Bulletins of American Paleontology

VOLUME 98, NUMBER 334 JUNE 6, 1990

Neogene Paleontology in the northern Dominican Republic

10. The Family Cancellariidae (Mollusca: Gastropoda)

by

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and

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BULLETINS OF AMERICAN PALEONTOLOGY
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Library of Congress Card Number: 90-61317

Printed in the United States of America
Allen Press, Inc.
Lawrence, KS 66044 U.S.A.

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by

PETER JUNG[1] AND RICHARD E. PETIT[2]

ABSTRACT

Twenty species of Cancellariidae belonging to seven genera are described and figured. Their mode of occurrence and their stratigraphic ranges are discussed. *Trigonostoma insulare* is the only species described from the Dominican Republic which is not represented in the extensive collections studied and may not occur in the Neogene of the northern Dominican Republic. The following 10 species are described as new: *Cancellaria* (*Cancellaria*) *juncta*, *Cancellaria* (*Pyruclia* ?) *uva*, *Cancellaria* (*Sveltia*) *inquilinus*, *Cancellaria* (*Bivetiella*) *bajonensis*, *Cancellaria* (*Bivetopsia*) *plectilis*, *Cancellaria* (*Hertleinia*) *miranda*, *Cancellaria* (*Massyla*) *lopezana*, *Perplicaria canae*, *Axelella emblema*, and *Admetula zalayana*. The genus *Cancellaria* is represented by 13 species, which are assigned to seven subgenera. The genus *Trigonostoma* is represented by two species (including the enigmatic *T. insulare*), and the remaining five genera (*Aphera*, *Perplicaria*, *Axelella*, *Agatrix*, and *Admetula*) by a single species each. In terms of material, *Aphera islacolonis* is the most abundant species. Of the 19 species present in the collections under study only one is definitely known to occur outside of the Dominican Republic, and three others have questionably been recorded from other localities. No interpretation of this high degree of endemism is possible at this time.

RESUMEN

Veinte especies de Cancellariidae pertenecientes a siete géneros son descritas y figuradas. Su ordenamiento estratigráfico y sus modos de ocurrencia son discutidos. *Trigonostoma insulare* es la única especie que no está representada en las amplias colecciones estudiadas y puede que no encuentre en el Neógeno de la República Dominicana septentrional. Las siguientes 10 especies son descritas como nuevas: *Cancellaria* (*Cancellaria*) *juncta*, *Cancellaria* (*Pyruclia* ?) *uva*, *Cancellaria* (*Sveltia*) *inquilinus*, *Cancellaria* (*Bivetiella*) *bajonensis*, *Cancellaria* (*Bivetopsia*) *plectilis*, *Cancellaria* (*Hertleinia*) *miranda*, *Cancellaria* (*Massyla*) *lopezana*, *Perplicaria canae*, *Axelella emblema*, y *Admetula zalayana*. El genéro *Cancellaria* está representado por 13 especies, las cuales son asignadas a siete subgéneros. El genéro *Trigonostoma* está representado por dos especies (incluyendo la enigmática *T. insulare*), y los restantes cinco gêneros (*Aphera*, *Perplicaria*, *Axelella*, *Agatrix*, y *Admetula*) por una única especie cada uno. En términos de material, *Aphera islacolonis* es la especie más abundante. De las 19 especies presentes en las colecciones bajo estudio, sólo una sola se conoce definitivamente representada fuera de la República Dominicana, y la ocurrencia de tres otras es cuestionable en otras localidades. Una interpretación de tal alto grado de endemismo no es posible por estos momentos.

INTRODUCTION

This paper continues the series of taxonomic studies dealing with Neogene fossils from sections situated in the Cibao Valley, northern Dominican Republic (Text-fig. 1). The project within which these studies are being carried out has been outlined by Saunders *et al.* (1982) and Saunders, Jung, and Biju-Duval (1986). Some comments concerning early collections of molluscs from this area have been given by Jung (1986, p. 5).

We wish to state that the excessive number of references to previously published material which makes the text difficult to follow in some instances, and the excessive number of tables, were mandated by editorial dictate as is the following statement of authorship.

This paper is the result of a joint effort in which both authors shared responsibility. The portions dealing with geology and stratigraphy are primarily the work of the senior author and the systematic portion is primarily the work of the junior author. However, both authors contributed to all sections and this is a true joint effort.

ACKNOWLEDGMENTS

The material on which this paper is based was collected during field work carried out in the years 1978, 1979, and 1980 as part of the project referred to above. The field work was made possible by a grant from the Swiss National Science Foundation (Grant 2.646-0.76). The financial help and the assistance in the field provided by Institut Français du Pétrole are gratefully acknowledged.

We are indebted to the following persons for the loan of specimens under their care: Dr. Emily H. Vokes, Tulane University; Dr. Peter R. Hoover, Paleontological Research Institution; Ms. Jann Thompson and Mr. F. J. Collier, United States National Museum of Natural History, Smithsonian Institution; Mr. C. P. Nuttall, British Museum (Natural History); Dr. Robert Robertson and Ms. Elena Benamy, Academy of Natural Sciences of Philadelphia; and Mrs. J. S. Lawless, Peabody Museum, Yale University. The manuscript

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was critically read by Dr. Matthew J. James, Sonoma State University and Dr. Gary Rosenberg, Academy of Natural Sciences of Philadelphia, and we are appreciative of their suggestions. In addition, we are especially grateful to Mr. Wolfgang Suter, photographer at the Naturhistorisches Museum Basel as well as to Dr. Richard Guggenheim and Mr. Marcel Düggelin, both of the Scanning Electron Microscope Laboratory, University of Basel, Switzerland.

BIOSTRATIGRAPHY

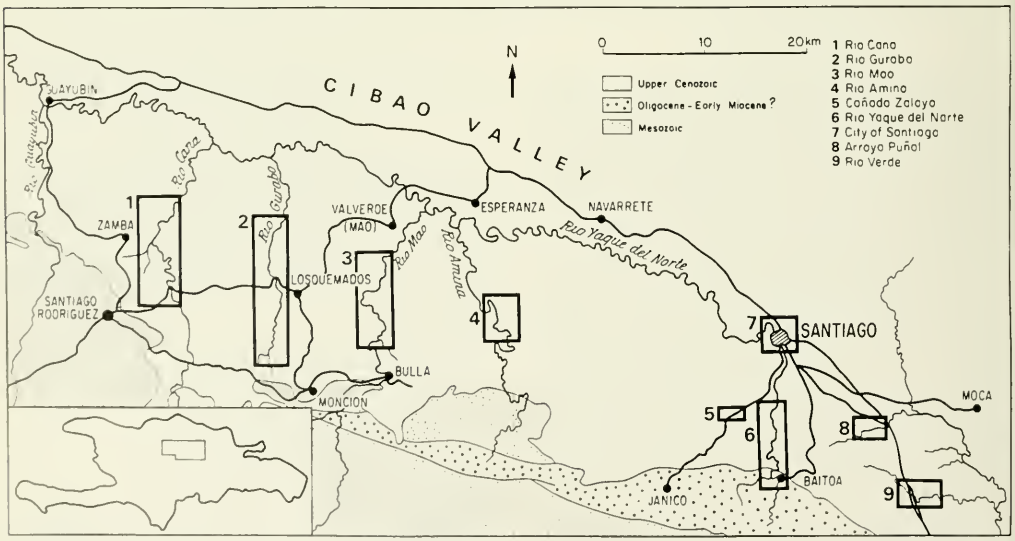
The Cancellariidae are represented in the Neogene of the Cibao Valley by 19 species. These species occur in the areas shown in Text-figure 1 except that no cancellariids occur in Area 8 (Arroyo Puñal).

The "ranges" of the various species in the different sections are shown in Text-figures 2 to 9. The word "ranges" is put in quotation marks because the term is misleading. The species concerned do not, of course, occur continuously through a given sequence of sediments. In fact, the occurrences are spotty. This is particularly evident in the text-figures showing sections comprising a thick sedimentary sequence such as those of the Río Cana, Río Gurabo, and the López section on Río Yaque del Norte.

The distributional patterns of the species discussed in this paper reflect a considerable degree of stratigraphic restriction. Twelve species (more than 60% of the cancellariid fauna) are restricted to single sections. This large percentage is surprising considering that the sediments of all the sections in which cancellariid species occur are of similar age (late Miocene to early Pliocene) with the exception only of the López section which is of late early to early middle Miocene age (Saunders, Jung, and Biju-Duval, 1986, p. 30). Of the 12 species restricted to single sections, four are known from only one locality each: *Cancellaria* (*Pyruclia* ?) *uva*, n. sp. is recorded only from locality NMB 17275: Arroyo López on Río Yaque del Norte (Saunders, Jung, and Biju-Duval, 1986, text-fig. 26); *Perplicaria canae*, n. sp. has been found only at locality TU 1230: Cercado Formation (late Miocene) of the section on Río Cana (Saunders, Jung, and Biju-Duval, 1986, text-fig. 15); and *Cancellaria* (*Bivetiella*) *gabbiana* Pilsbry and Johnson, 1917 and *Axelella emblema*, n. sp. are known only from localities NMB 16938 and NMB 16942, respectively: both situated in the Baitoa Formation (late early to early middle Miocene) of the López section on Río Yaque del Norte (Saunders, Jung, and Biju-Duval, 1986, text-figs. 21, 25).

The remaining eight species which are restricted to single sections are distributed as follows:

Section on Río Mao: *Cancellaria* (*Cancellaria*) *mauryae* Olsson, 1922 is known from localities at Arroyo Bajón and Bluff 3 of Maury, whereas *Cancellaria* (*Bivetiella*) *bajonensis*, n. sp. has been found at localities at Arroyo Bajón as well as at Bluffs 1, 2, and 3 of Maury (Saunders, Jung, and Biju-Duval, 1986, text-figs. 29, 30).



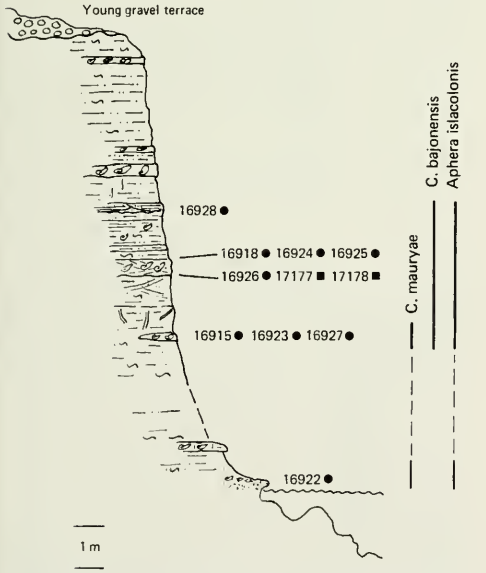
Text-figure 1.—Index map showing location of investigated areas in the Cibao Valley, Dominican Republic (after Jung, 1986, text-fig. 1).

Section on Río Gurabo: *Cancellaria* (*Cancellaria*) *juncta*, n. sp. and *Cancellaria* (*Hertleinia*) *miranda*, n. sp. are recorded from a number of localities within the late Miocene Cercado Formation; *Trigonostoma* (*Ventrilia*) *gurabis* (Maury, 1917) is represented from two localities in the late Miocene part of the Gurabo Formation.

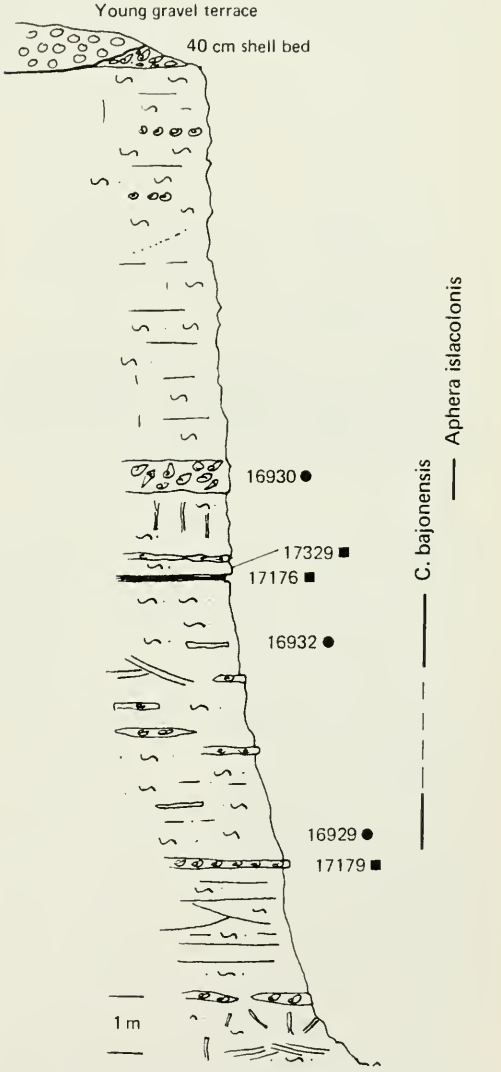
López section on Río Yaque del Norte (late early to early middle Miocene Baitoa Formation): *Cancellaria* (*Cancellaria*) *rowelli* Dall, 1896 has been found in many levels of the section, whereas *Cancellaria* (*Massyla*) *lopezana*, n. sp. is recorded from only two horizons.

In the section exposed along Río Cana, *Cancellaria* (*Bivetopsia*) *plectilis*, n. sp. is known from a single horizon in the early Pliocene part of the Gurabo Formation, but the species is also recorded from a nearby locality (TU 1422), the age of which has not been determined.

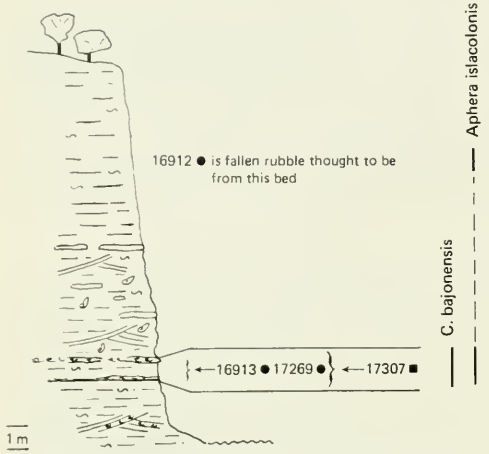
In addition to the 12 species with restricted distribution as mentioned above, there are seven species which occur in several sections. The most widespread of these are *Cancellaria* (*Bivetiella*) *epistomifera* Guppy, 1876, which occurs in beds exposed along the Río Cana, Río Gurabo, Río Mao, Río Amina, Río Yaque del Norte, and Río Verde; and *Aphera islacolonis* (Maury, 1917) which is recorded from the sections on



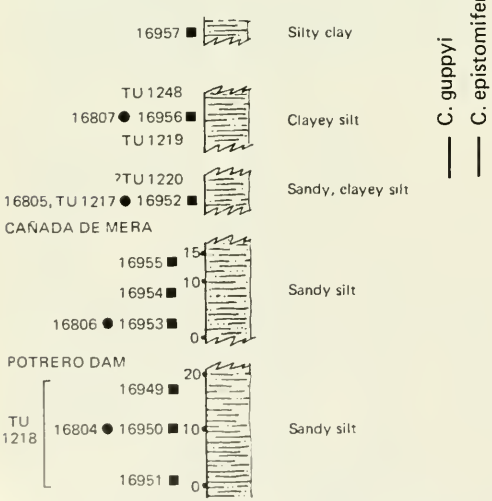
Text-figure 5.—Section at the mouth of Arroyo Bajón on Río Mao showing (discontinuous) "ranges" of cancellariid species and stratigraphic position of NMB localities; ■ = NMB localities collected for microfossils and lithologic analyses; ● = NMB localities collected for macrofossils (after Saunders, Jung, and Biju-Duval, 1986, text-fig. 32).



Text-figure 6.—Section exposed in Maury's Bluff 2 on Río Mao showing (discontinuous) "ranges" of cancellariid species and stratigraphic position of NMB localities: ■ = NMB localities collected for microfossils and lithologic analyses; ● = NMB localities collected for macrofossils (after Saunders, Jung, and Biju-Duval, 1986, text-fig. 31).



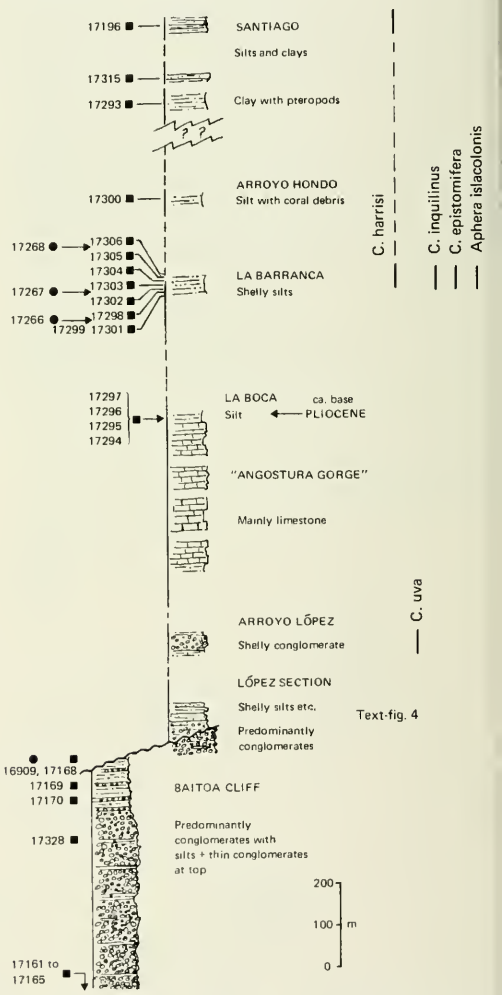
Text-figure 7.—Section exposed at the downstream (eastern) end of Maury's Bluff 3 on Río Mao showing (discontinuous) "ranges" of cancellariid species and stratigraphic positions of NMB and TU localities: ■ = NMB localities collected for microfossils and lithologic analyses; ● = NMB localities collected for macrofossils (after Saunders, Jung, and Biju-Duval, 1986, text-fig. 33).



Text-figure 8.—Schematic column for the central portion of Río Amina showing (discontinuous) "ranges" of cancellariid species and relative stratigraphic positions of NMB and TU localities: ■ = NMB localities collected for microfossils and lithologic analyses; ● = NMB localities collected for macrofossils (after Saunders, Jung, and Biju-Duval, 1986, text-fig. 35).

Río Cana, Río Gurabo, Río Mao, Arroyo Zalaya, Río Yaque del Norte, and Río Verde.

The sections of Text-figures 2 through 9 cover all the occurrences of cancellariid species except for three small areas: Bluff 1 of Maury on Río Mao, Arroyo Zalaya, and Río Verde (Saunders, Jung, and Biju-Duval, 1986, text-figures 29, 36, 38).



Text-figure 9.—Schematic column for Río Yaque del Norte showing (discontinuous) "ranges" of cancellariid species and relative stratigraphic positions of NMB localities: ■ = NMB localities collected for microfossils and lithologic analyses; ● = NMB localities collected for macrofossils (after Saunders, Jung, and Biju-Duval, 1986, text-fig. 24).

The following three species occur at Bluff 1 of Maury on Río Mao: *Cancellaria* (*Cancellaria*) *guppyi* Gabb, 1873, *C.* (*B.*) *epistomifera*, and *C.* (*B.*) *bajonensis*. According to Saunders, Jung, and Biju-Duval (1986, p. 32), the age of the beds exposed at Bluff 1 is late Miocene.

Along Arroyo Zalaya *Cancellaria* (*Sveltia*) *inquilinus*, n. sp., *Aphera islacolonis*, and *Admetula zalayana*, n. sp. have been found. The age of the beds is early Pliocene (Saunders, Jung, and Biju-Duval, 1986, p. 34).

Six species are recorded from Río Verde, all from locality TU 1250 (for location see Saunders, Jung, and Biju-Duval, 1986, text-fig. 38): *Cancellaria* (*Cancellaria*) *harrisi* Maury, 1917, *C.* (*S.*) *inquilinus*, *C.* (*B.*) *epistomifera*, *Aphera islacolonis*, *Agatrix losquemadica* (Maury, 1917), and *Admetula zalayana*. The age of the beds at this locality is N. 18, early Pliocene, according to Akers (*in* Vokes, 1989).

Only four of the 19 species present in the collections under study have been reported from localities outside of the Dominican Republic, and three of these reports are based on questionable material as shown in our discussions. In the absence of critical monographs on the cancellariid fauna of the Caribbean area, no determination is possible as to the uniqueness of this endemism. Our opinion, based on our knowledge of the cancellariid fauna of the area, is that this endemism is not particularly unusual and that this family will prove to be of considerable importance in stratigraphy. Monographs on other families, based on these same Dominican Republic collections, are in preparation by specialists. When these are published, it may become possible to more objectively interpret our species concept, paleoenvironment, and the biostratigraphic usefulness of the species.

Trigonostoma (*Ventrilia* ?) *insulare* (Pilsbry and Johnson, 1917) is known only from its holotype which has been described from an unknown locality and stratigraphic horizon of "Santo Domingo". As mentioned under that species (p. 114, herein), it is possible that *T.* (*V.* ?) *insulare* does not occur in the Neogene of the Dominican Republic.

BIOGEOGRAPHY AND PALEOECOLOGY

Twenty species of Cancellariidae have been reported from the areas studied, 19 of which are represented in our collections. These 20 species are grouped in 13 subgenera. All of these subgenera have at least one living representative in the Panamic–Pacific faunal province, but only seven of them have representatives living in the Caribbean faunal province.

Lists of paciphile genera and subgenera of Cancellariidae were published by Woodring (1966, p. 428) and Vermeij (1978, p. 232). As those lists are now outdated, a current list is given below. An asterisk (*) denotes those taxa which occur in the Dominican Republic. The first seven taxa listed are subgenera of *Cancellaria* Lamarck, 1799, *Perplicaria* is a genus, and *Extractrix* is a subgenus of *Trigonostoma* Blainville, 1827.

Euclia Adams and Adams, 1854
**Pyruclia* Olsson, 1932
**Bivetiella* Wenz, 1943
Narona Adams and Adams, 1854
**Hertleinia* Marks, 1949
**Sveltia* Jousseaume, 1887
**Massyla* Adams and Adams, 1854
**Perplicaria* Dall, 1890
Extractrix Korobkov, 1955

This list of nine genus-level taxa increases Vermeij's 1978 list of six such taxa by 50%. *Massyla* was previously known, but was overlooked in previous compilations; *Bivetiella* was known but was previously included in another subgenus; *Hertleinia* and *Sveltia* are here reported from the Neogene of the Caribbean for the first time; and *Aphera* Adams and Adams, 1854 was subtracted when Petuch (1981) reported a living species in the Caribbean.

The relative abundance of the subgenera and species of Cancellariidae in the Tertiary of the Dominican Republic is very unequal. The 13 species placed in subgenera of *Cancellaria* account for just over 50% of the specimens examined. However, the single species of *Aphera* is represented by almost as many specimens (1,300+) as all other species of Cancellariidae combined. Species of *Perplicaria*, *Trigonostoma*, *Axelella* Petit, 1988, *Agatrix* Petit, 1967, and *Admetula* Cossmann, 1889 are each represented by 16 or fewer specimens.

Cancellariids inhabit subtidal to bathyal sand and mud bottoms in temperate and tropical regions. Depth and bottom condition records for some living relatives of the species under study are given in appropriate sections of the *Systematic Paleontology* portion of this paper. All the species treated in this paper (except *Trigonostoma* (*Ventrilia* ?) *insulare* Pilsbry and Johnson, 1917, which is not represented in our collections) have been collected from silty sediments. The mode of occurrence may vary somewhat within a single species. A large proportion of the collected shells occurred scattered in silts (*i.e.*, at or close to the original place of burial). Many others, however, were found concentrated in lenses, in silty bands, in shelly layers, in pebbly beds, and in conglomeratic shell beds, lenses, and layers. These latter modes of occurrence point to probable transport over some distance before final depo-

sition. Judging from the good state of preservation of the material, this transport must have been minor.

Association of the species recorded herein with sandy sediments is rare. The following cases may be mentioned: *C.* (*C.*) *rowelli* Dall, 1896 [scattered in pebbly, silty sands and in sands and silts of the López section]; *C.* (*B.*) *epistomifera* Guppy, 1876 [in sand bed of the Río Gurabo section]; *Aphera islacolonis* (Maury, 1917) [in sandy and pebbly silts of the Río Cana section, and scattered in sands and silts of the López section]; and *Agatrix losquemadica* (Maury, 1917) [in sand bed of the Río Gurabo section]. These occurrences seem to be exceptions, and as a rule the species just mentioned also occur like the other cancellariid species.

Regarding the early ontogenetic development of the species dealt with in this paper, it is noteworthy that all the species have blunt apices and that the orientation of the outer lip of their protoconchs is prosocline. According to Shuto (1974), the blunt apices point to a lecithotrophic, direct type of development. This lack of a planktonic larval stage may account for the high degree of endemism previously mentioned.

Little ecological data are available for cancellariids. Small juveniles of the Indo-Pacific species *Cancellaria* (*Scalptia*) *contabulata* Sowerby, 1832b [fig. 28] have been found on the spires of several species of living gastropods (Cernohorsky, 1972, p. 181). A Persian Gulf cancellariid, *Nipponaphera paucicostata* (Sowerby, 1894), was reported by Melvill and Standen (1901, p. 451) as being found "adhering to the upper part of *Rapana bulbosa*, 30–50 fathoms." *Cancellaria* (*S.*) *scalariformis* Lamarck, 1822 [p. 113] has been found attached to living specimens of the bivalve *Eucrassatella* Iredale, 1924 in Australia (Garrard, 1975, p. 29). The reason for the association of these cancellariids with other molluscs is not known.

The pallial complex and reproductive system of cancellariids is similar to that of other neogastropods. The extreme anterior placement of the buccal ganglia, a simplified alimentary system posterior to the valve of Leiblein, and a highly specialized radula distinguish the Cancellariidae from other neogastropods. The cancellariid radula is uniserial, each tooth being about 50 times as long as wide, with anteriorly directed cusps at the distal end of each tooth. This unique radula structure was the basis of the ordinal name Nematoglossa (Olsson, 1970). For discussions of the soft parts and radulae of cancellariids, see Harasewych and Petit (1982, 1984).

Based on the functional morphology of the alimentary system, it was speculated that cancellariids are suctorial fluid feeders (Harasewych and Petit, 1982; Petit and Harasewych, 1986). That this is true for at least one species was demonstrated by O'Sullivan, McConnaughey, and Huber (1987) who found that *Cancellaria cooperi* Gabb, 1865 [p. 186] feeds by sucking the blood of the Pacific electric ray, *Torpedo californica* Ayres, 1855 [pp. 70, 71]. Neither food nor feeding habits are known for any other species of cancellariid.

Until more is known about the life history and ecology of Recent species of Cancellariidae, nothing can be inferred about their paleoecology.

ABBREVIATIONS OF REPOSITORY INSTITUTIONS

The following abbreviations for repository institutions are used in this paper:

ANSP: Academy of Natural Sciences, Philadelphia, PA, U. S. A.
BMNH: British Museum (Natural History), London, England, U. K.
NMB: Naturhistorisches Museum Basel, Switzerland (the letter H after NMB stands for gastropods).
PRI: Paleontological Research Institution, Ithaca, NY, U. S. A.
TU: Tulane University, New Orleans, LA, U. S. A.
USGS: United States Geological Survey, Washington, DC, U. S. A.
USNM: United States National Museum of Natural History, Smithsonian Institution, Washington, DC, U. S. A.
YPM: Peabody Museum of Natural History, Yale University, New Haven, CT, U. S. A.

