317, Luisian, Monterey Formation, San Clemente Island, slide no. 102: 3, 4 = X160; 5 = X128; 6 = X32; 7 = X160.


Trifarina fluens
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Uvigerina hannai Kleinpell

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Type Reference: Kleinpell, 1938, Miocene Stratigraphy of California, p. 294, not figured.

Above Figure: *Uvigerina californica* Hanna (not Cushman), 1928, pl. 9, fig. 3, magnification not indicated. [Synonymized by Kleinpell (1938)]

Type Level and Locality: Upper Mohnian, Monterey Formation, Canyon Segundo, Monterey County, California.

Taxonomic Remarks: Holotype (LSJU764) has a moderate number of poorly defined costae but is shattered, missing its neck, and is soaked with nonsoluble glue. Kleinpell's (1938) table specimens (LSJU) look like microspheric specimens of *Uvigerina hootsi* Rankin (*in* Cushman and Kleinpell, 1934) with striations on the early half of the test. Many of the recovered specimens tend toward *Hopkinsina*.

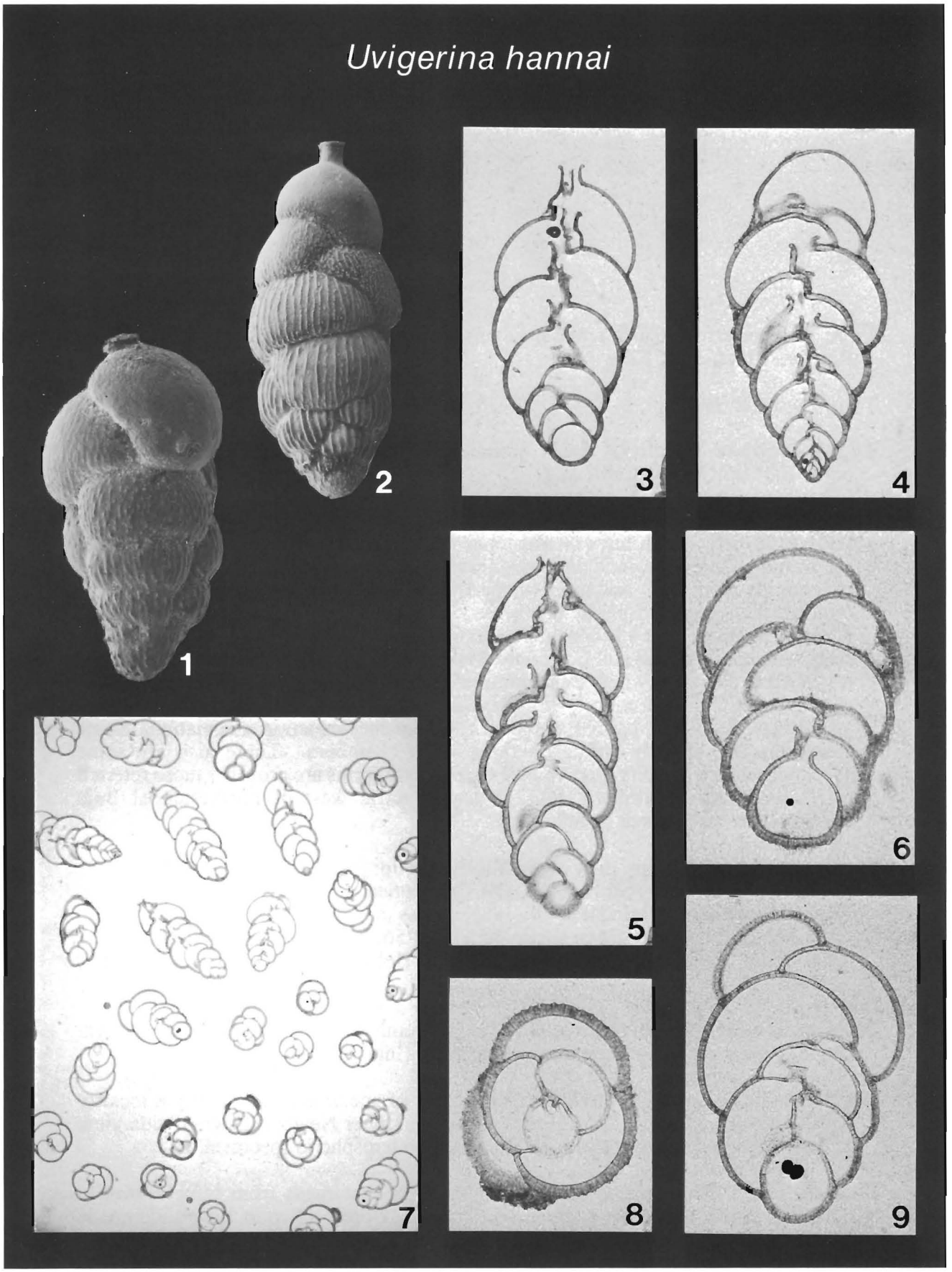
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Mohnian to early Delmontian.
Regional Literature: Mohnian to Delmontian (KL80).
This Study: Saucesian to "Delmontian". (IC, LH, MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit not determined, but its ornamentation intermediate between those of *U. subperegrina* Cushman and Kleinpell and *U. hootsi* suggests that it is upper bathyal or upper middle bathyal.

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality LH-7, Luisian, Monterey Formation, Laguna Hills: side view, X102.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality CRC40267-35, Luisian, Monterey Formation, Upper Newport Bay: side view, X68.

Plate-figs. 3-9: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 51: 3-5 = X64; 6 = X100; 7 = X20; 8 = X100; 9 = X80.


Uvigerina hannai
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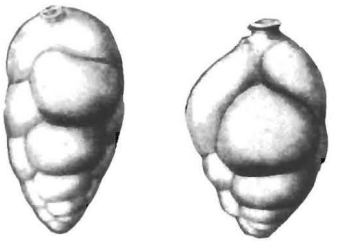
Uvigerina hootsi Rankin



8 9

Type Reference: *In* Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 22.

Type Figures: *Ibid.*, pl. 3, figs. 8, 9, X50; 8, holotype; 9, paratype.

Type Level and Locality: Basal Mohnian, Monterey Formation, Naples Beach, Santa Barbara County, California.

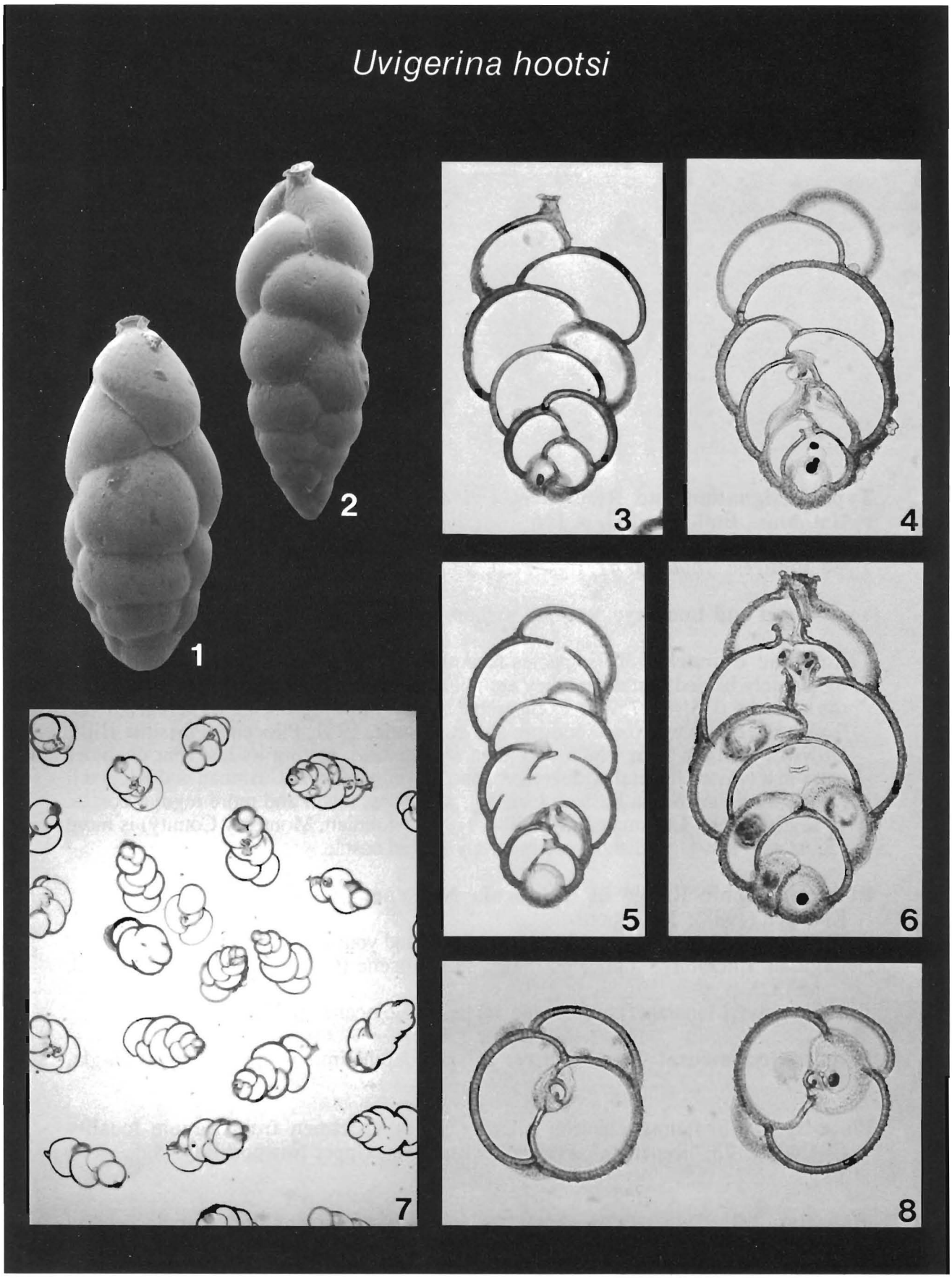
Taxonomic Remarks: Agrees with holotype (USNM20154) and paratype (USNM20155), which have chambers arranged in three vertical rows. However, recovered populations, including topotypes, vary in this coiling symmetry, as do all uvigerinids recovered, and those specimens with this neat arrangement are in the minority. Large microspheric forms are identical to *U. modeloensis* Cushman and Kleinpell (1934), which is considered here to be a junior synonym. Gradations are seen between *U. hootsi* and *U. hannai* Kleinpell (1938); forms with ornamentation restricted to the initial whorl are included in *U. hootsi*. In some cases, it is difficult to distinguish *U. hootsi* from immature *Hopkinsina magnifica* Bramlette (*in* Woodring and Bramlette, 1951), particularly when the two species are in association. Some specimens are slightly striate on the earliest chambers. There also are some specimens which are very slightly hispid; the latter forms are probably those referred to *U. senticosa* Cushman (1927, Recent, Pacific west of northernmost Baja California) in the regional literature.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Mohnian to early Delmontian.
Regional Literature: Relizian to Pliocene, ranges to Holocene (AR76, AR84, BE86, BL81, CB86, CG46, FI90, KL80, MA52, PI56, SM60, WH56).
This Study: Saucesian to Pliocene, ranges to Holocene. (GC, IC, MQ, NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980); oxygen-minimum zone indicator (Ingle, 1985).

