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Neogene Paleontology in the Northern Dominican Republic 18.

The Superfamily Volutacea (in part) (Mollusca: Gastropoda)

by

Emily H. Vokes

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CONTENTS

LIST OF ILLUSTRATIONS

NEOGENE PALEONTOLOGY IN THE NORTHERN DOMINICAN REPUBLIC 18. THE SUPERFAMILY VOLUTACEA (IN PART) (MOLLUSCA:GASTROPODA)

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ABSTRACT

This study concerns a group of taxa formerly included in the Superfamily Volutacea, most characterized by the presence of columellar plications. In all there are 19 species, divided among eight genus-group taxa. Numerically, the largest genera are *Vasum*, with six species, and *Turbinella*, with four species. The other groups include only a few species each: *Scaphella* s.s.—1; *Lyria* s.s.—3; *Lyria (Enaeta)*—1; *Harpa*—1; *Morum* s.s.—1; and *Morum (Oniscidia)*—2. Only one species, *Scaphella (Scaphella) striata* (Gabb), occurs in beds of the Gurabo Formation that represent deep-water deposition. All others occur in shallow-water beds, often in association with coralline facies. The shallow-water portion of the Gurabo Formation contains the largest number of species, 11 in all; however, only two are confined to these beds, the others also occur in the other shallow-water formations as well. The stratigraphically older Baitoa Formation contains seven species, of which five are endemic (three certain and two presumed to be from the same unit). Although the Mao Formation is generally representative of extremely deep-water deposition, five species occur in gravity-flow deposits of shallow material into the deeper beds. Fourteen of the species were described from the Dominican Republic by Sowerby, Gabb, and others; two are new to the fauna (one known previously only from the Chipola Formation, and one known previously only from the Recent of the Caribbean); and three are new species: *Lyria gabbi*, from the Baitoa Formation; *Turbinella pilsbryi*, from unnamed beds of Cercado age; and *T. praetextilis*, from the shallow-water Gurabo Formation.

RESUMEN

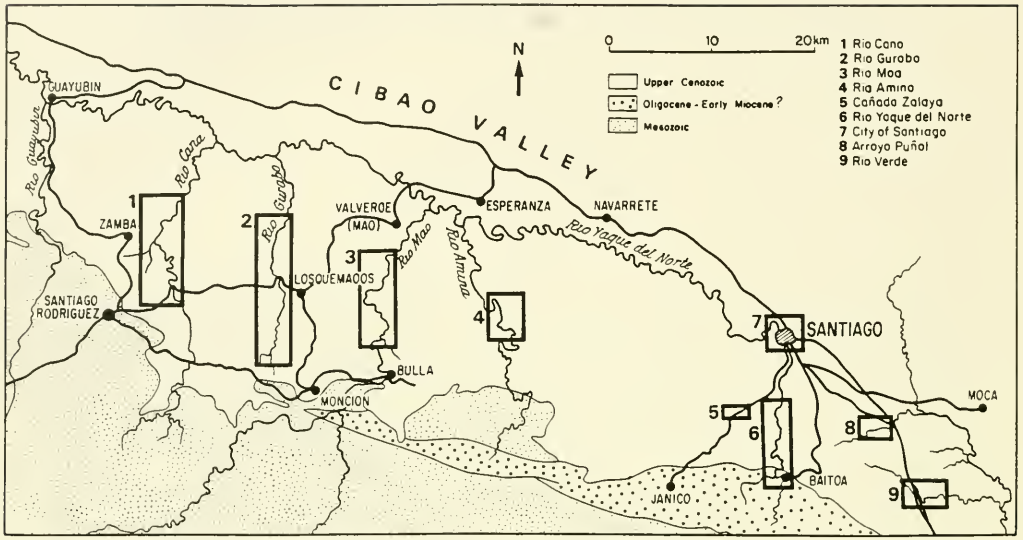
Este estudio trata un grupo de taxa previamente incluídos en la Superfamilia Volutacea, caracterizada principalmente por la presencia de pliegues columelares. En total hay 19 especies, divididas en ocho taxa al nivel genérico. Los géneros con más número de especies son *Vasum*, con seis especies, y *Turbinella*, con cuatro especies. Los otros géneros incluyen solamente unas pocas especies cada uno: *Scaphella* s.s.—1; *Lyria* s.s.—3; *Lyria (Enaeta)*—1; *Harpa*—1; *Morum* s.s.—1; *Morum (Oniscidia)*—2. Solamente una especies, *Scaphella (Scaphella) striata* (Gabb), ocurre en los estratos de la Formación Gurabo representativa de deposiciones de aguas profundas. Todas las otras ocurren en estratos de aguas bajas, con frecuencia en asociacion con faces coralinas. La porción de aguas bajas de la Formación Gurabo contiene la mayoría de las especies, 11 en total; sin embargo, solamente dos se limitan a estos estratos, las otros también ocurren en las otras formaciónes. La Formación Baitoa, estratigráficamente más antigua, contiene siete especies, de las cuales cinco son endémicas (tres con certeza y dos que se presume sean de la misma unidad). Aunque la Formación Mao generalmente representa deposiciones de aguas extremadamente profundas, se encuentran allí cinco especies en depósitos de material de aguas bajas en estratos más profundos debido a corrientes de gravedad. Catorce de estas especies fueron descritas como provenientes de la República Dominicana por Sowerby, Gabb, y otros; dos son nuevas a la fauna (una previamente conocida sólo de la Formación Chipola, y otra previamente conocida sólo del Reciente del Caribe); y tres son especies nuevas: *Lyria gabbi*, de la Formación Baitoa; *Turbinella pilsbryi*, de estratos sin nombre de la edad de Cercado; y *T. praetextilis*, de las aguas bajas de la Formación Gurabo.

INTRODUCTION

The paleontology of the northern Dominican Republic has been the subject of a number of papers, beginning with G.B. Sowerby's (1850) study of the material collected by T.S. Heneken, a British Army officer. This was followed by W.M. Gabb (1873), whose material was reworked by Pilsbry and Johnson (1917), who named certain of his undescribed material; later Pilsbry (1922) illustrated most of the Gabb Collection. In 1916 Carlotta Maury mounted an expedition to the Dominican Republic, which resulted in the publication of the most complete study (1917) of the stratigraphy and paleontology up to the present series.

Beginning in 1976, Harold E. Vokes and I spent a considerable amount of time (some seven months in all) collecting the Dominican fossil fauna. Shortly thereafter, in 1978, Peter Jung and John Saunders, of the Naturhistorisches Museum, Basel, embarked upon their major assault on the stratigraphy of this enticing area.

Soon we combined forces and the results of this collaboration now have been documented in a series of publications, the first being Saunders *et al.* (1986), wherein the framework of the stratigraphy, measured



Text-figure 1.—Locality map for the sections measured and described by Saunders *et al.* (1986). The TU collections were made in these same areas but in intervening areas, also. See Appendix 4 of that work for a complete description of all Tulane localities.

sections (see Text-fig. 1), and maps of all collecting localities, including those of the Maury 1916 expedition, the United States Geological Survey's 1919 expedition (shown as USGS), the Basel team (shown as NMB) and the Vokes's collections (shown as TU).

The history and philosophy of all of these various collecting ventures has been discussed at length in a study of the Dominican Muricidae (Vokes, 1989), and they will not be repeated here. The reader is referred to Saunders *et al.* (1986) for detailed information on the various localities mentioned in the text below.

One of the principal purposes of our original field work in the Dominican Republic was to localize, geographically and stratigraphically, the many species originally described as coming from simply "Santo Domingo." In most cases we believe that we can now say with a fair degree of certainty a given species was originally collected at a particular locality. Therefore, where there was no type locality mentioned by the original author, I have restricted the type locality to a Tulane locality number.

ACKNOWLEDGMENTS

As a small part of a much larger project, it would be impossible to single out everyone who has provided assistance in some way during the years we were collecting in the Dominican Republic. In addition, parts of this particular study long precede the Dominican Project (*Turbinella*: Vokes, 1964; *Vasum*: Vokes, 1966; *Lyria*: Hoerle and Vokes, 1978) and my gratitude to persons who provided specimens and other assistance for these previous studies must be carried forward to the present. Certainly, principal among the "pre-Dominican Project" help would be the late L.R. Cox, British Museum (Natural History) (now the Natural History Museum, London), who provided photographs of the Heneken material, many of which are used in this paper for the first time, and Horace G. Richards, Academy of Natural Sciences of Philadelphia, who loaned many *Vasum* specimens from the Gabb Collection. In a more recent time frame, deepest gratitude is extended to Peter Jung and John Saunders, Naturhistorisches Museum, Basel, who collected much of the material studied, and in particular, who originally located the Arroyo Hondo and López localities that are assumed to be the source of much of Gabb's material. To the more current personnel at the Academy of Natural Sciences of Philadelphia (Gary Rosenberg, David G. Robinson, Elena Benamy), the United States National Museum of Natural History (Thomas R. Waller, Warren Blow, the late Joseph Rosewater), the Paleontological Research Institution (Warren D. Allmon), and the Natural History Museum, London (Patrick Nuttall, L.R.M. Cocks, Paul Jeffery), I am grateful for the loan of specimens, hospitality in their institutions, and other less tangible means of assis-

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BIOSTRATIGRAPHY

The Neogene strata in the northern Dominican Republic have been covered extensively in the previous studies and a brief summary will suffice here. The earliest beds are those of the Baitoa Formation, which occur only in the vicinity of the type locality, where they rest upon the upturned strata of the Oligocene Tabera Formation (see Vokes, 1979, text-fig. 2; Saunders *et al.,* 1986, text-fig. 28). On the basis of the ostracode fauna, Bold (1988, p. 11), has dated the Baitoa Formation as Neogene Zones N.7–10, or upper Lower Miocene. The Baitoa was deposited in shallow water with gravel and coral boulders mixed in with the mollusks (see Vokes, 1979, text-fig. 1).

Elsewhere the basal beds of the Neogene consist of the Bulla Conglomerate, resting unconformably upon the Mesozoic basement, and containing large granitic boulders that mark the shoreline of the Late Miocene marine transgression. The Bulla Conglomerate rapidly grades upward into a marine facies known as the Cercado Formation, which is clearly very shallow water, with smaller boulders mixed in among the beautifully preserved molluscan shells.

Gradually, as one moves both away from the shoreline and up in time, the faunas indicate deepening water. These deeper beds have been named the Gurabo Formation. The nature of these two "formations" has been the subject of much discussion, and it is my conclusion that there are two distinct lithologic units involved, the Cercado being a coarse, highly fossiliferous sand and the Gurabo a fine siltstone, with scattered fossils. The contact is indeed gradational and there is some debate as to where the exact break should be placed. Nevertheless, at most localities there is no doubt as to whether one is in the Cercado or the Gurabo facies. The time-line between the Late Miocene and the Early Pliocene has been placed by Saunders *et al.* (1986, p. 19) at the point where the Gurabo Formation shows a marked deepening, which they attribute to a rise in sea-level at the onset of the Pliocene.

Through the Early Pliocene the waters continue to deepen until the Gurabo Formation gradually is replaced by the even younger (Upper Pliocene) and much deeper-water Mao Formation. In the uppermost beds of the Mao Formation there is a mélange of gravity slumps with shallow-water mollusks and gravel, signaling the beginning of the uplift that has brought all of these strata to a position several hundred meters above sea level today.

PALEOECOLOGY

On the basis of the muricid fauna, by analogy with closely related living forms, Vokes (1989, p. 21) determined that the Baitoa and the Cercado formations were deposited in water depths of 0 to 20 meters, and the shallower portions of the Gurabo Formation, including the coralline beds, in depths of about 20 to 50 meters. The moderately deep portions of the Gurabo Formation were deposited in depths of 50 to 150 meters, and the deepest portions of the Gurabo in 150 to 350 meters. The Mao Formation is thought, on the basis of planktic foraminifera, to have been deposited in water depths exceeding 350 meters. The mollusks in the present study agree with this previous assessment.

SYSTEMATIC PALEONTOLOGY

Introduction

In the various genera presented in this study we are hampered by the fact that the majority of the species may not have closely related living relatives either in the western Atlantic, or anywhere else. The most similar *appearing* species often prove to be only distantly related and so the inferences about ecologic conditions are largely guesswork. Nevertheless, there is a certain amount of information that may be extrapolated from the living faunas.

The synonymies presented here are as complete as possible and comparisons have been sought where they may be found. The only terms that might be confusing to the reader are "*non,*" which implies a senior homonym that preoccupies the taxon in question, *vs.* "not," which refers to a misidentification on the part of the author being cited.

In addition to the bibliographic references the original description is also included, as the wording given by the original author provides a special insight into the understanding of the species as originally conceived. Although many species have been provided with new descriptions, in some cases I do not feel that the work of a previous author can be improved upon and so these are provided instead of a new description.

Repository Abbreviations

ANSP Academy of Natural Sciences of Philadelphia, PA, USA

BMNH	Natural History Museum [British Museum (Natural History)], London, England, UK
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA
NMB	Naturhistorisches Museum, Basel, Switzerland
PRI	Paleontological Research Institution, Ithaca, NY, USA
TU	Tulane University, New Orleans, LA, USA
USNM	United States National Museum of Natural History, Washington, DC, USA

SYSTEMATICS

Superfamily **VOLUTACEA** Rafinesque, 1815

Remarks.—Although the Superfamily Volutacea has been subsumed into a larger group entitled "Superfamily Muricoidea" by Ponder and Warén (1988, p. 304), the Volutacea, originally proposed for those genera possessing columellar plications, is still a useful concept. The present study comprises a number of numerically small families, once included in the Volutacea, which are not being treated in other monographs in this series (*e.g.*, Olividae, Marginellidae, Mitridae). Once also considered a part of the Volutacea, the Family Cancellariidae is now the sole family in the superfamily Cancellarioidea and already has been monographed by Jung and Petit (1990).

Family **VOLUTIDAE** Rafinesque, 1815

Subfamily **SCAPHELLINAE** Adams and Adams, 1858

Genus **SCAPHELLA** Swainson, 1832

Scaphella Swainson, 1832, pl. 87.

Type species.—*Voluta junonia* Lamarck, 1804, by subsequent designation, Gray, 1847.

Maculopeplum Dall, 1906a, p. 143.

Type species.—*Voluta junonia* Lamarck, 1804, by original designation.

Clenchina Pilsbry and Olsson, 1953, p. 4.

Type species.—*Voluta dohrni* Sowerby, 1903, by original designation.

Subgenus **SCAPHELLA** s.s.

Remarks.—Although Clench (1946, p. 55) placed *Voluta dohrni* Sowerby, 1903, and *V. gouldiana* Dall, 1887, in the subgenus *Scaphella (Aurinia)* Adams and Adams, 1853, in a subsequent study of the radulae of the American volutes, Pilsbry and Olsson (1953) separated these species into a new subgenus they named *Clenchina* (type species: *V. dohrni*). Abbott (1974, p. 244) accepted the subgenus *Clenchina* but placed *V. dohrni* (and several other taxa) in the synonymy of *V. gouldiana.* Emerson and Old (1979, p. 11) accepted Abbott's synonymy of the various species but placed *Clenchina* in the synonymy of *Scaphella* s.s, stating that the supposed radular differences between *Scaphella,* with a central radular tooth having no small basal cusps, and *Clenchina,* with the central radular tooth having minute accessory cusps, were so minor that "the genus-group *Clenchina* is of questionable taxonomic value."

There seems little doubt that Emerson and Old are correct in their evaluation of *Clenchina,* but I cannot accept the synonymy of *S. dohrni* and *S. gouldiana.* All of the other taxa that have been assigned to the genus *Scaphella* and/or *Clenchina* are marked by spiral rows of intense brown dots; only *S. gouldiana* lacks these dots, although it may sometimes develop faint spiral bands (see Clench, 1946, pl. 30, fig. 3; Abbott, 1974, pl. 10, fig. 2663; Abbott and Dance, 1982, p. 224). The overall shell morphology is similar, with both species developing strong nodes at the shoulder for the first few teleoconch whorls, but *S. dohrni* is a more elongate shell. Both *S. dohrni* and *S. florida* (Clench and Aguayo, 1940), which has the greatest morphological resemblance to *S. gouldiana,* have three or four strong columellar plications but *S. gouldiana* has only two weak plicae in the adult shell.

Therefore, I consider *S. gouldiana* to be a valid species, assigned to the subgenus *Scaphella* s.s. This is relevant to the Dominican fauna because the single species of volute present is extremely close to *S. gouldiana.*

Scaphella (Scaphella) striata (Gabb, 1873)
Plate 1, figure 1

Scapha striata Gabb, 1873, p. 219; Guppy, 1876, p. 528.
Scaphella (Aurinia?) striata (Gabb). Dall, 1890, p. 88.
Aurinia striata (Gabb). Pilsbry, 1922, p. 339, pl. 22, fig. 9 (lectotype); Ramírez, 1950, p. 25, pl. 3, fig. 9; 1956, p. 12.

Diagnosis.—Elongate *Scaphella* with about 20–25 markedly pinched axial nodes per whorl at shoulder of third to fifth whorls; two strong columellar plications.

Original description.—"Two very young shells, evidently of this genus, occur in the collection, and I venture to name them despite their immature condition. Although the largest is barely over an inch long, they have both lost their nuclei and have the usual prominent but blunt apices. The larger is elongate, rather slender, the shoulder bears a series of short laterally compressed nodes which form a coronated angle. The suture is well marked and the whole surface is crossed by fine revolving striae. Below the angle, the sides are nearly straight and narrow sinuously in

advance. Columella with two prominent oblique folds." (Gabb, 1873, p. 219)

Description.—Maximum size of adult unknown; large blunt protoconch of approximately two and one-half smooth whorls, then gradually becoming ornamented with elongate axial ribs at shoulder. Ribs extremely weak on first ornamented whorl, approximately 20 in number, becoming stronger on second ornamented whorl, increasing to as many as 25 in number, then weakening again on third whorl, and (presumably) successive whorls. Ribs developed only at shoulder, about four times as long as wide; lateral margins markedly compressed giving a rectangular appearance to each rib; a strong angulation developed at shoulder. Spiral ornamentation of fine threads covering entire surface from suture to siphonal canal. Threads almost equi-sized but slightly heavier anterior to suture and over axial ribs; becoming somewhat weaker on remainder of body whorl. Suture appressed; subsutural slope concave into shoulder angle. Aperture elongate, outer lip simple, with angulation at shoulder; no callus developed on inner lip. Columella with two narrow, strongly oblique plications.

Type material and measurements.—Lectotype, ANSP 3274; height 25.0 mm, diameter 11.2 mm (designated by Pilsbry, 1922, p. 430). Paralectotype, ANSP 79166; height 13.0 mm, diameter 5.4 mm; locality unknown.

Type locality.—Gurabo Formation; Río Yaque del Norte, east bank, across from intake for water system, approximately 3.3 km (airline) upstream from bridge at Santiago de los Caballeros, and 0.5 km downstream from La Barranca, Dominican Republic (*fide* Ramírez, 1950, p. 25; here restricted).

Material studied.—Known only from the type lot of two immature specimens, plus a third, somewhat larger, specimen (height 38.0 mm, diameter 13.0 mm) collected by Ramírez (1950, p. 25).

Remarks.—In the Gabb Collection (Academy of Natural Sciences of Philadelphia) there are two incomplete examples of a species of *Scaphella,* similar to the living *S. gouldiana* (Dall, 1887). In all our collecting no further examples have been discovered, but a third, more complete, example was collected by Ramírez (1950, p. 50, pl. 3, fig. 9) at a locality neither Tulane or Basel ever reached, on the Río Yaque del Norte, just downstream from La Barranca. The beds at La Barranca, as well as those in the vicinity of Santiago de los Caballeros, are the deepest of the Gurabo Formation, having been deposited in depths of at least 200 meters (see Vokes, 1989, p. 21).

This deep-water habitat is no doubt the reason for the rarity of *S. striata* in collections. If the depth preference of *S. gouldiana* is any indication, then *S. striata* must have preferred depths on the order of 500 meters (records are from 143 to 926 meters, averaging 452 meters: Clench, 1946, p. 56).

Comparisons.—The most closely related species is the western Atlantic *Scaphella (Scaphella) gouldiana* (Dall, 1887) (Pl. 1, fig. 2), which differs in having the earliest non-ornamented whorls less extended and in having the shoulder nodes less "pinched." Although the holotype of *S. gouldiana* is larger (height 69 mm) than available specimens of *S. striata,* it has about three noded whorls, in contrast to the two and three-quarters noded whorls in the specimen figured by Ramírez, or the two noded whorls in the holotype of *S. striata* (these counts refer to the noded whorls rather than the "teleoconch" whorls because of lack of a precise dividing line between teleoconch and protoconch). A fully mature example of *S. striata* probably would be nearly the same size as *S. gouldiana.*

As noted above, *S. gouldiana* is unique among the species of *Scaphella* in lacking the characteristic brown color dots of the majority of the forms in the group (see color photographs in Abbott, 1974, pl. 10, fig. 2663; Abbott and Dance, 1982, p. 224). These intense color spots usually are visible even on fossil specimens, with the aid of ultraviolet light, but the two specimens of *S. striata* show no pattern suggesting that, like *S. gouldiana,* this species was monochromatic.

Occurrence.—Gurabo Formation: Río Yaque del Norte, Dominican Republic.

Distribution.—Gurabo Formation, Dominican Republic.

Subfamily **LYRIINAE** Pilsbry and Olsson, 1954

Genus **LYRIA** Gray, 1847

Lyria Gray, 1847, p. 141.

Type species.—*Voluta nucleus* Lamarck, 1811, by original designation.

Otocheilus Conrad, 1865, p. 24.

Type species.—*Fulgoraria mississippiensis* Conrad, 1848, by subsequent designation, Hoerle and Vokes, 1978.

Sannilyria Pilsbry and Olsson, 1954, p. 23.

Type species.—*Voluta pulchella* Sowerby, 1850, by original designation.

Dallivoluta Okutani, 1982, p. 115.

Type species.—*Dallivoluta surinamensis* Okutani, 1982, by original designation.

Subgenus **LYRIA** s.s.

Lyria (Lyria) pulchella (Sowerby, 1850)
Plate 1, figures 4–6
Plate 2, figures 1–12

Voluta pulchella Sowerby, 1850, p. 46, pl. 9, fig. 4; Guppy, 1866, p. 575; 1867, p. 160; 1874, p. 440; 1876, p. 528.
Voluta soror Sowerby, 1850, p. 46; Guppy, 1866, p. 575; 1867, p. 160; 1874, p. 440; 1876, p. 528.
Lyria pulchella (Sowerby). Gabb, 1873, p. 219; Dall, 1890, p. 84, in part, not pl. 4, fig. 3 [= *L.* sp. cf. *L. mississippiensis* (Conrad, 1848)]; 1915, p. 58, in part, not pl. 10, fig. 11 [= *L.(Harpeola) heilprini* Dall, 1915]; Maury, 1917, p. 73(237), pl. 11(37), figs. 10, 10a; Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 97, *et seq.*; Pilsbry, 1922, p. 338; Ramírez, 1950, p. 24, pl. 3, fig. 8; 1956, p. 12, *et seq.*
Not *Lyria soror* (Sowerby). Pilsbry, 1922, p. 338, pl. 24, figs. 11, 12 [= *L. (L.) gabbi*, n. sp.].
Lyria (Sannilyria) pulchella (Sowerby). Pilsbry and Olsson, 1954, p. 23(293), pl. 3(27), fig. 2.
Lyria (Lyria) pulchella (Sowerby). Pflug, 1961, p. 53, pl. 14, figs. 10–15 (figs. 11, 15 = lectotype); Hoerle and Vokes, 1978, p. 112, pl. 2, figs. 3, 4 (fig. 4, color pattern under UV light).
Lyria pulchella soror (Sowerby). Pflug, 1961, p. 54, pl. 15, figs. 1, 7 ("lectotype").

Diagnosis.—Medium-sized *Lyria* (maximum height about 50 mm), spire short and broad, about 15 axial costae on globose final whorl.

Original description.—"Testa oblongo-ovata, laevis, longitudinaliter costata, anfractibus senis subrotundatis, spira acuminata; costellis plerumque antice subobsoletis; labio externo intus laevi, columella plicata, plicis anticis majoribus." (Sowerby, 1850, p. 46)

Description.—"Shell globose with short spire; axially costate. Adult specimens consisting of five convex whorls plus one and one-half well-rounded nuclear whorls. Final teleoconch whorl with fourteen to sixteen sharply rounded, slightly sinuous axial costae, costae tending to fade anteriorly. Suture deeply impressed but not channeled. Outer lip ascending, with a broad terminal varix; margin sharp, smooth within. Parietal callus heavy, abapical half free-standing; two, occasionally three, coarse, oblique columellar plaits anteriorly, eight to twelve long lirations ornamenting remainder of columella. Siphonal fasciole weakly developed, with a few fine, wavy, spiral threads; siphonal notch broad and shallow." (Hoerle and Vokes, 1978, p. 112)

Type material and measurements.—Lectotype, BMNH G 83 956; height 37.0 mm, diameter 18.0 mm (designated by Pflug, 1961, p. 54). Holotype of *L. soror* (Sowerby), BMNH G 83 597; height 42.1 mm (incomplete), diameter 33.0 mm.

Type locality.—Locality TU 1219, Gurabo Formation; Río Amina, west of Potrero, Dominican Republic (restricted by Hoerle and Vokes, 1978, p. 112; see Saunders *et al.*, 1986, text-fig. 34).

Material studied.—This is the most widespread species of the Dominican "Volutacea," with hundreds of specimens in the collections taken from almost every locality in the Gurabo Formation, as well as rare examples in both the Cercado and Mao formations.

Remarks.—*Lyria pulchella* is by far the most abundant species of Volutidae in the Dominican beds. In the Tulane collections there are specimens from almost every Gurabo Formation locality, although the majority occur in beds of "shallow-water Gurabo," such as Potrero (loc. TU 1219; see Vokes, 1989, p. 18). There are a few specimens from the Cercado beds (locs. TU 1374 [2] and 1375 [7]) and, more surprisingly, in the gravity-flow of shallow-water material into the deep-water beds of the Mao Formation at Gurabo Afuero 12 examples have been collected. These younger examples have a somewhat larger protoconch (2 mm in diameter *vs.* 1.5 mm in Gurabo shells) but otherwise are identical to typical Gurabo specimens.

Comparisons.—This common species sometimes occurs together with the less common *L. incompetra,* which differs in having a more slender shell with a proportionally higher spire. The angle of the spire in *L. pulchella* measures from 67 to 70 degrees but that of *L. incomperta* is from 55 to 60 degrees. The final whorl in *L. pulchella* is more globose and the outer lip has a notable abapical flare.

From the Lower Miocene Pirabas Limestone of Brazil, Maury (1925a, p. 172/173, pl. 8, fig. 13) has described a species as *Lyria musicinoides* that is perhaps closely related to *L. pulchella.* Although she compared it to the Tampa Limestone species *Falsilyria musicina* (Heilprin, 1886), it bears much less resemblance to that form than does the other species she named *L. calligona* (Maury, 1925a, p. 172/173, pl. 4, figs. 9, 14), which even more closely resembles the Chipola Formation species *Falsilyria pycnopleura* (Gardner, 1937).

The type specimen of the Pirabas *L. musicinoides* is an incomplete external mold, which if complete would have measured approximately 40 mm in height. According to Maury, it bears about 10 strong rounded axial ribs on the last whorl. On the basis of this incomplete impression, the species has a more deeply impressed suture than does *L. pulchella* and the axial ribs lack the sinuous fold immediately anterior to the suture. But with no better material than is known, it is impossible to be sure just how distinct the Brazilian form is from the Dominican species.

