

ULTRA-VIOLET LIGHT AS A USEFUL TOOL FOR
IDENTIFYING FOSSIL MOLLUSKS, WITH EXAMPLES
FROM THE GATUN FORMATION, PANAMA

WILLIAM D. PITT^{1,2} and LOIS J. PITT²

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I. ABSTRACT

The color patterns of the 31 species illustrated here represent 30 species known from the Gatun Formation, and one that is new to the formation. These illustrations show the usefulness of ultra-violet light to distinguish morphologically similar forms, fossil and Recent.

II. INTRODUCTION

The use of ultra-violet light to induce fluorescence was pioneered by the late Axel Olsson of Coral Gables, Florida, in the 1960's; however, it was not widely used by him, or by many other workers, as a tool in the identification of fossil mollusks. This process has been more commonly used by Harold and Emily Vokes from Tulane University (Vokes and Vokes, 1968), and has also been used by Hoerle (1976), Pitt and Pitt (1992), as well as others.

The procedure used to induce fluorescence is to soak the specimens in a chlorine bleach for three days prior to photography. For the photographic process, Kodak Plus-X Pan film was used. We used a 6 watt, long-wave ultra-violet light. To counteract the effects of the light on the film, a yellow filter must be used. The photo-

graphs were taken at F/8 for two minutes. Exposure times from one minute to about two and one-half minutes seemed to make little difference in the results, although time must be increased if camera distance from the specimen is increased significantly. The photograph of *Turritella abrupta* (the largest specimen) was taken at three minutes. We used a single light, which was hand held for one minute on each side of the specimen. It was found that better results were obtained if the light was held above the plane of the camera lens. The photographs, as taken, show a reverse color pattern when printed, which is corrected by making a reverse negative. For a more complete account of the process see Krueger (1974).

The color patterns in the following species, for the most part, show a distinctive pattern for the species represented, but some seem to be highly variable. Most show patterns very similar to their living cognates.

The group that appears most in need of a major revision is the Cones. The *Conus molis* Brown and Pilsbry, 1911, and *C. bravoii* Spieker, 1922, complexes appear to be a particular problem, as we have numerous specimens tentatively identified as belonging to this group that have strikingly different color patterns. The color patterns would seem to indicate that there are more species of *Conus* in the Gatun Formation than indicated by Woodring (1970).

¹Field Associate, Dept. of Geology, California Academy of Sciences, San Francisco, California 94118

²Home Address: 2444 38th Ave., Sacramento, California 95822

This report is to show the color patterns of some fossil mollusks from the Gatun Formation of Panama, and to indicate their possible relationship to other species (fossil and Recent). It is not intended to be a taxonomic study of the species reported herein.

III. ACKNOWLEDGMENTS

We want to thank Emily Vokes of Tulane University for her encouragement of our endeavours and her help with this paper, Wayne Barnett of Houston, Texas for most of the ultra-violet photography, and Allan McMakin of Hammond, Oregon for the prints.

ABBREVIATIONS FOR REPOSITORY INSTITUTIONS

ANSP - Academy of Natural Sciences,
Philadelphia
BM(NH) - British Museum (Natural History)
CASG - California Academy of Sciences
(Geology)
CASGTC - California Academy of Sciences
(Geology Type Collections)
PRI - Paleontological Research Institution
USGS - United States Geological Survey
USNM - United States Museum of Natural
History

IV. SYSTEMATIC PALEONTOLOGY

Class GASTROPODA

Order MESOGASTROPODA

ARCHITECTONICA (ARCHITECTONICA) NOBILIS
Röding

Plate 1, figure 1

Architectonica nobilis RÖDING, 1798, Museum
Boltenianum, p. 78.

Architectonica nobilis nobilis RÖDING. WOODRING, 1959, U.S. Geol. Survey, Prof. Paper 306-B, p. 165, pl. 29, figs. 1-6, 10-12, 14-16.

Holotype: Museum Boltenianum.

Type locality: Recent, unknown.

Occurrence: Gatun Formation, Panama. Esmeraldas beds, Ecuador. Recent, western Atlantic and eastern Pacific.

ARCHITECTONICA (ARCHITECTONICA) KARSTENI
Rutsch

Plate 1, figure 2

Architectonica nobilis karsteni RUTSCH, 1934, Schweizer. Palaeont. Gesell., Abh., vol. 54, no. 3, p. 44, pl. 1, figs. 8-10.

Architectonica (Architectonica) nobilis karsteni Rutsch. WOODRING, 1959, U.S. Geol. Survey, Prof. Paper 306-B, p. 167, pl. 30, figs. 1-3.

Architectonica (Architectonica) karsteni (Rutsch). DeVRIES, 1985, Veliger, v. 27, no. 3, p. 282, figs. 2-12, 15, 16, 18, 20.

Holotype: Naturhistorisches Museum, Basel H-1836.

Type locality: Punta Gavilán Formation; Punta Gavilán, Venezuela.

Occurrence: Gatun Formation, Panama. Cantaura and Punta Gavilán formations, Venezuela. Esmeraldas beds and Duale Formation, Ecuador. Lobitos Tablazo, Peru. Navidad Formation, Chile. Agueguexquite Formation, Mexico. Recent, Mexico to Ecuador.

Discussion: DeVries (1985, p. 282) elevated the subspecies *Architectonica (A.) nobilis karsteni* Rutsch, 1934, to full species rank, based on morphological observations of specimens from numerous localities. DeVries also reported the first time occurrences of the species in the Recent Tropical East Pacific, from Baja California, Mexico to Cabo Pasado, Ecuador.

TURRITELLA (TURRITELLA) ABRUPTA
Spieker

Plate 1, figure 3

Turritella robusta var. *abrupta* SPIEKER, 1922, Johns Hopkins Univ., Studies in Geology, no. 3, p. 85, pl. 4, fig. 6.

Turritella abrupta Spieker. WOODRING, 1957, U.S. Geol. Survey, Prof. Paper 306-A, p. 106, pl. 23, figs. 6, 15, 16.

Holotype: Johns Hopkins University.

Type locality: Zorritos Formation; Zorritos, Peru.

Occurrence: Gatun Formation, Panama. Zorritos Formation, Peru. Angostura and Progreso formations, Ecuador. Punta Gavilán Formation, Venezuela. Tubará Group, Colombia.