Plate-figs. 1, 2: Scanning electron micrographs of specimens from sample locality CRC40267-43, Mohnian, Monterey Formation, Upper Newport Bay: 1, side view of megaspheric specimen, X91; 2, side view of microspheric specimen, X71.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality CRC40267-47a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 1: 3 = X64; 4 = X80; 5 = X64; 6 = X80; 7 = X20; 8 = X80.


Uvigerina hootsi
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Uvigerina "peregrina" Cushman

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Type Designation and Reference: *Uvigerina peregrina* Cushman, 1923, U.S. Nat. Mus., Bull., no. 104, p. 166.

Type Figures: *Ibid.*, pl. 42, figs. 7-10, X30.

Type Level and Locality: Recent, offshore northeastern United States.

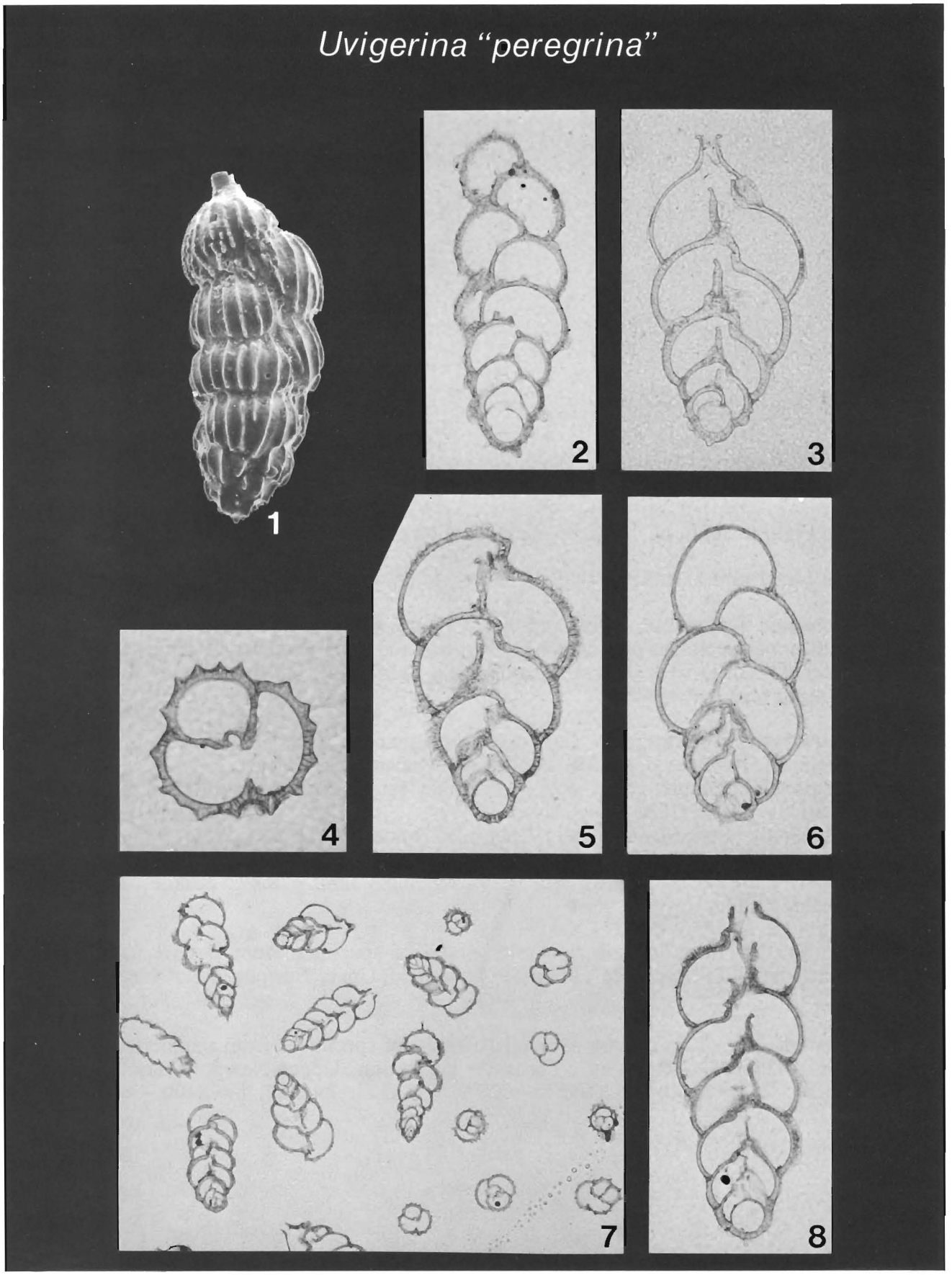
Taxonomic Remarks: This species resembles *U. peregrina* in having jagged and moderately bladed costae, but they are not as thick nor as closely spaced as those on the holotype (USNM17574). Comparable species in California are *U. peregrina* var. *foxenensis* Bramlette (*in* Woodring and Bramlette, 1951, Pliocene, Purisima Hills, USNM), a larger form which may be a *Hopkinsina*, having its last four chamber pairs in a twisted biserial arrangement, and *U. subperegrina* Cushman and Kleinpell (1934, Mohnian, Santa Barbara County), which has lower and more regular costae. *U. segundoensis* Cushman and Galliher (1934, Mohnian, Monterey County) is more robust with less-jagged and more regularly spaced costae.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not reported.
Kleinpell and Tipton (1980): Late Delmontian and younger.
Regional Literature: Pliocene, ranges to Holocene (CB86, CS30, GW27, HA80, MA52).
This Study: Mohnian(?) to Pliocene, ranges to Holocene. (UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980).

Plate-fig. 1 Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: side view, X87.

Plate-figs. 2-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 80: 2, 3 = X100; 4 = X160; 5, 6 = X100; 7 = X32; 8 = X100.


Uvigerina "peregrina"
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Uvigerina proboscidea Schwager

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Type Reference: Schwager, 1866, *Novara* Exped. 1857-1859, Geol. Theil., v. 2, pt. 2, p. 250.

Type Figure: *Ibid.*, pl. 7, fig. 96, magnification not indicated.

Type Level and Locality: Upper Tertiary, India.

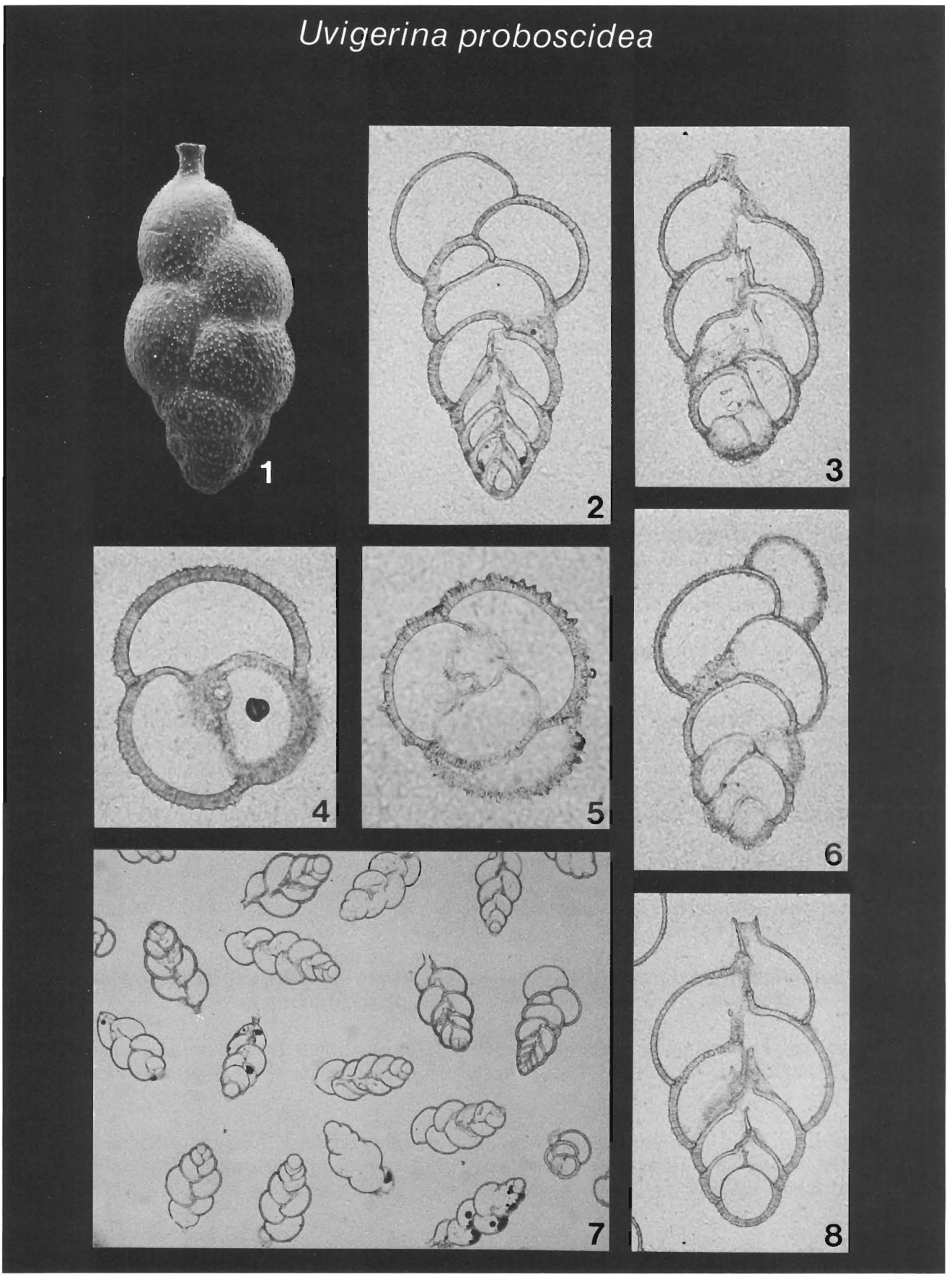
Taxonomic Remarks: Agrees with type figure which tends toward *Hopkinsina*. California specimens may also have been referred to *U. senticosa* Cushman (1927, Recent, Pacific west of northernmost Baja California), but that species is more elongate and more triserial.