There is no living western Atlantic species that has more than a generic resemblance to *L. pulchella.* Superficially, it resembles *L. deliciosa* (Montrouzier, 1859) from New Caledonia (see color figure in Abbott and Dance, 1982, p. 213) but that species has four

strong anterior plaits and no posterior lirations. The apertural ornamentation is more nearly like that of the Indo-Pacific species *L. planicostata* (Sowerby, 1903), but otherwise the shells are not especially similar with the latter being much more elongate than *L. pulchella*.

From the Pliocene Punta Gavilan Formation of Venezuela, Rutsch (1934, p. 87, pl. 7, figs. 7, 8) has figured a specimen he cited as "*Lyria* n. sp. aff. *pulchella*." It is just that, a new species resembling *L. pulchella* in the nature of the apertural ornamentation but more similar to *L. incomperta* Hoerle and Vokes (which follows) in the slender outline and the lesser number of axial ribs.

Occurrence.—Cercado/Gurabo formations: Río Gurabo (TU 1210–1215, 1231, 1246, 1277, 1278, 1296, 1374, 1375; NMB 15803, 15805, 15807, 15815–15817, 15820, 15843, 15848, 15849, 15861, 15863–15869, 15871, 15898, 15899, 16808–16810); Río Cana (NMB 16864, 16865, 16868, 16880); Río Mao area (TU 1225, 1292, 1293, 1409, 1410; NMB 16910); Río Amina area (TU 1219, 1220, 1248, 1370, 1411, 1412; NMB 16807); Santiago area (TU 1206, 1227, 1227A, 1250; NMB 17270). Mao Formation: Río Gurabo area (TU 1208, 1352, 1413; NMB 15821, 15833).

Distribution.—Cercado, Gurabo, and Mao formations, Dominican Republic.

Lyria (Lyria) incomperta Hoerle and Vokes, 1978
Plate 1, figures 3, 9
Plate 2, figures 13–24

Lyria (Lyria) incomperta Hoerle and Vokes, 1978, p. 112, pl. 2, figs. 1, 2.

Diagnosis.—Small *Lyria* (maximum height about 45 mm), slender, high spired, about 14 axial costae on narrow body whorl.

Original description.—"Adult specimens with one and one-half nuclear whorls plus six axially costate whorls. About fourteen low, rounded axial costae, bent forward at the suture and reaching nearly to the base on the final whorl. Suture distinct, slightly undulated by costae. Aperture elliptical; outer lip not ascending, terminal varix broad, smooth within, margin sharp; parietal wall callused, three strong oblique plaits anteriorly with the posterior one slightly weaker, ten to fifteen long thread-like lirations on remaining portion of columella. A few wavy spiral threads marking the weak siphonal fasciole; siphonal notch broad and shallow." (Hoerle and Vokes, 1978, p. 112)

Type material and measurements.—Holotype, USNM 253221; height 24.7 mm, diameter 12.7 mm. Paratype, USNM 253222; height 24.0 mm, diameter 11.7 mm; locality TU 1215.

Type locality.—Locality TU 1215, Gurabo Formation; Río Gurabo, bluffs on both sides from the ford on the Los Quemados-Sabaneta road, upstream to approximately 1 km above the ford, Dominican Republic (= locs. USGS 8539-8543; Maury's Zone D; see Saunders *et al.*, 1986, text-fig. 5).

Material studied.—Numerous specimens, primarily from the coralline facies of the Gurabo and (rarely) Cercado formations.

Remarks.—This species is almost totally confined to coralline facies. Although originally described as coming only from one coralline locality, TU 1215, subsequent collecting has provided a few examples from other localities in the Dominican Republic. The majority of the specimens are from the TU 1215 area (95 examples in all) but other similar coralline facies, such as Cañada de Zamba and the Río Cana area, have yielded some specimens (38 examples). There are also a few (10 examples) from the unnamed reefal unit at López (see Vokes, 1989, p. 20). Only another 12 examples have been taken at "shallow-water Gurabo" localities. A single example has been taken in the reefal Cercado beds of Arroyo Bellaco (loc. TU 1422).

Comparisons.—See *L. pulchella*, above, for comparison.

Occurrence.—Cercado/Gurabo formations: Río Cana area (TU 1354, 1356, 1422; NMB 16818, 16821, 16828); Río Gurabo (TU 1211, 1215, 1277, 1278; NMB 15842, 15845–15848, 15850, 15854–15859, 16883, 16934). Unnamed formation: López area (NMB 17273).

Distribution.—Cercado and Gurabo formations, and unnamed unit of the same age as the Cercado Formation, Dominican Republic.

Lyria (Lyria) gabbi, new species
Plate 1, figures 7, 8

Lyria pulchella (Sowerby). Gabb, 1873, p. 219 (in part, not Sowerby, 1850).

Lyria soror (Sowerby). Pilsbry, 1922, p. 338, pl. 24, figs. 11, 12 (not Sowerby, 1850).

Diagnosis.—Small *Lyria* (maximum height about 45 mm), slender, high-spired, about 24 axial costae on body whorl; margin of outer lip with a series of forward-directed barbs.

Description.—Adult specimens elongate, with a protoconch of two and one-half whorls plus five axially costate teleoconch whorls. On first three teleoconch whorls about 11 rounded axial costae, bent forward at the suture; on fourth teleoconch whorl costae increasing in number to about 15 and on last whorl from 22 to 26, strongest at shoulder but reaching nearly to base of whorl. Axial sculpture only on anterior portion of body whorl, with about eight faint, flattened cords (well shown in Pilsbry, 1922, pl. 24, fig. 11).

Suture distinct, slightly undulated by costae. Aperture elongate-oval; outer lip not ascending, terminal varix broad, on outer margin a series of about 18 sharp, forward-directed barbs; on inner edge numerous nodules, that at anterior end strongest. Parietal wall with strong callus, appressed in posterior portion, free-standing in anterior portion; three oblique plaits anteriorly with the posterior one slightly weaker; about 10 long lirations on remaining portion of columella extending well into the aperture, the posterior-most forming a small nodule. No siphonal fasciole; siphonal notch broad and shallow.

Etymology of name.—In honor of William M. Gabb.

Type material and measurements.—Holotype, NMB H 17645; height 36.8 mm, diameter 18.3 mm. Paratype, NMB H 17646; height 34.5 mm, diameter 17.5 mm; locality NMB 17265. Unfigured paratype, USNM 486258; height 39.5 mm, diameter 22.1 mm; locality USGS 26274. Unfigured paratype, USNM 486259; height 32.1 mm, diameter 19.5 mm; locality USGS 26274. Unfigured paratype, BMNH GG 20184; height 41.3 mm, diameter 17.3 mm; locality unknown.

Type locality.—Locality NMB 17290, Baitoa Formation; east side of Río Yaque del Norte, just above the mouth of Arroyo Hondo, Dominican Republic (see Saunders *et al.,* 1986, text-fig. 21).

Material studied.—The holotype and figured paratype (NMB), plus the two Gabb specimens at the Academy of Natural Sciences of Philadelphia figured by Pilsbry (1922, pl. 24, figs. 11, 12), one Heneken Collection specimen (BMNH GG 20184), two incomplete examples from the USNM and two incomplete examples from TU 1363.

Remarks.—From material presumed to be in the Gabb Collection (ANSP), Pilsbry figured two specimens (1922, pl. 24, figs. 11, 12) as *Lyria soror* (Sowerby, 1850), stating that they were clearly a different species from *Lyria pulchella* (Sowerby, 1850). He is correct; however, his specimens are not *L. soror* but a new species from the Baitoa Formation. They undoubtedly are the specimens to which Gabb was referring (1873, p. 219) when he said of *L. pulchella*: "Among 7 shells I have one variety almost undistinguishable from *L. Delessertiana.*" Unfortunately, these two specimens can no longer be located in the collections of the Academy of Natural Sciences, Philadelphia (Elana Benamy, personal communication, 12 July 1994) but should they be found they may be considered paratypes of this new species, based upon Pilsbry's excellent illustrations.

Pflug (1961, pl. 15, figs. 1, 7) figured the so-called "lectotype" of *L. soror* (refigured here, Pl. 1, fig. 5), a specimen which is in fact the holotype, as Sowerby (1850, p. 46) stated of *L. soror*: "There is only a single individual of this species, which has lost its spire." This individual is extremely large but, as may be seen by comparing it to our largest example (Pl. 2, fig. 12), it is no more than a very large specimen of *L. pulchella.*

In the same collection at the Natural History Museum, London [British Museum (Natural History)] there is another specimen (GG 20184) labeled as "?Syntype" of *L. soror* (perhaps by Pflug), which is not *L. soror* but is the new species from the Baitoa Formation here named *L. gabbi.*

That there should be examples of this Baitoa species in the Gabb Collection is no surprise, for our collecting has determined that much of Gabb's material was taken from the Baitoa Formation. Heneken also collected some material in the Baitoa area: for example *Turbinella valida* (Sowerby, 1850) is common along the Río Yaque del Norte, near Boca del Rios. Therefore, the presence of an example of *L. gabbi* in the Heneken Collection in the Natural History Museum, London, is not totally unexpected.

In the collections of the U.S. National Museum of Natural History there are also two specimens of this new species (USNM 486258, 486259), collected by A.A. Olsson and C.F. Dohm in 1940 from a locality said to be "Baitoa, lower bluff on river." Inasmuch as at the village of Baitoa the lower part of the bluff is composed of the Oligocene Tabera Formation (see Vokes, 1979, text-fig. 2; Saunders *et al.,* 1986, text-fig. 28)) and the Baitoa Formation occurs only at the top of the bluff, clearly their locality does not correspond to the type locality at Baitoa. The description, however, could refer to the Baitoa Formation exposure at López (see Saunders *et al.,* 1986, pl. 9), the type locality of the new species.

Comparisons.—This new species is immediately distinguishable from the other Dominican species of *Lyria* by the presence of sharp barbs along the margin of the outer lip. In this character it is most similar to *L. limata* Hoerle and Vokes, 1978, from the contemporaneous Chipola Formation of northwestern Florida. But otherwise the two species are not especially similar, with *L. limata* having only about 13–14 axial cords in contrast to the 22–26 of *L. gabbi.*

In the Recent fauna of the western Atlantic, *L. beauii* (Fischer and Bernardi, 1857) is presumed to be the descendant of *L. gabbi.* There has been much written lately, primarily in the French literature, as to whether *L. archeri* (Angas, 1865) is simply a shallow-water ecophenotype of *L. beauii.* When one considers that *L. beauii* is usually taken in traps in depths of 100–150 meters but *L. archeri* is taken in depths of only 3–15 meters (Bail, 1993, p. 9), it is difficult to accept these as the same species. But in any case, cu-

riously, it is not the shallow-water *L. archeri* but the deep-water *L. beauii* to which *L. gabbi* has the greatest morphological similarity. Both are smooth-shouldered, elongate shells, with numerous narrow, axial ribs. The color pattern in *L. gabbi* consists of fine spiral lines about 1 mm apart. This pattern is visible on the holotype specimen (NMB H 17645) but could not be brought out by ultra-violet light and was too faint to be photographed (it is most similar to the pattern seen in *L. deliciosa* Montrouzier, 1859, as figured in Abbott and Dance, 1982, p. 213). There is no evidence of color spots on the edge of the outer lip, characteristic of the living species.

Occurrence.—Baitoa Formation: Baitoa area (NMB 17265, 17290; TU 1363).

Distribution.—Baitoa Formation, Dominican Republic.

Subgenus **ENAETA** Adams and Adams, 1853

Enaeta H. Adams and A. Adams, 1853, p. 167.

Type species.—*Voluta harpa* Barnes, 1824 [*V. harpa* Barnes, 1824, *non* Mawe, 1823, = *V. barnesii* Gray, 1825], by subsequent designation, Cossmann, 1899.

Remarks.—There is a difference of opinion among various workers as to whether *Enaeta* should be considered a subgenus of *Lyria* or a full genus. Species assigned to *Enaeta* are smaller than those of *Lyria* s.s., and have a small nodule approximately mid-way along the length of the inner side of the outer lip. Except for the presence of this labral nodule there is very little difference between the two groups and *L. archeri* has been referred to *Enaeta* because of the presence of such a nodule (see Abbott and Dance, 1982, p. 213, for a good illustration). In view of the considerable morphological similarity between the two, the subgeneric assignment seems the better course to take.

Lyria (Enaeta) perturbatrix (Maury, 1917)
Plate 1, figure 10

Mitra (Strigatella?) perturbatrix Maury, 1917, p. 76(240), pl. 14(40), figs. 1, 2.
[Enaeta] perturbatrix (Maury). Woodring, 1964, p. 289.
Enaeta perturbatrix (Maury). Emerson, 1964, p. 14.
Lyria (Enaeta) perturbatrix (Maury). Hoerle and Vokes, 1978, p. 118, pl. 3, fig. 3.

Diagnosis.—Small, elongate *Enaeta* (maximum height about 20 mm), with axial ridges on the anterior half of each whorl; strong rounded callosity at posterior end of inner side of the outer lip.

Original description.—"Shell slender, somewhat Columebelliform, spire a trifle shorter than the aperture; suture distinct; whorls eight, the first two smooth, nuclear; post-nuclear whorls slightly convex, ornamented with weak, equidistant longitudinal plications, about twenty on each of the last two whorls; the plications are strongest over the convex portion of the volutions and fade out near the sutures; aperture narrowly elliptical, inner lip with a callus; columella with three sharp anterior and two weaker posterior plications; outer lip thickened with a stout, marginated external band, marked by an internal posterior Strombinoid notch and showing traces of obsolescent crenulations within, not lirate." (Maury, 1917, p. 240)

Type material and measurements.—Lectotype, PRI 28710; height 19.5 mm, diameter 8.5 mm (designated by Hoerle and Vokes, 1978, p. 118). Paralectotype, PRI 28709; height 19.5 mm, diameter 8.7 mm; locality TU 1215.

Type locality.—Zone D, Gurabo Formation; Río Gurabo at Los Quemados, Dominican Republic (= locality TU 1215; see Saunders *et al.*, 1986, text-fig. 5).

Material studied.—In addition to the two specimens in the type lot, five specimens from locality TU 1215, and another from NMB 15862.

Remarks.—In spite of intensive collecting by both ourselves and the Basel team, only an additional handful of specimens have been discovered, all at the type locality, a coral reef on the Río Gurabo (Maury's Zone D = loc. TU 1215; see Vokes, 1989, p. 16).

The living analog of this species is the equally rare *L. (E.) reevei* (Dall, 1907), which according to Garcia and Sunderland (1990, p. 19) is confined to the Bay Islands, Honduras, where it lives in sandy patches inside the reefs in about 3 meters of water.

Comparisons.—There are three species of *Enaeta* described from the Recent fauna of the western Atlantic that have a degree of similarity to *L. (E.) perturbatrix*. Of these, only *L. (E.) guildingii* (Sowerby, 1844) has the posterior callosity on the inner side of the outer lip (see Hoerle and Vokes, 1978, pl. 3, fig. 3c), but it is lower spired and more strongly ribbed; *L. (E.) reevei* (Dall, 1907) is morphologically the most similar to the Dominican species, but lacks the marked median tooth on the outer lip; *L. (E.) leonardhilli* (Petuch, 1988) has the tooth as well developed as in *L. (E.) perturbatrix*, but has a cancellate surface ornamentation. All three are found in shallow-water reefal situations.

Occurrence.—Gurabo Formation: Río Gurabo (TU 1215; NMB 15862).

Distribution.—Gurabo Formation, Dominican Republic.

Family **HARPIDAE** Bronn, 1849
Subfamily **HARPINAE** Bronn, 1849

Remarks.—The family name Harpidae Bronn, based upon the genus *Harpa*, was threatened by the trilobite

family based upon the genus *Harpes* Goldfuss, 1839. Application to resolve the conflict was made to the Commission on Zoological Nomenclature (Beu, 1971) and in Opinion 1436 (ICZN, 1987) the Commission placed the name Harpidae Bronn, 1849, on the Official List of Family-Group Names in Zoology.

Genus **HARPA** Röding, 1798

Harpa Röding, 1798, p. 179.

Type species.—*Harpa nobilis* Röding, 1798 [= *Buccinum harpa* Linnaeus, 1758], by tautonomy.

Harpalis Link, 1807, p. 114.

Type species.—*Harpalis major* Link, 1807 [= *Harpa major* Röding, 1798, both for Martini, 1777, pl. 119, fig. 1090], by subsequent designation, Rehder, 1973.

Harparia Rafinesque, 1815, p. 145 (*nom. nov. pro Harpa* Lamarck, 1799, *non* Röding, 1798).
Cithara "Klein" Jousseaume, 1881, p. xxxviii.

Type species.—*Harpa harpa* (Linnaeus, 1758), by subsequent designation, Rehder, 1973.

Remarks.—The group of "Harp Shells" is one that is readily identifiable and was denominated as *Harpa* by several early authors. The oldest name often cited is Walch, 1771, but this is a non-binomial work and the first valid usage of the name is that of Röding (Rehder, 1973, p. 237).

Harpa americana Pilsbry, 1922
Plate 3, figures 1, 2

Harpa rosea Lamarck. Gabb, 1873, p. 214 (not Lamarck, 1822).
Harpa americana Pilsbry, 1922, p. 337, pl. 23, fig. 13; Rehder, 1973, p. 257, pl. 228; Vokes, 1984, p. 56, pl. 1, figs. 7, 8.
Not *Harpa americana* Pilsbry. Perrilliat Montoya, 1960, p. 24, pl. 3, figs. 18, 19 [= *H. isthmica* Vokes, 1984]; Pitt, 1981, p. 155, text-fig. 1 [? = *H. crenata* Swainson, 1822].
Not *Harpa* cf. *americana* Pilsbry. Gibson-Smith and Gibson-Smith, 1979, p. 22 [? = *H. myrmia* Olsson, 1931].

Diagnosis.—Elongate species of *Harpa*, with low, nodulated varices; shell surface not polished.

Original description.—"The shell is ovate, of about 6 whorls, of which three smooth ones form the nipple-shaped embryonic shell, the last whorl of which, together with part of the first sculptured whorl, are very narrow. The last whorl has about eleven low and narrow axial ribs which rise into small spines where they pass over the angle bounding a narrow flattening below the suture. The whole surface below this angle is spirally striate, the striation strongest in the concavity of the sides below. The aperture is narrow for the genus. A thin callus spreads forward over the ventral convexity." (Pilsbry, 1922, p. 337)

Type material and measurements.—Holotype, ANSP 4061; height 33.3 mm, diameter 19.4 mm.

Type locality.—Dominican Republic, exact locality not known.

Material studied.—Two specimens, the holotype and a second example collected at locality TU 1444.

Remarks.—The name *Harpa americana* has been applied to almost every specimen of fossil *Harpa* discovered in the Neogene of the New World, but a previous study (Vokes, 1984) demonstrated that all of these references are incorrect and *H. americana* is known only from the unnamed Late Miocene formation that crops out along the Río Yaque del Norte at López (see Vokes, 1989, p. 20).

The small group of species consisting of *H. doris* Röding, 1798, and *H. crenata* Swainson, 1822, in the Recent fauna, and *H. isthmica* Vokes, 1984, in the Pliocene of Veracruz, Mexico, are all apparently descended from *H. americana*. They differ from the typical Indo-Pacific forms in having much less strongly developed varices, which are ornamented by nodules. The shell surface rather than being highly polished is finely cancellate, with a linen-like texture.

Comparisons.—Although Gabb used the name of the Recent West African species (*H. rosea* Lamarck, 1822 = *H. doris* Röding, 1798) for the Dominican shell, in many ways the latter is more closely related to the West American *H. crenata*. In both of these New World species the axial ribs are extremely narrow and low, being little more than raised ridges on the shell surface. Both have a series of pronounced nodes on the ribs, anterior to the spine at the shoulder. It is presumed that *H. americana* gave rise both to the Pacific *H. crenata* and to the Atlantic *H. isthmica*, named from the Middle Pliocene Agueguexquite Formation, Veracruz, Mexico. The Mexican shell differs in having heavier varices and a smoother shell, and the contemporaneous *H. crenata*, which occurs in the Pliocene Esmeraldas beds, Ecuador, has a more inflated shell.

Occurrence.—Unnamed formation: López area (TU 1444).

Distribution.—Unnamed unit of same age as the Cercado Formation, Dominican Republic.

Subfamily **MORUMINAE** Hughes and Emerson, 1987

Remarks.—Although the genus *Morum* Röding, 1798, has long been considered a member of the Family Cassidae, anatomical work by Hughes (1986) and Hughes and Emerson (1987) has shown the group to be more closely allied with the Harpidae; therefore, a new subfamily Moruminae (so named to avoid homonyny with the fish Family Moridae Goode and Beane,

1896) was proposed (Hughes and Emerson, 1987, p. 357).

Genus **MORUM** Röding, 1798

Morum Röding, 1798, p. 53.

Type species.—Morum purpureum Röding, 1798 [= *Strombus oniscus* Linnaeus, 1767], by monotypy.

Lambidium Link, 1807, p. 112.

Type species.—Strombus oniscus Linnaeus, 1767, by monotypy.

Oniscia Sowerby, 1824, pl. 233.

Type species.—Strombus oniscus Linnaeus, 1767, by subsequent designation, Hermannsen, 1847.

Plesioniscia Fischer, 1884, p. 660.

Type species.—Oniscia tuberculosa Sowerby *in* Reeve, 1842, by monotypy.

Oniscis "Sowerby" [*sic*]. Clench and Abbott, 1943, p. 4, error *pro Oniscia*.

Subgenus **MORUM** s.s.

Morum (Morum) oniscus (Linnaeus, 1767)
Plate 3, figures 3–9

Strombus oniscus Linnaeus, 1767, p. 1210.
Cypraea conoidea Scopoli, 1786, p. 78, pl. 24, fig. 3.
Morum purpureum Röding, 1798, p. 53.
Oniscia triseriata Menke, 1830, p. 64.
Oniscia lamarckii Deshayes, 1844, p. 12 (*non O. lamarckii* Lesson, 1840).
Oniscia oniscus (Linnaeus). Reeve, 1849, pl. 1, fig. 1 (said by Reeve to be "the pink-lip variety to which M. Deshayes has given the name *O. lamarckii*").
Morum oniscus (Linnaeus). Gabb, 1881, p. 357; Woodring, Brown, and Burbank, 1924, p. 251; Clench and Abbott, 1943, p. 4, pl. 3, figs. 1–5; Abbott, 1954, p. 192, pl. 25s; Warmke and Abbott, 1961, p. 97, pl. 23, fig. r; Dance and Emerson, 1967, p. 96, pl. 12, fig. 4; Work, 1969, p. 656, figs. 2A, 2B (egg capsule), 2C (juvenile); McGinty, 1970, p. 55; Hoerle, 1970, p. 63; Humfrey, 1975, p. 116, pl. 11, fig. 7; Kaicher, 1983, no. 3752; de Jong and Coomans, 1988, p. 67; Petuch, 1994, pl. 86, fig. D (not cited in text).
Lambidium oniscus (Linnaeus). Dall and Simpson, 1901, p. 419.
Morum floridana Tucker and Wilson, 1933, p. 9(71), pl. 1(10), figs. 3–5.
Morum (Morum) oniscus (Linnaeus). Rios, 1970, p. 68; 1975, p. 75, pl. 21, fig. 306; 1985, p. 72, pl. 26, fig. 317; 1994, p. 139, pl. 44, fig. 595; Abbott, 1974, p. 160, fig. 1732; Vokes and Vokes, 1983, p. 22, pl. 9, fig. 13.
Morum lamarcki (Deshayes) [*sic*]. Kaicher, 1983, no. 3760; Petuch, 1994, pl. 86, fig. C (not cited in text).
Morum floridanum Tucker and Wilson. Petuch, 1994, pl. 86, figs. E, F (not cited in text).

Diagnosis.—Low spired *Morum* with spiral cords and axial ribs intersecting to form heavy nodules on dorsal side; outer lip thickened and denticulate on inner side.

Original description.—"S. testa obovata cingulis nodosis, mucrone subulato laevi.

"Testa magnitudine coryli obovata, cingulis tribus subnodosis: nodis ordine longitudinali itidem dispositis, pallida, maculis nigricantibus sparsis contaminata. Spira obtusissima cingulo solitario noduloso: apice tenuissimo albo. Apertura alba, longitudinalis, columella laevis. Labro exteriore vix repando. Cauda nulla & basis vix manifeste emarginata." (Linnaeus, 1767, p. 1210)

Description.—"Shell reaching about 25 mm in length, subcylindrical and roughly sculptured with blunt tubercles. Whorls 7; the first two or three nuclear whorls are papilliform, forming a sharp point at the top of the low spire. Color varying from a white background with fine brown or gray specklings to a graying background with large mottlings of black-brown. Dead, wave-worn specimens are mottled with a light chestnut-brown. Tip of spire usually white, rarely tinged with deep rose. Columella and lip white, the latter often flecked on its outer edge with brown. Parietal wall thickened with a translucent glaze which is often ingrained with numerous white dots. Sometimes these dots are developed into minutely raised pustules. Interior of aperture white (occasionally lavender). Outer lip is thickened and bears a row of about 15 small teeth on the inner side. Suture slightly indented and wavy, somewhat overlapped by the whorl below. Three bands of rounded blunt nodules usually seven to eight to the row, run spirally on the body whorl. A series of coarse small spiral threads run in between these rows. In live specimens the growth lines in the periostracum cross these threads to form a minute lace-like network." (Clench and Abbott, 1943, p. 4)

Type figures.—Seba, 1761, pl. 55, figs. 23a-g (designated by Clench and Abbott, 1943, p. 5).

Type locality.—St. Thomas, Virgin Islands (restricted by Clench and Abbott, 1943, p. 5).

Material studied.—From the Dominican Republic, four specimens from the Cercado, Gurabo, and Mao formations. Numerous fossil and Recent examples from throughout the western Atlantic.

Remarks.—This well known western Atlantic species has been cited in numerous references; by no means are all listed above, only those that are either well-figured or that add geographic or stratigraphic information.

Dance and Emerson (1967) have given an excellent review of the genus *Morum*. In their annotated list of fossil representatives they note the occurrence of *M. oniscus* in the Moín Formation, Costa Rica (after Gabb, 1881). In the Tulane collections we have several specimens from the Moín Formation (Robinson, 1992, p. 516, p. 23, fig. 8), which is now considered to be

Early Pleistocene in age. In addition, we also have a single specimen from the Late Pliocene Agueguexquite Formation of Veracruz, Mexico (locality TU 1046).

Dance and Emerson (1967) also list *Morum floridana* [*sic*] Tucker and Wilson, 1933, from the "Pliocene" at Prairie Creek, Florida. Although the original authors gave no age or formational assignments for their new species, they also described *"Arca" [Caloosarca] aequalitas* from Prairie Creek (Tucker and Wilson, 1932, p. 41). This bivalve is typical of the Pleistocene Bermont Formation (H. Vokes, 1969, p. 2) and it is presumed, therefore, that *M. floridanum* is also from the Bermont beds. Both McGinty (1970, p. 55) and Hoerle (1970, p. 63) reported *M. oniscus* from the Bermont and in the Tulane collections we have numerous specimens from this unit as well (Pl. 3, figs. 5, 7, 8).

Although *M. floridanum* was stated to be distinguished from *M. oniscus* by having "six axial ribs while *oniscus* has only three" [Tucker and Wilson, 1933, p. 9(71)], *M. oniscus* has seven or eight *axial* ribs and three *spiral* ribs. Their holotype [*ibid.*, pl. 1(10), figs. 3–5] shows eight axial and three spiral ribs. The surface of the shell is somewhat smoother than the typical "warty" *M. oniscus* but from Bermont Formation localities along the Caloosahatchee River (locs. TU 759, 803) we have dozens of specimens that range from the typical *M. oniscus* morphotype (Pl. 3, fig. 8) to the smooth *M. floridanum* morphotype (Pl. 3, fig. 7). All of these specimens have identical protoconchs and apertures and except for the difference in ornamentation are indistinguishable.

