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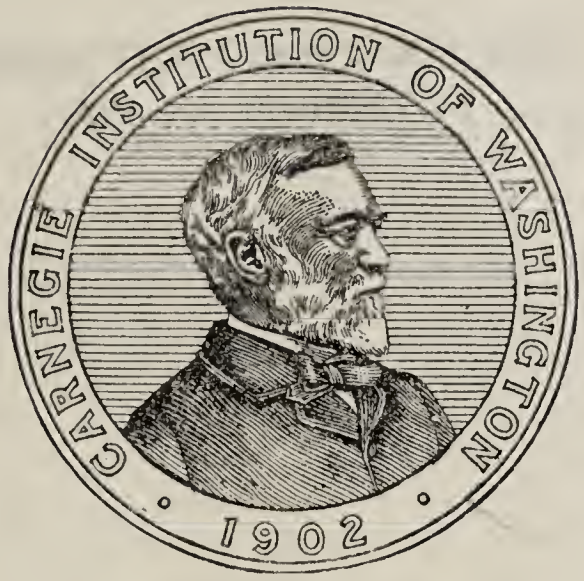

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CONTRIBUTIONS TO THE GEOLOGY AND PALAEONTOLOGY OF THE WEST INDIES

MIOCENE MOLLUSKS FROM BOWDEN, JAMAICA

PART II
GASTROPODS AND DISCUSSION OF RESULTS

BY

WENDELL P. WOODRING

PUBLISHED BY CARNEGIE INSTITUTION OF WASHINGTON
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MIOCENE MOLLUSKS FROM BOWDEN, JAMAICA

PART II, GASTROPODS AND DISCUSSION OF RESULTS

By Wendell P. Woodring

With forty plates and three text-figures

INTRODUCTION

This report is a continuation of Publication 366, issued in 1925, which contains an account of the fossil-bearing beds at Bowden, Jamaica, and descriptions of the pelecypods and scaphopods found there. The description of the gastropods, here presented, completes the account of the mollusks of the Bowden formation. In addition, a general account of the fauna, its ecologic significance, age, and relations to Miocene faunas in other parts of the world are given. The Pyramidellidae and Melanellidae, comprising about 47 species, are omitted in the descriptions of species, as it is expected that they will be included in a report on the mollusks of these two families from Bowden and other Caribbean fossil localities to be prepared by Dr. Paul Bartsch, of the United States National Museum.

The examination of the gastropods was begun at Johns Hopkins University in 1916. After many interruptions the work was completed under an informal cooperative agreement between the United States Geological Survey and the Carnegie Institution of Washington.

Six collections of Bowden fossils were examined during the preparation of this report. Two of these collections—the Duerden and Aldrich collections—are at Johns Hopkins University. Types and figured specimens from these collections were deposited by Professor Berry in the United States National Museum. Three collections are at the United States National Museum—the Guppy, Bland, and Henderson collections. The Henderson collection is the only large one of these three. The sixth collection, which was only partly examined, is at the Philadelphia Academy of Natural Sciences. Under the description of the species generally only the collection that contains the largest number of specimens is mentioned, without inferring, however, that the species is unrepresented in the other collections. More complete data are given for the species of which the representation in the different collections is markedly discrepant.

The proportion of new species among the gastropods is very much larger than among the pelecypods, principally because the parts of Dall's "Tertiary Fauna of Florida" dealing with the gastropods was limited to a much narrower field than the parts dealing with the pelecypods, and because at that time Dall had at his disposal no large collections of Bowden fossils. Guppy described most of the large species, but the small species were for the most part untouched.

At first it was planned to figure all the species, whether they were named or not. As the work progressed it became apparent that the

expense of figuring so much unnamed material was unwarranted. Therefore, some of the unnamed species are figured and some are not. Most of the unnamed species are new and many of them are represented by material that, if found elsewhere, would be considered suitable to serve as type material. In view of the perfect preservation of the bulk of the Bowden mollusks, I have refused, with few exceptions, to designate as type material very imperfect specimens or shells that clearly are immature. As additional barrels of Bowden fossils are sorted these unnamed species will be found to be represented by more perfect specimens, and additional species will turn up, for every large collection has a number of species unrepresented in any other collection.

The measurements were made with a caliper rule reading to tenths of a millimeter. If the dimensions of illustrations fail to agree with measurements in the text, it means that the enlargements are not precise or that the shell was tilted a little when photographed.

The term "nucleus" used in the description of the gastropods refers to the part of the shell from the apex to the beginning of adult sculpture or to a change in the texture or color of the shell when sculpture is absent. It embraces the whorls formed in the egg case, called "embryonic" whorls by some writers, and also the "nepionic" whorls, or part of a whorl, intervening between the "embryonic" and adult whorls. "Nucleus" is an unsatisfactory term and it has been used by some writers to refer only to the apical whorl. "Protoconch" is a more satisfactory term and its use in nautiloids and ammonoids seems to be no valid objection to its use in gastropods also. "Nucleus" or "nuclear whorls" is adopted because "post-nuclear" is a convenient term for the remaining whorls. "Post-protoconch" is unwieldy and "conch," the corresponding term in nautiloid and ammonoid terminology, is objectionable when applied to gastropods.

Comparisons with foreign Miocene species are deliberately omitted, not because none of the Bowden fossils are similar to foreign species, for many of them are, but because it seems advisable first to describe the American species and then to attempt to compare them with the foreign ones. At the present time even generic comparisons are none too certain, unless large reference collections are available.

The arrangement of families is the same as in Pilsbry's "Revision of W. M. Gabb's Tertiary Mollusca of Santo Domingo" (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 305–435, 1922). Though this arrangement proceeds from the most "specialized" gastropods to the simpler ones—the reverse order of that followed in the pelecypods—

it is the one generally in use in American literature, and the collections at the United States National Museum are arranged in this order.

Those who have attempted a monographic account of a large fauna will be lenient toward the errors and other shortcomings that will be found in this report. Many early designations of the types of genera were overlooked in the preparation of Publication 366. Omissions of nomenclature relating to this field probably will be found in this report, for it will be a long time before the earliest subsequent designations are gleaned from the literature. I also can not pretend to have covered the literature dealing with the families and genera represented in so large a fauna. Despite the attempt to consider all the Tertiary and Recent described species from the West Indian and adjoining regions, some recorded species may have been overlooked or misinterpreted, and some of the new species may turn out to be synonyms, particularly of living species.

In the treatment of a few features this report differs from Publication 366. In order to make available ready verification, complete references are given for subsequent designations of the types of genera. Also references are given for fossils with which the Bowden species are compared, but not for Recent species, illustrations of most of which can readily be found in manuals. Original descriptions of species are omitted to save space and also because they are unimportant. Formal descriptions are cut down to a minimum and only specific characters are emphasized, as generic characters are described in a brief diagnosis under each genus.

It should be remembered that all the specimens are from the one locality described on pages 7 to 8 of Publication 366, and that this locality is not repeated under the descriptions of the species.

As before, I have had the benefit of advice and assistance from the late Dr. W. H. Dall, Dr. Paul Bartsch, Dr. H. A. Pilsbry, Dr. Julia Gardner, and Dr. W. C. Mansfield. Workers at the United States National Museum will sorely miss Doctor Dall, who was ever willing to be interrupted, no matter how pressing the work on which he was engaged, and to give freely from his great store of information. I frequently consulted with Dr. Ralph Stewart, of Johns Hopkins University and the University of California, whose "Revision of Gabb's California Type Gastropods" marks an important step in the study of American Cretaceous and Tertiary mollusks. Prof. G. D. Harris, of Cornell University, offered the facilities of his laboratory during a visit to examine types. Dr. T. Wayland Vaughan, under whose general direction the project was completed, reviewed the discussion of results,

so that I have had the benefit of his extensive knowledge of the geology and palaeontology of the West Indian and other regions. I am deeply indebted to Dr. J. C. Merriam, President of the Carnegie Institution of Washington, through whose interest and assistance the project was completed. Dr. M. I. Goldman, of the United States Geological Survey, made many suggestions as to the interpretation of the ecology of the Bowden mollusks. I also wish to thank the Director and Chief Geologist of the United States Geological Survey for the opportunity to complete the report. Mr. L. R. Cox, of the Department of Geology of the British Museum, generously responded to appeals for the loan of type material and assisted in other ways. Finally, I wish to express my great obligations to Prof. E. W. Berry, of Johns Hopkins University, under whose direction this account of the Bowden mollusks was planned and whose inspiring example prompted the attempt to do something more than describe species.

NEW GENERA, SUBGENERA, AND SECTIONS, WITH THEIR TYPE SPECIES

Acmaturris. Type: *A. comparata,* new species.
Adelocythara. Type: *A. primolevis,* new species.
Agladrillia. Type: *A. callothyra,* new species.
Antillachelus. Type: *Calliostoma* (*Dentistyla*) *asperrium* var. *dentiferum* Dall.
Antillophos (subgenus of *Tritiaria*). Type: *Cancellaria candei* d'Orbigny.
Bactrocythara. Type: *Cythara obtusa* Guppy.
Bowdenagaza (subgenus of *Microgaza*). Type: *Microgaza* (*Bowdenagaza*) *cossmanni,* new species.
Brachycythara. Type: *Cythara gibba* Guppy.
Cibdezebina (subgenus of *Rissoina*). Type: *Rissoina browniana* d'Orbigny.
Cigclirina. Type: *C. sigma,* new species.
Coanollonia. Type: *C. ambla,* new species.
Compsodrillia. Type: *C. urceola,* new species.
Cryoturris. Type: *C. engonia,* new species.
Dactylidella (section of *Olivella*). Type: *Oliva anazora* Duclos.
Didianema. Type: *D. tytha,* new species.
Engoniophos. Type: *Phos erectus* Guppy.
Euclathurella. Type: *Clathurella vendryesiana* Dall.
Eumetadrillia (subgenus of *Agladrillia*). Type: *Agladrillia* (*Eumetadrillia*) *serra,* new species.
Eurissolina (subgenus of *Rissoina*). Type: *Rissoina* (*Eurissolina*) *ditomus,* new species.

Euryentmema. Type: *E. cigclis*, new species.
Eurypyrene (subgenus of *Pyrene*). Type: *Pyrene* (*Eurypyrene*) *eurynotum*, new species.
Fusiturricula. Type: *Turris* (*Surcula*) *fusinella* Dall.
Globidrillia. Type: *C. ula*, new species.
Glyphoturris. Type: *Mangilia quadrata* var. *rugirima* Dall.
Ithycythara. Type: *Mangilia psila* Bush.
Leptadrillia. Type: *Turris* (*Surcula*) *parkeri* Gabb.
Leptegouana (section of *Marginella*). Type: *Voluta guttata* Dillwyn.
Leptothyropsis (subgenus of *Homalapoma*). Type: *Leptothyra philipiana* Dall.
Lioglyphostoma. Type: *L. adematum*, new species.
Mirachelus. Type: *Calliostoma corbis* Dall.
Miraclathurella. Type: *M. vittata*, new species.
Mirarissoina (subgenus of *Rissoina*). Type: *Rissoina* (*Mirarissoina*) *lepida*, new species.
Ochetoclava (subgenus of *Clava*). Type: *Cerithium gemmatum* Hinds.
Otollonia. Type: *Liotia siderea* Guppy.
Pachycrommium. Type: *Amaura guppyi* Gabb.
Pachycythara. Type: *P. cryptonata*, new species.
Paraterebra (subgenus of *Terebra*). Type: *Terebra texana* Dall.
Platycythara. Type: *P. eurystoma*, new species.
Polystira. Type: *Pleurotoma albida* Perry.
Psilaxis (section of *Architectonica*). Type: *Architectonica* (*Philippia*) *krebsii* Mörch.
Pyrgocythara. Type: *P. eminula*, new species.
Saccharoturris. Type: *Mangilia consentanea* Guppy.
Syntomodrillia. Type: *Drillia lissotropis* Dall.
Taeniaturbo (section of *Turbo*). Type: *Turbo canaliculatus* Herrmann.
Tenaturris. Type: *Cythara guppyi* Dall.
Thelecythara. Type: *Cythara mucronata* Guppy.
Trachypollia. Type: *T. sclera*, new species.
Tylocassis (subgenus of *Semicassis*). Type: *Buccinum inflatum* Shaw.
Vaughanites. Type: *V. leptus*, new species.

COMPOSITION OF THE BOWDEN FAUNA

GENERAL FEATURES

The following mollusks from the Bowden formation are considered in this report and in Publication 366. Other Bowden fossils that have been described are included, so as to make available for ready reference a full faunal list. Changes in the names used for the pelecypods, other than a change in rank, are discussed in footnotes.

Mollusks and other fossils from Bowden formation

Foraminifera (described by J. A. Cushman, Carnegie Inst. Washington Pub. 291, pp. 21–71, 15 pls., 8 figs., 1919):

- Psammosphaera fusca Schulze
- Haplostiche dubia intermedia (Vanden Broeck)
- Haddonia minor Chapman
- Textularia barretti Jones and Parker
- Cuneolina pavonia d'Orbigny
- Cuneolina pavonia angusta Cushman
- Bulimina ovata d'Orbigny
- Nodosaria vertebralis (Batsch)
- Frondicularia alata d'Orbigny
- Cristellaria calcar aspinosa Cushman
- Cristellaria bowdenensis Cushman
- Cristellaria italica (de France)
- Cristellaria gemmata H. B. Brady
- Globigerina bulloides d'Orbigny
- Globigerina rubra d'Orbigny
- Globigerina sacculifera H. B. Brady
- Globigerina subcretacea Chapman
- Sphaeroidina dehiscens immatura Cushman
- Discorbis allomorphinoides (Reuss)
- Truncatulina praecincta (Karrer)
- Gypsina vesicularis (Parker and Jones)
- Gypsina globulus pilaris (H. B. Brady)
- Pulvinulina sagra (d'Orbigny)
- Amphistegina lessonii d'Orbigny
- Quinqueloculina auberiana d'Orbigny
- Quinqueloculina parkeri bowdenensis Cushman
- Triloculina brongniartiana d'Orbigny
- Triloculina tricarinata d'Orbigny
- Vertebralina striata d'Orbigny
- Orbiculina compressa d'Orbigny

Corals (listed and described in part by T. W. Vaughan, U. S. Nat. Mus. Bull. 103, pp. 212–213, 340–341, 355–360, 443–447, 499–500, 1919):

- Placotrochus costatus Duncan
- Sphenotrochus, new species
- Placocyathus barretti Duncan
- Placocyathus alveolus (Duncan)

Stylophora granulata Duncan
Asterosmilia profunda (Duncan)
Asterosmilia hilli Vaughan
Stephanocoenia intersepta (Esper)
Antillia walli Duncan
Thysanus excentricus Duncan
Thysanus elegans Duncan
Thysanus, new species
Syzygophyllia gregorii (Vaughan)
Siderastrea siderea (Ellis and Solander)
Goniopora, new species
Porites baracoäensis Vaughan
Acropora, new species

Bryozoa (described by F. Canu and R. S. Bassler, Carnegie Inst. Washington Pub. 291, pp. 73–102, 7 pls., 1919; U. S. Nat. Mus. Bull. 125, 301 pp., 47 pls., 38 figs., 1923 (see pp. 5 to 6):
Terebripora elongata Canu and Bassler
Terebripora sinefilum Canu and Bassler
Membranipora osburni Canu and Bassler
Membranipora tenella Hincks
Conopeum lacroixii Busk
Conopeum ovale Canu and Bassler
Cupuladria canariensis Busk
Acanthodesia savartii textura Reuss
Membrendoecium parvicapitatum Canu and Bassler
Callopora dumerillii Savigny-Audouin
Hemiseptella grandicella Canu and Bassler
Cupularia umbellata de France
Thalamoporella biperforata Canu and Bassler
Steganoporella parvicella Canu and Bassler
Stephanosella biaptera Michelin
Schizopodrella unicornis Johnston
Stylopoma spongites Pallas (not recorded in 1923 report)
Stylopoma minuta Canu and Bassler
Gemelliporella punctata Canu and Bassler
Hippodiplosia baccata Canu and Bassler
Cycloperiella rubra Canu and Bassler
Aimulosia brevis Canu and Bassler
Smittina ophidiana Waters
Rhamphostomella laticella Canu and Bassler
Rhamphostomella granulosa Canu and Bassler
Rhynchozoon verruculatum Smitt
Adeona heckeli Reuss
Bracebridgia deformis Canu and Bassler
Metrarabdotos lacrymosum Canu and Bassler
Mastigophora granulosa Canu and Bassler
Holoporella albirostris Smitt
Holoporella hemispherica Canu and Bassler
Mamillopora tuberosa Canu and Bassler

Mollusks:
- Gastropods:
  - Tralia (Tralia) vetula Woodring
  - Siphonaria species
  - Williamia parva Woodring
  - Cavolina telemus (Linné)
  - Cavolina ventricosa (Guppy)
  - Cavolina digitata (Guppy)
  - Cavolina vendryesiana (Guppy)
  - Diacria bisulcata Gabb
  - Acteon textilis (Guppy)
  - Acteon eurystoma Woodring
  - Acteon riomaensis Maury
  - Acteocina subbullata Pilsbry and Johnson
  - Acteocina lepta Woodring
  - Acteocina anetaspira Woodring
  - Acteocina coixlacryma (Guppy)
  - Sulcularia lipara Woodring
  - Cylichnella atacata Woodring
  - Volvula oxytata Bush
  - Volvula ornata Pilsbry and Johnson
  - Scaphander nannus Woodring
  - Atys (Aliculastrum) morantensis Woodring
  - Atys (Aliculastrum) dalli Woodring
  - Cylichna aula Woodring
  - Bulla vendryesiana Guppy
  - Ringicula (Ringiculella) tridentata Guppy
  - Atlanta (Atlanta) diamesa Woodring
  - Atlanta (Atlantidea) lissa Woodring
  - Terebra (Paraterebra) lepta Woodring
  - Terebra (Paraterebra) species
  - Terebra (Strioterebrum) bowdenensis Woodring
  - Terebra (Strioterebrum) eleutheria Woodring
  - Terebra (Strioterebrum) species *a*
  - Terebra (Strioterebrum) species *b*
  - Terebra (Strioterebrum) species *c*
  - Terebra (Strioterebrum) monida Woodring
  - Terebra (Strioterebrum) ischna Woodring
  - Terebra (Strioterebrum) cambiarsoi nugatoria Woodring
  - Hastula jamaicensis Woodring
  - Hastula homala Woodring
  - Polystira barretti (Guppy)
  - Crassispira jamaicensis (Guppy)
  - Crassispira ponida Woodring
  - Crassispira lomata Woodring
  - Crassispira annella Woodring
  - Crassispira aegis Woodring
  - Clathrodrillia tityra Woodring
  - Carinodrillia elocata meta Woodring

Carinodrillia bocatoroensis (Olsson)
Compsodrillia urceola Woodring
Compsodrillia catherina Woodring
Compsodrillia senaria Woodring
Agladrillia (Agladrillia) callothyra Woodring
Agladrillia (Agladrillia) leptalea Woodring
Agladrillia (Eumetadrillia) serra Woodring
Leptadrillia parkeri (Gabb)
Syntomodrillia espyra Woodring
Syntomodrillia iphis Woodring
"Drillia" species
Bellaspira ? species
Globidrillia ula Woodring
Ancistrosyrinx miranda (Guppy)
Fusiturricula iole Woodring
Fusiturricula panola Woodring
Ithycythara psiloides Woodring
Ithycythara ischna Woodring
Ithycythara maera Woodring
Ithycythara species
Ithycythara scissa Woodring
Adelocythara primolevis Woodring
Pyrgocythara eminula Woodring
Platycythara eurystoma Woodring
Thelecythara mucronata (Guppy)
Bactrocythara obtusa (Guppy)
Pachycythara cryptonata Woodring
Brachycythara gibba (Guppy)
Brachycythara species
"Cythara" species
Glyphoturris lampra Woodring
Cryoturris engonia Woodring
Cryoturris euengonia Woodring
Cryoturris nexilis Woodring
Cryoturris nisis Woodring
Cryoturris etrema Woodring
Cryoturris dianema Woodring
Cryoturris aptera Woodring
Saccharoturris consentanea (Guppy)
Saccharoturris species
Acmaturris comparata Woodring
Acmaturris brisis Woodring
Acmaturris scalida Woodring
Tenaturris guppyi (Dall)
Tenaturris terpna Woodring
Tenaturris isiola Woodring
Euclathurella vendryesiana (Dall)
Miraclathurella vittata Woodring
Miraclathurella entemna Woodring

Miraclathurella species
Glyphostoma exopitatum Woodring
Glyphostoma guppyi Woodring
Lioglyphostoma adematum Woodring
Lioglyphostoma moinica (Olsson)
Nannodiella amicta (Guppy)
Euryentmema cigclis Woodring
Euryentmema species
Microdrillia tersa Woodring
Daphnella ? species
"Daphnella" species
Scobinella magnifica (Gabb)
Vaughanites leptus Woodring
Conus (Dendroconus) apium Woodring
Conus (Lithoconus) species
Conus (Lithoconus) proteus Hwass
Conus (Lithoconus) ancylus Woodring
Conus (Lithoconus) nannus Woodring
Conus (Lithoconus) guppyi Woodring
Conus (Chelyconus) oniscus Woodring
Conus (Leptoconus) stenostoma Sowerby
Conus (Leptoconus) imitator lius Woodring
Conus (Leptoconus) planiliratus Sowerby
Conus (Leptoconus) multiliratus gaza Johnson and Pilsbry
Conus (Leptoconus) catenatus Sowerby
Conus (Leptoconus) consobrinus Sowerby
Conus (Leptoconus) granozonatus Guppy
Conus (Leptoconus) gracilissimus Guppy
Conus (Leptoconus) stibarus Woodring
Cancellaria (Cancellaria) barretti Guppy
Cancellaria (Cancellaria) laevescens Guppy
Cancellaria (Bivetopsis) moorei Guppy
Tribia epomis Woodring
Trigonostoma scalatella Guppy
"Cancellaria" species
Oliva (Oliva) reticularis trochala Woodring
Oliva (Oliva) plicata Guppy
Olivella (Olivella) acra Woodring
Olivella (Olivella) clarki Woodring
Olivella (Callianax) unica Woodring
Olivella (Dactylidia) indivisa Guppy
Olivella (Dactylidella) colpus Woodring
Ancilla (Eburna) pinguis Guppy
Marginella (Volvarina) species
Marginella (Leptegouana) coniformis Sowerby
Marginella (Serrata) glaphyra Woodring
Marginella (Serrata) mauryae Woodring
Cypraeolina pycna Woodring
Mitra (Tiara) henekeni illacidata Woodring

Mitra (Tiara) rhadina Woodring
Vexillum (Costellaria) dasaplurum Woodring
Vesillum (Costellaria) micramadum Woodring
Vexillum (Costellaria) cryptidulum Woodring
Vexillum (Costellaria) leurum Woodring
Vexillum (Uromitra) syntomum Woodring
Vexillum (Uromitra) callipictum Woodring
Vexillum (Uromitra) voraginosum Woodring
Vexillum (Uromitra) uncidum Woodring
Mitromorpha species
Xancus textilis (Guppy)
Xancus species
Latirus (Polygona) infundibulum polius Woodring
Latirus (Polygona) nematus Woodring
Fasciolaria semistriata leura Woodring
Fusinus species
Fusinus engonius Woodring
Tritiaria (Antillophos) moorei (Guppy)
Tritiaria (Antillophos) elegans (Guppy)
Engoniophos erectus (Guppy)
Nassarius (Uzita) cercadensis (Maury)
Nassarius (Uzita) gurabensis (Maury)
Trachypollia sclera Woodring
Columbella submercatoria Olsson
Columbella platynema Woodring
Pyrene (Eurypyrene) eurynotum Woodring
Mitrella (Mitrella) ocellata bowdenensis Woodring
Mitrella (Columbellopsis) lissa Woodring
Mitrella (Columbellopsis) lepta Woodring
Mitrella (Columbellopsis) species
Anachis (Costoanachis) orthopleura Woodring
Anachis (Costoanachis) aulata Woodring
Metuella (Metuella) species
Nassarina orna Woodring
Nassarina species
Cigclirina sigma Woodring
Strombina guppyi Woodring
Strombina gradata (Guppy)
Strombina caribaea Gabb
"Strombina" species
Metula species
Murex (Murex) recurvirostris Broderip
Murex (Phyllonotus) pomum Gmelin
"Muricopsis" collatus (Guppy)
"Muricopsis" species
Typhis (Typhinellus) siphon Woodring
Typhis (Talityphus) alatus obesus Gabb
Thais (Stramonita ?) species
Coralliophila miocenica (Guppy)

Cymatium (Lampusia) species *a*
Cymatium (Lampusia) species *b*
Cymatium (Gutturnium) species
Distorsio (Distorsio) decussatus simillimus (Sowerby)
Distorsio (Distorsio) clathratus gatunensis Toula
Bursa (Marsupina) proavus bowdenensis Pilsbry
Cassis sulcifera Sowerby
Semicassis (Tylocassis) reclusa (Guppy)
Sconsia (Sconsia) striata sublaevigata (Guppy)
Malea camura Guppy
Ficus pilsbryi (B. Smith)
Simnia (Calpurna) immunita (Guppy)
Cypraea (Talparia) isabella patrespatriae Maury
Cypraea (Zonaria) raymondrobertsi bowdenensis Pilsbry
Trivia (Trivia) cypha Woodring
Trivia (Trivia) globosa ("Gray") Sowerby
Trivia (Trivia) pediculus (Linné)
Erato (Erato) domingensis trochala Woodring
Strombus pugiloides Guppy
Strombus bifrons Sowerby
Strombus species
Strombus leurus Woodring
Seguenzia hapala Woodring
Triphora tritreta Woodring
Triphora apania Woodring
Triphora species *a*
Triphora species *b*
Cerithiopsis compsa Woodring
Cerithiopsis cigclis Woodring
Dizoniopsis vaughani Woodring
"Cerithiella" species
Seila species
Thericium species *a*
Thericium species *b*
Clava (Ochetoclava) costaricana stena Woodring
Clava (Ochetoclava) terpna Woodring
Bittium praeformatum Guppy
Bittiolum species
Bittiolum properatum Woodring
Alabina curta Woodring
Alaba turrita Guppy
Planaxis ame Woodring
Modulus modulus basileus Guppy
Vermicularia spirata (Philippi)
Lemintina papulosa (Guppy)
Petaloconchus species
Turritella guppyi Cossmann
Caecum species
Meioceras apanium Woodring

"Fossarus" species
"Fossarus (Gottoina)" mundulus Guppy
"Fossarus (Gottoina)" comptus Woodring
Architectonica (Architectonica) nobilis quadriseriata (Sowerby)
Architectonica (Psilaxis) krebsii lampra Woodring
Architectonica (Psilaxis) araea Woodring
Architectonica (Pseudotorinia) euprepes Woodring
Architectonica (Nipteraxis) species
Spirolaxis exquisita (Dall and Simpson)
Crepitacella cepula (Guppy)
Crepitacella aresca Woodring
Rissoina species
Rissoina (Zebinella) ame Woodring
Rissoina (Zebinella) oligopleura Woodring
Rissoina (Zebinella) species
Rissoina (Mirarissoina) lepida Woodring
Rissoina (Mirarissoina) species
Rissoina (Mirarissoina) xesta Woodring
Rissoina (Phosinella) guppyi Cossmann
Rissoina (Phosinella) rituola Woodring
Rissoina (Phosinella) pyrgus Woodring
Rissoina (Phosinella) species
Rissoina (Phosinella) debussa Woodring
Rissoina (Eurissolina) ditomus Woodring
Rissoina (Cibdezebina) browniana d'Orbigny
Rissoidae—3 species
Capulus (Capulus) epicranum Woodring
Capulus (Malluvium) lius Woodring
Hipponix ceras Woodring
"Hipponix" tortilis Guppy
Cheilea "equestris (Linné)"
Xenophora delecta (Guppy)
Natica (Natica) castrenoides Woodring
Natica (Natica) species
Natica (Naticarius) canrena antinacca Cossmann
Natica (Naticarius) species
Stigmaulax vererugosum Cossmann
Tectonatica pusilla (Say)
Polinices brunnea subclausa (Sowerby)
Eunaticina regia (Guppy)
Sigatica semisulcata bathyora Woodring
Sinum gatunense (Toula)
Sinum species
Sinum excentricum (Guppy)
Pachycrommium guppyi (Gabb)
Epitonium (Cycloscala) vetulum Woodring
Epitonium (Cycloscala) eumetrum Woodring
Epitonium (Hirtoscala) species
Epitonium (Spiniscala) gabbi (de Boury)

Epitonium (Spiniscala) etolium Woodring
Epitonium (Spiniscala ?) alidotum Woodring
Epitonium (Striatascala) anlanum Woodring
Epitonium (Striatascala) callipictum Woodring
Epitonium (Nitidiscala) aduncum Woodring
Epitonium (Nitidiscala) ventulum Woodring
Epitonium (Pictoscala) lepta Woodring
Ferminoscala pseudoleroyi (Maury)
Ferminoscala spathe Woodring
"Pliciscala (Nodiscala)" dasystoma Woodring
Janthina species
Mathilda plexita Dall
Mathilda species
Pyramidellidae—35 species
Melanellidae—12 species
Turbo (Taeniaturbo) dominicensis Gabb
Turbo (Taeniaturbo) species
Turbo (Senectus) species
Astraea (Astralium) sublongispina acosmeta Woodring
Astraea (Astralium) brevispina basilis Olsson
Astraea (Lithopoma) species
Homalopoma (Leptothyropsis) philipiana oedamata Woodring
Otollonia siderea (Guppy)
Coanollonia ambla Woodring
Coanollonia ? species
Tricolia (Tricolia) umbilicata (d'Orbigny)
Tricolia (Eulithidium) hadra Woodring
Liotia (Liotia) strebla Woodring
Liotia (Arene) lepidota Woodring
Liotia (Arene) venusta Woodring
Neritina (Nereina) woodwardi Guppy
Neritina (Clypeolum) pterota Woodring
Smaragdia (Smaragdia) viridis viridemaris (Maury)
Calliostoma (Calliostoma) pulcher bowdenense Woodring
Calliostoma (Calliostoma) roseoloide Woodring
Calliostoma (Dentistyla) guppyi Woodring
Solariella altiusulca Guppy
Solariella veresimilis (Guppy)
Antillachelus vaughani Woodring
Mirachelus precorbis Woodring
Microgaza (Microgaza) rotella vetula Woodring
Microgaza (Bowdenagaza) cossmanni Woodring
Chlorostoma (Omphalius) species
Vitrinella gabbi Woodring
"Circulus" bicarinatus (Guppy)
"Circulus" partulus Woodring
"Circulus" pentagonus (Gabb)
Episcynia naso (Pilsbry and Johnson)
Solariorbis clypeatus Guppy

Solariorbis colpus Woodring
Teinostoma (Teinostoma) laccus Woodring
Pseudorotella pycna Woodring
Pseudorotella homala Woodring
Didianema tytha Woodring
Cocculina decussata Woodring
Cocculina pustulata Woodring
Fissurella (Fissurella) arguta Woodring
Lucapina lipara Woodring
Lucapinella limatula vetula Woodring
Diodora alternata henekeni (Maury)
Diodora compsa Woodring
Puncturella (Fissurisepta) vetula Woodring
Emarginula (Emarginula) palia Woodring
Rimula pilsbryi Woodring
Hemitoma (Hemitoma) sclera Woodring
Acmaea actina Woodring
Acmaea acra Woodring

Scaphopods:

Dentalium (Dentalium) cossmannianum Pilsbry and Sharp
Dentalium (Dentalium) glaucoterrarum Maury
Dentalium (Dentalium ?) species *a*
Dentalium (Dentalium ?) species *b*
Dentalium (Tesseracme) dissimile dissimile Guppy
Dentalium (Tesseracme) dissimile ponderosum Gabb
Dentalium (Graptacme) species *a*
Dentalium (Graptacme) species *b*
Dentalium (Laevidentalium) haytense Gabb
Dentalium (Episiphon) schumoi Pilsbry
Dentalium (Episiphon) macilentum Pilsbry
Cadulus (Cadulus) simrothi Pilsbry
Cadulus (Gadilopsis) dentalinus (Guppy)
Cadulus (Gadilopsis) hendersoni Woodring
Cadulus (Polyschides) annulatus Pilsbry
Cadulus (Platyschides) depressicolis Pilsbry and Sharp
Cadulus (Platyschides) pilsbryi Woodring
Cadulus (Platyschides) species
Cadulus (Platyschides) annectens Woodring
Cadulus (Platyschides) arrosus Woodring

Pelecypods:

Nucula (Nucula) morantensis Woodring
Nucula ("Nuculopsis")[1] hilli Woodring
Nuculana[2] (Sacella) peltella (Dall)
Nuculana (Saccella) subcerata (Woodring)

[1] *Nuculopsis* is twice preoccupied (Girty, Ann. New York Acad. Sci., vol. 21, p. 133, 1911. Rollier, Abh. Schweizerischen Pal. Ges., vol. 38, p. 64, 1912).

[2] *Nuculana* Link (Beschr. Natur.-Samml. Univ. Rostock, p. 155, 1806; type, by monotypy), *Nuculana rostrata* (Gmelin) (*Arca rostrata* Gmelin) takes precedence over *Leda* Schumacher, 1817.

Nuculana (Saccella) indigena (Dall)
Nuculana (Jupiteria) bowdenensis bowdenensis (Woodring)
Nuculana (Jupiteria) bowdenensis subtumida (Woodring)
Nuculana (Jupiteria) duerdeni (Woodring)
Nuculana (Pseudoportlandia) clara (Guppy)
Yoldia (Orthoyoldia) ovalis Gabb
Tindaria (Tindaria) species
Glycymeris (Glycymeris) jamaicensis Dall
Glycymeris (Glycymeris) acuticostata plasia Woodring
Glycymeris (Glycymerella) prepennacea Woodring
"Arca"[1] occidentalis Philippi
"Arca" umbonata morantensis Woodring
"Arca" bowdeniana Dall
"Arca" yaquensis berryi Woodring
Barbatia (Barbatia) islopa Woodring[2]
Barbatia (Barbatia) delepida Woodring
Barbatia (Barbatia) inusitata Woodring[3]
Barbatia (Acar) domingensis (Lamarck)
Barbatia (Obliquarca) dentera Woodring
Barbatia (Obliquarca) subcandida Woodring
Barbatia (Obliquarca) modiolida Woodring
Anadara[4] halidonata halidonata (Dall)
Anadara halidonata oresta (Woodring)
Anadara perplura (Woodring)
Anadara prephina (Woodring)
Anadara inaequilateralis (Guppy)
Anadara dasia (Woodring)
Anadara wordeni (Woodring)
Anadara agnastha (Woodring)
Anadara actinophora thomasensis (Woodring)
Anadara donacia (Dall)
Anadara microtera (Woodring)
Anadara opthanta (Woodring)
Fossularca adamsi (Dall)[5]
Ovalarca ovalina (Dall)
Bathyarca hendersoni (Dall)
Limopsis (Pectunculina) ovalis silova Woodring
Limopsis (Pectunculina) jamaicensis Woodring
Pinna refurca Woodring
Atrina species

[1] According to the designation of *A. tortuosa* Linné as the type of *Arca* by Children in "1823," that well-known name is not available for this genus (see Cox, Pal. Zanzibar Protectorate, p. 93, 1927). This is one of the unfortunate results of subsequent designation.

[2] *B. endomena* Woodring seems to be a synonym of this species.

[3] *B. propertua* Woodring is suppressed as a synonym of this species.

[4] L. R. Cox, of the Department of Geology of the British Museum, after examining the type of *Arca antiquata* Linné informs me that it has no byssal gape and that some specimens of this species have ligament grooves and others have none. *Diluvarca* is suppressed as a synonym of *Anadara* (see Cox, Pal. Zanzibar Protectorate, pp. 94–95, 1927).

[5] The subspecific name *sawkinsi* apparently should be suppressed.

Pedalion[1] species
Pteria inornata (Gabb)
Ostrea (Lopha) paramegodon Woodring
Ostrea (Lopha) costaricensis Olsson[2]
Ostrea (Lopha) folioides Woodring
Pecten (Euvola) barretti Woodring[3]
Pecten (Euvola) bowdenensis Dall
Chlamys (Chlamys) species
Chlamys (Chlamys) vaginulus (Dall)
Chlamys ("Chlamys") bellipictus Woodring
Chlamys (Aequipecten) plurinominis morantensis Woodring
Chlamys (Plagioctenium) uselmae (Pilsbry and Johnson)[4]
Chlamys (Plagioctenium) concinnatus Woodring
Chlamys (Plagioctenium) ameleus Woodring
Chlamys (Plagioctenium) gonioides Woodring
Chlamys (Nodipecten) nodosus (Linné)[5]
"Palliolum ?" guppyi (Dall)[6]
Amusium (Amusium) papyraceum (Gabb) ?
Amusium (Parvamussium) spendulum Woodring
Spondylus bostrychites Guppy
Spondylus species
Plicatula guppyi Woodring
Lima (Lima) stenacostata Woodring
Lima (Mantellum) species
Limea solida Dall
Placunanomia lithobleta Dall
Anomia indecisa Dall
Modiolus (Brachydontes) guppyi Dall
Mytilopsis jamaicensis Woodring
Julia gardnerae Woodring
Poromya jamaicensis Dall
Cuspidaria (Cardiomya) craspedonia Dall
Cuspidaria (Bowdenia) distira Dall
Verticordia (Trigonulina) bowdenensis Dall
Verticordia (Haliris) jamaicensis Dall
"Crassatellites"[7] jamaicensis Dall
"Crassatellites" altaspissus Woodring
Crassinella guppyi (Dall)
Crassinella bowdenensis (Dall)
Crassinella xena Woodring
Cardita (Glans) scabricostata Guppy

[1] According to Iredale (Proc. Linn. Soc. New South Wales, vol. 49, p. 190, 1924), *Pedalion* Huddesford (Huddesford's ed. of Lister, index, p. 23, 1770) probably is the earliest name for this genus.

[2] *O. guppyi* Woodring is considered a synonym of this species.

[3] This species seems to fall in *Euvola* rather than in *Pecten* s. s.

[4] *Chlamys mansfieldi* Woodring is suppressed as a synonym of this species.

[5] This species is represented in material donated to the United States National Museum by T. H. Aldrich.

[6] The group of Pectens to which this species belongs seems to be unnamed.

[7] This generic name is not available for the Bowden species.

Pleuromeris acaris (Dall)
Chama involuta Guppy
Chama macerophylla Gmelin
Echinochama antiquata Dall
Codakia (Codakia) spinulosa Dall
Codakia (Codakia) lomonea Woodring
Codakia (Jagonia) vendryesi Dall
Codakia (Jagonia) guppyi Woodring
Lucina (Lucina) bowdenensis Woodring[1]
Myrtaea (Miyrtaea) limoniana Dall
Myrtaea (Myrteopsis) pertenera (Dall)
Myrtaea (Eulopia) vermiculata Dall
Myrtaea (Eulopia) furcata Dall
Miltha (Megaxinus) gluminda Woodring
Phacoides[2] (Phacoides ?) species
Phacoides (Linga) podagrinus podagrinus Dall
Phacoides (Linga) podagrinus alarantus Woodring
Phacoides (Linga) browni Woodring
Phacoides (Linga) tithonis Dall
Phacoides (Pleurolucina) quadricostatus Dall
Phacoides (Cardiolucina) recurrens Dall
Phacoides (Callucina) pauperatus pauperatus (Guppy)
Phacoides (Callucina) pauperatus oligocostatus Woodring
Phacoides (Callucina) eurycostatus Woodring
Phacoides (Parvilucina) yaquensis morantensis Woodring
Phacoides (Parvilucina) limnidus Woodring
Phacoides (Bellucina) actinus Dall
Divaricella (Divaricella) prevaricata Guppy
Diplodonta (Diplodonta) walli Woodring
Diplodonta (Diplodonta) homalostriata Woodring
Diplodonta (Felaniella) minor Dall
Diplodonta (Phlyctiderma) gabbi Dall
Erycina (Erycina) olssoni Woodring
Erycina (Erycina) pura Woodring
Neaeromya menotreta Woodring
Cardium ("Acanthocardia ?") dissidepictum Woodring
Cardium (Trachycardium) lingualeonis Guppy
Cardium (Trachycardium) bowdenense Dall
Cardium (Trachycardium) inconspicuum Guppy
Cardium (Trachycardium) waylandi Woodring
Cardium (Fragum) medium Linné
Cardium (Fragum) elattocostatum Woodring

[1] Material that was found after Publication 366 was issued shows that this species gets to be more than twice as large as the type.

[2] Iredale's (Proc. Malac. Soc. London, vol. 11, pp. 301–302, 1915) contention that *Phacoides* as used by Blainville is a vernacular name seems to be fully justified, but his refusal to accept it as of Gray, 1847, is open to question, for it is available as a substitute name for *Lucina* Gray, not Bruguière (see Iredale's discussion of *Lucina*). According to the view here taken the citation for *Phacoides* should be as follows: Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 195, type, by original designation, "*Venus*" *jamaicensis* [Spengler], apparently error for *Tellina*.

Cardium (Trigoniocardia) haitense haitense Sowerby
Cardium (Trigoniocardia) haitense cercadicum Maury
Cardium (Trigoniocardia) thaumastum Woodring
Cardium (Laevicardium) serratum Linné
"Nemocardium"[1] jamaicense (Dall)
Pliocardia bowdeniana (Dall)
Tivela (Tivela) jamaicensis Dall
Gouldia insularis (Dall and Simpson)
Pitar (Pitarella) gatunensis (Dall)[2]
Pitar (Hyphantosoma) carbaseus (Guppy)
"Callista" (Costacallista) planivieta (Guppy)[3]
Antigona (Dosina) caesarina (Dall)[4]
Antigona (Ventricola) blandiana (Guppy)
Cyclinella plasiatenuis Woodring
Chione (Chione) sawkinsi Woodring
Chione (Chione) woodwardi (Guppy)
Chione (Chione) retugida Woodring[5]
Chione (Lirophora) hendersonii Dall
Chione (Timoclea) granulata (Gmelin)[6]
Parastarte antillensis Woodring
Cooperella (Cooperellopsis) thaumasta Woodring
Tellina (Moerella) simpsoni Dall
Tellina (Moerella) hendersoni Dall
Tellina (Eurytellina) species
Tellina (Eurytellina) spiekeri Woodring
Tellina (Eurytellina) pharcida Dall
Tellina (Eurytellina) gonida Woodring
Tellina (Eurytellina) halistrepta Dall
Tellina (Eurytellina) apomsa Woodring
Tellina (Eurytellina) browni Woodring
Tellina (Merisca) species
Tellina (Merisca) sclera sclera Dall
Tellina (Merisca) sclera lerasca Woodring
Tellina (Merisca) acrocosmia Dall
Tellina (Scissula) healeyi Woodring
Tellina (Elliptotellina) cymobia Woodring
Strigilla (Strigilla) pisiformis (Linné)
Macoma (Psammacoma) tracta Dall
Macoma (Psammacoma) olivella Dall
Macoma (Cymatoica) vendryesi Dall
Semele (Semele) calliconcinnata Woodring
Abra (Abra) triangulata Dall

[1] This species is not like the type of *Nemocardium*.

[2] Material submitted by Mr. Aldrich indicates that "*Callocardia*" *ammondea* Woodring and "*C.*" *elethusa* Woodring should be suppressed as synonyms of this species.

[3] See Palmer, Palaeontographica Americana, vol. 1, No. 5, p. 89, 1927.

[4] Recorded by Palmer, Palaeontographica Americana, vol. 1, No. 5, p. 126, 1927.

[5] Palmer's record of *C. subrostrata* (Lamarck) (Palaeontographica Americana, vol. 1, No. 5, p. 150, 1927) may refer to this species, which she incorrectly places in *Timoclea*, but I have not seen specimens.

[6] Recorded by Palmer, Palaeontographica Americana, vol. 1, No. 5, pp. 158–159, 1927.

Abra (Abra) deutera Woodring
Donax (Donax) species
Donax (Paradonax) lennoxi Woodring
Solecurtus[1] sanctidominici (Maury)
Spisula (Mactromeris) matleyi Woodring
Ervilia gabbi Woodring
Corbula (Corbula)[2] heterogena Dall
Corbula (Caryocorbula)[2] sericea Dall
Corbula (Bothrocorbula) viminea Guppy
Basterotia (Basterotia) bowdeniana (Dall)
Rocellaria[3] rotunda (Dall)
Jouannetia sphaeroidalis (Guppy)
Martesia bowdeniana (Dall)
Xylophaga ? species
Teredo ? species

The preceding list shows a total of 610 species, subspecies, and varieties of mollusks as follows:

Species, subspecies, and varieties of mollusks from Bowden formation

Gastropods	406
Scaphopods	20
Pelecypods	184
Total	610

Of these 47 represent gastropods of the families Pyramidellidae and Melamellidae that are not described; three represent Rissoids that are not named even generically; and 75 are not given specific names, leaving a total of 485 named species, three of which are pelecypods not considered in Publication 366 (*Chlamys nodosus* (Linné), *Antigona caesarina* (Dall), and *Chione granulata* (Gmelin)). The pelecypods probably are somewhat overnamed.

It is apparent from the preceding list that the Bowden fauna is a very remarkable one, perhaps the most remarkable that has so far been found in America. No other American Tertiary locality has yielded 600 species of mollusks. The Bowden locality gives a more complete representation of the total number of shell-bearing mollusks than is generally found at American Tertiary localities. Dall's early estimate (U. S. Geol. Survey Bull. 84, p. 27, 1892; U. S. Fish Comm. Bull. 1900, vol. 1, p. 354, 1901) of 600 species for a tropical fauna is far too low. Perhaps 1000 species would be a modern estimate of the total number of shell-bearing mollusks that would be expected in

[1] *Solecurtus* Blainville, 1824, Dict. Sci. Nat., vol. 32, p. 351; type, by subsequent designation Deshayes, Dict. Class. Hist. Nat., vol. 15, p. 482, 1829 (quoted from Iredale, Proc. Malac. Soc. London, vol. 11, p. 306, 1915), *Solen strigilatus* Linné.

[2] See Gardner, Nautilus, vol. 40, No. 2, pp. 41–47, 1926.

[3] *Rocellaria* Blainville, 1828, Dict. Sci. Nat., vol. 57, p. 244; type, by monotypy, *Gastrochaena modiolina* Lamarck (=*Mya dubia* Pennant). (See Iredale, Proc. Malac. Soc. London, vol. 11, pp. 296–297, 1915.)

the West Indies in a strip covering every ecologic nitch from the shore to a depth of about 100 fathoms and also embracing the pelagic species. On the basis of this estimate the Bowden fauna as now known is only 60 per cent complete. It is not difficult to point out some of the gaps. The rock-clinging, rock-boring, and mud-burrowing species are almost entirely unrepresented. The following genera, which according to current age determinations were living in the Caribbean region during the time when the Bowden formation was deposited, so far are unrepresented in the Bowden fauna:

Caribbean middle Miocene genera so far unrepresented in Bowden formation[1]

Gastropods:

Limacina
Vaginella
Styliola
Rictaxis
Abderospira
Haminoea
Carinaria
Fusoterebra
"Clavatula" (labiata Gabb)
Knefastia
Gemmula
Leucosyrinx
"Drillia" (squamosa Gabb)
Borsonia
"Bivetia"
Narona
Aphera
Agaronia
Glabella
Prunum
Egouana
Bullata
Persicula
Voluta
Lyria
Enaeta
Aurinia
Halia
Mitra s. s.
Vasum
Dolicholatirus
Galeodes
Peristernia
Solenosteira
Northia
Nitidella
Sistrum
Cymia
Morum
Cypraecassis
Pustularia
Siliquaria
Torinia
Crepidula
Crucibulum
Calyptraea
Turgurium
Neverita
Botula
Lithophaga
Crenella
Pholadomya
Cyathodonta
Pandora
Coralliophaga
Pseudochama
Lucinisca
Miltha s. s.
Thyasira
Montacuta
Lophocardium
Dosinia
Clementia
Macrocallista
Petricola
Tellidora
Metis
Sanguinolaria
Tagelus
Solen
Harvella
Mactrella
Micromactra
Mulinia
Raeta
Mesodesma
Panope

Pelecypods:

Acila
Adrana
Cunearca
Senilia
Noetia
Dimya
Mytilus
Modiolus

No locality, however, is going to yield a complete fauna, for it is inconceivable that mollusks representing every ecologic niche could be brought together at one place by natural means.

[1] In this list, as in others, subgenera and sections are for convenience given the same rank as genera.

Despite the gaps in the Bowden fauna it is remarkable for the unusual representation of several families (particularly the Turridae, Conidae, Mitridae, Pyrenidae, Rissoinidae, Naticidae, Epitoniidae, Trochidae, Fissurellidae, Arcidae, Pectenidae, Lucinidae, and Tellinidae), and for the large number of genera that have not yet been found elsewhere in the Miocene deposits of tropical America. These genera are as follows:

Bowden genera not yet found elsewhere as Miocene fossils in tropical America

Gastropods:

Tralia
Siphonaria
Williamia
Vaughanites
Mitromorpha
Seguenzia
Cerithiopsis
Dizoniopsis
Seila
Planaxis
"Gottoina"
Psilaxis
Spirolaxis
Mirarissoina
Eurissolina
Cycloscala
Janthina
Mathilda
Leptothyropsis
Otollonia
Coanollonia
Clypeolum
Dentistyla
Antillachelus
Mirachelus
Microgaza
Cocculina
Fissurella
Lucapina
Lucapinella
Fissurisepta
Emarginula
Rimula
Hemitoma
Acmaea

Pelecypods:

"Nuculopsis"
Tindaria
Obliquarca
Ovalarca
Bowdenia
Myrteopsis
Pliocardia
Cooperellopsis
Elliptotellina
Jouannetia

Of the genera in the preceding list the following are not recorded at any other American Tertiary locality:

Bowden genera not yet found elsewhere as Tertiary fossils in America

Gastropods:

Tralia
Siphonaria
Williamia
Vaughanites
Seguenzia
Planaxis
Spirolaxis
Mirarissoina
Eurissolina
Cycloscala
Janthina
Leptothyropsis
Otollonia
Coanollonia
Dentistyla
Antillachelus
Mirachelus
Microgaza
Cocculina
Fissurisepta

Pelecypods:

"Nuculopsis"
Tindaria
Obliquarca
Ovalarca
Bowdenia
Myrteopsis
Pliocardia
Cooperellopsis
Elliptotellina
Jouannetia

ANALYSIS OF GENERA

Most of the Bowden genera are still living in West Indian waters, but a number are living elsewhere and about the same number are extinct. The living exotic genera, which are now found in the Pacific Ocean, are as follows:

Pacific exotic genera in Bowden fauna

Gastropods:
- Fusiturricula
- Dendroconus
- ? Tribia
- Dactylidella
- Strombina
- Metula
- ? Typhinellus
- Talityphus
- Malea
- Talparia
- Ochetoclava
- ? Eurissolina
- Eunaticina
- Clypeolum

Scaphopods:
- Tesseracme

Pelecypods:
- Placunanomia
- Julia
- Jouannetia

In addition, the following species have living analogues in the Pacific, but not in the Caribbean Sea:

Bowden species and analogous living Pacific species unrepresented in Recent Caribbean fauna

BOWDEN SPECIES	ANALOGOUS LIVING PACIFIC SPECIES
Acteon textilis Guppy	A. traskii Stearns
Terebra species	T. robusta Hinds
Cancellaria laevescens Guppy	C. obesa Sowerby
Strombina caribaea Gabb	S. gibberula (Sowerby)
Rissoina species	R. mexicana Bartsch

The following genera seem to be extinct:

Extinct genera in Bowden fauna

Gastropods:
- Globidrillia
- Scobinella
- Vaughanites
- Engoniophos
- ? Eurypyrene
- Metulella
- ? Cigclirina
- Mirarissoina
- Pachycrommium
- Otollonia
- Coanollonia

Pelecypods:
- ? "Nuculopsis"
- ? Pseudoportlandia
- ? Obliquarca
- Ovalarca
- Bowdenia
- Myrteopsis
- Pliocardia
- Cooperellopsis
- Bothrocorbula

Acteocina coixlacryma Guppy, which perhaps should be given a subgeneric name, represents an extinct phylum of Acteocinas.

On the basis of these lists and disregarding the question marks and the undescribed families, about 89 per cent of the Bowden genera are still living in the West Indian region, 5 per cent are exotic Pacific genera and 6 per cent are extinct. These figures are only approximate, for aside from the doubt about some of the genera listed, the Rissoidae, Melanellidae and Pyramidellidae are not considered, and it is not certainly known whether all the turrid genera except those listed are living West Indian genera.

ORIGIN OF THE BOWDEN FAUNA

It is not possible at the present time to trace the history of the genera represented in the Bowden formation. *Ancistrosyrinx*, *Microdrillia*, *Scobinella*, *Uromitra*, *Sigatica*, *Pachycrommium*, and *Elliptotellina* are outstanding Eocene survivors. Other Eocene genera are represented, but a modern revision of the Eocene mollusks of the Gulf coast of the United States would be required for an adequate comparison to supplement the rather meager Caribbean Eocene faunas. Likewise the mollusks of the Vicksburg group are needed to supplement the records of Caribbean Oligocene species. Lower Oligocene mollusks have not been recorded anywhere in the Caribbean region, unless the few species from Guallava, Costa Rica, collected from beds carrying *Lepidocyclina hilli* Cushman, and the "*Lucina*" *megameris*-bearing beds of Jamaica represent that stage. According to current age assignments, the Red Bluff formation of Mississippi should afford a means of tracing some of the Bowden genera during lower Oligocene time. Antigua and Porto Rico are the only localities in the Caribbean region that have yielded a considerable number of Oligocene mollusks and at these localities the beds are placed in the middle Oligocene. The Antigua mollusks, consisting of 26 recorded species, half of which are Pectens, are principally reef-dwellers. Those from Porto Rico represent a greater ecologic range, but most of the material is poorly preserved. They give an indication, however, of what might be expected from an Oligocene fauna as large as the Miocene ones. The unnamed Porto Rican *Xancus* is the earliest species from America. The Porto Rican *Hyphantosoma* far antedates the next younger species, which is of middle Miocene age. *Clementia dariena rabelli* Maury carries over the record of the *dariena* phylum from Eocene to Miocene. No marine upper Oligocene Caribbean mollusks are on record, unless some of the beds referred to the lowermost Miocene are upper Oligocene. The Byram marl of Mississippi (top formation of Vicksburg group), which is placed in the upper Oligocene, bridges over this gap. It carries many species that undoubtedly are the predecessors of those in the West Indian and Florida Miocene, including the earliest American species of *Distorsio* s. s. and *Sconsia* s. s., and the earliest *Xancus* on the American mainland. A great many Byram genera—among them *Acteocina*, *Crassispira*, *Ancistrosyrinx*, *Microdrillia*, *Scobinella*, *Uromitra*, *Vexillum*, *Xancus*, *Latirus*, *Distorsio*, *Semicassis*, *Sconsia*, *Ficus*, *Lucina*, *Myrtaea*, "*Acanthocardia ?*," and *Abra*—are found in the Bowden formation. Before the Miocene species from tropical America were known it was supposed that *Scobinella* disappeared after Byram time. Though the Byram marl carries many forerunners of Miocene species it has Eocene survivors

in the genera known as *Pleuroliria, Pleurofusia, Microsurcula, Bathytoma, Conorbis, Clavilithes,* and *Aporrhais,* but *Ampullinopsis* gives it an Oligocene stamp.

Beginning with the lower Miocene many of the Bowden genera and species can be traced in the Carribean and Florida faunas of the Anguilla, Tampa, Thomonde, Chipola, and Cercado horizons. The Carribean Miocene faunas seem to represent an abrupt invasion, but such an impression is erroneous and is due to the scarcity there of records of Oligocene mollusks. When more complete data are available it probably will be found that the bulk of the Bowden species represent autochthonous Oligocene and Miocene phyla and that a few are due to increments from the Mediterranean and from the eastern Pacific.

ECOLOGY OF THE BOWDEN MOLLUSKS

TEMPERATURE

It hardly need be remarked that the Bowden fauna is tropical. Both its size and composition, as well as its location show that. Yet it probably would be richer than the present West Indian fauna if it were fully known, for the present fauna is strikingly impoverished in terms of the middle Miocene fauna. The most dramatic event in the history of the West Indian fauna is the wholesale disappearance of genera at and soon after the close of Miocene time. Genus after genus, many of which are now living on the other side of Central America, then became extinct there and relatively few genera have taken their place. I hope at some future time to assemble the comparative data and to discuss this matter more fully. The significance of this event, which was well known to the pioneers in West Indian palaeontology, must still be left open. Inasmuch, however, as similar events in other parts of the world, such as the disappearance of tropical genera in the Mediterranean Sea early in the Pleistocene (Calabrian) and the reappearance there of a warm fauna in the *Strombus bubonius* fauna during the second interglacial stage, corresponding to the Chellian interglacial fauna of northern Europe, have a temperature significance, it seems to be a reasonable working hypothesis that the change in the West Indian fauna is due to a change in the temperature of the water, for no other reasonable hypothesis is apparent. Also inasmuch as the disappearance of these genera followed the closing of the channels across Central America that permitted free communication between the Caribbean Sea and the Pacific, and as many of the genera are still living on the Pacific coast of Central America, the change seems to be due at least in part to a change in oceanic circulation resulting in the exclusion of Pacific water from the Caribbean. This conclusion opens up a complex problem in which the many factors that determine the range of marine mollusks and other animals need consideration. According to studies of the life history of mollusks of economic importance, the temperature of the water during the reproductive period probably is the most important factor determining the northward range of species in the northern hemisphere. Unless the temperature reaches a certain minimum during the spawning season, spawning fails to take place or takes place abortively. Whether the change in oceanic circulation in the Caribbean Sea would result in a lowering of the temperature of the water there and whether it would be lowered enough to be effective as a factor in temperature selection is at the present time a matter of speculation, but this aspect deserves consideration (see Woodring, Jour. Washington Acad. Sci., vol. 16, No. 3, p. 77, 1926). Though a change in temperature

of the water may be the principal factor, the presence of at least two of the genera (*Cymia* and *Placunanomia*) as far north during Miocene time as New Jersey and North Carolina, respectively, shows that the problem is not so simple and that other factors must be considered. At all events if number of genera and species is a measure of temperature, the Caribbean Sea during the time when the Bowden formation was deposited was at least as warm as it now is.

SALINITY

Aside from a few species the Bowden mollusks are such as live in the open sea in water having only a slight range of salinity. According to the testimony of modern species belonging to the same groups, the two species of *Neritina*, the *Mytilopsis*, and the oyster (*O. folioides*) similar to the American mangrove oyster are the only ones that lived in brackish water. Many of the specimens of *Neritina* are badly corroded like Recent fresh-water or brackish-water shells. The absence of *Galeodes*, *Potamides* and other cerithioids, *Senilia*, and *Corbicula*, all of which prefer or tolerate brackish water and are found in middle Miocene deposits elsewhere in tropical America, as well as of fresh-water genera, indicates that very little brackish-water material had access to the locality where the part of the Bowden formation that has been explored was laid down. Yet the Neritinas are represented by too many specimens (18 of *N. woodwardi* and three of *N. pterota* in the Henderson collection, 25 and nine, respectively, in the Duerden collection) to dismiss them as "fortuitous." Somewhere near by a stream entered the sea, in the estuary of which these brackish-water species lived. These shells could not have lived with the marine species among which they now are found, but their presence apparently is to be attributed to unusual events, perhaps unusually heavy floods, for otherwise additional brackish-water genera should be represented.

CHARACTER OF BOTTOM

Records of shore collecting and of dredging operations must be relied on to furnish the data to be used in drawing any conclusions as to the character of the bottom on which the Bowden mollusks lived, and the records should deal with the American tropics to be of the greatest value. Records of shore collecting are scattered through a mass of literature, though by this time some of the data has filtered through to the manuals and the books on the natural history of the seashore. It was expected that the "Catalogue of shells collected at Panama" (334 pp., New York, 1852), by C. B. Adams, would be particularly useful, for it represents the remarkable achievement of collecting and recording the habitat of 41,800 specimens of 516 species of mollusks all within a period of a little more than a month. It is the most detailed account now available of the habitat of marine

mollusks in the American tropics. Conditions for shore collecting are very favorable in Panama Bay on account of the tidal range of 16 to 20 feet and on account of the variety of habitats. It is precisely the unusual tidal range, however, that is responsible for the finding of most of the active gastropods under stones, where they retire to await the return of the tide. It would be faulty to assume that the Bowden species of all these genera also lurked under or among stones, for in the Caribbean region most of these genera now are not exposed by the slight fall of the tide, and there is no reason to believe that the tidal range was any greater when the Bowden formation was deposited. The little book published anonymously by Krebs (The West-Indian marine shells, 137 pp., Copenhagen, 1864) is the only general account for the West Indian region that I know of. Records of modern dredging operations at moderate depths (less than 100 fathoms) are not available for either the West Indian or Panamic regions. Stations are not recorded under the species in the report on the mollusks of Porto Rico (Dall and Simpson, Bull. U. S. Fish Comm., 1900, vol. 1, 524 pp., pls. 53–58, 1901), though the character of the bottom is recorded in a list of the stations (p. 514). Records derived from the ordinary run of dredging operations are not entirely trustworthy, however, unless the hauls are numerous and of short duration. The dredge generally is dragged over too large an area, and on hard bottoms it misses the burrowers. The results of reoccupying more than 100 stations during the survey of the Woods Hole region may be taken as an example. Types of bottoms identical with the original record were recorded in only 14 per cent of these reoccupied stations. Only an additional 33 per cent were substantially identical, whereas in 6 per cent the record was totally different (Sumner and others, Bull. Bur. Fisheries, vol. 31 (1911), pt. 1, p. 31, footnote, 1913). Reliable data as to the bottom and as to the composition of animal communities on the bottom probably will not be available to serve as a basis for interpreting a West Indian Miocene fauna until some type of grab is used at moderate depths in the Caribbean region. (For the use of a grab and its results see Petersen, Rept. Danish Biol. Station, No. 20, pp. 47–50, 1911; Annal. Inst. Océanographique, vol. 6, No. 1, 13 pp., 10 figs., 1913; Proc. Zool. Soc. London, 1924, pt. 2, pp. 687–694. Sumner and others, California Univ. Pub. Zoology, vol. 14, p. 7, 1914. Packard, California Univ. Pub. Zoology, vol. 18, pp. 299–333, pls. 12–13, 6 figs., 1918. Davis, Great Britain, Ministry Agr. and Fisheries, Fishery Invest., ser. 2, vol. 6, No. 2, 54 pp., 11 figs., 1923. Stephen, Fishery Board for Scotland, Sci. Invest., 1922, No. 3, 21 pp., 2 charts, 1923.)

So far as the Bowden fauna is concerned the evidence as to the character of the bottom is partly negative and therefore not worth very much. There are hardly any mollusks that cling to rocks or bore in rocks. *Chlorostoma*, represented by three small badly broken

specimens, and *Thais*, represented by one very small specimen, seem to be the only intertidal rock-clingers. *Sistrum*, *Tectarius*, *Echinella*, *Littorina*, *Cittarium*, *Nerita*, large limpets, and large limpet-like pulmonates are absent. Both limpets and limpet-like pulmonates (*Acmaea* and *Siphonaria*, respectively) are represented at Bowden, but the shells are very small and resemble modern species that cling to sea weeds rather than to rocks. It is not known, however, whether all the other genera in the preceding list were living in the West Indian region during middle Miocene time, *Sistrum* being the only one for which there is any record. The others may have been living then, or if not some other genera took their place and they probably would be recognized as rock-clingers. The keyhole limpets have an unusually full representation in the Bowden fauna, but they generally live below low-water mark and cling to sea weeds as well as to rocks, and are also found under stones. It should be noted that rock-clinging species are very rare as Miocene fossils in the whole Caribbean region. Perhaps special conditions are necessary to preserve such shells, for they may be ground to pieces or dissolved before they can be buried. That they may be preserved is shown, for example, by the presence of *Tectarius*, *Littorina*, *Cittarium*, and *Nerita* in the Pliocene beds at Port Limon, Costa Rica.

Rocellaria, *Jouannetia*, and *Martesia* are the only rock- or coral-boring bivalves. *Lithophaga*, *Coralliophaga*, *Petricola*, *Saxicava*, and *Pholas* are unrepresented, though they are much more common as Miocene fossils in this region than the rock-clinging snails. Nevertheless, some of these genera probably were living at Bowden, for corals at least were there for them to bore. Even disregarding the records for Panama Bay many of the predaceous carnivores among the Bowden gastropods belong to genera (*Conus*, *Mitra*, *Vexillum*, *Murex*) that lurk beneath or among stones and in the labyrinths of coral reefs. Also some of the bivalves (*Arca* and *Lima*) make nests between stones, and others (*Fossularca*, *Spondylus*, *Plicatula*, *Chama*) are found on stones or corals. Possibly, however, the only "stones" were pieces of dead coral. It seems strange that the Calyptraeidae, which attach themselves to stones and to other shells, is represented only by the genus *Cheilea*.

The great abundance of *Oliva*, one species of which is represented by about 1000 specimens in the Duerden collection, and of *Olivella* conclusively shows that sand flats contributed to the Bowden fauna. Recent species of both these genera may be seen crawling about on intertidal sand flats. Adams (pp. 57 to 58), who collected 4500 specimens of "*Olivella*" *volutella* (Lamarck) at Panama, reports that this species crawls about very actively on the wet sand when the tide is out. The shell is covered with the mantle and the mantle is concealed by a thick coat of wet sand. When the returning tide washes off the

coat of sand these snails quickly bury themselves. The naticoids, which are represented at Bowden by a large number of species and specimens, prefer sandy places. They plow about in the sand, using the modified fore part of the foot as a plow and shield, searching for the bivalves on which they prey. Most of the burrowing bivalves are recorded from sandy bottoms, or from mixtures of sand and mud, and of sand and gravel. Perhaps the absence of *Clementia* and *Mulinia* indicates that no extensive mud flats were near by.

I had hoped to list the probable bottom habitat and depth range of the Bowden genera that are still living, but the data that were assembled are not precise enough and fail to cover the entire field. The Bowden fauna is too large to represent only one kind of bottom. So far as the burrowing bivalves and some of the carnivorous gastropods are concerned it seems to represent principally sand, and mixtures of mud, sand, and gravel. Some of the bivalves nest among stones, others are attached to stones and coral. Many of the carnivorous gastropods lurk among stones. The plant-feeders among the gastropods are for the most part independent of the bottom, except in so far as it controls the growth of plants. Some of the carnivores (*Coralliophila* and *Cypraea*) browse principally on corals, and *Simnia* is peculiarly modified to crawl about on the narrow rounded stems of gorgonians, on which it feeds. The negative evidence as to the rock-clingers, rock-borers, and mud-burrowers may not be significant.

DEPTH

Tralia and *Planaxis* are the only mollusks at Bowden whose modern representatives are amphibious and habitually live between high- and low-water marks or even above high-water mark. Adams (p. 210) found *Tralia panamensis* under stones at high-water mark, or crawling about over wet stones. *Chlorostoma* and *Thais* seem to be the only rock-clinging mollusks that live in the intertidal zone and also below the low-water mark. Some of the sand-facies species (*Oliva, Olivella, Natica*) may also be found on sand flats that are exposed during low tide.

It is apparent from a glance at the faunal list that most of the Bowden mollusks represent the neritic zone, or the zone from low-water mark to a depth of 200 meters, or about 100 fathoms. A few

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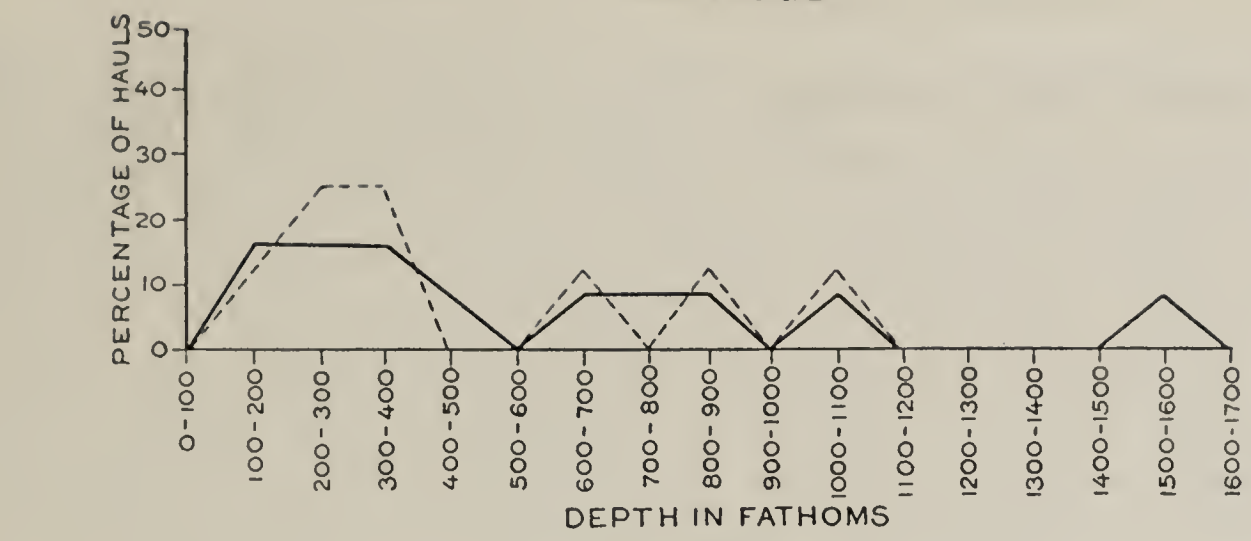
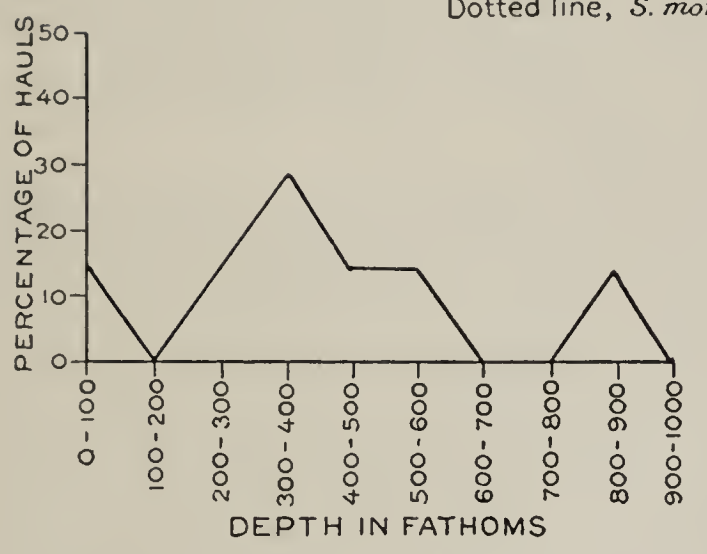
EXPLANATION OF FIGURE 1 (see page 33)

A. 8 hauls of *S. monocingulata* Seguenzia, and one each of *S. ionica* Watson, *S. carinata* Watson, *S. floridana* Dall, and *S. watsoni* Dall.
B. 3 hauls of *C. rathbuni* Dall, 3 of *C. reticulata* Verrill, and one of *C. pocillum* Dall.
C. 3 hauls of *Puncturella acuminata* Watson, and 2 of *P. circularis* Dall.
D. 3 hauls of *T. acinula* Dall, 3 of *T. amabilis* Dall, 2 of *T. smithi* Dall, and one each of *T. cytherea* Dall, and *T. lata* Verrill and Bush.
E. 7 hauls of *B. glomerula* (Dall), 3 of *B. oribculata* (Dall), 3 of *B. polycyma* (Dall), and 3 of *B. pectunculoides* (Scacchi).
F. 8 hauls of *Vexillum styria* (Dall).

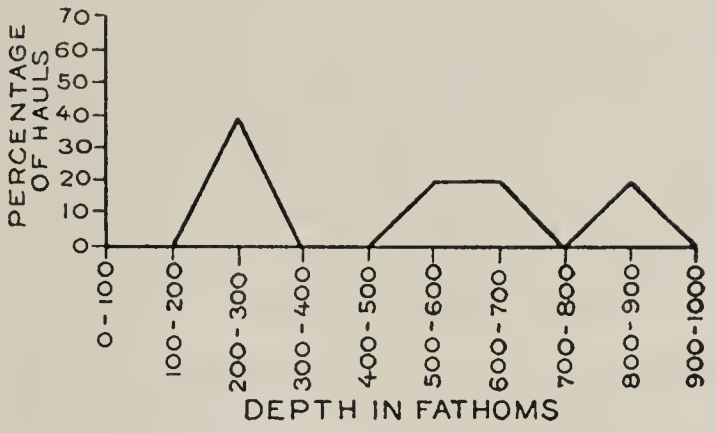


A. SEGUENZIA

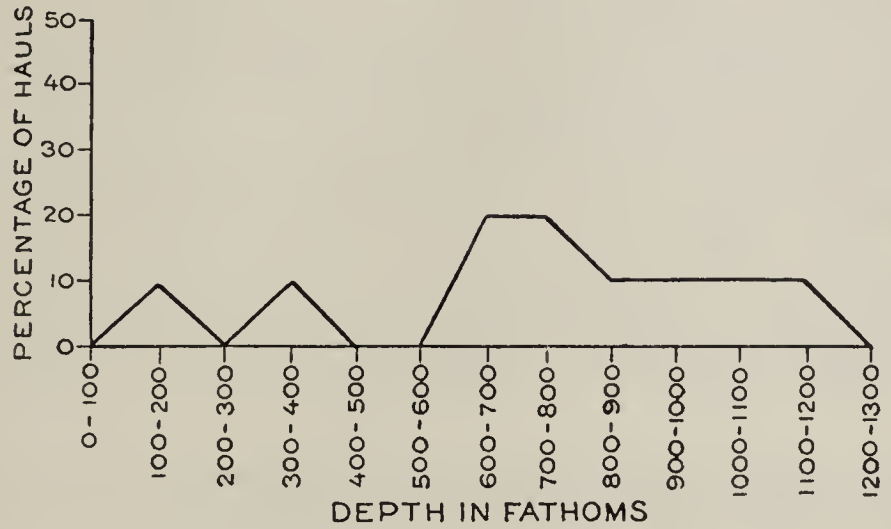
Dotted line, *S. monocingulata* (Seguenza)



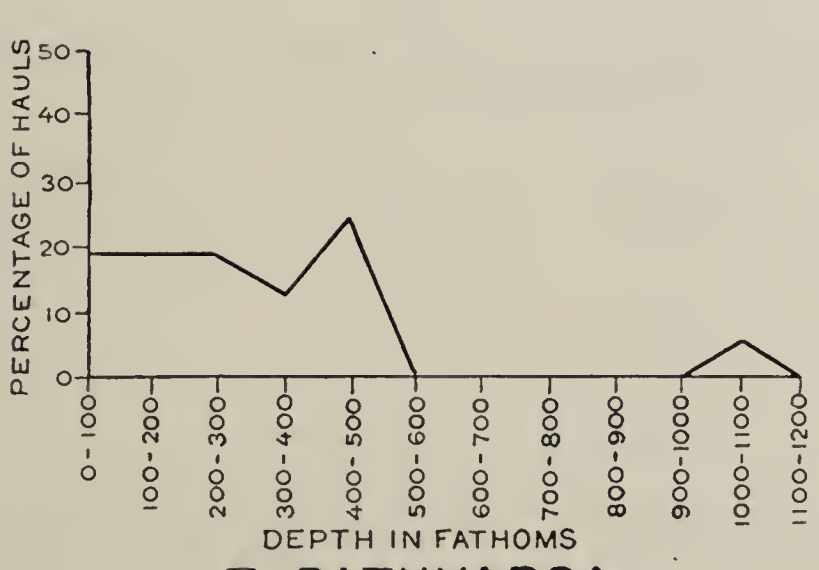
B. COCCULINA



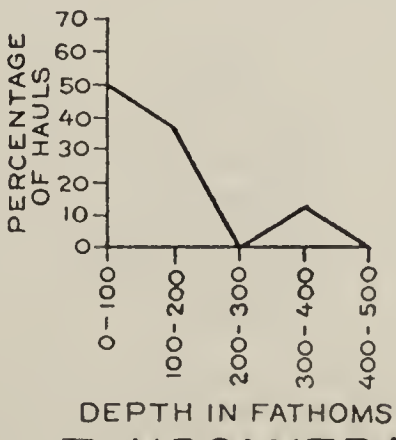
C. FISSURISEPTA



D. TINDARIA



E. BATHYARCA



F. UROMITRA

FIG. 1.—Depth frequency graphs for several Bowden genera, based on dredging records of Recent species in West Indian and Florida regions and Gulf of Mexico.

genera, however, were suspected of representing deeper water. In order to test out their probable depth significance the depth frequency graphs shown in fig. 1, based on specimens in the National collections dredged in the West Indian and Florida regions and in the Gulf of Mexico, were plotted. In compiling these records a station was used only once in any genus, though in several genera two species were identified from the same haul. Along the Atlantic coast of the United States, which lies outside the area considered, *Seguenzia* has been dredged at depths of 1290 to 2033 fathoms, *Cocculina* from 17 to 2033 fathoms, and *Tindaria* at 2620 fathoms. *Uromitra* (F of fig. 1) was chosen at random to represent an essentially shallow-water genus, records for which are based on almost the same number of dredge hauls as the average of the others.

On the assumption that during middle Miocene time these genera lived at the same depth as now and that the dredging records are sufficiently numerous to be safely used, these graphs clearly show that *Seguenzia, Fissurisepta,* and *Tindaria* represent a probable depth of more than 100 fathoms. Despite its remarkable range of 90 to 880 fathoms (17 to 2033 along Atlantic coast) *Cocculina* probably should be placed in the same class. *Bathyarca* does not necessarily mean deep water, even though it has been dredged in the West Indian region at depths as great as 1024 fathoms. The frequency graph for *Bathyarca* (E of fig. 1) shows that the maximum, which falls between 400 and 500 fathoms, does not represent a very much larger percentage of the hauls than the interval between low-water mark and 100 fathoms. Along the Atlantic coast of the United States *Bathyarca* is represented in hauls from 5 to 1825 fathoms. It also may be significant that *Seguenzia, Cocculina, Fissurisepta,* and *Tindaria* have not been found fossil at any other locality in America, whereas *Bathyarca* is not so rare.

The probable deep-water genera are represented in collections from Bowden by the following number of specimens:

Number of specimens of probable deep-water genera in collections from Bowden formation

Genus	Duerden collection	Aldrich collection	Henderson collection
Seguenzia	1	67	—
Cocculina	11	15	2
Fissurisepta	1	—	—
Tindaria	1	—	—

These genera are very small, and if all of them were represented by only one specimen, as two of them are, it would be necessary to consider seriously that they might have been eaten by fish in deep water and

then discharged in shallower water. But to account for 68 and 28 specimens by such means is fantastic.

The adequacy of the dredging records on which the frequency graphs are based is, however, open to suspicion. The records for *Bathyarca* show that a genus may have a remarkable depth range and a few shallow-water records for the other genera would completely change their depth significance. Genera that are considered deep-water dwellers are constantly being found in relatively shallow water. Dredgings by the *Fish Hawk* in Porto Rican waters at depths of less than 100 fathoms brought up a number of species that had been known only from hauls made by the *Blake* in deep water (Dall and Simpson, U. S. Fish Comm. Bull. 1900, vol. 1, p. 354, 1901).

Other factors than dredging records need consideration. The relatively large number of carnivores among the gastropods is a striking feature of the Bowden fauna, the great number of turrids, cones, and mitroids being particularly noteworthy. The most reasonable explanation for this discrepancy is that part of the fauna lived in relatively deep water, in the aphotic zone where the animals feed on fresh flesh or carrion, or are mud-eaters.

The relatively large number of pelagic mollusks, consisting of five species of pteropods, two of heteropods, and one of *Janthina*, may have the same depth significance. This is the largest number of species of pelagic mollusks that has been found anywhere in America and two of the pteropods are represented by almost a hundred specimens each in the Henderson collection. The Pteropod marl of the early Jamaican Survey (Sawkins and others, Reports on the geology of Jamaica: Mem. Geol. Survey [Great Britain], p. 46, 1869) may represent a concentrate of pelagic shells in the upper part of the Bowden formation.

According to the preceding discussions, mollusks that live in brackish-water estuaries, in the littoral zone, in the neritic zone, and also in water perhaps more than 100 fathoms deep are found mixed together at Bowden. How to reconcile such a depth range without field studies is largely a matter of speculation. It naturally is more reasonable to believe that the intertidal and shallow-water species were moved downward than that the deep-water species were moved upward. There are too many kinds of shallow-water shells among the gastropods to attribute their present location to the activities of hermit crabs. Aside from the variety of shallow-water gastropods and the presence of shallow-water pelecypods, the probable range of depth at Bowden is too great to admit hermit crabs to consideration. Most of the shallow-water shells are too fresh to have been carried far by waves or currents. The Bowden formation occupies only a narrow strip along the coastal edge of the White Limestone. In the absence of field evidence to the contrary, it is conceivable that it represents deposition along an unusually steep slope in which a narrow coastal shelf

was cut and that at times the sediments at the edge of the shelf and the shells buried in them were washed down the slope and came to rest at a greater depth, where they were mixed with the autochthonous material. Unusually steep slopes are to be expected in regions of active tectonic movements. All this is admittedly a matter of speculation, and it is hoped that it can eventually be tested in the field. The configuration of the pre-Bowden surface of the White Limestone, the presence or absence of crumpled layers in the Bowden formation and of layers containing only deep-water genera and pteropods alternating with layers carrying only shallow-water genera or a mixture of both, and the character of the sediments—all should yield evidence to test the indicated depth range. Dredging operations along some of the remarkably steep slopes in the West Indian region that lie only a short distance off shore would yield essential data.

It should be pointed out that both the corals and foraminifera yield results that may be interpreted in the same way as the mollusks. According to Vaughan (U. S. Nat. Mus. Bull. 103, p. 212, 1919), the Bowden corals indicate deeper water than other Miocene and Oligocene faunas in the Caribbean region and Florida, but some of the species furnish evidence that the depth was not so great as 20 fathoms. Cushman (Carnegie Inst. Washington Pub. 291, pp. 28–29, 1919) concluded that the foraminifera indicate a considerable depth, even if it were less than 100 fathoms. Both these estimates may represent an attempt to strike an average from the evidence of both shallow- and deep-water forms.

BORING GASTROPODS

The neatly rounded holes that can be seen on many of the photographs of both gastropods and pelecypods are evidence of the activities of some of the predaceous carnivorous gastropods, for it is well known that these holes are drilled by other mollusks. The method consists of selecting a place where the shell is relatively thin, generally on the beaks of bivalves and on the upper whorls of gastropods, and drilling the hole by patiently scraping with the radula. After the hole is bored the proboscis is inserted into the shell and the victim is leisurely devoured. Along the Atlantic coast of the United States the moon shell (*Lunatia heros* (Say)) and the oyster drill (*Urosalpinx cinereus* (Say)) are the worst offenders. Other genera, including *Buccinum*, "*Nassa*," *Murex*, and *Thais* are known to secure their food in this manner or are suspected of it. The relative number of drilled shells in each species of gastropods in the Henderson collection was tabulated in order to discover whether the genera responsible for this work at Bowden could be discovered. Of the carnivores that need to be considered *Conus*, *Murex*, *Nassarius*, and *Strombus* have the smallest percentage of bored shells, as follows:

Percentage of bored shells in several genera of predaceous carnivores

Genus	Percentage
Conus	16
Murex	10
Nassarius	6
Strombus	7

Strombus has never been accused of boring shells; in fact, it is supposed to be a carrion-feeder. It is well known, however, that it is very active and powerful. The percentage of bored shells in *Conus* is relatively high, but all the perforated shells belong to small species or are young specimens of large species. Doctor Pilsbry informs me that the teeth of the cones he has examined are very delicate and quite unsuited for boring. *Conus* apparently attacks only extended mollusks and paralyzes them with its powerful poison. So far as *Strombus* and *Conus* are concerned the small percentage of bored shells is a measure of aggressiveness rather than of boring. Perhaps *Murex* and *Nassarius* are responsible for most of the holes, but the worst offender may be concealed, as some of the borers are suspected of cannibalism. For some unknown reason the Terebras show the highest percentage of bored specimens, 75 per cent of them being bored. In three of the species of *Strioterebrum* all the shells are bored. Moreover, in one of these species (*T. monida*) all the shells have more than one hole, one having as many as eleven. Apparently more than one animal operated on these Terebras at the same time, for it is improbable that any gastropod would bore an empty shell. This conclusion points to a small animal, possibly *Nassarius*, as responsible for the holes, at least in *Terebra*.

SUMMARY AS TO ECOLOGY

In this discussion of the ecology of the Bowden mollusks more weight has been given to depth of the water than to any other factor. Perhaps depth in itself is not very significant, as the controlling factor may be disguised because it has not been separated from the depth factor in dredging operations. The ease with which depth can be determined in dredging, the accessibility of dredging records giving the depth, and above all the very limited number of records from shallow water in the West Indian region, may conspire to give depth an importance out of all proportion to its actual significance. Nevertheless, the relative abundance of pelagic shells and the large proportion of carnivorous gastropods indicate, aside from the doubtful evidence based on dredging operations, that some of the Bowden mollusks represent deep water. It is conceivable that under special conditions pelagic shells would accumulate in great numbers in shallow water and that an unusually large proportion of carnivores would live in shallow water, but when it is necessary to postulate special condi-

tions for each of several converging lines of evidence the simpler explanation is more reasonable. In the light of available data the conclusion that the Bowden fauna is an ecologic mixture so far as depth is concerned seems justified.

Other ecologic factors, aside from those discussed, that need consideration are omitted, either because no relevant data, based on the ecology of modern mollusks, could be found, or because it would be difficult to recognize the effects of such factors. It also should be remembered that I have never been at Bowden. Consequently the character of the sediments and other features that must be based on field observations are perforce ignored. The result of all this is to make this account of the ecology unsatisfactory and inconclusive.

The outstanding feature of the Bowden fauna is that it seems to represent an unusual ecologic range especially as to depth. It probably is this unusual range that makes the fauna so large and that makes it the most remarkable Tertiary fauna in tropical America.

AGE OF THE BOWDEN FAUNA

COMPARISON WITH MIOCENE FAUNAS ELSEWHERE

TROPICAL AMERICA

Standard Tertiary section for tropical America

The following composite section, which may be regarded as the present standard Tertiary section for tropical America, is based on stratigraphic and faunal data, but principally on the latter. It represents current interpretations and will inevitably be modified.

At the present time the lower and upper Oligocene and Pliocene parts of this section are in the most unsatisfactory state. It will also be noted that the Miocene part includes almost as many zones as all

Standard Tertiary section for tropical America

Time subdivision		Formation names and localities of unnamed deposits	Supposed European equivalents
Pliocene		Near Port Limon, Costa Rica; Matura, Trinidad; near Jacmel, Republic of Haiti	Astian Plaisancian
Miocene	Upper	Cerros de Sal formation, Dominican Republic; Springvale, Trinidad	Pontian Sarmatian
	Middle	Bowden formation, Jamaica; upper zone of Gatun formation, Panama and Costa Rica Gurabo formation, Dominican Republic; lower and middle zones of Gatun formation, Panama Canal Zone, and lower zone of Gatun formation, Costa Rica Cercado formation, Dominican Republic	Tortonian Helvetian
	Lower	Thomonde formation, Republic of Haiti; Baitoa formation, Dominican Republic; Quebradillas limestone, Porto Rico Anguilla formation, Anguilla; upper part of Culebra formation and Emperador limestone, Panama Canal Zone	Burdigalian Aquitanian
Oligocene	Upper	? Upper part of Antigua formation, Antigua	Chattian
	Middle	Lower part of Antigua formation, Antigua	Rupelian
	Lower	? Limestone in Republic of Haiti and Jamaica	Lattorfian
Eocene	Upper	St. Bartholomew limestone, St. Bartholomew; Bontour Point, Trinidad	Priabonian
	Middle	Yellow limestone, Jamaica; Plaisance limestone, Republic of Haiti	Auversian Lutetian
	Lower	Soldado Rock and Marac Quarry, Trinidad	Ypresian Thanetian

FIG. 2.—Sketch map showing Miocene localities in tropical America.

1. Yaque Valley, Dominican Republic.
2. Yaque del Sur Valley and Henriquillo Basin, Dominican Republic.
3. Central Plain, Republic of Haiti.
4. Port-au-Prince, Republic of Haiti.
5. Consolación del Sur, Cuba.
6. Santiago, Cuba.
7. Havana, Cuba.
8. Northern Porto Rico.
9. Southern Porto Rico.
10. Vieques.
11. Mona.
12. St. Croix.
13. Anguilla.
14. Guadeloupe.
15. Martinique.
16. Tampico embayment, Mexico.
17. Isthmus of Tehuantepec, Mexico.
18. Guatemala.
19. Costa Rica and adjoining parts of Panama.
20. Panama Canal Zone and adjoining parts of Panama.
21. Sinu region, Colombia.
22. Coastal region, Colombia.
23. El Banco, Colombia.
24. Atrato Valley, Colombia.
25. Falcon, Venezuela.
26. Maracaibo Basin, Venezuela.
27. Cumana, Venezuela.
28. Margarita.
29. Trinidad.
30. Tobago.
31. Darien, Panama.
32. Veraguas, Los Santos, and Herrera Provinces, Panama.
33. Chiriqui Province, Panama.
34. Puntarenas and interior of Costa Rica.
35. Nicaragua.

Northeastern Brazil, Peru, and Ecuador are not shown.

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Miocene deposits of tropical America

Time subdivision	Dominican Republic	Republic of Haiti	Cuba	Porto Rico	Vieques	St. Croix	Lesser Antilles	Mexico	Guatemala	Costa Rica and adjoining parts of Panama	Panama Canal Zone and adjoining parts of Panama	Colombia	Venezuela	Trinidad	Brazil	Peru	Ecuador	Pacific coast of Panama	Pacific coast of Costa Rica	Pacific coast of Nicaragua	Supposed European equivalents
UPPER MIOCENE	Cerros de Sal formation										? Toro limestone	Beds near Usiacuri		Springvale beds							Pontian Sarmatian
MIDDLE MIOCENE		Beds near Port-au-Prince	La Cruz marl; marl at Matanzas and Baracao							Upper zone of Gatun formation	Upper zone of Gatun formation		"Cumana"								Tortonian
	Mao clay; Mao Adentro limestone; Gurabo formation		Limestone near Havana					Tuxtepec and Barranca de Santa Maria Tatetla		Lower zone of Gatun formation	Middle zone of Gatun formation Lower zone of Gatun formation	Beds near Tubará and elsewhere	Beds carrying *Turritella "robusta"*	Brasso beds		Zorritos formation	Equivalent of Zorritos formation in Santa Elena Peninsula	Equivalent of Gatun formation, Darien, and Chiriqui Province			Helvetian
	Cercado formation	Las Cahobas formation					? Tuff in Martinique	Santa Rosa and Zulu-zum		"Uscari formation" (part)	Vamos-a-Vamos beds			Manzanilla beds							
LOWER MIOCENE	Baitoa formation	Thomonde formation		Quebradillas and Ponce limestone	Limestone (equivalent of Quebradillas limestone)	Limestone (equivalent of Quebradillas limestone)		Coatzacoalcos formation. Tuxpan formation		Sapota beds; Uscari formation	"Upper zone of Culebra formation"	Beds in Sinu region	Beds in Falcon and in Maracaibo Basin	Machapoorie beds	Pirabas and Estação formations			Beds in Los Santos, Herrera, Veraguas and Chiriqui Provinces	Beds near Puntarenas and in interior	"Brito formation" (part)	Burdigalian
	Cevicos limestone	Limestone in mountain ranges	Limestone at Consolación del Sur	Aguadilla limestone			Anguilla formation		Limestone on Rio Dulce		Emperador limestone and upper part of Culebra formation		Beds carrying *Turritella hubbardi* and other species								Aquitanian

the others put together—two lower, three middle, and one upper. So far as the mollusks are concerned, the beds that are called Miocene carry larger faunas than any of the others. Incomplete collections from the Cercado, Gurabo, Gatun, and Bowden formations probably would look so much alike that all would be lumped in one zone, whereas three actually are recognized. Therefore, it is clear that finer age distinctions are being made in the Miocene part of the section than in any other part. Still the possibility that Oligocene and Pliocene beds are being placed in the Miocene needs consideration. It is more probable, however, that the Cerros de Sal formation and the Springvale beds are Pliocene than that the Anguilla formation is Oligocene, and perhaps the Bowden formation and the upper zone of the Gatun formation should be placed in the upper Miocene.

The Bowden mollusks naturally are most similar to those found in Miocene deposits elsewhere in tropical America, which embraces southern Mexico, Central America, the West Indies, and northern South America.

The following discussion is planned to summarize the published information on the Miocene mollusks of this region and to put on record unpublished data based on collections in the United States National Museum. The localities that are considered are shown diagrammatically in fig. 2.

The table facing page 41 shows at a glance the relative age of these Miocene deposits, as here presented.

Literature list for tropical America

The following list covers reports on the Miocene mollusks of tropical America that were consulted in the preparation of this report. Abbreviated lists are given later for each group of localities that can be treated as a unit. Reports containing only lists of fossils are not included in this literature list, except for a few localities for which no other data are on record. The locality lists include not only reports that describe material from that locality, but also reports dealing primarily with other localities, in which species may be incidentally described or figured.

Literature list for Miocene mollusks from tropical America

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1927. Palmer, Katherine Van Winkle. The Veneridae of eastern America, Cenozoic and Recent. Palaeontographica Americana, vol. 1, No. 5, pp. 209–428.

1927. Hodson, Floyd, Helen K. Hodson, and Gilbert D. Harris. Some Venezuelan and Caribbean mollusks. Bull. Am. Paleontology, vol. 13, pp. 1–160, pls. 1–40.[1]

[1] This publication was received too late to be considered in the matter dealing with the descriptions of the Bowden gastropods. It should be pointed out that "*Venericardia*" *bowdenensis*, described as a new Bowden species, is a synonym of *Cardita scabricostata* Guppy 1866.

CARIBBEAN REGION

WEST INDIES

Dominican Republic

The literature list for Miocene mollusks from the Dominican Republic is as follows:

Literature list, Dominican Republic

Sowerby 1850
Guppy 1866*a*
Guppy 1867
Gabb 1873
Gabb 1873*a*
Guppy 1876
Gabb 1881
Gabb 1881*a*
Dall 1890–1903
Dall 1896
Guppy and Dall 1896
Pilsbry and Sharp 1897–98
Pilsbry and Sharp 1898
Grabau 1904
Maury 1910
Brown and Pilsbry 1911
Brown and Pilsbry 1913
Cossmann 1913
Sheldon 1917
Pilsbry and Brown 1917
Maury 1917
Pilsbry and Johnson 1917
Maury 1920
Cooke 1921*a*
Van Winkle 1921
Pilsbry 1922
Olsson 1922
Hanna 1924
Maury 1925
Woodring 1925
Woodring 1925*a*
Maury 1925*a*
Hodson 1926
Palmer 1927

The most complete Miocene section in the West Indies is found in the northern part of the Dominican Republic along northward-flowing streams that enter the Cibao Valley as tributaries of Rio Yaque del Norte and Rio Yuna. This section, as described by Cooke (Mem. Geol. Survey Dominican Republic, vol. 1, pp. 63–75, 1921), in descending order is as follows:

Miocene section in northern part of Dominican Republic

Time subdivision	Formation
Middle Miocene	Mao clay Mao Adentro limestone Gurabo formation Cercado formation Bulla conglomerate
Lower Miocene	Baitoa formation Cevicos limestone

Of these deposits those from the Bulla conglomerate to Mao clay, inclusive, are known from field studies to lie one on top of the other. The Baitoa formation on stratigraphic grounds clearly is older than the Cercado formation, but the boundary between them was not seen. All these beds crop out on tributaries of Rio Yaque del Norte, whereas the Cevicos limestone crops out farther east in the drainage basin of Rio Yuna.

Only a few fossils were collected from the Cevicos limestone, but those that were collected, particularly the echinoids, show that it is of the same age as the Anguilla formation of the island of Anguilla, which is now regarded as representing the lowest Miocene zone in this region. *Orthaulax aguadillensis* Maury is found in the Cevicos limestone and also in the next younger zone. This genus disappeared before the beginning of Cercado time and has never been found in the Bowden formation nor in any beds that are considered of about the same age. Gabb apparently collected from the Cevicos limestone, as he records "*Lithophagus corrugatus* Phil." "found boring coral at Cevico" (Trans. Am. Philos. Soc., n. s., vol. 15, p. 253, 1873).

The Bulla conglomerate was supposed to be of about the same age as the Baitoa formation, but it probably represents the basal beds of the Cercado formation, for the conglomerate is gradually replaced by sandy beds, and Cercado fossils are found in these transition beds (U. S. G. S. station 8529).

The Baitoa, Cercado, and Gurabo formations are discussed in the following pages. The Mao Adentro limestone may be interpreted as representing patches of reef limestone in the upper part of the Gurabo formation. Like most reef limestones, it carries relatively few mollusks. The fossils of the Mao clay are negligible. Its mollusks are like those of the Gurabo formation, and so far as they are concerned both the Mao Adentro limestone and Mao clay could be regarded as parts of the Gurabo formation.

Almost all the mollusks described in the Dominican literature are from the Baitoa, Cercado, and Gurabo formations, and by this time most of the species are described, the largest reports being those by Gabb (1873), Maury (1917), and Pilsbry (1922). Pilsbry's revision of the Gabb collection is very valuable, for in it the unfigured and unlocated species described by Gabb are figured and Gabb's many errors are corrected. By utilizing the stratigraphically located material collected by the Maury and United States Geological Survey parties it is possible to determine the age of most of Gabb's species and also those described by Sowerby and Guppy, but Gabb collected many species that no one else has found. The names in the lists that Mansfield and I published (Mem. Geol. Survey Dominican Republic, vol. 1, pp. 113–145, 1921), and for which I must take full responsibility, are not to be taken seriously. Many of the so-called new species in these

lists turn out to be species described by Gabb or by Pilsbry and Johnson, others are Recent species, and others are described fossil species that have a greater stratigraphic range than was supposed. Also the generic nomenclature is unreliable. The preliminary studies on which these lists are based were made for stratigraphic purposes and they served that end. About 900 specific names, based on descriptions, not lists, are already on record for mollusks from these deposits, but many of these names are synonyms. Maury renamed a number of Gabb's species, and Pilsbry and Johnson renamed some of Maury's species, and several of Sowerby's species, the first to be described from the Dominican Republic, have received other names. Though most of the species are described, a great deal of work remains to be done in straightening out these synonyms. During the preparation of this report the extensive collections made by the United States Geological Survey party were constantly consulted and the comparison between the Bowden and the Dominican mollusks has the advantage of uniform treatment based on specimens.

About 60 species were collected from the Baitoa formation. The most characteristic, none of which has been found in the Cercado or Gurabo formations, nor in the Bowden formation, are as follows:

Characteristic mollusks of Baitoa formation

Conus williamgabbi Maury	"Phos" costatus Gabb
Xancus rex Pilsbry and Johnson	Cymia henekeni Maury
Fasciolaria kempi (Maury)	Orthaulax inornatus Gabb
"Phos" semicostatus Gabb	Anadara hispaniolana (Maury)

Gabb did not believe in leaving records of localities, but it is clear that he and also Colonel Heneken, who collected the material Sowerby and Guppy described, collected from the Baitoa formation. In all probability many of Gabb's species not found by later collectors are from these beds, and he may have found a better locality than the type locality on Rio Yaque del Norte at Baitoa, for large numbers of the characteristic Baitoa species are in the Gabb collection. *Anadara patricia* (Sowerby), also known as *"Scapharca (Argina)" tolepia* Dall and *"Scapharca" arthurpennelli* Maury, which is very abundant in the Cercado formation, and other species are found in both the Baitoa and Cercado formations. *Conus aemulator* Brown and Pilsbry, of which *C. veatchi* Olsson is a synonym, and *Conus imitator* Brown and Pilsbry are found in the Baitoa, Cercado, and Gurabo formations, as well as in the Gatun formation of the Panama Canal Zone. *Galeodes consors* (Sowerby) and *Pachycrommium guppyi* (Gabb) also are Baitoa, Cercado, and Gurabo species. Other Baitoa species extend into the Gurabo formation and more are similar to Cercado and Gurabo species. *Pachycrommium guppyi* and two doubtfully identified species, *Conus proteus* Hwass and *Distorsio decussatus simillimus* (Sowerby), the

former a Recent species, seem to be the only Bowden species that are known from the Baitoa formation. The fauna of the Baitoa formation is clearly recognizable and it is considered of lower Miocene age, the upper one of the two lower Miocene zones now recognized in this region.

The Cercado formation carries about 500 species of mollusks, more than any other Dominican formation. It corresponds to Maury's "*Aphera islacolonis* formation." The overlying Gurabo formation, Maury's "*Sconsia laevigata* formation," carries about 400 species. The mollusks of these two formations are so similar that it is best to consider them together. Collections of fair size from these two formations generally can readily be discriminated, but many of the species are found in both. Transitional beds carry a Cercado fauna modified by the first appearance of Gurabo species (see Vaughan and Woodring, Mem. Geol. Survey Dominican Republic, vol. 1, pp. 97–98, 1921), indicating that if detailed field work were attempted it would be difficult, or perhaps impossible, to draw a boundary between them. The following are among the easily recognized Cercado species that were not found in the Gurabo formation:

Characteristic mollusks of Cercado formation

"Cythara" polygona Gabb
Conus furvoides Gabb
Conus cercadensis Maury
Aphera islacolonis (Maury)
Persicula cercadensis (Maury)
"Phos" gabbii Dall
Anadara patricia (Sowerby)
Anadara corcupidonis (Maury)
Cardium dominicanum Dall
Corbula viminea Guppy

The list of characteristic Gurabo species that were not found in the Cercado formation is larger, including the following:

Characteristic mollusks of Gurabo formation

Terebra haitensis Dall ("T. sulcifera Sowerby" of authors)
"Clavatula" labiata Gabb
"Drillia" squamosa Gabb
Clathrodrillia venusta (Sowerby)
Scobinella magnifica (Gabb)
Conus haytensis Sowerby[1]
Conus recognitus Guppy (C. yaquensis Gabb)
Conus stenostoma Sowerby
Conus planiliratus Sowerby
Conus multiliratus gaza Johnson and Pilsbry
Conus catenatus Sowerby
Conus consobrinus Sowerby
Cancellaria guppyi Gabb
Marginella coniformis Sowerby
Lyria pulchella (Sowerby)[1]
Tritiaria elegans (Guppy)
Metutella venusta (Sowerby)
Distorsio decussatus simillimus (Sowerby)
Sconsia laevigata (Sowerby)
Morum domingense (Sowerby)
Crepitacella melanoides (Gabb)
Ostrea haitensis Sowerby
Chlamys thetidis (Sowerby) ("Pecten" eugrammatus Dall)
Antigona blandiana (Guppy)

[1] Recorded by Maury from the Cercado formation.

Some of these species, however, are found in the "modified Cercado fauna." Maury's guide fossils—*Aphera islacolonis* for the Cercado formation and *Sconsia laevigata* for the Gurabo formation—were well chosen, for collections so far made have verified their range.

It would not be safe to assume that the difference between the Cercado and Gurabo faunas is due entirely to difference in age. Some of the genera and species conclusively show that it is not. Many of the characteristic Gurabo species belong to genera—"*Clavatula*," "*Drillia*" (*squamosa* Gabb), *Scobinella*, *Lyria*, *Metutella*, *Distorsio*, *Sconsia*, *Morum*, and *Crepitacella*—that are not represented at all in the Cercado formation, though it is known that they were living elsewhere during Cercado time or during even earlier periods. In like manner some of the characteristic Cercado species represent genera—*Aphera* and *Bothrocorbula*—not found in the Gurabo formation, though again they are known to have been living then elsewhere. *Distorsio decussatus simillimus* (Sowerby) is abundant in the Gurabo formation, but it is not found in the Cercado formation, though it probably is represented in the older Baitoa formation. *Murex recurvirostris* Broderip, *Trivia globosa* ("Gray") Sowerby, *Barbatia domingensis* Lamarck, *Diplodonta gabbi* Dall, and *Strigilla pisiformis* (Linné) are Recent species that occur in the Cercado formation, but not in the younger Gurabo formation. Assuming that the collections are adequate, such features show that at least some of the difference is due to some kind of ecologic control. Without knowing more about the distribution both in space and time of these and other genera involved and their ecologic significance it is impossible to determine their full significance. Perhaps one generalization is worth recording. The Cercado formation carries a large number of small species and genera not found in the Gurabo formation, and the proportion of large thick-shelled species is far greater in the Gurabo formation, though the material on which this comparison is based was collected in bulk—the only method that insures a representation of small shells—by the same collectors. Perhaps the Cercado formation, at least so far as it is known, was deposited in quiet protected water, whereas the Gurabo formation at most of the localities explored was deposited in places exposed to heavy surf. At one locality where a collection was made (U. S. G. S. station 8702) the Gurabo formation was laid down in relatively deep quiet water, and at this locality virtually all the thick-shelled species are absent.

I have several times gone on record as considering the Cercado formation of lower Miocene age, but I now think that it should be placed with the Gurabo formation in the middle Miocene, these two formations representing different zones in the middle Miocene. Either the Cercado formation overlaps the Baitoa formation along the greater part of the southern edge of the Cibao Valley, or the Baitoa formation

Bowden species found in Cercado and Gurabo formations[1]

SPECIES	Cercado formation	"Modified" Cercado fauna	Gurabo formation	Deeper water facies of Gurabo formation
Gastropods:				
Cavolina telemus (Linné)			?	
Diacria bisulcata Gabb	×			
Acteon riomaensis Maury	×	×		
Volvula oxytata Bush	×	×	×	×
Volvula ornata Johnson and Pilsbry			×	
Cylichna aula Woodring				×
Ringicula tridentata Guppy				×
Terebra elutheria Woodring			×	
Leptadrillia parkeri (Gabb)			×	
Bactrocythara obtusa (Guppy)	×			
Euclathurella vendryesiana (Dall)			×	
Scobinella magnifica (Gabb)			×	
Conus proteus Hwass	×		×	
Conus stenostoma Sowerby			×	
Conus planiliratus Sowerby		×	×	×
Conus multiliratus gaza Pilsbry and Johnson		×	×	
Conus catenatus Sowerby			×	
Conus consobrinus Sowerby		×	×	?
Oliva plicata Guppy	×	?	×	?
Marginella coniformis Sowerby			×	×
Tritiaria elegans (Guppy)			×	×
Nassarius cercadensis (Maury)	×	×	×	×
Nassarius gurabensis (Maury)			×	
Mitrella lepta Woodring	×		×	
Strombina caribaea Gabb			×	×
Murex recurvirostris Broderip	×	×		
Coralliophila miocenica (Guppy)			×	
Distorsio decussatus simillimus (Sowerby)		×	×	
Cassis sulcifera Sowerby	×	×	×	×
Semicassis reclusa (Guppy)	×	×	×	
Malea camura Guppy	×		×	?
Ficus pilsbryi (B. Smith)	?			
Cypraea isabella patrespatriae Maury			×	
Trivia globosa ("Gray") Sowerby	×			
Strombus pugiloides Guppy			?	
Strombus bifrons Sowerby			×	
Alabina curta Woodring	×		×	
Alaba turrita Guppy			×	
Modulus modulus basileus (Guppy)			×	
Vermicularia spirata (Philippi)	×	×	×	×
Lemintina papulosa (Guppy)	×		×	×
Architectonica nobilis quadriseriata (Sowerby)	×	×	×	
Architectonica euprepes Woodring	×		×	×
Rissoina guppyi Cossmann	×		×	
Rissoina pyrgus Woodring			×	
Rissoina browniana d'Orbigny	×	×	×	×
Capulus lius Woodring			×	
Xenophora delecta (Guppy)			×	

[1] In this list and in other similar lists turrids of the *Polystira albida* group and Naticas of the *canrena* group are omitted.

Bowden species found in Cercado and Gurabo formations—Continued

SPECIES	Cercado formation	"Modified" Cercado fauna	Gurabo formation	Deeper water facies of Gurabo formation
Stigmaulax vererugosum Cossmann	×	×	×	×
Tectonatica pusilla (Say)	×	×	×	×
Polinices brunnea subclausa (Sowerby)	×		×	×
Sigatica semisulcata bathyora Woodring	×			
Sinum gatunense (Toula)	×			
Pachycrommium guppyi (Gabb)	×	×	×	×
Epitonium gabbi de Boury	×			
Turbo dominicensis Gabb	×		×	?
Smaragdia viridis viridimaris (Maury)	×	×	×	×
Microgaza cossmanni Woodring			×	
Diodora alternata henekeni (Maury)	×			
Scaphopods:				
Dentalium cossmannianum Pilsbry and Sharp			×	
Dentalium glaucoterrarum Maury	×		×	×
Dentalium dissimile dissimile Guppy	×	×	×	×
Dentalium dissimile ponderosum Gabb	×		×	
Dentalium haytense Gabb	×	×	×	
"Dentalium" rudis Gabb[1]			×	
Pelecypods:				
Yoldia ovalis Gabb			×	
"Arca" occidentalis Philippi			×	
Barbatia domingensis (Lamarck)	×			
Anadara inaequilateralis (Guppy)	×			
Pteria inornata Gabb	×			
Chlamys vaginulus (Dall)			×	
Amusium papyraceum (Gabb) ?	×	×	×	?
Spondylus bostrychites Guppy		×	×	?
Limea solida Dall			×	
Placunanomia lithobleta Dall			×	
Anomia indecisa Dall	×	×	?	
Chama involuta Guppy	×		×	
Phacoides actinus Dall	?			
Diplodonta gabbi Dall	×			
Cardium medium Linné			×	
Cardium haitense haitense Sowerby	×	×	×	×
Cardium haitense cercadium Maury	×	×		
Cardium serratum Linné	×		×	
Pitar carbaseus (Guppy)		×		
"Pitar" planivietus (Guppy)	×	×	×	
Antigona blandiana (Guppy)			×	×
Chione sawkinsi Woodring	×			
Chione woodwardi (Guppy)	×	×		
Chione hendersonii Dall	×	×	×	?
Tellina healeyi Woodring	×	×		
Strigilla pisiformis (Linné)	×	×		
Psamosolen sanctidominici Maury	×		×	
Corbula viminea Guppy	×	×		

[1] This species, which is a worm tube, was discovered in a Bowden collection after Publication 366 was issued.

was eroded in places before it was laid down, for it is reasonably certain that the Cercado formation west of the type locality of the Baitoa formation rests directly on the metamorphic rocks. There also is a more pronounced faunal break between the Baitoa and Cercado than between the Cercado and Gurabo. Therefore, on both stratigraphic and faunal grounds the interval between the Baitoa and Cercado formations is a convenient place for the boundary between lower and middle Miocene. Whether this boundary corresponds to the division between lower and middle Miocene in the European section has not been determined and perhaps can never be determined.

The Bowden fossils are more similar to those of the Cercado and Gurabo formations than to those of any other Miocene deposits. The Bowden species listed on pages 54–55 are found in the Cercado and Gurabo formations. Others probably will be added when the Dominican collections are fully studied.

In addition, *Typhis alatus obesus* Gabb, *Sinum excentricum* (Guppy), *Episcynia naso* (Pilsbry and Johnson), and *Cadulus depressicolis* Pilsbry and Sharp are represented in stratigraphically unlocated collections from the Dominican Republic.

Of the 93 species in the preceding list, 88 are definitely determined, and of these 57 are found in the Cercado formation, 68 in the Gurabo formation, and 37 in both. For a fair comparison with the Cercado formation six of the 57 species should be dropped, for they are found in the "modified Cercado fauna," and not in the normal Cercado fauna. A comparison of similar instead of identical species would give comparable results. These similar species are noted in the descriptions. On the face of this list the Bowden fossils are similar to those of both the Cercado and Gurabo formations, but more closely resemble those of the Gurabo formation. However crude strictly numerical comparisons of fossils may be with their varying and indeterminable standards, this list seems to express in a general way the relations of the Bowden and Dominican faunas. There is no reason, however, to believe with Maury (Bull. Am. Paleontology, vol. 5, p. 433, table at end, 1917) that the Bowden fauna is "seemingly a mixed fauna representing these two formations." This quotation from Maury's correlation table implies a stratigraphic mixture, but the discussion on page 433 could be interpreted to mean both stratigraphic and ecologic mixing. The principal reason why the Bowden fauna resembles both rather than showing a clean-cut resemblance to one is because it is considerably larger than either. It represents a greater ecologic range and gives a more complete representation of the total number of shell-bearing mollusks then living. It embraces genera that are found only in the Cercado formation, and genera that are found only in the Gurabo formation, and also many genera that are found in neither. So far as Maury's guide fossils are concerned, the Bowden formation

carries no species of *Aphera*, but it carries a *Sconsia*, not, however, the Gurabo species. No particular age significance can be attached to either of these genera. *Aphera* is found in the Gatun formation of the Panama Canal Zone and also in the Miocene beds at Port Limon, Costa Rica, both of which certainly are younger than the Cercado formation. The lower Miocene beds of Costa Rica carry a *Sconsia* and for that matter the genus is recorded in deposits as old as the upper Oligocene Byram marl. Of the six Bowden species of *Conus* in the Dominican Republic, all are Gurabo species, whereas only one, a Recent species, is a Cercado species, though three others are found in the "modified Cercado fauna." *Marginella coniformis* Sowerby, *Tritiaria elegans* (Guppy), and *Strombus bifrons* Sowerby are abundant in both the Bowden and Gurabo formations, but they have not been collected from the Cercado formation. On the other hand, *Murex recurvirostris* Broderip (also known as *M. messorius* Sowerby) is found in the Bowden and Cercado formations, but a similar species, *M. domingensis* Sowerby, occurs in the Gurabo formation. *Corbula viminea* Guppy is another Bowden and Cercado species not found in the Gurabo formation. *Cylichna aula* Woodring and *Ringicula tridentata* Guppy were collected only from the deep-water Gurabo locality, which gives a clue to the significance of ecologic factors. It is not yet possible to make comparisons based on percentage of Recent species. About 11 per cent of the Bowden species occur in the Gurabo formation. This is not a very high percentage for faunas of approximately the same age. The percentage of Gurabo species found at Bowden will run higher. In comparing the Bowden and Gurabo faunas, it should be remembered that these localities are about 400 miles apart and in slightly different regions, the one on the outer or Atlantic edge of the West Indies and the other on the inner or Caribbean edge. The Bowden formation lacks some of the conspicuous Gurabo genera—"*Clavatula*," "*Drillia*" (*squamosa* Gabb), *Lyria*, *Morum*, *Pustularia*, and *Turgurium*—and it carries no cones like *C. haytensis* Sowerby, and no Cancellarias like *C. epistomifera* Guppy. It is not now possible to determine how much of this difference is due to geographic and facies factors and how much is due to difference in age.

It is concluded that the Bowden fossils are more like those of the Gurabo formation than like any other Dominican fossils. In view of the closer similarity of the Gurabo and Gatun faunas, which is discussed later, and in view of the presence in the Bowden formation of some Recent species not found in either the Gurabo or Gatun formations, the Bowden fossils are regarded as representing a younger horizon.

Miocene fossils also have been collected in the southern part of the Dominican Republic, but only a few of them have been described. *Orthaulax aguadillensis* Maury (see Cooke 1925*a*), *Turritella calostemma*

Pilsbry and Brown (1917), and *Dosinia azuana* Pilsbry and Johnson (1917; Pilsbry 1922) seem to be the only species so far described from the region about Azua and the valley of Rio Yaque del Sur. The collections made by the United States Geological Survey party are from the valley of Rio Yaque del Sur. I now doubt whether Vaughan and I were justified in accusing the collectors of mixing more than one horizon (Mem. Geol. Survey Dominican Republic, vol. 1, pp. 102–103, 1921). We probably were looking for too close a similarity with the Miocene fossils of the northern part of the country. These Miocene beds of the Yaque del Sur Valley extend westward into the San Juan Valley (Condit and Ross, Mem. Geol. Survey Dominican Republic, vol. 1, p. 211, 1921), and it is only a matter of time until their relations to the Thomonde and Las Cahobas formations of the Central Plain, the Haitian part of the San Juan Valley, are known. The Thomonde formation carries *Orthaulax aguadillensis* Maury, and so do some of these beds. Otherwise, however, the fossils are not very similar, which is all the more perplexing in view of the marked similarity of the Thomonde fossils to those in the Baitoa formation on the north side of the island. The presence of a *Senilia* closely resembling the Recent Panamic *S. grandis* (Broderip and Sowerby) was particularly misleading when these Dominican collections were first examined. This large "*Arca*," which generally goes under the name of "*Arca patricia* Sowerby," was not found in the northern part of the country by the United States Geological Survey party, and the Maury party collected it only high in the section. It turns out that this fossil *Senilia*, and also other species from tropical America ("*Arca*" *chiriquiensis* Gabb, "*Arca*" *chiriquiensis websteri* Pilsbry, and "*Arca*" *dolaticosta* Pilsbry and Johnson), not only tolerated, but generally even preferred, brackish water, which probably accounts for its apparent greatly restricted range in the Cibao Valley. These fossils from the Yaque del Sur Valley are not at all comparable with those from Bowden.

The Cerros de Sal formation, which crops out in the Enriquillo Basin, is considered younger than the beds just described. It was originally placed in the upper Miocene (Mem. Geol. Survey Dominican Republic, vol. 1, pp. 75, 103, 201, 214–215, 1921), and there seems to be no reason to change this assignment, though it probably is not much younger than the Bowden formation. Aside from the Recent species "*Arca*" *occidentalis* Philippi and *Cardium medium* Linné, both of which are Bowden and Cerros de Sal species, a number of other Cerros de Sal species are very similar to Bowden species (a *Lemintina* like *L. papulosa* (Guppy), a *Turritella* that may be *T. guppyi* Cossmann and an *Anadara* like *A. halidonata* (Dall)). A Cerros de Sal *Solenosteira* probably is *S. medioamericana* Olsson. This formation carries a representative of the *grandis*-like *Senilia*. According to

specimens in the collections of the United States National Museum the same beds are represented on an "island in Lake Henriquillo near Neyba," perhaps Isla de Cabritos. This island is the type locality of "*Pyrazisinus ?*" *haitensis* Dall and *Phacoides domingensis* Dall, both of which are found in the Cerros de Sal formation. According to other specimens, the Quaternary marine beds of the Enriquillo Basin also crop out on this island.

Republic of Haiti

Literature on Miocene mollusks from the Republic of Haiti is as follows:

Literature list, Republic of Haiti

Pilsbry 1910
Sheldon 1917
Pilsbry and Brown 1917
Pilsbry and Johnson 1917
Pilsbry 1922
Woodring 1923
Woodring and Mansfield 1924

This list is very short compared with the one for the Dominican Republic and accounts for only 17 species, aside from those only given in lists.

The largest number of mollusks are found in the Central Plain in the Thomonde formation and Maissade tongue, and in the overlying Las Cahobas formation. These deposits are fully described in the report on the geology of the Republic of Haiti. A few of the characteristic fossils are figured and lists are given (Woodring and Mansfield, Geology of the Republic of Haiti, pp. 165–205, pls. 15–16, 1924). These lists also are not to be taken too seriously, although they probably are more reliable than those for the Dominican Republic, except in the matter of generic nomenclature. The Thomonde formation carries *Xancus rex* Pilsbry and Johnson, "*Phos*" *semicostatus* Gabb, "*Phos*" *costatus* Gabb, and *Cymia henekeni* Maury, all of which have already been listed as characteristic species of the Baitoa formation of the Dominican Republic. It also carries other Baitoa species and *Orthaulax aguadillensis* Maury, which is like the Baitoa *O. inornatus* Gabb. It would not be surprising to discover that *Galeodes orthacanthus* (Pilsbry and Johnson), *Potamides dentilabris* (Gabb), and *Hemisinus truncatus* (Gabb), which were collected by Gabb, but by no one else in the Dominican Republic, and which are found in the Thomonde formation, will be discovered in the Baitoa formation, though all are facies (brackish- and fresh-water) fossils and may have a considerable stratigraphic range. It should be pointed out that *Conus aemulator* Brown and Pilsbry is an older name for the cone figured in the Haitian report as "*C. veatchi* Olsson." The correlation of the Thomonde formation with the lower Miocene Baitoa formation is as definite as any correlation in this region. Inasmuch as about

350 species of mollusks were collected from the Thomonde formation, whereas only 60 species have so far been collected from the Baitoa formation, it is taken as the type formation of this zone. It is the largest unworked Miocene fauna in the West Indian region, but many of the species will turn out to be Dominican species. At this time it is impracticable to list the Bowden species that are found in the Thomonde formation, but it is quite unnecessary to compare in any detail the fossils of the two formations, even though a number of species occur in both.

According to its position overlying the Thomonde formation, the fossils of the Las Cahobas formation should be more like those from Bowden, but they are not, principally because only about 50 species were collected from the Las Cahobas formation, and they came from oyster and coral reefs or from muds deposited near the mouths of rivers that contributed a considerable number of brackish- or fresh-water species. Though their fossils are so different, the Las Cahobas formation is considered the equivalent of the Cercado formation, and, therefore, according to the scheme here used, falls in the lower part of the middle Miocene. There is no evidence for an overlap of the Las Cahobas formation, comparable to the overlap of the Cercado formation, unless some beds along the northwest side of the Central Plain referred to the Thomonde formation represent the Las Cahobas formation.

Other Miocene beds cropping out along the south edge of the Cul-de-Sac Plain near Port-au-Prince carry fossils that are more similar to those from Bowden (Geology of the Republic of Haiti, pp. 219–223, 1924). As only about 35 species are represented, and as many of them are poorly preserved, no detailed comparison with the Bowden fossils can be made. A badly worn *Murex* from these beds seems to be *M. pomum* Gmelin, a Recent species that is found in the Bowden formation, but not in older beds. It was stated in the Haitian report that these beds probably are not as young as the Cerros de Sal formation of the eastern end of the trough of which the Cul-de-Sac Plain is a part, but they may be of the same age. The collections are not large enough to settle this point and these beds are regarded as representing the upper part of the middle Miocene or the upper Miocene.

Cuba

The literature list for Cuba is as follows:

Literature list, Cuba

d'Orbigny "1852"
Dall 1890–1903
de Boury 1912
Cooke 1919
Sanchez Roig 1920
Cooke 1921
Cooke 1921*a*
Woodring 1923
Maury 1925

Less is known about the Miocene mollusks of Cuba than of any other of the larger West Indian islands, partly because the Miocene beds seem to consist principally of limestones, out of which most of the mollusks, except the oysters and Pectens, come as unsatisfactory molds. Apparently the plates of d'Orbigny's report, which has for the most part been disregarded, were issued with the Spanish edition of de la Sagra's monograph on Cuba, but very few copies of the text were distributed. The copy of the text (in French) in the library of the Philadelphia Academy of Natural Sciences is the only one I know of in this country. Of the 38 species described by d'Orbigny 16 are recorded only from Guadeloupe and Marie Galante. According to d'Orbigny's statements the Cuban specimens were collected for the most part from the Quaternary coralliferous limestones, but the Miocene beds at Santiago and probably those near Havana also seem to be represented. Similar material and many of the species are in the collections of the United States National Museum.

The fossils described by Cooke from the Angela Elmira asphalt mine near Bejucal, south of Havana, consisting principally of fresh-water mollusks, probably are of Oligocene age rather than Miocene. The limestone at Consolación del Sur, Piñar del Rio Province, is lower Miocene and seems to represent the lower zone—that is, it is considered of the age of the Anguilla formation. Both *Orthaulax caepa* Cooke and *O. aguadillensis* Maury are recorded from this limestone, though the presence of two species of *Orthaulax* in the same bed needs verification.

Middle Miocene beds probably are widely distributed in Cuba, but there is nothing so far known that can be compared with the Bowden mollusks. The correlation of the marl at Matanzas and Baracao on the north coast, and of the La Cruz marl at Santiago on the south coast, with the Bowden formation rests on the corals (see Vaughan, U. S. Nat. Mus. Bull. 103, pp. 218–219, 1919; Mem. Geol. Survey Dominican Republic, vol. 1, p. 99, 1921). *Pecten barretti* Woodring, from Bowden, may be a synonym of *P. ventonensis* Cooke, from the La Cruz marl. *Ostrea haitensis* Sowerby is recorded from the La Cruz marl and also from Matanzas, as well as from a locality near Havana. In the northern part of the Dominican Republic this species is found in the Gurabo formation, but in the Republic of Haiti it occurs in the Las Cahobas formation and also in the younger beds near Port-au-Prince. "*Metis trinitaria* Dall" of the La Cruz marl should take the name of *Metis sagrae* (d'Orbigny) ("*Tellina*"). It also is found near Havana. Perhaps Dall's name need not be suppressed, however, for the type is from the Springvale beds of Trinidad and may represent a different species.

Cassis sulcifera Sowerby and *Malea camura* Guppy are two Bowden species that are represented by doubtful molds in the Province of Havana.

Porto Rico, Vieques, and Mona

Reports dealing with the Miocene mollusks of Porto Rico, Vieques, and Mona are as follows:

Literature list, Porto Rico, Vieques, and Mona

Maury 1920	Maury 1925
Hubbard 1921	Maury 1925*a*
Cooke 1921*a*	Palmer 1927

One of these reports (Hubbard 1921) contains the only records for Vieques, which lies east of Porto Rico, and also for Mona, the little island in the passage between Porto Rico and the island of Haiti.

The Miocene beds of Porto Rico, Vieques, and Mona are limestones and the mollusks that they carry are for the most part poor molds like those from Cuba. The youngest Tertiary beds in Porto Rico are the Quebradillas limestone and the Ponce limestone, which crop out on the north and south sides of the island, respectively. The Quebradillas limestone carries *Orthaulax aguadillensis* Maury (called *O. portoricoensis* by Hubbard), *"Phos" costatus* Gabb, a *Xancus* like *X. rex* Pilsbry and Johnson, and other species that probably are the same as Baitoa and Thomonde species. The correlation of the Quebradillas limestone with the Baitoa and Thomonde formations seems reasonably certain. This zone is perhaps the most definite and most easily recognized Miocene zone in the West Indies. In the eastern part of Porto Rico the Quebradillas limestone overlaps the older Tertiary beds and finally rests directly on the basement Cretaceous rocks (Hubbard, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 2, pt. 1, p. 48, 1923). A number of Bowden species are recorded from the Quebradillas and Ponce limestones. Although some of them are above suspicion, so many are based on virtually indeterminable material that it is inadvisable to list them. *Cancellaria laevescens portoricana* Maury represents a small race of the Bowden *C. l. laevescens* Guppy. It also was collected by Gabb, but by no one else, in the Dominican Republic, and it seems safe to assume that he collected it from the Baitoa formation.

The Ponce limestone probably is the equivalent of the Quebradillas limestone, but it may be a little younger. *Orthaulax* is not recorded from it and it carries *Ostrea cahobasensis* Pilsbry and Brown, which in the Republic of Haiti is found in the Las Cahobas formation.

The Aguadilla limestone (Los Puertos and Cibao limestones of Hubbard) seems to fall in the lowest Miocene horizon. It furnished the type specimen of *Orthaulax aguadillensis* Maury. To review Maury's and Hubbard's discussions of the age of the Porto Rican Tertiary beds would require too much space (see especially Hubbard, Scientific Survey Porto Rico and Virgin Islands, vol. 2, pt. 1, pp. 53–75, 1923). Unfortunately their work is not very well coordinated.

Maury fails to give the horizon under the species described and the data for the locality numbers have not yet been published. Hubbard's conclusion that the Bowden formation is upper Oligocene is not to be considered seriously.

Hubbard records *Orthaulax aguadillensis* Maury ("*O. portoricoensis* Hubbard") from a limestone on Vieques. The conclusion that this limestone is the same as the Quebradillas limestone seems fully justified. On Vieques it rests directly on the basement Cretaceous rocks (Hubbard, Scientific Survey Porto Rico and Virgin Islands, vol. 2, pt. 1, p. 48, 1923), just as in eastern Porto Rico the Quebradillas limestone overlaps the older Tertiary beds.

Hubbard (p. 144) considers that the limestone on Mona is of the same age as the Quebradillas and Ponce limestones, but only two poorly preserved species are recorded from this small island.

St. Croix

The literature list for St. Croix is as follows:

Literature list, St. Croix

Dall 1890–1903
Cooke 1919
Cooke 1921*a*

St. Croix is the only one of the islands between Vieques and the Anegada Passage that is known to have any Miocene beds, which again consist of limestone carrying *Orthaulax aguadillensis* Maury. It seems quite safe to correlate this *Orthaulax*-bearing limestone with the Quebradillas limestone, which is widespread and transgressive in Porto Rico and along the south edge of the Virgin Bank. St. Croix is the type locality of *Conus cruzianus* Dall, which seems to have been ignored. It probably was collected from the lower Miocene limestone.

Lesser Antilles

Anguilla, Guadeloupe and Marie Galante, and Martinique are the only Lesser Antillean islands that need to be considered. Literature lists are as follows:

Literature list, Lesser Antilles

ANGUILLA

Guppy 1866*a*
Guppy 1867
Guppy 1874
Dall 1890–1903
Cooke 1919
Cooke 1921
Cooke 1921*a*
Maury 1925
Palmer 1927

GUADELOUPE AND MARIE GALANTE

d'Orbigny "1852"
Dall 1890–1903

MARTINIQUE

Cossmann 1913
Pilsbry 1922

The Anguilla formation of the island of Anguilla was for many years called upper Oligocene, but it is now considered lower Miocene and has been taken by Vaughan as the type of the lowermost Miocene zone in the West Indian region. About 43 species of mollusks are recorded from the Anguilla formation, but only 27 of them are named. The presence of *Orthaulax*, *Ampullina*, and *Ampullinopsis* clearly shows that the Anguilla formation is older than the Bowden formation. "*Pecten* (*Aequipecten*) *thetidis* Sowerby" and *Spondylus* "*bostrychites* Guppy" are the only species that might be the same as Bowden ones, but it is not certain that they are. "*Scapharca* (*Scapharca*)" *anguillana* Cooke, based on float material, is very similar to *Senilia chiriquiensis* (Gabb). It may indicate younger beds or brackish-water beds in the Anguilla formation.

Most of the mollusks recorded by d'Orbigny from Guadeloupe and Marie Galante apparently were collected from Quaternary limestones, like most of the Cuban ones. The record of "*Natica*" *phasianelloides* d'Orbigny, which seems to be an *Ampullina*, and the less definite record of "*Tellina*" *sagrae* d'Orbigny from Marie Galante indicate the presence of Miocene beds on that small island, but it has not yet been confirmed. *Thracia guadalupensis* Dall and *T. spenceri* Dall (one species ?) apparently are the only Tertiary mollusks recorded from Guadeloupe. It is not certainly known whether they were collected from Miocene beds, evidence for the presence of which is discussed by Vaughan (U. S. Nat. Mus. Bull. 103, p. 592, 1919).

The Miocene mollusks from Martinique described by Cossmann are rather poorly preserved. He describes 27 species, 22 of which are named. Virtually none of Cossmann's identifications with previously described species can be accepted. He considers that the Martinique beds and the Gatun formation are of the same age, probably middle Miocene, but he calls the Bowden formation Aquitanian and the Miocene beds of the Dominican Republic upper Miocene, not knowing that several horizons are represented in the Dominican beds. Probably no Bowden species is found at Martinique, and the beds that carry these mollusks may represent the upper part of the lower Miocene or the lower part of the middle Miocene.

MEXICO

Papers dealing with the Miocene mollusks of the Atlantic coast of Mexico are as follows:

Literature list, Mexico

Dall 1890–1903
Böse 1906
Böse and Toula 1910
Engerrand and Urbina 1910
Toula 1911
Sheldon 1917
Berry 1922
Hanna 1924
Woodring 1926
Palmer 1927

Only one of these reports (Woodring 1926) deals with the Tuxpan formation of the Tampico embayment and it considers only one species (*Clementia grayi* Dall). Dickerson and Kew (Proc. California Acad. Sci., ser. 4, vol. 7, table opposite p. 128, 1917; Bull. Geol. Soc. America, vol. 28, pp. 224–225, 1917) listed mollusks from the Tuxpan formation and older Tertiary deposits of the Tampico embayment, but many of the determinations are unreliable. The Tuxpan formation carries *Chlamys condylomatus* (Dall), *Clementia grayi* Dall, and other Chipola species. Its correlation with the lower Miocene Chipola formation seems well established.

All the other reports in the preceding list deal with the Isthmus of Tehuantepec and adjoining regions. The following composite section is based on an interpretation of the mollusks that these beds carry:

Composite Miocene section for Isthmus of Tehuantepec and adjoining parts of Mexico

Time division	Formation and localities
Middle Miocene	Tuxtepec, Oaxaca, and Barranca de Santa Maria Tatetla, Vera Cruz
	Santa Rosa, Vera Cruz, and Zuluzum, Chiapas
Lower Miocene	Coatzacoalcos formation, Vera Cruz

J. W. Spencer (Bull. Geol. Soc. America, vol. 9, pp. 23, 25, 1897) gave the name Coatzacoalcos formation to the beds cropping out at places on the Tehuantepec Railroad, the mollusks from which have been described by Dall (1890–1903), Böse (1906), Böse and Toula (1910), and Toula (1911). These beds carry a peculiar cool-water and deep-water fauna, including an undescribed *Fusoterebra*, a relatively gigantic *Bathyarca*, *B. spenceri* (Dall), and the only Miocene *Astarte* from tropical America, *A. opulentora* Dall. It is difficult to determine just what part of the lower Miocene these beds represent, for the fauna is not comparable with any other. It may represent the Chipola and Baitoa formations. At all events apparently none of the species is also found at Bowden.

Böse (1906) described five species of mollusks from Santa Rosa, Vera Cruz, a locality near the border of Oaxaca along the branch of the National of Mexico Railroad that leads off from the Tehuantepec Railroad at Santa Lucrecia. Dr. Bruce Wade, while engaged in work for the Transcontinental Petroleum Company, obtained a collection of about 300 species of mollusks from the Santa Rosa beds. An

account of this material is being prepared by Mr. R. E. L. Collins of Johns Hopkins University. These beds carry an *Aphera* like *A. islacolonis* Maury, and an *Anadara* closely resembling *A. corcupidonis* (Maury) is extraordinarily abundant. The only American *Spirulirostra*, *S. americana* Berry, is based on material from these beds. They also carry the northernmost Caribbean representative of *Turritella "robusta"* Grzybowski. Some of the Santa Rosa species will turn out to be the same as Bowden species, but there is no doubt that the Santa Rosa beds are older than the Bowden formation and they are considered to be of the same age as the Cercado formation.

The mollusks described by Engerrand and Urbina from Zuluzum, a locality near Palenque, Chiapas, east of the Isthmus of Tehuantepec, are considered as representing the same horizon as the Santa Rosa beds, but the evidence is not very conclusive. I have never seen this paper mentioned in reports dealing with the Miocene mollusks of tropical America, except in Sheldon's compilation of the Arcas. *"Arca (Scapharca)" chavezi* Engerrand and Urbina probably is the name to use for the very abundant *Cardium*-like *"Arca"* of the Santa Rosa beds. *"Scapharca" corcupidonis* Maury may be a synonym. Engerrand and Urbina record *Cancellaria barretti* Guppy, *"Phos" elegans* Guppy, and *Chione woodwardi* (Guppy), all of which are Bowden species, from this locality, but the material on which these records are based is not described or figured.

Böse (1906) described 31 species of mollusks from Tuxtepec, which lies in Oaxaca, a short distance beyond the border of Vera Cruz. These beds clearly represent the horizon of the Gatun formation and, therefore, are considered middle Miocene and fall closer to the horizon of the Bowden formation than the preceding localities. Tuxtepec is the type locality of *Conus "agassizi" multiliratus* Böse. This species is one of the most characteristic middle Miocene species in the whole Caribbean region. The form in the Gatun, Gurabo, and Bowden formations is slightly different and takes the name *C. multiliratus gaza* Johnson and Pilsbry. *"Venus (Chione)" ebergenyii* Böse probably is a synonym of *Chione mactropsis* (Conrad), a characteristic Gatun species. Böse's *"Sconsia sublaevigata* Guppy" seems to be *S. laevigata* (Sowerby), which is found in the Gatun and Gurabo formations. *"Phos" mexicanus* Böse, a *Cancellaria*-like *"Phos,"* closely resembles *"Phos" gatunensis* Toula. *"Solarium" villarelloi* Böse is considered a synonym of *Architectonica nobilis quadriseriata* (Sowerby), a Gurabo and Bowden form. Böse records *Pecten bowdenensis* Dall from this locality, but it does not seem to be quite the same as the Bowden *bowdenensis*.

Böse's (1906) Santa Maria Tatetla locality, which lies near Huatusco, Verz Cruz, may represent the same horizon, but the material is not so well preserved.

Collections in the United States National Museum show that the middle Miocene Tuxtepec horizon is found at a large number of localities in the Tehuantepec region, in the states of Vera Cruz, Oaxaca, and Chiapas. According to a hasty examination, these collections contain *Conus molis* Brown and Pilsbry, *Conus imitator* Brown and Pilsbry, which may be a synonym of *C. almagrensis* Böse, *Conus multiliratus* Böse, "*Phos*" *mexicanus* Böse, *Sconsia laevigata* (Sowerby), *Distorsio clathratus gatunensis* (Toula), *Turritella tuxtepecensis* Böse, an *Anadara* like *A. actinophora* (Dall), and *Chione ebergenyii* (Böse). Collections from Arroyo Chapapoapan in the Sayula district, Vera Cruz, which is not to be confused with another Sayula in Chiapas, are placed here. They contain among other things *Conus imitator* Brown and Pilsbry and a *Metula* like *M. gabbi* Brown and Pilsbry. The only record of Sayula fossils that I know of is in Bulletin 103 of the United States National Museum, in which Pilsbry (pp. 185–186) records a Pliocene barnacle and the beds are called Pliocene. The same barnacle is also recorded from U. S. G. S. stations 5903 and 5906*a*, localities on the Chagres River near Alhajuela, east of the Canal Zone, where beds of Miocene age crop out.

This Mexican material should be described, as it comes from a critical region between Central America and Florida and offers the best means of comparing the Miocene deposits in these two widely separated regions.

CENTRAL AMERICA

Guatemala

No Miocene mollusks are described from any localities in the long stretch from Chiapas to Costa Rica, though they will probably be found in Yucatan and northern Guatemala.

Collections in the United States National Museum from a limestone on Rio Dulce, Guatemala, carry *Orthaulax aguadillensis* Maury and other poorly preserved mollusks, principally in the form of molds. This limestone seems to represent the lower Miocene Anguilla horizon, a conclusion that is sustained by the evidence furnished by the foraminifera and corals. Vaughan has already recorded the opinion that this limestone "probably represents a horizon very near that of the Emperador limestone" (U. S. Nat. Mus. Bull. 103, p. 586, 1919).

Lignite-bearing beds on Rio Carboneras carry a brackish- and freshwater fauna consisting of *Pachycheilus*, *Tryonia ?*, "*Unio*," and *Cyrenoida*. Dall briefly mentioned this occurrence of *Cyrenoida* and *Tryonia* (Nautilus, vol. 37, p. 98, 1924). These beds also probably are Miocene, but they may be as young as Pliocene.

COSTA RICA AND ADJOINING PARTS OF BOCAS DEL TORO PROVINCE, PANAMA

The literature list for the Atlantic coast of Costa Rica and adjoining parts of Panama is as follows:

Literature list, Costa Rica and adjoining parts of Panama

Gabb 1861
Gabb 1881
Gabb 1881*a*
Dall 1890–1903
Guppy and Dall 1896
Pilsbry and Sharp 1897–98
Grabau 1904
Pilsbry 1911
Dall 1912
Brown and Pilsbry 1913
Sheldon 1917
Maury 1917
Pilsbry and Johnson 1917
Pilsbry 1922
Olsson 1922
Palmer 1923
Dall 1925
Woodring 1926
Palmer 1927

For convenience reports dealing wholly with the Pliocene beds of Costa Rica are included in this list.