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *U. proboscidea*?: Late Relizian to late Luisian.
Regional Literature: Saucesian to Pliocene, ranges to Holocene (BE86, BL81, BO81, CB86, CS30, MA52).
This Study: Saucesian to Pliocene, ranges to Holocene. (UNB)

Paleoenvironmental Significance: Upper depth limit = lower middle bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: side view, X103.

Plate-figs. 2-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 81: 2, 3 = X100; 4 = X160; 5 = X200; 6 = X128; 7 = X32; 8 = X100.


Uvigerina proboscidea
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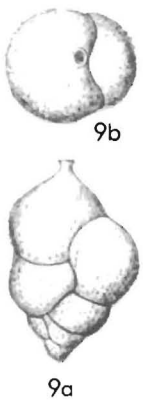
Uvigerina senticosa adiposa White



Type Designation and Reference: *Uvigerina senticosa* var. *adiposa* White, 1956, Jour. Paleont., v. 30, no. 2, p. 259.

Type Figures: *Ibid.*, pl. 32, figs. 9a, b, holotype, X86.

Type Level and Locality: Lower Pliocene, Fernando Formation, Orange County, California.

Taxonomic Remarks: Agrees with holotype (USNM237498), even though it is a very small juvenile form (broken by White on 3/23/55). This subspecies is finely papillate, whereas *U. proboscidea* Schwager (1866, Upper Tertiary, India) and *U. senticosa* Cushman (1927, Recent, Pacific west of northernmost Baja California) are hispid. This species tends toward *Hopkinsina* in its chamber arrangement.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Regional Literature: Pliocene (WH56).
This Study: Pliocene. (UNB)

Paleoenvironmental Significance: Upper depth limit for *U. senticosa* and *U. senticosa* var. = lower middle bathyal (Ingle, personal comm.).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay: side view, X82.

Plate-figs. 2-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 82: 2 = X100; 3 = X128; 4 = X100; 5 = X128; 6 = X32; 7 = X100; 8 = X160.

Uvigerina senticosa adiposa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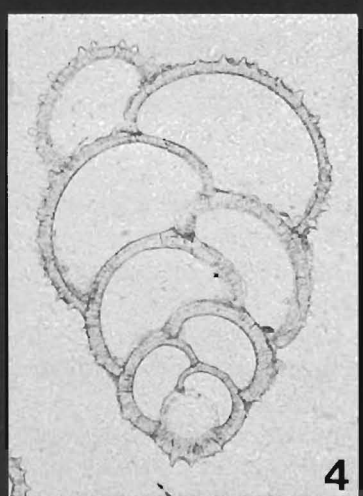
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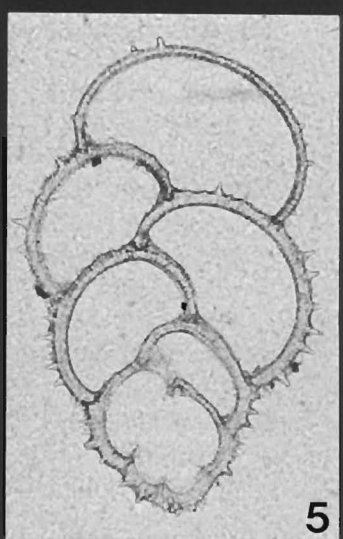
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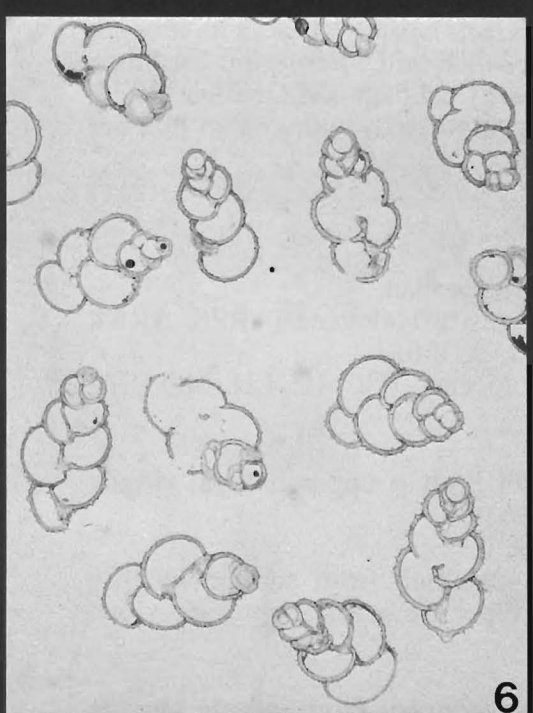
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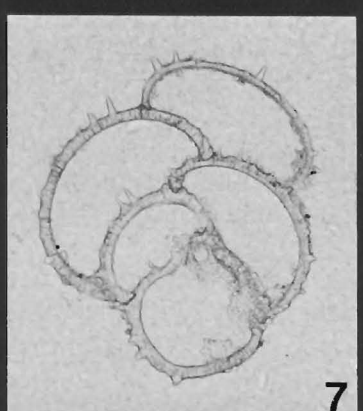
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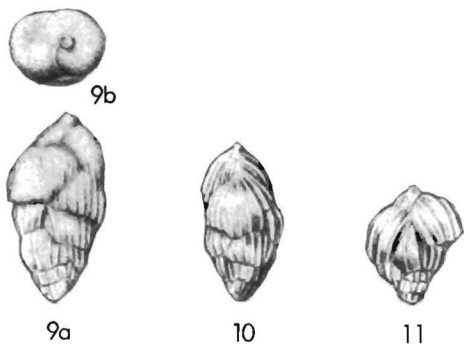
Uvigerina subperegrina Cushman and Kleinpell



Type Reference: Cushman and Kleinpell, 1934, Contr. Cushman Lab. Foram. Res., v. 10, pt. 1, p. 12.

Type Figures: *Ibid.*, pl. 2, figs. 9a-11, X35: 9a, b, holotype; 10, 11, paratypes.

Type Level and Locality: Lower Mohnian, Monterey Formation, Naples Beach, Santa Barbara County, California.

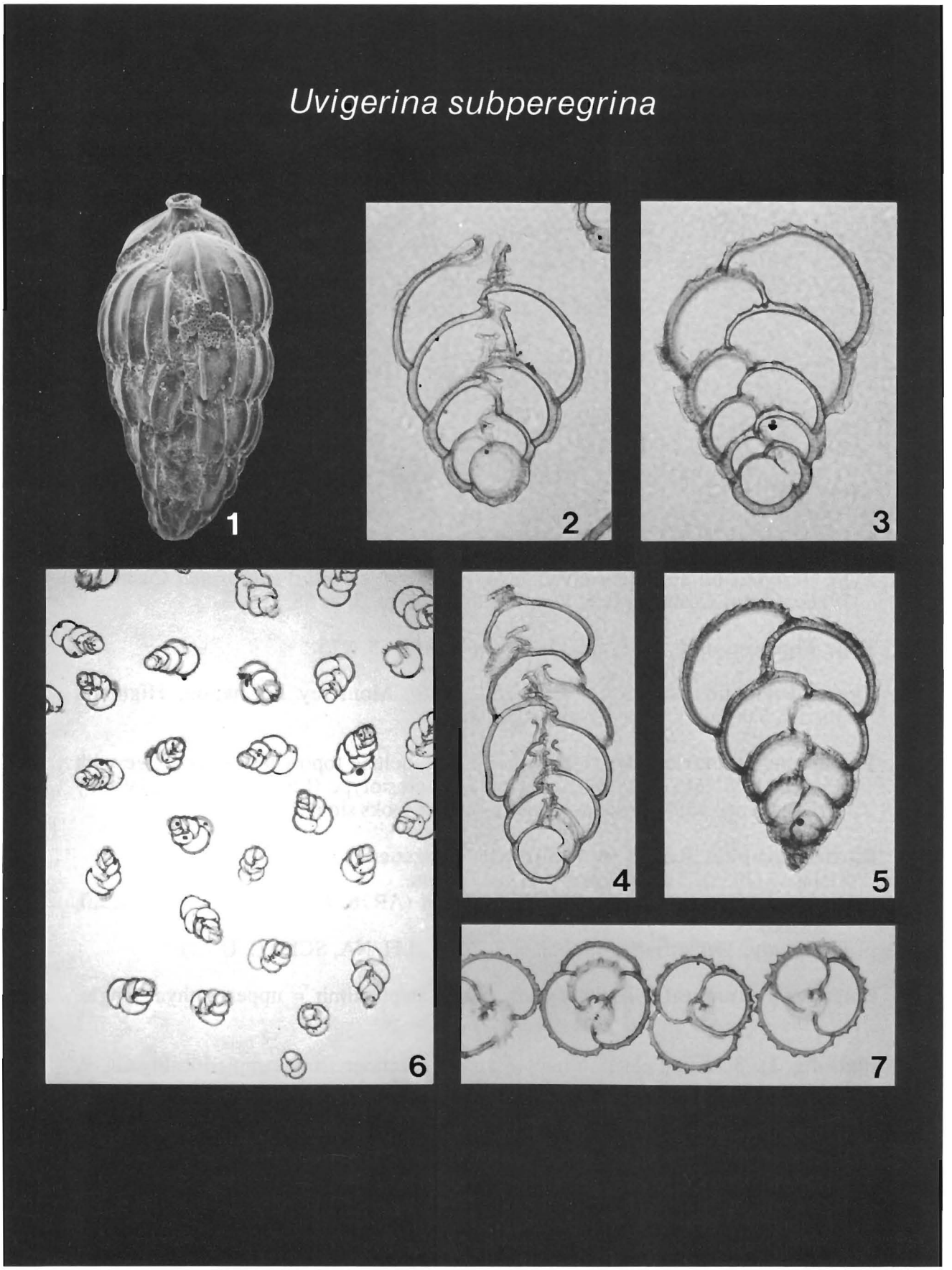
Taxonomic Remarks: Recovered specimens include topotypes and agree with holotype (USNM20137) and other topotypes (USGS). Costae variable in strength and number, but less numerous, bladed, and jagged than on *U. peregrina* Cushman (1923) and *U. "peregrina"* herein. *U. segundoensis* Cushman and Galliher (1934; Mohnian, Monterey County) is larger and less compressed, with costae that are relatively blunt, more numerous, and evenly spaced.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Mohnian to late Delmontian.
Kleinpell and Tipton (1980): Early Luisian to late Delmontian.
Regional Literature: Zemorrian to Pliocene, ranges to Holocene (AR76, AR84, CB86, CG46, FI90, KL80, HA80, PI56, SM60, WH56).
This Study: Zemorrian to Pliocene, ranges to Holocene. (GC, IC, LH, MQ, NA, SCI, TC, TR, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980); oxygen-minimum zone indicator (Blake, 1981).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality CRC40267-34, Luisian, Monterey Formation, Upper Newport Bay: side view, X112.