Petuch (1994, pl. 86, fig. D) has figured *M. oniscus* (plus "*M. lamarcki,*" pl. 86, fig. C) from the Bermont beds and *M. floridanum* (1994, pl. 86, figs. E, F) from the Caloosahatchee Formation,[1] implying that there is a stratigraphic distinction to be made between the two forms. We do have the *M. floridanum* morphotype from the Caloosahatchee Formation (TU 1512) but we also have typical *M. oniscus* from the Pinecrest beds (TU 797) and there seems little reason to separate these smoother specimens as a different species.

Thus, the previously known examples of *M. oniscus* are all from Plio-Pleistocene formations, and the two Late Miocene Cercado specimens (locs. NMB 16844; TU 1301) are the oldest occurrence of the species to date.

Comparisons.—On the west coast of tropical America is the cognate species *M. tuberculosum* (Reeve, 1842), which is more elongate and is usually larger (see Pl. 3, fig. 10), although we have one *M. oniscus* from Barbados (Pl. 3, fig. 9) that is as large as any specimen of *M. tuberculosum.* In addition, *M. tuberculosum* has the spiral cords less pronounced and the outer lip is thinner. The protoconch is also different: *M. oniscus* has a protoconch consisting of two and one-half bulbous whorls, of which the first is somewhat larger than the second (Pl. 3, fig. 5c); but *M. tuberculosum* has about two and one-half conical whorls. Kaicher has figured the protoconchs for *M. tuberculosum* (1983, no. 3747) and for *M. oniscus* (1983, no. 3752) but the latter does not seem to be correctly identified, appearing more like *M. tuberculosum.*

She also figured (1983, no. 3760) the protoconch of a species identified as "*M. lamarcki,*" which appears to be identical to typical *M. oniscus* and does not distinguish *M. lamarckii,* as she suggested. Specimens taken off the Atlantic coast of Panama have a lavender aperture and are often identified as *M. lamarckii.* But there are no morphological differences between these specimens and typical *M. oniscus* and *M. lamarckii* is no more than a color variety without taxonomic validity. Clearly Röding (1798, p. 53) believed the two forms were the same when he named the sole species of his genus *Morum* as "*M. purpureum.* Die purpurifarbene Maulbeere (The purple-stained mulberry)."

The only other species that may be referred to the genus *Morum* s.s. is the enigmatic *M. strombiformis* (Reeve, 1842), which Dance and Emerson (1967, p. 95) assigned to *Cancellomorum (= Oniscidia)* but which Beu (1976, p. 224) regards as a species of *Morum* s.s., thereby demonstrating the gradation between the two taxa.

Dance and Emerson (1967, pl. 12, fig. 3) have figured a juvenile shell from Cartagena, Colombia, which they believe to be a juvenile of this species. The type locality of *M. strombiformis* is said by Reeve to be "Honduras" and examples, which look much like the Colombian one, have been taken by divers in 1 to 2 meters off Roatan, Bay Islands, Honduras. These shells have every indication of being adult but the spire is not as high as in the holotype, nor is the shell as large (the holotype is 24 mm in height; our specimens and that figured by Dance and Emerson measure about 18 mm in height). But the protoconch, the ornamentation, and the color pattern are identical to that of the holotype; perhaps the height of the spire is within the range of specific variation in *M. strombiformis.*

[1] Petuch states that his figured specimen of *M. floridanum* (1994, pl. 86, figs. E, F) is 31 mm in height. The largest specimen in the Tulane Collections is just 25 mm and most are about 20 mm in height. Comparison of the diameter of the protoconch in the enlarged photograph with the diameter of 1 mm characteristic of the species indicates that the actual height of the specimen is about 26 mm, a more realistic dimension.

Certainly, as indicated above for *M. oniscus*, adult size is variable in this group.

Occurrence.—Cercado/Gurabo formations: Río Cana area (NMB 16844; TU 1301, 1354). Mao Formation: Guayubin area (TU 1281).

Distribution.—Cercado, Gurabo, and Mao formations, Dominican Republic; Agueguexquite Formation, Mexico; Pinecrest Beds, Caloosahatchee and Bermont formations, Florida; Moín Formation, Costa Rica; Recent, Bermuda and Bahama Islands to Brazil.

Subgenus **ONISCIDIA** Mörch, 1852

Oniscidia Swainson, 1840, p. 299, error *pro Oniscia* Sowerby, 1824. *Oniscidia* Mörch, 1852, p. 111.

Type species.—*Oniscia cancellata* Sowerby, 1824, by monotypy.

Pulchroniscia Garrard, 1961, p. 16.

Type species.—*Pulchroniscia delecta* Garrard, 1961 [= *Oniscidia bruuni* Powell, 1958], by monotypy.

Cancellomorum Emerson and Old, 1963, p. 18.

Type species.—*Oniscia grandis* A. Adams, 1855, by original designation.

Onimusiro Kira *in* Kuroda, Habe, and Oyama, 1971, p. 198.

Type species.—*Oniscia grandis* A. Adams, 1855, by original designation.

Remarks.—A great deal has been written concerning the taxonomic problem of the name *Oniscidia*, which as originally put forth by Swainson (1840, p. 299) was clearly an error for *Oniscia* Sowerby. Dall (1909, p. 68) discussed the problem in detail, pointing out that Mörch was the first to use the Swainson spelling for those species of "*Morum*" with a cancellate sculpture.

Since there is certainly a need for this taxon, the matter has finally been decided by the International Commission on Zoological Nomenclature and in Opinion 1040 (ICZN, 1975) the name *Oniscidia* Mörch was placed on the Official List of Generic Names in Zoology. For the best discussion of the nomenclatorial problems surrounding this name, the reader is referred to Beu (1976).

MacNeil (*in* MacNeil and Dockery, 1984, p. 113) has taken the position that the genera *Morum* and *Oniscidia* have been distinct since the Eocene, and as he could find no evidence that they either converge or are closely related, rejected the concept of *Oniscidia* as a subgenus of *Morum*. Certainly the cancellate morphotype has been extant since the Eocene, but comparison with typical examples of *Morum* s.s. (see Pl. 3, figs. 3–10) demonstrates the marked similarity between the two forms. Inasmuch as Hughes and Emerson (1987) in their anatomical study of the group saw fit to place the two taxa together, this seems the reasonable course.

Although authors make much of the number of axial and spiral elements when differentiating species of *Oniscidia*, they tend to ignore what seems to be the most fundamental character of all, the nature of the ornamentation on the columellar shield. From the Eocene onward, there are two different types of ornamentation, one similar to the morphotype named *Herculea* Adams and Adams, 1858, which is characterized by the presence of rugae on the columellar shield. The second, similar to *M. domingense* (Sowerby, 1850), has fine granules. Through time one can see a gradual shift from rugae to elongate pustules or granulations and, in fact, certain species in the *M. chipolanum* Dall *in* Maury, 1925a, lineage (see below) still retain a mixture of both.

As Beu (1976, p. 224) notes, a number of New World fossil species have been referred to *Herculea* on the basis of the strong anal channel, but this is not consistent and it not regarded as a valid generic character. The type species of *Herculea* (*M. ponderosum* Hanley, 1858) has weak spiral sculpture, very like that of *Morum* s.s., combined with the rugose shield ornament of *Oniscidia*. The taxon is monotypic and does not encompass any of the New World species, all of which have strong cancellate sculpture and either rugose, or granulose, or both, elements on the columellar shield.

The group of *Morum* s.s. is much younger geologically, known only from the Upper Miocene and younger beds of the New World (see above) and it would seem to be derived from the *Morum domingense* lineage, as it has fine granulations on the columellar shield.

Morum (Oniscidia) chipolanum Dall *in* Maury, 1925a

Plate 4, figures 1–4

Morum (Oniscidia) chipolanum Dall. Maury, 1925a, p. 114/115, pl. 4, fig. 4; Gardner, 1947, p. 538, pl. 54, fig. 18; Woodring, 1959, p. 203; Dance and Emerson, 1967, p. 96; Landau, 1996, p. 54, pl. 1, fig. 3; Raymond, 1997, p. 141.

(?) *Morum* cf. *M. chipolanum* Dall MS. Mansfield, 1937, p. 141.

Oniscidia chipolana (Maury). MacNeil and Dockery, 1984, p. 113.

Diagnosis.—Low-spired, cancellate *Morum*, pustules on columellar shield in the form of elongate rugae.

Description.—"Shell of moderate dimensions for the group, rather thick and heavy, ovate trigonal. Aperture nearly as long as the entire shell. Spire broad, scalariform. Whorls of conch probably five, closely appressed, increasing rapidly in diameter. Posterior tabulation wide, almost at right angles to the axis;

sides of whorls of spire shorter than the width of the shoulder and approximately vertical. Body somewhat obliquely constricted into the short, broad, ill-differentiated pillar. Sutures inconspicuous, finely crenulated in harmony with the axial sculpture, the later whorls so closely appressed that the posterior margin creeps up a little on the preceding whorl. Protoconch not preserved [one and one-half bulbous whorls] but doubtless very small. Axials very sharp and narrow and in the later whorls distinctly laminated, and the free edges fluted by the spirals; the number increasing from seven on the first whorl of the spire to 15 on the body. Incrementals appearing as thin, papery, overlapping plates, from four to six between each of the axials on the body. Both the incrementals and the costals persistent from suture to suture on the whorls of the spire and, on the body to the anterior fasciole; approximately vertical on the sides of the whorl but distinctly retractive on the shoulder. Intercostal areas broadly concave, about twice the width of the costals. Primary spirals strong, well-rounded cords, subequal, and regularly spaced over the entire conch, one or two on the whorls of the spire and 11 on the body not including the lower, narrow spirals on the pillar; spirals separated by concave interspaces of approximately their own width though slightly wider at the extreme base of the body; posterior primary outlining the periphery; secondaries not developed except for a couple of ill-defined threadlets on the shoulder. Anterior fasciole laminated by the axials but not spirally sculptured. Aperture narrow, obtusely angulated and obscurely sulcated posteriorly. Outer lip very feebly arcuate, thickened, somewhat reflected, and lirate along the inner margin, the lirae corresponding in position to the spaces between the spirals. Inner lip widely reflected over the body wall and pillar. Outer margin of callus discrete, parallel to the axis through the greater part of its extent, broadly arcuate behind; surface of callus coarsely granulated, the granules for the most part irregular but tending to be elongated and oriented normal to the axis along the oblique inner margin of the aperture. Anterior canal very short and broad, its entrance indicated on the labral side by a short, oblique liration. Anterior extremity narrowly and deeply emarginate." (Gardner, 1947, p. 538)

Type material and measurements.—Holotype, USNM 114095; height 32.0 mm, diameter 20.0 mm.

Type locality.—Locality USGS 2213, Chipola Formation; Chipola River, "one mile below Baileys Ferry," Calhoun County, Florida (= loc. TU 457).

Material studied.—Numerous examples from the Chipola Formation but only the two figured specimens and a third, incomplete, example from the Baitoa Formation.

Remarks.—In the Baitoa Formation there are rare examples of a species of *Morum,* which not surprisingly proves to be the same as that one described from the correlative Chipola Formation of northwestern Florida. Woodring (1959, p. 203) has discussed the problems of authorship of this species, which is based upon a Dall manuscript name. Although Gardner (1947, p. 538) cited the species as "Dall MS," it previously had been published by Maury (1925a, p. 114/115).

According to Woodring, the specimen figured by Maury is not the same as that figured by Gardner as the holotype, which is corroborated by the fact that Maury gives the size of her illustrated specimen as approximately 36 mm and Gardner cites the holotype as 32 mm in height. But, Maury did not indicate that her shell was supposed to be the "holotype"; she merely says of the illustration (1925a, pl. 4, fig. 4), "for comparison with the Pirabas species." Therefore, although the name may be valid as of Maury, 1925a, the shell that Gardner figured (1947, pl. 54, fig. 18) should be accepted as the holotype, as it was that one originally identified by Dall (and if Gardner's discussion is examined it would seem to be a unique example). Presumably, the shell figured by Maury was one collected by G.D. Harris and A.C. Veatch for the Cornell University Collection (see Maury, 1910) (now housed at the Paleontological Research Institution, PRI).

Comparisons.—The species that Dall identifed as *M. chipolanum* from the Tampa Limestone is not the same species; the ornamentation on the columellar shield consists of a series of coarse rugae rather than elongated pustules. [The Tampa species is very similar in appearance to that figured by Woodring (1959, pl. 25, figs. 11, 17) as *Morum ("Oniscidia")* sp., from the Middle Eocene Gatuncillo Formation, Panama.]

The nature of the ornamentation on the columellar shield is probably the best species character in this subgenus. The group of *M. chipolanum,* characterized by horizontally elongated pustules (presumably derived from rugae) originates with the Peruvian Eocene species *M. peruvianum* Olsson, 1931, includes the Oligocene *M. harpula* (Conrad, 1848), and the Plio-Pleistocene *M. macgintyi* Smith, 1937 (of which *M. obrienae* Olsson and Petit, 1964, is almost certainly a synonym, as suggested by Emerson, 1967, p. 289).[2]

[2] Although Olsson and Petit (1964, p. 556) suggest that *Morum macgintyi* may be from "Unit A" (= Bermont Formation), the type locality at Clewiston, Florida, is more likely in the Caloosahatchee Formation. In any case, we have no Bermont specimens of *M. macgintyi* in the Tulane collections. Furthermore, Petuch (1994, pl. 86, figs. A, B) has figured both "species" from the same Caloosahatchee locality at Cochran Rockpit, Hendry County, Florida (= loc. TU 991).

In the correlative beds of the Cantaure Formation, Venezuela, another closely related form has been named *Morum (Oniscidia) jungi* by Landau (1996, p. 53, pl. 1, figs. 1, 2). This more southern species differs from *M. chipolanum* in having fewer axial and spiral cords, together with numerous axial lamellae that give the shell a lacy appearance. The columellar shield is less expanded in *M. jungi* and the pustules are fewer and more elongated.

From the younger Dominican species, *Morum domingense* (Sowerby, 1850), *M. chipolanum* differs in its shorter, broader outline, and especially in the nature of the pustules on the columellar shield. In *M. domingense* they are fine, regularly rounded projections, which are randomly placed on the lip. In *M. chipolanum* they are coarser and more elongate, having a tendency to reflect the underlying spiral ornamentation.

In the latter trait, *M. chipolanum* is more closely related to a large species described from the Pinecrest beds as *Morum (Oniscidia) meganae* by Raymond (1997, p. 141, pl. 1, fig. 1). Other than the exceptionally large size (holotype = 60 mm), *M. meganae* is scarcely distinguishable from the older *M. chipolanum*. Both share a low-spired, sharply shouldered shell (in contrast to *M. domingense*, which has a sloping shoulder) and a surface ornamentation covered with growth lamellae. They differ, however, in *M. meganae* having fewer, but stronger axial ribs and an aperture with a larger, more flaring aperture.

The living representative of this group is *M. lindae* Petuch, 1987, from off the Goajira Peninsula, Colombia. But this species is a descendant of the correlative but more southern *M. jungi* rather than *M. chipolanum*. The somewhat similar appearing *M. matthewsi* Emerson, 1967, perhaps is a direct descendant of *M. tampanum*, or the similarity may be the result of convergence.

Occurrence.—Baitoa Formation: Baitoa area (NMB 16937; TU 1226, 1363).

Distribution.—Baitoa Formation, Dominican Republic; Chipola Formation, Florida.

Morum (Oniscidia) domingense (Sowerby, 1850)
Plate 4, figures 5–9

Oniscia domingensis Sowerby, 1850, p. 47, pl. 10, fig. 3; Guppy, 1866, p. 574, 588; 1867, p. 158; 1874, p. 439; 1876, p. 525; Dance and Emerson, 1967, p. 96.

Morum domigensis [*sic*] (Sowerby). Gabb, 1873, p. 223.

Not *Lambidium domingense* (Sowerby). Dall, 1903, p. 1567 [= *Morum tampanum* Mansfield, 1937].

Morum domingense (Sowerby). Dall, 1915, p. 85, in part, not pl. 12, fig. 28 [= *M. tampanum* Mansfield, 1937].

Morum domingense (Sowerby). Maury, 1917, p. 112(276), pl. 13(18), figs. 7, 8; Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 98, *et seq.*; Pilsbry, 1922, p. 363; Woodring, 1959, p. 203; Ramírez, 1956, p. 9, pl. 3, fig. 19; Pflug, 1961, p. 37, pl. 7, figs. 9–12, pl. 8, figs. 1, 2, 5, 6, 7 (figs. 6, 7 = lectotype).

Not *Morum (Oniscidia) dominguense* [*sic*] (Sowerby). Petuch, 1981, p. 319, figs. 24, 25 [= *M. lindae* Petuch, 1987].

Morum (Oniscidia) domingense (Sowerby). Landau, 1996, p. 54, pl. 1, fig. 4; Raymond, 1997, p. 142.

Diagnosis.—High-spired cancellate *Morum*, fine pustules on columellar shield.

Original description.—"Testa ovata-oblonga, subventricosa, crassiuscula, anfractibus senis, coronatis, decussatim costatis, postice subplanulatis; apertura elongata, postice acuminata, margine interno labii externi transversim costellifero, costellis sub-bifariam coordinatis; labio columellari granuloso.

"When young the granules of the columellar lip are indistinct, and do not extend so as to cover the lip, but when full-grown the columellar lip is entirely covered by granules; in which character it differs from *O. cancellata*. It is also distinguished from that species by the nature of the denticulations on the inside of the outer lip, which in *O. domingensis* are extended across the lip. It is worthy of remark, that *O. cancellata* is a Chinese species." (Sowerby, 1850, p. 47)

Description.—Shell triangular in outline, six teleoconch whorls and a protoconch of about one and three-quarters smooth, bulbous whorls. Spiral ornamentation on each spire whorl of about six flattened, equi-sized cords. On body whorl about 12 such cords, with numerous secondary threads intercalated. Shoulder ramp initially flat, giving a stepped appearance to the spire; but becoming more sloped by about fifth teleoconch whorl, with the suture increasingly appressed, especially on the sixth whorl. Axial ornamentation of eight or nine flange-like varices on early spire whorls, increasing to about 12 on adult; at shoulder angle small open spines produced, and on some specimens smaller open spinelets where varix crosses each major spiral cord. Numerous axial growth lamellae between each pair of varices. Combination of axial varices and major spiral cords giving rise to a cancellate appearance; in addition, combination of axial growth lamellae and secondary spiral threads giving a linen-like texture to entire shell surface. Aperture elongate, strong posterior notch, heavy parietal shield covered with numerous pustules only slightly elongated in an adapertural direction. Outer lip thickened, recurved abaperturally, covered with a series of elongate lirae, ranging from 24 to 30 in number and of varying lengths. Siphonal canal slightly recurved dorsally, forming an elongate siphonal fasciole, often covered by parietal shield.

Type material and measurements.—Lectotype, BMNH G 83 846; 29.0 mm, diameter 18.0 mm (designated by Pflug, 1961, p. 38).

Type locality.—Locality TU 1293 (here restricted), Gurabo Formation; Río Mao, west bank, bluff just below Paso Chorrera, or about 12 km (by road) south of Mao (Valverde), Dominican Republic (= locs. USGS 8519, 8520; Bluff 1 of Maury; see Saunders *et al.*, 1986, text-fig. 29).

Material studied.—Numerous specimens from the Cercado Formation and shallow-water portions of the Gurabo Formation; one example from the shallow-water gravity-flow into the Mao Formation at locality NMB 15833.

Remarks.—Although never common at any one locality, *M. domingense* is fairly widespread in the Cercado Formation and the shallow-water portions of the Gurabo Formation. The locality with the greatest number of specimens is Maury's Bluff 1, on the Río Mao (= loc. TU 1293, 36 specimens; = loc. NMB 16910, 10 specimens), a place where Heneken almost certainly collected. Therefore, the type locality is restricted to this site.

The living analog of *M. domingense* is the beautiful *M. dennisoni* (Reeve, 1842), which occurs from off North Carolina to Brazil (Abbott, 1974, p. 160) and has been recorded in depths ranging from 2 meters to 265 meters (Bayer, 1971, p. 139). This wide variation in depths is comparable to that of the Dominican species, which seemingly occupied a similar, though not quite as extensive, range. We have taken it in beds estimated to have been deposited anywhere from 20 to 150 meters, although it is most abundant in the 50 meter range. Dance and Emerson (1967, p. 93–94) cite living specimens from 62 to 138 meters, so the Recent form may prefer slightly deeper water than did the fossil one.

Comparisons.—Maury described *Morum harrisi* (1925a, p. 114/115, pl. 4, fig. 14) from the Lower Miocene Pirabas Limestone of Brazil, which is similar to *M. domingense*. On the basis of her unique holotype, an incomplete external mold, *M. harrisi* is larger than any known specimen of *M. domingense* (her shell is estimated to be 40 mm; our largest example of *M. domingense* is 38 mm and most are about 30 mm). More importantly, the Brazilian shell has a strong spiral cord on the subsutural ramp, not present in *M. domingense*. Unfortunately, we have no information on the nature of the columellar shield ornamentation, which is not preserved in the holotype.

The earliest species to demonstrate the finely pustulose ornamentation on the columellar shield is *M. coxi* (Trechmann, 1935; figured by Jung, 1971, pl. 10, figs. 1–5), from the Grand Bay Formation, Carriacou, Grenadine Islands, West Indies (Middle Miocene; Neogene zone N.11). But, except for the shield, there is not a strong resemblance to the younger *M. domingense*, for *M. coxi* is a more rotund shell, with a smaller columellar shield.

The large species of *Morum* described from the Pinecrest beds under the name *M. meganae* by Raymond (1997, p. 141, pl. 1, fig. 1), is, as noted above, more closely related to the older Floridian *M. chipolanum* than to the contemporary *M. domingense*. The two Florida species share a step-like spire, with a sharp, flat shoulder, due to the deeply incised suture. In *M. domingense*, and the living *M. dennisoni*, the shoulder is markedly sloped and the suture is appressed.

From the living *M. dennisoni*, the Dominican shell differs in having the spiral and axial ornamentation relatively stronger than in the Recent shell, which gives the fossil species a more cancellate appearance than the Recent one. The pustules on the columellar shield in *M. dennisoni* are relatively finer than those of *M. domingense*.

Petuch (1981, figs. 24, 25) figured a specimen from 11 meters depth off the Goajira Peninsula, Colombia, as *M. domingense*, noting at the time that the fossil species has 12 axial ridges (it varies from 10 to 12) whereas the Recent shell has 16. Subsequently, he named this Recent species *M. lindae* (Petuch, 1987, p. 95, pl. 23, figs. 1, 2), reiterating that *M. domingense* is "the direct ancestor" of *M. lindae* and noting that the fossil species "has fewer axial ribs, is broader and more angled, has a smaller parietal shield, and is far less sculptured and less squamore." However, the nature of the low, stepped spire, with its incised suture, and the numerous fine axial lamellae suggests that *M. lindae* is the linear descendant of the more recently described Cantaure Formation *M. jungi* Landau (1996, p. 53, pl. 1, figs. 1, 2) rather than of *M. domingense*.

Occurrence.—Cercado/Gurabo formations: Río Cana area (TU 1230, 1354, 1356); Río Gurabo (TU 1210–1213, 1215, 1231, 1246, 1278, 1373–1375, 1377, 1419); Río Mao area (TU 1225, 1293, 1294); Río Amina (TU 1219, 1220, 1248); Santiago area (TU 1227A, 1250, 1449). Mao Formation: Río Gurabo (NMB 15833).

Distribution.—Cercado, Gurabo, and Mao formations, Dominican Republic. Although Petuch (1981, p. 321) reported this species from the Gatun Formation, Panama, and the Bowden Formation, Jamaica, Woodring (1928, 1957–1982) has not recorded any occurrences and I am not aware of any specimens from either formation.

Family **TURBINELLIDAE** Swainson, 1840

Subfamily **TURBINELLINAE** Swainson, 1840

Genus **TURBINELLA** Lamarck, 1799

Xancus Röding, 1798, p. 134 [placed on Official Index of Rejected and Invalid Generic Names, ICZN Opinion 489 (ICZN, 1957)].

Type species.—*Voluta pyrum* Linnaeus, 1767, by subsequent designation, Dall, 1906b, p. 296.

Turbinella Lamarck, 1799, p. 73.

Type species.—*Voluta pyrum* Linnaeus, 1767, by monotypy.

Turbinellus Lamarck, 1801, p. 83 (? emendation).

Type species.—*Voluta pyrum* Linnaeus, 1767, by monotypy.

Buccinella Perry, 1811, pl. 27.

Type species.—*Buccinella caerulea* Perry, 1811 [= *V. pyrum* form *napus* Lamarck, 1822], by subsequent designation, Abbott, 1950, p. 203.

Scolymus Deshayes, 1843, p. 375 (*non Scolymus* Swainson, 1835).

Type species.—*Turbinella scolymus* Lamarck, 1816 [= *Murex scolymus* Gmelin, 1791], by tautonomy.

Mazza "Klein" H. Adams and A. Adams, 1853, p. 156.

Type species.—*Voluta pyrum* Linnaeus, 1767, by subsequent designation, Abbott, 1950, p. 203.

Turbofusula Rovereto, 1900, p. 169.

Type species.—*Turbinella fusus* Sowerby, 1825, by original designation.

Remarks.—Although Abbott (1950, p. 203) and Abbott and Dance (1982, p. 210) cite *Voluta pyrum* Linnaeus as of 1758, the species was not described until 1767 in the 12th Edition of *Systema Naturae* (*Murex pyrum* Linnaeus, 1758, is a species of *Cymatium*).

The problem of usage of the names *Turbinella vs. Xancus* was discussed in an earlier paper (Vokes, 1964, p. 66). The replacement of the Lamarckian *Turbinella* by *Xancus* Röding, 1798, created such controversy that ultimately the case was presented to the International Commission on Zoological Nomenclature (Baily, 1956) and that body, over the strong objections of leading malacologists in the United States (*e.g.*, R.T. Abbott, Myra Keen, H.A. Rehder, and P.E. Morrison, all quoted in Opinion 489), voted in Opinion 489 (ICZN, 1957) to restore *Turbinella* as the taxon to be used for this group. Such were the emotions engendered by this decision that Woodring made the statement "I am unable to accept Opinion 489" (1964, p. 287) and he continued to use the name *Xancus* for the remainder of his publications.

In the Dominican beds there are four species of *Turbinella*: one in the Baitoa Formation, and three in the Cercado and Gurabo formations. Each is distinctive and cannot be mistaken for anything else. The older *T. valida* (Sowerby), from the Baitoa Formation, may be assigned to the "Ancestral Lineage" (as delimited by Vokes, 1964, p. 42), which is characterized by having a relatively small protoconch and a shouldered shell. Among the younger species, the well-known and abundant *T. praelaevigata* Vokes (= *Xancus praeovoideus* Maury *non* Vredenburg) is a member of the smooth "*laevigata* Lineage" (Vokes, 1964, p. 49) and the other two, both new species described herein, are referable to the "*angulata* Lineage" (Vokes, 1964, p. 58), characterized by a shell with a noded, angulate shoulder and an extremely large protoconch.