The basin in which the Miocene beds were deposited extends at least from the latitude of Port Limon southeastward into Panama a short distance beyond Chiriqui Lagoon. During lower Miocene time it extended across central Costa Rica, and the Atlantic and Pacific Oceans were united. The Miocene deposits of the interior of Costa Rica are discussed later in the matter dealing with the Pacific coast.

Olsson's report is the most extensive one on Costa Rican Miocene fossils. Unfortunately it contains only an outline of the stratigraphy and hardly any precise locality records. His collections are from Port Limon, Rio Blanco, Rio Banana, Rio Betey (Biscay ?), and Rio Estrella and its tributaries; from several small streams entering the Caribbean Sea near Cahuita and Old Harbor (Puerto Viejo) between Rio Estrella and Punta Mona; from several islands in the Bocas del Toro archipelago, that is, in Almirante Bay and Chiriqui Lagoon; and from Coco Plum, a locality on the Panama coast "about 40 miles east of Bocas del Toro." All these localities, except Coco Plum and the islands in the Bocas del Toro archipelago, lie north of the ridge along the north side of the Talamanca Valley—a name given to the basin drained by Rio Sixaola and its numerous tributaries, the seaward part of which straddles the Costa Rica-Panama boundary. Pittier's map of Costa Rica (Petermann's Mitt., Ergänzungsband 37, Ergänzungsheft 175, 1912) and the map of Panama compiled by Sabas A. Villegas, of Panama City, in cooperation with the American Geographical Society, show most of these localities. The United States National Museum has collections from many of these localities, and also from others in the Talamanca Valley and south of it. These collections were made by Olsson, myself, and others during explorations for the Sinclair Central American Oil Corporation under the direction of Dr. Donald F. MacDonald. Large collections from Rio Banana were

made at an earlier date by MacDonald, and collections from the region around Port Limon were presented by Pittier and Wailes. All this material has been utilized in the following summary.

The Uscari formation, named by Olsson, comprises the lowest Miocene beds in this region. At the type locality on Uscari Creek it consists of strongly deformed shales that carry only a few very poorly preserved mollusks. It is a rather unfortunate choice for a type locality, for Olsson records no species from it. Without any discussion, but presumably on stratigraphic grounds, he records 11 species from the Uscari formation at Coco Plum and on several of the small streams flowing northeastward from the ridge along the north side of the Talamanca Valley. Three additional species are based on Gabb's descriptions of mollusks from Sapote (or Zapote) on Rio Revantazon, a locality that Olsson places in the Uscari formation. Gabb (1881*a*) described 33 species of mollusks from this locality, which apparently has not been revisited. His collection stands in urgent need of revision. So far as present material goes the Sapote beds should be regarded as the type lower Miocene of Costa Rica. They carry *Clementia dariena* (Conrad), which also is found in the lower part of the Gatun formation of the Panama Canal Zone and of Costa Rica, but the most striking species is a "*Phos*"-like mollusk called *Phos inornatus* by Gabb. The Uscari formation also crops out along the southern border of the Talamanca Valley. "*Arca* (*Barbatia ?*)" *oronlensis* Gabb, and *Turritella tristis* Brown and Pilsbry, both from "Oronli Creek," a tributary of Rio Uren, which in turn flows northward into Rio Sixaola, probably were collected from the Uscari formation. The Sapote beds seem to represent the Baitoa horizon. The Uscari species recorded by Olsson elsewhere than at the type locality resemble Cercado species and may represent a younger zone.

The Gatun formation, which carries most of the 334 Costa Rican species described by Olsson, overlies the Uscari formation. In the region of the type locality of the Uscari formation the Gatun formation unconformably overlies it. Elsewhere, according to Olsson, the contact is a disconformity. At places the Gatun formation overlaps the Uscari formation and rests directly on much older rocks. The boundary between these two formations is a convenient place for the boundary between lower and middle Miocene. According to Olsson, the Gatun formation of Costa Rica includes higher beds than any in the Gatun formation of the Panama Canal Zone. The time interval, however, probably is the same when the whole basin, of which the Atlantic side of the Canal Zone is only a part, is considered, as will be discussed later, even though the beds are much thicker in Costa Rica. Olsson discusses the different facies of the Gatun formation in Costa Rica. The landward facies consists of coastal swamp clays and lignite, and of heavy conglomerates and coarse sandstones.

The seaward facies comprises coralliferous limestones that were deposited in clearer and for the most part deeper water. Between them siltstone and fine sandstones are found.

The coastal swamp muds furnished the brackish-water mollusks described by Gabb in 1861, including *"Arca" chiriquiensis* Gabb and a *Potamides* that Gabb called *Terebra evansii*, and also *"Arca" dolaticosta* Pilsbry and Johnson. Both these Arcas are brackish-water Senilias. This material was collected during explorations to determine the extent of the lignite deposits, and is not necessarily from the immediate vicinity of Chiriqui Lagoon (see Evans, Geological Report; Report Chiriqui Commission, 36th Congress, 2nd Ses., House Ex. Doc. 41, pp. 45–55, 1861). We collected specimens of *Senilia dolaticosta* on a small eastward-flowing stream entering Rio Yorkin, which forms the boundary between Panama and Costa Rica, near its mouth.

Bowden mollusks recorded from Uscari and Gatun formations of Costa Rica

SPECIES	Uscari formation	Gatun formation	
		Landward facies	Seaward facies
Gastropods:			
Aceton textilis Guppy		×	
Volvula oxytata Bush	×		
Carinodrillia bocatoroensis (Olsson)			×
Ancistrosyrinx miranda (Guppy)		×	
Lioglyphostoma moinica (Olsson)			×
Conus proteus Hwass		×	×
Conus stenostoma Sowerby			×
Conus planiliratus Sowerby			×
Conus mutiliratus gaza Johnson and Pilsbry			×
Conus granozonatus Guppy		×	
Conus gracilissimus Guppy			×
Latirus infundibulum polius Woodring		?	
Tritiaria moorei (Guppy)		×	
Columbella submercatoria Olsson		×	
Strombina guppyi Woodring		×	
Murex recurvirostris Broderip		×	×
Typhis alatus obesus Gabb			×
Distorsio clathratus gatunensis (Toula)		×	×
Bursa proavus bowdenensis Pilsbry		?	
Cassis sulcifera Sowerby		×	
Semicassis reclusa (Guppy)		×	
Malea camura Guppy	×	×	×
Alaba turrita Guppy		×	
Lemintina papulosa (Guppy)		×	

Bowden mollusks recorded from Uscari and Gatun formations of Costa Rica—Continued

SPECIES	Uscari formation	Gatun formation	
		Landward facies	Seaward facies
Crepitacella cepula (Guppy)			×
Polinices brunnea subclausa (Sowerby)		×	
Astraea brevispina basilis (Olsson)		×	
Tricolia umbilicata (d'Orbigny)		×	
Smaragdia viridis viridemaris (Maury)		×	
Pelecypods:			
Glycymeris jamaicensis Dall		×	×
"Arca" occidentalis Philippi			×
"Arca" bowdeniana Dall			×
Pteria inornata Gabb	×	×	
Ostrea costaricensis Olsson		×	
Limea solida Dall		×	
Placunanomia lithobleta Dall		×	
Myrtaea limoniana Dall		×	×
Phacoides actinus Dall			×
Cardium medium Linné			×
Cardium serratum Linné		×	
Antigona blandiana (Guppy)		×	×
Strigilla pisiformis (Linné)		×	
Abra triangulata Dall			×
Corbula viminea Guppy		×	
Rocellaria rotunda (Dall)		×	

This stream was called "Shuab Creek" in an attempt to transcribe the Indian name, but Gabb (Informe sobre la exploración de Talamanca verificado durante los años de 1873–74, p. 65, San José, 1894) called it "Shoai." MacDonald collected the large *grandis*-like *Senilia* from "Carbon Creek," a small southeastward-flowing stream entering Rio Sixaola east of Chase Farm of the United Fruit Company, making three species of *Senilia* for this region. *Potamides evansii* has been ignored. *P. cahobasensis* Pilsbry, a Haitian species, is very similar to it and may turn out to be a synonym.

The detrital landward facies of the Gatun formation consists of one or more conglomerates and coarse sandstones, above which lie siltstones. *"Pecten" levicostatus* Toula is the most abundant fossil in the sandstones. The plants described by Berry (Proc. U. S. Nat. Mus., vol. 59, pp. 169–185, 1921) were collected from float material derived from beds lying immediately above a basal conglomerate. The

siltstones lying higher in the section or lying at the same horizon farther seaward carry the greatest number of mollusks found in any of the beds of the landward facies. Collections from these beds have been made both north and south of the Talamanca Valley, but south of it the structure is much more complicated. The largest collections are those from Rio Banana made by MacDonald, and when these collections are studied a considerable number of species will be added to the Costa Rican Gatun fauna. Olsson (pp. 187–188) lists some of the most abundant and most characteristic species.

The seaward facies of the Gatun formation is found principally at Port Limon, on some of the islands of the Bocas del Toro archipelago, and on Valiente Peninsula at the east end of Chiriqui Lagoon. Olsson (p. 188) lists some of the characteristic species of this facies, which carries a fauna that in many features differs from the fauna of the landward facies.

The Pliocene beds at and near Limon were confused with the Miocene beds by some of the earlier writers. They carry the only large Pliocene fauna so far known from the Caribbean region, and this material will be particularly valuable in attempting to trace the lineage of the Miocene species. Probably most of the 137 species described by Gabb (1881*a*) will turn out to be from these Pliocene beds. It is estimated that 50 or 60 per cent of the species in this fauna are Recent species. *Metula*, represented by a species very similar to *M. cancellata* Gabb, from the Gurabo formation, seems to be the only exotic genus in these Pliocene beds. According to collections in the United States National Museum, Quaternary marine beds also crop out near Limon.

Many Bowden species are found in the Gatun formation of Costa Rica. Those listed on pages 70 and 71 are already recorded, and others, especially among the small species, will be added when all the available material is studied. Three Bowden species recorded from the Uscari formation are also listed.

Of the 43 definitely identified species in this list 29 are found in the landward facies, 20 in the seaward facies, and 7 in both. On the face of this list the Bowden mollusks seem to be more similar to those of the landward facies. I am inclined to believe, however, that the evidence would be in favor of a closer similarity to the seaward facies if material representing as large a percentage of the whole fauna then living as is found in the Bowden formation were available for both facies. Olsson reached this conclusion. Most of the cones and *Crepitacella* show a similarity with the seaward facies. How much weight is to be given to the facies difference of contemporaneous deposits and how much to difference in age between the landward and seaward beds in Costa Rica is open to question. Olsson emphasizes both. Although some of the seaward deposits may be of the same age as the landward beds, most of them probably are a little younger. This conclusion is

supported by the transgression of the seaward facies along part of the Panama coast. Although the evidence as it now stands is not entirely conclusive, the Bowden formation is considered the equivalent of the seaward Gatun beds of Costa Rica. Whether these beds are to be considered upper Miocene, as Olsson was inclined to believe, is a matter of opinion as to where the boundary between middle and upper Miocene is to be drawn. Considering the Miocene deposits of the entire Caribbean region it seems more reasonable to place both these beds and the Bowden formation at the top of the middle Miocene. More precise correlation with the Florida section may alter this conclusion. A large collection from Port Limon, collected by Olsson (U. S. G. S. station 8343) is different from the Miocene material recorded from that locality. This collection may represent an upper Miocene horizon.

Though the Bowden formation is considered as representing approximately the same time interval as the seaward facies of the Gatun formation, it does not carry some of the most characteristic Costa Rican genera. It carries no species of *Fusoterebra* and *Leucosyrinx*, found in the seaward facies, no species of *Aphera*, *Cunearca*, *Noetia*, *Dosinia*, *Macrocallista*, *Mactrella*, *Harvella*, and *Mulinia*, which are abundant in the landward facies, and no species of "*Turricula*," *Agaronia*, *Voluta*, *Solenosteira*, *Lophocardium*, and *Clementia*, which are found in both. The absence of some of these genera may be due to the absence of a mud facies at Bowden, but the absence of others, and of many Gatun species representing genera found in the Bowden formation, is believed to be due to geographic location. It will be shown in the discussion of the Gatun formation of the Panama Canal Zone and of beds of the same age in northern South America that the Gatun fauna is a well-recognized unit, but that on the Atlantic side it is confined to the western and southern borders of the Caribbean Sea.

Panama Canal Zone and adjoining parts of Colon Province, Panama

The following is a list of reports dealing with the Miocene mollusks of the Panama Canal Zone. None has yet been issued on adjoining parts of the Province of Colon.

Literature list, Panama Canal Zone

Conrad 1855
Conrad 1856
Gabb 1881
Dall 1896
Guppy and Dall 1896
Dall 1890–1903
Toula 1909
Brown and Pilsbry 1911
Toula 1911*a*
Dall 1912
de Boury 1912
Brown and Pilsbry 1913
Cossmann 1913
Sheldon 1917
Cooke 1921*a*
Hubbard 1921
Olsson 1922
Hanna 1924
Dall 1925
Maury 1925
Hodson 1926
Woodring 1926
Palmer 1927
F. Hodson, H. K. Hodson, and Harris 1927

In several of these reports (Dall 1912, de Boury 1912, Dall 1925) the only Panama material considered may be of Pliocene age.

The stratigraphy of the Tertiary deposits of the Panama Canal Zone and also the fossils, except the mollusks, are described in Bulletin 103 of the United States National Museum (Vaughan and others, Contributions to the geology and paleontology of the Panama Canal Zone, 1918–19). The mollusks are so numerous that they had to be almost disregarded in this publication. Though the preceding list shows that many reports have been issued on the mollusks, most of the species still remain undescribed, or at least are not recorded from the Canal Zone. The United States National Museum has a set of collections made by MacDonald and by Vaughan and MacDonald during the construction of the canal. Many of the localities are now under water and will be inaccessible so long as the canal is in use. Other large collections, principally from localities near Mt. Hope and west of Gatun Lake and Chagres River, were made by Olsson during explorations for the Sinclair Central American Oil Corporation. Altogether it is an unusually fine set of collections, which I hope to describe.

The Miocene section in the Canal Zone and adjoining parts of the Province of Colon west of the Zone, as here presented, is as follows:

Miocene section in Panama Canal Zone and adjoining parts of Province of Colon

Time subdivision	Formations		Probable equivalents
Upper Miocene or Pliocene	Toro limestone		?
Middle Miocene	Gatun formation	Upper part	Bowden formation
		Middle part	Gurabo formation
		Lower part	
	Vamos-a-Vamos beds		Cercado formation
Lower Miocene	Emperador limestone and upper part of Culebra formation		Anguilla formation

Only seven species of mollusks have so far been described from the Culebra formation, but one of them has already had three names

(*Arca dalli* Brown and Pilsbry 1913, *Arca balboai* Sheldon 1917, and *Arca invalida* Hanna 1924). Aside from the record of *Orthaulax gabbi* Dall (Cooke 1921*a*) and the doubtful record of *Clementia dariena* (Conrad) (Woodring 1926), these species were described or listed by Brown and Pilsbry, whose "lignitic layers near Tower N, Las Cascadas" represent the Culebra formation. Much of the Culebra material is poorly preserved, but it is estimated that between 100 and 150 species of mollusks are represented, most of which are not found in other beds, except in the Emperador limestone. These collections of mollusks represent only the upper part of the Culebra formation. Brown and Pilsbry record *Turritella altilira* Conrad from the Culebra formation, but none of the specimens seem to be quite the same as the Gatun *altilira*. The *Orthaulax* from U. S. G. S. station 6515 (west side of canal about one-third of a mile north of Paraiso) recorded by Cooke as *O. gabbi* Dall may be *O. aguadillensis* Maury. "*Nassa*" *praeambigua* Brown and Pilsbry, *Bittium scotti* Brown and Pilsbry, a *Turritella* of lower Miocene type, several Pectens, *Spondylus scotti* Brown and Pilsbry, a large *Trachycardium*, and a *Chione* are abundant in many of the collections. It probably will be possible to recognize two faunal zones in the upper part of the Culebra formation, the upper one of which, represented by U. S. G. S. stations 5901, 6025, and 6026 (for data on 6025 and 6026 see U. S. Nat. Mus. Bull. 103, pp. 540–541, 1919) carries *Orthaulax gabbi* Dall, a *Turritella* very close to *altilira* and a *Flabellipecten* that probably is *P. gatunensis* Toula. It is expected that most of the upper part of the Culebra formation on the basis of the mollusks will be correlated with the Anguilla formation, which agrees with Vaughan's conclusion (U. S. Nat. Mus. Bull. 103, pp. 208, 585, 1919), but the "upper zone," which may correspond to the Caimito formation, may be considerably younger.

The only mollusks so far recorded from the Emperador limestone are the 13 species from the "Pecten bed at tower N, Las Cascadas" (Brown and Pilsbry 1913, p. 503). Probably 50 species of mollusks are represented in the Emperador collections, many of which are also found in limy beds in the upper part of the Culebra formation. "*Pecten*" *canalis* Brown and Pilsbry and *Amusium sol* Brown and Pilsbry are particularly abundant. The Emperador *Orthaulax*, recorded by Cooke as *O. gabbi* Dall, is considered as representing *O. aguadillensis* Maury. So far as the mollusks are concerned there is no basis for considering the Emperador limestone as younger than the "lower faunal zone" of the upper part of the Culebra formation. It seems to represent patches of reef limestone in the upper part of the Culebra formation (see Vaughan, U. S. Nat. Mus. Bull. 103, p. 585, 1919). It should be pointed out that the Culebra formation and Emperador limestone carry the youngest American species of *Lepidocyclina*. This genus has not yet been found in the Anguilla and Tampa forma-

tions, which are supposed to be of the same age as these Canal Zone formations.

The Miocene beds of the Canal Zone extend eastward up the Chagres River far beyond the limits of the Zone, at least almost as far as the mouth of Rio Pequeni. Just what part of the section they represent has not yet been determined. Some of these beds may be younger than the Culebra formation and Emperador limestone.

The locality from which Hill, and also Vaughan and MacDonald, collected at Vamos-a-Vamos is now under water. The beds at this locality are described by Hill and by MacDonald (Bull. Mus. Comp. Zool. Harvard College, vol. 28 (geol. ser., vol. 3), pp. 179–180, 1898; U. S. Nat. Mus. Bull. 103, p. 542, 1919). Dall reported that the fossils from the Vamos-a-Vamos beds are Eocene (in Hill, pp. 271, 273), but Hill (p. 207) could not quite understand how these beds could be older than the foraminiferal marls at Bujio (Bohio), which belong in the Culebra formation. Vaughan and MacDonald assumed that they represent the Gatun formation. Dall was justified in believing that they are older than the "Monkey Hill beds" (Gatun formation), but the poor preservation of most of the material was misleading. These beds carry *Turritella altilira* Conrad, *T. gatunensis* Conrad, *"Arca" dariensis* Brown and Pilsbry, *Clementia dariena* (Conrad), and *Chione mactropsis* (Conrad), all of which are Gatun species, but a number of the Vamos-a-Vamos species—*Glyptostyla panamensis* Dall, a *Morum*, several naticoids, *Cardium gatunense* Dall, *"Pitaria" hilli* Dall, and *Mactra dariensis* Dall—are not found in the Gatun formation. These beds, instead of the "upper faunal zone" of the Culebra formation, may represent the Caimito formation. At all events they are older than the Gatun formation and are considered the equivalent of the Cercado formation. The absence of the Vamos-a-Vamos beds, except at a locality that is now inaccessible, is attributed to the overlap of the Gatun formation.

The Gatun formation carries a far greater number of species of mollusks than any of the Canal Zone formations so far described. From a preliminary examination of the Gatun collections it is estimated that about 400 species are represented, more than half of which are undescribed or are not recorded from the Canal Zone. The basin in which the Gatun formation was deposited extends eastward a short distance into Panama and southwestward along the coast for a distance of at least about 25 miles beyond the border of the Zone. Three faunal zones can be recognized corresponding to the lower, middle, and upper parts of the formation. The lower zone is represented in the railroad cuts near Gatun station, in the Quebrancha Hills, and in the excavations for the Gatun locks. *Clementia dariena* (Conrad) is confined to this zone, so far as the Gatun formation is concerned. The middle zone is represented at Mindi and Mt. Hope, and also

west of Gatun dam and on the Chagres River below the spillway. Many of Toula's species came from this zone, which embraces the uppermost Gatun beds from which fossils were collected within the Canal Zone. *Cancellaria dariena* Toula, *Strombina lessepsiana* Brown and Pilsbry, and *"Arca" actinophora* Dall are abundant in this zone, but are not found in the lower zone. Many of the common Gatun species are found in both zones (*"Drillia" gatunensis* Toula, *Conus molis* Brown and Pilsbry, *Conus imitator* Brown and Pilsbry, *Oliva gatunensis* Toula, *"Phos" gatunensis* Toula, *Turritella gatunensis* Conrad, *Turritella altilira* Conrad, *"Solarium" gatunensis* Toula, *"Natica" guppyana* Toula, *"Arca" dariensis* Brown and Pilsbry, and *Chione mactropsis* (Conrad)). The upper faunal zone is represented along and near the coast west of the Canal Zone. It is by far the most distinctive of the three zones, as it carries a large number of species and genera not found in the lower and middle zones. It seems to be the equivalent of the seaward facies of the Gatun formation in Costa Rica and adjoining parts of the Province of Bocas del Toro, Panama. The same question arises here as to how much of the difference is due to facies and how much to age. Though the upper zone probably represents deeper and clearer water, it seems to be younger than the other zones. On Rio San Miguel it rests directly on the basement igneous rocks, apparently overlapping the part of the formation cropping out in the Canal Zone.

Not enough work has yet been done on the Gatun mollusks to compare them satisfactorily with those from the Bowden formation. The following species are recorded from both:

Bowden species recorded from Gatun formation

Conus proteus Hwass
Conus multiliratus gaza Johnson and Pilsbry
Conus consobrinus Sowerby
Murex recurvirostris Broderip
Distorsio clathratus gatunensis Toula
Polinices brunnea subclausa (Sowerby)
Sinum gatunense (Toula)
Cardilum serratum Linné
Pitar gatunensis (Dall) (see p. 21)
Pitar carbaseus (Guppy)
Corbula sericea Dall ?
Corbula heterogena Dall

Other species, especially small ones, will be added when the Gatun collections are described. Inasmuch as the Gatun formation of the Canal Zone clearly is the equivalent of the landward facies of the Gatun formation in Costa Rica, and inasmuch as the upper zone represents the seaward facies in Costa Rica, it is concluded that the Bowden formation is the approximate equivalent of the upper zone. It is not expected, however, that many Bowden species will be found in the upper zone, for no matter what Miocene stages are compared, the fauna of the southwest end of the Caribbean Sea is different from that of the north edge. The lower and middle zones of the Gatun

formation are considered the equivalent of the Gurabo formation. *Conus haytensis* Sowerby is the Gurabo analogue of the Gatun *C. molis* Brown and Pilsbry. Another Gatun cone resembles *C. symmetricus* Sowerby, the most abundant cone in the Gurabo formation. *Cypraea henekeni* Sowerby is found in both the Gatun and Gurabo formations. Records of such species, which seem to have no particular facies significance and which are not found at Bowden, are considered evidence that the Bowden formation differs in age from the Gurabo formation and from the Gatun formation of the Canal Zone. The Gatun fauna is remarkable for the large number of Cancellarias (about 13 species) and also for the large number of *Phos*-like mollusks (about 9 species).

The Gatun formation does not extend across the Isthmus like the underlying Emperador limestone and Culebra formation. No fossils have so far been recorded from the Panama formation, which is regarded as the equivalent of the Gatun formation on the Pacific side. MacDonald collected near Paraiso (U. S. G. S. station 6336) from a light-colored tuff in the stratigraphic position of the Panama formation an exterior mold of an *Acila* that probably is the Gatun species *A. isthmica* (Brown and Pilsbry), and another mold that may represent a fresh-water mussel.

About 25 species, mostly in the form of molds, are represented in collections from the Toro limestone. *Sthenorytis toroensis* (Dall), of which *S. chaperi* de Boury is a synonym, *S. toroensis insignis* Dall, and *Pecten macdonaldi* Olsson are the only Toro species so far described. Whether the Toro limestone is upper Miocene or Pliocene can hardly be determined from this material. It was called Pliocene in Bulletin 103 of the United States National Museum. Inasmuch as it unconformably overlies the Gatun formation, no reason is apparent for changing this age assignment.

It might not be out of place to point out that the only specimens of *"Pecten" ventricosus* Sowerby from the Canal Zone were collected from Quaternary deposits on the Pacific side, not on the Atlantic side. Also no specimens of *Northia northiae* Gray are in the collections from Atlantic Quaternary deposits (see Dall, Smithsonian Misc. Coll., vol. 59, No. 2, p. 1, 1912; Olsson, Bull. Am. Paleontology, vol. 9, p. 192, 1922).

NORTHERN SOUTH AMERICA

Colombia

The following papers, which account for only 41 species, deal with the Miocene mollusks of Colombia:

Literature list, Colombia

Pilsbry and Brown 1917
Woodring 1926
Anderson 1927
Palmer 1927
F. Hodson, H. K. Hodson, and Harris 1927

The following summary, which is based on work done in 1923 for the Tropical Oil Company, is published with the permission of Dr. O. B. Hopkins, Chief Geologist of the Imperial Oil Co. (Ltd.).

Marine Miocene deposits are found over a large part of the coastal region of Colombia and extend far up the valleys of Rio Magdalena, Rio Sinu, and Rio Atrato. About 400 species of mollusks are represented in collections from these beds. The lowest Miocene deposits from which fossils were collected crop out in the valley of Rio Sinu. A large *Dinocardium*, a *Nodipecten* like *C. condylomatus* (Dall), and a peculiar "*Phos*" resembling "*Phos*" *inornatus* Gabb are characteristic of these beds, which are considered of lower Miocene age. They are younger than the Culebra formation and Emperador limestone of the Panama Canal Zone and seem to be the equivalent of the Baitoa, Thomonde, and Chipola formations, and also of Gabb's Sapote beds of Costa Rica.

An unmistakable fauna corresponding to that of the Gatun formation of the Panama Canal Zone is found almost throughout the coastal region. *Conus molis* Brown and Pilsbry, *Oliva gatunensis* Toula, *Turritella gatunensis* Conrad, *Clementia dariena* (Conrad), and *Chione mactropsis* (Conrad) are some of the Gatun species that are abundant in these beds. *Glycymeris tumefactus* Pilsbry and Brown and *Antigona caribbeana* Anderson are confined to beds lying below those carrying the Gatun fauna. These beds are considered middle Miocene, and also those that carry the Gatun fauna. A giant *Turritella*, *T.* "*robusta*" Grzybowski, is found in both middle Miocene zones. Fossils from El Banco, which lies on Rio Magdalena about 150 miles in a direct line above its mouth, are considered of middle Miocene age, though most of the species are different from those in the coastal region.

Upper Miocene beds crop out in the vicinity of Usiacuri. Preliminary lists of some of the mollusks from these beds have been published (U. S. Nat. Mus. Bull. 103, pp. 588–589, 1919). The type of *Septastrea matsoni* Vaughan (U. S. Nat. Mus. Bull. 103, pp. 411–412, 1919), which is very similar to *S. marylandica* (Conrad), from the Yorktown formation of Virginia, was collected from these beds. They lie several thousand feet above those carrying a Gatun fauna and are considered younger than any part of the Gatun formation. *Turritella cartagenensis* Pillsbry and Brown (probably a synonym of *T. bifastigata* Nelson), *Turritella lloydsmithi* Pilsbry and Brown, and *Glycymeris canalis trilobicosta* Pilsbry and Brown are abundant in these beds. Some Gatun species, notably *Conus molis* Brown and Pilsbry, are found in these upper Miocene beds, but their fossils show a distinct faunal change. A collection from a locality far up Rio Atrato about 40 miles below Quibdó represents the upper Miocene beds, or possibly the middle Miocene ones.

The giant *Senilia* that is remarkably like the Recent Panamic *S. grandis* (Broderip and Sowerby) occurs throughout the Miocene

section. The smaller *Senilia chiriquiensis* (Gabb) is found in middle Miocene beds that carry a considerable number of brackish-water species. Both these Arcas are widely distributed in the Miocene deposits of the West Indies, Central America, and northern South America.

Pilsbry and Brown record the following Bowden species from Colombia:

Bowden species recorded from Colombia

Conus multiliratus gaza Johnson and Pilsbry
Murex pomum Gmelin
Semicassis reclusa (Guppy)
Polinices brunnea subclausa (Sowerby)

It is not expected that many other Bowden species will be found among the Miocene mollusks from Colombia. The Gatun fauna shows a remarkable unity from Costa Rica to Colombia, and to a less extent northward to the Isthmus of Tehuantepec in Mexico and eastward to Venezuela and Trinidad. Many of the species of this fauna that have an extensive distribution along the western and southern borders of the Caribbean Sea have never been found in the West Indies.

Venezuela

The literature list for Venezuela is as follows:

Literature list, Venezuela

Guppy 1866*a*
Guppy 1867*a*
Dall 1890–1903
Guppy 1913
Sheldon 1917
Maury 1925
Aguerrevere 1925 (Pliocene ?)
F. Hodson 1926
Woodring 1926
Palmer 1927
F. Hodson, H. K. Hodson, and Harris 1927

Very little information about the Miocene stratigraphy of Venezuela is available in the literature.[1] The 51 Turritellas described by F. Hodson seem to be greatly overnamed, and because of economic interests precise locality and stratigraphic records were withheld, as in the more recent report by F. Hodson, H. K. Hodson, and Harris, which adds a great many names to the literature without contributing much to the geologic history of the region.

Some of the Turritellas described by Hodson (*hubbardi*, *larensis*, and *gilbertharrisi*) resemble species that elsewhere are found in beds now regarded as representing the lowermost Miocene zone (Anguilla horizon). Beds cropping out in the northern part of the State of Falcon, from which *Clementia dariena* (Conrad) has been recorded (Woodring 1926, p. 35), also are considered lower Miocene. They seem to be of the same age as the lower Miocene beds in the Sinu

[1] The Geology of Venezuela and Trinidad (552 pp., 83 pls., 22 figs., 1928), by R. A. Liddle, appeared while this account was in proof.

region of Colombia and, therefore, are correlated with the Baitoa, Thomonde, and Chipola formations. They carry the large *Dinocardium* that is very abundant in the Colombian beds.

Another collection from the Miranda District, Zulia, in the Maracaibo Basin (U. S. G. S. station 1/293), which contains the striking species *Turritella zuliana* Hodson, and also *T. venezuelana* Hodson (? *T. tristis* Brown and Pilsbry) and an *Alveinus* like the Chipola species *A. rotundus* Dall, represents about the same horizon.

No middle Miocene collections from the Venezuelan mainland are in the collections of the United States National Museum, excepting possibly some material in a collection in the Guppy collection labeled Cumana. It is assumed that *Turritella "robusta"* Grzybowski is found in middle Miocene beds, and that the group of *T. bifastigata* Nelson occurs in both middle and upper Miocene deposits, as in Colombia.

The following material in the Guppy collection is labeled Cumana. The names in this list are taken from the labels.

Species in Guppy collection labeled Cumana, Venezuela

Conus marginatus Sowerby ?
Pleurotoma barretti Guppy
Oliva cylindrica Sowerby
Marginella coniformis Sowerby
Marginella
Fasciolaria tarbelliana Grat.
Nassa solidula Guppy (type material)
Columbella gradata crassa Guppy (type material; apparently a manuscript name)
Persona similima Sowerby
Cerithium plebeium Sowerby
Turritella tornata Guppy (type material)
Calyptraea scutellata
Arca pexata Say (changed to tolepia Dall)
Arca incongrua Say (changed to cumanensis Dall; presumably type material)
Janira soror Gabb
Cytherea juncea Guppy (type material)

In addition Guppy records *"Tornatina" coixlacryma* Guppy and *Crepitacella cepula* (Guppy), from Cumana. If all this material came from Cumana, it would be certain that middle Miocene beds of the age of the Bowden formation crop out there. *Acteocina coixlacryma*, *Turritella "tornata,"* and *Crepitacella cepula* are Bowden species. At least two of the specimens labeled *"Pleurotoma" barretti* represent *Polystira barretti*, *Oliva "cylindrica* Sowerby" is *O. reticularis trochala*, *"Persona similima* Sowerby" is *Distorsio clathratus gatunensis*, and *"Cerithium plebeium* Sowerby" is *Clava costaricana stena* Woodring, all of which are found at Bowden, making seven Bowden species recorded from Cumana. Inasmuch as most of these species have not yet been found elsewhere along the south edge of the Caribbean Sea, it would be very remarkable to get so many of them in one small collection. Moreover, the type of preservation and the matrix in

the two small specimens of *"Pleurotoma" barretti*, *Oliva "cylindrica,"* *"Cerithium plebeium,"* and *Turritella "tornata"* are so much like those of Bowden shells that is safe to assume that they came from Bowden. The occurrence of *Acteocina coixlacryma* and *Crepitacella cepula* at Cumana is based only on Guppy's record and can for the present be eliminated. This leaves only one species, *Distorsio clathratus gatunensis*, which is also a Gatun species and would not look out of place in Venezuela. In confirmation of the view that this locality record is not trustworthy, it should be noted that there is no record of any one else having obtained such material at or near Cumana. *"Janira soror* Gabb" is the only one of Guppy's species that can be unequivocally accepted as a Cumana fossil. Several collections in the United States National Museum from a locality east of the castle at Cumana consist almost entirely of Pectens, including topotypes of the giant *P. arnoldi* Aguerrevere. These beds probably are of Pliocene age.

A collection from Margarita Island (U. S. G. S. station 6309, entrance to Boca Laguna de Marites, eight miles west of Palamar) contains a *Turritella* of the group of *T. gatunensis* Conrad, another species that probably is *T. plebeia alowensi* Hodson, and also a species of the group of *T. bifastigata* Nelson. This material is considered middle Miocene. No Miocene fossils have heretofore been recorded from Margarita.

Curaçao

In the Wagner Institute papers Dall recorded a number of Bowden pelecypods from Curaçao, a Dutch island lying off the Venezuelan coast. A footnote was added to Publication 366 (p. 25) calling attention to a probable error in this record. The so-called Curaçao material was originally scattered through a general collection. When it was assembled it became apparent that not only all the species are Bowden species, but the specimens have all the appearance of Bowden shells. Twenty-seven species are represented in this material, but it hardly seems worth while to list them, as all the determinable ones are Bowden species.

Dr. J. E. Benedict, of the United States National Museum, who was the naturalist on the Fish Commission steamer "Albatross" in 1884 when the Curaçao fossils were collected, informs me that locality labels were printed on board ship and were put with the collections. None of these labels is with the Bowden species, but a collection, consisting principally of large specimens of *Spondylus echinatus* Martyn, which has one of these labels, finally was found. These fossils were collected from one of the elevated Quaternary reefs. The record of Miocene fossils from Curaçao clearly is spurious. This result agrees with accounts of the geology and palaeontology of Curaçao (Martin, Bericht über eine Reise nach Niederländisch West-Indien und darauf

gegründete Studien, pt. 2, Geologie, 238 pp., 2 pls., 4 maps, 40 figs., Leiden, 1888; J. Lorié, Fossile Mollusken von Curaçao, Aruba, und der Küste von Venezuela: Samml. Geol. Reichs-Mus. Leiden, ser. 2, vol. 1, pp. 111–149, 2 pls., 1889; Vaughan, Some fossil corals from the elevated reefs of Curaçao, Arube and Bonaire: Samml. Geol. Reichs-Mus. Leiden, ser. 2, vol. 2, 91 pp., 1901).

Trinidad

The literature list for Trinidad is as follows:

Literature list, Trinidad

Guppy 1866*a*	Pilsbry and Sharp 1897–98	Sheldon 1917
Guppy 1867	Guppy 1908	Van Winkle 1919
Guppy 1873*a*	Guppy 1910	Maury 1925
Guppy 1874	Guppy 1911	Mansfield 1925
Guppy 1882	Guppy 1912	Harris 1926
Dall 1890–1903	Maury 1912	Hodson 1926
Guppy and Dall 1896	Guppy 1913	Palmer 1927

The most recent discussion of the Miocene deposits of Trinidad is in Waring's report (The geology of the Island of Trinidad, B. W. I.: Johns Hopkins University Studies in Geology, No. 7, 180 pp., 20 pls., 1926) and Maury's report (1925) is the most complete description of the Miocene mollusks.

The stratigraphy of the Miocene beds of Trinidad is very complex and the nomenclature is confused. More than 400 Miocene and Pliocene species of mollusks are already on record. As no original data on Trinidad geology can be offered here, no attempt will be made to discuss the Miocene deposits other than to point out those that seem to be of about the same age as the Bowden formation. According to Maury, the Bowden species given in table on page 84 are found in the Miocene and Pliocene beds of Trinidad.

"*Leda*" *peltella* Dall and *Corbula heterogena* Dall, two Bowden species, the occurrence of which in Trinidad is based only on Guppy's record, are not included in this list, nor are *Conus planiliratus* Sowerby, *Typhis alatus obesus* Gabb, and *Glycymeris jamaicensis* Dall, which are recorded by Maury (see Pub. 366, p. 211). Some of the other identifications, based on poor material, are open to question. On a strictly numerical basis the Bowden fauna seem to most closely resemble that of the Manzanilla beds or of the Springvale beds. Inasmuch as none of the Trinidad faunas agree in size or in facies with the Bowden fauna, a comparison on such a basis is unwarranted. About the only conclusion that can be reached is that there is nothing in Trinidad to compare with the Bowden fauna. Maury's correlation of the Brasso beds with the Gurabo formation is accepted. Therefore, despite the preceding list, the Bowden formation seems to be of about

the same age or a little younger than the Brasso beds. Although many of the Brasso species resemble those from Bowden, only one, based on a worn unfigured specimen, has been recorded as identical.

Bowden species reported from Trinidad

SPECIES	Lower Miocene	Middle Miocene		Upper Miocene	Pliocene
	Machapoorie beds	Manzanilla beds	Brasso beds	Springvale beds	Matura beds
Gastropods:					
Conus stenostoma Sowerby				?	
Distorsio decussatus simillimus (Sowerby)		×			
Malea camura Guppy	?				
Strombus bifrons Sowerby	×				
Vermicularia spirata (Philippi)					×
Lemintina papulosa (Guppy)		×		×	
Architectonica nobilis quadriseriata (Sowerby)		×			
Diodora alternata henekeni Maury					?
Pelecypods:					
"Arca" occidentalis Philippi				×	×
Barbatia domingensis (Lamarck)					×
Anadara inaequilateralis (Guppy)			×		
Amusium papyraceum Gabb		×			
Crassinella guppyi (Dall)				×	
Chama involuta Guppy		×			
Cardium serratum Linné				×	
Strigilla pisiformis (Linné)					×

Tobago

Guppy (1903) recorded under the name of "*Arca patricia* Sowerby" the large *grandis*-like *Senilia* found at many other localities in Miocene deposits. This species has not yet been recorded from Pliocene deposits, but it would not be safe to assume that it disappeared at the end of Miocene time everywhere in the Caribbean region. The Tobago deposits that carry this species probably are of Miocene age, but additional material is needed to confirm this age determination.

Brazil

Only three reports (White 1887, Maury 1925*a*, and Palmer's compilation of the veneroids) deal with Miocene mollusks from Brazil. The material described by White and Maury was collected at two localities in the State of Para immediately south of the mouth of the Amazon. Almost 250 species have been described or recorded from these two localities, but many of them are based on unrecognizable molds. These beds are undoubtedly of lower Miocene age, and Maury's correlation of them with the Chipola formation of Florida, which in turn is correlated with the Baitoa, Thomonde, and Quebradillas formations, seems fully justified. Despite the great distance between the West Indies and the localities in Brazil, and the location of the mouth of the Amazon between them, the Brazilian fossils are, as Maury points out, very similar to lower Miocene species from the West Indies. An even more striking feature is the similarity of the living West Indian and Brazilian mollusks. Inasmuch as the great volume of water discharged by the Amazon would be an effective barrier to the spread of littoral marine species, Dall (Proc. Washington Acad. Sci., vol. 3, p. 139, 1901; Bull. U. S. Fish Commission, 1900, vol. 1, p. 355, 1901) concludes that the distribution of the Recent species apparently took place before the Amazon discharged so much water. The same conclusion can be reached for the lower Miocene species. The distribution of the Recent species can be regarded as indirect evidence of the late date of the uplift of the Andes, for, as Professor Berry orally suggests, the present Amazon system, which is fed principally by the heavy precipitation on the eastern slope of the Andes, is a direct consequence of that event.

At one of the Brazilian localities (Rio Pirabas) the lower Miocene beds carry *Orthaulax brasiliensis* Maury, which needs comparison with the West Indian lower Miocene *O. aguadillensis* Maury. *Clementia brasiliana* Maury may represent the small form of *C. dariena* (Conrad), found elsewhere in northern South America in lower Miocene deposits.

PACIFIC COAST

NORTHERN SOUTH AMERICA

Peru

It is not considered necessary to compare the Bowden mollusks with those from the Tertiary deposits of Argentina and Chile, for both these regions fall in a different faunal province and Miocene beds of the same age as the Bowden formation would carry a different fauna.

The literature list for Peru is as follows:

Literature list, Peru

Nelson 1870
Grzybowski 1899
Woods 1922
Spieker 1922
Hanna and Israelsky 1925
Hodson 1926
Palmer 1927

Both d'Orbigny (Voyage dans l'Amérique Méridionale, Paléontologie, vol. 3, pt. 4, 188 pp., 22 pls. in vol. 8 [1847], 1842) and Gabb (Am. Jour. Conch., vol. 5, pp. 25–32, 1870; Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, pp. 263–336, pls. 35–43, 1881) describe Mesozoic, Eocene, and Quaternary mollusks from Peru, but apparently none from the Miocene beds.

The Miocene mollusks so far recorded from Peru are from the Zorritos formation in the extreme northern coastal part of the country. Spieker divides this formation into three parts. He records six species as identical with Bowden species (*Conus multiliratus gaza* Johnson and Pilsbry, "*Dolium*" (*Malea*) *camura* (Guppy), "*Pitaria* (*Lamelliconcha*)" *planivieta* (Guppy) *Chione* (*Lirophora*) *hendersonii* Dall, *Tellina* (*Eurytellina*) *aequicincta* Spieker, and *Tellina* (*Angulus*) *pressa* Dall), but it is doubtful whether any of these species are represented at both localities. The relationships of the Zorritos mollusks are to be looked for in the Gatun formation of the Canal Zone and in the Miocene deposits of Colombia, Venezuela, and Darien. The presence of *Turritella "robusta"* Grzybowski, *T. bifastigata* Nelson, and a *Turritella* of the group of *T. altilira* Conrad, and of the Pacific genera *Aphera*, *Malea*, and *Clementia* gives the Zorritos fauna a familiar aspect in terms of Caribbean Miocene faunas, but "*Phos ?*" *latirugatus* Spieker, "*Argobuccinum*" *zorritense* Nelson, and *Triumphis solida* (Nelson) show that this fauna represents a different province. The Zorritos fauna as a whole has a middle Miocene appearance, the same as the Gatun formation. Iddings and Olsson (Bull. Am. Assoc. Petroleum Geologists, vol. 12, pp. 24–26, 1928), following Spieker, consider the Zorritos formation of lower Miocene age.

Ecuador

Clementia dariena (Conrad) (Woodring 1926, p. 35) is the only Miocene mollusk so far recorded from Ecuador.[1] This species was listed from a locality in the Santa Elena Peninsula from beds that were called lower (?) Miocene. *Turritella "robusta"* Grzybowski and probably several other Zorritos species are in the same collection and in collections from near-by localities. These Miocene beds of the Santa Elena Peninsula probably are of middle Miocene age, like the Zorritos formation.

CENTRAL AMERICA

Panama

Very little has been published on the Miocene deposits of the Pacific coast of Panama, the only reports being as follows:

Literature list, Pacific coast of Panama

Dall 1890–1903
Joukowsky and Clerc 1906
Woodring 1926
Palmer 1927

[1] A list was published recently by Sheppard (Notes on the Miocene of Ecuador: Bull. Am. Assoc. Petroleum Geologists, vol. 12, pp. 671–673, 1928).

Two of these reports (Dall and Woodring) deal with only one species—*Clementia dariena* (Conrad).

The deposits near Garachiné, in Darien, described by Joukowksy, may be of Miocene age, but more probably are Pliocene. The oyster recorded as "*Ostrea haitensis* Sowerby" belongs to the group of *O. megodon* Hanley.

Extensive collections from Darien were made by Dr. Axel A. Olsson and Dr. Frank Reeves on Rio Chucunaque and Rio Tuyra, and on tributaries of both these streams. Apparently these rivers flow in an extensive basin of Miocene deposits. Unfortunately it seems that either during shipment or during unpacking the collections from Darien were mixed with collections from localities near Mt. Hope or Mindi in the Canal Zone. Some of the collections now bearing a locality number for Darien look like straight Canal Zone collections, others seem to be a mixture, but others can be accepted as Darien material. Even the last collections have a number of characteristic Gatun species. *Conus molis* Brown and Pilsbry, a *Cancellaria* like *C. solida* Sowerby, "*Phos*" *gatunensis* Toula, *Solenosteira dalli* Brown and Pilsbry, and "*Arca*" *dariensis* Brown and Pilsbry are easily recognized ones. A spiny *Cancellaria*, a *Xancus*, a new *Cymia*, several queer *Phos*-like species, *Turritella* "*robusta*" Grzybowski, and a number of brackish-water species including a *grandis*-like *Senilia* are not found in the Gatun formation. Most of these species give a more pronounced Pacific aspect to the Darien fauna, but the *Xancus* is the only fossil or living species from the eastern Pacific. The correlation of the Darien Miocene beds with the Gatun formation is as certain as correlation between two different basins ever can be. The presence of the Gatun species is sufficient evidence to assume that a transisthmian strait connected the Atlantic and Pacific during middle Miocene time. Additional evidence for this assumption is furnished by the statement of Maack (in Selfridge, Reports of explorations and surveys to ascertain the practicability of a ship-canal between the Atlantic and Pacific Oceans by the way of the Isthmus of Darien, p. 163, Washington, 1874) to the effect that the fossil-bearing beds of the Tuyra Valley extend across the continental divide into the basin of Rio Atrato. These Miocene Darien species have not yet gotten into the literature unless Palmer's record (1927) of three veneroids from the "Province of Darien" refers to them

Miocene fossils have also been collected farther west in Panama, west of the Canal Zone. Joukowsky and Clerc described seven species from localities near Macaracas, in the Province of Los Santos. One of these species is a *Turritella* (*T. venezuelana* Hodson, ? = *T. tristis* Brown and Pilsbry), erroneously identified as *T. gatunensis* Conrad. These beds near Macaracas probably are of lower Miocene age. Other species, including a *Turritella* of the *altilira* group, are represented in

the United States National Museum in collections made near Macaracas and also in the Province of Herrera between Pesé and Ocú. These lower Miocene beds also crop out in the vicinity of Santiago, where they carry small specimens of *Clementia dariena* (Conrad), and farther south in the Province of Veraguas along streams draining into the Gulf of Montijo. Collections from localities near Tolé, San Felix, and David, in Chiriqui Province, show that the lower Miocene beds have an extensive distribution along the Pacific coast of western Panama. Most of the material is poorly preserved, but it is estimated that close to 100 species are represented in the collections of the United States National Museum.

Less deformed beds near David carry an unmistakable Gatun fauna, which is remarkably distinct and can be traced on the Caribbean side from Costa Rica to Colombia and on the Pacific side from Darien to Chiriqui. A collection from Rio Platanar (U. S. G. S. station 7955) carries *"Drillia" gatunensis* Toula, *Turritella gatunensis* Conrad, *Turritella "robusta"* Grzybowski, and possibly other Gatun or Darien species. At other places a relatively small *Senilia* is abundant. Both the lower and middle Miocene deposits of the Pacific coast of Panama carry *Clementia dariena* (Conrad) (see Woodring 1926, pp. 35–36).

Costa Rica

Clementia dariena Conrad (see Woodring 1926, p. 36) and seven other species listed by Romanes (Quart. Jour. Geol. Soc. London, vol. 68, p. 125, 1912) are the only Miocene mollusks recorded from the Pacific coast of Costa Rica. Material in the United States National Museum, collected at Carballo cliff and Carballo tunnel, is rather poorly preserved, but it undoubtedly is Miocene, and it seems to be of the same age as the lower Miocene beds of Panama. The same beds, which consist almost entirely of volcanic débris, crop out at Brazil, west of San José, and farther inland at Santa Maria de Dota, which lies near the east edge of the Province of San José. Here again they carry *Clementia dariena* (Woodring 1926, p. 36, identification doubtful). A *Turritella* of the *altilira* group in the Alfaro collection from Narajo, five kilometers south of Turrúcares, still farther east, and external molds from tuff at Turrúcares probably were collected from beds of the same age. These isolated outcrops, separated by later floods of lava and tuff, indicate an extensive transgression of the lower Miocene sea and the presence of a transcontinental strait across central Costa Rica during lower Miocene time, as several writers have pointed out (for references see Woodring 1926, p. 28). The lower Miocene beds of the Pacific coast and interior of Costa Rica and Gabb's Sapote locality seem to represent the same age. *Schizaster cristatus* Jackson (U. S. Nat. Mus. Bull. 103, pp. 113–114, pl. 52, figs. 2–4, 1919), from

Brazil, needs comparison with *Schizaster scherzeri* Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 348, pl. 45, figs. 28, 28*a*, *b*, 1881), from Sapote.

The limestones at Patarra, San Antonio de Desamparados, and San Miguel, described by Hill (Bull. Mus. Comp. Zool. Harvard College, vol. 28 (geol. ser., vol. 3), pp. 226–227, 1898), Alfaro (Bol. de Fomento, year 1, pp. 123–131, 5 figs., 1911), and Romanes (Quart. Jour. Geol. Soc. London, vol. 68, pp. 106–108, 1912) probably are older, but the Alfaro collection contains only fragmentary molds of a large and a medium-sized "*Pecten*" from these localities. This material, however, substantiates Romanes' view that these limestones are not Cretaceous, as they were called by Hill.

Nicaragua

No Miocene mollusks from the Pacific coast of Nicaragua are on record, but a small lot of poorly preserved material, collected from the "Brito formation" by Hayes 75 miles northwest of Brito Harbor (U. S. G. S. station 6409), contains at least one species (a *Cyclinella*) that is also found in the lower Miocene beds near Puntarenas, Costa Rica, and other species in the lot have a Miocene aspect. Apparently the lower Miocene beds of the Pacific coast of Panama and Costa Rica extend at least as far northwestward as the middle of Nicaragua. This material confirms Vaughan's statement (U. S. Nat. Mus. Bull. 103, pp. 197, 591, 1919), based on Bassler's determination of a bryozoan, that Hayes included beds of both Eocene and Miocene age in the Brito formation.

Other material from Nicaragua, labeled Granada (U. S. G. S. station 3094), which lies on Lake Nicaragua, consisting principally of giant specimens of *Malea*, *Ostrea*, *Chione*, and *Harvella*, is Pliocene or Quaternary.

The only material from the Machuca formation of eastern Nicaragua, which Hayes considered of about the same age as the Brito formation, consists of molds of a fresh-water gastropod, probably *Hemisinus*.

OTHER AMERICAN LOCALITIES

ATLANTIC COAST

Florida

The Florida Miocene section is as follows:

Florida Miocene deposits

Time subdivision	Formation	
Upper Miocene	Choctawhatchee marl	
Middle Miocene	Alum Bluff group	Shoal River formation Oak Grove sand[1]
Lower Miocene		Chipola formation
	Tampa and Chattahoochee formations	

[1] Gardner (Bull. Geol. Soc. America, vol. 35, pp. 861–862, 1924) considers the Oak Grove sand lower Miocene.

Dall has described the mollusks of the Tampa formation (U. S. Nat. Mus. Bull. 90, 1915), but many of the figures in this report are based on specimens from the Alum Bluff group. Whether these species are represented in the Tampa formation needs confirmation (see Gardner, Bull. Geol. Soc. America, vol. 35, pp. 858–859, 1924). The Chattahoochee formation is not so fossiliferous as the Tampa. Both these formations are considered as representing about the same horizon as the Anguilla formation. They are so much older than the Bowden formation that further discussion of them is unnecessary. Tampa records of *Spondylus bostrychites* Guppy, *Cardium bowdenense* Dall, and *"Gastrochaena" rotunda* Dall, all of which are Bowden species, are rejected or questioned in Publication 366.

The mollusks of the Alum Bluff group have been monographed by Dr. Julia Gardner, whose report is in course of publication, four parts, dealing with most of the pelecypods, having already been issued (U. S. Geol. Survey Prof. Paper 142–A, B, C, D, 184 pp., 28 pls., 1926). The deposits of the Alum Bluff group and the general character of their faunas are briefly described in the introduction to Gardner's report. The three formations of the group are not known to lie one above the other in any section, and their stratigraphic relations have been determined primarily by the fossils they carry. Detailed comparisons with the Bowden fauna must await the issue of the remainder of Gardner's report.

The Chipola formation carries almost 450 species of mollusks, according to Gardner (p. 2), a number that is far larger than the number found in either the Oak Grove sand or in the Shoal River formation. The Chipola fauna is subtropical and is much more like the Miocene faunas of tropical America than any other Florida Miocene fauna. Only a few of the genera are not found in the Miocene deposits of tropical America. The Chipola formation carries the last species of *Orthaulax* (*O. gabbi* Dall) known in the United States, and also the last species of *Alveinus* (*A. rotundus* Dall). It has a remarkable Eocene survivor in "*Ampullina*" *fischeri* Dall, which represents the genus *Globularia*. The Thomonde and Baitoa formations also carry *Orthaulax* and *Alveinus*, and it is expected that many other Thomonde and Baitoa species will be found to be similar to Chipola ones and that a number of species will be found in all three formations. The correlation of the Chipola, Tuxpan, Thomonde, and Baitoa formations, and Quebradillas limestone with each other is more definite than any other Miocene correlation between the Caribbean region and continental America.

Orthaulax has been mentioned so often in this discussion that it is natural to conclude that particular significance is attached to it. No more significance is given to it, however, than to any other widespread, easily recognized, and short-lived genus. The dangers of relying too much on the range of one genus are fully recognized. At one time *Orthaulax* was considered evidence of Oligocene age. According to current age assignments, however, it ranges from middle Oligocene to the top of the lower Miocene. Throughout tropical America and Florida it is not found in beds younger than the Thomonde, Baitoa, and Chipola formations, and the Quebradillas limestone. Other lines of evidence point to the essential synchroneity of these deposits, so that *Orthaulax* has turned out to be particularly valuable. Nagao (Japanese Jour. Geology and Geography, vol. 3, No. 1, pp. 13–18, pl. 1, 1924) has described a Japanese Eocene mollusk as *Orthaulax japonicus*. According to some of the figures (4*a*, 4*c*), the inner and outer lips of this species are not stromboid. It probably represents a genus of some other family that developed an *Orthaulax*-like habit of enveloping the spire and depositing callus between the whorls.[1]

The Oak Grove sand carries less than half as many species as the Chipola formation (Gardner, p. 2). The presence of large busyconoids, an *Astarte*, and a *Lyropecten*, similar to species from the Chesapeake embayment, and the absence of some of the Chipola genera indicate water of slightly lower temperature. The Shoal River formation, which has a slightly larger fauna, carries three species of *Astarte*, but the presence of several genera of Cancellarias, of *Echino-*

[1] Since this was written Dr. Nagao kindly sent me two paratypes that confirm the suspicion that this species represents some other genus, probably allied to *Pseudoliva*.

chama, and of other tropical groups shows that perhaps the water was not cooler than during Oak Grove time. When descriptions of the Alum Bluff mollusks are available it will be found that the Shoal River mollusks are similar to those from the middle Miocene of Mexico and the Gatun formation of Costa Rica and Panama, due allowance being made for the difference in temperature facies (see Gardner, Bull. Geol. Soc. America, vol. 35, p. 862, 1924).

In this report and in Publication 366 only three Bowden species are recorded from the Chipola formation—*Volvula oxytata* Bush, *Rissoina browniana* d'Orbigny, and *Typhis alatus obesus* Gabb,—two of which represent smooth forms under which more than one species may be placed. None is recorded from the Oak Grove and Shoal River formations, the latter of which apparently is of almost the same age as the Bowden formation. Similarities for Oak Grove and Shoal River species are to be looked for in Mexico and to a less extent in Central America rather than in the West Indies.

The Florida Miocene beds are particularly interesting because they are the first ones so far discussed in which remains of land mammals have been found. These remains were described by Sellards (Florida Geol. Survey Eighth Ann. Rept., pp. 82–92, 1916). They were collected from a part of the Alum Bluff group that is correlated with the Chipola formation. At the time when they were discovered it was customary, following Dall, to consider the Alum Bluff "formation," as it was then called, Oligocene. Sellards concluded from the presence of a horse of the genus *Merychippus* that it is Miocene. Vaughan (U. S. Nat. Mus. Bull. 103, p. 220, 1919) quotes Merriam's opinion that the *Merychippus* is of lower Miocene (Burdigalian) age. .

The Choctawhatchee marl unconformably overlies the Alum Bluff group. Dr. W. C. Mansfield is now engaged on a monographic study of the mollusks of the Choctawhatchee formation and also of other Florida upper Miocene deposits. His work is showing some interesting results, a discussion of which must await the completion of his report. Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1594, 1903) has emphasized the pronounced faunal change in some of the upper Miocene beds leading to the widespread appearance of genera and species from the Chesapeake embayment. It is not expected that any Bowden species will be found in the upper Miocene beds, except a few Recent ones, but Mansfield has discovered that some of the Florida species need comparison with those from Costa Rica, and some of the Costa Rican beds may eventually be correlated with the Florida upper Miocene.

Both the Alum Bluff group and the upper Miocene beds carry Chiones belonging to the group represented by *C. burnsii* Dall (Chipola formation), *C. glyptocyma* Dall (Oak Grove sand), *C. trimeris* Gardner (Shoal River formation), and *C. ulocyma* Dall (upper Miocene). Some

of these species are very similar to *C. mactropsis* (Conrad), one of the characteristic species of the Gatun formation and of its equivalents in Mexico, Costa Rica, and Colombia. This species has not been found in the West Indies and furnishes another example of the distinctness of the Mexico-Central America-northern South America Miocene fauna from the West Indian one. This group of Chiones, which is going under the subgeneric name of *Lirophora*, deserves a name. Like many other Miocene groups from the Caribbean region and Florida it is no longer living there, but is represented in the Panamic and Mazatlantic regions by *C. kellettii* (Hinds).

So far as numbers of identical species are concerned the Bowden formation is more like the Pliocene Caloosahatchee marl than like any of the Florida Miocene beds. The following Bowden species are recorded by Dall from the Caloosahatchee marl:

Bowden species recorded from Caloosahatchee marl

Gastropods:
- Volvula oxytata Bush
- Conus proteus Hwass
- Trivia pediculus (Linné)
- Rissoina browniana d'Orbigny
- Cheilea "equistris (Linné)"
- Tectonatica pusilla (Say)
- Murex pomum Gmelin

Pelecypods:
- "Arca" occidentalis Philippi
- Barbatia domingensis (Lamarck)
- Cardium medium Linné
- Cardium serratum Linné

It will be observed that all these are Recent West Indian species, and that none of the striking species characteristic of the Caloosahatchee marl is found at Bowden. So far as the Florida Miocene and Pliocene beds are concerned a numerical comparison with the Bowden fauna breaks down, for it is quite clear that the Bowden formation is not Pliocene, as the percentage of Recent species is far too low. The subtropical facies of the Caloosahatchee fauna and its greater size overbalance the age advantages that the Florida Miocene beds have.

Middle Atlantic States

The Miocene deposits of the middle Atlantic States are as follows:

Miocene deposits of middle Atlantic States

Time subdivision	Formation
Upper Miocene	Duplin marl Yorktown formation
Middle Miocene	St. Marys formation Choptank formation Calvert formation

The correlation of the Calvert formation with the Tortonian of Europe is based on both plants and marine mammals (Berry, U. S. Geol. Survey Prof. Paper 98–F, 1916; Kellogg, Bull. Geo. Soc. America, vol. 35, pp. 763–764, 1924). According to the conclusion here reached as to the age of the Bowden formation, it is of about the same age as the Calvert, Choptank, or St. Marys formation. The Bowden mollusks are so different from those of any of these deposits that they might as well come from some other part of the earth. *Cardium medium* Linné is recorded from the St. Marys and Duplin formations and *Volvula oxytata* Bush from the Duplin. Both these Recent species are found at Bowden. Not only is there such a great difference in species, but many of the Bowden genera are not found in the middle Atlantic Miocene. According to published accounts, the following Bowden genera are recorded from the Duplin marl, but not from any of the others:

Bowden genera recorded from Duplin marl, but not from Calvert, Choptank, St. Marys, and Yorktown formations

Ficus[1]	Triphora	Fossularca
Cypraea	Rissoina	Placunanomia
Trivia	Naticarius	Echinochama

[1] "*Pyrula*" *harrisi* Martin (Maryland Geol. Survey, Miocene, p. 226, pl. 55, fig. 3, 1904), from the Calvert formation, is not regarded as representing *Ficus*.

On account of its warmer facies the Duplin fauna is more similar to the Bowden fauna than any of the other Miocene faunas of Maryland, Virginia, and North Carolina.

PACIFIC COAST

Lower California

I have not found any record of Miocene deposits in the 2000-mile stretch between central Nicaragua and the southern part of the Peninsula of Lower California, where recent expeditions have discovered Eocene and Miocene beds (N. H. Darton, Geologic reconnaissance in Baja California: Jour. Geology, vol. 29, pp. 720–748, 22 figs., 1921. Arnold Heim, Notes on the Tertiary of southern Lower California: Geol. Mag., vol. 59, pp. 529–547, pls. 21–22, 7 figs., 1922. Anonymous, Informe sobre la exploración de la Baja California, par la "Marland Oil Company of Mexico": Bol. Petroleo, vol. 17, No. 6, pp. 417–453, pls. 4–46, map, 1924; vol. 18, No. 1, pp. 14–53, pls. 77–92, map, 1924). Darton's paper contains preliminary lists of the Miocene fossils collected. A list, based on specimens collected by Heim, was issued by Dickerson (Bull. Geol. Soc. America, vol. 28, pp. 230–232, 1917; Proc. California Acad. Sci., ser. 4, vol. 7, No. 8, pp. 197–205, 1917), and by Arnold and Clark (Bull. Geol. Soc. America, vol. 28, pp. 223–224, 1917). Descriptions of species, based for the most part

on the Marland collections, were recently issued by Hertlein and by Hertlein and Jordan (Proc. California Acad. Sci., ser. 4, vol. 14, No. 1, pp. 1–35, pls. 1–6, 1925; Proc. California Acad. Sci., ser. 4, vol. 16, No. 19, pp. 605–647, pls. 17–21, 1927).

The collections made by Darton, some of the material collected by the Marland expedition, and duplicates of the Heim collection are in the National collections. On the basis of this material it seems probable that both the lower and middle Miocene of Central America are represented in southern Lower California. Heim's material from Purisima, San Ramon, and La Huerta Vieja, containing the species identified by Dickerson as *Turritella tristis* Brown and Pilsbry, *Pecten oxygonum optimum* Brown and Pilsbry, and *Pecten condylomatus* Dall, would be called lower Miocene in Central America. "*Pecten oxygonum optimum*" probably represents *Chlamys canalis* (Brown and Pilsbry), from the Emperador limestone of the Panama Canal Zone. The specimens identified as "*Pecten*" *condylomatus* Dall closely resemble that species, which is found in the Chipola and Tuxpan formations, though they are considerably larger and for the most part less inflated. Neither of these Pectens is represented in the material described by Hertlein.

Heim's material that is considered middle Miocene was collected at Agua Verde and east of San Isidro. The Agua Verde collection contains Dickerson's "*Raeta gibbosa* Gabb" (probably *Raeta gardnerae* Spieker, the type of which is from the Zorritos formation of Peru), a mold of a *Chione*, a mold of a mactroid (probably a large *Mulinia* like *M. pallida* (Broderip and Sowerby)), and molds of a *Turritella*. The material collected east of San Isidro consists of a *Turritella* of the phylum of *T. ocoyana* Conrad, and an oyster like the Caribbean Miocene *O. haitensis* Sowerby, of which *O. gatunensis* Brown and Pilsbry may be a synonym, and also like *O. fischeri* Dall, now living in the Gulf of California. A Marland collection from a locality near San Ignacio (L. C. 7), containing *Turritella bösei* Hertlein and Jordan and *Cymia heimi* Hertlein and Jordan, in particular resembles the middle Miocene of Central America. A subspecies of *Cymia heimi*, or a species of the same phylum, is found in the middle Miocene beds of Darien that clearly are of the same age as the Gatun formation of the Panama Canal Zone (see p. 87). It represents a different phylum from the one embracing *C. henekeni* Maury of the Baitoa and Thomonde formations. *Turritella bösei* is the species repeatedly referred to in this discussion as *T.* "*robusta*" Grzybowski. The type material of *T.* "*robusta*" Grzybowski is from the Zorritos formation of Peru. It differs from *ocoyana*, as Spieker (Johns Hopkins Univ. Studies in Geology No. 3, pp. 85, 86, 1922) has pointed out, principally in its larger size and in having a sharper keel and heavier spiral threads. *T. robusta* Grzybowski (1899) is a homonym of

T. robusta Gabb (1864) and the Peruvian form will take the name of *Turritella abrupta* Spieker. Inasmuch as *T. "robusta" abrupta* Spieker and *T. charana* Spieker are considered synonyms of *T. "robusta,"* *T. supraconcava* Hanna and Israelsky (Proc. California Acad. Sci., ser. 4, vol. 14, No. 2, p. 59, 1925) is a quite unnecessary substitute name for *"robusta."* *T. robusta fredeai* Hodson (Bull. Am. Paleontology, vol. 11, pp. 183–184, 1926), based on material from Venezuela, and finally *T. bösei* Hertlein and Jordan are considered further synonyms. Though specimens from different localities and also from the same locality, even in the type region of *ocoyana*, differ in the prominence of the keel and in the strength and spacing of the spiral threads, and though it may be desirable to recognize the Lower California specimens as a subspecies, apparently six names have already been proposed for this tropical representative of *ocoyana*. *T. wittichi* Hertlein and Jordan probably represents the keelless variety of this phylum of Turritellas. Other species than those already mentioned are similar to Caribbean Miocene fossils. *Cypraea amandusi* Hertlein and Jordan is remarkably similar to *C. henekeni* Sowerby, found in the Gurabo and Gatun formations, and may turn out to be a synonym, or at least a subspecies, of *henekeni*.

Hertlein and Jordan consider that their material represents approximately the same horizon, which they correlate with the lower part of the Temblor formation of California. In accordance with the general practice of recognizing only two major Miocene divisions on the Pacific coast, they place this horizon in the lower Miocene, though it falls in the middle Miocene according to the nomenclature used in this discussion.[1]

Vaughan (cited by Heim) has already called attention to the strategic importance of these Miocene fossils from Lower California. Like the Miocene fossils of the Isthmus of Tehuantepec on the Caribbean side they are in a critical place to furnish a means for comparing the deposits of tropical America with those of the United States. With these Mexican localities it should be possible to complete a correlation circuit from Florida to California by way of Central America. The correlation of the Miocene beds on the Atlantic side of Panama and Costa Rica with the deposits on the Pacific side of these countries seems to be on a firm basis. The fossils should, however, be described and an effort should be made to find additional Miocene outcrops

[1] Wiedey (Notes on the Vaqueros and Temblor formations of the California Miocene with descriptions of new species: Trans. San Diego Soc. Nat. Hist., vol. 5, No. 10, pp. 95–182, pls. 9–21, 1928) discusses the affinities of *T. bösei* in a paper that appeared as the proof of this report was being read. He proposes to use *bösei* for the keeled Turritellas found in California and Lower California, and *ocoyana* for those that are not keeled. This arrangement is unsatisfactory, for keeled and unkeeled specimens, which are similar in other features, are found at the same locality. Hertlein and Jordan, for example, record *bösei*, *ocoyana*, and *wittichi* from the same locality.

between Lower California and Nicaragua. What has been said concerning the Miocene fossils of Lower California also applies to the Eocene ones. Some of the Eocene beds, which probably represent an upper Eocene zone, carry *Velates* and giant Cerithia. With the *Velates*-bearing upper Eocene beds of Chiriqui Province, Panama, and the middle Eocene beds of Los Santos Province, Panama, they offer an attractive field for comparing the Eocene of tropical America and California.

California

According to Clark (Bernice P. Bishop Mus. Special Pub. 7, table op. p. 804, 1921; Jour. Geology, vol. 29, table op. p. 586, 1921), the standard Miocene section for the California Coast Ranges, slightly modified to admit a middle Miocene division, is as follows:

Standard Miocene section, California Coast Ranges (after Clark)

Time subdivision	Formation	
Upper Miocene	San Pablo group[1]	Santa Margarita formation Cierbo formation (San Pablo formation of U. S. Geological Survey) Briones formation
Middle Miocene	Temblor[1] [and Topanga] formation. (*Turritella ocoyana* zone)	
Lower Miocene	Vaqueros formation. (*Turritella inezana* zone)	

[1] Not recognized by U. S. Geological Survey.

A direct comparison of the Bowden and California Miocene faunas is naturally more impracticable than a comparison with the Miocene fossils of the Chesapeake embayment. Perhaps a working correlation can be reached, however, by utilizing the Lower California and Central American localities. Unfortunately only the upper Miocene California faunas have so far been monographed. The Temblor fauna probably offers the most promising field for comparison with Lower California and Central America. According to Smith (Proc. California Acad. Sci., ser. 4, vol. 3, p. 165, 1912), the "Monterey-Temblor fauna" consists of about 154 species, and Anderson and Martin (Proc. California Acad. Sci., ser. 4, vol. 4, pp. 41–44, 1914) list 89 species from the Temblor formation of the Kern River region, which has yielded the best material. Smith (Proc. California Acad. Sci., ser. 4, vol. 9, p. 160, 1919) considers the "Monterey-Temblor fauna" tropical or subtropical, but it is not tropical either in terms of the

Recent Panamic fauna or in terms of the Caribbean Miocene faunas. The type locality of *Turritella ocoyana* Conrad falls in the Kern River region. This species is the guide fossil of the Temblor formation, or *Turritella ocoyana* zone, according to Merriam's designation (California Univ. Dept. Geol. Bull., vol. 3, pp. 377–381, 1904; Trans. Am. Philos. Soc., n. s., vol. 22, pp. 14–16, 1915). It has already been pointed out that Turritellas of the phylum of *T. ocoyana* are found in Lower California in beds that are considered of middle Miocene age, and that *T. abrupta* Spieker ("*robusta*" Grzybowski) represents the same phylum. Perhaps *T. abrupta* should be considered a subspecies of *ocoyana*, but its disposal must await comparisons with large suites of specimens from California and Lower California. Specimens of *ocoyana* from Southern California (Santa Monica and Santa Ana Mountains) generally are keeled, whereas only a small proportion of those from the type region in the Kern River region are keeled. The specimens from Southern California seem to be intermediate between the *ocoyana* of Central California and the large sharply keeled *abrupta* of tropical America.

In this discussion the tropical form of *ocoyana* is recorded from the Santa Rosa beds of the Isthmus of Tehuantepec, from Colombia and Venezuela, all on the Caribbean side; and from Peru, Darien, Chiriqui Province, Panama, and Lower California, on the Pacific side. It will be observed that the beds carrying Turritellas of the *ocoyana* phylum have on independent grounds been referred to the middle Miocene, except those in Venezuela for which no data are available. On the Caribbean side this *Turritella* is found in two middle Miocene zones corresponding to the Cercado and Gurabo formations of the Dominican Republic. No predecessor of *ocoyana* has been found in California, and it seems probable that the phylum reached the Pacific from the Atlantic, where it may have developed from a stock represented by *T. subgrundifera* Dall of the Chipola lower Miocene.

By means of this indirect comparison and relying for the most part on the admittedly slender evidence of one phylum of Turritellas it is concluded that the Bowden formation is of about the same age as the Temblor formation, or as the upper part of the Temblor formation. Additional material for testing this conclusion is available in the Lower California collections. Merriam's (Trans. Am. Philos. Soc., n. s., vol. 22, pp. 4–6, 14–26, 1915) conclusion that land mammals found in the Coalinga region in beds that are referred to the upper part of the Temblor formation represent a middle Miocene horizon, furnishes additional, though indirect, evidence as to the middle Miocene age of the deposits in Lower California and on the Pacific coast of Panama that are the equivalent of the Gatun formation of the Panama Canal Zone. Kellogg also has recorded marine pelagic mammals from the Temblor formation of the Kern River region,

which he considers is Helvetian (California University Bull. Dept. Geol. Sci., vol. 13, No. 4, pp. 23–132, 6 figs., 1922; Carnegie Inst. Washington Pub. 346, art. 2, 24 pp., 9 pls., 1927). So far mammals have been found in the Miocene beds under discussion only at the extreme ends of the correlation circuit—in Florida and California. It is to be hoped that they will be found at intermediate localities. In the two regions where they have been found the evidence that they furnish is in agreement with the evidence based on the mollusks.

EUROPE

For purposes of comparison with the Bowden formation the Miocene deposits of the North German, Aquitaine, and Piedmont Basins are taken as representative of the principal geographic divisions of the European marine Miocene.

North German Basin

A detailed comparison of the Bowden and German faunas is no more practicable than a comparison with localities in the Chesapeake embayment and California. Inasmuch as the German Basin was an extension of the present North Sea, it would not be supposed that the deposits there represent a warmer facies than any in the Chesapeake embayment. Yet according to the early reports by von Koenen (Schriften-Gesell. Beförderung gesammten Naturwiss. Marburg, vol. 10, pp. 137–262, 3 pls., 1872; Neues Jahrb., Beil.-Bd. 2, pp. 223–367, pls. 5–7, 1883) they carry "*Ancillaria*," "*Pyrula*" (=*Galeodes*), "*Phos*," "*Turbinella*" (=*Latirus*), and *Mathilda*, none of which is found in the Chesapeake embayment, as well as "*Ficula*," *Cypraea*, and *Trivia*, which occur in the Duplin marl, but not in the other Chesapeake formations. Kautsky (Abh. Preussischen Geol. Landesanstalt, n. s., No. 97, 255 pp., 12 pls., 1925) also records *Liotia* and *Triphora*, both of which in the Chesapeake embayment are found only in the Duplin marl. In terms of American faunas, however, the German Miocene would still be warm temperate. The Chesapeake Miocene offers the most promising field for direct comparison (see Dall, Maryland Geol. Survey, Miocene, pp. cl–cliii, 1904). The German Miocene includes lower, middle, and upper Miocene, but the principal fossiliferous beds (Holstein beds) generally are placed in the middle Miocene.

Aquitaine Basin

The type localities of the Aquitanian and Burdigalian stages lie in the Aquitaine Basin in southwestern France. As the part of the monograph by Cossmann and Peyrot on the Aquitaine mollusks dealing with the gastropods is incomplete, the comparison with the Bowden fauna is limited to the pelecypods. The Aquitaine faunas

are warm temperate to subtropical and should be compared with the Florida Miocene rather than with the Caribbean Miocene. The percentage of Bowden genera and of Recent species furnishes about the only basis for comparison. As a warning it should be stated that generic comparisons have not yet reached a reliable stage, for large collections from Aquitaine have not been examined. Some of the generic determinations in an earlier comparison probably are incorrect (Woodring, Bull. Geol. Soc. America, vol. 35, pp. 867–886, 4 figs., 1924).

The approximate percentage of Bowden genera and of Recent species is graphically shown in fig. 3. The time spacing in this graph is arbitrary. Data for the percentage of Recent species are taken

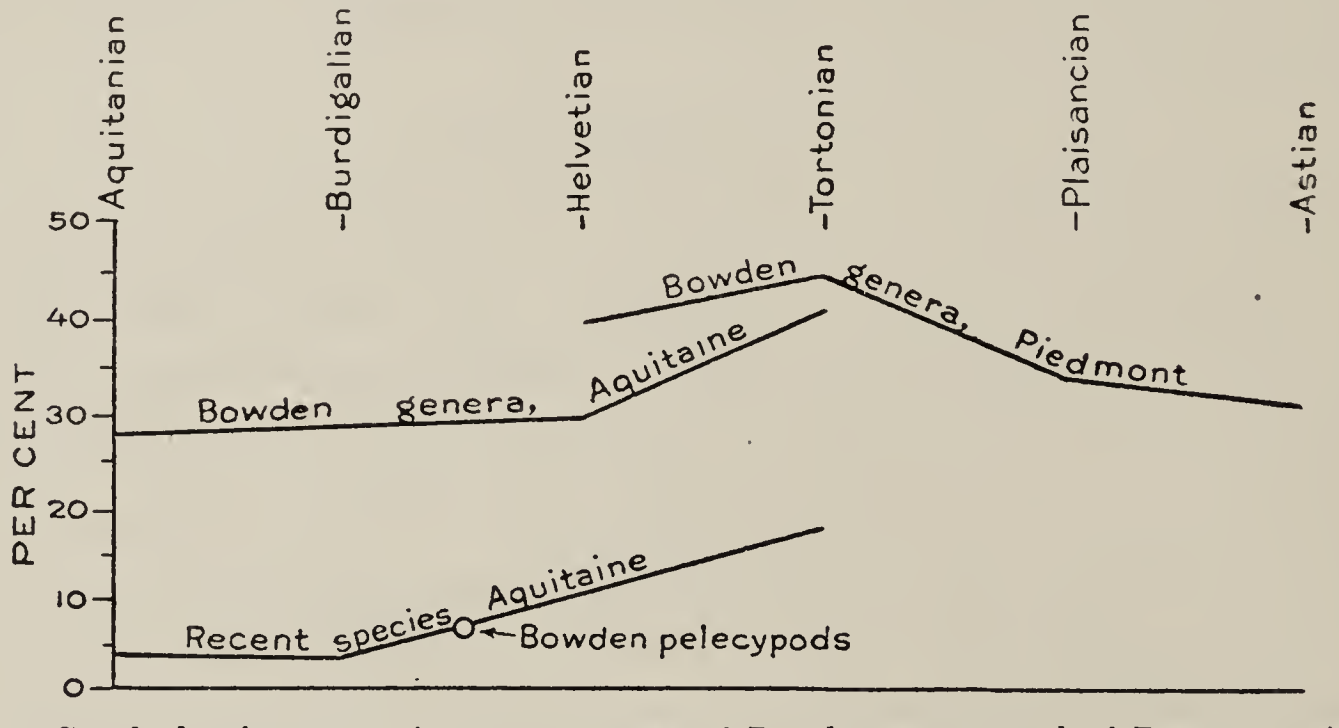

FIG. 3.—Graph showing approximate percentage of Bowden genera and of Recent species in Miocene faunas of Aquitaine Basin, and approximate percentage of Bowden genera in Miocene and Pliocene faunas of Piedmont Basin (based on pelecypods).

from Cossmann and Peyrot (Conch. Néog. Aquitaine, vol. 2, pt. 1 (Actes Soc. Lin. Bordeaux, vol. 66), p. 483, 1912). According to the number of genera in common the Bowden fauna is most like that of the Tortonian, whereas according to the percentage of Recent species it would fall between Burdigalian and Helvetian. Even if there were no question as to the identity of genera, such a numerical comparison is not to be taken too seriously, for it disregards too many factors. The Tortonian fauna is only a third as large as the others. The Bowden and Aquitaine faunas differ at least in temperature facies, and different workers have determined the percentage of Recent species. The percentage of Bowden genera may also be a function of facies and not of time.

The Chipola fauna of Florida offers perhaps the most promising field for direct comparison with the Aquitaine faunas. The Aquitanian and Burdigalian, like the Chipola formation, carry a strange Eocene survivor in the genus *Globularia* (*"Ampullaria" compressa* Basterot),

and they also carry an "*Amauropsis*" ("*Natica*" *eburnoides* Grateloup) like "*A.*" *burnsii* Dall, from the Chipola formation, and "*A.*" *burnsii meridionalis* Pilsbry, from an unknown horizon, probably the Baitoa formation, in the Dominican Republic. These two genera at least suggest that the Chipola formation falls in the first half of the Aquitaine marine series, though in the Piedmont basin *Globularia* survived until the Helvetian stage.

The only European species of *Noetia*, "*Arca* (*Anadara*)" *okeni* Mayer, is found in the Aquitanian and Burdigalian of Aquitaine and in the Helvetian of Touraine. This genus has not been recorded from Bowden or any other Miocene locality in the West Indies proper, but it is very abundant in Central America, northern South America, and Trinidad, 10 species having already been described. If long-continued residence and abundance of species mean anything *Noetia* is autochthonous in American waters, yet "*Arca* (*Anadara*)" *molengraaffi* Martin (Samml. Geol. Reichs-Mus. Leiden, n. s., vol. 2, No. 5, p. 184, pl. 7, figs. 191, 191*a–b*, 192, 192*a*, 1915), from the upper Eocene of Nanggulan, Java, has all the features of *Noetia*. Nevertheless, the isolated occurrence of only one species in Europe in beds as old as Aquitanian indicates that it reached Europe from America, where it is also found in the Chesapeake Miocene. Inasmuch as the earliest species so far recorded from America comes from the Manzanilla beds of Trinidad, which are placed in the lower part of the middle Miocene, *Noetia* should turn up in American beds at least as old as the Anguilla and Tampa formations, unless the age assignments of the American deposits is wrong by at least two stages. According to available information, *Noetia* reached the Caribbean region from the Pacific, and it should be looked for in the California Eocene or Oligocene.

No definite conclusions can be drawn at present from a comparison with the Aquitaine stages, though the Bowden fauna falls somewhere in the latter half of the Aquitaine series and the Chipola formation seems to fall in the first half, which agrees with current age assignments.

Piedmont Basin

The type localities of the Langhian, Tortonian, Plaisancian, and Astian stages lie in the Piedmont Basin, so that the Aquitaine and Piedmont Basins together contain the type localities of six Miocene and Pliocene stages. The Helvetian of the Piedmont Basin may also be regarded as typical of the stage that goes under that name in the Mediterranean region. The earlier numbers of the great series of monographs by Bellardi and Sacco on the Piedmont mollusks dealing with some of the gastropods are out of date as to nomenclature. For this reason and also so as to afford a basis for comparison with the Aquitaine Basin, the numerical comparison with the Bowden fauna is

limited to the pelecypods. As before, these comparisons are based for the most part on illustrations.

The approximate percentage of Bowden genera in the Piedmont faunas is graphically shown in fig. 3. Assuming that the Helvetian and Tortonian stages of the Piedmont and Aquitaine Basins represent the same time interval, a comparison of the graphs shows rather clearly that the percentage of Bowden genera is at least in part a function of climatic facies. The Piedmont faunas, at least the Miocene ones, are more tropical, and therefore the percentage of Bowden genera is larger. The presence of temperate and boreal genera (*"Chrysodomus," Astarte,* and *Macoma*) indicates, however, that the Piedmont faunas are not quite tropical in the same sense as the Bowden fauna, though they represent a much warmer facies than the Chesapeake Miocene, which lies 10° farther south. So far as temperature facies is concerned they most closely resemble the Mexican Miocene. The percentage of Bowden pelecypod genera in the Chesapeake Miocene does not run over about 34 in any of the beds, so that on the basis of comparing genera the Bowden fossils are more like those from the other side of the Atlantic than like those from the middle Atlantic coast, as Guppy recognized long ago (Quart. Jour. Geol. Soc. London, vol. 22, pp. 282, 285, 1866).

The presence of a great many genera—among them *Ancilla, Uromitra, "Turbinella," "Phos," "Thiarella"* (=*Metulella*), *Metula, Distorsio, Bursa, Sconsia, Malea, Ficus, Strombus, "Terebralia"* (=*Clava* in part), *Cheilea, "Perna"* (=*Pedalion*), *Amusium, Codakia, Linga,* and *Cardiolucina,*—all of which are found in the Bowden formation and all of which are exotics so far as present European seas are concerned, give the Piedmont fossils a familiar appearance in terms of those from Bowden. The resemblance between many of the species is so striking that the American specimens will have to be compared with the European ones. The similarity is particularly close in some families—Arcidae, Lucinidae, Marginellidae, Pyrenidae, Cymatiidae, Bursidae, Cassididae,—whereas in others most of the genera are different—Veneridae and Trochidae.

The maximum number of Bowden genera falls in the Helvetian, but the largest percentage falls in the Tortonian. For Bowden and other West Indian Miocene genera together the maximum percentage falls in the Helvetian (see Woodring, Bull. Geol. Soc. America, vol. 35, p. 885, fig. 4, 1924). Though the degree of similarity to the Bowden fauna has some facies significance, it is concluded from the number of common genera and of similar species in the Helvetian and Tortonian and from the percentage of Recent species in the Bowden formation that the Bowden fauna falls in the middle Miocene. I have several times gone on record as considering it Helvetian in terms of the Mediterranean Miocene (see Bull. Geol. Soc. America, vol. 35, pp.

881-884, 1924). I think that the evidence now available fails to warrant an attempt to make correlations across the Atlantic as fine as one stage. In shifting the American Miocene column the Bowden formation is now placed opposite the Tortonian, but that does not mean that it has been shown that it is Tortonian, as the graphs can not be accepted as representing age alone. If an European stage name must be used it seems better to use Vindobonian, a name that was proposed by Depéret for the Second Mediterranean stage of Suess minus the Pontian.

What significance is to be attached to the presence of so many genera in both the Miocene Mediterranean and Caribbean Seas and to their absence farther north in Europe and America during Miocene and earlier periods also must remain open. I have lent support to the idea that these shallow-water genera must have had shallow water to get across the Atlantic (Bull. Geol. Soc. America, vol. 35, pp. 425–436, 1924). This faunal similarity might also be cited in support of the Wegener hypothesis of continental drift. Probably not enough is known about the length of pelagic larval stages, and the distance larvae can be carried by currents to warrant such sweeping palaeogeographic conclusions. It seems reasonable to believe that the larval stage of gastropods that have a large "nucleus" consisting of many whorls, such as the frog-shells, tritons, and tuns, lasts long enough to permit transportation under favorable conditions across the Atlantic in the track of the south equatorial current. At all events some of the Recent species are even more widely distributed in the tropics. Perhaps the families that are represented by many identical genera on the two sides of the Miocene Atlantic are the ones that have a long larval stage, and the ones that are represented by endemic genera have a short stage or none at all. The assembling of available information on larval stages and the obtaining of additional data are the most urgent needs in the study of the distribution of Tertiary mollusks.

THE ORIENT

It is going rather far afield to compare a West Indian Miocene fauna with one from the Orient. A certain amount of similarity would be expected, for both regions are in the tropics, and the Recent West Indian and Oriental faunas have many genera in common and many pairs of analogous species. The Miocene faunas of the two regions are bound to be more similar on account of the Pacific exotics in the West Indian Miocene. Yet the similarity of the Miocene faunas goes even farther, for some of the Oriental Miocene and earlier Tertiary genera that are found in the West Indian Miocene are no longer living in the Orient. Attention has already been called (p. 101) to *Noetia*, which appears in the Javanese upper Eocene. Martin (Samml. Geol. Reichs-Mus. Leiden, n. s., vol. 1, pp. 158–159, pl. 24, figs. 336, 336*a*, 337, 337*a*, 1895) records from the Javanese Miocene

and Pliocene a *Sconsia* for which he uses the name given to a living West Indian species. At the present time *Sconsia* is confined to the West Indian region. According to available records it is found in the Oligocene of southern United States, the Mediterranean region, Sind, and Burma, and in the Miocene of the West Indian and Mediterranean regions, so that the Javanese species seems to be a survivor from an invasion from the Mediterranean. Vredenburg (Rec. Geol. Survey India, vol. 51, p. 95, 1921[1]) also considers *Cypraea murisimilis* Martin a synonym of *C. henekeni* Sowerby from the Gurabo and Gatun formations. In his first paper on the Indian Tertiary species of "*Turbinella*" Vredenburg recorded there the phylum of *Xancus ovoidea* (Kiener), which is now living on the coast of Brazil, and proposed the name "*Turbinella*" *praeovoidea* for a species from the upper Gaj (lower Miocene) of Sind (Mem. Indian Mus., vol. 6, p. 123, 1916). Later on discovering that the Indian fossils represent a different phylum the name was changed to *praemekranica*[2] (Rec. Geol. Survey India, vol. 55, pp. 119–128, 1923; Mem. Geol. Survey India, vol. 50, pt. 1, pp. 174–177, 1925). This genus also is first found in the Oligocene of southern United States, the West Indian region, and the Mediterranean region, and Vredenburg records the Mediterranean Oligocene species from the Nari series (Oligocene) of Sind. It lived in the Mediterranean Sea until Pliocene time and during middle Miocene time gained a temporary footing in the eastern Pacific as a migrant from the Caribbean. It is now living in both the West Indian and Oriental regions.

Data are not now available for a detailed comparison of the Bowden and Oriental Miocene faunas. According to Martin's monographs the Conidae, Marginellidae, Mitridae, and Pyrenidae of Java and the genera *Metula*, *Cassis*, *Sconsia*, and *Malea* have a particularly familiar appearance in terms of Bowden fossils.

No particular palaeogeographic significance can be attached to this resemblance, and it seems that the age determination of the Oriental Miocene deposits must rest on comparison with Europe without any essential aid from tropical America. It has been supposed that the Mediterranean Sea and Indian Ocean were no longer in communication after Eocene time (see discussion by Vaughan, Bernice P. Bishop Special Pub. No. 7, pp. 866–873, 1921), but the work by Vredenburg on the post-Eocene mollusks of northwest India, cut short by his

[1] I am unable to understand why Vredenburg (p. 112) proposed a new name, *C. antillarum*, for the Miocene Dominican species described by Gabb as *C. spurca* Linné, for he could have no idea of what Gabb had. Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 365, 1922) accepts *spurca* as a Dominican fossil, without, however, citing Gabb's record. Apparently *C. antillarum* Vredenburg is a synonym of *C. spurca* Linné.

[2] According to a strict adherence to the rules of the Code, Vredenburg could not withdraw his earlier name, for it was far from a *nomen nudum*. However unfortunate the result may be, apparently the Gaj species will have to be known as *X. praeovoideus* (Vredenburg) and *X. praeovoideus* Maury (Bull. Am. Paleontology, vol. 5, pp. 247–248, 1917; *preaevoideus* by error, see errata), which really is a predecessor of *ovoidea*, will have to have a new name.

lamented death, conclusively shows that the Nari series (Oligocene) carries a large number of Mediterranean Oligocene species, and that the characteristic European Miocene species *"Melongena" cornuta* (Agassiz) and *"M." lainei* (Basterot) are found in the overlying Gaj series (lower Miocene). Vredenburg (Mem. Geol. Survey India, vol. 50, pt. 1 pp. 3–5, 1925) concludes that the Mediterranean Sea and Indian Ocean were in free communication during at least part of Oligocene time, and that imperfect communication continued during lower Miocene time. It has already been pointed out that the occurrence of *Clementia*, *Placuna*, and other genera in the Miocene Mediterranean Sea indicates a temporary invasion of Oriental mollusks into the Mediterranean (Woodring, U. S. Geol. Survey Prof. Paper 147, p. 29, 1926).[1] The Oligocene and Miocene section of northwest India, the age of which is now well established in terms of Mediterranean deposits, offers the best basis for establishing the correlation of the Miocene beds of the East Indies and other parts of the Orient. According to Vredenburg, the Gaj series closely corresponds to the part of the Miocene section in Java that Martin on independent grounds referred to the lower Miocene.

PERCENTAGE OF LIVING SPECIES

Percentage of living species, used with due caution, still is the fundamental basis for determining the age of a late Tertiary fauna, no matter how much it has gone out of fashion. In this report and in Publication 366 the following Recent species are recorded from the Bowden formation:

Recent species in Bowden fauna

Gastropods:
- Cavolina telemus (Linné)
- Volvula oxytata Bush
- Conus proteus Hwass
- Conus planiliratus Sowerby[2]
- Murex recurvirostris Broderip
- Murex pomum Gmelin
- Trivia globosa ("Gray") Sowerby
- Trivia pediculus (Linné)
- Vermicularia spirata (Philippi)
- Spirolaxis exquisita (Dall and Simpson)
- Rissoina browniana d'Orbigny
- Cheilea "equestris (Linné)"
- Tectonatica pusilla (Say)
- Tricolia umbilicata (d'Orbigny)

Pelecypods:
- "Arca" occidentalis Philippi
- Barbatia domingensis (Lamarck)
- Fossularca adamsi (Dall)
- Chlamys nodosus (Linné)[4]
- Chama macerophylla Gmelin
- Diplodonta gabbi Dall[5]
- Cardium medium Linné
- Cardium serratum Linné
- Gouldia insularis (Dall and Simpson)
- Chione granulata (Gmelin)[6]
- Strigilla pisiformis (Linné)

[1] For a recent discussion see Cox (Pal. Zanzibar Protectorate, pp. 15–16, 1927).
[2] *C. stimpsoni* Dall probably is a synonym of this species.
[3] The subspecific name *sawkinsi* used in Publication 366 is suppressed.
[4] Not recorded in Publication 366.
[5] Recent specimens are recorded under name of *D. puncturella* Dall, which is a synonym.
[6] Not recorded in Publication 366.

It seems only fair to include also the forms that are considered subspecies of living species, for they fall within the same specific limits. It probably is apparent in the systematic account that the subspecific lines are finely drawn, except with very variable species. In accepting some of the subspecies I also may have been unwittingly influenced by the availability of a name, if one already were in use. Larger suites of specimens may show that others of the subspecific names are unwarranted. It will be seen that only one pelecypod is in this list, which is another indication that the pelecypods are overnamed. The following are recorded as subspecies of Recent species:

Subspecies of Recent species in Bowden fauna

Gastropods:

Oliva reticularis trochala Woodring
Latirus infundibulum polius Woodring
Mitrella ocellata bowdenensis Woodring
Distorsio decussatus simillimus (Sowerby)
Distorsio clathratus gatunensis (Toula)
Sconsia striata sublaevigata (Guppy)
Cypraea isabella patrespatriae Maury
Modulus modulus basileus (Guppy)
Architectonica nobilis quadriseriata (Sowerby)
Architectonica krebsii lampra Woodring
Natica canrena antinacca Cossmann
Polinices brunnea subclausa (Sowerby)
Sigatica semisulcata bathyora Woodring
Astraea brevispina basilis (Olsson)
Homalopoma philipiana oedamata Woodring
Smaragdia viridis viridemaris (Maury)
Calliostoma pulcher bowdenense Woodring
Microgaza rotella vetula Woodring
Lucapina limatula vetula Woodring
Diodora alternata henekeni (Maury)

Pelecypods:

"Arca" umbonata morantensis Woodring

According to these lists 25 Recent species and 21 subspecies of Recent species are recorded, making a total of 46, or about 9½ per cent of the 485 named species. This is only a little more than half of the original figure of about 17 per cent for the Miocene given by Lyell and Deshayes (Lyell, Principles of Geology, vol. 3, p. 54, 1833). It would be simple, however, to pick out 50 additional species that are so similar to Recent ones that they would have been considered the same in their generation; in fact 13 species now considered distinct from living ones were recorded by Guppy as Recent species. The percentage for the Bowden fauna is not far from Dall's early estimate of 12 per cent (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p.

1581, 1903). The percentage for some other Miocene deposits is as follows:

Percentage of Recent species in other Miocene beds

	Per cent
Calvert, Choptank, and St. Marys formations, Maryland	10[1]
Calvert formation, Maryland	9.3[2]
Choptank formation, Maryland	11.4[2]
St. Marys formation, Maryland	12.1[2]
St. Marys formation, Virginia	18[3]
Yorktown formation, Virginia	17[2]; 25[3]
Duplin marl, North Carolina	20[2]; 27[3]
Helvetian, Aquitaine (pelecypods only)	10.7[4]
Tortonian, Aquitaine (pelecypods only)	18.8[4]
Middle Miocene, Hemmoor, Germany	16[5]
First Mediterranean stage, Eggenburg, Austria	28[6]

It is expected that additional Bowden species will be found living in the West Indies, for little intensive dredging has been done there in water of moderate depths. One haul in Porto Rican waters is the only Recent record for *Spirolaxis exquisita* (Dall and Simpson) and four hauls in the same region have furnished the only Recent specimens of *Gouldia insularis* (Dall and Simpson), both of which are found at Bowden. *Diplodonta "puncturella"* Dall is represented from only three localities—Porto Rico, St. Thomas, and Jamaica. In addition the dredgings of the *Fish Hawk* in Porto Rican waters have furnished *Terebra guanica* Dall and Simpson, *"Cythara" asarca* Dall and Simpson, and *"Phos" oxyglyptus* Dall and Simpson, all of which are very similar to Bowden species.

One of the Recent species, *Murex recurvirostris* Broderip, is recorded as living on both the Atlantic and Pacific sides of Central America. Two others, *Mitrella ocellata bowdenensis* Woodring and *Architectonica nobilis guadriseriata* (Sowerby), fall within the specific limits of forms that are now living in both regions, though the *Mitrella* generally is given a different name. In considering the question as to the identity of living species in these two regions, the possibility of tracing lineages back to Miocene time when free intercommunication was possible, needs serious consideration.

Only three of the Recent species at Bowden—*Volvula oxytata* Bush, *Rissoina browniana* d'Orbigny, and *Tectonatica pusilla* (Say)—are

[1] W. H. Dall, Maryland Geol. Survey, Miocene, p. cxlvi, 1904.
[2] W. H. Dall, Maryland Geol. Survey, Miocene, p. cxlvii, 1904.
[3] J. A. Gardner, cited by T. W. Vaughan, Bull. Am. Assoc. Petroleum Geologists, vol. 7, p. 521, 1923.
[4] M. Cossmann and A. Peyrot, Conch. Néog. Aquitaine, vol. 2, pt. 1, p. 483, 1912.
[5] F. Kautsky, Abh. Preussischen Geol. Landesanstalt, No. 97, p. 223, 1925.
[6] F. X. Schaffer, Sitzungsber. K. Akad. Wiss., Math.-Nat. Cl., vol. 119, pt. 1, p. 251, 1910; vol. 121, pt. 1, p. 334, 1912.

smooth, whereas some of the others, such as the two species of *Murex*, have very elaborate sculpture. It is apparent that each species must be considered on its merits and that no particular stratigraphic reliance can be placed on elaborately sculptured species.

CONCLUSIONS AS TO AGE

On the basis of percentage of living species and in terms of the standard European section the Bowden fauna is Miocene, and the evidence seems to warrant considering it middle Miocene (Vindobonian). In terms of the American section it falls at the top of the middle Miocene or at the base of the upper Miocene.

These conclusions do not materially alter the age assignment made by Guppy, the pioneer in the study of West Indian Tertiary mollusks, more than half a century ago. The similarity to the Miocene of southern France and the Mediterranean region is too striking to have been missed by a palaeontologist trained in Europe. So far as relative place in the American section is concerned these conclusions also do not differ very much, aside from differences in nomenclature, from Dall's opinion that the Bowden formation probably is the equivalent of the Oak Grove sand or falls somewhere between the Chipola and Choctawhatchee formations (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1582, 1903). Dall's conclusion that the Miocene of the early workers in the West Indian region is Oligocene (Proc. U. S. Nat. Mus., vol. 19, pp. 303–304, 1896; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pp. 1580–1581, 1903), based solely on a misapprehension as to the age of some of the beds in the Aquitaine Basin, influenced American nomenclature for twenty years or more. My early conclusion that the Bowden fauna probably is Burdigalian (Johns Hopkins Univ. Circular, n. s., 1917, No. 3, p. 56, 1917) need not be considered seriously.

SYSTEMATIC DESCRIPTION OF BOWDEN GASTROPODS

GASTROPODA EUTHYNEURA

PULMONATA STYLOMMATOPHORA

Simpson (Proc. U. S. Nat. Mus., vol. 17, pp. 423–450, pl. 16, 1894) described as fossils from Bowden the following land snails: *Neocyclotus* (*Ptychocochlis*) *bakeri*, *Lucidella costata*, and *Pleurodonte bowdeniana*. He also recorded *Thysanophora*, *Opeas*, and *Succinea*, the latter two of which were regarded as representing Recent species, but this material is not in the Henderson collection of Bowden fossils. In addition to these species the Henderson collection contains specimens representing the genera *Stenogyra*, *Melaniella*, and *Truncatella*. These shells are not considered further in this report on account of the possibility that they are the remains of living snails that fell into openings in the ground and thus were collected with the fossil material. Their status must await a more complete knowledge of the living land snails of the Bowden region. The presence of some of these genera in Jamaica during Miocene time would be of far-reaching palaeogeographic and phyletic significance. It should be noted, however, that some of the specimens (*Ptychocochlis*, *Lucidella*, *Pleurodonte*, *Melaniella*, and an unnamed shell, No. 135469) have the appearance of Bowden fossils.

PULMONATA BASOMMATOPHORA

AURICULIDAE

TRALIA Gray

Subgenus TRALIA s. s.

Gray, 1840, in Turton, A manual of the land and fresh-water shells of the British Islands, new ed., p. 21.

Type (*by monotypy*).—*Voluta pusilla* Gmelin (=*Bulimus ovulus* Bruguière). Recent, West Indies and Florida.

Shell medium-sized, thin, spire low. Nuclear whorls small, papillate, axis at right angles to axis of post-nuclear whorls. Aperture long, narrow, dilated, and rounded at base. Edge of outer lip thickened, its middle part slightly bent inward, bearing far within the aperture a median horizontal ridge. Columella bearing an oblique basal fold, a heavy horizontal fold below the middle, and a smaller horizontal fold higher up far within the aperture almost opposite ridge on interior of outer lip. Sculpture absent or consisting of faint punctate spiral grooves on spire, and on body whorl above shoulder and on base.

These air-breathing amphibious mollusks live along the sea coast at high-water mark and in salt marshes. There are two living species of *Tralia* s. s., one (*T. ovula*) in the West Indies and Florida, and the other (*T. panamensis* C. B. Adams) on the Pacific coast of Panama. *T. ovula* has also been reported from the west coast of Africa (see Pilsbry and Bequaert, Bull. Am. Mus. Nat. Hist., vol. 53, p. 102,

1927). No fossil species have heretofore been recorded, but the presence of a Miocene species in the West Indies is in harmony with the present distribution of the subgenus. The Miocene Auriculids from Touraine, France, described by de Morgan (Bull. Soc. géol. France, ser. 4, vol. 16, pp. 31–34, figs. 31–38, 1916) as *Alexia* (*Tralia*) do not represent *Tralia* s. s.

Tralia (Tralia) vetula, new species

(Plate 1, Figure 1)

Shell small, thin, slender. Nuclear whorls partly immersed, about one and a quarter whorls visible, forming a prominent tip as in *Acteocina*. Outer lip thin, its middle part barely bent inward. Ridge on interior of outer lip flanked on either side by a very low ridge. Middle columellar fold barely visible without tilting shell. Upper columellar fold lying very far within aperture. Parietal wall and base of columella covered with thin callus. Sculpture consisting of obscure spiral grooves on early post-nuclear whorls.

Length 5.5 mm.; diameter 2.7 mm. (holotype).

This species is represented only by the holotype, which seems to be immature, as its outer lip is not thickened and the middle and upper columellar folds lie far within the aperture. On account of its slender outline it is more similar to *panamensis* than to *ovula*, though it is even more slender than *panamensis* and the nuclear whorls form a more prominent tip. No specimens of *panamensis* or *ovula* that were examined show the two low ridges on the interior of the outer lip in addition to the usual larger ridge, but it is improbable that these supplementary ridges are of any systematic importance.

Type material.—Holotype (Acad. Nat. Sci. Philadelphia, No. 12506).

SIPHONARIIDAE

SIPHONARIA Sowerby

Sowerby, 1824, Genera of Recent and fossil shells (no pagination).

Type (by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 181).—*Siphonaria sipho* Sowerby. Recent, Philippines.

Shell of varying size, patelliform, apex central or subcentral. Aperture elliptical, fluted by the ribs. Muscle impression horseshoe-shaped, open toward the front, the ends united by a shallow groove due to attachment of mantle, interrupted on right side by a wide, siphonal groove that may extend to the apex. Sculpture consisting of radial ribs.

These limpet-like pulmonates, which have both a pulmonary sac and branchiae, are distinguished from the limpets by the gap on the right side of the muscle impression. Like the limpets they cling to rocks and seaweed and are found in the intertidal zone or below low-water mark. The Recent species live in the warm seas and also in the cool seas of the southern oceans. In Europe the genus is recorded from Eocene deposits, but heretofore no American Tertiary species were recorded.

Siphonaria species

(Plate 1, Figures 2, 3)

The genus *Siphonaria* is represented in the Henderson collection by a very small apparently young specimen (U. S. Nat. Mus. No. 135344) having the following dimensions: length 5 millimeters, width 4.2 millimeters, height 1.7 millimeters. The apex is low and lies a little behind the center. The muscle impression is interrupted on the right side by a wide shallow groove that affects the outline of the shell. The sculpture consists of crude radial ribs.

The ribs of this specimen, which certainly represents a new species, are smaller and more uniform in width than in young specimens of *S. alternata* Say, a living West Indian species, but are more irregular in width than in *S. naufragum* Stearns (also known as *S. lineolata* d'Orbigny), another living West Indian species.

WILLIAMIA Monterosato

Monterosato, 1884, Nomenclatura generica e specifica di alcune conchiglia Mediterranee, p. 150.

Type (*by monotypy*).—*Ancylus ? gussonii* da Costa. Recent, Mediterranean.

Shell small, thin, patelliform. Apex near posterior end, twisted to left. Aperture rounded-ovate. Muscle impression horseshoe-shaped, the anterior ends joined by a shallow groove, interrupted on the right side by a wide obscure groove. Surface smooth or bearing obscure radial waves.

The spiral apex is the distinguishing feature of this genus of pulmonates, which otherwise resembles *Siphonaria*. Living species of *Williamia* are recorded from the warm parts of the Atlantic and Pacific Oceans and adjoining seas. Cossmann (Essais Paléoconch. Comp., pt. 1, pp. 137–138, 1895) placed an Eocene and an Oligocene species from Europe in this genus, but they are not similar to the type species. The muscle impression is obscure on the following species, which is referred to *Williamia* on account of its resemblance to living species. No American Tertiary species has heretofore been described.

Williamia parva, new species

(Plate 1, Figures 4, 5)

Shell small, thin, apex lying at posterior fourth of shell or even closer to posterior end. Nucleus coiled to the left, consisting of about one and a half whorls, separated from the rest of the shell by a constriction. Anterior end of aperture broader than posterior end. Muscle scar indistinct. Sculpture consisting of concentric growth lines.

Length 5.1 mm.; width 4.2 mm.; height 2.3 mm. (holotype).

The apex of the holotype is relatively higher than in smaller specimens and lies farther from the posterior end. The nuclear whorls are prominent like in the type species of the genus. This species resembles the living West Indian *W. krebsii* (Mörch), but the shell is narrower

than in most adult specimens of *krebsii*, its apex is relatively higher, and the growth lines are stronger.

Type material.—Holotype (U. S. Nat. Mus. No. 369311).

PTEROPODA THECOSOMATA

Pteropods are represented in the Bowden formation by the genera *Cavolina* and *Diacria*. The number of species and specimens of *Cavolina* is unusually large. It seems strange that no named American Tertiary species of this genus are on record other than those described by Guppy from Bowden. Maury (Bull. Am. Paleontology, vol. 5, p. 175, 1917) recorded one unnamed specimen from the Cercado formation of the Dominican Republic. *Cavolina tuomeyi* Holmes (Post-Pleiocene fossils of South Carolina, pp. 60–61, pl. 9, figs. 8, 8*a–e*, 1860), a Pleistocene fossil, may be a young specimen of the living *C. gibbosa* Rang (see Dall, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 431, 1892).

The living species of pteropods have an extensive distribution, like many other pelagic animals. It seems reasonable to believe that the Miocene species also were widely distributed, but no European species of *Cavolina* with which I am familiar closely resembles those from Bowden.

CAVOLINIDAE

CAVOLINA Abilgaard[1]

Abilgaard, 1791, Skrivter af Naturhistorie-Selskabet, vol. 1, No. 2, pp. 174, 175.

Type (*by monotypy*).—*Cavolina natans* Abilgaard (=*Monoculus telemus* Linné). Recent, warm and temperate seas.

Shell small or medium-sized, thin, composed of a dorsal and a ventral part. Dorsal part slightly inflated, ventral part greatly inflated, posterior end pointed, curved. Dorsal lip recurved and projecting over ventral lip. Central part of aperture moderately narrow, lateral parts very narrow and almost separated from ventral part by a projection extending from ventral lip and fitting into a depression on dorsal lip. Ventral surface bearing growth lines, dorsal surface generally sculptured with a few radiating grooves and ridges.

Pteropods of this genus have a cosmopolitan distribution in the warm and temperate seas.

Key to the Bowden species of Cavolina

Shell relatively large, length of adults 9 mm..... *C. telemus*
Shell small, length of adults not exceeding 5 mm.
  Dorsal part sculptured
    Dorsal part greatly inflated..... *C. ventricosa*
    Dorsal part slightly inflated..... *C. digitata*
  Dorsal part not sculptured..... *C. vendryesiana*

[1] Sykes (Proc. Malac. Soc. London, vol. 7, p. 5, 1906) following the general usage, formally gave *Cavolina* Abilgaard 1791 precedence over *Cavolina* Brugière (Ency. Méth., Vers., p. 85) published in the same year for a Nudibranch.

Cavolina telemus (Linné)

(Plate 1, Figures 6, 7)

Monoculus telemus Linné, 1758, Syst. Natur., ed. 10, p. 635.
Anomia tridentata Forskål, 1773, Descriptiones animalium quae in itinere orientali observavit, p. 124.
Cavolina natans Abilgaard, 1791, Skriv. Naturhist.-Selsk., vol. 1, No. 2, p. 175, pl. 10.
Hyalaea tridentata Lamarck, Rang and Souleyet, 1852, Hist. nat. moll. Ptéropodée, pp. 35–37, pl. 2, figs. 1–6, pl. 12, figs. 1–4. Boas, 1886, Spolia Atlantica, p. 115, pl. 1, fig. 8, pl. 2, fig. 19.
Cavolina tridentata (Forskål), Pelseneer, 1887, Challenger Rept., Zoology, vol. 23, pt. 65, pp. 83–84.
Cavolina telemus (Linné), A. Adams, 1859, Ann. Mag. Nat. Hist., ser. 3, vol. 3, p. 44. Dall, 1908, Bull. Mus. Comp. Zool. Harvard College, vol. 43, No. 6, pp. 230–234.
Cavolinia near *gibbosa* Rang, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1582 (list).

Shell relatively large. Ventral part greatly inflated, bearing near lip conspicuous growth lines that are slightly bent back medially. Dorsal part moderately inflated, sculptured with a low, rounded median ridge and two narrow lateral ridges. Dorsal lip projecting far over ventral lip and bent downward, the lower part separated from the main dorsal surface by a ridge. Lateral dorsal margin bearing socket to receive projection from ventral margin. Ventral lip abruptly recurved.

Length 9.3 mm. (posterior spine broken); width 7 mm.; height 6.5 mm. (figured specimen).

Type locality.—Mediterranean Sea (Recent).

The Bowden shells have the essential features of the living species known as *C. telemus,* or *C. tridentata,* though they are smaller than the shells in most hauls of *telemus.* A few badly broken shells are in the Henderson collection in addition to the figured specimen, on which the posterior spine and most of the downward prqjecting part of the dorsal lip are broken off. It is the only large *Cavolina* found at Bowden.

No attempt is made to give full citations for this species. It is probable that records of European fossil localities have escaped attention, for, according to Rang and Souleyet (cited above), this species is found fossil near Palermo, on the island of Ischia, and near Bordeaux. It is the large *Cavolina* of the Mediterranean Sea and Atlantic Ocean, and it is also found in the Pacific and Indian Oceans.

A specimen from the Gurabo formation of the Dominican Republic, consisting of the ventral part and a partial mold of the dorsal part, probably represents this species, though it is much smaller than Bowden specimens.

Other American fossil localities.—? Gurabo formation (middle Miocene), Dominican Republic.

Cavolina ventricosa (Guppy)

(Plate 1, Figures 8, 9)

Hyalea ventricosa Guppy, 1882, Proc. Sci. Assoc. Trinidad, vol. 2, pt. 12, p. 176, pl. 7, figs. 15*a*, *b* (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 245, pl. 9, figs. 15*a*, *b*).
Cavolinia ventricosa (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1582 (list).

Shell small. Dorsal part almost as strongly inflated as ventral part, sculptured with a narrow median ridge flanked by a very broad ridge, beyond which lies a very narrow ridge. Ventral surface sculptured with widely spaced growth lines. Dorsal lip projecting far beyond ventral lip.

Length 4.6 mm.; width 3.9 mm.; height 2.9 mm. (cotype). Length 4.3 mm.; width 3.8 mm.; height 2.8 mm. (figured specimen).

Type locality.—Jamaica (Miocene).

This species is like a miniature *Cavolina telemus*, having an inflated dorsal part, a more symmetrically inflated ventral part, and slightly different sculpture. It is represented by about 75 specimens in the Henderson collection, on all of which the posterior spine is partly or completely broken off. *C. gypsorum* (Bellardi) (Moll. ter. Piemonte, pt. 1, p. 55, pl. 3, figs. 5*a*, *b*, 1873), an upper Miocene species from Italy, has the same kind of sculpture, but it is larger and apparently the dorsal part is not so strongly inflated. It is impossible to recognize the specimen Guppy figured. Inasmuch as both type specimens are partly covered with glue and cleaning is impracticable, neither specimen is figured and no lectotype is designated.

Type material.—2 cotypes (U. S. Nat. Mus. No. 115625).

Cavolina digatata (Guppy)

(Plate 1, Figures 10, 11)

Hyalaea (*Diacria*) *vendryesiana* Guppy (part), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pt. 10, pl. 2, figs. 2*a* (not fig. 2*b*, = *C. vendryesiana*) (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, pp. 206–207). Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, pl. 17, fig. 2*a* (not fig. 2*b*, = *C. vendryesiana*).
Hyalea digitata Guppy, 1882, Proc. Sci. Assoc. Trinidad, vol. 2, pt. 12, p. 176, pl. 17, figs. 16*a*, *b* (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 245, pl. 9, figs. 16*a*, *b*).
Cavolinia digitata (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1582 (list).

Shell small. Dorsal part slightly inflated, sculptured with a narrow median ridge flanked by a similar ridge, beyond which lies a broad ridge. Ventral part moderately inflated. Dorsal lip projecting only a short distance beyond ventral lip.

Length 4.7 mm.; width 3.6 mm.; height 2.3 mm. (cotype). Length 3.9 mm.; width 3 mm.; height 1.8 mm. (figured specimen).

Type locality.—Jamaica (Miocene).

This species is the most abundant Bowden pteropod. It is represented by about 100 specimens in the Henderson collection. It is less

inflated than *C. ventricosa*, the dorsal lip is shorter, and the dorsal sculpture is stronger. In 1873 and 1874 Guppy confused this species with *C. vendryesiana*, but he corrected the error in 1882. The remarks concerning the type material of *C. ventricosa* apply to this species also.

Type material.—5 cotypes (U. S. Nat. Mus. No. 115623).

Cavolina vendryesiana (Guppy)

(Plate 1, Figures 12, 13)

Hyalaea (Diacria) vendryesiana Guppy (part), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pt. 10, pp. 74–75, pl. 2, fig. 2*b* (not fig. 2*a*, =*C. digitata* Guppy) (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, pp. 206–207). Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, p. 405, pl. 17, fig. 2*b* (not fig. 2*a* = *C. digitata* Guppy); p. 441 (list).

Hyalea vendryesiana Guppy, Guppy, 1882, Proc. Sci. Assoc. Trinidad, vol. 2, pt. 12, pp. 175–176 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, pp. 244–245).

Cavolinia vendryesiana (Guppy), Dall, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1582 (list).

Shell small. Dorsal part slightly inflated, smooth except for ridge along lip. Ventral part moderately inflated. Base of posterior spine very broad.

Length 4.7 mm.; width 2.5 mm. (lectotype, measurements approximate). Length 4.7 mm.; width 2.8 mm. (figured specimen, measurements approximate).

Type locality.—Jamaica (Miocene).

The type material of this species consists of three specimens. One, a complete shell, represents *C. digatata*, a ventral part apparently also represents *C. digatata*, and a badly broken specimen corresponds to Guppy's description of *vendryesiana* and to his figure 2*b* and is taken as the lectotype. If it is the holotype it has been badly broken since Guppy figured it. This specimen also is smeared with glue. In 1882 Guppy himself stated that figure 2*a* represents *C. digatata*.

This species is much less abundant than *ventricosa* and *digatata*, as only four specimens are in the Henderson collection. The smooth dorsal surface and broad-based posterior spine are characteristic features. The dorsal lip may end in a long process as in the living *C. inflexa* (Lesueur), but it is broken off on all specimens. On account of its broad-based spine the Bowden species resembles *inflexa*, which has sculpture on the dorsal part.

Type material.—Lectotype (U. S. Nat. Mus. No. 115624).

DIACRIA Gray

Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 203.

Type (by original designation).—Hyalea trispinosa Lesueur. Recent, warm and temperate seas.

Shell medium-sized, ovate trigonal, posterior end pointed, straight. Ventral part slightly more inflated than dorsal part. Dorsal lip projecting over ventral lip. Aperture narrow, the very narrow lateral parts not separated

from central part. Dorsal and ventral surfaces bearing broad grooves and ridges.

The shell of *Diacria* is more symmetrical dorso-ventrally than in *Cavolina*. Its posterior spine is straight and the lateral parts of the aperture are not separated from the wider central part. Perfect specimens of *D. trispinosa* have a small nepionic bulb at the end of the posterior spine separated from the rest of the shell by a partition.

Pteropods of this genus have a cosmopolitan distribution in the warm and temperate seas. Miocene species are recorded both from southern Europe and the West Indies.

Diacria bisulcata Gabb

(Plate 1, Figures 14 to 17)

Diacria bisulcata Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 200.
Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 309, fig. 4.
Cavolinia (*Diacria*) near *trispinosa* Lesueur, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1582 (list).

Shell medium-sized. Base of lateral spines moderately broad. Dorsal part of young shells bearing a broad central ridge, which may be undivided or obscurely divided into three parts, flanked by a narrow lateral ridge. On an adult shell the divisions of the central ridge are distinct. Ventral part broadly inflated, bearing an obscure lateral ridge on each side.

Length 7.7 mm.; width 8.9 mm.; height 3.3 mm. (larger figured specimen, posterior and lateral spines completely or partly broken).

Type locality.—Dominican Republic (Miocene).

About a dozen imperfect shells and 35 posterior spines are referred to this species. They may represent a different species, but the material is too scanty to settle this question. The type of *D. bisulcata* probably is a young shell, as it has a length of only 4.3 millimeters. The central dorsal ridge is undivided on this specimen, but it is indistinctly divided into three parts on a shell collected from the Cercado formation. A small specimen from Bowden (figs. 14, 15) has an undivided central dorsal ridge, but the base of its lateral and posterior spines are broader than in Dominican specimens. On the larger Bowden shell (figs. 16, 17) the central dorsal ridge is distinctly divided and the base of the lateral spines is broad, like on the small shell. The large Bowden specimen resembles *trispinosa*, but the lateral spines have a broader base and are not upturned, and the divisions of the central dorsal ridge are more distinct. So far as they go the small Dominican shells are more similar to *trispinosa*. Sacco (Moll. ter. terz. Piemonte e Liguria, pt. 30, p. 13, pl. 4, figs. 3, 4, 1904) records *trispinosa* from the Plaisancian of the Piedmont Basin.

Other localities.—Cercado formation (middle Miocene), Dominican Republic.

Type material.—Holotype (Acad. Nat. Sci. Philadelphia No. 2894).

OPISTHOBRANCHIATA TECTIBRANCHIATA

ACTEONIDAE

ACTEON Montfort

Montfort, 1810, Conchyliologie systématique, vol. 2, p. 315.
Type (*by original designation*).—*Voluta tornatilis* Gmelin (=*Voluta tornatilis* Linné). Recent, seas of Europe.

Shell small or medium-sized, ovate, spire high, suture channeled. Nuclear whorls small, coiled at an angle to axis of post-nuclear whorls, usually broken off. Aperture long, anterior end dilated and rounded. Columella bearing a heavy slightly oblique basal fold. Sculpture consisting of spiral grooves ornamented with fine axial bars.

Acteon has a long geologic history and the living species have a cosmopolitan distribution. Many of the living species have been dredged from deep water, but some, such as *A. punctostriatus* (Adams), a West Indian and east American species, are confined to shallow water.

Key to the Bowden species of Acteon

Entire shell sculptured with spiral grooves
  Shell large, height of adults 15 to 17 mm., aperture narrow, spiral grooves wide.....*A. textilis*
  Shell medium-sized, height of adults less than 8 mm., aperture relatively wide, spiral grooves narrow.....*A. curystoma*
Spiral grooves generally confined to anterior part of body whorl, shell small, height of adults less than 6 mm.....*A. riomaensis*

Acteon textilis (Guppy)

(Plate 2, Figure 1)

Tornatella textilis Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pt. 10, p. 77, pl. 1, fig. 4 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 209). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 407, pl. 16, fig. 4; p. 437 (list).
Actaeon textilis (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1582 (list).
Actaeon costaricensis Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 206*a*, pl. 18, fig. 15.

Shell relatively large, thick. Aperture narrow, columellar fold heavy, umbilical groove wide. Sculpture consisting of spiral grooves that are slightly wider than the flat-topped ridges between them. On the early whorls the grooves are relatively narrower. Grooves bearing fine axial threads.
Length 17.2 mm.; diameter 9.6 mm. (holotype).

Type locality.—Jamaica (Miocene).

The holotype is considerably larger than any other specimen examined. The holotype of *costaricensis* is larger and more slender, and therefore has a narrower aperture, but other Costa Rican shells are very similar to those from Bowden. This species resembles *A. subtornatilis* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 310, pl. 23, fig. 15, 1922), a Miocene species from the Dominican Republic known only from Gabb's specimens, but the shell

is more inflated and the spiral grooves are wider. Specimens from the Chipola formation in the collections of the United States National Museum labeled *A. textilis* represent a much smaller and more slender species. Among living species *A. textilis* resembles *A. traskii* Stearns from southern California. No similar large heavy-shelled *Acteon* is now found in the West Indies or along the Atlantic coast of the United States.

Other localities.—Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype (U. S. Nat. Mus. No. 115434).

Acteon eurystoma, new species

(Plate 2, Figure 2)

Shell medium-sized. Aperture relatively wide, umbilical groove narrow. Sculpture consisting of spiral grooves that are only about half as wide as the flat-topped ridges between which they lie, except near base of body where they are wider. Grooves bearing fine axial threads that produce a punctate effect on account of narrowness of grooves.

Length 6.9 mm.; diameter 2.9 mm. (holotype).

It is assumed that the largest specimens of this species, which is represented by only three shells, all in the Duerden collection, are full-grown, though this assumption is not fully justified. The aperture is wider and the spiral grooves narrower than in young shells of *textilis*, and the grooves are narrower than in *subtornatilis*, a species mentioned in the discussion of *textilis*. The turreted appearance of the spire in the figure of *eurystoma* is due largely to peeling off of the shell along the channeled suture.

Type material.—Holotype (U. S. Nat. Mus. No. 369317).

Acteon riomaensis Maury

(Plate 2, Figure 3)

Actaeon cubensis Gabb (part), 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 245.

Tornatella (*Actaeon*) *cubensis* (Gabb), Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 518.

Actaeon punctostriatus Dall (part, not Adams), 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 14.

Actaeon sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1582 (list).

Actaeon riomaensis Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 175–176, pl. 29, fig. 1.

Acteon punctostriatus Pilsbry (not Adams), 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 310.

Shell small, thin. Aperture relatively wide, columellar fold slender, umbilical groove narrow. Sculpture consisting of narrow spiral grooves that generally are confined to lower half of body whorl, but on some shells they appear on entire body whorl. Grooves made punctate by very fine axial threads.

Length 3.9 mm.; diameter 2.3 mm. (figured specimen).

Type locality.—Bluff 3, Cercado de Mao (=U. S. G. S. station 8525), Dominican Republic (Cercado formation).

Though this species is the most abundant Bowden *Acteon*, it is represented by only 6 specimens in the Henderson collection. It is very abundant at the type locality in beds of the Cercado formation. A larger percentage of these Dominican shells have spiral grooves over the entire body whorl than in specimens from Bowden. The Bowden shells are larger than the southern race of *A. punctostriatus* (Adams), and have a narrower aperture and less conspicuously turreted spire. If the southern race, which lives in shallow water in the West Indies and off the coast of southern United States, is distinct from the northern race, it will take the name *cubensis* Gabb. The largest Bowden shell has the following dimensions: length 5.5 millimeters; diameter 3 millimeters. *A. chipolanus* Dall (Proc. U. S. Nat. Mus., vol. 18, p. 23, 1896; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 59, fig. 11, 1903), from the Chipola formation, is larger and more slender.

Other localities.—Cercado formation (middle Miocene), Dominican Republic.

Type material.—Holotype (Cornell University).

ACTEOCINIDAE

ACTEOCINA Gray

Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 160.

Type (by original designation).—Acteon wetherellei Lea. Miocene, New Jersey.

Shell small or medium-sized, cylindrical, spire low, suture channeled. Nuclear whorls small, papillate, more or less submerged, coiled at an angle of about 90° to axis of post-nuclear whorls. Aperture long, narrow, dilated, and rounded at anterior end. Columella bearing an oblique basal fold emerging from aperture and merging into basal lip. Sculpture absent or consisting of faint spiral grooves.

In America the earliest species of this genus is from the upper Oligocene Byram marl, and living species are found on both the Atlantic and Pacific coasts. Whether these species are congeneric with *Tornatina* A. Adams (in Sowerby, Thes. Conch., vol. 2, pt. 11, p. 554, 1850; type, by subsequent designation, Pilsbry, Man. Conchology, ser. 1, vol. 15, p. 181, 1893, *Bulla voluta* Quoy and Gaimard, Recent, Guam) is open to question. Pilsbry's figure of the type of *Tornatina* shows a shell that has no columellar fold. Iredale (Proc. Malac. Soc. London, vol. 11, pp. 300–301, 1915) considers that *Tornatina* is the same as *Retusa* Brown (Illus. Conch. Great Britain and Ireland, pl. 38, figs. 1–6, 1827; type, *Bulla obtusa* Montagu, Recent, Great Britain),[1] a name that has been very much misused. *Acteocina* certainly is different from *Retusa*, as *Retusa* lacks the strong columellar fold of

[1] According to Iredale, the three species named by Brown (*plicata* Brown, *discors* Brown, and *obtusa* Montagu) all represent *obtusa*, so that *obtusa* becomes the type by monotypy, but this interpretation of monotypy is questionable. Iredale considers that *Voluta alba* Kanmacher 1798 is the earliest name for this species.

Acteocina, the anterior part of the aperture is wider, and the nuclear whorls are almost buried in the spire.

In addition to species similar to *A. bullata*, *A. recta*, and *A. candei*, now living in West Indian waters, the Bowden formation carries a peculiar *Acteocina* representing a phylum not found at the present time in this region.

Key to the Bowden species of Acteocina

Spire rising above body whorl, shell not expanding rapidly at base
- Shell large, length of adults 8 to 9 mm..... *A. subbullata*
- Shell small, length of adults less than 5 mm.
  - Shell slender, spire low, whorls tightly coiled..... *A. lepta*
  - Shell stout, spire high, last two whorls loosely coiled..... *A. anetaspira*

Spire not rising above body whorl, shell expanding rapidly at base..... *A. coixlacryma*

Acteocina subbullata Pilsbry and Johnson

(Plate 2, Figure 4)

Tornatina bullata Guppy and Dall (not Kiener), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 305. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Acteocina subbullata Pilsbry and Johnson, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 150–151. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 310, fig. 5.

Shell relatively large, slender, subcylindrical, slightly tapering toward posterior end, middle of body whorl slightly constricted near outer lip. Suture deeply channeled. Middle of outer lip slightly constricted. Behind the columellar fold lies a broad, shallow groove. Upper edge of parietal callus visible in suture on later whorls. Sculpture consisting of obscure closely spaced spiral grooves visible only on unworn shells.

Length 8.8 mm.; diameter 3.9 mm. (figured specimen).

Type locality.—"Dominican Republic" (Miocene).

All the material of this species in the Gabb collection clearly is from Bowden. The specimens may have been sent to Gabb by Guppy, or they may have been in later collections of Bowden fossils received at the Academy. At all events the color of the shells and the filling are unmistakable. The larger figured specimen, recognized by the neatly bored hole, is taken as the lectotype.

This *Acteocina* is the only large Bowden species of the genus. On most shells the faint spiral sculpture is visible only at the base, as noted in the original description, but on a few unworn shells it can be seen over the entire body whorl. This species closely resembles the living West Indian *A. bullata* (Kiener), but the fossils have a lower spire, less distinct sculpture, and expand more rapidly at the base. *A. bullata costaricana* Olsson (Bull. Am. Paleontology, vol. 9, pp. 206*a*–206*b*, pl. 18, figs. 20–21, 1922; Miocene, Costa Rica) has a shorter spire, stronger sculpture, and a more cylindrical outline. A large *bullata*-like *Acteocina* from the Cercado and Gurabo formations

is larger and more slender than *subbullata* and has a more cylindrical outline.

Type material.—Lectotype (Acad. Nat. Sci. Philadelphia No. 3193).

Acteocina lepta, new species

(Plate 2, Figure 5)

Tornatina recta Dall (not d'Orbigny), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell small, slender, tightly coiled, subcylindrical, body whorl tapering gently at base. Nuclear whorls forming a large tip. Anal fasciole concave, bearing axial puckers, bounded by sharp-edged ridges. Middle of outer lip slightly constricted. Umbilical groove narrow, deep.

Length 3.8 mm.; diameter 1.9 mm. (holotype).

The relatively wide, concave anal fasciole and the sharp-edged ridges bounding it are the most characteristic features of this species, which is represented by only a few shells. On some specimens the upper edge of the parietal callus can be seen inside the suture.

A. lepta is the Bowden representative of *A. recta* (d'Orbigny), living in West Indian waters. It is smaller than this living species and has a wider anal fasciole. It is larger and has a wider anal fasciole than a small *Acteocina* from the Cercado and Gurabo formations of the Dominican Republic identified as *A. recta* by Maury (Bull. Am. Paleontology, vol. 5, p. 178, pl. 29, fig. 3, 1917). The Bowden species resembles *A. persimilis* (Dall) (Proc. U. S. Nat. Mus., vol. 18, p. 26; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 59, fig. 22, 1903), which is found in the Chipola formation, but has a narrower anal fasciole and heavier columellar fold.

Type material.—Holotype (U. S. Nat. Mus. No. 369320).

Acteocina anetaspira, new species

(Plate 2, Figure 6)

Tornatina canaliculata Dall (part, not Say), 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 15.

Tornatina canaliculata Say var., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell small, relatively stout and thick, rounded cylindrical, last whorl or two loosely coiled, producing a high and irregularly expanded spire. Nuclear whorls forming a large tip. Anal fasciole very narrow, bearing very fine axial puckers. Middle of outer lip distinctly constricted. Umbilical groove narrow, deep. Upper edge of parietal callus visible in suture.

Length 3.5 mm.; diameter 1.9 mm. (holotype).

A. anetaspira is represented by about 65 specimens in the Henderson collection. It is a loosely coiled round-shouldered representative of the living West Indian *A. candei* (d'Orbigny). Though some adult shells are not so loosely coiled as the type, none is so tightly coiled as *lepta* and all have a rounded shoulder due to the narrow anal fasciole. The Bowden shells resemble loosely coiled specimens of a species

from the Cercado formation of the Dominican Republic, probably included in Maury's *A. recta* (d'Orbigny), but they have a slightly larger tip. They are stouter than loosely coiled living *canaliculata*, from the Atlantic coast of the United States, and have a larger tip. So far as the nuclear whorls are concerned they more closely resemble the living *candei*, though the shell is smaller, stouter, and more cylindrical.

Type material.—Holotype (U. S. Nat. Mus. No. 369321).

Acteocina coixlacryma (Guppy)

(Plate 2, Figure 7)

Tornatina coix-lacryma Guppy, 1867, Geol. Mag., decade 1, vol. 4, p. 500, fig. 3.

Tornatina coixlacryma Guppy, Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pt. 10, p. 77 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 209). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 407; p. 437 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Tornatina wetherilli Dall (part, not Lea), 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 15; Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Not *Tornatina coixlacryma* Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 518 (=*A. recta* (d'Orbigny), as identified by Maury).

Not *Tornatina coixlacryma* Cossmann, 1913, Journ. Conchyl., vol. 61, pp. 4–5, pl. 1, figs. 12–13 (=*A. mauryae* Cossmann, 1917, Rev. Crit. Palćozool., year 21, No. 4, p. 137, 1917).

Shell medium-sized, stout, subcylindrical, rapidly expanding toward base. Spire very low and flat or even concave, posterior end of shell almost squarely truncated, the nuclear whorls appearing as a prominent tip. Basal part of aperture greatly expanded. Middle of outer lip slightly constricted. Columellar fold very heavy for size of shell, extending far out from aperture. On adult shells a very low fold lies below it. Sculpture consisting of very fine closely spaced spiral grooves that are most prominent on base.

Length 4.4 mm.; diameter 2.4 mm. (neotype).

Type locality.—Jamaica or "Cumana, Venezuela" (not designated); Bowden, Jamaica, according to designation of neotype.

The very low spire, inflated base, heavy columellar fold, and the lower supplementary fold indicate that this species should be placed in a separate subgenus. It is an unmistakable species, and nothing like it is known elsewhere in America. The nuclear whorls are unusually prominent, for on most shells they alone are visible above the body whorl. *A. myrmecoön* (Dall) (Proc. U. S. Nat. Mus., vol. 18, pp. 25–26, 1896; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 59, fig. 18, 1903), a species from the Duplin marl of North Carolina, has a low spire, but the shell is more slender and more elliptical in outline.

This species is the most abundant Bowden *Acteocina* and Bowden probably is the original type locality, though Guppy also recorded it from Cumana, Venezuela. About 85 specimens are in the Duerden collection. As no specimens are in the Guppy collection, the original type material seems to be lost. The figured specimen from the Duerden collection is herewith designated the neotype.

Other localities.—Middle Miocene, Cumana, Venezuela (according to Guppy). This probably is a spurious record, see page 81.

Type material.—Neotype (U. S. Nat. Mus. No. 369322).

SULCULARIA Dall

Dall, 1921, U. S. Nat. Mus. Bull. 112, pp. 61, 202.

Type (*by original designation, p. 202*).—*Bulla sulcata* d'Orbigny. Recent, West Indies and Florida.

Shell small, slender, subcylindrical, constricted at middle, basal part more inflated than posterior part. Spire involute, apical perforation moderately wide, deep. Aperture very narrow except at expanded and extended anterior end. Posterior end of aperture separated from apical perforation by the overturned outer lip. Columella smooth. Inner lip bent back over a narrow umbilical groove. Sculpture consisting of strong closely spaced axial threads.

Tectibranchs similar to *Bulla sulcata* generally have been placed in the genus *Retusa* Brown on the erroneous assumption that *Bulla truncatula* Bruguière is the type species. The type of *Retusa* is an altogether different shell (see discussion under *Acteocina*, page 119). Species that are congeneric with *Bulla truncatula* apparently will take the name *Coleophysis* Fischer (Man. Conch., p. 555, 1883; type, by monotypy, *Utriculus truncatus* (Bruguière), Recent, seas of Europe). As the type of *Coleophysis* has a low columellar fold and axial threads on only the upper part of the shell, *Sulcularia* might as well be treated as a separate genus, at least until a study of the soft parts compels some other arrangement.

Sulcularia seems to be confined to the warm seas on the Atlantic and Pacific coasts of America. The earliest species so far known are of Miocene age.

Sulcularia lipara, new species

(Plate 2, Figure 8)

Cylichna near *sulcata* Orbigny, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell larger than usual, relatively stout, basal part greatly inflated. Apical perforation relatively wide. Axial threads very fine.

Length 3.1 mm.; diameter 1.5 mm. (holotype).

Two Bowden shells, the second and third of those for which measurements are given, are included in the type lot of "*Retusa sulcata*" *fossilis* Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 311, 1922). Pilsbry noted that these two specimens are "conspicuously swollen near the base." The other measured specimen, which is a slender Dominican shell, is taken as the lectotype of *fossilis*. Similar shells were collected from the Cercado formation. The Bowden species is larger and stouter, and the base is more inflated. Differences between *S. lipara* and the living West Indian *S. sulcata* involving

the same characters are even more pronounced. About 38 specimens of *S. lipara* are in the Duerden collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369323).

CYLICHNELLA Gabb

Gabb, 1872, Proc. Acad. Nat. Sci. Philadelphia, p. 273.
Type (*by monotypy*).—*Bulla bidentata* d'Orbigny. Recent, West Indies.

Shell small, stout, cylindrical-ovate, spire involute, apex slightly concave. Middle of aperture narrow, posterior part slightly expanded, anterior part greatly expanded. Columella bearing two basal folds, the anterior one short and oblique, the posterior one larger and less oblique. Umbilical groove narrow. Base of shell bearing fine spiral grooves.

Gabb named only *Bulla bidentata* d'Orbigny under *Cylichnella* in a paper dealing with Miocene fossils from the Dominican Republic. When he erected this genus he may have had in mind the Dominican fossils (*C. triticumtritonis* Maury), which he erroneously identified with the living *bidentata*. This is a matter of no great importance, as the fossils are congeneric with *bidentata*.

Cossmann (Essais Paléoconch. Comp., pt. 1, p. 97, 1895) records an undescribed species of this genus from the Eocene deposits of the lower Loire Valley, but in America the earliest species are of lower Miocene age. *C. vasatensis* ("Benoist") Cossman, a Miocene species from the Aquitaine Basin, closely resembles the American Miocene species. At the present time *Cylichnella* is found in the western Atlantic, where it is represented by two or three species—*bidentata* d'Orbigny, *biplicata* Lea, and *oryza* Totten,—though Pilsbry (Man. Conchology, ser. 1, vol. 15, 1893) records *biplicata* from St. Helena. According to Pilsbry the soft parts of this genus are unknown and it may belong in some other family.

Cylichnella atacata, new species

(Plate 2, Figure 9)

Shell very stout. Anterior columellar fold slender, strongly twisted, posterior fold higher, emerging from aperture to form edge of umbilical groove. Callus covering part of apex. Sculpture consisting of a few spiral grooves near base.

Length 2.4 mm.; diameter 1.6 mm. (holotype). Length 3 mm.; diameter 1.7 mm. (largest specimen).

This little *Cylichnella*, represented by 14 specimens in the Duerden collection, is very similar to *C. ovumlacerti* (Guppy), a Miocene species from Trinidad (see Mansfield, Proc. U. S. Nat. Mus., vol. 66, art. 22, p. 9, pl. 1, figs. 7, 9, 1925), though it is smaller and relatively stouter. It also is smaller and stouter than *C. triticumtritonis* (Maury) (Bull. Am. Paleontology, vol. 5, pp. 178–180, pl. 29, fig. 4, 1917), its basal fold is heavier and longer, and its sculpture is weaker. *C. triticumtritonis* is represented by hundreds of specimens from the Cercado

formation. It has been called *bidentata* and *ovumlacerti*. Two imperfect specimens from the Gurabo formation (U. S. G. S. station 8702) are more similar to Bowden shells, but they are more slender and have stronger sculpture. *C. atacata* is smaller and stouter than the living *C. bidentata* (d'Orbigny) and its shell is heavier.

Type material.—Holotype (U. S. Nat. Mus. No. 369324).

VOLVULA A. Adams

A. Adams, 1850, in Sowerby, Thesaurus Conchyliorum, pt. 11, p. 558.

Type (by subsequent designation, Bucquoy, Dautzenberg, and Dollfus, 1886, Moll. Roussillon, vol. 1, pt. 13, p. 533).—Volvula rostrata A. Adams. Recent, Australia.

Shell small, thin, spindle-shaped, anterior end rounded, posterior end extended into a spine concealing the spire. Aperture as long as shell, narrow, anterior end dilated. Base of columella bearing an obscure fold merging into margin of aperture. Umbilical groove very narrow. Sculpture generally consisting of faint spiral grooves at both ends of shell.