SYSTEMATIC PALEONTOLOGY

Introduction

The base for the preparation of this paper has been the combined collections of the Naturhistorisches Museum Basel and Tulane University. All of the type and figured specimens of Cancellariidae derived from these collections are deposited in the Naturhistorisches Museum Basel. The type specimens of all species of Cancellariidae occurring in the Dominican Republic, as well as the type specimens of species which were most important for comparative purposes, have been examined and refigured.

Although the amount of material available for this study is mentioned under each species, a summary of the number of specimens of each species is given in Table 1.

The 20 species of Cancellariidae treated herein are grouped into 13 subgenera. Seven of these subgenera, containing 13 species, are assigned to the genus *Cancellaria* Lamarck, 1799. The remaining seven species are placed in six genera. As is often the case with Ter-

Table 1.—Numbers of specimens of the nineteen species of cancellarid gastropods collected in the Cibao Valley for this study.

taxon	*number of specimens*
Cancellaria (*Cancellaria*) *guppyi*	75
Cancellaria (*Cancellaria*) *mauryae*	13
Cancellaria (*Cancellaria*) *juncta*	45
Cancellaria (*Cancellaria*) *harrisi*	528
Cancellaria (*Cancellaria*) *rowelli*	202
Cancellaria (*Pyruclia* ?) *uva*	4
Cancellaria (*Sveltia*) *inquilinus*	12
Cancellaria (*Bivetiella*) *gabbiana*	2
Cancellaria (*Bivetiella*) *epistomifera*	375
Cancellaria (*Bivetiella*) *bajonensis*	70
Cancellaria (*Bivetopsia*) *plectilis*	2
Cancellaria (*Hertleinia*) *miranda*	51
Cancellaria (*Massyla*) *lopezana*	2
Aphera islacolonis	1,300+
Perplicaria canae	2
Trigonostoma (*Ventrilia*) *gurabis*	10
Axelella emblema	3
Agatrix losquemadica	16
Admetula zalayana	5

tiary cancellariids, some species are represented by very few specimens. Fortunately, the species from the Dominican Republic represented by few specimens are morphologically so distinct that they can be separated on a genus-level basis, eliminating any possibility that they are only aberrant specimens of common species. The extensive collections upon which this report is based have made it possible to examine large numbers of individuals of some species and thus obtain some indication of variation. Few species exhibit great variability, even among those for which large numbers are available for study. Two notable exceptions are *Cancellaria* (*Cancellaria*) *harrisi* Maury, 1917 and *Aphera islacolonis* (Maury, 1917).

As mentioned elsewhere herein, genus-level division of the Cancellariidae has been inconsistent in published work, but probably no more so than in some other families. Subgenera are used herein to place together species which share morphological characters that are not considered to be of sufficient importance to warrant separation as full genera. We consider these subgenera, most of which identify species groups with limited spatial and temporal distribution, to be of considerable potential value in better understanding the stratigraphy of the Caribbean Tertiary. Our use of genera and subgenera is subjective, but is based on preliminary results of a study of the phylogeny of the family (Harasewych and Petit, in preparation).

In some instances cancellariids from the Dominican Republic treated herein as discrete taxa at the species level differ from populations from elsewhere in the Tertiary Caribbean faunal province in minor characters that are, however, consistent within each population. We consider these consistent differences to be of systematic importance as it is possible that some of these, although seemingly minor (such as the persistence of surface ornamentation as discussed under *Pyruclia* Olsson, 1932), may be of stratigraphic importance. If they are, they might assist in establishing more precise temporal relationships between the various Tertiary Caribbean faunas.

The *Diagnosis* is reserved for the description of supraspecific categories. The *Description* is used only in species-level taxonomy, and is a description of the species, not of specimens. Several equivalent descriptive terms are used (*e.g.*, *volution* and *whorl*; *bifid* and *bifurcate*; *etc.*), especially if they occur in the same sentence.

Generic and subgeneric diagnoses begin with a general statement referring to size. These statements are not quantified as they are subjective and are based on work still in progress. No such general statement as to size is made in the descriptions of species as measurements are given under the heading *Measurements*. The measurements of many species are plotted in graphs. All measurements given for unnumbered specimens and all measurements plotted on graphs are of individual specimens and are not averages.

Under the heading *Material* the number of specimens in the collections under study is given.

The heading *Occurrence* is followed by detailed geographic and stratigraphic information on a given species *within* the studied area of the Dominican Republic. Localities have been assigned to particular formations only in the sections on Río Gurabo and Río Cana, the López section on Río Yaque del Norte, and the lower part of the section on Río Mao. In all the other areas such assignments are not possible as they are too speculative at the moment (Saunders, Jung, and Biju-Duval, 1986, p. 39).

Under the heading *Distribution* there is general geographic and stratigraphic information on a given species within the Dominican Republic *plus* such information *outside* the Dominican Republic.

Family **CANCELLARIIDAE** Forbes and Hanley, 1851

Remarks.—The neogastropod family Cancellariidae arose in the Lower Cretaceous, and was already well-developed and widely dispersed in the Early Tertiary. The cancellariids were highly experimental and developed a wide variety of shell shapes (elongate to globose) and ornamentation (smooth to spinose). Many of these morphological forms, considered to be discrete taxonomic units, developed during the early history of the family, some being represented in the Recent fauna by only a few relict species.

The family is usually divided into three subfamilies based on the genera *Cancellaria* Lamarck, 1799, *Trigonostoma* Blainville, 1827, and *Admete* Möller, 1842. Subfamily divisions are not utilized herein because a viable phylogeny for the family remains to be determined. Preliminary results of work in progress indicate that several additional subfamilies may be required (Harasewych and Petit, in preparation).

Genus-level division of the Cancellariidae has traditionally been based on shell morphology, as has division of most molluscan families. Cladistic analysis based on soft-parts morphology and cladistic analysis based on shell characters produce equally parsimonious trees (Harasewych and Petit, in preparation) showing that there is a direct correlation between shell characters and soft-parts morphology. The division of the family into numerous genera and subgenera which seems necessitated by the wide variety of forms has been criticized by some authors. The problem was succinctly stated by Woodring (1970, p. 334): "Cancellariids present a great variety of form and sculpture. Classification of such diverse species is difficult and so far unsatisfactory. Ample precedent is available for both conservative treatment and more narrowly restricted genera and subgenera."

Genus CANCELLARIA Lamarck, 1799

Cancellaria Lamarck, 1799, p. 71.

Type species (by monotypy).—*Voluta reticulata* Linné, 1767. Recent, Caribbean.

Cancellarius Montfort, 1810, p. 562.

Type species (by original designation).—*Voluta reticulata* Linné, 1767. Recent, Caribbean.

Exechoptychia Cossmann, 1903, p. 189.

Type species (by original designation).—*Cancellaria conradiana* Dall, 1890. Pliocene, Florida and the Carolinas.

Diagnosis.—Shell of small to large size. General shape ovate, often high-spired. Outer lip prosocline with a weak stromboid notch. Interior of outer lip lirate. Columella with two or three folds, the adapical one being largest and overlying the prominent siphonal fasciole. Parietal callus weak but extending over the umbilical chink.

Subgenus CANCELLARIA *sensu stricto*

Diagnosis.—Shell of small to large size, generally ovate. Sculpture of axial ribs and spiral cords forming a cancellate pattern. Columella with three folds, the adapical one being largest and usually bifurcate. Incremental growth evidenced by a thickening of the shell and slight lateral compression at intervals of approximately 120°.

Remarks.—The nominotypical subgenus appears to be restricted to the later Tertiary and Recent faunas of the Western Hemisphere. The morphology of the shell and animal of *Cancellaria reticulata* (Linné, 1767) were described by Harasewych and Petit (1982). *Cancellaria* sensu stricto is usually restricted to those species with three distinct columellar folds, the adapical one being largest, broad, and bifid. A few species here assigned to *Cancellaria* s. s. have a sharp adapical fold, but possess the other characters of the subgenus.

Cancellaria (Cancellaria) guppyi Gabb, 1873
Plate 15, figures 1–11; Plate 20, figures 1–3; Text-figure 10

Cancellaria guppyi Gabb, 1873, p. 236; Maury, 1917, p. 228, pl. 10, figs. 7, 8; Pilsbry, 1922, p. 333, pl. 22, fig. 7; Ramírez, 1956, p. 21, pl. 3, fig. 12.

? *Cancellaria guppyi* Gabb. Anderson, 1929, p. 118.

Description.—Protoconch smooth, of about two-and-one-half volutions. Teleoconch of about six whorls with finely reticulate sculpture of numerous spiral cords and collabral axial ribs. Shape globose with width being two-thirds of height. Suture impressed. Aperture suboval, elongate. Inner surface of outer lip with about 12 lirations which do not extend to outer edge, but which extend well into the aperture. Evidence of a slight stromboid notch present in growth lines. Parietal callus exists only as a thin coating on the adapical half of aperture but on the abapical half it is heavier and extends as a shield over the umbilical chink. Columella with three folds, the bifid adapical fold overlying the siphonal fasciole and being much the largest; the descending center fold strong and often slightly bifurcate; the small abapical fold forms the edge of a short but pronounced siphonal canal.

Lectotype.—ANSP 2990. This specimen has been figured by Pilsbry (1922, pl. 22, fig. 7) and is refigured here (Pl. 15, figs. 1–3). Pilsbry (1922, p. 333) gave the measurements of "the type figured" and mentioned "the type and seven other specimens are no. 2990 A.N.S.P." We take this designation of the figured specimen as "type" to constitute lectotype designation.

Dimensions of lectotype.—Height, 28.1 mm; width, 18.6 mm.

Type locality.—A type locality has not been designated. Maury (1917, p. 64) cited the species from "Bluff 1, Cercado de Mao". Bluff 1 of Maury is therefore considered the type locality (= TU 1293 = NMB 16910): late Miocene. For location see Saunders, Jung, and Biju-Duval (1986, text-fig. 29).

Material.—Twenty-three lots with a total of about 75 specimens, most well-preserved, but almost always lacking the outermost part of the outer lip.

Measurements.—The measurements of 42 specimens are plotted in Text-figure 10.

Remarks.—These rotund shells usually exhibit flattened areas (see Pl. 15, fig. 2) reflecting rapid episodic growth as discussed by Harasewych and Petit (1982, p. 111) for *C. reticulata* (Linné, 1767).

Anderson (1929, p. 118) reported *Cancellaria guppyi* from the Tubará Group of northern Colombia (late Miocene or early Pliocene) on the basis of a single specimen which he did not illustrate.

Comparisons.—This distinctive species is easily recognized by its fine cancellations, globose shape, deeply impressed suture, and thick shell. It can only be confused with *Cancellaria mauryae* Olsson, 1922 [p. 81, pl. 6, fig. 5] which also has fine cancellations but is much more attenuate, and *C. juncta*, n. sp., which has a thin shell, a proportionally longer and wider aperture, and a sharp adapical columellar fold.

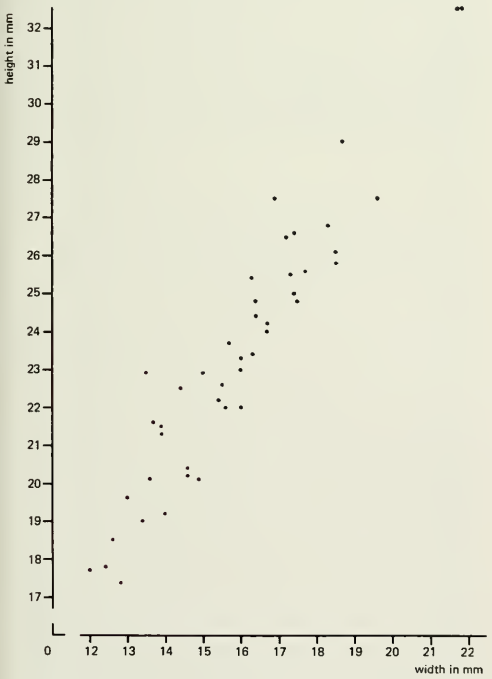
Occurrence.—This species is known from the following localities (for locations see Saunders, Jung, and Biju-Duval, 1986, text-figs. 4–6, 29, 34, 35):

Río Mao: late Miocene: NMB 16910 and TU 1293 (both correspond to Bluff 1 of Maury). Cercado Formation (late Miocene): NMB 16916 and TU 1379 (both Arroyo Bajón); NMB 16913 (= Bluff 3 of Maury).

Río Gurabo: upper part of Cercado Formation (late Miocene): NMB 15898, 15899, 15900, 15902, 15903, 15906, 15907, 15910, 15911, 15912, 15916, and TU 1359, 1375. Lower part of Gurabo Formation (late Miocene): NMB 15869, 15871, 16809, and TU 1296.

Río Amina: probably late Miocene: TU 1219, 1220.

Distribution.—Except for the report by Anderson (1929, p. 118) of a single specimen from northern Colombia, as mentioned above, the species has been reported only from the Dominican Republic.



Text-figure 10.—(Restored) height/width diagram of *Cancellaria* (*Cancellaria*) *guppyi* Gabb.

Cancellaria (Cancellaria) mauryae Olsson, 1922
Plate 15, figures 12–19

Cancellaria barretti Guppy. Guppy, 1866, p. 286 (list; not p. 289); Guppy, 1867, p. 157 (list, in part); Guppy, 1876, p. 520; Maury, 1917, p. 62, pl. 10, fig. 1; Maury, 1925b, pl. 9, fig. 17; Pilsbry, 1922, p. 332. Not of Guppy, 1866.
Cancellaria reticulata Linné. Gabb, 1873, p. 236. Not of Linné, 1767.
Cancellaria mauryae Olsson, 1922, p. 82, pl. 6, fig. 5.

Description.—Protoconch smooth, of about two volutions. Both spiral and axial sculpture begin abruptly at the beginning of the first postnuclear whorl. Teleoconch of about six whorls, slightly convex with an impressed suture. Finely reticulated sculpture consisting of about 17 primary spiral cords with one, or sometimes two, weaker cords in the interspaces which begin on approximately the fifth teleoconch whorl, and axial ribs that are evenly spaced except for crowding behind the outer lip. Small nodes are formed at intersections of primary spiral cords and axial ribs. Outer lip slightly prosocline with a shallow stromboid notch. Columella with three sharp folds, the adapical one largest and abapical one forming the edge of the well-defined, but short, anterior canal. One or more short spiral ridges sometimes present between the extremities of the columellar folds. Weak parietal callus present on large specimens. Columellar callus strong, half covering the chink-like umbilicus.

Holotype.—PRI 28661. This specimen was figured by Maury (1917, pl. 10, fig. 1), and by Olsson (1922, pl. 6, fig. 5), and is refigured here (Pl. 15, figs. 16–19). Olsson (1922, p. 83) selected Maury's figured specimen as "type of this species".

Dimensions of holotype.—Height, 36.7 mm; width, 22.7 mm.

Type locality.—The exact locality from which the holotype was collected is not known. Maury (1917, p. 63) mentioned Bluffs 1, 2 and 3 on Río Mao, Dominican Republic. We here restrict the type locality to locality NMB 16927 (Arroyo Bajón): late Miocene (Saunders, Jung, and Biju-Duval, 1986, text-figs. 30, 32).

Material.—Five lots with a total of 13 specimens, most of them juvenile or incomplete.

Measurements.—

	height (mm)	*width (mm)*	*h/w ratio*
PRI 28661 (holotype) [Pl. 15, figs. 16–19]	36.7	22.7	1.62
unnumbered specimen, from loc. TU 1294	29.8	17.9	1.66
unnumbered specimen, from loc. NMB 16922	38.7	23.3	1.66
unnumbered specimen, from loc. NMB 16923	25.0	14.5	1.72
NMB H 17296, from loc. NMB 16927 [Pl. 15, figs. 12–15]	25.2	16.4	1.54

Remarks.—Guppy (1866, p. 286; 1867, p. 157; 1876, p. 520) confused this Dominican Republic species with *C. barretti* Guppy, 1866 [p. 289, pl. 17, fig. 11] from the early Pliocene Bowden Formation of Bowden, Jamaica, as did Maury (1917, 1925b) and Pilsbry (1922). Gabb (1873, p. 236) also misidentified this species as *C. barretti*, and placed it in the synonymy of *C. reticulata* (Linné, 1767). Olsson (1922, p. 82) rectified the situation by naming the Dominican species *C. mauryae*. A discussion of *C. barretti* is given in the *Appendix* herein.

Ramírez (1950, p. 12, pl. 3, fig. 3; 1956, pp. 12, 18, 19) reported *C. barretti* from the Dominican Republic. However, the identity of the specimen figured cannot be determined from the poor illustration which shows only a dorsal view. Ramírez does not mention columellar dentition. It is probable that the species in question is *C. mauryae*.

Comparisons.—*Cancellaria* (*Cancellaria*) *mauryae* differs from *C.* (*C.*) *guppyi* Gabb, 1873 in having a sharp, unbifurcated adapical columellar fold and in being less globose. A bifid adapical columellar fold is a characteristic of *Cancellaria* sensu stricto, and its absence in this species, which is otherwise much like many Caribbean Neogene species, is notable.

Occurrence.—Río Mao: Cercado Formation (late Miocene): TU 1294 (= Bluff 3 of Maury) and NMB 16915, 16922, 16923, 16927 (all mouth of Arroyo Bajón) (Saunders, Jung, and Biju-Duval, 1986, text-figs. 29, 30, 32).

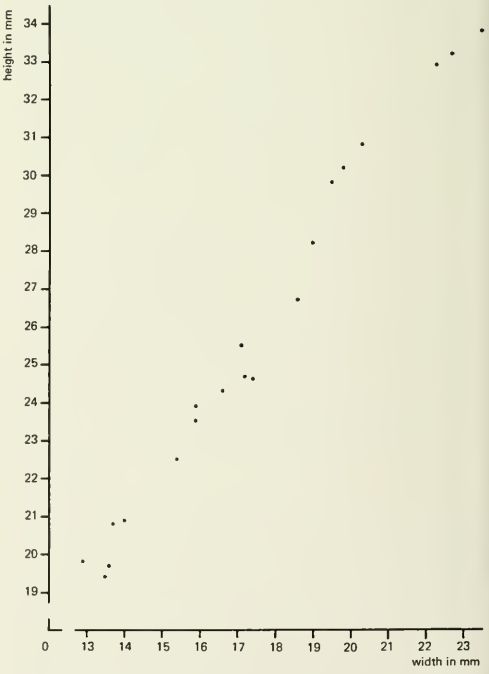
Distribution.—Except for Olsson's (1922, p. 83) report of a single imperfect specimen from Water Cay, Panama (beds of late Miocene or early Pliocene age), the species is not known from outside the Dominican Republic.

Cancellaria (Cancellaria) juncta, new species
Plate 16, figures 10–16; Text-figure 11

Etymology of name.—L. *juncta* = associated.

Description.—Slightly deviated protoconch smooth, prominent, of about two-and-one-half volutions. First teleoconch whorl with evenly spaced collabral ribs and fine spiral cords, the spiral cords quickly becoming equal in size to the axial ribs and forming typical cancellate sculpture with small nodes formed where the cords cross the ribs. Teleoconch of about five whorls, the earlier having evenly cancellate sculpture. On the penultimate whorl the axial ribs lose prominence, appearing more widely and sometimes irregularly spaced on the body whorl which has closely spaced growth lines. Spiral cords on the body whorl also become weak and more numerous than on earlier whorls. Suture slightly impressed. Varices, rarely formed, are indistinct. Prosocline outer lip thin with a distinct stromboid notch. Inner portion of outer lip with about 20 short lirae which do not extend to the edge of the lip. Columella with three folds, the sharp undivided adapical one largest, descending, and overlying the siphonal fasciole. Center fold also descending and sharp. The abapical fold forms the edge of the short siphonal canal, and has a longitudinal crease making it bifid. No umbilicus.

Holotype.—NMB H 17297 (Pl. 16, figs. 10–13).



Text-figure 11.—(Restored) height/width diagram of *Cancellaria* (*Cancellaria*) *juncta*, n. sp.

Dimensions of holotype.—Height, 33.8 mm; width, 23.5 mm.

Type locality.—TU 1358: Río Gurabo, upper part of Cercado Formation: late Miocene (Saunders, Jung, and Biju-Duval, 1986, text-figs. 4–6).

Material.—Nine lots with a total of 45 specimens; some of them juvenile or broken.

Measurements.—The measurements of 20 specimens are plotted in Text-figure 11.

Remarks.—Lateral compression, caused by incremental growth, is found only in very large specimens (over 40 mm) of *C. juncta*. Unfortunately, only incomplete specimens of that size have been found.

Cancellaria juncta is here placed in *Cancellaria* sensu stricto, even though its adapical columellar fold is not divided, due to its apparent close relationship to *C. guppyi* Gabb, 1873 and *C. mauryae* Olsson, 1922.

Comparisons.—Young specimens of *C. juncta* may be distinguished from young *C. guppyi* by their less impressed sutures and proportionately wider apertures. *Cancellaria juncta* differs from *C. guppyi* in having a thinner shell, a wider aperture, an undivided adapical columellar fold, and a proportionately longer aperture. It differs from *C. mauryae* in having a rounded tun-shaped shell that is more strongly constricted behind the siphonal fasciole.

Occurrence.—Río Gurabo: upper part of Cercado Formation (late Miocene): TU 1358, 1359, 1377, and NMB 15909, 15910, 15911, 15912, 15915, 15916 (Saunders, Jung, and Biju-Duval, 1986, text-figs. 4–6).

Distribution.—Not known from outside the Dominican Republic.

Cancellaria (Cancellaria) harrisi Maury, 1917
Plate 17, figures 1–13; Plate 20, figures 4–6; Text-figure 12

Cancellaria harrisi Maury, 1917, p. 64, pl. 10, figs. 9, 10; Ramírez, 1956, p. 25.

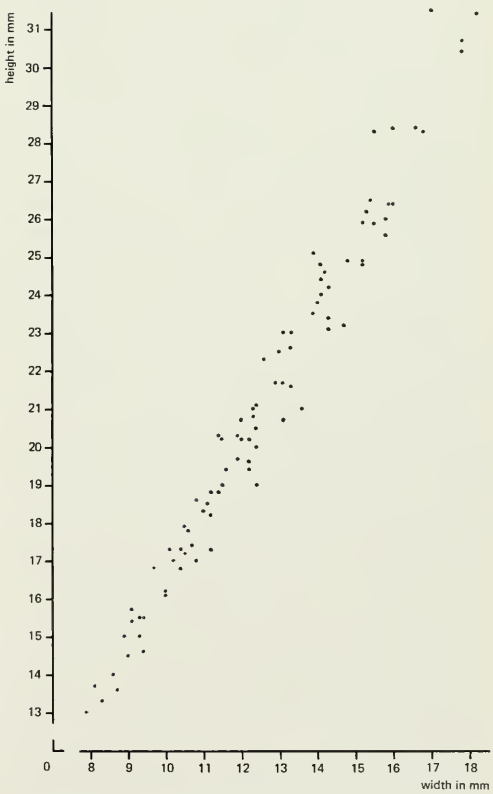
Not *Cancellaria harrisi* Maury. Li, 1930, p. 272, pl. 7, fig. 62 (= *C. balboae* Pilsbry, 1931; Recent).

Description.—Smooth, erect protoconch of two-and-one-quarter to two-and-three-quarters volutions. Teleoconch of about six or seven whorls. Sculpture of axial ribs crossed by spiral cords begins with onset of teleoconch. The prominent axial ribs decrease in number on succeeding whorls. Number of axial ribs on body whorl of adult specimens of identical size ranges from 14 to 20, with as many as 30 on adults in some populations. Spiral cords cross the ribs, forming small nodes at intersections; two or three more prominent spiral cords below the shoulder forming larger nodes, making the teleoconch somewhat coronate. Spiral cords on early whorls coequal; intermediate cords appear on later whorls. On adults there are usually two intermediate spiral cords which are not situated equidistant between the primary cords but crowd against the abapical side of the primary cords. Evidence of rapid episodic growth sometimes indicated by flattened areas on the body whorl at approximately 120° intervals. Suture impressed. Outer lip thin, weakly crenulate, with a distinct stromboid notch. Interior of outer lip with about 15 short lirations which do not extend to lip edge. Columella with three folds, the adapical one overlying the siphonal fasciole being largest, and with distal portion slightly bifid. Abapical fold indistinct, forming the edge of the short, well-defined siphonal canal. Center fold descending, slightly bifid. All folds extend to the lip of the inductura. Umbilicus chink-like.

Holotype.—PRI 28667 (Pl. 17, figs. 1–4).

Dimensions of holotype.—Height, 29.5 mm; width, 17.5 mm.

Type locality.—Maury (1917, p. 65) cited as occur-



Text-figure 12.—(Restored) height/width diagram of *Cancellaria* (*Cancellaria*) *harrisi* Maury.

rences her Zones H and I, Río Cana at Caimito, Dominican Republic. This being too imprecise, we here restrict the type locality to locality TU 1230: Cercado Formation (late Miocene) (Saunders, Jung, and Biju-Duval, 1986, text-fig. 15).

Material.—Twenty-six lots with a total of 528 specimens.

Measurements.—The measurements of 89 specimens are plotted in Text-figure 12.

Remarks.—Although many specimens of *C. harrisi* are in our collections, it is common at only a few localities with most lots consisting of five or fewer specimens. Of the total number studied, 56% are from a single locality (TU 1230), but only five specimens from that lot exceed 23 mm in height.

Cancellaria harrisi was said by Maury (1917, p. 65) to be "the most beautiful of the Dominican Cancellarias." Had she said "the most variable", her comment would be less subjective. The number of axial ribs varies greatly, even within populations. This change in the number of axial ribs has a dramatic effect on the overall appearance of the shell. The shoulder nodes also vary in intensity, giving some shells a coronate aspect and others a round-shouldered appearance.

Olsson (1932, p. 158), in a discussion of *Euclia* Adams and Adams, 1854 (type species: *C. cassidiformis* Sowerby, 1832a [p. 53]), placed *C. harrisi* in that subgenus. This placement was obviously based on the angled shoulder of *C. harrisi*, which seems exaggerated in Maury's figure (the holotype is refigured herein, Pl. 17, figs. 1–4). Marks (1949, p. 460) did not assign *C. harrisi* to a subgenus in his list of species. We prefer to place *C. harrisi* in *Cancellaria* s. s. until more is understood about the relationship between, and the necessity for, such genus-level taxa as *Euclia* and *Pyruclia* Olsson, 1922. For further comments, see discussion under *Pyruclia* [p. 100, herein].

Comparisons.—Young specimens are similar to *C. metuloides* Olsson, 1964 [p. 119, pl. 37, figs. 7, 7a] from the late Miocene Angostura Formation of northwestern Ecuador, but that species has closely packed spiral cords and axial ribs which make the shell appear beaded instead of cancellate. In his discussion, Olsson (1964, p. 120) mentioned the similarity of the Ecuadorian species to a "related undescribed *Cancellaria*" which "occurs in the Miocene beds at Baitoa, Santo Domingo." This is probably a reference to young specimens of *C. harrisi*.

Another species from the Angostura Formation, *Cancellaria maldonadoi* Olsson, 1964 [p. 122, pl. 21, figs. 5, 5a] is close to *C. harrisi*, but differs in being less tabulate and in having fewer and weaker axial ribs. Woodring (1970, pp. 339, 340) considered *C. maldonadoi* to be a nonspinose form of *C. codazzii* Anderson, 1929 [p. 116, pl. 14, figs. 4–7] from the Tubará Group (late Miocene or early Pliocene) of northern Colombia and placed it in the synonymy of *C. codazzii*. We consider the two to be distinct species.