Although the three younger species are presumably members of two distinct lineages, they share one very peculiar shell character. All three have, on the inner side of the shell along a line slightly anterior to the shoulder at the approximate line where the suture will fall, a row of very pronounced nodules (see Pl. 6, fig. 2c; Pl. 7, fig. 2b; Pl. 8, fig. 1c). Every specimen of all three species has these nodules, which do not occur in any other *Turbinella* species of any other age, so far as I am aware. One is tempted to attribute these nodules to some outside force, a parasite or symbiont, perhaps, but why should *every* shell have them, if that is the cause? Some specimens of *Turbinella* from other times and places may develop a thickened ridge along this line, but none have the nodules. At this point I have no satisfactory explanation for this phenomenon, but it is certainly intriguing and warrants further study.

Turbinella valida Sowerby, 1850
Plate 5, figures 1–5

Turbinellus validus Sowerby, 1850, p. 50; Guppy, 1866, p. 575; 1867, p. 157 (in part); 1874, p. 438 (in part); 1876, p. 523; 1910 (as *Turbinelus*), p. 6 (in part).

Not *Turbinelus* [*sic*] *validus* Sowerby. Guppy, 1910, p. 9 [? = *T. trinitatis* (Maury, 1925a)].

Turbinella valida Sowerby. Gabb, 1873, p. 218; Vredenburg, 1923, p. 125; Vokes, 1964, p. 47, text-fig. 1 (lectotype).

Xancus validus (Sowerby). Maury, 1917, p. 83(247), pl. 13(39), fig. 5; Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 113; Maury, 1925a, p. 154/155; Olsson, 1922, p. 112(284); Woodring, 1928, p. 252; 1973, p. 479; Ferreira and Cunha, 1957, p. 35.

Xancus rex Pilsbry and Johnson, 1917, p. 167; Pilsbry, 1922, p. 342, pl. 26, figs. 5, 8; Vredenburg, 1923, p. 127; Woodring, Brown, and Burbank, 1924, p. 182; Woodring, 1928, p. 251; Weisbord, 1929, p. 47(279); Mansfield, 1937, pp. 15, 112.

?Not *Xancus validus* (Sowerby). Hubbard, 1920, p. 155 [= *T. arecibonense* (Hubbard, 1920)].

Not *Xancus validus* (Sowerby). Pilsbry, 1922, p. 342, pl. 25, fig. 3 [= *T. pilsbryi*, n. sp.].

Xancus species. Woodring, 1964, p. 286.

Xancus cf. *X. rex* Pilsbry and Johnson. Woodring, 1964, p. 286.

Not *Xancus validus validus* (Sowerby)?. Woodring, 1964, p. 286, pl. 47, fig. 13 [= *T. hysterus* (Woodring, 1973)].

Xancus cf. *X. validus* (Sowerby). Woodring, 1973, p. 479.

Not *Xancus rex* Perrilliat [Montoya], 1973, p. 13, pl. 3, figs. 1, 2, 4, 5; pl. 4, figs. 1–4, pls. 5, figs. 1, 3 [= new species].

Diagnosis.—Large (maximum height over 280 mm), high-spired *Turbinella,* with 10 to 12 angulate tubercles at the shoulder. Protoconch about 3 mm in diameter.

Original description.—"Testa oblongo-subfusiformis, laevis, postice acuminata, antice coarctata, anfractibus 6 ad 8, subventricosis, spiraliter striatis, posticis transversim obtuse costatis, intermediis subtuberculatis, anticis duobus postice tuberculatis; sutura canaliculata, margine levata; apertura magna, canali valido extus striato.

"This species somewhat resembles *T. scolymus*: it differs, however, materially in its general form not being hexagonal; in the suture, whose margin is elevated and with a narrow channel; and in its tubercles, which are small and rounded." (Sowerby, 1850, p. 50)

Description.—"The shell is biconic, large and ponderous, the periphery about median. First whorl distorted, bulbous, smooth, next whorl contracted and narrow. Succeeding whorls have massive axial folds, 6 or 7 on a whorl, traversed by about 7 spiral cords. After the mid-neanic stage the spiral sculpture weakens, and the folds gradually give place to strong tubercles at the shoulder. On the last whorl of the type there are 12 such tubercles. Above the shoulder there is a steep, slightly concave slope to the suture, the surface being conspicuously, finely plicate and having a few spiral cords, which are indistinct in the adult stage. The whorl is appressed at the suture, the axial wrinkles becoming strong retractive laminae there. The basal half of the last whorl has many spiral cords. The inner lip is heavily calloused, columella with 3 strong plaits." (Pilsbry and Johnson, 1917, p. 167, as *T. rex*)

Type material and measurements.—Lectotype, BMNH GG 20212; height 130.0 mm, diameter 57.0 mm (designated by Vokes, 1964, p. 48). Paralectotype, BMNH GG 20216; height 97.3 mm, diameter 34.6 mm; locality unknown. Holotype of *T. rex,* ANSP 2628; height 212.0 mm, diameter 117.0 mm; locality unknown. Paratype of *T. rex,* ANSP 2828; height 115.0 mm, diameter 62.0 mm; locality unknown.

Type locality.—Locality NMB 17265 (here restricted), Baitoa Formation; east side of Río Yaque del Norte, just below mouth of Arroyo Hondo, Dominican Republic (see Saunders *et al.,* 1986, text-fig. 21).

Material studied.—About 30 complete individuals, plus fragments, from several Baitoa localities.

Remarks.—Because Sowerby did not illustrate his species *T. valida,* a great deal of confusion has been introduced into the literature. For whatever reason, Pilsbry and Johnson (1917, p. 167) concluded that the shell identified by both Gabb (1873) and Maury (1917) as *T. valida* was not that species but another, which was subsequently figured by Pilsbry (1922, pl. 25, fig. 3) as "*Xancus validus*"; this specimen is treated herein as *T. pilsbryi,* n. sp. (below). With this second species identified as *T. valida,* the relatively common form from the Baitoa Formation was without a name; therefore, Pilsbry and Johnson gave it the name *T. rex.*

Under the names "*Xancus* species" and "*Xancus* cf. *X. rex,*" Woodring (1964, p. 286) identified several incomplete specimens from the Culebra and La Boca formations of Panama (see Woodring, 1973, p. 479, for change in stratigraphic assignment of localities cited in 1964), which were not figured but which may well be examples of *T. valida.*

Comparisons.—Due to the confusion between *T. valida* and *T. pilsbryi,* n. sp., Woodring (1964), in his study of the Gatun fauna, originally figured as *Xancus validus validus* a species which bears little resemblance to the true *T. valida.* After the lectotype of *T. valida* was figured (Vokes, 1964, text-fig. 1), Woodring named the Panamanian species *Xancus validus hysterus,* stating that "the large size, late appearance of knobs, wider and more pinched knobs, and absence of strong, widely spaced, exaggerated growth threads on the slope between the suture and the shoulder distinguish this subspecies from the nominate species" (Woodring, 1973, p. 479).

There is little reason to consider this form a subspecies of *T. valida,* as the appearance of the two forms is quite different. The Panamanian species is more elongate, with much more subdued "knobs" at the shoulder and marked spiral cords on the body whorl.

Perrilliat (1973, p. 13, pls. 3–5) has figured yet another species under the name of "*Xancus rex.*" Her specimens, from the Upper Miocene beds at Santa Rosa, Veracruz, Mexico, are more similar in appearance to *T. valida* than the Panamanian examples, but differ in having a smoother shell, lacking the strong growth lamellae on the subsutural ramp, so characteristic of *T. valida,* and also having the tubercles at the shoulder with a more "pinched" appearance in the anterior/posterior dimension. The Santa Rosa specimens clearly represent another undescribed species in the *T. valida* line.

Previously (Vokes, 1964, p. 47), I included in the synonymy of *T. valida* the Venezuelan species "*Xancus*" *aviaguensis* Hodson, 1931, described from the Lower Miocene Agua Clara Formation. Although the two species are similar, and probably closely related, I no longer believe they are synonymous. The subsutural ramp is more sloping in *T. valida,* giving the shell an elongate outline. In *T. aviaguensis* the subsutural ramp is almost perpendicular to the suture, giving the shell a more "stepped" outline.

Occurrence.—Baitoa Formation: Baitoa area (NMB

16935, 16938, 16942, 16945, 17265, 17280, 17281, 17283, 17284, 17285, 17288; TU 1226, 1363, 1364, 1448 [river float]).

Distribution.—Baitoa Formation, Dominican Republic; Thomonde Formation, Haiti; Culebra and La Boca formations, Panama.

Turbinella pilsbryi, new species
Plate 8, figures 1, 2

Xancus validus (Sowerby). Pilsbry, 1922, p. 342, pl. 25, fig. 3 (not Sowerby, 1850).

Diagnosis.—Large (maximum height almost 200 mm) *Turbinella,* with only slightly shouldered shell, having numerous (*ca.* 15) indistinct tubercles at the shoulder angulation. Protoconch unknown, but estimated to be about 4 mm in diameter.

Description.—"The shell is obesely fusiform, ponderous. The embryonic stage is unknown, but the early and middle neanic whorls have thick, rounded axial folds, weak below the suture, six or seven on a whorl, and fine axial costulation, over which about eight rather acute, narrow spiral threads run. On the last two or three whorls the axial folds are replaced by small, rounded tubercles disposed along a slight shoulder angle; the spirals become weak and sparce except towards the base. The suture is rather narrowly, deeply channeled. At resting stages and the final lip the suture rises very little. There are three strong plaits, the anterior one lowest and thickest." (Pilsbry, 1922, p. 342, as *T. validus*)

Etymology.—For H.A. Pilsbry, in honor of his study of the Gabb Collection of mollusks from the Dominican Republic.

Type material and measurements.—Holotype, ANSP 2631; height 178.0 mm, diameter 77.0 mm. Paratype A, PRI 45265; height 70.8 mm, diameter 52.5 mm; locality TU 1445. Unfigured paratype B, ANSP 79411; height 175.0 mm, diameter 82.0 mm; locality unknown. Unfigured paratype C, ANSP 79411; height 110.0 mm, diameter 52.0 mm; locality unknown.

Type locality.—Locality TU 1445, unnamed formation; west bank Río Yaque del Norte, at "La Ventana" tunnel (López-Angostura hydro-electric project) between hard ledges just upstream from entrance to tunnel, Dominican Republic (not mapped by Saunders *et al.,* 1986).

Material studied.—The holotype and two other specimens from the Gabb Collection, plus one incomplete specimen from near López (loc. TU 1445).

Remarks.—Because of confusion over the identity of *T. valida,* Pilsbry (1922) identified another less nodose species, which occurs in the unnamed formation on the Río Yaque del Norte, near López (loc. TU 1445) as *T. valida.* Inasmuch as the section at López seems to have been one of Gabb's localities (see Vokes, 1989, p. 20), it is not surprising that in the Gabb Collection at the Academy of Natural Sciences of Philadelphia, there should be three specimens of this undescribed species.

As with all of the species of *Turbinella* present in the beds of the Cercado and Gurabo formations, this one is marked by a peculiar row of heavy nodules on the inner side of the shell, in a line anterior to the shoulder (Pl. 8, fig. 1c).

Comparisons.—This species bears little similarity to *T. valida* Sowerby, which is characterized by very strong, pointed nodes at the shoulder. The new species has only weak shoulder nodes and is perhaps most nearly allied with the Early Miocene Brazilian *T. amazonianum* (Ferriera and Cunha, 1957), which is based upon an incomplete external mold. From the appearance of a "plastotype" in my collection the Brazilian species has a more angulate shoulder, with the whorls less inflated, giving an almost square appearance to the whorls.

As Pilsbry noted (1922, p. 343), there is some resemblance to the form he named as *T. textilis jamaicensis* and figured for comparison (1922, pl. 25, figs. 5, 6), from the younger Bowden Formation of Jamaica. The latter has fewer but stronger nodes at the shoulder and is more like the species treated herein as *T. praetextilis,* n. sp. (below).

Occurrence.—Unnamed formation: López area (TU 1445).

Distribution.—Unnamed unit of same age as the Cercado Formation, Dominican Republic.

Turbinella praetextilis, new species
Plate 7, figures 2, 3

Diagnosis.—?Large species (maximum height not known, but probably about 200 mm) species of *Turbinella,* relatively low-spired, with about seven strong tubercles at shoulder. Protoconch approximately 4 mm in diameter.

Description.—Shell with probably seven teleoconch whorls; protoconch not preserved in present material. Axial ornamentation from first teleoconch whorl to last, of six or seven ridges; initially symmetrically rounded into ridges and valleys, becoming increasing farther apart and more knob-like at shoulder as shell increases in size. Spiral ornamentation beginning with about six equi-sized threads, increasing in number by intercalation as shell enlarges; diminishing in strength on about fifth teleoconch whorl, body whorl essentially smooth except for about 28 spiral threads on the siphonal canal. Suture appressed on early whorls, becoming increasingly incised by a raised rim along the

more anterior whorl. Subsutural ramp marked by numerous axial growth lines, bent abaperturally at shoulder tubercles, almost in the manner of a turrid notch. Aperture narrowly elongate, three sharp plications on columellar wall; decreasing in strength from posterior to anterior. On inner side of outer wall of shell, along a line anterior to shoulder tubercles (where suture will fall as shell grows) a series of heavy, rounded nodules, the last two formed about 15 mm apart.

Etymology.—Named thus because of similarity to the younger *T. textilis* (Guppy, 1873).

Type material and measurements.—Holotype, PRI 45264; height 122.5 mm, diameter 47.5 mm. Paratype, BMNH GG 20213 (presently missing from collections at the Natural History Museum, London); height 142.8 mm, diameter 74.0 mm; locality unknown.

Type locality.—Locality TU 1278, Gurabo Formation; large arroyo on east side of Río Gurabo, just below the bridge/ford on Los Quemados-Sabaneta road, Dominican Republic (see Saunders *et al.,* 1986, text-fig. 5).

Material studied.—Four specimens from the Gurabo Formation, one example in the collections of the Natural History Museum, London, and several poorly preserved specimens from the Gurabo-aged beds along the Río Yaque del Sur.

Remarks.—In the Tulane collections we have four incomplete specimens from the shallow-water Gurabo Formation on the Río Gurabo and Río Guanajuma, which cannot be referred to any known species. In addition, there is a single large example (GG 20213; height 142.8 mm), said to be a "paratype" (*i.e.,* syntype) of *T. valida,* in the collections of the Natural History Museum, London. From the Gurabo-equivalent beds on the south side of the Dominican Republic, along the Río Yaque del Sur near Quita Corazo, there are four poorly preserved specimens that also seem to be referable to this species but are too poorly preserved to be considered as paratypes.

This species, as do the other Cercado/Gurabo species of *Turbinella,* bears on the inner side of the shell, at the mid-point of the body whorl, a row of nodules (see Pl. 7, fig. 2b), which are identical to those seen in *T. pilsbryi* (above) and *T. praelaevigata* (below). As noted above, the three species have no more than a generic similarity, and so one wonders at the significance of these nodules.

Comparisons.—In general, this species has the most resemblance to the Jamaican *T. textilis* (Guppy, 1873) but differs in having a lower spire, fewer axial nodes (about seven *vs.* ten) and in having the protoconch and early whorls about one-half as large (compare Pl. 7, figs. 1 and 2c).

Occurrence.—Gurabo Formation: Río Gurabo (TU 1231, 1278); Río Guanajuma (TU 1411). Unit of the same age as the Gurabo Formation: Río Yaque del Sur (NMB 16849, 17373; TU 1255).

Distribution.—Presumably confined to the Gurabo and equivalent formations, Dominican Republic.

Turbinella praelaevigata Vokes, 1964
Plate 6, figures 1–4

Turbinellus ovoideus Kiener. Moore, 1850, p. 40; 1853, p. 130; Guppy, 1866, p. 575, 576 (in part); 1867, p. 157 (in part); 1874, p. 438 (in part); 1876, p. 523; 1910, p. 6 (in part) [not Kiener, 1841; the Guppy references in part = (?) *T. riosecana* (Hodson, 1931)].

Not *Turbinellus ovoideus* Kiener. Guppy, 1910, p. 9 [? = *T. riosecana* (Hodson, 1931)].

Turbinella ovoidea Kiener. Gabb, 1873, p. 218 (not Kiener, 1841).

Xancus proaevoideus [*sic*] Maury, 1917, p. 83 (247), pl. 14 (40), fig. 18. Corrected to *praevoideus* in errata. *non Turbinella praeovoidea* Vredenburg, 1916.

Xancus praeovoideus Maury. Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 119, *et seq.*; Pilsbry, 1922, p. 343; Maury, 1925a, p. 623, pl. 7, fig. 12; Hodson, 1931, p. 40; 1931, p. 13(107); Rutsch, 1934, p. 162; Ramírez, 1950, p. 26, pl. 4; Ferreira and Cunha, 1957, p. 27.

Turbinella praeovoidea (Maury). Vredenburg, 1923, p. 125.

[?] not *Xancus praevoideus* [*sic*] Maury. Maury, 1925b, p.207(359), pl. 38(49), fig. 1 [? = *T. riosecana* (Hodson, 1931)].

Xancus validus falconensis Hodson. Woodring, 1964, p. 286 (in part).

Turbinella praelaevigata Vokes, 1964, p. 52 (*nom. nov. pro Xancus praeovoideus* Maury, 1917, *non Turbinella praeovoidea* Vredenburg, 1916).

Xancus dodonaius praelaevigatus (Vokes). Woodring, 1973, p. 479 (in part).

Diagnosis.—Large (maximum height over 200 mm), moderately high-spired *Turbinella,* with the shoulder rounded. Protoconch approximately 4 mm in diameter.

Original description.—"Our recent shells of *X. ovoidea* collected by the Hartt expedition at Bahia, Brazil, show that the spire is spirally striate, *not costate.* In the fossils the spire is *strongly tuberculately costate* for about five whorls, and the three columellar plications are decidedly heavier." (Maury, 1917, p. 248)

Description.—Heavy, massive shell with seven teleoconch whorls and a protoconch of two and one-half large, bulbous whorls, first one and one-half whorls much larger than last whorl. First five whorls of teleoconch with axial ornamentation of about seven rounded ridges. Spiral ornamentation on first five whorls of about seven threads, becoming weaker with each successive whorl. After fifth whorl shell devoid of axial ornament, and spiral ornamentation only of about a dozen alternating larger and smaller threads on siphonal canal, plus about six extremely faint threads between suture and shoulder. Suture initially undulated by axial ridges, becoming incised by a raised rim on anterior whorl; subsutural ramp marked by numerous

somewhat retractive growth lamellae. Aperture ovate, inner lip with heavy callus, three columellar plications, decreasing in strength from posterior to anterior. Inner side of outer shell wall with a line of heavy nodules at approximately the midpoint of body whorl.

Type material and measurements.—Holotype, PRI 28723; height 178.0 mm, diameter 71.0 mm.

Type locality.—Locality NMB 16913 (here restricted), Cercado Formation; Río Mao, west bank, bluff just above Paso de los Perros, or about 5 km (by road) north of the Moncion-San Jose de las Matas road, Dominican Republic (= TU 1294; USGS 8525; Bluff 3 of Maury; see Saunders *et al.*, 1986, text-fig. 29).

Material studied.—About 40 specimens from the Cercado and shallow-water Gurabo formations.

Remarks.—As Maury (1917) noted, the common Dominican species of *Turbinella* that was identified by the early workers as the Recent *T. ovoidea* Kiener, 1841 (= *T. laevigata* Anton, 1839), differs from that form in having a larger size (over 200 mm in height; although most measure about 170 mm in height) and in having strongly costate early whorls (the axial ridges in *T. laevigata* persist for only about the first two teleoconch whorls in contrast to the first five whorls in *T. praelaevigata*).

The multiple taxonomic problems involving the name of the Dominican and the Recent species were discussed in a previous paper (Vokes, 1964, p. 52) and the homonymous Dominican species was renamed *T. praelaevigata*. Although Woodring (1964, p. 287) was of the opinion that there is little relationship between the fossil and Recent species, the Dominican species would still appear to be the logical ancestor of the Recent form, which lives along the northern coast of South America (Brazil to Barbados).

The fossil species shares with the other Dominican species of *Turbinella* the peculiar row of nodules on the inner side of the shell, in a line anterior to the shoulder (see Pl. 6, fig. 2). The Recent *T. ovoidea* may have a thickened ridge in the same location but the nodules are not present.

Maury did not designate a type locality for this species but said that it occurred at Bluff 1 (Gurabo Formation) and Bluff 3 (Cercado Formation) on the Río Mao. Inasmuch as the species is most abundant in the Cercado Formation and as there are five huge specimens (the largest 225 mm in height) in the collections at the Naturhistorisches Museum, Basel, from Bluff 3 (loc. NMB 16913), this is chosen as the type locality.

Comparisons.—Woodring (1964, 1973) greatly complicated the synonymy of *T. praelaevigata*. In 1964 (p. 268) he included it under *T. falconensis* (Hodson, 1931), which he made a subspecies of the only distantly related *T. valida*. In 1973 he admitted the earlier assignment was incorrect but then placed *T. praelaevigata* as a subspecies of the Chipola Formation species *T. dodonaia* (Gardner, 1944), which is at least of the same general smooth outline. Unfortunately, the Gatun species that Woodring illustrated (1964, pl. 46, figs. 4–6) is neither *T. praelaevigata* nor *T. falconensis* but is probably *T. trinitatis* (Maury, 1925b), described from the Springvale Formation of Trinidad.

In the Springvale Formation there seems to be two species of *Turbinella* present. Guppy (1874, p. 438; 1876, p. 523; 1910, p. 6) repeatedly cited both "*Turbinellus validus*" and "*Turbinellus ovoideus*" from Trinidad. Maury (1925b, p. 359), in her study of the Springvale fauna, included all of these references under *Xancus praevoideus* [*sic*] but it is more reasonable to assume that only what Guppy was calling "*ovoideus*" is the same form as that figured by Maury as "*Xancus*" *praeovoideus* [pl. 38(49), fig. 1] and the one cited by Guppy as "*validus*" is the species that she named "*Xancus*" *trinitatis* [pl. 39(50), fig. 1]. In any case, the species that Maury cited under the name *X. praeovoideus* is not the Dominican species, as it is much more inflated than any specimen in our collection from the Dominican Republic and it lacks the channeled suture characteristic of *T. praelaevigata*. It probably is better referred to *T. riosecana* (Hodson, 1931) (see Vokes, 1964, p. 54, for further discussion).

Occurrence.—Cercado/Gurabo formations: Río Cana (TU 1230); Río Gurabo (TU 1231, 1277, 1298, 1358, 1359, 1375, 1377, 1378, 1419; NMB 15898, 15904, 15906–15909, 15912, 15913, 16920); Río Amina (TU 1219, 1412); Río Mao (TU 1293, 1379; NMB 16913, 16917, 16919, 16923).

Distribution.—Cercado and shallow-water Gurabo formations, Dominican Republic.

Subfamily **VASINAE** Adams and Adams, 1853

Genus **VASUM** Röding 1798

Vasum Röding, 1798, p. 56.

Type species.—*Murex turbinellus* Linnaeus, 1758, by subsequent designation, Winckworth, 1945.

Volutella Perry, 1810, pl. 2 (sig. B1), fig. 1.

Type species.—*Volutella divergens* Perry, 1810 [= *Vasum muricatum* (Born, 1778)], by monotypy.

Cynodonta Schumacher, 1817, p. 73.

Type species.—*Voluta ceramica* Linnaeus, 1758, by original designation.

Scolymus Swainson, 1835, p. 21.

Type species.—*Turbinella cornigera* Lamarck, 1822 [= *Murex turbinellus* Linnaeus, 1758], by subsequent designation, Abbott, 1950.

Remarks.—There are six species of *Vasum* in the Dominican Republic. All are found in shallow-water, coralline beds, and four of the species occur in the Cercado and Gurabo formations, frequently together at the same locality. The nature of the columellar plications, however, in combination with the overall shell morphology permits separation readily.

The members of the Dominican *Vasum* fauna have been covered in detail in two previous papers (Vokes, 1966, 1979) and much material presented there is not repeated here.

Vasum dominicense Gabb, 1873
Plate 9, figures 1, 2

Vasum dominicensis Gabb, 1873, p. 218.

Vasum dominicense Gabb, Maury, 1917, p. 84(248); Pilsbry, 1922, p. 344, pl. 27, figs. 4, 5 (lectotype); Ferreira and Cunha, 1957, p. 39; Vokes, 1966, p. 2, pl. 1, fig. 8 (lectotype); 1979, p. 113, pl. 2, figs. 5 (lectotype), 6.

Not *Vasum dominicense* Gabb, Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 140 [= *Vasum aedificatum* (Guppy)].

Diagnosis.—Small (65 mm in height), elongate, non-spinose *Vasum,* with heavy axial ridges; three columellar plications.

Original description.—"Shell small, very robust; spire about as long as the mouth in old shells, not so long in the younger stages, whorls 10, concave above, angulated; body whorl convex in the middle, concave in advance and broadly umbilicated; surfaces marked by about 7 larger slightly oblique longitudinal ribs, more or less tuberculate on the angle and crossed by numerous revolving ribs, the whole rendered more or less squamose by lines of growth; there is a larger revolving rib or row of tubercules in advance. Aperture elongate-oval; inner lip covered with a heavy plate, with four transverse folds." (Gabb, 1873, p. 218)

Description.—Shell massive, small for the genus (maximum height about 65 mm); high-spired; probably eight teleoconch whorls in adult shell, nature of protoconch and early whorls not known. Axial ornamentation on all whorls of eight heavy, swollen ribs about twice as long as wide; in addition, numerous axial growth lamellae. Spiral ornamentation of alternating fine and coarse cords, four to five stronger cords on body whorl, plus one very heavy cord on siphonal canal. Between stronger cords numerous secondary ones, alternating with major cords between shoulder and base of body whorl; several minor cords on subsutural ramp and on depressed portion between body whorl and major cord on siphonal canal. Intersection of spiral cords and axial lamellae giving a reticulate pattern to shell surface; where major cords at shoulder and siphonal canal cross axial ribs, small open spinelets produced in early stages, lacking in mature specimen. Suture deeply indented; subsutural ramp concave into angulation at shoulder. Aperture elongate; inner lip heavy, smooth, appressed at posterior end, free-standing at anterior end. Three strong equi-sized columellar plications, almost perpendicular to shell axis. Outer lip simple, approximately eight lirae along inner margin. Siphonal canal short; recurved at distal end, giving rise to a relatively large open umbilicus.

Type material and measurements.—Lectotype, ANSP 2623; height 60.0 mm, diameter 37.5 mm (designated by Pilsbry, 1922, p. 344). Paratype, ANSP 2623A; height 32.0 mm, diameter 19.0 mm (*fide* Pilsbry, 1922, specimen lost); locality unknown.

Type locality.—Dominican Republic, exact locality not known.

Material studied.—The type lot, consisting of two specimens in the Gabb Collection at the Academy of Natural Sciences of Philadelphia, and two small specimens from the Chipola Formation of northwestern Florida.

Remarks.—As was noted previously (Vokes, 1966, p. 8), although Gabb described this species as having four columellar plications, the two specimens in the type lot have but three. It is assumed that Gabb was including in his concept of the species specimens of the form later described as *Vasum aedificatum* Guppy, which does have four plicae.

Vaughan *et al.* (1921, p. 140) list *V. dominicense* from the Gurabo Formation at locality USGS 8528 (Río Amina). This is probably an error for locality USGS 8538 (Río Gurabo), as there are no specimens in the USNM collection from USGS 8528, but there is a specimen of *V. aedificatum* (Guppy) from USGS 8538 (which is in the adjacent column), which might have been confused with *V. dominicense.* In any case, the report of the occurrence of *V. dominicense* in the Gurabo Formation is an error.

I previously suggested (Vokes, 1966) that *V. dominicense* came from the Baitoa Formation, inasmuch as subsequent collectors have not located the species. Today, in spite of all the collecting done in the Dominican Republic by both the Basel team and us, no additional material referable to *V. dominicense* has been discovered in the Dominican beds. In the Chipola Formation of Florida, we have collected two specimens (Pl. 9, fig. 2), which seem to be referable to *V. dominicense.* Otherwise nothing can be added to the knowledge of this form.