TURRITELLA (TORCULA) ALTILIRA ALTILIRA
Conrad

Plate 1, figure 4

Turritella altilira CONRAD, 1857, Pacific Railroad Expl., v. 6, pt. 2, p. 72, pl. 5, fig. 19.

Turritella (Torcula) altilira altilira Conrad. WOODRING, 1957, U.S. Geol. Survey, Prof. Paper 306-A, p. 102, pl. 23, figs. 1, 7, 12, 13.

Lectotype: ANSP 3513.

Type locality: Gatun Formation; Panama.

Occurrence: Gatun Formation, Panama. Unknown formations, Colombia and Venezuela.

NATICA (NATICA?) BOLUS

Brown and Pilsbry

Plate 1, figure 5

Natica bolus BROWN and PILSBRY, 1913, Acad. Nat. Sci. Phila., Proc., v. 64, p. 508, pl. 22, fig. 9.

Natica (Natica?) bolus Brown and Pilsbry. WOODRING, 1957, U.S. Geol. Survey, Prof. Paper 306-A, p. 84, pl. 20, figs. 1-3.

Holotype: ANSP 3846.

Type locality: Gatun Formation; Canal Zone, Panama.

Occurrence: Gatun Formation, Panama. Cercado and Gurabo formations, Dominican Republic. Springvale Formation, Trinidad.

NATICA (STIGMAULAX) GUPPIANA

Toula

Plate 1, figure 6

Natica guppiana TOULA, 1909, Geol. Reichs., Jahrb., v. 58, p. 696, pl. 25, fig. 6.

Stigmaulax guppiana (Toula). WOODRING, 1957, U.S. Geol. Survey, Prof. Paper 306-A, p. 86, pl. 20, figs. 11-16.

Type: Tech. Hochschule, Vienna.

Type locality: Gatun Formation; Gatun Locks, Canal Zone, Panama.

Occurrence: Gatun Formation, Panama. La Vela Formation, Venezuela. Tubará Group, Colombia. Angostura Formation and Daule Group, Ecuador. Río Banano Formation, Costa Rica. Shoal River Formation, Florida.

CYPRAEA (MURACYPRAEA) HENEKENI

Sowerby

Plate 1, figure 7

Cypraea henikeri SOWERBY, 1850, Geol. Soc. London, Quart. Jour., v. 6, p. 45, pl. 9, fig. 3 (error for *henekeni*).

Cypraea (Muracypraea) henekeni Sowerby. WOODRING, 1959, U.S. Geol. Survey, Prof. Paper 306-B, p. 194, pl. 31, figs. 6-10; pl. 32, figs. 1, 4, 6, 9.

Lectotype: BM(NH) G 83940.

Type locality: Cercado or Gurabo Formation, Dominican Republic.

Occurrence: Gatun Formation, Panama. Cercado and Gurabo formations, Dominican Republic. Springvale and Brasso formations, Trinidad. Unknown formations, Venezuela and Colombia. Angostura Formation and Esmeraldas beds, Ecuador. Bowden Formation, Jamaica, Río Banano Formation, Costa Rica.

Order NEOGASTROPODA

HAUSTELLUM POLYNEMATICUS

(Brown and Pilsbry)

Plate 2, figure 1

Murex polynematicus BROWN and PILSBRY, 1911, Acad. Nat. Sci. Phila., Proc., v. 63, p. 353, pl. 26, fig. 1.

Murex (Murex) polynematicus Brown and Pilsbry. WOODRING, 1959, U.S. Geol. Survey, Prof. Paper 306-B, p. 215, pl. 36, figs. 2, 3; pl. 37, figs. 6, 9.

Haustellum polynematicus Brown and Pilsbry. VOKES, 1990, Tulane Stud. Geol. Paleont., v. 23, nos. 1-3, p. 13, pl. 1, fig. 11.

Holotype: ANSP 1719.

Type locality: Gatun Formation; Gatun Locks, Canal Zone, Panama.

Occurrence: Gatun Formation, Panama. Angostura Formation and Esmeraldas beds, Ecuador. (?) Angostura Formation, Nariño, Colombia.

POIRIERIA (PANAMUREX) GATUNENSIS

(Brown and Pilsbry)

Plate 2, figure 2

Murex (Phyllonotus) gatunensis BROWN and PILSBRY, 1911, Acad. Nat. Sci. Phila., Proc., v. 63, p. 354, pl. 26, fig. 2.

Paziella (Panamurex) gatunensis (Brown and Pilsbry). WOODRING, 1959, U.S. Geol. Survey, Prof. Paper 306-B, p. 217, pl. 35, figs. 6, 7, 9, 10.

Poirieria (Panamurex) gatunensis (Brown and Pilsbry). VOKES, 1992, Tulane Stud. Geol. Paleont., v. 25, nos. 1-3, p. 40, pl. 8, figs. 3-6.

Holotype: ANSP 1720.

Type locality: Gatun Formation; Gatun Locks, Canal Zone, Panama.

Occurrence: Gatun Formation, Panama. Cantaura and Punta Gavilán formations, Venezuela. Tubará Group, Colombia.

ANTILLIPHOS (ANTILLIPHOS) CANDEI

GATUNENSIS Toula

Plate 2, figure 3

Phos gatunensis TOULA, 1909, Geol. Reichs., Jahrb., v. 58, p. 701, pl. 25, fig. 11; pl. 28, fig. 6.

Antilliphos (Antilliphos) candeii gatunensis (Toula). WOODRING, 1964, U.S. Geol. Survey, Prof. Paper 306-C, p. 264, pl. 42, figs. 3, 4.

Holotype: Lost; Neotype USNM 643660 (see Woodring, 1964, p. 264).

Type locality: Gatun Formation; Gatun Locks, Canal Zone, Panama.

Occurrence: Gatun Formation, Panama. Unknown formations, Colombia and Costa Rica.

CYMATOPHOS VEATCHI VEATCHI

(Olsson)

Plate 2, figure 4

Phos veatchi OLSSON, 1922, Bulls. Amer. Pale-

ontology, v. 9, no. 39, p. 121(293), pl. 9(12), figs. 2, 3.

Cymatophos veatchi veatchi (Olsson). WOODRING, 1964, U.S. Geol. Survey, Prof. Paper 306-C, p. 260, pl. 41, figs. 5, 6, 8, 13.