Cancellaria hettneri Anderson, 1929 [p. 114, pl. 10, figs. 5, 6] from the middle part of the Tubará Group (late Miocene or early Pliocene) of northern Colombia was stated by Anderson to be "allied to *C. harrisi* Maury, but is more coarsely sculptured, larger, and more spinose." Woodring (1970, pp. 339, 340) justifiably placed *C. hettneri* in the synonymy of *C. codazzii* Anderson, a species more closely related to the Recent *C. cassidiformis* than to *C. harrisi*.

Occurrence.—This species is recorded from the following areas and localities (for locations see Saunders, Jung, and Biju-Duval, 1986, text-figs. 5, 15, 16, 21, 38):

Río Cana: upper part of Cercado Formation (late Miocene): TU 1230, 1282, 1301, and NMB 16835, 16837, 16838, 16839, 16842, 16844, 16852, 16854, 16855, 16856, 16986, 17003. Gurabo Formation (latest Miocene and early Pliocene): TU 1354 and NMB 16818, 16825, 16828, 16866, 16867, 16869.

Río Gurabo: Gurabo Formation (latest Miocene): TU 1211.

Río Yaque del Norte: early Pliocene: NMB 17268 (near La Barranca).

Río Verde: N. 18, early Pliocene according to Akers (*in* Vokes, 1989): TU 1250.

Santiago de los Caballeros: early Pliocene: TU 1206.

Distribution.—Not known from outside the Dominican Republic.

Cancellaria (Cancellaria) rowelli Dall, 1896
Plate 18, figures 1–6; Plate 20, figures 7–9; Text-figure 13

Cancellaria rowelli Dall *in* Guppy and Dall, 1896, p. 307, pl. 29, fig. 1; Maury, 1917, p. 63, pl. 10, fig. 2; Pilsbry, 1922, p. 333.

? *Cancellaria rowelli* Dall. Olsson, 1922, p. 84, pl. 6, fig. 7; Weisbord, 1929, p. 50, pl. 6, figs. 9, 10.

? *Cancellaria* (*Cancellaria*) cf. *rowelli* Dall. Olsson, 1932, p. 156

? *Cancellaria* (*Cancellaria*) aff. *rowelli* Dall. Jung, 1965, p. 551, pl. 75, figs. 7, 8.

Description.—Protoconch smooth, of almost two-and-one-half volutions. Teleoconch of about seven whorls. Ornamentation begins with the formation of strong axial ribs at the onset of the teleoconch, with spiral cords being formed between the ribs before the onset of the second teleoconch whorl. Shell acute; suture impressed. On the body whorl there is a narrow, smooth channel between the shoulder and the suture. Sculpture of distinct axial ribs, about 35 on the body whorl. Fine spiral cords, of differing sizes, occur between the ribs, crossing them only on the abapical half

of the body whorl, and at the shoulder where two or three are larger than others and form nodes where they cross axial ribs. Outer lip thin with about 12 short lirae within, which do not extend to the edge of the lip. Evidence of a shallow stromboid notch may be seen on the axial sculpture. Columella with three folds, the adapical one largest, overlying the siphonal fasciole. The descending abapical fold forms the edge of the short siphonal canal and parallels the center fold. Short secondary folds occur on the edge of the inductura.

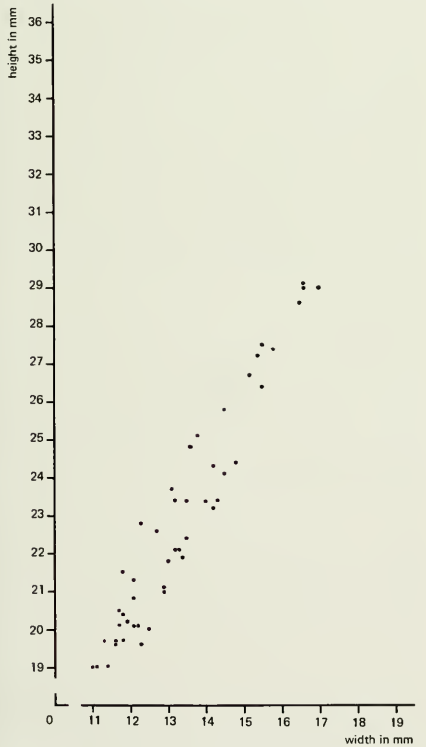
Holotype.—USNM 113762 (Pl. 18, figs. 1–3).

Dimensions of holotype.—Height, 26.1 mm; width, 14.0 mm.

Type locality.—Potrero, Río Amina, Dominican Republic. The type locality cannot be restricted at the moment because no material is available from the type area.

Material.—Eighteen lots with a total of 202 specimens.

Measurements.—The measurements of 49 specimens are plotted in Text-figure 13.



Text-figure 13.—(Restored) height/width diagram of *Cancellaria* (*Cancellaria*) *rowelli* Dall.

Remarks.—Maury (1917, p. 63, pl. 10, fig. 2) only published a copy of the original figure; she neither discussed the species nor gave any locality data. This most probably means that her field party did not collect the species at all.

Olsson (1922, p. 84, pl. 6, fig. 7) reported two specimens of *C. rowelli* from the East Grape Creek, Costa Rica (age of beds not determined). His figured specimen (PRI 20964) has a thickened terminal varix and generally coarser sculpture than specimens from the Dominican Republic, few of which reach the size of the Costa Rica specimens. It is possible that these two Costa Rica specimens are adults of *C. anomoia* Woodring, 1970 [p. 334, pl. 52, figs. 1, 2] from the lower part of the Gatun Formation (late Miocene) of Panama.

Weisbord (1929, p. 50, pl. 6, figs. 9, 10) reported a single specimen of *C. rowelli* from the Department of Atlántico, Colombia, from beds of undetermined age. This specimen (PRI 22950) has coarse sculpture and is possibly conspecific with the specimens from Costa Rica mentioned above.

Olsson (1932, p. 156) compared some poorly preserved material from the Montera Formation (age uncertain), Bayovar, Peru with *C. rowelli*, but pointed out differences which kept him from identifying his specimens as such, and stated that the Peruvian specimens may represent a different species.

Jung (1965, p. 551, pl. 75, figs. 7, 8) compared specimens from the late early Miocene Cantaure Formation of the Paraguaná Peninsula, Venezuela with *C. rowelli*, but pointed out consistent differences between them and Dominican specimens.

As none of the above cited records can be determined with certainty to be *C.* (*C.*) *rowelli*, they are omitted from our distribution records.

Comparisons.—*Cancellaria rowelli* was compared by Dall (1896, p. 307), Maury (1917, p. 63), and Pilsbry (1922, p. 333) with the living Panamic–Pacific *C. urceolata* Hinds, 1843 [p. 47]. It differs from that species in having a more rounded body whorl, in having finer sculpture, and in lacking an angled shoulder.

Cancellaria rowelli differs from *C. harrisi* Maury in having less prominent axial ribs, and in being higher-spired. Also, in *C. rowelli*, not all of the spiral cords rise over the axial ribs.

Occurrence.—As mentioned above, no material from the type area of this species is in our collections. All the studied specimens have been collected from the late early to early middle Miocene Baitoa Formation of the López section on Río Yaque del Norte (Saunders, Jung, and Biju-Duval, 1986, p. 30, text-figs. 21, 25), the only exception being locality TU 1226. Locality TU 1226 is situated along the cliff on Río Yaque del Norte, 500 m north of the bridge at the village of

Baitoa (Saunders, Jung, and Biju-Duval, 1986, text-figs. 21, 28). The upper part of the cliff is inaccessible; it is made up of beds of the Baitoa Formation, which unconformably overlie beds of the Tabera Group. The fossils from locality TU 1226 are from the Baitoa Formation; they were therefore not collected from outcrops, but picked up along the base of the cliff.

The López section has yielded material from the following localities: TU 1364, NMB 16935, 16936, 16938, 16940, 16942, 17265, 17280, 17281, 17282, 17283, 17284, 17286, 17287, 17288, 17289, 17290.

Distribution.—Except for the questionable reports listed under *Remarks* above, the species is not known from outside the Dominican Republic.

Subgenus **PYRUCLIA** Olsson, 1932

Pyruclia Olsson, 1932, p. 160.
Peruclia Pilsbry and Olsson, 1941, p. 24 (error for *Pyruclia*).

Type species (by original designation).—*Cancellaria solida* Sowerby, 1832a. Recent, Panamic–Pacific Province.

Diagnosis.—Shell usually of large size, pyriform. Sculpture present only on early whorls; body whorl smooth or predominantly so. Columella with two primary folds and a distinct siphonal fold. Of the two primary folds, the adapical one is much the larger and on large specimens is sometimes broadly divided, giving the appearance of an additional fold. This division is not strictly bifid as in *Cancellaria* s. s., but is often widely U-shaped or shelved. Non-umbilicate.

Remarks.—There are a number of nominal species of medium-sized to large cancellariids with sculptured early whorls and a smooth body whorl in the Neogene Caribbean faunal Province, and living in the Panamic–Pacific Province. They have similar characters, differing primarily in shape, ranging from pyriform to barrel-shaped. The pyriform species can immediately be placed in *Pyruclia*, the subgenus erected for them. Those that are not pyriform cannot be placed, with any degree of certainty, in any named genus-level group.

Some shells of similar shape differ in the number of volutions on which surface ornamentation persists, a difference which appears to be consistent within each lot. Although this seems to be a minor difference, it is thought advisable, in view of possible stratigraphic importance, to retain these as separate taxonomic units until more is known about their mutual relationship.

Those species with sculpture on the early whorls and a smooth body whorl are:

Cancellaria telemba Olsson, 1964 [p. 121, pl. 21, fig. 4; Angostura Formation, late Miocene, Ecuador]. This species can be distinguished by its high spire. The unnamed species figured by Marks (1949, pl. 78, fig. 9), tentatively referred to *C. telemba* by Olsson, is a low-spired, barrel-shaped shell, the specific identity of which has not been determined.

Cancellaria macneili Mansfield, 1937 [p. 609, pl. 85, figs. 1, 4; Choctawhatchee Formation, late Miocene, Florida] is similiar to *C. telemba*, with three or four spiral cords on the shoulder and numerous spiral cords on the anterior portion of the body whorl.

Cancellaria lacondamini Olsson, 1964 [p. 121, pl. 21, figs. 1–1c; Picaderos Formation (but listed under *Borbon Formation* on p. 11), late Miocene or early Pliocene, Ecuador]. This is a massive, low spired, pyriform species which is easily separable from the others discussed here.

Cancellaria scheibei Anderson, 1929 [p. 115, pl. 10, figs. 1–4; Usiacuri, Colombia; Tubará Group, late Miocene or early Pliocene]. This is also a large species, but it has a deeper and wider sutural channel than the other species.

Cancellaria spatiosa Nelson, 1870 [p. 191; Tumbes Formation, late Miocene, Zorritos, Peru]. This is another large species which is similar to *C. scheibei*.

Cancellaria diadela Woodring, 1970 [p. 338, pl. 53, figs. 7, 9; upper part of Gatun Formation, Panama; early Pliocene]. This species is close to *C. scheibei* in shape but differs in having an extremely low spire.

Cancellaria auriculaperta Vokes, 1938 [p. 22, figs. 19, 20; Springvale, Trinidad; Springvale Formation, early Pliocene]. Rutsch (1942, p. 163) placed this in the synonymy of *C. cibarcola* Anderson, 1929, but it differs from that species in several aspects, one of which is its earlier loss of ornamentation. Woodring (1970, p. 338) recognized that Rutsch's synonymy was incorrect.

Cancellaria pycta Olsson, 1964 [p. 122, pl. 21, figs. 3, 3a; Angostura Formation, late Miocene, Ecuador] was considered to be a subspecies of *C. cibarcola* by Woodring (1970, p. 338). Woodring had two species combined as *C. cibarcola* (see discussion under *C. cibarcola* below), and the smaller of the specimens he figured differs from *C. pycta* only in the persistence of the sculpture.

Cancellaria laevescens Guppy, 1866 [p. 289, pl. 17, fig. 12; Bowden Formation, early Pliocene, Jamaica] was reported from the Dominican Republic by Maury (1917, p. 64, pl. 10, fig. 6) and Pilsbry (1922, p. 333) from specimens collected by Gabb. These Dominican Republic specimens are *Cancellaria* (*Pyruclia* ?) *uva*, n. sp. *Cancellaria* (*Pyruclia* ?) *laevescens* differs from most species discussed here in having strong spiral and axial sculpture persisting through the penultimate whorl. For additional data on *C.* (*P.* ?) *laevescens*, see the *Appendix* herein.

Cancellaria laevescens portoricana Maury, 1920 [p. 69,

pl. 7, fig. 10; Quebradillas, Puerto Rico; late Miocene or early Pliocene]. Described from an artificial cast of an external mold, this elongate shell cannot be identified with any of the species listed herein. See discussion under *C.* (*P.* ?) *laevescens* in the *Appendix* herein.

Cancellaria casicalva Marks, 1949 [p. 464, pl. 78, figs. 3, 10; Daule Formation, late Miocene, Ecuador] was described with the comment that "the subgeneric allocation is not known." In general outline it resembles *C. pycta* Olsson, but differs in having a higher spire and in having two spiral bands which persist onto the body whorl.

Cancellaria schucherti Olsson, 1932 [p. 162, pl. 17, figs. 3, 4; Tumbes Formation, late Miocene, Peru] is similar to the Recent *C. obesa* Sowerby, 1832a. It was considered to be a subspecies of that species by Pilsbry and Olsson (1941, p. 21) who placed *C. schucherti* in *Cancellaria* s. s. Olsson listed his description of the species immediately following his description of the genus *Pyruclia* Olsson, 1932 and the listing of *C.* (*P.*) *spatiosa* Nelson, 1870. However, he did not assign it to a subgenus.

Cancellaria cibarcola Anderson, 1929 [p. 116, pl. 14, figs. 1–3; Cibarco, Colombia; Tubará Group, probably late Miocene] is close to *C. auriculaperta*. Woodring (1970, p. 338, pl. 52, figs. 9, 10; pl. 53, figs. 8, 10–12) combined two species from the lower part of the Gatun Formation of Panama (late Miocene) as *C. cibarcola*, neither of which are Anderson's species. The differences between the two species are consistent. The larger (Woodring, 1970, pl. 53, figs. 8, 10–12) has sculpture only on the first three teleoconch whorls and the plications on the inner portion of the outer lip are either weak or entirely absent. The smaller (Woodring, 1970, pl. 52, figs. 9, 10) has sculpture persisting through the fifth teleoconch whorl, has strong lirations inside the outer lip, and is less broadly constricted anterior to the siphonal fasciole. The relationship of these two species with others in this complex has not been determined. The smaller of the two species is obviously closely related to *C.* (*P.* ?) *uva*, n. sp.

Cancellaria solida Sowerby, 1832a [p. 50], the type species of *Pyruclia*, is uncommon offshore from the Gulf of California to Peru (Keen, 1971, p. 654). It was reported from the Pliocene of Ecuador by Pilsbry and Olsson (1941, p. 24) and by Olsson (1964, p. 120).

The living *Cancellaria bulbulus* Sowerby, 1832a [p. 55] has a limited range extending from El Salvador (Hernández, 1979, p. 204) to Panama (Keen, 1971, p. 654). It differs from *C. solida* in having a more attenuate spire, and its siphonal fasciole is either weak or absent. This species was also reported from the Pliocene of Ecuador by Pilsbry and Olsson (1941, p. 24).

The living Panamic–Pacific species *Cancellaria obesa* Sowerby, 1832a [p. 52] and *Cancellaria ovata* Sowerby, 1832a [p. 53] belong in *Cancellaria* s. s., but are mentioned here as both have almost smooth body whorls.

Cancellaria (Pyruclia ?) uva, new species
Plate 18, figures 7–9

Cancellaria laevescens Guppy. Guppy, 1866, p. 286 (list; not p. 289; Guppy, 1867, p. 167 (list, in part); Gabb, 1873, p. 236 (list); Guppy, 1876, p. 520; Maury, 1917, p. 64, pl. 10, fig. 6; Pilsbry, 1922, p. 333. Not of Guppy, 1866.

Etymology of name.—L. *uva* = grape.

Description.—Protoconch consists of a little more than two-and-one-half volutions. Teleoconch of about six or seven whorls. Sculpture on spire whorls of closely packed spiral cords and axial ribs of about equal size that form nodes at their intersections, making the sculpture appear pustulate instead of cancellate. The axial ribs disappear at the end of the penultimate whorl. The spiral cords weaken toward the end of the penultimate whorl and on the body whorl are barely discernible except in the depression above the siphonal fasciole. Suture impressed. Outer lip prosocline with a shallow stromboid notch and about 14 strong lirations within, which do not extend deeply into the aperture. Columellar callus thin but distinct. Body whorl constricted above the siphonal fasciole. Columella with three folds, the almost horizontal one largest, rarely slightly bifid, overlying the siphonal fasciole. The center fold and abapical fold descend sharply, the latter forming the edge of the short, well-defined anterior canal. Short secondary folds sometimes present on outer edge of inductura.

Holotype.—NMB H 17305 (Pl. 18, figs. 7–9).

Dimensions of holotype.—Height, 30.0 mm; width, 19.5 mm.

Type locality.—Locality NMB 17275: Río Yaque del Norte, near mouth of Arroyo López; probably late Miocene (Saunders, Jung, and Biju-Duval, 1986, p. 30, text-figs. 21, 26, pl. 8, fig. 5).

Material.—One lot containing four specimens, three of which are in good condition.

Measurements.—

	height (mm)	*width (mm)*	*h/w ratio*
NMB H 17305 (holotype) [Pl. 18, figs. 7–9]	30.0	19.5	1.54
NMB H 17306 (paratype)	28.9	18.7	1.55
NMB H 17307 (paratype)	27.2	18.3	1.49

Remarks.—Specimens from the Gabb collection were cited by Maury (1917, p. 64, pl. 10, fig. 6) and Pilsbry (1922, p. 333) as *C. laevescens* Guppy, 1866. The specimen figured by Maury (PRI 28664) and the ones mentioned by Pilsbry (ANSP 2985; three specimens) have been examined and prove to be *C. uva*. *Cancellaria laevescens* is discussed in detail in the *Appendix* herein.

Comparisons.—*Cancellaria uva* differs from *C. laevescens*, with which it has been confused, in being smaller, in having weaker and more numerous axial ribs, in having a more rounded and less tabulate outline, and in being less constricted above the siphonal fasciole. Also, strong sculpture persists on *C. laevescens* until its shell is larger than that of *C. uva*. It differs from the smaller specimen from the lower part of the Gatun Formation (late Miocene) figured by Woodring (1970, pl. 52, figs. 9, 10; not pl. 53, figs. 8, 10–12) as *C. cibarcola* Anderson, 1929, in having ornamentation persisting through the penultimate whorl.

Occurrence.—Known only from locality NMB 17275, the type locality of the species. The provenance of the specimens referred to by Maury and by Pilsbry is not known.

Distribution.—Not known from outside the Dominican Republic.

Subgenus **SVELTIA** Jousseaume, 1887

Sveltia Jousseaume, 1887, p. 214.

Type species (by original designation).—*Sveltia varicosa* [*sic*] Brocchi [= *Voluta varricosa* Brocchi, 1814]. Pliocene, Italy.

Diagnosis.—Shell of small to large size, normally high-spired with strong axial ribs which sometimes form spines at the shoulder. Shoulder usually angled. Columella with two folds, the adapical one slightly the larger, with a third incipient fold forming the edge of a short anterior canal. A chink-like umbilicus is present in most adults, as is a moderate parietal callus.

Remarks.—*Sveltia* is represented in the Tertiary faunas of Europe, Chile, Ecuador, and Central America. In the Recent fauna it is represented off the West Coast of Africa and the West Coast of Central America. The species described below is the first Caribbean record of *Sveltia*, which should be added to the list of paciphile genera.

Cancellaria (Sveltia) inquilinus, new species
Plate 19, figures 1–8; Plate 20, figures 10–12

Etymology of name.—L. *inquilinus* = temporary inhabitant.

Description.—Protoconch smooth, deviated, of one-and-three-quarters volutions. Teleoconch of about five shouldered whorls. Axial sculpture of strong collabral ribs, evenly spaced on early whorls but becoming less numerous on later whorls; about 11 ribs on penultimate whorl and nine or less on the body whorl. Axial ribs sometimes enlarged as varices. Spiral sculpture consists of cords of varying strength; about six primary cords on body whorl with three or four weaker cords in each interspace. The primary cords form sharp nodules where they cross the axial ribs; spiral cord on shoulder stronger than others and forming a short spine on each rib. Shoulder rounded back to an impressed suture. Aperture ovate. Slightly prosocline outer lip thickened with strong interior lirations which do not extend to the edge of the lip. Columella almost straight with two strong folds, the adapical one stronger; a third fold forms the edge of the short but distinct anterior canal. Columellar callus well-developed, sometimes not completely attached to the body whorl creating a pseudoumbilicus. Umbilicus normally chink-like.

Holotype.—NMB H 17309 (Pl. 19, figs. 5–8).

Dimensions of holotype.—Height, 16.6 mm; width, 10.2 mm.

Type locality.—Locality TU 1227, Arroyo Zalaya, Dominican Republic. Early Pliocene (Saunders, Jung, and Biju-Duval, 1986, text-fig. 36 and table 3).

Material.—Six lots containing 12 specimens.

Measurements.—(complete specimens only):

	height (mm)	*width (mm)*	*h/w ratio*
NMB H 17309 (holotype) [Pl. 19, figs. 5–8]	16.6	10.2	1.63
NMB H 17308 [Pl. 19, figs. 1–4]	16.7	10.8	1.55
unnumbered specimen, from loc. TU 1227	8.2	5.1	1.61
unnumbered specimen, from loc. TU 1250	17.8	9.3	1.91
unnumbered specimen, from loc. TU 1250	12.0	8.0	1.50
unnumbered specimen, from loc. TU 1250	10.3	6.4	1.61

Remarks.—The Recent Panamic *C. centrota* Dall, 1896 [p. 13; Dall, 1908, p. 295, pl. 1, fig. 8] and *C. gladiator* Petit, 1976 [p. 35, pl. 1, fig. 2] live at a depth of 75 m or greater. Recent specimens of the West African *C. lyrata* (Brocchi, 1814) [p. 311, pl. 3, fig. 6] are recorded only from greater depths, the shallowest recorded being 145 m (Barnard, 1959, p. 17.)

Of the 12 specimens available, six are well-preserved adults, the others being juvenile or broken. Localities NMB 17267 and TU 1357 are each represented by a single badly broken specimen.

Comparisons.—This new species is closest to *C. zahni* Böse, 1910 [p. 239, pl. 13, fig. 16] from beds of probably late Miocene or early Pliocene age of the Isthmus of Tehuantepec. In comparison with *C. inquilinus*, n.

sp., the Mexican species is more angular, has a deeper suture, possesses fewer axial ribs on early whorls, and is more umbilicate. The specimen figured by Toula (1911, pl. 29, fig. 12) as a "n. var." of *C. zahni* differs from the Dominican species in being proportionally wider at the shoulder and in being less constricted behind the siphonal fasciole. *Cancellaria inquilinus*, n. sp., possesses shoulder spines proportional in size to those of *C. centrota*, but differs in most other respects.

Occurrence.—This species is known from the following six localities:

TU 1227 (type locality): Arroyo Zalaya, early Pliocene.
TU 1250: Río Verde, N. 18, early Pliocene according to Akers (*in* Vokes, 1989); for location see Saunders, Jung, and Biju-Duval, 1986, text-figs. 3, 38.
TU 1357: Río Yaque del Norte, bluff on west side, just above new (1980) water plant at south edge of Bella Vista, 3 km (by road) south of bridge at Santiago de los Caballeros. Early Pliocene.
NMB 17266 and 17267: La Barranca on Río Yaque del Norte. Early Pliocene (Saunders, Jung, and Biju-Duval, 1986, text-figs. 21, 24 and table 3).
NMB 17271: Arroyo Zalaya: early Pliocene (Saunders, Jung, and Biju-Duval, 1986, p. 34, text-fig. 36).

Distribution.—Not known from outside the Dominican Republic.

Subgenus **BIVETIELLA** Wenz, 1943

Bivetia Jousseaume, 1887, p. 193, *non* p. 163.

Type species (by original designation).—*Cancellaria similis* Sowerby, 1833. Recent, northwest Africa.

Bivetiella Wenz, 1943, p. 1356 (new name for *Bivetia* Jousseaume, 1887 [p. 193, *non* p. 163]).

Type species (by original designation of *Bivetia* Jousseaume, 1887 [p. 193].—*Cancellaria similis* Sowerby, 1833.

Bivetiella Marks, 1949, p. 456.

Type species (by original designation).—*Cancellaria similis* Sowerby, 1833. Recent, northwest Africa.

Diagnosis.—Shell of medium size, stout, with a broad body whorl. Sculpture usually strongly and regularly cancellate. Varices present. Prosocline outer lip everted with a distinct stromboid notch. Inner portion of outer lip lirate. Columella with three folds, the adapical fold being sharp and the center and abapical folds either bifurcate or incipiently so. Umbilicus narrow or chink-like.

Remarks.—Jousseaume's 1887 monograph on Cancellariidae was published in parts. He unfortunately used the name *Bivetia* for two distinct genus-level groups. His first usage (p. 163) of *Bivetia* was in the description of *B. mariei* Jousseaume, 1887 (= *C. indentata* Sowerby, 1832a) which established that species as the type species of *Bivetia* by monotypy. One month later he described the genus *Bivetia*, naming *C. similis* Sowerby, 1833 as type species, and not even mentioning *B. mariei* in his list of included species.

Recognizing that Jousseaume had used *Bivetia* in two different senses, Wenz (1943, p. 1356) proposed the replacement name *Bivetiella*. Marks (1949, p. 456) came to the same conclusion and proposed exactly the same name used six years earlier by Wenz. It should be mentioned here that in 1949 there were only one or two copies of Wenz's work in the United States, and it was not available to Marks. That they should both propose the same name is not surprising, as *Bivetia* (of Jousseaume's second usage) was derived from "*Le Bivet*", Adanson's (1757, p. 123) name for the type species, and both Wenz and Marks evidently wished to retain this association.

Three Dominican species are here placed in the subgenus *Bivetiella*. Jung (1965, p. 549), in discussing his placement of *C. epistomifera* Guppy, 1876 in *Cancellaria* s. s., stressed the differences in the relative strength and number of axial ribs between the tropical American species and the type species. Some species from the later Tertiary of Europe, almost certainly ancestral to *C. similis*, exhibit sculptural patterns similar to *C.* (*B.*) *epistomifera*. The primary consideration for placement in *Bivetiella* is, however, the columellar dentition. In *Cancellaria* s. s. the adapical columellar fold is almost always wide and bifurcate. In *Bivetiella*, the adapical fold is sharp, but the central and the abapical fold bordering the siphonal canal are either bifurcate or incipiently so. Also, species of *Bivetiella* have marked varices which do not occur in species of *Cancellaria* s. s.

Cancellaria (Bivetiella) gabbiana
Pilsbry and Johnson, 1917
Plate 19, figures 9–15

Cancellaria gabbiana Pilsbry and Johnson, 1917, p. 163; Pilsbry, 1922, p. 334, pl. 22, fig. 12.