Comparisons.—This species is probably most closely related to the younger *V. gurabicum* Maury, 1917, which also has three strong columellar plications. However, in *V. dominicense* the axial ribs are much stronger and the siphonal canal is shorter.

Occurrence.—Not known, probably Baitoa Formation.

Distribution.—(?)Baitoa Formation, Dominican Republic; Chipola Formation, Florida.

Vasum pugnus Pilsbry and Johnson, 1917
Plate 9, figure 3

Vasum pugnus Pilsbry and Johnson, 1917, p. 167; Pilsbry, 1922, p. 344, pl. 27, fig. 1 (holotype); Ferriera and Cunha, 1957, p. 39; Vokes, 1979, p. 113, pl. 2, figs. 6 (holotype), 7.

Vasum pugnans [*sic*] Pilsbry and Johnson, Vokes, 1966, p. 9, pl. 2, fig. 3 (holotype).

Diagnosis.—Moderate-sized (80 mm in height), elongate, non-spinose *Vasum*; number of columellar plications not known.

Original description.—"The shell is biconic; spire elevated, the whorls having rounded peripheral nodes, about 8 on a whorl, and spiral threads, about 12 with a few minor ones, on the penult whorl. On the last whorl there are short, thick axial folds extending a short distance downward from the shoulder, and an inferior row of blunt tubercles. From the shoulder down there are low, well-spaced spiral cords, with about 3 smaller spirals in their intervals." (Pilsbry and Johnson, 1917, p. 167)

Type material and measurements.—Holotype, ANSP 2626; height 80.0 mm, diameter 50.0 mm.

Type locality.—Dominican Republic, exact locality not known.

Material studied.—The holotype.

Remarks.—There is nothing that can be added to the information concerning this species in the Dominican Republic. We have no additional material, although the preservation of the holotype and the fact that much of Gabb's material came from Baitoa, suggests that this is the source of the unique type specimen.

In the Chipola Formation, northwestern Florida, we have collected a single battered specimen (see Vokes, 1979, pl. 2, fig. 7) that may be referable to *V. pugnus*. It has a more marked subsutural constriction but otherwise (on the basis of the battered shell) seems closer to *V. pugnus* than any other species we have seen.

Comparisons.—The only species that bears even a remote resemblance to *V. pugnus* is the French Aquitanian *V. stephenense* Peyrot, 1928, which has a higher spire and, thus, a more elongate shell.

Occurrence.—(?)Baitoa Formation.

Distribution.—(?)Baitoa Formation, Dominican Republic; (?)Chipola Formation, Florida.

Vasum tuberculatum Gabb, 1873
Plate 9, figures 4, 5

Vasum tuberculatum Gabb, 1873, p. 218; Guppy, 1876, p. 523; Dall, 1890, p. 100; Cossmann, 1901, p. 66; Pilsbry, 1922, p. 344, pl. 26, figs. 2, 3 (holotype); Ferreira and Cunha, 1957, p. 39; Vokes, 1966, p. 8, pl. 2, fig. 4 (holotype); 1979, p. 112, pl. 2, fig. 1 (holotype)–3.

Not *Vasum tuberculatum* Gabb. Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 113 [= *V. haitense* (Sowerby, 1850)].

Diagnosis.—Large (more than 120 mm in height), high-spired *Vasum* with heavy, bifid, projecting shoulder spines; five columellar plications, three larger ones alternating with two smaller ones.

Original description.—"Shell large, ponderous, broad; spire elevated, half as long as the mouth, whorls about eight or nine; broadly angulated, concave and sloping above, bearing a few very large tubercules on the angle; body whorl tapering rapidly below the angle and strongly ridged in advance. Surface covered with a few revolving lines. Aperture broad behind, narrowed in advance and expanded at the termination of the anterior ridge. Inner lip with four or five large folds." (Gabb, 1873, p. 218)

Description.—Shell large (maximum height over 120 mm); high-spired; probably eight teleoconch whorls in adult, protoconch and early whorls not known. Axial ornamentation on earliest preserved whorls of eight elongate nodes, gradually decreasing in number to only five per whorl in fully adult shell. Numerous axial growth lamellae. Spiral ornamentation of fine threads on spire whorls; on body whorl five primary cords, alternating with several secondary ones; on siphonal canal two cords, one very strong, one somewhat weaker anterior to it. Cords decreasing in strength as shell grows larger; adult specimens almost smooth, only faint traces of major cords still visible. On immature shells, where spiral cords at shoulder and on siphonal cross axial ribs, small open spines produced; other major cords giving rise to raised welts only. In particular, welt generated by that primary cord immediately anterior to one at shoulder becoming very large, creating in fully adult shell large bifid projections at shoulder, with a low, open spine at posterior end. Suture extremely appressed, especially on early whorls, strongly sinuated by projecting axial ribs; flattening out somewhat with increasing size. Subsutural ramp markedly convex in early stages, less so in mature specimens. Aperture elongate-oval; inner lip with a smooth, appressed callus wash. Columella with five unequal plications; first, third and fifth plications strong, two intermediate ones much weaker. Outer lip simple, numerous elongate lirae extending well within aperture. Siphonal canal short, broad, recurved at distal end, giving rise to a deep umbilicus, largely filled in by columellar callus.

Type material and measurements.—Holotype, ANSP 2624; height 111.0 mm, diameter 86.0 mm.

Type locality.—Locality NMB 17284 (here restricted), Baitoa Formation; east side of Río Yaque del Norte, just upstream from the mouth of Arroyo Hondo, Dominican Republic (see Saunders *et al.,* 1986, text-fig. 21).

Material studied.—The type specimen, plus eight additional specimens from the Baitoa, Cercado, and Gurabo formations.

Remarks.—*Vasum tuberculatum* occurs in beds that are shallow water (Baitoa, loc. NMB 17284) and, especially, associated with coral reefs, whether in the Cercado (loc. TU 1422) or the Gurabo (locs. TU 1215, TU 1354) formations. The largest number of specimens (four) comes from the "float" in the Río Gurabo. In addition to the occurrences in the Dominican Republic, in a previous work (Vokes, 1979, pl. 2, figs. 2, 3) I figured examples of *V. tuberculatum* from the Chipola Formation, Florida, and the Cantaure Formation, Venezuela, both believed to be correlative with the Baitoa Formation.

Vaughan *et al.* (1921, p. 113) list only *Vasum tuberculatum* from USGS 8668 (Baitoa). In the USNM collections there are two specimens (USNM 483300), which are both *V. haitense,* and no specimens of *V. tuberculatum.* However, the species does occur at Baitoa. There are specimens in the Basel Collection from the Río Yaque del Norte at Arroyo Hondo and, as we know this was one of Gabb's localities, locality NMB 17284 is here restricted as the type locality.

In 1966 I indicated that Pilsbry had selected ANSP 2624 as "lectotype," implying that there was more than one specimen in the type lot. This is incorrect. The holotype is the only specimen in the type lot. It is also as good a specimen as we have; there are two other equally large specimens in the Tulane collections (the largest, from TU 1422, measures 123.5 mm in height), but neither is as well-preserved.

Comparisons.—The adult of this species is unmistakable, with its heavy bifid spines. The juveniles may be confused with similar sized specimens of *V. aedificatum,* but the five columellar plications in *V. tuberculatum,* in contrast to the four in *V. aedificatium* readily separates the two forms. The surface is also more scabrous in *V. aedificatum* and the suture is less appressed. Occurring with *V. tuberculatum* is the equally large *V. haitense,* which may be distinguished by the less markedly bifid shoulder spines and the lower spire.

There is a striking resemblance between the Dominican *V. tuberculatum* and the living Indian Ocean species *V. rhinoceros* (Gmelin, 1791), but the latter differs in having just three strong columellar plications, in contrast to the invariable five in *V. tuberculatum.*

Occurrence.—Baitoa Formation: Baitoa area (USGS 8668; NMB 17284); Gurabo/Cercado formation: Río Cana area (TU 1354, 1422); Río Gurabo (TU 1215, 1231).

Distribution.—Baitoa, Cercado, and Gurabo formations, Dominican Republic; Chipola Formation, Florida; Cantaure Formation, Venezuela.

Vasum haitense (Sowerby, 1850)
Plate 9, figures 6–8

Turbinellus haitensis Sowerby, 1850, p. 50; Guppy, 1866, p. 575; 1867, p. 157; 1874, p. 438; 1876, p. 523, pl. 29, fig. 3 (lectotype); Cossmann, 1901, p. 66.

Vasum haitensis (Sowerby). Gabb, 1873, p. 218; Hanna, 1926, p. 459; Emerson, 1964, p. 7.

Vasum muricatum (Born). Gabb, 1881, p. 354 (in part, not Born, 1778).

Turbinella (Vasum) haitense (Sowerby). Dall, 1890, p. 100.

Turbinella (Vasum) haitense var. *engonatum* Dall, 1890, p. 100.

Vasum haitense var. *engonatum* (Dall). Dall, 1903, p. 1569; Hanna, 1926, p. 460.

Vasum engonatum (Dall). Dall, 1903, p. 1576; Maury, 1925a, p. 158/159; Ferreira and Cunha, 1957, p. 40.

Not *Vasum engonatum* Dall. Dall, 1915, p. 63, pl. 11, figs. 2, 3; Manslield, 1937, p. 113; Cooke, 1945, p. 94 [= unnamed n. sp.; see Vokes, 1970, p. 89].

Vasum haitense (Sowerby). Maury, 1917, p. 84(248), pl. 13(39); 1925a, p. 158/159, pl. 9, fig. 16; Pilsbry, 1922, p. 344; Ferreira and Cunha, 1957, p. 38; Vokes, 1966, p. 10, pl. 3, figs. 1–4, pl. 4, fig. 3, text-fig. 1 (lectotype); 1970, p. 88, text-fig. 1; 1979, p. 112.

Vasum tuberculatum Gabb, Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 113 (not Gabb, 1873).

Vasum cf. *haitense* (Sowerby). Maury, 1925a, p. 156/157, pl. 9, fig. 18; Ferreira and Cunha, 1957, p. 3.

Vasum aff. *V. engonatum* (Dall). Gardner, 1944, p. 441.

Diagnosis.—Large (over 130 mm in height), low-spired *Vasum* with sharp strong shoulder spines directed at right angles to axis; four or five columellar plications.

Original description.—"Testa subtrigona, turbinata, transversim striata, tuberculata, spira subdepressa, subacuminata; anfractibus senis, postice anguliferis, ad angulum tuberculiferis, lateribus declivibus; antice seriebus duabus tuberculorum, quarum postice multo major; labio columellari quadriplicato; canal extus subtuberculato.

"The flatness of the spire at once distinguishes this from *T. pugillaris* Lam. [= *V. muricatum* (Born, 1778)]." (Sowerby, 1850, p. 50)

Description.—Heavy, massive shell with nine teleoconch whorls and a protoconch of one and one-half smooth, bulbous whorls. Axial ornamentation on early teleoconch whorls of about eight low, strap-like ridges; by fourth teleoconch whorl small open spines developed on each ridge at shoulder. On body whorl, another two rows of spines on siphonal canal. Spiral ornamentation initially of about four equal threads, in-

creasing in number by intercalation; two threads at shoulder increasing in size relative to ones on subsutural ramp. On body whorl these two heavier cords becoming spirally elongate knobs anterior to shoulder spine. Entire exterior shell surface covered by numerous spiral threads, of varying strength, crossed by less obvious axial growth lines, giving a linen-like surface texture. Suture on early teleoconch whorls located at periphery of shell but beginning on fourth teleoconch whorl (at same time as shoulder spines develop) suture moving increasingly adapically to envelop shoulder spines; angle of subsutural ramp changing from vertical to horizontal, with a resulting change in profile of shell. Suture markedly undulated as a result of following contour of shoulder spines. Subsutural ramp with retractive growth lines extending abaperturally from suture back to shoulder spines and then adaperturally anterior to spines. Growth lines also enfolded into spines on siphonal canal. Aperture narrow; only with final adult shell a heavy expanded parietal shield formed. Columellar wall with four strong plications, of varying strength from anterior to posterior: first and third of moderate size, second weakest, fourth (posteriormost) strongest. Outer lip on most specimens thin and opening into spines at shoulder and siphonal canal. On mature adult outer lip with a thickened margin in advance of spines.

Type material and measurements.—Lectotype, BMNH GG 20270; height 78.7 mm, diameter 74.9 mm (designated by Vokes, 1966, p. 11).

Type locality.—Locality TU 1226 (here restricted), Baitoa Formation; east side of Río Yaque del Norte, below the village of Baitoa, and above the confluence of the Río Yaque and the Río Bao, Dominican Republic (= USGS 8558; see Saunders *et al.*, 1986, text-fig. 21).

Material studied.—Twenty specimens from the Baitoa Formation, an unnamed unit of the same age as the Cercado Formation, and shallow-water portions of the Gurabo Formation, Dominican Republic, plus numerous examples from the Chipola Formation.

Remarks.—This is the largest species of *Vasum* found in the Dominican beds. From an unnamed formation of Cercado age (see Vokes, 1989, p. 21) the Basel team collected a magnificent specimen (NMB H 17654) measuring 130 mm in height (and weighing just over 1 kg), and from locality TU 1404, near La Barranca, we have another incomplete specimen that would have been of comparable size.

From locality USGS 8668, Vaughan *et al.* (1921, p. 113) cite as *V. tuberculatum* what prove to be two specimens of *V. haitense* (USNM 483300), the larger of which measures 100 mm in height. Both species occur in the Baitoa Formation, but *V. haitense* is the more common.

Comparisons.—As Sowerby noted (1850, p. 50), the flatness of the spire distinguishes this species from the living *Vasum muricatum* (Born, 1778) and any other species of *Vasum* as well. Juvenile specimens, which still retain the high-spired outline, may be confused with juveniles of *V. tuberculatum* but the presence of five columellar plications in the latter readily separates the two species. Gerontic specimens of *V. haitense* may develop a weak fifth columellar plication between the third and fourth plicae, but by the time this happens there is no problem distinguishing the low-spired *V. haitense* from *V. tuberculatum*.

An unnamed species of *Vasum* occurs in the Tampa Limestone of Florida (Dall, 1915, p. 63, pl. 11, figs. 2, 3), which has been identified as *V. haitense* (Vokes, 1966, p. 11, pl. 4, fig. 3). In this form, however, the suture is placed anterior to the shoulder spines, giving a "stepped" appearance to the spire.

In the Recent fauna, the eastern Pacific species *V. caestus* (Broderip, 1833) in some ways bears the strongest resemblance to *V. haitense*. Both have four (and rarely a fifth) columellar plications. In both, the suture envelops the shoulder spines rather than remaining anterior to them. The obvious difference between the two is the higher spire in the Recent form. In overall appearance it is *V. muricatum* with a cancellate surface ornamentation that seems closest to *V. haitense*. In *V. caestus* there are only four heavy spiral cords and the shell has a relatively smooth appearance.

Occurrence.—Baitoa Formation: Baitoa area (NMB 17283, 17284; TU 1226, 1363). Unnamed formation: López area (NMB 17278). Gurabo Formation: Río Cana area (NMB 16862, 16864; TU 1354); Río Gurabo (TU 1231, 1277, 1278); Río Mao area (TU 1225, 1293); Santiago area (TU 1250, 1404).

Distribution.—Baitoa, Gurabo and unnamed formations, Dominican Republic; Chipola Formation, Florida; Pirabas Limestone, Brazil.

Vasum aedificatum (Guppy, 1876)
Plate 10, figures 1–6

Turbinellus aedificatus Guppy, 1876, p. 523, pl. 28, fig. 5; Dall, 1890, p. 99.

Vasum dominicense Gabb. Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 140 (not Gabb, 1873).

Vasum gurabicum Maury. Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 140 (in part, loc. USGS 8549 only).

Vasum edificatum [*sic*] (Guppy). Pilsbry, 1922, p. 344 (in part, excluding references to *V. subcapitellum*, and *V. gurabicum*); Ferreira and Cunha, 1957, p. 40.

Vasum aedificatum (Guppy). Mansfield, 1937, p. 15, 113; Vokes, 1966, p. 13, pl. 1, fig. 5, text-fig. 2 (holotype).

Diagnosis.—Small (maximum height just over 70

mm), high-spired *Vasum*, with small spines at shoulder; four columellar plications, of which the anteriormost and two posterior ones are larger, the second from the anterior end smaller.

Original description.—"Shell solid, rimate, very shortly fusiform, spire high, composed of seven or eight whorls adorned with strong longitudinal ribs each terminating on the angle in a subtubular spine, and with numerous close spiral ridges, which are crossed by fine squamose lines of growth. Aperture narrow; inner lip covered with a thick callus bearing about four plaits." (Guppy, 1876, p. 523)

Description.—Shell small for the genus (maximum height about 70 mm); high-spired; protoconch of about one and one-half conical whorls; teleoconch of nine whorls. Axial ornamentation of six or seven pointed nodes on each whorl; on about fourth teleoconch whorl moderately long, pointed spines developed on each node at shoulder. On body whorl axial ornamentation of about seven elongate ridges, very strong and extending to base of body whorl on immature examples but almost disappearing on fully adult shells. Numerous axial growth lamellae. Spiral ornamentation on spire whorls consisting only of small cords on subsutural ramp; on body whorl five or six major cords, plus two major cords on siphonal canal; alternating irregularly with secondary threads. Where spiral cords cross axial ridges long spines produced at shoulder cords, and sometimes a second row of spines on major cord anterior to shoulder. In addition, on siphonal canal two rows of spines, the more posterior row stronger than anterior row. Combination of axial growth lamellae and spiral cords giving an extremely scabrous appearance to entire shell surface. Suture extremely appressed, reaching to base of shoulder spines on spire whorls, and sinuated by spines; subsutural ramp convex into shoulder spines. Aperture narrowly diamond-shaped with anal channel formed by appressed suture. Inner lip smooth, heavy, appressed at posteriormost portion, but generally free-standing along entire length. Columella with four plications, perpendicular to axis of shell; of these, anteriormost and two posterior ones largest, second from anterior end, smaller. Outer lip thin, scalloped on margin by major spiral cords, folding into spine at shoulder and larger spine on siphonal canal. Siphonal canal short, broad, recurved at distal end, forming a deep umbilicus.

Type material and measurements.—Holotype, BMNH GG 20255; height 62.6 mm, diameter 33.3 mm. Paratype, BMNH GG 20222; height 72.1 mm, diameter 46.3 mm; locality unknown.

Type locality.—Locality TU 1215 (here restricted), Gurabo Formation; Río Gurabo, bluffs on both sides, from the ford on the Los Quemados-Sabaneta road, upstream to approximately 1 km above the ford, Dominican Republic (= locs. USGS 8539–8543; Maury's Zone D; see Saunders *et al.*, 1986, text-fig. 5).

Material studied.—35 specimens from numerous localities in the Cercado, shallow-water Gurabo, and coralline Mao formations (Mao Adentro member).

Remarks.—In 1966, I attributed this species to the Gurabo Formation, on the basis of Mansfield's (1937, p. 15) statement that the species occurred in this formation. Presumably his assignment was based on the USNM material collected by Vaughan *et al.* (1921). But the species name *V. aedificatum* does not appear in their faunal lists. In the collections at the USNM, there are two specimens of *V. aedificatum* labeled (in Woodring's hand) as "*V. tuberculatum*," which seem to correlate with the material listed as *V. gurabicum* Maury from loc. USGS 8549 and *V. dominicense* Gabb from USGS 8538 (?= USGS 8528), both of which are in the Gurabo Formation.

However Mansfield made his determination, the information proves to be correct; the species is found in the shallow-water portions of the Gurabo Formation (locs. TU 1215, 1278, etc.) but it is more common in the Cercado Formation (locs. TU 1230, 1422), and also occurs in the coralline beds of the Mao Formation (loc. TU 1252, Mao Adentro member).

Unfortunately, in the same work (Vokes, 1966, p. 13), I indicated that the type locality for the species is the Río Yaque, but this is one place where the species has not been found. Therefore, as a substitute, TU 1215, a locality where Heneken, who provided the material studied by Guppy, was likely to have collected. (The largest number of specimens [13] in our collections come from TU 1231, river-float in the Río Gurabo, and this is very likely the actual source of Heneken's material as well!)

Comparisons.—Gabb apparently failed to separate *V. dominicense* and *V. aedificatum*. Both are relatively small, elongate species of *Vasum*. But, in addition to the difference in the number of columellar plications, which immediately separates the two, *V. dominicense* is marked by much heavier axial ridges. There is also a strong similarity between juvenile examples of *V. aedificatum* and *V. gurabicum*. Once again the number of columellar plications separates the two forms. In addition, *V. aedificatum* is a more massive shell, which becomes relatively smooth in the mature adult. In contrast, *V. gurabicum* retains the elaborate surface ornamentation up to the largest specimens seen.

Occurrence.—Cercado/Gurabo formations: Río Cana area (TU 1230, 1422); Río Gurabo (NMB 15816, 15848, 15863; TU 1212, 1215, 1231, 1278); Río Mao area (TU 1225); Santiago area (NMB 17270). Mao Formation: Santiago area (TU 1252).

Distribution.—Cercado, shallow-water Gurabo, and coralline Mao formations, Dominican Republic.

Vasum gurabicum Maury, 1917
Plate 10, figures 7–9

Vasum dominicense var. *gurabicum* Maury, 1917, p. 84(248), pl. 13(39), fig. 7; Pilsbry, 1922, p. 344.
Vasum gurabicum Maury. Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 140 (in part, loc. USGS 8539 only); Vokes, 1966, p. 14, pl. 1, figs. 6, 7.
Vasum sp. indet. Vaughan, Cooke, Condit, Ross, Woodring, and Calkins, 1921, p. 140.
Vasum edificatum [*sic*] (Guppy). Pilsbry, 1922, p. 344 (in part).

Diagnosis.—Small (under 60 mm in height), high-spired, spinose *Vasum;* three sharp columellar plications.

Original description.—"We have a number of specimens resembling *V. dominicense* Gabb but with only three instead of four plications on the columella." (Maury, 1917, p. 248)

Description.—"Shell biconic, moderate in size, with eight whorls in the adult. Spiral sculpture of four strong ribs which may bear long spines where they cross each of eight axial ribs. In addition, another spinose rib at the base of the short, somewhat recurved siphonal canal. Secondary spiral ornamentation of a network of fine spiral threads crossed by axial growth lines giving rise to a fimbriate surface texture. Suture wavy, appressed, occurring just anterior to the second row of spines on the previous whorl. Aperture elongate, approximately the same length as the height of the spire. Columella bearing three strong plaits and a free standing inductura on the parietal wall. Outer labium markedly lirate with about a dozen paired lirae." (Vokes, 1966, p. 14)

Type material and measurements.—Holotype, PRI 28708; height 37.0 mm, diameter 24.0 mm.

Type locality.—Gurabo Formation, Zone D, Río Gurabo at Los Quemados, Dominican Republic (= loc. TU 1215; see Saunders *et al.,* 1986, text-fig. 5).

Material studied.—Nearly 70 specimens from numerous localities in the Cercado, shallow-water Gurabo, and Mao formations.

Remarks.—Although *V. gurabicum* is the smallest of the Dominican species of *Vasum,* it attains a size larger than the holotype would indicate, as we have three examples approximately 60 mm in height. This species evidently lived in a high-energy environment; in the entire lot of almost 70 specimens not one is unbroken, including the holotype. Most of our specimens are from the type locality (= loc. TU 1215, 24 specimens) or the "float" in the Río Gurabo (loc. TU 1231, 10 specimens), which probably also came from the type locality.

Comparisons.—There are three smaller species of *Vasum* in the Dominican beds. Of these *V. aedificatum* may be distinguished by the presence of four columellar plications; only *V. dominicense* and *V. gurabicum* have three plications. Of the three species, *V. gurabicum* is the smallest and the most spinose, although most specimens are not as spinose as two examples in the Gabb Collection (ANSP 31242[3]; both figured by Vokes, 1966, pl. 1, figs. 6, 7; the first refigured here, Pl. 10, fig. 7). These two specimens were identified as *V. aedificatum* by Pilsbry (1922, p. 344), who included *V. gurabicum* in the synonymy of *V. aedificatum* and, as a result, believed that "the neanic stage [of *V. aedificatum*] is rather profusely spinose."

This Dominican species is most closely related to the living *V. capitellum* (Linnaeus, 1758), found today throughout the Caribbean. The Recent form has somewhat heavier spiral cords and slightly more pronounced axial ridges, but in truth there no absolute criterion to separate the two.

Occurrence.—Cercado/Gurabo formations: Río Cana area (NMB 16865, 16868; TU 1282, 1354, 1356, 1422); Río Gurabo (NMB 15811, 15846, 15857, 15859, 15863; TU 1211, 1215, 1231, 1246, 1277, 1278); Río Mao area (TU 1225); Santiago area (TU 1277A). Mao Formation: Río Gurabo (TU 1352); Santiago area: (TU 1252).

Distribution.—Cercado, shallow-water Gurabo, and Mao formations, Dominican Republic.

APPENDIX

Supplementary Locality Data

The following are Tulane University localities not in the Dominican Republic, which are cited in this paper. For all Dominican Republic localities see Saunders *et al.* (1986).

457. Chipola Formation, west bank of Chipola River, about ½ mile below Tenmile Creek (SW¼ Sec. 17, T1N, R9W), Calhoun Co., Florida.
458. Chipola Formation, east bank of Chipola River, above Farley Creek (SW¼ Sec. 20, T1N, R9W), Calhoun Co., Florida.
546. Chipola Formation, Tenmile Creek, about 1 3/4 miles west of Chipola River (NE¼ Sec. 12, T1N, R10W), Calhoun Co., Florida.
547. Chipola Formation, west bank of Chipola River, about 2000 ft. above Fourmile Creek (SW¼ Sec. 29, T1N, R9W), Calhoun Co., Florida.

[3] In 1966, I cited these two specimens as ANSP 31242 and 31243; however, I am advised by Gary Rosenberg of the Academy of Natural Sciences of Philadelphia that both specimens are catalogued under the same number ANSP 31242. Specimen number ANSP 31243 is a *Jenneria.*

554. Chipola Formation, east bank of Chipola River at power line crossing (SW¼ Sec. 17, T1N, R9W), Calhoun Co., Florida.
705. Bowden Formation, type locality, Bowden, east of Port Morant, Parish of St. Thomas, Jamaica.
727. Bermont Formation, borrow pits 2.2 miles east of U.S. Highway 27, 15 miles south of South Bay, Palm Beach Co., Florida.
759. Bermont Formation, spoil banks north side of Caloosahatchee River, 2 miles west of Ortona Lock (NE¼ Sec. 29, T42S, R30E), Glades Co., Florida.
797. Pinecrest Beds, material exposed during construction of "Alligator Alley" (now Everglades Parkway), 13.3 miles east of Florida Highway 29 (T49S, R32E), Collier Co. Florida.
803. Bermont Formation, spoil banks south side of Caloosahatchee River, two miles west of Ortona Lock (NE¼ Sec. 29, T42S, R30E), Glades Co., Florida.
991. Caloosahatchee Formation, Cochran rock pit, 2 ½ miles west of La Belle, on north side of Florida Highway 80, Hendry Co., Florida.
1046. Agueguexquite Formation, roadcuts on both sides of old Mexico Highway 180, 4.7 km west of junction with new Highway 180, or 12 km east of junction with side road into Coatzacoalcos, Veracruz, Mexico.
1196. Chipola Formation, Farley Creek, about 0.8 mile east of bridge on Florida Highway 275 (NE¼ Sec. 21, T1N, R9W), Calhoun Co., Florida.
1269. Cantaure Formation, series of arroyos about 500 meters south of "Casa Cantaure" (which is literally one house and which is about 400 meters south of older, now abandoned, house that was the "Casa Cantaure" of Jung, 1965, and others), 14 km (by road) west of Pueblo Nuevo, Paraguana Peninsula, Venezuela.
1512. Caloosahatchee and Bermont formations mixed, DeSoto Mining Company, pits two miles east of Florida Highway 31, about 12 miles south of Arcadia (T39S, R25E), DeSoto Co., Florida.