Syntypes: PRI 21021, 21022.

Type locality: Río Banano Formation; Hill 1a, Río Banano, Costa Rica.

Occurrence: Gatun Formation, Panama. Río Banano Formation, Costa Rica. Unknown formation, Venezuela.

STROMBINA (STROMBINA?) cf. LISSA
Gardner
Plate 2, figure 5

Strombina lissa GARDNER, 1947, U.S. Geol. Survey, Prof. Paper 142-H, p. 514, pl. 52, figs. 14, 15.

Strombina (Strombina?) cf. lissa Gardner. WOODRING, 1964, U.S. Geol. Survey, Prof. Paper 306-C, p. 254.

Holotype: USNM 371869.

Type locality: USGS 3742, Shoal River Formation; Shell Bluff, Shoal River, Walton County, Florida.

Occurrence: Gatun Formation, Panama. Shoal River Formation, Florida.

STROMBINA (STROMBINA) LESSEPSIANA
Brown and Pilsbry
Plate 2, figure 6

Strombina lessepsiana BROWN and PILSBRY, 1911, Acad. Nat. Sci. Phila., Proc., v. 63, p.

352, pl. 25, figs. 11, 12; WOODRING, 1964, U.S. Geol. Survey, Prof. Paper 306-C, p. 252, pl. 40, figs. 22, 23, 30, 31.

Holotype: ANSP 1718.

Type locality: Gatun Formation: Gatun Locks, Canal Zone, Panama.

Occurrence: Gatun Formation, Panama. Río Banano Formation, Costa Rica.

TORQUIFER PITTORUM
Roth
Plate 2, figure 7

Xancidae?, *Xancus?*, WOODRING, 1973, U.S. Geol. Survey, Prof. Paper 306-E, p. 480, pl. 73, figs. 12, 13.

Torquifer pittorum ROTH, 1981, Tulane Stud. Geol. Paleont., v. 16, no. 4, p. 149, pl. 1, figs. 1-4, 6.

Holotype: CASGTC 60375.

Type locality: CAS 58335, Gatun Formation; north of Transisthmian Highway, about 1 km northwest of Sabanita, Republic of Panama (9° 21.25' N, 79° 48.75' W).

Occurrence: Gatun Formation, Panama.

OLIVA (OLIVA) GATUNENSIS
Toula
Plate 2, figure 8

Oliva gatunensis TOULA, 1909, Geol. Reichs., Jahrb., v. 58, p. 702, pl. 25, fig. 12.

Oliva (Oliva) gatunensis Toula. WOODRING, 1964, U.S. Geol. Survey, Prof. Paper 306-C, p. 276, pl. 45, figs. 12, 13, 16.

PLATE 1

Figures	Page
1. <i>Architectonica nobilis</i> Röding, 1798	2
CASG 66589.02; height 13.2 mm, diameter 22.1 mm (X 4.0).	
Locality: P-95, Panama.	
2. <i>Architectonica karsteni</i> Rutsch, 1934	2
CASG 66589.03; height 18.8 mm, diameter 31.6 mm (X 3.1).	
Locality: P-95, Panama.	
3. <i>Turritella abrupta</i> Spieker, 1922	2
Pitt F-100; height 151.4 mm, diameter 39.8 mm (X 6.5).	
Locality: P-94, Panama.	
4. <i>Turritella (Torcula) altilira altilira</i> Conrad, 1857	2
CASG 66589.04; height 44.0 mm, diameter 11.9 mm (X 1.6).	
Locality: P-95, Panama.	
5. <i>Natica bolus</i> Brown and Pilsbry, 1913	3
CASG 66589.05; height 13.9 mm, diameter 13.0 mm (X 3.6).	
Locality: P-95, Panama.	
6. <i>Natica (Stigmaulax) guppiana</i> Toula, 1909	3
CASG 66589.01; height 25.1 mm, diameter 23.7 mm (X 2.0).	
Locality: P-95, Panama.	
7. <i>Cypraea (Muracypraea) henekeni</i> Sowerby, 1850	3
CASG 66589.06; height 37.3 mm, diameter 22.3 mm (X 1.3).	
Locality: P-95, Panama.	