Description.—Smooth, slightly bulbous protoconch of about two volutions. Teleoconch of about six whorls. Spiral sculpture of raised cords, five visible on penultimate whorl and about 15 on body whorl. Suture deeply impressed and narrowly canaliculate. Slightly rounded axial ribs, about 16–18 on body whorl. Varices present, weak on early whorls, occurring at approximately 120° intervals. Outer lip somewhat everted, thickened by terminal varix, flaring abapically. Shallow stromboid notch. Aperture wide, ovate, with about

14 sharp interior lirations which do not extend to the margin of the lip, and extend inward only a short distance. Parietal callus thin. Columella with three folds, the sharp adapical one being largest and almost horizontal; the center fold shorter and broader, descending sharply; the abapical fold borders the siphonal canal adaxially but becomes parallel to the center fold on the columellar callus. Short secondary folds and tubercules present on columellar callus. Umbilicus chink-like.

Lectotype (here designated).—ANSP 3288. This is the specimen figured by Pilsbry (1922, pl. 22, fig. 12) and refigured here (Pl. 19, figs. 9–11).

Dimensions of lectotype.—Height, 24.5 mm; width, 19.8 mm.

Type locality.—Santo Domingo. No locality data were given by Pilsbry and Johnson, and the type locality is here restricted to locality NMB 16938: López section on Río Yaque del Norte, Dominican Republic (Baitoa Formation, late early to early middle Miocene).

Material.—Known only from the lectotype, one paralectotype, and two specimens from locality NMB 16938.

Measurements.—

	height (mm)	*width (mm)*	*h/w ratio*
ANSP 3288 (lectotype) [Pl. 19, figs. 9–11]	24.5	19.8	1.24
ANSP 67545 (paralectotype)	25.2	19.2	1.31
NMB H 17311 [Pl. 19, figs. 12–15]	24.2	19.8	1.22
unnumbered specimen, from loc. NMB 16938	26.3	21.4	1.23

Remarks.—The wide, flaring aperture and squat form of *C. gabbiana* distinguish it from its congeners.

This species is evidently quite rare, as only four specimens are known. It was not present in Maury's collections.

Occurrence.—Known only from locality NMB 16938: López section on Río Yaque del Norte; Baitoa Formation (late early to early middle Miocene (Saunders, Jung, and Biju-Duval, 1986, p. 30, text-fig. 21).

Distribution.—Not known from outside the Dominican Republic.

Cancellaria (Bivetiella) epistomifera Guppy, 1876
Plate 21, figures 1–11; Text-figure 14

Cancellaria moorei Guppy. Guppy, 1866, p. 286 (list, in part; not p. 289); Guppy, 1867, p. 157 (list, in part); Gabb, 1873, p. 236; Guppy, 1876, p. 520; Dall, 1903, p. 1583 (list, in part). Not of Guppy, 1866.

Cancellaria epistomifera Guppy, 1876, p. 520, pl. 28, fig. 9; Maury, 1917, p. 63, pl. 10, figs. 3, 4, 5 (in part; fig. 5 only; figs. 3, 4 = *C. (B.) bajonensis*, n. sp.); Pilsbry, 1922, p. 333, pl. 22, fig. 13; Pflug, 1961, p. 52, pl. 14, figs. 1–9; Ramírez, 1950, p. 22, pl. 3, fig. 4; Ramirez, 1956, pp. 12, 18, 19, 23.

Not *Cancellaria epistomifera* Guppy. Cossmann, 1913, p. 53, pl. 4, figs. 5, 6 (= *C. dariena* Toula, 1909).

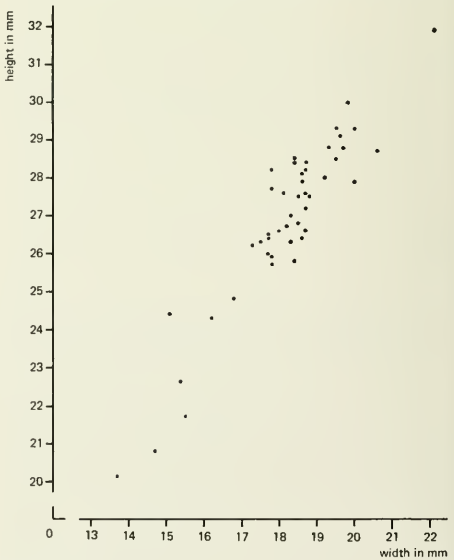
? *Cancellaria epistomifera* Guppy. Olsson, 1922, p. 83 (?= *C. epistomifera lipara* Woodring, 1970, p. 337, pl. 52, figs. 7, 8; *non C. lipara* Woodring, 1951; = *C. epistomifera sathra* Woodring, 1973, p. 481).

Not *Cancellaria epistomifera* Guppy. Maury, 1925a, p. 193, pl. 35, fig. 7 (= *C. montserratensis* Maury, 1925a).

Not *Cancellaria epistomifera* Guppy. Maury, 1925b, pl. 9, fig. 11; (= *C. (B.) bajonensis*, n. sp.).

Not *Cancellaria epistomifera* Guppy. Jung, 1965, p. 548, pl. 75, figs. 1–2.

Description.—Protoconch slightly mammillated, of just over two-and-one-half volutions. Teleoconch of about six convex whorls, rounded at the periphery. Sculpture starts with a few weak spiral cords which are soon crossed by prosocline axial ribs. On later whorls the axial ribs, and the spiral cords which cross over them, are about equal in strength except on the later varices where the axial ribs are replaced by crowded growth lines. Development of varices variable, usually beginning on the third or fourth teleoconch whorl, with those on early whorls usually being weak. Varices spaced at approximately 120° increments. Penultimate whorl with five or six spiral cords in evidence, which are sometimes doubled on the sharply rounded shoulder behind which there is a narrow, smooth, channeled area abaxial to the deeply impressed suture. Prosocline outer lip strongly everted at the deep stromboid notch. Interior of outer lip with over a dozen strong lirations which do not extend deeply within. Parietal callus weak.



Text-figure 14.—(Restored) height/width diagram of *Cancellaria (Bivetiella) epistomifera* Guppy.

Abapical portion of columellar lip partially obscuring the narrow umbilicus. Columella with three folds, the adapical one almost horizontal and undivided. The center fold is descending, sometimes slightly bifurcate. The bifurcate abapical fold borders the siphonal canal adaxially but on the columellar callus swings out to the edge of the inductura, parallel to the center fold. Short secondary folds and tubercules usually present on the columellar callus.

Lectotype.—BMNH G 83955 (figured herein). Selected by Pflug (1961, p. 53).

Dimensions of lectotype.—Height, 28.3 mm; width, 19.7 mm.

Type locality.—Yaque River (original label; see also Heneken, 1853, fig. 1), Dominican Republic. This information is rather vague. The material of *C.* (*B.*) *epistomifera* used for this paper was collected from several sections (see under *Occurrence*) including the Río Yaque del Norte section. However, specimens from that area are extremely scarce, and for this reason it is not advisable to restrict its type locality to a well-defined locality at this time.

Material.—Thirty-seven lots consisting of over 375 specimens, many juvenile or broken, but a large number of complete adult specimens.

Measurements.—The measurements of 46 specimens are plotted in Text-figure 14.

Remarks.—There has been considerable confusion regarding the Caribbean and Panamic Tertiary species of *Bivetiella* Wenz, 1943, probably due to the scarcity of sufficient material for comparison. Maury (1917) had both *C.* (*B.*) *epistomifera* and *C.* (*B.*) *bajonensis*, n. sp. and combined them. She divided her specimens into two sets: (1) with small protoconch; (2) with large protoconch. On the advice of Dall, she considered set (1) to be true *C. epistomifera* and suggested that set (2) might be a variety (her fig. 5 is indicated as "variety" on the plate caption). Unfortunately, this arrangement is reversed from the actual situation. Maury's set (1), figured by her as *C. epistomifera* (pl. 10, figs. 3, 4; PRI 28662), is actually *C.* (*B.*) *bajonensis*. Maury's figured "variety" (pl. 10, fig. 5; PRI 28663), is *C.* (*B.*) *epistomifera* Guppy.

Jung (1965, pp. 548–550, pl. 75, figs. 1–3) identified one adult and nine immature specimens from the late early Miocene Cantaure Formation of the Paraguaná Peninsula, Venezuela as *C. epistomifera* Guppy. The adult specimen is much more attenuate than any specimens of *C.* (*B.*) *epistomifera* we have examined from the Dominican Republic and, as pointed out by Jung, it has secondary spiral cords on the body whorl. For these reasons, we do not consider the Venezuelan specimens to be conspecific with *C.* (*B.*) *epistomifera*.

Woodring (1970, pp. 335–337) referred a number of small cancellariids to *C. epistomifera dariena* Toula, 1909, and *C. epistomifera lipara* Woodring, 1970 (*non C. lipara* Woodring, 1951; = *C. epistomifera sathra* Woodring, 1973, p. 481). It is unlikely that all of the varieties figured by Woodring actually represent these two subspecies. However, none of the specimens from the Gatun Formation (late Miocene and early Pliocene) has an enlarged protoconch.

Guppy (1866, p. 286; 1867, p. 157; 1876, p. 520) evidently confused *C. moorei* Guppy, 1866 [p. 289, pl. 17, fig. 7] from the Bowden Formation (early Pliocene) of Jamaica and *C.* (*B.*) *epistomifera*, as did Gabb (1873, p. 236). Their listing was repeated by Dall (1903, p. 1583). *Cancellaria moorei* is discussed in the *Appendix* herein.

Comparisons.—*Cancellaria* (*Bivetiella*) *epistomifera* differs from the two subspecies recognized by Woodring (see above under *Remarks*) and other species of *Bivetiella* in having a large bulbous protoconch.

Occurrence.—This species is recorded from localities of the following sections (from west to east):

Río Cana (Saunders, Jung, and Biju-Duval, 1986, text-figs. 15, 16): Cercado Formation (late Miocene): NMB 16857; lower part of Gurabo Formation (latest Miocene): NMB 16821.

Río Gurabo (Saunders, Jung, and Biju-Duval, 1986, text-figs. 4–6): upper part of Cercado Formation (late Miocene): TU 1359 and NMB 15898, 15899, 15902, 15903, 15904, 15905, 15906, 15907, 15910, 15911, 15912, 15915. Gurabo Formation (late Miocene and barely into the early Pliocene): TU 1210, 1211, 1212, 1213, 1214, 1215, 1231, 1278, and NMB 15804, 15809, 15813, 15816, 15817, 15818, 15868.

Río Mao (Saunders. Jung, and Biju-Duval, 1986, text-fig. 29): late Miocene: TU 1293 (= Bluff 1 of Maury); possibly early Pliocene: TU 1225 and NMB 16801.

Río Amina (Saunders, Jung, and Biju-Duval, 1986, text-figs. 34, 35): probably late Miocene: TU 1219, 1220.

Río Yaque del Norte (Saunders, Jung, and Biju-Duval, 1986, text-figs. 21, 24, table 3): Baitoa Formation (late early to early middle Miocene): TU 1364 (López section) and early Pliocene: NMB 17267 (La Barranca).

Río Verde (Saunders, Jung, and Biju-Duval, 1986, text-fig. 38): N. 18, early Pliocene according to Akers (*in* Vokes, 1989): TU 1250.

Distribution.—Olsson (1922, p. 83) reported *C. epistomifera* Guppy from "Gatun Stage: C.Z." on the basis of "a few, small and imperfect specimens." As it was not found in Panama or the Canal Zone by Woodring, it is probable that Olsson's specimens represent the subspecies *C. epistomifera sathra*, or some related species. Jung's (1965) report from Venezuela is discussed above under *Remarks*. The nominotypical sub-

species is not known, with certainty, from outside the Dominican Republic.

Cancellaria (Bivetiella) bajonensis, new species
Plate 22, figures 1–7; Plate 26, figures 1–3;
Text-figure 15

Cancellaria epistomifera Guppy. Maury, 1917, p. 63 (in part), pl. 10, figs. 3, 4 (not fig. 5); Maury, 1925b, pl. 9, fig. 11. Not of Guppy, 1876.

Etymology of name.—Named after Arroyo Bajón, the type locality.

Description.—Protoconch small, of about two smooth volutions. Teleoconch of about six slightly tabulate whorls. Spiral and axial sculpture begin immediately at onset of teleoconch. Axial sculpture of sharp ribs, closely and evenly spaced except on the varices where they are packed together and are barely visible as individual ribs. Development of varices variable, usually beginning on third or fourth teleoconch whorl, with those on early whorls being weak. Varices spaced at approximately 120° increments. Spiral sculpture of evenly spaced spiral cords, about four visible on penultimate whorl. On the body whorl there is usually a secondary spiral cord in the interspaces. Sharp nodes are formed where the spiral cords cross the axial ribs. The first spiral cord abapical from the crowded cords on the sharply rounded shoulder larger than the others, giving the shell a slightly angular, tabulate appearance. Suture impressed. Outer lip prosocline, everted at the distinct stromboid notch. Interior of outer lip with over a dozen strong lirations which do not extend deeply within. Columella with three folds, the adapical one sharp and almost horizontal. Center fold descending, usually unevenly bifurcate. The abapical fold forms the edge of the distinct siphonal canal and tends to be bifurcate. Short secondary folds and pustules present on the inductura. Umbilicus narrow but deep, partially obscured by the inductura.

Holotype.—NMB H 17314 (Pl. 22, figs. 1–4).

Dimensions of holotype.—Height, 32.8 mm; width, 22.6 mm.

Type locality.—NMB locality 16923: Arroyo Bajón, Río Mao. Late Miocene (Saunders, Jung, and Biju-Duval, 1986, p. 32, text-figs. 29, 30, table 3).

Material.—Sixteen lots consisting of 70 specimens, many juvenile or broken.

Measurements.—The measurements of 14 specimens are plotted in Text-figure 15.

Remarks.—For a discussion of the misidentification of this species by Maury (1917) see *Remarks* under *C. epistomifera* Guppy, 1876 [p. 105, herein].

Comparisons.—*Cancellaria bajonensis* differs from *C. epistomifera*, with which it has been confused, in having a smaller protoconch, a lower spire, and much sharper sculpture. The two species can be distinguished not only by sight, but by touch.

Occurrence.—Río Mao: Cercado Formation (late Miocene): TU 1294 and NMB 16913, 17269 (all correspond to Bluff 3 of Maury); TU 1379 and NMB 16916, 16917, 16918, 16923, 16924, 16927, 16928 (all Arroyo Bajón); NMB 16914, 16929, 16931, 16932 (all correspond to Bluff 2 of Maury). Late Miocene: NMB 16910 (= Bluff 1 of Maury). (See Saunders, Jung, and Biju-Duval, 1986, p. 32, text-figs. 29, 30, table 3.)

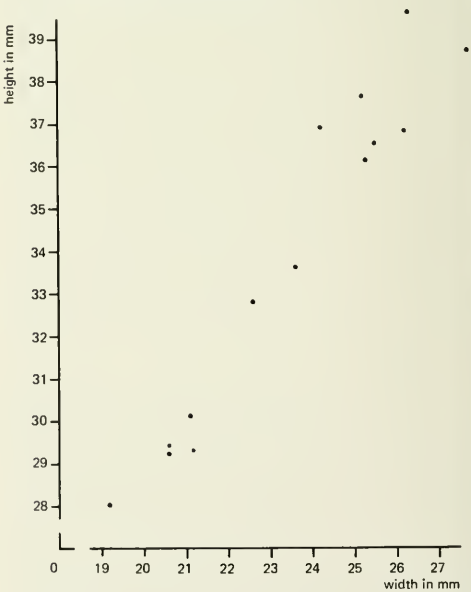
Distribution.—Not known from outside the Dominican Republic.

Subgenus **BIVETOPSIA** Jousseaume, 1887

Bivetopsia Jousseaume, 1887, p. 193.
Bivetopsis Jousseaume (emendation by Cossmann, 1899, p. 9).

Type species (by subsequent designation, Cossmann, 1888, p. 784).—*Cancellaria chrysostoma* Sowerby, 1832a. Recent, Panamic–Pacific Province.

Diagnosis.—Shell small, stocky. Outer lip prosocline, aperture rounded. Columella with three folds of about equal size. The almost horizontal adapical fold is slightly the largest. The descending abapical fold which borders the short siphonal canal is only slightly smaller, and the center fold, parallel to the abapical fold, is usually smallest. The body whorl is constricted above the strong siphonal fasciole.



Text-figure 15.—(Restored) height/width diagram of *Cancellaria* (*Bivetiella*) *bajonensis*, n. sp.

Remarks.—We consider *Bivetopsia* to be an American group, the few known species being confined to the later Tertiary of Florida, the Caribbean, and Ecuador, and to the Recent fauna of the Caribbean and the Panamic–Pacific provinces. The relationship between *Bivetopsia* and *Bivetiella* Wenz, 1943 should be investigated. As pointed out by Woodring (1928, p. 221) these two groups have much in common.

Cancellaria (Bivetopsia) plectilis, new species
Plate 22, figures 12–15

Etymology of name.—L. *plectilis* = complicated or intricate.

Description.—Paucispiral protoconch smooth, of about two volutions. Teleoconch of about five shouldered whorls. Sculpture of strong spiral cords, about nine on the body whorl, which are each composed of two to five smaller cords. Axial sculpture consists of strong rounded ribs, about nine on the body whorl, and numerous fine, closely packed growth lines. Body whorl severely constricted behind the strong siphonal fasciole. Outer lip prosocline, crenate, with about 11 lirae extending well back into the aperture. Posterior canal small but distinct. Columella with three strong folds, the most abapical one forming the edge of the short upturned siphonal canal. Columellar callus well developed, tuberculose, extending in front of the small umbilicus.

Holotype.—NMB H 17317 (Pl. 22, figs. 12–15).

Dimensions of holotype.—Height, 25.2 mm; width, 18.0 mm.

Type locality.—Locality TU 1354, Cañada de Zamba, Río Cana, Dominican Republic; Gurabo Formation (early Pliocene). (See Saunders, Jung, and Biju-Duval, 1986, text-figs. 15, 16.)

Material.—Known only from the holotype and one paratype, both well-preserved.

Measurements.—

	height (mm)	*width (mm)*	*h/w ratio*
NMB H 17317 (holotype) [Pl. 22, figs. 12–15]	25.2	18.0	1.40
NMB H 17318 (paratype), from loc. TU 1422	20.3	16.5	1.23

Remarks.—There do not seem to be any published depth records for the Recent species of *Bivetopsia* Jousseaume, 1887. We have examined specimens of the West Indian *Cancellaria* (*Bivetopsia*) *rugosa* Lamarck, 1822 [p. 115] which were dredged from a sandy bottom at moderately shallow depth. A specimen of this species (ANSP 272203) was taken in 25 m off Coral Bay, St. John, Virgin Islands (Rosenberg, written commun., 1988). Specimens of *C.* (*B.*) *haemastoma* Sowerby, 1832a [p. 54] are sometimes collected intertidally in the Galapagos Islands.

Comparisons.—*Cancellaria* (*Bivetopsia*) *plectilis* is closely related to *C.* (*B.*) *moorei* Guppy, 1866 [p. 289] from the Bowden Formation (early Pliocene) of Jamaica and its Floridian Pliocene subspecies, *C.* (*B.*) *moorei pachia* Smith, 1940 [p. 45], but differs in having rounded spiral cords subdivided by lesser cords and in having wider and more rounded ribs. The lectotype of *C. moorei* is figured herein (Pl. 22, figs. 8–11). The Recent Caribbean species *C.* (*B.*) *rugosa* possesses subdivided spiral cords but has weaker axial ribbing, a more angled shoulder, and is less constricted behind the siphonal fasciole. The Dominican species also differs from the Recent Panamic and Galapagan species in details of sculpture and form.

Occurrence.—Known only from two localities: TU 1354 (the type locality): Gurabo Formation (early Pliocene) of Río Cana (Cañada de Zamba) and TU 1422: Arroyo Bellaco, a tributary of Río Cana from the east, 3 km southwest of Las Caobas (age not determined; not plotted on any map in Saunders, Jung, and Biju-Duval, 1986).

Subgenus **HERTLEINIA** Marks, 1949

Hertleinia Marks, 1949, p. 457.

Type species (by original designation).—*Cancellaria mitriformis* Sowerby, 1832a. Recent, Panamic–Pacific Province.

Diagnosis.—Shell of medium size, slender, mitriform with an elongate aperture. Outer lip crenate with a prominent stromboid notch and a slightly recurved anterior canal. Columella fairly straight with two central folds, the adapical one largest. Sculpture cancellate.

Remarks.—*Hertleinia* is treated here in its traditional placement as a subgenus of *Cancellaria* Lamarck, 1799, although it should probably be given status as a full genus. The Dominican species described below is the fourth known species of *Hertleinia*. Besides the Recent type species, the only previously known species are the Ecuadorian *C.* (*H.*) *angosturana* Marks, 1949 [p. 463, pl. 78, figs. 1, 2] from the late Miocene Angostura Formation, and *C.* (*H.*) *marksi* Olsson, 1964 [p. 125, pl. 37, fig. 6] from the early Pliocene Esmeraldas Formation. *Hertleinia* must be added to the list of paciphile taxa.

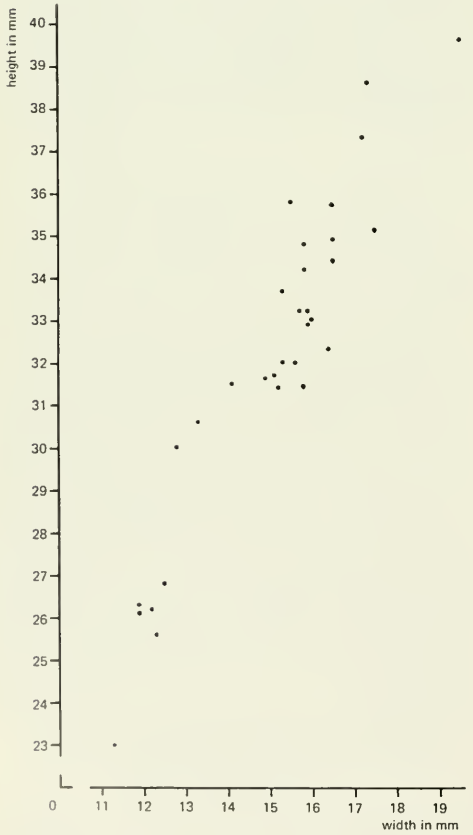
Cancellaria (Hertleinia) miranda, new species
Plate 23, figures 1–5; Plate 26, figures 4–7;
Text-figure 16

Etymology of name.—L. *mirandus* = wonderful, strange.

Description.—Protoconch smooth, high-spired, of

about two volutions. Attenuate teleoconch of about seven whorls. Sculpture of numerous spiral cords, about 17 on body whorl; evenly spaced except for slight crowding near suture. Sharp well-defined collabral ribs, about 20 on body whorl, evenly spaced except for crowding behind outer lip on adults. Outer lip slightly prosocline, rarely somewhat prosocyrt, crenate with a stromboid notch. Aperture ovate with strong but short interior lirations which do not extend to the outer lip. Columella almost straight with two sharp folds, the adapical one larger. Abapical portion of columella sloped to left and forming a short, well-defined, slightly upturned, anterior canal. Weak parietal wash sometimes present.

Holotype.—NMB H 17319 (Pl. 23, figs. 1–3).



Text-figure 16.—(Restored) height/width diagram of *Cancellaria* (*Hertleinia*) *miranda*, n. sp.

Dimensions of holotype.—Height, 37.3 mm; width, 17.2 mm.

Type locality.—Locality NMB 15903: Río Gurabo, Dominican Republic; upper part of Cercado Formation; late Miocene (Saunders, Jung, and Biju-Duval, 1986, text-figs. 4, 6).

Material.—Eight lots with a total of 51 specimens, most of which are complete and well-preserved.

Measurements.—The measurements of 31 specimens are plotted in Text-figure 16.

Remarks.—The Recent *C.* (*H.*) *mitriformis* Sowerby, 1832a [p. 51] ranges from Panama to Peru, "mostly offshore in depths to 37 m" (Keen, 1971, p. 653), although it is rarely collected intertidally in Panama. There is little variation among individuals of *C.* (*H.*) *miranda*. This is also true of *C.* (*H.*) *mitriformis*.

Comparisons.—The Dominican species differs from the other species of *Hertleinia* Marks, 1949 in not being tabulate. The previously described species of *Hertleinia* all have one or two strong spiral cords forming a shoulder behind which the shell slopes to the suture. In *C.* (*H.*) *miranda*, shouldering is present in juveniles, but not in adults. The sculpture of *C.* (*H.*) *miranda* is much finer than that of *C.* (*H.*) *angosturana* Marks, 1949 and *C.* (*H.*) *marksi* Olsson, 1964 from Ecuador. It also has a wider, more flaring aperture. The holotypes of *C.* (*H.*) *angosturana* and *C.* (*H.*) *marksi* are figured herein on Plate 23, figures 6–8 and 9–11, respectively.

Occurrence.—Río Gurabo: upper part of Cercado Formation (late Miocene): NMB 15903, 15907, 15910, 15911, 15912, 15914, 15915, 15916 (Saunders, Jung, and Biju-Duval, 1986, text-figs. 4, 6).

Distribution.—Not known from outside the Dominican Republic.

Subgenus **MASSYLA** Adams and Adams, 1854

Massyla Adams and Adams, 1854, p. 278.

Type species (by monotypy).—*Cancellaria corrugata* Hinds, 1843. Recent, Panamic–Pacific Province.

Diagnosis.—Shell of medium to large size. Whorls rounded, enlarging rapidly in early growth stages. Suture impressed. Sculpture consists primarily of spiral cords; axial folds and growth lines sometimes in evidence. Aperture ovate. Outer lip prosocline, lirate within. Columella with two strong folds, the adapical one being larger.

Remarks.—*Massyla* occurs in the later Tertiary of the southeastern United States, Central America and northwestern South America, and in the Recent fauna of the Panamic–Pacific Province. *Massyla* is a paciphile subgenus, although not listed as such by Woodring (1966, p. 428) or Vermeij (1978, p. 232).

Cancellaria (Massyla) lopezana, new species
Plate 23, figures 12–18

Etymology of name.—Named after the López section on Río Yaque del Norte, Dominican Republic.

Description.—Protoconch smooth, of about one-and-one-half volutions; border between protoconch and first postnuclear whorl marked by a slightly prosocline line, after which the sculpture consisting of six spiral threads and crowded, somewhat prosocline growth lines, starts immediately. There are about four-and-one-half teleoconch whorls, well rounded with deeply impressed suture. Body whorl with about 18 evenly spaced spiral cords. Aperture ovate, outer lip prosocline, strongly and deeply lirate within. Columella straight with two strong folds, the adapical one larger, which extend to the edge of the thin parietal callus behind which there is a moderately small but deep umbilicus. Siphonal fasciole strong. The adapical portion of the outer lip bears a strong fold appressed to the body whorl, forming a small posterior canal.

Holotype.—NMB H 17323 (Pl. 23, figs. 12–15).

Dimensions of holotype.—Height, 29.6 mm; width, 21.7 mm.

Type locality.—Locality NMB 17288: López section, Río Yaque del Norte, Dominican Republic; Baitoa Formation, (late early to early middle Miocene) (Saunders, Jung, and Biju-Duval, 1986, p. 30, text-figs. 21, 25).

Material.—Two lots with a total of only two specimens.