Eocene species of *Volvula* are recorded in Europe and America. The living species are widely distributed in the warm and temperate seas.

Key to the Bowden species of Volvula

Shell slender, apex not sculptured with fine axial folds.....*V. oxytata*
Shell stout, apex sculptured with fine axial folds.....*V. ornata*

Volvula oxytata Bush

(Plate 2, Figure 10)

Volvula cylindrica Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 246. Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 518. Dall, 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 16. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 180–181, pl. 29, fig. 5. Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 206c.

Not *V. cylindrica* Carpenter 1864, Rept. British Assoc. Adv. Sci., 1863, p. 647.

Volvula sp., Bush, 1885, Rept. U. S. Comm. Fish and Fisheries, p. 84.

Volvula oxytata Bush, 1885, Trans. Connecticut Acad. Arts and Sci., vol. 6, p. 468, pl. 45, fig. 12. Dall, 1889, U. S. Nat. Mus. Bull. 37, p. 86, pl. 41, fig. 12. Dall, 1889, Bull. Mus. Comp. Zool. Harvard College, vol. 18, pp. 50–51. Pilsbry, 1893, Man. Conchology, ser. 1, vol. 15, p. 235, pl. 26, fig. 63. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 312.

Volvula cercadensis Van Winkle, 1921, Bull. Am. Paleontology, vol. 8, p. 352.

Shell very slender, part of posterior spine generally broken off. Columella bearing an obscure fold. Inner lip reflected along the narrow umbilical groove. Sculpture consisting of fine spiral grooves at both ends of shell.

Length 3.5 mm.; diameter 1.3 mm. (figured specimen).

Type locality.—Off Cape Hatteras, North Carolina (Recent).

Bowden shells referred to *oxytata*, of which 20 are in the Duerden collection, are slightly more slender than the living southern race, and their posterior end tapers a little less rapidly than in the northern race. Imperfect specimens show that the largest shells have a length of 3.9 millimeters. Shells from the Cercado and Gurabo formations,

described by Gabb as *cylindrica*, a preoccupied name, have a maximum length of 5 millimeters, but otherwise are similar. Fossils from deposits on the American mainland as old as lower Miocene are referred to this species.

Other localities.—Chipola formation (lower Miocene), Florida. Uscari formation (lower Miocene), Costa Rica. Cercado and Gurabo formations (middle Miocene), Dominican Republic. Duplin marl (upper Miocene), North Carolina. Caloosahatchee formation (Pliocene), Florida. Living, Hatteras to Cuba in 5 to 63 fathoms.

Type material.—Yale University.

Volvula ornata Pilsbry and Johnson

(Plate 2, Figures 11, 12)

Volvula sp., near *caribaea* Orbigny, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Volvula ornata Pilsbry and Johnson, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 151. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 312, fig. 13.

Shell stout. Anterior part of aperture strongly dilated. Umbilical groove relatively wide. Apex bearing fine axial folds. Base sculptured with fine spiral grooves.

Length 4.2 mm.; diameter 2 mm. Length 3.3 mm.; diameter 1.6 mm. (figured specimens).

Type locality.—Dominican Republic (Miocene).

The apical axial folds are a characteristic feature of this species, which is represented by 45 specimens in the Duerden collection. Bowden shells are slightly stouter than specimens from the Dominican Republic.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (Acad. Nat. Sci. Philadelphia No. 3178).

SCAPHANDRIDAE

SCAPHANDER Montfort

Montfort, 1810, Conchyliologie systématique, vol. 2, p. 335.

Type (*by original designation*).—*Bulla lignaria* Linné. Recent, seas of Europe.

Shell external, ovate, imperforate, reaching a large size. Spire involute, apical perforation shallow, closed by callus. Aperture large, wide, anterior part broadly expanded. Inner lip closely appressed. Parietal wall covered with callus. Sculpture consisting of narrow spiral grooves.

Eocene species of *Scaphander* are recorded in Europe and America. The living species are widely distributed both geographically and bathymetrically.

Scaphander nannus, new species

(Plate 2, Figures 13, 14)

Shell very small. Apical perforation moderately wide and deep. Inner lip very narrow. Parietal callus thin. Sculpture consisting of deep narrow spiral

grooves of varying width and spacing on different parts of shell and bearing very fine axial threads. The grooves are widest on the posterior part and there the axial threads are most distinct.

Length 5.7 mm.; diameter 3.1 mm. (holotype, outer lip broken back).

This small *Scaphander* is represented by three specimens, one of which is a little larger than the holotype, but none is perfect. It is smaller than *S. langdoni* Dall (Proc. U. S. Nat. Mus., vol. 18, p. 28, 1896; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 59, fig. 10, 1903), from the Chipola formation of Florida, and has stronger sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 369327).

ATYS Montfort

Subgenus ATYS s. s.

Montfort, 1810, Conchyliologie systématique, vol. 2, p. 343.

Type (*by original designation*).—*Atys cymbulus* Montfort (=*Bulla nancum* Linné). Recent, Indo-Pacific.

The subgenus *Atys* s. s. is characterized by its large, greatly inflated shell and columellar fold. The living species are confined to the Indo-Pacific region. A Miocene species from the Dominican Republic (*A. doliolum* Maury), and to a less extent another Dominican Miocene species (*A. cinctorii* Pilsbry and Johnson) and one from the Chipola formation (*A. oedemata* Dall) resemble the type species except for their very small size. If they represent *Atys* s. s., they are the only known fossil species.

Subgenus ALICULASTRUM Pilsbry

Pilsbry, 1896, Man. Conchology, ser. 1, vol. 16, p. 237. Substitute name for *Alicula* Ehrenberg, 1831, Symbolae Physicae, Anim. evert., exc. Insectis (no pagination, p. 41 of Moll.); type, by monotypy, *Bulla cylindrica* [Helbling]. Not *Alicula* Eichwald, 1830, Naturh. Skizze Lithuaen, Volhynien und Podolien, p. 214.

Type (*see above*).—*Bulla cylindrica* Helbling. Recent, Indo-Pacific.

Shell medium-sized, cylindrical-ovate, spire involute. Aperture long, dilated at anterior end. Outer lip twisted and bearing a fold at its insertion in apex. Columella smooth. Inner lip bent back over a narrow umbilical groove. Sculpture consisting of spiral grooves at both ends of shell. (Based on Pilsbry's description of type species, Man. Conchology, ser. 1, vol. 15, p. 265, 1893.)

The cylindrical shape and the absence of a columellar fold distinguish *Aliculastrum* from *Atys* s. s. The Bowden species have a slender columellar fold and may belong to a different group. In America the earliest species referred to *Aliculastrum* are of lower Miocene age. The living species have an extensive distribution in the warm seas, but are most abundant in the Indo-Pacific region.

Key to the Bowden species of Aliculastrum

Shell slender, sculpture obscure ..... *A.* (*A.*) *morantensis*
Shell relatively stout, sculpture strong ..... *A.* (*A.*) *dalli*

Atys (Aliculastrum) morantensis, new species

(Plate 2, Figures 15, 16)

Atys obscurata Dall (part), 1895, Proc. U. S. Nat. Mus., vol. 18, p. 30. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell medium-sized, slender, ovate. Outer lip bearing a slender twisted fold at its insertion in apex. Columella bearing a slender basal fold. Sculpture consisting of obscure closely spaced spiral grooves at both ends of shell.

Length 4.8 mm.; diameter 2.3 mm. (holotype). Length 6.3 mm.; diameter 2.8 mm. (other figured specimen).

Though this species is represented by a large number of specimens (20 in Henderson collection), most of them are imperfect. The holotype is a medium-sized ovate shell. Figure 16 represents a larger more cylindrical worn specimen. This species tapers more rapidly at both ends than *A. obscurata* Dall (Proc. U. S. Nat. Mus., vol. 18, p. 30, 1896; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 59, fig. 4, 1903), a species from the Chipola formation of Florida, and has a narrower apical perforation and more obscure sculpture. Except for a few cylindrical specimens, it is less cylindrical than *A. yaquensis* (Maury) (Bull. Am. Paleontology, vol. 5, p. 181, pl. 29, fig. 6, 1917), which is found in both the Cercado and Gurabo formations, and its outer lip has a stronger twist at its insertion in the apex.

Type material.—Holotype (U. S. Nat. Mus. No. 369328).

Atys (Aliculastrum) dalli, new species

(Plate 2, Figures 17, 18)

Shell medium-sized, relatively stout, ovate. Posterior end of aperture relatively wide. Outer lip extended far beyond apex, bearing a heavy twisted fold at its insertion in apex. Columella bearing a slender basal fold. Umbilical groove very wide. Sculpture consisting of strong spiral grooves at both ends of shell.

Length 4.7 mm.; diameter 2.7 mm. (holotype). Length 6 mm.; diameter 2.7 mm. (other figured specimen).

All specimens of this species, of which about 13 are in the Henderson collection, are imperfect. The posterior extension of the outer lip, its heavy apical fold, and the basal columellar fold suggest features intermediate between *Atys* s. s. and *Aliculastrum*. Two species, one more slender than *dalli* and the other more ovate, are represented by undescribed material collected from the Cercado formation. According to the figures, "*Mnestia*" *boussaci* Cossmann and "*Bullinella* (*Cylichnina*)" *martinicensis* Cossmann (Journ. Conchyl., vol. 61, pp. 9–11, figs. 14–15, 17–18, 1913), which are found in the Miocene beds of Martinique, seem to represent *Aliculastrum*. *A. boussaci* is more inflated than *dalli*, whereas *A. martinicensis* is less inflated.

Type material.—Holotype (U. S. Nat. Mus. No. 369330).

CYLICHNA Lovén

Lovén, 1846, Index molluscorum litora Scandinaviae occidentalia habitantium, p. 10.

Type (*by subsequent designation, Herrmannsen, 1852, Indicis Gen. Malac., Supplement, p. 42*).—*Bulla cylindracea* Pennant. Recent, seas of Europe.

Shell small, very slender, cylindrical, posterior end truncated. Spire involute, apex slightly concave. Aperture narrow, anterior end dilated. Columella bearing a low, very oblique basal fold. Sculpture absent or consisting of faint spiral grooves.

Many Tertiary and even Cretaceous Tectibranchs are placed in this genus, and the living species referred to it have a cosmopolitan distribution. No species have heretofore been recorded in the Miocene beds of tropical America.

Cylichna aula, new species

(Plate 2, Figure 19)

Shell small, almost perfectly cylindrical except for the rounded base. Shoulder bearing a wide shallow groove that disappears toward outer lip. Columella bearing a heavy, oblique basal fold.

Length 2.8 mm.; diameter 1.3 mm. (holotype).

The holotype is the only Bowden specimen of this curious species, which is characterized by the wide shallow groove on the shoulder. It is also represented by a smaller specimen from the Gurabo formation (U. S. G. S. station 8702) that has a slightly deeper shoulder groove. Other mollusks from station 8702 indicate that at this locality the Gurabo formation was deposited in deeper water than elsewhere. *C. aula* may have lived in relatively deep water. At all events nothing like it has been collected from the shallow-water Miocene deposits of the Caribbean region.

Type material.—Holotype (U. S. Nat. Mus. No. 369332).

BULLIDAE

BULLA Linné

Linné, 1758, Systema Naturae, ed. 10, p. 725.

Type (*by subsequent designation, Monfort, 1810, Conch. Syst., vol. 2, p. 331*).—*Bullus ampula* Linné (=*Bulla ampula* Linné).[1] Recent, Indo-Pacific.

Shell reaching a large size, thick, ovate or subglobose, spire involute, apical perforation narrow, deep. Aperture long, wide, anterior end greatly expanded. Columella and parietal wall bearing a thick layer of callus. Sculpture consisting of fine spiral grooves at both ends of shell. Apical perforation generally bearing deep spiral grooves.

Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 43, p. 244, 1908) proposed to substitute *Bullaria* Rafinesque (Analyse Nat., p. 142, 1815) for *Bulla* on the grounds that it was preoccupied by its use on

[1] Whether Montfort's use of *Bullus* is to be regarded as a masculinizing of *Bulla*, or as a substitute for *Bulla*, or as a new name, is open to question. A combination like "*Bullus ampula*," shows that Montfort paid no attention to Latin grammar.

page 427 of the tenth edition of the Systema Naturae, where it is given as a subdivision of the cricket genus *Gryllus*. The consistent use of "G. B.," which clearly stands for *Gryllus Bulla*, at the head of each of the six species under the heading *Bulla* indicates that Linné used *Bulla* in the sense in which subgenera are now used, though in this genus, and also under many others, all the species of *Gryllus* are placed under the group names *Mantis*, *Acrida*, *Bulla*, *Acheta*, *Tettigonia*, and *Locusta*. If these names are accepted as subgenera, or genera, no species are left for the subgenus *Gryllus* s. s., and one of the subgenera must be suppressed as a synonym of *Gryllus* s. s. Dr. Carl Heinrich, of the United States National Museum, pointed out a similar case discussed by Barnes and Benjamin for the Lepidopteran genus *Phalaena* (Contributions to the natural history of the Lepidoptera of North America, vol. 5, No. 2, pp. 53–55, 1923). Group names, consisting of a word or of a phrase, also are used by Linné under the genera of mollusks and other animals, but under the mollusks the group name is not repeated after the generic name and is not placed in the running head. Therefore, they are not regarded as subgeneric names.

As the first one to deal with this matter Dall gave preference to the first use of *Bulla*. Inasmuch as the name was in use for mollusks long before it was revived for crickets, the continuation of its use in mollusks deserves special protection. Its status is now under consideration by the International Commission on Zoological Nomenclature.

According to Cossmann (Essais Paléoconch. Comp., pt. 1, p. 91, 1895) the earliest species referred to *Bulla* are of Jurassic age. At the present time the genus is represented by many species in the warm and temperate seas.

Bulla vendryesiana Guppy

(Plate 2, Figures 20, 21)

Bulla vendryesiana Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pt. 10, p. 77, pl. 1, fig. 6 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 209). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 407, pl. 16, fig.6; p. 437 (list).

Bulla striata Guppy (not Bruguière), 1874, Geol. Mag., decade 2, vol. 1, p. 437 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p.1583 (list).

Bulla (*striata* var. ?) *vendryesiana* Guppy, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell medium-sized, ovate. Aperture moderately wide, callus thick. Sculpture consisting of a few spiral grooves at both ends of shell. Apical perforation bearing deeper and wider spiral grooves.

Length 15.9 mm.; diameter 9.5 mm. (holotype). Length 25.9 mm.; diameter 8.9 mm. (larger figured specimen).

Type locality.—Jamaica (Miocene).

No large specimen of this species, of which 11 specimens are in the Duerden collection, is perfect. The columella and callus are broken

on the large figured specimen. This species is smaller than the living West Indian *B. amygdala* Dillwyn and has a wider and more strongly sculptured apical perforation. It is larger, less inflated, and less strongly sculptured than a species from the Cercado formation that apparently represents *B. paupercula* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 52, 1849).

The type material consists of a broken medium-sized specimen and a smaller unbroken specimen. The latter seems to be the specimen figured by Guppy and is considered the holotype.

Type material.—Holotype (U. S. Nat. Mus. No. 115432).

RINGICULIDAE

RINGICULA Deshayes

Subgenus RINGICULA s. s.

Deshayes, 1838, in Lamarck, Histoire naturelle des animaux sans vertèbres, ed. 2, vol. 8, p. 342.

Type (by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 140).—Auricula ringens Lamarck. Eocene. Paris Basin.

The subgenus *Ringicula* s. s., which is characterized by its denticulate outer lip and by its three almost equal parietal folds, is not represented in the Bowden formation.

Subgenus RINGICULELLA Sacco

Sacco, 1892, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 12, p. 16.

Type (by subsequent designation, Cossmann, 1895, Essais Paléoconch. Comp., pt. 1, p. 115).—Marginella auriculata Ménard. Miocene to Recent, Mediterranean Sea.

Shell small, stout, ovate. Aperture ear-shaped. Outer lip extending up on preceding whorl, greatly thickened by callus for some distance back from aperture, middle part of its inner edge extending toward aperture. Anterior canal forming a shallow notch. Columella bearing two oblique folds. A lower and more horizontal fold lies on the parietal wall. Parietal callus very heavy, forming with the callus on outer and basal lips a complete heavy margin to the aperture. Sculpture consisting of spiral grooves.

Cossmann (cited above) considered *Ringiculella* the same as *Ringiculina* Monterosato (Nomen. gen. spec. conch. Med., p. 141, 1884; type, by original designation, *Ringicula leptocheila* Brugnone, Recent, Mediterranean Sea), but *Ringiculina* has no parietal fold and a much thinner outer lip. *Ringiculella* differs from *Ringicula* s. s. in its heavier non-denticulate outer lip, heavier callus, and lower parietal fold. According to Pilsbry (Man. Conchology, ser. 1, vol. 15, p. 395, 1893), most of the living species, which are found in nearly all warm and temperate seas, belong to this subgenus, though at that time Pilsbry apparently was unaware of Sacco's name.

Ringicula (Ringiculella) tridentata Guppy
(Plate 2, Figure 22)

Ringicula tridentata Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pt. 10, p. 76 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 208). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 406. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell small, very stout and thick. Callus surrounding aperture very heavy. Outer lip thick, its inner edge extending toward aperture a little below middle. Parietal fold as heavy as the two columellar folds, but more horizontal. Sculpture consisting of four to seven shallow obscure spiral grooves on base of body whorl. Callus covering umbilical groove bearing two or three deep spiral grooves.

Length 2.8 mm.; diameter 2 mm. (neotype).

Type locality.—Jamaica (Miocene).

As the type of this species seems to be lost, the figured specimen is designated the neotype. About 60 specimens are in the Duerden collection. This species apparently is a little larger and stouter than *R. hypograpta* Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 64, p. 505, fig. 2, 1912), a species from the Gatun formation of the Panama Canal Zone, and has more obscure sculpture, though additional material from the Gatun formation may show that the Panama material represents the same species. The type of *hypograpta* could not be found at Philadelphia. It is much larger and heavier than *R. dominicana* Maury (Bull. Am. Paleontology, vol. 5, p. 185, pl. 29, fig. 11, 1917), which is found in great abundance in the Cercado formation. *R. tridentata* is represented in the Dominican Republic by an imperfect specimen from the Gurabo formation (U.S.G.S. station 8702).

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Neotype (U. S. Nat. Mus. No. 369334).

GASTROPODA STREPTONEURA

PECTINIBRANCHIATA HETEROPODA

The heteropods, or nucleobranchs, are pelagic mollusks embracing both shell-bearing and naked genera. *Carinaria caperata* Guppy (Proc. U. S. Nat. Mus., vol. 19, p. 318, pl. 27, fig. 14, 1896), from Miocene beds at Naparima, Trinidad, and the species of *Atlanta* mentioned in the following descriptions are the only described heteropods from the Tertiary deposits of tropical America.

ATLANTIDAE

ATLANTA Lesueur

Subgenus ATLANTA s. s.

Lesueur, 1817, Journal de Physique, de Chimie, d'Histoire Naturelle et des Arts, vol. 85, p. 390.

Type (by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 149).—*Atlanta peronii* Lesueur. Recent, Atlantic, Pacific, and Indian Oceans.

Shell small or medium-sized, very thin, discoidal, resembling a minute evolute ammonite. Early whorls coiled in a dextral spire, later whorls coiled in one plane, each whorl touching periphery of preceding whorl. Periphery bearing a very thin keel. Aperture ovate, prolonged in a deep narrow slit on the periphery.

The living species of this subgenus are found in the warm and temperate seas. Only a few fossil species, none older than Miocene, have been described.

Atlanta (Atlanta) diamesa, new species

(Plate 2, Figures 23 to 25)

Shell medium-sized. Early whorls partly broken, forming a spire of moderate dimensions. Later whorls flattened near periphery. Peripheral keel partly broken.

Diameter 3.7 mm.; height of aperture 1 mm. (holotype).

This species is represented by three specimens, one of which, the holotype, is considerably larger than the others. So far as size of the early whorls and also of the whole shell are concerned *diamesa* is intermediate between *cordiformis* Gabb (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 315, fig. 14, 1922) and the living *peronii* Lesueur. The type material of *cordiformis* consists of two very small shells having a diameter of only 1.5 millimeters, and a specimen of similar size has been collected from the Cercado formation. The early spiral whorls of *cordiformis* also are very small. Though the early whorls of *diamesa* are not perfectly preserved, it can be seen that they are larger than in *cordiformis*, but not so large as in *peronii*. The Bowden species differs from both these species in having the whorls more flattened near the periphery. The type of *A. ammonitiformis* Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 349, pl. 45, fig. 30, 1881), a Pliocene species from Limon, Costa Rica, is even smaller than *cordiformis* and is badly broken.

Type material.—Holotype (U. S. Nat. Mus. No. 369335).

Subgenus ATLANTIDEA Pilsbry

Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 314.

Type (by original designation).—*Atlanta rotundata* Gabb. Miocene, Dominican Republic.

Shell small or medium-sized, thin, resembling a minute *Bellerophon*. Early whorls coiled in a dextral spire, later whorls coiled in one plane, each touching and partly enveloping preceding whorl. Periphery rounded, not bearing a keel. Aperture rounded, ovate.

On account of the keel-less later whorls *Atlantidea* resembles the genus *Oxygyrus* Benson, but the spiral early whorls show that it is a modified *Atlanta*. *Atlanta souleyeti* Smith (Challenger Rept., Zoology, vol. 23, pt. 72, pp. 43–44, 1888; = *A. lamanonii* Eydoux and Souleyet, not Eschscholtz), an Atlantic species, is placed in this subgenus by

Pilsbry. It has a membranous keel, and the fossil species may have had a similar keel. The genotype and the following species are the only known fossils.

Atlanta (Atlantidea) lissa, new species

(Plate 2, Figures 26, 27)

Shell medium-sized. Early whorls partly broken, forming a low tilted spire. Later whorls greatly inflated, broadly rounded at periphery, not bearing fine spiral sculpture.

Diameter 2.8 mm.; height of aperture 1.7 mm. (holotype). Diameter 6.7 mm.; height of aperture 2.5 mm.

The early whorls are partly broken on the holotype, but enough can be seen to determine that they form a low, apparently tilted spire. This species has more inflated and more rapidly enlarging later whorls than the living *souleyeti*, and it lacks the fine spiral threads of *rotundata* (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 314, fig. 15, 1922), which has been collected from the Cercado formation.

Two specimens are referred to this species, both of which, like those of *A. diamesa*, are in the Johns Hopkins collection. The holotype is comparable to *rotundata* in size. The other specimen, which is much larger, is an internal mold to which small patches of shell cling. The early whorls of this specimen can not be made out and it may represent *Oxygyrus*.

Type material.—Holotype (U. S. Nat. Mus. No. 369336).

PECTINIBRANCHIATA STENOGLOSSA

TOXOGLOSSA

TEREBRIDAE

Forty species of the family Terebridae from the Miocene deposits of tropical America are in the literature. By eliminating synonyms this number is reduced to about 35, all except three of which are based on fossil material from this region. Many species still remain undescribed.

Bartsch (Nautilus, vol. 37, No. 2, pp. 60–64, 1923) proposed to divide this family into two genera—*Terebra*, characterized by one columellar fold, and *Myurella*, characterized by two columellar folds. It is difficult to apply this criterion. Some species have two well-defined folds, but many others have a columellar swelling lying behind the basal fold, or twist, and it is a matter of personal preference whether this inflation is considered a fold. It also is certain that a number of genera are represented in this family. Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 43, pp. 247–250, 1908) recognized three genera on anatomical grounds (*Terebra*, *Hastula*, and *Duplicaria*) and admitted a fourth genus (*Spineoterebra*), the soft parts of which are unknown. In most discussions of this family little attention is paid to the charac-

ters of the outer lip, anterior canal, and siphonal fasciole, though they are different in the various groups. Following Dall's usage two genera are represented in the Bowden formation—*Terebra* and *Hastula*.

It is not known what specimens from Bowden in the collections of the United States National Museum were intended to represent the following species listed by Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583, 1903): *Terebra inaequalis* Sowerby, *Terebra sulcifera* Sowerby, *Terebra* sp., near *protexta* Conrad, *Terebra* sp., near *inornata* Dall.

TEREBRA Bruguière

Subgenus TEREBRA s. s.

Bruguière, 1789, Encyclopédie Méthodique, Histoire naturelle des Vers, vol. 1, p. xv (genus without species).

Type (by monotypy; Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 71).—Buccinum subulatum Linné. Recent, Indo-Pacific.

The subgenus *Terebra* s. s. is characterized by its flaring aperture, by the extreme narrowness of the constricted area behind the siphonal fasciole, and by the absence of a heavy layer of callus on the parietal wall and columella. The outer lip is not abruptly inflected forward below the area corresponding to the sutural band of the early whorls. The presence of strong sculpture on the early whorls and its absence on the later whorls is duplicated in other divisions of the genus. This subgenus is not found living or fossil in America.

Subgenus PARATEREBRA, new subgenus

Type.—Terebra texana Dall. Recent, Gulf of Mexico and Caribbean Sea.

Shell large, generally moderately slender. Aperture relatively narrow. Outer lip inflected forward at about a third of distance from suture to base of anterior canal. Anterior canal relatively long, producing a wide constricted area behind siphonal fasciole, bearing a wide deep notch. Siphonal fasciole correspondingly wide, limited by a high thread and bearing more or less prominent growth lamellae. Columella bearing a basal fold. Columella and parietal wall covered with thick layer of callus. Sculpture of early whorls consisting of a sutural band, below which lies a narrower band, and of fine axial ribs curved forward. Sculpture partly or completely disappearing on later whorls.

The relatively narrow aperture and long anterior canal, rather strongly inflected outer lip, and heavy callus separate *Paraterebra* from *Terebra* s. s. *Oxymeris* Dall (Proc. U. S. Nat. Mus., vol. 26, p. 951, 1903; substitute name for *Acus* ("Humph.") Gray, Proc. Zool. Soc. London, pt. 15, p. 139, 1847, not *Acus* Edwards 1771; type, by original designation (Gray), *Terebra maculata* Lamarck, Recent, Indo-Pacific) has a wider and more flaring aperture, shorter anterior canal, no thick layer of callus, and its outer lip descends almost vertically from the suture and then bends backward and forward in a broad sweeping curve.

This subgenus embraces two groups of Caribbean Miocene Terebras, both of which should perhaps be named. One group, embracing *T. sulcifera* Sowerby, *T. isaacpetiti* Maury, and the Bowden species *T. lepta*, has moderately slender shells that partly lose their sculpture on the later whorls. These species are similar to *T. texana*, the type species, and to an undescribed species living on the Pacific coast of Panama. The type of *texana* is a worn beach shell found on Matagorda Island, Texas, after a storm. Another specimen was collected from a shell heap at Paranagua, Brazil. Dr. T. A. Link, of the Tropical Oil Company, recently collected and presented to the National Museum two smaller specimens from the Caribbean coast of Colombia near Cartagena. The Oriental *T. flammea* Lamarck has the same apertural features and the same plan of sculpture. The second group, consisting of *T. inaequalis* Sowerby, also known as *T. gabbi* Dall, and an undetermined Bowden species, has greatly inflated and smooth later whorls. This group is unrepresented at the present time in the Caribbean region, but is represented on the Pacific coast of Panama by *T. robusta* Hinds.

Another group of Terebras consists of very slender, strongly sculptured species that have a shorter canal and thinner callus. These species may have only one columellar fold, as in *T. haitensis* Dall, generally known as "*T. sulcifera* Sowerby," or two folds, as in *T. subsulcifera* Brown and Pilsbry. *T. floridana* Dall, living along the east coast of Florida, may be a modified representative of this group. Perhaps *Myurellina* Bartsch (Nautilus, vol. 37, No. 2, p. 63, 1923; type, by original designation, *Terebra ornata* Gray, Recent, Panama) is available for this group, though *T. ornata* is stouter and less strongly sculptured. It has two columellar folds.

Key to the Bowden species of Paraterebra

Shell slender, later whorls sculptured ..... *T.* (*P.*) *lepta*
Shell stout, later whorls not sculptured ..... *T.* (*P.*) species

Terebra (Paraterebra) lepta, new species

(Plate 3, Figure 1)

? *Terebra sulcifera* Guppy (not Sowerby), 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list).

Shell medium-sized, moderately slender. Aperture broken back on the only specimen. Outer lip, as determined by growth lines, sloping strongly backward from suture and then descending almost vertically. Columella bearing a heavy basal fold, behind which lies a shallow groove followed by a broad swelling. Parietal callus heavy. Spiral sculpture consisting of two bands on posterior half of whorls, the sutural band wider. On the later whorls the bands are very low, but are recognizable. Axial sculpture consisting of heavy slightly retractive cords on the spiral bands, changing, in harmony with growth lines, to more obscure vertical cords on anterior part of whorls.

Length 72.5 mm.; diameter 15.5 mm. (holotype, broken at both ends).

The only specimen of this species is worn and broken. It is smaller than *T. issacpetiti* Maury (Bull. Am. Paleontology, vol. 5, p. 195, pl. 30, fig. 4, 1917; vol. 10, pp. 336–337, 1925), a species from the Gurabo formation, and has more obscure and coarser sculpture. The same features separate it from the living *texana*. According to a paratype loaned by the British Museum, *T. sulcifera* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 47, 1850) is stouter and has stronger and finer sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 369337).

Terebra (Paraterebra) species

(Plate 3, Figure 2)

Terebra gabbi Dall (not Dall 1895), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

A worn broken shell in the Henderson collection (U. S. Nat. Mus. No. 135282), labeled *T. gabbi* Dall, represents a large *Paraterebra* that has no sculpture on the later whorls. Apparently it belongs to the group that has a concave outline to the spire due to the inflation of the later whorls, as in *T. gabbi* Dall and *T. robusta* Hinds. The whorls are flatter than in *gabbi* (Proc. U. S. Nat. Mus., vol. 18, p. 34, 1895; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 59, fig. 31, 1903). The columella has a strong basal fold. The anterior canal is long. The aperture is broken back and in the figure the shell is turned too far to the left, thus distorting the appearance of the canal.

Subgenus STRIOTEREBRUM Sacco

Sacco, 1891, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 10, p. 33.

Type (by original designation).—Terebra basteroti Nyst. Miocene, Mediterranean region.

Shell small or medium-sized, slender. Aperture narrow. Outer lip inflected forward below sutural band. Anterior canal moderately long, bearing a shallow notch. Siphonal fasciole low, bounded by a low thread. Columella (of type species) bearing a very low, broad basal swelling. Parietal wall bearing a very thin glaze of callus. Sculpture consisting of a sutural spiral band and of spiral grooves and axial ribs.

As interpreted in this report, in this group gradations can be seen from an obscure basal fold, as in the type species, through a strong basal fold and a central swelling to two strong folds. In Bartsch's classification species having two folds fall under the genus *Myurella* Hinds (in Sowerby, Thes. Conch., *Terebra*, p. 171; type, by subsequent designation, Dall, Nautilus, vol. 21, p. 249, 1908; Bull, Mus. Comp. Zool. Harvard College, vol. 43, p. 249, 1908; *Terebra myuros* Lamarck, cited by Hinds as *T. commaculata* Pfeiffer, Recent, Indo-Pacific).[1]

[1] Herrmannsen (Indicis Gen. Malac., supplement, p. 89, 1852) cites only *T. myuros* under *Myurella* without actually designating it as the type. Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 43, p. 246, 1908) has called attention to the position of the name *Myurella* on page 171 of Hind's monograph after the descriptions of the three species he placed under it, instead of before the descriptions.

T. myuros is quite different from reticulately sculptured Terebras resembling *Strioterebrum*. The type of *Strioterebrum* has a very obscure columellar fold, and if the name were limited to similar species, there probably would be very few species to put under it. It seems probable that different columellar characters are found in almost any group of Terebras based on other characters, and that the double columellar fold arose independently in several phyla rather than in a main branch of the family.

As here interpreted, *Strioterebrum* embraces a large number of Tertiary and living species, many of which are difficult to satisfactorily define.

Key to the Bowden species of Strioterebrum

Columella bearing a strong or weak basal fold and a low, broad or narrow posterior swelling.
  Sutural band strong.
    Sutural band narrow, axials narrow.
      Shell moderately slender, later whorls moderately inflated.
        Sutural band not sculptured with spiral grooves.
          Sculpture coarse.
            Spiral cords closely spaced, sutural band weak on early post-nuclear whorls..... *T. (S.) bowdenensis*
            Spiral cords relatively far apart, sutural band strong on early post-nuclear whorls.. *T. (S.) eleutheria*
          Sculpture fine..... *T. (S.)* species *a*
        Sutural band sculptured with spiral grooves..... *T. (S.)* species *b*
      Shell very slender, later whorls strongly inflated..... *T. (S.)* species *c*
    Sutural band very wide, axials wide..... *T. (S.) monida*
  Sutural band very obscure..... *T. (S.) ischna*
Columella bearing two strong folds..... *T. (S.) cambiarsoi nugatoria*

Terebra (Strioterebrum) bowdenensis, new species

(Plate 3, Figures 3 to 8)

Terebra inaequalis Guppy (part, not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 290. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list).

Terebra bipartitia Dall (not Sowerby), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell medium-sized, moderately slender. Nucleus consisting of two to two and a half moderately stout or very stout whorls, the first half whorl enlarging rapidly in diameter. Outer lip gently curved forward. Siphonal fasciole limited by a prominent thread. Columella bearing a basal fold and a broad posterior swelling. Parietal wall covered with a definitely limited layer of callus. Sutural band narrow, sculptured with slightly retractive axial ribs. Remainder of whorl sculptured with flat spiral cords and axial ribs that are slightly curved forward. At the intersections are obscure beads.

Length 21.2 mm.; diameter 4.8 mm. (holotype). Length 28.1 mm.; diameter 12.2 mm. (largest specimen, apex broken).

This species is the most abundant Bowden *Terebra*, being represented by about 50 specimens in the Duerden collection. Some of the shells are more slender than others and differences can be seen in details of sculpture, as is shown in the figures. Most specimens that show the nuclear whorls have a moderately stout nucleus, but in two

specimens it is very stout, the whorls having a diameter equal to that of the first post-nuclear whorl (see fig. 5). All the shells have a broad swelling on the posterior part of the columella in addition to the basal fold. The holotype is smaller than some broken large specimens.

In general features *bowdenensis* resembles a number of American Tertiary species. *T. cirrus* Dall (Proc. U. S. Nat. Mus., vol. 18, p. 38, 1896; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 59, fig. 28, 1903), a Miocene species from the Dominican Republic, has a wider sutural band and wider spiral cords, and on the early post-nuclear whorls the sutural band is even weaker. *T. laevifasciola* Maury (Bull. Am. Paleontology, vol. 5, p. 191, pl. 29, fig. 19, 1917), found in the Cercado formation, has coarser sculpture and two strong columellar folds. *T. gausapata* Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 63, pp. 340–341, pl. 22, figs. 8, 9, 1911), from the Gatun formation of the Canal Zone, is more slender, and has coarser sculpture and a more sharply defined posterior fold.

Type material.—Holotype (U. S. Nat. Mus. No. 369338).

Terebra (Strioterebrum) eleutheria, new species

(Plate 3, Figures 9 to 11)

Shell small, moderately slender. Nucleus consisting of almost two stout whorls. Posterior columellar swelling narrower than in *bowdenensis*. Sutural band narrow, sculptured with heavy slightly retractive axial ribs. Remainder of whorl sculptured with strong spiral cords separated by wide interspaces and with slightly curved axial ribs that are beaded at intersection with spirals.

Length 13.8 mm.; diameter 3.5 mm. (holotype, apex broken).

This species, of which 11 specimens are in the Henderson collection, is much smaller than *bowdenensis* and the posterior swelling on the columella is narrower, though it is not a narrow, high fold. The sculpture is more reticulate than in *bowdenensis*, as the spiral cords are farther apart. The beads also are stronger and the sutural band is stronger on the early post-nuclear whorls. On some specimens the spiral cords are not so far apart as on the type specimen. A few specimens from the Gurabo formation (U. S. G. S. stations 8528, 8733) seem to represent this species.

T. eleutheria is very similar to the living West Indian and Floridian *T. limatula* Dall, though it has a less pronounced posterior swelling on the columella and the spiral threads on the base of the body whorl generally are more crowded. *T. midiensis* Olsson (Bull. Am. Paleontology, vol. 9, p. 211, pl. 4, fig. 7, 1922), found in the Gatun formation of Costa Rica, is larger and stouter, and has coarser sculpture and two strong columellar folds.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 369341).

Terebra (Strioterebrum) species *a*

(Plate 3, Figures 12 to 14)

A broken slender shell has finer sculpture than the preceding species, and the axial ribs are rather strongly curved on the later whorls. The columella has a basal fold and a broad posterior swelling. A small specimen has a slender nucleus, much more slender than in *bowdenensis* and *eleutheria*, consisting of three and a quarter whorls. On this specimen the sutural band is strong on the early post-nuclear whorls, as in *eleutheria*. The spiral cords are farther apart than in the large specimen. If these two specimens represent the same species, it is quite distinct from the other Bowden species. The large specimen has the following dimensions: length 13 mm.; diameter 3.7 mm.

Terebra (Strioterebrum) species *b*

(Plate 3, Figure 15)

A broken shell represents a slender *Strioterebrum* that has a heavy sutural band sculptured with spiral grooves. The axial ribs are rather strongly curved. The columella has a low basal fold and a very low broad posterior swelling. The dimensions are as follows: length 12.7 mm.; diameter 4 mm.

This species is similar to *T. gausapata* Brown and Pilsbry (cited under *bowdenensis*), which has a similar heavy, spirally sculptured sutural band, but its axial ribs are heavier and farther apart, and its spiral cords are closer together.

Terebra (Strioterebrum) species *c*

(Plate 3, Figure 16)

A very slender *Strioterebrum* is represented by two broken specimens in the Henderson collection. The later whorls are strongly inflated and the axial ribs are moderately curved. The columella has a basal fold and a broad posterior swelling. The parietal callus is thick. The figured specimen has the following dimensions: length 17.2 mm.; diameter 4.8 mm.

T. berlinerae Maury (Bull. Am. Paleontology, vol. 5, p. 198, pl. 30, figs. 7, 8, 1917), a distinctive species from the Cercado formation, has the same inflated later whorls and the same type of sculpture, but it is much stouter, and has a different siphonal fasciole and very thin callus. *T. baculiformis* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 152, 1917; vol. 73, p. 316, pl. 22, figs. 5, 6, 1922), a very slender species from the Dominican Republic, has less strongly inflated whorls, more strongly curved axial ribs, and spiral sculpture on the sutural cord.

Terebra (Strioterebrum) monida, new species

(Plate 3, Figure 17)

Terebra inaequalis Guppy (part, not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 290. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list).

Shell medium-sized, moderately stout, whorls flat. Nucleus consisting of one and a half to two slender whorls. Outer lip curved forward below sutural band. Anterior canal relatively short, broad, bearing a shallow notch. Siphonal fasciole bounded by a prominent thread. Columella bearing a narrow basal fold, not clearly visible at the aperture, and a very slight posterior swelling. Parietal callus very thin. Sutural band very wide, occupying half of whorls of spire, set off from rest of whorl by a deep narrow groove that is more prominent than suture. Axial ribs very heavy and wide, protractive on spire, separated by V-shaped interspaces in which two to four obscure spiral grooves can be seen.

Length 22 mm.; diameter 6.1 mm. (holotype).

For a *Strioterebrum* this is a very distinctive species and perhaps deserves a section name. The whorls are unusually flat and the sutural band and ribs are unusually wide. The wide sutural band and heavy axials suggest the genus *Diplomeriza* Dall (Nautilus, vol. 33, p. 32, 1919, =*Duplicaria* Dall, Nautilus, vol. 21, pp. 124–125, 1908; Bull. Mus. Comp. Zool. Harvard College, vol. 43, pp. 248, 250, 1908, not *Duplicaria* Rafinesque, 1833; type by original designation, *Terebra duplicata* Lamarck, Recent, east coast of Africa), which has a straighter outer lip, less constricted and wider anterior canal, different siphonal fasciole and callus, and no spiral grooves on the flanks of the ribs below the sutural band. Despite its sculpture *monida* seems to be a *Strioterebrum*, though it has a shorter anterior canal and stronger thread at the siphonal fasciole than the type species. It is represented by 18 specimens in the Duerden collection.

No American Tertiary or living species remotely resembling this species has yet been described. A specimen from the middle part of the Gatun formation west of the spillway of Lake Gatun in the Panama Canal Zone (U. S. G. S. station 8382) seems to represent the same species. Three specimens from the Cercado formation on Rio Cana (U. S. G. S. station 8534) are more slender and perhaps represent a different subspecies. A stouter species having more numerous axial ribs is represented by one specimen from the middle or upper Miocene beds at Limon, Costa Rica (U. S. G. S. station 8343). Thus it is possible to trace this phylum of peculiar Terebras through two or three Miocene states and in the later stages the shells are stouter than in the preceding stage.

Other localities.—Gatun formation (middle Miocene), Panama Canal Zone.

Type material.—Holotype (U. S. Nat. Mus. No. 369347).

Terebra (Strioterebrum) ischna, new species

(Plate 3, Figure 18; Plate 4, Figure 1)

Shell very small, very slender. Nucleus consisting of one and a half to two slender cylindrical whorls. Outer lip slightly curved forward below sutural band. Base of anterior canal broken on all specimens. Siphonal fasciole limited by a rather heavy thread. Callus very thin. Columella bearing a very obscure basal fold. Sutural band very weak, almost disappearing on some specimens (see fig. 1), but represented by a constriction of the whorl. Other sculpture consisting principally of narrow axial ribs that are vertical on the early whorls and slightly curved on later whorls. Between the ribs are obscure spiral grooves that are absent on some specimens except on base of body whorl.

Length 7.5 mm.; diameter 1.9 mm. (holotype).

This little species, which has the columellar features of the type of *Strioterebrum,* is represented by eight specimens, all in the Henderson collection. The sutural band and spiral grooves are very obscure on some specimens, but all seem to represent the same species. Specimens that have obscure spiral sculpture are something like the genus *Hastula.* This species is very similar to *T. guanica* Dall and Simpson, a living species from Porto Rico. The fossils have a slender nucleus and slender early whorls that bear straighter axials, and the axials on the later whorls are stronger.

A broken specimen in the Henderson collection, larger than those referred to *ischna,* has the same columellar features, but seems to represent a different species, as it has a stronger sutural band bearing a narrow groove between the ribs.

Type material.—Holotype (U. S. Nat. Mus. No. 369609).

Terebra (Strioterebrum) cambiarsoi nugatoria, new subspecies

(Plate 4, Figures 2, 3)

Shell small, moderately slender. Nucleus consisting of two stout whorls. Outer lip rather strongly inflected forward below the sutural band. Anterior canal relatively long, bearing a wide, deep notch. Siphonal fasciole limited by a prominent thread. Columella bearing two strong folds, the posterior one a little wider than the basal one. Sculpture consisting of a sutural band, sculptured with vertical axial ribs. On remainder of spire whorls are heavy slightly curved axial ribs between which lie three broad spiral cords, separated by very narrow grooves.

Length 15.5 mm.; diameter 4.2 mm. (holotype, apex broken).

This is the only Bowden *Terebra* that has two strong columellar folds and would fall in the genus *Myurella,* as used by Bartsch. The Bowden specimens, of which eight are in the Duerden collection, are very similar to *T. c. cambiarsoi* Maury (Bull. Am. Paleontology, vol. 5, pp. 191–192, pl. 29, fig. 20, 1917), which is found in the Cercado formation, but the nucleus is much stouter and consists of fewer whorls. This may not be a valid basis for recognizing a subspecies, but the difference seems too pronounced to ignore. *T. cambiarsoi*

remotely resembles the living *T. dislocata* Say, which reaches a much larger size and has finer sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 369348).

HASTULA H. and A. Adams

H. and A. Adams, 1853, Genera of Recent Mollusca, vol. 1, p. 225.

Type (by subsequent designation, Cossmann, 1896, Essais Paléoconch. Comp., pt. 2, p. 53).—Buccinum strigilatum Linné.[1] Recent, Indo-Pacific.

Shell small or medium-sized, slender, whorls flat. Aperture wide. Outer lip descending vertically from suture or bulging forward a little. Anterior canal very short, not constricted, bearing a wide deep notch. Siphonal fasciole wide, bearing an obscure median groove. Boundary of fasciole forming an overlapping shelf. Columella bearing an obscure basal fold. Parietal wall covered with callus. Sculpture consisting of narrow axial ribs that disappear on anterior part of whorls.

According to Cossmann (cited above), the earliest species of this genus are of Eocene age. Living species, all of which are more or less similar, are found in the warm seas of the world. Heretofore no Tertiary species were recorded from tropical America.

Key to the Bowden species of Hastula

Shell moderately slender, sculpture relatively strong.....*H. jamaicensis*
Shell very slender, sculpture weak.....*H. homala*

Hastula jamaicensis, new species

(Plate 4, Figure 4)

Shell medium-sized, moderately slender. Outer lip descending almost vertically from suture. Siphonal fasciole worn on only specimen, bearing a broad shallow median groove. Sculpture consisting of narrow vertical axial ribs that undulate the suture and disappear near base of later spire whorls.

Length 17.9 mm.; diameter 5 mm. (holotype, apex broken).

This species is represented only by the holotype. It is smaller than the living West Indian *H. hastata* (Gmelin) and has flatter whorls, and its ribs disappear near the base of the later whorls of the spire. A more strongly sculptured species is represented by a specimen from the Cercado formation (U. S. G. S. station 8534).

Type material.—Holotype (U. S. Nat. Mus. No. 369350).

Hastula homala, new species

(Plate 4, Figure 5)

Shell small, very slender. Base of anterior canal broken on only specimen, siphonal fasciole worn. Columella bearing an obscure basal fold. Sculpture

[1] Cossmann cites *Terebra strigillata* Lamarck as the type, though H. and A. Adams include "*strigillata* Linn." in their list of species. They probably had in mind *strigilata* of later authors, which, according to Hanley (Ipsa Linnaei Conchylia, pp. 261-262, 1855), is different from *strigilata* of Linné, a species that he considers unrecognizable unless Born's identification is accepted (Test. Mus. Caes. Vind., pp. 264–265, pl. 10, fig. 10, 1780). Therefore, there is some uncertainty as to what the type of *Hastula* is. It is used here in the sense of *strigilata* of later authors.

consisting of narrow very low axial ribs that disappear on anterior third of later spire whorls.

Length 9.9 mm.; diameter 2.6 mm. (holotype).

Aside from its smaller size, which may not be significant, this species, also represented only by the holotype, is more slender than *jamaicensis* and has more obscure sculpture. In the figures the two species look similar, but it should be noted that the figure of *homala* is enlarged four times, whereas that of *jamaicensis* is enlarged only twice. An even smaller and more slender species having heavier ribs is represented by a specimen from the Cercado formation (U. S. G. S. station 8525).

Type material.—Holotype (U. S. Nat. Mus. No. 135287).

TURRIDAE

This family is perhaps the most difficult one of all the gastropods, both on account of the great abundance of genera and species and on account of nomenclatorial tangles. Its representation in the Bowden formation, like the Bowden representation of many other families, is remarkable, consisting of 70 species and 38 genera, 25 of which are described as new. No apologies are offered for this disproportionate number of new genera. Most workers who have dealt with this family realize the lack of generic names. No middle grounds can be taken between the old-fashioned usage of "*Pleurotoma*," "*Drillia*," "*Cythara*," "*Mangilia*," "*Clathurella*," "*Glyphostoma*," and "*Daphnella*" for most of the species and the frank recognition of many genera. Most of the genera are represented by very small shells, all of which have to be put under the microscope. If they were larger, no question would be raised about the validity of so many genera. Many names are available for the American and European Eocene genera and also for the Recent European genera; in fact, a good many of the Mediterranean genera are supplied with two or more names. Only a few of the Eocene genera survived until Miocene time and still fewer of the living temperate European genera are found in the Miocene deposits of tropical America. No intensive work has yet been done on the living West Indian turrids, which accounts for the large number of new generic names here proposed, for most of these genera are now represented there, though the living species are not in a satisfactory state for comparison.

Several of Casey's Eocene genera (*Eoclathurella*, *Lyrosurcula*, and *Microurcula*) were not considered in the search for generic names, for their types are unfigured and unavailable.

About 160 Miocene species of this family from tropical America have already been described. Each locality yields a large number of species, many of which apparently are not found elsewhere. Of the 70 Bowden species only seven so far are recognized at other localities.

TURRINAE

POLYSTIRA, new genus

Type.—Pleurotoma albida Perry. Recent, West Indies and Florida.

Shell relatively large, fusoid. Nucleus stout, cylindrical, consisting of almost two whorls, the last quarter whorl bearing a few axial riblets. Aperture narrow. Anterior canal long, narrow, unemarginate. Siphonal fasciole slightly or rather strongly inflated. Between it and the inner lip lies a narrow umbilical groove or a relatively wide umbilical opening. Anal sinus moderately deep, shaped like a V with a rounded apex, which lies on the peripheral keel. Interior of outer lip bearing far within aperture fine ridges or fluting. Sculpture consisting of spiral keels and threads, the peripheral keel strongest, and of strong growth threads.

This genus is the American tropical representative of the Indo-Pacific *Turris* ("Bolten") Roeding (Mus. Bolt., pt. 2, p. 123, 1798; type, by subsequent designation, Dall, U. S. Geol. Survey Prof. Paper 59, p. 24, end of first paragraph, 1909, *Murex babylonus* Gmelin (error for *babylonius*) = *Murex babylonius* Linné, Recent, Indo-Pacific), which also has the interior of the body whorl fluted. The sinus of *Turris* is deep and narrow and lies behind the peripheral keel on a flat band.

Polystira apparently does not extend back farther than lower Miocene time. A similar genus, *Pleuroliria* de Gregorio (Mon. faune éoc. Alabama, p. 38, 1890; type, by original designation, *Pleurotoma* (*Pleuroliria*) *supramirifica* de Gregorio, Eocene, Alabama), which is much smaller and has a less prominent peripheral keel, is found in the Eocene and Oligocene deposits of southeastern United States. No specimens of *supramirifica* are available, but according to de Gregorio's figures *Pleurotoma cochlearis* Conrad, a species from the upper Oligocene Byram marl, is very similar to it. This species has a nucleus different from that of *Polystira*, consisting of about four whorls, the first one of which is very small and the last two and a half of which are sculptured with many axial riblets. A branch of this early Tertiary genus is represented by a species from the middle Miocene Shoal River formation of Florida, described in manuscript by Gardner. It has a nucleus resembling that of *cochlearis*, though the number of whorls is reduced to a little less than four, but the shell is larger and the peripheral keel is stronger, so that except for the nucleus it resembles the still larger species of *Polystira*. If the arrangement here proposed is worth anything, this species should be placed in a subgenus under *Pleuroliria*. This same subgenus is represented by living species in the Panamic and Mazatlanic regions ("*Pleurotoma*" *picta* Reeve and "*Pleurotoma*" *albicarinata* Sowerby), but the number of nuclear whorls is again reduced to three or a little less than three. Both these species are smaller than the West Indian species and they are comparable in size to the Shoal River fossils. So far as can be discovered

all the living West Indian species fall in *Polystira*, though "*Pleurotoma albida* var." *tellea* Dall has relatively weak keels.

Casey (Trans. Acad. Sci. St. Louis, vol. 14, No. 5, pp. 130–132, 1904) recognized the two groups here called *Polystira* and *Pleuroliria*. At one time all the American Tertiary species, both of *Pleuroliria* and *Polystira*, were lumped under the one name "*Pleurotoma albida*."

Lophiotoma Casey (Trans. Acad. Sci. St. Louis, vol. 14, No. 5, p. 130, 1904) was proposed for Indo-Pacific species with the anal sinus on the peripheral keel, but *Pleurotoma virgo* Lamarck, a synonym of *Pleurotoma albida* Perry, was included under it. As apparently no type has yet been designated for *Lophiotoma*, *Pleurotoma tigrina* Lamarck is herewith designated. *Lophiotoma*, therefore, is similar to *Turris* s. s., but has a shorter canal and the anal sinus lies on a more prominent peripheral keel. It lacks the many strong spiral keels of *Polystira*.

Polystira barretti (Guppy)

(Plate 4, Figures 6, 7)

Pleurotoma barretti Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 290, pl. 17, fig. 6. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Pleurotoma haitense Guppy (not Sowerby), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 80 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 212). Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list).

Pleurotoma albida Dall (part, not Perry), 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 28. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Not [*Pleuroliria*] *barretti* Casey, 1904, Trans. Acad. Sci. St. Louis, vol. 14, No. 5, p. 132.

Shell moderately large. Nucleus stout, cylindrical, consisting of about one and three quarters whorls, the last quarter sculptured with four to six axial riblets. Siphonal fasciole very slightly swollen, pillar slender. Sculpture consisting of a strong peripheral keel and other keels and threads of several orders of magnitude. Strong growth threads, angulated on the peripheral keel in conformity to outline of anal sinus, lie between the spirals. These growth threads are more uniformly spaced on young shells than on adults.

Length 85 mm.; diameter 23.5 mm. (figured specimen, apex broken).

Type locality.—Jamaica (Miocene).

This species, which is the only large turrid at Bowden, is represented by over 100 specimens in the Duerden collection. Apparently Guppy did not realize how similar it is to the living West Indian "*Pleurotoma*" *albida* Perry, or "*P.*" *virgo* Lamarck, or he would not have described it as a new species. Even the nucleus is of about the same size and shape. It seems permissible, however, to retain Guppy's name, for these Miocene fossils are different from the living species. The nucleus of the fossils has more numerous and stronger riblets, the pillar is more slender and the siphonal fasciole less inflated, and the body whorl of adults is more loosely coiled, producing more of a slant to the

spirals. This slant is too strong, however, on Guppy's figure, and it does not continue up the whorls of the spire.

It is assumed that "*Pleurotoma*" *haitensis* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 50, 1850) is the species found in great abundance in the Gurabo formation. This species does not have the very prominent peripheral keel of *barretti*, and the initial nuclear whorl is larger and more bulging. Specimens from the Cerçado formation seem to represent the same species. Maury, however, figures specimens from the Dominican Republic that are as strongly keeled as *barretti* (Bull. Am. Paleontology, vol. 5, pp. 214–215, pl. 34, figs. 5, 6, 1917). How such specimens are to be treated must await a more detailed study of the Dominican material. No such specimens are among about 200 collected by the United States Geological Survey party. No attempt is made to compare *barretti* with similar material from other localities. "*Turris albida*" or "varieties" of it have been recorded from Mexico, Panama, Brazil, Trinidad, and Porto Rico, from both lower and middle Miocene beds.

The species from the Chipola formation of Florida, called *barretti* by Casey, is not so large, its keels are narrower, and the nucleus has a few more riblets that are more closely spaced.

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64065).

CRASSISPIRA Swainson

Swainson, 1840, Treatise on Malacology, p. 313.

Type (*by subsequent designation, Herrmannsen, March, 1847, Indicis Gen. Malac., vol. 1, p. 318*).—*Pleurotoma bottae* Valenciennes (Swainson cites "*Pleurotoma bottae* Auct."). Recent, Pacific coast of Mexico.

Shell medium-sized. Aperture moderately long and wide, scarcely contracted at the base, forming a suggestion of a canal, moderately emarginate at base. Siphonal fasciole slightly bulging. Body whorl varicose near outer lip. Anal sinus deep, narrow, the apex semicircular and lying some distance from the suture below thread on anal fasciole. Base of outer lip bearing a very shallow broad sinus, or stromboid notch. Inner lip detached. Parietal callus thickened adjoining anal sinus. Sculpture consisting of narrow axial ribs, between which lie spiral threads or grooves. Anal fasciole bearing a strong spiral cord. (Based on original figures, Kiener, Coq. Viv., *Pleurotoma*, pp. 33–34, pl. 15, fig. 2, 1839.)

It is very doubtful whether *Crassispira* can be considered a valid name for this genus of turrids. Swainson clearly had something else in mind and the descriptions on both pages 152 and 313 fit *Crassispira fasciata* Swainson, which is figured on page 151 (fig. 17*d*; 17*a* on p. 313 is an error). Apparently this species has not certainly been identified. Swainson places it in the Columbellidae; at all events it apparently is not a turrid and it may be a melanid. "*Pleurotoma bottae* Auct." is the only other name cited by Swainson under *Crassispira*. By inference this method of citation excludes *Pleurotoma bottae* of Valenciennes,

a view that is in harmony with Sherborn's citation of *Crassispira bottae* as a name of Swainson's (Index Anim., 1801–1850, p. 841, 1924). Under this interpretation "*Pleurotoma bottae* Auct." is a nude name and *Crassispira fasciata* Swainson becomes the monotype of *Crassispira*, which agrees with Gray's type designation (Proc. Zool. Soc. London, pt. 15, p. 134, 1847). The other interpretation is that inasmuch as Swainson did not cite "*Pleurotoma bottae* Auct. non Valenciennes," the *Pleurotoma bottae* of Valenciennes is not excluded and therefore Herrmannsen's designation is valid. I consider this a doubtful interpretation, but so long as there is room for a difference of opinion, and so long as *Crassispira* is more or less in use for this genus, it may be advisable to take refuge in Opinion 93 of the International Commission on Zoological Nomenclature, which states that "where a reasonable argument on both sides exists, it seems better to give current nomenclature the preference."

For many years *Crassipira* and many other turrid genera were placed by most writers under *Drillia* Gray (Ann. Nat. Hist., vol. 1, p. 28, 1838; type, by subsequent designation, Gray, Proc. Zool. Soc. London, pt. 15, p. 134, 1847, *Drillia umbilicata* Gray, Recent, West Africa). The conclusion reached by Dall and also by Hedley (Proc. U. S. Nat. Mus., vol. 54, p. 317, 1918: Rec. Australian Mus., vol. 13, p. 236, 1922) that *Drillia* probably is a synonym of *Clavatula* Lamarck (Syst. Anim. sans Vert., p. 84, 1801; type, by monotypy, *Clavatula coronata* Lamarck, Recent, West Africa) seems unjustified. According to the figure of *Drillia umbilicata* published by Maltzan (Jahrb. Deut. Malak. Gesell., year 10, p. 121, pl. 3, fig. 3, 1883), *Drillia* is a perfectly valid name for one of the groups traditionally placed under it. It is stout and *Phos*-like; the aperture is wide, the anal sinus is wide and deep, the stromboid notch is relatively deep, the siphonal notch is very deep, and the siphonal fasciole is strongly inflated, producing an umbilicus between it and the detached inner lip. The sculpture consists of swollen axial ribs, terminating at the anal fasciole, and of closely spaced fine spirals. An unnamed Recent species from the Gulf of California comes close to *Drillia*, but it is not so stout and it lacks the spiral sculpture. Apparently no such species are found in the West Indian region. The umbilicus of *Drillia umbilicata* is not an unusual feature, for any shell with a siphonal fasciole and detached inner lip may have an umbilicus. Even slender "Drillias" may be umbilicated. One specimen of "*Drillia*" *perspirata* Dall (Pliocene, Florida, U. S. Nat. Mus. No. 113152) has a very wide umbilicus, whereas all the other specimens in the same lot have only an umbilical groove.

Most genera and subgenera of *Drillia*-like turrids have been based on gross sculptural features, yet they show pronounced differences in characters of the aperture. In *Crassispira* the anterior canal is

hardly constricted off from the rest of the aperture, the stromboid notch is only a suggestion, and the siphonal notch is moderately deep.

There is a marked lack of names for the genera that have been masquerading under the name of "*Drillia.*" Hedley discards "*Drillia*" for the Australian species and substituting for it *Inquisitor* Hedley (Jour. Roy. Soc. New South Wales, vol. 51, p. M 79, 1918; type, by original designation, *Pleurotoma sterrha* Watson, Recent, Australia) places under that name a motley group of turrids. The type of *Inquisitor*, according to figures, has a narrow aperture and virtually unemarginate canal.

Almost 90 species referred to "*Drillia*" are already recorded from the Miocene deposits of tropical America. In addition to the species here described Guppy and also Dall (Quart. Jour. Geol. Soc. London, vol. 22, p. 289, 1866; Geol. Mag., decade 2, vol. 1, p. 440, 1874; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583, 1903) record *Pleurotoma consors* Sowerby from Bowden. No "*Drillia*" resembling *consors* is in any collection examined. Dall (cited above) also records "*Pleurotoma* (*Drillia*) *haitensis* Guppy," but no such species has been described.

Key to the Bowden species of Crassispira

Shell medium-sized or small, stout, aperture relatively wide, axials narrow.
  Spirals not overriding axials except on pillar.
    Axials bent backward at anal fasciole, anterior part of anal fasciole bearing strong growth threads.....*C. jamaicensis*
    Axials not bent backward at anal fasciole, anterior part of anal fasciole not bearing strong growth threads.
      Spirals moderately coarse and of irregular width.....*C. ponida*
      Spirals coarse and of uniform width.....*C. lomata*
  Spirals overriding axials.....*C. annella*
Shell large, slender, aperture narrow, axials broad.....*C. aegis*

Crassispira jamaicensis (Guppy)

(Plate 4, Figure 8)

Pleurotoma jamaicense Guppy, 1866,[1] Quart. Jour. Geol. Soc. London, vol. 22, p. 290, pl. 16, fig. 6. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list).

Pleurotoma (*Drillia*) *jamaicensis* Guppy, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 2, pt. 6, 1583 (list).

Drillia jamaicensis (Guppy), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 320.

Shell medium-sized, whorls of spire slightly bulging, outline of spire slightly concave, body whorl of adults more loosely coiled than whorls of spire. Nucleus slender, consisting of almost two whorls, the latter part bearing a few curved axial riblets. Aperture narrow, anterior canal barely constricted, siphonal notch moderately deep, siphonal fasciole slightly swollen. Sinus at base of outer lip very shallow. Interior of body whorl bearing a channel near outer lip and below anal notch. Sculpture consisting of narrow axial ribs, curved backward at anal fasciole, between which lie flat spiral threads, of irregular width on later whorls, roughened by growth lines. Anal fasciole

[1] *Pleurotoma* (*Clathurella*) *jamaicensis* Smith, 1884 (Ann. Mag. Nat. Hist., ser. 5, vol. 14, p. 324), needs a new name.

bearing a strong spiral cord, below which lie curved growth lines and several weak spiral threads.

Length 17.9 mm.; diameter 7 mm. (figured specimen).

Type locality.—Jamaica (Miocene).

C. jamaicensis is the most abundant Bowden *Crassispira*. It is represented in the Duerden collection by 28 specimens. Some specimens are stouter than others, but the slightly concave outline of the spire, the curving of the axials at the anal fasciole, and the irregular width of the flat spiral threads are characteristic features.

Similar Crassispiras differing principally in details of sculpture are found at many other localities. In most of the described species the ribs are squarely truncated at the anal fasciole instead of being bent backward. *"Drillia" ebenina* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 33, pl. 2, fig. 8, 1890; Pliocene (type) and Recent, Florida), which Pilsbry considers a synonym of *jamaicensis*, has a stouter nucleus, narrower and fewer ribs on the later whorls, and lacks the strong growth threads on the anal fasciole.

The figured specimen is one of five in the Guppy collection labeled "types."

Type material.—Holotype (British Museum, Natural History, Geological Department, No. 64066).

Crassispira ponida, new species

(Plate 4, Figure 9)

Shell moderately large. Sinus at base of outer lip very shallow. Siphonal notch relatively shallow. Sculpture consisting of narrow axial ribs, squarely truncated at anal fasciole, between which lie moderately coarse low spiral threads. Anal fasciole bearing a strong spiral cord, below which lie several strong spiral threads.

Length 24.6 mm.; diameter 8.3 mm. (holotype, apex broken).

This species is represented by two large shells, both in the Henderson collection. The apex of both specimens is broken. It is larger than *jamaicensis*, the ribs are squarely truncated at the anal fasciole, and the anal fasciole lacks the strong growth threads. *"Drillia" callistura* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 321, pl. 16, fig. 12, 1922; Miocene, Dominican Republic) lacks the strong spirals on the anal fasciole. *"Drillia" aurantia* Olsson (Bull. Am. Paleontology, vol. 9, pp. 240–241, pl. 8, fig. 15, 1922; Miocene, Costa Rica) and *"Drillia" maonisriparum* Maury (Bull. Am. Paleontology, vol. 5, p. 220, pl. 35, fig. 5, 1917; Cercado formation) are only half as large and differ in details of sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 135365).

Crassispira lomata, new species

(Plate 4, Figure 10)

Shell medium-sized. Nucleus slender, consisting of about two and three quarters whorls, bearing near its end two or three axial riblets. Sinus at

base of outer lip hardly perceptible, siphonal notch relatively shallow. Interior of body whorl of some specimens bearing several ridges well within aperture. Sculpture consisting of axial ribs, squarely truncated at anal fasciole, between which lie coarse widely spaced spiral threads. Anal fasciole bearing a strong spiral cord, below which lie two moderately strong spiral threads.

Length 14.6 mm.; diameter 5.6 mm. (holotype, apex broken).

The coarse widely spaced spiral threads are the most conspicuous feature of this species, which is represented by five specimens in the Duerden collection. Not all of them show the ridges or fluting on the interior of the body whorl. The very base of the aperture of the holotype is broken, so that the siphonal notch looks shallower than it really is.

Type material.—Holotype (U. S. Nat. Mus. No. 369362).

Crassispira annella, new species

(Plate 4, Figure 11)

Shell very small. Nucleus stout and broad-tipped, consisting of about one and a half whorls. Siphonal notch apparently shallow. Interior of body whorl fluted well within aperture. Sculpture consisting of narrow axial ribs, which on the later whorls are overridden by strong spiral threads that are slightly beaded on crests of axials. Body whorl, as in the other species, bearing a varix some distance from outer lip. Anal fasciole sculptured with a strong sutural spiral cord, below which lie one or two very obscure spiral threads and obscure growth lines.

Length 8 mm.; diameter 3 mm. (holotype).

This species, represented by a total of only three specimens, is the smallest of the Bowden Crassispiras and also the only one on which the spirals override the axials on the later whorls. The cord on the anal fasciole lies closer to the suture than in the other species, and the rest of the fasciole is weakly sculptured. The siphonal notch appears distorted on the photograph, for the base of the aperture is broken. Both this species and *C. lomata* have the interior of the body whorl fluted well within the aperture, though not all the specimens referred to *lomata* show this fluting.

"Drillia" losquemadica Maury (Bull. Am. Paleontology, vol. 5, p. 219, pl. 35, figs. 3, 3*a*, 1917), a species from the Gurabo formation, on which the spirals override the axials, is larger and stouter and has coarser sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 369363).

Crassispira aegis, new species

(Plate 4, Figure 12)

Pleurotoma henekeri Dall (not Sowerby), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell large, slender. Nucleus moderately stout, cylindrical, consisting of almost two whorls. Aperture long, narrow, not constricted off. Siphonal

notch moderately deep, siphonal fasciole slightly inflated. Sculpture consisting of heavy swollen axial ribs, overridden by spiral threads that are swollen on crest of ribs. Anal fasciole bearing a strong spiral cord, below which lie growth lines, conforming to outline of anal sinus, and very obscure spirals.

Length 45.8 mm.; diameter 13.6 mm. (holotype, apex broken).

C. aegis belongs to a group of "Drillias" that should perhaps receive a subgeneric or generic name. The shell is larger and more slender than in *Pleurotoma bottae*, the aperture is longer and narrower, and the ribs are heavier and more swollen. As in *Pleurotoma bottae*, the anterior canal is not set off from the rest of the aperture, the siphonal notch is moderately deep, and the anal sinus is placed some distance from the suture below a strong spiral cord. Hedley places a similar Australian species (*Melatoma dampieria* Hedley, Rec. Australian Mus., vol. 13, p. 250, pl. 45, fig. 14, 1922) in *Melatoma* Swainson (Treatise Malac., pp. 202, 342, 1840; type, by monotypy, *Melatoma costata* Swainson, Recent), though Swainson's figure of the genotype is quite different. Swainson (p. 202) states that *Melatoma* is founded on a shell from Ohio sent by Rafinesque. Though Dall (Proc. U. S. Nat. Mus., vol. 54, p. 317, 1918) considers it a turrid, it is nothing like these "Drillias."

This species is the Bowden representative of the Dominican "*Pleurotoma*" *henekeni* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 50, pl. 10, fig. 6, 1850; *henikeri* by error), found in both the Cercado and Gurabo formations, which is larger and has fewer and broader ribs. So far as the number and width of the ribs are concerned "*Drillia*" *henekeni caroniana* Maury (Bull. Am. Paleontology, vol. 10, p. 341, pl. 43, fig. 12, 1925), from the upper Miocene Springvale beds of Trinidad, is intermediate between *henekeni* and *aegis*.

Not more than two specimens are in any collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369364).

CLATHRODRILLIA Dall

Dall, 1918, Proc. U. S. Nat. Mus., vol. 54, pp. 317, 323.

Type (*by original designation, p. 323*).—*Pleurotoma gibbosa* Reeve (=*Pleurotoma gibbosa* Kiener). Recent, Indian Ocean ?.

Shell moderately large and slender. Aperture relatively short, wide, anterior canal slightly constricted. Siphonal notch moderately deep, siphonal fasciole slightly bulging. Edge of outer lip thin, frilled by the spirals. Base of outer lip bearing a narrow shallow sinus. Inner lip detached. Anal sinus moderately deep, adjoining suture, apex rounded. Parietal wall thickly callused adjoining anal sinus. Body whorl bearing a broad varix hump some distance from outer lip. Sculpture consisting of narrow axial ribs and spiral threads. Anal fasciole concave, weakly sculptured. (Based on Kiener's figures, Coq. Viv., *Pleurotoma*, pl. 16, fig. 2, 1839–40.)

Though *Clathrodrillia* was proposed for "the generally brown or brownish clathrate species," it seems to be a valid genus. The

aperture is shorter and wider than in *Crassispira*, the anterior canal is more definitely set off, the stromboid notch is more definite, the anal sinus lies closer to the suture, and the anal fasciole lacks the strong spiral cord.

Clathrodrillia tityra, new species

(Plate 4, Figure 13)

Pleurotoma venustum Guppy (not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 289. Guppy (part, not Sowerby), 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list).

Pleurotoma (*Drillia*) *venusta* Dall (not Sowerby), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pt. 1583 (list).

Shell moderately large, stout. Nucleus not known. Aperture moderately wide, anterior canal constricted off from rest of aperture. Siphonal notch deep. Notch at base of outer lip very narrow and shallow. Sculpture consisting of narrow axial ribs, overridden by spiral sculpture that produces an effect of overlapping bands, the upper margin of which is ledge-like. Anal fasciole bearing several spiral threads and growth lines, attenuated and crude prolongations of the ribs extending across the fasciole parallel to growth lines.

Length 30.5 mm.; diameter 13.4 mm. (holotype, tip of apex broken).

The outer lip is not perfect on any of the few specimens, but the basal part, showing the very narrow stromboid notch, is preserved on a specimen in the Guppy collection (U. S. Nat. Mus. No. 115572). The number of spiral threads on the anal fasciole and the strength of the attenuated prolongations of the ribs across the fasciole are variable.

This species is the Bowden representative of the Dominican "*Pleurotoma*" *venusta* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 50, pl. 10, fig. 6, 1850), which is found only in the Gurabo formation. It has narrower ribs than the Dominican species, "overlapping" bands instead of narrow spiral threads, and a shallower anal fasciole. Similar species differing principally in details of sculpture are found at many other localities. "*Drillia abundans*" *perrugata* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 31, 1890; Pliocene, Florida) is smaller and has stronger ribs on the anal fasciole.

Type material.—Holotype (U. S. Nat. Mus. No. 369365).

CARINODRILLIA Dall

Dall, 1919, Proc. U. S. Nat. Mus., vol. 56, p. 17.

Type (*by original designation*).—*Clathrodrillia* (*Carinodrillia*) *halis* Dall. Recent, Lower California.

Shell medium-sized, moderately slender. Nucleus (of type species) slender, consisting of about two and a half whorls, the last three quarters whorl sculptured with axial riblets. Aperture narrow, anterior canal short, strongly constricted. Siphonal notch shallow, siphonal fasciole slightly inflated. Base of outer lip bearing a shallow sinus. Anal sinus deep, the apex rounded, lying some distance from suture. Edge of inner lip detached. Parietal wall heavily callused adjoining anal sinus. Sculpture "*Fusus*"-like, consisting of swollen axial ribs, overridden by spiral threads. Anal fasciole concave, bearing a spiral cord or swelling above the sinus.

Carinodrillia was proposed as a section of *Clathrodrillia* on account of the "tendency for the peripheral cord to form a carina." The definitely formed anterior canal, shallow siphonal notch and "*Fusus*"-like sculpture seem to justify generic recognition. The presence or absence of a peripheral carina is not considered of any great significance. The holotype of *Clathrodrillia* (*Carinodrillia*) *halis* is an immature shell. Larger specimens show a more maturely formed aperture.

Carinodrillia has the sculpture of *Fusiturricula* (see p. 165), but the anterior canal is much shorter, wider, and emarginate.

Key to the Bowden species of Carinodrillia

Axial ribs widely spaced, anterior canal short.....*C. elocata meta*
Axial ribs closely spaced, anterior canal relatively long.....*C. bocatoroensis*

Carinodrillia elocata meta, new subspecies

(Plate 4, Figures 14, 15)

Pleurotoma henekeni Guppy (not Sowerby), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 79 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 211). Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list).

Shell medium-sized. Nucleus rather stout, cylindrical, consisting of almost two whorls, the latter part bearing two or three obscure axial riblets that bulge at periphery. Anterior canal short, siphonal notch shallow. Sinus at base of outer lip very shallow, according to growth lines. Sculpture consisting of broad swollen axial ribs, overridden by strong spiral cords. Anal fasciole bearing a strong spiral cord above the anal sinus and a weaker one below it. Some specimens show microscopic spiral threads.

Length 26.2 mm.; diameter 10.4 mm. (holotype, apex broken).

The holotype is one of two specimens in the Guppy collection labeled "*Pleurotoma henekeni* Sowerby." It seems strange that Guppy should have identified them as *henekeni*.

Several features of this *Carinodrillia* are variable. Some specimens are more slender than the holotype and have a shorter and wider canal. The spiral near the anterior edge of the anal fasciole may be strong or weak. Microscopic spirals, too fine to show on the photograph though they are present on the specimen represented in fig. 15, may appear between the spiral cords and on the anal fasciole. The holotype has a series of puckers on the upper part of the interior of the body whorl. Other specimens have only one ridge at the same place. The nucleus is stouter, fewer-whorled, and bears fewer axial riblets than in the type of *Carinodrillia*, but the apertural features seem to be the same.

The Bowden specimens closely resemble those from the Gurabo formation representing "*Drillia*" *elocata* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 318, pl. 16, fig. 9, 1922). The Dominican specimens have a slightly more slender, smooth nucleus, stouter early whorls, and more slender spiral cords. Many

specimens of the Dominican *elocata* have a longer canal than the Bowden specimens, and these long-canaled specimens are found at the same locality with short-canaled ones. *"Drillia" winchesterae* Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 318–319, pl. 16, figs. 7–8, 1922) is an unusually slender, long-canaled *elocata*. *"Defrancia" fusiformis* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 318, pl. 17, fig. 8, 1922) also is more slender and has a longer canal, as well as narrower and more closely spaced axials, and a weaker cord on the anal fasciole. This species also is found in the Gurabo formation, but it is much rarer than *elocata*. *"Drillia" papaya* Olsson (Bull. Am. Paleontology, vol. 9, pp. 235–236, pl. 7, fig. 5, 1922; Miocene, Costa Rica) is more slender and has stronger secondary spirals.

Type material.—Holotype (U. S. Nat. Mus. No. 115576).

Carinodrillia bocatoroensis (Olsson)

(Plate 4, Figure 16)

Drillia bocatoroensis Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 239, pl. 8, fig. 6.

Shell moderately large. Nucleus not known. Anterior canal relatively long. Siphonal notch shallow according to growth lines. Notch at base of outer lip very shallow and broad according to growth lines. Sculpture consisting of heavy, swollen, closely spaced axial ribs, overridden by strong spiral cords. Anal fasciole bearing a strong spiral cord, above which lie growth puckers. Between the spiral cords and on the anal fasciole lie very fine spiral threads, which do not show on the photograph.

Length 33.3 mm.; diameter 10.5 mm. (figured specimen, tip of apex and base of aperture broken, and outer lip broken back).

Type locality.—Bocas del Toro Island, Panama (Gatun formation).

The only specimen of this species is an immature shell that has an imperfectly formed inner lip. The base of the anterior canal is broken along a ragged edge. This specimen is larger and a little more slender than the holotype, and has weaker secondary spiral sculpture. This species also resembles *"Defrancia" fusiformis* Gabb, but the whorls bulge less, and the cord on the anal fasciole is heavier and farther from the suture. *"Drillia" propefusiformis* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, pp. 20–21, pl. 2, figs. 3–4, 1925; Miocene, Trinidad) has fewer and broader ribs. The living West Indian *"Drillia" gundlachi* Dall and Simpson is very similar, but is more slender and has fewer and broader ribs on all except the body whorl.

Other localities.—Gatun formation (middle Miocene), Panama.

Type material.—Holotype (Cornell University).

COMPSODRILLIA, new genus

Type.—Compsodrillia urceola, new species.

Shell small or moderately small, slender, body whorl varicose short distance from outer lip. Nucleus slender, cylindrical, consisting of about two

whorls, the latter part bulging at periphery and bearing one to three obscure axial riblets. Aperture short, wide, anterior canal short. Siphonal notch very shallow, siphonal fasciole not inflated. Stromboid notch virtually absent. Anal sinus moderately deep. Apex broadly rounded. Parietal wall moderately callused adjoining anal sinus. Inner lip thin, detached. Sculpture consisting of swollen axial ribs and of spiral cords and threads. Anal fasciole sculptured with a sutural cord and with spiral threads and growth lines.

Compsodrillia is proposed for small slender "Drillias" with "*Fusus*"-like sculpture. It resembles *Carinodrillia*, but the inner lip and parietal callus are thinner and the stromboid notch is even shallower. *Austrodrillia* Hedley (Journ. Roy. Soc. New South Wales, vol. 51, p. M 79, 1918; Rec. Australian Mus., vol. 13, p. 247, 1922; type, by original designation, *Pleurotoma angasi* Crosse, Recent, Australia) is stouter, and has a deeper siphonal notch, more crowded ribs, weaker spirals, and a more subdued anal fasciole that lacks the strong sutural cord.

Key to the Bowden species of Compsodrillia

Secondary spirals present, ribs closely spaced.
Anal fasciole strongly defined ..... *C. urceola*
Anal fasciole poorly defined ..... *C. catherina*
Secondary spirals absent, ribs not so closely spaced ..... *C. senaria*

Compsodrillia urceola, new species

(Plate 5, Figures, 1, 2)

Pleurotoma (*Drillia*) *ostrearum* Dall (not Stearns), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell small, slender. Nucleus and aperture as described under the genus. Sculpture consisting of swollen axial ribs, overridden by primary spiral cords and secondary threads. Anal fasciole bearing a sutural cord, below which lie strong growth lines and very fine spiral threads.

Length 13.3 mm.; diameter 4.2 mm. (holotype).

This species, which is represented in the Henderson collection by 36 specimens, is one of the most abundant "Drillias" at Bowden. Both the nucleus and the sculpture show some variation. Some specimens have bulging nuclear whorls and the obscure axials at the end of the nucleus are more distinct. The number and strength of the secondary spirals are particularly variable. One imperfect specimen doubtfully referred to *urceola* has a flatter anal fasciole, due to the greater attenuation of the ribs. "*Drillia*" *ostrearum* Stearns is nothing like this species.

Type material.—Holotype (U. S. Nat. Mus. No. 369367).

Compsodrillia catherina, new species

(Plate 5, Figure 3)

Shell small, slender. Nucleus consisting of between one and three quarters and two whorls, the latter part bulging and bearing three to five coarse axial riblets. Body whorl varicose near outer lip. Sculpture consisting of swollen axial ribs overridden by spiral cords and threads. Anal fasciole not strongly

set off, except on early whorls, sculptured with subdued continuations of the ribs, and also with growth lines, fine spiral threads, and a relatively weak sutural cord.

Length 7.8 mm.; diameter 2.9 mm. (holotype).

As in *C. urceola* the number and strength of the secondary spirals are somewhat variable. The outer lip of the holotype is broken back. This species, which is represented by 24 specimens in the Henderson collection, is smaller than *urceola*, and has narrower axials and a less distinct anal fasciole.

Type material.—Holotype (U. S. Nat. Mus. No. 369369).

Compsodrillia senaria, new species

(Plate 5, Figures 4 to 6)

Shell small, slender. Nucleus consisting of between one and three quarters and two smooth whorls. Inner lip very thin, the edge not detached or imperfectly detached even on adult shells. Varix indicated only by slightly greater inflation of last rib. Sculpture consisting of broad swollen axial ribs, overridden by spiral cords (generally 3 on penult whorl). Anal fasciole indicated by subduing of ribs and by appression of sutural area.

Length 12.4 mm.; diameter 4.2 mm. (holotype).

This species, like the preceding Compsodrillias, is represented by many specimens (78 in the Duerden collection). The characters of these specimens are uniform except that some specimens have four spirals on the later whorls of the spire. Two specimens are quite different. One (fig. 5) is grotesquely slender, the other (fig. 6) has five narrow spirals.

The absence of secondary spirals and the broad ribs distinguish *C. senaria* from the preceding species. *"Drillia" daditrina* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, p. 19, pl. 3, figs. 1, 5, 1925), a Miocene species from Trinidad, is stouter and has broader ribs.

Type material.—Holotype (U. S. Nat. Mus. No. 369370).

AGLADRILLIA, new genus

Subgenus AGLADRILLIA s. s.

Type.—Agladrillia callothyra, new species.

Shell small, moderately slender, body whorl bearing a varix some distance from outer lip. Nucleus rather stout, consisting of about two smooth whorls. Aperture long and narrow. Anterior canal strongly constricted. Siphonal notch moderately deep, asymmetrical, siphonal fasciole hardly inflated. Base of outer lip bearing a relatively deep notch. Inner lip detached. Anal sinus deep, adjoining suture, apex rounded. Parietal wall heavily callused adjoining suture. Sculpture consisting of narrow axial ribs and of spiral threads or grooves. Anal fasciole bearing a swelling across which obscure prolongations of the axials extend.

This genus is proposed for small "Drillias" that have a narrow aperture, definitely formed anterior canal, rather deep stromboid notch on the outer lip, and an asymmetrical siphonal notch. The

sculpture of *Agladrillia* s. s. consists of axials and spirals and the anal fasciole is set off by discrepant sculpture.

Key to the Bowden species of Agladrillia s. s.

Anal fasciole bulging, spiral sculpture consisting of bands separated by narrow grooves.....*A.* (*A.*) *callothyra*
Anal fasciole rather flat, spiral sculpture consisting of fine threads.....*A.* (*A.*) *leptalea*

Agladrillia (Agladrillia) callothyra, new species
(Plate 5, Figure 7)

Shell small, moderately slender. Nucleus consisting of about two whorls. Aperture as described under the genus. Sculpture consisting of narrow axial ribs, between which lie broad spiral bands separated by narrow grooves. Anal fasciole bearing a swelling adjoining suture, crudely undulated by obscure prolongations of the axials.

Length 19.5 mm.; diameter 7.1 mm. (holotype).

A. callothyra is represented by 33 specimens in the Henderson collection. Specimens on which the outer lip is broken back fail to indicate that the stromboid notch is so deep and that the siphonal notch is so asymmetrical. *"Drillia" foveolata* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 321, pl. 16, fig. 20, 1922; Miocene, Dominican Republic) has the same kind of sculpture, but the ribs are broader and more crudely formed and the sutural swelling is not so pronounced.

Five specimens in the Guppy collection are labeled *"Pleurotoma venustum* Sowerby" and one specimen in the Bland collection is labeled *"Pleurotoma (Drillia) jamaicensis* Guppy."

Type material.—Holotype (U. S. Nat. Mus. No. 369371).

Agladrillia (Agladrillia) leptalea, new species
(Plate 5, Figure 8)

Shell small, slender. Nucleus consisting of about two and a half whorls. Stromboid notch rather deep, according to growth lines. Siphonal notch moderately deep, asymmetrical. Sculpture consisting of narrow axial ribs weakly overridden by very fine widely spaced spiral threads. Anal fasciole flat, sculptured with curved attenuated prolongations of the ribs and with spiral threads that are finer and more closely spaced than those on rest of whorl.

Length 16 mm.; diameter 5.4 mm. (holotype, tip of apex broken).

The outer lip of the holotype, one of two specimens in the Duerden collection, is broken back slightly and the appearance of the aperture is correspondingly somewhat distorted.

Though so far as sculpture goes this species is like a diminutive finely sculptured *"Pleurotoma" venusta,* it is not placed in the same genus on account of the narrow aperture, strongly constricted anterior canal, rather deep stromboid notch, and almost flat siphonal fasciole. These features are considered more significant than the almost flat anal fasciole as contrasted to the bulging fasciole of *A. callothyra.*

Type material.—Holotype (U. S. Nat. Mus. No. 369372).

Subgenus EUMETADRILLIA, new subgenus

Type.—Agladrillia (*Eumetadrillia*) *serra*, new species.

Shell small, slender. Nucelus rather slender, consisting of about one and a half smooth whorls. Aperture as in *Agladrillia* s. s., but the stromboid notch is shallower and the siphonal notch is a little deeper and not so asymmetrical. Sculpture consisting of rounded swollen axial ribs, across which growth lines extend diagonally, and of microscopic file-like spirals. Anal fasciole shallow, unsculptured except for growth lines.

The aperture of *Eumetadrillia* is essentially the same as in *Agladrillia* s. s., with the exceptions given above. *Cymatosyrinx* Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 95, 1889; type, by original designation, *Pleurotoma lunata* Lea, Miocene, Virginia), which has been used for almost all "Drillias" that have no spiral sculpture, has a wide aperture, very deep narrow siphonal notch, swollen and definitely limited siphonal fasciole, and deep narrow stromboid notch that leaves its trace across the body whorl, and narrow anal sinus.

Agladrillia (Eumetadrillia) serra, new species

(Plate 5, Figure 9)

Pleurotoma (*Drillia*) *newmani* Dall (not Dall, 1890), Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell small, slender. Nucleus consisting of about one and a half whorls. Aperture narrow, anterior canal strongly constricted. Siphonal notch moderately deep, siphonal fasciole barely inflated. Stromboid notch on outer lip rather shallow. Sculpture consisting of widely spaced rounded ribs. Diagonal growth lines are visible crossing the whorls, and file-like spirals can be seen under high magnification. Anal fasciole slightly concave, slightly undulated by the ribs.

Length 11.5 mm.; diameter 4.2 mm. (holotype).

A. serra is represented by nine specimens in the Henderson collection. The diagonal growth lines are too faint to show distinctly on the photograph and the microscopic spiral sculpture is not visible at all. *"Drillia" isthmica* Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 344, pl. 23, figs. 10–11, 1911), a species from the Gatun formation, has a three-whorled, small-tipped nucleus and a sutural swelling. *"Drillia" newmani* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 29, pl. 4, figs. 5, 5*a*, 1890), found in the Tampa formation of Florida, has a sutural cord and narrower ribs.

Type material.—Holotype (U. S. Nat. Mus. No. 369373).

LEPTADRILLIA, new genus

Type.—Turris (*Surcula*) *parkeri* Gabb. Miocene, Dominican Republic and Jamaica.

Shell medium-sized, very slender, body whorl bearing a varix some distance from outer lip. Nucleus moderately stout, consisting of about two whorls, latter part slightly bulging at the periphery. Aperture narrow, anterior canal long and narrow. Siphonal notch very shallow, siphonal fasciole barely inflated. Stromboid notch on outer lip shallow. Anal sinus wide, lying

near suture, apex rounded. Parietal wall heavily callused adjoining anal sinus. Edge of inner lip detached. Sculpture consisting of narrow axial ribs that extend from suture to suture, but are bent and subdued on the anal fasciole.

Leptadrillia has a long narrow anterior canal, very shallow siphonal notch, and shallow stromboid notch. The anal fasciole is indicated only by a slight constriction of the whorl and by the curved subdued ribs. Hedley (Rec. Australian Mus., vol. 13, pp. 254–257, 1922) uses *Clavus* Montfort (Conch. Syst., vol. 2, pp. 434–435, 1810; type, by original designation, *Clavus flammulatus* Montfort, Recent, "Africa") for rather similar Australian shells, but the Bowden shells are nothing like Montfort's figure of the genotype, nor are they like Reeve's figure of *Pleurotoma echinata* Lamarck, which, according to Hedley's discussion, is supposed to represent the same species. *Villiersiella* Monterosato (Naturalista Siciliano, year 9, p. 191, 1890; substitute name for *Vielliersia* Monterosato (error for *Villiersia*, not d'Orbigny 1837), Nom. gen. spec. Conch. Medit., p. 128, 1884; type, by monotypy, *Murex attenuatus* Montagu, Recent, Europe) has a superficial resemblance to *Leptadrillia* on account of the rather similar sculpture, but its nucleus and aperture are different.

Leptadrillia parkeri (Gabb)

(Plate 5, Figure 10)

Turris (*Surcula*) *parkeri* Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 207.
Drillia parkeri (Gabb), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 321–322, pl. 16, fig. 21.

Shape, nucleus and aperture as described under the genus. Sculpture consisting of narrow, widely spaced axial ribs that are curved and subdued on anal fasciole. Spiral sculpture limited to fine, obscure threads on pillar. Diagonal growth lines cross the whorls.

Length 22.3 mm.; diameter 6.1 mm. (figured specimen, tip of apex broken).

Type locality.—Dominican Republic (Miocene).

The Bowden specimens closely agree with *parkeri*, which was collected from the Gurabo formation at four localities, though the holotype has fewer and narrower ribs than some of the Bowden shells. The degree of slenderness and the number and spacing of the ribs are, however, variable. The tip of the canal of the figured specimen is slightly broken. Six specimens are in the Duerden collection.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 2924).

SYNTOMODRILLIA, new genus

Type.—Drillia lissotropis Dall. Recent, West Indies.

Shell very small, slender, body whorl varicose some distance from outer lip. Nucleus slender, consisting of about two smooth whorls. Aperture short, relatively wide, anterior canal short. Siphonal notch shallow, siphonal

fasciole not inflated. Stromboid notch on outer lip very shallow. Anal sinus relatively wide, adjoining suture, apex rounded. Parietal wall slightly callused adjoining anal sinus. Edge of inner lip detached. Sculpture consisting of rather broad axial ribs extending from suture to suture, but subdued on anal fasciole. Spiral sculpture consisting of fine threads on pillar and of microscopic threads between ribs of later whorls.

This genus embraces very small slender "Drillias" that have a short relatively wide aperture, short canal, shallow siphonal notch, relatively thin callus on the parietal wall, and very shallow stromboid notch on the outer lip. The sculpture, as in other genera, is principally axial, and the anal fasciole is indicated only by the subdued ribs. The varix and perfectly formed inner lip show that these small Drillias are mature. *Elaeocyma* Dall (Proc. U. S. Nat. Mus., vol. 54, pp. 317, 326, 1918; type, by original designation (p. 326), *Drillia empyrosia* Dall, Recent, southern California), is larger and has a shallower anal sinus, deeper siphonal notch, and definitely limited siphonal fasciole.

Key to the Bowden species of Syntomodrillia

Sculpture of pillar consisting of spiral threads.....*S. espyra*
Sculpture of pillar consisting of one spiral thread at edge of siphonal fasciole....*S. iphis*

Syntomodrillia espyra, new species

(Plate 5, Figures 11 to 14)

Shell very small, slender. Nucleus consisting of between one and a half and two and a half smooth whorls, the latter part slightly bulging near anterior edge. Aperture as described under the genus. Sculpture consisting of rather narrow axial ribs, swollen at the periphery on early whorls, and subdued on anal fasciole. Pillar sculptured with fine spiral threads. On some specimens microscopic spiral threads are visible on later whorls.

Length 7 mm.; diameter 2.6 mm. (holotype). Length 7.6 mm.; diameter 2.6 mm. (largest specimen).

This little species is represented by a number of specimens (13 in Aldrich collection) that show variations in the number and inflation of the nuclear whorls and in the strength of the microscopic spirals, part of which may be due to wear. *"Drillia" enneacyma* Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 64, pp. 505–506, fig. 3, 1913), found in the Gatun formation, has spiral cords separated by narrow grooves between the ribs. *"Drillia" lissotropis* Dall, the type of *Syntomodrillia*, a Recent West Indian species, is larger and a little stouter and has a stouter nucleus.

Type material.—Holotype (U. S. Nat. Mus. No. 135400).

Syntomodrillia iphis, new species

(Plate 5, Figure 15)

Shell very small, slender. Nucleus consisting of about one and a half whorls. Aperture as in *S. espyra*, but the stromboid notch is more pronounced. Sculpture consisting of rather narrow axial ribs extending from suture to suture and bulging at periphery on early whorls. Spiral sculpture

limited to a thread at edge of siphonal fasciole. Anal fasciole indicated by a sutural appression and by subduing of ribs.

Length 6.3 mm.; diameter 2 mm. (holotype).

At first glance this species, represented by 12 specimens in the Aldrich collection, seems indistinguishable from *S. espyra*, but the absence of spirals on the pillar, except for the thread at the edge of the siphonal fasciole, and the appression of the anal fasciole show that it is a distinct species. It is more slender than *"Drillia" inadrina* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, p. 22, pl. 3, fig. 6, 1925), a Miocene species from Trinidad, and has more numerous ribs. *"Drillia" simpsoni* Dall, a Recent and Pliocene species from Florida, is stouter and has a stouter nucleus, less constricted fasciole, and lacks the thread at the edge of the siphonal fasciole.

Type material.—Holotype (U. S. Nat. Mus. No. 369376).

"DRILLIA" species

An imperfect shell in the Johns Hopkins University collection (U. S. Nat. Mus. No. 369377) and an immature shell in the Henderson collection represent a stout, short-pillared *"Drillia"* with heavy axial ribs, though not so heavy as in the following species. The anterior canal is very short. The final whorl of the larger specimen is sculptured with eight ribs that extend back to the suture, but they are slightly suppressed on the area corresponding to the anal fasciole. The last few whorls bear obscure spiral grooves that are most distinct on the base. According to the growth lines, the anal notch is moderately deep. The dimensions of the larger specimen are as follows: length 10.9 millimeters, diameter 4.8 millimeters.

This species may possibly be *"Drillia" riogurabonis* Maury (Bull. Am. Paleontology, vol. 5, p. 218, pl. 35, fig. 2, 1917; Gurabo formation), though it is a trifle stouter. It apparently represents an unnamed group of small stout "Drillias" that have a very short canal, no anal fasciole, and heavy ribs extending from suture to suture.

BELLASPIRA Conrad

Conrad, 1867, Am. Jour. Conch., vol. 3, p. 261.
Type (*by monotypy*).— *Mangelia virginiana* Conrad. Miocene, Virginia.

Shell medium-sized, rather stout. Aperture narrow, anterior canal not differentiated, siphonal notch broad and shallow. Outer lip varicose. Anal notch virtually absent. Inner lip fused to body whorl except at base. Sculpture consisting of heavy axial ribs and fine spiral grooves.

Conrad's figure of *Bellaspira virginiana* is very poor (Am. Jour. Conch., vol. 3, pl. 21, fig. 12, 1867). The ribs should be broader, and the area corresponding to the anal fasciole should be more appressed. The holotype, which has a length of 13.8 millimeters and a diameter of 5.7 millimeters and is labeled "Yorktown," is in the Philadelphia Academy. This species has not been recorded in later collections from

Yorktown or any other locality in Virginia. It is not to be confused with *Mangelia virginica* Conrad, the type of which also is in the Academy.

Haedropleura ("Monterosato") Bucquoy, Dautzenberg, and Dollfus (Moll. Roussillon, vol. 1, p. 110, 1883; type, by original designation, *Pleurotoma septangulare* (Montagu), Recent, Europe) may be a synonym of *Bellaspira*. Both genera have a very shallow anal notch. *Haedropleura* has an operculum with an apical nucleus.

Bellaspira ? species

A badly worn shell in the Henderson collection (U. S. Nat. Mus. No. 135390) is doubtfully referred to *Bellaspira*. It is small and very stout (length 8.2 mm.; diameter 3.6 mm.) and the apex is broken. The apertural features are like those of *Mangelia virginiana*, except that the anal notch is deeper and the parietal callus is heavier. The body whorl has seven heavy ribs and a terminal varix. Traces of minute spiral sculpture are visible on the crests of some of the ribs, but the shell is too badly worn to clearly see any fine sculpture.

This species may possibly be a "*Drillia*"-like turrid, for the parietal callus is heavy and the outer lip may be partly broken back, thus producing a shallow anal sinus. The shell is too much eroded to confirm the shape of the sinus from the growth lines. The stout heavily ribbed "*Drillia*," called "*Drillia*" species, has more numerous ribs and a definitely constricted pillar, and its anal sinus clearly is deep.

"*Drillia*" *pentagonalis* Dall, a Recent species from the southeast coast of the United States, seems to be a similar species.

GLOBIDRILLIA, new genus

Type.—Globidrillia ula, new species.

Shell very small, very slender, body whorl varicose some distance from outer lip. Nucleus rather stout, consisting of about one and a half whorls, the latter part bulging near anterior edge. Aperture short, relatively wide, anterior canal short. Siphonal notch shallow. Stromboid notch very shallow. Anal sinus wide, moderately deep, adjoining suture, apex rounded. Parietal wall thinly callused adjoining anal sinus. Edge of inner lip detached. Sculpture consisting of narrow axial ribs that break off into beads on anal fasciole.

Globidrillia is based on a minute species. The apertural features are much the same as in *Syntomodrillia*, but the canal is shorter.

Globidrillia ula, new species

(Plate 5, Figure 16)

Shape, nucleus and aperture as described under the genus. Sculpture consisting of narrow, closely spaced, protractive axial ribs that are squarely cut off at edge of anal fasciole, but reappear as beads on sutural part of fasciole. Pillar sculptured with relatively coarse spiral threads.

Length 5 mm.; diameter 1.5 mm. (holotype, dimensions approximate).

This striking minute species is represented by 86 specimens in the Aldrich collection, 12 in the Henderson collection, and only one in the Duerden collection. No records of any similar fossil or living species could be found.

Type material.—Holotype (U. S. Nat. Mus. No. 369378).

ANCISTROSYRINX Dall

Dall, 1881, Bull. Mus. Comp. Zool. Harvard College, vol. 9, pp. 53–54.
Type (by original designation).—Ancistrosyrinx elegans Dall. Recent, West Indies.

Shell medium-sized, slender, fusiform. Nucleus slender, smooth, consisting of about one and a half whorls. Aperture narrow, anterior canal long and narrow, unemarginate. Anal sinus, as shown by perfect specimens of *A. radiata* Dall, very deep, moderately wide, adjoining suture. Sculpture consisting of an upturned, serrate, peripheral frill.

This handsome genus has been in existence in American waters at least since middle Eocene time. Living species are found in the Floridian, West Indian, and Panamic regions, and also in the Orient.

According to Casey's and Dall's type designation (Trans. Acad. Sci. St. Louis, vol. 14, No. 5, p. 144, 1904; Bull. Mus. Comp. Zool. Harvard College, vol. 43, p. 257, 1908) of *Pleurotoma cristata* Conrad, a species from the upper Oligocene Byram marl of Mississippi, as the type of *Cochlespira* Conrad (Am. Jour. Conch., vol. 1, pp. 19–20, 1865), *Ancistrosyrinx* would be a synonym or a minor division of *Cochlespira*, as the principal differences between them would be the presence of a sutural cord in *Cochlespira* and its more slender nucleus consisting of a greater number of whorls. They ignored, however, the earlier type designation of *Pleurotoma engonata* Conrad made by Cossmann (Essais Paléoconch. Comp., pt. 2, p. 68, 1890). de Gregorio's statement (Mon. Faune éoc. Alabama, p. 37, 1890) that "Conrad proposa ce genre pour la *Coch. elongata* Conr." (error for *engonata*) is not considered a type designation, for in the next paragraph he states that "Conrad proposa ce genre pour les trois espèces suivantes." de Gregorio apparently was referring to a later citation of *Cochlespira* (Am. Jour. Conchology, vol. 1, p. 210, 1865). Cossmann was following de Gregorio, but that does not alter the issue, as *engonata* is in the original list. *Cochlespiropsis* Casey (Trans. Acad. Sci. St. Louis, vol. 14, No. 5, p. 143, 1904; type, by subsequent designation, Cossmann, Essais Paléoconch. Comp., pt. 7, p. 221, 1906; *Pleurotoma engonata* Conrad) is a perfect synonym of *Cochlespira*.

Miocene species of this genus are recorded from Mexico, Costa Rica, Panama, and Jamaica, and the collections of the United States National Museum contain undescribed material from the Dominican Republic.

Ancistrosyrinx miranda (Guppy)

(Plate 6, Figures 1 to 3)

Pleurotoma miranda Guppy. 1882, Proc. Sci. Assoc. Trinidad, vol. 2, No. 4, pt. 12, pp. 178–179, pl. 7, fig. 19 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, pp. 247–248, pl. 9, fig. 19).

Pleurotoma (*Ancistrosyrinx*) *miranda* Guppy, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Ancistrosyrinx dalli Olsson, 1922, Bull. Am. Paleontology, vol. 9, pp. 232–233, pl. 7, fig. 16.

Shell small. Nucleus slender, consisting of about one and a half whorls. Anterior canal long, narrow, and straight. Peripheral frill serrate, slightly upturned. Behind the frill lies a strong spiral thread. Base of body whorl bearing one or two very obscure spirals. Pillar sculptured with very obscure spirals.

Length 12.8 mm.; diameter 5 mm. (holotype).

Type locality.—Jamaica (Miocene).

In addition to the holotype, *A. miranda* is represented by a total of 10 specimens. Of the two living species from Florida and the West Indies, *A. elegans* Dall and *A. radiata* Dall, it more closely resembles *radiata*, but has a less upturned frill and weaker sculpture on the base of the body whorl and pillar. Large numbers of *A. radiata* were dredged by Henderson off Florida at depths of 22 to 100 fathoms, and it has also been dredged in the West Indies from depths of 73 to 170 fathoms. The type and only specimen of *A. elegans* comes from a depth of 805 fathoms off Havana.

The holotype of *A. dalli* Olsson is larger than Bowden specimens. It also has a smoother body whorl, and the anterior side of the frill is not edged. Böse (Jahrb. K.-k. geol. Reichsanstalt, vol. 60, pp. 251–252, pl. 13, fig. 26, 1910) records "*Pleurotoma* (*Ancistrosyrinx*) aff. *radiata* Dall" from the lower Miocene beds of the Isthmus of Tehuantepec. The figured specimen has a strongly sculptured base like *radiata*, but the frill is completely broken off. Two species of *Ancistrosyrinx* are represented in the Gurabo formation, one resembling *elegans* and the other resembling *radiata*. The *elegans*-like species also is found in the Cercado formation.

Other localities.—Gatun formation (middle Miocene), Panama.

Type material.—Holotype (U. S. Nat. Mus. No. 115584).

CLAVATULINAE

FUSITURRICULA, new genus

Type.—Turris (*Surcula*) *fusinella* Dall. Recent, Gulf of Panama.

Shell small or medium-sized, slender, "*Fusus*"-like. Nucleus smooth, consisting of a few whorls, slender or stout, in the type species slender and consisting of almost three uniformly enlarging whorls. Aperture narrow. Anterior canal long, narrow, slightly curved, expanded at base, unemarginate. Anal sinus wide, moderately deep, adjoining suture. Outer lip extending far forward. Sculpture consisting of swollen axial ribs, overridden by spiral threads. Anal fasciole flat or concave.

The aperture of the only specimen of the type species is imperfect, and the above description is based partly on "*Turris* (*Surcula*)" *armilda* Dall, a living species from the Pacific coast of Mexico, which would have been taken as the type, but no specimens have a perfect nucleus.

The "*Fusus*"-like shape and sculpture are striking features of this genus. All the fossil specimens examined have imperfect apertures, but the growth lines show that the outer lip extends far forward.

It is hardly necessary to compare *Fusiturricula* with the Oriental *Turricula* Schumacher (Essai nouv. syst., p. 217, 1817; type, by monotypy, *Turricula flammea* Schumacher = *Murex javanus* Chemnitz not Linné = *Murex tornatus* Dillwyn, not *Turris tornatum* ("Bolten"), Roeding, Recent, East Indies) or with *Surcula* H. and A. Adams (Gen. Rec. Moll., vol. 1, p. 88, 1853; type, by subsequent designation, Cossmann, Cat. coq. foss. éoc., Paris, pt. 4, p. 259, 1889, *Pleurotoma nodifera* Lamarck = *Murex javanus* Linné, Recent, East Indies).

Fusiturricula is represented by Miocene species in the West Indian region, but now is no longer found there. In company with many other West Indian Miocene genera it is now living in the Panamic and Mazatlanic regions. In the Eocene and Ogligocene deposits of southeastern United States it is replaced by *Pleurofusia* de Gregorio (Mon. Faune éoc. Alabama, pp. 33–34, 1890; type, by original designation, *Pleurotoma* (*Pleurofusia*) *longirostropis* de Gregorio, Eocene, Alabama). No specimens of *longirostropis* are in the collections of the United States National Museum from Claiborne, specimens so labeled representing a short-canaled "*Drillia*"-like turrid with fusoid sculpture. de Gregorio's figure shows that *longirostropis* is quite small and has a canal of moderate length. It seems probable that *Pleurotoma servata* Conrad, a larger species from the upper Oligocene Byram marl of Mississippi, represents *Pleurofusia*. This species has a conical nucleus of more than four whorls that enlarge very rapidly from the minute apical whorl. It is assumed that this nucleus represents the nucleus of *Pleurofusia*, and, although *servata* in other features can hardly be distinguished from the species of *Fusiturricula*, the difference in nuclear characters seems to be fundamental enough to assign generic rank to it. Casey (Trans. Acad. Sci. St. Louis, vol. 14, No. 5, p. 127, 1904) comments on the different kind of nuclear characters shown by species of *Pleurofusia*. It is not certain that the species mentioned represent *Pleurofusia*. *Pleurotoma declivis* Conrad, from the Byram marl, at all events apparently belongs to some other genus.

Tropisurcula Casey (Trans. Acad. Sci. St. Louis, vol. 14, No. 5, p. 153, 1904; type, by subsequent designation, Cossmann, Essais Paléoconch. Comp., pt. 7, p. 222, 1906, *Drillia caseyi* Aldrich, Oligocene, Mississippi) is small and has a shorter canal, a conical nucleus of about three whorls, and the ribs are angulated at the periphery. It is very similar to *Pleurofusia*.

It should be pointed out that *Knefastia* Dall (Proc. U. S. Nat. Mus., vol. 56, p. 3, 1919; type, by original designation, *Pleurotoma olivacea* Sowerby, Recent, Panama) seems to deserve generic rank. It is represented in the Miocene deposits of the West Indian region by *"Turricula" lavinoides* Olsson (Costa Rica), *"Turricula" lavinoides limonensis* Olsson (Panama), and *"Pleurotoma" jacquensis* Sowerby (Dominican Republic), but is no longer living there.

Key to the Bowden species of Fusiturricula

Shell very slender, canal straight ..... *F. iole*
Shell moderately slender, canal curved ..... *F. panola*

Fusiturricula iole, new species

(Plate 6, Figure 4)

Shell medium-sized, very slender. Nucleus moderately stout, consisting of about one and three quarters whorls, the last half whorl bulging near anterior edge. Anterior canal long and straight. Sculpture consisting of swollen axial ribs (10 on body whorl), overridden by primary and secondary spiral threads. Four primary spirals lie on the penult whorl, the peripheral ones being strongest. Anal fasciole sculptured with a spiral thread adjoining suture and with strong secondary threads.

Length 26.6 mm.; diameter 7.8 mm. (holotype, outer lip broken).

Two very small specimens in the Henderson collection have narrower and more crowded axial ribs. In shape and sculpture this species, of which five specimens are in the Duerden collection, closely resembles *"Pleurotoma (Surcula)" fusinella* Dall, but it has a stouter nucleus, heavier sculpture, and a less concave anal fasciole. *"Turris (Surcula)" humerosa* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 317–318, pl. 37, figs. 4–5, 1922), a species from the Gurabo formation, has a more concave anal fasciole and weaker primary spirals.

Type material.—Holotype (U. S. Nat. Mus. No. 369379).

Fusiturricula panola, new species

(Plate 6, Figures 5, 6)

Shell medium-sized, moderately slender. Nucleus very stout, consisting of about one and three-quarters whorls. Anterior canal moderately long, curved to the left. Sculpture consisting of swollen axial ribs (6 on body whorl), overridden by spiral threads (7 on penult whorl), between which lie faint secondary threads. Anal fasciole sculptured with a spiral thread lying some distance from suture and with faint secondary threads.

Length 27.2 mm.; diameter 8.5 mm. (holotype, apex and outer lip broken).

The holotype is a specimen in the Guppy collection that was confused by Guppy with a species of *"Fusus."* One other specimen is in the Duerden collection. The broad strongly swollen ribs and numerous spiral threads are characteristic. A similar undescribed species, which has a straighter canal and stronger secondary spirals, is found in the Gurabo formation.

Type material.—Holotype (U. S. Nat. Mus. No. 115578).

MANGELIINAE

ITHYCYTHARA, new genus

Type.—Mangilia psila Bush. Recent, southeast coast of United States.

Shell small, slender. Nucleus consisting of two and a half to three rapidly enlarging whorls, the last whorl or less keeled or not keeled and bearing weak protractive axial riblets. Aperture long, narrow, anterior canal generally not differentiated, siphonal notch shallow. Anal notch moderately deep, the apex rounded and lying some distance from suture. Outer lip varicose, interior bearing crude elongate denticles. Inner lip bearing a deeply set inflated denticle lying above middle, from which very obscure small denticles may extend downward. Sculpture consisting of narrow widely spaced axial ribs, generally arranged in continuous series on later whorls, angulated at periphery by an obscure spiral. Minute spirals present or absent.

This group is traditionally placed in the genus *Cythara* Schumacher (Essai nouv. syst., p. 245, 1817; type, by monotypy, *Cythara striata* Schumacher). Inasmuch as the type of *Cythara*, which is based on a figure in Chemnitz (vol. 4, p. 166, pl. 142, fig. 1330), has been interpreted as a turrid, a *Cancellaria*, a *Strombus*, and a *Lyria*, it is regarded as a *nomen dubium* (see Hedley, Rec. Australian Mus., vol. 13, pp. 260–261, 1922). Those who reject *Cythara* use in its place *Eucithara* Fischer (Man. Conch., p. 593, 1883; type by monotypy, *Mangelia stromboides* Reeve, Recent, Philippines), which has a series of strong denticles along both outer and inner lips. No fossils resembling the Oriental *Eucithara* have been found in the West Indian region and apparently no species are living there. *Ithycythara* is closer to *Eucithara* than any other genus of Bowden turrids. It is much more similar to *Pseudoraphitoma* Boettger (Nachr. Deut. Malak. Gesell., year 27, p. 56, 1895; type, by original designation, *Mangelia fairbanki* Nevill, Recent, Indian Ocean; see Hedley, Rec. Australian Mus., vol. 13, pp. 306–307, 1922), which has a shorter aperture and shallower anal notch. *Cytharella* Monterosato (*Cyharella* by error, Bull. Soc. Malac. Italiana, vol. 1, p. 73, 1875; type, herewith designated, *Murex costatus* Donovan, Recent, Europe) has the same shape and the same kind of sculpture, but the nucleus is larger and has rather strong spiral threads between the riblets, the outer lip has only a broad inflation below the anal notch, and the inner lip is smooth. Dall's designation of *Pleurotoma bertrandi* Payraudeau as the type of *Cytharella* seems to be invalid (Proc. U. S. Nat. Mus., vol. 54, p. 325, 1918).

Key to the Bowden species of Ithycythara

Spiral sculpture weak.
- Shell small, early whorls broad ..... *I. psiloides*
- Shell relatively large, early whorls narrow ..... *I. ischna*

Spiral sculpture relatively strong.
- Spiral sculpture consisting of many fine threads.
  - Shell stout, nucleus small ..... *I. maera*
  - Shell slender, nucleus large ..... *I.* species
- Spiral sculpture consisting of a few coarse threads that are weak except on ribs ..... *I. scissa*

Ithycythara psiloides, new species

(Plate 6, Figure 7)

Cythara elongata Dall (part, not Gabb), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell small, early whorls broad. Nucleus relatively slender, consisting of about two and a half whorls, the last one or less bearing curved, protractive axial riblets extending from suture to periphery, then abruptly curved forward and disappearing, the last few riblets farther apart and more swollen at periphery. Denticles on inner lip very obscure except the one lying above the middle, which on the type is bilobed. Sculpture consisting of narrow ribs (6 on later whorls), angulated at periphery on whorls of spire. On the early whorls an obscure spiral thread extends along periphery. Microscopic spiral grooves are visible on spire of unworn shells.

Length 5.8 mm.; diameter 2 mm. (holotype, dimensions approximate).

Some of the specimens are a little more slender than the holotype. This species, which is represented by more than 60 specimens in the Aldrich collection, closely resembles the living *"Mangilia" psila* Bush, but it has a smaller and more slender nucleus, weaker denticle on the inner lip, and the outline of the early whorls is asymmetric, due to the anterior position of the periphery. *"Mangelia" elongata* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 323, pl. 18, fig. 6, 1922; Cercado formation) has a more slender nucleus, less angulated early whorls, weaker denticles on the outer lip, and apparently none on the inner lip.

Type material.—Holotype (U. S. Nat. Mus. No. 369381).

Ithycythara ischna, new species

(Plate 6, Figure 8)

Cythara elongata Dall (part, not Gabb), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell relatively large, slender. Nucleus consisting of about three whorls, the last one or more sculptured with protractive, curved axial riblets that disappear below periphery, those on the last half whorl coarse and swollen. Central denticle on inner lip broad and low, not deeply set, other denticles on inner lip absent. Sculpture consisting of six narrow ribs, angulated at periphery on first two whorls. Traces of very fine spiral grooves are visible on spire and on upper part of body whorl.

Length 8.9 mm.; diameter 3 mm. (holotype).

The edge of the outer lip is broken on the holotype, and the anal notch appears too shallow. This species is represented by seven specimens in the Henderson collection. It is larger than *psiloides*, the latter part of the nucleus bears heavier riblets, the early whorls are more slender, and the peripheral angulation disappears at an earlier stage. It is difficult, however, to distinguish worn small specimens. The whorls of *"Mangelia" elongata* Gabb (cited under preceding species) have much the same shape, but it also is smaller and the nucleus is more slender.

Two specimens in the Guppy collection are labeled "*Mangelia elongata* Gabb." One of these represents *ischna* and the other *psiloides*.

Type material.—Holotype (U. S. Nat. Mus. No. 135413).

Ithycythara maera, new species

(Plate 6, Figure 9)

Shell very small, stout. Nucleus consisting of about two rapidly enlarging whorls, the last quarter whorl bearing curved protractive axial riblets that hardly extend forward beyond periphery. Denticles on outer lip weak, excepting the one below anal notch. Inner lip bearing only a slight median inflation. Sculpture consisting of seven axial ribs, angulated at periphery on whorls of spire, overridden by very fine spiral threads.

Length 4 mm.; diameter 1.7 mm. (holotype, dimensions approximate).

Though this species is very small, the aperture seems to have adult characters. It is represented by four specimens in the Duerden collection. The strong, very fine spiral threads are characteristic. The outline of the whorls is virtually the same as in corresponding whorls of *I. psiloides*.

Type material.—Holotype (U. S. Nat. Mus. No. 369382).

Ithycythara species

Another species of *Ithycythara* with relatively strong spiral sculpture is represented by an imperfect specimen in the Henderson collection (U. S. Nat. Mus. No. 135377). The nucleus is relatively large, consisting of three rapidly enlarging whorls, of which the last one bears an anterior keel sculptured with axial riblets that take the form of beads. The outer lip bears a heavy denticle below the anal notch, followed by a series of very obscure ones. The inner lip bears a broad median denticle. The anal notch is shallow. The sculpture consists of narrow axial ribs (7 on penult whorl), overridden by fine relatively strong spiral threads. The approximate dimensions are as follows: length 3.8 millimeters, diameter 1.4 millimeters.

This species has a larger nucleus than any of the others. It is more slender than *I. maera* and has slightly coarser spirals.

Ithycythara scissa, new species

(Plate 6, Figure 10)

Shell relatively large, slender. Nucleus consisting of about three whorls, the last whorl bearing a peripheral keel sculptured with beads, from which axial riblets extend backward and less clearly forward. Aperture narrow, anterior canal relatively long, scarcely emarginate. Anal notch moderately deep. Sculpture consisting of seven narrow, widely spaced axial ribs, generally arranged in continuous axial series, overridden by spiral threads (2 or 3 on penult whorl) that are very weak except on crests of ribs. Pillar sculptured with spiral threads.

Length 8.3 mm.; diameter 2.7 mm. (holotype).

This species has a more distinct canal than any of the preceding ones. The outer lip of the holotype is broken back. Young speci-

mens with a perfect aperture show weak denticles on the interior of the outer lip. The inner lip is smooth. One adult specimen, on which the anterior canal is broken, has ribs that are not arranged in continuous series. Four specimens are in the Aldrich collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369383).

ADELOCYTHARA, new genus

Type.—Adelocythara primolevis, new species.

Shell small, slender. Nucleus stout, broad-tipped, consisting of between one and a half and two whorls, the last quarter whorl or less bearing a few fine protractive axial riblets. Aperture long, narrow, anterior canal very short, barely emarginate. Outer lip varicose. Anal notch wide, moderately deep, interior of outer lip bearing a denticle below notch. Inner lip smooth, parietal callus thickened adjoining anal notch. Sculpture consisting of axial ribs, primary spiral threads, and minute spirals roughened by minute axials (frosted sculpture).

The apertural armature of this genus is more reduced than in *Ithycythara,* the inner lip being smooth, and the outer lip bearing only one denticle immediately below the anal notch. The nucleus also is stout, few-whorled, and almost smooth. *Lyromangilia* Monterosato (Bull. Soc. Zool. Ital., ser. 3, vol. 4, p. 25 (of separate), 1917; type, by monotypy, *Pleurotoma taeniata* Deshayes, Recent, Mediterranean) also has a denticle on the outer lip below the anal notch, but the notch is shallower, the strong spiral sculpture is absent, and the nucleus consists of one and a half loosely coiled slender whorls.

Adelocythara primolevis, new species

(Plate 6, Figure 11)

Outline, nucleus, and aperture as described under the genus. Sculpture consisting of narrow axial ribs (11 on penult whorl) overridden by strong spiral threads (generally 3 on penult whorl) and by very fine frosted spiral threads.

Length 4.1 mm.; diameter 1.7 mm. (holotype).

The frosted spirals, which are too fine to show on the photograph, are strongest on the area corresponding to the anal fasciole. This species is represented by six specimens in the Duerden collection. One shell in the Henderson collection is considerably larger than the holotype (length 5.1 millimeters). The nucleus of the holotype is somewhat worn.

Type material.—Holotype (U. S. Nat. Mus. No. 369385).

PYRGOCYTHARA, new genus

Type.—Pyrgocythara eminula, new species.

Shell small, slender, turreted. Nucleus small-tipped, consisting of about three whorls, about the last two sculptured with strong, fine, curved, protractive axial riblets. Aperture long, relatively wide, anterior canal very short, barely emarginate. Outer lip varicose. Anal notch wide, deep,

interior of outer lip bearing a denticle below notch. Parietal callus moderately thick adjoining notch. Sculpture consisting of narrow axial ribs overridden by frosted spiral threads of different orders of magnitude.

This genus also has a denticle on the outer lip below the anal notch. It differs from the preceding genera in the relatively wide aperture and in the many-whorled nucleus, which bears strong, fine axial riblets. *Mangiliella* Bucquoy, Dautzenberg, and Dollfus (Moll. Roussillon, vol. 1, p. 108, 1883; type, by original designation, *Pleurotoma multilineolata* Deshayes, Recent, Mediterranean), which has a somewhat similar outline and aperture, has a shallower anal notch, more obscure denticle on the outer lip, and a stout, few-whorled, smooth nucleus.

Pyrgocythara eminula, new species

(Plate 6, Figure 12)

Outline, nucleus, and aperture as described under the genus. Sculpture consisting of axial ribs (13 or 14 on penult whorl), overridden by frosted spiral threads of three orders of magnitude.

Length 4.3 mm.; diameter 1.8 mm. (holotype).

The secondary and tertiary spirals are too fine to clearly show on the photograph, and the shell is turned too far to the left so that the aperture appears too narrow. This species is represented by eight specimens in the Aldrich collection. It resembles *"Daphnella ?" elata* Dall, a living species from the southeast coast of the United States, but has fewer and broader axial ribs and weaker primary spirals.

Type material.—Holotype (U. S. Nat. Mus. No. 369386).

PLATYCYTHARA, new genus

Type.—Platycythara eurystoma, new species.

Shell small, slender. Nucleus stout, apically broad, consisting of two or two and a half whorls, the last whorl or half whorl bearing fine, closely spaced, protractive, curved axial riblets. Aperture long, relatively wide, especially at base above contraction forming the short barely emarginate anterior canal. Outer lip varicose, the edge bearing a slight stromboid notch at broad basal part of aperture. Anal notch wide, moderately deep. Interior of outer lip thin. Parietal callus slightly thickened adjoining notch. Sculpture consisting of axial ribs and strong spiral threads with frosted spirals in interspaces.

Platycythara resembles *Adelocythara* in having a broad-tipped, stout nucleus, but the riblets extend over a larger part of the nucleus. The wide aperture, slight stromboid notch, and absence of denticles on the outer lip are distinctive features.

Platycythara eurystoma, new species

(Plate 6, Figure 13)

Outline, nucleus, and aperture as described under the genus. Sculpture consisting of rather closely spaced axial ribs (15 or 16 on penult whorl),

overridden by strong spiral threads (4 on penult whorl). Interspaces between spirals bearing microscopic frosted spiral threads.

Length 5.6 mm.; diameter 2 mm. (holotype).

This species is represented by only two specimens, both in the Henderson collection. The slight stromboid notch is not clear on the unfigured specimen, for the very edge of the outer lip is broken back. The ribs on the body whorl of this specimen are narrower than in the holotype, thus producing a more evenly reticulate sculpture. "*Cythara*" *metria* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1633, pl. 60, fig. 13, 1903; Pliocene, Florida) has less bulging whorls and finer sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 135388).

THELECYTHARA, new genus

Type.—Cythara mucronata Guppy. Miocene, Jamaica.

Shell small, moderately slender, pupoid, body whorl loosely coiled. Nucleus forming an erect mammillary apex, consisting of about one and a half smooth whorls. Aperture long, narrow. Anterior canal very short, slightly emarginate. Outer lip varicose, its base bearing a shallow, but pronounced, stromboid notch. Anal notch moderately wide and deep. Parietal callus thickened adjoining notch. Edge of inner lip detached on adult shells. Sculpture reticulate.

The pupoid outline, loosely coiled body whorl, and mammillary nucleus give this genus a striking appearance.

Thelecythara mucronata (Guppy)

(Plate 6, Figure 14)

Cythara mucronata Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 306, pl. 27, fig. 6. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Outline, nucleus, and aperture as described under the genus. Sculpture consisting of narrow, closely spaced axial ribs, overridden by narrower spiral threads that are beaded on crest of ribs. Anal fasciole bordered by a strong sutural cord. Ribs slightly bent on anal fasciole.

Length 5.3 mm.; diameter 2.1 mm. (holotype). Length 5.8 mm.; diameter 2.5 mm. (largest perfect specimen).

Type locality.—Jamaica.

T. mucronata is one of the abundant "*Cythara*"-like turrids. It is represented in the Henderson collection by 23 specimens and in the Aldrich collection by 39 specimens. The holotype is a little smaller than many of the specimens, and the photograph fails to show the slight bending of the ribs on the anal fasciole. In the figure published by Guppy and Dall too much of the first nuclear whorl is partly submerged. A similar, but more coarsely sculptured species, is represented by poor material from both the Cercado and Gurabo formations.

Type material.—Holotype (U. S. Nat. Mus. No. 107087).

BACTROCYTHARA, new genus

Type.—Cythara obtusa Guppy. Miocene, Jamaica.

Shell small, very slender. Nucleus small-tipped, apex deeply submerged, consisting of three rapidly enlarging whorls, the last one and a half whorls sculptured with closely spaced, protractive, curved axial riblets. Aperture long, very narrow, anterior canal not differentiated, base moderately emarginate. Outer lip varicose, base bearing a broad, shallow stromboid notch. Anal notch broad, deep, apex expanded. Parietal callus thickened adjoining notch. Edge of inner lip detached. Sculpture consisting of narrow axial ribs, strongly bent at anal fasciole, and of weak spiral cords lying between ribs.

The hooked ribs, very narrow aperture, deep notch, and large nucleus are characteristic of *Bactrocythara*. The nucleus reaches a larger diameter than in any of the genera so far considered.

Bactrocythara obtusa (Guppy)

(Plate 6, Figures 15, 16)

Cythara obtusa Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, pp. 306–307, pl. 27, fig. 7. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Outline, nucleus, and aperture as described under the genus. Sculpture consisting of narrow axial ribs (12 to 14 on penult whorl), strongly hooked on area corresponding to anal fasciole. Spiral cords lying between ribs almost or quite disappearing on body whorl of adult shells. Pillar sculptured with spiral threads.

Length 5.4 mm.; diameter 1.9 mm. (holotype).

Type locality.—Jamaica.

B. obtusa is a striking species so far as West Indian Miocene turrids are concerned. It is represented by 11 specimens in the Henderson collection, which show considerable variation in the width of the ribs and in the strength of the hook, especially on the early whorls. In comparing the figures it should be noted that the photograph of the smaller specimen is not enlarged so much as the photograph of the holotype.

This species is represented by one poorly preserved specimen from the Cercado formation. According to the figure, "*Mangilia*" *asarca* Dall and Simpson (Bull. U. S. Fish Comm., 1900, vol. 1, p. 388, pl. 57, fig. 14, 1901), a living species from Porto Rico, is similar to *obtusa*, but is smaller and has some kind of spiral sculpture near the suture. This species could not be found in the collections of the United States National Museum.

Other localities.—Cercado formation (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 107088).

PACHYCYTHARA, new genus

Type.—Pachycythara cryptonata, new species.

Shell small, relatively stout, nucleus and early whorls somewhat turreted. Nucleus slender, consisting of about two and a half whorls, about

the last quarter whorl sculptured with obscure, protractive, curved, axial riblets. Aperture moderately long and narrow, anterior canal very short, barely emarginate, siphonal fasciole slightly bulging. Outer lip varicose, anal notch moderately deep. Parietal callus thickened adjoining notch. Sculpture consisting of swollen axial ribs, overridden by strong spiral threads and microscopic frosted spiral threads.

Pachycythara resembles *Adelocythara*, but has a more slender and more strongly sculptured nucleus, and the outer lip lacks the denticle below the anal notch. So far as outline is concerned it resembles *Clathromangilia* Monterosato, discussed later, which has a different nucleus and aperture. *Rissomangilia* Monterosato (Bull. Soc. Zool. Ital., ser. 3, vol. 4, p. 24 (of separate), 1917; type, by subsequent designation, Dall, Proc. U. S. Nat. Mus., vol. 54, p. 331, 1918, *Pleurotoma bertrandi* Payraudeau, Recent, Mediterranean) has a slender, loosely coiled nucleus of about one and a half whorls, a swelling on the outer lip below the notch, and only microscopic spiral sculpture.

Pachycythara cryptonata, new species

(Plate 6, Figure 17)

Outline, nucleus, and aperture as described under the genus. Sculpture consisting of swollen axial ribs (9 on penult whorl, 7 on body whorl), overridden by strong spiral threads (2 on penult whorl in addition to a weaker one on anal fasciole). Entire shell also sculptured with microscopic frosted spiral threads.

Length 6.2 mm.; diameter 2.5 mm. (holotype).

This species is represented only by the holotype. The upper edge of the outer lip is broken back, so that the anal notch appears too shallow.

Type material.—Holotype (U. S. Nat. Mus. No. 369388).

BRACHYCYTHARA, new genus

Type.—Cythara gibba Guppy. Miocene, Jamaica.

Shell small, stout, biconic. Nucleus small-tipped, consisting of about three very rapidly enlarging whorls, about the last whorl sculptured with crowded, protractive, curved, axial riblets. Aperture long, narrow, base barely emarginate, anterior canal not differentiated. Outer lip not varicose, except at intervals corresponding to axial ribs. Anal notch shallow. Specimens with a perfectly formed outer lip show a low denticle below the notch well within the aperture. Parietal callus moderately thickened adjoining notch. Sculpture consisting of axial ribs, barely overridden by fine spiral threads, and of microscopic frosted spirals.

Brachycythara is a genus of small, biconic turrids having a very rapidly enlarging axially sculptured nucleus, non-varicose outer lip, and no anterior canal. In general features its nucleus resembles that of *Bactrocythara*.

Key to the Bowden species of Brachycythara

Nuclear whorls not bulging, spiral sculpture weak ..... *B. gibba*
Nuclear whorls bulging, spiral sculpture strong ..... *B.* species

Brachycythara gibba (Guppy)
(Plate 6, Figure 18)

Cythara gibba Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 306, pl. 27, fig. 9.
Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).
Not *Cythara gibba* Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 223, pl. 35, fig. 11.

Outline, nucelus, and aperture as described under the genus. Sculpture consisting of axial ribs (11 to 13 on penult whorl), weakly overridden by fine spiral threads. Microscopic frosted spirals visible on unworn parts of shell.

Length 4 mm.; diameter 1.9 mm. (holotype). Length 4.3 mm.; diameter 2.1 mm. (figured specimen).

Type locality.—Jamaica.

B. gibba is represented by 12 specimens in the Henderson collection, all of which are more or less worn, especially on the crests of the ribs. A few specimens have a less rapidly enlarging nucleus of only two and a half whorls. The type material consists of two specimens. The larger of the two is broken and badly worn, so that it is clear that the smaller specimen was figured and it is regarded as the holotype. This specimen also is badly worn. The Recent West Indian "*Mangilia*" *biconica* C. B. Adams is larger and has a fewer-whorled nucleus.

Maury's *gibba* from the Cercado formation has a strong peripheral thread along which the whorls are angulated. Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 322–323, 1922) considers that "*Cythara*" *gibba* seems to resemble the young of "*Cythara*" *polygona* (Gabb), but that species apparently represents a different genus.

Type material.—Holotype (U. S. Nat. Mus. No. 107144).

Brachycythara species
(Plate 7, Figure 1)

Another species that is referred to *Brachycythara* is represented by a small damaged specimen in the Johns Hopkins University collection (U. S. Nat. Mus. No. 369390). It is not so stout as *B. gibba*. The nucleus is very large in proportion to the size of the shell, consisting of three rapidly enlarging whorls. About the last whorl and a half is sculptured with axial riblets. The last whorl has a peripheral bulge and the riblets hardly extend forward beyond the bulge. The sculpture consists of axial ribs, overridden by strong spiral threads and by minute frosted spirals. The anal notch is shallow. The approximate dimensions are as follows: length 3.7 millimeters, diameter 1.7 millimeters.

The nuclear bulge and stronger spiral sculpture separate this species from *B. gibba*.

"Cythara" species
(Plate 7, Figure 2)

A species of "*Cythara*"-like turrid is represented by several imperfect specimens. The nucleus is conical and consists of about two and a

half rapidly enlarging whorls of which almost the last is sculptured with axial riblets. The aperture is long and narrow, and the anterior canal is hardly differentiated. The anal notch is very shallow and broad, and the outer lip is varicose. The parietal callus adjoining the notch is moderately thickened. The sculpture consists of axial ribs, between which lie fine spiral threads, separated by narrow grooves and slightly roughened by microscopic axials. The dimensions of the figured specimen are as follows: length 5.2 millimeters, diameter 2 millimeters.

This species seems to represent a genus similar to *Brachycythara*, but the shape and sculpture are different and the nucleus enlarges less rapidly. The aperture and sculpture exclude it from *Acmaturris* and *Tenaturris*, described later.

GLYPHOTURRIS, new genus

Type.—Mangilia quadrata var. *rugirima* Dall. Recent, Florida.

Shell small, stout. Nucleus small-tipped, consisting of between two and four rapidly enlarging whorls, the last half whorl or more sculptured with curved, protractive axial riblets. Aperture short, anterior canal short, but strongly constricted, slightly emarginate. Outer lip varicose, anal notch moderately shallow. Interior of outer lip generally bearing a low broad denticle below notch and another at beginning of canal. Sculpture consisting of very high axial ribs, overridden by strong spiral cords and by microscopic frosted spiral threads.

This genus and many other genera of small turrids are traditionally placed in *Mangelia* Risso (Hist. Nat. Europe Mérid., vol. 4, p. 219, 1826), generally spelled "*Mangilia*." The designation of the type of this genus is very much confused. According to Dall (Proc. U. S. Nat. Mus., vol. 54, p. 316, 1918), Bellardi in 1847 designated *M. costulata* Risso as the type, but this designation could not be found in Bellardi's first monograph of the fossil "Pleurotomas" of the Piedmont (Mem. R. Acad. Sci. Torino, ser. 2, vol. 9, 1847). Gray's (Proc. Zool. Soc. London, pt. 15, pp. 134, 152, 1847) treatment of *Mangelia* is not regarded as a type designation. The citation on p. 134, "Mangelia (striolata), *Risso*, 1826, f. 101. Pleur. taeniatum *Desh. ?*" is very equivocal in view of Gray's definite method of designating types, and the citation on p. 152, "Mangelia, sp. *Risso*, 1826 (f. 102, 103). * * Mang. reticulata," indicates that Risso included species of *Rissoina* in *Mangelia*. Herrmannsen's (Indicis Gen. Malac., sup., p. 80, 1852) statement, "Mangelia (Leach mscr.) Gray 1847 Zool. Proc. 134, g. Coninorum, restrictum ad typum M. striolatae Riss.," apparently is to be regarded as a type designation, although it is based on Gray's action. *Mangelia striolata* Risso, therefore, seems to be the type of *Mangelia*. This species has not been satisfactorily accounted for. Bucquoy, Dautzenberg, and Dollfus (Moll. Roussillon, vol. 1, p. 102, 1883) refuse to accept Jeffrey's opinion that it is a synonym of "*Murex*"

attenuatus Montagu. At all events nothing like Risso's figure (fig. 101) is represented in the Bowden formation.

Turrids like "*Murex*" *nebula* Montagu, of which *Mangelia costulata* Risso, generally cited as the type of *Mangelia*, is regarded as a synonym or subspecies, apparently will take the name *Bela* ("Leach") Gray (Ann. Mag. Nat. Hist., vol. 20, p. 270, Oct., 1847; type, by subsequent designation, Gray, Proc. Zool. Soc. London, pt. 15, p. 134, Nov., 1847, *Murex nebula* Montagu; see Iredale, Proc. Malac. Soc. London, vol. 11, pp. 298–299, 1915). *Ginnania* Monterosato (Nom. gen. spec. Conch. Medit., p. 127, 1884; type, by tautonymy, *Mangelia ginnania* Risso, cited by Monterosato under *Pleurotoma fuscata* Ph.) seems to be a synonym of *Bela*.

Glyphoturris has a strongly constricted short canal and generally two denticles on the outer lip, though on some specimens the denticles are obscure. The ribs are very high and the microscopic frosted sculpture is pronounced. *Clathromangilia* Monterosato (Nom. gen. spec. Conch. Medit., p. 131, 1884; type, by monotypy, *Pleurotoma granum* Philippi, Recent, Mediterranean) has the same outline, but lacks the coarsely frosted sculpture, and has four strong denticles on the outer lip and a differently sculptured nucleus. *Heterocithara* Hedley (Rec. Australian Mus., vol. 13, p. 297, 1922; type, by original designation, *Clathurella bilineata* Angas, Recent, Australia) has a less distinct canal, a shallower notch, and denticles along the outer lip.

Glyphoturris lampra, new species

(Plate 7, Figure 3)

Outline and aperture as described under the genus. Nucleus consisting of almost four rapidly enlarging whorls, about the last two sculptured with axial riblets and bulging at the periphery. Sculpture consisting of high axial ribs (9 on penult whorl), overridden by strong spiral cords (3 on penult whorl) that are swollen on crest of ribs. Strongly frosted microscopic spirals cover the entire shell.

Length 5.3 mm.; diameter 2.5 mm. (holotype).

This species is represented by the holotype and by a smaller, but more perfect specimen in the Henderson collection. The photograph fails to give an adequate idea of the handsome sculpture. The appearance on the photograph of several denticles on the upper part of the outer lip is due to the serrate edge of the lip. "*Mangilia quadrata* var." *rugirima* Dall is more angulated at the periphery and has a smaller nucleus and more numerous primary spirals.

Type material.—Holotype (U. S. Nat. Mus. No. 369392).

CRYOTURRIS, new genus

Type.—Cryoturris engonia, new species.

Shell small or medium-sized, slender or moderately slender, whorls angulated at periphery or rounded. Nucleus slender or moderately slender, apex generally rising abruptly, consisting of about two and a half or three

whorls, the last whorl or half whorl bearing curved, protractive axial riblets and generally bulging at periphery. Aperture moderately narrow, anterior canal very short or hardly differentiated, slightly emarginate. Outer lip simple, except at intervals corresponding to position of varix-like ribs. Anal notch wide, shallow or moderately deep. Sculpture consisting of axial ribs, overridden by fine spiral threads and by microscopic frosted spiral threads.

Cryoturris is a genus of "Mangilias" that seems to be the tropical representative of the temperate genus *Kurtziella* Dall (Proc. Biol. Soc. Washington, vol. 31, p. 137, 1918; type, by orginial designation, *Pleurotoma cerina* Kurtz and Stimpson, Recent, east coast of United States), which has a similar aperture and sculpture, though the frosted effect is not so pronounced. The last nuclear whorl, or perhaps the first post-nuclear whorl, of *Kurtziella* bears, however, reticulate sculpture. It is doubtful whether *Kurtziella* can be generically separated from the European *Bela* (cited under preceding genus)—that is, the genus generally accepted as "*Mangilia*"—though *Bela* embraces larger species that have a slightly longer canal.

Guraleus Hedley (Jour. Roy. Soc. New South Wales, vol. 5, p. M 79, 1918; Rec. Australian Mus., vol. 13, p. 311, 1922; type, by original designation, *Mangelia picta* Adams and Angas, Recent, Australia) has a similar aperture and sculpture, but the nucleus is smooth, according to Hedley. *Raphitoma* Bellardi (Mem. R. Acad. Sci. Torino, ser. 2, vol. 9, p. 84 (of separate), 1847; type, by subsequent designation, Monterosato, Bull. Soc. Malac. Italiana, vol. 1, pp. 72–73, 1875, *Pleurotoma hystrix* Jan, Pliocene and Recent, Mediterranean) has a loosely coiled nucleus and spinose sculpture, and the anal sinus adjoins the suture. Many different species have been named as the type of *Raphitoma*, which originally included an assortment of genera, but Monterosato's designation is the earliest that was found. Bellardi's statement that one may regard *Raphitoma vulpecula* (Brocchi) as the typical form of the genus (Moll. Piemonte, pt. 2, p. 323, 1878) is not regarded as a type designation.

All the species referred to *Cryoturris* have the same general features, but they differ greatly in size. All have an axially sculptured nucleus, short canal or virtually no canal, simple outer lip, shallow or moderately deep anal notch, and minutely roughened or frosted sculpture. This type of sculpture is found in many other genera of turrids. The Bowden species are very difficult to handle. Either a large number of species are represented or the characters used for specific discrimination in other genera are valueless. The first alternative is the one accepted, although the number of species seems excessive and no species is represented by more than nine specimens in one collection.