Plate-figs. 2-7: Thin-section photomicrographs of specimens from sample locality CRC39842-68, Mohnian, Monterey Formation, Naples Beach, slide no. 122: 2, 3 = X100; 4, 5 = X80; 6 = X20; 7 = X64.


Uvigerina subperegrina
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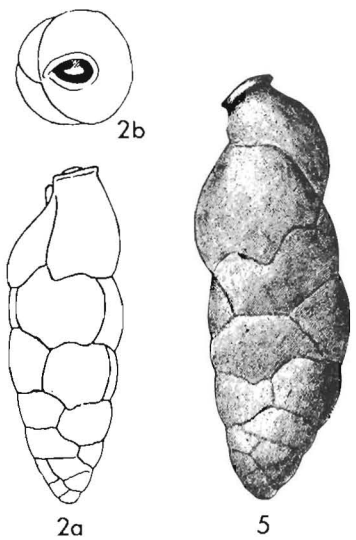
Uvigerinella californica Cushman



Type Designation and Reference: *Uvigerina* (*Uvigerinella*) *californica* Cushman, 1926c, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 58.

Type Figures: *Ibid.*, pl. 8, figs. 2a-5: 2a, b, X65; 5, X75.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland DIstrict, San Luis Obispo County, California.

Taxonomic Remarks: Recovered specimens include topotypes which agree with holotype (USNM5739). Kleinpell's (1938) plesiotype (LSJU676) is a relatively large specimen with broken neck, but otherwise looks similar.

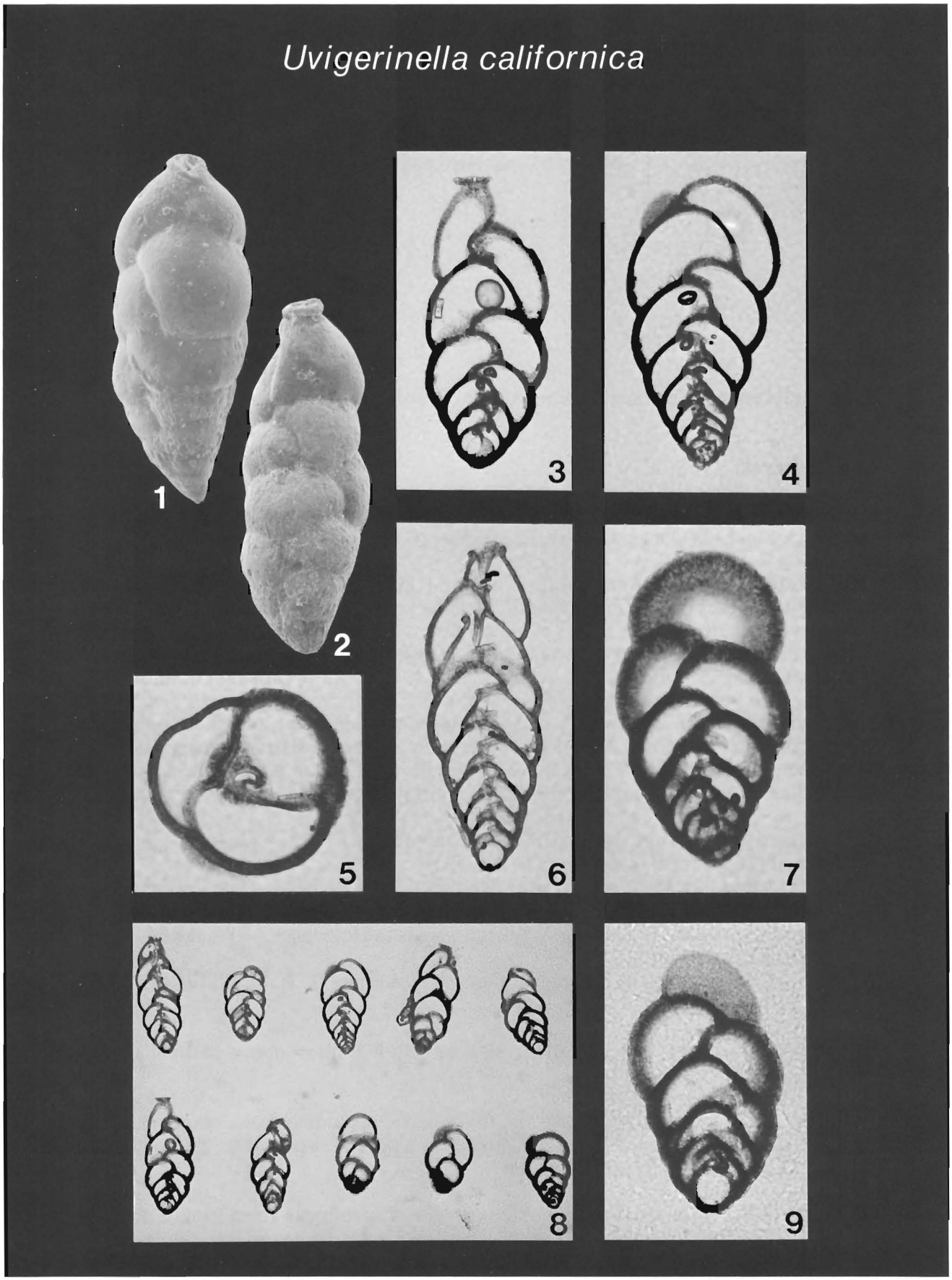
Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Zemorrian to late Luisian.
Regional Literature: Zemorrian to Mohnian (AR76, AR84, CL31, FI90, KL80, SM60).
This Study: Zemorrian to Mohnian. (GC, IC, LH, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980).

Plate-fig. 1: Scanning electron micrograph of specimen from sample locality GC-9, Relizian, Monterey Formation, Graves Creek: side view, X100.

Plate-fig. 2: Scanning electron micrograph of specimen from sample locality GC-2, Relizian, Monterey Formation, Graves Creek: side view, X90.

Plate-figs. 3-8: Thin-section photomicrographs of specimens from sample locality GC-2, Relizian, Monterey Formation, Graves Creek, slide no. 123: 3 = X80; 4 = X100; 5 = X160; 6 = X100; 7 = X160; 8 = X32; 9 = X100.


Uvigerinella californica
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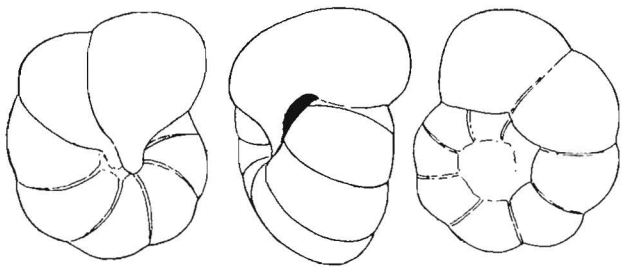
Valvulineria californica Cushman



Type Reference: Cushman, 1926c, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 60.