Measurements.—

	height (mm)	*width (mm)*	*h/w ratio*
NMB H 17323 (holotype) [Pl. 23, figs. 12–15]	29.6	21.7	1.36
NMB H 17324 (paratype) [Pl. 23, figs. 16–18]	25.4	16.8	1.48

Remarks.—Only two specimens are available. The holotype is complete except for the extreme abapical portion of the outer lip; the paratype has the outer lip broken off the entire length of the aperture. Specimens are otherwise in good condition.

Two living species of *Massyla* Adams and Adams, 1854 are known: *C.* (*M.*) *corrugata* Hinds, 1843 [p. 48; Hinds, 1844, p. 42, pl. 12, figs. 1, 2] and *C.* (*M.*) *obtusa* Deshayes, 1830 [p. 187]. A third possible Recent species is *C.* (*M.*) *cuningiana* Petit de la Saussaye, 1844 [pl. 112], although it is probably a junior subjective synonym of *C.* (*M.*) *obtusa*. These Recent species inhabit fairly shallow water in the southern part of the Panamic–Pacific Province. *Massyla* is represented in the Tertiary of the southeastern United States by a number of species, some still undescribed.

Comparisons.—*Cancellaria* (*Massyla*) *lopezana* is closely related to *C.* (*M.*) *jadisi* Olsson, 1964 [p. 123, pl. 21, fig. 7] from the late Miocene Angostura Formation of northwestern Ecuador but differs in having a greater whorl expansion rate, its shell being much larger although composed of the same number of whorls. Also, the Dominican species is constricted behind the siphonal fasciole whereas the siphonal fasciole of *C.* (*M.*) *jadisi* is much less prominent. It is also related to *C.* (*M.*) *propevenusta* Mansfield, 1929 [pl. 16, fig. 2; Mansfield, 1930, p. 47, pl. 17, fig. 2] of the Pinecrest Formation of Florida, which has more rapidly enlarging whorls. The systematic importance, if any, of the adapical canal mentioned in the *Description* has not been established, but it also occurs in *C.* (*M.*) *propevenusta*. It has not been noted either in the Recent species or in *C.* (*M.*) *jadisi*.

Occurrence.—López section on Río Yaque del Norte: Baitoa Formation (late early to early middle Miocene): NMB 17288, 16935 (Saunders, Jung, and Biju-Duval, 1986, p. 30, text-figs. 21, 25).

Genus **APHERA** Adams and Adams, 1854

Aphera Adams and Adams, 1854, p. 277.

Type species (by monotypy).—*Cancellaria tessellata* Sowerby, 1832a. Recent, Panamic–Pacific Province.

Diagnosis.—Shell small. Shape elliptical, with an elongate, narrow aperture. Outer lip thickened and denticulate, lirate internally. Columella with two folds, the adapical one being larger and somewhat bifid or shelved in adults. A pronounced shield-like callus usually present. Sculpture of evenly spaced spiral cords and axial ribs which form nodes at their intersections. Siphonal canal short but well-defined. Non-umbilicate.

Remarks.—*Aphera* is known only from the Tertiary of Florida, the Caribbean, Central America, and northwestern South America. Species from the later Tertiary of Italy placed in *Aphera* by Sacco (1894, pp. 66, 67) do not belong there.

Formerly considered to be a paciphile genus (Woodring, 1966, p. 428; Vermeij, 1978, p. 232), a living species, *A. lindae* Petuch, 1987 [p. 109], has recently been discovered (Petuch, 1981, p. 333; 1987, p. 109) off Barbados. Golfo de Triste, Venezuela, the locality originally given for the only known specimen of *Aphera lindae*, is incorrect. The correct locality is 200 m depth off St. James, Barbados (Petuch, 1988, footnote on p. 160). This species from Barbados and the type species of the genus are the only living species of *Aphera* known.

Aphera islacolonis (Maury, 1917)
Plate 24, figures 1–9, 14–17; Plate 25, figures 1–8;
Plate 26, figures 8–11; Text-figure 17

Cancellaria tessellata Sowerby. Gabb, 1873, p. 236. Not of Sowerby, 1832a.
Cancellaria (*Aphera*) *islacolonis* Maury, 1917, p. 65, pl. 10, figs. 12, 12a, b; Olsson, 1922, p. 86, pl. 6, fig. 12; Ramírez, 1956, pp. 19, 22, pl. 2, figs. 4, 5; pl. 4, figs. 1, 2.
Cancellaria ellipsis Pilsbry, 1922, p. 333, pl. 22, figs. 8, 9.
Aphera islacolonis (Maury). Perrilliat, 1973, p. 27, pl. 12, figs. 3–8.
Not *Aphera islacolonis* (Maury). Woodring, 1970, p. 344, pl. 56, figs. 1, 2. (= unnamed species).
Not *Aphera islacolonis* (Maury). Petuch, 1981, p. 333, figs. 81, 85, 86. (= *Aphera lindae* Petuch, 1987).

Description.—Protoconch of just over two smooth, erect volutions. Elongate, elliptical teleoconch of about five whorls. Spiral sculpture of fine cords begins with onset of teleoconch, formation of axial ribs following shortly. The evenly spaced axial ribs, crossed by equally evenly spaced spiral cords which form small nodes at the intersections, make the ornamentation finely cancellate. Spire high, often slightly concave. Aperture elongate, narrow. Outer lip thickened, most of the thickening occurring inside the aperture. Edge of outer lip with denticulations corresponding to the spiral cords. Inside of outer lip with about ten heavy, short lirations which reach only a short distance into the aperture. Near the adapical portion of the lip, one of these inner lirations is larger than the others. Columella with two strong, almost horizontal folds, the adapical one being larger, both incipiently bifid. Short secondary folds and pustules sometimes present on the inductura. Columellar callus shield-like, covering most of the apertural side of the shell, the edge extending as a shelf, sometimes everted abaxially. Siphonal canal short, well-defined. No umbilicus.

Lectotype (herein selected).—PRI 28960. This specimen has been figured by Maury (1917, pl. 10, fig. 12) and is refigured here (Pl. 24, figs. 1–3). Two paralectotypes (PRI 28669, 28670) have also been figured by Maury (1917, pl. 10, figs. 12a, b) and are refigured here (Pl. 24, figs. 4–5). The incomplete specimen here selected as lectotype is the only one of Maury's figured syntypes which has definite locality data.

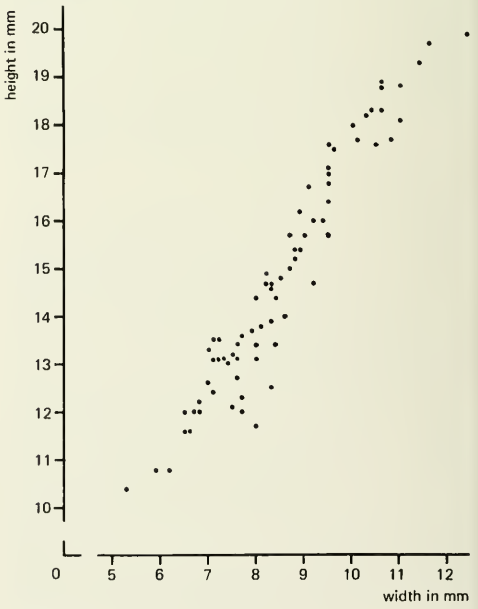
Dimensions of lectotype.—Height, 14.9 mm; width, 8.6 mm.

Type locality.—Maury's Bluff 2, on Río Mao, Dominican Republic; Cercado Formation (late Miocene) (Saunders, Jung, and Biju-Duval, 1986, p. 32, text-figs. 29, 30, table 3). Woodring (1970, p. 344) did not select a lectotype of *A. islacolonis*, but he designated Maury's Bluff 3 as the type locality. As the lectotype was collected from Bluff 2, Woodring's designation is supplanted.

Material.—This abundant species is represented in our collections by 64 lots containing over 1,300 specimens. The largest lots are from locality NMB 16923 (Cercado Formation of Arroyo Bajón on Río Mao): 235 specimens, and from locality NMB 15903 (uppermost Cercado Formation of the Río Gurabo section): 199 specimens.

Measurements.—The measurements of 74 specimens are plotted in Text-figure 17.

Remarks.—There are two distinct spire shapes in *Aphera islacolonis*, the prevalent shape being high-spired and almost, or slightly, concave (see Pl. 24, figs. 1–4; Pl. 24, figs. 14–17; Pl. 25, figs. 1–8). The other, less common, form is "normal" or slightly convex, giving the entire shell a bullet-like shape (see Pl. 24, figs. 5–7). Both forms were figured by Maury (1917, pl. 10). Pilsbry (1922, pl. 22) had one specimen of each form when he described *C. ellipsis* (see Pl. 24, figs. 6–9). Perrilliat (1973, pl. 12, figs. 3–8) figured both forms from the Agueguexquite Formation of Mexico. That all three of these authors should have both forms is surprising, as in the Dominican Republic material, which we have examined, less than 1% of the specimens are of the "bullet" shape. These few specimens came from only six localities, with a maximum number of three specimens from one locality. At only two localities was there a mixture of forms, and in both of these lots there was only one specimen of each form.



Text-figure 17.—(Restored) height/width diagram of *Aphera islacolonis* (Maury).

The Dominican Republic specimens of *A. islacolonis* are variable in sculpture, with some being more finely sculptured than others. Also, some specimens are much larger than others, with coarser sculpture in which the axial ribs are sharp and prominent. All specimens in individual lots are remarkably uniform, but we find no basis for distinguishing these minor sculptural differences.

The Recent *Aphera lindae* Petuch, 1987 [pl. 13, fig. 11; Petuch, 1981, figs. 81, 85, 86 (as *A. islacolonis*); Petuch, 1988, pl. 38, figs. 1, 2] is known from a single specimen. It has a "normal" spire which is neither concave nor convex, and is intermediate between the two forms discussed above. The width of this specimen is less than half its height, making it slimmer than any adult specimens of *A. islacolonis* which we have examined. *Aphera tessellata* (Sowerby, 1832a) [p. 51] also has a slender shell.

Approximately one-third of the specimens of *A. islacolonis* have been drilled, indicating that the species was subject to extensive naticid predation.

Comparisons.—The specimen from the middle part of the Gatun Formation (late Miocene) figured by Woodring (1970, pl. 56, figs. 1, 2) is separable from *A. islacolonis* by its much thicker shell, its larger and heavier columellar folds, and coarser sculpture. Olsson's (1922, p. 86) reference to the occurrence of *A. islacolonis* in the "Gatun Formation" is omitted from our distribution records as it probably refers to the unnnamed species figured by Woodring, the only species of *Aphera* known to us from the Gatun Formation.

Aphera wigginsi (Emerson and Hertlein, 1964) [p. 362, figs. 5d, e] from Pleistocene deposits of Isla Monserrate, Gulf of California, Mexico, was differentiated from *A. islacolonis* on the basis of its slender outline, the thicker parietal callus, the lack of grooving on the columellar plications, and in lacking a denticle on the upper portion of the columellar wall. The unique holotype is much larger than any specimen of *A. islacolonis* we have examined, but its height/width ratio does not serve to distinguish it. It does differ from *A. islacolonis* in the other characters mentioned, although few specimens of *A. islacolonis* have a denticle on the adapical portion of the columella. The most obvious distinction of *A. wigginsi* is its smooth, appressed, columellar callus, which is not everted at the edges.

Aphera peruana Nelson, 1870 [p. 190, pl. 6, fig. 3] from the Lower Zorritos Formation (early Miocene ?) and Tumbes Formation (late Miocene) of northern Peru, differs from *A. islacolonis* in having much coarser sculpture and a fairly smooth, heavy, non-everted columellar callus. It also has a strong denticle on the adapical portion of the columella, and the adapical columellar fold is broadly shelved. The holotype of *A. peruana* is refigured herein (Pl. 24, figs. 10–13).

The living *A. tessellata* (Sowerby, 1832a) from the Panamic–Pacific Province differs from all other species of *Aphera* in being slimmer and in lacking a well-developed columellar callus.

Occurrence.—This species is recorded from the following areas (from west to east):

Río Cana: upper part of Cercado Formation (late Miocene): TU 1230, 1282, and NMB 16835, 16837, 16838, 16839, 16842, 16844, 16857, 16986. Early Pliocene part of Gurabo Formation: TU 1354 and NMB 16817, 16818, 16866. A single specimen (loc. NMB 16872) was collected from the base of the Mao Adentro Limestone Member of the Mao Formation (early Pliocene)(Saunders, Jung, and Biju-Duval, 1986, text-figs. 15, 16).

Río Gurabo: upper part of Cercado Formation (late Miocene): TU 1358, 1359, 1373, 1377, 1419, and NMB 15896, 15900, 15903, 15904, 15906, 15907, 15909, 15910, 15911, 15912, 15913, 15914, 15915, 15916. Late Miocene part of Gurabo Formation: TU 1210, 1211, 1212, 1231, and NMB 15806, 15807, 15871, 15878, 15882 (Saunders, Jung, and Biju-Duval, 1986, text-figs. 4–6).

Río Mao: Cercado Formation (late Miocene): TU 1294 and NMB 16912, 16913, 17269 (all correspond to Bluff 3 of Maury); NMB 16915, 16916, 16917, 16918, 16922, 16923, 16924, 16926, 16927, 16928 (all Arroyo Bajón); NMB 16930 (= Bluff 2 of Maury) (Saunders, Jung, and Biju-Duval, 1986, text-figs. 29, 30, table 3).

Arroyo Zalaya: early Pliocene: TU 1227A (Saunders, Jung, and Biju-Duval, 1986, p. 34, text-fig. 36, table 3).

Río Yaque del Norte: Baitoa Formation (late early to early middle Miocene): NMB 17286 (López section); early Pliocene: TU 1403, 1405 (near La Barranca)(Saunders, Jung, and Biju-Duval, 1986, text-figs. 21, 25).

Río Verde: N. 18, early Pliocene according to Akers (*in* Vokes, 1989): TU 1250 (for location, see Saunders, Jung, and Biju-Duval, 1986, text-fig. 38).

Distribution.—Costa Rica: Uscari Formation (late Miocene ?). Mexico: Agueguexquite Formation (Pliocene). Dominican Republic: Baitoa Formation (late early to early middle Miocene), Cercado and Gurabo Formations (late Miocene and early Pliocene), Mao Adentro Limestone (early Pliocene).

Genus **PERPLICARIA** Dall, 1890

Perplicaria Dall, 1890, p. 90.

Type species (by monotypy).—*Perplicaria perplexa* Dall, 1890. Caloosahatachee Formation (Pliocene), Florida.

Daguinia Magne, 1966, p. 127.

Type species (by monotypy).—*Daguinia vigneauxi* Magne, 1966. Burdigalian (late early Miocene), France.

Diagnosis.—Shell small with rapidly enlarging convex whorls. Suture impressed. Aperture narrowly ovate, constricted adapically and expanded abapically. Outer lip thickened into a varix, internally lirate. Stromboid notch absent. Sculpture finely cancellate. Columella oblique but fairly straight, with three folds, the adapical one largest. The abapical fold borders the short siphonal canal and is sometimes joined by the central fold. Columellar callus small but prominent. No umbilicus.

Remarks.—Originally described in the Mitridae, *Perplicaria* was first shown to be cancellariid by Wilson (1948). With the sole exception of the type species, specimens of *Perplicaria* are extremely rare. The only Recent species, *P. clarki* Smith, 1947 [p. 55], is found intertidally from Jalisco, Mexico to Ecuador, but is very rare.

Daguinia has not previously appeared in the synonymy of *Perplicaria*, but we see little reason for separation as the French species appears to differ only in being more attenuate and in having a structure on the adapical portion of the columella. The exact nature of this structure cannot be determined from the poor published figure, and the type has not been located, but it is probably a fusion of the adapical and central columellar folds, resulting in a shelf-like structure.

The known species of *Perplicaria* are:

P. vigneauxi (Magne, 1966), Miocene, France.
P. prior Maury, 1910, Chipola Formation, late early Miocene, Florida.
P. canae, n. sp., Cercado Formation (late Miocene), Dominican Republic.
unnamed species of Woodring, 1928, pl. 13, fig. 2, Bowden Formation (early Pliocene), Jamaica.
P. perplexa Dall, 1890, Caloosahatchee Formation (Pliocene), Florida.
P. clarki Smith, 1947, Recent, Panamic–Pacific Province.

Perplicaria canae, new species
Plate 25, figures 9–15; Plate 26, figures 12–14

Etymology of name.—Named after Río Cana.

Description.—Protoconch smooth, consisting of a little more than one volution; its outer lip prosocline. Four teleoconch whorls. Profile of teleoconch whorls convex. First teleoconch whorl sculptured by four spiral cords. Just before the completion of the first teleoconch whorl secondary spiral threads are introduced, and slightly prosocline axial riblets begin to appear. At the intersection of the spiral and axial sculptural elements there are small knobs. Growth lines between the axial riblets are sometimes accentuated. Later spire whorls gradually become proportionally higher, and the number of spiral cords therefore increases as well. On average the spiral cords are more prominent than the axial riblets. Outer lip somewhat flaring near base, thickened, its inner surface with numerous lirae. Base of aperture rounded. Columella with three oblique folds decreasing in size abapically. Columellar callus prominent; parietal callus less prominent.

Holotype.—NMB H 17330 (Pl. 25, figs. 9–11).

Dimensions of holotype.—Height, 14.4 mm; width, 5.5 mm.

Type locality.—Locality TU 1230: Río Cana, east bank, just above the ford at Caimito on Los Quemados–Sabaneta Road (= loc. USGS 8534; Maury's Zone H). Cercado Formation (late Miocene) (Saunders, Jung, and Biju-Duval, 1986, p. 65, text-figs. 15, 16).

Material.—*Perplicaria canae* is based on only two specimens: the holotype and one smaller paratype from the same locality.

Measurements.—

	height (mm)	*width (mm)*	*h/w ratio*
NMB H 17330 (holotype) [Pl. 25, figs. 9–11]	14.4	5.5	2.62
NMB H 17331 (paratype) [Pl. 25, figs. 12–15]	11.3	4.4	2.57

Remarks.—Although slightly worn, both specimens of this species are well-preserved and appear to be adults, as they possess both a columellar callus and a thickened outer lip. The scarcity of material does not allow comments on variability.

Comparisons.—*Perplicaria canae* is certainly closely related to *P. perplexa* Dall, 1890 from the Pliocene Caloosahatchee Formation of Florida. *Perplicaria perplexa* is considerably larger than *P. canae* and its sculpture is coarser. On average, however, the axial riblets of *P. canae* are more accentuated. The protoconch of *P. canae* consists of a little more than one volution, whereas that of *P. perplexa* consists of one-and-one-half volutions.

Occurrence.—Known only from TU 1230, the type locality of the species: Cercado Formation (late Miocene) of the Río Cana section.

Distribution.—Not known from outside the Dominican Republic.

Genus **TRIGONOSTOMA** Blainville, 1827

Trigona Perry, 1811, expl. to pl. 51.
Not *Trigona* Jurine, 1807 (Hymenoptera).

Type species (by monotypy).—*Trigona pellucida* Perry, 1811 (= *Buccinum scalare* Gmelin, 1791). Recent, Indo-Pacific.

Trigonostoma Blainville, 1827, p. 652.

Type species (by monotypy).—*Delphinula trigonostoma* Lamarck, 1822 (= *Buccinum scalare* Gmelin, 1791). Recent, Indo-Pacific.

Subgenus **VENTRILIA** Jousseaume, 1887

Ventrilia Jousseaume, 1887, p. 194.

Type species (by monotypy).—*Ventrilia ventrilia* Jousseaume, 1887 (= *Cancellaria tenera* Philippi, 1848). Recent, Caribbean Province.

Arizelostoma Iredale, 1936, p. 318.

Type species (by original designation).—*Arizelostoma laseroni* Iredale, 1936. Recent, Australia.

Emmonsella Olsson and Petit, 1964, p. 541.

Type species (by original designation).—*Trigonostoma tenerum* (Philippi, 1848). Recent, Caribbean Province.

Diagnosis.—Shell of medium size, wide, openly and deeply umbilicate. Shoulder usually wide, angled, sloping down to the suture. Aperture trigonal. Columella with two descending folds, sometimes with a third weaker fold forming the edge of the short, notch-like anterior canal.

Remarks.—The subgenus *Ventrilia* occurs in the later Tertiary of Europe, southeastern United States, the Caribbean, northern South America and Central America, and in the Recent faunas of Australia and the Caribbean and Panamic–Pacific Provinces.

Species of *Ventrilia* seem to be separable into two forms (lineages ?). One group is typified by a wide shell with a sloping columella and primarily spiral sculpture such as the Recent Caribbean species *T.* (*V.*) *tenerum* (Philippi, 1848) [p. 24] and the living Eastern Pacific species *T.* (*V.*) *tuberculosum* (Sowerby, 1832a) [p. 51]. The other group has an almost vertical columella and has spiral and axial sculpture with some of the axial ribs developed into varices as in the living Eastern Pacific species *T.* (*V.*) *breve* (Sowerby, 1832a) [p. 52] and *T.* (*V.*) *goniostoma* (Sowerby, 1832a) [p. 51], and *T.* (*V.*) *gurabis* (Maury, 1917) [p. 65, pl. 10, fig. 11] from the late Miocene part of the Gurabo Formation, Dominican Republic.

Trigonostoma (Ventrilia) gurabis (Maury, 1917)
Plate 27, figures 1–12; Plate 29, figures 1–4

Cancellaria (*Trigonostoma*) *gurabis* Maury, 1917, p. 65, pl. 10, fig. 11.

Description.—Large deviated protoconch of a little less than one-and-one-half volutions. Teleoconch whorls, about four in number, rounded with a pronounced excavated shoulder. Axial sculpture of weak prosocline ribs and fine growth lines with irregularly spaced varices. Spiral sculpture of strong cords, about nine on the body whorl, with weaker spiral cords midway of each interspace, and even weaker spiral cords between the primary and secondary cords. Aperture trigonal, outer lip lirate within. Columella almost vertical, with two strong descending folds and a third weaker fold forming the edge of the short notch-like anterior canal. Umbilicus deep.

Holotype.—PRI 28668. This was apparently the only specimen Maury had when she described this species. It is refigured here (see Pl. 27, figs. 1–4).

Dimensions of holotype.—Height, 11.0 mm; width, 8.6 mm.

Type locality.—Río Gurabo at Los Quemados, Dominican Republic; Maury's Zone D. Late Miocene part of Gurabo Formation.

Material.—Two lots with a total of 10 specimens.

Measurements.—

	height (mm)	*width (mm)*	*h/w ratio*
PRI 28668 (holotype) [Pl. 27, figs. 1–4]	11.0	8.6	1.28
NMB H 17332, from loc. TU 1215; [Pl. 27, figs. 5–8]	11.4	9.0	1.27
NMB H 17333, from loc. TU 1215; [Pl. 27, figs. 9–12]	13.2	9.6	1.38
unnumbered specimen, from loc. NMB 15848	11.6	8.7	1.33
unnumbered specimen, from loc. TU 1215	13.0	9.2	1.41
unnumbered specimen, from loc. TU 1215	8.0	6.3	1.27

Remarks.—About half of the available material consists of complete, well-preserved adult specimens.

Comparisons.—*Trigonostoma* (*Ventrilia*) *gurabis* is more closely allied to the Recent Panamic–Pacific species *T.* (*V.*) *breve* (Sowerby, 1832a) than to the only living Caribbean species of *Ventrilia*, *T.* (*V.*) *tenerum* (Philippi, 1848). It differs from *T. breve* in its much stronger spiral sculpture and in having more varices. It differs from *T.* (*V.*) *tenerum* in having an almost vertical columella and axial sculpture forming varices.

Occurrence.—Río Gurabo: late Miocene part of Gurabo Formation: TU 1215 and NMB 15848 (Saunders, Jung, and Biju-Duval, 1986, text-figs. 4–6).

Distribution.—Not known from outside the Dominican Republic.

Trigonostoma (Ventrilia ?) insulare
(Pilsbry and Johnson, 1917)
Plate 27, figures 13–15

Cancellaria brevis Sowerby, Gabb, 1873, p. 236. Not of Sowerby, 1832a.

Cancellaria (*Trigonostoma*) *insularis* Pilsbry and Johnson, 1917, p. 163; Pilsbry, 1922, p. 334, pl. 22, fig. 11.

Description.—Protoconch smooth, of about one-and-one-half volutions. Rapidly enlarging teleoconch of about five whorls, rounded at the periphery but with a rounded shoulder behind which there is a channel at the suture. Sculpture of about 14 weak spiral cords, sometimes with weaker spiral threads in the interspaces. Axial sculpture of rounded collabral prosocline ribs, about 12 on the body whorl. Aperture trigonal, outer lip heavy and lirate within. Columella sloping with two strong descending folds and a third fold forming the edge of the shallow anterior canal. Numerous tubercules present on the edge of the columella between the folds. Adapical portion of aperture with shallow posterior canal, well-defined by lirations below the shoulder. Umbilicus deep.

Holotype.—ANSP 2989 (Pl. 27, figs. 13–15).

Dimensions of holotype.—Height, 24.2 mm; width, 21.0 mm.

Type locality.—Santo Domingo, exact locality and stratigraphic position unknown.

Material.—Known only from the holotype.

Remarks.—The concave columella of this species and its sharply defined posterior canal below the shoulder make placement in *Ventrilia* questionable.

This species was described from a specimen in the Gabb collection and no precise locality data are available. No additional specimens have been located. Woodring (1970, p. 345) lists a specimen from the Gatun Formation as *T.* cf. *insulare*. A specimen in the Petit collection, from the lower part of the Gatun Formation (late Miocene), is presumed to be the same species referred to by Woodring. This unnamed species is similar to *T. insulare*, differing in being less umbilicate, higher spired, and having a sharp shoulder.

Trigonostoma (*Ventrilia* ?) *insulare* closely resembles *T. smithfieldensis* Oleksyshyn, 1960 [p. 101, figs. 1, 2] from the Yorktown Formation (early Pliocene) of Virginia.

Occurrence.—Not known (see above). It is quite possible that this species does not occur in the Neogene of the Dominican Republic.

Distribution.—As this species is known only from a single specimen from an unknown locality, its distribution is not known.

Genus AXELELLA Petit, 1988

Olssonella Petit, 1970, p. 83.
Not *Olssonella* Glibert and Van de Poel, 1967, p. 121.

Type species (by original designation).—*Cancellaria smithii* Dall, 1888. Recent, North Carolina to Venezuela.

Axelella Petit, 1988, p. 130 (new name for *Olssonella* Petit, 1970 *non* Glibert and Van de Poel, 1967).

Type species (by original designation of *Olssonella* Petit, 1970).—*Cancellaria smithii* Dall, 1888. Recent, North Carolina to Venezuela.

Diagnosis.—Shell small, scalate, with a conical spire and rounded anterior. Teleoconch whorls rounded with an impressed suture. Sculpture of spiral cords and prosocline ribs. Columella almost vertical with two folds; a third weak fold sometimes forming the edge of the short siphonal canal. Degree of umbilication variable.

Remarks.—*Axelella* is a compact genus of cancellariids which has been recognized in Miocene and later formations of the southeastern United States, California, the Caribbean, and Central America, and Recent off the southeastern coast of the United States, the Gulf of Mexico, Venezuela, and in the Panamic–Pacific Province. One species occurs in the Recent fauna of the eastern Atlantic. The animal of *A. smithii* (Dall, 1888) [p. 70, fig. 292], the type species of the genus, has been described by Harasewych and Petit (1984).