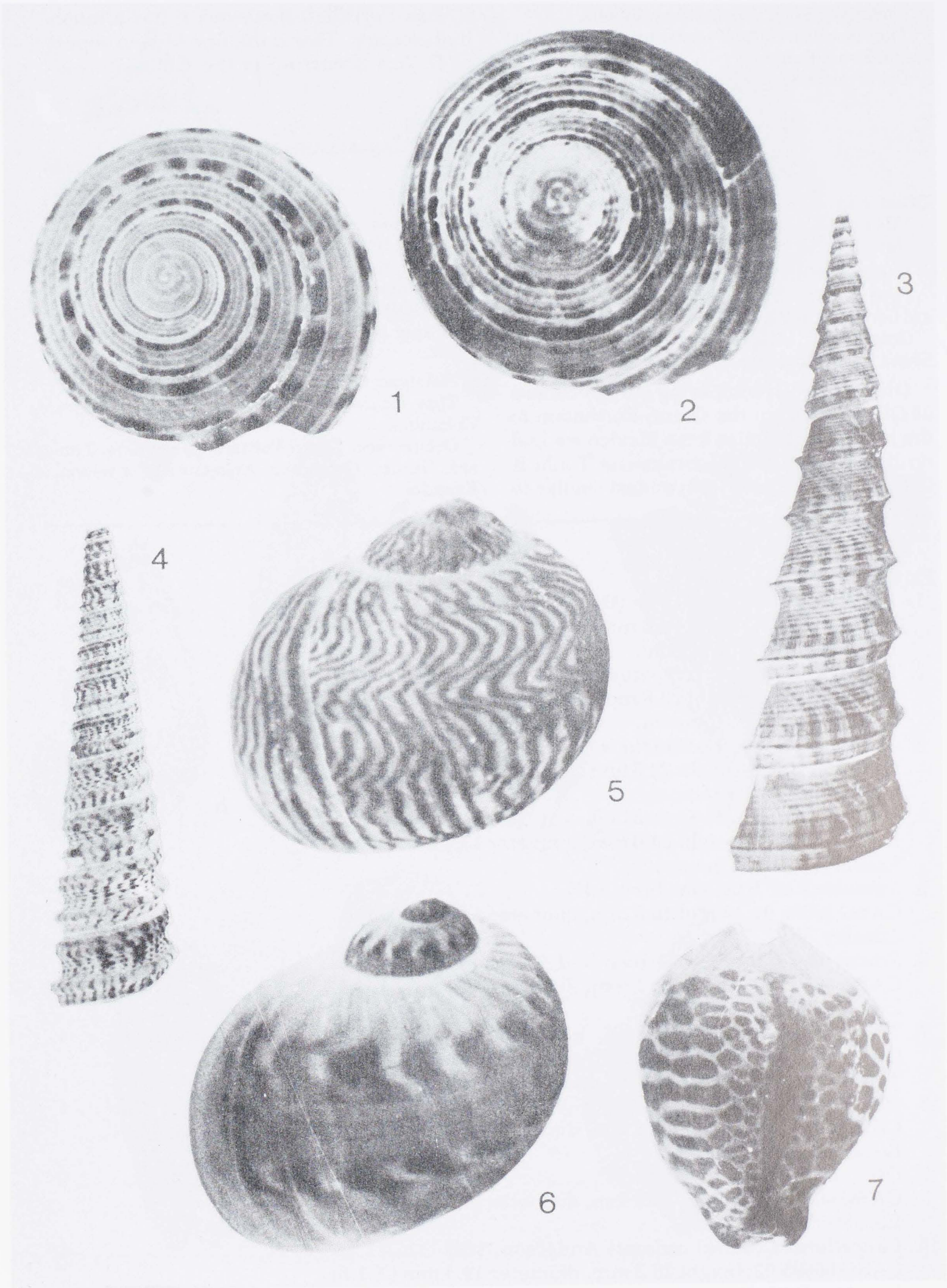


PLATE 1

Lectotype: Tech. Hochschule, Vienna.
Type locality: Gatun Formation; Gatun Locks,
 Canal Zone, Panama.
Occurrence: Gatun Formation, Panama.

OLIVA (OLIVA) LISA
 Perrilliat
 Plate 2, figure 9

Oliva lisa PERRILLIAT, 1972, *Paleontología
 Mexicana*, no. 32, p. 103, pl. 49, fig. 9; pl. 50,
 figs. 1-7.

Holotype: USNM 349982.

Type locality: USGS 9995, Santa Rosa beds; 3
 km northeast of Santa Rosa, Veracruz, Mexico.

Occurrence: Gatun Formation, Panama.
 Santa Rosa beds, Mexico.

Discussion: In comparing our specimens
 of *Oliva lisa* from the Gatun Formation to
 the holotype of *O. lisa* from Mexico we find
 no differences. *Oliva gatunensis* Toula is
 the Gatun Formation Olive most similar to

O. lisa Perrilliat, however, it has a much
 higher spire. This is the first known report
 of *O. lisa* occurring in the Gatun Forma-
 tion.

CANCELLARIA (EUCLIA) CODAZZII
 Anderson
 Plate 2, figure 10

Cancellaria codazzii ANDERSON, 1929, *Calif.
 Acad. Sci., Proc.*, (ser. 4), v. 18, no. 4, p. 116,
 pl. 14, figs. 4-7.

Cancellaria (Euclia) codazzii Anderson.
 WOODRING, 1970, U.S. Geol. Survey, Prof.
 Paper 306-D, p. 339, pl. 54, figs. 3, 4, 7, 8, 11,
 12.

Holotype: CAS 4645.

Type locality: Tubará Group; near Cibarco,
 Colombia.

Occurrence: Gatun Formation, Panama. Tub-
 ará Group, Colombia. Angostura Formation,
 Ecuador.

PLATE 2

Figures	Page
1. <i>Haustellum polynematicus</i> (Brown and Pilsbry, 1911)	3
USNM 450346; height 36.8 mm, diameter 23.4 mm (X 1.5). Locality: TU 958, Panama.	
2. <i>Poirieria (Panamurex) gatunensis</i> (Brown and Pilsbry, 1911)	3
USNM 462685; height 29.8 mm, diameter 18.0 mm (X 2.0). Locality: TU 958, Panama.	
3. <i>Antilliphos candei gatunensis</i> (Toula, 1909)	3
CASG 66589.07; height 22.5 mm, diameter 11.1 mm (X 2.2). Locality: P-95, Panama.	
4. <i>Cymatophos veatchi veatchi</i> (Olsson, 1922)	3
CASG 66694.01; height 26.0 mm, diameter 13.4 mm (X 3.7). Locality: P-94, Panama.	
5. <i>Strombina cf. lissa</i> Gardner, 1947	4
CASG 66695.01; height 10.3 mm, diameter 5.2 mm (X 4.9). Locality: P-97, Panama.	
6. <i>Strombina lessepsiana</i> Brown and Pilsbry, 1911	4
CASG 66589.08; height 24.1 mm, diameter 10.1 mm (X 2.1). Locality: P-95, Panama.	
7. <i>Torquifer pittorum</i> Roth, 1981	4
CASGTC 60375; height 82.8 mm, diameter 63.6 mm (X 0.85). Type locality: CAS 58335, Panama.	
8. <i>Oliva gatunensis</i> Toula, 1909	4
CASG 66694.02; height 35.1 mm, diameter 15.5 mm (X 1.4). Locality: P-94, Panama.	
9. <i>Oliva lisa</i> Perrilliat, 1972	6
CASG 66694.03; height 36.3 mm, diameter 16.5 mm (X 1.4). Locality: P-94, Panama.	
10. <i>Cancellaria (Euclia) codazzii</i> Anderson, 1929	6
CASG 66695.02; height 28.3 mm, diameter 19.4 mm (X 1.8). Locality: P-97, Panama.	