Type Figures: *Ibid.*, pl. 9, figs. 1a-c, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

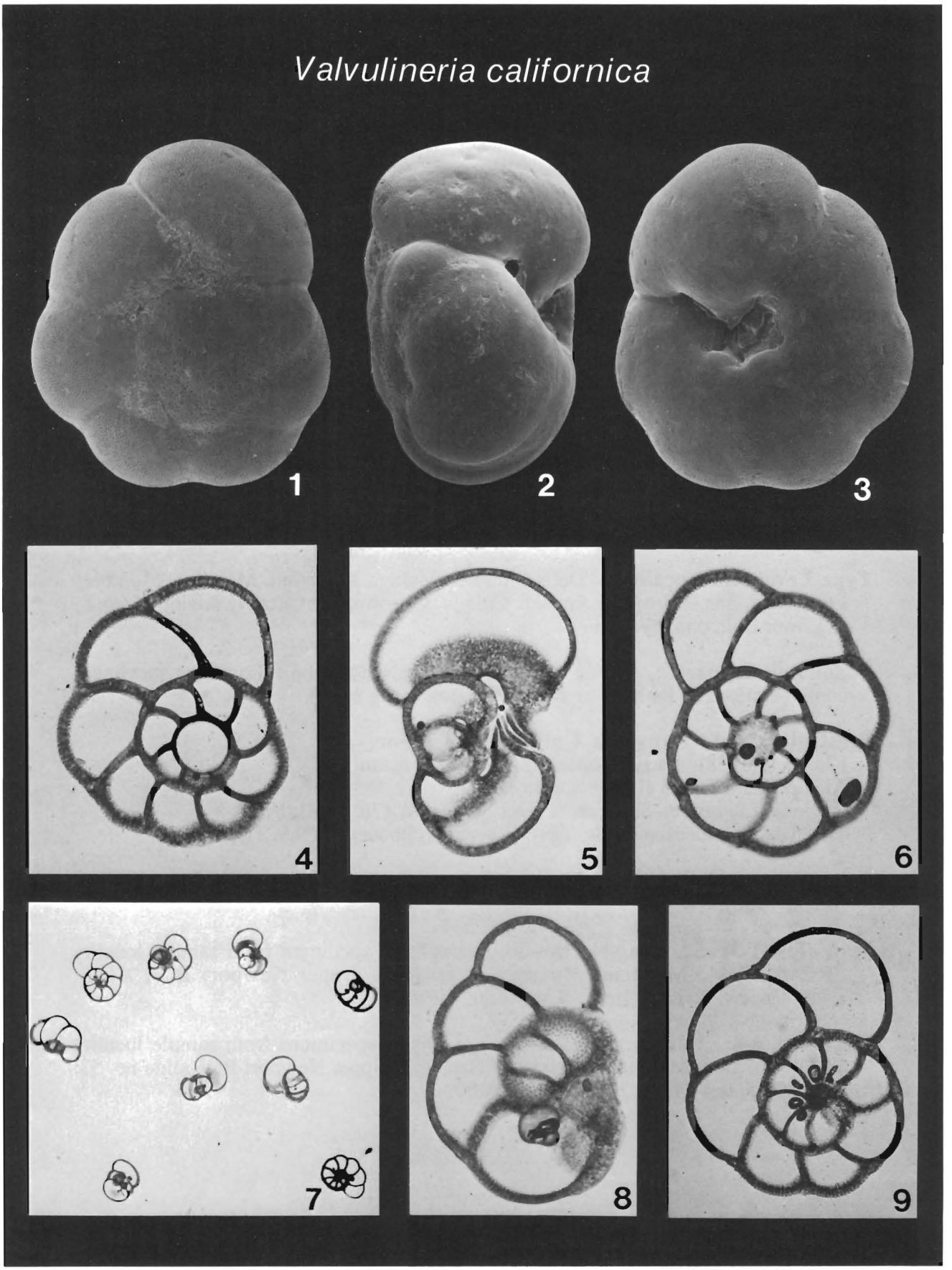
Taxonomic Remarks: Agrees with holotype (USNM5798) and topotypes (USGS). The later sutures on the spiral side of the holotype of *V. californica* s.s. are slightly concave inward, but this is not evident in the type figure. The species recovered from the Highland District was split by Cushman (1926c) into three varieties differentiated as follows: *V. californica* s.s. is evolute with radial sutures, *V. californica* var. *appressa* is evolute with oblique sutures, and *V. californica* var. *obesa* is involute. However, these forms are gradational and their published biostratigraphic records show no consistency in their relative ranges. Similar ecophenotypic variation is seen in populations of other California species of *Valvulineria* which have not been split into separate taxa.

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *V. californica* s.s.: Luisian
Kleinpell (*ibid.*) for *V. californica* var. *appressa*: Early Relizian to late Luisian.
Kleinpell & Tipton (1980) for *V. calif.* var. *obesa*: Early Relizian to early Mohnian.
Regional Literature: Relizian to Mohnian, ranges to Holocene (AR76, AR84, CL30, FI90, KL80, SM60).
This Study: Saucesian to Mohnian, ranges to Holocene(?). (GC, IC, LH, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-30, Luisian, Monterey Formation, Upper Newport Bay, X85: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-30, Luisian, Monterey Formation, Upper Newport Bay, slide no. 3: 4, 5, 9 = X80; 6, 8 = X100; 7 = X20.


Valvulineria californica
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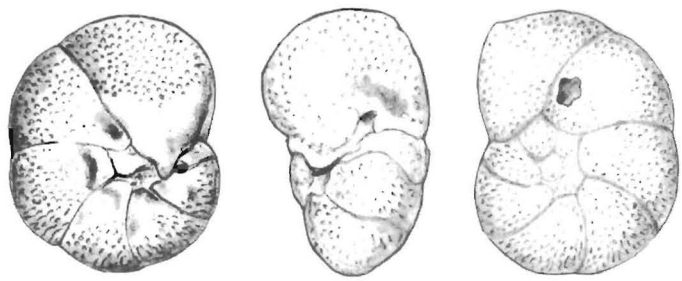
Valvulineria malagaensis Kleinpell



12 10 11

Type Designation and Reference: *Valvulineria araucana* var. *malagaensis* Kleinpell, 1938, Miocene Stratigraphy of California, p. 308.

Type Figures: *Ibid.*, pl. 22, figs. 10-12, X72.

Type Level and Locality: "Delmontian"*, Malaga Mudstone Member, Monterey Formation, San Pedro, Los Angeles County, Calfornia. [*Cited by Kleinpell (*ibid.*) as Lower Delmontian]

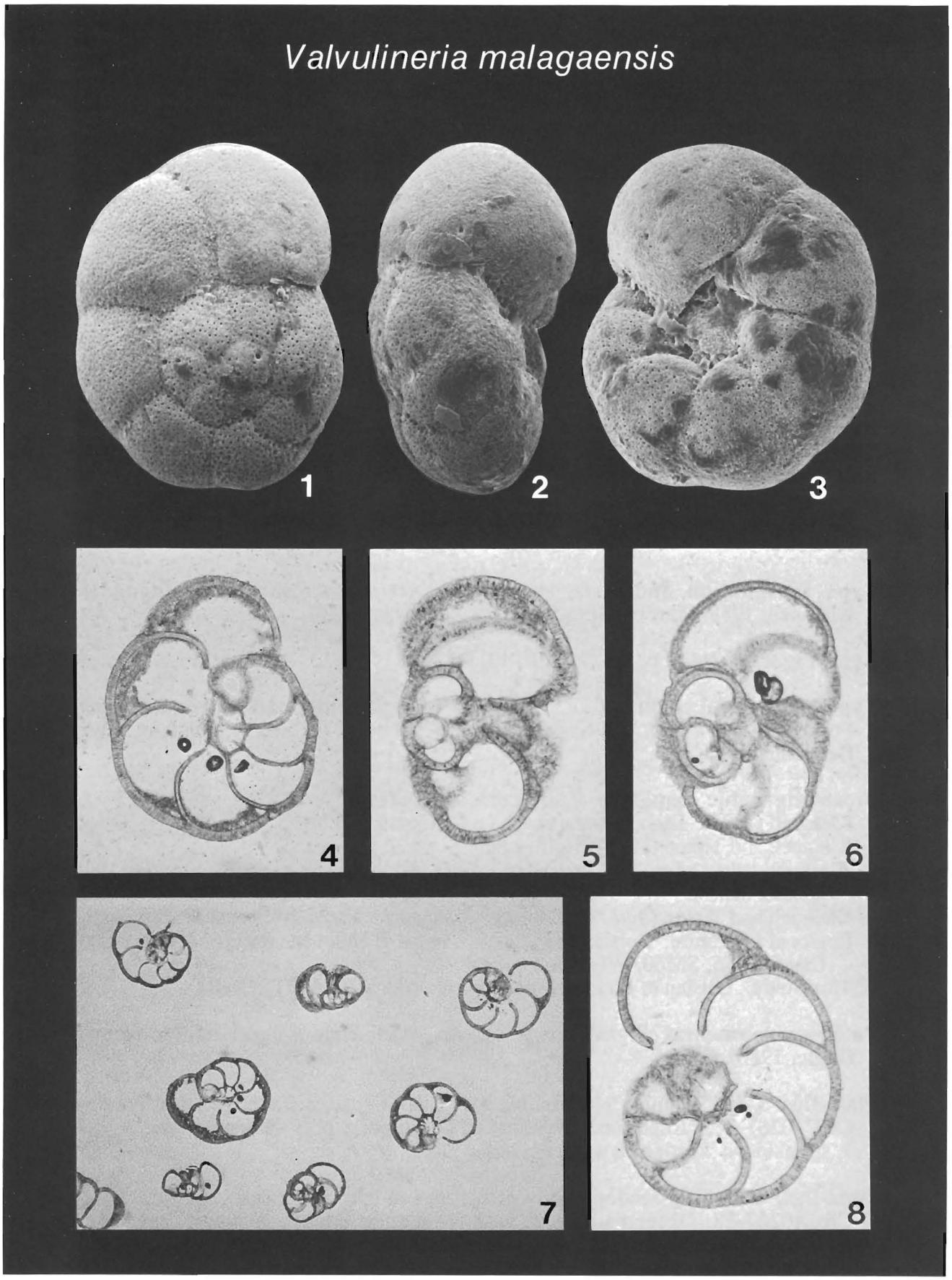
Taxonomic Remarks: Agrees with holotype (USNM497206). Immature specimens could be mistaken for another species (see following entry).

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Delmontian, Late Delmontian(?).
Kleinpell and Tipton (1980): Delmontian.
Regional Literature: Saucesian to Delmontian (AR76, BL81, PI56).
This Study: Saucesian to Relizian?, Luisian to Pliocene. (NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-44, Mohnian, Monterey Formation, Upper Newport Bay, X126: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality CRC40267-50a, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 53: 4 = X80; 5, 6 = X128; 7 = X32; 8 = X100.