Key to the Bowden species of Cryoturris

Later whorls angulated at periphery, shell small.
- Shell slender, peripheral angulation moderately strong ..... *C. engonia*
- Shell stout, peripheral angulation very strong ..... *C. euengonia*

Later whorls not angulated at periphery.
Ribs closely spaced on early part of body whorl, shell small.
Shell moderately slender, ribs closely spaced on early whorls.....*C. nexilis*
Shell very slender, ribs farther apart on early whorls.....*C. nisis*
Ribs not closely spaced on early part of body whorl, shell medium-sized or large.
Shell slender, medium-sized, primary spirals weak.
Ribs far apart .....*C. etrema*
Ribs more closely spaced .....*C. dianema*
Shell stout, large, primary spirals strong.....*C. aptera*

Cryoturris engonia, new species

(Plate 7, Figure 4)

Shell small, slender, whorls angulated at periphery. Nucleus slender, apex rising abruptly, consisting of about two and a half whorls, the last half whorl bulging at periphery and bearing axial riblets. Anterior canal short, anal notch moderately deep. Sculpture consisting of narrow axial ribs (about 16 on penult whorl), overridden by fine, relatively strong spiral threads (4 on penult whorl), the peripheral one strongest, and by microscopic frosted spiral threads. Last half of body whorl bearing four varix-like ribs.

Length 4.7 mm.; diameter 1.8 mm. (holotype, measurements approximate).

The outer lip of the holotype, one of three specimens in the Henderson collection, is seated near the last varix-like rib, so that it is varicose. One of the other specimens is a little larger.

Type material.—Holotype (U. S. Nat. Mus. No. 135406).

Cryoturris euengonia, new species

(Plate 7, Figure 5)

Shell small, relatively stout, whorls strongly angulated at periphery. Nucleus slender, the apex rising abruptly, consisting of between two and a half and three whorls, about the last half whorl slightly bulging and sculptured with axial riblets. Anterior canal short, but rather strongly constricted. Anal notch shallow. Sculpture consisting of axial ribs (about 12 on penult whorl), overridden by fine spiral threads, the peripheral one strongest, and by microscopic frosted spiral threads. Ribs heavier and more widely spaced on body whorl.

Length 4.6 mm.; diameter 2.4 mm. (holotype, measurements approximate).

This species, represented by three specimens in the Henderson collection and by nine specimens in the Aldrich collection, as compared with *C. engonia* marks a further change in the angulation of the whorls and in the reduction of the number of ribs. The shell also is stouter and the last nuclear whorl bulges less. The holotype is the most perfect, but not the largest, of the specimens.

Type material.—Holotype (U. S. Nat. Mus. No. 135391).

Cryoturris nexilis, new species

(Plate 7, Figure 6)

Shell small, slender, early whorls angulated at periphery. Nucleus slender, consisting of about two and a half whorls, the apex rising abruptly,

the last whorl or less bulging at periphery and sculptured with axial riblets. Anterior canal short, anal notch moderately deep. Sculpture consisting of narrow axial ribs (about 19 on penult whorl), overridden by fine spiral threads and by microscopic frosted spirals. Last half of body whorl bearing four or five varix-like axial ribs.

Length 5.5 mm.; diameter 2 mm. (holotype, dimensions approximate).

No adult shell of this species, of which five specimens are in the Henderson collection, is perfect. The holotype is worn and the sculpture, especially the microscopic frosted sculpture, is very imperfectly shown on the photograph. The number of axial ribs and the relative strength of the primary spirals are variable.

Type material.—Holotype (U. S. Nat. Mus. No. 369393).

Cryoturris nisis, new species

(Plate 7, Figure 7)

Shell small, slender. Nucleus slender, consisting of between two and a quarter and two and a half whorls, about the last half whorl sculptured with axial riblets. Anterior canal hardly differentiated, anal notch moderately deep. Sculpture consisting of axial ribs (13 to 15 on penult whorl), overridden by microscopic frosted spiral threads, some of which are a little heavier than others. Early part of body whorl bearing narrow ribs. Heavier ribs appear near outer lip and a very broad varix-like rib lies at the outer lip.

Length 5.3 mm.; diameter 1.9 mm. (dimensions approximate).

C. nisis is more slender than *C. nexilis* and has fewer and heavier ribs, except on the early part of the body whorl. The holotype is somewhat worn and the apex is broken. Part of the outer lip is broken back and the anal notch appears too shallow on the photograph. "*Turris* (*Bela*)" *dominicensis* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 322, pl. 35, fig. 1, 1922; "*Mangilia*" *lalonis* Maury, Bull. Am. Paleontology, vol. 5, pp. 222–223, pl. 35, fig. 10, 1917, probably is a synonym), which is very abundant in the Cercado formation, has more strongly angulated whorls, though they are not so strongly angulated as in *engonia* and *euengonia*. Six specimens are in the Aldrich collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369394).

Cryoturris etrema, new species

(Plate 7, Figure 8)

Shell medium-sized, slender. Nucleus large and relatively stout, small-tipped, consisting of about three whorls, the last whorl or more bearing axial riblets that hardly extend forward beyond a peripheral keel. Anterior canal hardly differentiated, anal notch moderately shallow. Sculpture consisting of widely spaced axial ribs (7 on penult whorl), overridden by fine spiral threads and by microscopic frosted spiral threads.

Length 8.5 mm.; diameter 2.7 mm. (holotype).

C. etrema, represented by a total of five specimens, is larger than any of the preceding species, and it also has fewer ribs and a more rapidly

enlarging nucleus. The ribs of the holotype are worn, the outer lip is broken back, and the apex is broken. One small specimen doubtfully referred to *etrema* has a more slender nucleus and more slender shell. *"Mangilia" cerinella* Dall, a Recent species from Florida, is larger, and has more angular whorls and wider ribs.

Type material.—Holotype (U. S. Nat. Mus. No. 369395).

Cryoturris dianema, new species

(Plate 7, Figure 9)

Shell medium-sized, moderately slender. Nucleus slender, consisting of about two and a half whorls, the last half whorl or more bulging at periphery and bearing axial riblets. Anterior canal short, anal notch shallow. Sculpture consisting of axial ribs (13 on penult whorl), overridden by fine spiral threads and by microscopic frosted spiral threads. Ribs heavier and farther apart on latter half of body whorl.

Length 6.9 mm.; diameter 2.2 mm. (holotype).

This species is represented by two specimens, both in the Henderson collection. The nucleus and first post-nuclear whorl of the holotype are tilted and the outer lip is broken back. It has the same kind of slender nucleus as all the preceding species, excepting *C. etrema.*

Type material.—Holotype (U. S. Nat. Mus. No. 135407).

Cryoturris aptera, new species

(Plate 7, Figure 10)

Shell very large as compared to preceding species, relatively stout. Nucleus large and relatively stout, probably consisting of about two and a half or three whorls, the last whorl bearing axial riblets that hardly extend forward beyond a peripheral keel. Aperture wide, anterior canal very short, siphonal fasciole slightly bulging. Sculpture consisting of broad axial ribs (about 11 on penult whorl), overridden by fine spiral threads of three orders of magnitude, all of which are frosted.

Length 11.4 mm.; diameter 3.9 mm. (holotype, apex broken).

In addition to the holotype this species is represented by four specimens, some of which are more slender. The early nuclear whorls are not preserved on any specimen. One shell in the Henderson collection, a fragment of a little more than three whorls, has a length of 12.7 millimeters, showing that the length of perfect adult shells would be much greater than the length of the holotype. Ignoring the difference in size *C. aptera* is like *C. dianema,* but is stouter, and has a stouter nucleus and broader ribs.

Type material.—Holotype (U. S. Nat. Mus. No. 369397).

SACCHAROTURRIS, new genus

Type.—Mangilia consentanea Guppy. Miocene, Jamaica.

Shell small, slender, whorls very strongly constricted. Nucleus consisting of three rapidly enlarging whorls, the apex rising abruptly, the last two whorls strongly keeled and bearing beads on the keel, from which fine axial

riblets extend. Aperture wide, anterior canal short, but strongly constricted, unemarginate. Outer lip not varicose, anal notch very shallow and broad. Sculpture consisting of heavy varix-like ribs, overridden by strongly frosted spiral threads of several orders of magnitude.

Saccharoturris is a genus of "Mangilias" that has a beaded nucleus, unemarginate canal, very shallow anal notch, and strongly frosted sculpture.

Key to the Bowden species of Saccharoturris

Shell stout, sculpture very strong.....*S. consentanea*
Shell slender, sculpture weaker.....*S.* species

Saccharoturris consentanea (Guppy)

(Plate 7, Figure 11)

Mangilia consentanea Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 307, pl. 27, fig. 4. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Outline, nucleus, and aperture as described under the genus. Sculpture consisting of heavy axial ribs (9 or 10 on penult whorl, 7 to 9 on body whorl), overridden by primary (3 or 4 on penult whorl), secondary, and tertiary spiral threads, all of which are strongly frosted.

Length 6.2 mm.; diameter 2.7 mm. (holotype, measurements approximate).

Type locality.—Jamaica (Miocene).

This species was received from Guppy with the manuscript label "*Fusus consentaneus.*" The upper part of the nucleus of the holotype is broken. Two other specimens, representing one or two species of *Cryoturris*, were included in the original type material. Two additional specimens are in the Henderson collection and five in the Aldrich collection.

S. consentanea is the most handsome of all the Bowden gastropods, but specimens must be seen to appreciate the beauty of the frosted or sugar-coated sculpture. The outer lip is broken back on all the specimens, and the anal notch may not be so shallow as it appears to be. "*Mangilia quadrata* var." *monocingulata* Dall, dredged off Barbados at a depth of 100 fathoms, is larger and has more numerous primary spirals, but otherwise is very similar.

Guppy's record of this species from Trinidad (Agr. Soc. Trinidad and Tobago Paper No. 520, p. 4, 1912; reprint, Bull. Am. Paleontology, vol. 8, p. 335, 1921) needs confirmation.

Type material.—Holotype (U. S. Nat. Mus. No. 107091).

Saccharoturris species

Another species of *Saccharoturris* is represented by a poorly preserved small specimen in the Johns Hopkins University collection (U. S. Nat. Mus. No. 369398). The nucleus is three-whorled and the last two whorls bear a beaded peripheral keel, from which axial riblets

extend; that is, it is like the nucleus of *S. consentanea*, but is a little stouter. The shell is more slender than in *consentanea*, the whorls are not so strongly constricted, the ribs are not so heavy, and the spirals are not so strong. The anterior canal is strongly constricted.

The approximate dimensions are as follows: length 5.5 millimeters, diameter 1.9 millimeters.

ACMATURRIS, new genus

Type.—Acmaturris comparata, new species.

Shell medium-sized, slender or moderately slender. Nucleus broad-tipped, consisting of about two and a half whorls, the last one sculptured with curved, protractive, axial riblets that may be swollen on a peripheral keel. Aperture long, moderately narrow. Anterior canal short, unemarginate. Outer lip strongly varicose, the edge frilled. Anal notch moderately deep, broadly rounded. Parietal callus thickened adjoining notch. Sculpture consisting of narrow axial ribs and of strong spiral threads, and also of microscopic frosted spiral threads.

Acmaturris is traditionally placed under *Cythara* or *Clathurella* (see p. 187), both of which have been used for a great number of genera. So far as the Bowden turrids are concerned it is distinguished by its moderately large size, strongly varicose outer lip, and ribbed nucleus.

Key to the Bowden species of Acmaturris

Shell medium-sized, axial riblets of nucleus not swollen on a peripheral keel.
Shell relatively stout ..... *A. comparata*
Shell slender ..... *A. brisis*
Shell relatively large, axial riblets of nucleus swollen on a peripheral keel ..... *A. scalida*

Acmaturris comparata, new species

(Plate 7, Figure 12)

Shell medium-sized, relatively stout, whorls strongly constricted. Nucleus consisting of two and a half whorls, the last one bearing an obscure peripheral keel and sculptured with axial riblets. Sculpture reticulate, consisting of narrow axial ribs (10 to 12 on penult whorl), slightly curved on anal fasciole, overridden by strong spiral threads (3 or 4 on penult whorl). In the interspaces lie microscopic frosted spirals.

Length 8.4 mm.; diameter 3.4 mm. (holotype).

This stout reticulately sculptured species is represented by three specimens, all in the Johns Hopkins University collection. A small specimen in the Henderson collection (U. S. Nat. Mus. No. 135382), doubtfully referred to this species, has a more slender nucleus of about two and a quarter whorls that bulge less, and the anal fasciole slopes more steeply.

Type material.—Holotype (U. S. Nat. Mus. No. 369399).

Acmaturris brisis, new species

(Plate 7, Figure 13)

Shell medium-sized, slender. Nucleus consisting of between two and a half and three whorls, the last one sculptured with closely spaced axial

riblets. Sculpture reticulate, consisting of narrow axial ribs (14 or 15 on penult whorl), barely curved on anal fasciole, overridden by spiral threads (3 or 4 on penult whorl). Interspaces bearing microscopic spiral threads, some of which may be relatively strong, frosted by microscopic axials.

Length 8.3 mm.; diameter 2.9 mm. (holotype).

This species is more slender than *A. comparata,* and the last nuclear whorl bulges less and is sculptured with more closely spaced riblets. The holotype is worn on the crests of the ribs. Four other specimens are referred to this species. A small broken specimen in the Henderson collection (U. S. Nat. Mus. No. 135308) has the same kind of last nuclear whorl (the others are broken off), but the anal fasciole slopes less steeply. It may possibly represent a different species.

Type material.—Holotype (U. S. Nat. Mus. No. 369400).

Acmaturris scalida, new species

(Plate 7, Figures 14, 15)

Shell relatively large, slender. Nucleus consisting of between two and a half and three whorls, the last whorl bearing a strong keel, lying behind middle, on which the axial riblets are swollen into beads. Riblets not extending forward beyond keel. Sculpture consisting of axial ribs (13 to 15 on penult whorl), overridden by spiral threads (4 to 6 on penult whorl). A secondary spiral thread may appear in interspaces. Microscopic axials and spirals visible in interspaces.

Length 11.2 mm.; diameter 3.9 mm. (holotype).

Eight specimens in the Henderson collection and 10 specimens in the collections at Baltimore are referred to this species. All have the same kind of nucleus, except that the spacing of beads and riblets differs, but the width of ribs and spirals and the presence or absence of secondary spirals are variable. Fig. 15, which unfortunately is not on the same scale as the other photographs, represents a specimen with relatively wide ribs, narrow spirals and secondary spirals in some of the interspaces.

Type material.—Holotype (U. S. Nat. Mus. No. 135379).

TENATURRIS, new genus

Type.—Cythara guppyi Dall. Miocene, Jamaica.

Shell medium-sized, stout. Nucleus conical, consisting of two and a half whorls, about the last one sculptured with axial riblets. (One species referred to this genus has a stout, cylindrical, smooth nucleus of two whorls.) Aperture long, moderately narrow, anterior canal short, barely emarginate. Outer lip varicose, anal notch immediately adjoining suture, moderately deep, broadly rounded. Interior of outer lip bearing a low broad denticle on notch. Parietal callus thin. Sculpture consisting of axial ribs, which may be varicose here and there on body whorl, and spiral threads, with microscopic frosted spirals in the interspaces.

This genus also would fall in *Cythara* or *Clathurella,* according to the old usage. It is distinguished from *Acmaturris* by having the sinus

mmediately adjoining the suture, and by the thin parietal callus. The sculpture also is less reticulate. *Marita* Hedley (Rec. Australian Mus., vol. 13, p. 312, 1922; type, by original designation, *Cythara compta* Adams and Angas, Recent, Australia) has a similar sinus, but the interior of the outer lip bears denticles, and the shape and sculpture of the shell are different.

Key to the Bowden species of Tenaturris

Nucleus conical, consisting of about 2½ whorls, about the last one sculptured with axial riblets.
- Ribs relatively broad and far apart on later whorls..... *T. guppyi*
- Ribs narrow and closely spaced on later whorls..... *T. terpna*

Nucleus cylindrical, consisting of about 2 smooth whorls..... *T. isiola*

Tenaturris guppyi (Dall)

(Plate 7, Figure 16)

Cythara guppyi Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 306, pl. 27, fig. 5.
Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell medium-sized, stout. Nucleus and aperture as described under genus. Sculpture consisting of narrow axial ribs (about 16 on penult whorl), generally varicose here and there on body whorl, weakly overridden by fine spiral threads, which are weaker and more closely spaced on anal fasciole. Between the threads lie microscopic frosted spirals.

Length 6.7 mm.; diameter 2.8 mm. (holotype). Length 8.2 mm.; diameter 3.3 mm. (largest specimen).

Type locality.—Jamaica (Miocene).

Six specimens of this species are in the Henderson collection, all except one of which has varicose ribs on the body whorl in addition to the heavy varix at the outer lip. The ribs generally are worn and the microscopic sculpture is obscure. In Dall's figure the width of the ribs is too uniform. The holotype is not quite full-grown. Larger shells have a slightly longer anterior canal and more distinct denticle on the anal notch.

Type material.—Holotype (U. S. Nat. Mus. No. 107145).

Tenaturris terpna, new species

(Plate 7, Figure 17)

Shell medium-sized, moderately stout. Nucleus as described under the genus. Anal notch relatively shallow. Sculpture consisting of axial ribs, weakly overridden by fine spiral threads. Axials of first three whorls relatively broad and far apart, those on remaining whorls narrow and more closely spaced (23 on body whorl). Interspaces bearing microscopic frosted spirals.

Length 9.1 mm.; diameter 3.6 mm. (holotype).

The holotype and only specimen in the Baltimore collections is somewhat worn. The only specimen in the Henderson collection is stouter and has a more steeply sloping anal fasciole on the later whorls. The sculpture of the early whorls is like that of *T. guppyi,* but the ribs are not so broad.

Type material.—Holotype (U. S. Nat. Mus. No. 369402).

Tenaturris isiola, new species

(Plate 7, Figure 18)

Shell medium-sized, stout. Nucleus stout, cylindrical, consisting of about two smooth whorls. Aperture relatively wide. Sculpture consisting of narrow axial ribs (16 or 17 on penult whorl), varicose here and there on body whorl, weakly overridden by fine spiral threads. Microscopic frosted spirals visible in interspaces.

Length 9.1 mm.; diameter 3.9 mm. (holotype).

T. isiola is represented by three specimens, all of which are rather badly worn. The basal part of the outer lip of the holotype is broken away, thus distorting the appearance of the aperture.

This species probably should be placed in a different genus on account of its smooth, cylindrical, two-whorled nucleus, though in other features it agrees with *T. guppyi*. It is the only one of the Bowden turrids that fails to show a general correlation between nuclear and apertural characters. Either the stout, few-whorled, smooth nucleus represents an aberrant "acceleration," or the aperture and sculpture as compared with *T. guppyi* represent a remarkable example of convergence.

Type material.—Holotype (U. S. Nat. Mus. No. 369403).

EUCLATHURELLA, new genus

Type.—Clathurella vendryesiana Dall. Miocene, Jamaica.

Shell medium-sized, very slender. Nucleus broad-tipped, consisting of about two whorls, about the last half or three quarters whorl sculptured with axial riblets. Aperture very long and narrow. Anterior canal relatively long, unemarginate. Outer lip varicose, stromboid notch very broad and shallow. Anal notch deep, apex broadly rounded. Interior of outer lip thickened adjoining notch. Parietal callus greatly thickened adjoining notch. Edge of inner lip detached on specimens with perfectly formed aperture. Sculpture consisting of narrow axial ribs, overridden by closely spaced spiral threads.

According to the old usage, this genus would be placed in *Clathurella* Carpenter (Cat. Mazatlan Moll., p. 399, 1857). As several writers have pointed out, this name was proposed as a substitute name for *Defrancia* Millet (Mém. Soc. Lin. Paris, vol. 5, p. 437, 1827; type, by subsequent designation, Dall, Bull. Mus. Comp. Zool. Harvard College, vol. 48, p. 259, 1908, *Defrancia pagoda* Millet, Miocene, Touraine; not *Defrancia* Bronn, Syst. Urw. Pflanz., p. 13, 1825) and its type, which apparently was not designated until 1908, must be chosen from Millet's list of species. *Defrancia pagoda*, according to the original figures, is a stout "*Mangilia*" with a strongly turreted spire and an anal notch immediately adjoining the suture. Several other substitute names for *Defrancia* have been proposed, but the earliest one is *Pleurotomoides* Bronn (Ital. Ter.-Gebilde, p. 47, 1831; see Iredale, Proc. Malac. Soc. London, vol. 12, pp. 326–327, 1917), which is the next turrid generic name in chronologic order.

Dall has recently used *Philbertia* Monterosato (Nomen. gen. spec. Conch. Medit., p. 132, 1884; type, by tautonymy, *Pleurotoma philberti* Michaud, cited as a synonym of *Pleurotoma bicolor* Risso, which generally is regarded as a synonym or subspecies of *Murex purpureus* Montagu, Recent, Europe), for the west American "Clathurellas." *Philbertia*, however, has a conical, three-whorled, diagonally reticulate nucleus, a narrow and shallow anal notch immediately adjoining the suture, and a lirate outer lip. No such species are in the Bowden formation. *Leufroyia* Monterosato (cited above, p. 134; type, by tautonymy, *Pleurotoma leufroyi* Michaud, Recent, Europe) is a synonym of *Philbertia*, and *Clathurina*, Melvill (Proc. Malac. Soc. London, vol. 12, p. 185, 1917; type, by original designation, *Pleurotoma foraminata* Reeve, Recent, Indian Ocean), which was proposed as a substitute name for *Clathurella* as used by Carpenter and later writers, but with a designated type,[1] also seems to be a synonym. *Homotoma* Bellardi (Bull. Soc. Malac. Italiana, pp. 8–9 (of separate), 1875) is an earlier name than any of these, and apparently has not yet been legitimately disposed of. As originally proposed it included only two species, *Murex reticulata* Renieri and *Raphitoma semicostata* Bellardi. No type has yet been designated from these two species. If *Murex reticulata* were taken as the type, *Homatoma* would be an earlier name for *Philbertia*, but *Homotoma* is preoccupied (Guerin-Ménéville, 1829) and was renamed *Peratotoma* by Harris and Burrows in 1891 (Eoc. and Olig. beds Paris Basin, p. 113). As the Bowden formation carries no species similar to either of the two species cited by Bellardi, the status of *Peratotoma* is left open. *Bellardia* Bucquoy, Dautzenberg, and Dollfus (Moll. Roussillon, vol. 1, p. 88, Jan., 1883; type, by monotypy, *Murex gracilis* Montagu, Recent, Europe) also has a sinus adjoining the suture and differs in other features from the Bowden "Clathurellas." *Bellardia* also is preoccupied (Robineau-Desvoidy 1863) and so is *Bellardiella*, Fischer's substitute name (Man. Conch., pp. 593–594, Dec., 1883; not Tapparone-Canefri, July, 1883), so that this genus will take the name of *Comarmondia* Monterosato (Nomen. gen. spec. Conch. Medit., p. 135, 1884), which was proposed on the chance that *Bellardia* was preoccupied (see Iredale, Proc. Malac. Soc. London, vol. 11, p. 333, 1915).

To return to the new genus here proposed, *Euclathurella* is not similar to any of the genera so far discussed. It probably closely resembles *Paraclathurella* Boettger (Nachr. Deut. Malak. Gesell., vol. 27, p. 56, 1895; type, by original designation, *Pleurotoma gracilenta* Reeve, Recent, Philippines), which, according to Reeve's figure of the genotype, has a shallower notch and less pronounced anal fasciole, but in the absence of specimens no adequate comparison can be made with

[1] Melvill's citation is as follows: "Genus *Clathurina*, nom. nov. = *Clathurella* Carpenter, 1857, *Defrancia* Millet, 1826, nom. praeocc.," which would make *Clathurina* a perfect synonym of *Pleurotomoides*, but the type designation may save the name.

this Oriental genus. *Otitoma* Jousseaume (Le Naturaliste, year 20, p. 106, 1898; type, by tautonymy *Otitoma ottitoma* [sic] Jousseaume, Recent, Red Sea) may need to be considered, but apparently the type is unfigured.

Euclathurella vendryesiana (Dall)

(Plate 8, Figure 1)

Clathurella vendryesiana Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 306, pl. 27, fig. 1. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 226, pl. 35, fig. 18.

Outline, nucleus, and aperture as described under the genus. Sculpture of first three whorls consisting of relatively broad axial ribs (about 16 on third whorl), overridden by spiral threads. On remaining whorls the axials are narrow and closely spaced and are finely reticulated by the spirals. Anal fasciole slightly concave on later whorls.

Length 13.8 mm.; diameter 4.3 mm. (holotype).

Type locality.—Jamaica (Miocene).

Though the holotype is as large as any specimen, its inner lip is not so completely formed as in two specimens in the Henderson collection, and the thickened area on the interior of the outer lip adjoining the notch is not so pronounced. The specimen from the Gurabo formation figured by Maury has a slightly less concave anal fasciole. "*Pleurotoma (Genota)*" *gertrudis* Toula (Jahrb. K.-k. geol. Reichsanstalt, vol. 58, pp. 708–709, fig. 9, 1909; Gatun formation) may be a synonym of *vendryesiana*, but no specimens are available.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 107086).

MIRACLATHURELLA, new genus

Type.—Miraclathurella vittata, new species.

Shell medium-sized, or relatively large, very slender. Nucleus stout, broad-tipped, consisting of between two and a half and three whorls, the end of the last whorl bearing a few coarse curved, protractive axial riblets, in front of which may lie a keel. Aperture very long and narrow. Anterior canal relatively long, slightly emarginate. Outer lip varicose, stromboid notch deep or relatively deep. Anal notch deep, apex broadly rounded. Interior of outer lip and parietal callus thickened adjoining notch. Edge of inner lip detached only on fully mature specimens. Sculpture consisting of axial ribs, which are narrower and more closely spaced on body whorl, overridden by strong spiral cords. Anal fasciole bearing a strong sutural cord.

Aside from the differences in nuclear characters, *Miraclathurella* is separated from *Euclethurella* by the deeper stromboid notch and by the presence of a sutural cord similar to that seen in many "Drillias."

Key to the Bowden species of Miraclathurella

Ribs on early whorls broad.
- Secondary spirals absent..... *M. vittata*
- Secondary spirals present..... *M. entemna*

Ribs on early whorls narrow..... *M.* species

Miraclathurella vittata, new species

(Plate 8, Figures 2 to 4)

Shell medium-sized, slender. Nucleus consisting of about three whorls, about the last half whorl bearing an anterior keel, behind which lie axial riblets. Stromboid notch very deep on some adult shells. Sculpture consisting of axial ribs, which become narrower and more closely spaced on penult and body whorls, overridden by spiral cords (4 to 7 on penult whorl). Anal fasciole bearing a strong sutural cord, one to three weak spiral threads, and curved growth wrinkles.

Length 12 mm.; diameter 4.1 mm. (holotype).

This species, which is represented by 13 specimens in the Henderson collection, is the most abundant "*Clathurella.*" The shape of the shell and the details of sculpture are somewhat variable. Fig. 4 represents a stout shell and fig. 3 represents a slender shell on which the sutural cord becomes weak on the body whorl.

Type material.—Holotype (U. S. Nat. Mus. No. 135376).

Miraclathurella entemna, new species

(Plate 8, Figures 5, 6)

Shell relatively large, very slender. Nucleus stout, consisting of about two and a half whorls, the last quarter whorl bearing an obscure anterior keel, behind which lie a few obscure axial riblets. Stromboid notch wide, moderately deep. Sculpture consisting of axial ribs, which are lower and more closely spaced on body whorl, overridden by primary spiral cords (4 or 5 on penult whorl), between which lie very fine secondary spiral threads. Anal fasciole bearing a sutural cord, secondary spirals, and subdued curved continuations of the ribs.

Length 15.5 mm.; diameter 4.7 mm. (holotype, apex broken).

The aperture of the anal notch of the holotype, which is about twice as large as either of the other two specimens, is greatly constricted. The fine secondary spirals, which are not satisfactorily shown on the photographs, are a distinctive feature. This species closely resembles "*Clathurella*" *amica* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 324, pl. 17, fig. 13, 1922; Miocene, Dominican Republic), but it has wider ribs that are not so strongly curved on the anal fasciole, and the spirals are a little coarser. "*Defrancia*" *gracilis* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 323–324, pl. 16, figs. 10–11, 1922; Miocene, Dominican Republic) is larger and more slender. "*Pleurotoma* (*Drillia ?*)" *subconsors* Böse (Jahrb. K.-k. geol. Reichsanstalt, vol. 60, pp. 250–251, pl. 13, fig. 25, 1910; lower Miocene, Tehuantepec) seems to be a similar species, but apparently lacks the secondary spirals.

Type material.—Holotype (U. S. Nat. Mus. No. 135374).

Miraclathurella species

Another species of *Miraclathurella* is represented by two small imperfect specimens in the Johns Hopkins University collection (U. S.

Nat. Mus. No. 369407). The nucleus is more conical than in either of the preceding species, and it has no anterior keel. At the end of the last whorl lie about three strongly curved, protractive axial riblets, the last one of which is varix-like. The anal fasciole bears a strong sutural cord, as in the preceding species, but the ribs are relatively narrow and far apart. On the third post-nuclear whorl a secondary spiral thread lies in some of the spaces between the primary spirals. The larger specimen has the following dimensions: length 6.9 millimeters, diameter 2.5 millimeters.

GLYPHOSTOMA Gabb

Gabb, 1873, Proc. Acad. Nat. Sci. Philadelphia, vol. 24 (1872), pp. 270–271.
Type (*by monotypy*).—*Glyphostoma dentiferum* Gabb. Miocene, Dominican Republic.

Shell relatively large, slender, strongly constricted at anal fasciole. Nucelus small-tipped, consisting of about three whorls, a strong anterior keel appearing on second whorl. Aperture long, narrow. Anterior canal moderately long, slightly emarginate, curved backward. Outer lip varicose, anal notch deep, apex broadly rounded. Aperture heavily armed with denticles and ridges on inner and outer lips and on thickened areas adjoining notch. Sculpture consisting of broad axial ribs, overridden by spiral cords. Microscopic pustular sculpture visible on unworn shells. Anal fasciole bearing strong growth wrinkles.

Glyphostoma is the only Bowden turrid genus that has a heavily armed aperture. Even imperfect or immature shells, which fail to show the characteristic apertural features, can be distinguished at a glance, either by the strong growth wrinkles on the anal fasciole or by the rapidly enlarging, strongly keeled nucleus.

The history of the use of the name *Glyphostoma* illustrates the lack of generic names in this family. Proposed in 1872 for a Miocene fossil from the Dominican Republic, within a few years it was in use almost all over the world for almost any kind of turrid that has denticles on the outer and inner lips. Since then the following names have come into use for some of the Recent exotic species of "*Glyphostoma*": *Lienardia* Jousseaume (Bull. Soc. Zool. France, vol. 8, p. xl, 1884; vol. 9, p. 184, 1884; type, by original designation, *Clavatula rubida* Hinds, Recent, New Guinea), *Hemilienardia* Boettger (Nachr. Deut. Malak. Gesell., year 27, p. 52, 1895; type, by original designation, *Pleurotoma* (*Defrancia*) *malleti* Recluz, Recent, western Pacific), *Thetidos* Hedley (Mem. Australian Mus., vol. 3, p. 472, 1899; Rec. Australian Mus., vol. 13, p. 285, 1922; type, by original designation, *Thetidos morsura* Hedley, Recent, Funafuti Atoll), *Etrema* Hedley (Jour. Roy. Soc. New South Wales, vol. 51, p. M 79, 1918; Rec. Australian Mus., vol. 13, pp. 272–274, 1922; type, by original designation, *Mangilia* (*Glyphostoma*) *aliciae* Melvill and Standen, Recent, Australia), and *Acrista* Hedley (Rec. Australian Mus., vol. 13, p. 285, 1922; type, by original designation, *Lienardia punctilla* Hedley, Recent, Australia).

Gabb is the only one who collected *Glyphostoma dentiferum*. Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 324, 1922) suggests that it may need a new name, on account of the earlier *Clavatula dentifera* Hinds, which might be a *Glyphostoma*. According to the original figure, however, it is improbable that the small species from New Guinea described by Hinds (Zool. Voyage Sulphur, Moll., p. 23, pl. 7, fig. 14, 1844) is a *Glyphostoma*. Cossmann (Journ. Conchyl., vol. 61, pp. 31–34, 1913) thought that Gabb used Hinds' name for the Dominican fossil.

Living species of *Glyphostoma* are found in the West Indian, Panamic, and Mazatlantic regions, but apparently nowhere else. Fossil species are known from the West Indian region and southeastern United States in deposits not older than lower Miocene.

Key to the Bowden species of Glyphostoma

Anal fasciole not appressed, sculptured with moderately strong growth wrinkles.....*G. exopitatum*
Anal fasciole appressed, sculptured with very strong growth wrinkles.....*G. guppyi*

Glyphostoma exopitatum, new species

(Plate 8, Figures 7, 8)

Shell medium-sized, anal fasciole not appressed. Nucleus consisting of between three and a half and four whorls, the last two bearing a strong keel, behind which near end of last whorl lie a few curved axial wrinkles. Denticles weak or absent on middle part of inner lip. Sculpture consisting of broad axial ribs (11 to 13 on penult whorl), overridden by spiral cords (7 or 8 penult whorl) that are slightly swollen on crests of ribs. Anal fasciole sculptured with moderately strong growth wrinkles and obscure spirals. Unworn parts of shell show a microscopic pustular sculpture.

Length 17.9 mm.; diameter 6.9 mm. (holotype).

This species is represented by seven specimens in the Henderson collection that show a considerable amount of variation in the degree of slenderness, in the constriction of the anal fasciole, and in the width and spacing of the ribs. *G. dentiferum* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 324, pl. 17, fig. 15, 1922), from an unknown Miocene horizon in the Dominican Republic, is almost twice as large, and has less bulging whorls and fewer ribs. *G. golfoyaquensis* Maury (Bull. Am. Paleontology, vol. 5, pp. 225–226, pl. 35, figs. 17, 17*a*, 1917), a species from the Cercado formation, is smaller and more slender, and also has less bulging whorls and coarser spirals. "*Pleurotoma* (*Glyphostoma*)" *mexicana* Toula (Jahrb. K.-k. Geol. Reichsanstalt, vol. 61, pp. 483–484, pl. 29, fig. 16, 1911; lower Miocene, Isthmus of Tehuantepec) is stouter and has coarser spirals. The Recent West Indian *G. gabbi* Dall is larger and stouter and has a shorter canal.

Type material.—Holotype (U. S. Nat. Mus. No. 369408).

Glyphostoma guppyi, new species

(Plate 8, Figure 9)

Shell medium-sized, relatively stout, anal fasciole strongly appressed. Nucleus consisting of about three and a half whorls, almost the last two bearing a strong keel. Inner lip bearing heavy denticles along its entire length. Sculpture consisting of very broad axial ribs (10 on penult whorl), overridden by spiral cords (5 on penult whorl) that are slightly swollen on crests of ribs. Anal fasciole sculptured with very strong growth wrinkles that take the form of narrow curved ribs, and with obscure spirals. Microscopic pustular sculpture visible on unworn parts of shell.

Length 14.1 mm.; diameter 5.9 mm. (holotype).

The appressed anal fasciole, which bears very strong growth wrinkles, is characteristic of this species, represented only by the holotype.

Type material.—Holotype (U. S. Nat. Mus. No. 369410).

LIOGLYPHOSTOMA, new genus

Type.—Lioglyphostoma adematum, new species.

Shell relatively small, moderately slender. Nucleus consisting of about three and a half rapidly enlarging whorls, about the last whorl bearing a moderately strong anterior keel. Aperture long, narrow. Anterior canal short, slightly emarginate, slightly curved backward. Outer lip varicose. Anal notch deep, apex broadly rounded. Interior of outer lip smooth, except for a slight thickening adjoining anal notch and at base of canal. Parietal callus heavily thickened adjoining anal notch. Inner lip bearing a few low denticles, the most conspicuous one lying far up on the lip. Sculpture consisting of broad axial ribs, overridden by spiral cords. Ribs subdued on anal fasciole, but continuing across it.

Lioglyphostoma is like a small *Glyphostoma* that has lost the denticles on the outer lip, most of the denticles on the inner lip, and also the growth wrinkles on the anal fasciole.

Key to the Bowden species of Lioglyphostoma

Fine secondary spiral threads present, ribs greatly subdued on anal fasciole. . *L. adematum*
Fine secondary spiral threads absent, ribs strong on anal fasciole. . . . . *L. moinica*

Lioglyphostoma adematum, new species

(Plate 8, Figure 10)

Shell moderately small. Nucleus and aperture as described under the genus. Sculpture consisting of broad axial ribs (8 or 9 on penult whorl), overridden by spiral cords (3 on penult whorl) that are swollen on crests of ribs. Between the cords lie microscopic spiral threads. Anal fasciole sculptured with subdued continuations of the ribs.

Length 9.5 mm.; diameter 3.8 mm. (holotype).

This heavily sculptured little species is represented by six specimens in the Duerden collection. *"Mangilia" aguadillana* var. *minor* Dall and Simpson, a Recent species from Porto Rico, has narrower and more numerous ribs and a sutural cord on the anal fasciole.

Type material.—Holotype (U. S. Nat. Mus. No. 369411).

Lioglyphostoma moinica (Olsson)

(Plate 8, Figure 11)

Glyphostoma moinica Olsson, 1922, Bull. Am. Paleontology, vol. 9, pp. 248–249, pl. 8 figs. 29–30.

Two immature specimens seem to represent this species. The outer lip of the more perfect specimen is broken and the inner lip is not fully formed. The tip of the nucleus apparently is broken off and plugged. About two and a half nuclear whorls remain, of which the last one bears a moderately strong keel. The sculpture consists of relatively narrow axial ribs, overridden by spiral cords. The anal fasciole is sculptured with strong narrow continuations of the ribs.

Length 6 mm.; diameter 2.2 mm. (figured specimen).

Type locality.—Port Limon, Costa Rica (Gatun formation).

These imperfect specimens agree with those from Costa Rica, except that the Costa Rican shells have a slightly broader and more strongly keeled nucleus, and the spirals are more suppressed in the interspaces. The specimen represented by fig. 30 is taken as the lectotype.

Other localities.—Gatun formation (middle Miocene), Costa Rica.

Type material.—Lectotype (Cornell University).

NANNODIELLA Dall

Dall, 1918, Proc. U. S. Nat. Mus., vol. 54, p. 329; vol. 56, p. 59, 1919.

Type (by original designation).—Nannodiella nana Dall (*Philbertia* (*Nannodiella*) *nana* Dall). Recent, Gulf of California.

Shell very small, stout, anal fasciole wide, whorls angulated at anal fasciole. Nucleus small-tipped, consisting of about four rapidly enlarging whorls, of which the last two bear a strong anterior keel. Aperture short, wide. Anal notch extraordinarily large for size of shell, forming a spout on the thickening near outer lip. Anterior canal short, wide, slightly emarginate. Outer and inner lips of type species apparently smooth. Sculpture consisting of narrow axial ribs, overridden by spiral threads.

Nannodiella, which was proposed as a section of *Philbertia*, may be regarded as related to *Glyphostoma*. The nuclei of the two genera are essentially the same. The very large spout-like anal notch is a striking feature. Some of the Australian species referred by Hedley to *Etrema* have a similar spout-like anal notch, but they have denticles on the outer or inner lips or on both. How much significance is to be attached to this armature is open to question. The type of *Nannodiella* apparently has none. The Bowden species has obscure denticles on the inner lip and fine denticles on the outer lip far within the aperture. An undescribed Recent species from Cape St. Lucas, Lower California, which otherwise resembles *Nannodiella nana*, has heavy denticles on both outer and inner lips. All these American species are regarded as representing *Nannodiella*.

This genus has been found at a number of Miocene localities in the West Indian region, where it generally goes under the name of "*Man-*

gilia" or "*Glyphostoma.*" Living species are found in the West Indian and Floridian regions, in the Gulf of California, and probably in the Orient.

Nannodiella amicta (Guppy)

(Plate 8, Figure 12)

Clathurella amicta Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 305, pl. 27, fig. 12. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell very small. Nucleus consisting of about four very rapidly enlarging whorls, the last two sculptured with a strong keel. Interior of outer lip bearing three or four fine denticles well within aperture. Inner lip bearing three or four obscure denticles. Sculpture consisting of narrow axial ribs (18 to 20 on penult whorl), overridden by spiral threads (3 on penult whorl). Anal fasciole occupying about half of whorls of spire, sculptured with fine spiral threads and curved continuations of the ribs. Microscopic pustular sculpture, which is even finer than in *Glyphostoma*, visible on unworn parts of shell.

Length 4.7 mm.; diameter 1.8 mm. (holotype, measurements approximate).

Type locality.—Jamaica (Miocene).

The degree of slenderness, position of the peripheral angulation, and number and spacing of the ribs are somewhat variable in the 12 specimens of this species, of which nine are in the Aldrich collection. "*Glyphostoma amicta*" *rintriada* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, pp. 27–28, pl. 4, figs. 2–3, 1925), from the Brasso beds of Trinidad, has stronger and more nodular spiral sculpture, and more distinct denticles on the inner lip. It should perhaps be given specific rank. "*Mangilia*" *nemorensis* Maury (Bull. Am. Paleontology, vol. 4, p. 130, pl. 20, fig. 8, 1910; Oak Grove sand, Florida) is more slender, and has finer sculpture and stronger armature at the aperture. "*Mangilia*" *melanitica* Dall, a living species from Florida, also is more slender and has finer sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 107142).

EURYENTMEMA, new genus

Type.—Euryentmema cigclis, new species.

Shell small, moderately slender. Nucleus very stout, cylindrical, consisting of about one and a half whorls. A few curved axial wrinkles lie near suture at end of nucleus. Aperture wide, anterior canal very short, slightly emarginate. Outer lip simple, stromboid notch relatively deep. Anal notch very wide and deep, immediately adjoining suture. Parietal callus thin. Sculpture consisting of narrow axial ribs, overridden and beaded by spiral cords.

Euryentmema is proposed for a genus of small turrids that has a few-whorled, smooth, cylindrical nucleus, wide aperture, wide and deep anal notch, and simple outer lip. So far as the aperture is concerned

it is like *Pleurotomella* (Verrill, Am. Jour. Sci., ser. 3, vol. 5, p. 15, 1873; type, by monotypy, *Pleurotomella packardi* Verrill, Recent, northeast coast of United States), which is much larger and less strongly sculptured, and its nucleus is sculptured with many fine axial riblets, between which lie obscure spirals. *Systenope* Cossmann (Cat. Ill. Coq. éoc. Paris, pt. 4, p. 293, 1889; type, by original designation, *Raphitoma polycolpa* Cossmann, Eocene, Paris Basin) is a small Eocene genus, which, like *Pleurotomella*, has a sculptured nucleus. Cossmann's (Essais Paléoconch. Comp., pt. 2, p. 133, 1896) placing of *Systenope* as a synonym of *Pleurotomella* needs confirmation.

Key to the Bowden species of Euryentmema

Shell not turreted, sculpture relatively coarse.....*E. cigclis*
Shell turreted, sculpture fine.....*E.* species

Euryentmema cigclis, new species

(Plate 8, Figure 13)

Outline, nucleus, and aperture as described under the genus. Sculpture consisting of narrow axial ribs, overridden by spiral cords (5 on penult whorl), which are beaded on the ribs. Ribs continuous from suture to suture on first whorl, the part on the anal fasciole gradually pinched off, forming a sutural row of beads, which gradually disappear, leaving only subdued curved continuations of the ribs on anal fasciole. Ribs gradually reduced on last half of body whorl.

Length 9.3 mm.; diameter 3.9 mm. (holotype).

This species is represented by only two specimens, both in the Johns Hopkins University collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369413).

Euryentmema species

A small imperfect specimen (U. S. Nat. Mus. No. 369414) seems to represent another species of *Euryentmema* that has a more turreted shape, due to a flatter anal fasciole. Both ribs and spirals are narrower than in the preceding species and the ribs are less protractive. The aperture is the same as in *E. cigclis*, except that no stromboid notch is visible. The dimensions are as follows: length 5.2 millimeters, diameter 2.4 millimeters (apex broken).

MICRODRILLIA Casey

Casey, 1903, Proc. Acad. Nat. Sci. Philadelphia, vol. 55, p. 276.

Type (*by subsequent designation, Cossmann, 1906, Essais Paléoconch. Comp., pt. 7, p. 223*).—*Pleurotoma cossmanni* Meyer (not Raincourt=*Pleurotoma meyeri* Aldrich). Eocene, Mississippi.

Shell very small, slender. Nucleus large, conical, consisting of four or five rapidly enlarging whorls, of which the last one or more bears curved axial riblets. Aperture short, narrow. Anterior canal very short or virtually absent, rather deeply emarginate. Anal notch deep, apex broadly rounded, lying near suture. Parietal callus thickened adjoining

notch. Inner lip smooth or bearing denticles. Outer lip bearing lirations. Between inner lip and siphonal fasciole lies an umbilical groove or opening. Sculpture consisting of strong spiral keels, between which lie fine growth threads.

Microdrillia is a striking genus entirely different from any other Bowden turrid. This genus has persisted from Eocene time in American waters. The Bowden species has a more slender and more heavily ribbed nucleus than any of the Eocene and Oligocene species examined, but some of the other Miocene species are like the older species so far as the nucleus is concerned. The aperture and sculpture of all these species are essentially the same, except that the inner lip may be smooth or denticulate.

Microdrillia is represented by material from a number of Miocene localities in the West Indian region, but only two species, mentioned under the following description, have so far been described. It is still living in West Indian waters. According to the description and figure, "*Pleurotoma* (*Oligotoma*)" *patricia* Melvill (Proc. Malac. Soc. London, vol. 6, p. 164, pl. 10, fig. 15, 1904), from the Persian Gulf, is a *Microdrillia*. If this species is correctly placed, *Microdrillia* also is living in the Orient. *Asthenotoma* Harris and Burrows (Eoc. and Olig. beds, Paris Basin, p. 113, 1891, = *Oligotoma* Bellardi, Bull. Soc. Malac. Italiana, p. 6 (of separate), 1875, not *Oligotoma* Westwood, 1836; type, by original designation, *Pleurotoma meneghinii* Mayer = *Pleurotoma tuberculata* Pusch, see Bellardi, Moll. Piemonte, pt. 2, pp. 239–240, pl. 7, fig. 26, 1878, Miocene, Italy), of which *Microdrillia* is considered a synonym by some writers, needs no comparison. *Pleurotoma basteroti* Desmoulins, erroneously cited as the type of *Oligotoma* (= *Asthenotoma*), has a different nucleus and aperture.

Microdrillia tersa, new species

(Plate 8, Figure 14)

Shell very small, slender. Nucleus consisting of between four and three-quarters and five whorls, enlarging in conformity with outline of entire shell, all except first one or two sculptured with heavy axial riblets. Interior of outer lip finely lirate. Inner lip bearing two deep-set obscure denticles. Sculpture consisting of strong spiral keels (3 on penult whorl), between which lie strong growth threads. One of the keels lies on the anal fasciole close to suture.

Length 3.8 mm.; diameter 1.4 mm. (holotype, measurements approximate).

This little *Microdrillia*, which is considerably smaller than some of the Eocene species, is represented by seven specimens, all in the Aldrich collection, three of which have more bulging whorls than the holotype. *M. propetrina* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, pp. 29–30, pl. 4, fig. 7, 1925) is stouter and has a shorter nucleus that bears more strongly curved riblets. *M. trina* Mansfield (Proc.

U. S. Nat. Mus., vol. 66, art. 22, pp. 28–29, pl. 4, fig. 5, 1922) is larger, and has more strongly curved riblets on the nucleus and more bulging whorls. These two Miocene species from Trinidad are the only fossil ones from the West Indian region so far described. A Recent West Indian *Microdrillia*, apparently *"Mangilia" comatotropis* Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 116, pl. 11, fig. 12, 1889), is almost twice as large and has a fewer-whorled nucleus. The figure of this species does not look much like a *Microdrillia* and the type, which is not so labeled, may represent some other genus.

Type material.—Holotype (U. S. Nat. Mus. No. 369415).

DAPHNELLINAE

DAPHNELLA Hinds

Hinds, 1844, Zoology Voyage H. M. S. Sulphur, vol. 2, Mollusca, p. 25.

Type (by subsequent designation, Herrmannsen, April, 1847, Indicis Gen. Malac., vol. 1, p. 370).—Pleurotoma lymneiformis Kiener. Recent, "Indian Ocean and Ile de France."

Shell medium-sized, slender, altitude of body whorl greater than that of spire. Nucleus rapidly enlarging, consisting of between three and four whorls, sculptured with intersecting protractive and retractive axial riblets, deeply notched at suture. Aperture wide, especially at base, which is slightly emarginate over a broad area extending under the columella. Outer lip thin, anal notch shallow, adjoining suture. Sculpture of early whorls consisting of swollen axial ribs overridden by spiral cords. The ribs gradually disappear and the cords are changed into finer, more closely spaced threads. (Based on specimens from West Indies labeled *"lymneiformis* Kiener.")

Daphnella has a diagonally cancellated nucleus, broad aperture, no anterior canal or varix, and a shallow anal sinus adjoining the suture. It seems to be widespread in the tropics, for Tryon gives an extensive distribution for *Pleurotoma lymneiformis* Kiener. Though the distribution of this species needs confirmation, the West Indian specimens are very similar to Kiener's figures.

Daphnella ? species

(Plate 8, Figure 15)

The Henderson collection contains an imperfect specimen (U. S. Nat. Mus. No. 135404) representing *Daphnella* or a related genus. The tip of the nucleus is broken off, but the two and a half remaining whorls bear diagonally cancellate sculpture. The sculpture of the first four and a half post-nuclear whorls, the only ones preserved, consists of narrow axial ribs, overridden by high spiral cords that are swollen on the crests of the ribs. Secondary spiral threads are introduced on the last whorl. The anal sinus adjoins the suture and apparently is shallow. The aperture is contracted at the base into a short unemarginate canal. The dimensions are as follows: length 7.9 millimeters, diameter 2.9 millimeters.

So far as this specimen goes it resembles immature shells of the West Indian species known as *lymneiformis* Kiener, but the base of the aperture is more definitely contracted to form a short canal. There is no way of telling whether at a later stage the Bowden fossil would have the sculpture and aperture of *Daphnella*.

"Daphnella" species

(Plate 8, Figure 16)

An unknown genus of the Daphnellinae is represented by two specimens, apparently immature, in the Aldrich collection. The shell is small and the whorls are abruptly angulated at the periphery. The nucleus is a slender cone consisting of about three and a half whorls, all except the first of which are diagonally cancellate. Both the aperture and anterior canal are long, but the aperture is not perfectly formed. The anal notch is shallow and adjoins the suture. The sculpture consists of axial ribs (12 on penult whorl) that end abruptly at the periphery limiting the anal fasciole. Both shells are worn, but traces of microscopic granular sculpture are visible. The approximate dimensions of the larger are as follows: length 3.9 millimeters, diameter 1.5 millimeters.

This species apparently represents a new genus. Nothing like it has been described from this region.

BORSONINAE

SCOBINELLA Conrad

Conrad, 1848, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 1, p. 120.
Type (*by monotypy*).—*Scobinella coelata* Conrad. Upper Oligocene, Mississippi.

Shell of varying size, generally medium-sized or large, slender, *Mitra*-like. Nucleus (of type species) a low, stout cone of about two and a half whorls, of which less than the last half whorl bears heavy axial riblets. Aperture long, very narrow, gradually tapering to form a long, unemarginate anterior canal. Anal notch deep, apex broadly rounded and lying some distance from suture. Interior of outer lip strongly lirate. Columella bearing a series of low *Mitra*-like folds. Sculpture consisting of beaded spirals.

Scobinella is another Eocene and Oligocene genus that survived until Miocene time in the West Indian region. In the United States no species are known later than upper Oligocene. The last surviving Miocene species are the largest of all. *Zelia* de Gregorio (Mon. faune éoc. Alabama, pp. 44–45, 1890; not *Zelia* Desvoidy 1830) seems to be a synonym of *Scobinella*, as Cossmann maintained. *Moniliopsis* Conrad (Am. Jour. Conch., vol. 1, p. 143, 1865; type, by monotypy, *Pleurotoma elaborata* Conrad, Eocene, Alabama) has the same kind of sculpture, but has a longer nucleus, shorter aperture, and smooth outer lip and columella.

Scobinella magnifica (Gabb)

(Plate 8, Figures 17, 18)

Cordiera magnifica Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 210.
Scobinella magnifica (Gabb), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 325, pl. 17, fig. 16.

Shell very large and slender. Nucleus stout, consisting of two whorls, bearing a few axial riblets at its end. Interior of outer lip strongly lirate. Columella bearing a series of folds becoming heavier upward. Within the aperture, but not visible except on broken specimens, lie additional short folds. Sculpture consisting of strongly beaded spiral bands, the heaviest beads adjoining anal fasciole. Anal fasciole concave, bearing a beaded sutural cord, and fine beaded spiral threads.

Length 48 mm.; diameter 14.3 mm. (larger figured specimen, apex and base broken).

Type locality.—Dominican Republic (Miocene).

This appropriately named species is represented by three imperfect specimens. They have slightly coarser beads on the shoulder than in Dominican specimens of *magnifica*, which has been found in the Gurabo formation, and also coarser beads on the sutural cord and elsewhere on the anal fasciole. These differences hardly warrant even subspecific separation. The holotype of *magnifica* is a very large shell, having a length of 70.5 millimeters, and an imperfect specimen in the collections made by the United States Geological Survey party has a length of 65 millimeters.

"Euchilodon" morierei ("Laville") Cossmann (Journ. Conchyl., vol. 61, p. 34, pl. 3, figs. 5–7, 1913; Gatun formation, Panama Canal Zone) and *S. tristis* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 325, pl. 17, figs. 17–18, 1922; Miocene, Dominican Republic), the only other species from this region, are stouter and more coarsely sculptured.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 2926).

VAUGHANITES, new genus

Type.—Vaughanites leptus, new species.

Shell medium-sized, very slender, *Mitra*-like. Nucleus consisting of between two and three whorls, about the last one sculptured with coarse axial riblets. Aperture long, narrow. Anterior canal very long and narrow, unemarginate. Anal notch, according to growth lines and ribs, rather wide and shallow, the apex lying on a prominent spiral some distance from suture. Columella bearing two strong *Mitra*-like folds. Sculpture consisting of strong axial and spiral cords, forming an open lattice-work.

Vaughanites, which is named in honor of Dr. T. Wayland Vaughan, Director of the Scripps Institution of Oceanography, under whose direction this work was carried on, is the most *Mitra*-like of the turrids. *Eucheilodon* Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4,

pp. 379–380, 1860; type, by monotypy, *Eucheilodon reticulata* Gabb, Eocene, Texas) is a small Eocene genus with a very long, narrow canal. Its nucleus, however, is large, and both outer and inner lips are denticulate. Nothing very similar to *Vaughanites* seems to have been described.

Vaughanites leptus, new species

(Plate 9, Figures 1, 2)

Outline, nucleus, and aperture as described under the genus. Sculpture consisting of an open lattice-work of spiral and axial cords. Five spirals, of which the third from the suture is strongest, lie on penult whorl. Spirals overriding axials, but slightly swollen at intersections. Axials bent at strong spiral marking apex of anal notch.

Length 17.9 mm.; diameter 4.7 mm. (holotype, apex broken).

This remarkable species is represented by nine specimens, on all of which the outer lip is broken back. All except one of the specimens are in the Johns Hopkins University collections.

Type material.—Holotype (U. S. Nat. Mus. No. 369418).

CONIDAE

CONUS Linné

Subgenus CONUS s. s.

Linné, 1758, Systema Naturae, ed. 10, p. 712.

Type (*by subsequent designation, Children, "1823," Lamarck's genera of shells, p. 107*[1]).—*Conus marmoreus* Linné. Recent, Indo-Pacific.

Satisfactory subdivisions of the genus *Conus* have not been established, as most of the names proposed are based on differences in shape and sculpture. Inasmuch as this genus is represented in the Bowden formation by 16 species, some kind of subdivision seems desirable, and an attempt is made to use as subgenera names introduced by Swainson and Mörch. As here used these subgenera are based primarily on characters of the anterior canal, siphonal fasciole, outer lip, and anal fasciole.

The following is a key to the subgenera here used:

Key to the Bowden subgenera of Conus

Siphonal notch relatively deep, anal notch very shallow, anal fasciole flat.... *Dendroconus*
Siphonal notch shallow or virtually absent.
  Anal notch moderately deep, outer lip moderately retractive.
    Anal fasciole concave..... *Lithoconus*
    Anal fasciole flat (anal notch very shallow in Bowden species)..... *Chelyconus*
  Anal notch very deep, outer lip strongly retractive, anal fasciole concave... *Leptoconus*

The subgenus *Conus* s. s., which is not represented in the Bowden formation, is characterized by the wide, shallow siphonal notch,

[1] This is the second page 107 in this book, the pagination of which is imperfect. It originally appeared in parts anonymously under the same title in volumes 14, 15, and 16, 1823–24, of the Quarterly Journal of Science, Literature, and the Arts (Royal Inst. Great Britain).

correspondingly wide bulging siphonal fasciole, deep anal notch, concave anal fasciole, and by the presence of broad heavy tubercles on the shoulder. The aperture is distinctly broader at the base. All species of the genus have an oblique groove near the posterior end of the parietal wall well within the aperture. It has been found that the characters of the anal fasciole are much more reliable guides in discriminating species than the sculpture of the body whorl, which changes with growth.

Conus is a characteristically tropical genus, and is represented by many species in the Miocene deposits of tropical America, though the number of named species in the literature is a gross exaggeration of the actual number so far described. There are 82 named species and subspecies in the literature, four of which are based on unrecognizable molds. By eliminating these unrecognizable species and by suppressing synonyms this number is reduced to 66 or possibly 61. All except two of these species are based on fossil material from this region. Most of these species are from deposits now considered of middle Miocene age. No named Eocene or Oligocene species are recorded from this region and only three Pliocene species have been described.

It is not known what species from Bowden were intended to represent *C. domingensis* Sowerby and *C. haitensis* Sowerby, as listed by Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Subgenus DENDROCONUS Swainson

Swainson, 1840, Treatise on Malacology, p. 311.

Type (*by subsequent designation, Herrmannsen, April, 1847, Indicis Gen. Malac., vol. 1, p. 377*).—*Conus betulinus* Linné. Recent, Indo-Pacific.

Shell medium-sized or large, shoulder rounded and bulging, spire low. Siphonal notch wide and relatively deep. Siphonal fasciole correspondingly wide and slightly bulging. Anal notch very shallow, anal fasciole flat. Sculpture consisting of low threads of irregular width on base of shell.

The wide relatively deep siphonal notch, very shallow anal notch, and flat anal fasciole are characteristic features of this subgenus.

Conus (Dendroconus) apium, new species

(Plate 9, Figure 3)

Conus solidus Guppy (not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 287, pl. 1, fig. 16.

Conus recognitus Guppy (part), 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 171. (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 198). Guppy (part), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 79 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 211). Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, p. 409; p. 440 (list).

Not *C. recognitus* of authors.

Shell medium-sized, spire low, its outline slightly concave. Shoulder rounded and broadly bulging. Anal notch very shallow, outer lip very slightly retractive as it approaches anal notch. Anal fasciole flat, limited by

a low obscure thread concealed on spire by overlap of succeeding whorl. Sculpture consisting of obscure wavy spiral threads on anterior half of body whorl.

Length 58 mm.; diameter 35.8 mm. (holotype).

This is the species called *C. solidus* Sowerby by Guppy in 1866. In 1867 he discovered that this name was preoccupied, so he proposed the name *recognitus*. It happens that Sowerby's *solidus* is a different species (see p. 205). Inasmuch as Guppy was renaming Sowerby's *solidus*, *recognitus* should be used for that species, even though Guppy may not have had any Dominican shells before him.

C. williamgabbi Maury (Bull. Am. Paleontology, vol. 5, p. 200, pl. 31, fig. 2, 1917), which is found only in the Baitoa formation, is larger and less pyriform, and the outline of the spire is more concave. "*C. recognitus* Guppy" Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 327, pl. 19, fig. 2, 1922) is *williamgabbi*. "*C. recognitus* Guppy" Maury (Bull. Am. Paleontology, vol. 5, p. 209, pl. 33, fig. 9, 1917), found in the Baitoa and Cercado formations, is smaller and more slender than *apium*, though in other features the two species are very similar. *C.* "*molis* var." *bravoi* Spieker (Johns Hopkins Univ. Studies in Geology, No. 3, pp. 41–42, pl. 1, fig. 6, 1922; Miocene, Peru) has the same kind of flat anal fasciole, but is larger and stouter than *apium*.

No cones similar to *apium* are now living in the West Indian region, but this fossil species resembles *C. pyriformis* Reeve, living on the Pacific coast of Central America. The Bowden species is larger and broader at the shoulder, and has a lower spire. Apparently its early whorls are not tuberculate, though they are worn on all of the few specimens. A young shell in the Henderson collection referred to this species is more slender than would be supposed from the adult shell. Three specimens are in the Duerden collection and two in the Henderson collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369351).

Subgenus LITHOCONUS Mörch

Mörch, 1852, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, Comes de Yoldi, p. 66.

Type (*by subsequent designation, Cossmann, 1896, Essais Paléoconch. Comp., pt. 2, p. 156*).—*Conus millepunctatus* Lamarck (generally regarded as a subspecies of *literatus* Linné). Recent, Indo-Pacific.

Shell medium-sized or large, shoulder angular, spire very low or moderately low. Aperture distinctly widened at base. Siphonal notch wide, shallow. Siphonal fasciole wide, slightly bulging. Anal notch moderately deep. Anal fasciole concave, smooth or sculptured with obscure spiral threads. Sculpture virtually absent on body whorl, or consisting of very obscure spiral threads at base.

The siphonal notch is shallower than in *Dendroconus*, but the anal notch is deeper and the anal fasciole is concave. The shoulder of the spire whorls appears as a ridge bordering the anal fasciole.

Key to the Bowden species of Lithoconus

Shell moderately slender or stout.
  Anal fasciole very slightly concave.
    Shell small and stout, anal fasciole bearing weak spiral grooves, spire low.....*C.* (*L.*) species
    Shell medium-sized, moderately slender, anal fasciole not bearing spirals, spire relatively high.....*C.* (*L.*) *proteus*
  Anal fasciole distinctly concave.
    Shell very stout, early whorls not tuberculate.....*C.* (*L.*) *ancylus*
    Shell moderately slender, early whorls tuberculate.....*C.* (*L.*) *nannus*
Shell very slender, anal fasciole distinctly concave.....*C.* (*L.*) *guppyi*

Conus (Lithoconus) species

One small somewhat worn specimen in the Johns Hopkins University collection (U. S. Nat. Mus. No. 369594) seems to be different from the other cones. In shape it resembles *C. symmetricus* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 44, pl. 9, fig. 1, 1850), which is very abundant in the Gurabo formation, but the anal fasciole has a slight central concavity that bears two weak spiral grooves, and the body whorl lacks the granules of *symmetricus*. The anal fasciole is too flat and the spire is too low for *proteus* and *ancylus*, the next species to be described.

The dimensions of this specimen are as follows: length 25.9 millimeters, diameter 16.6 millimeters.

Conus (Lithoconus) proteus Hwass

(Plate 9, Figure 4)

Conus proteus Hwass, 1792, Encycl. Méth., Vers, vol. 1, pp. 682–683, vol. 2, pl. 334, figs. 1, 2. Reeve, 1844, Conch. Icon., *Conus*, pl. 40, figs. 219*a*, *b*. Tryon, 1884, Man. Conch., ser. 1, vol. 6, p. 12, pl. 2, figs. 30–35. Dall, 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 26. Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 206, pl. 32, fig. 11. Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 32. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 331. Olsson, 1922, Bull. Am. Paleontology, vol. 9, pp. 215–216, pl. 5, figs. 3, 4.

Conus spurius ("Gmelin"), Sowerby, 1857, Thes. Conch., *Conus*, pp. 26–27, pl. 2, figs. 235–236, 241.

Conus proteus Hwass ?, Gabb, 1873, Trans. Am. Phil. Soc., n. s., vol. 15, p. 232.

Conus leonius Hwass, Gabb, 1881, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 359.

Shell medium-sized; spire low, concave. Shoulder subangular, bulging. Siphonal notch shallow, broad. Siphonal fasciole very slightly bulging. Outer lip rather strongly retractive as it approaches anal notch. Anal notch moderately deep. Anal fasciole narrow, very slightly concave, bordered by shoulder which on spire whorls forms an obscure ridge. Sculpture consisting of obscure rough spiral threads at base of body. Color pattern consisting of rectangular brownish blotches arranged in narrow or broad spiral bands.

Length 59 mm.; diameter 33.5 mm. (figured specimen).

Type locality.—[West Indies] (Recent).

This species, of which 15 specimens are in the Duerden collection, retains its color pattern more persistently than any other American

fossil cone. The Bowden specimens have a lower spire and more rounded shoulder than most living specimens, but, as the name implies, these and other features are variable. This is one of the two living species of *Conus* found in the Miocene deposits of tropical America, the other being *C. mus* Hwass. It has been found at many localities and everywhere the color pattern is remarkably fresh.

Other localities.—? Baitoa formation (lower Miocene), Dominican Republic. Cercado and Gurabo formations (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Panama and Costa Rica. Middle Miocene, Colombia. Caloosahatchee formation (Pliocene), Florida. Pliocene, Limon, Costa Rica. Living, Gulf of Mexico to Venezuela in 10 to 20 fathoms.

Conus (Lithoconus) ancylus, new species

(Plate 9, Figure 5)

Shell medium-sized, stout, crudely conical, spire moderately high. Shoulder abruptly truncated. Aperture distinctly wider at base. Siphonal notch moderately wide, shallow. Siphonal fasciole bulging. Outer lip rather strongly retractive as it approaches anal notch. Anal notch moderately deep. Anal fasciole narrow, deeply concave, bordered by shoulder, which on spire whorls forms a broad rounded ridge. Sculpture consisting of weak, obscurely beaded narrow spiral threads on anterior half of body whorl.

Length 46.6 mm.; diameter 28.5 mm. (holotype).

C. ancylus has essentially the same apertural features as *proteus*, but the anal fasciole is more concave. It is represented by three specimens, all in the Henderson collection. At first it was identified as *C. yaquensis* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 331, pl. 21, fig. 6, 1922; "modified" Cercado and Gurabo faunas), but the outline of the body whorl is too convex and the granulated spirals at the base of the body whorl are too numerous and too closely spaced. The type of *yaquensis* has a well-preserved color pattern that is the reverse of *proteus*. *C. proteus humerosus* Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 332, pl. 21, fig. 4, 1922) probably is more similar to *yaquensis* than to *proteus*, but has a different color pattern.

I am greatly indebted to L. R. Cox, of the British Museum, for a cast of the holotype of *C. solidus* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 45, 1850; not *C. solidus* Sowerby 1841). It is a young shell having a length of 39.5 millimeters and a diameter of 23 millimeters. In shape it resembles *proteus*, but the anal fasciole is too deeply concave. It seems to represent Gabb's *yaquensis*, and it is very much like a small shell from U. S. G. S. station 8739 (Rio Gurabo), though its anal fasciole is more concave. Guppy (see under *C. apium*) renamed this species *C. recognitus*, so that *recognitus* seems to be the name for both *solidus* and *yaquensis*. It has already been pointed out that Maury's *C. "recognitus"* is a pyriform species found in the Baitoa

and Cercado formations. Pilsbry's *C. "recognitus"* is *williamgabbi* Maury.

Two additional specimens of *ancylus* in the collections of the United States National Museum are incorrectly labeled Curaçao, Dutch West Indies.

Type material.—Holotype (U. S. Nat. Mus. No. 135280).

Conus (Lithoconus) nannus, new species

(Plate 9, Figure 6; Plate 10, Figure 1)

Conus recognitus Dall (not Guppy), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell moderately small, moderately slender, spire high, early whorls bearing tubercles on shoulder that gradually disappear on later whorls. Siphonal fasciole slightly bulging. Outer lip rather strongly retractive, anal notch moderately deep. Anal fasciole narrow, concave, bearing obscure spiral grooves. Sculpture of body whorl consisting of narrow obscure spiral threads on basal part.

Length 38.6 mm.; diameter 19.1 mm. (holotype).

C. nannus, like *C. ancylus*, has a distinctly concave anal fasciole, but the shell is much more slender and has tuberculate early whorls. In shape it closely resembles small specimens of *proteus*, but the spire is higher and tuberculate, and the anal fasciole is more concave. Small specimens might be confused with small specimens of *C. consobrinus*, described later, which have stronger body sculpture and the tubercles continue until a later stage. Olsson's *Conus* cf. *interstinctus* (Bull. Am. Paleontology, vol. 9, p. 220, pl. 6, fig. 12, 1922) has only a slightly concave anal fasciole and stronger body sculpture. *C. cedonulli* Hwass, a living West Indian species, has more persistent tubercles and a flatter anal fasciole.

This species is represented by 20 specimens in the Henderson collection. Many show narrow widely spaced spiral bands of brownish blotches and larger blotches on the shoulder and spire. By some strange juggling specimens in the Guppy collection are labeled "types" of *C. recognitus* Guppy, though the actual type of *recognitus* is a Dominican shell and the Bowden species described by Guppy as *solidus* (later changed to *recognitus*) is a different species here described as *C. apium*. The type specimen of *nannus* was included by Guppy in the so-called "types" of *interstinctus* in his collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369611, one of Guppy's "types" of *C. interstinctus*).

Conus (Lithoconus) guppyi, new species

(Plate 10, Figure 2)

Shell moderately small, very slender, spire moderately high, shoulder truncated. Nuclear whorls projecting as a prominent tip. Aperture very narrow. Siphonal notch narrow, shallow. Siphonal fasciole narrow, low.

Outer lip rather strongly retractive as it approaches anal notch. Anal notch moderately deep. Anal fasciole concave, bearing one or two obscure spiral threads. Shoulder forming a broad ridge on spire whorls. Sculpture consisting of narrow very low spiral threads, which on type extend from base to shoulder.

Length 39.6 mm.; diameter 17.8 mm. (holotype).

On account of the slender shape, narrow aperture, correspondingly narrow siphonal notch and siphonal fasciole, this species seems rather far removed from the type of *Lithoconus* and from the preceding three species, though it has the same kind of outer lip and anal fasciole as "*yaquensis*." On the early whorls the anal fasciole is flatter. Two small specimens in the National Museum are much less strongly sculptured than the type, as they have obscure spiral threads only at the base. One of these is a specimen in the Guppy collection labeled "*Conus haitensis* Sowerby," which is a very different species. Nine specimens of *guppyi* are in the Duerden collection.

C. olssoni Maury (Bull. Am. Paleontology, vol. 5, p. 207, pl. 33, fig. 3, 1917), a species from the Gurabo formation, is very slender and has similar nuclear whorls, but on the early whorls the anal fasciole bulges and on the later whorls it is flat, and the shoulder is more bulging. *C. furvoides* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 328, pl. 20, fig. 1, 1922), found only in the Cercado formation, has a narrow ridge at the shoulder and its outer lip is more strongly retractive.

Type material.—Holotype (U. S. Nat. Mus. No. 369353).

Subgenus CHELYCONUS Mörch

Mörch, 1852, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, Comes de Yoldi, p. 69.

Type (by subsequent designation, Cossmann, 1896, Essais Paléoconch. Comp., pt. 2, p. 160).—Conus testudinarius Martini. Recent, West Africa.

Shell of varying size, moderately slender, spire high, conical. Siphonal notch broad, very shallow. Siphonal fasciole broad, bulging. Outer lip slightly retractive at shoulder. Anal notch moderately deep. Anal fasciole flat or slightly concave. Sculpture (of type species) consisting of obscure spiral threads at base of body whorl.

The species referred to *Chelyconus* is more biconic than the type species, and its anal notch is much shallower. On account of its more slender shape the siphonal fasciole is narrower.

Conus (Chelyconus) oniscus, new species

(Plate 10, Figure 3)

Shell small, biconic. Shoulder very low, rounded. Siphonal notch very shallow, siphonal fasciole low. Outer lip barely retractive, anal notch very shallow. Anal fasciole forming a flat or slightly concave channel, bearing rather prominent retractive growth lines bent forward at the anterior edge. On the early whorls the shoulder forms a rounded ridge due to a spiral thread.

Sculpture consisting of rather widely spaced low spiral threads on posterior half of body whorl, and of narrow spiral grooves bordered by similar threads on anterior half.

Length 37.3 mm.; diameter 15.8 mm. (holotype).

This small biconic species is represented by four specimens in the Henderson collection. The low shoulder and very shallow anal notch are unmistakable features. Some specimens from the Pliocene Waccamaw marl of South Carolina referred to *C. marylandicus* Green are somewhat similar, but their shoulder, even on the later whorls, is a sharp-edged ridge and their anal notch is a little deeper.

Type material.—Holotype (U. S. Nat. Mus. No. 369354).

Subgenus LEPTOCONUS Swainson

Swainson, 1840, Treatise on Malacology, p. 312.

Type (*by subsequent designation, Herrmannsen, May, 1847, Indicis Gen. Malac., vol. 1, p. 584*).—*Conus amadis* Martini. Recent, Indo-Pacific.

Shell reaching a large size, spire moderately high, shoulder truncated. Aperture distinctly widened at base. Siphonal notch virtually absent. Siphonal fasciole wide, bulging. Outer lip strongly retractive as it approaches anal notch, which is very deep. Anal fasciole concave, bearing obscure spiral threads. Sculpture (of type species) consisting of obscure grooves at base of body whorl.

The strongly retractive outer lip and very deep anal notch are characteristic features of *Leptoconus*. The anterior edge of the anal notch follows the edge of the shoulder for a considerable distance back from the outer lip.

Key to the Bowden species of Leptoconus

Shoulder of later whorls not bearing tubercles.
- Spiral threads or bands on body whorl not beaded.
  - Spiral threads or bands generally absent on posterior part of body whorl.
    - Retraction of outer lip very strong, spire moderately high. ..... *C. (L.) stenostoma*
    - Retraction of outer lip moderately strong, spire very high ..... *C. (L.) imitator lius*
  - Spiral threads or bands present on entire body whorl.
    - Anal fasciole and interspaces between spiral bands not bearing strong growth threads ..... *C. (L.) planiliratus*
    - Anal fasciole and interspaces between spiral bands bearing strong growth threads ..... *C. (L.) multiliratus gaza*
- Spiral threads on body whorl beaded ..... *C. (L.) catenatus*

Shoulder of later whorls bearing tubercles.
- Shell relatively stout, interspaces between spiral bands not bearing strong growth threads.
  - Spiral bands on body whorl not beaded ..... *C. (L.) consobrinus*
  - Spiral bands on body whorl beaded ..... *C. (L.) granozonatus*
- Shell very slender, interspaces between spiral bands bearing strong growth threads.
  - Anal fasciole bearing strong spiral threads ..... *C. (L.) gracilissimus*
  - Anal fasciole not bearing strong spiral threads ..... *C. (L.) stibarus*

Conus (Leptoconus) stenostoma Sowerby

(Plate 10, Figure 4)

Conus stenostoma Sowerby, 1850, Quart. Jour. Geol. Soc. London, vol. 6, p. 44. Guppy, 1886, Quart. Jour. Geol. Soc. London, vol. 22, p. 287, pl. 16, fig. 2. Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 230. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 327–328, pl. 21, fig. 1. ? Maury, 1925, Bull. Am. Paleontology, vol. 10. p. 337, pl. 45, fig. 10.

Conus stenostomus Sowerby, Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list). Dall. 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list). Guppy, 1911, Agr. Soc. Trinidad and Tobago Paper No. 454, p. 6 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 311). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 203, pl. 32, fig. 4. Olsson, 1922, Bull. Am. Paleontology, vol. 9, pp. 214–215, pl. 6, fig. 2.

Conus catenatus Guppy (part, not Sowerby), 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 527.

Shell large, spire moderately high, shoulder truncated. First few postnuclear whorls bearing tubercles that generally are eroded. Base of aperture wide, not notched. Siphonal fasciole hardly discernible. Outer lip very strongly retractive, anal notch very deep. Anal fasciole concave, bearing a few obscure threads. Sculpture consisting of spiral bands that are narrower on anterior half of body whorl.

Length 60.4 mm.; diameter 33 mm. (figured specimen). Length 66.2 mm.; diameter 36.3 mm. (largest specimen).

Type locality.—Dominican Republic (Miocene).

The very strongly retractive outer lip gives this species an unmistakable appearance. Sixteen specimens are in the Duerden collection. The type has not been figured, but Sowerby's description leaves little doubt. In the Dominican Republic it is found only in the Gurabo formation. The body whorl of these Dominican shells is less strongly sculptured than in those from Bowden, but the spiral threads on the anal fasciole are stronger. *C. cacuminatus* Spieker (Johns Hopkins Univ. Studies in Geology No. 3, pp. 40–41, pl. 1, fig. 5, 1922), a species from the middle Miocene Zorritos formation of Peru, is stouter and has a lower spire, weaker sculpture, and a less strongly retractive outer lip. *C. centurio* Born, a living West Indian species, has a higher spire and shallower anal fasciole, and its outer lip is not quite so strongly retractive.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa Rica. ? Upper Miocene, Springvale, Trinidad.

Type material.—Holotype (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12798).

Conus (Leptoconus) imitator lius, new subspecies

(Plate 10, Figures 5, 6)

Shell medium-sized, spire high, shoulder angular. Early whorls not tuberculate. Siphonal fasciole slightly bulging. Outer lip strongly retractive, anal notch deep. Anal fasciole concave, bearing obscure fine spiral threads.

Sculpture of adult shells consisting of spiral grooves on anterior half of body whorl.

Length 46.6 mm.; diameter 21.7 mm. (holotype).

Young shells have sculpture over the entire body whorl, but the grooves are replaced by fine low threads on the posterior part of the whorl. The principal difference between this subspecies and *C. i. imitator* Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 342, pl. 23, fig. 4, 1911), from the Gatun formation of the Panama Canal Zone, lies in the absence of tubercles on early whorls of Bowden specimens. In addition, the outer lip is more strongly retractive, the anal fasciole is more concave, and the body sculpture consists of grooves rather than threads. A small race of *C. i. imitator* is found in the Baitoa, Cercado, and Gurabo formations. *C. chipolanus* Dall (Proc. U. S. Nat. Mus., vol. 18, p. 42, 1896; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 60, fig. 23, 1906, Chipola formation, Florida) is smaller and has a broader shoulder than small specimens of *imitator lius*. A living species, known as *C. delesserti* Recluz, found from Cape Hatteras to the Gulf of Mexico, has tubercles on the early whorls like *C. i. imitator*. *C. arcuatus* Sowerby, living on the Pacific coast of Central America and Mexico, also has tuberculate early whorls and its shoulder is not quite so broad.

This cone can hardly be confused with immature specimens of *stenostoma*, which have a lower spire, broader shoulder, and more retractive outer lip, as well as tuberculate early whorls. It is represented by six specimens, all in the Henderson collection.

Type material.—Holotype (U. S. Nat. Mus. No. 135276).

Conus (Leptoconus) planiliratus Sowerby

(Plate 10, Figures 7 to 9; Plate 11, Figures 1, 2)

Conus planiliratus Sowerby, 1850,[1] Quart. Jour. Geol. Soc. London, vol. 6, p. 44. Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 287, pl. 16, fig. 7. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 528. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list). Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 329, pl. 20, figs. 6, 9. Olsson, 1922, Bull. Am. Paleontology, vol. 9, pp. 222–223, pl. 6, figs. 10, 13.

Conus regularis Gabb (not Sowerby), 1881, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 359, pl. 46, figs. 45–48.

Conus (*Leptoconus*) *planiliratus* Sowerby, Cossman, 1913, Journ. Conchyl., vol. 61, pp. 48–49, pl. 3, fig. 27 (not figs. 24–26 = *C. multiliratus gaza* Johnson and Pilsbry).

? *Conus karlschmidti* Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 211–212, pl. 33, fig. 14.

? *Conus stimpsoni* Dall, 1902, Proc. U. S. Nat. Mus., vol. 24, p. 503, pl. 29, fig. 7.

Not *Conus planiliratus* Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 230 (= *C. perlepidus* Pilsbry and Johnson, = *C. vanattai* Maury). Not Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 209–210, p. 33, fig. 10. Not Maury, 1925, Bull. Am. Paleontology, vol. 10, p. 338, pl. 45, fig. 6.

[1] *Conus planiliratus* Sowerby, 1870 (Proc. Zool. Soc. London, p. 255; Recent), has been renamed *C. maculospira* by Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 329–330, 1922).

Shell moderately small, generally bulging at shoulder, spire high. Early post-nuclear whorls obscurely tuberculate. Base of aperture somewhat flaring. Outer lip strongly retractive, anal notch deep. Anal fasciole generally slightly concave, though flat on some specimens, bearing three or four faint or strong spiral threads. Sculpture of body whorl consisting of spiral bands, which may be broad only at the base or over the entire whorl. Two specimens have crude axial wrinkles on the body whorl.

Length 42.9 mm.; diameter 19.9 mm. (largest figured specimen).

Type locality.—Dominican Republic (Miocene).

This species presents a puzzling series of variations. As the figures show, it might be possible to consider that the Bowden material represents three or four species or subspecies, but it seems unreasonable that so many similar species of carnivorous mollusks are found at one locality. Besides, *planiliratus* shows similar variations in the Dominican Republic, where it was first discovered. Most of the 17 specimens in the Henderson collection are like those shown in figs. 7 and 8, that is, they have a slightly concave anal fasciole, they broaden slightly or very noticeably at the shoulder, and the spiral bands on the posterior part of the body whorl are thread-like. One specimen (fig. 9) has a flatter anal fasciole, broad spiral bands over the entire body whorl, obscure axial wrinkles, and obscure spiral threads on the anal fasciole. In another (fig. 1) the axial wrinkles are more pronounced and the anal notch is more asymmetric. Still another specimen (fig. 2) that has broad spiral bands and a flat anal fasciole has very strong spiral threads on the anal fasciole.

In the Dominican Republic *planiliratus* is found only in the Gurabo formation, which carries many specimens, and in beds carrying a modified Cercado fauna. Maury's *planiliratus* is a different species. The shoulder of *C. karlschmidti* Maury does not stand out far enough on the spire whorls, and the body sculpture is not strong enough. *C. xenicus* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 328, pl. 20, figs. 11, 11*a*, 1922) probably is a stout, short-spired *planiliratus*. *C. planiliratus bocasensis* Olsson (Bull. Am. Paleontology, vol. 9, p. 223, pl. 6, figs. 14, 16, 1922), which is stouter and has the posterior part of the body whorl more inflated, may be a valid subspecies, but *C. p. planiliratus* also is found in the Miocene beds of Bocas Island (U. S. G. S. station 8307). Specimens agreeing closely with those from Bowden and the Dominican Republic are found in Pliocene beds at Limon, Costa Rica. The cone from the upper Miocene beds at Springvale, Trinidad, described by Maury as *planiliratus* lacks spirals on the anal fasciole and has widely spaced, narrow spiral grooves on the body whorl. It represents the same species as *C. "burckhardti* Böse" (pl. 45, fig. 5). It is very doubtful whether *C. stimpsoni* Dall, described from living material collected off the east coast of Florida, can be separated from the fossil *planiliratus*. The type of *stimpsoni*, dredged in 30 fathoms off Key West, has the

same kind of outer lip and anal fasciole, and its body sculpture consists of broad bands separated by grooves that decrease in width toward the shoulder.

The type of *planiliratus* has never been figured and the current usage of the name is based on Guppy's identification of Bowden and Dominican specimens. Thirty-three specimens are in the Duerden collection.

Other localities.—"Modified" Cercado and Gurabo formations (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Panama and Costa Rica. Pliocene, Limon, Costa Rica. ? Recent, Florida.

Type material.—Eight cotypes (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12799).

Conus (Leptoconus) multiliratus gaza Johnson and Pilsbry

(Plate 11, Figure 3)

Conus gaza Johnson and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, pp. 342–343, pl. 23, figs. 2, 3. Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 32. Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 210–211, pl. 33, fig. 12. Pilsbry (part), 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73. p. 330.

Conus marginatus Gabb (not Sowerby), 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 230. Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 210, pl. 33, fig. 11.

Conus (*Leptoconus*) *planiliratus* Cossmann (part, not Sowerby), 1913, Journ. Conchyl., vol. 61, pp. 48–49, pl. 3, figs. 24–26 (not fig. 27).

Conus multistriatus Böse, Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 226, pl. 4, figs. 21, 23.

Not *Conus multiliratus* var. *gaza* Johnson and Pilsbry, Spieker, 1922, Johns Hopkins Univ. Studies in Geology No. 3, pp. 37–38.

Shell small, stout, biconic, spire high. Outer lip strongly retractive, anal notch deep. Anal fasciole deeply concave, sculptured with exaggerated growth threads. First post-nuclear whorl obscurely tuberculate. Body whorl sculptured with about 20 high, narrow spiral bands. The interspaces, which are wider than the bands, bear prominent growth threads.

Length 23.3 mm.; diameter 12.2 mm. (figured specimen).

Type locality.—Dominican Republic (Miocene).

This strikingly sculptured cone is one of the most characteristic middle Miocene fossils of tropical America. It is found in beds of the Cercado formation that carry a few Gurabo species, in the Gurabo formation, in the Bowden formation, in the Gatun formation of Panama, and in middle Miocene beds in Colombia. It is represented in the Duerden collection by 40 specimens. It is a little smaller than *C. m. multiliratus* Böse (Inst. geol. Mexico Bol. 22, pp. 49–50, pl. 5, figs. 34–38, 1906; *multistriatus* in explanation of plate; Tuxtepec, Oaxaca, Mexico), the anal fasciole is more deeply concave, and the growth threads on the anal fasciole and between the spiral bands are stronger. Böse considered the beds at Tuxtepec of Pliocene age, but they undoubtedly are middle Miocene. Specimens from the Gurabo

formation run a little larger than those from Bowden. *C. multiliratus walli* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, p. 13, pl. 2, figs. 1, 9, 1925, middle Miocene, Trinidad) is more like *C. m. multiliratus* and has weaker body sculpture. The species from the Zorritos formation of Peru, recorded by Spieker as *gaza*, has weaker spiral bands and less distinct growth threads.

The name *gaza* was originally given to a Dominican cone without reference to any previously described species, but in 1922 Pilsbry used the name as a substitute for *marginatus* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 44, 1850), preoccupied by J. de C. Sowerby in 1837. I recently received from L. R. Cox a cast of the holotype of *C. marginatus* Sowerby, 1850. It is nothing like *multiliratus gaza*, and it has not been possible to identify it with any Dominican cone, though it is something like the small race of *C. imitator* Brown and Pilsbry found in the Cercado formation. Fortunately the name is a homonym and the type material may be disregarded, unless someone incautiously proposes a substitute name.

Other localities.—"Modified" Cercado and Gurabo formations (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Panama. Middle Miocene, Colombia.

Type material.—Holotype (Acad. Nat. Sci. Philadelphia No. 2554).

Conus (Leptoconus) catenatus Sowerby

(Plate 11, Figures 4, 5)

Conus catenatus Sowerby, 1850,[1] Quart. Jour. Geol. Soc. London, vol. 6, p. 45, pl. 9, fig. 2. Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 230. Guppy (part), 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 527. Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 202, pl. 31, fig. 4, pl. 32, figs. 1, 2. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 328, pl. 22, figs. 3, 4.

Conus interstinctus Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288, pl. 16, fig. 3. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Not *Conus catenatus* Hörnes, 1856, Abh. K.-k. Geol. Reichsanstalt, vol. 3, p. 42, pl. 5, figs. 4, 4*a–d*. Hubbard, 1921, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, pp. 161–162, pl. 24, fig. 15.

Shell large, moderately slender, spire high, its outline deeply concave, shoulder rounded. First post-nuclear whorl obscurely tuberculate. Base of aperture somewhat flaring. Outer lip strongly retractive, anal notch deep. Anal fasciole flat on early whorls, concave on later whorls, sculptured with two to five spiral threads. Sculpture of body whorl consisting of low, narrow spiral threads, some of which are beaded. The threads gradually disappear on the posterior part of the whorl.

Length 66.5 mm.; diameter 29.9 mm. (large figured specimen).

Type locality.—Dominican Republic.

A cast of the holotype of *catenatus*, kindly sent by L. R. Cox, shows that there is no reasonable doubt that it is a very young shell of the species that Guppy later called *interstinctus*. The smallest specimens from Bowden have a higher spire and fuller shoulder than the type.

[1] *C. catenatus* Sowerby, 1878 (Proc. Zool. Soc. London, p. 796; Recent), needs a new name.

Large Bowden shells closely agree with those from the Gurabo formation, but are a little more slender and the edge of the shoulder facing the anal fasciole generally is more excavated. Some of the Bowden shells have a faint color pattern consisting of brownish blotches arranged in crude spiral bands. Young shells have a relatively higher spire and more strongly beaded spiral threads.

C. catenatus is represented by 14 specimens in the Duerden collection. Five specimens in the collections of the United States National Museum are incorrectly labeled Curaçao, Dutch West Indies. In the Dominican Republic *catenatus*, like other Bowden cones, is found only in the Gurabo formation and in the "modified" Cercado fauna.

Hubbard's *catenatus* from the lower Miocene Quebradillas limestone of Porto Rico represents some other species that is much stouter and has a lower, flatter spire. Olsson's *Conus* cf. *interstinctus* (Bull. Am. Paleontology,vol. 9, p. 220, pl. 6, fig.12, 1922) from the Gatun formation of Costa Rica, has a tuberculate spire and represents a different group of cones.

Other localities.—"Modified" Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Two cotypes (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12771).

Conus (Leptoconus) consobrinus Sowerby

(Plate 11, Figures 6, 7)

Conus consobrinus Sowerby, 1850, Quart. Jour. Geol. Soc. London, vol. 6, p. 45. Gabb (part), 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 229. Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 79, pl. 2, fig. 4 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 211). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 409, pl. 17, fig. 3; p. 440 (list). Guppy (part), 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 527. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 203, pl. 32, figs. 5, 6. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 330, pl. 20, figs. 7, 7*a*, 7*b*.

Conus granozonatoides Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 203–204, pl. 32, fig. 7.

Not *Conus consobrinus* Gabb, 1881, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 359 (=*C. consobrinus ultimus* Pilsbry and Johnson). Not Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 341 (=*C. tortuosostriatus* Toula).

Not *Conus* (*Chelyconus*) *consobrinus* Cossmann, 1913, Journ. Conchyl., vol. 61, pp. 46–48, pl. 3, figs. 17, 18.

Shell moderately large, spire high, conical, shoulder low, rounded. Aperture flaring at base. Outer lip strongly retractive, anal notch deep. Anal fasciole narrow, slightly concave, bearing two to four narrow spiral grooves that are more prominent on early whorls. Shoulder of all except last whorl or two of adults bearing heavy tubercles that gradually disappear. Sculpture of body whorl consisting of narrow, low spiral bands decreasing in strength toward shoulder. The basal bands may be obscurely beaded, and on young shells all the bands are crudely beaded.

Length 58.4 mm.; diameter 24.3 mm. (figured specimen).

Type locality.—Dominican Republic (Miocene).

C. consobrinus is the only large Bowden cone that has a high conical spire and low rounded shoulder. It is represented by seven specimens in the Duerden collection. Young shells (fig. 7) could perhaps be mistaken for a different species. The outer lip is strongly retractive, but not so strongly as in *stenostoma*. Some specimens show widely spaced brownish rectangles on the spiral bands. On some specimens the anal fasciole is more concave than in the figured specimen. In the collections made in the Dominican Republic by the United States Geological Survey party this cone also is confined to the Gurabo formation, but Maury records it from beds of the Cercado formation carrying some Gurabo species. The figured specimen is a little larger than any from the Dominican Republic. Maury's *granozonatoides* is an adult *consobrinus* and is not at all similar to *granozonatus*. The type material of *consobrinus* has not been figured, and the usage of the name is based on Guppy's identifications. One Bowden specimen in the collections of the United States National Museum is incorrectly labeled Curaçao, Dutch West Indies.

C. consobrinus toroensis Olsson (Bull. Am. Paleontology, vol. 9, pp. 220–221, pl. 5, fig. 7, 1922, middle Miocene, Panama) has a slightly flatter anal fasciole and weaker body sculpture. *C. consobrinus ultimus* Pilsbry and Johnson (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 330, pl. 20, fig. 8, 1922), found in Pliocene beds at Limon, Costa Rica, has a broader and more concave anal fasciole, and has tubercles on the body whorl, but none of the specimens is so large as the largest *C. c. consobrinus*. *C. scaliae* Böse (Inst. geol. Mexico Bol. 22, p. 51, pl. 5, figs. 41–43, 1906, middle Miocene, Tuxtepec, Oaxaca, Mexico), the type of which is a very young shell, has fewer tuberculate whorls, a more concave anal fasciole, and weaker body sculpture.

Other localities.—"Modified" Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Holotype (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12803).

Conus (Leptoconus) granozonatus Guppy

(Plate 12, Figures 1, 2)

Conus granozonatus Guppy, 1866, Quart. Jour. Geol. Soc., vol. 22, p. 287, pl. 16, fig. 5. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list). Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 222, pl. 6, fig. 15.

Not *Conus granozonatus* Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 341 (=*C. tortuosostriatus* Toula).

Shell moderately small, spire high, conical, shoulder angular. Aperture slightly flaring at base. Outer lip rather strongly retractive, anal notch deep. Anal fasciole deeply concave, bearing strong growth threads. Shoulder of first post-nuclear whorl obscurely tuberculate. Shoulder of later

whorls smooth, but on the next to last whorl low truncated tubercles appear and continue to outer lip. Sculpture of body whorl consisting of broad spiral bands separated by narrow grooves and bearing widely spaced beads.

Length 32.5 mm.; diameter 14.2 mm. (larger figured specimen).

Type locality.—Jamaica (Miocene).

This is the only Bowden cone that starts with a tuberculate shoulder, loses it, and then regains it. The broad beaded spiral bands also are a distinctive feature. Young shells of *imitator lius* have the same shape and the same kind of anal fasciole. Olsson's figured specimen has a more concave spire and heavier beads. Brown and Pilsbry's *granozonatus* from the Gatun formation is *tortuosostriatus* Toula. Two of three specimens in the Guppy collection labeled "types" of *granozonatus* represent this species. One of these specimens is figured. The third is the young shell of *consobrinus*, also figured. Six specimens are in the Duerden collection.

Other localities.—Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64059).

Conus (Leptoconus) gracilissimus Guppy

(Plate 12, Figures 3, 4)

Conus gracilissimus Guppy, 1866, Quart. Journ. Geol. Soc. London, vol. 22, p. 288, pl. 16, fig. 4. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list). Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 224, pl. 4, fig. 14.

Not *Conus gracilissimus* Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 527. Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 204–205, pl. 32, fig. 8 (=*C. gabbi* Pilsbry and Johnson).

Not *Conus gracillimus* Guppy, Cossmann, 1913, Journ. Conchyl., vol. 61, p. 39, pl. 4, fig. 13 (=*C. stibarus* new species).

Shell moderately small, very slender, spire high, shoulder angular. Aperture not distinctly expanded at base, siphonal fasciole very low. Outer lip not retractive except immediately in front of shoulder, anal notch deep. Anal fasciole wide, concave, bearing four strong spiral threads and less prominent growth threads. Shoulder of all whorls bearing tubercles. Body whorl sculptured with strong wide spiral bands, separated by narrower interspaces bearing fine growth threads.

Length 33.8 mm.; diameter 12 mm. (large figured specimen).

Type locality.—Jamaica (Miocene).

Both specimens figured are from the Guppy collection and are two of six specimens labeled "types." The larger specimen is similar to Guppy's figure, which represents the type specimen in the British Museum. About 35 specimens are in the Duerden collection. The outer lip is not retractive except immediately in front of the shoulder. On some specimens, as shown in fig. 4, the tubercles tend to disappear. These small specimens have narrower spiral bands than adults. Olsson's figured specimen has a higher spire and a strong thread on the

anal fasciole, and the early whorls have a more strongly beaded shoulder.

A number of other slender, strongly sculptured American Miocene cones have been described. *C. gabbi* Pilsbry and Johnson (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 332, pl. 21, figs. 8, 9, 1922), found in both the Cercado and Gurabo formations, is stouter, and has narrower spiral threads. *C. larvatus* Pilsbry and Johnson (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 332, pl. 21, fig. 10, 1922, Miocene, Dominican Republic) is more slender and has finer spiral sculpture. *C. burckhardti* Böse (Inst. geol. Mexico Bol. 22, pp. 50–51, pl. 5, figs. 39–40, 1906, middle Miocene, Tuxtepec, Mexico) and *C. tortuosostriatus* Toula (Jahrb. K.-k. geol. Reichsanstalt, vol. 61, p. 508, pl. 31, fig. 22, 1911, Gatun formation, Panama Canal Zone) are stouter, and have a flatter anal fasciole and coarser sculpture. The living West Indian *C. mazei* Deshayes is more slender and has finer sculptures.

It seems inappropriate to use *Conilithes* Swainson (Treatise Malac., p. 311; type, by original designation, *Conus antediluvianus* Brugière, Miocene and Pliocene, Mediterranean region) for these slender tuberculate cones, as the type of *Conilithes* has a very strongly retractive outer lip, as strongly retractive as in the Bowden species *C. stenostoma*.[1]

Other localities.— Gatun formation (middle Miocene), Panama and Costa Rica.

Type material.— Holotype (British Museum, Natural History, Geological Department No. 64058).

Conus (Leptoconus) stibarus, new species
(Plate 12, Figure 5)

"*Conus gracillimus* Guppy," Cossmann, 1913, Journ. Conchyl., vol. 61, p. 39, pl. 4, fig. 13.

Shell moderately small, slender, spire high, shoulder angular. Outer lip strongly retractive, anal notch deep. Anal fasciole concave, bearing strong growth threads and, on the early whorls, obscure spiral threads. Shoulder tuberculate, but the tubercles gradually become broader and lower on body whorl. Body whorl sculptured with strong, wide spiral cords, separated by narrower interspaces bearing fine growth threads.

Length 31.4 mm.; diameter 11.9 mm. (holotype).

However unreasonable it may seem to have two similar species of slender cones at one locality, this species, represented by four specimens in the Henderson collection, is quite different from *gracilissimus*, as the outer lip is more strongly retractive. The flattening and broadening of the tubercles and the absence of spiral threads on the anal fasciole of the later whorls also are characteristic features. The

[1] Cossmann (Essais Paléoconch. Comp., pt. 2, p. 155, 1896) prefers to use *Conospirus* de Gregorio (Mon. Faune éoc. Alabama, p. 21, 1890), which has, by original designation, the same type, on the ground that *Conilithes* is preoccupied by *Conilites* Schlotheim 1820 and Lamarck 1822.

spiral sculpture, except at the base, consists of rounded cords instead of flattened bands, as in *gracilissimus*. *C. pernodosus* Pilsbry and Johnson (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 332, pl. 21, fig. 7, 1922, Miocene, Dominican Republic) has tubercles that flatten out on the body whorl, but the outer lip is not so strongly retractive and the spiral bands are flatter.

The type of *stibarus* is another of the six specimens in Guppy's collection labeled "types" of *gracilissimus*.

Type material.—Holotype (U. S. Nat. Mus. No. 369612).

CANCELLARIIDAE

Thirty-eight named species of the family Cancellariidae are on record from the Tertiary deposits of tropical America. One of these seems to be a synonym and three are virtually unrecognizable. All are of Miocene age. Many Caribbean Miocene species, some of which belong to phyla now represented only along the Pacific coast of Central America and Mexico, remain undescribed. The Bowden formation carries four species described by Guppy more than fifty years ago and also two new species. Apparently none of these species is found elsewhere.

CANCELLARIA Lamarck

Subgenus CANCELLARIA s. s.

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 71.

Type (*by monotypy*).—*Voluta reticulata* Linné. Recent, Florida and West Indies.

Shell medium-sized or moderately large, ovate. Nucleus consisting of about two smooth naticoid whorls. Aperture lunate, wide. Outer lip extending obliquely backward from suture, bearing near its base an obscure shallow sinus, or stromboid notch. Base of aperture bearing a wide deep notch at base of a very short canal, which on adults is barely recognizable as a canal. Siphonal fasciole broad and high. Columella bearing three folds, the lower one very oblique and emerging from the aperture, the other two very prominent and less oblique, their lower face bearing a ridge that makes them bifid. Parietal callus heavy, bearing a ridge on parietal wall and one or two rugosities near its outer edge between middle and posterior columellar folds. Between siphonal fasciole and edge of the callus lies a narrow umbilical groove. Interior of outer lip strongly lirate. Sculpture consisting of spiral cords and retractive axial cords.

The anterior canal is not completely absent, as it can clearly be seen on young specimens of *reticulata*, though adult shells have only a bare suggestion of it. In *reticulata* the stromboid notch at the base of the outer lip is very obscure. Only the largest specimens of *reticulata* have a heavy callus. *Exechoptychia* Cossmann (Essais Paléoconch. Comp., pt. 5, pp. 189–190, 1903; type, by original designation, *Cancellaria conradiana* Dall, Pliocene, Florida) is a synonym of *Cancellaria* s. s.

Key to the Bowden species of Cancellaria s. s.

Shell slender, sculpture reticulate on all whorls.....*C. (C.) barretti*
Shell stout, sculpture of later whorls consisting of heavy axial ribs that generally gradually disappear.....*C. (C.) laevescens*

Cancellaria (Cancellaria) barretti Guppy

(Plate 12, Figure 6)

Cancellaria barretti Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 289, pl. 17, fig. 11. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list). ? Engerrand and Urbina, 1910, Bol. Soc. Geol. Mexicana, vol. 6, pp. 125–126.

Not *Cancellaria barretti* Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 520. Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 226–227, pl. 36, fig. 1. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 332–333 (=*C. mauryae* Olsson).

Not *Cancellaria barretti* Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 253, pl. 9, fig. 6 (? =*C. dariena* Toula).

Shell medium-sized, relatively slender. Stromboid notch very obscure. Anterior canal short. Upper columellar fold bifid. Parietal callus thin. Sculpture consisting of spiral cords, beaded by more widely spaced retractive axial cords. At intervals the axial cords are narrower and more crowded. Length 31.6 mm.; diameter 16.8 mm. (figured specimen).

Type locality.—Jamaica (Miocene).

The type, which is in the British Museum, and the figured specimen from the Guppy collection, labeled "type" by Guppy, are the only known specimens of this species. According to Guppy's figure, the specimen here figured is more slender than the type, though it is only slightly smaller.

C. barretti seems to represent a Miocene branch of the *reticulata* phylum. It is smaller and more slender than *reticulata*. So far as shape is concerned it more closely resembles *C. conradiana* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 42, pl. 3, fig. 13, 1890), a Pliocene species from Florida, but it is much smaller, its columellar folds are heavier and the upper one is more distinctly bifid. It is more slender than *C. dariena* Toula (Jahrb. K.-k. geol. Reichsanstalt, vol. 58, pp. 703–704, pl. 25, fig. 13, pl. 28, fig. 2, 1909), a species from the Gatun formation that is more like *reticulata*. *C. cossmanni* Olsson (Bull. Am. Paleontology, vol. 9, pp. 253–254, pl. 9, figs. 9, 11, 1922), found in the Gatun formation of Costa Rica, is smaller and stouter and has coarser sculpture and more slender folds.

C. barretti has not certainly been identified at any other locality. Olsson's *barretti* from Costa Rica probably is *dariena;* it is stouter and has more closely spaced spirals. The species from the Dominican Republic called *barretti* by Guppy, Maury, and Pilsbry, and *reticulata* by Gabb, is *mauryae* Olsson (Bull. Am. Paleontology, vol. 9, pp. 254–255, pl. 9, fig. 5, 1922). It is much stouter than *barretti* and has finer sculpture and more slender folds. Maury records this species from both the Cercado and Gurabo formations, but the United States

Geological Survey party found it only in the Cercado formation. It is improbable that the species recorded by Engerrand and Urbina from Zuluzum, Chiapas, Mexico, is *barretti*, but they give no figures and no specimens are available for comparison.

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64069).

Cancellaria (Cancellaria) laevescens Guppy

(Plate 12, Figures 7, 8)

Cancellaria laevescens Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 289, pl. 17, fig. 12. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list). Maury, 1920, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 1, p. 69.

Not *Cancellaria laevescens* Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 236. Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 520. Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 228, pl. 36, fig. 6. Hubbard, 1921, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, p. 157, pl. 24, figs. 5, 6. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 333 (=*C. laevescens portoricana* Maury).

Shell moderately large, stout. Nucleus flat-topped, consisting of about two stout whorls. Anterior canal very short, barely perceptible on adults. Stromboid notch moderately deep. Columellar folds slender, the upper one obscurely bifid. Parietal callus very heavy, even on small specimens. Sculpture of early whorls reticulate. On the later whorls the spiral cords gradually disappear and the axial cords are transformed into heavy ribs that become progressively wider and then generally disappear on all or on part of last whorl.

Length 35.7 mm.; diameter 22.2 mm. (figured specimen). Length 40.9 mm.; diameter 25.5 mm. (largest specimen).

Type locality.—Jamaica (Miocene).

Aside from the striking sculpture, *laevescens* is characterized by its very heavy callus and by the rather prominent stromboid notch, which is much more pronounced than in *barretti* and *reticulata*. It is represented by 17 specimens in the Duerden collection. Four Bowden specimens in the collections of the United States National Museum are incorrectly labeled Curaçao, Dutch West Indies.

This species represents a phylum of Cancellarias no longer living in the Caribbean Sea, though it seems to be represented in the Gulf of California by *C. obesa* Sowerby and *C. acuminata* Sowerby, neither of which has the heavy axial ribs of *laevescens*. Specimens of *laevescens* from the Dominican Republic are in both the Gabb and Geological Society of London collections, but none was found by the Maury and United States Geological Survey parties. Inasmuch as the Cercado and Gurabo formations have been rather thoroughly exploited, it seems probable that these Dominican specimens were collected from the lower Miocene Baitoa formation. This supposition is supported by the small size of the specimens in the Gabb collection, which have a

maximum length of only 28 millimeters. Thus they resemble the small race in the lower Miocene Quebradillas limestone of Porto Rico, which has a length of 23 to 26 millimeters. Maury (New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 1, p. 69, pl. 7, fig. 10, 1920) called this Porto Rican race *laevescens portoricana*. Though the Porto Rican material consists of unsatisfactory molds, the Dominican specimens probably should be referred to *portoricana*. Guppy recorded *laevescens* from the Tamana district of Trinidad (Proc. Agr. Soc. Trinidad and Tobago, vol. 13, p. 4, 1913; reprint, Bull. Am. Paleontology, vol. 8, p. 339, 1921), but in the absence of specimens this record can not be accepted.

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64070).

Subgenus BIVETOPSIS Jousseaume

Jousseaume, 1887, Le Naturaliste, ser. 2, year 9, p. 193.

Type (by subsequent designation, Cossmann, 1899, Essais Paléoconch. Comp., pt. 3, p. 9).—Cancellaria chrysostoma Sowerby. Recent, Pacific coast of Central America.

Shell medium-sized, stout. Aperture wide, ovate. Anterior canal short, twisted backward and to right, deeply emarginate. Siphonal fasciole prominent. Basal part of outer lip not sinuated or everted. Interior of outer lip lirate. Columella bearing three low slender folds increasing in prominence posteriorly. Parietal callus heavy, bearing rugosities on parietal wall and near edge opposite middle and posterior folds. Umbilical opening wide. Sculpture consisting of heavy axial ribs and fine spiral threads. (Based on *C. haemastoma* Sowerby, which may be the same as *chrysostoma*.)

The aperture is wider than in *Cancellaria* s. s., the anterior canal is longer, the columellar folds are lower and more slender, the outer lip is not notched, and the umbilical opening is wider. Though the anterior canal of *Bivetopsis* is longer than in adult specimens of *reticulata*, it is hardly longer than in young specimens. Cossmann (cited above) considered *Bivetopsis* the same as *Bivetia* Jousseaume on the basis of a misunderstanding as to the type of *Bivetia*. By a curious coincidence *Bivetia* was used by Jousseaume twice in the same periodical with different meanings. On page 163 of Le Naturaliste, ser. 2, year 9, 1887, the new species *Bivetia mariei*, locality unknown, is described. As this is the earliest publication of *Bivetia*, *mariei* becomes the type by monotypy. On page 193, published a month later, *Bivetia* again is used and *Le Bivet* Adanson (= *Cancellaria similis* Sowerby, Recent, West Africa) is designated as the type. In view of this double use, the group of *similis*, which is represented by the Miocene Dominican species *epistomifera* Guppy, seems to be unnamed. In this group the basal part of the outer lip is everted forming a notch, the aperture is narrower than in *Bivetopsis*, the columellar folds are heavier, and the callus is much thinner. The view, advocated by Cossmann, that "*Bivetia*" should be regarded as a separate genus on

the grounds that it has an anterior canal whereas *Cancellaria* s. s. has none, is unjustified.

In the Caribbean region, the earliest species of *Bivetopsis* are of Miocene age. Living species are found in tropical American waters along both the Atlantic and Pacific coasts.

Cancellaria (Bivetopsis) moorei Guppy

(Plate 12, Figure 9)

Cancellaria moorei Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 289, pl. 17, fig. 7. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).
Not *Cancellaria moorei* Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 236. Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 520 (=*C. epistomifera* Guppy).

Shell medium-sized, stout. Nucleus flat-topped, moderately stout, consisting of about two smooth whorls. Anterior canal very short. Basal part of outer lip very slightly everted. Parietal callus very heavy, even on young shells. Umbilical opening relatively narrow. Sculpture consisting of heavy retractive axial ribs, thickened at intervals forming varices, and of spiral cords that override the ribs.

Length 23.2 mm.; diameter 15.5 mm. (figured specimen).

Type locality.—Jamaica (Miocene).

In the photograph the shell was turned too far to the right to show the anterior canal. This species agrees with *C. haemostoma*, and presumably also with *chrysostoma*, except that the outer lip is barely everted and the umbilical opening is narrower. It is represented in the Duerden collection by 75 specimens of all growth stages and is the most abundant *Cancellaria* at Bowden. It is not similar to any other described Miocene species from the Caribbean region. It closely resembles the living West Indian *C. rugosa* Lamarck, but it is more slender, and has finer ribs and more slender folds. *C. epistomifera* Guppy (Quart. Jour. Geol. Soc. London, vol. 32, p. 520, pl. 28, fig. 9, 1876), found in the Gurabo formation, represents the group formerly called *Bivetia*, as it has a strongly everted and notched outer lip, narrower aperture, and heavier folds.

Two specimens in the collections of the Philadelphia Academy (No. 3702), sent to Gabb by Guppy, are labeled "type."

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64068).

TRIBIA Jousseaume

Jousseaume, 1887, Le Naturaliste, ser. 2, year 9, p. 221.
Type (*by original designation*).—*Cancellaria angasi* Crosse. Recent, locality unknown.

Shell small, moderately slender, turreted. Aperture triangular-ovate. Outer lip not notched. Anterior canal short, slightly emarginate. Siphonal fasciole low, broad. Columella bearing three low folds. Interior of outer lip lirate. Parietal callus heavy. Between the siphonal fasciole and the edge of the callus lies a moderately wide umbilical groove. Sculpture con-

sisting of heavy axial ribs and fine spiral threads. (Based on Crosse's figure, Journ. Conchyl., vol. 11, pl. 2, fig. 8, 1863.)

Crosse's figure shows a slight emargination in the anterior canal, even in apertural view, but it may possibly be due to a break in the shell. Unfortunately the locality of the type species is not known and no specimens are available for comparison. In other features the Bowden species here referred to *Tribia* is similar to the figure of the type species. The Bowden species has a short anterior canal, which is slightly emarginate when viewed from the base, but is not emarginate in apertural view. The basal fold, as in the preceding species, is the basal twist of the columella bordering the canal. *Tribia* is used by Cossmann (Essais Paléoconch. Comp., pt. 3, pp. 12–13, 1899) in the same sense.

Tribia epomis, new species

(Plate 12, Figure 10)

Cancellaria (*Trigonostoma*) sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell small, stout, turreted. Nucleus consisting of almost two smooth rapidly enlarging whorls. Anterior canal short, not emarginate in apertural view. Siphonal fasciole low, broad. Columellar folds low, the middle one slightly heavier than the posteriormost one. Umbilical groove moderately wide. Callus thick. Sculpture consisting of heavy retractive axial ribs and of narrow widely spaced spiral cords.

Length 11.8 mm.; diameter 7.3 mm. (holotype).

T. epomis is represented by the type and two other specimens, all in the Henderson collection. The turreted outline and short unemarginate canal are striking features. It has fewer and more widely spaced spiral threads and a wider anterior canal than "*Cancellaria* (*Narona*)" *losquemadica* Maury (Bull. Am. Paleontology, vol. 5, p. 230, pl. 36, fig. 13, 1917), a species from the Gurabo formation that has the same apertural features and represents the same genus. *Narona* H. and A. Adams (Gen. Recent Moll., vol. 1, p. 277, 1854; type, by subsequent designation, Jousseaume, Le Naturaliste, ser. 2, year 9, p. 222, 1887, *Cancellaria clavatula* Sowerby, Recent, Pacific coast of Panama) has a much longer canal, a flat siphonal fasciole, and only two columellar folds.

Type material.—Holotype (U. S. Nat. Mus. No. 135418).

TRIGONOSTOMA Blainville

Blainville, 1827, Manuel de Malacologie et de Conchyliologie, p. 652.
Type (*by monotypy*).—*Delphinula trigonostoma* Lamarck. Recent, Indo-Pacific.

Shell medium-sized or large, loosely coiled, widely umbilicate. Aperture triangular, the base constricted, forming a suggestion of a very short unemarginate canal. Peristome complete, bordering parietal wall for only a short distance. Siphonal fasciole represented only by ridge bordering umbilicus. Columella bearing two low folds and an obscure basal fold or

twist bordering the canal. Interior of outer lip lirate. Sculpture (of type species) consisting of weak axial ribs, forming crude scales at shoulder, and of spiral cords. (Based on Sowerby's figures, Thes. Conch., *Cancellaria* (vol. 2, pt. 1), pl. 94, figs. 45, 46, 1848.)

The aperture of *Trigonostoma* is very different from that of *Cancellaria* s. s. The Bowden species has a triangular-ovate, instead of triangular, aperture and may not represent *Trigonostoma* in the restricted sense.

Trigonostoma scalatella (Guppy)

(Plate 13, Figure 1)

Cancellaria scalatella Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 78, pl. 2, fig. 4 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 210). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 408, pl. 17, fig. 4, p. 438 (list).

Cancellaria (*Trigonostoma*) *scalatella* Guppy, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell medium-sized, relatively slender, scalariform, deeply constricted at suture. Nucleus consisting of about one and a half smooth, rather slender whorls. Aperture triangular-ovate, constricted at base to form a very short canal. Siphonal fasciole represented by broad ridge bordering umbilicus. Columella bearing two slender folds and an obscure basal twist. Umbilicus moderately wide. Sculpture consisting of heavy retractive axial ribs and of fine closely spaced spiral threads. A secondary spiral thread lies in the interspaces on later whorls.

Length 15.9 mm.; diameter 9.1 mm. (holotype).

Type locality.—Jamaica (Miocene).

No Caribbean Tertiary species similar to *T. scalatella* has been described, nor are there any very similar living species in the West Indian region. *T. smithii* (Dall), living off the coast of the United States from Cape Hatteras to Florida, has the same kind of sculpture and aperture, but its peristome is attached to the greater part of the parietal wall, and consequently its umbilicus is much narrower. Eight specimens are in the Aldrich collection. The larger one of the two specimens in the type lot agrees rather closely in dimensions with the original figure and is considered the holotype.

Type material.—Holotype (U. S. Nat. Mus. No. 115474).

"Cancellaria" species

(Plate 13, Figure 2)

A new species of *Mitra*-like "*Cancellaria*" is represented by two specimens in the Henderson collection (U. S. Nat. Mus. No. 135432). The figured specimen is immature and the other specimen has only part of an additional whorl. The nucleus consists of almost one and a half smooth rapidly enlarging whorls. The aperture of the immature specimen is wide and, although the very base is broken, apparently the anterior canal is represented only by a slight eversion of the aperture

adjoining the columella. The columella bears two slender folds and a basal twist, and its base is virtually vertical. The sculpture consists of primary and secondary spiral threads. Axial threads gradually appear and become progressively stronger and bead the spirals.

Although this species is recognizable, the material is too imperfect. Nothing like it has been described from tropical America, nor is it known to what genus it belongs. It is not a *Cancellaria* s. s., as it has only two slender folds and virtually no canal. *Brocchinia* Jousseaume (Le Naturaliste, ser. 2, year 9, p. 221, 1887; type, by subsequent designation, Sacco, Moll. Piemonte, pt. 16, p. 68, 1894, *Voluta mitraeformis* Brocchi, Miocene and Pliocene, Italy) is *Mitra*-like and has only two columellar folds, but the columella is strongly twisted to the left, the folds are more horizontal, and the sculpture is different. Very young specimens of *Aphera* H. and A. Adams (Gen. Rec. Moll., vol. 1, p. 277, 1854; type, by monotypy, *Cancellaria tessellata* Sowerby, Recent, Pacific coast, Mexico to Ecuador), on which the callus is not developed, have a somewhat similar aperture, but the base of the columella is broader, the folds are higher, more horizontal, and extend farther out, and wrinkles lie on the inner lip between the ends of the folds.

The figured specimen has a length of 6.9 millimeters and a diameter of 3.3 millimeters.

RACHIGLOSSA

OLIVIDAE

OLIVA Martyn

Subgenus OLIVA s. s.

Martyn, 1786, The Universal Conchologist, vol. 3, explanatory table, pl. 111.
Type (*by subsequent designation, Dall, 1905, Proc. U. S. Nat. Mus., vol. 29, pl. 428*).—*Oliva corticata* Martyn. Recent, "coasts of Guinea."

Shell varying in size, smooth, polished, generally slender, ovate-cylindrical, spire low, suture channeled. Aperture long and narrow, deeply emarginate at base. Siphonal fasciole wide, its upper edge marked by a ledge. Parietal callus thick, bearing many fine plaits, some of which lying on inner lip extend far out on body whorl. Between parietal wall and upper edge of the outer lip lies a narrow channel, continued in the channeled suture, the upper edge of which is bordered by callus continuous with the parietal callus. (Based on Martyn's figure, supplemented by specimens of *O. incrassata* Solander, also known as *O. angulata* Lamarck, which is regarded as representing the same species.)

Oliva corticata is not mentioned by Sowerby, Reeve, or Tryon, and so far as known it has not been identified with any species described after the appearance of Martyn's work. According to Martyn's figure, *corticata* has a very thick outer lip that is rather abruptly bent at the shoulder and then tapers rapidly to the suture. The only *Oliva* in the collections of the United States National Museum that has such an outer lip is *O. incrassata* Solander (*O. angulata* Lamarck), from the

Pacific coast of Mexico and Central America. Moreover, *incrassata* has dark-brown spiral blotches and inverted V-shaped brown blotches at the suture, something like the scallops of Martyn's figure. If *corticata* and *incrassata* are the same species, Martyn's locality is incorrect, and the parietal and sutural callus are not accurately represented. In *O. incrassata* the plaits on the upper part of the parietal callus are obscure. Inasmuch as *O. corticata* and *O. incrassata* apparently were published in the same year and no data are available as to the month of publication of either, *O. corticata* is given precedence over *O. incrassata*. Sherborn (Index Anim., 1758–1800, p. xxxvii, 1902) gives 1789 as the date of volume 3 of Martyn's work, but Dall (Proc. U. S. Nat. Mus., vol. 33, p. 187, 1907) has shown that the date is 1786. *O. striata* Martyn apparently is "*Voluta*" *oliva* Linné, but this species can not be considered the type by tautonymy, for there is no reference to Linné's name.

Eighteen named species of *Oliva*, all of Miocene and Pliocene age, from the Tertiary deposits of tropical America are in the literature. Three of these names are synonyms and one of the species (*O. ispidula* Linné, recorded by Gabb from lower Miocene and Pliocene beds in Costa Rica) certainly is misidentified. *O. gradata* Gabb, found in the Cercado formation, represents the subgenus *Omogymna* Dall. So far as known the only place where this name appeared was in the explanation of a plate (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1631, 1903; type, by monotypy, *Oliva* (*Omogymna*) *martensii* Dall, lower Miocene, Florida). This subgenus is characterized by a broad ledge paralleling the suture on the body whorl.

It is not known what species was meant by Dall's record of "*Oliva* near *masaris* Duclos" from Bowden (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583, 1903).

Key to the Bowden species of Oliva s. s.

Shell medium-sized, length of adults not exceeding 58 millimeters, nucleus stout ..... *O. (O.) reticularis trochala*
Shell very large, length of adults reaching 100 millimeters, nucleus slender ..... *O. (O.) plicata*

Oliva (Oliva) reticularis trochala, new subspecies

(Plate 13, Figures 3 to 5)

Oliva reticularis Lamarck, Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list).
Oliva near *reticularis* Lamarck, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).
Oliva cylindrica Cossmann (not Sowerby), 1913, Journ. Conchyl., vol. 61, pl. 5 figs. 2, 3.

Shell medium-sized, rather stout. Nucleus flat-topped, low, and very stout, consisting of about two whorls. Parietal plaits strong. Sutural callus moderately thick, outer edge of suture not forming definite ledge

projecting over preceding whorl. Color pattern, when preserved, generally consisting of light brown zigzag axial markings, but a few shells have solid light brown spiral bands of varying width.

Length 51.7 mm.; diameter 23.7 mm. (holotype). Length 56.7 mm.; diameter 25.7 mm. (largest specimen).

It is estimated that this *Oliva* is represented by fully a thousand specimens in the Duerden collection. It is the most abundant mollusk at Bowden. It has the same kind of stout heavy nucleus as the living *O. r. reticularis* Lamarck, found in the West Indies and Florida, and shows the same kind of variations affecting the height of the spire and the color pattern. The outline of the spire of the fossils is smoother, as the edge of the whorls at the suture fails to form a prominent ledge, and the largest shells are stouter than in *O. r. reticularis*. The fossils are smaller, stouter, and less cylindrical than *O. sayana* Ravanel (more generally known as *O. litterata* Lamarck), which ranges northward from Florida to Cape Hatteras, and they also have a smoother spire. *O. r. reticularis* is found in the Pliocene beds at Limon, Costa Rica. Cossmann's Bowden specimens seem to be high-spired representatives of *reticularis trochala*, though they may represent the next species described. About 27 specimens in the collections of the United States National Museum are incorrectly labeled Curaçao, Dutch West Indies.

No *Oliva* similar to this remarkably abundant Bowden fossil is in the collections from the Dominican Republic made by the United States Geological Survey party, except one specimen from station 8522 (modified Cercado fauna) that has a wider and more ledge-like suture and therefore is like *O. r. reticularis*. Pilsbry records *reticularis* from the Gabb collection. Young specimens of *reticularis trochala* are much more slender and have a higher spire than *O. cylindrica* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 45, 1850) The type of *cylindrica* has not been figured but according to paratypes loaned by the British Museum it is the rather small, stout, low-spired species found in great abundance in the Cercado formation, and less abundantly in the Gurabo formation. It was called *brevispira* Gabb by Maury in 1917 (Bull. Am. Paleontology, vol. 7, p. 232, pl. 36, figs. 16, 17) and *cercadica* Maury in 1925 (Bull. Am. Paleontology, vol. 10, p. 348). Young Bowden shells are similar in general shape to *O. gatunensis* Toula (Jahrb. K.-k. geol. Reichsanstalt, vol. 58, pp. 702–703, pl. 25, fig. 12, 1909), a species found in the Gatun formation of the Panama Canal Zone, but they have a thinner sutural callus and less concave spire. *O. liodes* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 58, fig. 1, 1903), a species from the Chipola formation of Florida, has a similar shape, but is smaller and has a more slender and more cylindrical nucleus.

Type material.—Holotype (U. S. Nat. Mus. No. 369420).

Oliva (Oliva) plicata Guppy

(Plate 13, Figures 6, 7)

Oliva plicata Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 308, pl. 30, fig. 12. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Oliva cylindrica Gabb (part, not Sowerby), 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 215. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list). Maury, 1917, Bull. Am. Paleontology, vol. 7, p. 231, pl. 36, figs. 14, 14*a*.

? *Oliva magna* Dall (apparently a nude name), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Oliva cristobalconi Maury, 1917, Bull. Am. Paleontology, vol. 7, pp. 231–232, pl. 36, fig. 15.

Oliva proavia Pilsbry and Johnson, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 164–165. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 335, pl. 23, fig. 1.

Shell very large, slender, spire high. Nucleus flat-topped, slender, high, cylindrical, consisting of about three whorls, the last much higher than the others. Outline of spire smooth, sutural callus relatively thin. Upper parietal plaits strong on small and medium-sized specimens. Color pattern consisting of zigzag light brown axial blotches, like the marks made by bearing heavily on a pen.

Length 12.4 mm.; diameter 4.7 mm. (holotype). Length 119 mm.; diameter 43 mm. (large figured specimen).

Type locality.—Jamaica (Miocene).

It would be impossible to work out the above synonymy of this magnificent *Oliva* from Bowden specimens. Despite the great number of Olivas none that are referred to this species are intermediate in size between the three small shells in the type lot and a specimen about 80 millimeters long. The most distinctive feature of the small shells in the type lot is the many-whorled cylindrical nucleus. Unfortunately the nucleus of the large figured specimen is broken off and its early post-nuclear whorls are worn, and the whole upper part of the only other large specimen is broken off, so that there will always be some doubt as to the view here taken, at least until specimens of intermediate size are collected. If the small type material and the very large specimens represent the same species, it increases very rapidly in size. The small shells in the type lot have four and a half post-nuclear whorls, whereas the large figured specimen has only seven whorls, all of which, so far as can be seen, are post-nuclear. The small shells are readily separated from very young specimens of *reticularis trochala* by their more slender cylindrical nucleus, higher spire, and wider suture. High-spired Olivas of intermediate size, such as the one shown in fig. 5, which might at first glance be taken for intermediate shells, have the nucleus of *reticularis trochala*.

A series of topotypes of *O. cristobalconi* Maury furnishes the key to the situation. Among them is a small specimen of the size of the shells in the type lot of *plicata*, and it has precisely the same kind of

nucleus and spire. The type of *cristobalconi*, the figure of which is somewhat enlarged, is rather slender and has a length of 32 millimeters and a diameter of 12 millimeters. The largest topotype of *cristobalconi* in the collections of the United States National Museum has a length of only 46 millimeters. At other localities in the Cercado formation and also in the Gurabo formation, larger, stouter, and shorter-spired specimens of *cristobalconi* are found, but those that have a nucleus show the characters of *cristobalconi*. These specimens, called "*cylindrica* Sowerby" by Maury, have a maximum length of 63.6 millimeters. No very large specimens from the Dominican Republic were collected by the Maury and United States Geological Survey parties, but Gabb, who, whatever else is said about him, was a very good collector, got two large specimens having a length of 81.5 and 101 millimeters. These two specimens, called *proavia* by Pilsbry and Johnson, are remarkably similar to one of the large specimens from Bowden. This specimen is in the Guppy collection, the larger figured specimen is in the Henderson collection, and another is in the Duerden collection.

O. couvana Maury (Bull. Am. Paleontology, vol. 10, pp. 347–348, pl. 44, fig. 6, 1925; fig. 3 "*cylindrica* Sowerby" seems to be the same species), which is abundant in the upper Miocene beds at Springvale, Trinidad, clearly belongs to the same phylum. It is smaller and has a larger nucleus, and is more uniformly slender and high-spired. Perhaps it should be considered a subspecies of *plicata*. No later similar species are known in the Caribbean region.

The small figured specimen from the type lot of three is recognized as the holotype.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 107090).

OLIVELLA Swainson

Subgenus OLIVELLA s. s.

Swainson, 1831, Zoological Illustrations, ser. 2, vol. 2, explanation of pl. 58 (*Oliva*, pl. 2).

Type (by subsequent designation, Dall, 1909, U. S. Geol. Survey Prof. Paper 59, p. 31).—*Oliva purpurata* Swainson (=*O. dama* Mawe). Recent, Pacific coast of Mexico.,

Shell medium-sized, smooth, polished, spire relatively high, suture deeply channeled. Aperture wedge-shaped, deeply emarginate at base. Siphonal fasciole limited by an obscure thread, fasciole and entire base of body whorl covered with callus. Columella bearing a heavy fold lying above the basal twist. Above this fold lie several plaits, those on the parietal callus obscure, those lying below the parietal callus on inner lip stronger and extending out on body whorl. Sutural callus continuous with parietal callus, extending almost to posterior edge of whorls of spire.

Herrmannsen's designation of *Oliva nivea* Gmelin as the type (Indicis Gen. Malac., vol. 2, p. 143, 1847) is not regarded as a valid designation, for *nivea* is not named by Swainson, and although *eburnea*, one of the two species named by Swainson, generally is regarded as a synonym of *nivea*, opinions as to it may differ or may change. *Oliva biplicata* Sowerby, often cited as the type, is not available, for Swainson called his first species "*Oliva biplicata ?*" in the text and *Olivella purpurata* on the plate.

The heavy columellar fold lying above the basal twist is a characteristic feature of *Olivella* s. s. On account of this fold the columella appears excavated. Sixteen Miocene Olivellas are on record from the Caribbean region, but only a few of them represent *Olivella* s. s.

Key to the Bowden species of Olivella s. s.

Sutural channel narrow, length of adult shells reaching 15 or 16 millimeters. . . (*O. O.*) *acra*
Sutural channel wide, length of adult shells not exceeding 10 or 11 millimeters. . . *O.* (*O.*) *clarki*

Olivella (Olivella) acra, new species

(Plate 13, Figures 8 to 10)

Olivella rotunda Dall var., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).
Olivella near *jaspidea* Gmelin, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell medium-sized, slender or relatively stout, spire moderately high or very high. Nucleus consisting of about one and a half small whorls, appearing as a cylinder on high-spired shells, but partly immersed on low-spired shells. Columellar fold above the basal twist very heavy, bearing on the inner lip two or three plaits. Above these plaits several similar plaits extend out on the inner lip. Parietal callus bearing strong short plaits. Middle of interior of outer lip obscurely thickened.

Length 14.7 mm.; diameter 6.3 mm. (holotype). Length 16.8 mm.; diameter 7.5 mm. (large figured specimen). Length 15.4 mm.; diameter 5.9 mm. (slender high-spired figured specimen).

This species, represented by about 130 specimens in the Duerden collection, is the most abundant *Olivella*. Most of the specimens, like the holotype, are moderately stout, but some are stouter and lower-spired, and others are slender and high-spired (see figs. 9, 10). On almost all the specimens the outer shell layer is eroded except where protected by callus. Fig. 9 represents an unusually large heavily callused shell on which the outermost plait emerging on the inner lip has disappeared and its place is covered with callus. Both the parietal plaits and those on the inner lip are stronger than in *dama*.

O. acra is smaller than the unfortunately named *O. muticoides* (Gabb) (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 336, pl. 23, figs. 5–7, 1922), found in the Cercado and Gurabo formations, and has a much stronger columellar fold. *O. eutacta* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 58, fig. 3, 1903),

from the Chipola formation of Florida, is more slender and has a lower columellar fold. The Bowden species is more similar to the living West Indian *O. rotunda* Dall than to any of these fossil species, but it is smaller and adult shells have coarser plaits on the inner lip than in adult shells of *rotunda*.

Type material.—Holotype (U. S. Nat. Mus. No. 369423).

Olivella (Olivella) clarki, new species

(Plate 13, Figure 11; Plate 14, Figure 1)

Shell relatively small and slender. Nucleus cylindrical, consisting of about two whorls, the first whorl reaching a length almost or fully twice as great as length of first post-nuclear whorl. Sutural channel wide. Columellar fold above basal twist heavy on adult shells, slender on young shells, bearing two plaits on inner lip. Above it two plaits extend out on inner lip, and higher up on parietal callus lie four plaits.

Length 10 mm.; diameter 4.2 mm. (holotype). Length 7.9 mm.; diameter 3.1 mm. (other figured specimen).

O. clarki, which is named for the late Professor William Bullock Clark, is represented by only a few specimens. The holotype is a worn shell and the other figured specimen is broken back, and in the photograph the shell is turned too far to the left, thus distorting the appearance of the columella. This species has a much wider sutural channel than *acra*.

Type material.—Holotype (U. S. Nat. Mus. No. 369425).

Subgenus CALLIANAX H. and A. Adams

H. and A. Adams, 1853, Genera Recent Mollusca, p. 146.

Type (by subsequent designation, Cossmann, 1899, Essais Paléoconch. Comp., pt. 3, p. 55).—Oliva biplicata Sowerby. Recent, Pacific coast of United States.

Shell reaching a relatively large size, stout, spire moderately high. Aperture wide at base, deeply emarginate. Columella bearing a strong basal fold, above which on inner lip lie one to three plications merging into margin of inner lip. Parietal callus smooth. Sutural callus thin.

The basal columellar fold, supplementary basal plications and smooth parietal callus are characteristic of *Callianax*. The following species is not a typical *Callianax*, as it has obscure plications on the parietal callus. It may be transitional between *Olivella* s. s. and *Callianax*, but its columella is more similar to that of *Callianax*.

Olivella (Callianax) unica, new species

(Plate 14, Figure 2)

Shell small, moderately stout. Nucleus consisting of about two and a half whorls, the first whorl reaching a length greater than that of the first post-nuclear whorl. Channel between outer lip and parietal callus long and narrow. Columella bearing a basal fold, above which on inner lip lie three partly fused plications followed by a strong plication forming edge of inner

lip. Parietal callus bearing very obscure fine plications, the posteriormost one strongest. Sutural channel barely indenting preceding whorl. Sutural callus relatively thick.

Length 8.6 mm.; diameter 3.9 mm. (holotype).

The very slight channeling of the preceding whorl at the suture gives this species a characteristic *Acteocina*-like appearance. The parietal plications can be seen only in good light and under magnification. On a few young shells, which are the only specimens in addition to the holotype, only the posteriormost parietal plication can be seen. *O. bocasensis* Olsson (Bull. Am. Paleontology, vol. 9, p. 266, pl. 10, figs. 24, 25, 1922), which is a stouter species from the middle Miocene beds of Bocas Island, Panama, seems to be a *Dactylidia*. It lacks the strong basal columellar fold of *unica* and has stronger parietal plications. The living West Indian *O. rosalina* Duclos, which has a shallow sutural channel, also lacks the strong basal fold and has a smooth parietal callus.

Type material.—Holotype (U. S. Nat. Mus. No. 369613).

Subgenus DACTYLIDIA H. and A. Adams

Section DACTYLIDIA s. s.

H. and A. Adams, 1853, Genera Recent Mollusca, vol. 1, p. 146.

Type (by subsequent designation, Cossmann, 1899, Essais Paléoconch. Comp., pt. 3, p. 54).—Olivella mutica Say. Recent, Cape Hatteras to Florida.

Shell small, moderately slender, spire high. Aperture broad at base, siphonal notch moderately deep. Columella bearing a basal fold, above which on inner lip and also on parietal callus lie low plaits, their outer margin sharply defined and continuous with ledge along inner lip. Interior of outer lip smooth. Sutural callus extending from suture to suture.

The basal fold, sharply limited parietal plaits, and the absence of lirations on the interior of the outer lip, are characteristic of *Dactylidia* s. s.

Olivella (Dactylidia) indivisa Guppy

(Plate 14, Figure 3)

Olivella indivisa Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 308, pl. 30, fig. 10. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Not *Olivella indivisa* Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 233, pl. 37, fig. 3.

Shell medium-sized, thin, very slender. Nucleus consisting of about one and a half small whorls. Columella bearing a slender basal fold, above which lie obscure plications on a flattened area. Parietal callus bearing fine plications. Inner lip narrow, the ledge at its edge low.

Length 6.8 mm.; diameter 2.2 mm. (holotype, young shell).

Type locality.—Jamaica (Miocene).

Both specimens in the type lot are young shells, and no perfect adult shells are in the collections. Young shells are more slender than

young shells of the species from the Dominican Republic called *oryza* Lamarck by Gabb, *indivisa* Guppy by Maury, and *floralia* Duclos by Pilsbry, and they have weaker plications above the columellar fold and none on the parietal callus. Fragmentary adult shells of *indivisa* show that they are thinner and more slender than adults of the Dominican species, and that they have a narrower inner lip and weaker plications. The apertural features of adult *indivisa* are quite different from those of adult *mutica*, but in young shells they are essentially the same, and the differences in adults seem to be correlated with the thinner and more slender shell of *indivisa*. The Dominican fossils, which are found in great abundance in the Cercado formation, and also in the Gurabo formation, and the very similar, or perhaps identical, living *floralia* lack the ledge at the margin of the parietal plaits seen in *mutica*, but have the same kind of columella and inner lip.

The figured specimen, the larger of two in the type lot, is recognized as the holotype.

Type material.—Holotype (U. S. Nat. Mus. No. 107087).

Section DACTYLIDELLA, new section

Type.—Oliva anazora Duclos. Recent, Pacific coast of Mexico.

Shell resembling *Dactylidia*, though the type species is larger and more slender. Apertural features as in *Dactylidia*, except that interior of outer lip bears fine low lirations.

Dactylidella is proposed for Dactylidias that have fine lirations on the interior of the outer lip. The type species has the strong basal fold and sharply limited plaits of *Dactylidia*, though the plaits are stronger. A number of other fossil species with lirate outer lip are known in addition to the Bowden species here described. Dr. W. C. Mansfield, of the United States Geological Survey, has described in manuscript a new species from the upper Miocene Choctawhatchee marl of Florida and has kindly called my attention to *Olivella galvestonensis* Harris (Bull. Am. Paleontology, vol. 1, p. 100, pl. 9, fig. 13, 1895), which also has lirations. This Miocene species was found in a deep well at Galveston, Texas. Another undescribed species is represented by a large number of specimens from the Miocene beds at Limon, Costa Rica. This section apparently is no longer living in West Indian waters.

On some specimens of *anazora* the lirations occupy a broad area covering as much of the interior of the outer lip as can be seen, on other specimens they lie far within the aperture, on others they form a narrow fringe at the very edge of the lip, and on others they can not be seen at all. They may possibly be due to conditions affecting the size of the animal, such as abundance of food, rather than to some genetic difference, though this can be determined only by an anatomical study of *anazora*.

Olivella (Dactylidella) colpus, new species

(Plate 14, Figures 4, 5)

Olivella near *mutica* Say, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell medium-sized, stout. Nucleus consisting of about one and a quarter low whorls. Basal columellar fold strong. Above it lies a groove followed by a series of fine plaits, the outer edge of which is sharply defined and continuous with the high ledge along inner lip. Interior of outer lip bearing fine lirations, which are stronger on some specimens than on others, and can not be seen on a few immature shells. Sutural callus extending from suture to suture.

Length 9.2 mm.; diameter 4 mm. (holotype). Length 10 mm.; diameter 4.5 mm. (largest specimen).

Of 24 specimens in the Henderson collection all except five show strong or moderately strong lirations. All of these five specimens are immature and some have part of the outer lip broken. Therefore, the lirations seem to be a constant character of adult shells. They are stronger and more widely spaced than in *anazora*. *O. galvestonensis* is more slender and has weaker lirations. Aside from the lirations, *colpus* is similar to immature specimens of *O. mutica* Say, though it is not so stout and the ledge along the inner lip is higher. About 40 specimens are in the Duerden collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369427).

ANCILLA Lamarck

Subgenus ANCILLA s. s.

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 70.

Type (*by monotypy*).—*Voluta* [*basi constricti* etc.] Martini (=*Voluta ampla* Gmelin, *Ancillaria candida* Lamarck). Recent, Indo-Pacific.

The subgenus *Ancilla* s. s., which is characterized by its short spire, long aperture, wide siphonal notch, plicate inner lip, and wide groove along the border of the inner lip, is not found living or fossil in America.

Subgenus EBURNA Lamarck

Lamarck, 1801, Systême des Animaux sans Vertèbres, p. 78.

Type (*by monotypy*).—*Buccinum glabratum* Linné (renamed *Eburna flavida* by Lamarck). Recent, West Indies.

Shell reaching a large size, polished, stout, spire high. Callus concealing suture. Aperture wide, siphonal notch wide and deep. Siphonal fasciole bordered by a wide V-shaped groove that produces a tooth-like projection on basal part of outer lip. Columella bearing a narrow projecting basal twist. Inner lip bearing obscure plications. Beyond edge of inner lip lies a ridge of callus. Parietal callus standing out from parietal wall, producing a wide long umbilicus. Callus above suture at edge of outer lip bearing a triangular depression.