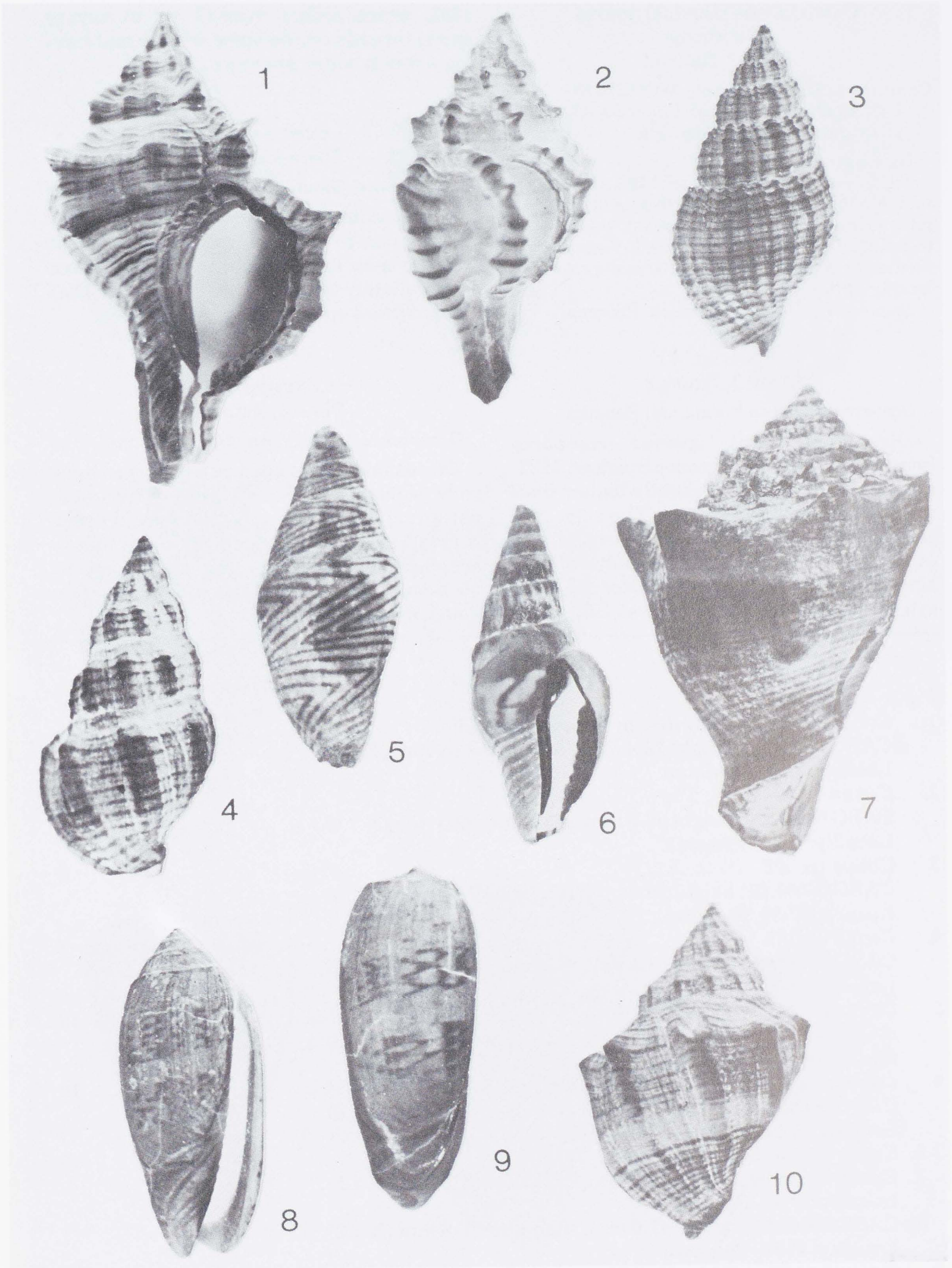


PLATE 2

CANCELLARIA (EUCLIA) DINOTA
Woodring
Plate 3, figure 1

Cancellaria (Euclia) dinota WOODRING, 1970,
U.S. Geol. Survey, Prof. Paper 306-D, p. 340,
pl. 54, figs. 1, 2; pl. 56, figs. 5, 6.

Holotype: USNM 645728.

Type locality: Woodring no. 138C, Gatun Formation; about 100 meters north side of Transistmian Highway and about 75 meters west of road to refinery site on Payardi Island, Panama; immediately east of Cativá and 100 meters north of locality 138.

Occurrence: Gatun Formation, Panama.

CONUS sp. #1
Plate 3, figure 2

Occurrence: Gatun Formation, Panama.

Discussion: This species compares favorably with *Conus bravoii* Spieker, 1922, except that the spire is slightly higher than most specimens of *C. bravoii*. The color pattern differentiates this from *C. bravoii* and other Gatun Cones. The color pattern most closely resembles that of the Recent eastern Pacific *Conus purpurascens* Sowerby,

1833, which differs from *C. sp.* in having spiral threads on the spire whorls and having a much wider aperture.

CONUS sp. #2
Plate 3, figure 3

Occurrence: Gatun Formation, Panama.

Discussion: This species is morphologically similar to the previous species, except that the spire is lower and the color pattern is completely different. It is possible that both of these species are undescribed.

CONUS sp. #3
Plate 3, figure 4

Occurrence: Gatun Formation, Panama.

Discussion: This species is morphologically similar to *Conus bravoii*. The color pattern is also similar but the central band is much more narrow and the axial bands are also more narrow. This may prove to be a variation within the species rather than a new species.

PLATE 3

Figures	Page
1. <i>Cancellaria (Euclia) dinota</i> Woodring, 1970	8
CASG 66589.09; height 22.4 mm, diameter 13.4 mm (X 2.3).	
Locality: P-95, Panama.	
2. <i>Conus sp. #1</i>	8
CASG 66694.04; height 50.0 mm, diameter 29.5 mm (X 1.0).	
Locality: P-94, Panama.	
3. <i>Conus sp. #2</i>	8
CASG 66694.05; height 46.3 mm, diameter 27.0 mm (X 1.1).	
Locality: P-94, Panama.	
4. <i>Conus sp. #3</i>	8
CASG 66695.03; height 58.8 mm, diameter 35.9 mm (X 1.2).	
Locality: P-97, Panama.	
5. <i>Conus acolus</i> Woodring, 1970	10
CASG 66695.04; height 21.9 mm, diameter 13.2 mm (X 2.3).	
Locality: P-97, Panama.	
6. <i>Conus aemulator aemulator</i> Brown and Pilsbry, 1911	10
CASG 66695.05; height 48.9 mm, diameter 31.4 mm (X 1.0).	
Locality: P-97, Panama.	
7-8. <i>Conus bravoii</i> Spieker, 1922	10
7. CASG 66695.06; height 35.3 mm, diameter 21.3 mm (X 1.5).	
Locality: P-97, Panama.	
8. CASG 66695.07; height 47.0 mm, diameter 32.8 mm (X 1.2).	
Locality: P-97, Panama.	
9. <i>Conus burckhardti harrisi</i> Olsson, 1922	10
CASG 66695.08; height 25.0 mm, diameter 9.4 mm (X 2.2).	
Locality: P-97, Panama.	