Valvulineria malagaensis
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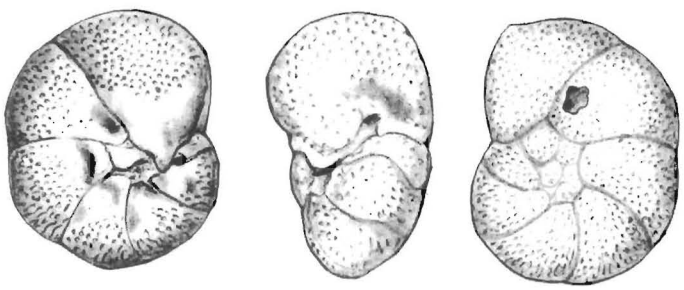
Valvulineria malagaensis Kleinpell (immature form)



12 10 11

Note: The plate illustrations are of the immature form of *Valvulineria malagaensis* referred to in the regional literature as *V. araucana* (d'Orbigny) and possibly *V. alicia* Pierce. The historical data listed below refers to *V. malagaensis*, unless otherwise indicated.

Type Designation and Reference: *Valvulineria araucana* var. *malagaensis* Kleinpell, 1938, Miocene Stratigraphy of California, p. 308.

Type Figures: *Ibid.*, pl. 22, figs. 10-12, x72.

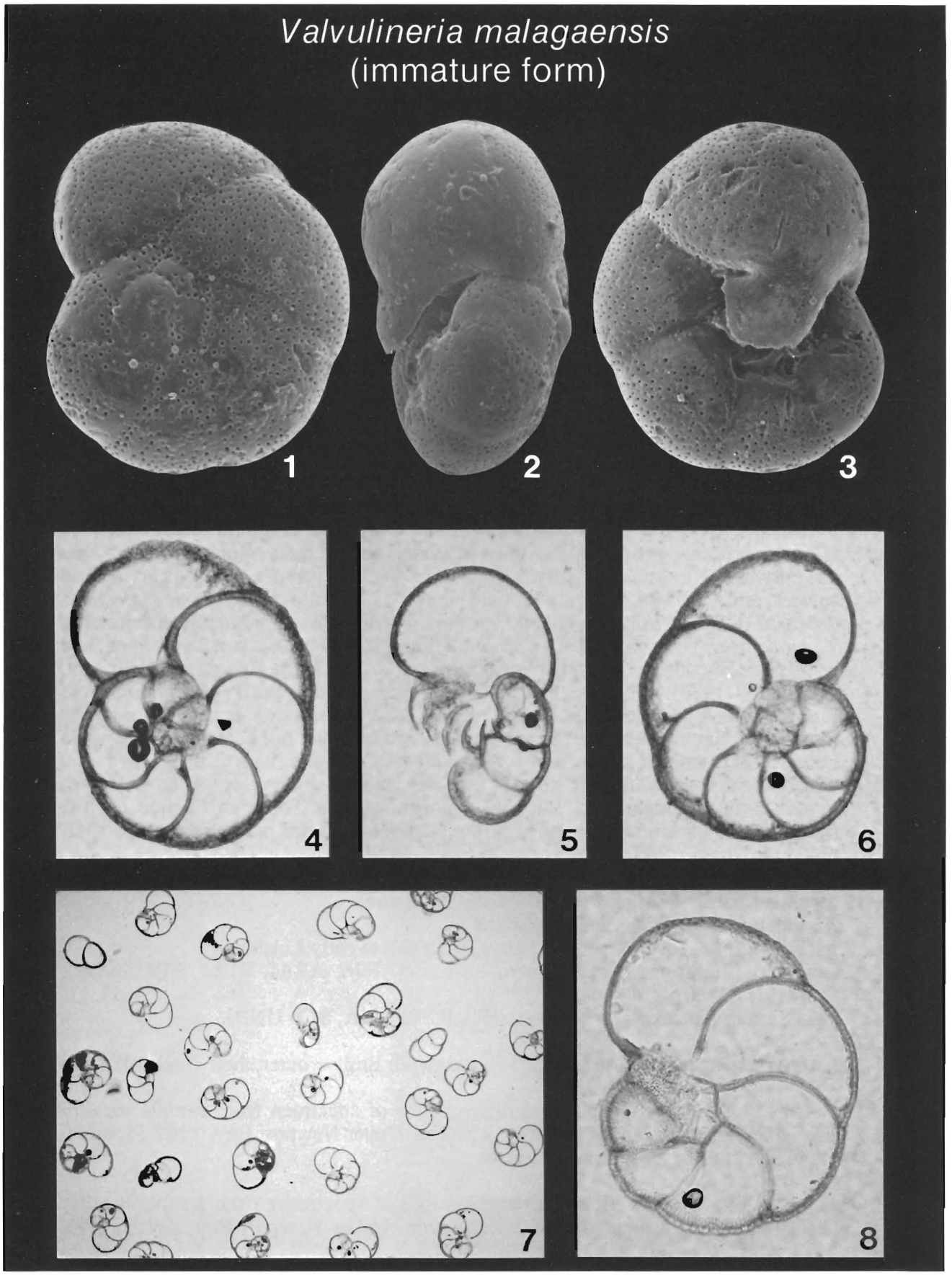
Type Level and Locality: "Delmontian"*, Malaga Mudstone Member, Monterey Formation, San Pedro, Los Angeles County, Calfornia. [*Cited by author as Lower Delmontian]

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Early Delmontian, Late Delmontian(?).
Kleinpell and Tipton (1980): Delmontian.
Kleinpell (*ibid.*) for *"V." araucana*: Early Mohnian to early Delmontian, late Delmontian(?).
Kleinpell and Tipton (*ibid.*) for *"V." araucana* gens.: Narizian (Eocene) to Recent.
Regional Literature: Luisian to Pliocene, ranges to Holocene (AR76, AR84, BE86, CB86, PI56, SM60, WH56).
This Study: Luisian to Pliocene, ranges to Holocene. (NA, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper middle bathyal (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, x180: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-8: Thin-section photomicrographs of specimens from sample locality CRC40267-28, "Repettian", Fernando Formation, Upper Newport Bay, slide no. 62: 4-6 = x160; 7 = x32; 8 = x200.


Valvulineria malagaensis
(immature form)
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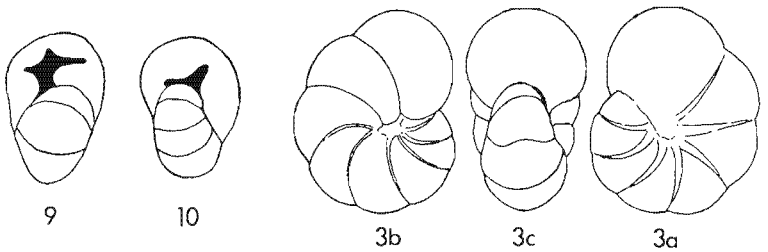
Valvulineria miocenica Cushman



Type Reference: Cushman, 1926c, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 61.

Type Figures: *Ibid.*, pl. 8, figs. 9, 10, X50; pl. 9, figs. 3a-c, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

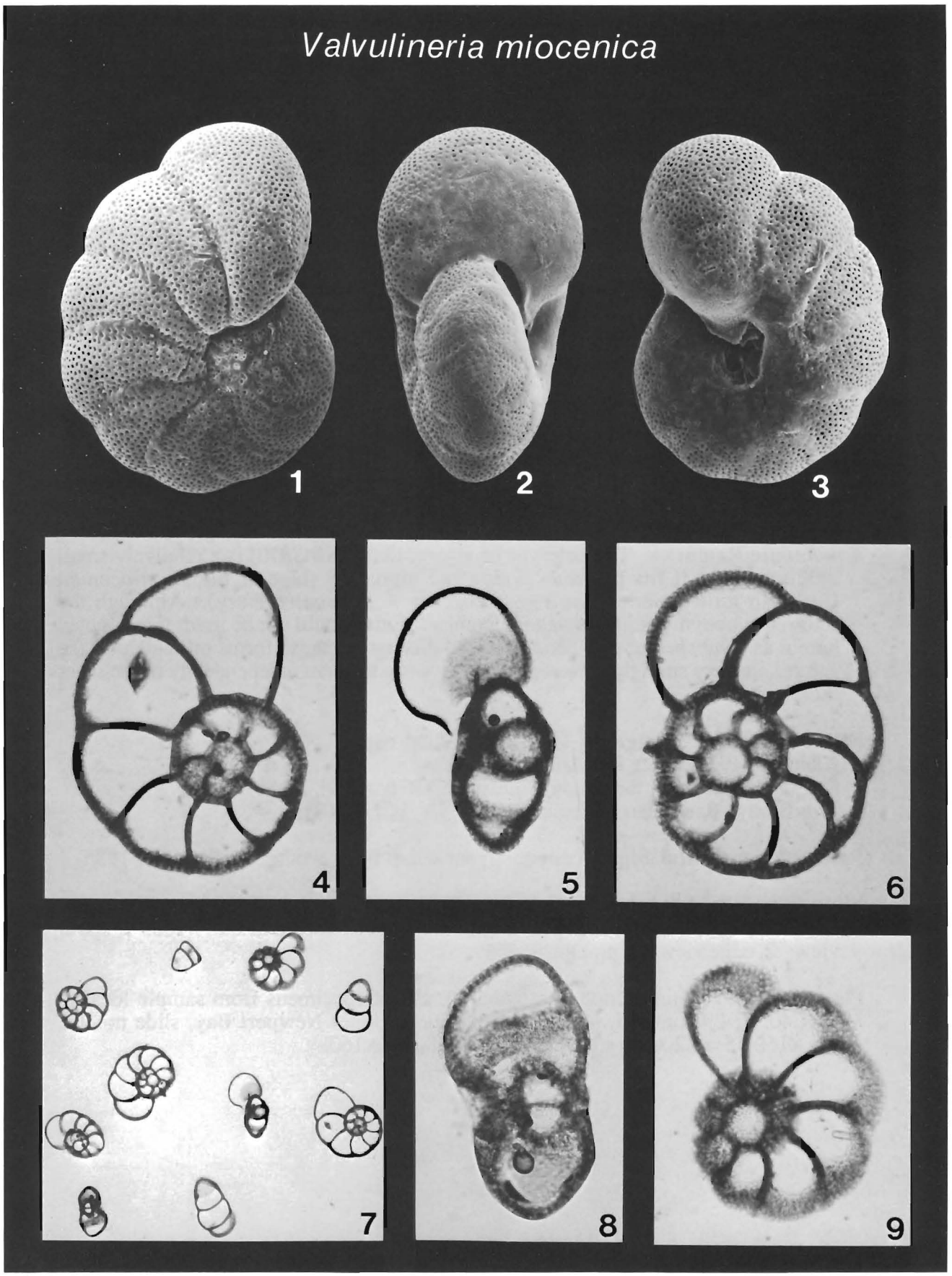
Taxonomic Remarks: Agrees with holotype (USNM5789). The unusual apertures displayed in the type figures from plate 8 are due to breakage In his description of the fauna recovered from the Highland District, Cushman (1926c) differentiated three related morphotypes primarily on the pronouncement of their sutures: *V. miocenica* has only its early sutures slightly limbate, *V. miocenica* var. *depressa* has no limbate sutures, and *V. ornata* has very limbate sutures. The holotype of *V. miocenica* var. *depressa* (USNM5783) is small and appears to be a worn and immature specimen of *V. miocenica*. The holotype of *V. ornata* (USNM5810) is also a small specimen, and it fits perfectly within the immature stage of the *V. miocenica* growth series. In fact, Kleinpell's (1938) table specimens (LSJU) of *V. miocenica* and *V. ornata* both have limbate sutures, although those on *V. ornata* tend to be more raised. Although the inferred synonymy suggests that the nomen *ornata* should not be used, it is adopted herein at the rank of subspecies (of *V. miocenica*) to distinguish those forms on which all the sutures are very strongly limbate (see next two entries), since they seem to occur independently of the other morphotypes. The significance of this morphologic variation is perplexing, as all three taxa are part of the outer-shelf biofacies (Ingle, 1980, 1985).