The open umbilicus is characteristic of *Eburna*.

Ancilla (Eburna) pinguis (Guppy)

(Plate 14, Figures 6, 7)

Ancillaria pinguis Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pp. 83–84, pl. 1, fig. 3 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, pp. 215–216). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 434, pl. 16, fig. 3; p. 439 (list).

? *Ancillaria glandiformis* Guppy (not Lamarck), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 84 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 216). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list).

Ancilla pinguis (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell small, moderately slender. Siphonal fasciole limited by a band at upper edge of which lies a deep narrow groove producing a tooth-like projection on outer lip. Inner lip very heavy, not plicate. Upper part of umbilicus closed by appression of parietal callus. Callus bearing a low spiral thread on posterior part of whorls. Behind it on early whorls lie several very obscure threads. On some shells an obscure thread marks posterior edge of whorls of spire.

Length 19.7 mm.; diameter 9.6 mm. (holotype). Length 29.7 mm.; diameter 12.8 mm. (largest specimen).

Type locality.—Jamaica (Miocene).

A. glabrata, the type species of *Eburna,* shows no trace of spiral threads on the callus, and the groove producing the tooth-like projection on the outer lip lies at the middle of the band adjoining the siphonal fasciole, and not at its posterior edge. The parietal callus of *glabrata* stands farther out from the parietal wall, producing a longer umbilicus.

A. pinguis is represented by only a few specimens in each collection. On all the specimens the callus is worn off on the body whorl except at the base. Perhaps Guppy had small specimens of it in mind when he recorded "*Ancillaria glandiformis*" from Bowden. He also recorded "*glandiformis*" from the Dominican Republic (Quart. Jour. Geol. Soc. London, vol. 32, p. 526, 1876), though no one else has found this genus in the Miocene deposits of that country.

No American species similar to *pinguis* is known. *A. c. caroniana* Maury (Bull. Am. Paleontology, vol. 10, pp. 350–351, pl. 44, figs. 4, 10, 12, 1925) and *A. caroniana springvalensis* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, p. 35, pl. 5, fig. 5, 1925), both from the upper Miocene beds at Springvale, Trinidad, and *A. brassica* Maury (Bull. Am. Paleontology, vol. 10, p. 351, pl. 44, figs. 1, 8, 9, 1925), also from Trinidad, are more similar to *glabrata. A. lamellata* Guppy (Quart. Jour. Geol. Soc. London, vol. 22, p. 579, pl. 26, fig. 9, 1866) and *paralamellata* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, pp. 33–34, pl. 5, figs. 2, 7, 1925), Miocene species from Trinidad, represent a subgenus, apparently unnamed, that is somewhat similar to *Chilotygma* H. and A. Adams (Gen. Rec. Moll., vol. 1, p. 149, 1853; type, by monotypy, *Ancillaria exigua* Sowerby, locality not known), for these species have a strong parietal plate.

The larger of two specimens in the type lot, unfortunately not the one here figured, is recognized as the holotype. A specimen in the collections of the Philadelphia Academy (No. 3717), sent to Gabb by Guppy, is labeled "type."

Type material.—Holotype (U. S. Nat. Mus. No. 115567).

MARGINELLIDAE

Fifty-eight named species of this family from the Miocene and Pliocene deposits of tropical America are in the literature. By suppressing synonyms and by eliminating unrecognizable species this number is reduced to about 50, all except six of which are based on fossil material from this region. About a third of these species belong to the group here named *Leptegouana*, but *Glabella*, a group no longer living in American waters, *Volvarina*, *Prunum*, *Egouana*, *Serrata*, *Bullata*, *Persicula*, and *Cypraeolina*, formerly placed under *Closia*, also are represented.

MARGINELLA Lamarck

Subgenus MARGINELLA s. s.

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 70.
Type (*by monotypy*).—*Voluta glabella* Linné. Recent, West Africa.

The most characteristic feature of *Marginella* s. s., which is not found in the Bowden formation, is the very short, slightly emarginate siphonal canal and slightly bulging siphonal fasciole. On account of the canal the anteriormost of the four columellar folds descends almost vertically for a relatively long distance as it emerges from the aperture. The spire is relatively high, the inner edge of the outer lip is obscurely denticulate, and the parietal wall has no thick deposit of callus.

Subgenus VOLVARINA Hinds

Section VOLVARINA s. s.

Hinds, 1844, Proc. Zool. Soc. London, pt. 12, p. 75.
Type (*by original designation*).—*Marginella avena* Valenciennes. Recent, West Indies.

Shell moderately small, slender, spire low. Aperture narrow, its base unemarginate. Outer lip slightly thickened with callus, its inner edge smooth and slightly bent inward. Columella bearing four folds. Beyond the outer ends of the folds lies a deposit of callus that spreads upward on the parietal wall as a thin wash.

Hinds' statement that "*M. avena*, Valenciennes, is a typical species" of *Volvarina* is regarded as a type designation, although this view is open to question. The only other species mentioned—and the only one described—is *Marginella nitida* Hinds, the locality of which was unknown to Hinds. Tomlin (Proc. Malac. Soc. London, vol. 12, p. 245, 1917) cites *nitida* as the type of *Volvarina* and considers that it is the same as *M. mitrella* Risso, a Mediterranean species.

Volvarina seems to be the earliest name for the great bulk of Marginellas that have an unconcealed spire, unemarginate or barely emarginate base, and four columellar folds. *Hyalina* Schumacher (Essai Nouv. Syst., p. 23, 1817; type, by monotypy, *H. pellucida* Schumacher) is considered a *nomen dubium*, as the type species is based on a figure (Martini, Conch. Cab., vol. 2, pl. 42, fig. 426, 1771) that generally is regarded as unrecognizable. *Porcellanella* Conrad (Proc. Acad. Nat. Sci. Philadelphia, 1862, p. 564; type, by monotypy, *P. bella* Conrad, Miocene, Virginia) is a synonym of *Volvarina*. The section *Volvarina* s. s. is characterized by its slightly thickened outer lip, which has a smooth inner edge.

Marginella (Volvarina) species

A small broken specimen in the Henderson collection (U. S. Nat. Mus. No. 135341) represents a species of *Volvarina*. The shell is relatively stout and the spire is moderately high. The base of the aperture is very slightly emarginate. The outer lip is slightly thickened, and its inner edge is smooth and bent inward along the greater part of its length. The second columellar fold from the base extends farther out than in *avena*, and its termination is more clearly separated from the basal fold, which is not so heavy as in *avena*. The approximate dimensions are as follows: length 5 millimeters; diameter 2.5 millimeters.

This species is much stouter than *M. avena*, which is recorded by Olsson from the middle Miocene beds of Costa Rica (Bull. Am. Paleontology, vol. 9, p. 269, pl. 10, figs. 21, 28, 1922). It also is stouter than *M. collina* Olsson (Bull. Am. Paleontology, vol. 9, pp. 269–270, pl. 10, figs. 26, 27, 1922), a middle Miocene species from Costa Rica, and its outer lip is less thickened.

Section LEPTEGOUANA, new section

Type.—Voluta guttata Dillwyn. Recent, West Indies and Florida.

Shell reaching a moderately large size, stout, spire low. Aperture narrow, truncate at base or terminating in a slight projection. Outer lip heavily thickened with callus, which extends up almost to tip of spire. Columella bearing four folds. Inner edge of outer lip bearing obscure or strong coarse low denticles. Upper part of parietal wall bearing a thick deposit of callus that thins out over base.

This name is proposed for Marginellas that have a low unconcealed spire, narrow aperture, heavy denticulate outer lip and heavy callus on the upper part of the parietal wall. *Leptegouana*, a name that refers to the thin basal callus as compared to that of *Egouana*, is used for species, like the type, that have a truncated base, and also for species, like the one here described, that have a projecting base. *Egouana* Jousseaume (Rev. Mag. Zool., ser. 3, vol. 3, pp. 167, 209,

1875; type, by tautonymy, *Porcellana egouen* Adanson (=*Marginella amygdala* Kiener), Recent, West Africa),[1] has a smooth outer lip, and the heavy callus on the outer lip extends over the ventral part of the spire and down on the parietal wall and base, thus completely encircling the aperture. *Prunum*, apparently first used in binomial nomenclature by Herrmannsen (Indicis Gen. Malac., supplement, pp. 113–114, 1852; type, by monotypy, *Voluta prunum* Gmelin, Recent, West Indies), has a smooth outer lip, wider aperture, and the upper part of the parietal wall has only a thin callus. Several writers use *Glabella* Swainson (Treatise Malac., p. 324, 1840; type, by subsequent designation, Gray, Proc. Zool. Soc. London, pt. 15, p. 142, 1847, *Voluta faba* Linné, Recent, West Africa) for Marginellas of the group of *M. prunum*, but on account of Gray's type designation this name replaces the more generally used *Faba* Fischer (Man. Conch., p. 602, 1883), which has the same type by monotypy. *Miscrospira* Conrad (Am. Jour. Conch., vol. 4, p. 66, 1868; type, by monotypy, *Volutella oviformis* Conrad, Miocene, Virginia) may be available for the section called *Leptegouana*, but I was unable to find the type of *oviformis* at the Philadelphia Academy, and this species has not been recorded in later collections.

Marginella (Leptegouana) coniformis Sowerby

(Plate 14, Figures 8, 9)

Marginella coniformis Sowerby, 1850, Quart. Jour. Geol. Soc. London, vol. 6, pp. 45–46. Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288, pl. 17, fig. 2. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list). Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 221. Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 528. Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, pp. 309–310. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 234, pl. 37, figs. 5, 5*a*. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 337–338. ? Maury, 1920, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 1, pp. 64–65.

Not *Marginella coniformis* Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 348, pl. 24, fig. 12 (=*M. pilsbryi* Olsson).

Shell moderately large, stout, spire low. Aperture very narrow, terminating at the base in a projection on the columellar side. Heavy callus of outer lip extending over part of spire and down on upper part of parietal wall, but thinning out on base. Inner edge of outer lip coarsely denticulate. Columellar folds heavy.

Length 21 mm.; diameter 12.4 mm. (figured specimen).

Type locality.—Dominican Republic (Miocene).

M. coniformis is the only large *Marginella* found at Bowden. In the Dominican Republic it occurs only in the Gurabo formation, which carries a large number of specimens. The Dominican specimens reach a larger size and have a lower spire, and the largest specimens have a

[1] On p. 167 the spelling *Egouena* is used.

heavier callus beyond the terminations of the basal columellar folds. No specimens of intermediate size are in the Henderson collection, but intermediates among the 23 specimens in the Duerden collection form a series between the extremes, such as are figured.

A number of similar species have been described from the Miocene deposits of tropical America. *M. mediocris* Pilsbry and Brown (Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 32–33, pl. 5, fig. 2, 1917), a species from Colombia, is smaller and a little stouter. *M. domingoensis* Dall (Proc. U. S. Nat. Mus., vol. 19, p. 310, 1896), from the Dominican Republic, is stouter, and has a truncated base and thinner parietal callus. *M. amina* Dall (Proc. U. S. Nat. Mus., vol. 19, p. 309, pl. 29, fig. 15, 1896), also from the Dominican Republic, and *M. limonensis* Dall (Proc. U. S. Nat. Mus., vol. 19, p. 309, pl. 29, fig. 12, 1896), a Pliocene species from Limon, Costa Rica, are more slender and have a truncated base. A species from the Chipola formation of Florida, *M. aurora* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 51, pl. 6, fig. 4*a*, 1890), has a higher spire and truncated base. *M. macdonaldi* Dall (Smithsonian Misc. Coll., vol. 59, No. 2, p. 7, 1912; Proc. U. S. Nat. Mus., vol. 66, art. 17, pl. 17, figs. 4, 5, 1925), found in great abundance in the middle Miocene beds of Costa Rica, seems to belong to a different group, as it has a wide deep channel between the parietal wall and the outer lip, and the entire parietal wall and base are covered with thick callus.

It is improbable that the unsatisfactory molds from the Quebradillas limestone of Porto Rico, recorded by Maury as *coniformis*, represent *coniformis*. Guppy's record of *coniformis* in the upper Miocene beds at Springvale, Trinidad (Proc. Agr. Soc. Trinidad and Tobago, vol. 10 (Paper 440), p. 8, 1910; reprint, Bull. Am. Paleontology, vol. 8, p. 299, 1921) probably refers to *M. calypsonis* Maury (Bull. Am. Paleontology, vol. 10, pp. 351–352, pl. 45, figs. 12, 13, 1925), which seems to be an *Egouana*. The living West Indian *M. guttata* Dillwyn is smaller and has a truncated base, more obscure denticles on the outer lip and more slender folds.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12805).

Section SERRATA Jousseaume

Jousseaume, 1875, Revue et Magasin de Zoologie, ser. 3, vol. 3 (38th year), pp. 167, 230–232.

Type (*by tautonymy*).—*Marginella serrata* Gaskoin. Recent, Mauritius.

Shell slender or stout, spire moderately high. Aperture narrow, base truncated. Outer lip heavily thickened. Inner edge of outer lip bearing strong denticles. Columella bearing four folds. Parietal wall not covered with thick deposit of callus. (Based on figures given by Reeve, Conch.

Icon., vol. 15, *Marginella*, pl. 23, figs. 124*a*, *b*, 1865, to which Jousseaume refers, though Reeve gives the locality as the West Indies.)

The section *Serrata* is here used for slender or stout Marginellas that have a moderately high spire, narrow aperture, and strong denticulations on the lip. The type species is slender and Cossmann (Essais Paléoconch. Comp., pt. 3, p. 87, 1899) prefers to use *Eratoidea* Weinkauff (Syst. Conchylien-Cabinet, vol. 5, pt. 4, p. 140, 1879; type, by subsequent designation, Cossmann, cited above, *Marginella margarita* Kiener, Recent, West Indies) for stout species, but there seems to be no fundamental difference between these two groups.

Key to the Bowden species of Serrata

Spire high, length of adult shell reaching 17 mm.....*M.* (*S.*) *glaphyra*
Spire low, length of adult shell not exceeding 6 mm.....*M.* (*S.*) *mauryae*

Marginella (Serrata) glaphyra, new species

(Plate 14, Figure 10)

Shell relatively large, moderately stout, spire very high. Edge of outer lip broken on only specimen. Siphonal fasciole bulging very slightly. Columellar folds heavy for size of shell. Part of surface of shell, especially on body whorl, bearing obscure coarse axial wrinkles.

Length 17.1 mm.; diameter 8.6 mm. (holotype).

Despite the relatively large size and high spire, this species, represented only by the holotype, is not a *Marginella* s. s., for it does not have a definite, emarginate anterior canal. Although the edge of the outer lip is broken, it seems to be a *Serrata*. It is larger and more slender than *M. sowerbyi* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 337, pl. 23, fig. 14, 1922), found in the Cercado and Gurabo formations, and has a higher spire. The same differences separate it from *M. haematita* Kiener, a living species from Florida and Cuba.

Type material.—Holotype (U. S. Nat. Mus. No. 369430).

Marginella (Serrata) mauryae, new species

(Plate 14, Figure 11)

Shell small, stout, spire low. Outer lip heavily thickened, overlapping a third of preceding whorl. Inner edge of outer lip bearing strong denticles, the uppermost one almost vertical. Columellar folds heavy for size of shell, except basal one. A layer of callus lies along outer edge of the folds. Obscure axial wrinkles can be seen between shoulder and suture.

Length 5.6 mm.; diameter 3.5 mm. (holotype).

This small stout species is represented in the Henderson collection by nine specimens. It is smaller and more slender than *M. hispaniolana* Maury (Bull. Am. Paleontology, vol. 5, p. 236, pl. 37, fig.

8, 1917), which is found in the Gurabo formation and in beds carrying a modified Cercado fauna, and has a higher spire and heavier folds.

Type material.—Holotype (U. S. Nat. Mus. No. 369431).

CYPRAEOLINA Cerulli-Irelli

Cerulli-Irelli, 1911, Palaeontographica Italica, vol. 17, p. 231.

Type (*by monotypy*).—*Marginella clandestina* Brocchi. Pliocene and Recent, Mediterranean.

Shell minute, greatly inflated, *Cypraea*-like, spire involute. Aperture very narrow, crescentic, truncated at base. Outer lip thickened, its inner edge strongly denticulate. Callus extending from outer lip over apex and down on parietal wall. Columella bearing four folds, progressively decreasing in length upward.

This genus embraces minute egg-shaped American and European Marginellas that have gone under various names. They seem to be most similar to *Closia* Gray (Guide Syst. Dist. Moll. Brit. Mus., pt. 1, p. 36, 1857; type, by monotypy, *Marginella sarda* Kiener, Recent, Indo-Pacific ?). According to Kiener's description and figures, the type of *Closia* has an involute spire and denticulate outer lip, like *Cypraeolina*, but a heavy band of callus extends out from the columellar folds, the aperture is wider, the parietal wall is not covered with callus, and the shell is much larger. *Bullata* Jousseaume (Rev. Mag. Zool., ser. 3, vol. 3, pp. 167, 250–254, 1875, = *Volutella* Swainson, Zool. Ill., ser. 2, vol. 1, pl. 44, 1831; type, by subsequent designation, Gray, Proc. Zool. Soc. London, pt. 15, p. 142, 1847, *Marginella bullata* Lamarck (= *Voluta bullata* Born, Recent, West Indies; not *Volutella* Perry, Conchology, pl. 26, 1811) also has an involute spire, but the outer lip fails to extend up to the apex and the shell is relatively gigantic.

Merovia Dall (U. S. Nat. Mus. Bull. 112, p. 86, 1921; type, by monotypy, *Volutella pyriformis* Carpenter, Recent, Pacific coast of North America) is a synonym of *Cypraeolina*.

Cypraeolina pycna, new species

(Plate 14, Figure 12)

Shell very small, moderately stout. Aperture extremely narrow. Outer lip and callus on apex and parietal wall very thick. Posteriormost columellar fold lying far within aperture.

Length 2 mm.; diameter 1.3 mm. (holotype, measurements approximate).

This species, represented by four specimens, all in the Aldrich collection, is smaller than the living West Indian *C. ovuliformis* (d'Orbigny), but has a heavier outer lip, and heavier callus at the apex and on the parietal wall. It is not so inflated as *C. nitrina* (Mansfield) (Proc. U. S. Nat. Mus., vol. 66, art. 22, p. 40, pl. 6, fig. 7, 1925), a middle Miocene species from Trinidad, and its apical and parietal callus are heavier. An undescribed species from the Gurabo formation

also is more inflated. *C. gabbii* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 56, 1890; Pliocene, Costa Rica) has a thinner shell and the posterior part is more inflated. *C. lacrimula* (Gould), a living species ranging from Florida to Hatteras, is larger and more inflated.

The apex of the shell is tilted forward in the photograph.

Type material.—Holotype (U. S. Nat. Mus. No. 369432).

MITRIDAE

MITRA Martyn

Subgenus MITRA s. s.

Martyn, 1784, The Universal Conchologist, vol. 1, explanatory table, pl. 19.

Type (by subsequent designation, Dall, 1905, Proc. U. S. Nat. Mus., vol. 29, p. 428).—Mitra tessellata Martyn. Recent, Indo-Pacific.

The subgenus *Mitra* s. s., which is not represented in the Bowden formation, is characterized by its wide siphonal notch, correspondingly wide siphonal fasciole, and by its crude axial ribs.

Subgenus TIARA Swainson

Swainson, 1831, Zoological Illustrations, ser. 2, vol. 2, explanation of pl. 50 (Mitranae, pl. 5).

Type (by subsequent designation, Herrmannsen, 1849, Indicis Gen. Malac., vol. 2, p. 576).—Tiara isabella Swainson. Recent, China.

Shell reaching a moderately large size, slender. Base of body whorl somewhat constricted. Aperture long, narrow. Interior of outer lip smooth. Siphonal notch narrow, deep. Siphonal fasciole low. Columella bearing four or five folds increasing in strength posteriorly. Parietal wall covered with layer of callus. Sculpture consisting of strong, widely spaced spiral cords, between which lie fine closely spaced axial threads. (Based on Swainson's figures.)

This name is not a homonym of *Thiara* ("Bolten") Roeding 1798 (Mus. Boltenianum, pt. 2, p. 190), which is incorrectly given as "*Tiara*" by Herrmannsen (cited above). Agassiz (Nomen. Zool. Mollusca, p. 90, 1846) cites "*Tiara* Menke 1830," but that name also is spelled *Thiara* (Syn. meth. Molluscorum, ed. 2, p. 42, 1830). *Cancilla* Swainson 1840 (Treatise Malac., p. 320), which generally is used for this group of Mitras, is an exact synonym of *Tiara*, according to Herrmannsen's designation of *Tiara isabella* Swainson as the type (Indicis Gen. Malac., vol. 1, p. 166, 1846).

Tiara has a longer aperture and narrower siphonal notch than *Mitra* s. s., and its sculpture is predominantly spiral. The base of the Bowden species is less constricted than in the type species.

Key to the Bowden species of Tiara

Shell moderately slender ..... *M. (T.) henekeni illacidata*
Shell very slender ..... *M. (T.) rhadina*

Mitra (Tiara) henekeni illacidata, new subspecies

(Plate 14, Figure 13)

Mitra henekeni Sowerby, Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 440 (list).
Mitra henekeri Sowerby, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell relatively small, moderately slender, base slightly constricted. Columella bearing three folds and an obscure basal twist. Siphonal notch narrow, deep. Siphonal fasciole low. Parietal callus thin. Sculpture consisting of strong spiral cords, four of which lie on whorls of spire. Between the spiral cords are fine axial threads.

Length 18.9 mm.; diameter 6.7 mm. (holotype, apex broken).

The Bowden specimens referred to this subspecies are less than a third as large as specimens of *M. h. henekeni* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 46, pl. 9, fig. 5, 1850; *henekeri* is an obvious error for *henekeni*) from the Gurabo formation. They also are a little stouter than most young specimens of *M. h. henekeni*, and the early whorls bulge more and have stronger spiral sculpture, but one young shell of *M. h. henekeni* (U. S. G. S. station 8548) is as stout as Bowden specimens and has spiral sculpture of almost the same strength. The United States Geological Survey party collected many specimens of *M. h. henekeni* from the Gurabo formation, but only three from the Cercado formation. These Cercado specimens are similar to Bowden specimens so far as size and shape are concerned, but the early whorls bulge less and have weaker spiral sculpture.

M. henekeni illacidata is represented in the Henderson collection by 13 specimens. About 10 other species and subspecies of *Tiara* are on record from the lower and middle Miocene deposits of tropical America. Of these *henekeni illacidata* is perhaps most similar to *dariensis* Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 346, pl. 24, fig. 9, 1911; Gatun formation, Panama Canal Zone), which is more slender and has a less constricted base *M. dalli* Engerrand and Urbina (Bol. Soc. Geol. Mexicana, vol. 6, p. 127, pl. 59, figs. 31, 32, 1910; middle Miocene, Zuluzum, Chiapas, Mexico) is larger and stouter, and has fewer spiral cords.

Type material.—Holotype (U. S. Nat. Mus. No. 369433).

Mitra (Tiara) rhadina, new species

(Plate 14, Figure 14)

Shell relatively small, very slender, base slightly constricted. Aperture very narrow, siphonal notch narrow, deep. Siphonal fasciole very low. Columella bearing three folds and an obscure basal twist. Parietal callus very thin. Sculpture of spire whorls consisting of four widely spaced spiral cords, the one at the suture weaker than the others. On the body whorl and the whorl preceding it one or two secondary spirals may lie in the interspaces. Between the spirals are fine axial threads.

Length 22.4 mm.; diameter 6.3 mm. (holotype, apex broken). Length 26.7 mm.; diameter 6.9 mm. (largest specimen, apex broken).

This species, represented by 15 specimens in the Henderson collection, is a little larger than *henekeni illacidata*. It also is more slender and its spiral cords are farther apart. It is the Bowden analogue of *M. longa* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 339–340, pl. 24, fig. 3, 1922), which is found in both the Cercado and Gurabo formations, and also in the Gatun formation of the Panama Canal Zone. *M. longa* is more slender and is about three times as large. Its body whorl is proportionately longer, and secondary spirals are introduced at an earlier stage. *M. couvensis* Maury (Bull. Am. Paleontology, vol. 10, pp. 355–356, pl. 46, figs. 1, 4, 1925; upper Miocene, Trinidad) is stouter than *longa* and *rhadina*, and has more numerous secondary spirals.

Type material.—Holotype (U. S. Nat. Mus. No. 369434).

VEXILLUM ("Bolten") Roeding

Subgenus VEXILLUM s. s.

Section VEXILLUM s. s.

Roeding, 1798, Museum Boltenianum, pt. 2, p. 138.

Type (*herewith designated*).—*Vexillum plicatum* ("Bolten") Roeding (=*Voluta plicaria* Linné). Recent, Indo-Pacific.

Apparently no one has designated a type for *Vexillum*, though Dall (Jour. Conchology, vol. 11, p. 296, 1906) gave "*Mitra plicaria* Lam." as the first species, meaning the first valid species, for *fossile*, a nude name, is the first species in the Museum Boltenianum. So long as the Bolten names are accepted, there seems to be no way of getting rid of the name.

The genus *Vexillum*, also known as *Turricula* and *Vulpecula*, in contrast to *Mitra* has lirations on the interior of the outer lip. The base of the pillar is strongly curved backward. The siphonal notch is deep and the siphonal fasciole is prominent. A ridge of callus (parietal ridge) lies on the parietal wall at the posterior end of the aperture, forming a channel. The section *Vexillum* s. s., which is not represented in the Bowden formation, has heavy axial ribs that terminate some distance from the suture at the edge of an anal fasciole.

Section COSTELLARIA Swainson

Swainson, 1840, Treatise on Malacology, p. 320.

Type (*by monotypy*).—*Mitra rigida* Swainson (? =*M. semifasciata* Lamarck). Recent, Indo-Pacific.

Shell medium-sized, moderately slender. Aperture narrow, anterior canal very short. Edge of outer lip slightly bent inward near base. Interior of outer lip lirate. Siphonal notch narrow, deep. Siphonal fasciole relatively high. Columella bearing four folds. Parietal ridge broad. Sculpture (of type species) consisting of axial ribs and, on the pillar, of crude spiral cords.

The pillar is less strongly curved backward than in *Vexillum* s. s., and the anal fasciole is absent.

Key to the Bowden species of Costellaria

Anterior canal short, early whorls not appressed at suture, axial ribs not disappearing on body whorl.
  Spiral sculpture absent above pillar.
    Shell relatively large, pillar slightly constricted..... *V.* (*C.*) *dasaplurum*
    Shell very small, pillar strongly constricted..... *V.* (*C.*) *micramadum*
  Spiral sculpture present above pillar, pillar strongly constricted.... *V.* (*C.*) *cryptidulum*
Anterior canal relatively long, early whorls appressed at suture, axial ribs disappearing on body whorl..... *V.* (*C.*) *leurum*

Vexillum (Costellaria) dasaplurum, new species
(Plate 14, Figure 15)

Shell medium-sized, relatively stout. Anterior canal very short. Siphonal notch moderately deep, siphonal fasciole high. Between the siphonal fasciole and edge of inner lip lies a narrow deep umbilical groove. Columellar folds very heavy. Sculpture consisting of slightly retractive axial ribs, replaced on pillar by crude wrinkled spiral threads and cords.

Length 21 mm.; diameter 8.2 mm. (holotype).

V. dasaplurum is represented by only two specimens, both in the Aldrich collection. It is the stoutest *Mitra*-like mollusk found at Bowden. The heavy ribs and absence of spiral sculpture above the pillar are characteristic features and distinguish it from Caribbean Miocene species heretofore described. *V. orthocolpum* (Cossmann) (Journ. Conchyl., vol. 61, p. 63, pl. 5, figs. 20, 21, 1913) is a similar Miocene species from Martinique, but it has spiral threads between the ribs.

A badly worn very small shell in the Henderson collection (U. S. Nat. Mus. No. 135436) shows no spiral sculpture above the pillar, but both the shell and the ribs are too slender for *dasaplurum*.

Type material.—Holotype (U. S. Nat. Mus. No. 369435).

Vexillum (Costellaria) micramadum, new species
(Plate 14, Figure 16)

Shell very small, moderately stout, base of body strongly constricted, forming a definite pillar. Nucleus consisting of almost four smooth, slender, small, barely constricted whorls. Anterior canal very short, moderately emarginate. Sculpture consisting of swollen axial ribs. Pillar sculptured with heavy spiral threads.

Length 4.5 mm.; diameter 2 mm. (holotype). Length 5.5 mm.; diameter 2.2 mm. (largest specimen).

This little species is represented by 12 specimens in the Henderson collection, none of which is perfect. They show considerable variation in degree of inflation. The holotype is not a full-grown shell. Most of the specimens have a few narrow widely spaced brownish bands, the holotype showing five on the body whorl. The pillar is more strongly constricted than in the type of *Costellaria*.

Type material.—Holotype (U. S. Nat. Mus. 369436).

Vexillum (Costellaria) cryptidulum, new species

(Plate 14, Figure 17)

Shell small, relatively stout, pillar strongly constricted. Anterior canal moderately short. Siphonal notch moderately deep. Sculpture consisting of axial ribs, which gradually disappear near suture and above the pillar, and of obscure spiral threads that are beaded near suture. Pillar sculptured with heavy spiral cords.

Length 8 mm.; diameter 3.7 mm. (holotype).

The anterior canal is relatively longer than in *V. dasaplurum* and in the type species of *Costellaria*, and the shell has spiral sculpture above the pillar. The holotype is somewhat worn and may not be full-grown. Two very small specimens in the Henderson collection are referred to this species. They have an obscurely beaded sutural band and a nucleus consisting of almost four slender whorls. Three small worn specimens have an obscurely beaded sutural band, but they are too slender for this species.

Type material.—Holotype (U. S. Nat. Mus. No. 369437).

Vexillum (Costellaria) leurum, new species

(Plate 14, Figure 18)

Shell small, moderately slender, early whorls appressed at suture. Anterior canal relatively long, siphonal notch relatively shallow. Sculpture consisting of axial ribs that disappear on body whorl of adults and that on early whorls are absent near suture. Pillar sculptured with crude spiral cords.

Length 12.5 mm.; diameter 4.6 mm. (holotype).

This species, like *dasaplurum*, has no spiral sculpture above the pillar, but the axial ribs disappear on the body whorl of full-grown shells. It is represented by five specimens of different growth stages, all in the Henderson collection. The relatively long anterior canal and relatively shallow siphonal notch represent a transition to *Uromitra*.

Type material.—Holotype (U. S. Nat. Mus. No. 135434).

Subgenus UROMITRA Bellardi

Bellardi, 1887, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 5, p. 277.

Type (*by subsequent designation, Cossmann, 1899, Essais Paléoconch. Comp., pt. 3, p. 168*).—*Voluta* (*Mitra*) *cupressina* Brocchi. Miocene and Pliocene, Italy.

Shell medium-sized, very slender. Nucleus consisting of about four smooth barely constricted whorls. Aperture narrow. Anterior canal long, twisted to right, barely emarginate and flaring at base. Interior of outer lip lirate. Columella bearing four folds. Sculpture consisting of axial rib and of spiral threads or cords lying between them or overriding them. (Based on Bellardi's figure of type species and on specimens of a similar species from the Vienna Basin.)

The long, barely emarginate or virtually unemarginate, and flaring anterior canal is characteristic of *Uromitra*. Not all the Bowden

species referred to this subgenus have so long a canal as the type species, and on some of them it is more distinctly emarginate.

On the basis of its earliest publication *Fusimitra* Conrad (Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 261, 1856) represents a group of the genus *Mitra* and probably is a synonym of *Tiara* (see Harris, Cat. Ter. Moll. British Museum, pt. 1, Australasian, pp. 124–125, 1897). The only species listed in this publication are as follows: *M. conquisita* Conrad and *M. mississippiensis* Conrad, both from the upper Oligocene Byram marl of Mississippi and now regarded as representing the same species, and *M. mellingtoni* Conrad, from the upper Eocene Jackson formation of Mississippi. So far as known no type has been designated from these three, or two, species, but all represent the same group. The name *Fusimitra* is generally cited as of Conrad 1865 (Am. Jour. Conchology, vol. 1, p. 25). In this publication *M. cellulifera* Conrad, also from the Byram marl, heads the list of species, and it generally is regarded as the type species; in fact, it is so cited by Cossmann (Essais Paléoconch. Comp., pt. 3, p. 166, 1899). Despite Cossmann's opinion *M. cellulifera* is a *Uromitra*, though its canal is not quite so long as in *cupressina*. Inasmuch as Cossmann cites Eocene species of "*Fusimitra*," *Uromitra* seems to have a range extending from Eocene to Recent. It is represented at the present time in the West Indies by *M. styria* Dall.

Key to the Bowden species of Uromitra

Spiral cords not overriding axial ribs.
- Shell relatively stout, anterior canal relatively short, spiral sculpture weak ..... *V.* (*U.*) *syntomum*
- Shell very slender, anterior canal long, spiral sculpture strong ... *V.* (*U.*) *callipictum*

Spiral cords overriding axial ribs.
- Shell relatively stout, columella bearing five folds ..... *V.* (*U.*) *voraginosum*
- Shell slender, columella bearing four folds ..... *V.* (*U.*) *uncidum*

Vexillum (Uromitra) syntomum, new species

(Plate 14, Figure 19)

Shell medium-sized, moderately slender. Nucleus consisting of four slender whorls, barely constricted at suture. Anterior canal relatively short, siphonal notch very shallow. Sculpture consisting of heavy axial ribs, between which and on the flanks of which lie obscure spiral threads. Pillar sculptured with heavier crude spiral cords.

Length 19.9 mm.; diameter 6.6 mm. (holotype). Length 21 mm.; diameter 6.2 mm. (largest specimen).

V. syntomum is stouter than the type species of *Uromitra*, and consequently has a wider aperture. Its anterior canal also is shorter, but it is longer and less emarginate than in the species referred to *Costellaria*. Ten specimens in the Henderson collection represent different growth stages, and some of the shells are stouter than the holotype. *V. tortuosum* (Gabb) (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 341, pl. 24, fig. 8, 1922), found in the Gurabo formation, is larger

and has V-shaped spaces between the ribs. *V. tortuosellum* (Pilsbry and Johnson) (see Pilsbry, cited above, p. 341, pl. 24, fig. 13), also found in the Gurabo formation, has a narrower aperture and canal, more numerous axial ribs, and spiral grooves rather than threads between the ribs. *V. barnardensis* (Maury) and *V. scopuli* (Maury) (Bull. Am. Paleontology, vol. 4, p. 136, pl. 21, figs. 9, 10, 1910), both from the lower Miocene Chipola formation of Florida, are smaller and differ in details of sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 369438).

Vexillum (Uromitra) callipictum, new species

(Plate 14, Figure 20)

Mitra styria Dall (not Dall 1889), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell medium-sized, very slender. Nucleus consisting of about three and a half slightly constricted whorls. Aperture narrow, anterior canal long, narrow, twisted, unemarginate. Sculpture consisting of axial ribs, between which lie flat spiral threads separated by wide flat-troughed grooves. Pillar sculptured with heavier cords that are farther apart.

Length 12.9 mm.; diameter 3.7 mm. (holotype).

This slender, long-canaled *Uromitra* is similar to the type species, but is not so slender and has stronger spiral sculpture. It is represented in the Henderson collection by eight specimens, some of which are a little stouter than the holotype. It is similar to the living West Indian *V. styria* (Dall), but is smaller and has a relatively longer canal, and the spiral cords fail to override the ribs. It also resembles *V. cellulifera* (Conrad), a species from the upper Oligocene Byram marl, but has a relatively longer canal and differs in details of sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 369439).

Vexillum (Uromitra) voraginosum, new species

(Plate 14, Figure 21)

Shell medium-sized, relatively stout. Aperture narrow, anterior canal relatively short, unemarginate. Columella bearing five folds, the lowermost one not visible on young shells. Sculpture consisting of narrow closely spaced axial ribs overridden by wide flat spiral cords, separated by narrow grooves. Pillar sculptured with narrower and cruder spiral cords and threads.

Length 12.7 mm.; diameter 4.5 mm. (holotype).

The relatively stout shell and heavy spiral sculpture are characteristic of this species, which is represented by five specimens in the Henderson collection.

Type material.—Holotype (U. S. Nat. Mus. No. 135437).

Vexillum (Uromitra) uncidum, new species

(Plate 15, Figure 1)

Shell medium-sized, slender. Anterior canal long, unemarginate. Sculpture consisting of closely spaced axial ribs, overridden and beaded by wide

flat spiral cords, separated by narrow grooves. Pillar sculptured with cruder spiral cords and threads. On the early whorls the axials are stronger than on the later whorls.

Length 13.7 mm.; diameter 4.2 mm. (holotype).

This species is more slender than *voraginosum*, and has beaded sculpture. It is represented by the holotype, in the Duerden collection, and by one specimen in the Henderson collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369440).

MITROMORPHA ("Adams") Carpenter

Carpenter, 1865, Ann. Mag. Nat. Hist., ser. 3, vol. 15, p. 182.
Type (*by monotypy*).—*Daphnella ? filosa* Carpenter. Recent, California and Mexico.

Shell small, biconic, moderately slender. Nucleus consisting of about one and a half large whorls, forming a cylindrical apex. Aperture long, narrow, its base barely emarginate. Edge of outer lip thickened, its interior bearing short heavy denticles. Parietal wall bearing thin coat of callus. Sculpture consisting predominantly of strong spiral threads. The first whorl bears weak axial ribs, but on remaining whorls only microscopic axial threads lie between the spirals.

Iredale (Proc. Mal. Soc. London, vol. 12, pp. 328–329, 1917) has discussed the history of this name, which is generally accredited to A. Adams, and for which *Mitromorpha lirata* A. Adams is generally cited as the type.

The smooth columella shows that this genus should not be placed in the family Mitridae, to which it is generally tentatively referred, but so far as known, its proper place has not been determined by a study of the animal. It probably belongs near the Conidae.

Species of *Mitromorpha* are living along both the Atlantic and Pacific coasts of America. The species here recorded is the earliest species in tropical America. *"Mitramorpha" parsonsi* Dickerson (California Univ. Pub., Dept. Geology Bull., vol. 9, No. 17, p. 495, pl. 38, fig. 11, 1916), a middle Eocene species from California, is not congeneric with *Mitromorpha filosa*, nor are any of the species listed by Cossmann (Essais Paléoconch. Comp., pt. 2, p. 100, 1896; pt. 4, p. 251, 1901; pt. 7, p. 224, 1906).

Mitromorpha species

(Plate 15, Figure 2)

Mitromorpha sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6 p. 1583 (list).

The Henderson collection contains an imperfect apparently immature specimen representing *Mitromorpha* (U. S. Nat. Mus. No. 135414). The outer lip is broken back revealing an oblique groove on the upper part of the parietal wall, as in *Conus*. Within the aperture the columella has a slight central bulge. The first postnuclear whorl has weak axial ribs, but they rapidly disappear leaving

only the strong spiral threads, between which are faint growth threads. The dimensions are as follows: length 4.2 millimeters, diameter 2 millimeters.

This species, the first fossil *Mitromorpha* recorded from tropical America, is a little stouter than *M. cincta* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 95, pl. 3, fig. 6, 1890), a Pliocene species from Florida, and has a more slender nucleus. It is more slender and more finely sculptured than the living West Indian *M. dormitor* (Sowerby).

XANCIDAE

XANCUS ("Bolten") Roeding

Roeding, 1798, Museum Boltenianum, pt. 2, p. 134.
Type (*by subsequent designation, Dall, 1906, Jour. Conchology, vol. 11, p. 296*).—*Voluta pyrum* Gmelin. Recent, Indian Ocean.

Shell large or very large, very stout or moderately stout, spire high or moderately high. Nucleus consisting of several large, heavy, smooth whorls, at the tip of which is a scar where the uncalcified part was attached. Aperture long, wide, constricted at the base forming a long, slightly emarginate canal. Siphonal fasciole low. Columella bearing three or four parietal folds, only three of which generally are strong, and in some species a basal twist. Parietal wall covered with thick coat of callus, which may be very heavy on adult shells, and its edge may stand out from the pillar. At posterior end of aperture lies a narrow channel that may extend upward to edge of outer lip on adult shells. Sculpture consisting of axial ribs or nodes and of spiral threads, both of varying strength.

This genus, for which Lamarck's name *Turbinella* is used by those who refuse to accept the Bolten names, has long attracted attention, because of the small number of species, and because the type species is held in veneration by the Hindus. Only a few living species are known; two on the coast of Brazil and two in the Indian Ocean, though several subspecies of the genotype are recognized. In Europe, America, and India the earliest species are of Oligocene age. In America the largest number of species are found in Miocene deposits, eight species, some of which may be nominal, being on record from the Miocene deposits of tropical America. No fossil or living species have been found in the eastern Pacific, except for an undescribed very large species from the middle Miocene deposits of Darien. Several different phyla can be traced with more or less assurance in the American species. Two species seem to be represented in the Bowden formation, but one is represented only by pieces of the columella.

Xancus textilis (Guppy)

(Plate 15, Figure 3)

Fasciolaria textilis Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pt. 10, pp. 80–81, pl. 1, fig. 2 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, pp. 212–213). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 410, pl. 16, fig. 5; p. 438 (list).

Turbinella textilis (Guppy) Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Xancus textilis jamaicensis Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 343, pl. 25, figs. 5, 6.

Shell moderately large, moderately stout, spire high. Nucleus very large, cylindrical, consisting of a little more or a little less than two large whorls, at the apex of which lies a broad scar. First nuclear whorl immediately reaching an altitude greater than that of beginning of first post-nuclear whorl. Obscure axial undulations are visible on latter part of last nuclear whorl. Columella bearing three strong slightly oblique parietal plaits. Parietal wall of immature specimens at hand not covered with callus. Sculpture consisting of broad axial ribs disappearing near suture and of strong spiral threads, between which secondary threads may lie. On the specimen figured by Pilsbry, which seems to be adult, the ribs of the later whorls are reduced to broad nodes lying below a concave area adjoining the suture, and on the body whorl the spiral threads are suppressed except on the pillar and sutural concavity, which also bears fine axial wrinkles.

Length 65 mm.; diameter 29.6 mm. (holotype).

Type locality.—Jamaica (Miocene).

None of the specimens in the collections of the United States National Museum and of Johns Hopkins University is mature, the holotype being the largest in the lot. Not more than three specimens are in any collection. The large specimen called *X. textilis jamaicensis* by Pilsbry, which has a length of 123 millimeters, seems to be mature. It shows, as would be expected, that on the later whorls of adult shells the axial and spiral sculpture is somewhat suppressed, and it also shows that the later whorls have an axially wrinkled concave area adjoining the suture. Perhaps the most striking feature of this species is the very large nucleus.

This species seems to represent an extinct branch of the phylum that gave rise to the living *scolymus*. It has the very large nucleus of *scolymus*, and the sculpture of the early whorls of the two species is similar, but *scolymus* reaches a much larger size, and on the later whorls of adults the axials are very strong below the sutural concavity. *X. rex* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 342, pl. 26, figs. 5, 8, 1922), found in the Baitoa and Thomonde formations, and an undescribed species from the Gatun formation of the Panama Canal Zone, which has a length of about 300 millimeters, more closely resemble *scolymus*, but are more slender and have weaker axial nodes. The columellar fragments described by Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 347, pl. 24, figs. 7, 8, 1911) as "*Mitra* sp. undet." probably represent the undescribed Gatun species.

The oldest *Xancus* in the Caribbean region, *X. precursor* Hubbard (New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, p. 153, pl. 23, figs. 6–7, 1921), of middle Oligocene age from Porto Rico, is more slender than *textilis*, and the early whorls

have a sutural cord. It probably belongs to the group represented by *X. wilsoni* (Conrad), from the upper Oligocene Byram marl of Mississippi, but the Porto Rican material is too scanty to afford a basis for a safe comparison. *X. wilsoni* quite clearly belongs in the direct line of the lower Miocene *rex* and the middle Miocene Gatun species. The lower Miocene Brazilian *X. brasilianus* Maury (Mon. Serv. Geol. Mineral. Brasil, vol. 4, p. 155, pl. 7, fig. 3, 1925) is the oldest species similar to *textilis*, though it is more slender and the whorls are more appressed at the suture. *X. validus* (Sowerby) (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol, 73, pp. 342–343, pl. 25, fig. 3, 1922), which has the same shape, seems to belong to this phylum, but in this species the sculpture is reduced at an earlier stage. This species comes from some unknown Miocene horizon in the Dominican Republic. Vredenburg (Records Geol. Survey India, vol. 55, pt. 2, pp. 125–126, 1923) supposed that it represented an early stage in the "*praeovoideus*"-*ovoideus* phylum, but it seems to belong to the *scolymus* stock.

The figured specimen, which is the larger of two in the type lot, is recognized as the holotype.

A small specimen in the collections of the Philadelphia Academy (No. 3691), sent to Gabb by Guppy, is labeled "type."

Type material.—Holotype (U. S. Nat. Mus. No. 115482).

Xancus species

Two columellar fragments in the Duerden collection represent a very large *Xancus* that can hardly be referred to *textilis*. The aperture alone, if complete, would have a length of about 150 millimeters, and the diameter of the columella at the top of the pillar is 40 millimeters. These fragments are comparable in size to *X. rex* and the undescribed species from the Gatun formation, and may very well represent that group of species, though it might possibly resemble the equally large *X. scopulus* Olsson (Bull. Am. Paleontology, vol. 9, p. 283, pl. 14, 1922), an extreme coronate offshoot of the *scolymus* stock, found in the middle Miocene beds of Costa Rica.

FASCIOLARIIDAE

LATIRUS Montfort

Subgenus LATIRUS s. s.

Montfort, 1810, Conchyliologie systématique, vol. 2, p. 531.

Type (*by original designation*).—*Latirus aurantiacus* Montfort (=*Murex filosus* Lamarck =*Murex gibbulus* Gmelin). Recent, Australia.

The subgenus *Latirus* s. s., characterized by its wide aperture, relatively short, wide, and oblique canal, faint columellar folds, and deeply concave anal fasciole, is not represented in the Bowden formation.

Subgenus POLYGONA Schumacher

Schumacher, 1817, Essai d'un nouveau système des habitations des vers testacés, p. 241.

Type (*by monotypy*).—*Polygona fusiformis* Schumacher (=*Murex infundibulum* Gmelin). Recent, West Indies.

Shell medium-sized, slender, fusiform. Aperture long, narrow, abruptly constricted to form a long, very narrow, deep, slightly oblique, slightly emarginate canal. Siphonal fasciole very narrow, high, lamellar. Columella bearing three low folds immediately above beginning of canal, and on adult shells a weaker fold lying above them. Interior of outer lip strongly lirate. Parietal wall covered with callus, umbilical opening of varying width and depth. At posterior end of aperture lies a channel formed by the parietal ridge. Sculpture consisting of swollen axial ribs and of strong spiral threads.

The two genotypes, "*Murex*" *infundibulum* and "*Murex*" *gibbulus*, are very different, but other species having canals of intermediate length, width, and degree of obliquity partly bridge the gap between them. Despite this intergradation, the recognition of *Polygona* seems justified, for all the living species certainly known from the West Indies and Florida—*infundibulum* Gmelin, *brevicaudatus* Lamarck, and *cayohuesonicus* Sowerby—and the Tertiary fossils from the same region have a long or relatively long, narrow canal, the species with a short, relatively wide, strongly oblique canal falling in the genus *Leucozonia* Gray (Proc. Zool. Soc. London, pt. 15, p. 136; type, by original designation, *Murex nassa* Gmelin (*Turbinella cingulifera* Lamarck), Recent, West Indies), which has a tooth-like projection near the base of the outer lip. Some of the living western Pacific species, such as *nodatus* Martyn, have an aperture essentially similar to that of *infundibulum*, but several different genera probably are represented in the Pacific species now referred to *Latirus*. Until the Pacific species have been segregated it seems desirable to give *Polygona* subgeneric rank, though it probably will eventually be given full generic standing.

Key to the Bowden species of Polygona

Whorls not strongly appressed at suture, spiral sculpture consisting of widely spaced threads of two orders of magnitude. . *L.* (*P.*) *infundibulum polius*
Whorls strongly appressed at suture, spiral sculpture consisting of closely spaced threads of one order of magnitude. . . . . *L.* (*P.*) *nematus*

Latirus (Polygona) infundibulum polius, new subspecies

(Plate 15, Figures 4, 5)

Latirus infundibulum Gmelin, Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).
? *Latirus infundibulum* (Gmelin) var. Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 279, pl. 11, fig. 10.

Shell medium-sized, moderately slender. Anterior canal long, very narrow, slightly oblique. Columella bearing three low folds and a fourth weak one. Sculpture consisting of swollen axial ribs, numbering nine on

body whorl of largest shells, and of strong spiral threads, between which secondary or even tertiary threads may lie. Two threads near the suture are not so strong as the other primaries. Between the threads are growth wrinkles that are most prominent, and even lamellar, near suture.

Length 59.9 mm.; diameter 21 mm. (holotype).

This Bowden representative of the living West Indian *L. i. infundibulum*, of which four specimens are in the Duerden collection, is a little stouter than living specimens, and consequently has one or two more ribs to the whorl. It also is considerably smaller and the spiral threads stand out farther. The ribs are more convex than in most living specimens, but this feature seems to be variable in living shells. The immature Miocene fragment from Costa Rica described by Olsson probably represents the same subspecies, but specimens from the Pliocene beds near Limon, recorded by Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 354, 1881) seem to be *L. i. infundibulum*. The *Latirus* from the Gurabo formation of the Dominican Republic, called *infundibulum* by Gabb, Guppy, and Pilsbry, is a recognizable species, for which the name *gurabensis*, casually proposed by Maury (Bull. Am. Paleontology, vol. 5, p. 246, pl. 39, fig. 3, 1917), is available. Its whorls are distinctly appressed at the suture, and it has a stouter pillar, shorter canal, fewer ribs, and more crowded spiral threads.

One Bowden specimen in the collection of the United States National Museum is incorrectly labeled Curaçao, Dutch West Indies.

Type material.—Holotype (U. S. Nat. Mus. No. 135460).

Latirus (Polygona) nematus, new species

(Plate 15, Figure 6)

Latirus sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell medium-sized, stout, whorls closely appressed at suture. Anterior canal moderately long and narrow, oblique. Columella bearing three low folds and an indistinct fourth one. Sculpture consisting of swollen axial ribs ending rather abruptly some distance from suture, and of strong closely spaced spiral threads of about equal strength, except on pillar. Near the suture the threads are farther apart than elsewhere, and lamellar growth wrinkles adjoin the suture.

Length 60.4 mm.; diameter 23 mm. (holotype).

This finely sculptured species is not similar to any living or Tertiary Caribbean or Panamic species. It remotely resembles *L. protractus* (Conrad) (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 1, p. 120, pl. 12, fig. 7, 1848), a species from the upper Oligocene Byram marl of Mississippi, but is larger and stouter, and has more distinctly appressed whorls and finer sculpture. Two specimens are in each of the Duerden and Henderson collections.

Type material.—Holotype (U. S. Nat. Mus. No. 369442).

FASCIOLARIA Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 73.
Type (*by monotypy*).—*Murex tulipa* Linné. Recent, West Indies and southeast coast of United States.

Shell reaching a gigantic size, stout, fusiform. Nucleus forming a blunt apex, consisting of between one and two broad smooth whorls. Aperture long and very wide, contracted at base to form a short, relatively narrow, oblique canal, flaring and slightly emarginate at base. Siphonal fasciole low, broad. Columella bearing immediately above beginning of canal three low oblique folds decreasing in strength upward. Parietal wall covered with glaze of callus. Interior of inner lip finely lirate. Anal fasciole narrow, depressed. Sculpture consisting of spiral cords and grooves, with or without axial nodes or ribs on the shoulder.

This genus is represented by living species in both Atlantic and Pacific tropical American waters. The earliest species in this region are of lower Miocene age.

Fasciolaria semistriata leura, new subspecies

(Plate 15, Figure 7)

Fasciolaria semistriata Guppy (not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288, pl. 16, fig. 12. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Fasciolaria intermedia Guppy (not Sowerby), 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1583 (list).

Shell relatively small. Nucleus consisting of about one and a half whorls, the first whorl cap-shaped and forming a broad blunt apex, the last half whorl bearing obscure spiral threads and very obscure axial wrinkles. Parietal callus heavy. Anal fasciole concave. Sculpture of body whorl confined to pillar and anal fasciole, consisting of spiral threads of two orders of magnitude on the pillar and of four broad, widely spaced spiral threads on the anal fasciole. First few post-nuclear whorls bearing a broad thread at suture and obscure finer threads over remainder of whorl, and also very obscure axial undulations. Color pattern consisting of fine, widely spaced brownish spiral bands.

Length 81.8 mm.; diameter 39 mm. (holotype, tip of canal broken).

The differences between Bowden shells and specimens of *F. s. semistriata* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 49, 1849), found in the Gurabo formation, are too pronounced to ignore. The Dominican shells have a more slender nucleus and the early post-nuclear whorls have relatively strong axial ribs that gradually disappear. On the Bowden shells the anal fasciole also is more clearly set off. Only a few shells are in any collection.

F. semistriata leura resembles young specimens of the living *tulipa* from the West Indies and Florida, but its anal fasciole is more concave, its aperture is shorter and wider, and its canal is longer and narrower.

It also has a stouter nucleus, and the axial sculpture on the latter part of the last nuclear whorl is much fainter. Likewise the suggestion of axial nodes is stronger on the first post-nuclear whorls of living specimens. So far as nuclear and early post-nuclear characters are concerned *F. s. semistriata* and *tulipa* are similar to each other, and there seems to be no possibility of fitting *semistriata leura* into a continuous phyletic series.

Type material.—Holotype (U. S. Nat. Mus. No. 107007).

FUSINUS Rafinesque

Rafinesque, 1815, Analyse de la Nature, p. 145. Substitute name for *Fusus* "Lamarck" (Bruguière, 1789, Encycl. méth., Vers., p. 15, genus without species; Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 73; type, by monotypy, *Murex colus* Linné). Not *Fusus* Hebling 1779 (Abhand. einer Privatgesellschaft in Böhmen zur Aufnahme der Mathematik, der vaterländischen Geschichte und der Naturgeschichte, vol. 4, pp. 116–120, quoted from Dall, Jour. Conchology, vol. 11, p. 290, 1906).

Type (*see above*).—*Murex colus* Linné. Recent, Indo-Pacific.

Shell large, slender, spindle-shaped (fusiform). Nucleus consisting of about one and a half whorls, the last half whorl sculptured with axial riblets. Aperture wide, contracted to form a very long, narrow, deep, slightly emarginate anterior canal, the posterior half of which (in type species) is straight and almost vertical, but below the middle it is slightly twisted to right and then to left. Edge of inner lip continuous along parietal wall. On upper part of parietal wall some of spiral threads ornamenting body whorl show through the callus, but in addition adult shells have a heavy parietal ridge near posterior end of parietal wall. Edge of outer lip serrate, interior finely lirate. Sculpture consisting of swollen axial ribs, which may disappear on last whorl, and of strong spiral threads.

This genus is more commonly known by the preoccupied name *Fusus*, as used by Lamarck. Cuvier in 1798 (Tableau Élément. Hist. Nat. Animaux, p. 403) apparently was the first one to assign species to Bruguière's *Fusus*, when he cited *Murex fusus* and *Murex colus* as representatives of Bruguière's "*Fuseaux*," which he regarded as a subdivision of the Linnean *Murex*. Inasmuch as he used only the vernacular name, Lamarck's citation of *Murex colus* in the Prodrome can be regarded as the first valid assignment of a species to the genus. If Cuvier's naming of species were accepted, the results would be very unfortunate, for *Murex fusus* would then become the type of "*Fusus*" by tautonymy and *Fusinus* would become a synonym of *Rostellaria* Lamarck (1799).

The name *Fusus* has been very much abused for Cretaceous and Tertiary fossils, perhaps more so than any other gastropod generic name. According to Grabau (Smithsonian Misc. Coll., vol. 44, No. 1417, 1904), the earliest species congeneric with "*Fusus*" *colus* are of Eocene age and are found in the Paris-London and Hampshire Basins. The earliest American species seem to be those from the lower Miocene deposits of the Caribbean region.

Key to the Bowden species of Fusinus

Shell very slender, later whorls not angulated, nucleus slender, bearing fine axial riblets.....*F.* species
Shell moderately slender, later whorls angulated, nucleus stout, bearing coarse axial riblets.....*F. engonius*

Fusinus species

(Plate 15, Figure 8)

Fusus henekeri Dall (not Sowerby), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).
Fusus henekeni Grabau (part, not Sowerby), 1904, Smithsonian Misc. Coll., vol. 44, No. 1417, p. 19.

Shell moderately large, very slender, whorls strongly bulging. Nucleus rather slender, consisting of almost two whorls, the last quarter whorl or less sculptured with very fine, crowded, axial riblets. Aperture broken on all available specimens. Sculpture consisting of heavy swollen axial ribs and of strong spiral threads, between which secondary threads lie on later whorls.

Length of figured fragment 33 mm.; diameter 13.4 mm.

However unreasonable it may seem to have a different species of *Fusinus* at almost every Miocene locality in this region, this species certainly is not *F. henekeni* (Sowerby) (Quart. Jour. Geol. Soc. London, vol. 6, p. 49, 1850, by error *henikeri;* Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 347, pl. 26, figs. 6, 7, 1922). Its nucleus is essentially like that of *henekeni,* though the axial riblets are not quite so fine. The nucleus of the figured specimen bulges more than in another specimen from Bowden and more than in *henekeni.* The shell of this Bowden species is much more slender than any in a suite of over 70 specimens of *henekeni* representing nine localities in both the Cercado and Gurabo formations. In addition the whorls are more appressed at the suture. *F. veatchi* (Maury) (Bull. Am. Paleontology, vol. 5, pp. 243–244, pl. 38, fig. 3, 1917; Cercado formation), *miocosmius* (Olsson) (Bull. Am. Paleontology, vol. 9, pp. 275–276, pl. 11, fig. 5, 1922; middle Miocene, Panama), *honensis* (Olsson) (Bull. Am. Paleontology, vol. 9, pp. 276–277, pl. 11, fig. 6, 1922; middle Miocene, Costa Rica), *springvalensis* (Maury) (Bull. Am. Paleontology, vol. 10, p. 358, pl. 46, fig. 11, 1925; upper Miocene, Trinidad), *gabbi* (Grabau) (Smithsonian Misc. Coll., vol. 44, No. 1417, p. 56, 1904; Pliocene, Costa Rica), and the living West Indian *eucosmius* Dall all are stouter and differ in other features. Of these species the Bowden shells probably are most similar to *honensis,* but are more slender, and have more swollen ribs and finer nuclear riblets.

Though this species seems to be new and is quite recognizable from the available material, these specimens are too imperfect to serve as type material. The figured specimen is from the Guppy collection and is labeled "*Fusus henekeni* Sowerby." One specimen is in the Duerden collection and another in the Henderson collection.

Fusinus engonius, new species

(Plate 15, Figure 9)

Shell large, moderately slender, early whorls rounded, later whorls angulated at periphery. Nucleus large, consisting of almost two whorls, a little less than the last half whorl sculptured with about eight relatively coarse axial riblets. Several indistinct folds are visible on columella within body whorl. Sculpture consisting of swollen axial ribs and of strong spiral threads, between which on later whorls secondary and tertiary threads lie. Peripheral spiral becoming stronger on later whorls and at same time the ribs become lower and are confined to an area on and adjoining periphery, thus producing peripheral angulation. Toward outer lip the axials become progressively lower and destroy the angulation.

Length 85 mm.; diameter 27.6 mm. (holotype, broken at both ends).

So far as shape of the later whorls is concerned this species is the Bowden representative of *F. haitensis* (Sowerby) (Quart. Jour. Geol. Soc. London, vol. 6, p. 49, 1850; Guppy, vol. 32, p. 524, pl. 28, fig. 2, 1876). There has been some doubt as to whether *haitensis* is a subspecies or variety of *henekeni*, but it is a valid species. Of 13 collections of *Fusinus* from the Cercado and Gurabo formations *haitensis* is found in only four collections, all from the Gurabo formation. Moreover, no other *Fusinus* was collected at these four localities. Therefore, *haitensis* and *henekeni*, which was collected from the Gurabo formation at five localities, on the basis of these collections, are mutually exclusive.

The later whorls of *engonius* are even more angulated than those of *haitensis*, and on all the whorls the ribs are fewer and broader. *F. haitensis* also has more distinctly lamellar growth sculpture. One imperfect immature specimen from the Gurabo formation referred to *haitensis* (the only specimen from U. S. G. S. station 8538) is more slender than the others, and suggests the unnamed Bowden species, but it has the narrow ribs and distinctly lamellar sculpture of *haitensis*. Though the later whorls of *engonius* and *haitensis* are similar, the two species are not closely related if nuclear characters are of any significance. The Bowden species has a stout nucleus sculptured with a few coarse riblets, whereas *haitensis* has a slender nucleus bearing many very fine riblets. Perhaps another species of this phylum is represented by very young and imperfect specimens from one locality in the Cercado formation (U. S. G. S. station 8521), showing a nucleus even stouter and having even fewer coarse riblets. Grabau considered *haitensis* an "accelerated" *henekeni*, but it seems strange that both should be found in beds of the same age, a feature Grabau was under no compulsion to consider, as nothing was then known about the age of the two species. These two species have the same kind of nucleus, though in some specimens of *henekeni* the riblets have almost completely disappeared, and in the National Museum collections *haitensis* is found only in the Gurabo formation, whereas *henekeni* is found in both the Gurabo and underlying Cercado formations. Both these

features support Grabau's supposition, but Maury (Bull. Am. Paleontology, vol. 5, p. 243, 1917) records *haitensis* from the Cercado formation also. If this record is substantiated, it would be difficult to support the idea that *haitensis* is derived from *henekeni*.

Some specimens of *F. dupetit-thourasii* (Kiener), living along the Pacific coast of Central America and Mexico, have angulated later whorls and broad heavy ribs, but generally the ribs disappear and the later whorls are smoothly rounded. Grabau described several varieties of this species.

Six specimens are in the Duerden collection. A fragment of the anterior part of a large *Fusinus*, probably representing this species, in the collections of the United States National Museum, is incorrectly labeled Curaçao, Dutch West Indies.

Type material—Holotype (U. S. Nat. Mus. No. 369443).

NASSARIIDAE ("Nassidae")

TRITIARIA Conrad

Subgenus TRITIARIA s. s.

Conrad, 1865, Am. Jour. Conchology, vol. 1, p. 21.

Type (by monotypy).—Buccinum mississippiensis Conrad. Upper Oligocene, Mississippi.

The subgenus *Tritiaria* s. s. is characterized by its relatively small size, by its large nucleus, the later part of which is sculptured with many curved axial riblets, and by the slight suggestion of a stromboid notch near the base of the outer lip. This subgenus apparently is found only in the upper Eocene and Oligocene deposits of the Gulf Coastal Plain. Steward (Proc. Acad. Nat. Sci. Philadelphia, vol. 78 (1926), p. 391, 1927) has pointed out the similarity of *Phos hilli* Harris, a Jackson species, to the genotype. *Buccinum vicksburgensis* Aldrich (Jour. Cincinnati Soc. Nat. Hist., vol. 8, p. 149, pl. 2, fig. 9, 1886), from the upper Oligocene Byram marl, seems to be a similar species, but I have not seen specimens.

Subgenus ANTILLOPHOS, new subgenus

Type.—Cancellaria candei d'Orbigny. Recent, West Indies.

Shell medium-sized, moderately stout. Nucleus consisting of between three and four rapidly enlarging whorls, the last whorl or more bearing a spiral thread near anterior edge, above which, on the last quarter whorl, lie about five widely spaced, strongly curved, protractive axial riblets. Aperture moderately wide, forming a short, wide, deeply emarginate canal. Siphonal fasciole broad, low, limited by a narrow spiral thread, bearing spiral threads and weak axial ribs. Columella bearing a basal fold, behind which lies a groove, followed by a slight swelling. Edge of inner lip above basal fold bearing several irregular denticles. Parietal wall bearing a ridge near its posterior edge. Near base of outer lip lies a shallow stromboid notch. Interior of outer lip strongly lirate. Sculpture consisting of axial ribs and spiral threads.

It is quite apparent that several genera are represented among the 27 species of Miocene fossils from tropical America referred to the genus *Phos*, and that probably none of them are congeneric with "*Murex*" *senticosus* Linné, the type of *Phos* Montfort (Conch. syst., vol. 2, p. 495; type, by original designation, *Murex senticosus* Linné, Recent, Indo-Pacific) Many nassoid genera have the same general appearance, but it seems desirable to give recognition to pronounced differences in nuclear and apertural features. In attempting to find satisfactory names for the Bowden species I have tried to eliminate the many generic and subgeneric names that have been proposed, but some of them may have been overlooked. None of the Tertiary or living *Phos*-like species from the Caribbean and Panamic regions closely resemble *senticosus*.

Strongylocera Mörch (Cat. Conchy. Yoldi, p. 80, 1852) is the only other name that has been in use for some of these species. Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 178, 1889; Proc. U. S. Nat. Mus., vol. 19, pp. 311–312, 1896) suggested the desirability of using this name for species like *S. textilina* Mörch (=*Nassa unicincta* Say, according to Tryon), which have an operculum different from that of *Phos*. There also are differences in the shell that need not be discussed here. Unfortunately *Buccinum cancellatum* Quoy and Gaimard, the only other species in Mörch's list, is the type of *Strongylocera*, according to the earliest actual designation that could be found (Cossmann, Essais Paléoconch. Comp., pt. 4, p. 141, 1901). This species, according to the figures (Voy. Astrolabe, Moll., pl. 32, pp. 30–31, 1833), is not similar to *unicincta*, and therefore the group of *unicincta*, which is not represented in the Bowden formation, is unnamed.

Antillophos, the new subgenus here proposed, has a longer and less recurved canal than *Phos*, its siphonal fasciole is lower and less strongly sculptured, the edge of the inner lip bears denticles, the aperture is narrower, and the nucleus is larger and stouter, and bears a strong spiral thread that angulates the later whorls. It is more similar to *Tritiaria* and is placed under *Tritiaria* as a subgenus, as it seems to be a descendant of the Eocene and Oligocene species of that genus. The shell is larger than that of *Tritiaria*, the nucleus has a strong anterior spiral thread and fewer axial riblets, the siphonal fasciole is less inflated, and the stromboid notch on the outer lip is deeper.

Of the described species from tropical America the following are placed in this subgenus: *moorei* Guppy, *moorei costaricensis* Olsson, *gabbii* Dall, *estrellensis* Olsson, *elegans* Guppy, *elegans limonensis* Olsson, *subfasciolatus* Böse, *guppyi* Gabb, *metuloides* Dall, *gatunensis* Toula, and *mexicanus* Böse.[1] The strength of the denticles on the

[1] *Phos mexicanus* Dall, 1917 (Proc. U. S. Nat. Mus., vol. 51, p. 578; Recent), needs a new name.

inner lip is variable. On some species (*gatunensis* and *mexicanus*) they are so strong that the shell has a *Cancellaria*-like appearance. Apparently the earliest species of *Antillophos* are of lower Miocene age. According to the figures, some of the Miocene and Pliocene species from the Mediterranean region described by Bellardi as *Phos* (Moll. Piemonte, pt. 3, pp. 4–9, 1882) may belong to *Antillophos*. Living species are found at least in the Caribbean, Panamic, and Mazatlanic regions.

In addition to the *Phos*-like mollusks here described, Guppy and also Dall (Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 82, 1873; Geol. Mag., decade 2, vol. 1, p. 439, 1874; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584, 1903) recorded *Phos solidulus* Guppy from Bowden; Guppy and Dall (Proc. U. S. Nat. Mus., vol. 19, p. 311, 1896; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584, 1903) recorded *Phos gabbii* Dall from Bowden; and Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584, 1903) recorded *Strongylocera guppyi* (Gabb) from Bowden. Both Guppy and Dall also record *Melongena consors* Sowerby from Bowden (Geol. Mag., decade 2, vol. 1, p. 438, 1874 ("*Pyrula melongena* Lin."); Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584, 1903). None of these fossils are in any collection examined, and the records probably are erroneous.

Key to the Bowden species of Antillophos

Shell relatively stout, sculpture coarse, secondary spiral sculpture absent. . . *T.* (*A.*) *moorei*
Shell relatively slender, sculpture fine, secondary spiral sculpture present. . . . *T.* (*A.*) *elegans*

Tritiaria (Antillophos) moorei (Guppy)

(Plate 15, Figures 10, 11)

Phos moorei Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 290, pl. 16, fig. 11. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Phos moorei costaricensis Olsson, 1922, Bull. Am. Paleontology, vol. 9, pp. 290–291, pl. 12, figs. 8, 9.

Not *Phos moorei* Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 250, pl. 40, figs. 7, 8.

Shell relatively large, moderately stout. Nucleus consisting of almost three rapidly enlarging whorls, the last whorl bearing an anterior spiral thread and the last quarter whorl or less sculptured with three to six strongly curved axial riblets lying above the thread. Inner lip bearing weak denticles. Stromboid notch shallow. Sculpture consisting of strong axial ribs (12 to 14 on penult whorl), which near the outer lip are thickened at intervals and the ribs between these varix-like ribs are more closely spaced. Ribs overridden by narrow spiral cords, which are strongly swollen on the ribs (4 on whorls of spire, in addition to one or two weaker threads near suture).

Length 30.9 mm.; diameter 13.5 mm. (slender figured specimen). Length 28.7 mm.; diameter 13.7 mm. (stouter figured specimen). Length 35.3 mm.; diameter 15.8 mm. (largest specimen).

Type locality.—Jamaica (Miocene).

This species is the largest *Phos*-like mollusk at Bowden. It is represented in the Duerden collection by 165 specimens that have remarkably constant characters except that some specimens are a little more slender than others. The specimens from Costa Rica described by Olsson are a little smaller than those from Bowden, but otherwise are too similar to deserve a subspecific name. As Olsson suggested, Maury's *moorei* from the Gurabo formation is a different species. It is more slender and has very fine secondary sculpture. Some of these specimens, on which the secondary sculpture disappears on the later whorls, are very similar to *moorei*, but the secondary sculpture can be seen on the early whorls. The Gurabo specimens probably represent a subspecies of *gabbii* Dall (Proc. U. S. Nat. Mus., vol. 19, pp. 310–311, pl. 29, fig. 4, 1896). Typical specimens of *gabbii* are found in the Cercado formation. They are smaller and stouter than *moorei* and have secondary spiral sculpture. The living West Indian *candei* has finer sculpture and secondary spirals.

The figured specimens are two of six in the Guppy collection labeled "types." On Guppy's figure the columellar lip extends down too far.

Other localities.—Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64061).

Tritiaria (Antillophos) elegans (Guppy)

(Plate 16, Figure 1)

Phos elegans Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 290, pl. 16, fig. 13. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 524. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). ? Engerrand and Urbina, 1910, Bol. Soc. Geol. Mexicana, vol. 6, p. 128. Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 250–251, pl. 40, fig. 10. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 349.

Shell medium-sized, moderately slender. Nucleus consisting of three and a half to four rapidly enlarging whorls, the last two bearing an anterior spiral thread, the last quarter whorl sculptured with five or six widely spaced, curved, axial riblets lying above the thread. Denticles at edge of inner lip faint or absent. Sinus near base of outer lip broad and shallow. Sculpture consisting of narrow axial ribs (19 to 20 on penult whorl), here and there varix-like, overridden by narrow primary spiral threads (7 to 9 on penult whorl). Between the primary threads lies a secondary thread and at places a tertiary thread lies between the secondaries.

Length 21.9 mm.; diameter 9.9 mm. (figured specimen). Length 23.9 mm.; diameter 10.3 mm. (largest specimen).

Type locality.—Jamaica (Miocene).

This finely sculptured species is represented in the Duerden collection by 47 specimens. Denticles at the edge of the inner lip are quite or virtually absent. This species also is found in abundance in the

Gurabo formation. A Costa Rican subspecies, *elegans limonensis* Olsson (Bull. Am. Paleontology, vol. 9, pp. 291–292, pl. 12, figs. 12–13, 1922), from the upper Miocene beds at Limon, runs a little larger and has finer secondary spirals. Engerrand and Urbina give no description or figure of the specimens from Zuluzum, Chiapas, identified by them as *elegans*. "*Phos elegans* variety *portoricoensis*" Hubbard (New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, p. 150, pl. 22, fig. 11, 1921), from the Quebradillas limestone of Porto Rico, is based on unsatisfactory material. "*Phos*" *oxyglyptus* Dall and Simpson, a living species from Porto Rico, has the same kind of nucleus and the same kind of sculpture, but it is more slender, and has a deeper stromboid notch and heavy denticles on the inner lip.

The figured specimen is one of eight in the Guppy collection labeled "types."

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64062).

ENGONIOPHOS, new genus

Type.—*Phos erectus* Guppy. Miocene, Jamaica.

Shell medium-sized, moderately stout, later whorls angulated near suture. Nucleus consisting of a little more than three whorls, the last part sculptured with five to eight curved axial riblets. Aperture relatively narrow. Anterior canal short, wide, recurved, deeply emarginate. Siphonal fasciole broad, high, sculptured with crude spirals, limited by a narrow spiral thread. Columella bearing a basal fold, followed by a groove, behind which lies a swelling. Posterior part of parietal wall bearing a ridge. Outer lip bearing a narrow deep stromboid notch. Interior of outer lip strongly lirate. Sculpture consisting of heavy axial ribs and fine spiral threads.

The unusually deep stromboid notch and the angulated later whorls are the most characteristic features of this genus. The nucleus is not sculptured with a spiral thread as in *Antillophos*, the siphonal fasciole is more inflated, the inner lip does not bear any denticles, and the stromboid notch is deeper. *Phos* has a more slender nucleus, a shallower stromboid notch, a shorter canal, and a more bulging and lamellar siphonal fasciole. *Engoniophos* probably is closely related to the group of *Nassa unicincta* Say, generally known as "*Strongylocera*" (see p. 260), which has a shorter and more deeply emarginate canal, broader siphonal fasciole, a broad flattened area between the inner lip and the anterior edge of the fasciole, and only a slight trace of a stromboid notch. The group of *unicincta* is represented in the Caribbean region by the Miocene fossils *costatus* Gabb, *fasciolatus* Dall, and *solidula* Guppy. No fossil or living *Phos*-like species that are congeneric with "*Phos*" *erectus* could be found.

Engoniophos erectus (Guppy)

(Plate 16, Figures 2, 3)

Phos erectus Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 81, pl. 1, fig. 1 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 213, 1921). Guppy, 1874, Geol. Mag., decade 2, vol. 1, pp. 410–411, pl. 16, fig. 1; p. 439 (list).

Outline, nucleus, and aperture as described under the genus. Sculpture consisting of heavy axial ribs (10 or 11 on penult whorl) that are swollen at angulation of later whorls and are overridden by spiral threads, which generally become progressively weaker on later whorls, except at base. Near suture and between primaries of early whorls lie very fine spiral threads.

Length 24.2 mm.; diameter 10.1 mm. (holotype).

Type locality.—Jamaica (Miocene).

This curious species is represented by 11 specimens in the Duerden collection. Even immature specimens have the characteristic deep stromboid notch on the outer lip. One specimen (fig. 3) has stronger spirals on the central part of the body whorl, and the peripheral spiral is stronger, producing a more pronounced angulation.

Maury (Bull. Am. Paleontology, vol. 10, p. 362, 1925) records an undescribed and unfigured "*Phos* cf. *erectus*" from the Brasso beds (middle Miocene) of Trinidad.

The figured specimen (fig. 2), the largest of three in the type lot, agrees in dimensions with Guppy's figure and is regarded as the holotype. His figure, however, is very poor.

Type material.—Holotype (U. S. Nat. Mus. No. 115487).

NASSARIUS Duméril

Subgenus NASSARIUS s. s.

Duméril, 1806, Zoologie Analytique, p. 166. Regarded as a substitute name for *Nassa* Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 71; type (by monotypy), *Buccinum mutabile* Linné. Not *Nassa* ("Bolten") Roeding, 1798, Mus. Bolt., pt. 2, p. 132.

Type (*see above*).—*Buccinum mutabile* Linné. Recent, Mediterranean Sea.

Nassa Lamarck, 1799, is a homonym of *Nassa* ("Bolten") Roeding, 1798 (see Dall, Bull. Mus. Comp. Zool. Harvard College, vol. 43, p. 306, 1908). Dall proposed to substitute *Alectrion* Montfort (Conch. Syst., vol. 2, pp. 566–567, 1810; type, by original designation, *Alectrion papillosus* (Linné) = *Buccinum papillosum* Linné) for it, but *Alectrion* certainly represents a different genus. Iredale (Proc. Malac. Soc. London, vol. 12, pp. 79–84, 1916) considers that Duméril's reference in the preface to works by Cuvier, Poli, and Lamarck is sufficient ground for considering the names, all of which end in *ius*, as substitute names for genera that can be allotted to those authors in the order named. Whether this interpretation will stand is open to question, as there is no direct evidence that *Nassarius* is a substitute for *Nassa* Lamarck, the citation being "Les nassiers (nassarius)." The objection

that the name is written with a small "n" (see article 8 of Code) probably need not be considered. If *Nassarius* were regarded as a new name, it would be a genus without species and the type would become by monotypy *Buccinum arcularia* Linné (Froriep, Duméril's Anal. Zoologie, p. 167, 1806; quoted from Iredale, Proc. Malac. Soc. London, vol. 12, p. 83, 1916; "*ancularia*" by error). In this event the name would not be available for the Bowden group.

The subgenus *Nassarius* s. s. is not represented by fossil or living species in the Caribbean region. Its shell is of medium size, the outer lip has a broad, very shallow stromboid notch, the basal columellar fold or twist stands far out, and the parietal callus does not stand out from the parietal wall.

Subgenus UZITA H. and A. Adams

H. and A. Adams, 1853, Genera Recent Mollusca, vol. 1, p. 120.

Type (*by subsequent designation, Cossmann, 1901, Essais Paléoconch. Comp., pt. 4, p. 205*).—*Buccinum migum* Bruguière (cited by H. and A. Adams as "*miga* Adans."). Recent, West Africa.

Shell relatively small, stout. Nucleus stout, consisting of about three smooth whorls. Aperture wide, bearing at base a deep, wide emargination. Siphonal fasciole wide, bulging, set off by a groove. Columella bearing a basal fold, above which lies a narrow groove. Inner lip thick, bearing irregular denticles. Parietal callus thick, its edge standing out from parietal wall. Parietal ridge short and heavy. Interior of outer lip lirate, the liration at the base thick and with the columellar fold constricting off the basal emargination. Sculpture consisting of axial ribs, one of which at the outer lip is varix-like, and of spiral threads.

The siphonal notch of *Uzita* is more constricted off from the rest of the aperture than in *Nassarius* s. s., the parietal callus does not spread out so far, but it stands out from the parietal wall, a parietal ridge is present, the basal columellar fold is less prominent and less twisted along the margin of the basal emargination, and the outer lip is varicose and has no notch near its base. Perhaps *Nassarius* and *Uzita* will eventually be placed apart generically. In that event *Uzita* apparently will become a subgenus of *Hima* ("Leach") Gray (Leach's Synopsis Mollusca Great Britain, p. 123, 1852), if *Hima minuta* (Pennant) is taken as the type of *Hima*. Inasmuch as *Buccinum minutum* Pennant is a synonym of *Buccinum incrassatum* Ström, accredited by some writers to Müller, such a type designation would have the same result as the invalid citation of *incrassatum* as the type (Cossmann, Essais Paléoconch. Comp., pt. 4, p. 210, 1901; Dall, Bull. Mus. Comp. Zool. Harvard College, vol. 43, p. 306, 1908). In all probability *Hinia* ("Leach") Gray (Ann. Mag. Nat. Hist., vol. 20, p. 269, 1847) and *Hima* were intended for the same thing, as precisely the same three species were cited under each name, but both names are in use and *Buccinum reticulatum* Linné has been designated the type of *Hinia* (Cossmann, cited above, p. 204, 1901). *Uzita* differs from the

group of *Buccinum incrassatum* in having the siphonal canal more curved and more constricted from the rest of the aperture, and in having the parietal callus stand out from the parietal wall.

According to Cossmann, the earliest European species of *Uzita* are of Miocene age. No American species seems to be older.

In addition to the two species here described Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584, 1903) recorded "*Nassa* near *bidentata* Emmons" from Bowden. No specimens similar to *bidentata* are in the collections.

Key to the Bowden species of Uzita

Shell stout, length not exceeding 8.5 mm., axial ribs wide, secondary spirals not present, spire whorls concave near base.....*N.* (*U.*) *cercadensis*
Shell moderately stout, length reaching 11 mm., axial ribs relatively narrow, secondary spirals present, spire whorls not concave near base.....*N.* (*U.*) *gurabensis*

Nassarius (Uzita) cercadensis (Maury)

(Plate 16, Figure 4)

Nassa incrassata Guppy (part, not Müller), 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list).

Nassa ambigua Dall (not Montagu), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Alectrion cercadensis Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 254, pl. 41, figs. 19–20.

Shell very small, stout. Nucleus consisting of about three whorls, the last whorl bearing at its end two or three obscure, curved, axial riblets. Siphonal notch strongly constricted from rest of aperture. Inner lip and parietal callus bearing irregular denticles. Sculpture consisting of broad, swollen axial ribs (13 or 14 on body whorl), replaced at outer lip by a varix-like thickening, overridden by spiral threads (4 to 6 on whorls of spire). On whorls of spire the spirals increase slightly in width anteriorly, the anteriormost one being widest, or a narrow low spiral is visible below this wide spiral. In either event a slight concavity is produced in outline of whorls.

Length 5 mm.; width 3.2 mm. (figured specimen). Length 8.2 mm.; diameter 4.8 mm. (unusually large specimen).

Type locality.—Bluff 2 or Bluff 3 (not designated), Cercado de Mao, Rio Mao, Dominican Republic (Cercado formation).

"*Alectrion*" *cercadensis*, found in both the Cercado and Gurabo formations, at any locality shows a considerable range of variation in the coarseness of the spiral threads and in the number of axial ribs. The Bowden specimens are not quite like the Dominican shells, as they are smaller and have slightly finer sculpture. The specimen represented by Maury's figure 20, which has a length of 5.9 millimeters and a diameter of 3.3 millimeters, is taken as the lectotype. "*Alectrion*" *losquemadica* Maury (Bull. Am. Paleontology, vol. 5, pp. 255–256, pl. 41, figs. 22–23, 1917; Gurabo formation) is stouter and has wider spirals. The specimen shown in figure 22 is taken as the

lectotype. All these specimens need comparison with "*Nassa*" *caribaea* Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 353, pl. 46, fig. 38, 1881; Pliocene, Limon, Costa Rica). "*Nassa*" *praeambigua* Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 64, pp. 506–507, pl. 22, figs. 6–7, 1913; lower Miocene, Culebra formation, Panama Canal Zone) and *brassica* Maury (Bull. Am. Paleontology, vol. 10, pp. 362–363, pl. 47, fig. 12, 1925; middle Miocene, Trinidad) have heavier and fewer spirals. The living West Indian *ambigua* Montagu, as Maury has pointed out, is larger and has a fewer-whorled and blunter nucleus. "*Nassa*" *hotessieri* d'Orbigny, also living in the West Indies, has the same kind of nucleus as *cercadensis*, but the shell is larger and has a heavier parietal ridge and denticles, and more reticulate sculpture.

This species is represented in the Henderson collection by about 100 specimens, most of which are badly worn. The figured specimen has the very base of the inner lip broken. Among these specimens only one is unusually large. There also is an unusually large specimen among about 150 shells from a Dominican locality (U. S. G. S. station 8525).

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Lectotype (Cornell University).

Nassarius (Uzita) gurabensis (Maury)

(Plate 16, Figures 5, 6)

Nassa near *consensa* Ravenel, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Alectrion gurabensis Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 255, pl. 41, fig. 21.

Shell small, stout or moderately stout. Nucleus consisting of between three and four whorls, the last whorl bearing near its end a few obscure, curved, axial riblets extending upward from a slightly elevated area near anterior edge of whorl. Sculpture consisting of narrow swollen axial ribs (10 to 13 on body whorl), overridden by spiral threads (4 to 7 on penult whorl). On some specimens very fine secondary spiral threads lie in interspaces on body whorl and on later whorls of spire, but on other specimens they are present only on body whorl below periphery.

Length 7.3 mm.; diameter 4.2 mm. (slender figured specimen). Length 7.6 mm.; diameter 4.5 mm. (stout figured specimen). Length 11 mm.; diameter 5.9 mm. (largest specimen).

Type locality.—Zone D, Rio Gurabo at Los Quemados, Dominican Republic (Gurabo formation).

As here interpreted, this species, represented by 15 specimens in the Henderson collection, embraces relatively large and finely sculptured specimens of *Nassarius* from the Gurabo formation that have smoothly inflated whorls and bear secondary spirals. They also are larger and more slender than *cercadensis*, though some are stouter than others,

and they have narrower ribs. The secondary spirals are present either over all of the latter whorls or only on part of the body whorl. None of the Bowden specimens is as large as one specimen from the Gurabo formation that has a length of 12.4 millimeters. The holotype has the following dimensions: length 10.8 millimeters; diameter 6.4 millimeters. There are 15 specimens in the Henderson collection referred to *gurabensis*, most of which, like those of *cercadensis*, are badly worn. "*Nassa*" *consensa* Ravenel, found in waters off Florida and northward to Hatteras, is larger and generally has finer spiral sculpture.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (Cornell University).

TRACHYPOLLIA, new genus

Type.—Trachypollia sclera, new species.

Shell small, moderately slender, pillar short. Nucleus stout, consisting of about three smooth whorls rapidly enlarging in diameter. Aperture rather wide, contracted to form a short, wide, oblique, recurved, moderately emarginate canal. Siphonal fasciole broad, moderately inflated. Between it and edge of inner lip lies a narrow umbilical groove. Edge of inner lip standing out from pillar on adult shells. Inner lip bearing near base of columella two or three crude low denticles and also a short low parietal ridge. Interior of outer lip bearing five elongate denticles, the posteriormost one and the parietal ridge forming a posterior channel. Sculpture consisting of swollen axial ribs and of crude beaded spiral threads.

The genus *Trachypollia* is proposed for a small Bowden species. It apparently is close to *Pollia* Sowerby (Gen. Rec. Fossil Shells, vol. 1, footnote on second page under *Purpura*, 1834; type, by monotypy, *Triton undosus* Lam. = *Buccinum undosum* Linné, Recent, Indo-Pacific), which Iredale (Proc. Malac. Soc. London, vol. 10, p. 221, 1912; Trans. Proc. New Zealand Inst., vol. 47, pp. 466–467, 1915) has shown replaces the absolutely synonymous *Tritonidea* Swainson (Treatise Malac., p. 302, 1840; type, by subsequent designation, Gray, Proc. Zool. Soc. London, pt. 15, p. 133, 1847, *Buccinum undosum* Linné), a name that is more generally used. Since the names in the Museum Boltenianum have come into use it has become customary to replace *Tritonidea* with *Cantharus* ("Bolten") Roeding (Mus. Boltenianum, pt. 2, p. 132, 1798; type, by subsequent designation, Suter, Man. New Zealand Moll., p. 393, 1913, *Buccinum tranquebaricus* Gmelin, Recent, Indian Ocean),[1] but the type of *Cantharus* is so different that there is no reason to believe that they represent the same genus, or that *Pollia* (or *Tritonidea*) should be placed as a subgenus under *Cantharus*.

Trachypollia is much smaller than *Pollia*. Its canal is longer, the columella lacks a basal fold, the edge of the inner lip has no denticles,

[1] To be exact the type should be cited as *Cantharus globularis* ("Bolten") Roeding = *Buccinum tranquebaricus* Gmelin, as Gmelin's species is renamed.

the posteriormost denticle on the outer lip and the parietal ridge are weaker and less converging, and the outer lip is not varicose. *Trachypollia* also resembles the genus known as *Engina* Gray, which has a series of denticles and ridges along the entire edge of the inner lip, a more definitely formed posterior channel, and no umbilical groove. The name *Engina* was proposed by Gray in 1839 (Zool. Capt. Beechley's Voy. (Blossom), p. 112) for two unfigured new species *zonata* and *elegans* from the "Atlantic Ocean." If Gray's citation of "Enzina (zonata), Gray, 1839" (Proc. Zool. Soc. London, pt. 15, p. 133, 1847) is accepted as a type designation, *zonata* is the type. *Enzina* in this citation may be regarded as an error for *Engina*. According to Tyron (Man. Conch., vol. 5, p. 196, 1883), *zonata* is a "lost species." He regards (p. 192) the other species, *elegans*, as "almost certainly" the same as "*Ricinula*" *turbinella* Kiener, the West Indian species that is generally regarded as the type (Cossmann, Essais Paléoconch. Comp., pt. 4, p. 142, 1901).

Possibly "*Nassarina*" *grayi* Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, pl. 32, fig. 12*a*, 1889; Recent, West Indies) is a modern *Trachypollia*, though it has a less definitely constricted pillar and canal, a less oblique canal, and heavier denticles on the outer lip. At all events this species is not a *Nassarina* (see p. 279). "*Nassarina*" *solida* Dall (Proc. U. S. Nat. Mus., vol. 51, p. 579, 1917; Recent, Gulf of California) more probably represents *Trachypollia*, but it has a wider and slightly less deeply emarginate canal and a less inflated siphonal fasciole.

Trachypollia sclera, new species

(Plate 16, Figures 7, 8)

Shape, nucleus and aperture as described above. Sculpture consisting of broad axial ribs overridden by spiral threads. Primary spirals crude, greatly swollen on summits of ribs. In each interspace on later whorls lies a fine secondary spiral.

Length 8.2 mm.; diameter 3.8 mm. (holotype, tip broken).

This small species is represented by seven shells in the Duerden collection. The holotype is worn—in fact, all the shells are more or less worn or broken—but has a perfectly formed inner lip. On most of the other specimens the edge of the inner lip is not raised. The holotype has all the appearances of a mature shell. No similar fossil or living species has been described from the West Indian region. "*Tritonidea*" *pauper* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 129, pl. 4, fig. 8*c*, 1890; lower Miocene, Florida), aside from differences in the shape and in the nucleus, has a wider aperture and canal, denticles at the edge of the inner lip, and a more definite posterior channel.

Type material.—Holotype (U. S. Nat. Mus. No. 135520).

PYRENIDAE ("Columbellidae")

The family "Columbellidae" is represented by a large number of genera and species in the Miocene deposits of tropical America, embracing *Conus*-like, *Terebra*-like, *Mitra*-like, and *Phos*-like species, in addition to the more common columbellid forms. Several of these genera are now wholly extinct in the Caribbean region. The genus *Strombina*, represented by about 21 Caribbean Miocene species, the genus *Parametaria*, represented by several remarkable *Conus*-like species similar to a living species in the Gulf of California, and the *Terebra*-like genus *Strombinella* are no longer found in the Caribbean region, but both *Strombina* and *Parametaria* are living on the Pacific coast of Central America or Mexico. It has also been supposed that the genus *Metulella* is extinct, but "*Nassarina*" *columbellata* Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 182, 1889), dredged at a depth of 124 fathoms off the Yucatan coast and also at 100 fathoms off Barbados, has all the features of the short-canaled Metulellas.

COLUMBELLA Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 70.
Type (*by monotypy*).—*Voluta mercatoria* Linné. Recent, West Indies.

Shell medium-sized, stout, spire low. Nucleus subcylindrical, consisting of about one and a half smooth whorls. Aperture long, narrow, shaped like a slightly flexed S, the base rather deeply emarginate, the posterior end forming a narrow channel. Siphonal fasciole slightly swollen. Columella bearing a heavy basal denticle, followed by a narrow deep groove, behind which lies another denticle. Basal edge of inner lip bearing a series of denticles. Posterior part of parietal wall bearing a deposit of callus along the posterior channel and on some large shells a few denticles. Outer lip varicose, its outer edge convex forward, its inner edge bulging toward columella at middle, bearing heavy *Cypraea*-like denticles. Sculpture consisting of rounded spiral cords and of crude axials on and above the shoulder.

The following species are the earliest American Columbellas in the restricted sense. Before *submercatoria* was described the earliest known species (*C. rusticoides* Heilprin) was of Pliocene age. According to Cossmann (Essais Paléoconch. Comp., pt. 4, p. 232, 1901), no European species is found in deposits earlier than Pliocene.

Key to the Bowden species of Columbella

Sculpture consisting of relatively fine spiral cords and of crude axials on and above shoulder..... *C. submercatoria*
Sculpture consists of heavy spiral cords..... *C. platynema*

Columbella submercatoria Olsson

(Plate 16, Figure 9)

Columbella submercatoria Olsson, 1922, Bull. Am. Paleontology, vol. 9, pp. 297–298, pl. 13, figs. 33–34.

Shell relatively small, whorls somewhat shouldered. Nucleus cylindrical, consisting of one and a half whorls. Basal columellar denticles heavy and

standing out. Basal edge of inner lip bearing five widely spaced denticles. Parietal wall bearing only the callus adjoining posterior channel as in small and in most large specimens of *mercatoria*. Sculpture consisting of spiral cords, wrinkled by crude axials on and above shoulder.

Length 12.2 mm.; diameter 6.6 mm. (figured specimen).

Type locality.—Red Cliff Creek, Costa Rica (Gatun formation).

This *Columbella* is represented by one specimen that is much smaller than Olsson's specimens and has more shouldered whorls, and the shoulder has more distinct axial wrinkles. It is somewhat worn, but it shows faint rosy and brownish blotches. This species, or at least the Bowden specimen, which seems to be the same as those from Costa Rica, is so similar to *mercatoria*, even as to color pattern, that it should perhaps be considered a subspecies. It is considerably smaller than *mercatoria*, even the small Bowden specimen having adult apertural features, particularly the heavy basal columellar denticles, though the parietal wall bears no denticles. It also has weaker and narrower spiral cords.

The specimen represented by figure 33 is taken as the lectotype.

Other localities.—Gatun formation (middle Miocene), Costa Rica.

Type material.—Lectotype (Cornell University).

Columbella platynema, new species

(Plate 16, Figure 10)

Shell medium-sized, stout, biconic. Base of columella bearing two heavy denticles. Edge of inner lip bearing about nine denticles, the posteriormost ones extending in farther than the others. Posterior parietal callus absent on only specimen. Sculpture consisting of broad widely spaced spiral cords.

Length 17.1 mm.; diameter 9.6 mm. (holotype).

It seems strange that both this species and *submercatoria* should be represented by only one specimen. *C. platynema* is more evenly biconic than *submercatoria* and has heavier spiral cords. The apex of the only specimen is badly worn. There are no similar living or fossil Caribbean species.

Type material.—Holotype (U. S. Nat. Mus. No. 369449).

PYRENE ("Bolten") Roeding

Subgenus PYRENE s. s.

Roeding, 1798, Museum Boltenianum, pt. 2, p. 134.

Type (by monotypy).—Pyrene rhombiferum ("Bolten") Roeding (=*Buccinum punctatum* Bruguière and *Voluta discors* Gmelin of authors). Recent, Indo-Pacific.

Pyrene, also known as *Conidea* Swainson, which has the same type (Treatise Malac., p. 313, 1840; type by monotypy, *Columbella semipunctata* Lamarck (=*Buccinum punctatum* Bruguière), is given generic standing because of the weak or relatively weak armature on the columella and inner and outer lips, and because of its less twisted aperture. No fossil or living species of *Pyrene* in the restricted sense are found in the Caribbean region.

Subgenus EURYPYRENE, new subgenus

Type.—Pyrene (*Eurypyrene*) *eurynotum*, new species.

Shell medium-sized, stout, biconic, spire low. Nucleus subcylindrical, consisting of about one and a half whorls. Aperture relatively wide, forming at posterior end a broad channel roofed over by the outer lip which is arched over, base deeply emarginate. Siphonal fasciole bulging slightly. Columella smooth, edge of inner lip bearing obscure denticles. Callus at posterior channel bearing short ridges. Outer lip varicose over broad area, bearing very shallow sinus near suture, middle of its inner edge not swollen, interior bearing relatively long lirations. Sculpture consisting of spiral threads at base.

Eurypyrene has a wider aperture than *Pyrene* s. s., the interior of its outer lip does not bulge inward, and bears lirations rather than denticles, the posterior channel is wider and shorter and is bordered on the parietal wall by a ridged callus. *Brachelixella* Sacco (Moll. Piemonte, pt. 6, p. 34, 1890; type, by monotypy, *Columbella klipsteinii* Michelotti, Miocene, Italy) has a narrow aperture and narrow posterior channel, like *Pyrene*. No living species of *Eurypyrene* could be found. The living West Indian *Columbella ovulata* Lamarck, which belongs in the genus *Conella* Swainson (Treatise Malac., p. 312, 1840; type, by monotypy, *Conella picata* Swainson, = *Columbella ovulata* Lamarck), does not have the bordered and denticulate inner lip of *Pyrene* and *Eurypyrene*.

"Conus" prototypus Guppy (Proc. Sci. Assoc. Trinidad, pt. 3, pp. 171–172, 1867; Reprint, Bull. Am. Paleontology, vol. 8, pp. 198–199, 1921; upper Miocene, Trinidad) represents some kind of *Pyrene*, but the outer lip of the only specimen is broken.

Pyrene (Eurypyrene) eurynotum, new species

(Plate 16, Figures 11, 12)

Columbella sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Pillar slightly constricted, whorls slightly turreted. Nucleus and aperture as described under the subgenus. Sculpture consisting of weak spiral threads on anterior half of body whorl. Very obscure narrow axials, which perhaps are exaggerated growth lines, are visible on shoulder of body and preceding whorls.

Length 14 mm.; diameter 7.8 mm. (holotype). Length 15.5 mm.; diameter 8.1 mm. (other figured specimen).

Pyrene eurynotum is represented by two species, one in the Henderson collection and the other in the Johns Hopkins University collection. Both specimens are badly worn, especially on the spire, and the shape of the early whorls is not known. *"Columbella" inflata* (Gabb) (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 350, pl. 18, fig. 14, 1922; Miocene, Dominican Republic) is a *Eurypyrene*, but is larger and has a wider aperture and more turreted whorls. *"Colum-*

bella inflata" *brassica* Maury (Bull. Am. Paleontology, vol. 10, p. 363, pl. 47, fig. 8, 1925; middle Miocene, Trinidad) is more similar to *eurynotum*, but is larger and has more bulging whorls, a higher spire, and a more constricted pillar.

Type material.—Holotype (U. S. Nat. Mus. No. 135512).

MITRELLA Risso

Subgenus MITRELLA s. s.

Risso, 1826, Histoire naturelle des principales productions de l'Europe Méridionale, vol. 4, p. 247.

Type (*herewith designated*).—*Mitrella flaminea* Risso (=*Murex scriptus* Linné). Recent, Mediterranean.

Shell medium-sized, moderately slender, spire high, pillar slightly constricted. Nucleus slender, consisting of about one and a half bulging whorls, the first part rather loosely coiled. Aperture relatively wide. Anterior canal virtually absent, the outer lip extending down to base of aperture without any constriction. Siphonal notch shallow. Columella slightly bulging at base. Inner lip bearing slender denticles. Parietal callus thin except at posterior channel. Outer lip somewhat varicose, bearing a very shallow broad notch near suture, the interior bearing heavy denticles. Sculpture limited to weak spiral cords on pillar.

"L'espèce suivante [*Columbella scripta* (Linné)] peut être considérée comme type" (Bucquoy, Dautzenberg, and Dollfus, Moll. Roussillon, vol. 1, p. 73, 1882) is not considered a valid type designation, nor are Cossmann's and Pace's designations of *Murex scriptus* Linné (Essais Paléoconch. Comp., pt. 4, p. 235, 1901; Proc. Malac. Soc. London, vol. 5, p. 44, 1902), although the designation here made has the same effect.

The subgenus *Mitrella* s. s. has virtually no anterior canal, and the pillar is only slightly constricted. Perhaps the following species with its thick shell and unconstricted pillar should be placed in a different group, though it does not belong in *Nitidella* Swainson (Treatise Malac., p. 313, 1840; type, by monotypy, *Columbella nitida* Lamarck, Recent, West Indies), where it is placed by some writers.

Mitrella (Mitrella) ocellata bowdenensis, new subspecies

(Plate 16, Figure 13)

Nitidella near *cribraria* Lamarck, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol 3, pt. 6, p. 1584 (list).

Shell relatively small, very stout, very thick, pillar not constricted. Apex broken on all specimens. Aperture narrow. Inner lip bearing low broad denticles. Outer lip heavily thickened, slightly everted at base, the interior bearing heavy denticles. Sculpture consisting of weak spiral cords on pillar. Color pattern consisting of a light brownish meshwork encircling light blotches.

Length 8.4 mm.; diameter 4.2 mm. (holotype, apex broken). Length 8.9 mm.; diameter 4.6 mm. (largest specimen, apex broken).

This interesting columbellid is represented by five specimens, all of which are in the Henderson collection. All have broken apices. They are so similar to the living West Indian *Mitrella ocellata* (Gmelin), more generally known by the Lamarckian name of *cribraria*, that perhaps they should not be separated even subspecifically. According to the material at hand, however, the Bowden specimens are considerably smaller than full-grown living specimens, and they also are stouter and have a more heavily marginized aperture than living specimens of the same size. But in all other features, even in the color pattern, the fossils are duplicates of living shells. They even have broken apices like beach specimens of living shells. In view of the discovery of these fossils it is not surprising that there is some dispute as to whether *ocellata* is now living on both sides of Central America, for similar shells are also found at Panama and northward to Lower California. Those who refuse to accept the belief that the same species is living on both sides of Central America use the name *guttata* Sowerby for the Pacific shells. The Pacific shells seem to be a little more slender than those from the Caribbean Sea.

Type material.—Holotype (U. S. Nat. Mus. No. 135522).

Subgenus COLUMBELLOPSIS Bucquoy, Dautzenberg, and Dollfus

Bucquoy, Dautzenberg, and Dollfus, 1882, Les mollusques marins du Roussillon, vol. 1, p. 77.

Type (by original designation).—Columbella minor Scacchi. Recent, Mediterranean.

Shell small, slender, pillar strongly constricted. Nucleus consisting of about one and a half smooth whorls. Aperture definitely constricted to form a short, wide, slightly emarginate anterior canal. Siphonal fasciole barely bulging. Base of columella bearing a slight bulge. Edge of inner lip obscurely denticulate. Outer lip varicose, bearing a faint notch near suture, the interior bearing a few heavy denticles. Parietal callus thin except at posterior end. Sculpture consisting of spiral threads confined to pillar.

Columbellopsis has a definite anterior canal and a strongly constricted pillar. For some time it has been customary to refer all smooth American columbellids to the genus *Astyris* H. and A. Adams (Gen. Rec. Moll., vol. 1, p. 187, 1853; type, by subsequent designation, Cossmann, Essais Paléoconch. Comp., pt. 4, p. 238, 1901, *Columbella rosacea* Gould, Recent, northeast coast of North America), the type of which has a thin shell, wide aperture, and thin, smooth inner lip.

Key to the Bowden species of Columbellopsis

Shell relatively stout, pillar moderately constricted..... *M. (C.) lissa*
Shell very slender, pillar strongly constricted.
  Nucleus slender..... *M. (C.) lepta*
  Nucleus very stout..... *M. (C.)* species

Mitrella (Columbellopsis) lissa, new species

(Plate 16, Figure 14)

Astyris sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell medium-sized, relatively stout, whorls of spire slightly bulging. Nucleus stout, consisting of about one and a half smooth whorls. Aperture relatively wide. Base of columella not swollen. Outer lip thickened, slightly constricted at beginning of anterior canal, the interior bearing elongate denticles. Sculpture limited to weak spiral threads on pillar.

Length 8.3 mm.; diameter 3.6 mm. (holotype).

This species is represented by five specimens in the Henderson collection, all of which are worn. The outer lip is not so strongly constricted along the anterior canal as in the type species. The living West Indian *M. perpicata* (Dall and Simpson) is larger and has a stouter and wider canal.

Type material.—Holotype (U. S. Nat. Mus. No. 369451).

Mitrella (Columbellopsis) lepta, new species

(Plate 16, Figure 15)

Astyris caribaea Dall (not Gabb), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell small, very slender, whorls of spire flat, body whorl subangular at periphery, pillar strongly constricted. Nucleus consisting of about one and a half whorls. Outer lip definitely constricted at beginning of anterior canal. Inner lip bearing four to six relatively strong denticles. Sculpture consisting of relatively strong and coarse spiral threads on pillar.

Length 6 mm.; diameter 2.3 mm. (holotype, tip broken). Length 8 mm.; diameter 2.7 mm. (largest unbroken specimens).

All of the 13 specimens of this slender species in the Henderson collection are worn and broken. The outer lip is more strongly constricted at the beginning of the anterior canal than in *lissa,* the canal and pillar are more curved, and the inner lip is definitely denticulate. Four specimens in the Guppy collection are labeled "*Columbella caribea* Gabb," which is a *Strombina,* as described by Gabb. It should be pointed out that "*Strombina caribaea*" *micra* Pilsbry is not a *Strombina,* but is a *Mitrella* and seems to be a synonym of "*Astyris*" *debooyi* Maury.

M. lepta is very similar to, or perhaps the same as, a living West Indian and Floridian species that goes under the name of *fusiformis* d'Orbigny. According to d'Orbigny's figure (Moll. Cuba, Spanish ed., pl. 21, figs. 25–27, 1842 ?), the body whorl of *fusiformis* is bulging and rounded. This is not a matter of growth stage, as d'Orbigny gives a length of six millimeters. *M. lepta* also is found in the Cercado and Gurabo formations.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 369452).

Mitrella (Columbellopsis) species

Three immature fragmentary shells in the Johns Hopkins University collection (U. S. Nat. Mus. No. 369453) seem to represent a species of *Columbellopsis* that has a remarkably stout cylindrical nucleus. The pillar is strongly constricted and is sculptured with spiral threads. Otherwise the shell is smooth. The whorls bulge more than in *M. lepta*. The dimensions of the largest specimen are as follows: length 5.6 millimeters, diameter 2 millimeters.

ANACHIS H. and A. Adams

Subgenus ANACHIS s. s.

H. and A. Adams, 1853, Genera Recent Mollusca, vol. 1, p. 184.
Type (*by subsequent designation, Tate, 1875, Woodward's Man. Mollusca, ed. 3, Appendix, p. 13*).—*Columella scalarina* Sowerby. Recent, Panama.

The subgenus *Anachis* s. s. embraces relatively large, stout species that have virtually no anterior canal and heavy axial ribs. It is not represented in the Bowden formation.

Tate's type designation would have escaped attention without Pace's valuable list of columbellid names (Proc. Malac. Soc. London, vol. 5, pp. 41–46, 1902). It should be noted, however, that many of the type designations that Pace cites as having been made by earlier workers are invalid, as the species cited were given merely as examples. This applies to Chenu's so-called type designations.

Subgenus COSTOANACHIS Sacco

Sacco, 1890, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 6, p. 57.
Type (*by subsequent designation, Pace, 1902, Proc. Malac. Soc. London, vol. 5, p. 43*).—*Columbella* (*Anachis*) *turrita* Sacco. Miocene, Italy.

Shell small, moderately stout, spire high. Aperture relatively wide. Outer lip slightly constricted along the short, wide, moderately emarginate anterior canal. Inner lip bearing fine denticles. Outer lip varicose over a broad area, slightly notched near suture, interior bearing coarse denticles. Sculpture consisting of narrow axial ribs and of spiral threads, the latter generally confined to anterior half of body whorl. (Based on Sacco's figures of type species, supplemented by specimens of "*Buccinum*" *corrugatum* Brocchi, Pliocene, Italy.)

Pace (p. 41) states that "where no type has been specified by the author, or selected by a later writer, I have recorded the first species mentioned in the original list, and this should, in future, be regarded as the type."

As here used *Costoanachis* embraces small axially sculptured columbellids that have at least some trace of an anterior canal; that is, the outer lip is constricted near the base. None are so large or so stout as *Anachis* s. s.

Key to the Bowden species of Costoanachis

Shell small, pillar stout, sutural band absent.....*A.* (*C.*) *orthopleura*
Shell medium-sized, pillar slender, sutural band present.....*A.* (*C.*) *aulata*

Anachis (Costoanachis) orthopleura, new species

(Plate 16, Figure 16)

Shell moderately small, moderately stout, whorls of spire almost flat, pillar stout. Nucleus consisting of about one and a quarter whorls. Anterior canal short. Inner lip bearing fine denticles. Outer lip bearing coarse elongate denticles. Sculpture consisting of almost vertical heavy axial ribs (14 on penult whorl), and of coarse spiral cords on pillar, and of weak spiral threads on periphery of body whorl and at base of preceding whorl.

Length 6.4 mm.; diameter 2.7 mm. (holotype).

A. orthopleura is represented only by the holotype. It is half again as large as *A. exilis* (Gabb) (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 350, pl. 18, fig. 13, 1922), a species found in great abundance in the Cercado formation, and has a different nucleus. The living West Indian *A. catenata* (Sowerby) is stouter and has shallow spiral grooves between the ribs.

Possibly another species of *Costoanachis* that has narrower and more crowded ribs is represented by a badly broken and worn specimen in the Henderson collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369454).

Anachis (Costoanachis) aulata, new species

(Plate 16, Figure 17)

Anachis haitensis Dall (not Sowerby), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell relatively large, stout, pillar slender, whorls of spire slightly bulging. Nucelus stout, consisting of about one and a half whorls. Aperture long, anterior canal relatively long. Inner lip bearing many obscure elongate slender denticles. Outer lip bearing elongate denticles. Sculpture consisting of axial ribs and of spiral threads and grooves. Ribs slender and closely crowded on first whorl, more widely spaced on later whorls (15 or 16 on penult whorl). Later whorls bearing a sutural band, consisting of one or two spiral threads set off by a groove. Pillar and part of body whorl between periphery and pillar sculptured with relatively strong spiral threads.

Length 7.9 mm.; diameter 3.5 mm. (holotype).

This species is the most abundant of the smaller columbellids, being represented by 17 specimens in the Henderson collection, but all the shells are badly worn. The ribs are worn down and appear doubled. Perfect specimens probably would have faint spiral grooves on the whorls of the spire. The aperture is longer and wider than in the type species, and the denticles on both inner and outer lips are more slender and more elongate.

A. fugax Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 63, pp. 351–352, pl. 25, fig. 5, 1911; middle Miocene, Gatun forma-

tion, Panama Canal Zone) is larger and stouter. According to Maury's figure of the type, *Columbella haitensis* Sowerby (Bull. Am. Paleontology, vol. 5, pp. 258–259, pl. 41, fig. 18, 1917) is a *Costoanachis* that is smaller than *aulata* and lacks the sutural band. A specimen from the Gurabo formation (U. S. G. S. station 8735) apparently represents *haitensis*.

Type material.—Holotype (U. S. Nat. Mus. No. 369455).

METULELLA Gabb

Subgenus METULELLA s. s.

Gabb, 1873, Proc. Acad. Nat. Sci. Philadelphia, 1872, p. 270.

Type (*by original designation*).—*Metulella fusiformis* Gabb. Miocene, Dominican Republic.

Shell medium-sized, slender, *Mitra*-like, pillar long. Nucleus slender, consisting of about two whorls. Aperture long, narrow. Anterior canal very long, narrow, unemarginate. Outer and inner lips strongly denticulate. Outer lip slightly varicose, barely notched near suture. Sculpture consisting of axial ribs and of spiral threads.

The type species seems to be rare, as no specimens were collected by the United States Geological Survey or Maury parties, though Gabb got seven specimens.

The genus *Metulella* embraces a number of Caribbean Miocene and Mediterranean Miocene and Pliocene species that have a distinctive facies. Some of the species are slender and have a very long canal, others are stout and have a short canal. As names are available for both groups, it is here proposed to restrict *Metulella* to the slender species with a long unemarginate canal. *Crenisutura* Cossmann (Essais Paléoconch. Comp., pt. 4, p. 245, 1901 (=*Thiarella* Sacco, Moll. Piemonte, pt. 6, p. 52, 1890, not Swainson, Treatise Malac., p. 319, 1840[1]); type, by subsequent designation, Cossmann, cited above, *Murex thiara* Brocchi, Miocene and Pliocene, Italy) represents the same subgenus as *Metulella* s. s., but perhaps could be retained as the name for a minor group on account of its sculpture. The stout species having a short emarginate canal fall in the subgenus *Thiarinella* Sacco (Moll. Piemonte, pt. 6, p. 56, 1890; type, by monotypy, *Fusus comptus* Bronn, Miocene and Pliocene, Italy). *Columbella venusta* Sowerby is an American species of this subgenus. *Scabrella* Sacco (cited above, p. 54; type, by subsequent designation, Cossmann, cited above, p. 247, *Columbella scabra* Bellardi) could perhaps be used for Thiarinellas with an obscure sutural collar.

It seems remarkable that both subgenera of *Metulella* should be found in the Caribbean and Mediterranean Miocene Seas and apparently nowhere else. Both survived in the Mediterranean region until

[1] *Thiarella* Swainson may very well be a misprint for *Tiarella*, as it is spelled on p. 131 and in the index (p. 418).

Pliocene time. *Thiarinella* is now living in the Caribbean region, where it is represented by *"Nassarina" columbellata* Dall (see p. 270). *Metulella* s. s. seems to be extinct.

Metulella (Metulella) species

The subgenus *Metulella* s. s. is represented by a badly broken shell in the Henderson collection (U. S. Nat. Mus. No. 135521). The shell is small, slender, and remarkably *Mitra*-like. The anterior canal is long, narrow, and unemarginate. The outer lip is broken back. The sculpture is coarsely reticulate, consisting of narrow axial ribs and of widely spaced spiral cords that are of about the same width as the ribs. The spiral cords are swollen as they override the axials. The dimensions are as follows: length 10.6 millimeters, diameter 3.8 millimeters (outer lip broken back).

This specimen is more *Mitra*-like and has more coarsely reticulate sculpture than any of the described Metulellas, and clearly represents a new species, but it is too poor to serve as type material. A somewhat similar undescribed species is represented by equally imperfect material from the Gurabo formation.

NASSARINA Dall

Dall, 1889, Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 181.

Type (*by original designation*).—*Nassarina bushii* Dall. Recent, West Indies and Florida.

Shell small, slender, pillar short. Nucleus slender, consisting of almost two smooth whorls. Aperture narrow, contracted to form a short, relatively wide, recurved, slightly emarginate canal. Siphonal fasciole slightly swollen. Edge of inner lip standing out from pillar and parietal wall. Columella slightly flattened above base. Edge of inner lip bearing very obscure fine denticles. Outer lip bearing a broad shallow notch some distance below suture. Interior of outer lip bearing four denticles, the posteriormost one heaviest. Sculpture *Fusus*-like, consisting of swollen axial ribs and of spiral threads.

This genus was placed in the family Buccinidae by Dall and in a new family Pyramimitridae by Cossmann (Essais Paléoconch. Comp., pt. 4, pp. 124–128, 1901). Despite the type of sculpture, the presence of denticles on the outer and inner lips, the absence of a basal columellar fold and of a parietal ridge, the slightly emarginate canal, and the notch on the outer lip, all suggest that it falls in the Columbellidae. In fact *Nassarina* is very similar to *Thiarinella*, except that *Thiarinella* has a longer and straighter aperture, and heavier and more numerous denticles on both inner and outer lips. The soft parts of *Nassarina* are still unknown. *Nassarina olssoni* Maury is the only fossil species heretofore described from the Caribbean region. *"Nassarina (? Metulella)" isthmica* Böse (Jahrb. K.-k. geol. Reichsanstalt, vol. 60, p. 230, pl. 12, fig. 9, 1910; lower Miocene, Isthmus of Tehuantepec) and

"*Nassarina isthmica*" *elongata* Toula (Jahrb. K.-k. geol. Reichsanstalt, vol. 61, pp. 478–479, pl. 29, fig. 8, 1911; same locality) represent a species of *Thiarinella*.

Nassarina is represented on the American mainland in Miocene and Pliocene deposits, and species are living in both Atlantic and Pacific American waters. Some of the living species referred to *Nassarina* represent other genera.

Key to the Bowden species of Nassarina

Spiral sculpture weak, pillar relatively slender.....*N. orna*
Spiral sculpture strong, pillar stout.....*N.* species

Nassarina orna, new species

(Plate 16, Figures 18, 19)

Nassarina sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell small, moderately slender. Nucleus consisting of almost two slender, smooth whorls. Anterior canal rather deeply emarginate. Columella distinctly flattened above base. Edge of inner lip bearing two obscure denticles, visible only when viewed obliquely past outer lip. Interior of outer lip bearing four denticles increasing in strength posteriorly. Sculpture consisting of heavy axial ribs (9 on body whorl) and of spiral threads that are obscure except at base of spire whorls and on pillar.

Length 3.7 mm.; diameter 1.5 mm. (holotype, dimensions approximate).

This *Nassarina* is represented by the holotype, in the Henderson collection, and by three specimens in the Duerden collection. It is stouter than *N. olssoni* Maury (Bull. Am. Paleontology, vol. 5, pp. 252–253, pl. 47, fig. 2, 1917), a species from the Cercado formation, and lacks the angulation at the base of the whorls of the spire due to a relatively prominent spiral thread.

One specimen (U. S. Nat. Mus. No. 135518, fig. 19), doubtfully referred to *orna*, is a little more slender and has stronger spiral threads over the entire whorls.

Type material.—Holotype (U. S. Nat. Mus. No. 369614).

Nassarina species

(Plate 16, Figure 20)

Shell small, relatively stout, pillar stout. Anterior canal slightly emarginate. Outer lip heavy. Inner lip bearing obscure denticles. Interior of outer lip bearing four denticles. Sculpture consisting of axial ribs overridden by strong widely spaced spiral threads.

Length 4.1 mm.; diameter 1.6 mm. (figured specimen, apex broken, dimensions approximate).

This species is represented by two specimens, one of which is stouter than the figured one, and has less bulging whorls and coarser sculpture. The sculpture of both specimens is very much like that of the living *N. glypta* (Bush), from the southeast coast of the United States, but is coarser.

This species or one very similar to it is represented by one specimen from the Gurabo formation (U. S. G. S. station 8702).

CIGCLIRINA, new genus

Type.—Cigclirina sigma, new species.

Shell small, slender. Nucleus blunt-tipped, consisting of about one and a half smooth whorls. Aperture narrow, anterior canal short, bent backward, rather deeply emarginate. Siphonal fasciole slightly inflated. Outer lip varicose, interior lirate, bearing a broad, shallow sinus near suture. Inner lip detached on adult shells and bearing two to four obscure denticles. Sculpture rather finely reticulate.

This genus is proposed for small slender *Nassarina*-like shells that have reticulate sculpture. The inner lip does not stand out as in *Nassarina*, the anterior canal is not so strongly bent back, and the siphonal fasciole is not so inflated. The shallow anal notch give both *Cigclirina* and *Nassarina* a turrid appearance. *Donovania* Bucquoy, Dautzenberg, and Dollfus (Moll. Roussillon, vol. 1, p. 112, 1882; type, by subsequent designation, *Buccinum minimum* Montagu = *B. brunneum* Donovan, Recent, Europe) has a more loosely coiled nucleus, shorter, wider, and less deeply emarginate canal, no denticles on the inner lip, a less distinct anal notch, and coarser sculpture. *Donovania*, and also several other names for this genus, is preoccupied (Leach 1814), and Iredale proposed for it the substitute name *Syntagma* (Proc. Malac. Soc. London, vol. 13, pp. 34–35, 1918). Its radula is buccinoid, which may indicate that both *Cigclirina* and *Nassarina* are incorrectly placed when they are referred to the Columbellidae.

Cigclirina sigma, new species

(Plate 16, Figure 21; Plate 17, Figure 1)

Outline, nucleus, and aperture as described under the genus. Sculpture reticulate, axials a little stronger than spirals, which override them and are swollen on their crests (22 to 24 axials and 6 or 7 spirals on penult whorl).

Length 5.5 mm.; diameter 2 mm. (holotype). Length 6.5 mm.; diameter 2.3 mm. (largest specimen).

This little species is represented by nine specimens in the Henderson collection. The early whorls have coarser sculpture than the later ones, and there is some variation in the details of sculpture. All the specimens are more or less worn or otherwise damaged, the holotype being the most perfect one. A species from the Caloosahatchee marl of Florida labeled "*Mangilia monilifera* (Sowerby)" seems to belong to this genus, but it is stouter and has coarser sculpture. *Columbella monolifera* Sowerby (Thes. Conch., *Columbella*, p. 144, pl. 40, fig. 177, 1847) according to Sowerby's figure is different from this Pliocene species.

Type material.—Holotype (U. S. Nat. Mus. No. 135389).

STROMBINA Mörch

Mörch, 1852, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, Comes de Yoldi, p. 85.

Type (*by subsequent designation, Cossmann, 1901, Essais Paléoconch. Comp., pt. 4, p. 241*).—*Columbella lanceolata* Sowerby (=*C. recurva* Sowerby). Recent, Panama.

Shell relatively large, moderately slender, pillar stout. Nucleus slender, consisting of about one and a half smooth whorls. Aperture long, narrow, gradually tapering at base, base recurved and moderately emarginate. Posterior end of aperture forming a long shallow posterior channel. Inner lip thick, its edge obscurely denticulate. Parietal callus heavy. Outer lip varicose, slightly notched below suture, the interior thickened and denticulate below the notch. Above the notch along posterior channel lies a heavy denticle. Cross-section of body whorl of type species triangular, due to thickening of outer lip and to other similar thickenings at intervals of 120°. Sculpture of type species consisting of axial ribs on early whorls transformed into *Strombus*-like nodes on later whorls.

Species referred to this genus have different kinds of sculpture and different apertural features, and it seems probable that several groups will eventually be recognized. The species here assigned to *Strombina* have virtually no anterior canal, but the base of the aperture is rather deeply emarginate. None has the striking triangular body whorl cross-section.

Strombina is one of the characteristic genera of tropical mollusks along the Pacific coast of Central America and Mexico. During Miocene time it was widespread in the Caribbean Sea and also in the Gulf of Mexico, but it now is extinct in Atlantic waters.

Cossmann (Essais Paléoconch. Comp., pt. 4, p. 241, 1901) proposed to substitute a new name *Strombocolumbus* for *Strombina* on the grounds that it is preoccupied by Bronn in 1849, but Bronn used this name only as a group name embracing *Chenopus*, *Rostellaria*, *Pterocera*, *Strombus*, and *Pterdonta* (Index Pal., pt. B, p. 440, 1849).

Key to the Bowden species of Strombina

Shell large, posterior channel not long, siphonal fasciole not swollen.
- Sculpture consisting of axial ribs extending from suture to suture.....*S. guppyi*
- Sculpture consisting of crude axial ribs confined to a swollen area near the suture.....*S. gradata*

Shell small, posterior channel very long, siphonal fasciole swollen.....*S. caribaea*

Strombina guppyi, new species

(Plate 17, Figure 2)

Columbella ambigua Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288, pl. 18, fig. 8. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list).

Columella [*Strombina*] *ambigua* Guppy, Pace, 1902, Proc. Malac. Soc. London, vol. 5, p. 52 (list).

Strombina ambigua (Guppy), Gabb, 1873, Trans. Am. Phila. Soc., n. s., vol. 15, p. 221. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Olsson, 1922, Bull. Amer. Paleontology, vol. 9, p. 298, pl. 13, fig. 9.

Not *Columbella ambigua* Kiener, 1841, Coq. Viv., *Columbella* (Purpurifères, pt. 2), p. 11.

Shell large, slender. Nucleus subcylindrical, consisting of about one and a quarter whorls. Outer lip not thickened below notch, but bearing elongate heavy denticles. Inner lip very obscurely denticulate. Base of aperture deeply emarginate. Parietal wall free from callus except along posterior channel. Cross-section of body whorl circular. Sculpture consisting of low broad axial ribs (22 or 23 on penult whorl) and of heavy spiral cords at base of body whorl.

Length 27.9 mm.; diameter 10 mm. (holotype, apex broken).

This species, which is represented by six specimens in the Henderson collection, is by no means a typical *Strombina,* but is more or less intermediate between *Thiarinella* and *Strombina.* The shape and sculpture is more like that of *Thiarinella,* but the virtual absence of an anterior canal, the rather deep siphonal notch, and the heavy denticle on the outer lip bordering the posterior channel suggest that it should be placed in *Strombina.* On the body whorl the ribs extend up to and over the varicose outer lip.

Olsson records this species from the middle Miocene beds cropping out on Banana River, Costa Rica. One specimen from Bowden in the collections of the United States National Museum is incorrectly labeled Curaçao, Duth West Indies.

Although there is no reasonable doubt that the specimens before me represent the same species as Guppy's *ambigua,* I am describing them as a new species and designating as the holotype the figured specimen from the Guppy collection labeled "type" of *ambigua.*

Other localities.—Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype (U. S. Nat. Mus. No. 115514).

Strombina gradata (Guppy)

(Plate 17, Figures 3, 4)

Columbella gradata Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, pp. 288–289, pl. 16, fig. 10. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list).

Columbella [*Strombina*] *gradata* Guppy, Pace, 1902, Proc. Malac. Soc. London, vol. 5, p. 88.

Strombina gradata (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Not *Strombina gradata* Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 221; nor *Columbella gradata* Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 526 (=*S. prisma* Pilsbry and Johnson and *S. cyphonotus* Pilsbry and Johnson).

Shell large, moderately stout. Nucleus stout, subcylindrical, consisting of about one and a half whorls. Outer lip not thickened below notch, or only slightly thickened. Inner lip obscurely denticulate. Siphonal notch deep. Parietal wall free from callus except along posterior channel. Cross-section of body whorl circular. Early whorls smooth except for obscure axial swellings. Later whorls sculptured with short crude ribs confined to a swollen area near suture (13 on penult whorl), replaced near the varicose outer lip by wrinkles extending almost whole length of whorl. Pillar sculptured with spiral threads.

Length 24 mm.; diameter 10.4 mm. (figured specimen, apex broken). Length 25.5 mm.; diameter 11.8 mm. (largest specimen, apex broken).

Type locality.—Jamaica (Miocene).

Though this species has more of the appearance of *Strombina* than *guppyi*, its cross-section is circular and the inner edge of the outer lip is not decidedly thickened below the notch. The siphonal notch is very deep.

This species, which is represented by 11 specimens in the Henderson collection, has not yet been found elsewhere. *S. aldrichi* (Maury) (Bull. Am. Paleontology, vol. 4, p. 142, pl. 23, fig. 3, 1910; lower Miocene, Florida) is smaller and more slender, but has the same kind of sculpture.

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64064).

Strombina caribaea Gabb

(Plate 17, Figure 5)

Strombina caribaea Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 221. Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 262, pl. 41, fig. 6. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 350–351, pl. 18, fig. 9.

S.[*trombina*] *caribaea* Gabb, Pace, 1902, Proc. Malac. Soc. London, vol. 5, p. 64 (list).

Strombina neustrasenorae Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 262, pl. 41, fig. 11. (Corrected in errata to *nuestrasenorae.*)

Shell relatively small, stout, spire slender. Nucleus slender, consisting of about one and a half whorls. Aperture very heavily margined. Outer lip strongly varicose, posterior channel long. Inner lip bearing long heavy denticles. Siphonal notch deep, siphonal fasciole swollen. Early whorls sculptured with fine axial ribs. Intermediate whorls worn on all specimens. Body whorl sculptured with a few heavy ribs that are strongest opposite outer lip and are absent on latter half of whorl. Pillar sculptured with broad spiral threads.

Length 11.5 mm.; diameter 6.1 mm. (figured specimen).

Type locality.—Dominican Republic (Miocene).

The only specimen is a little larger than any from the Dominican Republic and differs in other features. It lacks, for example, the very deep posterior channel of Dominican specimens. It is apparent that the sculpture is variable. One Dominican specimen has ribs on all the whorls, but on another they virtually disappear on the intermediate whorls. The type specimen is worn, but it does not have the heavy ribs opposite the outer lip seen on other Dominican and on Bowden shells. I was unable to find the type specimen at the Philadelphia Academy. The early whorls of the *caribaea* that Maury figured are worn, but if this specimen had any ribs they failed to extend down as far as on the type of *nuestrasenorae*, and the spire is more slender.

Perhaps this species deserves a subgeneric name, inasmuch as in some features it is intermediate between *Strombina* and *Bifurcium*

Fischer (Man. Conch., p. 638, 1884; type, by monotypy, *Columbella bicanalifera* Sowerby, Recent, Panama), in which the posterior tip of the outer lip is deeply notched by the posterior channel. *Bifurcium*, however, has a deeper siphonal notch, and its inner lip is smooth. *S. caribaea* differs from the type of *Strombina* in having a long deep posterior channel, swollen siphonal fasciole, and heavily denticulate inner lip. It belongs to the group of the living Panamic *S. gibberula* (Sowerby). The figured specimen was injured during life and then repaired, which accounts for the groove on the pillar.

In the Dominican Republic *caribaea* is found only in the Gurabo formation, and is particularly abundant at U. S. G. S. station 8702.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 3996).

"Strombina" species

A badly worn specimen in the Henderson collection (U. S. Nat. Mus. No. 135513) represents a *Strombina*-like columbellid that has a relatively long, emarginate anterior canal and slightly swollen siphonal fasciole. All the whorls except the body whorl are almost completely worn off, but a small patch remains of the surface of each of the two whorls preceding the body whorl. They are smooth except for fine axial wrinkles. The body whorl is sculptured with low axial ribs. The dimensions are as follows: length 13.1 millimeters; diameter 5.5 millimeters.

The relatively long anterior canal excludes this species from *Strombina*.

METULA H. and A. Adams

H. and A. Adams, 1853, Genera Recent Mollusca, vol. 1, p. 84.

Type (*by tautonymy*).—*Buccinum metula* Hinds (cited by H. and A. Adams as *Metula hindsii* H. and A. Adams). Recent, Pacific coast of Panama.

Shell medium-sized, moderately slender or very slender, whorls not constricted at suture or slightly constricted, body whorl very long. Nucleus stout, consisting of almost two smooth whorls. Aperture very long, narrow, elliptical, tapering to an acute angle at posterior end, constricted at anterior end to form a short, wide, slightly recurved, moderately emarginate canal. Siphonal fasciole low. Edge of inner lip forming a definite edge along pillar and parietal wall. Outer lip varicose, its inner edge bearing broad denticles that may be extended into short lirations. Sculpture reticulate. (Based on original figures of *Buccinum metula* (Zool. Voy. Sulphur, vol. 1, p. 31, pl. 16, figs. 13–14, 1844), which apparently represents an immature shell, supplemented by specimens of the same or a similar species from the Gulf of California.)

H. and A. Adams placed the following four species in their genus *Metula* without designating a type: *clathrata* Adams and Reeve, Cape of Good Hope; *cumingii* Adams, west coast of Africa; *hindsii* H. and A. Adams, Panama; *mitrella* Adams and Reeve, China Seas.

Such a distribution would be remarkable unless these four species represent a genus that formerly had a more extensive distribution. There is no evidence of such a history, and, moreover, it is apparent that several genera are represented by these four species. Inasmuch as there is every reason to believe that one of the species in the original list has as a synonym a species with the specific name *metula*, it becomes the type by tautonymy (Int. Rules Zool. Nomenclature, art. 30*d*). It is clear that H. and A. Adams changed this name to *hindsii* on the basis of the old-fashioned idea of avoiding the tautonomic combination *Metula metula*, although there is nothing in their publication to prove this, and by a strict interpretation *hindsii* might be considered a nude name. Cossmann's designation of *Buccinum clathratus* Adams and Reeve as the type (Cat. Ill. Coq. éoc. Paris, pt. 4, p. 144, 1889; Essais Paléoconch. Comp., pt. 4, p. 141, 1901) is disregarded. This species certainly represents a different genus, according to the original figure (Zool. Voy. Samarung, Moll., p. 32, pl. 11, fig. 12, 1850), a good reproduction of which is given by Tryon (Man. Conchology, vol. 3, pl. 72, fig. 238, 1881). This figure is quite different from the figure given by H. and A. Adams (Gen. Rec. Moll., pl. 9, fig. 4). The West African shell, "*Metula*" *cumingii* Adams, seems to represent still a third genus, but *Buccinum mitrellum* Adams and Reeve, from the "China Seas," apparently is a *Metula*.

As the genus *Metula* now stands it is represented by two living species, one in the eastern Pacific and the other in the western Pacific. The base of the outer lip of "*Metula*" *daphnelloides* Melvill and Standen (Ann. Mag. Nat. Hist., ser. 7, vol. 12, pp. 299–300, pl. 21, fig. 3, 1903), from the Persian Gulf, flares, and this species apparently is not a *Metula*. Like many other tropical Pacific genera, *Metula* lived in the Miocene Caribbean Sea, where it was represented by several species (*cancellata* Gabb, Dominican Republic; *gabbi* Brown and Pilsbry, Panama Canal Zone; *harrisi* Olsson (not Dickerson), Panama; *limonensis* Olsson, Costa Rica). In this region it survived until Pliocene time, for it is found in the Pliocene beds near Limon, Costa Rica. This Pliocene species is very similar to the Dominican *cancellata;* in fact, it was called *cancellata* by Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 351, pl. 46, fig. 32, 1881). Guppy recorded dredging a dead shell of *Metula*, *M. lintea* Guppy, from the Gulf of Paria (Proc. Sci. Assoc. Trinidad, vol. 2, No. 4, p. 178, pl. 7, fig. 18, 1882; Reprint, Bull. Am. Paleontology, vol. 8, p. 247, 1921). Guppy suggested (p. 177) that this and other dead shells dredged at the same time may have been derived from a submarine Tertiary bed. Whether the genus is still living in the Caribbean region awaits confirmation. *Metula sylvaerupis* Harris (Bull. Am. Paleontology, vol. 3, p. 56, pl. 7, fig. 7, 1899; Wilcox group, Alabama) apparently is an ancestral *Metula*, but perhaps should receive subgeneric rank, as it has whorls of different

shape, and a less recurved and less deeply emarginate canal. *Metula harrisi* Dickerson (California Univ. Pub. Bull. Dept. Geol., vol. 9, p. 494, pl. 42, fig. 1, 1916; middle Eocene, California) probably represents the same subgenus. *Daphnobela* Cossmann (Essais Paléoconch. Comp., pt. 2, p. 93, 1896; type, by original designation, *Buccinum junceum* Sowerby, Eocene, England), placed by Cossmann in the "Pleurotomidae," seems to be available for these Eocene Metulas.

Metula generally is placed in the Buccinidae, but it may belong in the family Columbellidae.

Metula species

(Plate 17, Figure 6)

Metula cancellata Dall (not Gabb), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell relatively large and stout, early whorls bulging and slightly turreted. Whorls bearing varix-like thickenings at intervals. Nucleus cylindrical, consisting of about two and a half whorls. Aperture relatively wide. Denticles on outer lip drawn out into short lirations. Sculpture consisting of strong spiral threads that are swollen as they override the low axial ribs. Ribs disappearing on varix-like outer lip and on the similar thickenings elsewhere.

Length 27 mm.; diameter 10 mm. (dimensions estimated from the two figured fragments).

This *Metula* is represented by a few shells in all the collections, but all the shells are broken. It probably represents a subspecies of *M. harrisi* Olsson (Bull. Am. Paleontology, vol. 9, p. 288, pl. 13, fig. 10, 1922; middle Miocene, Panama) that has more bulging early whorls. *M. limonensis* Olsson (Bull. Am. Paleontology, vol. 9, pp. 288–289, pl. 13, figs. 5, 6, 1922; upper Miocene, Costa Rica) is more slender.

As *Metula harrisi* Olsson is a homonym of *Metula harrisi* Dickerson (see above) the name *olssoni* is proposed for Olsson's species. *"M. harrisi" limonensis* Olsson seems to be a distinct species.

MURICIDAE

MUREX Linné

Subgenus MUREX s. s.

Linné, 1758, Systema Naturae, ed. 10, p. 746.

Type (by subsequent designation, Montfort, 1810, Conch. Syst., vol. 2, p. 619).—Murex pecten Montfort (=*M. tribulus* Linné). Recent, Indo-Pacific.

Shell medium-sized. Nucleus cylindrical, consisting of about one and a half bulging, loosely coiled whorls. Aperture subcircular. Anterior canal very long and narrow, unemarginate, straight or nearly straight, almost completely roofed over, except near base. Edge of inner lip detached. Edge of outer lip serrate. Each of later whorls bears three spine-bearing varices, which on body whorl extend down anterior canal. Between the varices lie low axial ribs. Spiral cords and threads override ribs and varices, the primaries producing the long spines, which are open on side facing outer lip.

The very long, straight, or nearly straight, anterior canal, down which the three spine-bearing varices extend, is characteristic of *Murex* s. s. The following species has a shorter and more curved canal than the type species, and also has denticles on the inner lip and parietal wall. Perhaps it should be placed in a different section.

Murex (Murex) recurvirostris Broderip[1]

(Plate 17, Figures 7, 8)

Murex recurvirostris Broderip, 1832, Proc. Zool. Soc. London, p. 174. Reeve, 1845, Conch. Icon., *Murex*, fig. 75. Sowerby, 1879, Thes. Conchyl., *Murex*, pl. 11, fig. 15. Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 201. Tryon, 1880, Man. Conch., vol. 2, pp. 80–82, pl. 11, fig. 193; pl. 12, figs. 124–125. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 353.

Murex nigrescens Sowerby, 1834, Conch. Ill., *Murex*, fig. 113. Sowerby, 1840, Proc. Zool. Soc. London, p. 138. Reeve, 1845, Conch. Icon., *Murex*, fig. 92. Sowerby, 1879, Thes. Conchyl., *Murex*, pl. 11, fig. 18.

Murex messorius Sowerby, 1834, Conch. Ill., *Murex*, fig. 93. Sowerby, 1840, Proc. Zool. Soc. London, pp. 137–138. Reeve, 1845, Conch. Icon., *Murex*, fig. 90. Sowerby, 1879, Thes. Conchyl., *Murex*, pl. 11, fig. 20. Dall, 1889, Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 196. Dall, 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 139. Dall and Simpson, 1901, Bull. U. S. Fish Comm., vol. 20, pt. 1, p. 407. Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 353. Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 265, pl. 42, figs. 1–2. Maury, 1920. New York Acad. Sci., Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 1, pp. 63–64. Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 303. Maury, 1925, Brasil Serv. Geol. e Mineral. Mon., vol. 4, pp. 136–139, pl. 6, fig. 5.

Murex domingensis Guppy (not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288. Guppy (part, not Sowerby), 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

? *Murex sutilis* White, 1887, Arch. Mus. Nac. Rio de Janeiro, vol. 7, pp. 137–138, pl. 11, fig. 11. Maury, 1925, Brasil Ser. Geol. e Mineral. Mon., vol. 4, pl. 6, fig. 10.

Shell relatively small. Nucleus consisting of between one and a half and two loosely coiled whorls. Anterior canal moderately long, curved to the right as it leaves aperture, then straightened out, tip slightly curved backward. Edge of inner lip bearing a series of denticles, which on adult shells are continuous around to outer lip. Parietal ridge short and heavy. Each whorl bears three varices between which lie low axial ribs (three on early whorls, generally four on later whorls). Spiral threads of two orders of magnitude override ribs and varices (4 or 5 primaries on penult whorl). Middle primary forming a spine on varices, which is broken off on all specimens, but apparently is short. Varix along columellar side of canal bearing drooping spines.

Length 39.9 mm.; diameter 22.7 mm. (larger figured specimen, canal broken). Length 38.2 mm.; diameter 19.4 mm. (smaller figured specimen, canal broken).

Type locality.—Pacific coast of Costa Rica (Recent).

This species is named with some hesitation. In view of the similar features of living specimens from both the Atlantic and Pacific sides of

[1] The citations for this species cover only the original publications, the records for Caribbean fossils, and the more accessible manuals.

Central America, Pilsbry's conclusion that they represent the same species seems justified. This view is strongly supported by the occurrence of these Miocene fossils that lived in the Caribbean Sea when it and the Pacific were in free communication across Central America. Most of the Bowden fossils have finer and more subdued ribs than any specimens of *messorius* from Florida and the Caribbean Sea in the collections of the United States National Museum, but they are remarkably similar to specimens from the Pacific coast of Panama labeled *nigrescens*.

This rather small *Murex* is abundant at Bowden, being represented by 55 specimens in the Duerden collection. Very few of them have a complete canal and all except the shortest spines are broken. Only one specimen has three relatively heavy ribs between varices on the later whorls, and this specimen more closely resembles the living Caribbean *messorius* and also specimens from the Cercado formation.