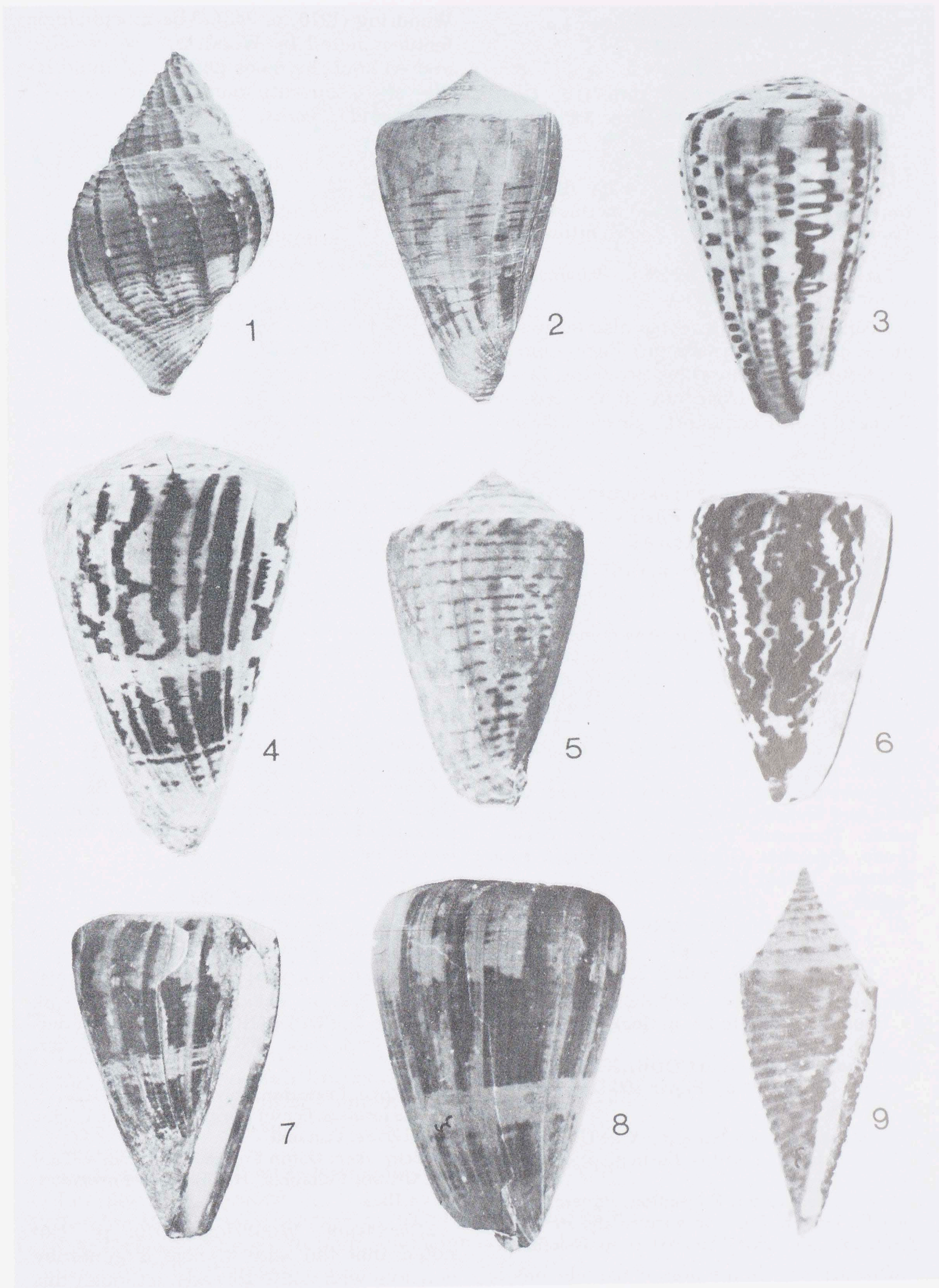


PLATE 3

CONUS ACOLUS

Woodring

Plate 3, figure 5

Conus acolus WOODRING, 1970, U.S. Geol. Survey, Prof. Paper 306-D, p. 349, pl. 55, fig. 3.

Holotype: USNM 645741.

Type locality: Woodring no. 136A, (Stanford Univ. 2611) Gatun Formation; north side of Transisthmian Highway, 1.2 km northwest of Sabanita, Panama.

Occurrence: Gatun Formation, Panama. Angostura Formation, Ecuador.

Discussion: *Conus acolus* also occurs in the late Miocene Angostura Formation at Punta Verde, Esmeraldas Province, Ecuador, and has a close ally in the Recent Tropical East Pacific in *C. perplexus* Sowerby, 1857.

CONUS AEMULATOR AEMULATOR

Brown and Pilsbry

Plate 3, figure 6

Conus aemulator BROWN and PILSBRY, 1911, Acad. Nat. Sci. Phila., Proc., v. 63, p. 342, pl. 23, fig. 9.

Conus aemulator aemulator Brown and Pilsbry. WOODRING, 1970, U.S. Geol. Survey, Prof. Paper 306-D, p. 351, pl. 55, figs. 5, 6; pl. 56, figs. 4, 8.

Holotype: ANSP 1691.

Type locality: Gatun Formation; Gatun Locks, Canal Zone, Panama.

Occurrence: Gatun Formation, Panama. Cercado and Gurabo formations, Dominican Republic. Thomonde Formation, Haiti. Tubará Group, Colombia. Guayacan Formation? (see Whittaker, 1988, p. 16, fig. 5; p. 23), Ecuador.

CONUS BRAVOI

Spieker

Plate 3, figures 7, 8

Conus molis var. *bravoi* SPIEKER, 1922, Johns Hopkins Univ., Studies in Geol., no. 3, p. 41, pl. 1, fig. 6.