Axelella emblema, new species
Plate 27, figures 16–19

Etymology of name.—Gr. *emblema* = inlaid work.

Description.—Shell scalate. Protoconch smooth, of about one-and-one-half volutions. Teleoconch whorls, about four in number, sculpture with seven to nine strong collabral ribs crossed by about 10 evenly spaced spiral cords which rise over the axial ribs, usually with a single weaker spiral thread in each interspace. Aperture roughly trigonal, being rounded at the shoulder. Suture slightly impressed. Outer lip with about 12 interior lirations which extend well into the aperture. Columella with two broad horizontal folds, the adapical one being larger, and a barely perceptible third oblique fold forming the edge of a short siphonal canal. Umbilicus chink-like.

Holotype.—NMB H 17335 (Pl. 27, figs. 16–19).

Dimensions of holotype.—Height, 10.7 mm; width, 7.1 mm.

Type locality.—Locality NMB 16942: López section on Río Yaque del Norte, Dominican Republic; Baitoa Formation (late early to early middle Miocene) (Saunders, Jung, and Biju-Duval, 1986, p. 30, text-figs. 21–25).

Material.—Known only from the holotype and two paratypes.

Measurements.—

	height (mm)	*width (mm)*	*h/w ratio*
NMB H 17335 (holotype) [Pl. 27, figs. 16–19]	10.7	7.1	1.51
NMB H 17336 (paratype)	9.3	5.7	1.63
NMB H 17339 (paratype)	8.2	5.2	1.58

Remarks.—All three available specimens are well-preserved, but probably immature. None of the three have protoconchs preserved well enough to be used for SEM photography.

Recent species of *Axelella* live at depths from 20 to 110 m.

Comparisons.—*Axelella emblema* is closer to the living *A. smithii* (Dall, 1888) than to any of its Caribbean Tertiary congeners, and differs from it in being proportionally broader with a much less impressed suture and in having coarser primary spiral cords. Both *A. thisbe* (Olsson, 1964) [p. 126, pl. 22, fig. 6] from the Esmeraldas Formation (early Pliocene) of Ecuador and *A. scalatella* (Guppy, 1873) [p. 78, pl. 2, fig. 4] from the Bowden Formation (early Pliocene) of Jamaica have much finer spiral sculpture and deeply impressed sutures. *Axelella panamica* (Petit, 1976) [p. 35, pl. 2, fig. 1] from the lower part of the Gatun Formation (late Miocene) of Panama has very prominent axial ribs with spiral cords that become prominent only where they cross the axial ribs.

Occurrence.—Known only from locality NMB 16942: López section on Río Yaque del Norte, Baitoa Formation (late early to early middle Miocene) (Saunders, Jung, and Biju-Duval, 1986, p. 30, text-figs. 21, 25).

Distribution.—Not known from outside the Dominican Republic.

Genus **AGATRIX** Petit, 1967

Agatrix Petit, 1967, p. 218.

Type species (by original designation).—*Trigonostoma agassizii* Dall, 1889. Recent, North Carolina to the Gulf of Mexico.

Diagnosis.—Shell small, tabulate. Sculpture cancellate. Suture impressed behind a rounded shoulder. Aperture ovate-trigonal, lirate within. Stromboid notch distinct. Columella sloping or concave with three folds, the abapical one forming the edge of a short but distinct siphonal canal. A thin parietal callus becomes shield-like abapically and extends over the umbilical chink.

Remarks.—Several Indo-Pacific Recent and Tertiary species have been referred to *Agatrix* in the past few years, but their true relationship to the species of the Caribbean and Panamic–Pacific provinces has not been determined.

Agatrix losquemadica (Maury, 1917)
Plate 28, figures 1–10; Plate 29, figures 5–8; Text-figure 18

Cancellaria (*Narona*) *losquemadica* Maury, 1917, p. 66, pl. 10, fig. 13.

Cancellaria (*Tribia* ?) *losquemadica* Maury. Marks, 1949, p. 460.

Description.—Pronounced protoconch smooth, of about one-and-one-quarter volutions. Teleoconch of about six whorls. On the first teleoconch whorl spiral cords appear a little before the axial riblets. Shell tabulate with deeply impressed suture behind a rounded shoulder. Sculpture of axial ribs, about 10 on body whorl, sometimes enlarged as varices, crossed by about 15 spiral cords. Spiral cords evenly spaced except for crowding on the shoulder, with occasional weaker spiral threads in interspaces. Spiral cords not present on inner half of shoulder. Aperture ovate-trigonal. Outer lip lirate within, with a noticeable stromboid notch in adults. Columella sloping, with three distinct folds, the abapical one forming the edge of a short but distinct anterior canal. A thin parietal callus, shield-like abapically, extends over the umbilical chink.

Holotype.—PRI 28671. This was apparently the only specimen Maury had when she described this species. It is refigured here (see Pl. 28, figs. 1–3).

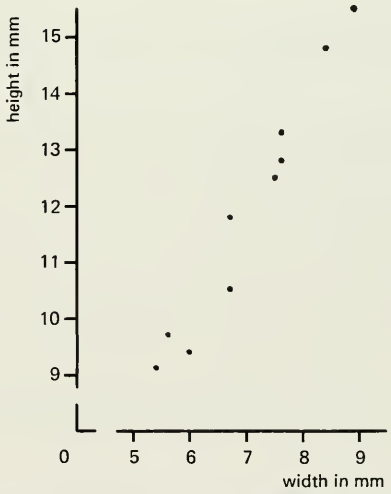
Dimensions of holotype.—Height, 12.8 mm; width, 7.6 mm.

Type locality.—Río Gurabo at Los Quemados, Dominican Republic; Maury's Zone E. The type locality is here restricted to locality NMB 15863 which falls in the lower part of the Gurabo Formation (late Miocene) (Saunders, Jung, and Biju-Duval, 1986, text-figs. 4, 6).

Material.—Ten lots with a total of 16 specimens.

Measurements.—The measurements of 10 complete specimens are plotted in Text-figure 18.

Remarks.—Well-preserved adult specimens constitute only about half of the available material. There is



Text-figure 18.—(Restored) height/width diagram of *Agatrix losquemadica* (Maury).

some variability among the specimens, a few having slightly weaker axial ribs which are not sharply rounded at the shoulder.

Comparisons.—*Agatrix losquemadica*, while related to *A. epomis* (Woodring, 1928) [p. 223, pl. 12, fig. 10] of the Recent fauna of Venezuela and the Bowden Formation (early Pliocene) of Jamaica, and to *A. beatrix* (Olsson, 1964) [p. 128, pl. 22, fig. 9] from the Esmeraldas Formation (early Pliocene) of Ecuador, differs from both species in having a greater number of spiral threads making the shell more finely sculptured. The living Western Atlantic species *A. agassizii* (Dall, 1889) [p. 130, pl. 35, fig. 4], the type species of the genus, and the Panamic–Pacific species *A. strongi* (Shasky, 1961) [p. 19, pl. 4, fig. 4] also have less prominent axial ribs and less deeply impressed sutures.

Occurrence.—This species has been found in several areas (for locations see Saunders, Jung, and Biju-Duval, 1986, text-figs. 4–6, 15, 16, 38):

Río Gurabo: late Miocene part of Gurabo Formation: TU 1296 and NMB 15804, 15814, 15863, 15869.

Río Cana: upper part of Cercado Formation (late Miocene): NMB 16838, 16854; Gurabo Formation (late Miocene and early Pliocene): NMB 16821, 16866.

Río Verde: N. 18, early Pliocene according to Akers (*in* Vokes, 1989): TU 1250.

Distribution.—Not known from outside the Dominican Republic.

Genus **ADMETULA** Cossmann, 1889

Admetula Cossmann, 1889, p. 228.

Type species (by original designation).—*Cancellaria evulsa* (Solander), (= *Buccinum evulsum* Solander, 1766). Eocene, England.

Diagnosis.—Shell small, rounded, non-tabulate. Aperture broadly ovate, lirate within. Columella excavated with two strong descending folds and a third fold which forms the edge of the short but distinct anterior canal. Sculpture cancellate. Varices usually present at irregular intervals. Columellar callus not developed into a shield. No umbilicus.

Remarks.—Two Caribbean and one Galapagan Recent species have been cited as *Admetula*, but they lack varices and may possibly be improperly placed in this genus. These species are:

A. bayeri Petit, 1976 [p. 38, pl. 1, fig. 4], Gulf of Mexico;
A. vossi Petit, 1976 [p. 39, pl. 1, fig. 5], Bahamas;
A. deroyae (Petit, 1970) [p. 85, pl. 1, figs. 3a, b], Galapagos Islands.

Admetula zalayana, new species
Plate 29, figures 9–12

Etymology of name.—Named after Arroyo Zalaya, Dominican Republic.

Description.—Protoconch large, of about one-and-one-half volutions, the first smooth, the last one-half with weak spiral threads. Postnuclear whorls begin abruptly with axial ribbing. Teleoconch of about five rounded whorls with deeply impressed suture. Sculpture of axial ribs, about 10 on body whorl, crossed by evenly spaced primary spiral cords, about 10 on the body whorl, with one or two secondary spiral threads in the interspaces. Axial ribs sometimes pronounced as irregularly spaced varices, the strongest varices on some specimens being at 90° intervals. Aperture ovate, lirate within. Columella excavated with two strong descending folds and a third fold which forms the edge of the short but distinct anterior canal. One or more tubercules sometimes present between the extremities of the columellar folds. No umbilicus.

Holotype.—NMB H 17343 (Pl. 29, figs. 9–12).

Dimensions of holotype.—Height, 11.2 mm; width, 7.7 mm.

Type locality.—Locality TU 1227: Arroyo Zalaya; early Pliocene (Saunders, Jung, and Biju-Duval, 1986, p. 34 and text-fig. 36).

Material.—Two lots with a total of only five specimens, all but one in an excellent state of preservation.

Measurements.—

	height (mm)	*width (mm)*	*h/w ratio*
NMB H 17343 (holotype) [Pl. 29, figs. 9–12]	11.2	7.7	1.45
unnumbered specimen, from loc. TU 1227	11.1	7.6	1.46
unnumbered specimen, from loc. TU 1227	8.9	5.7	1.56
unnumbered specimen, from loc. TU 1227	11.4	7.9	1.45

Remarks.—As mentioned above, the Recent species now placed in *Admetula* may represent a separate lineage as they lack varices. The two Caribbean species live at depths in excess of 500 m (Petit, 1976, pp. 38, 39) while the Galapagan species occurs at 150 m (Petit, 1970, p. 85).

Comparison.—*Admetula zalayana* differs from *A. zapoteca* (Böse, 1910) [p. 240, pl. 13, fig. 17], which occurs in beds of probably late Miocene or early Pliocene age of the Isthmus of Tehuantepec, in being proportionally wider with heavier sculpture and more pronounced varices. There are no other similar varicate species known from the Recent or Tertiary faunas of the Caribbean area.

Occurrence.—Arroyo Zalaya: early Pliocene: TU 1227.

Río Verde: N. 18, early Pliocene according to Akers

(*in* Vokes, 1989): TU 1250. (For location see Saunders, Jung, and Biju-Duval, 1986, text-figs. 36, 38.)

Distribution.—Not known from outside the Dominican Republic.

APPENDIX

In this *Appendix* we briefly treat species from the Tertiary Caribbean faunal Province that have been mistakenly identified with Dominican Republic species.

Cancellaria (Cancellaria) barretti Guppy, 1866
Plate 16, figures 1–4

Cancellaria barretti Guppy, 1866, p. 289, pl. 17, fig. 11; Guppy, 1867, p. 157 (list, in part); Guppy, 1874, p. 438 (list, in part); Dall, 1903, p. 1583 (list, in part).

Not *Cancellaria barretti* Guppy. Guppy, 1866, p. 286 (list; not p. 289); Guppy, 1867, p. 157 (list, in part); Guppy, 1876, p. 520; Maury, 1917, p. 226, pl. 36, fig. 1; Pilsbry, 1922, p. 332; Maury, 1925b, pl. 9, fig. 17; Ramírez, 1950, p. 22, pl. 3, fig. 3; Ramírez, 1956, pp. 12, 18, 19. (all = *Cancellaria mauryae* Olsson, 1922).

Not *Cancellaria barretti* Guppy. Engerrand and Urbina, 1910, p. 125.

Not *Cancellaria barretti* Guppy. Olsson, 1922, p. 81, pl. 6, fig. 6. (?= *Cancellaria dariena* Toula, 1909).

Cancellaria (*Cancellaria*) *barretti* Guppy. Woodring, 1928, p. 219, pl. 12, fig. 6.

Not *Cancellaria* (*Cancellaria*) *barretti* Guppy. Tucker and Wilson, 1932, p. 8, pl. 3, fig. 3.

Not *Cancellaria barreti* [*sic*] Guppy. Gómez P. and Valerio G., 1971, p. 44, fig. 3. (= *C. petiti* Olsson, 1967).

Holotype.—BMNH G 64069 (Pl. 16, figs. 1–4).

Dimensions of holotype.—Height, 34.6 mm; width, 18.8 mm.

Type locality.—Bowden, Jamaica. Bowden Formation (early Pliocene).

Remarks.—The Dominican Republic references to *C. barretti* are discussed under *C. mauryae* Olsson, 1922 [p. 95, herein].

Engerrand and Urbina (1910, p. 125) reported the species from Zuluzum, Chiapas, Mexico, on the basis of two incomplete specimens which were not figured. We agree with Woodring (1928, p. 220) that it is improbable that their material represents *C. barretti*.

The record by Olsson (1922, p. 81, pl. 6, fig. 6) from the Río Banano, Costa Rica (Río Banano Formation, early Pliocene) appears to be based on a specimen of *C. dariena* Toula, 1909. Woodring (1928, p. 219) was also of this opinion.

The Floridian shell reported as *C. barretti* by Tucker and Wilson (1932, p. 8, pl. 3, fig. 3) is one of a number of variable forms of *Cancellaria* sensu stricto in the later Tertiary of Florida which remain to be treated comprehensively.

For comments on the record given by Gómez P. and Valerio G. (1971, p. 44, fig. 3), see *Remarks* under *C. petiti* Olsson, 1967 [p. 117, herein].

As mentioned by Woodring (1928, p. 219) the only known specimens of *C. barretti* are the holotype (figured herein; Pl. 16, figs. 1–4) and the specimen figured by Woodring (1928, pl. 12, fig. 6). This latter specimen has a more rounded body whorl than the holotype.

Cancellaria (Cancellaria) petiti Olsson, 1967
Plate 16, figures 5–9

Cancellaria (*Cancellaria*) *cossmanni* Olsson, 1922, p. 81, pl. 6, figs. 9, 11. Not *C. cossmanni* Morlet, 1888, p. 209, pl. 9, figs. 10, 10a, b.

? *Cancellaria* (*Cancellaria*) *cossmanni* Olsson. Anderson, 1929, p. 117.

Not *Cancellaria* (*Cancellaria*) *cossmanni* Olsson. Oinomikado, 1939, p. 623, pl. 29, fig. 17. (? = juvenile *Distorsio* Röding, 1798).

Cancellaria (*Cancellaria*) *petiti* Olsson, 1967, p. 44 (new name for *C. cossmanni* Olsson, 1922 *non* Morlet, 1888).

Cancellaria barreti [*sic*] Guppy. Gómez P. and Valerio G., 1971, p. 44, fig. 3. Not of Guppy, 1866.

Cancellaria cossmanni Olsson. Gómez P. and Valerio G., 1971, p. 44, fig. 4.

Lectotype (herein selected).—PRI 20966. This is the larger of the two specimens figured by Olsson (1967, pl. 6, fig. 9) and is refigured herein (Pl. 16, figs. 5–9).

Dimensions of lectotype.—Height, 25.7 mm; width, 14.6 mm.

Type locality.—Río Banano, Limón Province, Costa Rica. Río Banano Formation (early Pliocene).

Remarks.—This species is included as it has been confused with *C. barretti* Guppy, 1866, from the Bowden Formation (early Pliocene) of Jamaica, which in turn has been reported from the Dominican Republic. See *Remarks* under *C. barretti* Guppy, 1866 and *C. mauryae* Olsson, 1922 [pp. 117 and 95 herein, respectively].

As may be seen from the illustrations herein, *C. barretti* and *C. petiti* are distinct, differing in overall shape as well as in ornamentation.

Cancellaria petiti was reported (as *C. cossmanni* Olsson) from near Cibarco, Colombia (Tubará group; late Miocene or early Pliocene) by Anderson (1929, p. 117) on the basis of a single specimen which he did not figure.

This species was also reported from southwestern Colombia (Cucurrupí River; beds of late Miocene or early Pliocene age) by Oinomikado (1939, p. 623, pl. 29, fig. 17). His poor figure of a small shell is not recognizable, but appears to be of a juvenile *Distorsio*. It is certainly not *C. petiti*.

Gómez P. and Valerio G. (1971, p. 44, figs. 3, 4) figured two specimens, identifying the larger as *C. barreti* [*sic*]. Their specimens are clearly conspecific with each other and with *C. petiti*.

Cancellaria (Pyruclia ?) laevescens Guppy, 1866
Plate 18, figures 10–12

Cancellaria laevescens Guppy, 1866, p. 289, pl. 17, fig. 12; Guppy,

1867, p. 157 (list, in part); Guppy, 1874, p. 438 (list, in part); Dall, 1903, p. 1583 (list, in part); Maury, 1920, p. 69 (in part).
Not *Cancellaria laevescens* Guppy. Guppy, 1866, p. 286 (list; not p. 289); Guppy, 1867, p. 157 (list, in part); Gabb, 1873, p. 236 (list); Guppy, 1876, p. 520; Maury, 1917, p. 64, pl. 10, fig. 6; Pilsbry, 1922, p. 333. (all = *Cancellaria* (*Pyruclia* ?) *uva*, n. sp.).
Not *Cancelaria* [*sic*] *laevescens* Guppy. Guppy, 1910, p. 6; Guppy, 1913, p. 4. (= *Cancellaria auriculaperta* Vokes, 1938).
Not *Cancellaria laevescens* Guppy. Hubbard, 1920, p. 157, pl. 24, figs. 5, 6. (= *Cancellaria laevescens portoricana* Maury, 1920); Li, 1930, p. 272, pl. 8, fig. 63 (= *C. bulbulus* Sowerby, 1832a; Recent).
Cancellaria (*Cancellaria*) *laevescens* Guppy. Woodring, 1928, p. 220, pl. 12, figs. 7, 8.
Cancellaria (*Cancellaria*) *lavescens* [*sic*] Guppy. Marks, 1949, p. 460 (list).

Lectotype.—BMNH G 64070. This specimen is the syntype figured by Guppy (1866, pl. 17, fig. 12) and refigured here (Pl. 18, figs. 10–12). We consider Woodring's citation (1928, p. 221) of this specimen as "holotype" to constitute lectotype designation.

Dimensions of lectotype.—Height, 42.6 mm; width, 27.2 mm.

Type locality.—Bowden, Jamaica. Bowden Formation (early Pliocene).

Remarks.—*Cancellaria laevescens portoricana* Maury, 1920 [p. 69, pl. 7, fig. 10] was described from an artificial cast of an external mold. It was stated by Maury to resemble "Gabb's Dominican specimen of *C. laevescens* [= *C. uva*, n. sp.] but is still smaller and is only a third the size of Guppy's type." We consider the specimens referred to *C. laevescens* by Hubbard (1920, p. 157, pl. 24, figs. 5, 6) to be conspecific with *C. portoricana*. Both Maury's and Hubbard's material came from Quebradillas, Puerto Rico (late Miocene or early Pliocene). *Cancellaria portoricana* cannot be considered a subspecies of *C. laevescens* as available material does not permit this determination.

The species from Springvale, Trinidad (early Pliocene) listed as *C. laevescens* by Guppy (1910, p. 6; 1913, p. 4) was described as *C. auriculaperta* Vokes, 1938 [p. 22, figs. 19, 20].

All reports of *C. laevescens* from the Dominican Republic are considered to be for *C. uva*, n. sp., and are discussed thereunder [p. 101, herein].

Cancellaria laevescens appears to be restricted to the Bowden Formation of Jamaica (early Pliocene) as all reports of it from elsewhere are referable to other species.

Cancellaria (Bivetopsia) moorei Guppy, 1866
Plate 22, figures 8–11

Cancellaria moorei Guppy, 1866, p. 289, pl. 17, fig. 7; Guppy, 1867, p. 157 (list, in part); Guppy, 1874, p. 438 (list, in part); Dall, 1903, p. 1583 (list, in part).
Not *Cancellaria moorei* Guppy. Guppy, 1866, p. 286 (list; not page 289); Gabb, 1873, p. 236 (list); Guppy, 1876, p. 520. (all = *Cancellaria* (*Bivetiella*) *epistomifera* Guppy, 1876).
Cancellaria (*Bivetopsia*) *moorei* Guppy. Woodring, 1928, p. 222, pl. 12, fig. 9.
Cancellaria moorei (?) Guppy. Anderson, 1929, p. 117.
Cancellaria (*Bivetopsia* ?) *moorei* Guppy. Marks, 1949, p. 460 (list).

Lectotype.—BMNH G 64068. This specimen is the syntype figured by Guppy (1866, pl. 17, fig. 7) and is refigured here (Pl. 22, figs. 8–11). We consider Woodring's citation (1928, p. 222) of this specimen as "holotype" to constitute lectotype designation.

Dimensions of lectotype.—Height, 19.0 mm; width, 13.6 mm.

Type locality.—Bowden, Jamaica. Bowden Formation (early Pliocene).

Remarks.—This species was confused with *C. epistomifera* Guppy by both Guppy and Gabb, and thus appeared in their lists of Dominican Republic taxa. The only Dominican species of *Bivetopsia* known to us is *C.* (*B.*) *plectilis*, n. sp. [see *Remarks* on p. 107, herein].

Cancellaria moorei was reported from near Usiacurí, Colombia (Tubará group; late Miocene or early Pliocene) by Anderson (1929, p. 117) on the basis of a single specimen which he did not figure. This is the only report of the nominotypical subspecies from outside of the Bowden Formation (early Pliocene) of Jamaica.

The subspecies *C.* (*B.*) *moorei pachia* Smith, 1940 [p. 45, pl. 2, fig. 2] from near Belle Glade, Florida (probably Bermont Formation; Pleistocene) differs from the nominotypical subspecies in being less attenuate and in having fewer but larger axial ribs.

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PLATES

EXPLANATION OF PLATE 15

All figures ×2

Figure — Page

1–11. ***Cancellaria* (*Cancellaria*) *guppyi*** Gabb, 1873 94

1–3. Lectotype. ANSP 2990; Santo Domingo (exact locality not known); 1. front view; 2. apical view; 3. rear view. Height, 28.1 mm; width, 18.6 mm.

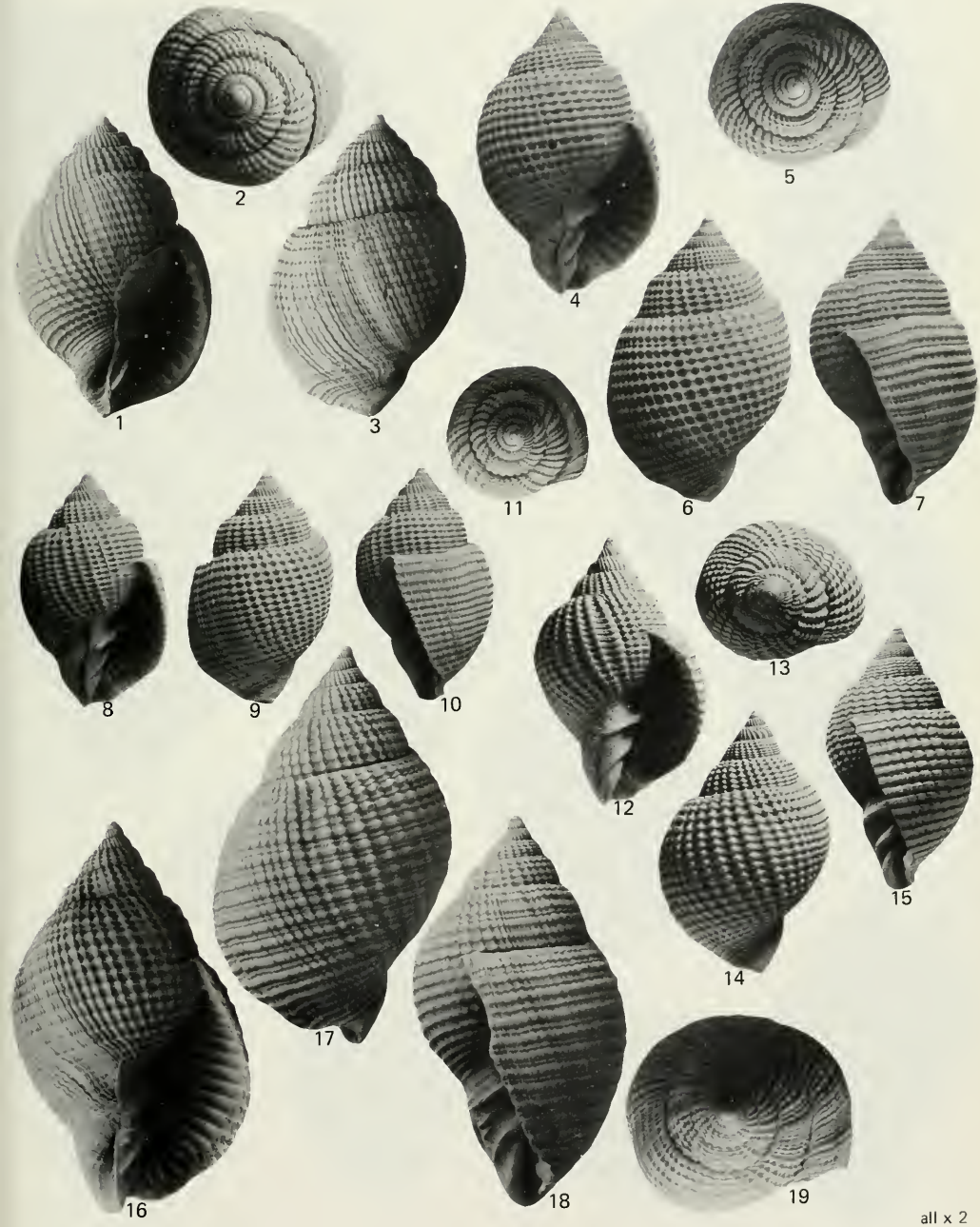
4–7. NMB H 17293; from locality NMB 15898: Río Gurabo; upper part of Cercado Formation (late Miocene); 4. front view; 5. apical view; 6. rear view; 7. from right side. Height 26.5 mm; width 17.2 mm.

8–11. NMB H 17294; from locality NMB 16910: Río Mao; late Miocene; 8. front view; 9. rear view; 10. from right side; 11. apical view. Height, 21.6 mm; width, 13.7 mm.

12–19. ***Cancellaria* (*Cancellaria*) *mauryae*** Olsson, 1922 95

12–15. NMB H 17296; from locality NMB 16927: Río Mao (Arroyo Bajón); late Miocene; 12. front view; 13. apical view; 14. rear view; 15. from right side. Height 25.2 mm; width: 16.4 mm.

16–19. Holotype. PRI 28661. Río Mao (exact locality not known); late Miocene. Specimen figured by Maury (1917, pl. 10, fig. 1) and Olsson (1922, pl. 6, fig. 5). Height, 36.7 mm; width, 22.7 mm.