Biostratigraphic Range in California Neogene:
Kleinpell (1938) for *V. miocenica*: Luisian.
Kleinpell (*ibid.*) for *V. depressa*: Early Saucesian to early Luisian.
Regional Literature: Saucesian to Luisian (AR76, AR84, BL81, FI90, KL80, PM81, SM60).
This Study: Saucesian to Luisian. (GC, IC, LH, NA, SCI, UNB)

Paleoenvironmental Significance: Upper depth limit = outer shelf (Ingle, 1980).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC40267-29, Luisian, Monterey Formation, Upper Newport Bay, X162: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-29, Luisian, Monterey Formation, Upper Newport Bay, slide no. 46: 4-6 = X160; 7 = X40; 8 = X200; 9 = X160.


Valvulineria miocenica
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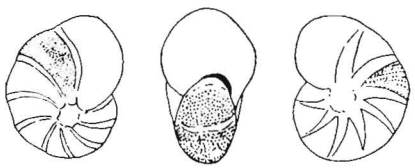
Valvulineria miocenica ornata Cushman



Type Designation and Reference: *Valvulineria ornata* Cushman, 1926c, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 61.

Type Figures: *Ibid.*, pl. 9, figs. 4a-c, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

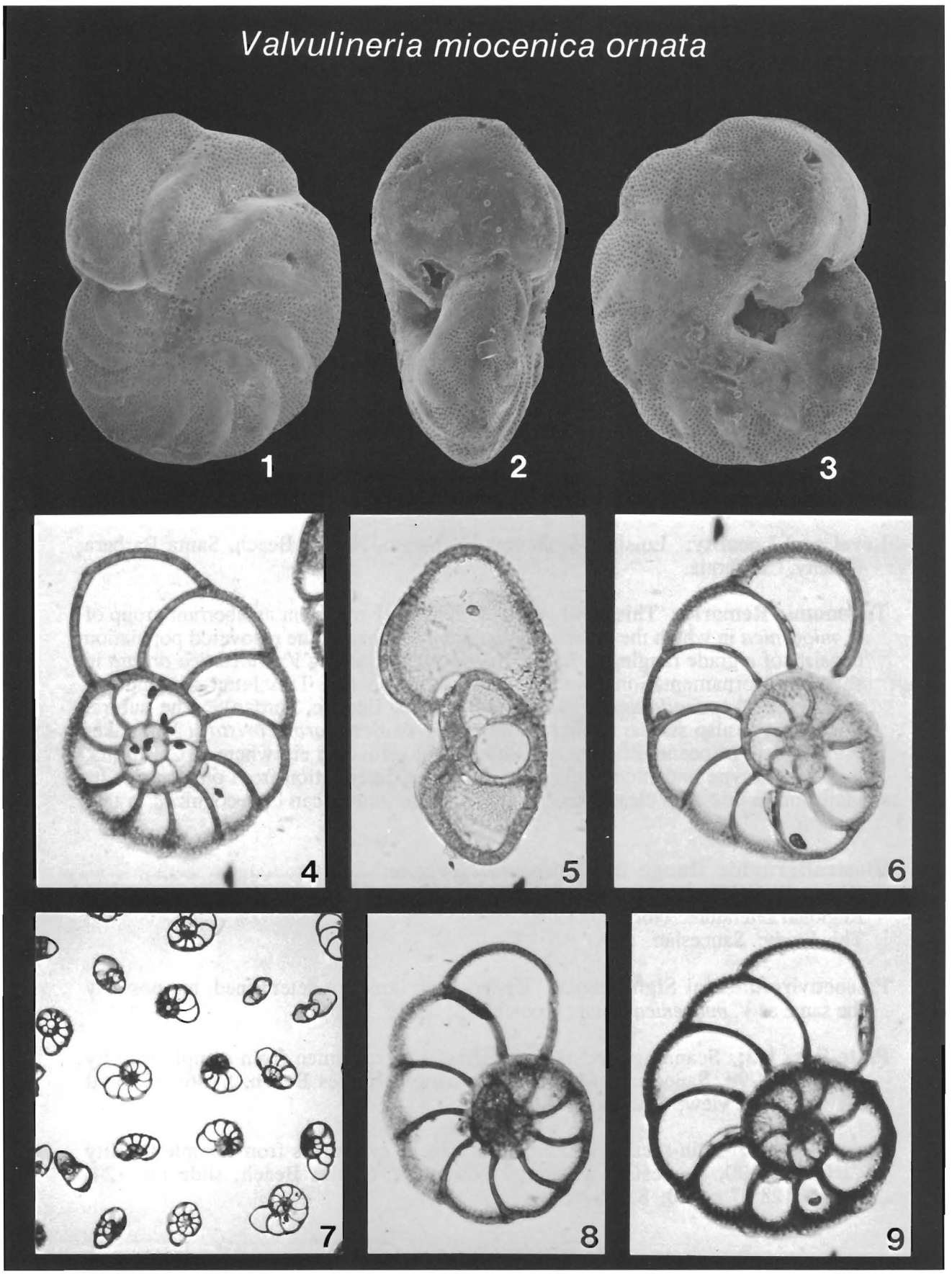
Taxonomic Remarks: The holotype of *V. ornata* (USNM5810) is a relatively small specimen, and it fits perfectly within the immature stage of the *V. miocenica* Cushman growth series (see remarks under *V. miocenica* entry). Although the inferred synonymy suggests that the nomen *ornata* should not be used, it is adopted herein as a subspecies of *V. miocenica* to distinguish those forms on which all the sutures are very strongly limbate, since they seem to occur independently of the other morphotypes.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Relizian to late Luisian.
Regional Literature: Saucesian to Luisian (AR76, AR84, KL80).
This Study: Saucesian to Luisian. (GC, NA, SCI, UNB)

Paleoenvironmental Significance: Upper depth limit = outer shelf (Ingle, 1985).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC42984-20, Luisian, Monterey Formation, San Clemente Island, X106: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-29, Luisian, Monterey Formation, Upper Newport Bay, slide no. 15: 4 = X160; 5 = X200; 6 = X160; 7 = X32; 8, 9 = X160.


Valvulineria miocenica ornata
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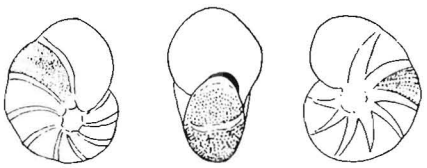
Valvulineria cf. *V. miocenica ornata* Cushman



Type Designation and Reference: *Valvulineria ornata* Cushman, 1926c, Contr. Cushman Lab. Foram. Res., v. 2, pt. 3, p. 61.

Type Figures: *Ibid.*, pl. 9, figs. 4a-c, X65.

Type Level and Locality: Relizian/Luisian, Monterey Formation, Highland District, San Luis Obispo County, California.

Level and Locality: Luisian, Monterey Formation, Naples Beach, Santa Barbara County, California.