Conus bravoi Spieker. WOODRING, 1970, U.S. Geol. Survey, Prof. Paper 306-D p. 348, pl. 56, figs. 10, 11.

Holotype: Peabody Museum, Yale University.

Type locality: Zorritos Formation; Zorritos, Peru.

Occurrence: Gatun Formation, Panama. Zorritos Formation, Peru. Angostura and Progreso formations, Ecuador. Tubará Group, Colombia.

Discussion: *Conus bravoi* usually has a low evenly-tapering spire. The anal fasciole is flat or slightly concave, as noted by

Woodring (1970, p. 348). The morphologic features noted by Woodring are variable and without the color pattern it would be difficult to separate many specimens of *C. bravoi* and *C. molis*.

CONUS BURCKHARDTI HARRISI

Olsson

Plate 3, figure 9

Conus harrisi OLSSON, 1922, Bulls. Amer. Paleontology, v. 9, no. 39, p. 53(225), pl. 3(6), fig. 1.

Conus burckhardti harrisi Olsson. WOODRING, 1970, U.S. Geol. Survey, Prof. Paper 306-D, p. 358, pl. 57, fig. 17.

Holotype: PRI 20899.

Type locality: Río Banano Formation; Hill 3, Río Banano, Costa Rica.

Occurrence: Gatun Formation, Panama. Punta Gavilán Formation, Venezuela. Guayacan Formation?, Ecuador. Río Banano Formation, Costa Rica.

CONUS CONSOBRINUS CONSOBRINUS

Sowerby

Plate 4, figure 1

Conus consobrinus SOWERBY, 1850, Geol. Soc. London, Quart. Jour., v. 6, p. 45.

Conus consobrinus consobrinus Sowerby. WOODRING, 1970, U.S. Geol. Survey, Prof. Paper 306-D, p. 352, pl. 56, figs. 3, 7, 9.

Lectotype: BM(NH) G83962.

Type locality: Dominican Republic.

Occurrence: Gatun Formation, Panama. Gurabo Formation, Dominican Republic. Agueguexquite Formation, Mexico. Bowden Formation, Jamaica.

CONUS cf. MOLIS

Brown and Pilsbry

Plate 4, figure 2

Conus molis BROWN and PILSBRY, 1911, Acad. Nat. Sci. Phila., Proc., v. 63, p. 343, pl. 23, fig. 1; WOODRING, 1970, U.S. Geol. Survey, Prof. Paper 306-D, p. 350, pl. 55, figs. 8-10.

Holotype: Princeton University, no. 5502.

Type locality: Gatun Formation; Gatun Locks, Canal Zone, Panama.

Occurrence: Gatun Formation, Panama. Tubará Group, Colombia. Río Banano Formation, Costa Rica.

Discussion: Woodring (1970, p. 350) noted that the anal fasciole is generally concave with spiral threads, although this is not a consistent feature. This immature specimen is one of many that we have with