M. domingensis Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 49, pl. 10, fig. 5, 1850), which is found only in the Gurabo formation, reaches a larger size and has a higher spire, and its spirals are less swollen on the ribs, but some young specimens are very much like the Bowden specimens of *recurvirostris*. Maury records *messorius* from the Gurabo formation, but apparently all the Gurabo specimens in the collections made by the United States Geological Survey party should be referred to *domingensis*, though it is virtually impossible to distinguish young shells.

Maury records *messorius* from the lower Miocene Quebradillas limestone of Porto Rico and also from the lower Miocene Pirabas formation of Brazil, though White's figure of *sutilis* shows more strongly pinched ribs.

Other localities.—Quebradillas limestone (lower Miocene), Porto Rico. Pirabas formation (lower Miocene), Brazil. Cercado formation (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Panama Canal Zone, Panama, and Costa Rica. Pliocene, Florida and Costa Rica. Living, Cedar Keys, Florida, to West Indies and Colon in 2 to 30 fathoms; Cape St. Lucas, Mexico, to Panama.

Subgenus PHYLLONOTUS Swainson

Swainson, 1833, Zoological Illustrations, ser. 2, vol. 3, pl. 109.

Type (*by monotypy*).—*Murex* (*Phyllonotus*) *imperialis* Swainson (=*M. pomum* Gmelin). Recent, West Indies and southeast coast of United States.

Shell large, stout. Nucleus stout, consisting of about three rapidly enlarging whorls. Aperture subcircular. Anterior canal moderately short, strongly recurved, partly roofed over by a flat projection from the columellar side. Edge of inner lip detached, bearing, farther in, a series of irregular elongate denticles. Parietal ridge long, bordering the shallow posterior channel. Inner edge of outer lip lirate, conforming with serrate edge. Each whorl bears three or four lamellar varices, between which are a few heavy

axial ribs. Rough spiral threads and cords override ribs and varices. Varices bearing short heavy lamellae or open spines on pillar.

Phyllonotus has a short, recurved, wide, partly roofed canal and lamellar varices.

Murex (Phyllonotus) pomum Gmelin[1]

(Plate 17, Figure 9)

Murex pomum Gmelin, 1792, Syst. Nat., ed. 12, p. 3527. Reeve, 1845, Conch. Icon., *Murex*, fig. 35. Sowerby, 1879, Thes. Conchyl., *Murex*, pl. 14, fig. 135. Tryon, 1880, Man. Conchology, vol. 2, pp. 97–98, pl. 20, fig. 182. Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 34.

Murex (*Phyllonotus*) *pomum* Gmelin, Dall, 1889, Bull. Mus. Comp. Zool. Harvard College, vol. 18, pp. 198–199, pl. 16, fig. 2. Dall, 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 142. Dall and Simpson, 1901, Bull. U. S. Fish Comm., vol. 20, pt. 1, p. 408.

Murex (*Phyllonotus*) *pomum* Gmelin var., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Murex imperialis Swainson, 1832, Zool. Ill., ser. 2, vol. 2, pl. 67. Reeve, 1845, Conch. Incon., *Murex*, fig. 42. Sowerby, 1879, Thes. Conchyl., *Murex*, pl. 17, fig. 161; pl. 21, fig. 205. Tryon, 1880, Man. Conch., vol. 2, p. 101, pl. 23, fig. 206. Heilprin, 1887, Trans. Wagner Inst. Philadelphia, vol. 1, p. 68.

Murex (*Phyllonotus*) *imperialis* Swainson, 1833, Zool. Ill., ser. 2, vol. 3, pl. 109.

Murex globosa Emmons, 1858, Rept. North Carolina Geol. Survey, pp. 247–248 fig. 105*a*.

Shell moderately large. Aperture as described under the subgenus. Each whorl bears three heavy lamellar varices, between which lie two heavy axials or a heavy one and a smaller one. Here and there, especially near suture, are growth lamellae. Varices and ribs overridden by strong spiral cords (3 or 4 on penult whorl), forming deep shelves on side of varix opposite outer lip, and by scaly roughened secondaries and tertiaries on both primaries and in interspaces.

Length 77.4 mm.; diameter 44.3 mm. (figured specimen, tip of apex and base of canal broken).

Type locality.—"West Africa" [West Indies] (Recent).

It is remarkable that the two species of *Murex* at Bowden should be living species. None of the few Bowden specimens are so large as large living shells, but otherwise no significant differences can be seen. The inner lip and parietal wall of the fossils are colored a rich chestnut-brown.

This is the earliest record of *pomum*, although Pilsbry and Brown record it from Miocene beds in Colombia, but their exact age is not known. It also is not known whether Emmons' *globosa* came from Miocene or Pliocene beds.

No analogue of this species is now living on the Pacific coast of Central America. *M. regius* Sowerby and *M. bicolor* Valenciennes are larger, and have more numerous and more foliaceous varices.

Other localities.—Miocene, Colombia (Pilsbry and Brown). Upper Miocene or Pliocene, North Carolina. Caloosahatchee marl (Pliocene), Florida. Living, Beaufort, North Carolina to Venezuela.

[1] No attempt is made to give an elaborate synonymy for this species. The citations cover all references to Caribbean fossils.

MURICOPSIS Bucquoy and Dautzenberg

Bucquoy and Dautzenberg, 1882, in Bucquoy, Dautzenberg, and Dollfus, Mollusques marins du Roussillon, vol. 1, p. 19.

Type (*by monotypy*).—*Murex blainvillei* Payraudeau (regarded by some writers as a synonym or subspecies of *Murex cristatus* Brocchi). Recent, Mediterranean.

The genus *Muricopsis* has many lamellar varices and no other axial sculpture. It has a short, recurved, wide canal that is partly roofed over by a shelf projecting from the columellar side. The columella has two broad obscure basal folds. The interior of the outer lip bears heavy denticles. The varices form scales on the siphonal fasciole.

Muricopsis is used for the following two species for want of a better name, although they do not represent this genus. Similar species go under the name of *Aspella* Mörch (Malak. Blätter, vol. 24, p. 24, 1877; type, by monotypy, *Ranella anceps* Lamarck, reputed to be extensively distributed in tropical seas), though that is a totally different genus. The Bowden species also do not represent *Trophon* Montfort (Conch. Syst., vol. 2, p. 483, 1810; type, by original designation, *Murex magellanicus* Gmelin = *M. gerversianus* Pallas, Recent, Straits of Magellan to Peru), *Muricidea* Swainson (Treatise Malac., pp. 64–65, 1840; type, by original designation, *Murex magellanicus* Gmelin), a perfect synonym of *Trophon*, or *Ocenebra* ("Leach") Gray (Ann. Mag. Nat. Hist., vol. 20, p. 269, 1847; type, by monotypy, *Murex "erinacea* Montagu," Recent, Europe)—names that have been applied to these fossils or to similar species. In all probability they represent a new genus that will take the place of *Poweria* Monterosato (Nomen. gen. spec. Conch. Medit., p. 113, 1884; type, by original designation, *Murex scalarina* Bivona = *M. scalaroides* Blainville, Recent, Mediterranean), a homonym of *Poweria* Bonaparte, 1841, but not enough time was available to eliminate the multitude of *Murex* generic names.

Key to the Bowden species referred to "Muricopsis"

Shell stout, canal short ..... *"M." collatus*
Shell slender, canal long ..... *"M."* species

"Muricopsis" collatus (Guppy)

(Plate 17, Figures 10, 11)

Murex collatus Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 83, pl. 1, fig. 8 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 215). Guppy, 1874, Geol. Mag., decade 2, vol. 1, pp. 433–434, pl. 16, fig. 8; p. 438 (list).

Muricidea collata (Guppy) Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell medium-sized, stout, spire low, obscurely turreted. Aperture elliptical. Anterior canal short, recurved, partly roofed over by narrow shelf projecting from columellar side. Siphonal fasciole bearing scales produced by varices. Between siphonal fasciole and edge of inner lip lies

a wide shallow umbilical opening. Interior of inner lip bearing six heavy denticles. Sculpture consisting of lamellar varices (6 or 7 on body whorl), bearing short spines at shoulder and strongly angulated at shoulder. Last few varices consisting of several superimposed lamellae. Several widely spaced obscure spiral threads are visible on body whorl.

Length 21.8 mm.; diameter 13.2 mm. (holotype).

Type locality.—Jamaica (Miocene).

This species lacks the broad columellar folds and strong spiral sculpture of *Muricopsis*, and the denticles on the outer lip are not so heavy. It is represented by only a few specimens. *"Trophon" dominicensis* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 354, pl. 28, figs. 2–3, 1922; Miocene, Dominican Republic) is more slender, and has stronger spiral sculpture and a much narrower umbilical opening. *"Murex (Trophon)" werneri* Toula (Jahrb. K.-k. geol. Reichsanstalt, vol. 61, p. 479, pl. 29, figs. 9*a*, 9*b*, 1911; lower Miocene, Tehuantepec) is more slender and has a longer canal. It may be, as Pilsbry suggests, the same species as *dominicensis*. *"Aspella scalaroides* Blainville" Maury (Bull. Am. Paleontology, vol. 5, p. 268, pl. 43, fig. 11, 1917; Gurabo formation, Dominican Republic) resembles *dominicensis*, but has widely spaced spiral cords. No species similar to *collatus* is living in the Caribbean region.

The figured specimen, the larger of two in the type lot, is recognized as the holotype, though Guppy's figure is poorly drawn.

Type material.—Holotype (U. S. Nat. Mus. No. 115479).

"Muricopsis" species

(Plate 18, Figure 1)

Shell small, slender. Anterior canal relatively long, narrow, tip recurved, projecting shelf broken on only specimen. Umbilical opening absent. Interior of outer lip bearing six heavy denticles. Sculpture consisting of lamellar varices (7 on body whorl). Those on spire bearing spines on shoulders; those on body whorl bearing spines on and below shoulder, but the shoulder spines are longest. Between the varices are widely spaced low spiral cords.

Length 13.9 mm.; diameter 6 mm. (figured specimen).

The throat of the only specimen is beautifully enameled and colored yellowish brown.

This species is represented by a small specimen that in all probability is immature. The canal is longer than in *"Muricopsis" collatus* and in the type of *Muricopsis*. The sculpture is the same as in Maury's *scalaroides* (cited above), but the shell is even more slender and the canal is relatively longer. The living West Indian species referred to as *scalaroides* Blainville and varieties (Dall, Bull. Mus. Comp. Zool. Harvard College, vol. 18, pp. 208–210, 1889) are stouter and more coarsely sculptured.

TYPHIS Montfort

Subgenus TYPHIS s. s.

Montfort, 1810, Conchyliologie systématique, vol. 2, p. 615.
Type (*by original designation*).—*Murex tubifer* Bruguière. Middle Eocene, Paris Basin.

The subgenus *Typhis* s. s., which is not represented in the Bowden formation, has a relatively slender and high spire. The varices bear spines on and below the shoulder, and the varix at the outer lip is not expanded.

Subgenus TYPHINELLUS Jousseaume

Jousseaume, 1879, Revue et Magasin de Zoologie, year 42 (ser. 3, vol. 7), p. 337.
Type (*by original designation*).—*Typhis sowerbyi* Broderip (=*T. tetrapterus* Bronn). Miocene to Recent, Mediterranean.

Shell medium-sized, relatively slender, spire high. Aperture elliptical. Anterior canal moderately short, curved backward, closed. Edge of inner lip detached. Varix at outer lip moderately expanded. Sculpture consisting of lamellar varices, bearing a spine at the shoulder, and of obscure widely spaced spiral threads. Arising from the shoulder between the varices are hollow tubules. Varices producing overlapping scales on siphonal fasciole.

Typhis with its characteristic tubules is a compact unmistakable genus, and Jousseaume's extreme subdivision of the group into 12 genera is unwarranted, though some of his names are useful in recognizing groups of species. The following species seems to fall in *Typhinellus*, though the varix at the outer lip is not so strongly expanded as in the type species.

Typhis (Typhinellus) siphon, new species

(Plate 18, Figure 2)

Typhis sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell relatively small. Varix at outer lip slightly expanded. Body whorl bearing five lamellar varices that bear at shoulder an upturned and incurved spine. On later part of body whorl several indistinct widely spaced spiral threads are visible. Low triangular partitions extend from tubules about halfway up preceding whorl, joining the tubules to a varix.

Length 15.7 mm.; diameter 8.7 mm. (holotype, tip of canal broken). Length 16.3 mm.; diameter 7.9 mm. (larger and more slender specimen, tip of canal broken).

This species is represented by only two specimens, both in the Guppy collection. They probably are not fully mature. *T. floridanus* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, pp. 152–153, pl. 9, fig. 5, 1890; Pliocene, Florida) has more strongly incurved spines and reaches a larger size. Shells of the same size as the Bowden specimens have a more expanded varix at the outer lip and a lower spire. No similar living species have been found in the Caribbean region.

T. cercadicus Maury (Bull. Am. Paleontology, vol. 5, p. 265, pl. 42, fig. 12, 1917; Gurabo formation, Dominican Republic), which is very slender and has a sharply angulated shoulder, belongs to a different subgenus.

Type material.—Holotype (U. S. Nat. Mus. No. 115495).

Subgenus TALITYPHIS Jousseaume

Jousseaume, 1879, Revue et Magasin de Zoologie, year 42 (ser. 3, vol. 7), p. 338.
Type (*by original designation*).—*Typhis expansus* Sowerby. Recent, locality unknown.

Shell stout, spire low. Aperture elliptical. Anterior canal short, curved backward, closed. Edge of inner lip detached. Varix at outer lip greatly expanded. Sculpture consisting of lamellar varices, bearing a spine at shoulder, and of obscure widely spaced spiral threads. Tubules lying between varices. (Based on Sowerby's figures, Thes. Conch., *Typhis*, pl. 2, figs. 24–25, 1866.)

The greatly expanded outer lip is characteristic of this group, which perhaps should be recognized only as a section of *Typhinellus*.

Typhis (Talityphis) alatus obesus Gabb

(Plate 18, Figures 3, 4)

Typhis obesus Gabb, 1873, Trans. Am. Philos. Soc. n. s., vol. 15, pp. 203–204. Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 313. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 354, pl. 28, figs. 5–6.

Typhis alatus Sowerby, Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 83 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 215). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 434; p. 438 (list). Guppy (part), 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 522. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Olsson, 1922, Bull. Am. Paleontology vol. 9, p. 304, pl. 13, fig. 15.

Typhis alatus Sowerby var. *obesus* Gabb, Dall, 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 151. Not Maury, 1925, Bull. Am. Paleontology, vol. 10, p. 366, pl. 47, figs. 6, 9.

Shell medium-sized, stout. Aperture subcircular to elliptical. Each whorl bears four varices raised on shoulder into triangular spines directed upward. Tubules lying between varices, but closer to preceding varix, the side away from the outer lip joined to varix on preceding whorl by a high triangular partition. Varix at outer lip greatly expanded, bearing a broad shallow sinus near base, joined to preceding whorl by a broad high partition. Flanks of varices sculptured with four or five low, widely spaced spiral cords.

Length 23.9 mm.; diameter 16.4 mm. (figured specimen).

Type locality.—Dominican Republic (Miocene).

No specimens of *T. alatus* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, pp. 48–49, pl. 10, fig. 4, 1850) were collected by the United States Geological Survey party, nor for that matter, were any specimens of *obesus*, so that it is not known whether these two forms should be regarded as separate species, or as geographic subspecies, or as varieties found at one locality. The type of *obesus* is so similar to

Sowerby's figure of *alatus*, except for the stouter outline and shorter spire, that it seems best to regard it as a subspecies of *alatus*, but the name may eventually be suppressed.

The Bowden specimens, only a few of which are in any collection, resemble the type of *obesus*, though they are a little smaller and have a more elliptical aperture, and the triangular partitions attached to the tubules generally extend farther up on the preceding whorl. Toro Cay specimens have fainter spiral sculpture, but otherwise resemble *obesus*. Specimens from the Chipola formation of Florida are reasonably similar to the type and to Bowden shells, though they are smaller and have less distinct spiral sculpture. It apparently is one of the very few Bowden species found in the Chipola formation. Maury's specimen from the Manzanilla beds of Trinidad is larger, and has a higher spire, narrower varix, and heavier sculpture.

Talityphis also is now extinct in the Caribbean region, but is still living on the Pacific coast of tropical America. *T. latipennis* Dall, dredged off Lower California, closely resembles *obesus*, but is larger and apparently has more obscure spiral sculpture, though the type is worn.

Other localities.—Miocene, Dominican Republic. Chipola formation (lower Miocene), Florida. Gatun formation (middle Miocene), Toro Cay, Panama.

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 3251).

THAIDIDAE

THAIS ("Bolten") Roeding

Subgenus THAIS s. s.

Roeding, 1798, Museum Boltenianum, pt. 2, p. 54.

Type (*by subsequent designation, Iredale, 1915, Trans. Proc. New Zealand Inst., vol. 47, p. 472*).—"*T. neritoides* = *M. fucus* Gmelin" (cited by Roeding as *Thais lena* ("Bolten") Roeding; see Stewart, Proc. Acad. Nat. Sci. Philadelphia, vol. 78, p. 386, 1927). Recent, Cape Verde and Ascension Islands.

The subgenus *Thais* s. s., which has a low spire and heavy tubercles, is not represented in the Bowden formation.

Subgenus STRAMONITA Schumacher

Schumacher, 1817, Essai d'un nouveau système des habitations des vers testacés, p. 226.

Type (*by subsequent designation, Cossmann, 1903, Essais Paléoconch. Comp., pt. 5, p. 71*).—*Buccinum haemastoma* Linné (cited by Cossmann as *P.*[*urpura*] *hemastoma* (Linné)). Recent, West Indies.

Shell medium-sized, spire moderately low. Aperture large, wide, anterior canal very short. Siphonal notch narrow, deep, siphonal fasciole inflated. Outer lip notched at suture, the interior lirate. Inner lip moderately wide, slightly excavated, base bearing wrinkles. Between the inner lip and siphonal notch lies an umbilical groove. Parietal ridge heavy. Sculpture consisting of closely set spiral cords. Adult shells bear heavy tubercles at periphery.

Thais (Stramonita ?) species

A species of *Thais* is represented by a very young shell in the Philadelphia Academy collection (No. 11270). The inner lip is wider and more excavated than in *haemastoma*, and it lacks the wrinkles at the base. The columella has a basal twist, which causes a distinct break in the outline of the inner lip. The sculpture consists of closely set spiral cords of two orders of magnitude that are more lamellar and scaly than in *haemastoma*. The siphonal fasciole is distinctly lamellar. The dimensions are as follows: length 6.2 millimeters; diameter 3.6 millimeters.

This specimen is too small to be certain as to its subgeneric position. *T. santodomingensis* Pilsbry and Johnson (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 354, pl. 28, figs. 8–9, 1922), from the Dominican Republic, is the only Miocene species so far on record from this region.

CORALLIOPHILIDAE

CORALLIOPHILA H. and A. Adams

H. and A. Adams, 1853, Genera Recent Mollusca, vol. 1, p. 135.
Type (*by subsequent designation, Cox, 1927, Pal. Zanzibar Protectorate, p. 90*).—*C. violacea* (Kiener) (*Purpura violacea* Kiener = *Murex neritoideus* Chemnitz not Linné). Recent, Indo-Pacific.

Shell medium-sized, stout, spire very low. Aperture long and wide. Outer lip not constricted at base. Anterior canal moderately emarginate. Siphonal fasciole narrow, raised. Base of inner lip flattened. Between siphonal fasciole and inner lip lies an umbilical groove. Edge of inner lip finely serrate, interior lirate. Sculpture consisting of scaly spiral threads.

Inasmuch as H. and A. Adams cite "*neritoideus* Chem.," it would be more proper to reverse the citation and give that species as the type, though it apparently takes the name *Purpura violacea* Kiener. Cossmann's designation of "*Purpura neritoidea* Lamarck" as the type is not considered valid (Essais Paléoconch. Comp., pt. 5, p. 83, 1903).

The shoulder of the type species is abruptly angulated. Beach specimens have the spiral threads worn off and the shell is covered with a calcareous crust. The living species are found on coral reefs. According to Cossmann, the oldest species are of Miocene age.

Coralliophila miocenica (Guppy)

(Plate 18, Figures 5, 6)

Purpura miocenica Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 80, pl. 1, fig. 9 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 212). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 410, pl. 16, fig. 9; p. 439 (list).
Coralliophila miocenica (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 269, pl. 44, fig. 6.

Shell medium-sized, stout, spire moderately low, shoulder rounded. Anterior canal slightly emarginate. Umbilical opening wide. Siphonal

fasciole consisting of a series of heavy overlapping scales. Sculpture consisting of low swollen spiral ribs, overridden by narrow high scaly spirals, the scales worn off over large areas.

Length 22.3 mm.; diameter 15 mm. (holotype, outer lip broken back).

Type locality.—Jamaica (Miocene).

The outer lip of the holotype is broken. Only two small specimens of this species are in the Henderson collection. The specimen from the Gurabo formation, figured by Maury, is stouter, but the living species are very variable. The living West Indian *C. abbreviata* (Lamarck) has a higher spire and many specimens have an angular shoulder. Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 354, 1922) considers that *"Muricidea" lata* Gabb, a Dominican fossil, represents *abbreviata*.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 115493).

PECTINIBRANCHIATA TAENIOGLOSSA

CYMATIIDAE

CYMATIUM ("Bolten") Roeding

Subgenus CYMATIUM s. s.

Roeding, 1798, Museum Boltenianum, pt. 2, p. 129.

Type (by subsequent designation, Dall, 1904, Smiths. Misc. Coll., vol. 47, p. 133).—Cymatium femorale (Linné) (*Murex femorale* Linné). Recent, West Indies.

The subgenus *Cymatium* s. s., which reaches a large size and has a relatively long canal and very heavy varices, is not represented in the Bowden formation.

Subgenus LAMPUSIA Schumacher

Schumacher, 1817, Essai d'une nouveau système des habitations des vers testacés, p. 250.

Type (by subsequent designation, Herrmannsen, 1847, Indicis Gen. Malac., vol. 1, p. 575).—Murex pileare Linné. Recent, Mediterranean Sea and other localities.

Shell medium-sized, relatively slender, bearing varices at irregular intervals. Nucleus conical, consisting of about five smooth rapidly enlarging whorls. Aperture elliptical. Anterior canal moderately long, slightly emarginate, strongly curved backward. Inner lip bearing ridges and denticles. Outer lip varicose, the edge and interior strongly lirate. Sculpture consisting of spiral bands and threads, and of axial threads or wrinkles.

Key to the Bowden species of Lampusia

Early post-nuclear whorls stout, axial ribs narrow.....*C.* (*L.*) species *a*
Early post-nuclear whorls slender, axial ribs broad.....*C.* (*L.*) species *b*

Cymatium (Lampusia) species *a*

A small broken and badly worn shell in the Henderson collection (U. S. Nat. Mus. No. 135297) represents a *Lampusia* that probably is *C. pileare* (Linné), which is reported by Maury (Bull. Am. Paleon-

tology, vol. 5, pp. 269–270, 1917) from the Gurabo formation, and is also recorded by Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 356, 1922). "*Simpulum antillarum* var. *cercadensis*" Maury (Bull. Am. Paleontology, vol. 5, p. 270, pl. 43, fig. 2, 1917), from the Cercado formation, also seems to represent *pileare*.

The Bowden fragment consists of a little more than three whorls having a length of 15 millimeters and a diameter of 8.6 millimeters. No varices are on these early whorls.

Cymatium (Lampusia) species *b*

A very young shell in the Henderson collection (U. S. Nat. Mus. No. 135295) having a length of 11.3 millimeters and a diameter of 6 millimeters seems to represent another species of *Lampusia* that is more slender than *pileare*. The nucleus is slender and consists of about four whorls. The first varix appears at the end of the first post-nuclear whorl. The sculpture consists of broad axial ribs overridden by spiral threads of different width. This shell is even more slender than young specimens of *C. gracile* (Reeve).

Subgenus GUTTURNIUM Mörch

Mörch, 1852, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, Comes de Yoldi, p. 109.

Type (*by subsequent designation, Dall, 1904, Smiths. Misc. Coll., vol. 47, p. 133*).—*Triton tuberosum* Lamarck. Recent, West Indies and elsewhere in tropics.

Shell medium-sized, moderately stout, bearing varices at irregular intervals. Nucleus stout, conical, consisting of between four and five whorls. Aperture elliptical. Anterior canal relatively long, narrow, strongly curved backward. Inner lip bearing ridges along base of columella and a parietal ridge. Outer lip varicose, the edge bearing heavy denticles that continue into the interior as heavy ridges. Sculpture consisting of low broad axial ribs and of wrinkled spiral cords and threads.

Gutturnium has a longer canal than *Lampusia*, heavy denticles on the outer lip instead of paired lirations, and fewer ridges on the inner lip.

Cymatium (Gutturnium) species

Another very young and badly broken shell in the Henderson collection (U. S. Nat. Mus. No. 135296) seems to represent a species of *Gutturnium*. It probably is similar to *C. tuberosum* (Lamarck), living in the West Indies, but the early whorls are not so strongly angulated by a prominent spiral cord. For the size of the shell the inner lip is thick. The dimensions are as follows: length 13 millimeters; diameter 7.3 millimeters (tip broken and outer lip broken back).

C. tuberosum, or a species very similar to it, is represented by one specimen from the Gurabo formation. The tip of this specimen is broken, so that comparison with the young shell from Bowden is

impossible. "*Gutturnium gracile* variety *gurabonicum*" Maury (Bull. Am. Paleontology, vol. 5, p. 271, pl. 43, fig. 10, 1917; Gurabo formation) seems to be a synonym of *C. domingense* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 356, pl. 29, fig. 2, 1922)

DISTORSIO ("Bolten") Roeding

Subgenus DISTORSIO s. s.

Roeding, 1798, Museum Boltenianum, pt. 2, p. 133.
Type (*by subsequent designation, Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 357*).—*Distorsio anus* (Linné) (*Murex anus* Linné). Recent, Indo-Pacific.

Shell medium-sized, stout, whorls bearing at irregular intervals rounded humps ending in a varix. Aperture contracted into an irregular shape by a heavy armature of denticles and ridges on outer and inner lips and parietal wall. Canal short, curved backward, on some specimens at an angle of almost 90°. Edge of inner lip spread far out in type species. Sculpture cancellate.

Pilsbry's type designation is the earliest formal designation that could be found, though *Murex anus* has tacitly been assumed to be the type ever since the Bolten names were revived. Dall's citation of only this species under *Distorsio* is not a type designation, especially in view of his preference at that time for *Distortrix* Link (Smiths. Misc. Coll., vol. 47, p. 138, 1904).

The inner lip of the type species is heavier and spreads out farther than in the American fossils.

Pilsbry (cited above) has traced the geologic history and distribution of this genus. The earliest species, *Distorsio septemdentata* Gabb (Jour. Acad. Nat. Sci. Philadelphia, vol. 4, p. 380, pl. 67, fig. 21, 1860), from the middle Eocene Claiborne group of Texas, is small, and has a short canal. Its aperture is not so heavily margined as in the later species. It should be placed in the subgenus *Personella* Conrad (Am. Jour. Conch., vol. 1, p. 21, 1865), of which it is the monotype. The next species, "*Triton*" *crassidens* Conrad (Jour. Acad. Nat. Sci. Philadelphia, vol. 1, p. 118, pl. 11, fig. 40, 1848), from the upper Oligocene Byram marl of Mississippi, is the earliest *Distorsio* s. s., and is very similar to the Caribbean Miocene species. The earliest European species is found in the Burdigalian of Aquitaine (Cossmann, Essais Paléoconch. Comp., pt. 5, p. 105, 1903). The living species are confined to the warm seas of the Pacific, Indian, and western Atlantic Oceans.

Key to the Bowden species of Distorsio s. s.

Nucleus moderately large, humps angular, bearing two closely spaced spiral cords at shoulder, secondary spirals strong ..... *D. (D.) decussatus simillimus*
Nucleus very large, humps smoothly rounded, bearing two widely spaced spiral cords at shoulder, secondary spirals weak ..... *D. (D.) clathratus gatunensis*

Distorsio (Distorsio) decussatus simillimus (Sowerby)

(Plate 18, Figures 7 to 9; Plate 19, Figure 1)

Triton simillimus Sowerby, 1850, Quart. Jour. Geol. Soc. London, vol. 6, p. 48.
Persona simillima (Sowerby), Guppy (part), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288. Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 522.
Distortia simillimus (Sowerby), Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 212.
Distorsio simillimus (Sowerby), Gabb, 1881, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 353.
Distortrix simillima (Sowerby), Dall (part), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 272, pl. 43, figs. 4–5. Maury, 1925, Bull. Am. Paleontology, vol. 10, pp. 368–369.
Distorsio constrictus simillimus (Sowerby), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 356–360.

Shell medium-sized, relatively slender, humps greatly inflated. Nucleus moderately large, consisting of about three and a half rapidly enlarging, bulging whorls. Parietal ridges heavy, rather far apart, the posterior one close to edge of parietal callus. Shoulder of later whorls angulated and bearing two spiral cords, which generally are doubled, lying close to each other. Elsewhere the primary spirals are farther apart. Secondary spirals appear early on the first whorl. Later additional secondaries and tertiaries appear and are relatively strong on later whorls.

Length 53.7 mm.; diameter 29 mm. (large figured specimen, apex and tip of canal broken). Length 27.1 mm.; diameter 16.1 mm. (small figured specimen).

Type locality.—Dominican Republic (Miocene).

This *Distorsio* is discussed on the following pages.

Other localities.—Manzanilla beds (middle Miocene), Trinidad (Maury). "Modified" Cercado and Gurabo faunas (middle Miocene), Dominican Republic. Pliocene, Limon, Costa Rica.

Type material.—7 cotypes (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12813).

Distorsio (Distorsio) clathratus gatunensis Toula

(Plate 19, Figures 2, 3)

Persona simillima Guppy (part, not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288, pl. 17, fig. 13. Guppy (part, not Sowerby), 1874. Geol. Mag., decade 2, vol. 1, p. 439 (list).
Distortrix simillima Dall (part, not Sowerby), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Olsson (not Sowerby), 1922, Bull. Am. Paleontology, vol. 9, pp. 304–305.
Distorsio (Distortrix, Persona) gatunensis Toula, 1909, Jahrb. K.-k. geol. Reichsanstalt, vol. 58, pp. 700–701, pl. 25, fig. 10.
Distorsio gatunensis (Toula), Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 356, pl. 26, fig. 8.

Shell medium-sized, stout, humps broadly rounded. Nucleus large, consisting of about three and a half rapidly enlarging whorls, the last ones greatly inflated. Axis of nucleus slightly oblique to axis of post-nuclear whorls. Parietal ridges heavy, relatively far apart, the posterior one far

from edge of parietal callus. Shoulder and rest of later whorls sculptured with spiral cords forming rectangles with the axial ribs. Secondary spiral sculpture consisting of very fine threads on later whorls, which are strongest near suture.

Length 45.2 mm.; diameter 25.6 mm. (figured specimen, apex broken). Length 50.7 mm.; diameter 26.2 mm. (largest specimen, apex broken).

Type locality.—Panama Canal Zone (Gatun formation).

Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 356, 359, 1922) has already pointed out that two kinds of *Distorsio* are found at Bowden. If this locality alone were considered it would be reasonable to suppose that these two kinds of shells were varieties of the same species, or possibly an expression of sex-linked characters. This view is supported by the features of living specimens of *Distorsio* from the West Indies and the southeast coast of the United States. According to Pilsbry, the West Indian specimens represent the smoothly humped, evenly reticulate *clathratus* Lamarck, whereas specimens from the Pacific coast of Central America represent the more slender angular humped and unevenly reticulate *constrictus* Broderip—a name that is supplanted by "*Tritonium*" *decussatum* Valenciennes (Humboldt and Bonpland, Voy. rég. equinox. nouv. cont., Recueil obser. Zoologie, vol. 2, p. 306, 1832). In 1889 Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 222, 1889) showed that representatives of both these groups, for which he used the names *clathrata* and *reticulata*, respectively, are found in the West Indies. It is precisely these two groups that are found at Bowden.

The question as to what names to use for the Bowden specimens is further complicated by the distribution of the genus in other Miocene deposits of tropical America. Only the relatively slender, angular humped form is found in the Dominican Republic. Thirty-one specimens of this form, called *simillima* by Sowerby, are in the collections made by the United States Geological Survey party, representing 13 localities in the Gurabo formation and one locality in beds carrying a Cercado fauna modified by the appearance of some Gurabo species. In the Gatun formation of Panama and Costa Rica and also at "Cumana, Venezuela,"[1] only the stouter, smoothly humped form, to which Toula gave the name *gatunensis*, is found. Both forms are found at Bowden, and representatives of both groups are living in the West Indies, whereas only the angular humped group is living on the Pacific coast of Central America. Inasmuch as the two groups at Bowden are recognizable, both are named. Perhaps during Miocene time the *gatunensis* group was confined to the western and southern part of the Caribbean Sea and the *simillimus* group to the northern border, and at Jamaica the ranges overlapped. During Pliocene time the *simillimus* group lived along the western border of the Caribbean

[1] This locality record may be unreliable.

Sea, at least in Costa Rica. Apparently both groups are now living in the Caribbean Sea, the Gulf of Mexico, and off the southeast coast of the United States.

Of 18 specimens in the Henderson collection 10 represent the angular humped form, the largest of which has a length of only 41 millimeters. The large figured specimen is from the Guppy collection. They virtually duplicate specimens from the Gurabo formation, except that even the largest specimen is not quite so large as the largest Dominican specimens. They also are smaller than living specimens from the Pacific coast of Central America and have, as Pilsbry has pointed out, stronger secondary spirals. One small specimen has the two primary spiral cords at the shoulder so evenly divided that they take the form of four equal cords. Following Pilsbry, this *Distorsio* is considered a subspecies of the living Pacific Coast species. Pilsbry has noted that *D. crassidens* (Conrad), found in the upper Oligocene Byram marl of Mississippi, belongs to this phylum. It is smaller and more slender and deserves full specific rank. I would not hazard an opinion as to what name should be used for the living Atlantic form, all the specimens of which are even smaller than those from Bowden.

Eight specimens in the Henderson collection represent the smoothly humped form. Their large tilted nucleus, the last whorl of which is greatly inflated and strongly constricted, is striking. The nucleus is not quite so large as in specimens from the Gatun formation, and the angle of tilt is not so great. The Gatun specimens also have stronger secondary spiral threads, so that another name might be justified for the Bowden specimens, but the nomenclature of these Miocene Distorsios is complicated enough as it is. The Bowden and Gatun shells are considered a subspecies of the living West Indian "*Triton*" *clathratum* Lamarck (Hist. Nat. Anim. sans Vert., vol. 7, p. 186, 1822). Living specimens from the West Indies have the same kind of large constricted tilted nucleus, but the shell reaches a much larger size (length 66 mm.).

Other localities.—Gatun formation (middle Miocene), Panama and Costa Rica. "Miocene, Cumana, Venezuela" (Guppy).

Type material.—? Natural History Museum, Vienna.

BURSIDAE

BURSA ("Bolten") Roeding

Subgenus BURSA s. s.

Roeding, 1798, Museum Boltenianum, pt. 2, p. 128.

Type (by subsequent designation, Jousseaume, 1881, Bull. Soc. Zool. France, vol. 6, p. 174).—Murex bufonius Gmelin (renamed *Bursa monitata* by Roeding). Recent, Indo-Pacific.

The subgenus *Bursa* s. s. has a narrow deep anterior canal that is strongly curved backward and toward the outer lip. It is not represented in the Bowden formation.

Subgenus MARSUPINA Dall

Dall, 1904, Smiths. Misc. Coll., vol. 47, No. 1475, p. 118. Substitute name for *Buffo* Montfort, 1810, Conch. Syst., vol. 2, p. 575; type (by original designation), *Buffo spadiceus* Montfort. Not *Buffo* Lacépède, 1788, Hist. Nat. Quad. Ovip. et Serpens, vol. 1.

Type (*see above*).—*Buffo spadiceus* Montfort (? =*Ranella crassa* Dillwyn). Recent, West Indies ?.

Shell medium-sized, stout, biconic. Each whorl has two varices in two continuous series 180° apart. Aperture long, elliptical. Anterior canal short, wide, slightly curved backward, moderately emarginate. Inner lip and parietal wall covered with ridges and denticles. Anal sinus long, deep, extending upward along varix at outer lip and in a similar manner on the other varices. Outer edge of outer lip frilled, inner edge bearing elongate denticles. Sculpture consisting of beads and nodes arranged in spiral bands.

Marsupina has a longer aperture than *Bursa* s. s., and also a wider and straighter canal. *Bufonaria* Schumacher (Essai nouv. syst., p. 251, 1817; type, by subsequent designation, Herrmannsen, Indicis Gen. Malac., vol. 1, p. 135, 1846, *Ranella spinosa* Lamarck, Recent, Indo-Pacific) has weaker armature around the aperture and spines on the varices.

Bursa (Marsupina) proavus bowdenensis Pilsbry

(Plate 19, Figure 4)

Ranella crassa Guppy (not Dillwyn), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 288, pl. 18, fig. 9. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list).

Gyrineum crassum Dall (not Dillwyn), 1903, Trans. Wagner Inst. Philadelphia vol. 3, pt. 6, p. 1584 (list).

Bursa crassa bowdenensis Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 360, pl. 29, fig. 8.

? *Bursa crassa* Olsson (not Dillwyn), 1922, Bull. Am. Paleontology, vol. 9, p. 306, pl. 18, fig. 15.

Shell medium-sized. Nucleus stout, naticoid, consisting of about four whorls, the early whorls sculptured with axial riblets and spiral threads, the riblets disappearing first. Aperture relatively narrow. Anterior canal relatively long and straight. Anal sinus very long. Sculpture consisting of beads and nodes arranged in spiral bands. Shoulder bearing heavy nodes. For some distance below shoulder rows of heavy and small beads alternate.

Length 68 mm.; diameter 37 mm. (figured specimen).

Type locality.—Bowden, Jamaica (Miocene).

All the specimens in the Henderson and Guppy collections, and also the holotype, are relatively small. The figured specimen is one of seven from the Duerden collection. The outer and inner lips and parietal wall are colored light brown. Several shells retain faint traces of pinkish color.

Pilsbry described both *proavus*, from the Dominican Republic, and *bowdenensis* as subspecies of the living West Indian *B. crassa* (Dillwyn). This living species has a wider aperture, shorter and more recurved

canal, shorter anal sinus and smaller nodes on the shoulder. Therefore it seems desirable to give the fossils full specific rank. The holotype of *B. proavus* is a small shell from the Gabb collection. It has a shorter canal and broader pillar, and heavier nodes on the shoulder than small Bowden specimens. Maury's "*Bursa crassa* Dillwyn" (Gurabo formation ?) probably is the same species (Bull. Am. Paleontology, vol. 5, p. 272, pl. 43, figs. 6–7, 1917). Olsson's specimen from Costa Rica may represent *bowdenensis*, but it is very small.

In the photograph the shell is turned too far to the left, so that the aperture appears narrower than it really is.

Other localities.—? Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 3747).

CASSIDIDAE

CASSIS Scopoli

Scopoli, 1777, Introductio ad Historiam naturalem, p. 393.

Type (by subsequent designation, Montfort, 1810, Conch. Syst., vol. 2, p. 599).—Cassis cornutus (Linné) (*Buccinum cornutum* Linné). Recent, Indo-Pacific.

Shell large, heavy, stout, spire very low, bearing at intervals heavy varices. Aperture long, narrow, deeply emarginate at base, forming a short, strongly curved canal. Siphonal fasciole high. Inner and outer lips very thick. Columella and adjoining part of inner lip plicate. Interior of outer lip bearing heavy ridges or denticles. Sculpture consisting of nodes and axial wrinkles.

In the type species the extremities of the outer lip and the posterior part of the inner lip lack denticles or ridges.

This is one of the few genera that lived on both the Atlantic and Pacific coasts of Central America during Tertiary time, but survived only on the Atlantic side. No Miocene species have yet been discovered on the Pacific coast, but it is safe to assume that the genus was living there during Miocene time when the Atlantic and Pacific were joined. The only described species from the Pacific coast, *C. subtuberosa* Hanna (see Schenck, California Univ. Pub., Bull. Dept. Geol. Sci., vol. 16, No. 4, p. 75, 1926), is found in the beds of Imperial County, California, that generally are regarded as of lower Pliocene age. The fauna of these beds is in many respects a relict Caribbean Miocene fauna, and this feature has some significance in an interpretation of its palaeogeographic significance. The earliest definitely dated species from tropical America is the following one, but, as described under it, the genus appears in middle Oligocene deposits in Georgia.

Cassis sulcifera Sowerby

(Plate 19, Figures 5, 6)

Cassis sulcifera Sowerby, 1850, Quart. Jour. Geol. Soc. London, vol. 6, p. 47, pl. 10, fig. 1. Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 286. Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 222. Guppy,

1874, Geol. Mag., decade 2, vol. 1, p. 439 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 525. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 274, pl. 44, figs. 1–3. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 360–361. Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 306.

? *Cassidea sulcifera* (Sowerby) *?*, Cooke, 1919, Carnegie Inst. Washington Pub. 291, p. 113.

Not "*Cassis sulcifera* Sowerby," Dall, 1916, Proc. U. S. Nat. Mus., vol. 51, p. 508, pl. 86, fig. 4.

Shell reaching a large size, as shown by fragments, but all the perfect shells are small or medium-sized. Inner and outer lips of medium-sized shells bearing ridges along their entire length. Sculpture of small shells consisting of fine axial ribs, replaced by heavier nodes on shoulder. On medium-sized shells the ribs gradually disappear, except at base, and the nodes at shoulder become heavier.

Length 53.6 mm.; diameter 41.7 mm. (figured medium-sized specimen).

Type locality.—Dominican Republic (Miocene).

The figured specimen, from the Guppy collection, is rather badly battered and worn. The siphonal fasciole is broken, and an oyster and bryozoa grew on the inner lip, the basal part of which also was riddled by a boring organism, probably a sponge. The dorsal surface and spire are worn. Only a few other specimens are in the collections. A fragment of a large shell in the Henderson collection represents a shell that must have had a length of almost 100 millimeters, comparable to the large Dominican specimens, which have three rows of nodes and a greatly expanded inner lip. The largest Dominican shells are from the Cercado formation. The principal differences between this species and the living West Indian *C. tuberosa* (Lamarck) are in size and axial sculpture, the fossils being smaller and having coarser axial ribs or wrinkles.

The specimens from Calabazar, Havana Province, Cuba, described by Cooke, are internal molds, but they seem to represent the same or a similar large *Cassis*. The Georgia specimens described by Dall come from the middle Oligocene beds called the Glendon formation by Cooke. They are smaller and have rather heavy nodes above the shoulder. They seem, however, to represent the earliest American species of *Cassis*. Cooke (U. S. Geol. Survey Prof. Paper 133, p. 6, 1923) identified these specimens as *Cassis caelatura* Conrad, but that species is a small "*Phalium*."

Guppy (Agricultural Soc. Trinidad and Tobago, Paper 454, p. 4, 1911; reprint, Bull. Am. Paleontology, vol. 8, p. 209, 1921) listed *sulcifera* from the upper Miocene beds at Springvale, Trinidad, but in the absence of specimens this record can not be accepted.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa Rica. ? Miocene (?), Cuba.

Type material.—7 cotypes (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12779).

SEMICASSIS Mörch

Subgenus SEMICASSIS s. s.

Mörch, 1852, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, Comes de Yoldi, p. 112.

Type (by subsequent designation, Harris, 1897, Cat. Ter. Moll. British Mus., pt. 1, Australasian, p. 198).—Cassis japonica Reeve. Recent, Japan.

The subgenus *Semicassis* s. s., which has long ridges of irregular length at the base of the inner lip, is not represented by living, and probably not by fossil, species in America.

Dall (U. S. Geol. Survey Prof. Paper 59, pp. 61–62, 1909) proposed to use *Bezoardica* Schumacher (Essai nouv. syst., p. 248, 1817) for this group of mollusks, but Cossmann's type designation (Essais Paléoconch. Comp., pt. 5, pp. 121, 128, 1903) of *Buccinum glaucum* Linné (renamed *Bezoardica vulgaris* by Schumacher) makes *Bezoardica* a perfect synonym of *Phalium* Link. Gray's type designations of *Bezoardica* are disregarded, as he made two of them (Proc. Zool. Soc. London, pt. 15, p. 137, 1847). Iredale (Rec. Australian Mus., vol. 15, p. 331, 1927) considers that *B. vulgaris* (=*B. glaucum*) is the type by virtual tautonymy.

Semicassis is given full generic rank. *Phalium* Link (Beschr. Natur.-Sam. Rostock, p. 112, 1807; type, by subsequent designation,[1] Dall, U. S. Geol Survey Prof. Paper 59, p. 62, 1909, *Buccinum glaucum* Linné, Recent, Philippines) has teeth at the base of the outer lip and is regarded as a separate genus. *Cassidea* Bruguière (Ency. Méth., Vers, vol. 1, p. xv, 1789, p. 414, 1792; type, by subsequent designation, Cossmann, Essais Paléoconch. Comp., pt. 5, p. 123, 1903, *Buccinum cornutum* Linné) is a perfect synonym of *Cassis*.

Subgenus TYLOCASSIS, new subgenus

Type.—Buccinum inflatum Shaw. Recent, West Indies and southeast coast of United States.

Shell reaching a large size, greatly inflated, spire low. Most shells have only a terminal varix, but some have two or more varices. Nucleus naticoid, consisting of about three and a half whorls. Aperture long, wide, deeply emarginate at base, forming a short canal. Siphonal fasciole greatly inflated. Edge of inner lip detached at base, fused to body whorl above base. Columella bearing a basal twist. Basal part of inner lip bearing many denticles, replaced on middle part of columella by ridges. Parietal wall bearing several ridges. Outer lip greatly thickened, its inner edge bearing long lirations. Sculpture consisting of low spiral bands, modified by axial wrinkles.

[1] Herrmannsen's citation of only "*Cassis glauca* L." under *Phalium* (Indicis Gen. Malac., sup., p. 104, 1852) is not a type designation.

All the later Tertiary species from eastern America, and also *inflata* (Shaw) and *abbreviata* (Lamarck), the latter living on the Pacific coast of Mexico and Central America, represent *Tylocassis*, which differs from *Semicassis* s. s. principally in having wart-like denticles instead of long ridges on the basal part of the inner lip. *Echinophoria* Sacco (Moll. Piemonte, pt. 7, p. 39, 1890), for which apparently no type has yet been designated, has elongate denticles on the inner lip and a sculpture of strongly developed nodes.

Semicassis (Tylocassis) reclusa (Guppy)

(Plate 19, Figures 7 to 9; Plate 20, Figures 1, 2)

Cassis monilifera Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 287, pl. 17, fig. 8. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 525. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 34. Maury, 1925, Brasil Serv. Geol. Mineral. Mon., vol. 4, pl. 5, fig. 1.

Not *Cassis monilifer* Sowerby, 1846, in Darwin, Geological observations on South America, app. (not seen). Geological observations on coral reefs, volcanic islands, and on South America, app., pp. 260–261, 1851.

Cassidea granulosa Gabb (not Bruguière), 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 222.

Cassis reclusa Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 84 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 216). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 434; p. 438 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Phalium moniliferum (Guppy), Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 110–111, pl. 44, figs. 4–5, pl. 45, fig. 1. Olsson, 1922, Bull. Am. Paleontology, vol. 9, pp. 135–136, pl. 15, fig. 11.

Cassis inflata monilifera (Guppy), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 361.

Shell relatively small. Some shells ("*monilifera*") are shouldered and bear low nodes on the shoulder; others (*reclusa*) are not shouldered and lack the nodes. Some shells have only the terminal varix, others have two varices. Inner lip thick for size of shell. Sculpture consisting of flat spiral bands, bearing axial wrinkles or nodes arranged along retractive axial lines.

Length 18.4 mm.; diameter 13 mm. (smaller figured specimen). Length 30.5 mm.; diameter 20.4 mm. (larger figured specimen, holotype of *reclusa*). Length 31.9; diameter 22.1 millimeters (largest specimen).

Type locality.—Jamaica (Miocene).

Bowden is the type locality for both "*monilifera*" and *reclusa*, but the differences between them are hardly greater than in suites of the Recent species *S. inflata* (Shaw) and *S. abbreviata* (Lamarck). *S. inflata*, living in the West Indies, reaches a much larger size (length 110 millimeters). It generally has weaker axial sculpture, and most specimens are not shouldered and do not bear nodes at the shoulder. *S. abbreviata*, living on the Pacific coast of Central America, generally is shouldered and generally bears nodes on the shoulder, or on and below the shoulder. The figured shouldered specimen from the Guppy

collection is very much like young specimens of *abbreviata*. Pilsbry suggests that the fossil form may be the common progenitor of the Atlantic and Pacific species, a view that would account for the rather divergent features of the fossils.

In the Dominican Republic *reclusa* reaches a larger size (length 45 millimeters), and most of the specimens in both the Cercado and Gurabo formations are shouldered and bear nodes, though, as at Bowden, even at the same locality strongly shouldered and weakly shouldered, or non-shouldered, specimens are found. *S. caelatura* (Conrad) (Jour. Acad. Nat. Sci. Philadelphia, vol. 1, p. 119, pl. 11, fig. 44, 1848), a small species from the upper Oligocene Byram marl of Mississippi, has nodes on the shoulder and also above and below it. *S. aldrichi* (Dall) (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, pp. 162–163, 1890), another small species from the lower Miocene Chipola formation of Florida, has strong nodes on the shoulder and strong sculpture below it. *S. paraensis* (Maury) (Brasil Serv. Geol. Mineral. Mon., vol. 4, p. 119, pl. 5, figs. 5–7, 1925), a lower Miocene species from Brazil, has a higher spire.

Ten specimens are in the Duerden collection.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa Rica (Olsson). Miocene, Colombia (Pilsbry and Brown).

Type material.—Holotype (U. S. Nat. Mus. No. 115505).

SCONSIA Gray

Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 137.
Type (*by original designation*).—*Cassidaria striata* Lamarck. Recent, West Indies.

Shell medium-sized, stout, inflated, spire low, bearing varices at intervals. Nucleus naticoid, consisting of between two and three small whorls. Aperture long, moderately wide, contracted at base into a short, moderately emarginate canal. Siphonal fasciole low. Edge of inner lip detached at base, fused to body whorl above base. Basal part of inner lip and parietal wall bearing short ridges. Outer lip thick, its edge bearing lirations.

Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 361–362, 1922) has traced the history of this genus in American waters. *"Cassis" nuperus* Conrad (Fossil Shells Ter. formations North America, vol. 1, No. 4, p. 46, 1833) from the middle Eocene Gosport sand of Alabama, the oldest species, should be placed in a separate subgenus on account of its deep siphonal notch and inflated fasciole. It probably falls in *Galeodosconsia* Sacco (Boll. Mus. Zool. Anat. comp. R. Univ. Torino, vol. 5, No. 82, p. 17, 1890; type, by subsequent designation, Cossmann, Essais Paléoconch. Comp., pt. 5, p. 133, 1903, *Cassidaria striatula* Bonelli, Miocene, Italy), which is based on a Mediterranean Miocene species that has a less inflated fasciole. *"Cassidaria" lintea* Conrad (Jour. Acad. Nat. Sci. Philadelphia, vol. 1, p. 118, pl. 11, fig. 4, 1848),

from the upper Oligocene Byram marl of Mississippi, is the earliest American species representing *Sconsia* s. s., but it has a more inflated fasciole than the later species. No Sconsias are recorded from tropical America from deposits older than lower Miocene. *"Sconsia" felix* Maury (Brasil Serv. Geol. Mineral. Mon., vol. 4, p. 117, pl. 4, fig. 5. 1925) probably is a *Cymatium;* at all events it is not a *Sconsia.*

The only living Sconsias are found in the West Indies.

Sconsia (Sconsia) striata sublaevigata (Guppy)

(Plate 20, Figures 3 to 6)

Cassidaria sublaevigata Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 287, pl. 17, fig. 10. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list).

Sconsia sublaevigata (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Sconsia near *striata* Lamarck, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Not *Sconsia sublaevigata* Böse, 1906, Geol. Inst. Mexico Bol. 22, pp. 36–37, pl. 4, figs. 9–10.

Shell reaching a large size, relatively stout. Nucleus consisting of two and a half whorls. Sculpture consisting of narrow, flat, spiral bands, separated by narrower grooves. Early whorls bearing in addition weak retractive axial ribs, which gradually are replaced by growth lines. On the later whorls of adult shells the spiral bands become weaker except at base.

Length 63.6 mm.; approximate diameter 40 mm. (large figured specimen). Length 39.1 mm.; diameter 24.8 mm. (small figured specimen).

Type locality.—Jamaica (Miocene).

This *Sconsia* is represented by seven specimens in the Henderson collection and by 10 in the Duerden collection, but the only large specimen is in the Guppy collection. Pilsbry's view (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 361–362, 1922) that it is a subspecies of the living *striata* seems to be justified. The Bowden shells are larger and broader than *striata,* and at the same growth stage have weaker sculpture. So far as sculpture is concerned *S. bocasensis* Olsson (Bull. Am. Paleontology, vol. 9, pp. 309–310, pl. 15, figs. 12–13, 1922), from Bocas Island, Panama, is more similar to *striata,* but it is broader than *striata* and has a higher spire than either *striata* or *sublaevigata.* It is regarded as a subspecies of *striata. S. laevigata* (Sowerby) (Quart. Jour. Geol. Soc. London, vol. 6, p. 47, pl. 10, fig. 2, 1850) is found in great abundance in the Gurabo formation, and Maury used it as a guide fossil for these beds, inasmuch as, according to her collections, it was confined to the "*Sconsia laevigata* zone," later renamed the Gurabo formation. The extensive collections made by the United States Geological Survey party confirm the stratigraphic significance of this species in the Dominican Republic. It was collected at 20 localities, and it is represented by as many as 35 specimens

from one locality. It is broader than *sublaevigata*, and on adult shells the sculpture of the bulging part of the body whorl is reduced to microscopic striae. Young shells have weaker sculpture than Bowden specimens of the same size. The separation of *gabbi* Olsson (Bull. Am. Paleontology, vol. 9, pp. 308–309, pl. 15, fig. 3, 1922) as a subspecies of *laevigata* is unjustified, at least on the basis of a suite of specimens from Toro Cay, Panama. The Toro Cay specimens are more slender and less shouldered than many Dominican specimens, and have slightly stronger sculpture, but some Dominican specimens, especially those from U. S. G. S. station 8516 (Rio Amina), are like Toro Cay shells. Similar specimens are found in the Gatun formation of the Canal Zone. Böse's "*sublaevigata*" from the middle Miocene beds of Tuxtepec, Mexico, is a rather strongly sculptured "*gabbi*," according to the figures and according to a specimen from a locality farther east in the Isthmus of Tehuantepec. *S. cocleana* Olsson (Bull. Am. Paleontology, vol. 9, p. 310, pl. 15, fig. 7, 1922), recorded from the lower Miocene Uscari formation of Costa Rica, is broad and has a very low spire.

S. hodgei (Conrad), found in the Duplin marl of North Carolina, is not like any of the Caribbean Miocene species. It has an inflated siphonal fasciole and falls in *Galeodosconsia*.

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64075).

TONNIDAE ("DOLIIDAE")

Genus MALEA Valenciennes

Valenciennes, 1832, in Humboldt and Bonpland, Voyage aux régions équinoxales du nouveau continent; Recueil d'observations de zoologie et d'anatomie comparée, vol. 2, p. 324.

Type (by subsequent designation, Herrmannsen, 1847, Indicis Gen. Malac., vol. 2, p. 13).—Malea latilabris Valenciennes (=*Cassis ringens* Swainson). Recent, Lower California to Peru.[1]

Shell reaching a large size, subglobose, spire low. Nucleus naticoid, consisting of between three and four whorls, the later ones enlarging rapidly. Aperture large, wide, deeply emarginate at base, forming a wide, short canal. Siphonal fasciole inflated. Inner lip detached on adult shells at base. Columella bearing a heavy basal twist on which several folds are imposed on inner lip. Middle of parietal wall bearing two or three heavy ridges. Outer lip varicose, resorbed as growth continues, outer edge frilled, inner edge heavily ridged. Sculpture consisting of broad spiral bands.

Before the well-known name *Malea* can be used for the grinning tuns it is necessary to dispose of *Cadus* ("Bolten") Roeding (Mus. Boltenianum, pt. 2, p. 150, 1798) and *Cadium* Link (Beschr. Natur.-Sam. Rostock, p. 113, 1807), for both these genera include *Buccinum*

[1] Inasmuch as *Malea latilabris* and *Malea crassilabris*, the only species cited by Valenciennes, are considered synonyms of *Cassis ringens*, that species virtually is the type by monotypy.

pomum Linné, an Indo-Pacific species that is congeneric with *Cassis ringens*, though it is smaller and differs in details of the inner lip. Apparently no actual type designation has been made for either of these genera. Therefore, *Buccinum perdix* Linné is herewith designated the type for both *Cadus* and *Cadium*, thus making both synonyms of *Tonna* Brünnich (Zoologiae Fundamenta, p. 248, 1771; genus without species), as that name is used. Suter (Man. New Zealand Moll., p. 314, 1913) cites *Buccinum galea* Linné as the type of *Tonna*, but I have not discovered who first assigned species to *Tonna*, and what species, therefore, are available as the type.

This is another Pacific genus that was widespread in the Caribbean Sea during Miocene time, but has become extinct there. It also lived in the Miocene and Pliocene Mediterranean Sea. *"Dolium" jamaicense* Trechmann (Geol. Mag., vol. 60, No. 710, p. 356, pl. 18, fig. 7, 1923), a species from the middle Eocene Yellow Limestone of Jamaica, looks like a *Malea*, according to the figure. If so, it is the earliest American species.

Malea camura Guppy

(Plate 20, Figures 7, 8)

Malea camura Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 287 pl. 17, fig. 9. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 525. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 276–277, pl. 45, fig. 3. ? Cooke, 1919, Carnegie Inst. Washington Pub. 291, pp. 113–114. ? Maury, 1920, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 1, pp. 59–60. ? Hubbard, 1921, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, pp. 148–149. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 363. Maury, 1925, Bull. Am. Paleontology, vol. 10, p. 370, pl. 47, fig. 7.

Malea ringens Gabb (part, not Swainson), 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 223.

Malea goliath Pilsbry and Johnson, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 170. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 363, pl. 29, figs. 1, 9.

Malea elliptica Olsson (not Pilsbry and Johnson), 1922, Bull. Am. Paleontology, vol. 9, p. 311, pl. 15, fig. 2.

Not *Malea camura* Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 356.

Not *Dolium* (*Malea*) *camura* Spieker, 1922, Johns Hopkins University Studies in Geology, No. 3, pp. 52–53.

Shell small, spire relatively high. Nucleus consisting of three and a half whorls. Base of columella bearing a heavy callus twist, beyond which on inner lip lie irregular denticles. Middle of parietal wall bearing a heavy callus ridge, which may be bifid, above which lies a series of lower ridges. Sculpture consisting of low flat spiral bands, wider than the interspaces in which lie very fine spiral threads. Secondary spirals may appear in some interspaces on body whorl.

Length 35.8 mm.; diameter 25.7 mm. (figured specimen).

Type locality.—Jamaica (Miocene).

It is difficult to evaluate this species, as all the specimens from Bowden are small, the figured specimen, a so-called "type" from the Guppy collection, being as large as any. It also is apparent that more or less similar Maleas were living in the Caribbean Sea during lower and middle Miocene time, and that there is no sensible break between these fossils and the living *M. ringens* of the Pacific coast.

Specimens from the Cercado formation apparently represent *camura*, though they have slightly higher and heavier spiral cords. They reach a larger size than Bowden specimens, the largest that can be measured having a length of 61 millimeters. Specimens from the Gurabo formation agree with *M. goliath*, which is based on stratigraphically unlocated material in the Gabb collection, but they are not so large and the spiral bands are not quite so wide. This material from the Gurabo formation is not so satisfactory as the Cercado specimens, but it seems reasonable to believe that *goliath* is the very large stage of *camura*, even though young shells from the Gurabo formation have more clean-cut bands than Cercado shells. One specimen from the Gurabo formation has a trilobed parietal ridge, whereas the type of *goliath* has four lobes. *M. elliptica* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 169–170, 1917; vol. 73, p. 363, pl. 29, fig. 3, 1922), also from the Dominican Republic, has a high spire and is not represented in any stratigraphically located collections. Olsson's "*elliptica*" seems to represent a large *camura*.

The Gatun *Malea*, called *camura* by Brown and Pilsbry and *ringens* by Conrad, is distinctly shouldered, and represents a new species or a subspecies of *ringens*, of which it is in all probability the immediate predecessor. The *Malea* from the Zorritos formation of Peru, described by Spieker as *camura*, probably is the same as the Gatun species.

The specimen from Cuba described by Cooke is an internal mold representing a *Malea* like *camura*. Maury's and Hubbard's material from the lower Miocene Quebradillas limestone of Porto Rico and Maury's material from the lower Miocene Machapoorie beds of Trinidad are unfigured. The specimen figured in the Trinidad report is from the Dominican Republic. Guppy (Agricultural Soc. Trinidad and Tobago Paper No. 549, p. 5, 1913; reprint, Bull. Am. Paleontology, vol. 8, p. 340, 1921) recorded *camura* from Yabalito, Venezuela.

The Bowden specimens of *camura* are less shouldered than most specimens of the living *ringens*, and they also have heavier callus armature than small living shells, indicating, as Cooke suggested, that they reached maturity at an earlier stage. Not more than four shells are in any collection.

Other localities.—? Quebradillas limestone (lower Miocene), Porto Rico (Maury, Hubbard). ? Machapoorie beds (lower Miocene),

Trinidad (Maury). ? Miocene (?), Cuba. Uscari formation (lower Miocene), Costa Rica (Olsson). Cercado and Gurabo formations (middle Miocene), Dominican Republic. Gatun formation (middle Miocene, Costa Rica (Olsson).

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64076).

FICIDAE

FICUS ("Bolten") Roeding

Roeding, 1798, Museum Boltenianum, pt. 2, p. 148.

Type (by subsequent designation, Dall, 1906, Jour. Conch., vol. 11, p. 296).—Bulla ficus Gmelin (renamed *Ficus communis* and *Ficus variegata* by Roeding). Recent, Indo-Pacific.[1]

Shell moderately large, pear-shaped, spire low. Nucleus naticoid, consisting of between one and two whorls. . Aperture very long and wide, tapering to a short wide, unemarginate anterior canal. Sculpture consisting of spiral cords and axial threads.

This genus is more generally known by the Lamarckian name of *Pyrula*. One of the strange results of adopting the names in the Museum Boltenianum is to have the same name, *Ficus mississippiensis*, for a fossil mollusk (Conrad, Jour. Acad. Nat. Sci. Philadelphia, vol. 1, p. 117, 1848) and also for a fossil plant (Lesquereux, Dana's Man. Geol., ed. 1, p. 513, fig. 794, 1866; Berry, U. S. Geol. Survey Prof. Paper 131, p. 9, 1922).

Ficus pilsbryi (B. Smith)

(Plate 20, Figure 9; Plate 21, Figures 1, 2)

Ficus papyratia Gabb (not Say), 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 223.

Ficula carbasea Guppy (not Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 580, pl. 26, fig. 7), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 80 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 212). Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, p. 439 (list).

Pyrula carbasea Dall (not Guppy), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Pyrula pilsbryi B. Smith, 1907, Proc. Acad. Nat. Sci. Philadelphia, vol. 59, pp. 213–214, fig. 1. Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 277. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 364.

Shell relatively small. Nucleus relatively small, consisting of between one and one and three-quarter whorls. Sculpture cancellate, consisting of primary spiral threads, between which lies one secondary spiral, overridden by strong axial threads that are as strong as the secondary spirals or as strong as the primary spirals. On adult shells a tertiary spiral thread appears between the secondaries.

Length 25.2 mm.; diameter 13.1 mm. (small figured specimen). Estimated length 50 mm.; diameter 27 mm. (large figured specimen).

Type locality.—Bowden, Jamaica (Miocene).

[1] Inasmuch as the only two valid species cited by Roeding are new names for *Bulla ficus*, that species virtually is the type by monotypy.

No perfect specimens of this species are in any of the collections at Washington or Baltimore. Even the largest shell is relatively small. The smaller figured specimen is worn. The larger figured specimen is one of two in the Guppy collection labeled "types" of "*Ficula carbasea*." No specimens were collected in the Dominican Republic by the United States Geological Survey party, but Maury records it from the Cercado formation, and Pilsbry cites specimens that Gabb collected.

F. pilsbryi closely resembles *F. papyratia* (Say), living in the West Indies and northward to North Carolina, but is smaller and has a smaller nucleus and stronger axial sculpture. *F. paraensis* White (see Maury, Brasil Serv. Geol. Mineral. Mon., vol. 4, p. 123, figs. 10, 12, 1925), a lower Miocene species from Brazil, also has weaker axial sculpture. *F. carbasea* (Guppy), the type of which is from the upper Miocene Springvale beds of Trinidad, has stronger primary spirals. *Pyrula trinitaria* Maury (Bull. Am. Paleontology, vol. 10, pp. 374–375, pl. 52, figs. 9, 12, 1925), also from the Springvale beds, probably is a synonym of *carbasea*. Fragments of a similar species are in collections from the Cercado formation, but they have narrower primary spirals and weaker secondaries. *F. micronematica* (Brown and Pilsbry) (Proc. Acad. Nat. Sci. Philadelphia, vol. 64, pp. 507–508, pl. 22, fig. 8, 1913) also is similar to *carbasea*. The type of *micronematica* is from the Emperador limestone of the Panama Canal Zone, but it also is found in the Culebra formation. All these species (*carbasea*, the Cercado species, and *micronematica*) are similar to *F. ventricosa* (Sowerby), also known as *F. decussata* (Wood), living in the Panamic region, and represent a phylum now extinct in West Indian waters.

Other localities.—Cercado formation (middle Miocene), Dominican Republic (Maury, Pilsbry).

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 11144).

AMPHIPERASIDAE ("Ovulidae")[1]

SIMNIA ("Leach") Risso

Subgenus SIMNIA s. s.

Risso, 1826, Histoire naturelle des principales productions de l'Europe Méridionale, vol. 4, p. 235.

Type (by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 143).—*Simnia nicaeensis* Risso (? = *Bulla patula* Pennant). Recent, Mediterranean.

So far as known the type of this genus has not been certainly identified. It generally is regarded as a young shell of "*Bulla*" *patula* Pennant. Risso's figure (fig. 150) shows a shell that is more slender and has a narrower aperture, yet it is not so slender as "*Bulla*" *spelta* Linné, the type of the following subgenus. If *Simnia nicaeensis* is regarded as representing "*Bulla*" *patula*, the subgenus *Simnia* s. s.

[1] Perhaps the name of this family will have to be changed to Amphiperidae.

is characterized by its relatively inflated shell and thin outer lip, and by the absence of callus on the inner lip. On this basis it is not represented in the Bowden formation.

Schilder (Rec. Geol. Survey India, vol. 58, pt. 4, pp. 362, 376, 1926) places this family as a subfamily Amphiperasinae under Cypraeidae.

Subgenus CALPURNA Fleming

Fleming, 1828, History of British Animals, p. 331.

Type (*by monotypy*).—*Ovula leathesi* Sowerby (? =*Bulla spelta* Linné). Pliocene, England.

Shell medium-sized, moderately slender, polished, spire concealed. Body whorl of adults bulging at periphery. Aperture as long as shell, prolonged into a canal at both ends, unemarginate at base. Columella excavated and flattened above base. Inner lip and parietal wall covered with callus. Posterior part of parietal wall bearing a spiral callus. Posterior channel extending to apex of shell. Outer lip thickened. Sculpture consisting of fine faint spiral grooves at ends. (Based on *Bulla spelta* Linné.)

There is nothing in Fleming's publication to indicate that he intended *Calpurna* as a modification of *Calpurnus* Montfort 1810, which Schilder (Rec. Geol. Survey India, vol. 58, pt. 4, p. 375, 1926) places in his subfamily Eocypraeinae. It has become customary to use *Neosimnia* Fischer (Man. Conch., p. 664, 1884; type, by monotypy, *Bulla spelta* Linné) for egg shells of the group of *Bulla spelta* on the grounds that *Calpurna* is a homonym of *Calpurnus* or is too similar to it.

S. Wood (Crag Moll., Univalves, p. 14, pl. 2, figs. 1*a*, *b*, 1848) considers *Ovula leathesi* as in all probability a synonym of *Bulla spelta*, but Sowerby's figures (Min. Conch., vol. 5, p. 124, pl. 478, 1825) shows a more inflated shell.

Simnia (Calpurna) immunita (Guppy)

(Plate 21, Figures 3 to 8)

Ovulum immunitum Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pp. 78–79, pl. 1, fig. 7 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, pp. 210–211). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 409, pl. 16, fig. 7; p. 440 (list).

Ovula (*Simnia*) *immunita* (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Ovula (*Simnia*) sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell medium-sized, slender, or moderately slender, body whorl of adults humped at periphery. Parietal spiral callus heavy. Young shells (figs. 7, 8) show, where outer shell layer and callus is worn off, very fine spiral threads, probably representing interspaces between spiral grooves on outer shell layer.

Length 19.2 mm.; diameter 6.9 mm. (holotype, slender shell). Length 17.8 mm.; diameter 7.3 mm. (stout shell).

Type locality.—Jamaica (Miocene).

The holotype is relatively slender, other shells being stouter and having a more pronounced hump. On young shells (fig. 7) the spiral parietal callus of adults is absent, but the lower part of the posterior channel is bounded by a ridge of callus that is almost continuous with the ridge leading up to the apex of the shell. At a later stage (fig. 5) the adult spiral callus appears, but it is weak and the callus along the lower part of the channel is strong. Additional material from the type locality of "*Ovula* (*Neosimnia*)" *wisewoodae* Maury (Bull. Am. Paleontology, vol. 5, pp. 277–278, pl. 48, fig. 17, 1917; Cercado formation) may show that it is a synonym of *immunita*. The type is a little stouter than the stoutest specimen of *immunita*. The living West Indian *S. aureocincta* Dall has a less pronounced hump and the callus around the entire aperture is heavier.

Five specimens are in the Duerden collection.

Type material.—Holotype (U. S. Nat. Mus. No. 115598).

CYPRAEIDAE

CYPRAEINAE

CYPRAEA Linné

Subgenus CYPRAEA s. s.

Section CYPRAEA s. s.

Linné, 1758, Systema Naturae, ed. 10, p. 718.

Type (by subsequent designation, Montfort, 1810, Conch. Syst., vol. 2, p. 631).—Cypraea tigris Linné. Recent, Indo-Pacific.

Cypraea s. s. is not represented in the Bowden formation. In this section the fossula, or depression at the base of the columella, is long, broad, and shallow, and is not separated from the columellar furrow extending along the columella.

Section TALPARIA Troschel

Troschel, 1863, Das Gebiss der Schnecken zur Begründung einer natürlichen Classification, vol. 1, pp. 204, 206.

Type (by subsequent designation, following virtual tautonymy, Schilder, 1926, Rec. Geol. Survey India, vol. 58, pt. 4, p. 375).—Cypraea talpa Linné. Recent, Indo-Pacific.

Shell small or medium-sized, relatively slender. Aperture very narrow. Fossula very deep. Basal columellar fold heavy. Teeth on outer and inner lip fine and numerous, on the inner lip extending across upper part of fossula and across part of columellar furrow.

Schilder (cited above), who considers *C. mappa* Linné the type of *Cypraea* on the grounds that it alone was cited by Lamarck in the Prodrome, does not recognize this group, and on the basis of accepting *tigris* as the type would consider it a synonym of *Cpraea* s. s. It is here recognized because of the significance of its geographic distribution. A *Cypraea* very similar to *isabella*, which falls in *Talparia*, is found as a fossil in the Caribbean region, but no species of this group are now living there. *Talparia*, as opposed to *Cypraea* s. s., has many

fine teeth, and the fossula is very deep and separated from the columellar furrow.

Cypraea (Talparia) isabella patrespatriae Maury

(Plate 21, Figure 9)

Cypraea isabella Linné, Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 235. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 364.
Cypraea patrespatriae Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 280, pl. 45, fig. 10.

Shell small, slender, spire concealed under a depression. Fossula very deep and broad. Basal columellar fold heavy. Outer and inner lips bearing many fine teeth. Fossula bounded by teeth along edge of columella. The teeth on inner lip fail to extend across columellar groove and fossula, except as an irregular ridge across upper part of fossula.

Length 20.9 mm.; lateral diameter 12.1 mm.; dorso-ventral diameter 9.6 mm. (figured specimen).

Type locality.—Bluff 1, Cercado de Mao, Dominican Republic (Gurabo formation).

This *Cypraea* is represented by only one small specimen. It is remarkable that it is so similar to *C. isabella mexicana* Stearns, living on the Pacific coast of Mexico, and to *C. i. isabella* from the western Pacific, and that no similar species is now living in the West Indies. According to Pilsbry the similarity is so close that the fossils should take the name of the living species. Even a large topotype from the Gurabo formation, which has a length of 32.3 millimeters, is considerably smaller than *mexicana*, which reaches a length of 48 millimeters. The small Bowden specimen is broader than small specimens of *mexicana*. Though these differences may not be significant, it seems desirable to consider the fossils as a subspecies of the *isabella* group.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (Cornell University).

Section ZONARIA Jousseaume

Jousseaume, 1884, Bull. Soc. Zoologique France, vol. 9, pp. 92–93.
Type (by original designation).—"*Cypraea zonata* Chemnitz" (=*Cypraea zonaria* Gmelin). Recent, West Africa.

Shell medium-sized, lateral margins more or less heavily margined with callus. Fossula small and shallow. Columellar furrow shallow. Teeth on outer and inner lips long, not extending from inner lip across fossula or furrow. Columella smooth.

The following species seems to be a *Zonaria*, though the teeth on the inner lip extend across the fossula and furrow.

Schilder places *Zonaria* as a subgenus under *Erronea* Troschel (Gebiss-Schnecken, vol. 1, pp. 205, 210, 1863; type, by subsequent designation, Jousseaume, Bull. Soc. Zool. France, vol. 9, p. 94, 1884, *C. errones* Linné, Recent, Indo-Pacific), which he gives generic rank.

Cypraea (Zonaria) raymondrobertsi bowdenensis Pilsbry

(Plate 21, Figures 10, 11; Plate 22, Figure 1)

Cypraea near *spurca* Linné, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Cypraea raymondrobertsi bowdenensis Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 365, pl. 30, fig. 6.

Shell small, very broad, lateral margins heavily callused, the edge of the callus standing up as a ridge. Columellar furrow and fossula very shallow. Teeth on outer and inner lips heavy and long, those on inner lip extending across furrow and fossula.

Length 26.6 mm.; lateral diameter 19.5 mm.; dorso-ventral diameter 13.2 mm. (figured specimen).

Type locality.—Bowden, Jamaica (Miocene).

The heavy callus on the margin of the shell is a striking feature in this *Cypraea*, represented by four specimens in the Duerden collection. The subspecies from Bowden has a heavier callus than *C. r. raymondrobertsi*, a specimen of which was collected from the Gurabo formation, and it has fewer and longer teeth on both outer and inner lips. This *Cypraea* also has no living representatives in the Caribbean region. It is perhaps most similar to *C. robertsi* Hidalgo (*punctulata* Gray not Gmelin), a living Panamic species, which is not so broad and has a thinner callus, a deeper fossula, and shorter teeth.

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 11146).

TRIVIINAE

TRIVIA ("Gray") Broderip

Subgenus TRIVIA s. s.

Broderip, 1837, Penny Cyclopaedia, vol. 8, p. 256. (Quoted from Iredale, Proc. Mal. Soc. London, vol. 12, p. 35, 1916.)

Type (by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 142).—*Cypraea europaea* Montagu (=*Voluta jonensis* Pennant). Recent, seas of Europe.

Shell small, globose, spire concealed. Dorsal surface generally bearing a groove. Aperture narrow, slightly expanded toward base, both ends barely emarginate, posterior end bent toward concealed spire. Columellar furrow extending along entire length of aperture, widening and deepening toward base. Outer lip callused, the thickening extending around extremities of aperture. Threads extend out from outer and inner lips encircling shell and extending across columellar furrow. On some species the threads are granular on dorsal surface.

Jousseaume (Bull. Soc. Zool. France, vol. 9, pp. 99–100, 1884) proposed five genera for the shells that generally go under the name of *Trivia*, but the Bowden fossils do not fit into these groups. *T. cypha* might be regarded as representing *Trivia* s. s., though its outer lip is relatively wide and the lower part of the aperture is narrower than in the type species. Likewise *T. globosa* might be placed in *Niveria* (type, by original designation, "*Trivia nivea* Gray" = *Cypraea nivea* Sowerby not Roeding = *Trivia nix* Schilder, Recent, West Indies),

though its aperture is less arcuate than in the type species. No names are available for *T. pediculus*, on which granules appear on the dorsal surface of the shell. *Pusula* (type, by subsequent designation, Roberts, Tryon's Man. Conch., vol. 7, p. 161, 1885; *Cypraea radians* Lamarck, Recent, California to Ecuador) has dorsal granules, but the lateral margins of the shell are callused and pinched as in some species of *Cypraea*.

Key to the Bowden species of Trivia s. s.

Dorsal surface not granular, dorsal groove weak.
Shell moderately inflated, outer lip wide ..... *T. cypha*
Shell greatly inflated, outer lip moderately wide ..... *T. globosa*
Dorsal surface granular, dorsal groove strong ..... *T. pediculus*

Trivia (Trivia) cypha, new species

(Plate 22, Figures 2, 3)

Trivia suffusa Dall (not "Gray"), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell medium-sized, moderately inflated, dorsal surface strongly convex. Aperture very slightly expanded toward base. Outer lip relatively wide. Dorsal groove faint or obscured by a hump at one side.

Length 10.7 mm.; lateral diameter 8.3 mm.; dorso-ventral diameter 6.6 mm. (holotype).

This species is represented by seven specimens in the Duerden collection. The smallest shell in the Henderson collection has a length of 9.1 millimeters. It has a weak dorsal groove, but on the others the groove is very faint, as it is obscured by the hump at the apex of the dorsal surface. *T. sanctidominici* Maury (Bull. Am. Paleontology, vol. 5, pp. 281–282, pl. 45, fig. 15, 1917; Cercado formation) is smaller and has finer sculpture, and the posterior end of the aperture is more abruptly turned toward the apex. The living West Indian *T. suffusa* ("Gray") Sowerby has a narrower outer lip and less inflated dorsal surface.

Type material.—Holotype (U. S. Nat. Mus. No. 369469).

Trivia (Trivia) globosa ("Gray") (Sowerby)

(Plate 22, Figures 4, 5)

Cypraea globosa ("Gray"), Sowerby, 1832, Conch. Illustr., *Cypraea*, p. 12, No. 117, fig. 34. Reeve, 1845, Conch. Icon., *Cypraea*, pl. 26, fig. 152. Sowerby, 1859, Thes. Conchyl., *Cypraea*, p. 47, pl. 35, figs. 466–467. Hidalgo, 1907, Mon. *Cypraea*, pp. 369–370.

Trivia globosa ("Gray"), Roberts, 1885, Tryon's Man. Conch., vol. 7, p. 200, pl. 21, figs. 92–93. Dall, 1889, Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 241. Dall, 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 168. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 281, pl. 45, fig. 13.

Shell small, greatly inflated. Aperture very narrow, moderately arcuate. Dorsal groove faint or absent on the only specimens, which apparently are

immature, the threads interfingering across the dorsal surface or extending across it.

Length 2.9 mm.; lateral diameter 2.5 mm.; dorso-ventral diameter 2.3 mm. (figured specimen). Length 3.9 mm.; lateral diameter 3 mm.; dorso-ventral diameter 2.6 mm. (largest specimen).

Type locality.—[West Indies ?] (Recent).

The two specimens of this greatly inflated *Trivia* are very small. They are like small Recent specimens of *globosa*, but additional material may show that they should receive another name. Maury reports from the Cercado formation specimens having a length of 5.5 millimeters; that is, only a little smaller than adult living *globosa*.

In the photograph representing the ventral view the apex of the shell is tilted backward, and in the one representing the dorsal view the apex is tilted forward.

Other localities.—Cercado formation (middle Miocene), Dominican Republic. Caloosahatchee marl (Pliocene), Florida. Living Cedar Keys, Florida to Barbados in 23 to 640 fathoms.

Trivia (Trivia) pediculus (Linné)

(Plate 22, Figures 6 to 11)

Cypraea pediculus Linné, 1758, Syst. Nat., ed. 10, p. 724. Reeve, 1845, Conch. Icon., *Cypraea*, pl. 23, fig. 131. Sowerby, 1859, Thes. Conchyl., *Cypraea*, p. 43, pl. 34, figs. 429–438. Hidalgo, 1907, Mon. *Cypraea*, pp. 463–465.

Trivia pediculus (Linné), Gabb, 1881. Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 360. Roberts, 1885, Tryon's Man. Conch., vol. 7, p. 201. Dall, 1889, Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 240. Dall, 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, p. 168. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell medium-sized, moderately inflated, dorsal groove long, relatively deep. Aperture narrow, distinctly widened toward base. Threads strongly granular on dorsal surface, varying in number and width.

Length 11.8 mm.; lateral diameter 8.2 mm.; dorso-ventral diameter 6.5 mm. (finely sculptured figured specimen). Length 12.2 mm.; lateral diameter 9.1 mm.; dorso-ventral diameter 7.6 mm. (coarsely sculptured figured specimen).

Type locality.—[West Indies] (Recent).

Six specimens are referred to this species. Five of them are finely sculptured and have no border of callus along the lateral margin adjoining the inner lip (figs. 6 to 9). The fifth, which is in the Guppy collection, is coarsely sculptured and has a callus border on the side of the inner lip (figs. 10, 11). Essentially similar variations can be seen in suites of living shells of *pediculus*, which is very common in the West Indies, but it is unusual to have the edge of the callus border on the side of the inner lip so distinct along its entire length. The fossils are not so large as living specimens, which reach a length of 16.5

millimeters, and they also have a narrower aperture than small living specimens. In fig. 8 the shell is turned too far to the right, making the outer lip appear too narrow.

Other localities.—Pliocene, Costa Rica. Caloosahatchee marl (Pliocene), Florida. Living, St. Augustine, Florida to Barbados.

ERATO Risso

Subgenus ERATO s. s.

Risso, 1826, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 240.

Type (*by monotypy*).—*Voluta cypraeola* Brocchi (considered as a synonym or subspecies of *Voluta laevis* Donovan). Miocene and Pliocene, Italy.

Shell small, *Marginella*-like, spire low, entire shell covered with layer of callus. Aperture long, narrow, virtually unemarginate at base. Inner lip bearing at edge of aperture a series of denticles that almost or quite disappear on middle part of lip. Short folds extend out on pillar from base of inner lip. Columellar furrow shallow, extending along entire length of aperture. Outer lip thickened, its edge finely denticulate.

Cypraea vaughani Maury is the only Tertiary *Erato* from the Caribbean region, aside from the species here recorded. Van Winkle (Bull. Am. Paleontology, vol. 8, p. 23, 1919) places this species, which is found in the Eocene beds of Trinidad, in *Erato*.

Erato (Erato) domingensis trochala, new subspecies

(Plate 22, Figure 12)

Erato maugeriae Dall (not Gray), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell very small, broad, spire very low. Lower part of inner lip bearing small denticles, parietal wall bearing a heavier oblique ridge. Columellar furrow not sharply limited along inner lip except at base.

Length 3.9 mm.; diameter 2.8 mm. (holotype).

This *Erato* is more or less intermediate between *E. d. domingensis* Maury (Bull. Am. Paleontology, vol. 5, p. 282, pl. 47, fig. 8, 1917), from the Cercado formation, and the living West Indian *E. maugeriae* Gray. It is a little larger than *E. d. domingensis*, and has stronger denticles on the lower part of the inner lip, whereas even the largest specimens of *E. d. domingensis* have only a slight suggestion of denticles. The Cercado fossils also have a sharp ridge along the entire length of the columellar furrow. The Bowden fossils are smaller than the living species, and have weaker denticles on the outer lip. They also are broader at the shoulder than small living shells of the same size.

This species is represented by six specimens, all in the Henderson collection.

Type material.—Holotype (U. S. Nat. Mus. No. 135338).

STROMBIDAE

STROMBUS Linné

Linné, 1758, Systema Naturae, ed. 10, p. 742.
Type (*by subsequent designation, Montfort, 1810, Conch. Syst., vol. 2, p. 515*).—*Strombus pugilis* Linné. Recent, West Indies and Florida.

Shell medium-sized or large, spire moderately high. Aperture long, wide, deeply emarginate at base. Siphonal fasciole bulging. Base of pillar bent backward. Inner lip and parietal wall heavily coated with callus. Outer lip dilated, forming a deep, wide anal sinus. Base of outer lip bearing a deep, wide sinus or stromboid notch. Interior of outer lip bearing irregular lirations. Sculpture of early whorls consisting of axial ribs, occasionally varicose, and of spiral threads, the ribs generally changing to spines on shoulder of later whorls.

Some species of *Strombus* have heavy wrinkles far back on the parietal wall and outer lip. Other species have wrinkles on the base of the columella. In the type species the outer lip is not dilated upward, and fails to reach the suture of the preceding whorl.

Only the first two of the following species represent *Strombus* in the restricted sense.

Key to the Bowden species of Strombus

Outer lip not ascending, spines present, body whorl sculptured.
  Spiral sculpture absent on body whorl except at suture and on pillar..*S. pugiloides*
  Spiral sculpture present on entire body whorl.
    Shell medium-sized.....*S. bifrons*
    Shell very large.....*S.* species
Outer lip ascending, spines absent, body whorl smooth.....*S. leurus*

Strombus pugiloides Guppy

(Plate 23, Figures 1, 2)

Strombus pugilis Guppy (not Linné), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 287. Gabb (part), 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 233. Dall (part), 1890, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, pp. 177–178.

Strombus pugiloides Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 82 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 214). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 433; p. 438 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 284, pl. 46, fig. 6.

Strombus proximus Guppy (part, not Sowerby), 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 521.

Strombus proximus pugiloides Guppy, Pilsbry (part), 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 367–368.

Not *Strombus pugiloides* Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 314, pl. 16, figs. 1–3.

Shell medium-sized, whorls shouldered, later whorls loosely coiled. Nucleus stout, consisting of about three rapidly enlarging whorls. Interior of outer lip crudely lirate. On some specimens the lirations are absent or are confined to an area below the anterior sinus. Sculpture of early whorls consisting of axial ribs with weak spiral threads in the interspaces. As the shoulder develops the axials become swollen into nodes on the shoulder and disappear elsewhere, and the spirals gradually disappear except for one

or two adjoining suture. On next to last whorl the nodes become sharp spines, which on adult shells generally are absent on body whorl, but may reappear on dorsal surface. Pillar sculptured with spiral threads. Color pattern consisting of narrow chevron-shaped brownish bands, the apex of the chevron lying below the shoulder. Enamel at aperture dark chestnut-brown.

Length 56.2 mm.; diameter 38.2 mm. (figured lectotype). Length 64.6 mm.; diameter 38.5 mm. (largest specimen).

Type locality.—Jamaica (Miocene).

Strombus pugiloides is the most abundant *Strombus* at Bowden. It is represented in the Duerden collection by 87 specimens. The chevron-shaped color bands are a striking feature. Most specimens have lirations on the interior of the outer lip, but on a few they are entirely absent. Some shells have lirations along the entire length of the lip, most of them have them only on the anterior half of the lip, others have them only below the anterior notch or extending up a short distance above the notch. On one specimen the spines extend around the body whorl, but they are low and blunt on the ventral surface. On other specimens they are confined to the dorsal surface of the body whorl, or to the dorsal and ventral surface adjoining the inner lip, or they are entirely absent on the body whorl.

This species probably belongs in the phylum of the living *S. pugilis* Linné, though it is smaller than the living species and has weaker spiral sculpture. It bears relatively long spines, like the West Indian race of *pugilis*. The larger northern race of *pugilis* generally has very low blunt spines. Many northern specimens of *pugilis* have, as Dall has pointed out (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 1, pp. 174, 177–178, 1890), a pattern of zigzag brown bands, mottled and partly concealed by the general brown color, but none has the very uniform chevron-shaped bands of *pugiloides*. *S. gracilior* Sowerby, the analogous Panamic species, is larger than *pugiloides*, and generally has weaker spiral sculpture and more uniformly spaced spines. It also lacks the color bands.

No specimens that can be referred to *pugiloides* were collected by the United States Geological Survey party in the Dominican Republic, though Gabb, Maury, and Pilsbry record it. Two worn shells collected from the Gurabo formation resemble this species, but they have a heavier pillar, a shallower stromboid notch, and the shoulder and spines lie farther down on the later whorls. Pilsbry places *pugiloides* as a subspecies of *S. proximus* Sowerby, but it is more similar to *pugilis*. The specimen of *pugiloides* figured by Maury has stronger spiral sculpture than Bowden specimens.

Olsson's "*pugiloides*" from Costa Rica represents a different species or subspecies that has stronger lirations on the interior of the outer lip, a shallower stromboid notch, and stronger spiral sculpture. Apparently *veatchi* (Bull. Am. Paleontology, vol. 9, p. 314, 1922) is a nude

name for this form. The color bands in this Costa Rican *Strombus* are narrower than in *pugiloides*.

Five specimens in the collections of the United States National Museum are incorrectly labeled Curaçao, Dutch West Indies.

Other localities.—Gurabo formation ? (middle Miocene), Dominican Republic.

Type material.—Lectotype, one of three specimens in Guppy collection apparently types, but not so labeled (U. S. Nat. Mus. No. 115477).

Strombus bifrons Sowerby

(Plate 23, Figures 3, 4; Plate 24, Figure 1)

Strombus bifrons Sowerby, 1850, Quart. Jour. Geol. Soc. London, vol. 6, p. 48, pl. 9, fig. 9. Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 287. Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 83 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 215). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 521. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 283, pl. 46, figs. 2, 3. Maury, 1925, Bull. Am. Paleontology, vol. 10, pp. 373–374, pl. 47, fig. 2. Maury, 1925, Brasil Serv. Geol. Mineral. Mon., vol. 4, pl. 4, fig. 3.

Strombus pugilis Gabb (part, not Linné), 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 233.

Strombus ambiguus Dall (not Sowerby), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Strombus ambiguus form *bifrons* Sowerby, Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 367.

Shell medium-sized, stout or slender, spire high, early whorls slender. Nucleus slender, consisting of about three whorls. Interior of outer lip bearing coarse lirations which on some specimens extend only halfway up the lip. Stromboid notch narrow and deep. Base of body whorl bulging near notch. Sculpture of early whorls consisting of closely spaced axial ribs, between which lie spiral threads. The axials become farther apart and are reduced to nodes as the shoulder develops, and finally become spines that extend around the body whorl, but may be low near inner lip. Body whorl sculptured with strong spiral threads.

Length 57.4 mm.; diameter 39.5 mm. (stout figured specimen). Length 49.6 mm.; diameter 25.8 mm. (slender figured specimen).

Type locality.—Dominican Republic (Miocene).

The Bowden specimens referred to this species, of which 29 are in the Duerden collection, are smaller than *pugiloides* and have a heavier callus on the lower part of the inner lip, and most of them are broader. All of them have strong spiral sculpture on the body whorl. The body whorl has a peculiar oblique inflation some distance beyond the apex of the stromboid notch. Some specimens have wrinkles on the basal part of the columella and on the posterior part of the parietal wall. These wrinkles are particularly strong on two slender specimens called "*ambiguus*" by Dall.

S. bifrons is abundant in the Gurabo formation of the Dominican Republic and, according to the collections of the United States Geological Survey party, is confined to it. Maury records this species from the Cercado formation, but her specimens may represent *S. proximus* Sowerby. Some of the Bowden specimens closely duplicate Gurabo specimens, but others, like the stout figured specimen, are stouter than any Dominican shells. The Gurabo specimens also generally have stronger lirations on the interior of the outer lip and a shallower notch. Maury records *bifrons* from the lower Miocene Machapoorie beds of Trinidad, but figures a Dominican specimen, and Hubbard (New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, pp. 144–145, 1921) doubtfully records it from the Quebradillas limestone of Porto Rico.

Through the kindness of L. R. Cox, of the British Museum, I recently received casts of the holotypes of some of Sowerby's Dominican species of *Strombus* and paratypes of the others. On the basis of this material and the collections made by the United States Geological Survey party, the following arrangement is offered.

It has already been stated that *S. bifrons* is abundant in the Gurabo formation, and that it apparently is confined to it. The only "typical" specimens of *S. proximus* were collected from the Cercado formation at station 8525 (Bluff 3 of Maury). This species has a lower row of spines, weak spiral sculpture on the later whorls and weak lirations on the interior of the outer lip. The early whorls are virtually the same as in *bifrons*. At one locality (station 8519, Bluff 1 of Maury) the Gurabo formation carries both *bifrons* and a variety of it that simulates *proximus* in having two or three spines in a lower row. This variety of *bifrons* differs from *proximus* in having stronger spiral sculpture, heavy lirations on the outer lip, and in having the oblique bulge on the body whorl near the notch on the outer lip. *S. haitensis* is found in both the Cercado and Gurabo formations, but is most abundant in the Gurabo formation. *S. maoensis* Maury probably is a weakly sculptured *haitensis*. *S. ambiguus* is the most unsatisfactory of all to dispose of. It seems to be a subspecies or variety of *haitensis* that is deeply concave above the shoulder.

Though Sowerby's comparison of *bifrons* with the Oriental *S. columba* Lamarck, which has fine lirations on both inner and outer lips, was far-fetched, there is no similar living species in the West Indian or Panamic regions.

One specimen of *bifrons* in the collections of the United States National Museum is incorrectly labeled Curaçao, Dutch West Indies.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (British Museum, Natural History, Geological Department, Geol. Soc. London, No. 12778).

Strombus species

(Plate 24, Figure 2)

Strombus haitensis Dall (not Sowerby), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

The Henderson and Duerden collections contain fragments of a large *Strombus* that are too meager to identify. The material in the Henderson collection (U. S. Nat. Mus. No. 135291) consists of the lower part of two large heavy columellas and parts of two outer lips, one of which is figured. The upper part of the outer lip is dilated. So far as this material goes it resembles the living West Indian *S. costatus* Gmelin. *S. galliformis* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 366, pl. 31, figs. 1, 2, 1922), a Miocene species from the Dominican Republic, is comparable in size, but the outer lip has finer spiral sculpture. *S. haitensis* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 48, pl. 9, fig. 7, 1850), a moderately large species found in the Cercado and Gurabo formations, has a heavy spine in a lower row lying near the edge of the outer lip. The figured fragment has a length of 88 millimeters.

Strombus leurus, new species

(Plate 24, Figures 3 to 5)

Shell medium-sized, relatively thin and slender, spire moderately high, smoothly conical. Aperture relatively narrow. Siphonal notch apparently shallow. Pillar and base of columella slender. Inner lip and parietal wall thickly coated with callus. Posterior part of parietal wall bearing several low heavy wrinkles well within aperture. Outer lip extending upward beyond suture of preceding whorl, not shouldered or notched at posterior end. Stromboid notch on outer lip very shallow. Interior of basal part of outer lip lirate. Early whorls, or all whorls except body whorl, bearing low, broad varices, which generally are eroded, leaving pits. Early whorls sculptured with low crowded axial ribs, between which lie spiral threads. Axials disappearing on about fourth whorl, but the spirals continue and then gradually disappear. Later whorls smooth.

Length 61.2 mm.; diameter 29.4 mm. (holotype, apex and pillar broken). Length 68.5 mm.; diameter 26 mm. (largest specimen, apex, pillar and outer lip broken).

This species looks so strange for an American *Strombus* that it seems rash to place it in the same genus with *Strombus pugilis*. Nothing like it is known either fossil or living in America, but when the Oriental species are considered it is seen that all the distinctive features of *leurus*—smooth later whorls, absence of spines, ascending undilated outer lip, and very shallow stromboid notch—are found in living species referred to *Strombus*, though no one of them combines them in the exceptional manner of *leurus*. Perhaps this combination deserves generic or subgeneric rank, but it would be necessary to consider so many species that time is not available to make the required com-

parative study. Cossmann (Essais Paléoconch. Comp., pt. 6, p. 9, 1904) uses "*Gallinula* Klein" for *S. epidromus* Linné, which has small nodes at the shoulder, a deeper and curved posterior channel, and a deeper and wider stromboid notch. It is impossible, however, to rescue this name for a group of *Strombus*, for its first binomial use falls long after it was proposed for a genus of birds (Brisson 1760).

S. leurus is represented by three specimens, none of which is perfect. The pillar is broken on all the specimens, but apparently it is slender.

Type material.—Holotype (U. S. Nat. Mus. No. 369474).

SEGUENZIIDAE

SEGUENZIA Jeffreys

Jeffreys, 1876, Proc. Royal Soc. London, vol. 25, pp. 187, 200.

Type (*by subsequent designation, Harris, 1897, Cat. Ter. Moll. British Mus., pt. 1, Australasian, p. 266*).—*Seguenzia formosa* Jeffreys. Recent, North Atlantic, also reported from Bay of Biscay, and northeast coast of United States).

Shell small, trochoid, somewhat nacreous. Nucleus strongly inflated, rising abruptly from apex of shell, consisting of about one whorl. Aperture ovate. Outer lip bearing at suture a deep, narrow anal sinus, and also a shallow sinus at periphery and base. Basal lip everted below columella, producing a suggestion of a canal. Columella ending in a tooth-like projection. Inner lip reflected over a narrow umbilical opening in type species. Sculpture consisting of sharp spiral ridges and very fine spiral threads, and of axial threads curved in conformity to shape of outer lip.

The type material of *S. formosa* is in the collections of the United States National Museum (No. 181650). Verrill (Trans. Connecticut Acad. Arts and Sci., vol. 6, pt. 1, pp. 186–188, 1884) has described the soft parts of a species, dredged off the northeast coast of the United States, that he refers to *formosa*. Despite the turrid notch and the trochoid shape and nacre, Verrill finds that the radula is taenioglossate.

This characteristic deep-water genus has not heretofore been found fossil in America. It has been dredged in the West Indian region and off the coast of the United States at depths of 100 to 2033 fathoms.

Seguenzia hapala, new species

(Plate 24, Figures 6, 7)

Shell very small, somewhat nacreous under the outer shell layer. Nucleus consisting of about one whorl. Outer lip deeply notched at suture, slightly notched at periphery and base. Basal lip slightly everted below columella, which ends in a small tooth. Umbilical opening narrow. Later whorls of spire sculptured with a heavy median spiral ridge and a smaller ridge lying near the suture. Body whorl sculptured with a sutural ridge, two heavy peripheral ridges, and six on the base. Incremental threads conspicuous in interspaces. They are concave forward between sutural ridge and upper peripheral ridge, convex forward between the two peripheral ridges and between lower peripheral ridge and first basal ridge, retractive between

first two basal ridges, and protractive between second and third basal ridges, all in conformity to sinuses on outer lip.

Length 2.1 mm.; diameter 1.5 mm. (holotype, dimensions approximate).

This species is represented by 67 specimens in the Aldrich collection, but only one specimen is in the Duerden collection, and none in the Henderson collection. It is much smaller than any of the living species in the West Indian, western Atlantic, and Panamic regions, though in general features it resembles several of these species (*formosa* Jeffreys, *eritima* Verrill, and *caliana* Dall).

Type material.—Holotype (U. S. Nat. Mus. No. 369475).

TRIPHORIDAE

TRIPHORA Blainville

Blainville, 1828, Dictionnaire des sciences naturelles, vol. 55, p. 344.

Type (*by monotypy*).—*Triphora gemmatum* Blainville (=*Cerithium tristoma* Blainville). Recent, Mauritius.

Shell very small, slender, sinistral. Aperture subcircular. Anterior canal short, curved backward, slightly emarginate, upper part almost or completely closed. Anal notch small, closed in some species and located some distance from aperture. Sculpture consisting of spiral rows of beads joined by axial threads. (Based on fig. 3, pl. [31] of plates of Dict. Sci. Nat., Zoologie, Conchyliologie et Malacologie.)

In the description of *Triphora gemmatum*, Blainville refers to pl. 20, fig. 3 of the atlas of the Dictionnaire. The plates are unnumbered, but the *Triphora*, called "Cérite tristome," is on pl. 31. The same plate is pl. 20 of Blainville's Manuel de Malacologie et de Conchyliologie (1825), in which this species (p. 404) is given the formal Latin name of "*C.*[*erithium*] *Tristoma*," as an example of the genus "Triphore ou Tristome Deshayes." The same arrangement is given on p. 204 of vol. 31 of the Dictionnaire.

The status of the names that have been proposed as subdivisions of this curious genus has not been fixed and *Triphora* is here used only in the unrestricted sense.

Key to the Bowden species of Triphora

Axial sculpture weak.
- Spiral sculpture consisting of two rows of coarse beads..... *T. tritreta*
- Spiral sculpture consisting of three subequal rows of beads..... *T. apania*

Axial sculpture relatively strong.
- Spiral sculpture consisting of three rows of beads, the middle row smaller than the others..... *T.* species *a*
- Spiral sculpture consisting of three equal threads, with beads at intersections with axial ribs..... *T.* species *b*

Triphora tritreta, new species

(Plate 25, Figure 1)

Shell slender, pupoid. Nucleus not known. Aperture circular, tubular, surrounded by a complete peristome. Anterior canal short, stout, strongly curved backward, completely closed except at base. Anal sinus closed, tubular, located on dorsal surface about 90° from aperture. Sculpture of spire consisting of two rows of coarse beads, not arranged in axial series.

Length 4.3 mm.; diameter 1.8 mm. (holotype, apex broken).

This coarsely sculptured species is represented by the holotype, on which the tubular anal sinus is located some distance from the aperture, and by several doubtful worn fragments.

Type material.—Holotype (U. S. Nat. Mus. No. 369476).

Triphora apania, new species

(Plate 25, Figure 2)

Shell slender, pupoid. Nucleus slender, consisting of about five whorls, the first whorl forming the slightly swollen apex, the remaining whorls bearing an anterior keel from which axial riblets extend forward and backward to suture. The keel gradually takes a position near middle of whorl. Aperture subcircular, basal lip extended. Anterior canal short, abruptly curved backward, slightly emarginate, closed by tip of basal lip. Anal sinus very narrow and shallow. Sculpture of later whorls of spire consisting of three spiral rows of beads, arranged in axial series and partly joined by obscure axial threads. Beads in middle row slightly smaller than those on other two rows.

Length 4 mm.; diameter 1.7 mm. (holotype, apex broken).

This species is represented by 17 broken specimens, all of which, and also the specimens of *tritreta*, are in the Duerden collection. *T. calypsonis* Maury (Bull. Am. Paleontology, vol. 5, pp. 286–287, pl. 47, fig. 13, 1917), recorded from both the Cercado and Gurabo formations, is more slender and has two spiral threads on the nucleus.

Type material.—Holotype (U. S. Nat. Mus. No. 369477).

Triphora species *a*

The Henderson collection contains a specimen of *Triphora* (U. S. Nat. Mus. No. 135331) that is stouter than either of the two preceding species. The sculpture of the later whorls consists of three rows of beaded spirals, the beads in the middle row being smaller than those in the flanking rows. The beads are arranged in axial series and are joined by distinct axial threads. Both the apex and aperture of this specimen are broken.

Triphora species *b*

Another species of *Triphora* is represented by several specimens, the apex and aperture of all of which are broken. This species is slender and the shell apparently would be relatively long, if perfect. The sculpture is openly reticulate, consisting of three equal spiral threads and axial ribs with small beads at the intersections. The base of the later whorls of the spire is slightly excavated.

CERITHIOPSIDAE

CERITHIOPSIS Forbes and Hanley

Forbes and Hanley, 1853, History of British Mollusca, and their shells, vol. 3, p. 364.

Type (by monotypy).—Murex tubercularis Montagu. Recent, European seas.

Shell small, very slender. Nucleus slender, consisting of about four and a half smooth glassy whorls, not enlarging in diameter so rapidly as post-

nuclear whorls. Aperture broadly ovate. Anterior canal short, deep, emarginate. Sculpture consisting of trellised axial ribs and spiral cords.

Bartsch (Proc. U. S. Nat. Mus., vol. 40, No. 1823, 1911) recognizes several subgenera of this genus based on nuclear characters. *Cerithiopsis veatchiana* Maury (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 15, p. 92, pl. 12, fig. 21, 1912), an Eocene species from Trinidad, is the only described fossil from the Tertiary deposits of tropical America referred to *Cerithiopsis*. It is based on an apical fragment and in all probability is not *Cerithiopsis*.

Key to the Bowden species of Cerithiopsis

Beads at intersection of axials and spirals strongly swollen.....*C. compsa*
Beads at intersection of axials and spirals weakly swollen.....*C. cigclis*

Cerithiopsis compsa, new species

(Plate 25, Figure 3)

Shell very small. Nucleus slender, consisting of about three and a half whorls slightly enlarging in diameter. Anterior canal short, emarginate. Sculpture consisting of spiral threads (3 on later whorls of spire) strongly beaded at intersections with narrow axial ribs. Siphonal fasciole limited by a narrow thread.

Length 2.5 mm.; diameter 0.9 mm. (holotype, apex broken and outer lip broken back).

This minute species is represented only by the holotype, which is in the Duerden collection. The outer lip is broken back a little, especially at the base, and in photographing the shell was turned too far to the left, distorting the appearance of the aperture. The anterior canal is very short and moderately emarginate.

Type material.—Holotype (U. S. Nat. Mus. No. 369478).

Cerithiopsis cigclis, new species

(Plate 25, Figure 4)

Shell very small. Outer lip and apex of only specimen broken. Sculpture consisting of an open lattice formed by spiral threads (3 on later whorls of spire) and widely spaced axial ribs, with slightly swollen beads at the intersections.

Length 2.6 mm.; diameter 0.8 mm. (holotype, apex broken and outer lip broken back).

This species, which also is very small and is represented only by the holotype, is a little more slender than *compsa*. Its axial ribs also are farther apart and the beads are not so strong. The appearance of the aperture is distorted because the outer lip is broken back and also broken at the base. *C. greenii* Adams, a living species from Florida and the West Indies, and also found in the Pliocene Caloosahatchee marl of Florida, has the same kind of sculpture, but the shell is larger and stouter.

Type material.—Holotype (U. S. Nat. Mus. No. 369479).

DIZONIOPSIS Sacco

Sacco, 1895, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 17, p. 67.

Type (*by original designation*).—*Cerithium bilineata* Hoernes. Miocene, Austria.

Shell very small, pupoid. (Nucleus not available.) Aperture subcircular. Basal part of outer lip extending forward over aperture. Anterior canal very short, very deeply emarginate. Sculpture consisting of two beaded spiral cords.

Dizoniopsis generally is regarded as a subgenus of *Cerithiopsis*, but the very deeply emarginate canal, basal projection of the outer lip, as well as the shape and sculpture, entitle it to generic rank.

Dizoniopsis vaughani, new species

(Plate 25, Figure 5)

Shell very small, pupoid. Basal part of outer lip projecting over aperture. Anterior canal very deeply emarginate. Sculpture consisting of two coarsely beaded spiral cords, the beads connected by axial threads. Base of body whorl sculptured with two smooth spiral threads.

Length 3.4 mm.; diameter 1.2 mm. (holotype, apex broken).

This little species is represented only by the holotype, which has a perfect aperture, but the apex is broken.

Type material.—Holotype (U. S. Nat. Mus. No. 369480).

CERITHIELLA Verrill

Verrill, 1882, Trans. Connecticut Acad., vol. 5, pt. 2, p. 522. Substitute name for *Lovenella* Sars, 1878, Mollusca Regionis Arcticae Norvegiae, p. 187; type, by monotypy, *Cerithium metula* Loven, Recent, Europe. Not *Lovenella* Hincks, 1869, Hist. British Hydroid Zoophytes, vol. 1, p. 177.

Type (*see above, also given by Verrill for Cerithiella*).—*Cerithium metula* Loven.

Shell medium-sized, very slender. Nucleus stout and bulging, consisting of a little more than two whorls, the last one sculptured with curved, protractive axial riblets. Aperture ovate. Anterior canal short, wide, oblique, curved backward, slightly emarginate. Columella bearing a basal twist, which is more pronounced on young shells. Sculpture consisting of weakly beaded spiral cords with obscure axials connecting the beads.

Iredale (Proc. Malac. Soc. London, vol. 9, pp. 260–261, 1911) has reviewed the confused synonymy of this genus.

"Cerithiella" species

A *Cerithiella*-like genus is represented by a small specimen in the Johns Hopkins University collection (U. S. Nat. Mus. No. 369481) that has both ends broken. The canal is narrow, oblique, and curved backward. The columella bears a more pronounced basal twist than in *Cerithiella metula*. The sculpture consists of two beaded spiral cords with axials joining the beads. On the later whorls the beads become obscure. The approximate dimensions are as follows: length 5.7 millimeters, diameter 1.7 millimeters.

This specimen is too fragmentary for satisfactory determination. It probably does not represent the boreal genus *Cerithiella*, but no other name seems to be available for it.

What seems to be a species of an allied genus is represented by a still smaller specimen in the same collection (U. S. Nat. Mus. No. 369482). The very tip is broken off, but two slender smooth nuclear whorls remain. The anterior canal apparently is very short and narrow. The sculpture consists of three weakly beaded spiral cords with strong axial threads joining the beads. The approximate dimensions of this specimen are as follows: length 2.7 millimeters, diameter 1 millimeter.

SEILA A. Adams

A. Adams, 1861, Ann. Mag. Nat. Hist., ser. 3, vol. 7, p. 131.

Type (*by subsequent designation, Dall, 1889, Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 250*).—*Seila dextroversus* (Adams and Reeve) (*Triphoris dextroversus* Adams and Reeve). Recent, Japan.

Shell small, very slender, whorls flat. Nucleus broken off on all available specimens of type species. Aperture broadly ovate, deeply notched at base, though there is virtually no canal. Siphonal fasciole inflated, limited by a thread. Sculpture consisting of strong spiral keels (3 to a whorl on spire) between which lie microscopic growth threads.

S. terebrale (C. B. Adams), an east American Recent species, has a slender nucleus of about two and a half whorls. The sculpture is very much like that of *Microdrillia*. No Tertiary species of this genus from tropical America are on record.

Seila species

The genus *Seila* is represented by one small imperfect specimen in the Johns Hopkins University collection (U. S. Nat. Mus. No. 369483). The last whorl is broken back and the apex is broken off. The approximate dimensions are as follows: length 5.7 millimeters; diameter 1.4 millimeters.

So far as this specimen goes it is like similar fragments of "*Cerithium*" *terebrale* C. B. Adams, which is recorded from Massachusetts to the West Indies.

CERITHIIDAE

THERICIUM ("Rochebrune") Monterosato

Monterosato, 1890, Naturalista Siciliano, year 9, No. 7, pp. 163–164.

Type (*by original designation*).—*Cerithium vulgatum* Bruguière. Recent, Mediterranean.

Shell reaching a moderately large size. Last whorl bearing a varix opposite outer lip. Whorls of spire bearing varices at intervals, but on some specimens they are indistinct. Aperture ovate. Anterior canal short, oblique, slightly curved backward, unemarginate, but appearing emarginate because of backward curve. Inner lip and parietal wall covered with a coat of callus that is very thick along posterior channel formed by outer lip. Edge of outer lip serrate and slightly frilled. Sculpture consisting of axial ribs, which are spiny at the shoulder, and of spiral cords and threads.

Vulgocerithium Cossmann (Essais Paléoconch. Comp., pt. 7, p. 77, 1906) is a perfect synonym of *Thericium*, for it has the same type. Cossmann's discussion of *Thericium* is irrelevant, as Monterosato designated *Cerithium vulgatum* as the type of *Thericium* (see Vignal, Journ. Conch., vol. 58, p. 141, 1910).

Stewart (Proc. Acad. Nat. Sci. Philadelphia, vol. 78 (1926), pp. 355–356, 1927) discusses the question of the type of *Cerithium* Bruguière (Encycl. Méth., Vers., vol. 1, p. xv, 1789; p. 467, 1792) and reaches the conclusion that by a rather strained interpretation of tautonymy *Cerithium adansonii* Bruguière is the type by tautonymy. According to Adanson (Hist. Nat. Sénégal, Hist. Coquillages, pp. 155–156, pl. 10, fig. 2, 1757), this species, Le Cérite of Adanson, lives in the mud of the Gambia River on the west coast of Africa. Cossmann (Essais Paléoconch. Comp., pt. 7, pp. 66–67, 1906), who reproduces Adanson's figures, states that no specimens of this species are in the collections at Paris, and he considers that it belongs to the brackish-water group known as *Pyrazus*. Adanson's figures represent a shell that is reasonably similar to some of the small Indo-Pacific species, such as *Cerithium columna* Sowerby, though the anterior canal is rather wide and short. It lacks the prominent basal extension of the outer lip seen in *C. nodulosum* Bruguière, which is accepted by many writers as the type species. Montfort's designation of *Cerithium virgatum* Montfort (Conch. Syst., vol. 2, p. 511, 1810, substitute name for *Murex vertagus* Linné) as the type makes *Cerithium* a synonym of *Clava*. The acceptance of *C. adansonii* as the type seems to be, as Stewart points out, the only means of saving the name *Cerithium*.

On the basis of Adanson's figures *Cerithium* has a more circular aperture than *Thericium*, a more expanded and deeply frilled outer lip, a stronger varix opposite the outer lip, and a less strongly recurved anterior canal. Whether these differences deserve generic recognition is doubtful, but in view of the uncertainty concerning *Cerithium*, *Thericium* is here given generic rank. Cox (Pal. Zanzibar Protectorate, pp. 84–85, 1927) accepts Montfort's type designation and uses *Gourmya* Bayle in place of the traditional *Cerithium*.

Key to the Bowden species of Thericium

Shell medium-sized, whorls angulated at periphery.....*Thericium* species *a*
Shell large, whorls flat.....*Thericium* species *b*

Thericium species *a*

Cerithium algicola Dall (part, not Adams), 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 282. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

The Bland collection contains a broken shell labeled "*Cerithium algicola* Ads." (U. S. Nat. Mus. No. 61551). A fragment of two whorls in the Henderson collection (U. S. Nat. Mus. No. 135325)

seems to represent the same species. The aperture of both specimens is broken. The body whorl bears a varix opposite the outer lip, and in addition each of the other whorls bears two relatively heavy varices. The sculpture consists of axial ribs angulated at the shoulder and of closely spaced spiral cords and threads. The dimensions of the more perfect specimen are as follows: length 23.8 millimeters, diameter (outer lip broken) 8.5 millimeters.

These specimens are too imperfect to identify. *T. algicola* (Adams), a living species from Florida and the West Indies, has less prominent varices.

Thericium species *b*

(Plate 25, Figure 6)

A large cerithioid shell, apparently a *Thericium*, is represented by fragments in several collections. The aperture and apex of all these specimens are broken. The figured fragment consists of three and a half whorls. Though probably more than half of this shell is broken off, the apex is plugged. A smaller fragment of the same number of whorls in the Henderson collection is similarly plugged. The sculpture consists of spiral cords and threads, the widest ones bearing crude nodes. The widest cord adjoins the suture. The figured fragment has the following dimensions: length 28.7 millimeters, diameter 16.5 millimeters. The body whorl of a badly broken larger shell in the Henderson collection has a length of 21 millimeters.

This species is similar to *T. microlineatum* (Gabb) (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 369–370, pl. 32, figs. 2–3, 1922), from the Gurabo formation, but has wider spirals below the sutural band and the sutural nodes are not so heavy. No *Thericium* of this size is now living in the West Indian or Panamic regions.

CLAVA Martyn

Subgenus CLAVA s. s.

Martyn, 1784, The Universal Conchologist, vol. 1, explanatory table, pls. 12–13. *Type* (*by subsequent designation, Pilsbry, 1901, Proc. Acad. Nat. Sci. Philadelphia, vol. 53, p. 392, 1901; Dall, 1907, Proc. Acad. Nat. Sci. Philadelphia, vol. 59, p. 366*).—*Clava rugata* Martyn (regarded by most writers as a synonym of *Murex asper* Linné). Recent, Indo-Pacific.

The subgenus *Clava* s. s. has a long anterior canal and a short posterior channel. It is not represented by fossil or living species in America.

If Pilsbry's statement that *C. rugata* "may be considered type of Martyn's genus" is considered too guarded, Dall's designation is unequivocal.

Subgenus OCHETOCLAVA, new subgenus

Type.—Cerithium gemmatum Hinds. Recent, Pacific coast of Central America and Mexico.

Shell medium-sized, slender. Body whorl bearing a varix opposite outer lip, other whorls varicose at intervals. Aperture ovate. Anterior canal relatively short, oblique, deep, curved backward, unemarginate. Columella bearing a basal twist and a median fold. Edge of inner lip detached along pillar, bearing an obscure sinus at top of pillar. Outer lip ascending, forming a long narrow posterior channel. Interior of outer lip furrowed. Sculpture consisting of spiral bands bearing nodes or beads.

The shorter and less horizontal canal and strongly ascending outer lip, which produces a long posterior channel, separate *Ochetoclava* from *Clava* s. s. All the American fossil and living species fall in *Ochetoclava*. This subgenus is represented in the Miocene deposits of Florida and the Caribbean region, and even in the Pliocene of Florida, but probably is extinct there, though Dall mentions a specimen of a living species that was reputed to have been collected at Barbados in 1864 (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, pp. 291–292, 1892). This specimen could not be found in the collections of the United States National Museum. *Ochetoclava* is represented, however, on the Pacific coast of Central America and Mexico by the genotype. *Clava californica* Dall (Proc. U. S. Nat. Mus., vol. 56, No. 2295, p. 346, 1919) is a synonym of, or at the most a subspecies of, "*Cerithium*" *gemmatum* Hinds.

Key to the Bowden species of Ochetoclava

Sculpture coarse, varices low, later whorls flat.....*C.* (*O.*) *costaricana stena*
Sculpture fine, varices prominent, later whorls bulging.....*C.* (*O.*) *terpna*

Clava (Ochetoclava) costaricana stena, new subspecies

(Plate 25, Figures 7, 8)

Cerithium plebeium Guppy (not Sowerby), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 290, pl. 16, fig. 9. Guppy (part, not Sowerby), 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list).
Clava plebeia Dall (part, not Sowerby), 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 290. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell medium-sized, slender, first few whorls angular, succeeding whorls flat. Varices on spire low. Anterior canal narrow and deep. Columellar fold barely visible at aperture unless shell is tilted. Sculpture of later whorls of spire consisting of three spiral bands, the one at the suture wider than the others, nodulated by axial ribs. Spaces between cords as wide as the cords and bearing a secondary spiral thread.

Length 26 mm.; diameter 9.9 mm. (holotype, apex broken). Length 22 mm.; diameter 13.3 mm. (fragment of three whorls).

The holotype is the largest shell that has a perfect aperture. Some of the 20 specimens in the Henderson collection are much larger. The small figured specimen has finer sculpture than most of the other shells. *C. c. costaricana* Olsson (Bull. Am. Paleontology, vol. 9, pp. 316–317, pl. 13, figs. 3–4, 1922; Miocene, Costa Rica) has wider ribs, wider spiral cords, and secondary spirals generally are present only on the body whorl and at the base of spire whorls. So far as width and

spacing of spirals are concerned the Bowden specimens are more similar to *C. venada* Maury (Bull. Am. Paleontology, vol. 10, p. 374, pl. 52, fig. 10, 1925; Miocene, Trinidad), which has more distinctly bead-like sculpture. *C. plebeia* (Sowerby) (Quart. Jour. Geol. Soc. London, vol. 6, p. 51, 1850), found in both the Cercado and Gurabo formations, is smaller and has a wider apical angle. It also has bulging early whorls and wider axial ribs. *C. costaricana stena* is more similar to *C. caloosaënsis* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 291, pl. 14, fig. 3*a*, 1892), a Pliocene species from Florida, but is a little stouter and has narrower axial ribs.

Type material.—Holotype (U. S. Nat. Mus. No. 369485).

Clava (Ochetoclava) terpna, new species

(Plate 25, Figure 9)

Clava sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell small, slender, varices prominent, early whorls angular, later whorls slightly bulging. Columellar fold weak, absent on some specimens. Outer lip slightly ascending. Sculpture of later whorls of spire consisting of four or five narrow spiral cords nodulated by narrow closely spaced axial ribs. Between the spiral cords lies a fine spiral thread.

Length 11.7 mm.; diameter 5 mm. (holotype).

Perhaps this species, which is represented by five specimens in the Henderson collection, is not an *Ochetoclava*. No columellar fold can be seen at the aperture of the holotype, nor on some shells on which the outer lip is broken back; others have a slight bulge, but nothing comparable to the sharp fold of *costaricana*. The slight upward extension of the outer lip may be due to the immaturity of the shells. On the figured small specimen of *costaricana stena* the outer lip does not extend so far up as in the holotype of *terpna*. Two specimens in the Henderson collection that are doubtfully referred to this species have relatively few axial ribs.

This is a finely sculptured species that has unusually prominent varices. It also is found in the Cercado and Gurabo formation. *C. alajuela* Olsson (Bull. Am. Paleontology, vol. 9, p. 317, pl. 13, fig. 30, 1922; middle Miocene, Costa Rica) also is finely sculptured, but it has flatter whorls, less prominent varices, and fewer axial ribs.

Type material.—Holotype (U. S. Nat. Mus. No. 369486).

BITTIUM ("Leach") Gray

Gray, Oct., 1847, Ann. Mag. Nat. Hist., vol. 20, p. 270.

Type (by subsequent designation, Gray, Nov., 1847, Proc. Zool. Soc. London, p. 154).—*Murex reticulatus* Montagu (=*Strombiformis reticulatus* Da Costa). Recent, European seas.

Shell small, very slender, spire high, body whorl small. Whorls varicose. Nucleus consisting of about four glassy smooth whorls. Aperture ovate,

anterior canal broad, very stout, unemarginate. Sculpture consisting of axial ribs, overridden by spiral threads that are swollen on the axials.

The genus *Bittium* has a short wide canal. Bartsch (Proc. U. S. Nat. Mus., vol. 40, No. 1826, 1911) recognizes several subgenera depending on nuclear characters, on the presence or absence of varices, and on the sculpture.

Bittium praeformatum Guppy

(Plate 25, Figure 10)

Bittium (*Styliferina*) *praeformatum* Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, pp. 318–319, pl. 28, fig. 2.
Bittium (*Alabina*) *praeformatum* Guppy, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, very slender, later whorls varicose. Anterior canal short. Sculpture consisting of heavy axial ribs, overridden by spiral threads (3 on later whorls of spire, in addition to a narrow one at suture).

Length 5.2 mm.; diameter 1.6 mm. (holotype).

Type locality.—"Jamaica (Miocene)."

This species, represented only in the Guppy collection, probably should be deleted from the list of Bowden fossils, as none of the four specimens has the appearance of a Bowden shell and the filling also is different.

Type material.—Holotype (U. S. Nat. Mus. No. 107124).

BITTIOLUM Cossmann

Cossmann, 1906, Essais Paléoconchologie Comparée, pt. 7, p. 139.
Type (*by original designation*).—*Bittium podagrinum* Dall. Pliocene, Florida.

Shell small, stout, body whorl narrower than preceding whorl. Whorls of spire excavated at base. Nucleus small, consisting of about three smooth whorls. Body whorl bearing a varix some distance behind outer lip, shell thin between varix and outer lip. Aperture broadly ovate, bearing a slight suggestion of an anterior canal. Inner lip detached. Sculpture consisting of narrow axial ribs and spiral cords or threads.

This group seems to deserve generic rank. It embraces stout or relatively stout species that have a broad aperture, a thin outer lip, and a very short anterior canal. The figure of the genotype (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, pl. 21, fig. 12, 1892) is misleading, as it shows no anterior canal whatever.

Key to the Bowden species of Bittiolum

Shell stout.....*B.* species
Shell relatively slender.....*B. properatum*

Bittiolum species

(Plate 25, Figure 11)

A stout species of *Bittiolum* is represented by an imperfect worn shell that probably is immature (U. S. Nat. Mus. No. 369487). The body whorl bears a varix some distance from the outer lip, which is broken

back. The aperture has a slight suggestion of an anterior canal. The sculpture consists of narrow axial ribs overridden by narrow spiral threads. The dimensions are as follows: length 2.9 millimeters, diameter 1.4 millimeters (apex broken and outer lip broken back).

This little shell resembles the genotype, *B. podagrinum*, but is not so stout and has finer axials and spirals.

Bittiolum properatum, new species

(Plate 25, Figure 12)

Shell small, relatively slender. Body whorl bearing a varix some distance behind outer lip, which is broken back. Nucleus consisting of a little more than two rapidly enlarging whorls. Anterior canal very short. Sculpture consisting of narrow axial ribs overridden by spiral threads that are swollen on the ribs (4 spirals on later whorls of spire, excluding a very narrow one at base, increasing in width anteriorly).

Length 4 mm.; diameter 1.5 mm. (holotype, apex broken and outer lip broken back).

Though this species is more slender than *B. podagrinum*, it has the same kind of body whorl and aperture. The anterior canal would not be so prominent if the outer lip were not broken back. Additional material may show that it is the same as *B. varium* (Pfeiffer), a variable living species from Florida and the West Indies, and also found in the Pliocene Caloosahatchee marl of Florida, which generally has finer sculpture. According to the figures, *Bittium toulai* Engerrand and Urbina (Bol. Soc. Geol. Mexicana, vol. 6, p. 129, pl. 59, figs. 38–41, 1910; Miocene, Zuluzum, Mexico) belongs to this genus. It has stronger and more cleanly cut axial ribs.

Three specimens of this species are in the Aldrich collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369488).

ALABINIDAE

ALABINA Dall

Dall, 1902, Nautilus, vol. 15, No. 11, p. 127.

Type (*by original designation*).—*Bittium cerithidioide* Dall. Pliocene and Recent, Florida.

Shell small, slender, body whorl varicose. Nucleus slender, consisting of about three glassy smooth whorls enlarging less rapidly than the post-nuclear whorls. Aperture subcircular. Basal lip extended and everted, producing a suggestion of a canal. Behind the inner lip lies a narrow umbilical groove. Sculpture consisting of narrow curved axial ribs and obscure spiral threads.

The nomenclature of this genus, which has been discussed by Dall (Nautilus, vol. 35, No. 1, pp. 27–28, 1922; Proc. U. S. Nat. Mus., vol. 70, p. 87, 1927), is quite involved. *Alabina* was proposed as a substitute name for *Elachista* Dall and Bartsch (Nautilus, vol. 15, No. 5,

p. 58, Sept., 1901; (not *Elachista* Treitschke, Schmetl. Europa, vol. 9, pt. 2, p. 177, 1833); type, by monotypy, *Bittium* (*Elachista*) *californicum* Dall and Bartsch, Pleistocene and Recent, California), but instead of being a straight substitute name a type was assigned to it agreeing with a later use of *Elachista* (Dall and Simpson, Bull. U. S. Fish Comm., 1900, vol. 1, p. 427, Nov., 1901). Apparently the manuscript on the Porto Rican mollusks was prepared long before the note in The Nautilus, and Dall overlooked the earlier publication of the note. It is doubtful whether the type of *Elachista* represents the same genus as the type of *Alabina*.

According to Dall, *Finella* A. Adams (Ann. Mag. Nat. Hist., ser. 3, vol. 6, p. 336, 1860; type, by monotypy, *Finella pupoides* A. Adams, Recent, Japan) is an earlier name for the genus represented by *Alabina*. A. Adams himself states (Ann. Mag. Nat. Hist., ser. 3, vol. 13, p. 39, 1864) that *Finella* was a typographic error for *Fenella*, which is a homonym of *Fenella* Westwood 1840 (Introd. class. Insect., vol. 2, Syn., p. 54).

Alabina curta, new species

(Plate 25, Figure 13)

Bittium (*Styliferina*) *cerithidiodes* Dall (part), 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 276.

Bittium (*Styliferina*) *cerithidioide* Guppy and Dall (not Dall), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 318.

Bittium (*Alabina*) *cerithidoide* Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell moderately small, last two or three whorls of adult shells bearing heavy varices. Nucleus consisting of about two and a half slender whorls. First two post-nuclear whorls angulated at periphery, remaining whorls rounded and slightly bulging. Basal lip slightly everted and angulated. Sculpture consisting of fine axial ribs, which are suppressed or absent between varices on later whorls, and of fine spiral threads that are most distinct at base of whorls of spire and on base of body whorl.

Length 4.3 mm.; diameter 1.7 mm. (holotype).

This heavily varicose species is represented in the Aldrich collection by 130 specimens, and is the most abundant cerithioid mollusk at Bowden. Only 26 specimens are in the Henderson collection and five in the Duerden collection. It quite clearly is the predecessor of *cerithidioides*, but it is more robust. It is considerably larger and the last two or three whorls have heavy varices, which are absent on *cerithidioides* or are confined to the last whorl. Some specimens are more slender than the holotype. The details of sculpture are very variable. The axial ribs of the later whorls may be fine or coarse. On the later whorls the spiral threads are strong at the base. On the remainder of the whorl they generally are faint, though they may be strong.

One slender specimen that seems to be this species was collected from the Gurabo formation, and other specimens were collected from the Cercado formation at several localities. *"Bittium" canaliculata* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 375, pl. 25, fig. 2, 1922), found in great abundance in the Cercado formation, has rounded early whorls, weaker spiral sculpture and weaker varices, which generally are confined to the last whorl. *A. angustior* (Pilsbry) (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 376, pl. 25, fig. 3, 1922), also from the Dominican Republic, resembles *canaliculata*, but has fewer and heavier axial ribs.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 135329).

LITIOPIDAE

ALABA H. and A. Adams

H. and A. Adams, 1853, Genera Recent Mollusca, vol. 1, p. 241.

Type (*by subsequent designation, Nevill, 1885, Hand List Moll. Indian Mus., pt. 2, p.* 181).—*Alaba melanura* (C. B. Adams) (*Rissoa melanura* C. B. Adams). Recent, West Indies.

Shell small, moderately slender, thin, later whorls bearing heavy varices. Nucleus slender, consisting of between three and four glassy whorls, the last two sculptured with very fine axial riblets. Aperture broadly ovate, having a suggestion of a canal below end of columella. Sculpture consisting of spiral grooves that are most prominent at base of whorls. (Based on *Rissoa tervaricosa* C. B. Adams, the other species cited by H. and A. Adams as *"trivaricosa."*)

Alaba turrita Guppy

(Plate 25, Figures 14, 15)

Alaba turrita Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 321, pl. 18, fig. 7.
Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 325.

Shell small, relatively slender. Later whorls of spire bearing two varices at irregular intervals, body whorl bearing two or three. Nucleus relatively slender, consisting of about four whorls enlarging less rapidly than post-nuclear whorls, the last two bearing obscure fine axial riblets. Anterior canal distinct. Sculpture consisting of a few spiral grooves at base of later whorls of spire and on anterior half of body whorl.

Length 5.1 mm.; diameter 2 mm. (holotype, apex broken and outer lip broken back). Length 6.4 mm.; diameter 2.4 mm. (figured specimen, apex broken and outer lip broken back).

Type locality.—Jamaica.

The holotype of this species is an immature broken shell. The varices on most of the specimens are eroded forming pits. Twenty-seven specimens of *Alaba turrita* are in the Aldrich collection. Olsson records it from Costa Rica, and one poorly preserved specimen was collected from the Gurabo formation. *A. chipolana* Dall (Trans.

Wagner Inst. Philadelphia, vol. 3, pt. 2, pp. 292–293, pl. 21, fig. 9, 1892; lower Miocene, Chipola formation, Florida) is a little stouter and has no spiral sculpture. The living West Indian *A. tervaricosa* (C. B. Adams) is stouter and has stronger spiral sculpture. *Cerithium maoensis* Gabb, a Dominican species referred to *Alaba* by Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 376, pl. 35, fig. 11, 1922), is relatively large and has very strong spiral grooves. It may not represent *Alaba*.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa Rica (Olsson).

Type material.—Holotype (U. S. Nat. Mus. No. 107128).

PLANAXIDAE

PLANAXIS Lamarck

Lamarck, 1822, Histoire naturelle des animaux sans vertèbres, vol. 7, p. 50.

Type (by subsequent designation, Children, "1823," Lamarck's Genera of Shells, p. 118).—*Planaxis sulcata* Lamarck (=*Buccinum sulcatum* Born). Recent, Indo-Pacific.

Shell medium-sized, stout, conical. Aperture broadly ovate. Siphonal canal undercutting columella, but not producing any extension of basal lip and only slightly emarginating basal lip. Siphonal fasciole very low. Columella bearing low ridges extending out on inner lip. Parietal wall bearing a heavy callus ridge along a narrow posterior channel. Outer lip extending backward from suture, interior strongly lirate. Sculpture consisting of spiral grooves.

Though Lamarck states that he had no specimens of *Buccinum sulcatum* Born and that *Planaxis sulcata* ("*Buccinum sulcatum* var. *b*. Brug.") came from the West Indies, there is no doubt that *B. sulcatum* Born is the type of *Planaxis*, both on the basis of Lister's figure to which Lamarck refers for *Planaxis sulcata* and on the basis of Lamarck's description of this species. No *Planaxis* agreeing with the description of "alba, nigromaculata; maculis subquadratis" is found in the West Indies. Inasmuch as *Planaxis undulata* Lamarck, the only other species cited by Lamarck, is considered a synonym of *Buccinum sulcatum* Born, that species in effect becomes the type by monotypy.

The fossil here described and the only species living in the West Indies, *P. nucleus* (Wood) and *P. lineata* (Da Costa), have a deep siphonal notch, a character that should perhaps be given subgeneric recognition. Though several divisions have been proposed under this genus none that could be found embrace these or similar species, and the name *Planaxis* is here used in the unrestricted sense.

The following species is the only fossil *Planaxis* from tropical America, and, for that matter, so far as known the only fossil American species. "*Planaxis*" *crassilabrum* Guppy (Geol. Mag., decade 2, vol. 1, p. 411, pl. 18, fig. 13, 1874; Pliocene, Trinidad) is a *Strombina*.

Planaxis ame, new species

(Plate 25, Figure 16)

Planaxis sp., near *nucleus* Wood, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell medium-sized, relatively slender. Apex worn and plugged. Siphonal notch very deep. Inner lip flattened and concave, bearing an obscure narrow ridge along columella. A heavy callus denticle lies along the relatively wide posterior channel. Interior of outer lip obscurely lirate. Sculpture consisting of very obscure spiral markings that are farther apart and slightly grooved on base of body whorl.

Length 13.5 mm.; diameter 6.7 mm. (holotype, apex worn).

The holotype of this species is a specimen in the Guppy collection labeled "*Clea truncata* Gabb" (*Ectracheliza truncata* Gabb, the genotype of *Ectracheliza*, is a *Hemisinus;* see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 379, 1922). It also is represented by a slightly smaller more slender specimen and by two doubtful very young shells in the Henderson collection. The holotype probably is immature, for the ridge along the columellar side of the inner lip, seen in *P. nucleus*, is obscure and smooth, and the interior of the outer lip is only obscurely lirate.

This almost smooth deeply notched species is quite different from the genotype. Aside from the differences in the aperture already mentioned, it is more slender than the living West Indian *P. nucleus* (Wood), and has a deeper and narrower siphonal notch and much weaker sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 115639).

MODULIDAE

MODULUS Gray

Gray, 1842, Synopsis of the contents of the British Museum, ed. 44, p. 60 (genus without species). (Quoted from Iredale, Proc. Malac. Soc. London, vol. 10, p. 306, 1913.) Gray 1847, Proc. Zool. Soc. London, pt. 15, p. 150.

Type (*by original designation, 1847*).—*Trochus modulus* Linné. Recent, West Indies.

Shell medium-sized, turbinate, periphery angular. Nucleus relatively slender, consisting of about two whorls. Aperture subcircular, oblique to axis of shell. Columella bearing a heavy basal horizontal tooth, below which lies an excavated area. Behind the inner lip lies a deep narrow umbilicus. Interior of outer lip bearing fine lirations. Sculpture consisting of spiral cords undulated by obscure axial ribs.

The earliest American species of this genus are of Miocene age. The Cretaceous species mentioned by Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, pp. 293–294, 1892) hardly represent *Modulus.*

Modulus modulus basileus (Guppy)

(Plate 25, Figure 17; Plate 26, Figures 1 to 4)

Monodonta basilea Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 85, pl. 1, fig. 2 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 217). Guppy, 1874, Geol. Mag., decade 2, vol. 1, pp. 434–435, pl. 16, fig. 2; p. 438 (list).

Modulus modulus L. var. *basileus* Guppy, Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 319. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list). ? Hubbard, 1921, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, pp. 140–141.

Modulus near *floridanus* Conrad, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Not *Modulus basileus* Guppy, 1913, Agric. Soc. Trinidad and Tobago Paper 549, p. 4 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 339) = *M. tamanensis* Maury, 1925, Bull. Am. Paleontology, vol. 10, pp. 389–390, pl. 51, figs. 2–3.

Shell medium-sized, peripheral cord heavy on some specimens, spire high or low. Columellar tooth slender, umbilical opening narrow. Sculpture variable. Most specimens (figs. 1, 2) have a heavy peripheral cord above which lie four spiral threads and below which lie strong spiral cords. On such specimens the axial sculpture consists only of heavy nodes on peripheral cord and of obscure axial wrinkles above peripheral cord. Others (figs. 3, 4), embracing both high-spired and low-spired shells, lack the strong peripheral cord and have low, broad axial ribs above the periphery.

Length 14.5 mm.; diameter 12.4 mm. (holotype, high-spired shell with strong peripheral cord). Length 8 mm.; diameter 5.9 mm. (figured high-spired shell lacking strong peripheral cord). Length 6 mm.; diameter 6.1 mm. (figured low-spired shell lacking strong peripheral cord).

Type locality.—Jamaica (Miocene).

All the Bowden specimens of *Modulus*, of which there are 18 in the Henderson collection, are referred to *M. modulus basileus*, though they might be considered as representing three species. Specimens of the living West Indian *M. m. modulus* show, however, almost precisely the same variation among lots collected at one locality. It is, in fact, almost impossible to distinguish the fossils from living shells. Even the holotype, the largest shell in any collection, is smaller than large living shells. Most of the fossils, like the holotype, have a heavy peripheral cord, and on the large shells it is heavier and more strongly noded than in living shells. Not many living low-spired ribbed shells have so rounded a periphery as the fossils. The low-spired ribbed fossils are like the living *M. floridanus* Conrad, which generally is regarded as a subspecies or variety of *modulus*. Only one of the fossils has a loosely coiled body whorl such as is seen in many living specimens.

Two small low-spired shells from the Gurabo formation apparently should be referred to *basileus*. Hubbard records it from the lower Miocene limestone of Vieques, which lies east of Porto Rico. *M. tamanensis* Maury, a Miocene species from Trinidad, is larger and has heavier spiral sculpture.

Other localities.—? Lower Miocene, Vieques (Hubbard). Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 115469).

"VERMETIDAE"[1]

VERMICULARIA Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 78.
Type (by monotypy).—Serpula lumbricalis Linné. Recent, western Pacific.

Shell unattached. Early whorls regularly coiled, turritelloid, later whorls irregularly coiled or twisted, or more or less straight. Aperture subcircular or subpolygonal, depending on presence or absence of spiral cords and threads. Sculpture of early whorls consisting of one or more spiral threads, which may disappear on later whorls or may be changed to heavier cords, between which lie fine threads. (Based on figure of *lumbricalis* in Tryon, Man. Conchology, vol. 8, p. 55, fig. 98, 1886, and on specimens of *Vermiculus spiratus* Philippi, West Indies.)

The perfect coiling of the early whorls, irregular coiling of the later whorls, and absence of internal lamellae are characteristic of this genus.