The following are Tulane University Recent locality numbers:

R-166. Barra de Navidad, rocky point across inlet from main sand bar, Jalisco, Mexico.
R-390. Playa Costambar, west of Puerto Plata, Dominican Republic.
R-543. Bridgetown, Barbados.

REFERENCES CITED

Abbott, R.T.
1950. The genera *Xancus* and *Vasum* in the western Atlantic. Johnsonia, vol. 2, no. 28, pp. 201–219, pls. 89–95.
1954. American seashells. [1st Edition.] Van Nostrand Reinhold Company, New York, xiv + 541 pp., 40 pls., 100 text-figs.
1974. American seashells. (2nd Edition.) Van Nostrand Reinhold Company, New York, 663 pp., 24 color plates, 6405 text-figs.

Abbott, R.T., and Dance, S.P.
1982. Compendium of seashells; a color guide to more than 4,200 of the world's marine shells. E.P. Dutton, Inc., New York, 411 pp., 4000+ color illus.

Adams, A.
1855. Descriptions of new genera and species of gasteropodous Mollusca. Proceedings of the Zoological Society of London, pt. 21 [1853], pp. 182–186.

Adams, H., and Adams, A.
1853–1858. The genera of Recent Mollusca, arranged according to their organization. London, vol. 1, pts. 1–8, pp. 1–256, pls. 1–32 [1853], pts. 9–15, pp. 257–484, pls. 33–60 [1854]; vol. 2, pts. 16–18, pp. 1–92, pls. 61–72 [1854], pts. 19–24, pp. 93–284, pls. 73–96 [1855], pts. 25–28, pp. 285–412, pls. 97–112 [1856], pts. 29–32, pp. 413—540, pls. 113–128 [1857]; vol. 3, pts. 33–35, pp. 541—661, pls. 129–138 [1858].

Angas, G.F.
1865. Descriptions of ten new species of shells, chiefly from the Australian seas. Proceedings of the Zoological Society of London, pt. 1, pp. 55–58, pl. 2.

Anton, H.E.
1839. Verzeichniss der Conchylien welche sich in der Sammlung von Hermann Eduard Anton befinded. Halle, xvi + 110 pp.

Bail, P.
1993. The genus *Lyria* Gray, 1847 (Part II). *Xenophora*, no. 64, pp. 4–19.

Baily, J.L., Jr.
1956. Proposed use of the plenary powers to preserve the generic name "*Turbinella*" Lamarck, 1799, as the name for the sacred chank shell of India. Bulletin of Zoological Nomenclature, vol. 11, pt. 11, pp. 330–332.

Barnes, D.H.
1824. Notice of several species of shells. Annals of the Lyceum of Natural History of New York, vol. 1, pp. 131–140, pl. 9.

Bayer, F.M.
1971. New and unusual mollusks collected by R/V *John Elliott Pillsbury* and R/V *Gerda* in the tropical western Atlantic. Bulletin of Marine Science, vol. 21, no. 1, pp. 111–236, figs. 1–72.

Beu, A.G.
1971. Cassididae and Harpidae: two family-group homonyms in Mollusca and Arthropoda Z.N.(S.) 1938. Bulletin of Zoological Nomenclature, vol. 28, pt. 1, pp. 56–58.
1976. Revision of the southwest Pacific species of *Morum (Oniscidia)* (Gastropoda: Cassidae). Journal of the Malacological Society of Australia, vol. 3, nos. 3–4, pp. 223–321, 15 figs.

Bold, W.A. van den

1988. Neogene paleontology in the northern Dominican Republic. 7. The Subclass Ostracoda (Arthropoda:Crustacea). Bulletins of American Paleontology, vol. 94, no. 329, pp. 1–105, pls. 1–13, 15 text-figs., 5 tables.

Born, I.

1778. Index rerum naturalium Musei Caesarei Vindobonensis. Pars 1, Testacea. Vindobonae [Vienna], xliii + 458 pp., 1 pl.

Brnderip, W.J.

1833. Characters of new species of Mollusca and Conchifera, collected by Mr. Cuming. Proceedings of the Zoological Society of London, pt. 1, pp. 4–8.

Brnnn, H.G.

1849. Handbuch der Geschichte der Natur. Vol. 3, No. 3. Index Palaeontologicus. Stuttgart, 980 pp.

Clench, W.J.

1946. The genera *Bathyaurinia, Rehderia* and *Scaphella* in the western Atlantic. Johnsonia, vol. 2, no. 22, pp. 41–60, pls. 24–31.

Clench, W.J., and Abbott, R.T.

1943. The genera *Cypraecassis, Morum, Sconsia* and *Dalium* in the western Atlantic. Johnsonia, vol. 1, no. 9, pp. 1–8, pls. 1–4.

Clench, W.J., and Aguayo, G.G.

1940. Notes and descriptions of new deep-water Mollusca obtained by the Harvard-Habana expedition off the coast of Cuba. III. Memorias de la Sociedad Cubana de Historia Natural, vol. 14, no. 1, pp. 77–94, pls. 14–16.

Conrad, T.A.

1848. Observations on the Eocene formation, and description of one hundred and five new fossils of that period, from the vicinity of Vicksburg, Mississippi; with an appendix. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 3, pp. 280–299.

1865. Catalogue of the Eocene and Oligocene Testacea of the United States. American Journal of Conchology, vol. 1, pp. 1—35.

Cooke, C.W.

1945. Geology of Florida. Florida Geological Survey, Bulletin, no. 29, 339 pp., 477 figs., 1 map.

Cossmann, A.E.M.

1899–1901. Essais de paléoconchologie comparée. Paris, vol. 3, 201 pp., 8 pls. [1899]; vol. 4, 293 pp., 10 pls. [1901].

Dall, W.H.

1887. [A letter containing notes on Antillean mollusks]. The Conchologists' Exchange [Nautilus], vol. 2, no. 1, pp. 9–10.

1890–1903. Contributions to the Tertiary fauna of Florida, with especial reference to the Miocene silex-beds of Tampa and the Pliocene beds of the Caloosahatchie [*sic*] River. Transactions of the Wagner Free Institute of Science, vol. 3. Part 1. Pulmonata, opistobranchiate and orthodont gastropods, pp. 1–200, pls. 1–12 [1890]; Part 2. Streptodont and other gastropods, pp. 201–473, pls. 13–22 [1892]; Part 3. A new classification of the pelecypoda, pp. 483–570 [1895]; Part 4. I. Prionodesmacea: *Nucula* to *Julea*. II. Teleodesmacea: *Teredo* to *Ervillia*, pp. 571–947, pls. 23–35 [1898]; Part 5. Teleodesmacea concluded, pp. 949–1218, pls. 36–47 [1900]; Part 6. Concluding part, pp. 1219–1654, pls. 46–60 [1903].

1906a. Notes on some names in the Volutidae. Nautilus, vol. 19, no. 12, pp. 143–144.

1906b. Early history of the generic name *Fusus*. Journal of Conchology, vol. 11, no. 10, pp. 289–297.

1907. A review of the American Volutidae. Smithsonian Miscellaneous Collections, vol. 48, pt. 3, no. 1663, pp. 341–373.

1909. Contributions to the Tertiary paleontology of the Pacific coast. 1. The Miocene of Astoria and Coos Bay, Oregon. United States Geological Survey, Professional Paper 59, 278 pp., 23 pls., 14 text-figs.

1915. A monograph of the molluscan fauna of the *Orthaulax pugnax* zone of the Oligocene of Tampa, Florida. United States National Museum, Bulletin, no. 90, 173 pp., 26 pls.

Dall, W.H., and Simpson, C.T.

1901. The Mollusca of Porto Rico. United States Fish Commission, Bulletin, vol. 20, pt. 1, pp. 351–524, pls. 53–58.

Dance, S.P., and Emerson, W.K.

1967. Notes on *Morum dennisoni* (Reeve) and related species. Veliger, vol. 10, no. 2, pp. 91–98, pl. 12.

de Jong, K.M., and Coomans, H.E.

1988. Marine gastropods from Curaçao, Aruba, and Bonaire. Studies on the Fauna of Curaçao and Other Caribbean Islands, no. 214, 261 pp., 47 pls.

Deshayes, G.P.

1843–1844. *In* Deshayes, G.P., and Milne-Edwards, H., Histoire naturelle des animaux sans vertèbres par J.B.P.A. Lamarck, deuxième edition. Paris, vol. 9, 725 pp. [1843]; vol. 10, 638 pp. [1844].

Emerson, W.K.

1964. Results of the Puritan–American Museum of Natural History Expedition to western Mexico. 20. The Recent mollusks: Gastropoda: Harpidae, Vasidae, and Volutidae. American Museum Novitates, no. 2202, 23 pp., 9 figs.

1967. A new species of *Morum* from Brazil, with remarks on related species (Gastropoda:Tonnacea). Veliger, vol. 9, no. 3, pp. 289–292, pl. 39, 1 text-fig.

Emerson, W.K., and Old, W.E., Jr.

1963. Results of the Puritan–American Museum of Natural History expedition to western Mexico. 19. The Recent mollusks: Gastropoda, Strombacea, Tonnacea, and Cymatiacea. American Museum Novitates, no. 2153, pp. 1–38, 28 figs.

1979. *Scaphella contoyensis*, a new volutid (Gastropoda) from East Mexico. Nautilus, vol. 93, no. 1, pp. 10–14, 7 figs.

Ferreira, C.S., and Cunha, O.R. da

1957. Contribuiçao a paleontologia do Estado do Pará. 1. (Mollusca: Gastropoda). Museu Paraense Emilio Goeldi, Boletin (n.s.), Geologia, no. 2, 61 pp., 3 pls., 3 "fotos," 4 charts.

Fischer, P.

1884. Manuel de conchyliologie et de paléontologie conchyliogique. Paris, fasc. 7, pp. 609–688.

Fischer, P., and Bernardi, A.C.

1857. Descriptions d'espèces nouvelles. Journal de Conchyliologie, vol. 5, no. 3, pp. 292–300, pls. 8, 10 [9].

Gabb, W.M.

1873. On the topography and geology of Santo Domingo. Transactions of the American Philosophical Society, new ser., vol. 15, pp. 49–259, 2 maps.

1881. Descriptions of new species of fossils from the Pliocene Clay Beds between Limon and Moen, Costa Rica, together with notes on previously known species from there and elsewhere in the Caribbean area. Journal of the Academy of Natural Sciences of Philadelphia, ser. 2, vol. 8, pp. 349–380, pls. 45–47.

Garcia, E.F., and Sunderland, K.
1990. Notes on the genus *Lyria* in the western Atlantic. American Conchologist, vol. 18, no. 1, pp. 18–20, illust.

Gardner, J.A.
1937–1947. The molluscan fauna of the Alum Bluff Group of Florida. United States Geological Survey, Professional Paper 142-F, pp. 251–435, pls. 37–48 [1937]; 142-G, pp. 436–492, pls. 49–51 [1944]; 142-H, pp. 493–656, pls. 52–62 [1947].

Garrard, T.A.
1961. Mollusca collected by M/V "Challenge" off the east coast of Australia. Journal of the Malacological Society of Australia, vol. 1, no. 5, pp. 2–37, pls. 1, 2.

Gibson-Smith, J., and Gibson-Smith, W.
1979. The genus *Arcinella* (Mollusca:Bivalvia) in Venezuela and some associated faunas. GEOS, no. 24, pp. 11–32, 3 pls., 2 text-figs.

Gmelin, J.F.
1791. Caroli a Linné. Systema naturae per regna tria naturae. Editio decima tertia. Vol. 1, Pars VI, Classis VI, Vermes. Lipsiae [Leipsig], pp. 3021–3910. [Second printing, Lugduni (Lyon), post-1791.]

Goode, G.B., and Bean, T.H.
1896. Oceanic ichthyology: a treatise on the deep-sea and pelagic fishes of the world, based chiefly upon the collections made by the steamers "Blake," "Albatross," and "Fish Hawk," in the North-western Atlantic. United States National Museum, Special Bulletin ["1895"], xxxv + 553 pp., 123 pls.

Goldfuss, G.A.
1839. Bietrage zue Petrefactenkunde. Academiae Caesarae Leopoldino-Carolina naturae curiosum. Nova Acta Physico-Medica, vol. 19, no. 1, pp. 358–359.

Gray, J. E.
1825. Monograph on the Cypraeidae, a family of testaceous Mollusca. The Zoological Journal, vol. 1, pp. 489–518, *errata et addendum* following p. 601, pl. 12.
1847. A list of the genera of Recent Mollusca, their synonyma and types. Proceedings of the Zoological Society of London, pt. 15, pp. 129–219.

Guppy, R.J.L.
1866. On the relations of the Tertiary formations of the West Indies. Quarterly Journal of the Geological Society of London, vol. 22, pp. 570–590, pl. 26.
1867. On the Tertiary fossils of the West Indies with especial reference to the classification of the Kainozoic rocks of Trinidad. Proceedings of the Scientific Association of Trinidad, vol. 1, pt. 3, pp. 145–176. [Reprinted *in* Harris, 1921, pp. 172–203.]
1873. On some new Tertiary fossils from Jamaica. Proceedings of the Scientific Association of Trinidad, vol. 2, no. 2, pt. 10, pp. 71–88, pls. 1, 2. (Reprinted *in* Harris, 1921, pp. 204–220.)
1874. On the West Indian Tertiary fossils. The Geological Magazine, new ser., (decade 2), vol. 1, no. 10, pp. 404–411, 433–446, pls. 16–18.
1876. On the Miocene fossils of Haiti. Quarterly Journal of the Geological Society of London, vol. 32, pp. 516–532, pls. 28, 29.
1910. On a collection of fossils from Springvale, near Couva, Trinidad. Agricultural Society of Trinidad and Tobago, Society Paper 440, pp. 1–15. [Reprinted *in* Harris, 1921, pp. 292–305.]

Hanley, S.
1858. Description of a new *Oniscia*. Proceedings of the Zoological Society of London, pt. 26, pp. 255–256, pl. 42.

Hanna, G.D.
1926. Paleontology of Coyote Mountain, Imperial County, California. Proceedings of the California Academy of Sciences, (ser. 4), vol. 14, no. 18, pp. 427–503, pls. 20–29, 1 text-fig.

Harris, G.D.
1921. A reprint of the more inaccessible paleontological writings of Robert John Lechmere Guppy. Bulletins of American Paleontology, vol. 8, no. 35, pp. 149–346, pls. 5–14.

Heilprin, A.
1886–1887. Explorations on the west coast of Florida and in the Okeechobee wilderness with special reference to the geology and zoology of the Floridian Peninsula. Transactions of the Wagner Free Institute of Science, vol. 1, [1886] title page, pp. 6–127; [1887] pp. i–xiv + 1–64, 64A, 64B, + 128—136, pls. 1–19,16a, 16b, + 2 unnumbered. [See Petit and Wilson, 1986, pp. 95, 96.]

Hermannsen, A.N.
1847. Indicis generum malacozoorum primordia. . . Vol. 1. Cassell, pp. 233–637.

Hodson, H.K.
1931. *In* Hodson, F., and Hodson, H.K. Some Venezuelan mollusks. Bulletins of American Paleontology, vol. 16, no. 59, pp. 1–94, pls. 1–24; Part II, vol. 16, no. 60, pp. 95–132, pls. 25–36.

Hoerle, S.E.
1970. Mollusca of the "Glades" unit of southern Florida: Part II. List of molluscan species from the Belle Glade rock pit, Palm Beach County, Florida. Tulane Studies in Geology and Paleontology, vol. 8, no. 2, pp. 56–68.

Hoerle, S.E., and Vokes, E.H.
1978. A review of the volutid genera *Lyria* and *Falsilyria* (Mollusca: Gastropoda) in the Tertiary of the western Atlantic. Tulane Studies in Geology and Paleontology, vol. 14, no. 3, pp. 105–130, pls. 1–5.

Hubbard, B.
1920. Tertiary Mollusca from the Lares District, Porto Rico. New York Academy of Sciences, Scientific Survey of Porto Rico and the Virgin Islands, vol. 3, pt. 2, pp. 77–164, pls. 10–25.

Hughes, R.N.
1986. Anatomy of the foregut of *Morum* Röding, 1798 (Gastropoda:Tonnacea) and the taxonomic misplacement of the genus. Veliger, vol. 29, no. 1, pp. 91–100, 9 figs.

Hughes, R.N., and Emerson, W.K.
1987. Anatomical and taxonomic characteristics of *Harpa* and *Morum* (Neogastropoda:Harpidae). Veliger, vol. 29, no. 4, pp. 349–358, 7 figs.

Humfrey, M.
1975. Sea shells of the West Indies. Taplinger Publishing Company, New York, 351 pp., 32 pls., 20 text-figs.

ICZN [International Commission on Zoological Nomenclature]
1957. Opinion 489. Validation under the Plenary Powers of the generic name *Turbinella* Lamarck, 1799 (Class Gastropoda), as the name for the Sacred Chank of India. Bulletin of Zoological Nomenclature, vol. 17, pt. 2, pp. 158–178.
1975. Opinion 1040. *Oniscidia* Mörch, 1852 (Mollusca): placed on the Official List. Bulletin of Zoological Nomenclature, vol. 32, pt. 3, pp. 139–140.
1987. Opinion 1436. HARPIDAE Hawle & Corda, 1847 (Trilobita) and HARPIDAE Bronn, 1849 (Mollusca, Gastrop-

oda): a ruling to remove the homonymy. Bulletin of Zoological Nomenclature, vol. 44, pt. 2, pp. 137–138.

Jousseaume, F. P.

1881. Observations relatives aux mollusques du genre *Harpa*. Bulletin de la Société Zoologique de France, vol. 5, Proces-verbaux, pp. xxxvii–xxxviii.

Jung, P.

1971. Fossil mollusks from Carriacou, West Indies. Bulletins of American Paleontology, vol. 61, no. 269, pp. 143–262, pls. 1–22, 2 text-figs., 1 table.

Jung, P., and Petit, R.E.

1990. Neogene paleontology in the northern Dominican Republic. 10. The family Cancellariidae (Mollusca:Gastropoda). Bulletins of American Paleontology, vol. 98, no. 334, pp. 83–144, pls. 15–29, 18 text-figs..

Kaicher, S.D.

1983. Card catalogue of world-wide shells. Pack no. 36—Cassidae & Oocorythidae. Published by the author, St. Petersburg, Florida.

Kiener, L.C.

1840–1841. Spécies général et iconographie des coquilles vivantes. Vol. 5. Famille des canalifères, première partie. Genre Fuseau, pp. 1–62, pls. 1–30 [1840]. Vol. 6, Famille des canalifères, deuxiéme partie. Genre Turbinelle, pp. 1–50, pls. 1–21 [1841].

Kuroda, T., Habe, T., and Oyama, K.

1971. The sea shells of Sagami Bay. Tokyo, xix + 741 pp. [Japanese], 489 pp. [English]; indices, pp. 1–28 [Japanese], 29–51 [Latin]; 121 pls., 1 map.

Lamarck, J.B.P.

1799. Prodrome d'une nouvelle classification des coquilles. Mémoires de la Société d'Histoire Naturelle de Paris, vol. 1, pp. 63–91.

1801. Système des Animaux sans vertèbres, ou tableau general des classes, des ordres et des genres de ces Animaux, Paris, viii + 432 pp.

1804. Mémoire sur deux espèces nouvelles de Volutes des mers de la Nouvelle-Hollande. Annales du Muséum d'Histoire Naturelle, vol. 5, pp. 154–160, pl. 2.

1811. De la determination des espèces de mollusques testaces. Volute (*Voluta*). Annales du Muséum d'Histoire Naturelle, vol. 17, pp. 54–80.

1816. Tableau encyclopedique et méthodique des trois regnes de la nature, part 23, pls. 391–488; Liste des objects representes, pp. 1–6.

1822. Histoire naturelle des animaux sans vertèbres. Vol. 7. Paris, 711 pp.

Landau, B. M.

1996. A new species of *Morum* (Gastropoda: Harpidae) from the Lower Miocene Cantaure Formation of Venezuela. Tulane Studies in Geology and Paleontology, vol. 29, no. 2, pp. 53–56, pl. 1.

Lesson, R.P.

1840. Molluscorum novae. Review Zoolologique (Société Cuvierienne), vol. 3, p. 212.

Link, H.F.

1807. Beschreibung der Naturalien-Sammlung der Universitat zu Rostock. Abt. 2, pp. 82–160.

Linnaeus, C.

1758. Systema naturae per regna tria naturae secundun classes, ordines, genera, species, cum characteribus, differentiis synonymis, locis. Editio Decima, Reformata. Holmiae [Stockholm], vol. 1 (Regnum Animale), 824 pp.

1766–1767. Systema naturae per regna tria naturae . . . Editio Duodecima, Reformata. Holmiae [Stockholm], vol. 1 (Regnum Animale), pt. 1, pp. 1–532 [1766]; pt. 2, pp. 533–1327 [1767].

MacNeil, F.S., and Dockery, D.T., III

1984. Lower Oligocene Gastropoda, Scaphopoda, and Cephalopoda of the Vicksburg Group in Mississippi. Mississippi Geological Survey, Bulletin, no.124, 415 pp., 72 pls., 16 text-figs.

Mansfield, W.C.

1937. Mollusks of the Tampa and Suwannee Limestones of Florida. Florida Geological Survey, Bulletin, no. 15, 334 pp., pls. A–D, 1–21, 2 text-figs., 2 tables.

Martini, F.H.W.

1777. Neues Systematisches Conchylien-Cabinet, Vol. 3. Nürnberg, 434 pp., pls. 66–121.

Maury, C.J.

1910. New Oligocene [Miocene] shells from Florida. Bulletins of American Paleontology, vol. 4, no. 10, pp. 119–164, pls. 18–26.

1917. Santo Domingo type sections and fossils, Part 1: Mollusca. Bulletins of American Paleontology, vol. 5, no. 29, pp. 165–415, pls. 27–65; Part 2: Stratigraphy. Bulletins of American Paleontology, vol. 5, no. 30, pp. 416–460, pls. 66–68.

1925a. Fosseis Terciarios do Brasil, con descripição de novas formas Cretaceas. Servico Geologico e Mineralogico do Brasil, Monographia no. 4 ["1924"], 665 pp., 24 pls.

1925b. A further contribution to the paleontology of Trinidad (Miocene horizons). Bulletins of American Paleontology, vol. 10, no. 42, pp. 153–402, pls. 10–54.

Mawe, J.

1823. The Linnaean system of conchology. London, 207 pp., 37 pls.

McGinty, T.L.

1970. Mollusca of the "Glades" unit of southern Florida: Part 1. Introduction and observations. Tulane Studies in Geology and Paleontology, vol. 8, no. 2, pp. 53–56.

Menke, C.T.

1830. Synopsis methodica molluscorum generum omnium et specierum earum, quae in museo Menkeana adservantur; cum synonymia critica et novarum specierum diagnosibus. Editio 2. Pyrmonti, xvi + 168 pp.

Montrouzier, R.P.

1859. Descriptions d'espèces nouvelles de l'Archipel Calédonien. Journal de Conchyliologie, vol. 7, pp. 373–375.

Moore, J.C.

1850. On some Tertiary beds in the Island of San Domingo: from notes by J.S. Heniker, Esq., with remarks on the fossils. Quarterly Journal of the Geological Society of London, vol. 6, pp. 39–53, pls. 9, 10.

1853. Notes on the fossil Mollusca and fish from San Domingo. *in* On some Tertiary deposits in San Domingo, by T.S. Heneken, Quarterly Journal of the Geological Society of London, vol. 9, pp. 129–134, figs. 1–7.

Mörch, O.A.L.

1852. Catalogus conchyliorum quae reliquit d. Alphonso d'Aguirra & Gadea Comes de Yoldi, regis Daniae eubiculariorum princeps, ordinis dannebrogici in prima classe & ordinis caroli tertii eques. Part 1, Cephalophora. Hafinae [Copenhagen], 170 pp.

Okutani, T.

1982. A new genus and five new species of gastropods trawled

off Surinam. Venus (Japanese Journal of Malacology), vol. 41, no. 2, pp. 109–120, pls. 1, 2.

Olsson, A. A.

1922. The Miocene of northern Costa Rica with notes on its general stratigraphic relations. Bulletins of American Paleontology, vol. 9, no. 39, pp. 174–460, pls. 4–35.

1931. Contributions to the Tertiary paleontology of northern Peru. Part 4. The Peruvian Oligocene. Bulletins of American Paleontolology, vol. 17, no. 63, pp. 97–218, pls. 13–33.

Olsson, A.A., and Petit, R.E.

1964. Some Neogene Mollusca from Florida and the Carolinas. Bulletins of American Paleontology, vol. 47, no. 217, pp. 509–574, pls. 77–83.

Perrilliat [Montoya], M. del C.

1960. Moluscos del Mioceno de la Cuenca Salina del Istmo de Tehuantepec, México. Palentología Mexicana, no. 8, 38 pp., 4 pls., 2 text-figs., 1 table.

1973. Monografía de los moluscos del Mioceno Medio de Santa Rosa, Veracruz, México. Parte 2 (Gasteropodes:Mitridae a Terebridae). Paleontología Mexicana, no. 35, 97 pp., 39 pls., 1 table.

Perry, G.

1810. Arcana, or the museum of natural history: containing the most recent discovered objects. Embellished with coloured plates, and corresponding descriptions: with extracts relating to animals, and remarks of celebrated travellers; combining a general survey of nature. London, 21 parts of 4 plates each [unnumbered; 84 in total, nos. 1–48 published in 1810]

1811. Conchology, or the Natural History of Shells: containing a new arrangement of the genera and species. London, 4 pp., 61 pls.

Petit, R.E., and Wilson, D.

1986. Publication dates of Heilprin's Explorations on the West Coast of Florida. Tulane Studies in Geology and Paleontology, vol. 19, no. 2, pp. 95, 96.

Petuch, E.J.

1981. A relict Neogene Caenogastropod fauna from northern South America. Malacologia, vol. 20, no. 2, pp. 307–347, 130 figs.

1987. New Caribbean molluscan faunas. Coastal Education and Research Foundation (CERF), Charlottesville, Virginia, 154 pp. + Appendix (4 pp.), 29 pls., 1 text-fig.

1988. Neogene history of tropical American mollusks. Coastal Education and Research Foundation (CERF), Charlottesville, Virginia, 217 pp., 39 pls., 23 (+7 unnumbered) text-figs.

1994. Atlas of Florida fossil shells (Pliocene and Pleistocene marine gastropods). Chicago Spectrum Press, Chicago, Illinois, 394 pp., 100 pls., 20 text-figs.

Peyrot, A.

1928. Conchyliologie néogénique de l'Aquitaine: Gastropodes et Cephalopods (vol. 5, fasc. 2). Actes de la Société Linnéenne de Bordeaux, vol. 79, Supplement, pp. 2–262, pls. 5–14.

Pflug, H.D.

1961. Mollusken aus dem Tertiar von St. Domingo. Acta Humboldtiana, Series Geologica et Paleontologica, no. 1, 107 pp., 26 pls., 1 text-fig.

Pilsbry, H.A.

1922. Revision of W.M. Gabb's Tertiary Mollusca of Santo Domingo. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 73, pp. 305–435, pls. 16–47, 48 text-figs.