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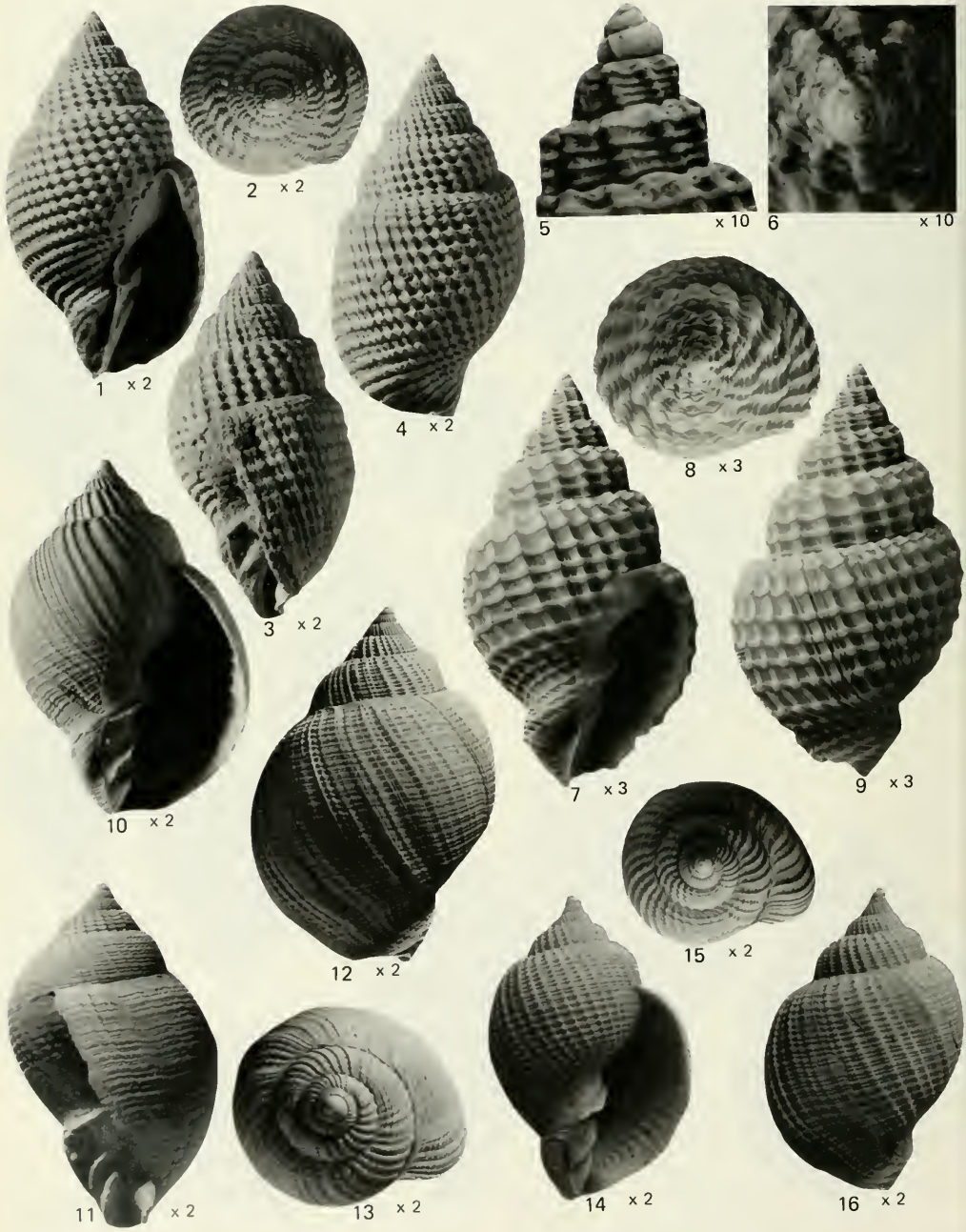
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Explanation of Plate 16

Figure — Page

1–4. ***Cancellaria* (*Cancellaria*) *barretti*** Guppy, 1866 117
Holotype. BMNH G 64069. Bowden, Jamaica; Bowden Formation (early Pliocene); 1. front view; 2. apical view; 3. from right side; 4. rear view. Height, 34.6 mm; width, 18.8 mm. ×2.

5–9. ***Cancellaria* (*Cancellaria*) *petiti*** Olsson, 1967 117
Lectotype. PRI 20966. Río Banano, Limón Province, Costa Rica; Banano Formation (early Pliocene). Specimen figured by Olsson (1967, pl. 6, fig. 9); 5. early whorls, ×10; 6. apical view, ×10; 7. front view; 8. apical view; 9. rear view. Height 25.7 mm; width: 14.6 mm. 7–9: ×3.

10–16. ***Cancellaria* (*Cancellaria*) *juncta***, new species 96
10–13. Holotype. NMB H 17297; from locality TU 1358: Río Gurabo; upper part of Cercado Formation (late Miocene); 10. front view; 11. from right side; 12. rear view; 13. apical view. Height 33.8 mm; width: 23.5 mm. ×2.
14–16. Paratype. NMB H 17298; from locality NMB 15912: Río Gurabo; upper part of Cercado Formation (late Miocene); 14. front view; 15. apical view; 16. rear view. Height, 28.2 mm; width, 19.0 mm. ×2.

EXPLANATION OF PLATE 17

All figures ×3

Figure — Page

1–13. ***Cancellaria* (*Cancellaria*) *harrisi*** Maury, 1917 97

1–4. Holotype. PRI 28667. Río Cana at Caimito; Cercado Formation (late Miocene); 1. front view; 2. apical view; 3. rear view; 4. from right side. Height, 29.5 mm; width, 17.5 mm.

5–8. NMB H 17299; from locality NMB 16844: Río Cana: upper part of Cercado Formation (late Miocene); 5. front view; 6. rear view; 7. from right side; 8. apical view. Height, 23.0 mm; width, 13.3 mm.

9–11. NMB H 17300; from locality NMB 16839: Río Cana; upper part of Cercado Formation (late Miocene); 9. apical view; 10. front view; 11. rear view. Height 24.4 mm; width: 14.1 mm.

12, 13. NMB H 17301; from locality NMB 16844: Río Cana; upper part of Cercado Formation (late Miocene); 12. front view; 13. rear view. Height, 20.2 mm; width, 12.2 mm.

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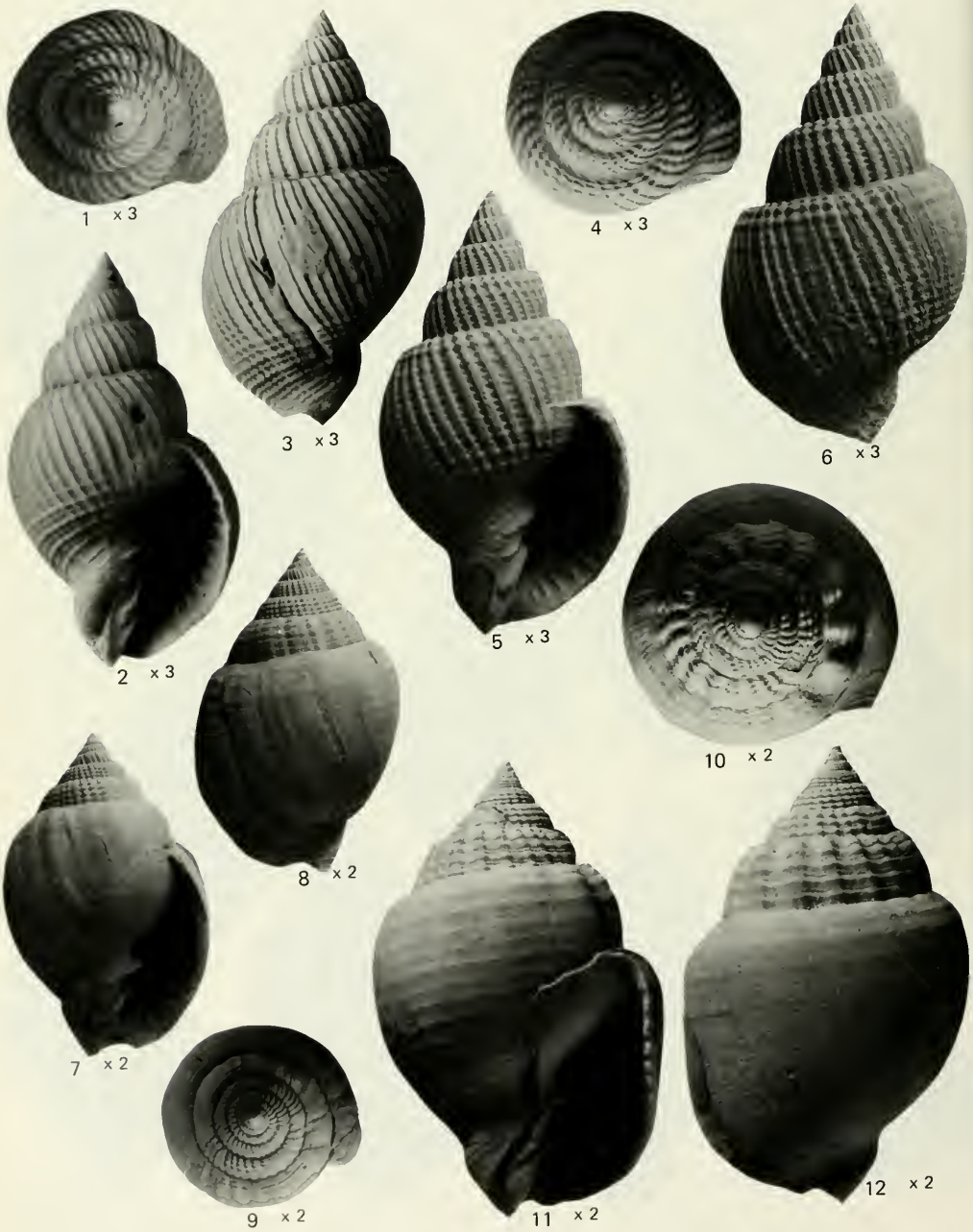
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Explanation of Plate 18

Figure — Page

1–6. ***Cancellaria* (*Cancellaria*) *rowelli*** Dall, 1896 — 98

1–3. Holotype. USNM 113762. Potrero, Río Amina; 1. apical view; 2. front view; 3. rear view. Height 26.1 mm; width: 14.0 mm. ×3.

4–6. NMB H 17303; from locality NMB 17281: López section on Río Yaque del Norte; Baitoa Formation (late early to early middle Miocene); 4. apical view; 5. front view; 6. rear view. Height 27.2 mm; width: 15.4 mm. ×3.

7–9. ***Cancellaria* (*Pyruclia* ?) *uva***, new species — 101

Holotype. NMB H 17305; from locality NMB 17275: Río Yaque del Norte, near mouth of Arroyo López; probably late Miocene; 7. front view; 8. rear view; 9. apical view. Height 30.0 mm; width: 19.5 mm. ×2.

10–12. ***Cancellaria* (*Pyruclia* ?) *laevescens*** Guppy, 1866 — 117

Lectotype. BMNH G 64070. Bowden, Jamaica; Bowden Formation (early Pliocene); 10. apical view; 11. front view; 12. rear view. Height 42.6 mm; width: 27.2 mm. ×2.

EXPLANATION OF PLATE 19

Figure — Page

1–8. ***Cancellaria* (*Sveltia*) *inquilinus***, new species — 102

1–4. Paratype. NMB H 17308; from locality NMB 17266: La Barranca, Río Yaque del Norte; early Pliocene; 1. front view; 2. rear view; 3. from right side; 4. apical view. Height, 16.7 mm; width, 10.8 mm. ×4.

5–8. Holotype. NMB H 17309; from locality TU 1227: Arroyo Zalaya; early Pliocene; 5. front view; 7. from right side; 8. apical view. Height 16.6 mm; width: 10.2 mm. ×4.

9–15. ***Cancellaria* (*Bivetiella*) *gabbiana*** Pilsbry and Johnson, 1917 103

9–11. Lectotype. ANSP 3288. Exact locality not known; 9. front view; 10. apical view; 11. rear view. Height, 24.5 mm; width, 19.8 mm. ×2.

12–15. NMB H 17311; from locality NMB 16938: López section on Río Yaque del Norte; Baitoa Formation (late early to early middle Miocene); front view; 13. rear view; 14. apical view; 15. from right side. Height, 24.2 mm; width, 19.8 mm. ×2.


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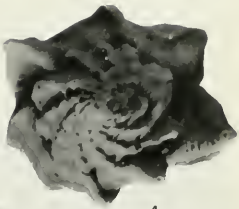
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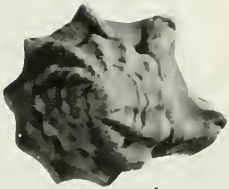
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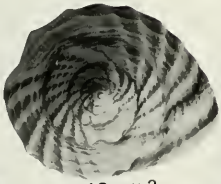
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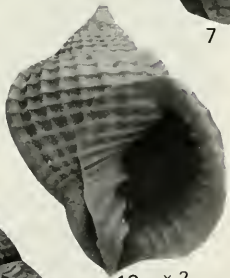
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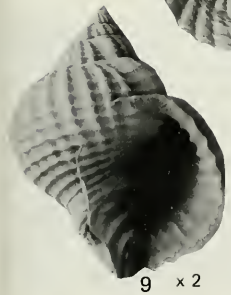
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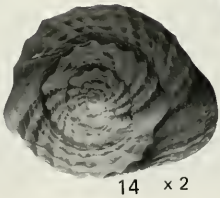
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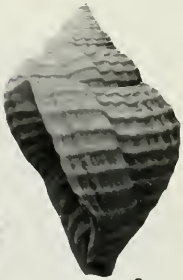
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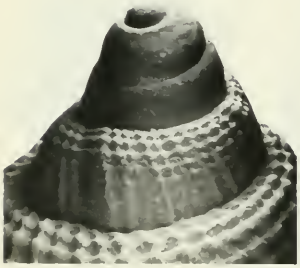
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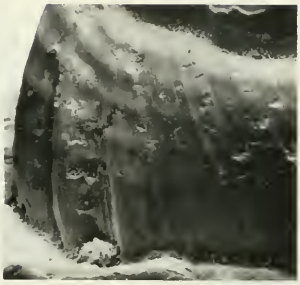
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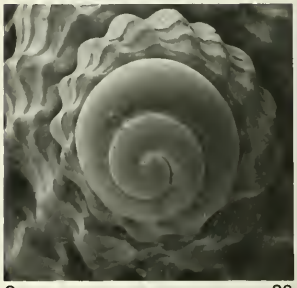
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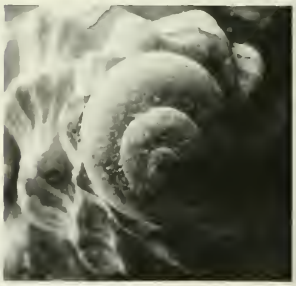
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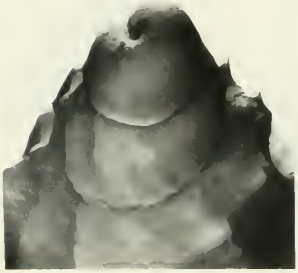
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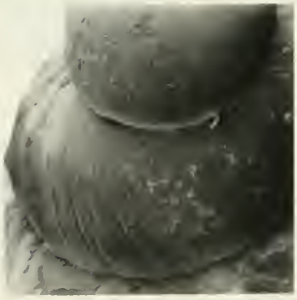
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EXPLANATION OF PLATE 20

Figure — Page

1–3. ***Cancellaria* (*Cancellaria*) *guppyi*** Gabb, 1873 94
NMB H 17295; from locality NMB 15910: Río Gurabo; upper part of Cercado Formation (late Miocene). Note prosocline outer lip of protoconch; 1. protoconch, ×14; 2. transition protoconch/teleoconch, ×70; 3. apical view, ×12.

4–6. ***Cancellaria* (*Cancellaria*) *harrisi*** Maury, 1917 97
NMB H 17302; from locality NMB 16844: Río Cana; upper part of Cercado Formation (late Miocene); 4. protoconch, ×40; 5. transition protoconch/teleoconch, ×80; 6. apical view, ×30.

7–9. ***Cancellaria* (*Cancellaria*) *rowelli*** Dall, 1896 98
NMB H 17304; from locality NMB 17288: López section on Río Yaque del Norte; Baitoa Formation (late early to early Middle Miocene); 7. protoconch, ×28; 8. protoconch with transition to teleoconch, ×30; 9. apical view, ×35.

10–12. ***Cancellaria* (*Sveltia*) *inquilinus***, new species 102
Paratype. NMB H 17310; from locality NMB 17271: Arroyo Zalaya; early Pliocene; 10. protoconch, ×32; 11. transition protoconch/teleoconch, ×65; 12. apical view, ×35.

EXPLANATION OF PLATE 21

Figure — Page

1–11. ***Cancellaria* (*Bivetiella*) *epistomifera*** Guppy, 1876 104

1–4. NMB H 17312; from locality NMB 15816: Río Gurabo; early Pliocene part of Gurabo Formation; 1. front view; 2. rear view; 3. apical view; 4. from right side. Height, 27.6 mm; width, 19.7 mm. ×3.

5–10. NMB H 17313; from locality NMB 16801: Río Mao; probably early Pliocene: 5. front view, ×3; 6. rear view, ×3; 7. apical view, ×3; 8. from right side, ×3; 9. apical view, ×10; 10. early whorls, ×10. Height, 21.7 mm; width, 16.0 mm.

11. Lectotype. BMNH G 83955. "Yaque River". Front view. Height, 28.3 mm; width, 19.7 mm. ×3.


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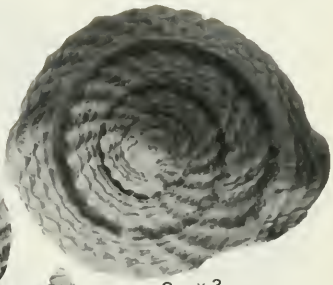
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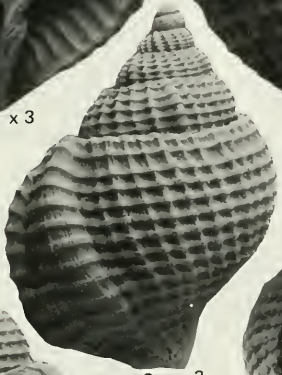
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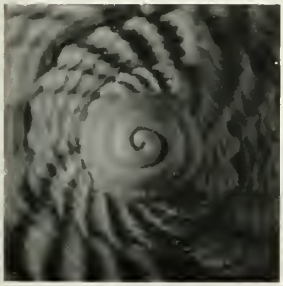
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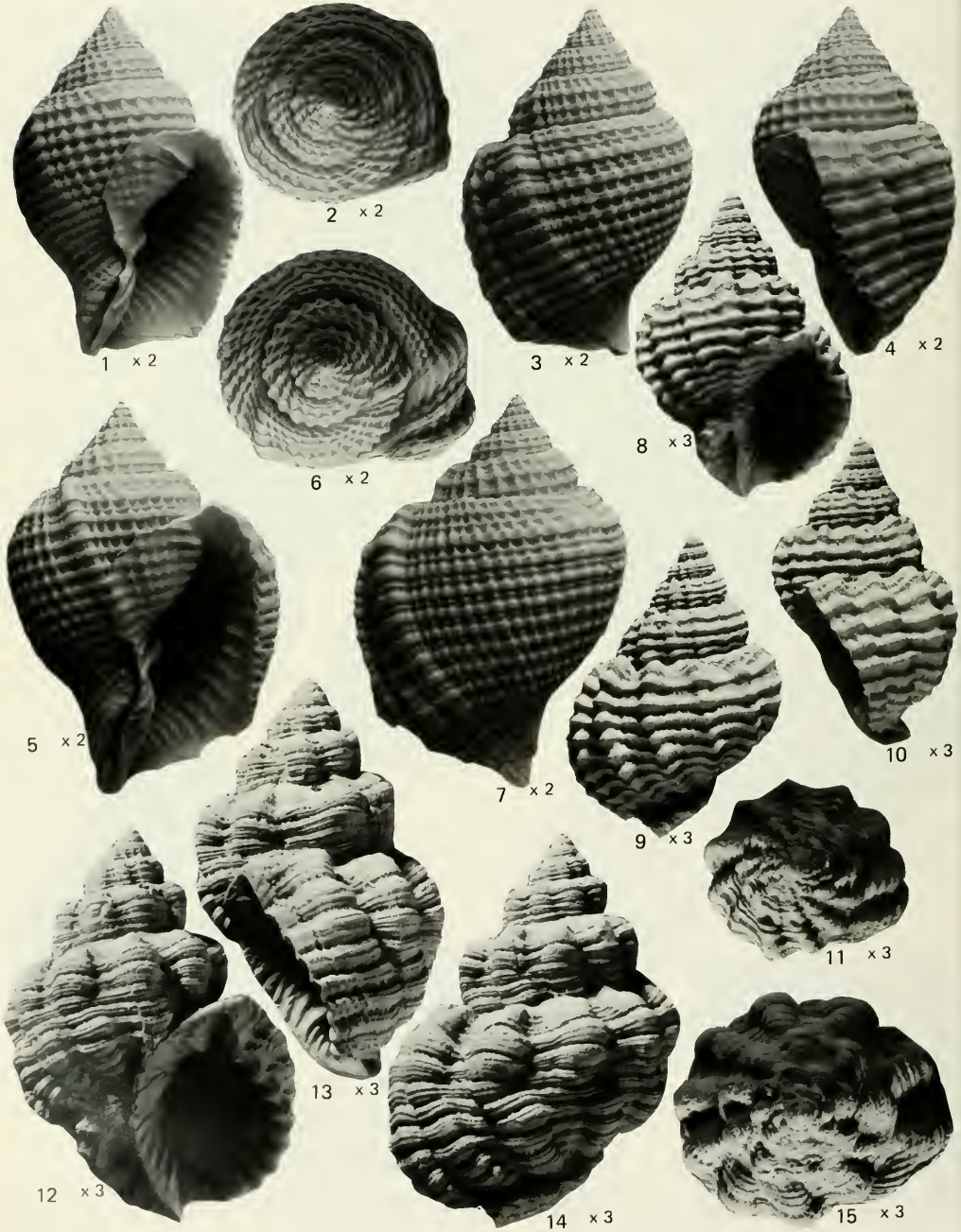
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EXPLANATION OF PLATE 22

Figure — Page

1–7. ***Cancellaria (Bivetiella) bajonensis***, new species 106

1–4. Holotype. NMB H 17314; from locality NMB 16923: Río Mao (Arroyo Bajón); late Miocene; 1. front view; 2. apical view; 3. rear view; 4. from right side. Height, 32.8 mm; width, 22.6 mm. ×2.

5–7. Paratype. NMB H 17315; from locality NMB 17269: Río Mao (Bluff 3 of Maury); late Miocene; 5. front view; 6. apical view; 7. rear view. Height, 36.8 mm; width, 26.2 mm. ×2.

8–11. ***Cancellaria (Bivetopsia) moorei*** Guppy, 1866 118

Lectotype. BMNH G 64068. Bowden, Jamaica; Bowden Formation (early Pliocene); 8. front view; 9. rear view; 10. from right side; 11. apical view. Height, 19.0 mm; width, 13.6 mm. × 3.

12–15. ***Cancellaria (Bivetopsia) plectilis***, new species 107

Holotype. NMB H 17317; from locality TU 1354: Río Cana (Cañada de Zamba); Gurabo Formation (early Pliocene); 12. front view; 13. from right side; 14. rear view; 15. apical view. Height, 25.2 mm; width, 18.0 mm. ×3.

EXPLANATION OF PLATE 23

Figure — Page

1–5. ***Cancellaria* (*Hertleinia*) *miranda***, new species 107

1–3. Holotype. NMB H 17319; from locality NMB 15903: Río Gurabo; upper part of Cercado Formation (late Miocene); 1. front view; 2. rear view; 3. from right side. Height, 37.3 mm; width, 17.2 mm. ×2.

4. Paratype. NMB H 17320; from locality NMB 15903: Río Gurabo; upper part of Cercado Formation (late Miocene); front view. Height 33.7 mm; width: 15.3 mm. ×2.

5. Paratype. NMB H 17321; from locality NMB 15910: Río Gurabo; upper part of Cercado Formation (late Miocene); front view. Height 38.6 mm; width: 17.3 mm. ×2.

6–8. ***Cancellaria* (*Hertleinia*) *angosturana*** Marks, 1949 108

Holotype. PRI 20387. Angostura Cave on Río Santiago, Esmeraldas Province, Ecuador; Angostura Formation (late Miocene); 6. front view; 7. rear view; 8. from right side. Height, 21.7 mm; width, 9.3 mm. ×3.

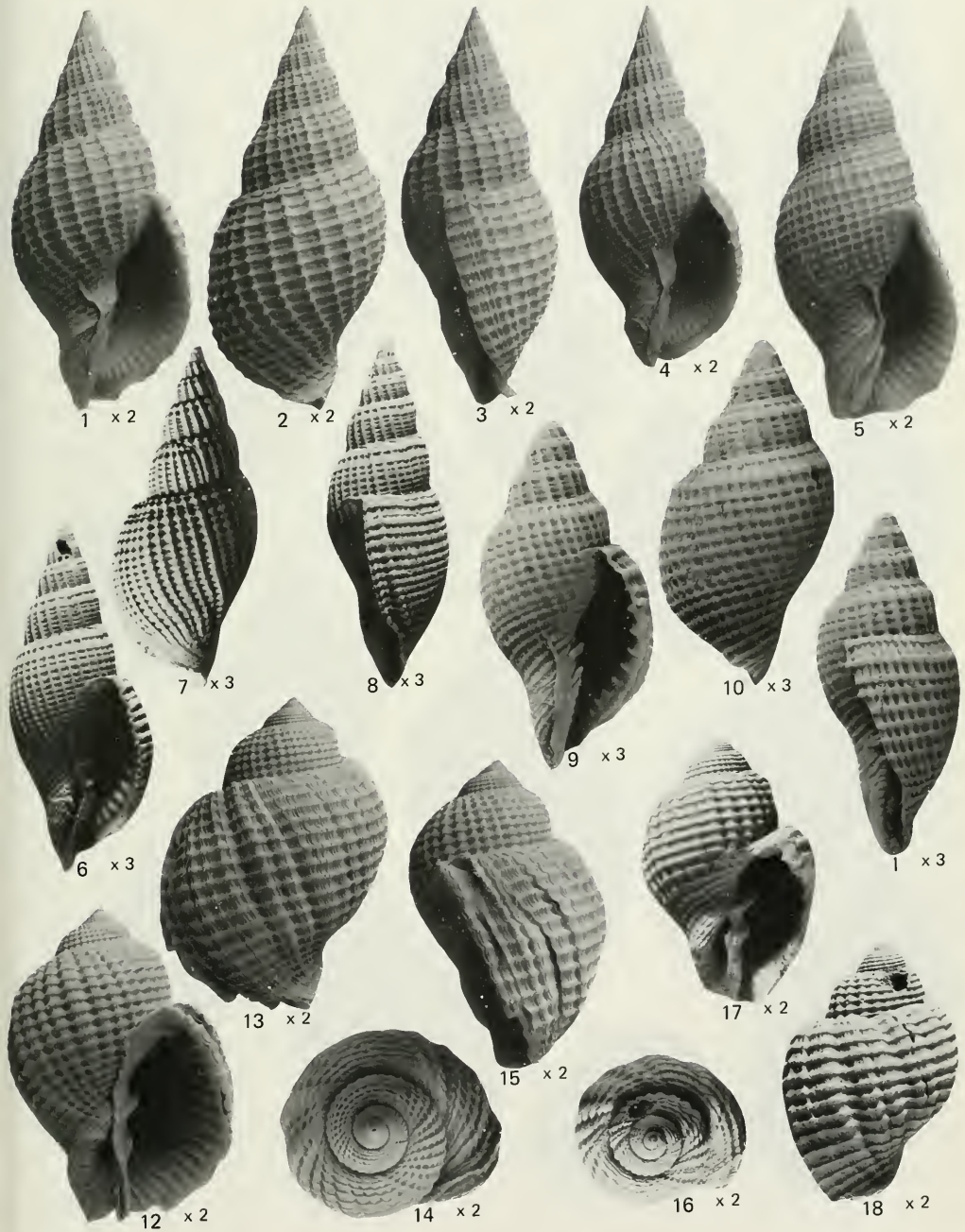
9–11. ***Cancellaria* (*Hertleinia*) *marksi*** Olsson, 1964 108

Holotype. USNM 643876. Quebrada Camarones, Esmeraldas Province, Ecuador; Esmeraldas Formation (early Pliocene); 9. front view; 10. rear view; 11. from right side. Height, 22.0 mm; width, 11.1 mm. ×3.