Vermicularia spirata (Philippi)

(Plate 26, Figure 5)

Vermiculus spiratus Philippi, 1836, Arch. Naturges., p. 244.
Vermetus trilineatus Guppy (part), 1867, Proc. Sci. Assoc. Trinidad, pt. 3, p. 170 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 197). Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, p. 408 (not pl. 18, fig. 12); p. 437 (list).
Vermetus lumbricalis Guppy (not Linné), 1874, Geol. Mag., decade 2, vol. 1, p. 437 (list). Gabb, 1881, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 363.
Vermicularia spiratus (Philippi), Tryon, 1886, Man. Conchology, vol. 8, pl. 55, figs. 99–100.
Serpulorbis (*Vermicularia*) *spirata* (Philippi), Dall, 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 304.
Vermicularia near *spirata* Philippi, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Vermicularia spirata (Philippi), Maury, 1925, Bull. Am. Paleontology, vol. 10, pp. 379–380, pl. 52, fig. 13.
Vermicularia spirata var. *trilineata* Maury (not Guppy), 1925, Bull. Am. Paleontology, vol. 10, p. 380, pl. 52, fig. 6.

Shell small; first five to seven whorls forming a slender turritelloid spire, remaining two or three whorls irregularly coiled or twisted. Nucleus minute, consisting of between one and a half and two whorls. Aperture elliptical. Sculpture of early whorls consisting of a prominent peripheral spiral thread, above which a weaker thread may lie. Both these threads and a basal thread become crude spiral cords on later whorls, and between them lie secondary spiral threads.

Length 11.2 mm.; diameter of aperture 4 mm. (figured specimen).

All the Bowden specimens referred to this species are small, the figured specimen being the largest. Fourteen specimens are in the

[1] *Vermetus*, as used binominally, is not the oldest genus name in this family.

Duerden collection. Living specimens found in the West Indies and Florida are too variable to warrant separating the fossils under another name. Some of the Bowden specimens have only one spiral thread on the early whorls, others, like the one figured, have two. The spiral sculpture is stronger than in specimens from the Pliocene beds at Matura, Trinidad, in the Guppy collection labeled "*Vermetus lumbricalis* Linné." It seems quite certain that the type material of *Vermetus trilineatus* Guppy, consisting of six specimens, embraces "*Vermetus lumbricalis* Linné," and also the very slender tips of a *Turritella* that has three strong spiral threads on the early whorls. The longest of these very slender tips, which are more slender than the tips of the *Vermicularia* and have flatter whorls, agrees in dimensions with Guppy's figure and should be taken as the holotype.

Small tips of *V. spirata* having two spiral threads (three counting the basal one) are quite abundant in the Cercado formation and less abundant in the Gurabo formation.

The citations of this species, which has a considerable number of synonyms, given above are designed to cover the fossil records in tropical America.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic. Pliocene, Costa Rica, Trinidad, Florida, North Carolina. Living, east coast of United States and West Indies in 3 to 175 fathoms.

LEMINTINA Risso

Risso, 1826, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 114.

Type (*by monotypy*).—*Lemintina cuvieri* Risso (generally regarded as a synonym of *Serpula arenaria* Linné; see Bucquoy, Dautzenberg, and Dollfus, Moll. Roussillon, vol. 1, p. 236, 1884). Recent, Mediterranean.

Shell attached or free, tubular, irregularly coiled or twisted, or more or less straight, divided at intervals by partitions concave forward. Aperture circular. Sculpture consisting of fine granular spiral threads. (Based on *Serpula arenaria* Linné.)

Tulaxodus Guettard (Mémoires sur différentes parties des sciences et arts, vol. 3, p. 143, 1770), generally cited as "*Thylacodes*," may be the earliest name for this genus. Guettard's specific names are polynomial and in the vernacular. According to the Code, however, the generic names of such binary writers are available. Some writers use *Serpulus* Montfort (Conch. Syst., vol. 2, pp. 26–27, 1810; type, by original designation, "*Serpulus contortuplicatus* Linné") for this genus. This name may, however, be a masculinization of *Serpula* Linné. Montfort masculinized many, though not all, genera of mollusks with feminine terminations. Though Montfort cites *Serpulus contortuplicatus* (*Serpula contortuplicata* Linné) as the type, his figure apparently represents *Serpula arenaria* Linné. On account of

the double uncertainty as to the generic name and as to its type, *Serpulus* is considered a *nomen dubium*.

Serpulorbis Sasso (Giornale ligustico di scienze, lettere ed arti, pt. 5, p. 482, 1827; type, by monotypy, *Serpulorbis polyphragma* Sasso (=*Serpula arenaria* Linné); quoted from review in Ferussac's Bull. Sci. Nat., vol. 19, pp. 123–124, 1829), used by most American writers, seems to be a synonym of *Lemintina*.

Cossmann (Essais Paléoconch. Comp., pt. 9, pp. 133, 138, 1912) uses *Lemintina* as a subgenus of "*Vermetus* Adanson," but the absence of internal lamellae, the presence of transverse partitions, and rather strong sculpture justify generic recognition.

Lemintina papulosa (Guppy)

(Plate 26, Figure 6)

Vermetus papulosus Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 292, pl. 17, fig. 3. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 437 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 519.

Petaloconchus sculpturatus Gabb (part, not Lea), 1873, Trans. Amer. Philos. Soc., n. s., vol. 15, pp. 240–241.

Serpulorbis papulosus (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list). Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 376.

Serpulorbis papulosa (Guppy), Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 291–292, pl. 48, fig. 10. Olsson, 1922, Bull. Am. Paleontology, vol. 9, pp. 317–318, pl. 15, fig. 1. Maury, 1925, Bull. Am. Paleontology, vol. 10, pp. 377–378.

Early part of shell contorted and generally showing attachment scars. Most of the specimens consist of short lengths of later part of shell, generally slightly curved. Sculpture of early part consisting of axial wrinkles and irregularly arranged spiral pustules. Sculpture of later part consisting of heavy pustules, arranged in 9 to 12 spiral rows, between which lie a varying number of roughened spiral threads.

Length 30 mm.; diameter of larger end 7.8 mm. (figured specimen).

Type locality.—Jamaica (Miocene).

The holotype of this species, represented by 19 fragments in the Duerden collection, is a slender fragment, which was poorly figured. The heavy pustules are a characteristic feature.

L. papulosa is found in the Gurabo formation, but these Dominican specimens are more variable than those from Bowden, some of them bearing heavy pustules, like Bowden shells, and others bearing fine pustules or none at all. A few finely sculptured specimens from the Cercado formation apparently should also be referred to *papulosa*. Olsson records it from the middle Miocene beds of Costa Rica and Maury from the Manzanilla and Springvale beds of Trinidad. The living West Indian *L. decussata* (Gmelin) has finer sculpture.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa

Rica (Olsson). Manzanilla beds (middle Miocene), Trinidad (Maury). Springvale beds (upper Miocene), Trinidad (Maury).

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64081).

PETALOCONCHUS H. C. Lea

H. C. Lea, 1843, Trans. Am. Philos. Soc., n. s., vol. 9, p. 233.
Type (by monotypy).—Petaloconchus sculpturatus Lea. Miocene, Virginia.

Shell more or less regularly coiled in an open spire during part of growth, more or less straight during final stage. Early stage contorted or more regularly coiled. Aperture circular. Columellar wall bearing two relatively long thin lamellae that disappear near aperture and may be absent elsewhere. Sculpture consisting of spirally arranged crude pustules or of axial wrinkles.

Cossmann (Essais Paléoconch. Comp., pt. 9, pp. 132, 135, 1912) and others also considered *Petaloconchus* a division of the genus "*Vermetus.*" The presence of two relatively long thin columellar lamellae seems to warrant generic rank.

Petaloconchus species

The Johns Hopkins University collection contains a small contorted mass consisting of a tube having a diameter of between one and two millimeters (U. S. Nat. Mus. No. 369494). At one place where the tube is broken two lamellae can be seen on the columellar wall. The lower lamella is much longer than the upper one and is curved upward. The sculpture consists principally of axial wrinkles, but at places the outline of the tube is modified by crude spiral threads.

This small specimen is the early stage of a *Petaloconchus*, and in all probability represents *P. domingensis* Sowerby (Quart. Jour. Geol. Soc. London, vol. 6, p. 551, pl. 10, fig. 9, 1850), early convoluted tubes of which have similar axial wrinkles and crude spiral threads. *P. domingensis*, which is abundant in the Gurabo formation, probably should be considered a subspecies of *sculpturatus*, of which Olsson considers it a synonym (Bull. Am. Paleontology, vol. 9, pp. 318–319, 1922). *P. alcimus* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, p. 51, pl. 9, figs. 2–4, 1925), from the upper Miocene Springvale beds of Trinidad, has weaker sculpture than *domingensis*.

Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585, 1903) listed *Petaloconchus domingensis* from Bowden, but no specimens are in the collections of the United States National Museum.

TURRITELLIDAE

TURRITELLA Lamarck

Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 74.
Type (by monotypy).—Turbo terebra Linné. Recent, western Pacific.

Shell slender, many-whorled, spire high, whorls more or less bulging or flat. Aperture broadly ovate. Outer lip of type species flexed backward near suture, then extending backward and more gently forward, forming

a broad shallow asymmetric sinus. Other species have outer lips of different shape. Sculpture of type species consisting of heavy spiral threads between which lie very fine spiral threads. Some species have beaded spiral cords.

Guillaume (Bull. Soc. géol. France, ser. 4, vol. 24, No. 5, pp. 281–311, 33 figs., pls. 10–11, 1924) has recently published an important discussion of the European Tertiary subdivision of *Turritella*, in which he shows that the shape of the outer lip, generally revealed only by the growth lines, is the only satisfactory criterion of phylogenetic value, and that the sculpture, on which current subdivisions are for the most part based, may have little significance. Unfortunately, as Stewart remarks (Proc. Acad. Nat. Sci. Philadelphia, vol. 78 (1926), p. 352, footnote, 1927), Guillaume fails to correlate his groups with the subgeneric names already available, preferring to group the species about those he regards as typical and for which the group is named. *Turritella* s. s. is available for the "groupe de *T. terebralis* Lmk."; *Haustator* Montfort (Conch. Syst., vol. 2, pp. 182–183, 1810; type, by original designation, *Haustator gallicus* Montfort = *T. imbricataria* Lamarck, Eocene, Paris Basin) for the "groupe de *T. imbricataria* Lmk."; *Archamediella* Sacco (Moll. Piemonte, pt. 19, p. 12, 1895; type, by original designation, *Turritella archimedes* Brongniart (not Dillwyn) = *T. cochlias* Bayan, Eocene, Italy) for the "groupe de *Turritella turris* Basterot"; and *Torculoidella* Sacco (Moll. Piemonte, pt. 19, p. 28, 1895; type, by original designation, *Turritella varicosa* Bronn, Pliocene, Italy) for the "groupe de *Turritella subangulata* Br." Apparently the "groupe de *Turritella hybrida* Desh." is the only one of Guillaume's groups for which no name is available.

T. domingensis Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 35–36, pl. 5, figs. 7, 7*a*, 9, 1917) and *T. cartagenensis* Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 34–35, pl. 5, fig. 13, 1917) are the only tropical American Miocene species considered by Guillaume. *T. domingensis*, of which *T. submortoni* Maury (Bull. Am. Paleontology, vol. 5, p. 294, pl. 48, fig. 16, 1917) is a synonym, is found in the Gurabo formation, and therefore is of middle Miocene age. This species is placed by Guillaume in the "groupe de *Turritella imbricataria.*" *T. cartagenensis*, which is very variable, is not an Oligocene species, but is found in middle and upper Miocene beds in Colombia and is most abundant in upper Miocene deposits. It falls in the "groupe de *Turritella terebralis.*" *T. cartagenensis* may be a synonym of *T. bifastigata* Nelson, a species from the Zorritos formation of Peru, generally considered of middle Miocene age. The lectotype of *bifastigata* was figured by Hodson (Bull. Am. Paleontology, vol. 11, pp. 218–219, pl. 34, fig. 1, 1926). In view of the variable characters of this species in Peru, Colombia, and Venezuela, the utility of Hodson's subspecies is questionable. *T. oreodoxa* Olsson (Bull. Am. Paleontology, vol. 9, pp. 324–

325, pl. 17, fig. 1, 1922), based on specimens from the middle Miocene beds of Costa Rica, is another name for this group of Turritellas.

The representation of this genus in the Bowden formation is very meager. The only species does not belong in any of Guillaume's groups, nor, so far as known, is any name available for the group in which it falls.[1] Therefore, *Turritella* is used in the unrestricted sense.

Turritella guppyi Cossmann

(Plate 26, Figures 7 to 9)

Turritella tornata Guppy (part), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 580, pl. 26, fig. 12. Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, p. 79 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 211). Guppy (part), 1874, Geol. Mag., decade 2, vol. 1, p. 437 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Not *Turritella tornata* Klipstein, 1845, Mitt. Geb. Geol. Palaeont., vol. 1, p. 178.

Turritella guppyi Cossmann, 1909, Rev. Crit. Paléozool., year 13, No. 4, p. 225, footnote. Hodson, 1926, Bull. Am. Paleontology, vol. 11, pl. 31, fig. 1.

Turritella guppyi Cossmann *morantensis* Hodson, 1926, Bull. Am. Paleontology, vol. 11, pp. 212–213, pl. 30, figs. 3, 5, 6, 8; pl. 32, fig. 4.

Not *Turritella tornata* Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 240. Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 519. Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 294, pl. 48, fig. 15. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 377 (= *T. carlottae* Hodson, 1925, Bull. Am. Paleontology, vol. 11, pp. 213–214, pl. 30, fig. 2; pl. 31, fig. 11).

Not *Turritella tornata* Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 36 (? subspecies of *T. altilira* Conrad).

Not *Turritella altilira tornata* Maury, 1925, Bull. Am. Paleontology, vol. 10, pp. 382–384, pl. 53, figs. 3–5.

Shell relatively small, whorls bicarinate. Outer lip, as shown by growth lines, slightly flexed between posterior cord and suture, then forming a deep relatively narrow sinus lying between the spiral cords, then flexed again in front of anterior cord. Sculpture consisting of two beaded spiral cords and weaker spiral threads. One relatively strong thread and several weak ones lie between the cords and an obscurely beaded one between the posterior cord and suture. Beads elongated in direction of growth lines. On some specimens the cords are farther apart and the beads are less distinct.

Length 25.8 mm.; diameter 8.3 mm. (smaller heavily beaded figured specimen). Length 38.9 mm.; diameter 10.1 mm. (larger obscurely beaded figured specimen).

Type locality.—"Cumana, Venezuela" (Miocene).

The holotype of this species, which is labeled "Cumana, Venezuela," has all the appearance of a Bowden shell (see p. 82). The specimen shown in fig. 8 is very similar to it. Only two specimens are in the Duerden collection and six tips in the Henderson collection.

Maury's "*T. tornata*" (= *T. carlottae* Hodson[2]), found in the Gurabo formation, has lower and less strongly beaded cords and many fine

[1] *Torcula* Gray (Proc. Zool. Soc. London, pt. 15, p. 155; type, by original designation, *Turbo exoletus* Linné) is available for this group of Turritellas, but the availability of the name was not realized until this account was in page proof.

[2] This *Turritella* needs a new name, as *T. carlottae* is a homonym of *T. carlottae* Watson (Jour. Lin. Soc., vol. 15, p. 222, 1881).

threads. Perhaps it should be considered a subspecies of *guppyi*. Maury's specimens from Trinidad have more strongly constricted whorls, stronger secondary spirals, and on the early whorls the posterior spiral lies closer to the suture. The relations of *guppyi* to the middle Miocene Gatun species *T. altilira* Conrad and the bewildering number of named species and subspecies of the *altilira* group are not clear. "*T. tornata*" of European writers in the literature of the geology of the Panama Canal Zone is *T. altilira*.

T. guppyi fails to fit into any of Guillaume's groups. It is something like the "groupe de *T. hybrida* Desh.," but the points of inflection of the growth lines are farther apart and the sinus is more symmetrical. It belongs in the group of *T. exoleta* Linné, which, as Guillaume suggests (p. 309), typifies a group comparable to those he establishes. *T. exoleta*, which is a living West Indian species, has less distinct beads, weaker secondary sculpture, and a more deeply concave and wider intercordal area, but the weakly beaded variety of *guppyi* found at Bowden clearly is similar to it.

Other localities.—"Miocene, Cumana." This record probably is spurious.

Type material.—Holotype (U. S. Nat. Mus. No. 115451).

CAECIDAE

CAECUM Fleming

Fleming, 1813, Brewster's Edinburgh Encyclopaedia, vol. 7, p. 67. (Quoted from Sherborn, Index Animal., 1801–50, pt. 5, p. 950.) Am. ed., vol. 6, pt. 2, p. 689, 1815.

Type (by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 203).—*Dentalium trachaea* Montagu. Recent, European seas.

Shell tubular. Nucleus consisting of several whorls coiled in one plane and of a short curved tube, separated by a septum from the next stage, which is a curved tube, which in turn is separated by a conical pointed septum or plug from the adult shell. Both these stages generally are detached from the adult shell, which consists of a tube curved in same plane as coil of nuclear whorls. Aperture circular. Adult shell smooth, or variously sculptured, generally with annular rings.

The early stages of shells of this genus are rarely found as fossils. E. Willard Berry (Nautilus, vol. 39, No. 2, pp. 66–67, 1925) recently described specimens consisting of the nuclear and nepionic stages of a Miocene species from Maryland referred to *C. patuxentium* Martin.

Caecum species

(Plate 26, Figure 10)

Adult shell a slender gently curved tube. Aperture consisting of a narrow thin flange following a thick ring. Plug flat, the pointed apex lying near dorsal side. Sculpture consisting of rather narrow, crowded annular rings, over which fine threads extend.

Length 3 mm.; greatest diameter 0.6 mm. (figured specimen).

This species is represented by eight specimens, all of which are small or worn. The figured specimen is a worn shell that was badly broken after being photographed. This *Caecum* apparently is a new species that is more slender than *C. anellifer* Pilsbry and Johnson (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 378, fig. 18, 1922), from the Cercado formation, and has stronger axial sculpture.

MEIOCERAS Carpenter

Carpenter, 1858, Proc. Zool. Soc. London, pt. 26, p. 438.
Type (*by subsequent designation, Cossmann, 1912, Essais Paléoconch. Comp., pt. 9, p. 154*).—*Meioceras cornucopiae* Carpenter. Recent, West Indies.

Adult shell small, stout, curved, tubular, dorsal surface more strongly curved than ventral. Aperture circular, oblique to axis of shell. Apical plug pointed. Shell smooth.

No type designation antedating Cossmann's could be found. The above description is based on doubtfully identified specimens of *cornucopiae* from Cuba that are not like the figure given by Tryon (Man. Conchology, vol. 8, pl. 67, fig. 75, 1886), which shows an evenly tapering tube, the dorsal surface of which is not more strongly curved than the ventral surface.

According to Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 296, 1892), *Meioceras* begins like *Caecum*, but the second stage enlarges rapidly and is shaped like a cow's horn.

Meioceras apanium, new species

(Plate 26, Figures 11, 12)

Shell relatively slender, dorsal surface strongly curved, ventral surface very slightly curved. Shell abruptly inflated at a point less than half of distance from aperture to apex. Plug low, conical, terminating in a sharp apex near dorsal surface. Aperture very oblique. Surface smooth except for coarse incremental undulations.

Length 2.3 mm.; greatest diameter 0.8 mm. (holotype, dimensions approximate).

This relatively slender, abruptly inflated *Meioceras* is represented by four specimens. It is the first fossil species of this type recorded from the West Indian region. *M. constrictum* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 378, fig. 17, 1922), which is found in the Gurabo formation, and is the only other fossil species from this region, has no bulging equator. *M. cingulatum* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 302, pl. 16, figs. 6–7, 1892), a Pliocene species from Florida, has the same shape, but is much stouter. *M. nitidum* (Stimpson), a living species from Florida and the West Indies, and also found in the Pliocene deposits of Florida, also is stouter and generally less abruptly inflated at the equator.

Type material.—Holotype (U. S. Nat. Mus. No. 369498).

FOSSARIDAE ?

FOSSARUS Philippi

Subgenus FOSSARUS s. s.

Philippi, 1841, Archiv für Naturgeschichte, year 7, vol. 1, pp. 42, 47.
Type (*by monotypy*).—*Fossarus adansonii* Philippi (Le Fossar Adanson, ? = *Turbo ambiguus* Linné). Recent, Senegal.

Shell small, stout, spire low, body whorl large and broad. Nucleus generally broken off, when present forming a slender cylinder of about three whorls sculptured with obscure axial riblets. Aperture ovate. Outer lip frilled by the spiral ridges. Basal lip flattened and everted below columella, forming an abrupt angle with inner lip. Umbilical opening of varying width. Sculpture consisting of spiral ridges and threads. (Based on *Turbo ambiguus* Linné.)

The following species, which is represented by only one small specimen that probably is immature, is referred to *Fossarus* for want of a better name. The thin uneverted basal lip shows that it is not a *Fossarus*, and it may not even belong in this family.

"Fossarus" species

(Plate 26, Figures 13, 14)

The only specimen of this species (U. S. Nat. Mus. No. 369499) is a very small thin shell having a greatly enlarged body whorl. The aperture is broadly ovate. The outer and basal lips are modified by the sculpture. The umbilical opening is narrow. The sculpture consists of heavy spiral ridges and of obscure axial ribs, which are confined to the later part of the body whorl. The approximate dimensions are as follows: length 1.7 millimeters, diameter 1.8 millimeters.

In photographing the apertural view the shell was tilted back and to the right. Except for the less circular aperture, this little shell is surprisingly like some of the Australian and Neozelanic species of *Fossarina* Adams and Angas, which Suter (Man. New Zealand Moll., p. 139, 1913) places in the Trochidae.

Subgenus GOTTOINA A. Adams

A. Adams, 1863, Proc. Zool. Soc. London, pt. 2, p. 112.
Type (*by subsequent designation, Cossmann, 1915, Essais Paléoconch. Comp., pt. 10, p. 84*).—*Gottoina sulcifera* A. Adams. Recent, Japan.

No specimens or figures of the genotype are available, and the following species are referred to *Gottoina* because similar living species from Florida were placed there by Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, pp. 272–273, 1889). Even if these fossil and living species are congeneric with *G. sulcifera* it is doubtful whether they should be regarded as representing a subgenus of *Fossarus*. They may belong in some other family. No similar fossils are recorded elsewhere in tropical America.

Key to the Bowden species referred to Gottoina

Axial sculpture absent.....*"F. (G.)" mundulus*
Axial sculpture present.....*"F. (G.)" comptus*

"Fossarus (Gottoina)" mundulus Guppy

(Plate 26, Figure 15; Plate 27, Figures 1, 2)

Fossarus (Gottoina) mundulus Guppy (part), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 320, pl. 27, fig. 16. Dall, 1903, Trans. Wagner Inst., vol. 3, pt. 6, p. 1585 (list).

Shell small, thick, stout, trochoid. Nucleus low, stout, consisting of about one and a half rapidly enlarging whorls. Aperture circular. Outer lip slightly frilled by the spiral ridges, minute grooves extending across face of lip from apex of frills. Basal lip bearing several small denticles. Inner lip reflected over a narrow umbilical groove. Sculpture consisting of spiral ridges (4 on penult whorl) and of very fine spiral threads on ridges and interspaces. A spiral thread extends from basal lip into umbilicus.

Length 3.1 mm.; diameter 2.8 mm. (holotype). Length 2.7 mm.; diameter 2.5 mm. (other figured specimen).

Type locality.—Jamaica (Miocene).

This species is represented by nine specimens in the Aldrich collection. It is very similar to *"Fossarus (Gottoina)" bella* Dall, a living species from Florida, but is smaller and the basal lip is not so thick below the columella

Type material.—Holotype (U. S. Nat. Mus. No. 107093).

"Fossarus (Gottoina)" comptus, new species

(Plate 27, Figures 3, 4)

Fossarus (Gottina) mundulus Guppy (part), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 320.

Shell small, stout, very thick. Nucleus consisting of about one and a half whorls. Aperture circular, outer and inner lips very thick. Face of outer and inner lips bearing minute denticles. Umbilicus relatively wide. A spiral thread extends into umbilicus from basal lip. Sculpture consisting of heavy spiral ridges (3 on penult whorl) and of coarse axial ribs that are present only on sutural spiral of penult whorl, but on body whorl gradually extend toward base.

Length 2.3 mm.; diameter 1.9 mm. (holotype).

Two specimens of this thick-shelled little species are included with *mundulus* in the Guppy collection. The holotype is one of 26 in the Aldrich collection. The denticles on the basal and outer lips are like the smaller denticles on the basal lip of *mundulus*, and probably are correlated with the thicker lips of *comptus*. On young shells the outer and basal lips are thin and strongly frilled. No species similar to *comptus* is now living in West Indian waters.

Type material.—Holotype (U. S. Nat. Mus. No. 369501).

ARCHITECTONICIDAE

ARCHITECTONICA ("Bolten") Roeding

Subgenus ARCHITECTONICA s. s.

Section ARCHITECTONICA s. s.

Roeding, 1798, Museum Bottenianum, pt. 2, p. 78.
Type (by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 151, "Architectoma").—Trochus perspectivus Linné. Recent, Indo-Pacific.

Shell reaching a moderately large size, low, conical, periphery angular, umbilicus wide, deep, funnel-shaped, ladder-like. Nucleus anastrophic (inverted and pseudosinistral), only one inflated whorl visible from dorsal surface. Aperture subquadrate. Junction of outer and basal lips grooved by the peripheral cord. Junction of basal and inner lips deeply grooved by umbilical cord, basal lip bearing a smaller groove corresponding to cord lying outside umbilical cord. Posterior part of inner lip bearing a deep groove, below which lie several shallow grooves. Sculpture consisting of spiral cords, cut by retractive axial grooves. A wide crenulated cord adjoins the umbilicus, and another narrower and less strongly crenulated cord is separated from the umbilical cord by a deep groove.

Architectonica s. s., more familiarly known by the Lamarckian name of *Solarium*, is recorded in deposits as old as Eocene.

Architectonica (Architectonica) nobilis quadriseriata (Sowerby)

(Plate 27, Figures 5 to 7)

Solarium quadriseriatum Sowerby, 1850, Quart. Jour. Geol. Soc. London, vol. 6, p. 51, pl. 10, figs. 8*a*, *b*, *c*. Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 291. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 438 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 520. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 295, pl. 49, figs. 1, 2. Maury, 1925, Brasil Serv. Geol. Mineral. Mon., vol. 4, pl. 2, fig. 3.

Architectonica quadriseriata (Sowerby), Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 228. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 379. Maury, 1925, Bull. Am. Paleontology, vol. 10, p. 389.

Solarium granulatum Lamarck, Dall (part), 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 329. ? Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 295, pl. 49, fig. 3.

Salarium villarelloi Böse, 1906, Inst. Geol. Mexico Bol. 22, pp. 30–31, pl. 3, figs. 4–11.

Shell moderately large. Grooves on inner lip faint except the one at base. Sculpture of whorls of spire consisting of four spiral bands cut into nodes by retractive axial grooves. These grooves gradually disappear on body whorl, or on preceding whorl, of large specimens, and are replaced by growth lines. Body whorl bearing in addition a narrow spiral band above periphery and a rounded peripheral cord. Ventral surface sculptured with a wide, heavily crenulated band adjoining umbilicus, a narrower and less heavily crenulated band lying farther out, followed by a broad area bearing spiral grooves. Adjoining peripheral cord lies a very narrow thread, followed by a wider band. On young shells this band is crenulated, and also the inner part of the broad area.

Length 16 mm.; diameter 32.5 mm. (figured specimen). Length 22.5 mm.; diameter 41 mm. (largest specimen).

Type locality.—Dominican Republic (Miocene).

A. nobilis quadriseriata is one of the most abundant of the larger gastropods at Bowden. It is represented by about 70 specimens in the Duerden collection. The ventral surface of young shells is more strongly crenulated than in adult shells. This *Architectonica* is found in both the Cercado and Gurabo formations, but is abundant only in the Gurabo formation. The largest Gurabo shell has a diameter of 47 millimeters. The material from the Cercado formation is unsatisfactory.

According to the figures, Böse's *villarelloi,* from the middle Miocene beds of Tuxtepec, Mexico, represents the same form. Very little difference can be seen between the Dominican and Bowden fossils and the living West Indian and Panamic *A. nobilis* ("Bolten") Roeding, more familiarly known as *Solarium granulatum* Lamarck. The fossils generally have a narrower umbilical cord and the nodes on the dorsal surface generally last until a later stage, yet these fossils are virtually indistinguishable from specimens from the Duplin marl referred to "*granulatum.*" *A. "granulata" chipolana* (Dall) (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 329, 1892; lower Miocene, Chipola formation, Florida) is much smaller and has a more strongly sculptured base. It probably could be given full specific rank.

A. gatunensis Toula (Jahrb. K.-k. geol. Reichsanstalt, vol. 58, pp. 692–693, pl. 25, fig. 3, 1909), found in the Gatun formation of the Canal Zone and also in Costa Rica, has a heavy cord on the ventral surface adjoining the peripheral cord. It needs comparison with *A. sexlinearis* (Nelson) (see Woods, Bosworth's Geol. Peru, p. 109, pl. 17, figs. 1*a, b, c,* 1922), from the Zorritos formation of Peru.

Guppy (Agric. Soc. Trinidad and Tobago Paper No. 440, p. 8, 1910; Reprint, Bull. Am. Paleontology, vol. 8, p. 299, 1921) records *quadriseriata* from the Springvale beds of Trinidad, but this record needs confirmation.

Other localities.—Manzanilla beds (middle Miocene), Trinidad (Maury). Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—5 cotypes (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12786).

Section PSILAXIS, new section

Type.—Architectonica (*Philippia*) *krebsii* Mörch. Recent, West Indies and Florida.

Shape of shell and umbilicus, and apertural features as in *Architectonica* s. s., though the aperture is more ovate. Dorsal part of nucleus consisting of one large whorl. Axial sculpture of dorsal surface confined to sutural wrinkles on first post-nuclear whorl. Spiral sculpture of dorsal surface consisting of cords adjoining periphery. Ventral sculpture consisting of a crenulated

umbilical cord, separated from a narrower crenulated thread by a groove, which in turn is separated by a groove from the smooth main part of base. A narrow spiral thread adjoins the periphery.

The recognition of this group of Architectonicas seems justified because of the very large nuclear whorl, as seen in dorsal view, and because of the distinctive sculpture. It is represented by living species in the western Atlantic and western Pacific. The species here described are the first American fossils recorded. Heretofore species of *Psilaxis* were placed under *Philippia* Gray (Proc. Zool. Soc. London, pt. 15, p. 146, 1847; type, by original designation, *Solarium luteum* Lamarck, Recent, Australia), which has a higher shell, more rounded aperture, and narrower umbilicus, bordered by a weakly crenulated area not set off from the rest of the base by a deep groove.

Key to the Bowden species of Psilaxis

Axial sculpture of dorsal surface consisting of sutural wrinkles on first post-nuclear whorl..... *A.* (*P.*) *krebsii lampra*
Axial sculpture of dorsal surface consisting of weak nodes on first two post-nuclear whorls..... *A.* (*P.*) *araea*

Architectonica (Psilaxis) krebsii lampra, new subspecies

(Plate 27, Figures 8 to 11)

Shell relatively small. Nucleus, as seen from dorsal surface, consisting of one very large whorl. Axial sculpture of dorsal surface consisting of sutural wrinkles on first half or three-quarters of first post-nuclear whorl. On the remaining whorls exaggerated growth lines appear here and there. Spiral sculpture of dorsal surface consisting of a peripheral rounded cord, above which lies a narrow thread. Sculpture of ventral surface consisting of a crenulated umbilical cord, set off by a deep groove from a narrow undulated thread, which is set off from the main part of the base by a groove, and also of a weak thread adjoining periphery. Obscure spiral markings are visible on main part of both dorsal and ventral surfaces.

Length 4.9 mm.; diameter 8.5 mm. (holotype). Length 10.7 mm.; diameter 9.1 mm. (largest specimen).

This species also is abundant, being represented in the Henderson collection by 38 specimens of all growth stages. It closely resembles living specimens of *A. k. krebsii* (Mörch), found in the West Indies and off the southeast coast of United States, but the thread surrounding the umbilical cord is less strongly crenulated and the sculpture of the first post-nuclear whorl is weaker. It also is remarkably similar to the exotic *A. cingula* (Kiener).

The first post-nuclear whorl of the holotype is worn and its sutural wrinkles are not clear.

Type material.—Holotype (U. S. Nat. Mus. No. 369503).

Architectonica (Psilaxis) araea, new species

(Plate 27, Figures 12 to 14)

Shell small. Dorsal part of nucleus consisting of one very large whorl. Sculpture of first half post-nuclear whorl consisting of four narrow, weakly

nodulated spiral bands. All except the posteriormost two of these bands disappear within the first whorl and the nodes gradually disappear. Later whorls bearing two spiral cords at periphery, two median flat spiral bands separated by a narrow shallow groove, and a narrow peripheral band. Peripheral cord rounded. Base sculptured with a heavily crenulated umbilical band separated by a deep narrow groove from main part of base, which bears several grooves and the inner part of which is crenulated. Adjoining peripheral cord lies a similar rounded cord.

Length 3 mm.; diameter 6 mm. (holotype).

In some features this species, which is represented by only three imperfect specimens, is intermediate between *Architectonica* s. s. and *Psilaxis*, but it has the very large nucleus and suppressed sculpture of *Psilaxis*. The heavy basal peripheral cord, crenulated area lying outside the umbilical cord, and stronger dorsal sculpture separate it from *A. krebsii lampra*.

Type material.—Holotype (U. S. Nat. Mus. No. 369504).

Section PSEUDOTORINIA Sacco

Sacco, 1892, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 12, p. 66.

Type (*by original designation*).—*Solarium obtusum* Bronn. Miocene and Pliocene, Italy.

Shell medium-sized, low, periphery partly rounded. Nucleus anastrophic. Aperture subovate. Umbilicus moderately wide, ladder-like. Sculpture of dorsal and ventral surfaces consisting of strongly beaded spiral threads, the beads connected across the interspaces by fine spiral threads. Umbilicus bordered by a wide crenulated spiral cord, set off by a relatively wide groove from the narrower spirals elsewhere on base. (Based on Sacco's figures of genotype.)

The partly rounded periphery and elaborate sculpture are characteristic of *Pseudotorinia*.

Architectonica (Pseudotorinia) euprepes, new species

(Plate 27, Figures 15 to 17)

Shell small, very low. Nucleus small, a little more than the last large whorl visible from dorsal surface. Aperture ovate. Edge of outer, inner, and basal lips strongly frilled by the spiral sculpture. Sculpture of dorsal and ventral surfaces consisting of elaborately beaded spiral cords and threads, the peripheral cord being heavy. On the dorsal surface five or six cords lie between periphery and suture. The beads are joined by slender axial threads.

Length 3 mm.; diameter 6.8 mm. (holotype).

This small, elaborately sculptured species is represented by 29 specimens in the Aldrich collection. It also is found in both the Cercado and Gurabo formations. It resembles *A. bisulcata* (d'Orbigny), a living species from the West Indies and southeastern United States, but has a wider umbilicus, narrower spirals in the umbilical region, and more sharply sculptured beads. *A. semidecussata* (Guppy) (Proc. Sci. Assoc. Trinidad, pt. 3, p. 170, 1867; Reprint,

Bull. Am. Paleontology, vol. 8, p. 197, 1921; Geol. Mag., decade 2, vol. 1, p. 408, pl. 18, fig. 14, 1874), a Pliocene species from Trinidad, has the same kind of sculpture, but the beads on the holotype and only specimen are not so strong and the umbilical cord is wider. It may be *bisulcata*. A specimen representing some other genus (*Microgaza ?*) is in the vial with the holotype of *semidecussata*.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 369505).

Section NIPTERAXIS Cossmann

Cossmann, 1915, Essais Paléoconchologie Comparée, pt. 10, p. 167.
Type (*by original designation*).—*Solarium plicatum* Lamarck. Eocene, Paris Basin.

Shell medium-sized, very low. Nucleus small, anastrophic. Aperture broadly ovate. Umbilicus very wide, funnel-shaped, ladder-like. Umbilical wall bearing a median beaded spiral. Sculpture of dorsal and ventral surfaces consisting of finely beaded spiral threads and cords, the beads obscurely joined across the interspaces by slender axial threads.

The following species seems to have the features of *Nipteraxis*, which is characterized by its wide umbilicus, umbilical thread, and elaborate sculpture.

Architectonica (Nipteraxis) species

Another species of *Architectonica* is represented in the Henderson collection (U. S. Nat. Mus. No. 135539) by two badly broken shells, which, though recognizable, are too poor to serve as type material. The periphery is bicarinate. The umbilicus is very wide and has rapidly converging sides. The umbilical wall is sculptured with a beaded cord. The dorsal surface is elaborately sculptured with strongly beaded spiral threads and cords, the beads being connected by slender axial threads. The sculpture of the ventral surface consists of a crenulated umbilical cord, followed by successively narrower cords on which the crenulations are gradually changed to beads.

No fossil or living species from the West Indian region is similar to these fragments.

SPIROLAXIS Monterosato

Monterosato, 1913, Proc. Malac. Soc. London, vol. 10, p. 363.
Type (*by monotypy*).—*Pseudomalaxis centrifuga* Monterosato. Recent, Mediterranean Sea and Madeira.

Shell small, discoidal, biconcave, last whorl or more uncoiled. Nucleus anastrophic. Aperture subquadrate. Sculpture consisting of crenulated ridges at the four edges of the whorls, with or without microscopic spiral threads.

Monterosato proposed *Spirolaxis* as a subgenus of *Pseudomalaxis* Fischer (Man. Conchyl., p. 714, 1885; type, by monotypy, *Bifrontia ?*

zanclaea Philippi, Pliocene, Sicily), but inasmuch as *Pseudomalaxis* is not uncoiled and has a flat dorsal surface and deeply concave ventral surface, *Spirolaxis* might as well be given generic rank.

Iredale's (Proc. Malac. Soc. London, vol. 9, pp. 253–257, 1911) interpretation of the type of *Pseudomalaxis* would make *Spirolaxis* a synonym of *Pseudomalaxis*. It is necessary to accept as the type the species Fischer named, "*P. zanclaea* Philippi," not the Recent species from the Mediterranean and off Madeira, even though Fischer makes no mention of "*P. zanclaea* Philippi" as a fossil. The living species called "*Bifrontia zanclaea* Philippi" by Gray, which is the type of *Spirolaxis*, was renamed *Pseudomalaxis macandrewi* by Iredale, who was unaware of Monterosato's earlier name, *Pseudomalaxis centrifuga*. Two specimens of this species, labeled "*Bifrontia zanclea* Phil., Madeira, McAndrew," are in the collections of the United States National Museum (No. 14719). They have, as Iredale describes for specimens in the British Museum, only the last whorl or a little more uncoiled, but even these two specimens show variation in the degree of uncoiling, and Monterosato's figure shows a shell as much uncoiled as the American "*Omalaxis*" *exquisita* Dall and Simpson, described below.

Iredale considers that "*Omalaxis*" *exquisita* is congeneric with "*Omalaxis*" *nobilis* Verrill, the type, by original designation, of *Discosolis* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 331, 1892), which has the tightly coiled plano-concave shell of *Pseudomalaxis*, though according to Verrill the operculum is trochoid, not torinoid as in living species of *Pseudomalaxis*.

No fossils similar to these peculiar uncoiled shells have been found elsewhere in America. "*Homalaxis*" *rotula-catharinae* Melvill and Standen (Ann. Mag. Nat. Hist., ser. 7, vol. 12, pp. 299–300, pl. 21, fig. 3, 1903), from the Persian Gulf, seems to be a *Spirolaxis*.

Spirolaxis exquisita (Dall and Simpson)

(Plate 27, Figures 18 to 20)

Omalaxis exquisita Dall and Simpson, 1901, Bull. U. S. Fish. Comm., 1900 vol. 1, p. 432, pl. 54, fig. 12.

Shell very small and thin, whorls generally uncoiled, but the degree of uncoiling is slightly variable. Outline of whorls subquadrate, dorsal and ventral surface of whorls sloping from outer to inner edge. At each edge lies a minutely crenulated ridge, the two outer ridges heavier than the two inner ones.

Diameter 3 mm.; height at aperture 0.9 mm. (figured specimen, dimensions approximate).

Type locality.—Porto Rico (Recent).

The remarkable character of the Bowden fauna is shown by the presence of 22 of these fragile shells in the Aldrich collection. Only one specimen is in the Duerden collection, and the collections at the

United States Museum have none. Though the degree of uncoiling is slightly variable, no specimens are so tightly coiled as the specimens of *S. centrifuga* at hand.

When this account was written none of the shells representing the type lot of *S. exquisita*, consisting of four specimens dredged at a depth of 25 fathoms in Mayaguez Harbor, Porto Rico, could be found, but several years ago in making a preliminary study of the Bowden gastropods the fossils were compared with the type, and the conclusion was reached that they represent the same species. On the basis of dimensions and the figure of the type I can see no reason for changing this conclusion, though according to the figure the type is more loosely coiled than any of the fossils. The nucleus of the figured specimen was broken after the photographs were made.

Other localities.—Living, Porto Rico in 25 fathoms.

Type material.—Holotype (U. S. Nat. Mus.).

RISSOINIDAE

CREPITACELLA Guppy

Guppy, 1867, Geological Magazine, vol. 4, p. 500.

Type (*by monotypy*).—*Crepitacella cepula* (Guppy) ("*Melanopsis capula* Guppy"). Miocene, "Cumana, Venezuela"; Jamaica.

Shell relatively large and stout. Nucleus slender or moderately stout, consisting of two or three smooth whorls. Aperture ovate. Outer lip extending forward from suture and then back in a broad bulge, forming a posterior sinus. Basal lip strongly channeled. Siphonal fasciole narrow, high. Edge of inner lip detached. Sculpture consisting of protractive axial riblets that generally disappear on last whorl or two and of obscure spiral threads.

Cossmann (Essais Paléoconch. Comp., pt. 12, p. 76, 1921) referred this genus to his family Rissoinidae and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 380–382, 1922) independently arrived at the conclusion that it is similar to *Rissoina*, the principal difference being the absence of a thickened outer lip. This conclusion seems so reasonable that it is remarkable that *Crepitacella* has ever been referred to such families as the Buccinidae, Strombidae, Turridae, Trichotropidae, and so on.

Dolophanes Gabb (Proc. Acad. Nat. Sci. Philadelphia, p. 272, 1873; type, by monotypy, *D. melanoides* Gabb, Miocene, Dominican Republic) is a synonym of *Crepitacella*.

Crepitacella is represented by living species in the waters of Florida and the West Indies. It tolerates a considerable depth range, for off Florida it has been dredged at depths of 24 and 35 fathoms, whereas in the West Indies the only records are at depths of 158, 785, and 805 fathoms.

Key to the Bowden species of Crepitacella

Shell stout, spiral sculpture weak.....*C. cepula*
Shell slender, spiral sculpture strong.....*C. aresca*

Crepitacella cepula (Guppy)

(Plate 28, Figures 1 to 3)

Melanopsis capula Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 580, pl. 26, fig. 14 (*Melanopsis cepula* on p. 590, explanation of plate).

C.[repitacella] cepula (Guppy), Guppy, 1867, Geol. Mag., vol. 4, p. 500.

Crepitacella cepula (Guppy), Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2. No. 2, p. 84 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, p. 216). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 434, p. 439 (list). Dall, 1903. Trans. Wagner Inst. Philadelphia, vol. 3, pt. 5, p. 1585 (list). Cossmann, 1921, Essais Paléoconch. Comp., pt. 12, pp. 76–77, pl. 3, figs. 22–23.

Crepitacella limonensis Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 315, pl. 18, fig. 17.

Not *Crepitacella cepula* Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, pp. 524–525. Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 285–286, pl. 47, fig. 9. Pilsbry, 1922, Proc. Acad. Nat. Sci., Philadelphia, vol. 73, pp. 380–382, pl. 34, figs. 12–13 (=*C. melanoides* (Gabb)).

Shell stout, relatively thick, early whorls turreted. Nucleus stout, consisting of two whorls. Channel on basal lip wide. Sculpture consisting of protractive axial riblets that disappear on last whorl or on the one preceding it. On the early turreted whorls the ribs are slightly beaded at the shoulder. This row of beads may be continued as a spiral thread. Very fine spiral striations are visible, but they are very obscure except on anterior half of body whorl.

Length 15.9 mm.; diameter 8.5 mm. (figured specimen).

Type locality.—"Cumana, Venezuela (Miocene)."

No specimens of *Crepitacella* from Cumana are in the Guppy collection, and in view of the probability that the Cumana records of Bowden species are spurious, Bowden probably is the type locality. Five specimens in the Guppy collection from "Jamaica," meaning Bowden, one of which is figured, are labeled "types" and probably represent the type lot. Guppy's figure seems to be poorly drawn, as the aperture is too flaring. It also shows riblets on the body whorl.

This *Crepitacella* is abundant at Bowden, being represented in the Duerden collection by about 40 specimens, all of which are stout and relatively thick-shelled. Pilsbry referred to *cepula* not only the Dominican *Crepitacella*, but suggested that the living species were the same. The Dominican *Crepitacella*, which is found only in the Gurabo formation, is more variable than Bowden specimens. As Pilsbry has pointed out, they generally are not so stout as Bowden shells, though a few specimens among them are about as stout. Most of them also are more strongly turreted and have stronger spiral sculpture. Of even greater significance is the difference in nuclear characters. The Dominican specimens have a slender nucleus of three whorls, whereas Bowden shells have a stout nucleus of two whorls. *Crepitacella melanoides* (Gabb) (see Pilsbry cited above), therefore, seems to be a valid species. *C. cepula spiralistriata* Maury (Bull. Am. Paleontology, vol. 5, p. 286, pl. 47, fig. 10, 1917), also from the Gurabo formation, is considered a synonym of *melanoides*, as it is an unusually slender *melanoides* with unusually strong spiral sculpture. It has the slender three-whorled nucleus of *melanoides*. Olsson's *limonensis* is con-

sidered a synonym of *cepula;* at least, it is the same as the Bowden species. Olsson depended on the Dominican *melanoides* as representing *cepula.*

C. gabbi Dall, dredged at a depth of 785 fathoms off St. Vincent, has a nucleus like *cepula,* but it is smaller, more slender, more strongly turreted, and has stronger spiral sculpture. Another described living species, *C. columbella* (Dall), from a depth of 158 fathoms off Havana, also is smaller and more slender than *cepula.* It has a stouter nucleus, weaker axial sculpture, and stronger spiral sculpture. Three specimens from Florida in the collections of the United States National Museum represent a third Recent species, still undescribed.

Other localities.—Gatun formation (middle Miocene), Costa Rica (Olsson). "Miocene, Cumana, Venezuela" (Guppy). This record probably is spurious.

Type material.—Probably represented by the Bowden material labeled "types." If this is confirmed by the failure to find *Crepitacella* at Cumana, the figured specimen is to be regarded as the lectotype (U. S. Nat. Mus. No. 115513).

Crepitacella aresca, new species

(Plate 28, Figure 4)

Shell very small, slender, strongly turreted. Nucleus stout, consisting of about two whorls. Channel on basal lip relatively broad and shallow. Siphonal fasciole moderately high. Sculpture consisting of protractive axial ribs, beaded at the shoulder, and of very fine strong spiral threads.

Length 4 mm.; diameter 2.2 mm. (holotype, dimensions approximate).

Although the only specimen of this species probably is a very young shell its description as a new species seems justified because it is so different from any of the other species. The nucleus is like that of *cepula.* The ribs are narrower, the spirals stronger, and the whorls higher than even in the extreme form of *melanoides* named *spiralistriata* by Maury. *"Daphnella" leucophlegma* Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 12, pl. 9, fig. 9, 1886; vol. 18, p. 102, 1889), a living West Indian species, is more slender and has weaker spiral sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 135574).

RISSOINA d'Orbigny

Subgenus RISSOINA s. s.

d'Orbigny, 1840, Voyage dans l'Amérique Méridionale, vol. 5 (Mollusques), p. 395.

Type (*by monotypy*).—*Rissoina inca* d'Orbigny. Recent, Peru and Chile.

d'Orbigny's figure of the genotype may not be correct, as it shows an unthickened outer lip, whereas on Schwartz von Mohrenstern's figures (see Bartsch, Proc. U. S. Nat. Mus., vol. 49, pl. 31, figs. 6, 8, 1915) the lip is thickened. The channel on the basal lip lies far to the side and undercuts the columella. The sculpture consists of heavy

axial ribs, between which lie fine spiral threads. No Rissoinas of this type are found in the Bowden formation.

The representation of this genus in the Bowden formation is quite remarkable. It is impossible to satisfactorily compare the fossils with the living West Indian species, for these living species have never been exhaustively studied.

Subgenus ?

Rissoina species

A small thick-shelled species, which apparently represents an unnamed subgenus, is represented in the Johns Hopkins University collection by three worn specimens (U. S. Nat. Mus. No. 369507). The margin of the aperture is very heavy. The basal lip is not distinctly channeled, and there is no siphonal fasciole. The sculpture consists of rather heavy, crowded, slightly protractive axial ribs. The interspaces are smooth. The dimensions are as follows: length 3.2 millimeters, diameter 1.4 millimeters.

This little species, which, so far as can be seen, has no trace of spiral sculpture, seems to be unlike any living West Indian *Rissoina*. It resembles *R. mexicana* Bartsch and *R. nereina* Bartsch, from the Gulf of California and the Mazatlanic region, but the shell is stouter, the whorls bulge less, and the ribs have a more uniform trend.

Subgenus ZEBINELLA Mörch

Mörch, 1876, Malakozoologische Blätter, vol. 23, p. 47.

Type (*by subsequent designation, Nevill, 1885, Hand list Mollusca Indian Museum, pt. 2, pp. 73, 87*).—*Rissoina decussata* (Montagu) (*Helix decussata* Montagu). Recent, West Indies and Florida.

Shell moderately small, slender. Nucleus consisting of about two and a half smooth whorls. Outer lip varicose, extending forward. Channel across basal lip shallow, slightly undercutting the columella. Parietal wall callused, forming a channel with outer lip. Sculpture consisting of fine axial ribs, between which lie fine spiral threads.

Aside from the difference in sculpture, the outer lip is more flaring than in *Rissoina* s. s., and the channel across the basal lip is wider and shallower, and does not undercut the columella so strongly.

Key to the Bowden species of Zebinella

Shell small, early whorls bulging ..... *R.* (*Z.*) *ame*
Shell large, early whorls almost flat.
  Sculpture faint except on first few whorls ..... *R.* (*Z.*) *oligoplura*
  Sculpture strong on all whorls ..... *R.* (*Z.*) species

Rissoina (**Zebinella**) **ame,** new species

(Plate 28, Figure 5)

Rissoina striatacostata Guppy and Dall (part, not d'Orbigny), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 322. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, moderately slender. Nucleus stout, consisting of about two and three-quarters whorls. Parietal callus and outer lip forming a distinct

but not constricted posterior channel. Channel across basal lip not undercutting columella. Sculpture consisting of fine axial ribs, between which lie very fine spiral threads. The axial ribs are progressively more closely spaced. Base of body whorl sculptured only with spiral threads.

Length 5.7 mm.; diameter 2.4 mm. (holotype).

This species, which is represented in the Henderson collection by eight specimens, is smaller than the living West Indian *R. decussata* (Montagu), of which *R. striatacostata* d'Orbigny is generally regarded as a synonym, and has more widely spaced axials and spirals. The basal channel also undercuts the columella less strongly. It perhaps more closely resembles *R. multicostata* C. B. Adams, also a living species from the West Indies and Florida, but is larger and has less bulging whorls, and on the later whorls the ribs are more crowded. An undescribed larger species from the Cercado formation has finer ribs.

Type material.—Holotype (U. S. Nat. Mus. No. 369508).

Rissoina (Zebinella) oligoplura, new species

(Plate 28, Figure 6)

Rissoina browniana Guppy and Dall (part, not d'Orbigny), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 322. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell large, body whorl subangulated at periphery, later whorls of spire almost flat. Nucleus consisting of about two and three-quarters whorls. Labial varix heavy, anterior channel wide. Sculpture very weak except on early whorls, which bear crowded axial ribs, between which lie spiral pits. After the third or fourth whorl the sculpture gradually disappears, but on some specimens can be faintly seen even on body whorl.

Length 9.7 mm.; diameter 3.6 mm. (holotype).

This is the largest *Rissoina* at Bowden and is recognized by the gradually fading sculpture. The sculpture of the early whorls is like that of a larger species from the West Indies and Florida called *R. albida* (C. B. Adams), but in the Recent species the sculpture changes to finer axials and spirals that persist on the later whorls, and the anterior channel is narrower. *R. browniana* d'Orbigny is too different to need comparison. Eight specimens of *R. oligoplura* are in the Duerden collection.

Type material.—Holotype (U. S. Nat. Mus. No. 135568).

Rissoina (Zebinella) species

One large specimen in the Johns Hopkins University collection (U. S. Nat. Mus. No. 369595) resembles *R. oligoplura*, but the sculpture is persistent and the anterior channel is narrower. It is very much like the living species known as *R. albida* (C. B. Adams), and additional material may show that it represents that species. The sculpture consists of fine axial ribs, between which lie finer spirals.

On the body whorl the ribs are finer and the sculpture becomes reticulate. It is not so pitted as in most specimens of the Recent species.

The dimensions of this specimen are as follows: length 8.2 millimeters, diameter 3.5 millimeters (apex broken).

Subgenus MIRARISSOINA, new subgenus

Type.—Rissoina (Mirarissoina) lepida, new species.

Shell small, or medium-sized, slender. Nucleus consisting of between two and a half and three and a half smooth whorls. Outer lip varicose, strongly extended forward, bearing at suture a strongly constricted, narrow anal notch. Anterior channel broad and shallow. Siphonal fasciole narrow, low or high. Sculpture generally consisting of fine protractive axial ribs and finer spiral threads.

The distinct anal notch and broad anterior channel are distinctive of *Mirarissoina.* The outer lip and sculpture are like that of other subgenera of *Rissoina,* but so far as I know no other fossil or living shells have such a characteristic *Rissoina* shape and outer lip, and so distinct an anal notch. *Folinia* Crosse (Journ. Conchyl., vol. 16, p. 218, footnote, 1868; type, by monotypy, *Rissoa insignis* de Folin (not Adams and Reeve = *Rissoina signae* Bartsch); Recent, Negritos [Peru ?] and Pearl Islands, Panama) has a similar anal notch, but the shape of the shell is so different that there is no reason to suppose that *Folinia* and *Mirarissoina* have any genetic relation.

Key to the Bowden species of Mirarissoina

Sculpture strong, consisting of axials and spirals.
- Sculpture reticulate ..... *R. (M.) lepta*
- Spirals finer than axials ..... *R. (M.)* species

Sculpture very weak, consisting of spiral grooves on base of body whorl .... *R. (M.) xesta*

Rissoina (Mirarissoina) lepida, new species

(Plate 28, Figures 7, 8)

Rissoina striatacostata Guppy and Dall (part, not d'Orbigny), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 322. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, slender. Nucleus consisting of about three and a half smooth whorls. Siphonal fasciole very low. Sculpture consisting of axial ribs, the interspaces pitted by spiral threads that are almost as broad as the ribs. On later part of body whorl the spirals begin to override axials. Elsewhere they are confined to and pit interaxial areas.

Length 3.3 mm.; diameter 1.4 mm. (holotype, dimensions approximate).

This curious species is represented by three specimens, all of which have five post-nuclear whorls.

Type material.—Holotype (U. S. Nat. Mus. No. 369509).

Rissoina (Mirarissoina) species

A large broken shell, consisting of the last two whorls, probably represents a different species (U. S. Nat. Mus. No. 369596). It has

the same kind of anal notch as *R. lepta*, but the anterior channel is more distinct and the siphonal fasciole is high. The sculpture consists of narrow axial ribs overridden by very narrow spiral threads.

The approximate dimensions of these last two whorls are as follows: length 4.7 millimeters, diameter 2.8 millimeters.

Rissoina (Mirarissoina) xesta, new species

(Plate 28, Figure 9)

Shell small, slender. Nucleus consisting of about two and a half smooth whorls. Anal notch narrow, strongly constricted. Anterior channel distinct. Siphonal fasciole high, narrow. Sculpture consisting of very fine spiral grooves confined to basal half of body whorl and to very base of latter part of penultimate whorl. On early whorls obscure axial wrinkles are visible.

Length 3.6 mm.; diameter 1.6 mm. (holotype, dimensions approximate).

This weakly sculptured species is represented only by the holotype. The sediment visible in the aperture was left undisturbed to strengthen the body whorl, which is badly cracked.

Type material.—Holotype (U. S. Nat. Mus. No. 369597).

Subgenus PHOSINELLA Mörch

Mörch, 1876, Malakozoologische Blätter, vol. 23, p. 51.
Type (*by subsequent designation, Nevill, 1885, Hand list Mollusca Indian Museum, pt. 2, pp. 73, 83*).—*Rissoina pulchra* (C. B. Adams) (*Rissoa pulchra* C. B. Adams). Recent, West Indies.

Shell small, slender. Nucleus consisting of two or three whorls. Posterior channel shallow. Anterior channel broad and deep. Siphonal fasciole low and broad. Sculpture reticulate.

Phosinella has a distinct siphonal fasciole and reticulate sculpture.

Key to the Bowden species of Phosinella

Sculpture reticulate.
  Spirals and axial closely spaced.
    Sculpture fine ..... *R. (P.) guppyi*
    Sculpture coarse ..... *R. (P.) rituola*
  Spirals and axials widely spaced.
    Shell small, slender, whorls strongly constricted ..... *R. (P.) pyrgus*
    Shell relatively large, stout, whorls not strongly constricted ..... *R. (P.)* species
Axial stronger than spirals ..... *R. (P.) debussa*

Rissoina (Phosinella) guppyi Cossmann

(Plate 28, Figure 10)

Rissoina sagraiana Guppy and Dall (part, not d'Orbigny), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 322. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list). Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 296–297, pl. 47, fig. 20.
Rissoina (*Phosinella*) *guppyi* Cossmann, 1921, Essais Paléoconch. Comp., pt. 12, pp. 84, 318, pl. 3, figs. 51–52.

Shell small, slender. Nucleus consisting of three whorls, the last one bulging. Siphonal fasciole low, broad, set off by a wide weakly sculptured depres-

sion. Sculpture reticulate, beginning of penult whorl bearing four spirals. Siphonal fasciole sculptured with heavier and more closely spaced spirals.

Length 5.1 mm.; diameter 2 mm. (figured specimen).

Type locality.—Bowden, Jamaica (Miocene).

Cossmann's figures are very poor, but apparently they are intended to represent the species here identified as *guppyi*, which is represented in the Henderson collection by 11 specimens that show some variation in the details of sculpture. Maury's *sagraiana*, found in both the Cercado and Gurabo formations, seems to be the same species. According to the original figures, *R. sagraiana* d'Orbigny (*sagra* in explanation of plates), has heavy axial ribs, cut into nodes by spiral grooves. The living West Indian species known as *R. cancellata* Philippi is larger and stouter, and has coarser sculpture.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Cossmann collection.

Rissoina (Phosinella) rituola, new species

(Plate 28, Figure 11)

Shell small, slender. Nucleus consisting of about two and three-quarters whorls, the last one bulging. Siphonal fasciole slightly bulging. Sculpture reticulate, relatively coarse, consisting of spiral threads (4 at beginning of penult whorl) and axial ribs, with beads at the intersections. Siphonal fasciole sculptured with more closely spaced spiral threads.

Length 4.9 mm.; diameter 2 mm. (holotype).

The sculpture of this species, which is represented by 15 specimens in the Aldrich collection, is coarser than in *R. guppyi*. One specimen in the Henderson collection referred to it has slightly narrower axials and spirals, and correspondingly weaker beads. The living West Indian species called *R. cancellata* Philippi reaches a larger size and has finer axials and spirals.

Type material.—Holotype (U. S. Nat. Mus. No. 369511).

Rissoina (Phosinella) pyrgus, new species

(Plate 28, Figure 12)

Rissoina sagraiana Guppy and Dall (part, not d'Orbigny), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 322. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell very small, slender, whorls strongly constricted at suture. Nucleus consisting of about three and a half whorls, the last whorl bulging. Siphonal fasciole flat. Sculpture reticulate. Beginning of penult whorl bearing two spirals. Anterior half of body whorl bearing more closely spaced spirals.

Length 4.2 mm.; diameter 1.8 mm. (holotype).

This species is the smallest and also the most abundant of the reticulately sculptured Rissoinas. It is represented in the Aldrich collection by about 135 specimens that have very constant characters.

The large nucleus and openly reticulate sculpture are unmistakable. It also is found in the Gurabo formation.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 369512).

Rissoina (Phosinella) species

A large stout broken specimen in the Henderson collection (U. S. Nat. Mus. No. 135570) represents another species of *Phosinella.* The nucleus is broken off. The labial varix is very heavy, the anterior channel wide and deep, and the siphonal fasciole slightly bulging. The sculpture is openly reticulate.

This species is larger and stouter than any of the other reticulately sculptured Rissoinas.

Rissoina (Phosinella) debussa, new species

(Plate 29, Figure 1)

Shell medium-sized, slender. Nucleus consisting of about three whorls. Labial varix very heavy. Anterior channel wide and deep. Siphonal fasciole low. Sculpture consisting of relatively heavy axial ribs, between which lie spiral threads of irregular width and spacing. Spirals heavier on anterior half of body whorl and overriding axials.

Length 5.8 mm.; diameter 2.2 mm. (holotype).

This species is represented by only two specimens. The relatively heavy axial sculpture is characteristic.

Type material.—Holotype (U. S. Nat. Mus. No. 369513).

Subgenus **EURISSOLINA,** new subgenus

Type.—Rissoina (*Eurissolina*) *ditomus,* new species.

Shell small, slender. Nucleus slender, consisting of about three whorls. Entire margin of aperture very heavy on adult shells. Posterior channel shallow and wide. Outer lip projecting forward. Anterior channel moderately deep. Siphonal fasciole represented by a short beaded cord. Outside this fasciole and extending across its upper end lies a wider cord beaded by the axials. Sculpture consisting of relatively heavy, widely spaced, protractive axial ribs.

The pair of spiral cords at the base, the inner one of which represents the siphonal fasciole, are characteristic of *Eurissolina.* It resembles *Rissolina* Gould (Proc. Boston Soc. Nat. Hist., vol. 7, p. 401; type, by subsequent description, Nevill, Hand list Moll. Indian Mus., pt. 2, pp. 73, 77, 1885, *Rissoina plicatula* Gould, Recent, China), which, however, has only the outer basal cord, a stouter nucleus, and fine spiral sculpture. This comparison is based on the figure of *R. plicatula* Gould (Tryon, Man. Conch., vol. 9, pl. 56, fig. 62, 1887) and on specimens of *R. plicata* A. Adams from Ceylon, which seems to be similar to the genotype.

Rissoina (Eurissolina) ditomus, new species

(Plate 29, Figures 2 to 5)

Rissoina elegantissima Guppy and Dall (not d'Orbigny), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 322. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small. Nucleus, aperture, and base of shell as described under the subgenus. The later whorls have a slightly raised area adjoining suture. Axial ribs strongly protractive, strongly curved before they reach basal cord. Between the ribs microscopic axial markings are visible.

Length 4.7 mm.; diameter 2.2 mm. (holotype).

This little species is represented by 45 specimens in the Aldrich collection, on all except one of which the apex is broken. The very heavily margined aperture and the pair of basal cords are striking features. The outer cord notches the edge of the basal lip, and on immature shells with a thin basal lip the notch extends across the entire lip. d'Orbigny's figures of *R. elegantissima* are nothing like this species, nor is Tryon's figure (Man. Conchology, vol. 9, pl. 56, fig. 51, 1887), which is copied from Schwartz von Mohrenstern. In fact, no living species in the West Indian region seems to be similar to this fossil. Specimens from Florida labeled "*Rissoina chesnelii* Michaud" have a more thinly margined aperture and a bulging siphonal fasciole instead of two cords. *Rissoina effusa* Mörch (see Bartsch, Proc. U. S. Nat. Mus., vol. 49, p. 54, pl. 32, fig. 7, 1915), from the Pacific coast of Central America, probably is a *Eurissolina*, but no specimens are at hand.

Type material.—Holotype (U. S. Nat. Mus. No. 135573).

Subgenus CIBDEZEBINA, new subgenus

Type.—Rissoina browniana d'Orbigny. Recent, West Indies.

Shell very small, relatively stout, perfectly smooth, whorls of spire almost flat. Nucleus consisting of about two and a half whorls. Outer lip varicose, extending forward. Anterior channel broad and shallow. Interior of outer lip bearing a denticle near its posterior end, basal lip bearing a similar denticle. Siphonal fasciole weakly inflated.

It is customary to place the smooth fossil and living Rissoinas from the West Indian region in the subgenus *Zebina* H. and A. Adams (Gen. Rec. Moll., vol. 1, p. 328, 1854; type, by subsequent designation, Nevill, Hand list Mollusca Indian Mus., pt. 2, pp. 73, 93, 1885, *Rissoina coronata* ("Recluz") Schwartz von Mohrenstern, Recent, Mauritius), but according to the type designation by Nevill, the earliest that could be found, that name is not available. The original figure of *coronata*, reproduced by Tryon (Man. Conchology, vol. 9, pl. 59, fig. 43, 1887), shows a shell with heavily sculptured early whorls, and the outer and basal lips have no denticles. *R. tridentata* Michaud, evidently a similar Oriental species—Tryon considers *coronata* a

synonym—is much larger and stouter than *browniana*. It also has sculptured early whorls, a prominent posterior channel, due to the truncation of the parietal callus, and two or three irregularly disposed denticles on the basal lip and on the lower part of the outer lip.

d'Orbigny's figures of *browniana* show no denticles and the whorls bulge somewhat, but there seems to be no doubt that the living West Indian species known as *browniana* is correctly identified.

Rissoina (Cibdezebina) browniana d'Orbigny

(Plate 29, Figure 6)

Rissoina browniana d'Orbigny, 1842, Sagra's Hist. fis. polit. nat. Isla Cuba, pt. 2, vol. 5, p. 164, pl. 12, figs. 33–35 (French ed., Moll., vol. 2, p. 28). Schwartz von Mohrenstern, 1861, Denk. K. Akad. Wiss. (Wien), vol. 19, pt. 2, pp. 178–179, pl. 10, fig. 78. Tryon, 1887, Man. Conchology, vol. 9, p. 390, pl. 59, figs. 45–46. Guppy and Dall (part), 1896, Proc. U. S. Nat. Mus. vol. 19, p. 322. Dall (part), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Rissoa laevigata C. B. Adams, 1850, Cont. Conch., p. 114.

Iopsis fusiformis Gabb, 1873, Proc. Acad. Nat. Sci. Philadelphia, p. 272. Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, pp. 227–228.

Eulima crassilabris Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 227. Not Gabb, 1881, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 358, pl. 46, fig. 43.

Rissoina laevigata (Adams), Dall, 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 342.

Rissoina crassilabris Gabb (Maury), 1917, Bull. Am. Paleontology, vol. 5, p. 296, pl. 47, fig. 19.

Rissoina (Zebina) laevigata (C. B. Ad.), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 382–383, pl. 34, figs. 3–4, text fig. 19.

Shell small. Nucleus consisting of about two and three-quarters whorls, enlarging less rapidly than post-nuclear whorls. Aperture as described under the subgenus. Shell smooth except for obscure growth lines.

Length 3.5 mm.; diameter 1.6 mm. (figured specimen).

Type locality.—Cuba (Recent).

It is difficult to satisfactorily identify this smooth little *Rissoina*. Except that the fossils are a trifle smaller and a trifle stouter, they are very much like the living West Indian species called both *browniana* and *laevigata*. These two names probably refer to the same species, though Schwartz von Mohrenstern accepts both as valid species. Specimens from the Cercado and Gurabo formations of the Dominican Republic run a little larger than those from Bowden. Adult shells from the Dominican Republic were named *Eulima crassilabris* by Gabb, a homonym of *Rissoina crassilabrum* (Garrett) 1857 ("*Rissoa*"), and *Iopsis fusiformis*, the genotype of *Iopsis*, was based on an immature shell. The type of Gabb's *crassilabris* has no denticles within the aperture. It probably is not quite mature, as many other specimens from the Dominican Republic have the denticles.

This smooth species is reputed to have an extensive geologic range. It is represented by 30 specimens in the Aldrich collection.

Other localities.—Chipola formation (lower Miocene), Florida. Cercado and Gurabo formations (middle Miocene), Dominican Republic. Coloosahatchee marl (Pliocene), Florida. Living, Florida and West Indies.

RISSOIDAE

The family Rissoidae, as generally used, is represented by only 11 specimens, representing three species and as many genera. It is impossible within a reasonable period of time to determine what genera they represent, particularly as the living West Indian species have not been worked up. Therefore, these three species are not formally described.

One of these specimens, an imperfect shell in the Johns Hopkins University collection (U. S. Nat. Mus. No. 369516), is small and stout. It has a length of about 2 millimeters and a diameter of 1.3 millimeters. Most of the nucleus is broken off. The outer lip is varicose and the aperture is broadly ovate. The sculpture consists of axial ribs, noded at the shoulder, and of weak spiral threads that are strongest on the base of the body whorl. This species apparently represents the same genus as "*Rissoa*" *acuticostata* Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 280, pl. 19, fig. 10, 1889), dredged in the Gulf of Mexico and off Barbados.

The second species is represented by a small slender specimen in the Philadelphia Academy collection (No. 11325). The early whorls are smooth. The sculpture of the last whorl and a half consists of a row of short spines near the suture and of obscure spirals. A narrow umbilical groove adjoins the inner lip. This specimen has a length of about 2.5 millimeters and a diameter of 1.4 millimeters.

The other species, which is represented by six specimens in the Johns Hopkins University collection, by two specimens in the Philadelphia Academy collection, and by one specimen in the Henderson collection (U. S. Nat. Mus. No. 135565), apparently is the one listed by Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585, 1903) as "*Rissoa*, near *lantzii* Velain." It is small and slender, having a length of 2.7 millimeters and a diameter of 1.2 millimeters. The outline is pupoid and the aperture is very small and subcircular. The body whorl bulges a short distance back of the outer lip. The sculpture consists of strong axial threads.

CAPULIDAE

CAPULUS Montfort

Subgenus CAPULUS s. s.

Montfort, 1810, Conchyliologie systématique, vol. 2, pp. 54–55.
Type (*by original designation*).—*Patella ungarica* [Linné]. Recent, European seas.

Shell reaching a relatively large size, cap-shaped, apex lying far to the rear. Nucleus forming a loose dextral coil. Aperture subcircular. Muscle scar

horseshoe-shaped, open toward the front. Sculpture consisting of radial threads.

The subgenus *Capulus* s. s. embraces shallow-water sculptured species that have a relatively loosely coiled apex.

Capulus (Capulus) epicranum, new species

(Plate 29, Figure 7)

Shell very small, thick, strongly inflated. Apex extending beyond posterior end of aperture. Nuclear whorls and muscle scar indistinct. Aperture circular. Sculpture consisting of coarse, obscure radial ribs.

Length 5.2 mm.; width 3.7 mm.; convexity 2.9 mm. (holotype).

This thick-shelled little *Capulus* is represented by only two specimens that are partly coated with a calcareous crust, probably deposited by calcareous algae. It resembles the small *Capulus* found in the West Indies and Florida, called *Capulus intortus* Lamarck, but it has coarser sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 369517).

Subgenus MALLUVIUM Melvill

Melvill, 1906, Proc. Malac. Soc. London, vol. 7, p. 82.

Type (*by original designation*).—*Capulus lissus* Smith. Recent, Bay of Bengal, Persian and Oman Gulfs.

Shell small, cap-shaped, apex lying far to the rear. Nucleus forming a tight dextral coil. Aperture subcircular or elliptical. Muscle scar horseshoe-shaped, open toward the front. Surface smooth except for growth lines. Foot forming a shelly plate between shell and its support. (Based on Melvill's figures and description.)

Malluvium seems to be a useful name for small, smooth, rather deep-water species that secrete a shelly plate. It was proposed as a subgenus of *Amalthea* Schumacher. Smith (Proc. Malac. Soc. London, vol. 7, pp. 122–123, 1906) would reject this subgenus on the grounds that some species referred to *Amalthea* secrete a shelly plate, and that the absence of sculpture has no significance.

Capulus (Malluvium) lius, new species

(Plate 29, Figures 8, 9)

Capulus sp., Dall, 1906, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, strongly inflated. Apex projecting slightly beyond posterior end of aperture. Nucleus consisting of a little more than one whorl, forming a prominent neritoid coil. Aperture subcircular. Posterior margin of aperture somewhat flattened, forming a narrow shelf. Muscle scar horseshoe-shaped, the ends broad. Surface smooth except for growth lines.

Length 7.7 mm.; width 6.5 mm.; convexity 3.6 mm. (holotype).

This small *Capulus* has a prominent neritoid nucleus. It is very similar to the living "*Amalthea*" *benthophila* Dall, dredged in the West Indies and Florida at depths of 50 to 245 fathoms. It is more uni-

formly inflated than even the broad forms of the Recent species. *Capulus inornatus* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 384, pl. 30, figs. 11–12, 1922) has fine radial sculpture here and there, and its nucleus is smaller and is coiled more nearly in one plane.

Three specimens from the Gurabo formation are referred to *C. lius*. Two of these are adult shells that are narrower and higher than the holotype, and have undulating growth lines due to irregularities of the apertural margin. A young shell attached to one of these specimens is, however, like the holotype.

This species is represented by five specimens in the Duerden collection. A young slightly inflated shell in the Henderson collection that has a smaller and more submerged nucleus is questionably referred to it.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 369518).

HIPPONICIDAE

HIPPONIX de France

de France, 1819, Journal de Physique, de Chimie, d'Histoire Naturelle et des Arts, vol. 88, p. 217.

Type (*by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 157*).—*Patella cornucopia* Lamarck. Eocene, Paris Basin.

Shell reaching a moderately large size, cap-shaped or shaped like a rapidly enlarging cornucopia. Apex near posterior end or projecting beyond posterior end of aperture. Nucleus forming a dextral spire. Aperture broadly elliptical or subcircular. Muscle scar horseshoe-shaped, open toward front, very broad at ends. Sculpture consisting of concentric lamellae and radial threads.

Hipponix, the type of which is an Eocene species, apparently is available for the Tertiary and living species placed by many writers under *Amalthea* Schumacher (Essai Nouv. Syst., p. 181, 1817), which is a homonym of *Amalthea* Rafinesque (Analyse Nat., p. 123, 1815). The Bowden species are less elongate than the genotype, and have stronger sculpture.

The citation for this genus is generally given as "Bulletin des Sciences, par la Société Philomatique de Paris, year 1819, p. 8," which, as E. A. Smith has pointed out (Proc. Malac. Soc. London, vol. 7, p. 123, 1906), is a notice by de Blainville of de France's paper. Both serials are dated 1819, but in the absence of evidence to the contrary it can be assumed that the original paper appeared first.

Key to the Bowden species referred to Hipponix

Sculpture consisting of concentric lamellae and strong radial threads, nucleus smooth ..... *H. ceras*

Sculpture consisting of weakly frilled concentric lamellae, nucleus sculptured with spiral threads ..... *"H." tortilis*

Hipponix ceras, new species

(Plate 29, Figures 10 to 13)

Hipponyx subrufus Carpenter, Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 322.

Amalthea subrufa Carpenter, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell moderately small, moderately high, apex near posterior end. Nucleus generally broken off, consisting of about two naticoid whorls, coiled almost at right angles to direction of adult shell. Aperture broadly elliptical. Muscle scar broad at ends. Sculpture consisting of concentric lamellae overridden by strong narrow radial ribs.

Length 11.5 mm.; width 9.5 mm.; convexity 5.2 mm. (holotype). Length 12.6 mm.; width 10 mm.; convexity 6.7 mm. (largest specimen).

Though the sculpture of this species is variable, only a few specimens are so coarsely sculptured as the one shown in figs. 12 and 13. Most of them are sculptured like the holotype. Forty specimens of this species are in the Duerden collection. It resembles living specimens of *H. subrufa* Lamarck from the West Indies and Florida, but is broader and more strongly sculptured.

Type material.—Holotype (U. S. Nat. Mus. No. 369519).

"Hipponix" tortilis (Guppy)

(Plate 29, Figures 14, 15)

Hipponyx tortilis Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 322, pl. 27, fig. 15.

Amalthea tortilis (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, moderately high, apex at posterior end. Nucleus consisting of a little more than one whorl, sculptured with strong spiral threads. Aperture broadly elliptical. Muscle scar gradually increasing in diameter towards ends. Sculpture consisting of overlapping lamellae bearing fine radial grooves.

Length 6.4 mm.; width 5 mm.; convexity 2.9 mm. (holotype).

Type locality.—Jamaica (Miocene).

The type material of this species, consisting of the holotype, recognized as the specimen figured by Guppy, and a paratype, are the best specimens, though several worn shells are in the Henderson collection. It probably should be put in a different genus on account of the very strongly sculptured nucleus and rather gently enlarging muscle scar.

Type material.—Holotype (U. S. Nat. Mus. No. 107147).

CALYPTRAEIDAE

CHEILEA Modeer

Modeer, 1793, Kongl. Vetenskaps Academiens Nya Handlingar, vol. 14, pp. 110, 111.

Type (herewith designated).—Patella equestris Linné. Recent, Indian Ocean and elsewhere (?) in tropics.

Shell medium-sized, cap-shaped, conical, apex lying behind middle. Nucleus generally broken off, forming a short dextral spire. Aperture

circular. Interior opposite apex bearing a process shaped like a half funnel open toward front. Sculpture consisting of irregular radial ribs or lamellar undulations. (Based on specimens from West Indies.)

Though no formal type designation was discovered, Dall (Bull. U. S. Fish. Comm., 1900, vol. 1, p. 436, 1901) used *Cheilea* in the sense of accepting *Patella equestris* as the type.

Hanley (Ipsa Linnaei Conchylia, p. 414, 1855) accepts Gualtieri's figure ("Gualt. test. t. 9, f. x") as characteristic of *Patella equestris* and Lamarck's identification (Hist. nat. anim. sans vert., vol. 6, pt. 2, pp. 21–22, 1822). Lamarck cites the Indian Ocean as the locality for "*Calyptraea*" *equestris*. Whether this species is so widely distributed in the tropics as Tryon (Man. Conchology, vol. 8, pp. 137–138, 1886), for example, supposes, is very doubtful, but according to the current practice, the living West Indian species is called *equestris*.

Some writers still use for this genus *Mitrularia* Schumacher (Essai Nouv. Syst., pp. 56, 183, 1817; type, by monotypy, *Mitrularia neptuni* [Dillwyn] = *Patella equestris* Linné), which is a later name.

Cheilea "equestris (Linné)"

(Plate 30, Figures 1, 2)

? *Patella equestris* Linné, 1758, Syst. Nat., ed. 10, p. 780.
Mitrularia equestris (Linné), Tryon (part ?), 1886, Man. Conchology, vol. 8, p. 137, pl. 41, figs. 25–32; pls. 42, 43, figs. 57–67, 70. Dall, 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 348. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, 1585 (list).

Shell medium-sized. Nucleus consisting of between one and a half and two whorls, the last of which enlarges rapidly, coiled at right angles to direction of adult shell. Internal process thin and partly broken on all specimens. Sculpture consisting of very fine vermicular radial threads and of irregular concentric undulations.

Length 15.3 mm.; width 15.6 mm.; convexity 7.5 mm. (figured specimen).

Type locality.—Indian Ocean (Recent).

The Bowden specimens referred to this species, of which six are in the Duerden collection, resemble small finely sculptured living specimens from Florida and the West Indies. *C. princetonia* Brown and Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol, 63, pp. 360–361, fig. 2, 1911), based on an internal mold from the Gatun formation, may represent the same species.

Tryon gives an elaborate synonymy for *equestris* and records it from the Indo-Pacific and Panamic regions, West Africa, and the West Indies. It is quite certain that several species are represented in such a mixture, but they have not yet been recognized.

The specimens on which Dall's record of *Crepidula plana* Say from Bowden was based could not be found (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585, 1903).

Other localities.—Caloosahatchee marl (Pliocene), Florida. Living, Cape Hatteras to Florida and West Indies.

XENOPHORIDAE

XENOPHORA Fischer de Waldheim

Fischer de Waldheim, 1807, Museum Demidoff, pt. 3, p. 213.
Type (*by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 158*).—*Trochus conchyliophorus* Born (renamed *Xenophora laevigata* by Fischer de Waldheim). ent, West Indies.

Shell small or medium-sized, trochoid. Nucleus consisting of about three *Helix*-like whorls. Aperture subquadrangular, very oblique to axis of shell, angulated and drawn out at periphery. Outer lip extending far backward. Basal lip deeply concave. Parietal callus reflected over an umbilical opening. Dorsal surface partly concealed by attached shells, pebbles and other objects, the unconcealed part bearing fine diagonal wrinkles. Base sculptured with roughened lamellae conforming to outline of basal lip.

The remarkable habit of attaching objects to the dorsal surface of the shell has remained unchanged since Cretaceous time, but probably too many American Tertiary species have been lumped under *X. conchyliophora*.

Xenophora delecta (Guppy)

(Plate 30, Figures 3, 4)

Phorus agglutinans Gabb (not Lamarck), 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 241.
Phorus delectus Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 529, pl. 28, fig. 10.
Xenophora dilecta (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list). Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 385, pl. 32, figs. 7–8.
Xenophora delecta (Guppy), Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 298, pl. 49, figs. 8–9.

Shell relatively small, umbilical opening shallow, relatively wide or closed. Dorsal surface sparsely covered with small shells, small pebbles, foraminifera, bryozoa, or crab claws. Unconcealed part bearing wrinkles along erratic diagonal lines. Base sculptured with granules arranged along growth lines parallel to basal lip.

Length 13.3 mm.; diameter 19 mm. (largest specimen).

Type locality—Dominican Republic (Miocene).

This species is represented in the Aldrich collection by 17 specimens, of which the measured one is the largest. The specimen here figured, which has a closed umbilicus and on which the basal granules are obscure on account of the heavy growth lamellae, apparently was lost after being photographed. Three specimens in the Guppy collection are labeled "types" of *Phorus delectus*.

The Bowden specimens and also those from the Dominican Republic are much smaller than the living West Indian *X. conchyliophora* (Born), and they also have a more strongly granular base. Maury also records *conchyliophora* from the Gurabo formation.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12842).

NATICIDAE
NATICINAE
NATICA Scopoli
Subgenus NATICA s. s.

Scopoli, 1777, Introductio ad Historiam naturalem, p. 392.

Type (*by subsequent designation, Harris, 1897, Cat. Ter. Moll. British Mus., pt. 1, Australasian, p. 255*).—*Nerita vitellus* Linné ("*Natica rufa* Born" of authors). Recent, western Pacific.

Shell medium-sized, greatly inflated, spire low. Aperture large, semiovate. Umbilicus moderately wide. Funicle very low, emerging along middle of umbilical wall. Parietal callus thick. Operculum calcareous, the exterior bearing two marginal ribs. (Description of operculum based on specimens labeled *N. spadicea* (Gmelin).)

Only one citation is given by Linné for *Nerita vitellus*, and that refers to an unmistakable figure ("Rumph. mus. t. 22. f. D") of the *Natica* generally known as *Natica rufa* Born. This figure agrees with a specimen in the Linnaean cabinet marked 625, the number of *Nerita vitellus* in the tenth edition of the Systema Naturae (see Hanley, Ipsa Linnaei Conchylia, pp. 394–395, 1855). According to Hanley, the acceptance of *vitellus* for the shell generally so designated is based on the use of "*vitellus*" by Rumphius in his description of it. Those who accept this unwarranted identification of *Nerita vitellus* consider that "D" in Linné's citation is a misprint for "A."

Natica s. s. has only a very low broad central funicle or rib spiraling up the umbilicus. How much importance is to be attached to this feature is open to question, for there seem to be gradations from virtually no funicle to the broad heavy funicle of the *canrena* group. No opercula of *N. vitellus* are in the collections of the United States National Museum or at the Philadelphia Academy, but specimens labeled *N. spadicea* (Gmelin), which certainly represent a similar species, have an operculum with two marginal ribs and also denticles along the inner edge. If opercular characters are to be used as a basis of subdivision, a great many groups will have to be recognized under *Natica*.

Two Bowden species, one represented by shells and the other by opercula which apparently do not belong together, are referred to *Natica* s. s.

Natica (Natica) castrenoides, new species

(Plate 30, Figure 5)

Natica alticallosa Dall (not Dall 1892), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, spire moderately low. Nucleus consisting of about one and a half whorls, the apical one large. Funicle represented by a slight

bulge on umbilical wall. Sculpture consisting of obscure wrinkles that are most prominent near suture.

Length 9.3 mm.; diameter 9.4 mm. (holotype).

This little species is represented by 16 specimens in the Duerden collection, most of which are much smaller than the holotype. It resembles *N. castrensis* Dall, a living species from Florida and the West Indies, but has a less distinct funicle. The operculum of *castrensis* has only a low marginal rib. *N. subinterna* Böse (Jahrb. K.-k. geol. Reichsanstalt, vol. 60, pp. 226–227, pl. 12, fig. 6, 1910), a species from the lower Miocene beds of the Isthmus of Tehuantepec, has the same umbilical features, but the funicle is narrower and the shell is less rotund.

N. alticallosa Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 365, pl. 22, fig. 28, 1892; Chipola formation, Florida) has a thick pad of callus filling the umbilicus.

Type material.—Holotype (U. S. Nat. Mus. No. 61519).

Natica (Natica) species

Three broken opercula in the Henderson collection (U. S. Nat. Mus. No. 135311) have two marginal ribs. These opercula are much too large for any specimens of *N. castrenoides*, and that species has a shell closely resembling the shell of a Recent species that has an operculum with only one marginal rib. Therefore, it is not probable that these opercula represent *N. castrenoides*. Perhaps they belong to a shell represented by a worn and broken small specimen in the Henderson collection. It has a lower spire than *N. castrenoides*, a more prominent central funicle, and a nucleus of two whorls, the apical one of which is large.

Subgenus NATICARIUS Duméril

Duméril, 1805, Zoologie Analytique, p. 164. Regarded as substitute name for *Natica* Lamarck (not Scopoli), 1799, Mém. Soc. Hist. Nat. Paris, p. 77; type, by monotypy, *Nerita canrena* Linné. Recent, West Indies.

Shell reaching a relatively large size, greatly inflated, spire low. Aperture semiovate, umbilicus wide, funicle broad, heavy, emerging at base of umbilicus. Parietal callus moderately heavy, overlapping upper end of umbilicus. Sculpture consisting of retractive axial wrinkles at suture. Exterior of operculum bearing many ribs except on a smooth area opposite nucleus.

I am indebted to Dr. Stewart for calling attention to the possibility that *Naticarius* is available for the *canrena* group. The question as to whether Duméril's names should be regarded as substitute names or as genera without species has already been discussed under *Nassarius* (p. 264). In either event the type of *Naticarius* is *Nerita canrena* Linné. If it is regarded as a substitute name, it must be a substitute for *Natica* Lamarck, not for *Natica* Scopoli. If it is regarded as

a genus without species, *Nerita canrena* becomes the type by monotypy (Froriep, Duméril's Anal. Zoologie, p. 165, 1806; quoted from Iredale, Proc. Malac. Soc. London, vol. 12, p. 83, 1916). Before my attention was called to *Naticarius* it was decided to use *Naticus* Montfort (Conch. Syst., vol. 2, pp. 218–219, 1810; type, by original designation, *Naticus canrenus* (Linné) = *Nerita canrena* Linné), although I have avoided using Montfort's names that differ from earlier names only by the masculine ending on the grounds that they are to be regarded as emendations or substitute names and not as new names. *Naticus*, however, presents a particular case, for according to the type designation it is a substitute for *Natica* Lamarck.

On several occasions Dall used *Cochlis* ("Bolten") Roeding (Mus. Bolt., pt. 2, p. 146, 1798), indicating *Nerita spadicea* Gmelin as the type without actually designating it (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 362, 1892; Bull. Mus. Comp. Zool. Harvard College, vol. 43, p. 332, 1908; U. S. Geol. Survey Prof. Paper 59, p. 85, 1909). The only formal designation that could be found is a recent one by Iredale (Proc. Lin. Soc. New South Wales, vol. 49, p. 254, 1924), who designated *Cochlis albula* ("Bolten") Roeding. This species is based on two of the figures ("Chem. 5. t. 188. f. 1896 a. b.") cited by Gmelin for *Nerita spadicea* Gmelin (Syst. Nat., ed. 12, p. 3672, 1792), and so far as known is a synonym of *spadicea*. Iredale's designation seems to make *Cochlis* a synonym of *Natica* s. s., though he apparently considers that *Cochlis* has an operculum that is smooth except for an obscure sulcus near the edge. Two specimens in the collections of the United States National Museum (No. 149826) labeled "*Natica rufa* Born var. *spadicea* Gm., Singapore" and another (No. 217594) labeled "*Natica spadicea* Gm., Hongkong" have an operculum with two marginal ribs. These opercula were used in drawing up the diagnosis of *Natica* s. s. Whether these specimens are correctly identified I am not in a position to judge, though the determination agrees with the traditional use of *spadicea*. The ventral view to which Roeding refers for *albula* shows no funicle, whereas these specimens have a low funicle. At all events *Cochlis* is not available for the *canrena* group.

It should be pointed out that, even after discovering that *Natica* should be accredited to Scopoli, Dall continued to use it in the Lamarckian sense, for which *Naticarius* is here used, and placed the species of *Natica* s. s. under *Cochlis*.

Nacca Risso (Hist. Nat. Europe Mérid., vol. 4, p. 148, 1826; type, by subsequent designation Herrmannsen, Indicis Gen. Malac., vol. 2, p. 89, Sept. 1847, *Natica fulminea* (Gmelin) (*Nerita fulminea* Gmelin), Recent, West Africa) has a faint funicle or none at all, as in *Natica* s. s. No opercula of the type species are available.

According to Hanley (Ipsa Linnaei Conchylia, pp. 392–393, 1855),

at least six species were confused in the synonymy of *Nerita canrena* in the tenth edition of the Systema Naturae. By almost common consent "Gualt. 67, V" has been accepted as representing the lectotype of *canrena*. Gmelin (Syst. Nat., ed. 12, p. 3669, 1791) added under α "List. Conch. t. 560. f. 4" and "Martini 5. t. 186. f. 1860. 61," both of which seem to represent the shell and operculum of the West Indian species. The latter citation alone is given under *Cochlis canrena* by Roeding.

Key to the Bowden species of Naticarius

Operculum bearing about 9 ribs.....*N.* (*N.*) *canrena antinacca*
Operculum bearing 4 ribs.....*N.* (*N.*) species

Natica (Naticarius) canrena antinacca Cossmann

(Plate 30, Figures 6 to 8)

Natica canrena Linné, Dall (part), 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 364.
Natica near *canrena* (Linné), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Natica antinacca Cossmann, 1924, Essais Paléoconch. Comp., pt. 13, p. 110, footnote 1, pl. 1, figs. 11–13.

Shell generally medium-sized, but reaching a moderately large size. Nucleus consisting of two and a quarter to two and a half whorls. Funicle wide, its outer surface almost flat, emerging at base of aperture, separated from umbilical wall by a deep, relatively wide groove. Sculpture consisting of short curved retractive axial grooves at suture. Operculum assumed to belong to this species bearing a narrow marginal rib, then four ribs, followed by a wide rib, which in turn is followed by two narrow ribs.

Length 28 mm.; diameter 28.8 mm. (figured specimen).

Type locality.—Bowden, Jamaica (Miocene).

It is very difficult to satisfactorily name this abundant *Natica*, which is represented in the Duerden collection by about 180 shells and 30 opercula (30 shells and 16 opercula in Henderson collection). No operculum is in place, but it is safe to assume that the shells and opercula belong together. The largest operculum would fit a shell almost twice as large as the largest shell in any collection. The shape of the shells is quite variable. Some have a lower spire and more bulging shoulder than others—possibly a sex difference. The sutural grooves also are variable. On some shells they are relatively long and far apart, and on others they are short and close together. Even the opercula are variable. The broad rib of some opercula is hardly wider than the other ribs, and only one rib may lie inside it instead of two.

Cossmann professed to see some difference in the parietal callus and shortness of the spire between these Bowden fossils and the living *canrena*. No difference can be seen in the parietal callus, and the

height of the spire of fossil and living shells is variable. The available fossil shells are much smaller than living ones, but the one large fossil operculum would fit a shell almost as large as any living shell. Even the opercula are very similar, though the two ribs lying within the wide rib generally are more uniformly present and of more uniform width in the fossils, though this is not true of the figured one. The groove between the funicle and umbilical wall is slightly wider in the fossils than in most living shells, and the funicle has a flatter top, but these differences are slight and not constant. About the only difference that can be seen to separate the fossils is that they have a nucleus that has a smaller apical whorl and a larger number of whorls. Living shells of *canrena* have a nucleus of only about one and a half whorls, the apical one being quite large, whereas all the fossils examined have between two and a quarter and two and a half whorls and the apical whorl is very small. That is, the fossils have a nucleus more like that of the living West Indian *N. maroccana* Dillwyn, which has a narrower shell and more central funicle. Its operculum is altogether different, as it is smooth except for two marginal ribs.

All references to *canrena*-like fossils elsewhere in tropical America are omitted in the synonymy. They are recorded from Mexico (Böse, Inst. Geol. Mexico Bol. 22, pp. 33–34, 56, pl. 3, figs. 24–25, 1906; Engerrand and Urbina, Bol. Soc. Geol. Mexicana, vol. 6, p. 130, 1910; Böse, Jahrb. K.-k. geol. Reichsanstalt, vol. 60, pp. 225–226, pl. 12, fig. 5, 1910), Costa Rica (Gabb, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 357, 1881), Panama (Brown and Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 64, p. 508, 1913; Olsson, Bull. Am. Paleontology, vol. 9, p. 327, pl. 15, fig. 9, 1922), the Dominican Republic (see Maury, Bull. Am. Paleontology, vol. 5, pp. 298–299, pl. 49, fig. 10, 1917), Trinidad (see Maury, Bull. Am. Paleontology, vol. 10, pp. 390–391, pl. 51, fig. 8, 1925), and Porto Rico (Maury, New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 1, pp. 48–49, 1920), from beds ranging in age from lower Miocene to Pliocene. It would take an exhaustive study to attempt to find out just what these fossils represent.

Cossmann with characteristic disregard of all nomenclatorial principles except those that happen to suit him, after proposing *Natica antinacca* for the Bowden fossils, in a second footnote on the same page proposes to use *N. antinacca* in place of *N. plicatella* Conrad, which is alleged to be preoccupied by Bronn. There seems to be no "*N. plicatella* Bronn," the most similar of Bronn's names being *N. plicatula* (Ital. Ter.-Geb., p. 72, 1831). *N. plicatella* was proposed by Conrad (Proc. Acad. Nat. Sci. Philadelphia, 1862, p. 564, 1863) for fossils from the Carolinas that in all probability are not the same as those from Bowden. At all events the shell from Bowden figured by Cossmann is the type of *antinacca*.

Specimens of *N. canrena antinacca* in the collections of the United States National Museum are labeled "*Natica costaricense* Dall," which apparently is a manuscript name. Several specimens are incorrectly labeled Curaçao, Dutch West Indies.

Type material.—Holotype (Cossmann collection).

Natica (Naticarius) species

(Plate 30, Figure 9)

An operculum in the Henderson collection (U. S. Nat. Mus. No. 135310) apparently represents another species of *Naticarius*. It has two marginal ribs, followed by a broad groove bearing two very low ribs, followed in turn by a moderately narrow rib and a wide rib. No shells could be found for this operculum. It is improbable that it belongs to *N. castrenoides*, for that species has a shell closely resembling that of a living species, which has an operculum with only a marginal rib.

STIGMAULAX Morch

Mörch, 1852, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, Comes de Yoldi, p. 133.

Type (*by subsequent designation, Harris, 1897, Cat. Ter. Moll. British Mus., pt. 1, Australasian, p. 262*).—*Natica sulcata* Born (*Nerita sulcata* Born). Recent, West Indies.

Shell medium-sized, greatly inflated, spire low. Aperture semiovate, umbilicus very wide. Funicle broad, emerging near base of umbilicus, separated from umbilical wall by a broad groove. Parietal callus thick, short. Sculpture consisting of curved, retractive axial grooves and of less prominent spiral grooves, producing a cancellate effect. Operculum bearing a broad, thick, rough central rib, flanked by much narrower, smooth ribs.

No opercula of *N. sulcata* are in the collections of the United States National Museum, but a shell with operculum in place was found at the Philadelphia Academy (No. 35430).

Stigmaulax generally is regarded as a subdivision of *Natica*, but it is here given generic rank. The funicle is broad as in *Naticarius*, but it is more twisted, for the umbilicus is wider and deeper. The sculpture is distinctive, and apparently the heavy central rib on the operculum also is distinctive.

Stigmaulax vererugosum (Cossmann)

(Plate 30, Figures 10, 11)

Natica sulcata Guppy (not Born), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 290, pl. 18, figs. 14–15. Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 223. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 437 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 518. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 386.

Natica (*Stigmaulax*) *sulcata* Dall (not Born), 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 366. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list). Maury, 1917, Bull. Am. Paleontology, vol.

5, pp. 299–300, pl. 49, fig. 13. Cossmann (part), 1924, Essais Paléoconch. Comp., pt. 13, p. 115, pl. 1, figs. 6–7.

Natica (*Stigmaulax*) *vererugosum* Cossmann, 1924, Essais Paléoconch. Comp., pt. 13, p. 115, pl. 1, figs. 15–16.

Shell medium-sized. Nucleus consisting of about two and a half whorls, the apical one small. Outer lip slightly sinuate near suture. Umbilicus very wide and deep. Funicle strongly twisted, its base indented at aperture. Sculpture consisting of strong, curved, retractive axial grooves, in which lie irregularly spaced spiral grooves, producing a pitted effect. Operculum assumed to belong to this species bearing a broad, heavy, rough central rib. Between this rib and the outer edge lies a narrow rib.

Length 24.3 mm.; diameter 21.5 mm. (figured specimen).

Type locality.—Bowden, Jamaica (Miocene).

By a remarkable coincidence this species is represented in the Henderson collection by exactly the same number (13) of shells and opercula, but 85 shells and only 30 opercula are in the Duerden collection. There is no reasonable doubt that the shells and opercula belong together, although no operculum was found in place. The figured shell is the largest one in any collection.

S. vererugosum resembles the living West Indian *S. sulcata* (Born), but the spiral sculpture is less pronounced and the funicle is more deeply indented at the aperture. The operculum of the fossil species lacks the fine ribs, partly covered with callus, lying inside the heavy central rib.

This Bowden species also is found in the Cercado and Gurabo formation. Many specimens from the Cercado formation, especially those from station 8525 on Rio Mao, have narrower axial grooves and fainter spiral sculpture. Opercula from both formations have several ribs lying outside the heavy central rib. *S. guppyana* Toula (Jahrb. K.-k. geol. Reichsanstalt, vol. 58, p. 696, pl. 25, fig. 6, 1909), found in the Gatun formation of Panama and Costa Rica and also in the Gurabo formation, has narrow axial grooves that entirely disappear on adult shells.

Maury (Brasil Serv. Geol. Mineral. Mon., vol. 4, pp. 70–73, pl. 1, figs. 9, 11, 18, 1925) records *sulcata* and two varieties all from the same locality in the lower Miocene beds of Brazil. *N. sulcata* also is recorded by Maury (New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 1, p. 49, 1920) from beds in Porto Rico, the age of which is not given.

Cossmann cites both [Bowden] Jamaica and Martinique for *S. vererugosum* without designating a type locality. His figures clearly represent a Bowden shell, which is regarded as the holotype. The Martinique record needs confirmation.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic. Miocene, Martinique (Cossmann).

Type material.—Holotype (Cossmann collection).

TECTONATICA Sacco

Sacco, 1890, Bollettino Musei Zoologia Anatomia comparata R. Universita Torino, vol. 5, No. 86, p. 33 (pagination continued from No. 82).
Type (*by monotypy*).—*Natica tectula* Bonelli. Pliocene, Itlay.

Shell small or medium-sized. Aperture semiovate. Umbilicus completely filled with callus. Parietal callus moderately thick. (Based on Sacco's figures of genotype, Moll. Piemonte, pt. 8, pl. 2, figs. 53*a*, *b*, 1891.)

Cossmann's view that *Cryptonatica* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 362, 1892; type, by subsequent designation, Dall, U. S. Geol. Survey Prof. Paper 59, p. 85, 1909, *Natica clausa* Broderip and Sowerby, Recent, Arctic Ocean to San Diego and Hatteras) is a synonym of *Tectonatica* seems to be justified. Apparently the operculum of the genotype is not known, but the American living species have a smooth calcareous operculum. The American species are not so obliquely elongate as the genotype.

The American shells referred to this genus are principally arctic and boreal, but they also seem to reach the tropics. The tropical species, which are found in relatively shallow water, are very small and have a heavier parietal callus than most of the boreal and arctic specimens. These differences hardly warrant generic or even subgeneric recognition. *Tectonatica* is represented in the Bowden formation by one of the small tropical species.

Tectonatica pusilla (Say)

(Plate 30, Figure 12)

[*Natica*] *pusilla* Say, 1822, Jour. Acad. Nat. Sci. Philadelphia, vol. 2, p. 257.
Natica pusilla Say, Tryon, 1886, Man. Conchology, vol. 8, pp. 31–32, pl. 21, fig. 6.
Natica (*Cryptonatica*) *pusilla* Say, Dall, 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 367.
Natica (*Cryptonatica*) sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell very small, rotund. Nucleus consisting of about two whorls, the apical one small. Umbilicus filled with callus, along the outer edge of which lies a groove. Parietal callus heavy.

Length 4 mm.; diameter 3.7 mm. (figured specimen).

Type locality.—"Southern coast" [of United States] (Recent).

The figured specimen is considerably larger than any of the 21 specimens in the Henderson collection, which have a length of only about three millimeters or less. Part of the outer shell layer has peeled off on many of the specimens. These fossils closely resemble Recent specimens of *pusilla*, except that some Recent shells are twice as large, and they show a greater range of variation in the height of the spire and in the inflation of the shoulder. Yet many hauls of *pusilla*

from localities as far north as off Cape Hatteras consist of shells all of which are as small as the fossils. It seems strange to find in the Bowden formation a Recent species that lives as far north as Massachusetts. But it also lives in the West Indian region. The only specimens from West Indian waters in the collections of the United States National Museum were dredged at a depth of 25 fathoms in Mayaguez harbor, Porto Rico. One specimen is labeled "Bahia, Brazil." It probably will be found throughout the West Indian region in moderately shallow water. Living specimens have a smooth operculum like their much larger boreal and arctic relatives.

This little species is found also in the Cercado and Gurabo formations.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic. Caloosahatchee marl (Pliocene), Florida. Waccamaw marl (Pliocene), South Carolina. Living, Massachusetts, southward to Florida, Gulf of Mexico, and West Indies in 2 to 200 fathoms (generally in 2 to 25 fathoms), the depth slightly increasing toward the south.

POLINICES Montfort

Montfort, 1810, Conchyliologie systématique, vol. 2, pp. 222–223.

Type (*by original designation*).—*Polinices albus* Montfort (=*Natica mammillaris* Lamarck=*Natica brunnea* Link). Recent, West Indies.

Shell medium-sized, elongate, inflated, appressed at suture. Aperture semiovate, umbilicus wide and deep. Funicle low and broad, expanding at aperture. Parietal callus very thick, indented opposite upper edge of umbilicus. Operculum horny.

Stewart has discussed the question as to the type of *Polinices* (Proc. Acad. Nat. Sci. Philadelphia, vol. 78, p. 325, footnote, 1927). Montfort cites "*nerita mamilla* Linn." in the synonymy of *Polinices albus*, but his figure, which represents the type of the genus, shows the West Indian shell generally known as *Natica mammillaris* Lamarck, for which the earliest name seems to be *Natica brunnea* Link. In the Oriental "*Nerita*" *mammilla* Linné the umbilicus is filled with callus.

Some writers use for this genus the name *Uber* from the Museum Calonnianum, which according to Opinion 51 of the International Commission on Zoological Nomenclature is not to be accepted as a basis for any nomenclatorial work.

Polinices brunnea subclausa (Sowerby)

(Plate 30, Figure 13)

Natica subclausa Sowerby, 1850, Quart. Jour. Geol. Soc. London, vol. 6, p. 51. Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 290, pl. 18, fig. 8. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 437 (list).

Natica mammillaris Lamarck, Guppy, Quart. Jour. Geol. Soc. London, vol. 22, p. 291. Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 519.

Mammilla mamillaris (Lamarck), Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 223.
Polynices subclausa (Sowerby), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Polinices subclausa (Sowerby), Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 360. Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 300, pl. 49, fig. 14. Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 329, pl. 16, figs. 16–17.
Polinices mammillaris (Lamarck), Pilsbry and Brown, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, p. 34.
Polinices mamillaris (Lamarck), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 386.

Shell reaching a moderately large size. Spire moderately high or low, shoulder flat or bulging. Nucleus consisting of a little more than two whorls, the apical one small. Umbilical callus heavy and wide. Parietal callus very heavy, distinctly indented a little above upper end of umbilicus.

Length 41.5 mm.; diameter 29.7 mm. (figured specimen, outer lip broken back).

Type locality.—Dominican Republic (Miocene).

Bowden specimens show the usual variation in height of spire and inflation of shoulder, and comparisons with other material based on shape are untrustworthy. This *Polinices* is very abundant, being represented by about 300 specimens in the Duerden collection. On one specimen the parietal callus extends down unusually far and closes part of the umbilicus. So far as size and shape are concerned these fossils are very much like *P. b. brunnea* (Link), more familiarly known as *P. mammillaris* (Lamarck), though the living shells reach a slightly larger size. All the fossils, however, have a heavier umbilical callus and correspondingly narrower umbilicus. Living shells show more variation in this feature than the fossils, and the difference is not quite so pronounced in Dominican shells.

This *Polinices* is found in both the Cercado and Gurabo formations, but is most abundant in the Cercado formation. None of these Dominican specimens is so large as those from Bowden. *P. stanislas-meunieri* Maury (Bull. Am. Paleontology, vol. 5, pp. 300–301, pl. 49, figs. 15–16, 1917) may represent specimens of *subclausa* on which the parietal callus extends far down. *P. canalizonalis* (Brown and Pilsbry) (Proc. Acad. Nat. Sci. Philadelphia, vol. 64, p. 508, pl. 22, fig. 10, 1913), described from the Gatun formation, has a wider umbilicus and more prominent funicle.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Panama Canal Zone (Brown and Pilsbry, Olsson), and Costa Rica (Olsson). Miocene, Colombia (Pilsbry and Brown).

Type material.—6 cotypes (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12826).

SININAE

EUNATICINA Fischer

Fischer, 1885, Man. Conchyliologie, p. 768. Substitute name for *Naticina* Gray,[1] 1847, Proc. Zool. Soc. London, pt. 15, p. 150; type, by original designation, *Natica papilla* Gmelin. Not *Naticina* Guilding, 1834, Trans. Lin. Soc. London, vol. 5, p. 30.

Type (*see above*).—*Natica papilla* Gmelin. Recent, western Pacific.

Shell small or medium-sized, greatly inflated. Aperture broadly semi-ovate. Umbilicus wide, funicle very low and broad. Umbilical callus folded over edge of umbilicus. Parietal callus moderately thick, indented opposite upper end of umbilicus. Sculpture consisting of spiral grooves.

It seems doubtful whether *Eunaticina* should be used for the fossil American species, which have no indentation on the parietal callus. This genus is not now living in American waters. "*Eunaticina*" *carolinensis* Dall, from the southeast coast of the United States, represents *Sigatica*, the next genus described, and "*Eunaticina*" *oldroydi* Dall, from the Pacific Coast, represents some other genus. *Eunaticina* seems to be another Tertiary genus that survived in the Caribbean Sea until Miocene time, and then disappeared except in the Orient.

Eunaticina regia (Guppy)

(Plate 30, Figures 14, 15; Plate 31, Figure 1)

Naticina regia Guppy, 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pp. 60–61, pl. 2, fig. 6 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, pp. 208–209). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 406, pl. 17, fig. 6; p. 437 (list).

Eunaticina regia (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, spire relatively high. Nucleus consisting of about two whorls. Aperture moderately wide. Umbilical callus bent over edge of umbilicus along the low broad funicle. Parietal callus moderately thick. Sculpture consisting of trough-like spiral grooves.

Length 13.8 mm.; diameter 9.5 mm. (holotype).

Type locality.—Jamaica (Miocene).

Only a few specimens of this species are in any collection (six in Duerden collection). It is not so broad as the genotype, and the parietal callus is not indented. No similar fossils have been described from this region excepting "*Lunatia*" *sculpturata* Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 339, pl. 44, fig. 5, 1881), a lower Miocene species from Costa Rica, which is larger and stouter and has narrower spiral grooves. No species of the genus is now living in the West Indian or Panamic regions.

Type material.—Holotype (U. S. Nat. Mus. No. 115450).

[1] Gray cites this name as though it were a new name introduced in the "Synopsis of the Contents of the British Museum." According to Iredale's collation (Proc. Malac. Soc. London, vol. 10, pp. 294–309, 1913), it was not intended as a new name in that publication. This is a matter of no great importance, as, if *Eunaticina* is not regarded as a substitute name, *Natica papilla* becomes the type by monotypy.

SIGATICA Meyer and Aldrich

Meyer and Aldrich, 1886, Jour. Cincinnati Soc. Nat. Hist., vol. 9, No. 2, p. 42.
Type (*by monotypy*).—*Sigaretus* (*Sigatica*) *boettgeri* Meyer and Aldrich. Eocene, Mississippi and Alabama.

Shell small, shaped like a flattened *Natica*. Aperture semiovate, umbilicus very wide and deep. Upper part of inner lip slightly bent back along umbilicus. Peristome attached to body whorl for only a short distance along the thick parietal callus. Sculpture (of type species) consisting of spiral grooves near suture, and also surrounding umbilicus and within umbilicus. (Based on figures given by Meyer and Aldrich.)

Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 380, 1892) and Cossmann (Essais Paléoconch. Comp., pt. 13, pp. 148, 149, 1924) place *Sigatica* as a synonym of *Eunaticina*, but these two genera are quite different. *Sigatica* has been living in American waters since Eocene time.

Sigatica semisulcata bathyora, new subspecies

(Plate 31, Figure 2)

? *Eunaticina*, near *semisulcata* Gray, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, rotund. Nucleus consisting of about two whorls. Umbilicus very wide and deep. Upper part of inner lip slightly bent back over edge of umbilicus. Parietal callus thick. Sculpture consisting of very fine grooves, which on later whorls are confined to a narrow area near suture and surrounding umbilicus. Interior of umbilicus bearing obscure spiral grooves.

Length 4.3 mm.; diameter 3.9 mm. (holotype).

This *Sigatica*, represented by three specimens in the Duerden collection, apparently is the one listed by Dall, although no specimens now seem to be in the collections of the United States National Museum. It closely resembles Recent specimens of "*Natica*" *semisulcata* (Gray) from Florida. The Recent shells are larger, and shells of the same size as the fossils are sculptured over a larger part of the shell or over the entire shell. The holotype of "*Euspira*" *bahamensis* Dall, dredged at a depth of 33 fathoms on the Great Bahama Bank, is larger than *semisulcata bathyora* and has weaker sculpture. The holotype of "*Eunaticina*" *carolinensis* Dall, dredged off Hatteras at a depth of 124 fathoms, is thinner and has stronger sculpture and a more deeply impressed suture. Perhaps too many names have been applied to these east American living Sigaticas, all of which clearly represent the same phylum. *S. carolinensis* is recorded from the Pliocene Caloosahatchee marl of Florida (Dall, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 380, 1892). These Pliocene fossils are larger than those from Bowden, and have a more deeply impressed suture.

The Bowden subspecies also is found in the Cercado formation.

Other localities.—Cercado formation (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 369527).

SINUM ("Bolten") Roeding

Roeding, 1798, Museum Boltenianum, pt. 2, p. 14.

Type (by subsequent designation, Dall, 1915, U. S. Nat. Mus. Bull. 90, p. 109).—Sinum haliotoideum (Linné) (*Helix haliotoidea* Linné, cited by Roeding as *Helix haliotoidea* Gmelin). Recent, western Pacific ?.

Shell of varying size, flattened. Nucleus consisting of about two rapidly enlarging whorls. Aperture very large, elliptical, very oblique. Outer lip bulging forward in a broad curve. Inner lip reflected back over columellar margin. Parietal callus thin. A shallow posterior channel lies in the angle of the outer lip. Sculpture consisting of trough-like spiral grooves. (Based on the Oriental species known as *Sigaretus neritoideus* (Linné).)

This genus is better known by the Lamarckian name *Sigaretus*.

There is some question as to just what species the type of *Sinum* is. Two species are listed under this genus in the Museum Boltenianum, *S. fuscum* and *S. haliotoideum,* in the synonymy of both of which "*Helix haliotoidea* Gmelin" is cited with references added by Gmelin in the twelfth edition of the Systema Naturae. Dall's type designation apparently refers to the species cited by Roeding as "*S. haliotoideum,*" for which only one figure ("Knorr Vergn. 6. t. 39. fig. 5") is cited. This figure is a ventral view of a medium-sized, greatly flattened, imperforate "*Sigaretus.*" It probably can not be determined whether it is the same species as *Helix haliotoidea* Linné, a dorsal view of the type of which was figured by Hanley (Ipsa Linnaei Conchylia, pp. 390–391, pl. 4, fig. 7, 1855; "*haliotidea*" by error). At all events both these figures represent shells that are congeneric.

Sacco (Moll. Piemonte, pt. 8, pp. 98–104, 1891) uses *Cryptostoma* Blainville for the greatly flattened shells of this genus and *Sigaretus* Lamarck for the less flattened shells. The type of both *Sinum* and *Sigaretus,* however, is greatly flattened, and it is doubtful whether the separation of the less flattened shells under another name is warranted (see Cossmann, Essais Paléoconch. Comp., pt. 13, pp. 143–144, 1924). Some of the species also have a narrow umbilical opening.

Nine species of this genus are already on record from the Miocene deposits of tropical America.

Key to the Bowden species of Sinum

Shell greatly flattened.....*S. gatunense*
Shell moderately flattened.
  Shell imperforate, callus thick.....*S.* species
  Shell slightly perforate, callus thin.....*S. excentricum*

Sinum gatunense (Toula)

(Plate 31, Figures 3, 4)

Sigaretus, near *maculatus* Say, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Sigaretus (*Lupia* Conrad) *gatunensis* Toula, 1909, Jahrb. K.-k. geol. Reichsanstalt, vol. 58, p. 697, pl. 28, fig. 3.
Sigaretus gatunensis Toula, Brown and Pilsbry, 1911, Proc. Acad. Nat. Sci. Philadelphia, vol. 63, p. 360.
Sinum gatunense (Toula), Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 302, pl. 50, fig. 2.

Shell small, thin, greatly flattened, imperforate. Nucleus consisting of about one and a half whorls. Sculpture consisting of narrow, trough-like spiral grooves, the edges of which are finely crenulated by growth lines.

Length 4 mm.; diameter 13.7 mm. (figured specimen).

Type locality.—Panama Canal Zone (Gatun formation).

The identification of this species is not certain, for no specimens are in the Gatun collections in the United States National Museum, and the specimen figured by Toula is an internal mold, to which parts of the shell cling. The Bowden material represents the same species as the one from the Cercado formation recorded by Maury as *gatunense*. Guppy (Agric. Soc. Trinidad and Tobago Paper No. 549, p. 5, 1913; reprint, Bull. Am. Paleontology, vol. 8, p. 340, 1921) recorded *gatunense* from Yabalito, Venezuela, but this record needs confirmation.

S. gatunense is a small, greatly flattened species that resembles the much larger and slightly less flattened *S. perspectivum* (Say), a living species found from Virginia to Brazil. The dorsal surface of the figured specimen is somewhat worn. A larger and thicker worn shell in the Henderson collection is doubtfully referred to this species, which is represented by three specimens in the Duerden collection.

Other localities.—Cercado formation (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Panama Canal Zone.

Type material.—? Natural History Museum, Vienna.

Sinum species

A moderately flattened *Sinum* having a thick shell and a heavy umbilical and parietal callus is represented in the Henderson collection by a medium-sized broken specimen (U. S. Nat. Mus. No. 36919). This shell has a height of 8 millimeters and a diameter of 15 millimeters, but the outer lip is broken far back. The sculpture consists of relatively wide grooves. This species probably is a representative of the living *S. maculatum* (Say), found from North Carolina to Brazil. No other fossil representatives of this group are on record from tropical America.

Sinum excentricum (Guppy)

(Plate 31, Figures 5, 6)

Sigaretus excentricus Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 519, pl. 29, fig. 11.
Sigaretus, near *minor* Dall, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Not *Sigaretus excentricus* Grzybowski, 1899, Neues Jahrb., Beilage-Bd. 12, pt. 3, p. 643, pl. 20, fig. 9.

Shell small, moderately flattened, slightly perforate. Nucleus consisting of a little more than two rapidly enlarging whorls. Inner lip reflected over a narrow umbilical opening. Sculpture consisting of spiral threads of three orders of magnitude.

Length 8 mm.; diameter 11.7 mm. (figured specimen).

Type locality.—Dominican Republic (Miocene).

The identification of this species, represented by five specimens in the Aldrich collection, also is not certain, for *S. excentricum* has not been collected in the Dominican Republic since Heneken made his first collections. Guppy's figure represents a larger shell, and it is not clear whether it is imperforate. The Bowden shells closely resemble *S. minor* (Dall), dredged off Florida and on the Yucatan Bank at depths of 55 to 90 fathoms, but are larger and more strongly sculptured.

The species from the Payta formation of Peru described under this name by Grzybowski in all probability does not even belong in the same family.

Other localities.—Miocene, Dominican Republic (Guppy).

Type material.—Holotype (British Museum, Natural History, Geological Department, Geol. Soc. London No. 12853).

AMPULLINAE

PACHYCROMMIUM, new genus

Type.—Amaura guppyi Gabb. Miocene, Dominican Republic.

Shell medium-sized, stout, imperforate, spire moderately high, whorls shouldered. Aperture semiovate. Outer lip extending backward from suture. Basal part of inner lip folded back and closely appressed, the upper part covered by the parietal callus, which extends far down.

Stewart (Proc. Acad. Nat. Sci. Philadelphia, vol. 78, pp. 330–339, 1927) has assembled a great deal of valuable information on the ampullinoids. Inasmuch as this group is now represented by only one species, *Cernina fluctuata* (Sowerby), living in Philippine waters, whereas during Tertiary time it was represented by many genera and species, he suggests that it should be placed in a family apart from the naticoids, and points out that Cossmann (Essais Paléoconch. Comp., pt. 13, p. 11, 1924) had already done so, but under a name (Euspiridae) that is not available for it.

Stewart uses *Euspirocrommium* Sacco (Boll. Mus. Zool. Anat. comp. R. Univ. Torino, vol. 5, No. 86, p. 42 (pagination continued

from No. 82), 1890; type, by subsequent designation, Cossmann, Annuaire Géol. Univ., vol. 8, p. 741, 1892 (?), *Euspirocrommium elongatum* (Michelotti) (*Natica elongata* Michelotti, 1861, not Hoeninghaus 1829), =*Crommium* (*Euspirocrommium*) *degensis* Sacco var. ?, Oligocene, Italy) for the ampullinoids here called *Pachycrommium*. No specimens of *Natica "elongata"* Michelotti are available, but Sacco's figures (Moll. Piemonte, pt. 9, pl. 1, figs. 11*a*, *b*, 12*a*, *b*, 1891) shows that it has a *Phasianella*-like shape and very high spire, and the inner lip is folded back as a thin edge along virtually its entire length, producing a different kind of aperture. The height of the spire may not be significant, but the difference in apertural features seems to be important.

According to the view here taken, *Euspirocrommium* is an European Oligocene phylum of ampullinoids that never appeared in American waters and is not even known in European Eocene or Miocene deposits. *Pachycrommium*, however, is a more widespread group, as it is recorded from American Eocene and Miocene deposits and from European Eocene and Oligocene beds. *"Ampullaria ?" perovata* Conrad (Proc. Acad. Nat. Sci. Philadelphia, 1846, p. 21, pl. 1, fig. 16; Harris, Bull. Am. Paleontology, vol. 1, p. 49, pl. 1, fig. 4, 1895; middle Eocene, Alabama) and *"Natica" acuminata* Lamarck (see Cossmann and Pissarro, Icon. Eoc. Paris, vol. 2, pl. 11, fig. 64 bis-4, 1910; Eocene, Paris Bain), which Cossmann incorrectly cites as the type of *Euspirocrommium* (Essais Paléoconch. Comp., pt. 13, p. 58, 1924), are two of the Eocene species referred to *Pachycrommium*. *Crommium ferrugineum ?* var. *acuminatoides* Sacco (Moll. Piemonte, pt. 9, p. 9, pl. 1, fig. 10, 1891; Tongrian, Italy) clearly is an European Oligocene species. *"Ampullaria ?" perovata* Conrad is the monotype of *Lupia* Conrad (Am. Jour. Conch., vol. 1, p. 27, 1865), which is a homonym of *Lupia* Robineau-Desvoidy, 1863 (Histoire naturelle des Diptères, vol. 1, p. 910). The shell of *Amaurellina* ("Bayle") Fischer (Man. Conchyl., p. 766, 1885; type, by monotypy, *Natica spirata* Lamarck, Eocene, Paris Basin) is very small and perforate, and has spiral sculpture. *Crommium* Cossmann (Cat. Ill. Coq. éoc. Paris, pt. 3, p. 177, 1888; type, by original designation, *Natica willemeti* Deshayes, Eocene, Paris Basin) has about the same shape as *Pachycrommium*, but the shell is perforate and has faint spiral sculpture, and the inner lip is not so closely appressed. Perhaps *Pachycrommium* should be used as a subgenus of *Crommium*. *Ampullospira* Harris (Cat. Ter. Moll. British Mus., pt. 1, Australasian, p. 265, 1897; type, by original designation, *Euspira canaliculata* Morris and Lycett, Jurassic, England) has a stout shell, channeled suture, angulated shoulder, and different inner lip.

Pachycrommium, as well as *Ampullina* and *Globularia*, as Stewart points out, are common Eocene genera, but are less abundant in the Oligocene seas and survived until Miocene time in the Gulf of Mexico

and the Caribbean Sea. *Globularia* and an unnamed group related to *Pachycrommium* also are found in the lower Miocene of Aquitaine. The American species of *Pachycrommium* have been masquerading under various names. Those from tropical America generally go under the name *Amauropsis* Mörch (Rink's Grønland, geographisk og statisk beskrevet, ap., p. 81, 1857; separate under title Fortegnelse over Grønlands Bløddyr, p. 9, 1857; type, by subsequent designation, Dall, U. S. Geol. Survey Prof. Paper 59, p. 89, 1909, *Natica helicoides* Johnson (=*Nerita islandicus* Gmelin)), an arctic and boreal genus that has no trace of a folded back inner lip. Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 387, 1922) suspected that the Dominican Miocene species might represent "*Lupia*."

Pachycrommium guppyi (Gabb)

(Plate 31, Figures 7, 8)

Natica phasianelloides Guppy (not d'Orbigny), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 291, pl. 17, fig. 1. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 437 (list). Guppy, 1876, Quart. Jour. Geol. Soc. London, vol. 32, p. 519.

Amaura guppyi Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 224.

Ampullina guppyi (Gabb), Dall, 1906, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Amauropsis guppyi (Gabb), Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 301–302, pl. 49, fig. 19. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 386–387, pl. 34, figs. 25–27.

Amauropsis guppyi var. *gurabensis* Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 302, pl. 49, fig. 20.

Shell medium-sized, thin, moderately stout, or very stout, spire of varying height. Nucleus consisting of a little more than one whorl. Basal part of inner lip bent back. Callus thin.

Length 20.7 mm.; diameter 7.5 mm. (figured specimen).

Type locality.—Dominican Republic (Miocene).

Abundant material of this species from the Baitoa, Cercado, and Gurabo formations conclusively confirms Pilsbry's view that the length of the spire and also the degree of inflation are variable. The largest of these Dominican shells has a length of 40 millimeters and a width of 25 millimeters, twice as large as the figured Bowden shell. The specimens from Bowden, of which three are in the Henderson collection, are very poor. On the figured specimen part of the parietal callus and the outer shell layer are worn off, thus destroying the appearance of the bent back inner lip and producing a semblance of an umbilical groove, all of which makes the shell look like *Amauropsis*. This specimen also is more slender than most of the Dominican shells. Guppy's figure also represents a very poor specimen, but it is stouter than the one here figured.

Pachycrommium lived in the Caribbean region from Eocene to middle Miocene time. "*Amauropsis*" *caloramans* Maury and "*A.*" *smithiana* Maury are Eocene species from Trinidad (Jour. Acad. Nat. Sci.

Philadelphia, ser. 2, vol. 15, pp. 101–103, pl. 13, figs. 9, 11–13, 1912). "*Ampullospira* cf. *levesquei* d'Orb.," recorded by Trechmann from the middle Eocene Yellow Limestone of Jamaica (Geol. Mag., vol. 60, No. 710, pp. 349–350, pl. 16, figs. 22–23, 1923), seems to belong here. "*Amauropsis*" *nativitatis* Maury (Brasil Serv. Geol. Mineral. Mon., vol. 4, pp. 77–78, pl. 2, figs. 8, 10, 11, 1925; fig. 8 seems to show columellar folds) from Brazil, and "*Amauropsis*" *trinitatensis* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art, 22, p. 58, pl. 10, figs. 4, 6, 1925), from Trinidad, are lower Miocene species. In addition to *P. guppyi*, "*Amauropsis*" *altispira* (Gabb) and "*Amauropsis*" *burnsii meridionalis* Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 387, text, fig. 20, pl. 34, figs. 23–24, 1922) are recorded from the Miocene deposits of the Dominican Republic. The latter has a deeply channeled suture and heavily margined aperture, and represents an unnamed group of *Pachycrommium*, to which "*Ampullospira*" *eburnoides* (Grateloup) (see Cossmann and Peyrot, Conch. néog. Aquitaine, vol. 3, pt. 2, pp. 458–459, pl. 12, figs. 55–56, 1919), from the Aquitanian and Burdigalian of Aquitaine, clearly belongs.

Ampullina (*Ampullinopsis*) *spenceri* Cooke (Carnegie Inst. Washington Pub. 291, pp. 123–124, pl. 5, figs. 1–3, 1919), from the middle Oligocene beds of Antigua, of which "*Natica* (*Ampullina ?*)" *callazoensis* Hubbard (New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, p. 135, pl. 21, figs. 11–12, 1921; middle Oligocene, Porto Rico) probably is a synonym, is a West Indian representative of the *Ampullinopsis* group. "*Ampullina*" *anguillana* Cooke (Carnegie Inst. Washington Pub. 291, p. 123, pl. 4, figs. 9*a*, *b*, 1919; lower Miocene, Anguilla) is a West Indian lower Miocene survivor of the Eocene genus *Globularia*. "*Natica*" *phasianelloides* d'Orbigny (Sagra's Cuba, Paléont., p. 9, pl. 1, fig. 7, "1852"), a Cuban fossil, probably is an Oligocene or lower Miocene *Ampullina*.

Other localities.—Baitoa formation (lower Miocene); Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 2881).

PECTINIBRANCHIATA STREPTODONTA

PTENOGLOSSA

EPITONIIDAE

EPITONIINAE

EPITONIUM ("Bolten") Roeding

Subgenus EPITONIUM s. s.

Section EPITONIUM s. s.

Roeding, 1798, Museum Boltenianum, pt. 2, p. 91.

Type (by subsequent designation, Suter, 1913, Man. New Zealand Moll., p. 319).—*Turbo scalaris* Linné. Recent, western Pacific.

The section *Epitonium* s. s., which embraces large species with loosely coiled whorls and detached peristome, is not found fossil or

living in America. According to Hanley (Ipsa Linnaei Conchylia, p. 339, 1855), there is no doubt that *Turbo scalaris* is the well-known large species generally known as *Scalaria pretiosa* Lamarck.

This genus is also called *Scala*, a name used in the Museum Calonnianum, and *Scalaria* Lamarck. Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, pp. 299–307, 1889) has given an elaborate review of the generic nomenclature. If both the Museum Calonnianum and Museum Boltenianum were barred, the name to be used would be *Cyclostoma* Lamarck.

The Bowden formation carries an unusually large representation of the mollusks of this family. More species are found in it than are yet recorded from all other Miocene localities in tropical America put together. In addition to the species here described the collections of the United States National Museum contain a large *Cirsotrema* labeled "Bowden, Jamaica" (No. 135422). According to the appearance of shell and filling, this specimen is not a Bowden shell.

The diversity of shell characters in this family is so great that de Boury, who made an exhaustive study of it, proposed a bewildering number of generic and subgeneric names. It would take an unwarranted length of time to consider all the possible names that might be applicable to the Bowden fossils. For convenience I have followed for the most part the arrangement published by Cossmann, with the alleged collaboration of de Boury, in the Essais de Paléoconchologie Comparée, pt. 9, 1912. de Boury (Journ. Conchyl., vol. 63, pp. 13–62, 1917) strenuously objected to being considered a collaborator in this arrangement.

Section CYCLOSCALA Dall

Dall, 1889, Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 316.

Type (by subsequent designation, de Boury, 1909, Journ. Conchyl., vol 57, p. 258).—Scala dunkeriana Dall (=*Scalaria soluta* Dunker 1874, not A. Adams 1862). Recent, West Indies.

Shell very small, very loosely coiled. Aperture subcircular, peristome completely detached. Sculpture consisting of obscurely frilled axial lamellae, rising to a point on shoulder.

The whorls are even more loosely coiled than in *Epitonium* s. s., and the lamellae are obscurely frilled. No fossil species of this section have heretofore been recorded.

Key to the Bowden species of Cycloscala

Whorls very loosely coiled.....*E. (C.) vetulum*
Whorls moderately loosely coiled.....*E. (C.) eumetrum*

Epitonium (Cycloscala) vetulum, new species

(Plate 31, Figure 9)

Shell very small, slender, very loosely coiled excepting first whorl. Aperture subcircular, peristome completely detached. Sculpture consisting of

thin, slightly frilled axial lamellae. At base of body whorl the lamellae plunge into umbilicus without being fused. Lamellae not fused across open space between whorls except at rare intervals and not arranged in continuous axial series. Interlamellar spaces smooth.

Length 3 mm.; diameter 1.7 mm. (holotype, apex broken, dimensions approximate).

The aperture of the holotype and only specimen of this species is filled with hard mud. The shell is so loosely coiled that it has a grotesque appearance suggesting a minute *Turrilites*. *E. dunkerianum* (Dall) is stouter and not so loosely coiled.

Type material.—Holotype (U. S. Nat. Mus. No. 369531).

Epitonium (Cycloscala) eumetrum, new species

(Plate 31, Figure 10)

Shell small, moderately slender, moderately loosely coiled, open spaces visible between whorls. Aperture subcircular, peristome completely detached. Outer edge of peristome slightly pointed at angle of outer lip. Sculpture consisting of thin axial lamellae, not arranged in continuous axial series, and therefore rarely fused across open space between whorls. At base of body whorl the lamellae plunge into umbilicus without being fused. Interlamellar spaces smooth.

Length 3.5 mm.; diameter 2.3 mm. (holotype, apex broken, dimensions approximate).

This species is represented by two imperfect specimens, both of which, like the holotype of *E. vetulum*, are in the Duerden collection. The shell is larger and stouter than in *E. vetulum*, and also less loosely coiled. The slight projection of the peristome at the angle of the outer lip suggests that if the shell were larger the lamellae would be spiny. *Asperiscala* de Boury (Journ. Conchyl., vol. 57, p. 258, 1909; type, by original designation, *Scala bellastriata* Carpenter, Recent, California) has spiny lamellae and the same kind of aperture, but the whorls are more tightly coiled and the interlamellar spaces are sculptured with spiral threads. *E. eumetrum* lacks the frilled lamellae of the type of *Cycloscala*.

A somewhat similar species is represented by fragmentary material from the Cercado formation.

Type material.—Holotype (U. S. Nat. Mus. No. 369532).

Subgenus HIRTOSCALA Monterosato

Section HIRTOSCALA s. s.

Monterosato, 1890, Naturalista Siciliano, year 9, No. 6, p. 149.
Type (*by monotypy*).—*Scalaria cantrainei* Weinkauff. Recent, Mediterranean.

Shell medium-sized, moderately slender. Aperture subcircular. Basal lip slightly channeled, producing a projection ("auricle") and rather strong fasciole. Sculpture consisting of heavy reflected lamellae, varicose here

and there on later whorls, slightly spinose at shoulder. Interlamellar spaces bearing obscure spiral grooves.

The section *Hirtoscala* s. s. has heavy slightly spinose lamellae.

Epitonium (Hirtoscala) species

A medium-sized slender *Epitonium* is represented by a specimen in the Henderson collection (U. S. Nat. Mus. No. 135429), on which the last whorl or more is broken off. Although the apertural features are unknown and the shell is more slender than in the genotype, this species is referred to *Hirtoscala* on account of its moderately heavy, slightly spinose lamellae. The interlamellar spaces seem to be smooth. The approximate dimensions of this fragmentary specimen are as follows: length 7.4 millimeters, diameter 2.3 millimeters.

Section SPINISCALA de Boury

de Boury, 1909, Journ. Conchyliologie, vol. 57, p. 257.
Type (*by original designation*).—*Scalaria frondicula* Wood. Pliocene, Italy, Belgium, England.

Shell medium-sized, imperforate. Aperture ovate. Outer edge of peristome projecting as a spine at angle of outer lip. Basal lip slightly channeled, producing a slight auricle, from which a narrow fasciole extends upward along edge of peristome. Sculpture consisting of retractive axial lamellae, some of which are varicose on later whorls. Lamellae bearing a spine at shoulder. Interlamellar areas virtually smooth or bearing more or less distinct spiral grooves or threads. (Based on a specimen in Jeffreys collection (No. 182511) from Reggio, Italy [Pliocene ?] labeled "*Scalaria frondicula* Nyst." This specimen closely resembles Wood's figure, Crag Moll., pt. 1, p. 92, pl. 8, fig. 16, 1848.)

de Boury definitely states that the type of *Spiniscala* is the Italian [Pliocene] form, which he accepts as conspecific with *Scalaria frondicula* Wood of the English Coralline Crag.

Key to the Bowden species referred to Spiniscala

Lamellae high, spiral sculpture weak.
  Lamellae strongly reflected ..... *E.* (*S.*) *gabbi*
  Lamellae very slightly reflected ..... *E.* (*S.*) *etolium*
Lamellae low, spiral sculpture strong ..... *E.* (*S. ?*) *alidotum*

Epitonium (Spiniscala) gabbi (de Boury)

(Plate 31, Figures 11, 12)

Scalaria minutissima Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 224.
Epitomium minutissimum (Gabb), Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 303, pl. 50, fig. 3.
Epitonium minutissimum (Gabb), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 388, pl. 34, figs. 10–11.
Not *Scalaria minutissima* Deshayes, 1864, Descr. anim. sans vert. Bassin Paris, vol. 2, p. 344.
Scalaria gabbi de Boury, 1913, Journ. Conchyl., vol. 61, p. 84.

Shell moderately small, moderately slender. Nucleus slender, consisting of about three whorls. Basal lip slightly channeled, fasciole narrow. Sculp-

ture consisting of retractive axial lamellae, bearing a spine at shoulder, between which lie fine obscure spiral threads. On the last whorl or two several lamellae are varicose.

Length 5.7 mm.; diameter 2.5 mm. (larger figured specimen, apex broken, dimensions approximate).

Type locality.—Dominican Republic (Miocene).

Most of the Bowden specimens are stouter than the type material and also than specimens from the Cercado formation that represent "*Scalaria minutissima*" Gabb, but the figures show that the degree of inflation and the number and spacing of the lamellae are variable. This species is represented in the Duerden collection by 21 specimens, no two of which are alike. The living West Indian *E. uncinaticostum* (d'Orbigny) is a little stouter and has stronger spiral sculpture.

Other localities.—Cercado formation (middle Miocene), Dominican Republic.

Type material.—Holotype (Philadelphia Acad. Nat. Sci. No. 2824).

Epitonium (Spiniscala) etolium, new species

(Plate 31, Figures 13, 14)

Shell medium-sized, relatively stout. Nucleus slender, consisting of about three and a quarter whorls. Basal lip obscurely channeled, fasciole narrow. Sculpture consisting of thin, very slightly reflected lamellae, fused across the sutures, bearing a short broad spine at suture. Interlamellar areas bearing faint spiral grooves that almost disappear on later whorls.

Length 7.3 mm.; diameter 3.7 mm. (holotype, apex broken, dimensions approximate).

Some of the specimens have more closely spaced lamellae than others. This species is the most abundant *Epitonium* in the Aldrich collection, in which it is represented by 28 specimens. It probably should be placed in a different section on account of the very slightly reflected lamellae. *E. amosbrowni* Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 388–389, pl. 34, fig. 7, 1922), from the Cercado formation, is more slender and has stronger spiral sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 369534).

Epitonium (Spiniscala ?) alidotum, new species

(Plate 31, Figure 15)

Shell small, slender, whorls moderately inflated. Basal lip slightly channeled, fasciole relatively wide. Sculpture consisting of rather fine strongly reflected retractive lamellae, varicose here and there on later whorls, bearing a short spine at shoulder. Interspiral spaces bearing strong, relatively heavy spiral threads.

Length 5.3 mm.; diameter 2.1 mm. (holotype, apex broken, dimensions approximate).

The shape of the shell and strong spiral sculpture indicate that this species belongs in some other section, though it has the apertural features and spines of *Spiniscala*. It is represented only by the holotype.

Type material.—Holotype (U. S. Nat. Mus. No. 369536).

Subgenus STRIATASCALA de Boury

de Boury, 1909, Journ. Conchyliologie, vol. 57, p. 257.
Type (*by original designation*).—*Scalaria brugnonei* de Boury. Pliocene, Italy.

Shell medium-sized, slender, slightly perforate. Aperture subcircular. Basal lip slightly channeled, producing an auricle and very narrow fasciole. Sculpture consisting of rather fine, widely spaced, retractive lamellae bearing a fine spine on shoulder. Interlamellar areas bearing fine spiral threads. Lamellae varicose here and there on later whorls. (Based on Cossmann's description and figure).

Striatascala has rather fine, widely spaced, slightly spiny lamellae and a very narrow fasciole. The type species has a narrow umbilical opening. One of the Bowden species referred to *Striatascala* is virtually imperforate.

Key to the Bowden species of Striatascala

Shell slightly perforate, spiral sculpture relatively weak.....*E.* (*S.*) *anlanum*
Shell virtually imperforate, spiral sculpture strong.....*E.* (*S.*) *callipictum*

Epitonium (Striatascala) anlanum, new species

(Plate 31, Figures 16, 17)

Shell medium-sized, slender, umbilicus very narrow and shallow. Fasciole narrow. Sculpture consisting of thin lamellae, at intervals varicose, fused across suture and bearing at shoulder a low spine. Interlamellar areas bearing spiral threads of irregular width and spacing.

Length 9.7 mm.; diameter 4.2 mm. (holotype, apex broken, dimensions approximate).

E. anlanum is the largest of the Bowden Epitoniums. A fragment in the Henderson collection is considerably larger than the holotype. As the figures show, there is some variation in the strength of the spirals and in the spacing of the lamellae. Thirteen specimens are in the Duerden collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369537).

Epitonium (Striatascala) callipictum, new species

(Plate 31, Figure 18)

Shell medium-sized, slender. Umbilical opening masked by the lamellae, which extend down and virtually touch peristome. Fasciole very narrow. Sculpture consisting of rather heavy, strongly recurved lamellae, varicose here and there, bearing a spine at shoulder. Interlamellar areas bearing strong spiral threads and also miscroscopic axial and spiral threads.

Length 7.5 mm.; diameter 2.8 mm. (holotype, apex broken, dimensions approximate).

The holotype and only specimen has a narrow umbilical opening, but the rather heavy lamellae mask it. This species has heavier and more closely spaced lamellae than *E. anlanum*, and the spiral sculpture is stronger.

Type material.—Holotype (U. S. Nat. Mus. No. 369539).

Subgenus CLATHRUS Oken

Section CLATHRUS s. s.

Oken, 1815, Lehrbuch der Zoologie, pt. 1 [Lehrbuch der Naturgeschichte, pt. 3, No. 1], p. 256.