Pilsbry, H.A., and Johnson, C.W.

1917. New Mollusca of the Santo Domingan Oligocene. Proceedings of the Academy of Natural Sciences of Philadelphia, vol. 69, pp. 150–202.

Pilsbry, H.A., and Olsson, A.A.

1953. Materials for a revision of east coast and Floridian volutes. Nautilus, vol. 67, no. 1, pp. 1–13, pls. 1–3.

1954. Systems of the Volutidae. Bulletins of American Paleontology, vol. 35, no. 152, pp. 271–306, pls. 25–35.

Pitt, W.D.

1981. Two new gastropod occurrences in the Ecuadorian Neogene. Tulane Studies in Geology and Paleontology, vol. 16, no. 4, pp. 155–156, 3 figs.

Ponder, W.F., and Warén, A.

1988. Classification of the Caenogastropoda and Heterostropha—a list of the Family-Group names and higher taxa. Malacological Review, Supplement 4, pp. 288–326.

Powell, A.W.B.

1958. Mollusca of the Kermadec Island, Part I. Records of the Auckland Institute and Museum, vol. 5, nos. 1, 2, pp. 65–85, pls. 9–11.

Rafinesque, C.S.

1815. Analyse de la nature, ou tableau de l'univers et des corps organisés. Palermo, 224 pp., 1 portrait.

Ramírez, R.

1950. Descripción de algunos moluscos del Mioceno del Valle del Cibao de la Republica Dominicana. Publicaciones de la Universidad de Santo Domingo, ser. 4, vol. 70, no. 1 ["1949"], pp. 3–39, pls. 1–7.

1956. Paleontología Dominicana. Publicaciones de la Universidad de Santo Domingo, ser. 4, vol. 103, no. 2, pp. 1–26, pls. 1–8.

Raymond, T.C.

1997. Two new gastropods from the Pliocene Pinecrest Beds of Florida. Tulane Studies in Geology and Paleontology, vol. 29, no. 4, pp. 141–144, pl. 1.

Reeve, L.A.

1842. Conchologia systematica, or complete system of conchology. London, vol. 2, pp. 1–337, pls. 130–300.

1849. Conchologia iconica, or illustrations of the shells of molluscous animals. Vol. 5. Monograph of the genus *Oniscia*. London, pl. 1.

Rehder, H.A.

1973. The family Harpidae of the world. Indo-Pacific Mollusca, vol. 3, no. 16, pp. 207–274, pls. 183–247.

Rios, E. de C.

1970. Coastal Brazilian seashells. Museu Oceanográfico, Río Grande, RGS, Brazil, 255 pp., 60 pls., 4 maps.

1975. Brazilian marine mollusks iconography. Museu Oceanográfico, Río Grande, RGS, Brazil, 331 pp., 91 pls.

1985. Seashells of Brazil. Museu Oceanográfico, Río Grande, RGS, Brazil, 329 pp., 102 pls.

1994. Seashells of Brazil, 2nd Edition. Museu Oceanográfico de Río Grande, Río Grande, RGS, Brazil, 368 pp., 113 pls.

Robinson, D.G.

1992. The systematics and paleoecology of the prosobranch gastropods of the Pleistocene Moín Formation of Costa Rica. Unpublished Ph.D. dissertation, Tulane University, New Orleans, Louisiana, 748 pp., 28 pls.

Röding, P.F.

1798. Museum Boltenianum sive catalogus cimeliorum e tribus regnis naturae que olim collegerat Joa. Fried Bolten, M. D. p. d. Part 2. Hamburgi, 199 pp.

Rovereto, G.

1900. Illustrazione dei Molluschi fossili tongriani posseduti dal Museo Geologico dalla R. Università di Genova. Genova, 210 pp., 9 pls.

Rutsch, R.

1934. Die Gastropoden aus dem Neogen der Punta Gavilan in Nord-Venezuela. Part 1. Schweizerischen Palaeontologischen Gesellschaft, Abhandlungen, vol. 54, no. 3, pp. 1–88, pls. 1–7. Part 2., vol. 55, no. 1, pp. 89–169, pls. 8, 9.

Saunders, J.B., Jung, P., and Biju-Duval, B.

1986. Neogene paleontology in the northern Dominican Republic. 1. Field surveys, lithology, environment, and age. Bulletins of American Paleontology, vol. 89, no. 323, pp. 1–79, pls. 1–9, 39 text-figs., 4 tables, 4 appendices.

Schumacher, H.C.F.

1817. Essai d'un nouveau système des habitations des vers testacés. Copenhague, iv + 287 pp., 22 pls.

Scopoli, J.A.

1786. Deliciae Florae et Faunae Insubricae seu novae, aut minus cognitae species Plantarum et Animalium quas, in Insubria Austriaca. Part II. Ticino [not seen].

Seba, A.

1761. Locupleissimi rerum naturalium thesauri accurata descriptio et iconibus. Amstelaedami [Amsterdam] [not seen].

Smith, M.

1937. Further notes upon Tertiary and Recent mollusks from Florida together with descriptions of new species. Nautilus, vol. 51, no. 2, pp. 65–68, pl. 6.

Sowerby, G.B.

1824. The genera of Recent and fossil shells, for the use of students in conchology and geology, with original plates. [Published in parts; no. 24—*Oniscia, Pyramidella, Pyrula, Mactra, Lutraria, Tornatella,* in 1824.]

1825. A catalogue of the shells contained in the collection of the late Earl of Tankerville, arranged according to the Lamarckian conchological system; together with an appendix, containing descriptions of many new species. London, vii + 92 pp., 9 pls.; Appendix, pp. i–xxxiv.

1844. Descriptions of six new species of *Voluta.* Proceedings of the Zoological Society of London, pt. 12, pp. 149–152.

Sowerby, G.B. [II]

1850. Descriptions of some new species of fossil shells found by J.S. Heniker, Esq. *in* On some Tertiary beds in the Island of San Domingo; from notes by J.S. Heniker, Esq., with remarks on the fossils, by J.C. Moore. Quarterly Journal of the Geological Society of London, vol. 6, pp. 39–53, pls. 9, 10.

Sowerby, G.B. [III]

1903. Descriptions of new species of *Nassa, Purpura, Latirus, Voluta, Conus, Stomatella,* and *Spondylus.* Journal of Malacology, vol. 10, no. 3, p. 73–77, pl. 5.

Swainson, W.

1822. A catalogue of the . . . shells which formed the collection of Mrs. Bligh, with an appendix containing . . . descriptions of many new species. London, 58 pp., 2 pls.

1829–1833. Zoological illustrations, or original figures and descriptions of new, rare, or interesting animals, selected chiefly from the classes of ornithology, entomology, and conchology, and arranged on the principles of Cuvier and other modern zoologists, Series 2. London, 136 pls. [pls. 1–30 (1829); pls. 31–45 (1830); pls. 46–85, (1831); pls. 86–96, (1832); pls. 97–136, (1833)].

1835. The elements of modern conchology, briefly and plainly stated for the use of students and travellers. London, viii + 62 pp.

1840. A treatise on malacology; or the natural classification of shells and shell fish. London, 419 pp.

Trechmann, C.T.

1935. The geology and fossils of Carriacou, West Indies. Geological Magazine, vol. 72, no. 858, pp. 528–555, pls. 20–22.

Tucker, H.I., and Wilson, D.

1932. Some new or otherwise interesting fossils from the Florida Tertiary. Bulletins of American Paleontology, vol. 18, no. 65, pp. 39–62, pls. 5–9.

1933. A second contribution to the Neogene paleontology of south Florida. Bulletins of American Paleontolology, vol. 18, no. 66, pp. 63–82, pls. 10–13.

Vaughan, T.W., Cooke, C.W., Condit, D.D., Ross, C.P., Woodring, W.P., and Calkins, F.C.

1921. A geological reconnaisance of the Dominican Republic. Memoirs of the Geological Survey of the Dominican Republic, vol. 1, 268 pp., 23 pls.

Vokes, E.H.

1964. The genus *Turbinella* in the New World. Tulane Studies in Geology, vol. 2, no. 1, pp. 38–68, pls. 1–3, 1 text-fig., 1 table.

1966. The genus *Vasum* (Mollusca:Gastropoda) in the New World. Tulane Studies in Geology, vol. 5, no. 1, pp. 1–36, pls. 1–6, 2 text-figs., 1 table.

1970. Notes on the fauna of the Chipola Formation—III. Two new species of *Vasum* (Mollusca:Gastropoda), with comments on *Vasum haitense* (Sowerby). Tulane Studies in Geology and Paleontology, vol. 8, no. 2, pp. 88–92, pl. 1, 1 text-fig.

1979. The age of the Baitoa Formation, Dominican Republic, using Mollusca for correlation. Tulane Studies in Geology and Paleontology, vol. 15, pp. 105–116, pls. 1, 2, 3 text-figs.

1984. The genus *Harpa* (Mollusca:Gastropoda) in the New World. Tulane Studies in Geology and Paleontology, vol. 18, no. 2, pp. 53–60, pl. 1, 1 text-fig., 2 tables.

1989. Neogene paleontology in the northern Dominican Republic. 8. The Family Muricidae. Bulletins of American Paleontology, vol. 97, no. 332, pp. 5–94, pls. 1–12, 21 text-figs., 3 tables..

Vokes, H.E.

1969. The anadarid subgenus *Caloosarca,* in the western Atlantic region. Tulane Studies in Geology and Paleontology, vol. 7, no. 1, pp. 1–40, pls. 1–6, 3 text-figs., 1 table.

Vokes, H.E., and Vokes, E.H.

1983. Distribution of shallow-water marine Mollusca, Yucatan Peninsula, Mexico. Mesoamerican Ecology Institute, Monograph 1 (Middle American Research Institute, Publication 54), 183 pp., 50 pls., 9 text-figs., 3 tables, 1 map.

Vredenburg, E.W.

1916. Note on the geological history of *Turbinella* in India. Memoirs of the Indian Museum, vol. 6, no. 2, pp. 123–125.

1923. On the phylogeny of some Turbinellidae. Records of the Geological Survey of India, vol. 55, pt. 2, pp. 119–132, pl. 19.

Walch, J.E.I.

1771. Die Naturgeschichte der Versteinerungen zur Erlauterung der Knorrischen Sammlung von Merkwurdigkeiten der Natur, vol. 3. Nurnburg [not seen].

Warmke, G.L., and Abbott, R.T.
1961. Caribbean seashells. Livingston Publishing Company, Narberth, Pennsylvania, x + 348 pp., 44 pls., 34 text-figs., 19 maps and end-papers.

Weisbord, N. E.
1929. Miocene Mollusca of northern Colombia. Bulletins of American Paleontology, vol. 14, no. 54, pp. 1–57, pls. 1–9.

Winckworth, R.
1945. The type of the Boltenian genera. Proceedings of the Malacological Society of London, vol. 26, pp. 136–148.

Woodring, W.P.
1928. Miocene mollusks from Bowden, Jamaica; Part 2, gastropods and discussion of results. Carnegie Institution of Washington Publication 385, 564 pp., 40 pls.
1957–1982. Geology and paleontology of Canal Zone and adjoining parts of Panama. United States Geological Survey, Professional Paper 306, 759 pp., 124 pls. [pt. A, pp. 1–145, pls. 1–23 (1957); pt. B, pp. 147–239, pls. 24–38 (1959); pt. C, pp. 241–297, pls. 39–47 (1964); pt. D, pp. 299–452, pls. 48–66 (1970); pt. E, pp. 453–539, pls. 67–82 (1973); pt. F, pp. 541–759, pls. 83–124 (1982)].

Woodring, W.P., Brown, J.S., and Burbank, W.S.
1924. Geology of the Republic of Haiti. Republic of Haiti, Department of Public Works, 631 pp., 40 pls., 37 figs.

Work, R.C.
1969. Systematics, ecology, and distribution of the mollusks of Los Roques, Venezuela. Bulletin of Marine Science, vol. 19, no. 3, pp. 614–711, 5 figs.

PLATES

EXPLANATION OF PLATE 1

Figure — Page

1. *Scaphella (Scaphella) striata* (Gabb) 8
ANSP 3274 (lectotype). (?)Río Yaque del Norte, Gurabo Formation, exact locality unknown. Height 25.0 mm; diameter 11.2 mm. a. Apertural view, × 2. b. Abapertural view, × 2.

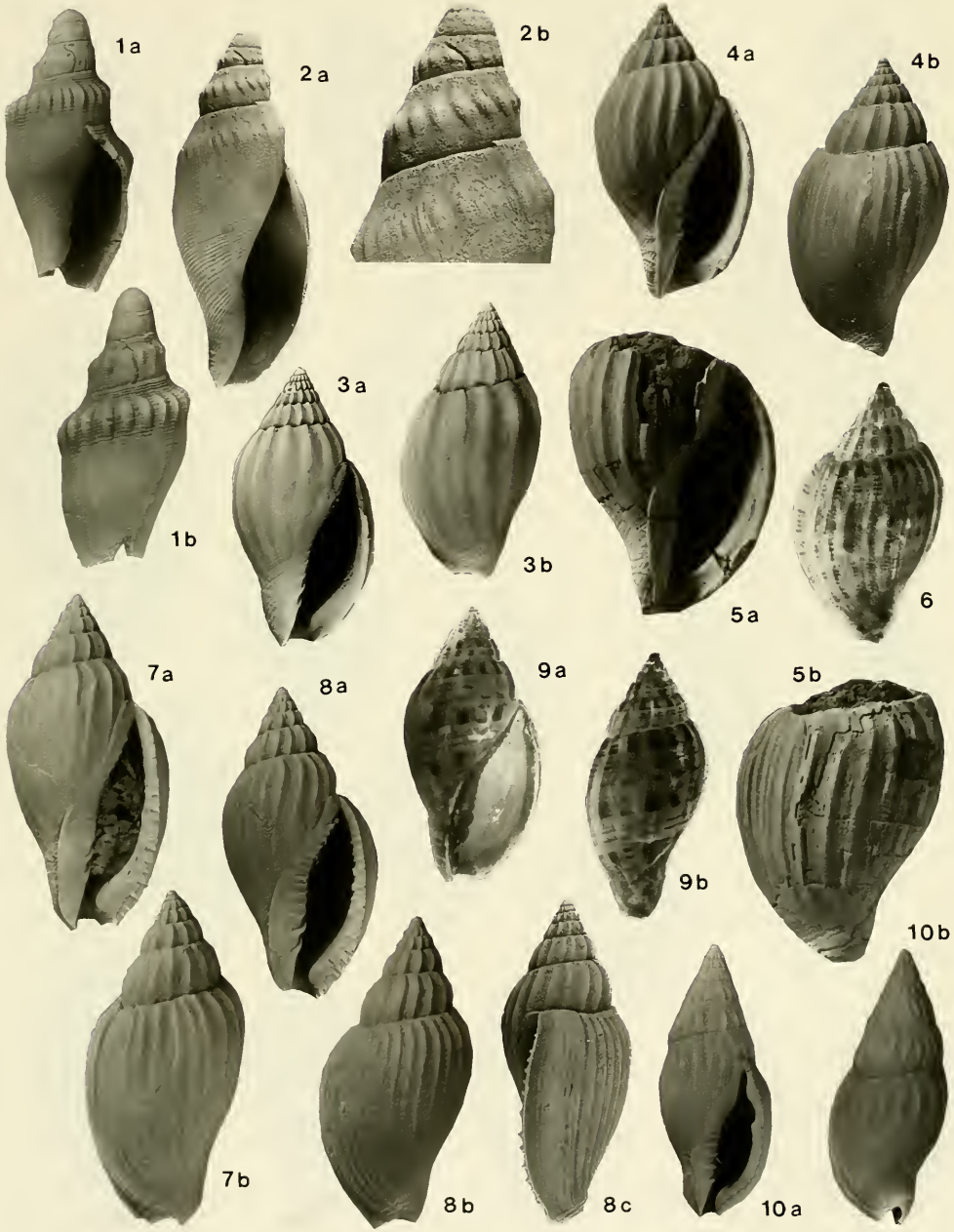
2. *Scaphella (Scaphella) gouldiana* (Dall) 9
USNM 83872 (holotype). Recent, *Albatross* Station 2625, southeast of Cape Fear, North Carolina, 500 meters. Height 62.0 mm, diameter 23.5 mm. a. Apertural view, × 1. b. Enlargement of apex, × 2½.

3, 9. *Lyria (Lyria) incomperta* Hoerle and Vokes 11
3. USNM 253221 (holotype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 24.7 mm, diameter 12.7 mm. a. Apertural view, × 2. b. Abapertural view, × 2.
9. USNM 253222 (paratype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 24.0 mm, diameter 11.7 mm. a. Apertural view, × 2. b. Abapertural view, × 2. (Color pattern as revealed by ultraviolet light.)

4–6. *Lyria (Lyria) pulchella* (Sowerby) 10
4. BMNH G 83 956 (lectotype). (?)Gurabo Formation, exact locality unknown, *ex* Heneken Collection. Height 37.0 mm, diameter 18.0 mm. a. Apertural view, × 1½. b. Abapertural view, × 1½.
5. BMNH G 83 597 (holotype—*L. soror*). (?)Gurabo formation, exact locality unknown, *ex* Heneken Collection. Height 42.1 mm (incomplete), diameter 33.0 mm. a. Apertural view, × 1¼. b. Abapertural view, × 1¼.
6. USNM 253224 (hypotype). Río Mao, Gurabo Formation, locality TU 1293. Height 23.5 mm; diameter 14.3 mm. Adapertural view, × 2. (Color pattern as revealed by ultraviolet light.)

7, 8. *Lyria (Lyria) gabbi,* n. sp. 11
7. NMB H 17645 (holotype). Río Yaque del Norte, Baitoa Formation, locality NMB 17290. Height 36.8 mm, diameter 18.3 mm. a. Apertural view, × 1½. b. Abapertural view, × 1½.
8. NMB H 17646 (paratype). Río Yaque del Norte, Baitoa Formation, locality NMB 17265. Height 34.5 mm, diameter 17.5 mm. a. Apertural view, × 1½. b. Abapertural view, × 1½. c. Lateral view, × 1½.

10. *Lyria (Enaeta) perturbatrix* (Maury) 13
USNM 253226 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 20.5 mm, diameter 9.0 mm. a. Apertural view, × 2½. b. Abapertural view, × 2½.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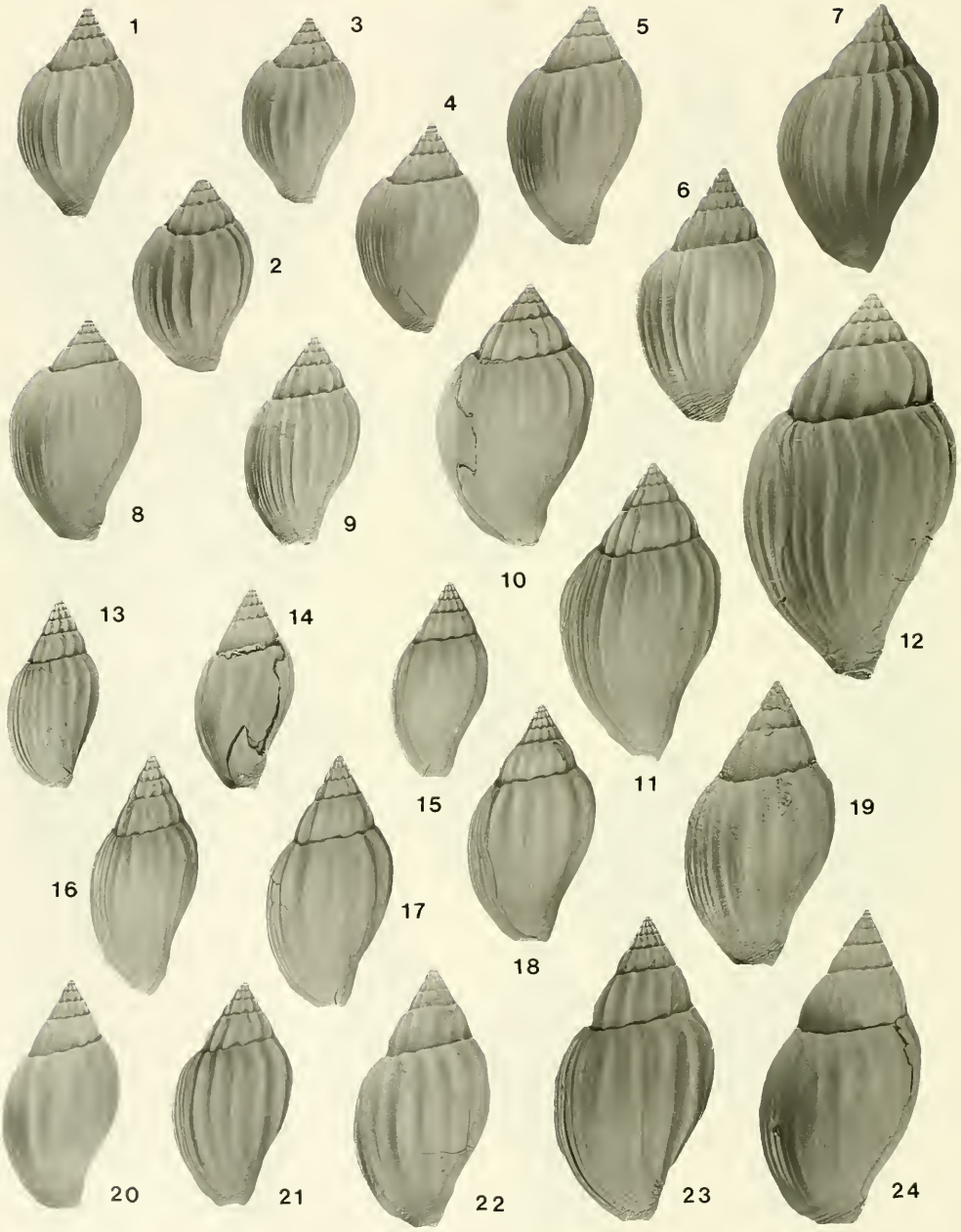
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Explanation of Plate 2

All specimens abapertural views, all × 1¼

Figure — Page

1–12. *Lyria (Lyria) pulchella* (Sowerby) 10

1. PRI 45221 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1211. Height 30.0 mm, diameter 17.0 mm.
2. PRI 45222 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1211. Height 26.8 mm, diameter 18.0 mm.
3. PRI 45223 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1211. Height 26.6 mm, diameter 16.4 mm.
4. PRI 45224 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1211. Height 29.6 mm, diameter 17.8 mm.
5. PRI 45225 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1211. Height 33.4 mm, diameter 19.6 mm.
6. PRI 45226 (hypotype). Santiago area, Gurabo Formation, locality TU 1206. Height 35.6 mm, diameter 19.7 mm.
7. PRI 45227 (hypotype). Santiago area, Gurabo Formation, locality TU 1206. Height 35.8 mm, diameter 22.3 mm.
8. PRI 45228 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1211. Height 31.0 mm, diameter 19.0 mm.
9. PRI 45229 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1211. Height 29.4 mm, diameter 16.5 mm.
10. PRI 45230 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1211. Height 38.2 mm, diameter 23.5 mm.
11. PRI 45231 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1211. Height 43.4 mm, diameter 24.8 mm.
12. NMB H 17647 (hypotype). Río Cana, Gurabo Formation, locality NMB 16865. Height 53.5 mm, diameter 30.5 mm.

13–24. *Lyria (Lyria) incomperta* Hoerle and Vokes 11

13. NMB H 17648 (hypotype). Río Yaque del Norte, unnamed formation, locality NMB 17273. Height 27.8 mm, diameter 13.6 mm.
14. PRI 45232 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 28.8 mm, diameter 14.8 mm.
15. PRI 45233 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 28.8 mm, diameter 14.5 mm.
16. NMB H 17649 (hypotype). Río Yaque del Norte, unnamed formation, locality NMB 17273. Height 35.4 mm, diameter 16.6 mm.
17. PRI 45234 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 36.3 mm, diameter 18.2 mm.
18. PRI 45235 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 34.0 mm, diameter 18.1 mm.
19. PRI 45236 (hypotype). Río Cana area, Cercado Formation, locality TU 1422. Height 39.6 mm, diameter 21.3 mm.
20. PRI 45237 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1211. Height 32.6 mm, diameter 17.0 mm.
21. PRI 45238 (hypotype). Cañada de Zamba, Gurabo Formation, locality TU 1354. Height 32.3 mm, diameter 17.6 mm.
22. PRI 45239 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1277. Height 37.0 mm, diameter 19.6 mm.
23. NMB H 17650 (hypotype). Río Gurabo, Gurabo Formation, locality NMB 15848. Height 43.4 mm, diameter 22.4 mm.
24. PRI 45240 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1278. Height 45.2 mm, diameter 23.7 mm.

EXPLANATION OF PLATE 3

All figures × 2, except protoconchs as noted

Figure — Page

1, 2. *Harpa americana* Pilsbry 14

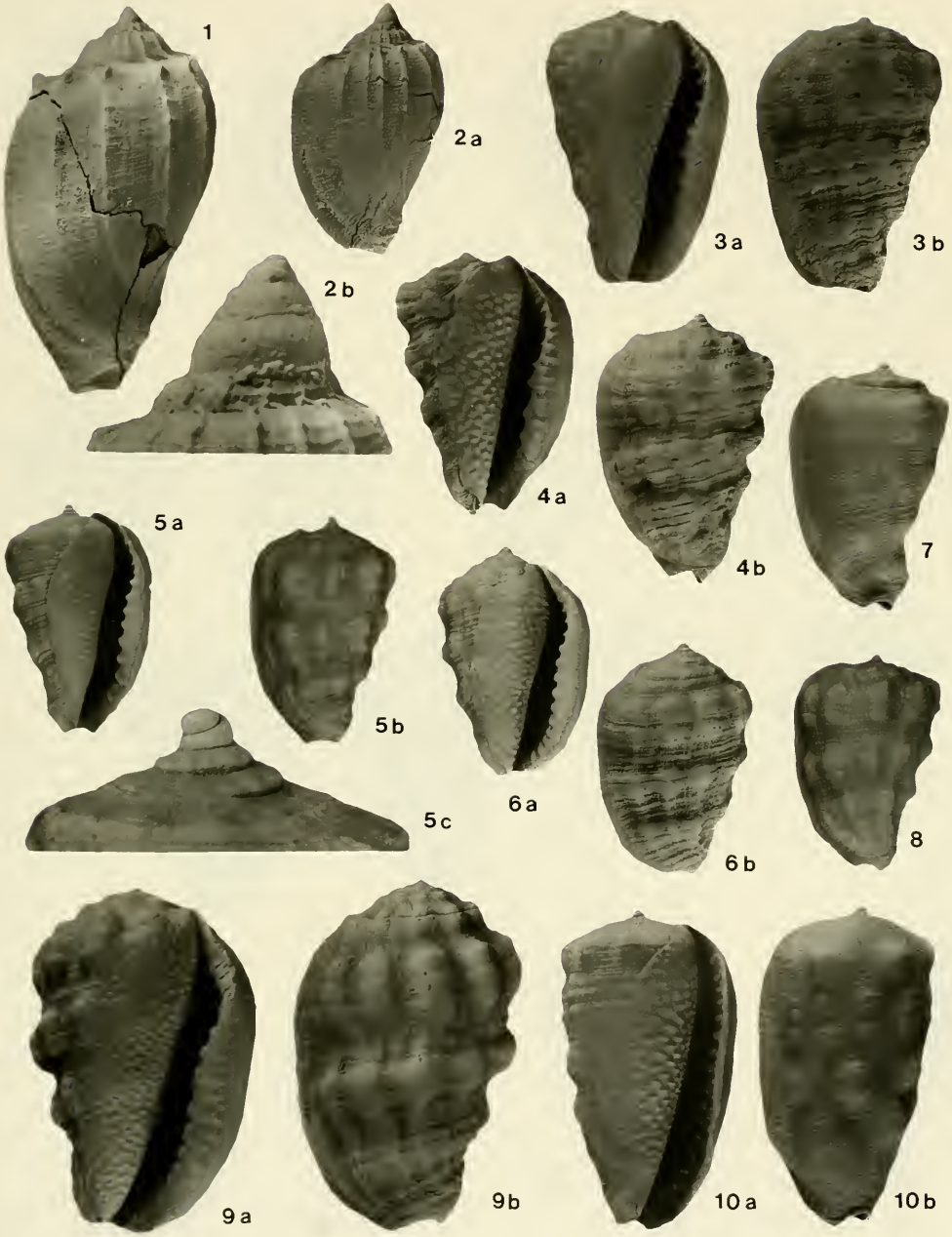
1. ANSP 4061 (holotype). (?)Río Yaque del Norte, (?)unnamed formation, exact locality unknown. Height 33.3 mm, diameter 19.4 mm. Abapertural view.
2. USNM 377397 (hypotype). Río Yaque del Norte, unnamed formation, locality TU 1444. Height 23.0 mm, diameter 14.3 mm. a. Abapertural view. b. Enlargement showing protoconch, × 10.