12–18. ***Cancellaria* (*Massyla*) *lopezana***, new species 109

12–15. Holotype. NMB H 17323; from locality NMB 17288: López section on Río Yaque del Norte; Baitoa Formation (late early to early middle Miocene); 12. front view; 13. rear view; 14. apical view; 15. from right side. Height, 29.6 mm; width, 21.7 mm. ×2.

16–18. Paratype. NMB H 17324; from locality NMB 16935: López section on Río Yaque del Norte; Baitoa Formation (late early to early middle Miocene); 16. apical view; 17. front view; 18. rear view. Height, 25.4 mm; width, 16.8 mm. ×2.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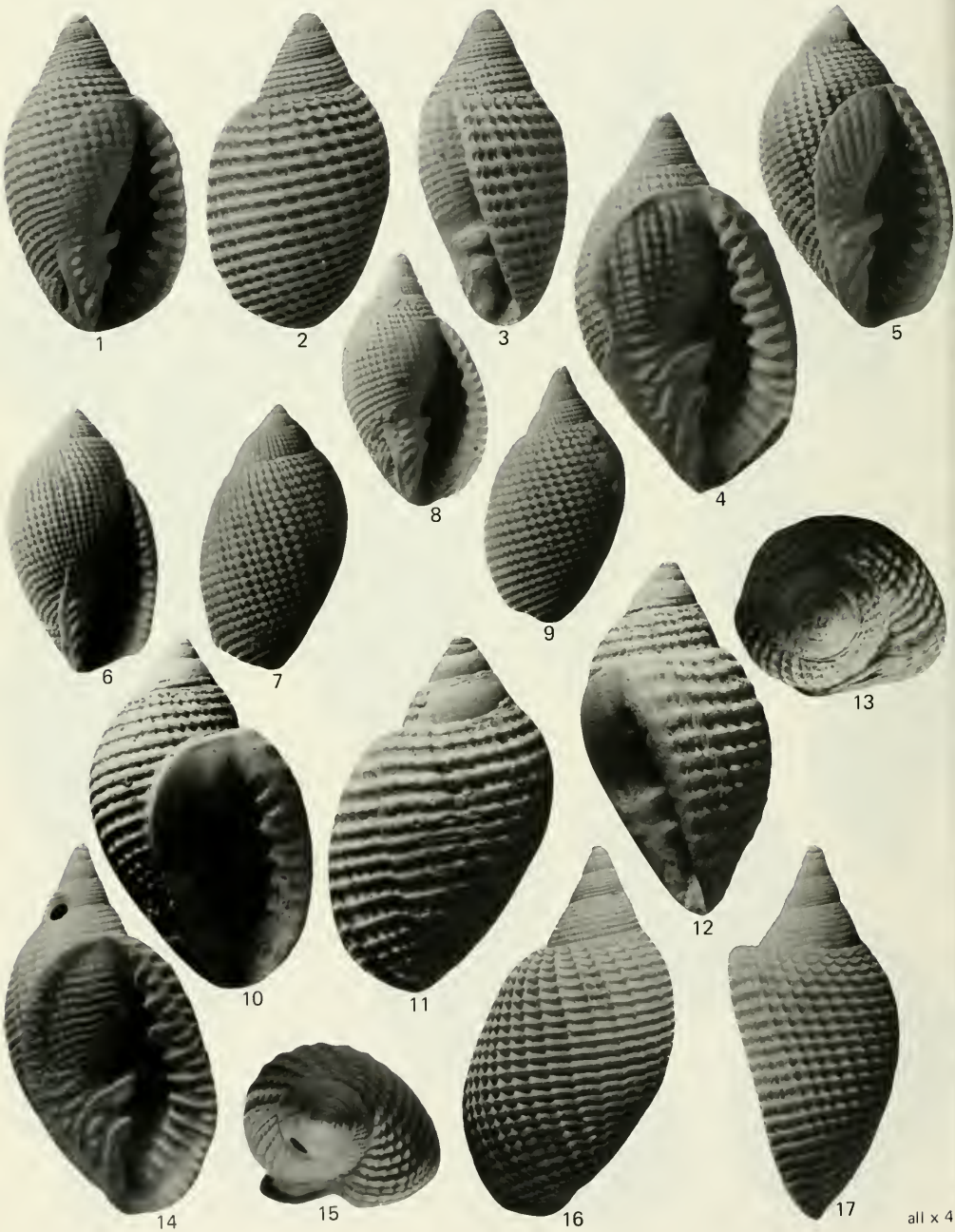
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EXPLANATION OF PLATE 24

All figures ×4

Figure — Page

1–9. ***Aphera islacolonis*** (Maury, 1917) 110

1–3. Lectotype. PRI 28960. Río Mao (Bluff 2 of Maury); Cercado Formation (late Miocene); 1. front view; 2. rear view; 3. from right side. Height, 14.9 mm; width, 8.6 mm.

4. Paralectotype. PRI 28670. Cercado de Mao; front view. Note prominent callus on columella and parietal wall. Height, 17.8 mm; width, 10.5 mm.

5. Paralectotype. PRI 28669. Cercado de Mao; front view. Height, 15.1 mm; width, 8.7 mm.

6, 7. Holotype of *Cancellaria ellipsis* Pilsbry, 1922. ANSP 2909. Santo Domingo (exact locality not known); 6. front view; 7. rear view. Height, 12.3 mm; width, 6.6 mm.

8, 9. Paratype of *Cancellaria ellipsis* Pilsbry, 1922. ANSP 2909. Santo Domingo (exact locality not known); 8. front view; 9. rear view. Height, 11.8 mm; width, 6.5 mm.

10–13. ***Aphera peruana*** Nelson, 1870 111

Holotype. YPM 525. Quebrada Tucillal at Zorritos, northern Peru; Tumbes Formation (late Miocene); 10. front view; 11. rear view; 12. from right side; 13. apical view. Height, 16.5 mm; width, 10.1 mm.

14–17. ***Aphera islacolonis*** (Maury, 1917) 110

NMB H 17325; from locality NMB 15903: Río Gurabo; upper part of Cercado Formation (late Miocene); 14. front view; 15. apical view; 16. rear view; 17. from right side. Height, 17.6 mm; width, 9.3 mm.

EXPLANATION OF PLATE 25

Figure — Page

1–8. ***Aphera islacolonis*** (Maury, 1917) — 110

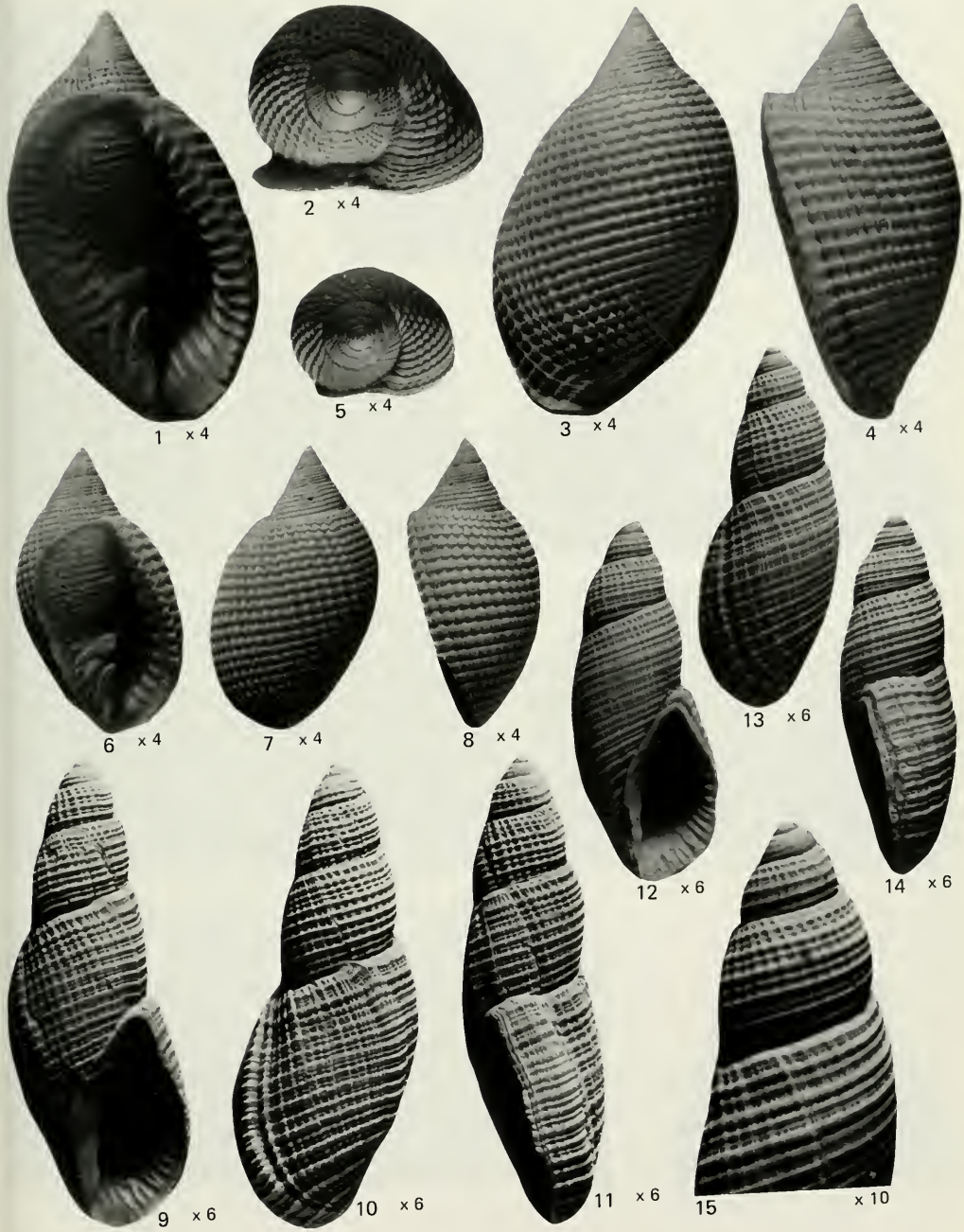
1–4. NMB H 17326; from locality NMB 16844: Río Cana; upper part of Cercado Formation (late Miocene); 1. front view; 2. apical view; 3. rear view; 4. from right side. Height, 19.4 mm; width, 11.6 mm. ×4.

5–8. NMB H 17327; from locality NMB 16927: Río Mao (Arroyo Bajón); Cercado Formation (late Miocene); 5. apical view; 6. front view; 7. rear view; 8. from right side. Height, 13.4 mm; width, 7.6 mm. ×4.

9–15. ***Perplicaria canae***, new species — 112

9–11. Holotype. NMB H 17330; from locality TU 1230: Río Cana at Caimito; Cercado Formation (late Miocene); 9. front view; 10. rear view; 11. from right side. Height 14.4 mm; width: 5.5 mm. ×6.

12–15. Paratype. NMB H 17331; from locality TU 1230: Río Cana at Caimito; Cercado Formation (late Miocene); 12. front view, ×6; 13. rear view, ×6; 14. from right side, ×6; 15. early whorls, ×10. Height 11.3 mm; width: 4.4 mm.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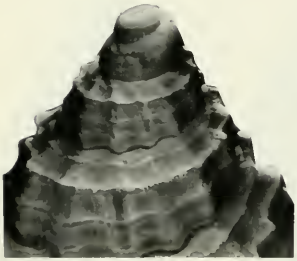
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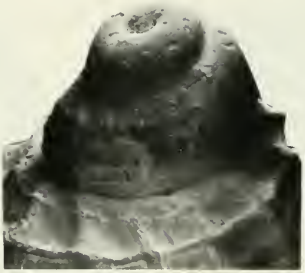
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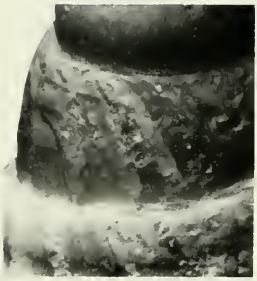
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Explanation of Plate 26

Figure — Page

1–3. ***Cancellaria* (*Bivetiella*) *bajonensis***, new species 106
Paratype. NMB H 17316; from locality NMB 16924: Río Mao (Arroyo Bajón); Cercado Formation (late Miocene); 1. early whorls, ×15; 2. protoconch with transition to teleoconch, ×40; 3. apical view, ×40.

4–7. ***Cancellaria* (*Hertleinia*) *miranda***, new species 107
Paratype. NMB H 17322; from locality NMB 15907: Río Gurabo; upper part of Cercado Formation (late Miocene); 4. early whorls, ×32; 5. oblique apical view of protoconch, ×40; 6. transition protoconch/teleoconch, ×65; 7. apical view, ×40.

8–11. ***Aphera islacolonis*** (Maury, 1917) 110
8, 9. NMB H 17328; from locality NMB 16923: Río Mao (Arroyo Bajón); Cercado Formation (late Miocene); 8. early whorls, ×30; 9. transition protoconch/teleoconch, ×60.
10, 11. NMB H 17329; from locality NMB 15903; Río Gurabo; upper part of Cercado Formation (late Miocene); 10. oblique apical view showing transition protoconch/teleoconch, ×50; 11. apical view, ×32.

12–14. ***Perplicaria canae***, new species 112
Paratype. NMB H 17331; from locality TU 1230: Río Cana at Caimito; Cercado Formation (late Miocene); 12. early whorls, ×30; 13. transition protoconch/teleoconch, ×60; 14. apical view, ×60. Same specimen as Pl. 25, figs. 12–15.

EXPLANATION OF PLATE 27

Figure — Page

1–12. ***Trigonostoma* (*Ventrilia*) *gurabis*** (Maury, 1917) 113

1–4. Holotype. PRI 28668. Río Gurabo at Los Quemados; late Miocene part of Gurabo Formation; 1. front view; 2. rear view; 3. from right side; 4. apical view. Height 11.0 mm; width: 8.6 mm. ×4.

5–8. NMB H 17332; from locality TU 1215; Río Gurabo; late Miocene part of Gurabo Formation; 5. front view; 6. rear view; 7. from right side; 8. apical view. Height, 11.4 mm; width, 9.0 mm. ×4.

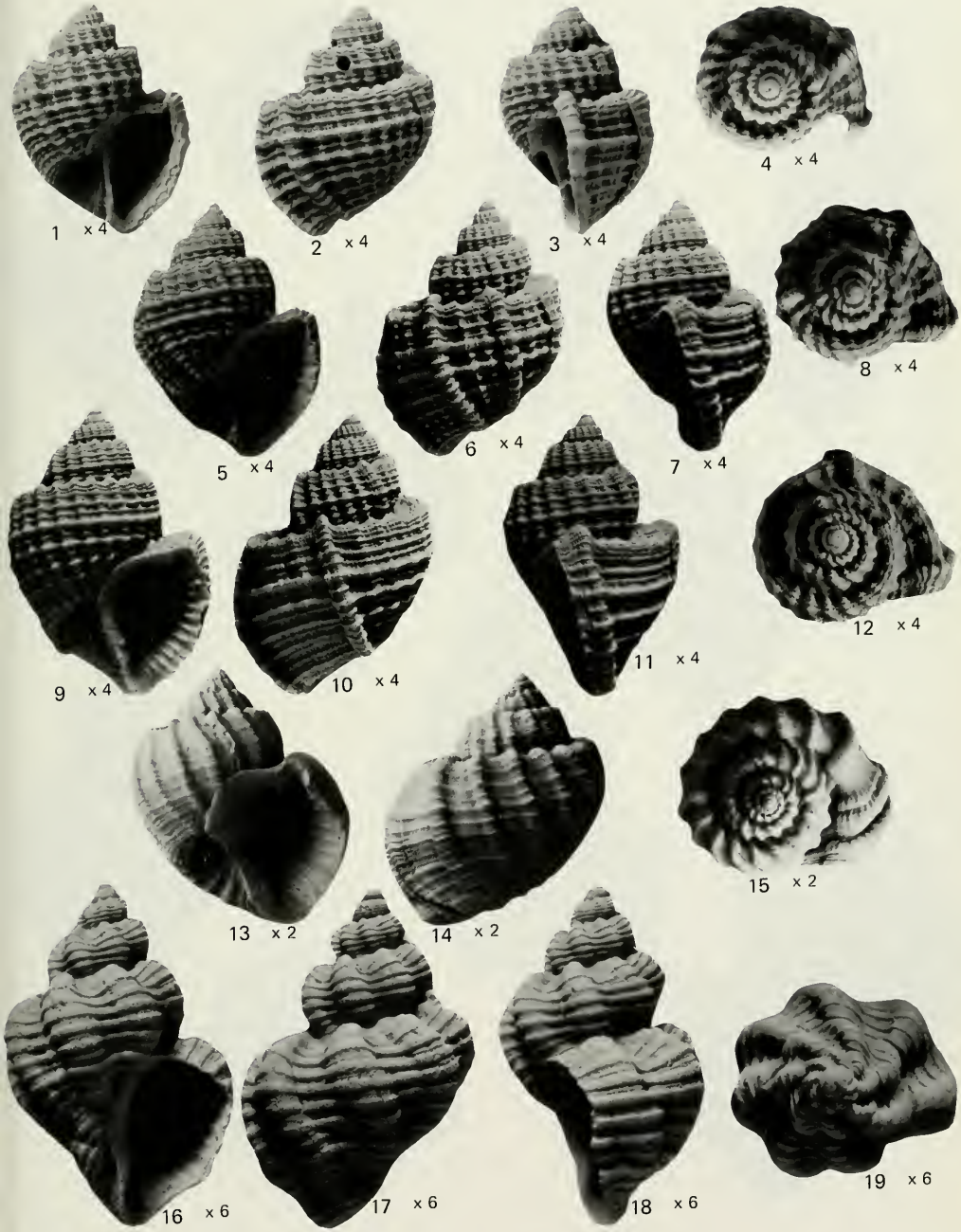
9–12. NMB H 17333; from locality TU 1215; Río Gurabo; late Miocene part of Gurabo Formation; 9. front view; 10. rear view; 11. from right side; 12. apical view. Height, 13.2 mm; width, 9.6 mm. ×4.

13–15. ***Trigonostoma* (*Ventrilia* ?) *insulare*** (Pilsbry and Johnson, 1917) 113

Holotype. ANSP 2989. Santo Domingo (exact locality not known); 13. front view; 14. rear view; 15. apical view. Height, 24.2 mm; width, 21.0 mm. ×2.

16–19. ***Axelella emblema***, new species 114

Holotype. NMB H 17335; from locality NMB 16942: López section on Río Yaque del Norte; Baitoa Formation (late early to early middle Miocene); 16. front view; 17. rear view; 18. from right side; 19. apical view. Height, 10.7 mm; width, 7.1 mm. ×6.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Explanation of Plate 28

All figures ×6

Figure Page

1–10. *Agatrix losquemadica* (Maury, 1917) 115

1–3. Holotype. PRI 28671. Río Gurabo at Los Quemados; late Miocene part of Gurabo Formation; 1. front view; 2. rear view; 3. from right side. Height, 12.8 mm; width, 7.6 mm.

4–6. NMB H 17340; from locality TU 1250: Río Verde; early Pliocene; 4. apical view; 5. front view; 6. rear view. Height, 12.5 mm; width, 7.5 mm.

7–10. NMB H 17341; from locality NMB 15863: Río Gurabo; late Miocene part of Gurabo Formation; 7. front view; 8. rear view; 9. apical view; 10. from right side. Height, 15.5 mm; width, 8.9 mm.

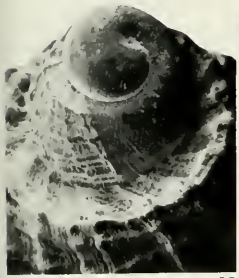
EXPLANATION OF PLATE 29

Figure — Page

1–4. ***Trigonostoma* (*Ventrilia*) *gurabis*** (Maury, 1917) — 113
NMB H 17334; from locality TU 1215; Río Gurabo; late Miocene part of Gurabo Formation; 1. protoconch, ×28; 2. transition protoconch/teleoconch, ×55; 3. apical view, ×28; 4. apical view, ×55.

5–8. ***Agatrix losquemadica*** (Maury, 1917) — 115
NMB H 17342; from locality TU 1250; Río Verde; early Pliocene; 5. protoconch, ×30; 6. transition protoconch/teleoconch, ×60; 7. apical view, ×60.

9–12. ***Admetula zalayana***, new species — 116
Holotype. NMB H 17343; from locality TU 1227; Arroyo Zalaya, early Pliocene; 9. front view; 10. rear view; 11. from right side; 12. apical view. Height 11.2 mm; width: 7.7 mm. ×6.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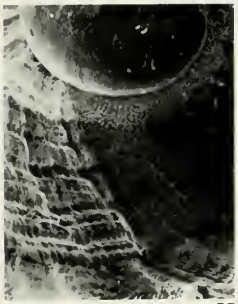
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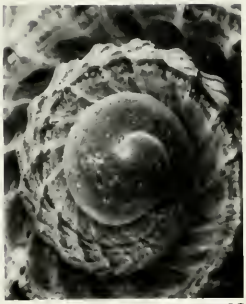
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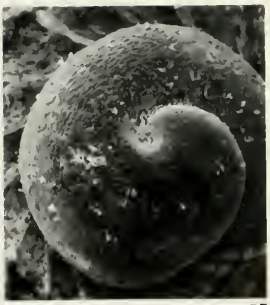
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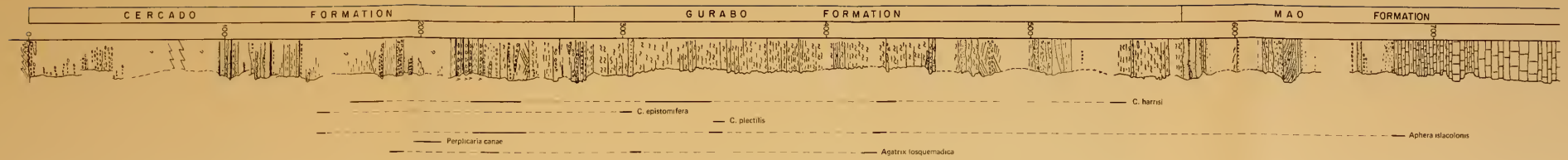
INDEX

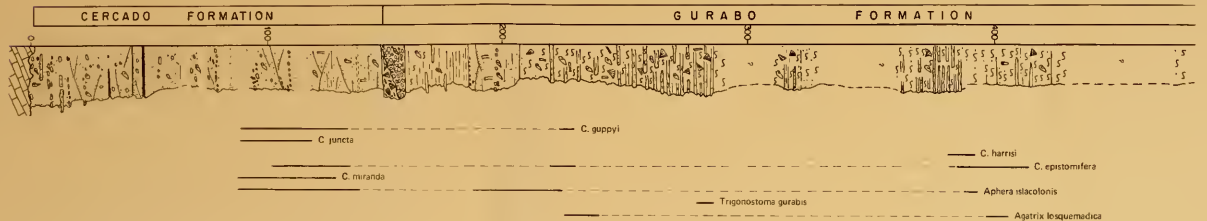
Note: Page numbers are in light face; plate numbers are in **bold face** type; the page numbers on which principal discussions occur are in *italics*; **B** indicates the foldout inside the back cover.

Text-figure 2



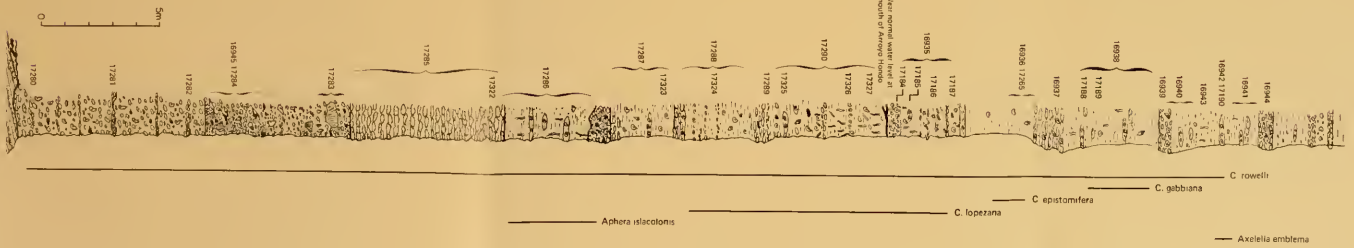
Text-figure 2.—Columnar section of Rio Cana showing (discontinuous) "ranges" of cancellariid species (after Saunders, Jung, and Biju-Duval, 1986, text-fig 16). Numbers in second column from left refer to thickness in m.

Text-figure 3



Text-figure 3.—Columnar section of Rio Gurabo showing (discontinuous) "ranges" of cancellariid species (after Saunders, Jung, and Biju-Duval, 1986, text-fig 6). Numbers in second column from left refer to thickness in m.

Text-figure 4



Text-figure 4.—Columnar section of cliff exposures on Rio Yaque [illegible] near López, north of Bantos, showing (discontinuous) [illegible] cancellariid species and stratigraphic position of NMB [illegible] (after Saunders, Jung, and Biju-Duval, 1986, text-fig 25)

PREPARATION OF MANUSCRIPTS

Bulletins of American Paleontology usually comprises two or more separate monographs in two volumes each year. This series is a publication outlet for significant longer paleontological monographs for which high quality photographic illustrations and the large quarto format are a requisite.

Manuscripts submitted for publication in this monograph series must be typewritten, and double-spaced *throughout* (including direct quotations and references). All manuscripts should contain a table of contents, lists of text-figures and (or) tables, and a short, informative abstract that includes names of all new taxa. Format should follow that of recent numbers in the series. All measurements must be stated in the metric system, alone or in addition to the English system equivalent. The maximum dimensions for photographic plates are 178 mm × 229 mm (7″ × 9″; outlined on this page). Single-page text-figures should be drafted for reproduction as single column (82 mm; 3¼″) or full page (178 mm; 7″) width, but arrangements can be made to publish text-figures that must be larger. Any lettering in illustrations should follow the recommendations of Collinson (1962).

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Collinson, J.
1962. *Size of lettering for text-figures.* Journal of Paleontology, vol. 36, p. 1402.

Gilbert Dennison Harris
(1864 - 1952)

Founder of the *Bulletins of American Paleontology* (1895)

ISBN 0-87710-415-8