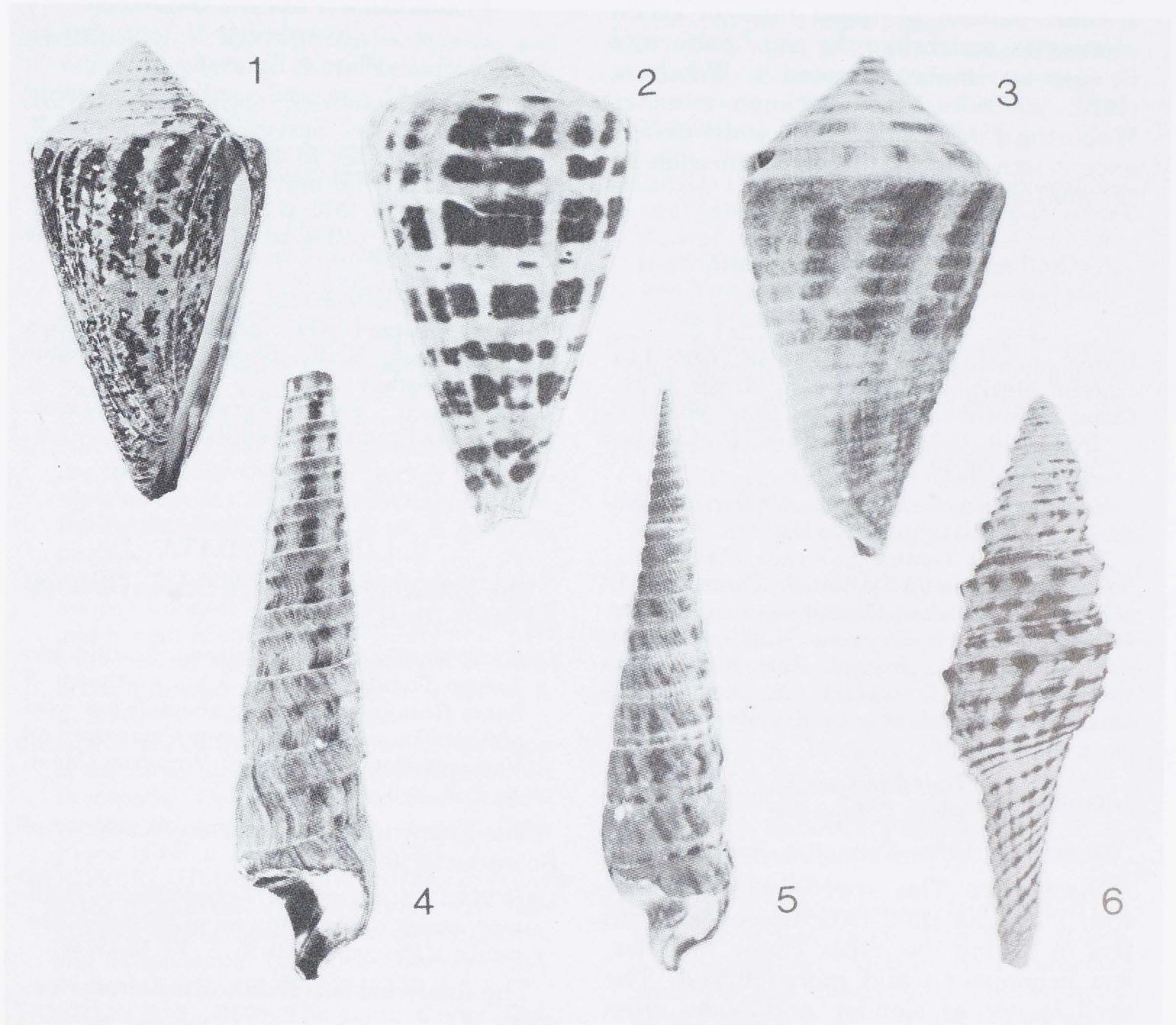


PLATE 4

Figures	Page
1. <i>Conus consobrinus consobrinus</i> Sowerby, 1850	10
CASG 66695.09; height 49.8 mm, diameter 25.5 mm (X 1.1).	
Locality: P-97, Panama.	
2. <i>Conus</i> cf. <i>molis</i> Brown and Pilsbry, 1911	10
CASG 66694.06; height 32.1 mm, diameter 19.8 mm (X 1.3).	
Locality: P-94, Panama.	
3. <i>Conus multiliratus multiliratus</i> Böse, 1906	12
CASG 66589.10; height 25.7 mm, diameter 14.7 mm (X 2.3).	
Locality: P-95, Panama.	
4. <i>Terebra</i> species	12
CASG 66696.01; height 76.9 mm, diameter 17.8 mm (X 1.0).	
Locality: P-98, Panama.	
5. <i>Terebra</i> (<i>Panaterebra</i>) <i>cucurrupeensis</i> Oinomikado, 1939	12
CASG 66589.11; height 76.1 mm, diameter 17.5 mm (X 0.9).	
Locality: P-95, Panama.	
6. <i>Pleuroliria</i> (<i>Polystira</i>) <i>tenagos</i> (Gardner, 1938)	12
CASG 66589.12; height 49.0 mm, diameter 15.1 mm (X 1.2).	
Locality: P-95, Panama.	

a color pattern of spiral rows of crude rectangles, much like the color pattern of *C. spurius* Gmelin, as noted by Woodring (1970, p. 350). This specimen matches Woodring's description of *C. molis* closely except that it lacks the spiral threads on the anal fasciole.

CONUS MULTILIRATUS MULTILIRATUS

Böse

Plate 4, figure 3

Conus agassizi multiliratus BÖSE, 1906, Inst. Geol. México, Bol. 22, p. 49, pl. 5, figs. 34-38.

Conus multiliratus multiliratus Böse. WOODRING, 1970, U.S. Geol. Survey, Prof. Paper 306-D, p. 356, pl. 57, figs. 3, 4.

Holotype: Inst. de Geología, Universidad Nacional de México (apparently lost).

Type locality: Tuxtepec, Oaxaca, Mexico.

Occurrence: Gatun Formation, Panama. Tubará Group, Colombia. Cercado and Gurabo formations, Dominican Republic. Unknown formation, Mexico. Río Banano Formation, Costa Rica. Bowden Formation, Jamaica. Daule Group and Esmeraldas beds, Ecuador.

TEREBRA species

Plate 4, figure 4

Occurrence: Gatun Formation, Panama.

Discussion: This species has affinities with *T. lucana* Dall, 1903; however, it differs in having the axials closer together, less pronounced and more curved. The shell is not as slender and lacks cross threads on the lower half of the body whorl. *Terebra lucana* lacks any color pattern and this species is possibly undescribed.

TEREBRA (PANATEREBRA) CUCURRUPIENSIS

Oinomikado

Plate 4, figure 5

Terebra (Paraterebra) cucurrupiensis OINOMIKADO, 1939, Geol. Soc. Japan, Jour., v. 46, p. 626, pl. 29, fig. 1.

Terebra (Panaterebra) cucurrupiensis Oinomikado. WOODRING, 1970, U.S. Geol. Survey, Prof. Paper 306-D, p. 407, pl. 61, figs. 10, 11, 15, 16.

Holotype: Geological Survey of Japan.

Type locality: Rio San Juan, Colombia.

Occurrence: Gatun Formation, Panama. Unknown formation, Colombia. Brasso Formation, Trinidad.

PLEUROLIRIA (POLYSTIRA) TENAGOS

(Gardner)

Plate 4, figure 6

Polystira (Pleuroliria) tenagos GARDNER, 1938, U.S. Geol. Survey, Prof. Paper 142-F, p. 288, pl. 38, figs. 25, 26.

Pleuroliria (Polystira) tenagos (Gardner). WOODRING, 1970, U.S. Geol. Survey, Prof. Paper 306-D, p. 364, pl. 57, figs. 12, 23, 24; pl. 65, fig. 2.

Holotype: USNM 351134.

Type locality: USGS 3742, Shoal River Formation; Shell Bluff, Shoal River, Walton County, Florida.

Occurrence: Gatun Formation, Panama. Shoal River Formation, Florida.

V. LOCALITY DATA

The following is a United States Geological Survey locality:

USGS 9995. Head of small stream flowing into Arroyo Tomas Martinez, 3 km northeast of Santa Rosa [now Istal], or about 28 km west of Santa Lucrecia [now Jesus Carranza], on Veracruz-Pacific Railroad, Veracruz, Mexico. Coll. Bruce Wade, 1920.

The following is a California Academy of Sciences locality:

CAS 58335. North side of Transisthmian Highway, about 1 km northwest of Sabanita, Republic of Panama (9° 21.25' N, 79° 48.75' W).

The following is a Tulane University locality:

TU 958. Hillslope on east side of road from Boyd-Roosevelt Highway to "Refinería Panamá, S.A.," about 1/2 km north of junction, just east of Cativá, Prov. of Colón, Panama.

The following are Pitt localities and all are from the Gatun Formation, Colón Province, Panama:

P-94. Small hill on east side of road from Cativá to "Refinería Panamá S.A.," at Isla Payardi, about 3 km northeast of Cativá.

P-95. San Judas Todeo housing project, south side of Boyd-Roosevelt Highway, about 2 km west of Cativá.

P-97. North side of Boyd-Roosevelt Highway, about 1 km west of junction of road to Puerto Pilon at Sabanita.

P-98. Top of hill, directly north of junction of Boyd-Roosevelt Highway and road to Puerto Pilon at Sabanita.

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