3–9. *Morum (Morum) oniscus* (Linnaeus) 15

3. NMB H 17651 (hypotype). Río Cana, Cercado Formation, localiy NMB 16844. Height 23.7 mm, diameter 16.4 mm. a. Apertural view. b. Abapertural view.
4. PRI 45241 (hypotype). Guayubin area, Mao Formation, locality TU 1281. Height 23.1 mm, diameter 16.0 mm. a. Apertural view. b. Abapertural view.
5. PRI 45242 (hypotype). Southern Florida, Bermont Formation, locality TU 727. Height 19.8 mm, diameter 13.4 mm. a. Apertural view. b. Abapertural view. c. Enlargement showing protoconch, × 10.
6. PRI 45243 (hypotype). Dominican Republic, Recent, locality TU R-390. Height 19.8 mm, diameter 13.8 mm. a. Apertural view. b. Abapertural view.
7. PRI 45244 (hypotype). Southern Florida, Bermont Formation, locality TU 759. Height 21.1 mm, diameter 13.6 mm. Abapertural view.
8. PRI 45245 (hypotype). Southern Florida, Bermont Formation, locality TU 759. Height 19.0 mm, diameter 13.8 mm. Abapertural view.
9. PRI 45246 (hypotype). Barbados, Recent, locality TU R-543. Height 29.7 mm, diameter 20.5 mm. a. Apertural view. b. Abapertural view.

10. *Morum (Morum) tuberculosum* (Sowerby *in* Reeve) 16

PRI 45247 (hypotype). Jalisco, Mexico, Recent, locality TU R-166. Height 26.9 mm, diameter 15.0 mm. a. Apertural view. b. Abapertural view.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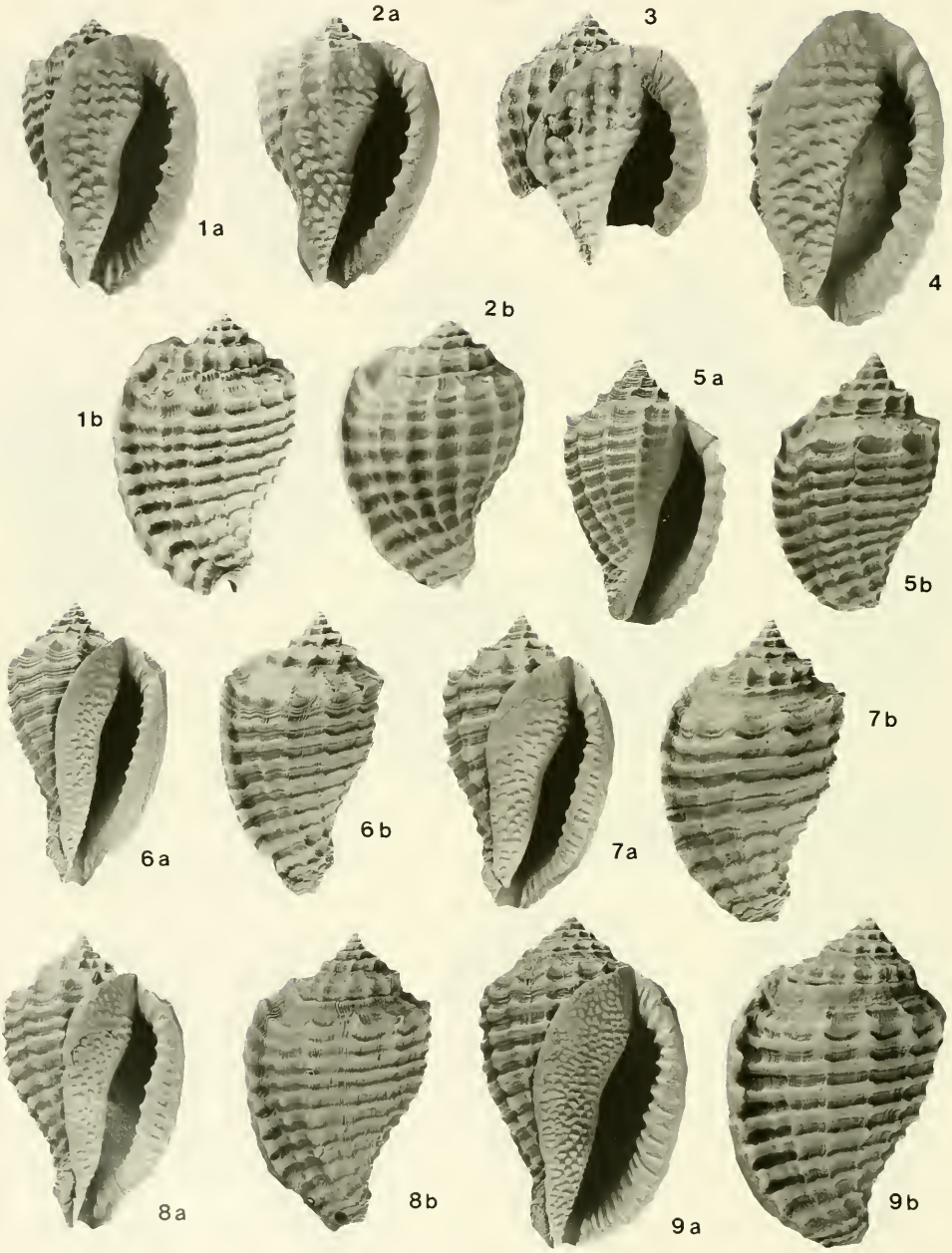
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EXPLANATION OF PLATE 4

Figure — Page

1–4. *Morum (Oniscidia) chipolanum* Dall *in* Maury 17

1. PRI 45248 (hypotype). Chipola River, Chipola Formation, locality TU 554. Height 25.4 mm, diameter 17.6 mm. a. Apertural view, × 2. b. Abapertural view, × 2.
2. PRI 45249 (hypotype). Río Yaque del Norte, Baitoa Formation, locality TU 1226. Height 24.3 mm, diameter 17.6 mm. a. Apertural view, × 2. b. Abapertural view, × 2.
3. PRI 45250 (hypotype). Arroyo Hondo, Baitoa Formation, locality TU 1363. Height 22.7 mm (incomplete), diameter 20.5 mm. Apertural view, × 2.
4. PRI 45251 (hypotype). Chipola River, Chipola Formation, locality TU 547. Height 27.8 mm (incomplete), diameter 18.0 mm. Apertural view, × 2.

5–9. *Morum (Oniscidia) domingense* (Sowerby) 19

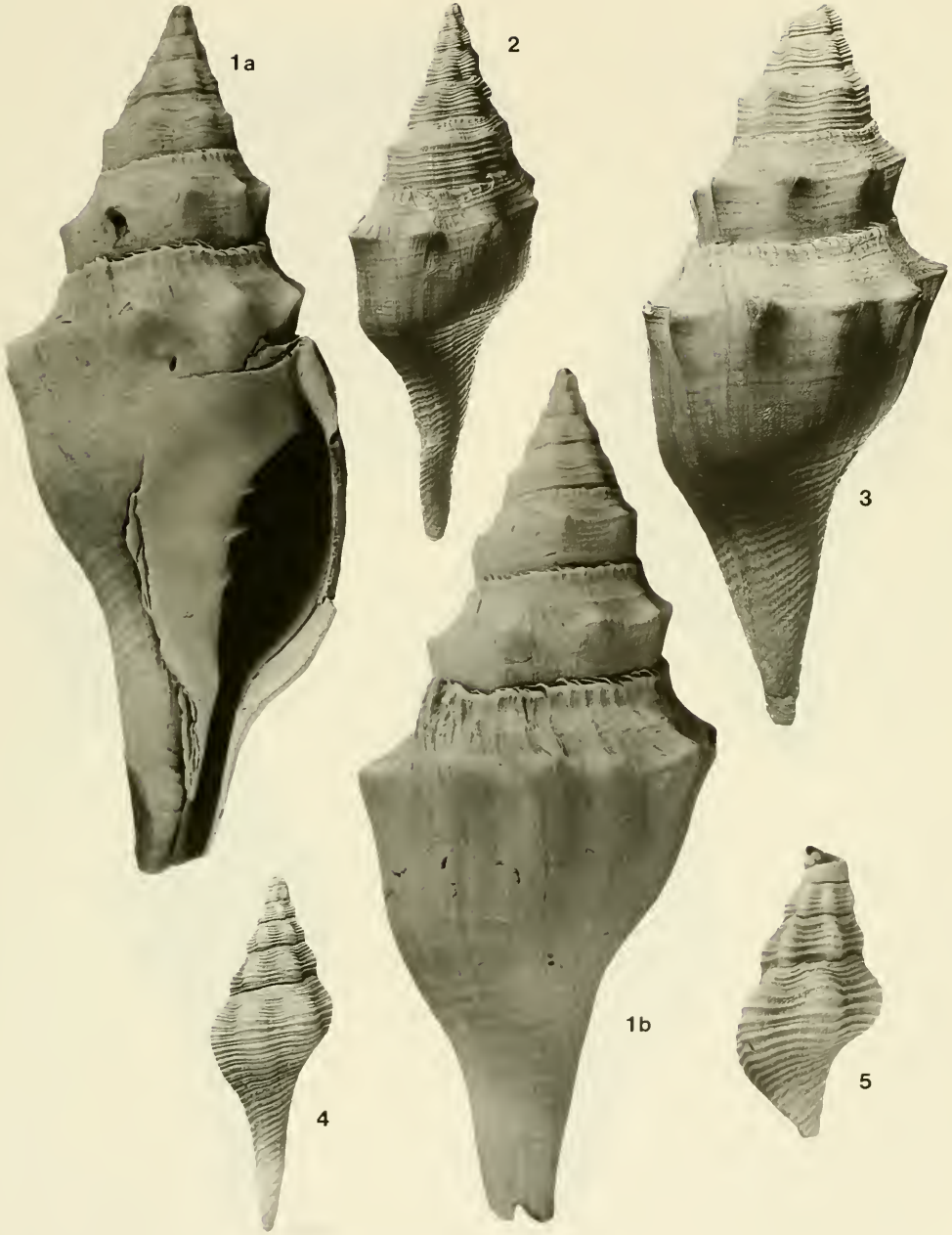
5. PRI 45252 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1231. Height 23.1 mm, diameter 15.5 mm. a. Apertural view, × 2. b. Abapertural view, × 2.
6. PRI 45253 (hypotype). Río Mao, Cercado Formation, locality TU 1294. Height 31.7 mm, diameter 19.0 mm. a. Apertural view, × 1½. b. Abapertural view, × 1½.
7. PRI 45254 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 33.0 mm, diameter 20.7 mm. a. Apertural view, × 1½. b. Abapertural view, × 1½.
8. PRI 45255 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 33.0 mm, diameter 21.0 mm. a. Apertural view, × 1½. b. Abapertural view, × 1½.
9. PRI 45256 (hypotype). Río Cana, Cercado Formation, locality TU 1230. Height 38.2 mm, diameter 25.3 mm. a. Apertural view, × 1½. b. Abapertural view, × 1½.

EXPLANATION OF PLATE 5

Figure — Page

1–5. *Turbinella valida* Sowerby. 21

1. NMB H 17652 (hypotype). Río Yaque del Norte, Baitoa Formation, locality NMB 17265. Height 154.0 mm, diameter 66.0 mm. a. Apertural view, × 1. b. Abapertural view, × 1.
2. BMNH GG 20216 (paralectotype). (?)Río Yaque del Norte, Baitoa Formation, exact locality unknown. Height 97.3 mm, diameter 34.6 mm. Abapertural view, × 1; photograph courtesy of the Natural History Museum, London.
3. BMNH GG 20212 (lectotype). (?)Río Yaque del Norte, Baitoa Formation, exact locality unknown. Height 130.0 mm, diameter 57.0 mm. Abapertural view, × 1; photograph courtesy of the Natural History Museum, London.
4. PRI 45257 (hypotype). Arroyo Hondo, Baitoa Formation, locality TU 1364. Height 60.7 mm, diameter 21.8 mm. Abapertural view, × 1.
5. PRI 45258 (hypotype). Arroyo Hondo, Baitoa Formation, locality TU 1364. Height 16.4 mm (incomplete), diameter 8.8 mm. Abapertural view, × 3.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EXPLANATION OF PLATE 6

Figure — Page

1–4. *Turbinella praelaevigata* Vokes 24

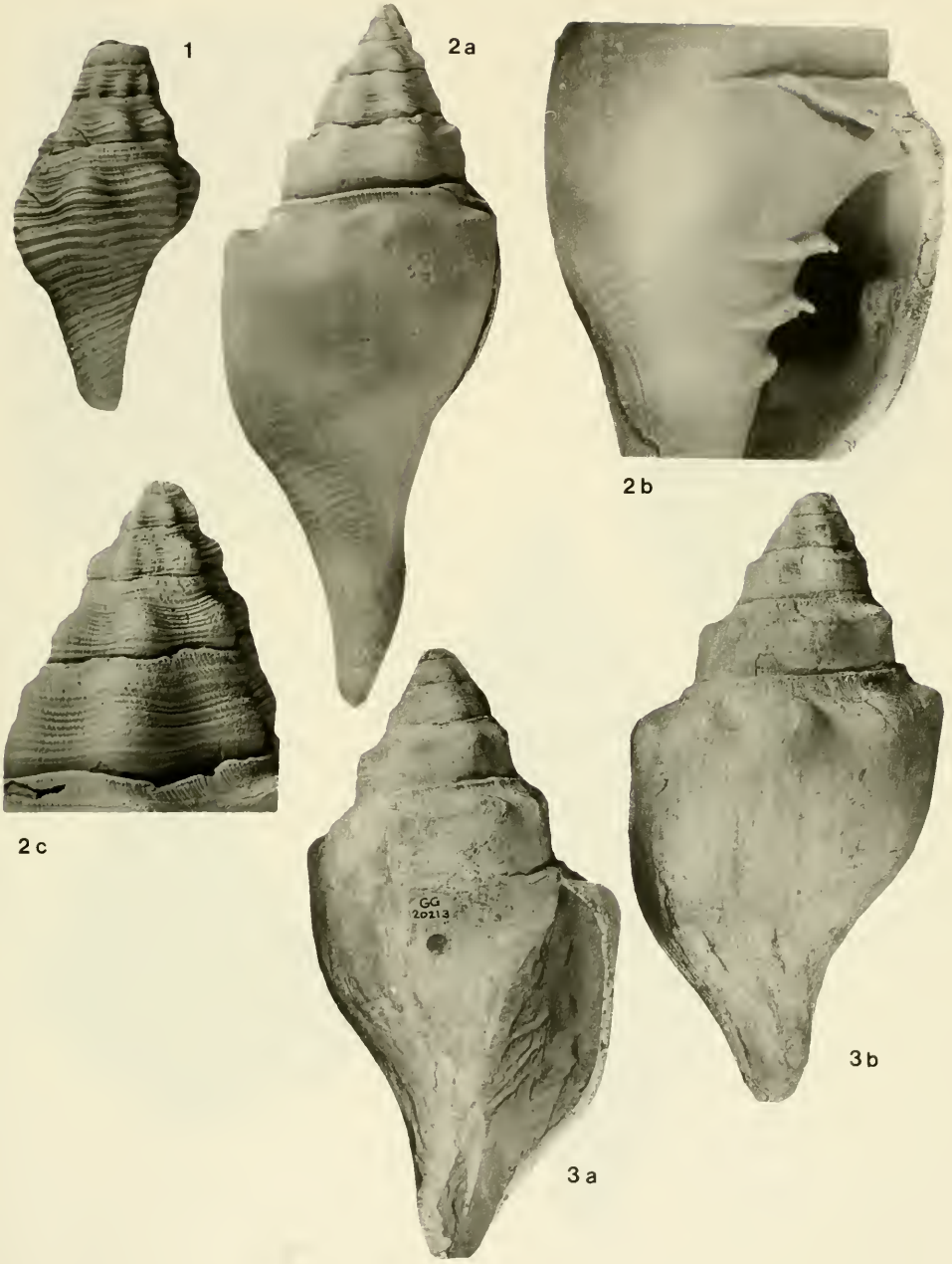
1. PRI 45259 (hypotype). Río Gurabo, Cercado Formation, locality TU 1379. Height 129.5 mm, diameter 54.5 mm. a. Apertural view, × 1. b. Abapertural view, × 1.
2. PRI 45260 (hypotype). Río Gurabo, Cercado Formation, locality TU 1419. Height 103.4 (incomplete), diameter 44.2 mm. Interior view to show nodules, × 1½.
3. PRI 45261 (hypotype). Río Mao, Gurabo Formation, locality TU 1293. Height 94.8 mm, diameter 35.4 mm. Abapertural view, × 1.
4. PRI 45262 (hypotype). Río Gurabo, Cercado Formation, locality TU 1379. Height 28.1 mm, diameter 11.0 mm. Apertural view, × 2

EXPLANATION OF PLATE 7

Figure Page

1. *Turbinella textilis* (Guppy) 24
PRI 45263 (hypotype). Bowden, Jamaica, Bowden Formation, locality TU 705. Height 32.8 mm, diameter 16.8 mm. Abapertural view, × 2.

2, 3. *Turbinella praetextilis*, new species 23
2. PRI 45264 (holotype). Río Gurabo, Gurabo Formation, locality TU 1278. Height 122.5 mm, diameter 47.5 mm. a. Abapertural view, × 1. b. Interior view to show nodules, × 1½. c. Early whorls, × 2.
3. BMNH GG 20213 (paratype). (?)Río Gurabo, (?)Gurabo Formation, exact locality unknown, *ex* Heneken Collection. Height 142.8 mm, diameter 74.0 mm. a. Apertural view, × 3/4. b. Abapertural view, × 3/4.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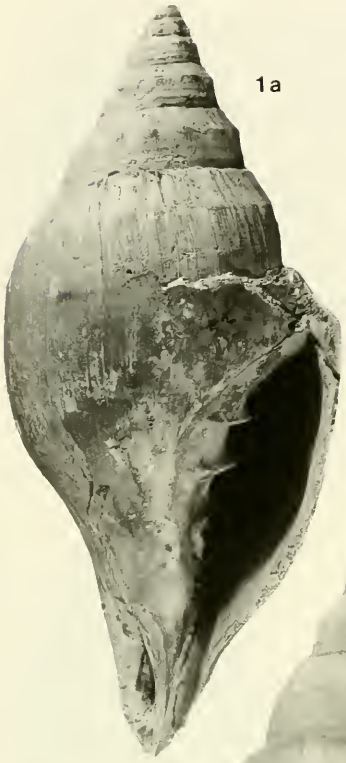

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EXPLANATION OF PLATE 8

Figure — Page

1, 2. *Turbinella pilsbryi*, new species 23

1. ANSP 2631 (holotype). (?)Río Yaque del Norte, (?)unnamed formation, exact locality unknown, *ex* Gabb Collection. Height 178 mm, diameter 77 mm. a. Apertural view, × 3/4. b. Abapertural view, × 3/4. c. Interior view to show nodules, × 1½.
2. PRI 45265 (paratype A). Río Yaque del Norte, unnamed formation, locality TU 1445. Height 70.8 mm (incomplete), diameter 52.5 mm (incomplete). Abapertural view, × 1.

EXPLANATION OF PLATE 9

Figure — Page

1, 2. *Vasum dominicense* Gabb 26

1. ANSP 2623 (lectotype). (?)Baitoa Formation, exact locality unknown. Height 60.0 mm, diameter 37.5 mm. Apertural view, × 1.

2. USNM 263957 (hypotype). Farley Creek, Chipola Formation, locality TU 1196. Height 33.5 mm, diameter 17.4 mm. a. Apertural view, × 1½. b. Abapertural view, × 1½.

3. *Vasum pugnus* Pilsbry and Johnson 27

ANSP 2626 (holotype). (?)Baitoa Formation, exact locality unknown, *ex* Gabb Collection. Height 80.0 mm, diameter 50.0 mm. Abapertural view, × 1.

4, 5. *Vasum tuberculatum* Gabb 27

4. ANSP 2624 (holotype). (?)Baitoa Formation, exact locality unknown. Height 111.0 mm, diameter 86.0 mm. a. Apertural view, × 3/4. b. Abapertural view, × 3/4.

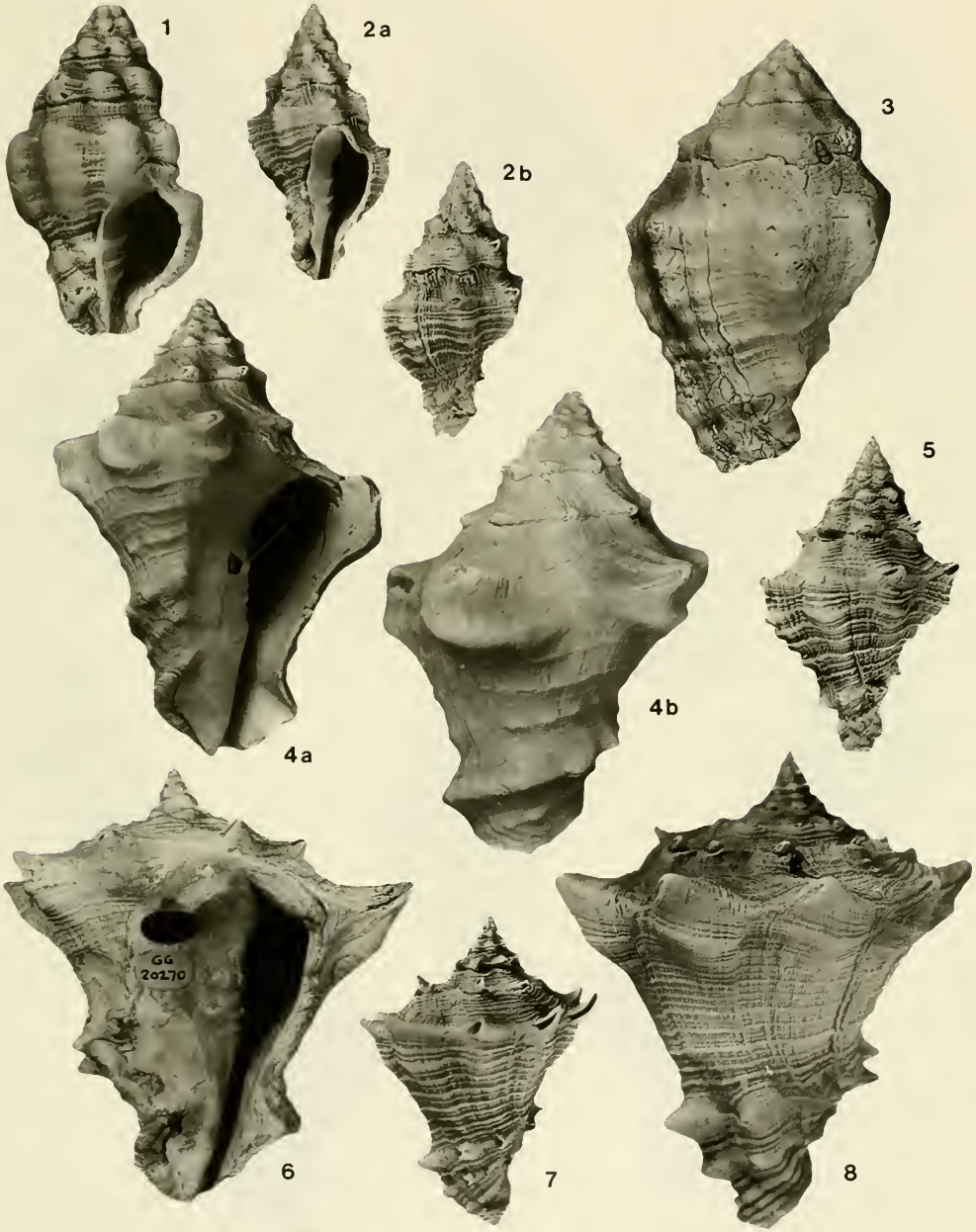
5. PRI 45266 (hypotype). Cañada de Zamba, Río Cana area, Gurabo Formation, locality TU 1354. Height 36.8 mm, diameter 26.0 mm. Abapertural view, × 1½.

6–8. *Vasum haitense* (Sowerby) 28

6. BMNH GG 20270 (lectotype). (?)Baitoa Formation, exact locality unknown, *ex* Heneken Collection. Height 78.7 mm, diameter 74.9 mm. Apertural view, × 1; photograph courtesy of the Natural History Museum, London.

7. PRI 45267 (hypotype). Tenmile Creek, Chipola Formation, locality TU 546. Height 35.0 mm, diameter 27.9 mm. Abapertural view, × 1½.

8. PRI 45268 (hypotype). Santiago area, Gurabo Formation, locality TU 1250. Height 83.5 mm, diameter 75.0 mm. Abapertural view, × 1.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EXPLANATION OF PLATE 10

Figure Page

1–6. *Vasum aedificatum* (Guppy). 29

1. BMNH GG 20255 (holotype). (?)Gurabo Formation, exact locality unknown, *ex* Heneken Collection. Height 62.6 mm, diameter 33.3 mm. Apertural view, × 1.
2. BMNH GG 20222 (paratype). (?)Gurabo Formation, exact locality unknown, *ex* Heneken Collection. Height 72.1 mm, diameter 46.3 mm. Apertural view, × 1; photograph courtesy of the Natural History Museum, London.
3. PRI 45269 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1278. Height 53.5 mm, diameter 42.8 mm. Abapertural view, × 1.
4. PRI 45270 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1278. Height 54.4 mm, diameter 35.7 mm. Abapertural view, × 1.
5. PRI 45271 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 37.7 mm, diameter 25.5 mm. Abapertural view, × 1½.
6. PRI 45272 (hypotype). Río Cana, Cercado Formation, locality TU 1230. Height 37.0 mm, diameter 20.7 mm. Abapertural view, × 1½.

7–9. *Vasum gurabicum* Maury 31

7. ANSP 31242 (hypotype). (?)Gurabo Formation, exact locality unknown, *ex* Gabb Collection. Height 44.0 mm, diameter 27.0 mm (including spines). a. Apertural view, × 1½. b. Abapertural view, × 1½.
8. PRI 45273 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1215. Height 51.2 mm, diameter 28.5 mm. a. Apertural view, × 1½. b. Abapertural view, × 1½.
9. PRI 45274 (hypotype). Río Gurabo, Gurabo Formation, locality TU 1246. Height 32.6 mm, diameter 16.3 mm. Abapertural view, × 1½.

INDEX