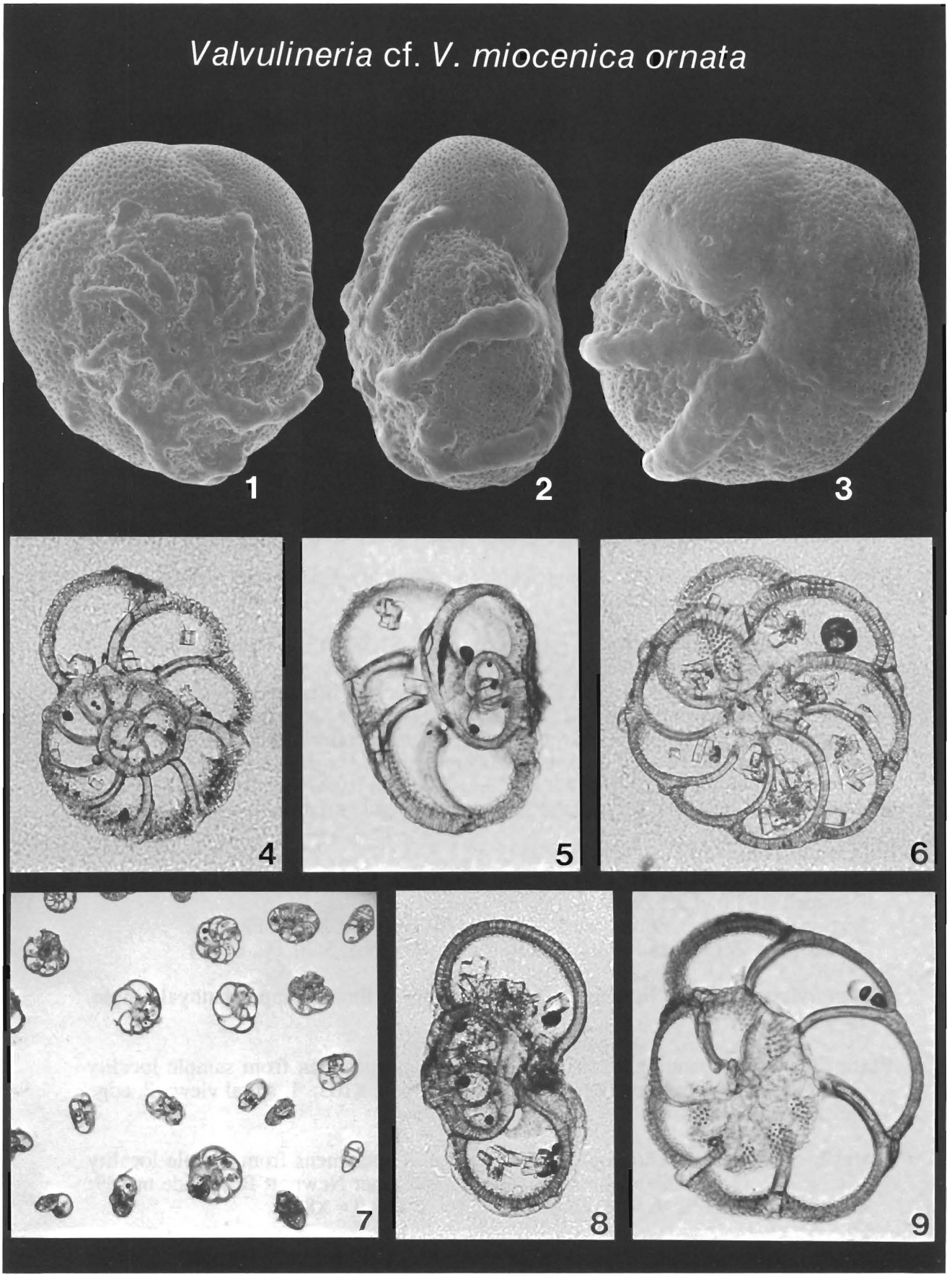
Taxonomic Remarks: This highly variable form may represent an aberrant group of *V. miocenica* in which the sutures are extremely limbate. The recovered population consists of a grade ranging in form from ones approaching *V. miocenica ornata* in shape and ornamentation to that that illustrated here. This latter morphotype resembles *V. pseudotumeyensis* Futyan (1976, Eocene, Jordan). The sutural thickening is also similar to that characteristic of *Ecuadorota bristowi* Whittaker (1988, Early Miocene, Ecuador). Although not recovered elsewhere in California, this morphotype is distinct enough to warrant differentiation from other taxa. Its inclusion in this atlas clearly reveals that limbate sutures can be recognized in thin section.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Not recognized.
Regional Literature: Not recognized.
This Study: Saucesian. (NA)

Paleoenvironmental Significance: Upper depth limit not determined, but possibly the same as *V. miocenica ornata* = outer shelf (Ingle, 1985).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality CRC39842-90, Saucesian, Monterey Formation, Naples Beach, X136: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC39842-90, Saucesian, Monterey Formation, Naples Beach, slide no. 124: 4-6 = X128; 7 = X20; 8, 9 = X128.


Valvulineria cf. V. miocenica ornata
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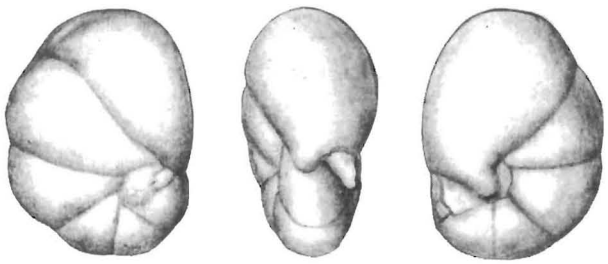
Valvulineria robusta (Kleinpell)



8a 8b 8c

Type Designation and Reference: *Baggina robusta* Kleinpell, 1938, Miocene Stratigraphy of California, p. 325.

Type Figures: *Ibid.*, pl. 11, figs. 8a-c, X40.

Type Level and Locality: Upper Relizian, Monterey Formation, Reliz Canyon, Monterey County, California.

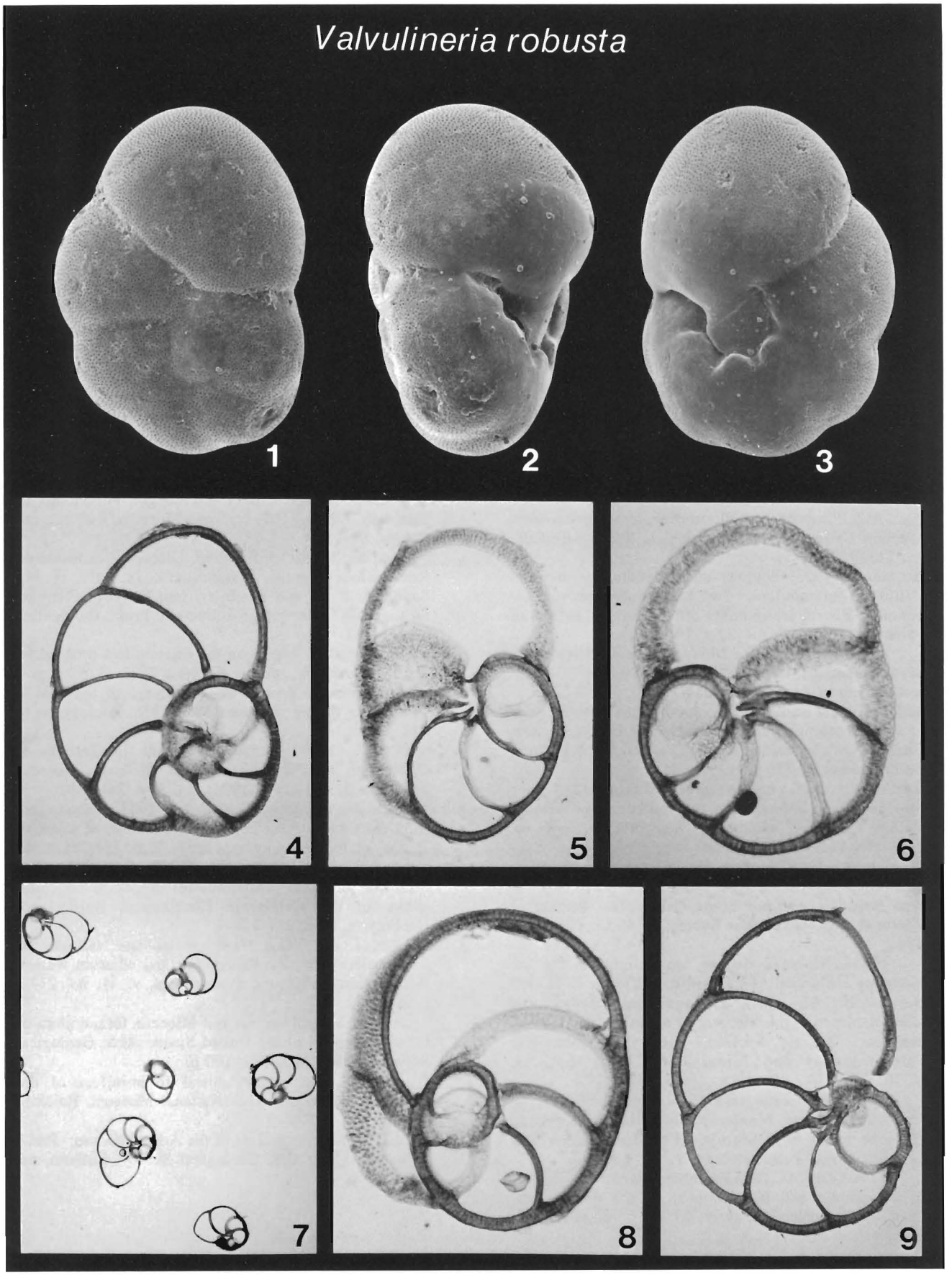
Taxonomic Remarks: Agrees with holotype (LSJU873). It is baffling that this species has been retained in *Baggina* in all publications to date, when it clearly has the umbilicus characteristic of *Valvulineria*. This species differs from *V. subinequalis* (= *Baggina subinequalis* Kleinpell, 1938) which is a large and compressed form with a flaring ultimate chamber. The holotype of *Baggina cancriformis* Kleinpell (1938; LSJU863) appears to be a diagenetically compressed *V. robusta*. The holotype of *B. robusta* var. *globosa* Kleinpell (1938; LSJU906) is only slightly more inflated than the species *sensu stricto*, and such morphologic variation is within the grade observed.

Biostratigraphic Range in California Neogene:
Kleinpell (1938): Late Zemorrian to late Luisian.
Regional Literature: Zemorrian to Mohnian (BL81, FI90, KL80, PM81).
This Study: Zemorrian to Mohnian. (GC, IC, MQ, NA, SCI, TC, UNB)

Paleoenvironmental Significance: Upper depth limit = upper bathyal (Ingle, 1985).

Plate-figs. 1-3: Scanning electron micrographs of specimen from sample locality GC-2, Relizian, Monterey Formation, Graves Creek, X103: 1, spiral view; 2, edge view; 3, umbilical view.

Plate-figs. 4-9: Thin-section photomicrographs of specimens from sample locality CRC40267-38, Mohnian, Monterey Formation, Upper Newport Bay, slide no. 39: 4 = X128; 5 = X100; 6 = X160; 7 = X20; 8 = X128; 9 = X80.


Valvulineria robusta
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APPENDIX

Bibliography of Regional Literature Used to Determine Biostratigraphic Ranges of Species in This Catalog

(Bold-faced codes in brackets are cited in the text)

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