Type (*by tautonymy*).—*Turbo clathrus* Linné (renamed *Clathrus spurius* by Oken). Recent, Europe.

The section *Clathrus* s. s. is characterized by its relatively large shell and relatively wide fasciole. It is not represented in the Bowden formation.

Hanley (Ipsa Linnaei Conchylia, pp. 339–340, 1855) considers that *Scalaria communis* Lamarck may be regarded as the *Turbo clathrus* of the tenth edition of the Systema Naturae, although two species were confused under that name.

Section NITIDISCALA de Boury

de Boury, 1909, Journ. Conchyliologie, vol. 57, p. 257.

Type (*by original designation*).—*Scalaria unifasciata* Sowerby. Recent, West Indies.

Shell small, moderately slender. Aperture subcircular. Fasciole very narrow. Sculpture consisting of strongly reflected retractive axial lamellae, arranged in continuous series and fused across the sutures. Interlamellar spaces smooth. (Based on Sowerby's figure, Thes. Conchyl., *Scalaria*, pl. 33, fig. 68, 1847.)

The fasciole can not be seen on Sowerby's figure, but it may be assumed that it is very narrow and that the aperture has only a slight suggestion of an auricle.

Key to the Bowden species of Nitidiscala

Shell medium-sized and relatively slender, lamellae far apart.....*E.* (*N.*) *aduncum*
Shell small and stout, lamellae more closely spaced.....*E.* (*N.*) *ventulum*

Epitonium (Nitidiscala) aduncum, new species

(Plate 31, Figure 19)

Shell medium-sized, relatively slender. Basal lip slightly bent back and barely channeled. Fasciole very narrow, represented by a narrow border to the peristome. Sculpture consisting of thin lamellae fused across sutures. Interlamellar spaces smooth.

Length 8.3 mm.; diameter 3.7 mm. (holotype, apex broken, dimensions approximate).

The fasciole is very narrow in this species, which is smaller and stouter than the living West Indian *E. unifasciatum* (Sowerby). Four specimens are in the Aldrich collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369540).

Epitonium (Nitidiscala) ventulum, new species

(Plate 32, Figure 1)

Shell very small, relatively stout. Basal lip barely channeled. Fasciole very narrow. Sculpture consisting of slightly reflected lamellae, fused across sutures. Interlamellar spaces smooth.

Length 3.5 mm.; diameter 2 mm. (holotype, apex broken, dimensions approximate).

The differences between this species, represented only by the holotype, and *E. aduncum* are more distinct than is apparent from a comparison of the photographs, which unfortunately are not enlarged the same. *E. ventulum* is stouter and has shallower sutures, and more closely spaced, slightly heavier, and more reflected lamellae. *E. cercadicum* Maury (Bull. Am. Paleontology, vol. 5, p. 304, pl. 50, fig. 5, 1917), a species from the Cercado formation, has thinner lamellae and faint spiral grooves between the lamellae.

Type material.—Holotype (U. S. Nat. Mus. No. 369541).

Subgenus PICTOSCALA Dall

Dall, 1917, Proc. U. S. Nat. Mus., vol. 53, No. 2217, p. 477.

Type (by subsequent designation, de Boury, Journ. Conchyl., vol. 64, p. 37, 1918).—*Scala lineata* Say. Recent, Massachusetts to Florida.

Shell medium-sized, thick, moderately slender. Basal lip slightly extended, fasciole absent. Sculpture consisting of low axial threads, here and there varicose, the terminal varix and perhaps one or two others very heavy. Interaxial spaces bearing fine spiral grooves.

Dall clearly had in mind *Scalaria lineata* Say as the type of *Pictoscala*, but his statement that *Pictoscala* is proposed "to receive shells of the type of *Scalaria lineata* Say" is not considered a type designation.

Perhaps the following thin-shelled umbilicated species should not be referred to *Pictoscala.*

Epitonium (Pictoscala) leptum, new species

(Plate 32, Figure 2)

? *Scala* near *lineata* Say, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

? *S.*[*calaria*] *pseudolineata* de Boury, 1918, Journ. Conchyl., vol. 64, p. 38 (nude name).

Shell relatively small, thin, umbilical opening narrow and shallow. Basal lip slightly extended, fasciole absent. Sculpture consisting of very slender axial threads, slightly varicose here and there. Terminal varix thin. Interaxial spaces bearing relatively strong spiral threads.

Length 7.8 mm.; diameter 3.6 mm. (holotype, apex broken, dimensions approximate).

This species is represented in the Duerden collection by three specimens. It hardly needs comparison with the large thick-shelled *E.*

lineatum (Say). The umbilical opening probably is to be correlated with the thin shell and thin varix.

This species probably is the one listed by Dall as "*Scala* near *lineata* Say," but it is impossible to confirm this view, as the specimen in the Henderson collection is not so labeled. de Boury apparently was unwilling to forego the opportunity to miss any opening to name a "*Scalaria*," but his *pseudolineata*, based only on Dall's listing of a "*Scala* near *lineata* Say," is regarded as a nude name.

Type material.—Holotype (U. S. Nat. Mus. No. 135425).

ACRILLINAE

FERMINOSCALA Dall

Dall, 1908, Bull. Mus. Comp. Zool. Harvard College, vol. 43, p. 315.

Type (*by original designation*).—"*Scala ferminiana*" Dall (*Epitonium* (*Ferminoscala*) *ferminianum* Dall). Recent, Gulf of Panama to California.

Shell relatively large, turritelloid, body whorl having a basal disk. Basal lip bearing a broad shallow channel, from which a narrow fasciole extends up along the peristome. Outer lip bearing a broad channel adjoining suture. Sculpture consisting of curved retractive axial threads, lamellar near suture and slightly varicose here and there on body whorl, and of strong coarse spiral threads. Sculpture of basal disk consisting of the axial threads and of closely spaced spiral cords.

There is no reason to suppose that *Ferminoscala* bears any direct relation of *Acrilla* H. Adams (Proc. Zool. Soc. London, pt. 28, p. 241, 1860; type, by original designation, "*Aclis acuminata* H. and A. Adams" (*Scalaria acuminata* Sowerby), Recent, western Pacific), which is very slender, and has virtually no auricle, a very slender fasciole, and slight channel on the outer lip, and is sculptured with closely set axial riblets, between which lie obscure spiral grooves. Both genera have basal disks. Many of the American and European Tertiary fossils described as species of *Acrilla* fall in *Ferminoscala*. *Acrilloscala* Sacco (Moll. Piemonte, pt. 9, p. 86, 1890; type, by subsequent designation, de Boury, Journ. Conchyl., vol. 57, p. 256, 1909, *Turbo geniculatus* Brocchi, Pliocene, Italy) has heavier varices and apparently no channel on the outer lip.

Ferminoscala pseudoleroyi (Maury)

(Plate 32, Figures 3, 4)

Scalaria leroyi Guppy (part, not Guppy, 1867), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pp. 75–76, pl. 1, fig. 10 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, pp. 207–208). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 406, pl. 16, fig. 10; p. 437 (list).

Scala (*Amaea*) *leroyi* (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Epitonium (*Acrilla*) *pseudoleroyi* Maury, 1925, Bull. Am. Paleontology, vol. 10, p. 394.

Shell medium-sized, slender. Basal lip bent backward, forming an auricle and a very obscure fasciole. Sculpture consisting of fine curved

retractive axial threads, slightly lamellar at suture and on later whorls slightly varicose here and there, and of strong spiral threads. On unworn specimens microscopic spiral threads and finer growth threads are visible.

Length 25.6 mm.; diameter 13.9 mm. (holotype, fragment of three whorls).

Type locality.—Jamaica (Miocene).

The type of *Scalaria leroyi* Guppy (Proc. Sci. Assoc. Trinidad, pt. 3, pp. 168–169, 1867; reprint, Bull. Am. Paleontology, vol. 8, pp. 195–196, 1921; Geol. Mag., decade 2, vol. 1, p. 406, pl. 18, fig. 2, 1874), a mold from the upper Miocene Springvale beds of Trinidad, is not in the Guppy collection in the United States National Museum. Maury (Bull. Am. Paleontology, vol. 10, pp. 241–242, pl. 52, figs. 8, 11, 1925) redescribes this species. It is not known what genus it represents, but it may be something like *Opalia*. According to Guppy, some of the specimens had a length of six inches.

F. pseudoleroyi is represented by a number of broken specimens (12 in Henderson collection). The obscure fasciole probably is to be correlated with the size of the shells, as young specimens of *F. ferminiana* have a similar fasciole. The microscopic sculpture of unworn specimens produces in strong light a beautiful frosted appearance. "*Scala* (*Acrilla*)" *weigandi* Böse (Jahrb. K.-k. geol. Reichsanstalt, vol. 61, pp. 228–230, pl. 12, fig. 8, 1910; lower Miocene, Isthmus of Tehuantepec, Mexico) is stouter and has stronger spiral threads. "*Scala*" *mitchelii* Dall, a living species from the Gulf of Mexico, also is stouter and has cruder sculpture.

The holotype of *F. pseudoleroyi* is the Bowden specimen figured by Guppy in 1874.

Type material.—Holotype (U. S. S. Nat. Mus. No. 115437).

Ferminoscala spathe, new species

(Plate 32, Figure 5)

Scalaria leroyi Guppy (part, not Guppy, 1867), 1873, Proc. Sci. Assoc. Trinidad, vol. 2, No. 2, pp. 75–76 (Reprint, Harris, 1921, Bull. Am. Paleontology, vol. 8, pp. 207–208). Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 406.

Scala (*Acrilla*) sp., near *retifera* Dall, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell small, slender. Fasciole very narrow. Sculpture consisting of blade-like retractive axial lamellae, slightly varicose here and there, and of high spiral threads, producing deep rectangular pits. Unworn specimens show microscopic axial and spiral sculpture.

Length 14.1 mm.; diameter 4.8 mm. (holotype, apex broken).

The type is a specimen from the Guppy collection. Guppy commented on the possibility of two species being represented in his Jamaican "*Scalaria leroyi.*" Specimens of *F. spathe* are in all the collections, but all of them are small and broken (eight in Duerden collection). The blade-like axial lamellae and high relatively narrow spirals distinguish it from *pseudoleroyi*. "*Scala* (*Acrilla*)" *retifera*

Dall, a living species from the southeast coast of the United States, has even more lamellar axials that bear short spines on the shoulder of the later whorls.

Type material.—Holotype (U. S. Nat. Mus. No. 115437).

OPALIINAE

PLICISCALA de Boury

Subgenus PLICISCALA s. s.

de Boury, 1887, Étude sur les sous genres de Scalidae du Bassin de Paris, p. 19.

Type (*by original designation*).—*Pliciscala* (*Scalaria*) *gouldi* Deshayes) (*Scalaria gouldi* Deshayes). Eocene, Paris Basin.

According to figures of *Scalaria gouldi* Deshayes (Cossmann and Pissarro, Icon. Eoc. Paris, vol. 2, pl. 8, figs. 52–57, 1910), the subgenus *Pliciscala* s. s. has occasional varices, a rather thick basal disk, and fine axials. It is not represented in the Bowden formation.

Subgenus NODISCALA de Boury

de Boury, 1890, Bullettino Società Malacologica Italiana, vol. 14, p. 12 (of separate).

Type (*by original designation*).—*Nodiscala bicarinata* (Sowerby) (*Scalaria bicarinata* Sowerby). Recent, Philippines.

Shell small, slender, suture serrate. Basal disk poorly developed. Peristome complete, thick. Sculpture consisting of obscure crude axial ribs and of spiral grooves. The body whorl bears two heavy spiral ridges, the lower one of which seems to limit the basal disk. (Based on Sowerby's figures, Thes. Conchyl., *Scalaria*, p. 104, pl. 35, figs. 113–114, 1847.)

de Boury, Sacco, and Cossmann use *Nodiscala* for species similar to the following one. It is very improbable that they have any genetic relation to the peculiar little Philippine shell described by Sowerby, but no other name seems to be available for them.

"Pliciscala (Nodiscala)" dasystoma, new species

(Plate 32, Figure 6)

Opalia sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Shell small, slender, interaxial areas forming pits at suture. Early whorls occasionally varicose. Basal disk indicated by abrupt disappearance of axials along a low spiral ledge. Aperture heavily margined. An inner shell layer extends out from aperture and overlaps peristome for short distance. Sculpture consisting of crude heavy axial ribs, between which and over which extend microscopic spiral threads, roughened by microscopic axial threads. On later part of body whorl the axials bulge at periphery.

Length 7.9 mm.; diameter 2.6 mm. (holotype, apex broken).

Only two specimens of this species are in the collections. The microscopic sculpture is too fine to show on the photograph. Recent shells from Florida that probably fall under "*Scala* (*Dentiscala*) *hellenica* Forbes variety *nodosocarinata* Dall" are stouter and more

strongly varicose, and the ribs generally bulge more on the body whorl. *"Opalia" retiporosa* Carpenter, from the Gulf of California and southern California, also is a little stouter and more strongly varicose.

Type material.—Holotype (U. S. Nat. Mus. No. 369543).

JANTHINIDAE

JANTHINA ("Bolten") Roeding

Roeding, 1798, Museum Boltenianum, pt. 2, p. 75.

Type (*by tautonymy*).—*Helix janthina* Gmelin=*Helix ianthina* Linné (renamed *Janthina violacea* by Roeding). Recent, pelagic, recorded from Atlantic, Pacific, and Indian Oceans.

Shell thin, medium-sized, trochoid. Nucleus oblique to axis of shell, consisting of several small whorls. Aperture broadly ovate. Outer lip extending backward from suture to periphery, then forward. Junction of basal and inner lips angulated. Columella twisted, inner lip folded back. Parietal wall covered with a thin layer of callus that covers a small umbilical opening.

These pelagic mollusks, which in life have a beautiful violet color, are at times when the wind is blowing in the right direction swept up on tropical beaches in myriads (Simpson, Nautilus, vol. 10, pp. 133–134, 1897). So far as known this genus is not recorded as a fossil at any other locality in America.

Janthina species

The genus *Janthina* is represented by one small broken specimen in the Henderson collection (U. S. Nat. Mus. No. 135575). It has the characteristic angulation between the basal and inner lips, the folded back inner lip, and twisted columella. The nucleus is broken off. The approximate dimensions are as follows: length 5.7 millimeters, diameter 4.7 millimeters.

This specimen is too small to identify. The shell is higher and the suture deeper than in the common species usually called *J. communis* Lamarck. It probably is a young shell of a species similar to *J. globosa* Swainson.

MATHILDIDAE

MATHILDA Semper

Semper, 1865, Journ. Conchyliologie, vol. 13, p. 330.

Type (*by subsequent designation, Cossmann, 1888, Cat. Ill. Coq. Fos. éoc. Paris, pt. 3, p. 309*).—*Turbo quadricarinatus* Brocchi. Pliocene, Itlay.

Shell medium-sized, slender, turritelloid. Nucleus heterostrophous (dextral and coiled almost at right angles to axis of shell). Aperture ovate. Basal lip everted. Inner lip bent back over a narrow umbilical opening. Sculpture consisting of spiral cords and threads, and fine axial threads.

This genus is recorded from Eocene deposits in both Europe and America, but the following species are the only ones recorded from the Miocene deposits of tropical America.

Key to the Bowden species of Mathilda

Whorls strongly constricted at suture.....*M. plexita*
Whorls moderately constricted at suture.....*M.* species

Mathilda plexita Dall

(Plate 32, Figures 7, 8)

Mathilda plexita Dall (part), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 320, pl. 29, fig. 5. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell medium-sized, whorls strongly constricted at suture. Nucleus heterostrophous, consisting of almost two whorls. Aperture ovate. Edge of outer lip frilled by the primary spirals. Basal lip strongly everted. Inner lip bent back over a narrow umbilical opening. Sculpture consisting of spiral cords (4 on penult whorl), between which lies a spiral thread, and of fine axial threads overriding and slightly swollen on the spirals. Base sculptured with intermediate and secondary spirals.

Length 12.9 mm.; diameter 6.3 mm. (piece of holotype, fragment of a little more than three whorls).

Type locality.—Jamaica (Miocene).

The holotype of this species apparently was broken after the original figure was drawn. One of the three small specimens in the Henderson collection shows the nucleus. This species is not similar to any of the living West Indian species. It is represented by 15 specimens in the Aldrich collection.

Guppy and Dall recorded *M. plexita* also from the "*Ditrupa*" bed at Pointapier, Trinidad. The only specimen from Pointapier, consisting of only a little more than two whorls, has less strongly constricted whorls and more closely spaced spirals.

Type material.—Holotype (broken in two pieces, U. S. Nat. Mus. No. 115436).

Mathilda species

Mathilda sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Another species of *Mathilda* is represented by eight small broken specimens in the Duerden collection and by three similar specimens in the Henderson collection, two of which from each collection show the heterostrophous nucleus. The base is flatter than in *M. plexita*, and therefore the aperture is more rounded. The whorls are only moderately constricted at the suture. The spiral sculpture consists of only three spiral cords, the posteriormost one lying close to the suture. A secondary thread lies only in the interspace between this cord and the middle one.

These specimens clearly represent a new species, but they are too immature to serve as type material. The larger specimen, a fragment of three whorls, has a length of 5.3 millimeters and a diameter of 2.9 millimeters.

GYMNOGLOSSA

The Bowden mollusks of this superfamily are not considered in this report, as it is expected that they will be included in a report by Doctor Bartsch on fossil species from localities in the West Indian region. The approximate number of Bowden species and the names of the species so far described are given below. In these lists the described species are listed under the names given to them in the original description.

PYRAMIDELLIDAE

Approximate number of Bowden species: 35.
Described species:

Pyramidella (*Longchaeus*) *jamaicensis* Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 315, pl. 29, fig. 10. *Callongchaeus jamaicensis* (Dall), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list). (This species is the type of *Callongchaeus* Dall and Bartsch.)

Pyramidella (*Longchaeus*) *forulata* Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, pp. 315–316, pl. 28, fig. 13. *Longchaeus forulatus* (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Oscilla indiscreta Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 317, pl. 28, fig. 14. *Triptychus indiscretus* (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Turbonilla tenuilineata Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 317, pl. 28, fig. 8. *Eulimella tenuilineata* (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Turbonilla turritissima Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 316, pl. 28, fig. 5. *Turbonilla* (*Pyrgiscus*) *turritissimus* Guppy, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Turbonilla angulata Guppy, Proc. U. S. Nat. Mus., vol. 19, p. 316, pl. 28, fig. 10. *Turbonilla* (*Pyrgiscus*) *angulata* Guppy, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Turbonilla simplicior Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 317, pl. 28, fig. 1.

MELANELLIDAE

Approximate number of Bowden species: 12.
Described species:

Eulima (*Liostraca*) *nobilis* Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 315, pl. 30, fig. 9. *Liostraca nobilis* (Guppy), Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Aclis acuminata Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, pp. 313–314, pl. 28, fig. 9. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

Aclis ? (*Amblyspira*) *prominens*, Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 314, pl. 28, fig. 6. *Aclis* (*Amblyspira*) *prominens* Guppy, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1584 (list).

SCUTIBRANCHIATA RHIPIDOGLOSSA

TURBINIDAE

The family Turbinidae is represented in the Tertiary deposits of tropical America by the genera *Turbo* and *Astraea* (also known as *Astralium*), both of which are now living in the West Indian region. Nine species and subspecies of *Turbo*, ranging in age from middle Oligocene to Pliocene, and five species of *Astraea*, all of Miocene age, have already been described. In addition to these two genera the Bowden formation carries a *Homalopoma* that is very similar to a living West Indian species.

TURBO Linné

Subgenus TURBO s. s.

Section TURBO s. s.

Linné, 1758, Systema Naturae, ed. 10, p. 761.
Type (*by subsequent designation, Montfort, 1810, Conch. Syst., vol. 2, p. 203*).—*Turbo petholatus* Linné. Recent, Indo-Pacific region.

The section *Turbo* s. s. is characterized by its smooth polished shell, basal callus, and granular operculum. At the present time it is confined to the Indo-Pacific region, and it has not been found fossil in America.

Turbo marmoratus Linné has generally been accepted as the type because it was the only species cited by Lamarck in the Prodrome. Montfort's designation of *petholatus* is 13 years earlier than the first actual designation of *marmoratus* by Children (Lamarck's Genera of Shells, p. 118, "1823"). *Laeviturbo* Cossmann (Essais Paléoconch. Comp., pt. 11, p. 118, 1918), which also has *petholatus* as its type, is a perfect synonym of *Turbo* s. s.

Section TAENIATURBO, new section

Type.—Turbo canaliculatus Herrmann (also known as *Turbo spenglerianus* Gmelin). Recent, West Indies.

Shell moderately large, whorls rounded or subangular, completely imperforate. Aperture subcircular. Inner lip fused with a wide thick spiral band of callus extending from juncture of inner and basal lips to umbilical region. Parietal wall covered with thick coat of callus that is channeled where it meets outer lip. Sculpture consisting of closely spaced spiral cords, which may be beaded. Operculum subcircular; exterior asymmetrically inflated due to thick deposit of callus, edge bordered by low ridge except where obscured by callus and outer part obscurely granular, except where callus reaches edge, and bearing several grooves near outer edge and approximately parallel to it.

It may seem rash to propose a new name under the genus *Turbo*. The wide inflated band of callus with which the inner lip is fused is a

striking feature of this section. It is similar to *Turbo* s. s., though the callus adjoining the inner lip is much wider and thicker; the inner lip is less distinct; and the operculum is less distinctly granular and has marginal grooves. The strong sculpture of *Taeniaturbo* as compared to the smooth shell of *Turbo* s. s. is of secondary importance. The similarity to *Turbo* s. s. may be the result of convergence rather than genetic relations, for the features of young fossil Taeniaturbos indicate derivation from a stock resembling the living West Indian *Turbo castaneus* Gmelin. It has been customary to refer *T. canaliculatus* to *Senectus* ("Humphrey") Swainson (Treatise on Malacology, pp. 206, 213, 215, 348, 1840; type, by subsequent designation, Herrmannsen, Indicis Gen. Malac., vol. 2, p. 438, Feb. 1848, *Turbo chrysostomus* Linné, Recent, tropical western Pacific), which has no callus in the umbilical region and differs also in characters of the operculum.

So far as known the earliest species of *Taeniaturbo* are found in West Indian Miocene deposits, and the genotype seems to be the only living species, at least it is the only living species in American waters.

Key to the Bowden species of Taeniaturbo

Spiral cords beaded, height of adult shells not exceeding 35 mm.....*T.* (*T.*) *dominicensis*
Spiral cords not beaded, height of adult shells reaching 55 mm.....*T.* (*T.*) species

Turbo (Taeniaturbo) dominicensis Gabb

(Plate 32, Figures 9 to 13)

Turbo castaneus Guppy (not Chemnitz), 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 291. Guppy (not Gmelin), 1874, Geol. Mag., decade 2, vol. 1, p. 441 (list).

Turbo dominicensis Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 242. Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pp. 395–396, pl. 42, figs. 16, 17.

Turbo near *crenulatus* Gmelin, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Turbo dominicensis var. *laloi* Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 318, pl. 50, fig. 15.

Shell relatively thin, medium-sized, imperforate, later whorls rounded or subangular. Apex of perfect young shells flat. Aperture broken back on all adult specimens. Inner lip of adults fused to a wide thick band of callus adjoining it. Very young shells (fig. 10) have a wide heavily corrugated spiral cord in the umbilical region. This cord encloses a narrow umbilical groove and produces a depression on the inner part of the basal lip. At a later stage the umbilical groove is closed and the spiral cord is concealed by the gradual upward and outward spreading of the callus, which is very wide and thick on adults. The early whorls have an anterior flange due to a prominent spiral thread, which soon loses its prominence, and a peripheral spiral may then become prominent causing the whorls to be subangular. Spiral threads or cords closely spaced, beaded or wrinkled by retractive axial grooves. The beads are most prominent on the sutural spiral and may disappear on peripheral spirals. The early whorls bear fine retractive axial threads between the spirals. Opercula assumed to

belong to this species as described above, but some that are heavily callused fail to show the marginal grooves.

Height 33.5 mm.; diameter 27.8 mm. (figured adult specimen, aperture broken back).

Type locality.—Dominican Republic (Miocene).

This species is represented by a large number of shells, though only a few young shells are perfect. Most of the shells have a rather prominent peripheral spiral on the later whorls. On a few specimens brownish blotches are visible. No opercula have been found in place, but it seems safe to assume that the shells and opercula belong together. The Henderson collection contains 41 shells and 40 opercula of varying size. In addition, several shells and a large number of opercula were discarded as duplicates when this collection was sorted. Thirty shells and more than 200 opercula are in the Duerden collection.

Young shells could easily be mistaken for a different genus. These young shells have apertural features similar to those of the living *Turbo castaneus* Gmelin, except that they have an umbilical groove, indicating that *dominicensis* was derived from a *castaneus*-like stock. The elimination of the umbilical groove and the gradual covering by callus of the spiral cord in the umbilical region is very well shown by the suite of specimens in the Henderson collection. On adults the callus is relatively wider and thicker than in *T. canaliculatus*.

The type material of this species is rather poor, but much better specimens from the Dominican Republic are in the collections of the United States National Museum. Some of these specimens probably are topotypes, though this can never be determined, for Gabb did not believe in recording localities. Shells from the Cercado formation, which duplicate Gabb's type and also Maury's *laloi*, are very similar to shells from Bowden. The peripheral spiral is of varying prominence, as in the Bowden shells. Only a very few opercula from the Cercado formation show the marginal grooves, and then they are indistinct. Only one imperfect shell was collected from the Gurabo formation by the Geological Survey party.

This species is not at all like the living West Indian *T. castaneus* Gmelin. Its sculpture is somewhat like that of *T. castaneus crenulatus* Gmelin, but the characters of the basal lip and umbilical region are different. Hubbard (New York Acad. Sci. Scientific Survey Porto Rico and Virgin Islands, vol. 3, pt. 2, pp. 130–131, 1921) described as *Turbo dominicensis quebradillensis* very imperfect unfigured molds from the lower Miocene Quebradillas limestone of Porto Rico. *Turbo* (*Senectus*) *martinicensis* Cossmann (Essais Paléoconch. Comp., pt. 11, pp. 350–351, pl. 3, figs. 21–22, pl. 4, figs. 1–2, 1918), a species from the Miocene beds of Martinique, is based on poorly preserved shells. It probably is a *Taeniaturbo*, but according to the figures, the spiral cords are more widely spaced than in *dominicensis*.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Holotype (Acad. Nat. Sci. Philadelphia No. 2843).

Turbo (Taeniaturbo) species

(Plate 32, Figure 14)

Turbo near *filosus* Fischer, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

The Henderson collection contains two broken very large Turbos, one of which is figured. Its dimensions are as follows: height 56.9 millimeters, diameter 51.8 millimeters. The other specimen, which is more badly broken, is considerably larger. These large shells are similar to *T. dominicensis*, but the spiral cords are not beaded or are only wrinkled. Remnants of the thick band of callus can be seen on one of the large shells. This material is too imperfect to name. Additional specimens may show that it is to be regarded as a variety of *dominicensis*.

Perhaps two very small specimens, one in each collection, represent the young of this species. They have a higher spire and finer sculpture than the young of *dominicensis*.

Subgenus SENECTUS ("Humphrey") Swainson

Swainson, 1840, Treatise on Malacology, pp. 206, 213, 215, 348.

Type (by subsequent designation, Herrmannsen, Feb., 1848, Indicis Gen. Malac., vol. 2, p. 438).—Turbo chrysotomus Linné (cited by Swainson as "*chrysostomus* Mart."). Recent, tropical western Pacific.

Shell moderately large, whorls generally angulated at periphery, imperforate or bearing a narrow umbilical groove. Inner lip flattened. Sculpture consisting of spiral cords and lamellar growth threads. Spiral cords generally spinose or beaded at periphery. Exterior of operculum asymmetrically inflated, slightly granular or smooth.

Senectus has no callus on the inner lip or parietal wall, and the sculpture is spiny or beaded.

Turbo (Senectus) species

A species of *Senectus* is represented by an imperfect immature specimen in the Duerden collection (U. S. Nat. Mus. No. 369598). The apex and base are broken, but the length is only 9.6 millimeters and the diameter is 8.9 millimeters. The sutural area is channeled. The spiral cords are spiny at the periphery and are beaded elsewhere. Lamellar growth threads are visible between the cords. This specimen resembles small shells of the living West Indian *T. castaneus* Gmelin, and may represent that species. *T. crenulatoides* Maury (Bull. Am. Paleontology, vol. 5, pp. 317–318, pl. 50, fig. 14, 1917), found in the Cercado and Gurabo formations, probably is a synonym of *castaneus*.

ASTRAEA ("Bolten") Roeding

Subgenus ASTRAEA s. s.

Section ASTRAEA s. s.

Roeding, 1798, Museum Boltenianum, pt. 2, p. 79.

Type (*by subsequent designation, Suter, 1913, Man. New Zealand Mollusca, p. 166*).—*Trochus imperialis* Gmelin (=*Trochus heliotropium* Martyn). Recent, New Zealand.

The section *Astraea* s. s. is characterized by its wide umbilicus, and the exterior of the operculum is only slightly convex and bears a spiral ridge near the lower margin.

Section ASTRALIUM Link

Link, 1807, Beschreibung der Naturalien-Sammlung der Universität zu Rostock, p. 135.

Type (*herewith designated*).—*Astralium deplanatum* Link (=*Trochus costulatus* Lamarck, regarded as a subspecies of *Trochus longispina* Lamarck; see Pilsbry, Man. Conchology, vol. 10, pp. 220, 222, 1888). Recent, West Indies.

Shell medium-sized, spire low, base slightly convex, inner layer nacreous, periphery bearing long spines. Umbilicus relatively narrow or closed. Aperture flattened, ovate. Outer lip angulated at periphery. Parietal wall covered with callus. Sculpture consisting of imbricating scales and spines. Operculum ovate; exterior greatly inflated, bearing a slight depression opposite the nucleus, lower part obscurely granular; interior flat, nucleus eccentric, consisting of many whorls, all except the last two increasing very slowly in diameter.

It has become customary to separate the West Indian and western Pacific shells in different subgenera or sections (see Pilsbry, quoted above). If this is to be continued, *Astralium* is available for the West Indian shells. No one seems to have taken the formality of designating a type from the two species cited by Link. According to Pilsbry, *Astralium deplanatum* here designated is "*Trochus*" *costulatus* Lamarck, regarded as a subspecies of "*Trochus*" *longispina* Lamarck, so that in effect the designation is the same as that by writers who cite "*Trochus*" *longispina* as the type (see, for example, Cossmann, Essais Paléoconch. Comp., pt. 11, p. 143, 1918). The West Indian shells have a narrower umbilicus than the type of *Astraea* or are imperforate, and their operculum has a more convex and smoother exterior surface, and a flatter interior surface.

Key to the Bowden species of Astralium

Shell perforate, spire low, peripheral spines long.....*A.* (*A.*) *sublongispina acosmeta*
Shell imperforate, spire relatively high, peripheral spines short..*A.* (*A.*) *brevispina basilis*

Astraea (Astralium) sublongispina acosmeta, new subspecies

(Plate 33, Figures 1 to 3)

Shell small, bearing long spines at periphery, spire low. Umbilicus relatively wide, deep, base rather abruptly angulated at edge of umbilicus. Parietal callus heavy. Upper part of body whorl, including spines, sculptured with a few low undulating spiral threads and retractive growth lines that here and there are replaced by very fine threads, which are most prominent on the spines. Base bearing a prominent spiral thread about

one-third of distance from edge to umbilicus and two or three less distinct threads, only one of which is continuous, lying closer to umbilicus. Base and umbilicus also sculptured with curved axial threads, which at places become less distinct growth lines.

Height 5.4 mm.; diameter 11.7 mm. (holotype).

The two specimens of this subspecies probably are not full-grown shells. The upper part of the shell has less distinct spiral sculpture than in *A. s. sublongispina* (Maury) (Bull. Am. Paleontology, vol. 5, pp. 318–319, pl. 50, figs. 16–17, 1917), from the Cercado formation of the Dominican Republic, the base has fewer spirals, and the umbilical margin is more angular. As Maury pointed out, these fossils clearly are the forerunners of *A. longispina* Lamarck. All the fossils so far collected are small, and they fail to show the rough scaly or granular sculpture of the living species.

Type material.—Holotype (U. S. Nat. Mus. No. 369548).

Astraea (Astralium) brevispina basilis (Olsson)

(Plate 33, Figures 4 to 6)

Astralium brevispinum Lamarck var. *basilis* Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 334, pl. 18, figs. 4, 5.

Shell medium-sized, bearing short spines at periphery, spire relatively high, apex flat. Umbilicus completely closed. Inner lip reflected over umbilical region, covered by the callus, which has a thick outer edge. Upper part of body whorl sculptured with four or five spiral cords which bear scales where the retractive axial lamellae cross them. Base sculptured with four similar spirals, but the lamellae are longer and more widely spaced.

Height 17.9 mm.; diameter 24 mm. (figured specimen).

Type loality—Old Man Sam Creek (near Manzanilla Point), Costa Rica (Gatun formation).

The two Bowden specimens have narrower cords on the base than the holotype. The scales or tubercles on the upper part of the fossils are not so strongly developed as in specimens of the living Caribbean *A. b. brevispina*, though the sculpture of the base is remarkably similar to that of *A. b. brevispina* and *A. longispina*. It seems remarkable that even as far back as Miocene time the Caribbean Sea contained Astraeas so similar to *longispina* and *brevispina*.

Other localities.—Gatun formation (middle Miocene), Costa Rica.

Type material.—Holotype (Cornell University).

Subgenus LITHOPOMA Gray

J. E. Gray, 1850, in M. E. Gray, Figures of Molluscous Animals, vol. 4, p. 88.
Type (*by monotypy*).—*Trochus tuber* Linné. Recent, West Indies.

Shell reaching a moderately large size, conical, periphery rounded or subangular, imperforate. Aperture ovate. Inner lip reflected over umbilical region, beyond its outer edge lies a depression. Callus spreading considerable distance beyond outer edge of inner lip and over parietal wall. Base of shell truncated along lower outer edge of callus. Near base of inner lip and also a short distance above its base lies a low tooth-like deposit

of callus. Sculpture of upper part of shell consisting of crude, curved, protractive axial ribs and threads, somewhat modified by obscure axial grooves. Base sculptured with obscure or strong spirals. Exterior of operculum coarsely granular, bearing a rapidly enlarging spiral rib, the apex and base of which are connected by a rib parallel to margin of operculum. Nucleus lying near margin.

In the absence of opercula and of a perfectly preserved inner lip, the position of the following species is somewhat doubtful, though it seems to represent *Lithopoma*, a subgenus now confined to the West Indian region.

Astraea (Lithopoma) aora, new species
(Plate 33, Figure 7)

Shell medium-sized, thick, crudely conical, imperforate, periphery subangular, base slightly convex. Base of inner lip broken. Base of shell not distinctly truncated along lower outer edge of callus. Depression along outer edge of inner lip narrow, deep. Upper part of shell sculptured with crude, slightly protractive axial ribs, which, on the body whorl, disappear about halfway to periphery, where they are replaced by two or three crude spiral cords, between which lie obscure protractive axial cords. Whole upper part of shell bearing crudely imbricate strongly retractive axial lamellae corresponding in direction to growth lines. On the spire short scales are visible at periphery. Base sculptured with three broad low spiral cords and curved axial lamellae.

Height 30.9 mm.; diameter 30 mm. (holotype, apex broken).

On the interior of the outer lip opposite the periphery and extending far within the aperture lies a shallow, though well-marked, groove. This groove may have some systematic significance, as it does not seem to be correlated with the degree of angularity of the periphery. It is clearly seen in *Astraea tuber*, which has a rounded periphery, and also in *A. americana* (Gmelin) and *A. imbricata* (Gmelin), which have an angular periphery. It is less distinct in *A. caelata* (Gmelin), which, it should be noted, has a different operculum from the preceding species, as its exterior is smoothly inflated. In *A. tuber* several short grooves, emerging on the basal lip, lie between this groove and the base of the inner lip.

A. aora is somewhat similar to *A. americana* (Gmelin), but its shell is more broadly conical, the axial sculpture is not so strong, and the basal sculpture is weaker. It also is represented by only two specimens. None of the species of *Astraea* is represented in the Henderson collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369550).

HOMALOPOMA Carpenter

Subgenus HOMALOPOMA s. s.

Carpenter, 1864, Rept. British Assoc. Adv. Sci., 1863, p. 537.
Type (*by monotypy*).—*Homalopoma sanguineum* [Linné] (*Turbo sanguinea* Linné). Recent, Mediterranean.

Homalopoma was published at about the same time as *Leptonyx* ("Carpenter and A. Adams") Carpenter (Proc. California Acad. Sci.,

vol. 3, p. 175, 1864; not *Leptonyx* Swainson, Zool. Ill., ser. 2, vol. 3, pl. 117 and text, 1832). It is not a homonym of *Homalopomus* Girard (Proc. Acad. Nat. Sci. Philadelphia, vol. 8 (1856), p. 132, 1857), and, therefore, the better known name *Leptothyra* ("Carpenter") Dall (Am. Jour. Conchology, vol. 7, p. 130, 1871) is rejected.

The subgenus *Homalopoma* s. s. is characterized by its imperforate shell, and also by the tooth-like deposit of callus at the base of the inner lip, below which on the basal lip lie one or two smaller projections. The living species are found almost all over the world in tropical and subtropical seas.

Subgenus LEPTOTHYROPSIS, new subgenus

Type.—Leptothyra philipiana Dall. Recent, West Indies.

Shell small, spire low, inner layer nacreous, umbilicus wide. Aperture subcircular, peristome incomplete. Inner part of basal lip reflected. A spiral thread extends into the umbilicus from the base of the inner lip. Sculpture consisting of strong spiral threads. Operculum thin, nucleus subcentral, composed of many slowly enlarging whorls, visible from the exterior; exterior smooth, central part slightly concave.

The discovery of a Miocene fossil remarkably similar to "*Leptothyra*" *philipiana* seems to justify the recognition of its peculiar features. The basal part of the inner lip of the only adult specimen of *philipiana* available is broken, but a smaller shell fails to show the tooth-like projection of *Homalopoma* at its base. The larger specimen of *philipiana* is considered adult because the sculpture fails to affect the outer lip, whereas on the smaller shell the edge of the outer lip is frilled. Aside from the absence of the tooth-like projection at the base of the inner lip, *Leptothyropsis* is characterized by the wide umbilicus and umbilical thread, and reflected basal lip. The operculum is like that of some species of *Homalopoma*. *Anadema* A. Adams (Proc. Zool. Soc. London, 1854, p. 39; type, by monotypy, *Omphalius caelatus* A. Adams, Recent, east coast of Africa) has entirely different apertural and umbilical features. So far as known "*Leptothyra*" *philipiana* is the only living *Leptothyropsis*, and the Bowden fossil here described is the only fossil species.

Homalopoma (Leptothyropsis) philipiana oedemata, new subspecies

(Plate 33, Fgures 8 to 11)

Shell small, apex blunt, umbilicus wide and shallow. Inner part of basal lip reflected outward. At base of inner lip lies an obscure swelling, and below it a low inflated area, both probably corresponding to the tooth-like projections of *Homalopoma*. Umbilical spiral rising from base of inner lip. Parietal callus thick. Sculpture consisting of strong spiral threads, seven of which lie on the body whorl. Two spirals lying near suture bear low bumps and two near umbilicus are beaded, the inner one more distinctly.

Inside the heavy spiral bordering umbilicus lies a narrow spiral thread. On adult shells the spirals disappear near outer lip, and obscure secondary spirals may lie in the interspaces. Operculum subcircular, nucleus subcentral, composed of many slowly enlarging whorls. Exterior bearing a central concavity and showing only the last whorl, which is set off by a deep groove.

Height 4.8 mm.; diameter 5 mm. (holotype).

This subspecies is represented by 14 specimens in the Duerden collection. One shell, as shown in fig. 11, had the operculum in place, but later the aperture of this shell was broken back to examine the inner surface of the operculum. The resemblance of these fossils to the living *H. p. philipiana* (Dall) (Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 353, pl. 24, figs. 7, 7*a*, 1889), dredged off Dominica at a depth of 138 fathoms, is very striking. The fossils have one less spiral thread between the periphery and the umbilicus, and the Recent specimens have no slender thread inside the heavy thread bounding the umbilicus. The bumps on the two spirals near the suture are more pronounced on the fossils.

Type material.—Holotype (U. S. Nat. Mus. No. 369551).

COLLONIIDAE

The type of the genus *Collonia* is an Eocene shell, and, although the name has been repeatedly used for Recent species, it is doubtful whether any living species can be referred to it. Three Bowden species, which are regarded as representing two new genera, are placed in the family Colloniidae. Neither genus is now living in the West Indian region.

OTOLLONIA, new genus

Type.—Liotia siderea Guppy. Miocene, Jamaica.

Shell small, broadly conical, umbilicate. Aperture circular, peristome complete, thick, its edge on adult shells entirely free from body whorl. At base of inner lip, along its outer edge, and projecting out into umbilicus lies a thickened auricle, from the upper edge of which an obscure thread decends into the umbilicus. Sculpture consisting of beaded spiral threads, a heavy cord bounding the umbilicus.

Cossmann (Essais Paléoconch. Comp., pt. 11, p. 137, 1918) placed *Liotia siderea* in his genus *Cirsochilus* (Cat. Illus. Coq. éoc. Paris, pt. 3, p. 76, 1888; type, by original designation *Delphinula striata* Lamarck, Eocene, Paris Basin), though the apertural features are much more similar to those of *Collonia* Gray (J. E. Gray, in M. E. Gray, Figs. Moll. Animals, vol. 4, p. 87, 1850; type, by subsequent designation, Cossmann, 1888, cited above, p. 73, *Delphinula marginata* Lamarck, Eocene, Paris Basin). The peristome of *Liotia siderea* is even more detached from the body whorl than in *Collonia*, the auricle is narrower

and does not overhang the umbilicus, as in *Collonia*, and the thread descending into the umbilicus is less prominent and disappears more rapidly. No similar Tertiary or living species could be found. The American Tertiary fossils described by Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, pp. 386–388, 1892) as *Collonia* have a deep depression on the basal lip where the umbilical cord joins it.

Otollonia siderea (Guppy)

(Plate 33, Figures 12 to 14; Plate 34, Figure 1)

Liotia siderea Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 324, pl. 27, fig. 18.
Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, suture deeply depressed, umbilicus moderately wide, shallow. Peristome thick, on adults its edge free from the body whorl. Basal lip thickened where umbilical cord meets it. Above this thickening lies a narrow auricle, from which a thread descends down to umbilical wall. Sculpture consisting of closely spaced, beaded spiral threads. Two spirals at the periphery stand out more prominently than others and modify outline of shell. Beads on spiral adjoining suture farther apart than on other spirals. Near outer lip of adults the beads are less prominent. Very fine axial threads can be seen under high magnification. Spiral bordering umbilicus wide and heavily ribbed.

Height 4 mm.; diameter 3.6 mm. (holotype). Height 5.2 mm.; diameter 4.6 mm. (figured specimen).

Type locality.—Jamaica (Miocene).

The holotype of this species, which is represented by 19 specimens in the Aldrich collection, is not a full-grown shell. On very young shells a narrow beaded thread can be seen in the umbilicus adjoining the heavy cord at the margin of the umbilicus.

Type material.—Holotype (U. S. Nat. Mus. No. 107095).

COANOLLONIA, new genus

Type.—Coanollonia ambla, new species.

Shell medium-sized, spire very low, umbilicus wide and deep. Periphery bicarinate on young shells, rounded on adult shells. Aperture subcircular, peristome incomplete. Peristome greatly thickened where it meets umbilical border, which is very thick, but becomes thinner and is gradually transformed into a thin rib that spirals up umbilicus. Lower edge of thick umbilical border, or auricle, everted. Sculpture consisting of retractive axial grooves with obscure nodes in the interspaces.

The prominent umbilical rib, which starts out as a heavy rib as wide as the auricle, gives this genus a striking appearance. I have not been able to find any similar fossil or living American shells.

Key to the Bowden species of Coanollonia

Upper part of shell sculptured with spiral nodes.....*C. ambla*
Upper part of shell sculptured with fine spiral threads.....*C. ?* species

Coanollonia ambla, new species

(Plate 34, Figures 2 to 6)

Shape, aperture, and umbilicus as described under the genus. Edge of outer lip slightly flexed near suture. Outer lip bearing a posterior channel. Sculpture consisting of widely spaced retractive axial grooves, conforming to outline of outer lip, between which lie low spiral nodes. Base bearing only three rows of nodes with the nodes on every other interspace.

Height 6.9 mm.; diameter 9.7 mm. (holotype).

This curious species is represented by the holotype and a small specimen, which is biangulated and has a very slender umbilical rib. The holotype has a rather uniform light brownish color with darker brown areas partly outlining the basal nodes. Part of the inner lip is broken. Both specimens are in the Johns Hopkins University collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369554).

Coanollonia ? species

Another species that probably belongs to a different genus is represented in the Henderson collection by a badly broken small shell (U. S. Nat. Mus. No. 135468). The umbilical rib is very slender and slightly beaded. Another slender rib lying within it can be seen far in the umbilicus. The umbilicus is very sharp-edged. The upper edge of the periphery has a prominent spiral thread, below which lies a weaker one. The upper part of the body whorl and the spire are sculptured with very fine spiral threads, one or two of which may be a little heavier than the others. So far as can be seen the base is smooth. The aperture is destroyed.

TRICOLIIDAE

TRICOLIA Risso

Subgenus TRICOLIA s. s.

Risso, 1826, Histoire naturelle des principales productions de l'Europe Méridionale, vol. 4, p. 122.

Type (*by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 144*[1]).—*Turbo pullus* Linné. Recent, European seas.

Shell small, ovate, body whorl inflated. Aperture broadly ovate. Outer lip thickened, abruptly angulated and slightly channeled where it meets callus on parietal wall. Umbilical opening reduced to a narrow trough-like groove or virtually closed. Operculum calcareous, outer surface inflated, inner surface concave and bearing near its lower inner edge an eccentric spiral nucleus.

Tricolia formerly was considered a subgenus of *Phasianella* Lamarck (Ann. Mus. Hist. Nat. Paris, vol. 4, p. 295, 1804; type, by original designation, *Faisan* (=*Buccinum australis* Gmelin), Recent, Austra-

[1] On page 144 this name is given as *Tricolea*, and in the index as *Tricolaea*. Both are regarded as errors for *Tricolia*.

lia[1]), which embraces exotic species that are more than ten times as large as the European and American species. It is now placed in a separate family.

The subgenus *Tricolia* s. s. is characterized by its relatively high spire and very narrow umbilical groove, which may be entirely closed.

Tricolia (Tricolia) umbilicata (d'Orbigny)

(Plate 34, Figures 7 to 9)

Phasianella umbilicata d'Orbigny, 1842, Sagra's Hist. fis. polit. nat. Isla Cuba, pt. 2, vol. 5 (Moluscos), pp. 195–196, pl. 19, figs. 32–34 (Spanish ed.). Pilsbry, 1888, Man. Conchology, ser. 1, vol. 10, pp. 171–172, pl. 39, figs. 3, 4, 95. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).[2]

Phasianella mollis Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 332.

Shell small, spire relatively high, its apex blunt. Umbilical groove narrow, deep, concave, limited on the side facing the body whorl by a sharp-edged ridge. On some shells a pattern of dark bands separated by narrow light-colored zigzag axial bands is visible. Other shells have closely spaced dark-colored blotches. One shell has very fine obscure spiral threads and two others have heavier spiral threads, one of which modifies the outline of the early whorls.

Height 4.2 mm.; diameter 2.4 mm. Height 3.8 mm.; diameter 2.6 mm. (figured specimens.)

Type locality.—Cuba (Recent).

This little species is represented by about 160 specimens in the Aldrich collection. Some shells are stouter than others, and there is a pronounced variation in the distinctness of the color pattern and sculpture, depending partly on preservation. Some show virtually no markings of either color or sculpture. Those on which the dark blotches can be seen generally fail to show the dark-colored irregular axial bands. Spiral sculpture can be distinctly seen on only a few specimens. Though the extremes referred to this species are very different, they show precisely the same variation as living shells referred to *Tricolia umbilicata*. It seems impossible to find any characters to separate the fossils from the living *umbilicata*, though fewer of the fossils have spiral sculpture than in living specimens. Of about 80 specimens in the Henderson collection, only three have spiral

[1] The view that this species is the type by original designation is justified by Lamarck's statement, "J'ai donné à ce genre le nom de phasianelle, d'après celui d'une coquille qui m'a fourni l'occasion de l'établir, et qui est connue sous le nom de faisan (*phasianus*)." He then goes on to say that this shell was very rare in Europe before the voyage of Baudin, that it has an aperture almost exactly like that of the "bulimes," but is marine, and that the animal bears a calcareous operculum. There is no doubt that Lamarck named this genus for *Buccinum australis*, though the only species formally named are two middle Eocene fossils from the Paris Basin. It would be very unfortunate to insist on choosing a type from these two species. According to Bucquoy, Dautzenberg, and Dollfus (Moll. Roussillon, vol. 1, pt. 8, p. 336, 1884), *Buccinum australis*, also known as *Buccinum tritonis* Chemnitz and *Phasianella bulimoides* Lamarck, was called "Faisan" by Favanne in 1784 (Catalogue du cabinet de la Tour-d'Auvergne, p. 12, pl. 1, fig. 46).

[2] No attempt is made to give complete citations for this species.

sculpture. The Bowden fossils run a little larger than those from Costa Rica. The *Tricolia* from the Cercado formation of the Dominican Republic, described by Gabb (Trans. Am. Philos. Soc., n. s., vol. 15, p. 240, 1873) as *Lacuna punctata*, is larger and stouter, and has a uniform color pattern of closely spaced dark blotches that may be eroded to form pits. Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 396, 1922) considered these Dominican fossils the same as the living West Indian *Tricolia affinis* (Adams), but, as he noted, the fossils have a deeper and generally wider umbilical groove and the ridge bounding the groove is more sharp-edged. In view of these differences, which seem to be uniform, it is desirable to consider the fossils as a subspecies of *affinis*. As *punctata* is preoccupied in *Tricolia* by Risso (Hist. Nat. Europe Mérid., vol. 4, p. 123, 1826), this subspecies is herewith renamed *Tricolia* (*Tricolia*) *affinis gabbi*.

Other localities.—Gatun formation (middle Miocene), Costa Rica. Living in the West Indian and Floridian regions in shallow water.

Subgenus EULITHIDIUM Pilsbry

Pilsbry, 1898, Manual of Conchology, ser. 1, vol. 17, p. 319 (index, under *Eucosmia*). Pilsbry, 1898, Nautilus, vol. 12, p. 60. Substitute name for *Eucosmia* Carpenter (Ann. Mag. Nat. Hist., ser. 3, vol. 13, p. 475, 1864; not *Eucosmia* Stephens, 1831, Ill. Brit. Ent., p. 265).

Type (*herewith designated*).—*Eucosmia variegata* Carpenter. Recent, southern California and Lower California.

Shell very small, spire very low and blunt, body whorl greatly inflated. Aperture broadly ovate. Outer lip not thickened where it meets parietal callus, which is thin. Umbilical groove narrow, deep, concave, bounded on side facing body whorl by a sharp-edged ridge. Operculum resembling *Tricolia* s. s.

Dall (Proc. U. S. Nat. Mus., vol. 34, p. 255, 1908) indicated *Eucosmia variegata*, Carpenter's first species, as the type, without formally designating it. He renamed this species *Phasianella* (*Eulithidium*) *typicum* on account of the conflict with the earlier *Phasianella variegata* Lamarck. Though Carpenter proposed *Eucosmia* as a subgenus of *Phasianella*, he actually used the combination *Eucosmia variegata*. If this species is referred to the genus *Tricolia*, as here advocated, Dall's name is unnecessary.

The low spire, greatly inflated body whorl, and more uniform umbilical groove separate *Eulithidium* from *Tricolia* s. s. The living species are confined to the Atlantic and Pacific coasts of tropical and temperate America. The oldest species is recorded from the lower Miocene Chipola formation of Florida.

Tricolia (Eulithidium) hadra, new species

(Plate 34, Figures 10, 11)

Eulithidium near *breve* d'Orbigny, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell very small, stout, resembling a minute *Natica* or *Tectonatica*, all the whorls greatly inflated. Umbilical groove relatively wide, deep.

Height 2.6 mm.; diameter 2.5 mm. (holotype). Height 3.3 mm.; diameter 3 mm. (largest shell).

On some shells dark violet mottled color markings can be seen. This species is not so abundant as *T. umbilicata*, though it is represented by 37 specimens in the Duerden collection. It is much stouter than the living West Indian *T. brevis* (d'Orbigny). It is more similar to *T. cyclostoma* (Carpenter), a living species from Lower California, though the spire and body whorl are more equally inflated.

Type material.—Holotype (U. S. Nat. Mus. No. 369556).

LIOTIIDAE

LIOTIA Gray

Subgenus LIOTIA s. s.

Gray, 1840, Synopsis of the contents of the British Museum, ed. 44, p. 57 (genus without species). (Quoted from Iredale, Proc. Malacol. Soc. London, vol. 10, p. 306, 1913.) Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 145.

Type (*by original designation, 1847*).—*Delphinula cancellata* Gray. Recent, Peru to Chile.

Shell small, thick, umbilicate, spire low, inner layer somewhat nacreous. Aperture circular, oblique, peristome continuous, very thick. Sculpture (of type species) consisting of axial and spiral threads. Umbilicus bordered by spiral thread that fails to modify outline of aperture. (Based on figure of genotype given by Pilsbry, Man. Conchology, ser. 1, vol. 10, pl. 36, fig. 2, 1888.)

According to the manuals this genus has a corneous multispiral operculum with a calcareous layer formed of spirally arranged pearly particles. The very thick continuous circular peristome, which is attached to the body whorl for only a short distance, is characteristic of *Liotia*. The subgenus *Liotia* s. s. is further characterized by its very low spire and by the absence of scaly sculpture.

Three Tertiary species, of Eocene and Miocene age, from tropical America have been described under the name of *Liotia*, but, so far as can be seen, none has the thick continuous peristome of the genotype. This genus is now living in West Indian waters.

Liotia (Liotia) strebla, new species

(Plate 34, Figures 12 to 14)

Shell small, spire very low and flat, umbilicus narrow. Nucleus consisting of one smooth, uniformly inflated whorl. Peristome very thick, except in umbilical region. Sculpture consisting principally of a few beaded spirals. On the body whorl a spiral thread bearing erect spine-like beads bounds the trough adjoining the suture. A conspicuously beaded spiral lies at the outer edge of the body whorl. Some obscure beads lie behind it and two barely beaded spiral threads lie in front of it, the lower one forming the basal edge. Along the outer edge and also near the suture are very

fine retractive axial threads. Outer part of base sculptured with three obscure spiral threads. Edge of umbilicus sculptured with a row of coarse beads, from which irregular wavy axial threads extend outward. Within the umbilicus a row of slender, widely spaced spines is visible.

Height 2.6 mm.; diameter 4.3 mm. (holotype).

Though this species may not represent *Liotia* s. s., it has the apertural features of the genotype. It is represented by about 125 specimens in the Duerden collection. The vermicular threads converging toward the umbilical region are a striking feature. *"Margarita" tricarinata* Gabb (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 397, fig. 33, 1922) may be a similar species, but the type and only specimen is very small and poorly preserved.

A poorly preserved high-spired specimen in the Henderson collection (U. S. Nat. Mus. No. 135487) probably represents another species.

Type material.—Holotype (U. S. Nat. Mus. No. 369557).

Subgenus ARENE H. and A. Adams

H. and A. Adams, 1854, Genera Recent Mollusca, vol. 1, p. 404.

Type (*herewith designated*).—*Turbo cruentatus* Megerle von Mühlfeld. Recent, West Indies.

Shell small or medium-sized, spire moderately low, turreted, umbilicus narrow. Aperture circular, oblique. Peristome, thick, continuous, attached to parietal wall for only a short distance. Sculpture consisting of spiral threads bearing scales.

No valid type designation could be discovered. *Delphinula radiata* Kiener, generally cited as the type, is considered a synonym of the species here designated, which is the first species listed by H. and A. Adams.

The subgenus *Arene* seems to have the same apertural features as *Liotia* s. s. So far as the shell is concerned, the separation of these two subgenera is based on shape and sculpture, *Arene* having a higher turreted spire and scaly sculpture.

Key to the Bowden species of Arene

Spire relatively high, axial sculpture weak.....*L.* (*A.*) *lepidota*
Spire very low, axial sculpture strong.....*L.* (*A.*) *venusta*

Liotia (Arene) lepidota, new species

(Plate 35, Figures 1 to 3)

Shell small, spire moderately high, its apex flattened, umbilicus narrow. Peristome very thick, except in umbilical region. Sculpture consisting of scaly or beaded spiral threads. On the body whorl two spirals that bear scales open forward lie at the periphery. A heavily beaded spiral lies near the suture, and between it and the upper scaly spiral are two weaker spirals. The scales and beads are more or less distinctly joined, and very fine irregular axial threads, which fail to show on the photograph, are visible under high

magnification. Umbilicus bounded by a broad area bearing heavy axial threads. Between this area and the lower scaly spiral are four closely spaced and closely beaded spirals.

Height 4.2 mm.; diameter 5.5 mm. (holotype).

This species is represented by only four shells, one of which is larger than the holotype. On all specimens the scales on the body whorl and on part of the spire are broken. In general features it resembles on a small scale the genotype, *L. cruentata*, living in the West Indies. The fossil species has two rows of scales and its scales are much smaller.

Type material.—Holotype (U. S. Nat. Mus. No. 369558).

Liotia (Arene) venusta, new species

(Plate 35, Figures 4 to 6)

Shell very small, spire very low, umbilicus relatively wide. Peristome continuous, thin. Sculpture of body whorl consisting of three strong spiral threads separated by deep grooves and overridden by strong axial threads that form scales, open forward, on the two upper spirals. Two obscure spirals lie near the suture. Very fine irregular axial threads are visible under high magnification. Base sculptured with a spiral near outer edge and with three spirals facing the umbilicus. Axials obscure on base except in and near umbilicus.

Height 2.4 mm.; diameter 3.2 mm. (holotype).

If this species, represented only by the holotype, is an *Arene* the only specimen is not full-grown, as its peristome is thin. It is very similar to *Liotia* (*Arene*) *peramata* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, pp. 409–410, pl. 19, figs. 2, 2*b*, 1892), a Pliocene species from Florida, but is smaller, and has more distinct scales and more widely spaced axials. Only the largest specimens from Florida have a thick peristome.

Type material.—Holotype (U. S. Nat. Mus. No. 369559).

NERITIDAE

The Neritidae afford a striking example of the occupation of various ecologic niches by one family. Some members lie only in the sea, others live on tidal flats or on rocks and are uncovered during ebb tide, others live in brackish or fresh water, or tolerate both, and one Oriental group, *Neritodryas*, lives in trees. H. Burrington Baker's recent arrangement of the family, based on studies of the radula (Proc. Acad. Nat. Sci. Philadelphia, vol. 75, pp. 117–178, 1923), is here followed. According to Baker, only the marine genera, and to a less extent the estuarine genera, have an extensive distribution.

Nerita has not yet been recorded from the later Tertiary deposits of tropical America, though it is represented in collections of Pliocene age from Costa Rica. The absence of this genus in the Miocene deposits of this region probably is due to the scarcity among fossils

of shells that clung to rocks. Five species of *Neritina* and one of *Smaragdia* have been described from the Oligocene, Miocene, and Pliocene beds of tropical America.

For some reason fossil Neritinas retain their color markings in a remarkable manner. Among the Miocene mollusks from tropical America they have more distinct color markings than any other genus.

NERITINAE

NERITINA Lamarck

Subgenus NERITINA s. s.

Section NERITINA s. s.

Lamarck, 1816, Encyclopédie Méthodique, Vers, vol. 2, pl. 455; 1822, Hist. Nat. Anim. sans Vert., vol. 6, pt. 2, p. 182.

Type (*by subsequent designation, Children, "1823," Lamarck's Genera of Shells, p. 111*).—*Nerita pulligera* Linné. Recent, rivers of India and Melanesia.

So far as hard parts are concerned, the principal differences between the section *Neritina* s. s., which is found in the Orient, and the sections represented in the Bowden formation, lie in details of the opercula.

Section NEREINA Christofori and Jan

Cristofori and Jan, 1832, Catalogus in IV sectiones divisus rerum naturalium in museo exstantium Josephi de Cristofori et Georgii Jan, section 2, p. 8.

Type (*by monotypy*).—*Nereina lacustris* Cristofori and Jan (=*Neritina punctulata* Lamarck). Recent, mainly fluviatile, West Indies, Mexico to Brazil.

Shell medium-sized, spire low. Outer lip channeled at junction with parietal wall. Callus flattened. Inner edge of columellar lip bearing a series of small denticles.

Though the opercula are calcareous, none has been found in the Bowden formation. The following species is assigned to the section *Nereina* on account of the general similarity of its shell to *N. punctulata*. According to Baker, the section *Nereina* is mainly fluviatile, and is now found in the West Indies and on the American mainland from Mexico to Brazil.

Neritina (Nereina) woodwardi Guppy

(Plate 35, Figures 7 to 9)

Neritina woodwardi Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 291, pl. 18, figs. 4, 5. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 441 (list). Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell relatively small, spire low. Edge of columellar lip bearing small, very obscure denticles that may disappear on adult shells. Color pattern consisting of closely spaced, wavy, axial, narrow dark bands.

Height 14.3 mm.; diameter 16.2 mm. (largest specimen in Guppy collection marked "types").

Type locality.—Jamaica (Miocene).

On most specimens of this species almost the entire outer shell layer with its narrow dark bands is worn off, but the bands can be seen at the outer edge of the callus where this layer is protected by the callus. White blotches may lie between the wavy bands. On some young shells that seem to belong to this species the coloring consists of light-colored spots on a uniformly dark background. All adult shells are more or less corroded. The Duerden collection contains 25 specimens.

This species resembles the living West Indian *N. punctulata* Lamarck, though it is smaller and the area covered by the callus is relatively wider and more uniformly flattened.

Type material.—Holotype (British Museum, Natural History, Geological Department No. 64080).

Subgenus NERIPTERON Lesson

Section NERIPTERON s. s.

Lesson, 1831, Voyage de la Coquille, Zoologie, vol. 2, pt. 1, p. 384.

Type (*by subsequent designation, H. B. Baker, 1923, Proc. Acad. Nat. Sci. Philadelphia, vol. 75, p. 143*).—*Neritina* (*Neripteron*) *taitensis* Lesson. Recent, East Indies and other parts of Orient.

The shell of the section *Neripteron* s. s., which is found in the Orient, is characterized by its greatly expanded inner and outer lips.

Section CLYPEOLUM Recluz

Recluz, 1842, Revue Zoologique, year 1842, p. 235.

Type (*by subsequent designation, Pilsbry, 1927, Bull. Am. Mus. Nat. Hist., vol. 53, p. 162*).—*Neritina latissima* Broderip. Recent, streams along Pacific coast of Central America.

Shell medium-sized, spire very low, not rising above body whorl of adults. Upper part of outer lip and inner part of basal lip expanded and wing-like. Callus flattened. Edge of columellar lip bearing small obscure denticles.

The name *Alina*, employed by some writers for this section, was used by Recluz on the same page where *Clypeolum* appeared (see Pilsbry and Bequaert, Bull. Am. Mus. Nat. Hist., vol. 53, p. 162, 1927). According to its position and typography it apparently was not intended as a systematic name, and it may be a misprint for a descriptive adjective. At all events it is a homonym of *Alina* Risso, 1826 (Hist. Nat. Europe Mérid., vol. 4, p. 277). Although Recluz failed to use the name *Clypeolum* at the bottom of the page at the head of the species, it is clear that he divided the "auriculate Neritinas" into two groups, for the first of which he adopted the name *Neripteron*, used by Lesson, and for the second of which he used *Clypeolum*. *Neritina latissima* Broderip heads the list of eight species of the second group.

The wing-like projection of the outer and basal lips are characteristic of shells of this section. According to Baker, *Clypeolum* is estuarine and fluviatile, and now is found along the Pacific coast of Central America and northern South America and also along the West

African coast. This distribution is more readily understood by the discovery of the following West Indian Miocene species, which, so far as shell characters are concerned, belongs in this section.

Neritina (Clypeolum) pterota, new species

(Plate 35, Figures 10 to 12)

Shell medium-sized, spire very low, on adult shells not rising above body whorl. On young shells a broad ridge lies in front of suture. Upper edge of outer lip rising in wing-like projection that is slightly channeled where it meets body whorl. Inner part of basal lip flaring. Columellar lip flattened, bearing small crude denticles. Color pattern consisting of closely spaced, wavy axial dark bands among which uncolored blotches lie. The blotches may be arranged in three spiral bands having areas of solid dark color.

Height 16.3 mm.; diameter 19.5 mm. (holotype).

The flaring wing-like outer and basal lips distinguish this species from other American fossil species. In young shells this feature is not so striking, though the outer lip extends far up on the body whorl. The young shell shown in figs. 11 and 12 has remarkably fresh color markings. No similar species is now living in the West Indies, but the fossil closely resembles *Neritina latissima* Broderip, found in rivers along the Pacific coast of Central America. The fossil species is smaller and more inflated, its callus area is not so flattened, and its basal lip is more rounded, but these differences, based on only a few fossil shells, may not be very significant in view of the great variability of Neritinas. Nine specimens referred to this species are in the Duerden collection.

Type material.—Holotype (U. S. Nat. Mus. No. 135475).

SMARAGDINAE

SMARAGDIA Issel

Subgenus SMARAGDIA s. s.

Issel, 1869, Malacologia del Mare Rosso, p. 212.

Type (by subsequent designation, Bucquoy, Dautzenberg, and Dollfus, 1884, Moll. Roussillon, vol. 1, p. 328).—Neritina feuilleti Audouin. Recent, Red Sea.

Shell small, obliquely elongate, spire low. Inner part of outer and basal lips slightly projecting over columellar lip. Callus thicker on upper part of callus area than on lower part. Edge of columellar lip bearing fine denticles.

This genus is exclusively marine, and is now found in the West Indies, the Mediterranean Sea, and the Indo-Pacific region. According to the manuals, the eyes are sessile, not stalked as in *Neritina* and *Nerita*.

Smaragdia (Smaragdia) viridis viridemaris (Maury)

(Plate 35, Figure 13)

Neritina viridis Linné, Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 242.
Neritina (Smaragdia) near *viridis* Lamarck, Dall. 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list)

Neritina (*Smaragdia*) *viridemaris* Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 316–317, pl. 50, fig. 11. Olsson, 1922, Bull. Am. Paleontology, vol. 9, p. 331, pl. 18, fig. 22.

Smaragdia viridis (Linné), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 396.

Shell very small. Callus thick, not flattened except near edge of columellar lip. Edge of columellar lip bearing very fine denticles. Color markings consisting of very fine widely spaced zigzag brownish stripes on a greenish background.

Height 4.6 mm.; diameter 3.7 mm. (largest specimen). Height 3.8 mm.; diameter 3 mm. (figured specimen).

Type locality.—Bluff 3, Rio Mao, Dominican Republic (=station 8525, U. S. Geological Survey) (Cercado formation).

This species is very abundant, being represented by about 200 specimens in the Henderson collection. Most of the largest shells are worn and the thin outer lip is broken. Shells that retain the outer shell layer show the very fine zigzag stripes and a vague suggestion of a yellowish green background. Shells from the type locality have a much more distinct greenish color. All the shells from the Bowden formation are much smaller than living adult *S. v. viridis*, their callus area bulges more, and the axis of greatest elongation seems to lie a little closer to the vertical axis of the shell. The largest shells from the Cercado formation of the Dominican Republic are fully as large as *S. v. viridis*, but their aperture is narrower parallel to the axis of greatest elongation, and the upper part of the callus area bulges more. *S. v. viridis* from the West Indies generally has white blotches on a pale pea-green background, but an occasional shell has fine zigzag stripes. In the fossils the reverse is seen, for most of them have zigzag stripes, though some, especially those from the type locality, have white blotches. The prevalance of shells with zigzag stripes apparently is the basis for Pilsbry's statement that specimens in the Gabb collection are more like European than West Indian specimens. Mediterranean shells having a zigzag color pattern generally are not given even subspecific standing, though they have received the name *matonia* Risso (see Bucquoy, Dautzenberg, and Dollfus, Moll. Roussillon, vol. 1, p. 330, 1884). *Smaragdia merida* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 60, fig. 5, 1903), a Pliocene species from Florida, has a more elongate and less inflated body whorl than the West Indian fossils.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic. Gatun formation (middle Miocene), Costa Rica.

Type material.—Cornell University.

TROCHIDAE

Calliostoma and *Solariella* are the most common genera of this family in the Tertiary deposits of tropical America. About 20 species

of *Calliostoma* and four of *Solariella*, all of Miocene or Pliocene age, have already been described from this region. Only one species of *Chlorostoma*, *C. costaricensis* Olsson is recorded, but this genus is further represented by undescribed material from the Cercado formation of the Dominican Republic. In addition to *Chlorostoma*, *Calliostoma*, and *Solariella*, the Bowden formation carries *Microgaza* and two new genera, all of which are now living in the West Indian region.

GIBBULINAE

CALLIOSTOMA Swainson

Subgenus CALLIOSTOMA s. s.

Swainson, 1840, Treatise on Malacology, pp. 218, 351.

Type (*by subsequent designation, Herrmannsen, 1846, Indicis Generum Malacozoorum, vol. 1, p. 154*).—*Trochus conulus* Linné (cited by Swainson as "*conula* Mart."). Recent, Mediterranean Sea.

Shell small or medium-sized, conical, imperforate, edge of body whorl angular or rounded, inner part of shell nacreous. Aperture oblique to vertical axis of shell, crudely diamond-shaped. Outer lip, as viewed from above, strongly bent backward except near suture. Basal lip, as viewed from below, arched backward. Base of columella generally bearing an obscure bulge or tooth facing outward. Parietal wall covered with thin glaze. Sculpture consisting of beaded or unbeaded spiral threads.

The type designation by Herrmannsen is valid, as "*conula* Mart. 166. f. 158," which, according to Hanley (Ipsa Linnaei Conchylia, p. 322, 1855), represents *Trochus conulus* Linné, is in Swainson's list of species of *Calliostoma*. To regard *Calliostoma* as monotypic because on page 218, where Swainson first mentions it, "*Trochus zizyphinus* of British writers" (=*Calliostoma zizyphinum conuloides* Lamarck) is the only species mentioned, seems a forced interpretation, though several writers cite *Trochus conuloides* as the type. Fortunately the status of the genus remains the same, as *Trochus conulus* and *Trochus conuloides* are congeneric.

According to Pilsbry (Man. Conchology, ser. 1, vol. 11, p. 332, 1889), *Calliostoma* is found in all seas and at depths ranging from low-water mark to 500 fathoms. The subgenus *Calliostoma* s. s. is characterized by its generally imperforate axis and by the obscure tooth at the base of the columella produced by a thickening of the columella. Some species referred to *Calliostoma* s. s. have a narrow umbilical groove. Cossmann (Essais Paléoconch. Comp., pt. 11, p. 288, 1918) considers that the earliest species of *Calliostoma* s. s. are of Eocene age. About 18 species are now living in the Caribbean region, and eight, or possibly ten, Miocene and Pliocene species have already been described from tropical America. Both species found in the Bowden formation are very similar to living Caribbean species.

Guppy and also Dall listed *Calliostoma decipiens* (Guppy) from Bowden, but this record is erroneous, and probably is due to a typo-

graphic error in Guppy's table (Geol. Mag., decade 2, vol. 1, p. 441, 1874; Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585, 1903).

Key to the Bowden species of Calliostoma s. s.

Shell imperforate, spiral threads strongly beaded.....*C.* (*C.*) *pulcher bowdenense*
Shell having an umbilical groove, spiral threads weakly beaded.....*C.* (*C.*) *roseoloide*

Calliostoma (Calliostoma) pulcher bowdenense, new subspecies

(Plate 35, Figure 14)

Calliostoma pulcher C. B. Adams, Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 323. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Calliostoma decussatum Gloyne, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, relatively slender, whorls smoothly conical or slightly bulging at anterior end. Periphery of body whorl angulated on young shells, abruptly rounded on adult shells. Nucleus consisting of about three-fourths of a smooth whorl, its tip hidden. Base of columella slightly thickened over a relatively large area, but not bearing a tooth. Sculpture consisting of strongly beaded spiral threads, generally four to a whorl on spire. A secondary spiral may lie in the interspaces, particularly on posterior part of whorl. From the beads axial threads or exaggerated growth lines extend part or all of distance across interspaces. Base sculptured with similar beaded spirals that are closely spaced except near axis of shell. Basal lip crenulated by the spirals.

Height 10.9 mm.; diameter 7.9 mm. (holotype).

Though the Bowden shells closely resemble Recent specimens of *C. p. pulcher* C. B. Adams, their outline is more smoothly conical, as the whorls bulge less at their anterior end, and the periphery of the body whorl of adult shells is more rounded than in most Recent specimens. *C. pulcher* is found from Cape Hatteras southward to Old Providence and St. Thomas in one to 70 fathoms. The Bowden subspecies is represented by 25 specimens in the Henderson collection. They may turn out to be the same as *C. rhombotum* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, p. 59, pl. 8, figs. 4, 8, 1925), a Miocene species from Trinidad. The type of *rhombotum* seems to be a very young shell that is a little stouter and has stronger beads than Bowden shells of the same size. Whether these differences would be more pronounced on adult shells can not now be determined.

Type material.—Holotype (U. S. Nat. Mus. No. 369562).

Calliostoma (Calliostoma) roseoloide, new species

(Plate 35, Figures 15, 16; Plate 36, Figures 1 to 3)

Calliostoma roseolum Guppy and Dall (not Dall), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 324. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell medium-sized, anterior part of later whorls generally bulging, periphery of body whorl rounded. Nucleus consisting of almost one whorl, its tip hidden. Columella slightly swollen at base. Umbilicus not entirely

closed, leaving a narrow groove, barely visible on some shells. Sculpture consisting of weakly beaded spiral threads, the anterior two threads of whorls of spire stronger than the three or four lying behind it. A secondary spiral may lie in interspaces. Base sculptured with beaded spirals, the beads partly joined by exaggerated growth lines.

Height 10 mm.; diameter 9.4 mm. (holotype, tip broken). Height 6.9 mm.; diameter 6.1 mm. (small shell).

C. roseoloide seems to be the Bowden representative of *C. roseolum* Dall, a species dredged along the Atlantic coast from Cape Hatteras to Yucatan at depths of 12 to 95 fathoms. The Bowden species has less strongly beaded spirals and an umbilical groove. It also is not quite so slender, and the anterior bulge on the spire whorls generally is more abrupt. The umbilical groove is narrow, but is of varying width, and on at least one shell is completely closed. The early whorls may be smoothly conical (see fig. 2), but they generally bulge. *C. attrina* Mansfield (Proc. U. S. Nat. Mus., vol. 66, art. 22, p. 58, pl. 10, figs. 7, 8, 1925), a species from Trinidad, may be the lower Miocene representative of *C. roseoloide*, as it has an umbilical groove and the same kind of sculpture, but it is larger and the bulge occupies a larger area on the spire whorls. *C. roseoloide* is not quite so abundant as *C. pulcher bowdenense*. It is represented by 20 specimens in the Duerden collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369563).

Subgenus DENTISTYLA Dall

Dall, 1889, Bull. Museum Comparative Zoology Harvard College, vol. 18, pp. 373–374.

Type (herewith designated).—Margarita asperrima Dall. Recent, North Carolina to Barbados.

Shell small, conical, umbilicate. Aperture quadrangular-ovate. Outer lip, as viewed from above, sloping backward uniformly from suture to periphery of body whorl. Basal lip deeply emarginate, its edge crenulated by basal spirals. Parietal wall covered with very thin glaze of callus. Inner face of columella thickened by white deposit of callus, its base almost vertically truncated. Sculpture consisting of spiral cords and narrow axial threads.

As no one seems to have designated a type species for *Dentistyla*, *Margarita asperrima* is herewith named. This subgenus embraces small strongly sculptured species from moderately deep water. They have a narrow umbilicus. *C. asperrimum dentiferum* (Dall) represents a different genus, also found at Bowden (see p. 433). The Bowden species referred to *Dentistyla* differs from the type species, but the principal difference seems to be due essentially to an umbilical spiral thread that modifies the outline of the columella. Living species of *Dentistyla* are confined to east American waters, both in the West Indian region and off the southeast coast of the United States. They have been dredged in moderately deep water at depths of 100 to 220 fathoms. No other fossil species have been described.

Calliostoma (Dentistyla) guppyi, new species

(Plate 36, Figures 4, 5)

Calliostoma asperrimum Guppy and Dall (not Dall), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 323. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, umbilicus very narrow, base of body whorl angulated. Nucleus consisting of a little more than one rapidly enlarging whorl. Inner face of columella slightly thickened, its base spread out and slightly concave due to a spiral thread emerging from umbilicus. Sculpture consisting of a spine-bearing spiral thread lying near anterior suture of spire whorls and of two beaded spirals lying behind it. Base sculptured with five spiral threads, the innermost one slightly wrinkled, the others smooth. A wrinkled spiral rises out of umbilicus and extends to base of columella.

Height 4.6 mm.; diameter 3.8 mm. (holotype).

The spine-bearing spiral thread is a striking feature of this species, which is represented by five specimens. It may not represent *Dentistyla*. Aside from the difference in sculpture, it has a much narrower umbilicus, a more slender columella, and a strong umbilical thread that causes the base of the columella to spread out. *C. asperrimum* has an obscure thread in the umbilicus, but it is not strong enough to modify the base of the columella. The Bowden species is more similar to "*Margarita*" (or "*Solariella*") *scabrisulca* Dall, a living species dredged at a depth of 539 fathoms in the Gulf of Mexico.

Type material.—Holotype (U. S. Nat. Mus. No. 369565).

SOLARIELLA S. Wood

S. Wood, 1842, Ann. Mag. Nat. Hist., vol. 9, p. 531.
Type (*by monotypy*).—*Solariella maculata* S. Wood. Pliocene, England.

Shell small, spire low, inner layer nacreous, umbilicus very wide and deep. Aperture subcircular, almost parallel to vertical axis of shell, peristome attached to parietal wall along only small part of its circumference. Outer lip, as viewed from above, slightly convex forward between suture and periphery of body whorl. Basal lip virtually straight. Sculpture consisting of spiral threads modified by fine axial threads.

According to Pilsbry (Man. Conchology, ser. 1, vol. 11, pp. 307–330, 1889), the living species of *Solariella* are rather widely distributed, particularly in the Atlantic. Cossmann (Essais Paléoconch. Comp., pt. 11, p. 260, 1918) refers to this genus species as old as Lower Cretaceous. The small area of attachment of the peristome to the parietal wall, the vertical position of the aperture, and the wide umbilicus are considered characteristic features.

Key to the Bowden species of Solariella

Shell relatively large, sculpture consisting of spiral threads and very fine axial threads lying between them ..... *S. altiusulca*
Shell small, sculpture consisting of spiral threads overridden by strong axial threads ..... *S. veresimilis*

Solariella altiusulca Guppy

(Plate 36, Figures 6 to 8)

Solariella altiusulca Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 324, pl. 27, fig. 17. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell medium-sized, thick. Aperture oblique to vertical axis of shell, basal lip strongly arched. Sculpture consisting of strong spiral threads, two of which lie on spire whorls, but the number is increased by secondary threads that gradually increase in size. Thread near suture of body whorl slightly wrinkled. Base sculptured with similar but more closely spaced threads. Four heavy, distantly spaced, wrinkled spirals face the umbilicus. Over entire shell very fine axial threads lie between the spirals.

Height 4.2 mm.; diameter 5.2 mm. (holotype). Height 5.1 mm.; diameter 6.7 mm. (largest specimen).

Type locality.—Jamaica (Miocene).

The shell is thicker, the aperture is more inclined, and the basal lip is more arched than in the type species of *Solariella*. The inclination of the aperture is not so great as appears from the figures, for the basal lip is broken back farther than the rest of the aperture. By turning the shell in strong light brilliant reflections, probably due to the nacreous layer, can be seen here and there. This species, which is represented by only four specimens, is very similar to the living West Indian *S. lacunella depressa* Dall. The posterior part of the whorls of the Bowden species is not so abruptly angulated and the umbilical cords are heavier.

Type material.—Holotype (U. S. Nat. Mus. No. 107125).

Solariella veresimilis (Guppy)

(Plate 36, Figures 9 to 11)

Liotia veresimilis Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 324, pl. 27, fig. 13. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell very small, moderately thin. Aperture slightly oblique to vertical axis of shell. Basal lip virtually straight. Sculpture of later whorls consisting of two spiral threads, which angulate the whorls, overridden by widely spaced, retractive axial threads. A spiral thread, beaded by the axials, surrounds the umbilicus. Another spiral lies on base near outer edge. Between them and also facing umbilicus are obscure spirals.

Height 2.2 mm.; diameter 2.3 mm. (holotype).

Type locality.—Jamaica (Miocene).

Patches of the nacreous layer can be seen where the outer shell layer is worn off. This species, represented by 15 specimens in the Aldrich collection, more convincingly represents *Solariella*. In type of sculpture it resembles the much larger living species *S. aegleis* (Watson), which has been dredged in the West Indian region at depths of 230 to 940 fathoms. The holotype was not photographed, as it is smeared with glue.

Type material.—Holotype (U. S. Nat. Mus. No. 107092).

ANTILLACHELUS, new genus

Type.—Calliostoma (*Dentistyla*) *asperrimum* var. *dentiferum* Dall. Recent, Barbados.

Shell small, conical, umbilicate, inner layer nacreous. Aperture subquadrate. Outer lip, as viewed from above, slanting backward from suture. Basal lip gently arched. Outer and basal lip lirate within aperture. Columella bearing a heavy tooth at its base. Far within aperture one or two small denticles lie below the tooth. Parietal wall covered with thin wash of callus. Sculpture reticulate.

This genus in a general way resembles *Euchelus* Philippi (Zeitschr. Malakozoologie, year 4, p. 20, 1847; type, by subsequent designation, Herrmannsen, Indicis Gen. Malac., vol. 1, p. 430, 1847, *Trochus quadricarinatus* Chemnitz), the type of which is a relatively large Oriental shell that has a more flaring aperture and a flattened umbilical region, which with the columella forms a projecting shelf. The columellar tooth of *Euchelus* is relatively more slender. *Ancistrobasis* Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 383, 1889; type, by monotypy, *Basilissa costulata* Watson, Recent, West Indies and southeast coast of United States) has a sutural sinus on the outer lip and another on the outer part of the basal lip, and a heavy denticle on the inner part of the basal lip.

Though the type of the genus *Antillachelus* was described as a "variety" of *Calliostoma asperrimum*, the two forms have little in common except the same shape and remarkably similar reticulate sculpture, which seems to represent an example of the common occurrence of convergence in characters of sculpture. No specimens of *Calliostoma asperrimum* are lirate within the aperture, and none has the heavy columellar tooth. So far as known no other fossil representatives of this genus are recorded, and the living species seem to be confined to the West Indian region.

Antillachelus vaughani, new species

(Plate 36, Figures 12 to 14)

Basilissa (*Ancistrobasis*) near *costulata* Watson, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, umbilicus wide. Lirae within outer and basal lip strong and narrow. Columellar tooth relatively small. Below the tooth and well within aperture lie several denticles, one of which is more prominent than others. Sculpture of next to last whorl consisting of four spiral threads, the one near the base and the one near the top stronger than the others. Spirals bearing prominent beads joined by axial threads that thin out between the spirals. Base sculptured with five similar beaded spirals. Umbilicus bordered by a wide heavily beaded spiral, and within the umbilicus three smaller heavily beaded spirals are visible.

Height 5.6 mm.; diameter 5.5 mm. (holotype).

Antillachelus vaughani is very similar to *A. dentiferus* (Dall), which was dredged at a depth of 140 fathoms near Barbados. It has more

spirals than the living species, more slender beads, a wider umbilicus, and a much smaller columellar tooth. All of the five shells from Bowden are more or less crushed.

Type material.—Holotype (U. S. Nat. Mus. No. 107097).

MIRACHELUS, new genus

Type.—Calliostoma corbis Dall. Recent, West Indies.

Shell small, conical, imperforate, inner layer nacreous. Aperture subquadrangular. Outer lip, as viewed from above, slanting backward from suture. Basal lip almost straight. Outer and basal lips lirate within aperture. Columella vertical, bearing a tooth-like inflation near base. Parietal wall covered with thin wash of callus. Sculpture reticulate.

It is quite clear that "*Calliostoma*" *corbis* is not a *Calliostoma*, and also that it does not represent *Herpetopoma* Pilsbry (Man. Conchology, vol. 11, p. 430, 1889; type, by original designation, *Euchelus scabriusculus* Adams and Angas, Recent, Australia), as Cossmann supposed (Essais Paléoconch. Comp., pt. 11, p. 303, 1918). *Herpetopoma* has a more circular and more flaring aperture, the columella has a strong tooth at its very base, and a denticle lies near it on the interior of the basal lip.

Mirachelus differs from *Antillachelus* in having a much more slender columellar tooth, in lacking the denticles on the columella far within the aperture, and also by the absence of an umbilicus. The following Bowden species is the only known fossil *Mirachelus*.

Mirachelus precorbis, new species

(Plate 36, Figures 15, 16)

Calliostoma corbis Guppy and Dall (not Dall), 1896, Proc. U. S. Nat. Mus., vol. 19, p. 324. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Euchelus (*Herpetopoma*) cf. *corbis* Dall, Cossmann, 1918, Essais Paléoconch. Comp., pt. 11, p. 303, pl. 10, figs. 43, 44, text-fig. 112.

Shell small, base of whorls of spire overhanging suture. Nucleus consisting of about one smooth whorl. Columella slightly inflated near its base. Liration on interior of outer and basal lips extending far into aperture. Sculpture consisting of spiral threads, four on later whorls of spire, overridden and beaded by slightly retractive axials. Base similarly sculptured, but both spirals and axials become weaker toward columella.

Height 5.9 mm.; diameter 4.6 mm. (holotype).

This species is the most abundant trochid found at Bowden. It is represented by about 300 specimens in the Duerden collection and by about 200 in the Henderson collection. It is remarkably similar to *M. corbis* (Dall), which has been dredged in the Gulf of Mexico and in the Caribbean Sea at depths of 84 to 250 fathoms. The Bowden species is a little stouter, its sculpture is finer, and the inflation on the columella is not so pronounced.

Type material.—Holotype (U. S. Nat. Mus. No. 369569).

TROCHININAE

MICROGAZA Dall

Subgenus MICROGAZA s. s.

Dall, 1881, Bull. Mus. Comp. Zool. Harvard College, vol. 9, p. 50.
Type (*by monotypy*).—*Microgaza rotella* Dall. Recent, West Indies.

Shell moderately small, circular, spire low, inner layer nacreous, umbilicus very wide and deep, each whorl making a step within the umbilicus. Aperture subquadrate. Outer lip, as viewed from above, sloping backward from suture to outer edge of body whorl, but not so rapidly near suture. Basal lip slightly everted and channeled at the angle. Parietal wall covered with very thin callus. Sculpture consisting of a beaded spiral adjoining suture and of axial wrinkles adjoining umbilicus.

Microgaza rotella Dall, which has been dredged in the West Indian region and in waters off Florida at depths of 25 to 115 fathoms, and *M. r. inornata* Dall, which ranges from off Hatteras to Barbados in 50 to 181 fathoms, are the only known living representatives of this genus. The Bowden species, which clearly is the forerunner of the living *rotella*, is the only fossil *Microgaza* s. s. *M. pontileviensis*, described by Cossmann (Essais Paléoconch. Comp., pt. 11, pp. 258, 358–359, pl. 9, figs. 11–14, 1918, Helvetian of Touraine) as an European Miocene species, seems to belong to a different genus, as its peristome is not abruptly angulated, everted, and channeled at the junction between the basal and inner lips.

Microgaza (Microgaza) rotella vetula, new subspecies

(Plate 37, Figures 1 to 3)

Microgaza rotella Dall, Guppy and Dall, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 323. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Microgaza rotella var. *inornata* Dall (not Dall 1889), 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Eumargarita (*Microgaza*) *rotella* Dall subsp., Cossmann, 1918, Essais Paléoconch. Comp., pt. 11, p. 258, pl. 9, figs. 9, 10.

Shell remarkably similar to the Recent *M. r. rotella.* Nucleus consisting of about one inflated smooth whorl. Basal lip, as viewed from below, curving sharply backward at junction with inner lip, the edge of the peristome everted and distinctly channeled at the junction. Second post-nuclear whorl bearing obscure axial wrinkles. Sculpture of later whorls consisting of a low spiral band adjoining suture and bearing widely spaced low broad beads. This band may disappear on later part of body whorl. Fine spiral threads lie on and near periphery of body whorl. Base sculptured with puckered axial wrinkles adjoining sharply angulated edge of umbilicus. One to three very slender spiral threads can be seen in umbilicus at upper edge of whorl.
Height 3.9 mm.; diameter 7 mm. (holotype).

This subspecies is represented by almost 100 specimens in the Duerden collection. The axial wrinkles on the second post-nuclear whorl and the threads in the umbilicus are the principal features separating

it from *M. r. rotella*. The spiral threads at the periphery of the body whorl are of varying strength, but generally are stronger than on Recent shells. A few of the fossils show traces of narrow brownish color bands spirally diverging from the suture.

Type material.—Holotype (U. S. Nat. Mus. No. 369570).

Subgenus BOWDENAGAZA, new subgenus

Type.—Microgaza (*Bowdenagaza*) *cossmanni*, new species.

Shell moderately small, spire low, body whorl strongly inflated, umbilicus moderately wide, deep. Aperture large, ovate. Outer lip, as viewed from above, slanting backward from suture to periphery of body whorl. Basal lip, as viewed from below, slightly bent back at junction with inner lip, the edge of peristome broadly everted at and near junction. Inner lip vertical, its edge slightly bent back. Parietal wall covered with thin callus. Sculpture consisting of a beaded spiral near suture and of spiral threads facing umbilicus.

Aside from the difference in outline, this subgenus differs from *Microgaza* s. s. in its less angulated, more broadly everted, and unchanneled peristome at the junction of the basal and inner lips, and also in its non-scalariform umbilicus. *Bowdenagaza* may represent an intermediate stage toward *Callogaza* Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 9, p. 49, 1881; type, by subsequent designation, Dall, Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 356, 1889, *Callogaza watsoni* Dall, Recent, West Indies), which has an unangulated peristome and the umbilicus is partly covered by a pad extending from the inner lip. The Bowden species here described is represented in the Gurabo formation of the Dominican Republic (U. S. G. S. station 8726) by one young imperfect shell, but no other species are known.

Microgaza (Bowdenagaza) cossmanni, new species

(Plate 37, Figures 4 to 6)

General features and aperture as described above. Sculpture of later whorls consisting of a spiral thread near suture bearing widely separated beads. Slender strongly retractive axial threads, corresponding in direction to growth lines, extend from the beads to the suture and in opposite direction to or slightly beyond a slender spiral thread near main spiral thread. Base of shell near umbilicus bearing a few spiral threads wrinkled by widely spaced puckers. Several wrinkled spiral threads lie within umbilicus.

Height 4.2 mm.; diameter 5.2 mm. (holotype). Height 5.6 mm.; diameter 7 mm. (largest shell).

This species is represented by 13 shells, none of which is perfect. On the holotype the outer shell layer is broken away around the umbilicus and the sculpture there is much more obscure than it should be.

Other localities.—Gurabo formation (middle Miocene), Dominican Republic.

Type material.—Holotype (U. S. Nat. Mus. No. 369571).

CHLOROSTOMA Swainson

Subgenus CHLOROSTOMA s. s.

Swainson, 1840, Treatise on Malacology, p. 350.
Type (*by subsequent designation, Herrmannsen, 1846, Indicis Gen. Malac., vol. 1, p. 231*).—*Trochus argyrostomus* Gmelin. Recent, Indo-Pacific.

The subgenus *Chlorostoma* s. s., which is not found in the Bowden formation and is not living in east American waters, embraces both umbilicate and imperforate, rather strongly sculptured species.

Subgenus OMPHALIUS Philippi

Philippi, 1847, Zeitschrift für Malakozoologie, year 4, p. 21.
Type (*by subsequent designation, Herrmannsen, 1847, Indicis Gen. Malac., vol. 2, p. 146*).—*Trochus rusticus* Gmelin. Recent, Japan.

Shell medium-sized, body whorl subangular or rounded at periphery, umbilicate. Aperture oblique, elliptical. Inner lip bearing a heavy tooth at base, below which lies a more obscure tooth-like swelling. Callus spreading from parietal wall toward and partly over umbilicus. Sculpture consisting of spiral threads or of crude protractive axial ribs.

These mollusks live on rocks between high- and low-tide levels. Only one Miocene species has been described from tropical America, *C. costaricensis* Olsson (Bull. Am. Paleontology, vol. 9, p. 335, pl. 18, fig. 16, 1922), which, like the species from Bowden, is represented by very fragmentary material.

Chlorostoma (Omphalius) species

Omphalius near *fasciatus* Born, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

The Henderson collection contains three young badly broken specimens (U. S. Nat. Mus. No. 135491) that seem to represent *Chlorostoma*. The sculpture consists of fine spiral threads that are strongest on the base. So far as shape and sculpture go these shells resemble the living West Indian *C. scalare* (Anton), also known as *C. indusii* (Chemnitz), but the sculpture is not so strong.

VITRINELLIDAE

The nomenclature of the small gastropods placed in the families Cyclostrematidae, Adeorbiidae, or Vitrinellidae by different writers is at the present time hopelessly confused. Several different families, or even superfamilies, and many genera probably are represented, but it is impossible to correctly place the fossils until the living species are classified and until an attempt is then made to correlate anatomical characters with shell characters. Probably all the genera placed in this family that are found in the Bowden formation, except *Solariorbis*, are now living in West Indian waters.

VITRINELLA C. B. Adams

C. B. Adams, 1850, Monograph of Vitrinella, p. 3.

Type (*by subsequent designation, Bush, 1897, Trans. Connecticut Acad. Arts and Sci., vol. 10, pp. 105, 106*).—*Vitrinella helicoidea* C. B. Adams. Recent, Jamaica.

Shell small, thin, *Helix*-like, spire low, umbilicus wide and deep, bounded by a sharp keel. Aperture broadly lunate, oblique to vertical axis of shell. Parietal wall covered with relatively thick glaze of callus. Upper part of outer lip, as viewed from above, arched forward between suture and periphery of body whorl. Sculpture limited to growth lines. (Description based on figure given by Bush, cited above.)

According to Miss Bush's type designation, the name *Vitrinella*, which was used by Adams to embrace a number of genera, can be used only for small, smooth, *Helix*-like shells having a wide umbilicus, relatively heavy parietal callus, and an outer lip making a curve convex forward between the suture and the periphery.

Vitrinella gabbi, new species

(Plate 37, Figures 7 to 9)

Shell very small, relatively thick. Whorls slightly appressed at suture, particularly on later half of body whorl. Nucleus consisting of one and a half whorls, the last whorl more inflated than early post-nuclear whorls. Outer lip inflected forward at periphery. Inner lip thickened. Parietal callus moderately heavy. Umbilicus relatively narrow, the keel bounding it obscure. Sculpture consisting only of an obscure spiral cord at suture, due principally to appression of whorl.

Height 0.9 mm.; diameter 1.4 mm.

This small species is represented by seven specimens, all in the Duerden collection. No similar Tertiary species is known in tropical America. *Adeorbis simplex* Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 365, pl. 46, fig. 61, 1881), a Pliocene species from Limon, Costa Rica, has a very wide umbilicus and probably represents *Cyclostremella*.

Type material.—Holotype (U. S. Nat. Mus. No. 369572).

CIRCULUS Jeffreys

Jeffreys, 1865, British Conchology, vol. 3, p. 315.

Type (*by monotypy*).—*Delphinula duminyi* Requien. (In vol. 5, p. 203, this species is considered the same as "*Solarium*" *philippi* Cantraine. Pilsbry (Man. Conchology, vol. 11, pp. 274–275, 1889) considers it the same as "*Valvata*" *striata* Philippi.) Recent, European seas.

Shell small, thin, circular, spire low, umbilicus wide and deep. Nucleus transparent, smooth, consisting of about two whorls. Aperture broadly lunate, oblique to vertical axis of shell. Parietal wall covered with thin glaze of callus. Outer lip not inflected forward between suture and periphery. Upper edge of outer lip serrate, the edge extended by the spiral threads, lower edge drawn out at the basal keel. Inner lip slightly emarginate and turned backward over part of body whorl facing umbilicus. Sculpture of spire and of upper part of body whorl consisting of strong spiral threads. At

base of body whorl lies a spiral keel. Part of body whorl facing umbilicus sculptured with obscure wrinkled spiral threads. According to Bush (Trans. Connecticut Acad. Arts and Sci., vol. 10, p. 111, 1897), operculum thin, horny, having a central nucleus and probably five or more whorls.

The preceding description, which probably embraces some characters that are only of specific value, is based on the specimens of "*Trochus duminyi* Req." (U. S. Nat. Mus. No. 181343) that Jeffreys had before him when he proposed *Circulus* as a subdivision of the genus *Trochus*. This species, whatever its name, is the type of the genus *Circulus*. It has become customary following the example of Miss Bush (Trans. Connecticut Acad. Arts and Sci., vol. 10, pp. 125–129, 1897) to use this name for shells similar to those described below, though this custom is hardly an improvement on the earlier custom of calling them "*Cyclostrema*" or "*Adeorbis*." The generic name *Tornus* Turton and Kingston (type, *Helix subcarinata* Montagu; see Iredale, Proc. Malac. Soc. London, vol. 11, pp. 171–172, 1914), used by some European palaeontologists for similar shells, seems less appropriate than *Circulus*. According to characters of the nucleus and outer lip, it is apparent that three genera are represented by the three species here described. Although these genera may be new, no new names are here introduced, as a revision of these shells should be based on living species.

Key to Bowden species referred to Circulus

Nuclear whorls not abruptly rising from apex.
- Outer lip inflected forward near suture. Axial threads absent between spiral threads..... "*C.*" *bicarinatus*
- Outer lip inflected forward near periphery. Axial threads present between spiral threads..... "*C.*" *partulus*

Nuclear whorls abruptly rising from apex.
- Outer lip not inflected forward between suture and periphery..... "*C.*" *pentagonus*

"Circulus" bicarinatus (Guppy)

(Plate 37, Figures 10 to 12)

Cyclostrema bicarinata Guppy, 1866, Quart. Jour. Geol. Soc. London, vol. 22, p. 291, pl. 17, figs. 5*a*, 5*b*. Guppy, 1874, Geol. Mag., decade 2, vol. 1, p. 441 (list).

Adeorbis beaui Dall (part, not Fischer), 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 345.

Adeorbis beaui Fischer var. *bicarinata* Guppy, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell relatively large and thick, umbilicus wide and deep. Nucleus obscure, apparently consisting of about one and a half smooth whorls, the last one enlarging rapidly. Aperture broadly elliptical, oblique to vertical axis of shell. Parietal wall covered with very thin glaze of callus. As viewed from above, outer lip inflected forward near suture, its outer edge extended by the spiral threads. Inner lip slightly emarginated and thickened along part of body whorl facing umbilicus. Sculpture of spire and of upper part of body whorl consisting of strong spiral threads (4 on body whorl), between which lie fine secondary spiral threads. A similar, but slightly heavier, primary

spiral thread forms the periphery of the body whorl and another lies at its base. On the base are two obscure spiral threads that disappear toward aperture.

Height 4 mm.; diameter 7.5 mm. (neotype).

Type locality.—Jamaica (Miocene).

The inflection of the outer lip near the suture, which is clearly shown by the growth lines and by the unbroken part of the lip itself, probably has some generic significance. Nothing similar to this inflection can be seen on the type species of *Circulus*. The Bowden species lacks the prominent upper and peripheral keels of *Lydiphnis* Melvill (Proc. Malac. Soc. London, vol. 7, p. 25, 1906; type, by original designation, *Cyclostrema euchilopteron* Melvill and Standen, Recent, Gulf of Oman), and even the basal keel is not so expanded as in that genus. According to Melvill's figure, the outer lip is not inflected forward in the smooth curve seen in the Bowden species.

"C." bicarinatus closely resembles a living species from Florida known as *"Adeorbis" beaui* Fischer, though it has a more strongly sculptured base. The type of *bicarinatus* seems to be lost. It originally was in the Barrett collection deposited in the British Museum, but according to Mr. L. R. Cox it is no longer there. The figured specimen, the only specimen now known, is from the Guppy collection and is labeled "type." This specimen is taken as the neotype. Guppy may have carried the original type material back with him to Trinidad, but this is unlikely, as other species, whose types are in the British Museum, are represented in the Guppy collection at the United States National Museum by specimens marked "types." The apparent crust surrounding the umbilicus is glue and is the result of Guppy's custom of gluing specimens to cards.

Type material.—Neotype (U. S. Nat. Mus. No. 115621).

"Circulus" partulus, new species

(Plate 37, Figures 13 to 15)

Shell medium-sized, umbilicus wide and deep. Nucleus consisting of about one and a half apparently smooth whorls. Aperture subcircular, broken back on available specimens, but a thin glaze is visible on parietal wall. According to growth lines, outer lip, as viewed from above, sloping backward to a point just above periphery, then gently sloping forward in a broad curve, thus forming an inflection forward. Sculpture of spire and of upper part of body whorl consisting of closely spaced spiral threads, between which lie very fine axial threads that obscurely bead the sides of the spirals. Near periphery of body whorl lies an area that is smooth except for growth lines arched backward. A prominent slightly upturned spiral thread forms the periphery. Sculpture of base similar to that of upper part, but on part of body whorl near aperture a smooth area faces the umbilicus.

Height 1.5 mm.; diameter 3.9 mm. (holotype).

The axial threads, which produce a punctuate effect when viewed under low magnification, are a characteristic feature of this species.

It is represented by only two imperfect specimens. The upper part of the outer lip is inflected forward near the periphery instead of near the suture, as in *"C." bicarinatus*.

Type material.—Holotype (U. S. Nat. Mus. No. 369573).

"Circulus" pentagonus (Gabb)

(Plate 37, Figures 16 to 18)

Cyclostrema pentagona Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 243.
Vitrinella pentagona (Gabb), Gabb, 1881, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 368, pl. 47, fig. 68.
Adeorbis supranitidus Dall (part, not Wood), Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, pp. 344–345.
Adeorbis near *sincera* Dall, Dall, 1903, Trans. Wagner, Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Circulus pentagona (Gabb), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 397.

Shell small, umbilicus wide and deep. Nucleus consisting of a little more than a whorl, rising abruptly from the apex. Aperture subcircular. Parietal wall covered with thin glaze of callus. Outer lip slightly grooved at junction with body whorl and at intersection of the spiral threads forming the sculpture. According to growth lines, outer lip, as viewed from above not flexed forward, but sloping gently backward, except near periphery where it slopes more rapidly. Sculpture consisting of three spiral threads, one on upper surface of body whorl near periphery, one at periphery, and another at edge of base. Later part of body whorl slightly appressed against suture. Facing umbilicus are spiral threads slightly wrinkled by strong growth lines arched backward.

Height, 1.4 mm.; diameter 3.3 mm. (largest specimen). Height 1 mm.; diameter 2.4 mm. (figured specimen).

Type locality.—Dominican Republic (Miocene).

The abrupt emergence of the nuclear whorls and the absence of an outward inflection on the upper part of the outer lip show that this species does not represent the same genus as *"C." bicarinatus* and *"C." partulus*. Bowden specimens of this species, of which 10 are in the Aldrich collection, are larger than specimens from the Dominican Republic, but closely agree in other features. On the figured specimen the upper spiral thread becomes obscure near the aperture, but on a larger specimen in the Henderson collection (U. S. Nat. Mus. No. 135500) it is as sharp near the aperture as elsewhere.

This species resembles *"Circulus" trilix* (Bush) (see Trans. Connecticut Acad. Arts and Sci., vol. 10, p. 127, pl. 22, figs. 6, 10, 10*a*, 12*a–g*; pl. 23, figs. 10, 15, 1897), a common living species originally dredged off Cape Hatteras in 7 to 17 fathoms, but is smaller and the sculpture facing the umbilicus is stronger. The Bowden shells have stronger spiral, but weaker axial, sculpture facing the umbilicus than in *"Cyclostrema" quadrilineatum* Toula (Jahrb. K.-k. geol. Reichsanstalt, vol. 61, p. 497, pl. 31, figs. 11*a*, *b*, *c*, 1911), a similar species from the Gatun formation of the Panama Canal Zone.

Other localities.—Cercado and Gurabo formations (middle Miocene), Dominican Republic.

Type material.—Holotype (Acad. Nat. Sci. Philadelphia No. 2831).

EPISCYNIA Mörch

Mörch, 1875, Malakozoologische Blätter, vol. 22, p. 155.
Type (*by monotypy*).—*Solarium inornatum* d'Orbigny. Recent, West Indies.

Shell small, thin, polished, circular, spire low, umbilicus moderately wide, deep. Aperture broadly ovate, moderately oblique to vertical axis of shell. Outer lip, as viewed from above, sloping backward from suture to periphery. Basal lip, as viewed from below, arched forward. Parietal wall covered with thin wash of callus. Sculpture consisting principally of a keel along periphery.

The genus *Episcynia* is characterized by its sharp-edged body whorl and moderately wide umbilicus, and also by its thin polished shell. Living shells have a hairy epidermis.

Episcynia naso (Pilsbry and Johnson)

(Plate 37, Figures 19 to 21)

Adeorbis carinata Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 243.
Not *Adeorbis carinata* A. Adams, 1863, Proc. Zool. Soc. London, p. 75.
Vitrinella (*Episcynia*) sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).
Discopsis ? naso Pilsbry and Johnson, 1917, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, pp. 184–185.
Vitrinella (*Episcynia*) *naso* (Pilsbry and Johnson), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 397, pl. 37, figs. 5, 5*a*.

Shell small, polished, umbilicus relatively narrow, deep. Nucleus apparently consisting of almost one whorl. Aperture broken back on only specimens. Parietal callus thin. According to growth lines, upper part of outer lip slopes directly from suture to periphery, but growth lines on base bend forward at outer edge of body whorl. Spire and upper part of body whorl smooth except for faint growth lines. Keel at outer edge of body whorl sharp-edged and bearing very fine projections producing a serrate profile, not visible on the photographs. From the projections obscure wrinkles extend for very short distance on base. Base irregularly wrinkled near keel at edge of umbilicus.

Height 1.3 mm.; diameter 2.4 mm. (figured specimen).

Type locality.—Dominican Republic (Miocene).

The two Bowden specimens of this species are smaller than the type in the Gabb collection, the only specimen so far collected in the Dominican Republic. It is similar to the genotype *E. inornata* (d'Orbigny), but the Recent species has a smooth keel. Pilsbry's figure of the type shows that the inner lip is slightly bent back at the umbilicus.

Other localities.—Miocene, Dominican Republic (Gabb).

Type material.—Holotype (Acad. Nat. Sci. Philadelphia No. 2832).

SOLARIORBIS Conrad

Conrad, 1865, American Jour. Conchology, vol. 1, p. 30.

Type (by subsequent designation, Dall, 1892, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 414).—Delphinula depressa Lea. Middle Eocene, Alabama.

Shell medium-sized, moderately thick, spire low. Nucleus consisting of a few smooth whorls. Aperture flattened at base. Parietal callus thin. Outer lip, as viewed from above, bent backward near periphery, distinctly channeled at junction with parietal callus. Inner lip thickened by a smooth area spirally arranged around umbilicus and resembling callus. Sculpture (of type species) consisting of punctate spiral grooves and obscure axial threads.

It is doubtful whether the Bowden species belong to this genus, at least in the restricted sense. They have the channel at the junction of outer lip and parietal callus, but the parietal callus is heavier and the base is not covered with a smooth callus-like area.

Key to Bowden species referred to Solariorbis

Body whorl bounded by upturned keel, spiral sculpture strong.....*S. clypeatus*
Body whorl not bounded by upturned keel, spiral sculpture obscure.....*S. colpus*

Solariorbis clypeatus Guppy

(Plate 38, Figures 1 to 3)

Solariorbis clypeatus Guppy, 1896, Proc. U. S. Nat. Mus., vol. 19, p. 323, pl. 27, fig. 3. Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell medium-sized, umbilicus relatively wide. Nucleus consisting of a little more than one smooth whorl, its later part more inflated and larger than beginning of first post-nuclear whorl Aperture modified by keel at edge of body whorl. Outer lip, as viewed from above, bent backward near keel at periphery. Parietal callus thick, especially near junction with outer lip, and distinctly channeled at junction with outer lip. Periphery consisting of an upturned keel, behind which lies a wide furrow. Sculpture of spire and upper part of body whorl consisting of fine spiral grooves and obscure axial grooves, which disappear on later part of body whorl. Base sculptured with fine spiral grooves modified by axial wrinkles near umbilicus.

Height 1.8 mm.; diameter 3.8 mm. (figured specimen).

Type locality.—Jamaica (Miocene).

On large shells, such as the one figured, the later part of the body whorl is not so tightly coiled as the other whorls, leaving a groove at the suture. Both specimens in the type lot are smaller than the specimen figured. The smaller of these two is recognized as the specimen originally figured. The upturned keel at the edge of the body whorl is an unmistakable feature of this species, which is represented by 13 specimens in the Aldrich collection. It has a wider umbilicus than the type species of *Solariorbis* and other American Tertiary species. *S. microforatis* (Dall) (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 415, pl. 23, figs. 9, 10, 1892), a species from the Chipola formation of Florida, is more similar to the type species of the genus except for the thin parietal callus.

Type material.—Holotype (U. S. Nat. Mus. No. 107075).

Solariorbis colpus, new species

(Plate 38, Figures 4 to 6)

Shell small, umbilicus relatively wide, the part of the whorl facing it concave. Nucleus obscure. Outer lip, as viewed from above, gently curving backward between suture and periphery. Basal lip thickened where umbilical keel meets it. Parietal callus heavy, channeled at junction with outer lip. Sculpture consisting of very fine obscure spiral grooves. Periphery near parietal wall consisting of a sharp keel, which disappears on later two-thirds of body whorl. Umbilicus bounded by sharp keel.

Height 1.1 mm.; diameter 2.5 mm. (holotype).

The thickening of the basal lip at its junction with the umbilical keel produces an aperture somewhat like that of *S. depressa* Lea, the type species of *Solariorbis*. No other American species seems to have the deeply concave umbilicus. This species is represented only by the holotype.

Type material.—Holotype (U. S. Nat. Mus. No. 369576).

TEINOSTOMA H. and A. Adams

Subgenus TEINOSTOMA s. s.

H. and A. Adams, Aug., 1853, Genera Recent Mollusca, vol. 1, p. 122.

Type (*by subsequent designation, Cossmann, 1888, Cat. Ill. Coq. éoc. Paris, pt. 3, p. 48*).—*Teinostoma politum* A. Adams (Cossmann used *"Tinostoma"*). Recent, Ecuador.

Shell medium-sized, thick, ovate, spire low, base flat. Nucleus concealed by overlap of later whorls, all of which overlap until last half-turn. Aperture flattened, ovate. Outer lip, as viewed from above, slightly flexed forward near suture, then extending almost straight to outer edge of body whorl. Umbilicus filled with thick layer of callus that spreads upward to outer lip and downward over large part of base of shell. Parietal callus very narrow, reaching down on basal lip. Sculpture consisting of vague suggestions of spiral striae.

The preceding description is based on the figure of the genotype given by H. and A. Adams (Gen. Rec. Moll., vol. 1, p. 123, pl. 12, fig. 9, 1853), and on specimens from the Gulf of California that represent this species or a very similar one (U. S. Nat. Mus. No. 34131). Despite the difference in size, shape, and sculpture, *Teinostoma laccus* seems to be a *Teinostoma* s. s., for its umbilical callus reaches the outer lip, and the parietal callus is narrow and overlaps only a small part of the umbilical callus. It is doubtful whether the many Tertiary species from eastern America and Europe called *Teinostoma* can be regarded as representing *Teinostoma* s. s.

Iredale (Proc. Linn. Soc. New South Wales, vol. 49, p. 233, 1924) called attention to the earliest publication of this name, which generally is accredited to A. Adams (Proc. Zool. Soc. London, pt. 21, p. 183, 1853). In designating *T. politum* as the type Iredale overlooked at least two earlier designations by Cossmann.

Teinostoma (Teinostoma) laccus, new species

(Plate 38, Figures 7 to 9)

Shell small, hemispherical, base flat, early whorls embracing, suture visible only on last half-turn. Outline of aperture modified by flat base. Margin of umbilical callus extending upward and forming edge of thickened area at suture. Parietal callus covering small part of umbilical callus, thickened near suture, its edge extending down along basal lip, causing it to appear everted. Sculpture of entire shell consisting of fine, strong spiral threads, the spaces between which are made punctate by microscopic axial threads, which are too fine to show on the photographs. Spiral threads on umbilical callus making an angle with those elsewhere on base.

Height 1.5 mm.; diameter 2.7 mm. (holotype).

This strikingly sculptured species, which is represented by only two specimens, is unlike any described American species. In some features it resembles the subgenus *Idioraphe* Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 398, 1922; type, by original designation, *Cyclops angulatum* Gabb, Miocene, Dominican Republic), but its umbilical callus reaches the outer lip, and its parietal callus is narrower. The enveloping whorls, considered a characteristic feature of *Idioraphe* by Pilsbry, are also found in *Teinostoma* s. s. An undescribed species, very similar to *T. laccus*, was collected in the Dominican Republic by the U. S. Geological Survey expedition from the Cercado formation on Rio Cana at Caimito.

Type material.—Holotype (U. S. Nat. Mus. No. 369577).

PSEUDOROTELLA Fischer

Fischer, 1857, Journal de Conchyliologie, vol. 6 (ser. 2, vol. 2), p. 52.
Type (*by monotypy*).—*Rotella semistriata* d'Orbigny. Recent, West Indies.

Shell small, moderately thin or thick, circular, spire low. Outer lip, as viewed from above, arched backward between suture and periphery. Basal lip, as viewed from below, arched backward. Umbilicus covered with moderately thick subcircular callus that covers only small part of base and fails to reach suture. Parietal callus overlapping only small part of umbilical callus, thickened and slightly channeled where it meets outer lip, extending down on part of basal lip as very narrow border causing it to appear everted. Sculpture (of type species) consisting of very fine spiral threads on spire and on upper part of body whorl. (Description based on d'Orbigny's figures, in Sagra's Hist. fis. polit. nat. Isla de Cuba, Moluscos, pp. 185–186, pl. 18, figs. 20–22, 1845, Spanish ed.)

No specimens agreeing with d'Orbigny's figures are available. The rather strong eversion of the basal lip and lower part of the outer lip, shown in fig. 22 of d'Orbigny's report, probably is misleading. *Pseudorotella* generally is regarded as a subgenus or section of *Teinostoma*, but the forward arching of the outer lip, backward arching of the basal lip, small umbilical callus, heavy slightly channeled parietal callus, and uncovered spire seen to justify generic standing.

The agreement between *Pseudorotella pycna* and d'Orbigny's figures of the genotype is reasonably close. As this Bowden species resembles

Umbonium vitreum Gabb, the type of *Parkeria* Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 368, 1881; type, by original designation), Fischer's contention that *Parkeria* is a synonym of *Pseudorotella* seems justified (Man. Conchyl., p. 834, 1887). Pilsbry has pointed out that *Parkeria* is preoccupied (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 399, 1922). The other Bowden species *P. homala*, seems to represent a different division of *Pseudorotella*, as, aside from differences in outline and sculpture, its umbilical callus covers a larger area and its upper edge is not semicircular. This species in some features suggests *Rotellorbis* Cossmann (see Cossmann, Essais Paléoconch. Comp., pt. 11, pp. 91–93, 1918), but it lacks the basal ridge that modifies the outline of the spire.

Key to Bowden species referred to Pseudorotella

Upper edge of umbilical callus semicircular, shell smooth.....*P. pycna*
Upper edge of umbilical callus not semicircular, shell sculptured with spiral threads and obscure axial threads.....*P. homala*

Pseudorotella pycna, new species

(Plate 38, Figures 10 to 12)

Teinostoma sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, thick, smooth, shining. Body whorl appressed at suture, forming obscure spiral thread at suture. Nucleus difficult to distinguish from post-nuclear whorls. Outer lip, as viewed from above, arched forward between suture and periphery. Basal lip arched backward very slightly. Edge of outer and basal lips thick due to thickness of shell. Umbilical callus small, its upper edge semicircular, its lower edge extending downward and forming thin border to edge of part of basal lip. Parietal callus heavy, slightly thickened and obscurely channeled at junction with outer lip.

Height 1.4 mm.; diameter 2 mm. (holotype).

Pseudorotella pycna resembles *P. vitrea* (Gabb) (see Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 399, pl. 37, figs. 3, 3*a*, 3*b*, 1922), a species represented in collections from the Cercado formation of the Dominican Republic, but it is thicker, its body whorl is appressed to the suture, and its umbilical callus is more circular. "*Teinostoma* (*Pseudorotella ?*) *caronensis*" (Mansfield), described from beds of middle Miocene age in Trinidad (Proc. U. S. Nat. Mus., vol. 66, art. 22, p. 60, pl. 8, figs. 9, 11, 1925), is thick-shelled like the Bowden species, but its body is not appressed at the suture and it is sculptured with microscopical spiral striae. It should be noted that Mansfield's name is preoccupied by *Teinostoma caroniense* Maury (Bull. Am. Paleontology, vol. 10, p. 401, pl. 54, figs. 3, 4, 1925). These two species may possibly be the same, though Maury's shell is three times as large and was collected from the Trinidad upper Miocene Springvale beds.

Type material.—Holotype (U. S. Nat. Mus. No. 135502).

Pseudorotella homala, new species

(Plate 38, Figures 13 to 15)

Shell small, discoidal, periphery flat. Nucleus obscure. Aperture subcircular. Outer lip, as viewed from above, arched forward between suture and periphery, its edge slightly turned upward. Parietal wall covered with heavy coat of callus extending over umbilical callus, thickened and slightly channeled at junction with outer lip. Umbilicus filled with thick layer of callus that extends upward toward suture, but is overlapped by parietal callus. Sculpture consisting of fine spiral threads obscurely wrinkled by microscopic retractive axial threads that are too fine to show on the photographs. Spiral thread at base of outer edge of body whorl heavier than those elsewhere. Base similarly sculptured except where covered with callus.

Height 1.2 mm.; diameter 1.9 mm. (holotype).

This species is represented by two specimens. Two smaller shells that have more rounded whorls and an imperfectly filled umbilicus are doubtfully referred to it. There are no similar American species.

Type material.—Holotype (U. S. Nat. Mus. No. 369578).

DIDIANEMA, new genus

Type.—Didianema tytha, new species.

Shell very small, polished, relatively thick, spire low, body whorl strongly inflated, umbilical opening moderately wide. Aperture subcircular, peristome complete, expanded at contact with body whorl. Outer lip, as viewed from above, arched forward between suture and periphery. Basal lip almost straight. Within aperture and visible on inner lip and parietal wall lies a narrow shelf against which the operculum probably fitted. Basal lip excavated at junction with inner lip. At outer edge of umbilicus are two spiral threads disappearing upward into umbilicus, the inner one disappearing first.

The shelf inside the inner side of the aperture, which is interpreted as an opercular shelf, and the two spiral threads emerging from the umbilical opening are striking features. In some characters this little Bowden shell resembles *"Ethalia" solida* Dall, dredged off Cuba in 310 fathoms, which has the upper part of the peristome similarly expanded and an opercular shelf within the inner side of the aperture. On this Recent species, however, the basal lip is more excavated at its junction with the inner lip, and a heavy wrinkled cord rises from the umbilicus and impinges on this excavated area. It is not known to what genus this species belongs, though it certainly is not *Ethalia* (see Pilsbry, Man. Conch., ser. 1, vol. 11, p. 457, 1889). *"Dillwynella" errata* Guppy, a Miocene species from Trinidad, is very similar to *Didianema tytha*, but no other fossil species are known. It is clear that these small species do not represent *Dillwynella* Dall (Bull. Mus. Comp. Zool. Harvard College, vol. 18, p. 362, 1889; type, by monotypy, *D. modesta* Dall, Recent, West Indies), in which the umbilical opening is completely closed by a thick pad extending far down on the basal lip.

Didianema tytha, new species

(Plate 38, Figures 16 to 18)

General features, aperture, and umbilical region as described above. Nucleus apparently consisting of about half a whorl. Shell smooth except for growth lines.

Height 1.1 mm.; diameter 1.3 mm. (holotype).

D. tytha closely resembles *"Dillwynella" errata* Guppy (Proc. U. S. Nat. Mus., vol. 19, p. 323, pl. 27, fig. 2, 1896), a species from the *"Ditrupa"* bed at Pointe-à-Pierre, Trinidad. Though this bed is of Miocene age, its precise age is not yet known. The Bowden species is slightly larger, the upper part of the outer lip is less expanded, the parietal lip is not so closely appressed to the parietal wall, its base is not wrinkled outside the outer umbilical thread, and only two, instead of three, cords rise from the umbilicus. *D. tytha* is represented by four specimens, all in the Aldrich collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369579).

COCCULINIDAE

This family embraces only one genus, *Cocculina,* found in the West Indian region, the north Atlantic, on the Pacific coast of Central and North America, and in the Oriental seas. It is for the most part confined to deep or moderately deep water. In the West Indian region *Cocculina* has been dredged at depths of 230 to 880 fathoms. Farther north along the Atlantic coast of America species have been dredged at depths of 17 to 2033 fathoms, but most of the records show depths greater than 100 fathoms. The Bowden species are the first fossil representatives of the genus found in America.

COCCULINA Dall

Dall, 1882, Proceedings U. S. Nat. Mus., vol. 4, p. 402.

Type (by subsequent designation, Suter, 1913, Man. New Zealand Moll., p. 173).—*Cocculina rathbuni* Dall. Recent, Marthas Vineyard to West Indies.

Shell thin, small or medium-sized, limpet-like, broadly conical. Apex near middle of shell, or behind middle, inclined backward. Nucleus spiral, generally broken off on adult shells, leaving a scar. Sculpture generally consisting of fine radial ribs with or without fine concentric threads. Muscle scar far up in shell, horseshoe-shaped, the ends of the horseshoe open toward the front.

The spiral nucleus and fine sculpture distinguish this genus from other genera of limpet-like shells found in the Bowden formation. Two sections of the genus, based on anatomical features, are recognized among the living species.

Key to the Bowden species of Cocculina

Sculpture consisting of concentric and radial threads.....*C. decussata*
Sculpture consisting of minute beads or pustules.....*C. pustulata*

Cocculina decussata, new species

(Plate 38, Figures 19 to 21)

Shell small, apex subcentral. Nucleus partly embedded in shell, about half a coil visible, coiled in median anterior-posterior plane of shell. Sculpture consisting of fine, closely spaced concentric threads, and finer and more obscure radial threads that for the most part fail to override the concentric threads.

Length 6.8 mm.; width 5.1 mm.; height 2.3 mm. (holotype).

Cocculina decussata is similar to the living species *C. rathbuni* Dall, found in the West Indies and also off Marthas Vineyard. The fossil species, which is represented by seven specimens in the Duerden collection, is smaller and has stronger concentric sculpture.

Type material.—Holotype (U. S. Nat. Mus. No. 369580).

Cocculina pustulata, new species

(Plate 38, Figures 22, 23)

Shell very small, relatively high, apex lying back of middle. Nucleus broken off on type specimen, but half a coil is visible on other shells. Sculpture consisting of minute, closely spaced beads or pustules arranged along intersecting curved radial lines.

Length 4.2 mm.; width 3.5 mm.; height 2.4 mm. (holotype).

The muscle scar can be distinctly seen, but it is so high up in the shell that it would hardly be visible on a photograph of the interior. This species is represented by 10 specimens in the Aldrich collection. The pustular sculpture, which is not found on any of the living American species, is a striking feature.

Type material.—Holotype (U. S. Nat. Mus. No. 369581).

FISSURELLIDAE

The keyhole limpets and slit limpets are represented in the Bowden formation by an unusually large number of genera and species. Pilsbry's classification of the family (Man. Conchology, vol. 12, pp. 140–294, 1890), subject to later changes in nomenclature, is here followed.

Only a few fossils belonging to this family have been described from the Tertiary deposits of tropical America, and most of them, generally described as "*Fissuridea*," belong to the genus *Diodora*. Heretofore the subfamily Fissurellinae was supposed to be unrepresented in American Tertiary deposits older than Pliocene, but the species of *Fissurella* here described extends the record back to middle Miocene time.

FISSURELLINAE

FISSURELLA Bruguière

Subgenus FISSURELLA s. s.

Section Fissurella s. s.

Bruguière, 1789, Encyclopédie Méthodique, Hist. Nat. Vers, vol. 1, p. xiv (genus without species).

Type (*by monotypy, Lamarck, 1799, Mém. Soc. Hist. Nat. Paris, p. 78*).—*Patella nimbosa* Linné. Recent, West Indies.

Shell small or medium-sized, broadly conical, apex lying slightly in front of middle of shell, base level, margin crenulated. Sculpture consisting of radial ribs. Callus bordering interior of apical perforation not truncated posteriorly.

Patella nimbosa Linné must be accepted as the type of *Fissurella*, as Iredale has pointed out (Proc. Mal. Soc. London, vol. 11, p. 331, 1915). This species was cited as the type by Bucquoy, Dautzenberg, and Dollfus (Moll. Roussillon, vol. 1, pt. 11, p. 437, 1886), but other writers, including Pilsbry, have tacitly assumed that *Patella picta* Gmelin (=*P. personata* Martyn) is the type.

The genus *Fissurella* is characterized by having a shell large enough to contain the animal and by having an untruncated callus bounding the anal perforation on the interior of the shell. The subgenus *Fissurella* s. s. is further characterized by having a level basal margin, and the apex is placed near the middle of the shell. The section *Fissurella* s. s. is still further characterized by having a crenulated basal margin, and living shells have no dark-colored band bordering the inner edge of the aperture. The living species are widely distributed for the most part in the warm seas. Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 369, 1881) cited *Fissurella nodosa* (Born) from Pliocene beds at Limon, Costa Rica, but no other Tertiary species are recorded from tropical America.

Fissurella (Fissurella) arguta, new species

(Plate 39, Figures 1 to 3)

Shell small, moderately low, base ovate, posterior end broader than anterior. Apex lying in front of middle. Sculpture consisting of low radial ribs slightly roughened by irregular concentric threads. The radial ribs are of three orders of magnitude, the primary ribs being separated by one to three secondaries. Callus bordering the perforation forming a thin band, bordered by a narrow groove that is slightly wider at the posterior end.

Length 13.8 mm.; width 9.4 mm.; height 3.5 mm. (holotype).

The margin of the shell is partly broken on all of the few specimens, so that the basal crenulation is obscure. In general features this species closely resembles small specimens of *F. rosea* (Gmelin), a living West Indian species, though its apex lies farther from the middle of the shell.

Type material.—Holotype (U. S. Nat. Mus. No. 369582).

FISSURELLIDINAE

LUCAPINA ("Gray") Sowerby

Sowerby, 1835, Conchological Illustrations, *Fissurella*, p. 4.

Type (*by monotypy*).—*Lucapina elegans* Gray (=*Fissurella cancellata* Sowerby). Recent, Florida and West Indies.

Shell small or medium-sized, broadly conical, base ovate, sides of shell generally slightly raised. Apex lying in front of middle of shell, apical

perforation elliptical. Sculpture consisting of radial ribs and concentric threads. Callus surrounding interior of apical perforation slightly truncated at posterior end.

Dall (Proc. U. S. Nat. Mus., vol. 48, pp. 437–439, 1915) has reviewed the status of this genus. The slightly truncated callus is a characteristic feature of *Lucapina*. The living species, called *Chlamydoglyphis* by Pilsbry, are confined to the warm waters of the Caribbean Sea and the near-by coast of the United States. *Lucapina cancellata* (Sowerby) is recorded from the Pliocene Caloosahatchee marl of Florida, but heretofore no Tertiary species were known from tropical America.

Lucapina lipara, new species

(Plate 39, Figures 4 to 7)

Lucapinella near *callomarginata* Carpenter, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1586 (list).

Shell small, ovate. Sides of shell slightly raised. Sculpture cancellate, consisting of strong radial ribs and thin erect concentric frills forming slender beads on the ribs. One secondary rib generally lies between primaries and a tertiary rib may lie between secondaries. Callus slightly truncated at posterior end, its margin rather obscure near anterior end.

Length 9.3 mm.; width 5.9 mm.; height 2.8 mm. (holotype).

On account of its strong cancellate sculpture *Lucapina lipara* closely resembles *L. elongata* Philippi, a living West Indian species, but it is smaller and its concentric frills are not so closely spaced. It is represented by four specimens.

Type material.—Holotype (U. S. Nat. Mus. No. 135356).

LUCAPINELLA Pilsbry

Pilsbry, 1890, Man. Conchology, vol. 12, pp. 179, 195.

Type (*by original designation*).—*Clypidella callomarginata* Carpenter. Recent, Monterey Bay, California, to Magdalena Bay, Lower California.

Shell small or medium-sized, ends of base, especially the posterior end, slightly upturned. Apex subcentral, apical perforation relatively large, shaped like the shell. Sculpture consisting of scaly radial ribs. Callus bounding the interior of the perforation not truncated posteriorly.

The animal of this genus and of other genera in the subfamily Fissurellidinae is much too large for the shell. Living species of *Lucapinella* are confined to the warmer waters of America on both the Atlantic and Pacific sides. *L. limatula* (Reeve), the only living West Indian species, has been found in the lower Miocene Chipola formation of Florida, in the Pliocene Waccamaw marl of North Carolina, and in the Pliocene Caloosahatchee marl of Florida. Heretofore the genus has not been recorded from the Tertiary deposits of tropical America.

Lucapinella limatula vetula, new subspecies

(Plate 39, Figures 8 to 10)

Fissurellidea near *limatula* Reeve, Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1586 (list).

Shell small, ovate, anterior end narrower than posterior. Basal margin slightly contracted at middle of shell, posterior end slightly upturned. Sculpture consisting of scaly radial ribs. At the anterior end a primary rib alternates with a secondary rib, but elsewhere three secondary ribs generally lie between primaries. The ribs are overridden by widely spaced concentric frills forming erect scales. Between the frills are very fine concentric threads. Callus surrounding apical perforation very wide for size of shell. Inner edge of shell thickened.

Length 11.9 mm.; width 6.9 mm.; height 2.4 mm. (holotype).

Externally the Bowden specimens are indistinguishable from *L. l. limatula* (Reeve), though they are a little smaller. The apical callus of the fossils is considerably wider in proportion to the size of the shell than in Recent specimens, and this feature is used as the distinguishing character of the subspecies *vetula*, which is represented by three specimens in the Henderson collection.

Type material.—Holotype (U. S. Nat. Mus. No. 369584).

EMARGINULINAE

DIODORA Gray

Gray, 1821, London Medical Repository, Monthly Journal and Review, vol. 15, p. 233.

Type (*by monotypy*).—*Patella apertura* Mont.[agu] (young shell). Recent, British Islands.

Shell small or medium-sized, conical, ovate. Base level or sides slightly raised. Apex lying in front of middle, perforated. Sculpture consisting of radial ribs and concentric threads. Callus bordering interior of aperture distinctly truncated at posterior end and bordered by a pit.

Iredale (Proc. Mal. Soc. London, vol. 11, p. 331, 1915) has shown that the name *Diodora* displaces the better known name *Glyphis* Carpenter, 1856. The adoption of *Diadora*, as Gray published it in 1847 (Proc. Zool. Soc. London, pt. 15, p. 147), seems unjustified. The living species of this genus have an extensive distribution. Most of the American Tertiary fossils have been described under the name "*Fissuridea*."

Key to the Bowden species of Diodora

Sculpture coarse.....*D. alternata henekeni*
Sculpture fine.....*D. compsa*

Diodora alternata henekeni (Maury)

(Plate 39, Figures 11 to 17)

Lucapina alternata (Say), Gabb, 1873, Trans. Am. Philos. Soc., n. s., vol. 15, p. 244.

Fissuridea henekeni Maury, 1917, Bull. Am. Paleontology, vol. 5, p. 321, pl. 50, fig. 21.

Fissuridea alternata (Say), Maury, 1917, Bull. Am. Paleontology, vol. 5, pp. 321–322, pl. 50, fig. 22 .

Diadora alternata henekeni (Maury), Pilsbry, 1922, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 399.

Shell small, broadly ovate, anterior slope straight or slightly convex, posterior slope convex. Apical perforation small, keyhole-shaped. Sculpture very variable, consisting of radial ribs overridden by concentric frills forming scales or beads on the ribs. On most shells every fourth rib is larger, but there are primary, secondary, and tertiary ribs. Callus thin, the posterior end truncated and bordered by a deep pit.

Length 18 mm.; width 12.2 mm.; height 8.3 mm. (largest specimen).

Type locality.— Rio Cana at Caimito, Dominican Republic (Cercado formation).

Diodora alternata henekeni seems to be a suitable name for West Indian Miocene Diodoras that are similar to *D. a. alternata* (Say), the common keyhole limpet along the southeast coast of the United States and in the West Indies. The figures show that the sculpture may be fine or coarse, but it is not so coarse as in *D. listeri* (d'Orbigny), a living West Indian species. The Bowden shells, of which 25 are in the Duerden collection, are smaller than living specimens of *D. a. alternata*, the largest being not more than half as large as large living specimens. The type specimen of *"Fissuridea" henekeni* was collected from the Cercado formation on Rio Cana, Dominican Republic. The hollow vaulted scales formed by the concentric frills as they override the ribs, mentioned by Maury as a characteristic feature of the type specimen, apparently is not very significant, as some specimens of *D. a. alternata* show the same feature, and it is not apparent on other specimens from the Cercado formation, referred to *"Fissuridea" henekeni* by Maury, nor on specimens from Bowden. According to Pilsbry, the apical perforation of specimens in the Gabb collection from the Dominican Republic is slightly longer than in living shells, but in the Bowden shells the perforation seems to be slightly shorter.

"Fissuridea" derbyi Maury (Brasil Serv. Geol. Mineral. Mon., vol. 4, p. 49, pl. 1, fig. 3, 1925), a species from the lower Miocene Pirabas formation of eastern Brazil, is a well-defined species recalling *D. viridula* (Lamarck), now living in the West Indies and off the coast of Brazil. *"Fissurella" immortalis* White (Arch. Mus. Nac. Rio de Janeiro, vol. 7, p. 200, pl. 10, fig. 10, 1887), from the same locality, probably is a *Diodora*, but it is virtually unrecognizable. Gabb (Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 369, 1881) listed *"Lucapina" alternata* (Say) from Pliocene beds at Port Limon, Costa Rica, and Maury (Bull. Am. Paleontology, vol. 10, p. 401, pl. 54, fig. 1, 1925) described *"Fissuridea" alternata* (Say) from the Pliocene Matura beds of Trinidad. The Trinidad specimens may represent *D. alternata henekeni*, as they are of the same size as specimens from Bowden and the Dominican Republic. No other Tertiary species are recorded from tropical America.

Other localities.—Cercado formation (middle Miocene), Dominican Republic. ? Matura beds (Pliocene), Trinidad.

Type material.—Holotype (Cornell University).

Diodora compsa, new species

(Plate 39, Figures 18 to 20)

Shell small, narrow, ovate, anterior and posterior slopes convex, base level. Apical perforation relatively large, ovate. Sculpture consisting of narrow radial ribs, every second to fourth of which is a primary rib, and of very fine closely spaced concentric threads, which override the ribs, but are barely thickened on their crests. Margin of callus obscure at anterior end, bordered by a deep pit at posterior end.

Length 8.8 mm.; width 5.4 mm.; height 2.7 mm. (holotype).

This species, represented only by the holotype, not only is smaller than *D. alternata henekeni*, but its sculpture is much finer. The fine sculpture suggests that it is not a littoral shell. It is lower and has finer sculpture than *D. fluviana* (Dall), a species from moderately deep water (40 to 200 fathoms) in the West Indian region.

Type material.—Holotype (U. S. Nat. Mus. No. 369588).

PUNCTURELLA Lowe

Subgenus PUNCTURELLA s. s.

Lowe, 1827, Zoological Journal, vol. 3, p. 78.

Type (*by original designation*).—*Patella noachina* Linné. Recent, circumpolar and widely distributed elsewhere.

Most of the species of this genus, which is characterized by the internal shelf extending over the anal perforation, live in moderately deep water. In the subgenus *Puncturella* s. s., which is not represented in the Bowden formation, the apex is not absorbed by the perforation.

Subgenus FISSURISEPTA Seguenza

Seguenza, 1863, Annali del'Accademia degli Aspiranti Naturalisti, Napoli, ser. 3, vol. 2, p. 83.

Type (*herewith designated*).—*Fissurisepta papillosa* Seguenza. Miocene, Sicily.

Shell small, generally thin, conical, ovate. Apex absorbed on adult shells by anal perforation. Sculpture generally consisting of fine beads or of low radial ribs studded with very fine beads. Internal shelf forming a thin almost vertical triangular plate.

Pilsbry apparently considered *Fissurisepta papillosa*, Seguenza's first species, as the type without actually designating it. As no one seems to have gone to the formality of designating a type, it is herewith designated.

The subgenus *Fissurisepta* is characterized by having the apex absorbed on adult shells by the anal perforation. The Bowden species here described has a relatively heavy shell and cancellate sculpture, but it has the apical features of the type species. No other fossil

species have been found in America. According to the figures, *Puncturella phrygia* Grzybowski (Neues Jahrb., Beilage-Band 12, p. 642, pl. 20, figs. 12, 12*a*, 1899), from the Zorritos formation of Peru, is an internal mold of a calyptraeoid genus, probably *Crucibulum*. Nelson (Trans. Connecticut Acad. Arts and Sci., vol. 2, p. 188, 1870) described *Crucibulum inerme* from Zorritos and Grzybowski's species probably is the same thing.

Puncturella (Fissurisepta) vetula, new species

(Plate 39, Figures 21, 22; Plate 40, Figure 1)

Shell small, relatively thick, high, conical, base ovate. Apex leaning backward, occupied by apical perforation. Sculpture consisting of strong radial ribs and concentric threads of about the same width, forming a rectangular mesh with obscure beads at the intersections. Internal shelf triangular, leaning slightly forward.

Length 3.5 mm.; width 2.2 mm.; height 2.8 mm. (holotype).

The strong reticulate sculpture and relatively thick shell separate this species from all the known species. It is represented by two specimens.

Type material.—Holotype (U. S. Nat. Mus. No. 369589).

EMARGINULA Lamarck

Subgenus EMARGINULA s. s.

Lamarck, 1801, Systême des Animaux sans Vertèbres, p. 69.

Type (by monotypy).—Emarginula conica Lamarck (=*Patella fissura* Linné). Recent, northeast Atlantic.

Shell small or medium-sized, conical, ovate. Apex coiled backward and slightly to the right. Anal perforation a deep narrow slit lying at the anterior end. From the slit an anal fasciole, differing in sculpture from the rest of the shell, extends upward to the apex. Sculpture consisting of radial ribs and concentric threads.

The long anterior slit and anal fasciole are characteristic features of the genus *Emarginula*. In addition to *Emarginula* s. s. Pilsbry (Man. Conchology, vol. 12, p. 249, 1890) recognized two other "sections" based on exotic species.

Heretofore no Tertiary species of *Emarginula* were known from tropical America. A species from the Pliocene Caloosahatchee formation of Florida is cited under the description of the following species.

Emarginula (Emarginula) palia, new species

(Plate 40, Figures 2, 3)

Shell small, high, narrow. Apex lying at about posterior third of shell, strongly curved backward, producing a convex anterior slope and a deeply concave posterior slope. Anal notch relatively shallow. Anal fasciole narrower than ribs, sculptured with concentric threads slightly arched up-

ward. Sculpture consisting of heavy, widely spaced radial ribs, generally alternating with secondary ribs, and crude concentric threads overriding the ribs, especially near base of shell.

Length 7.5 mm.; width 4.5 mm.; height 4.5 mm. (holotype).

Part of the anterior margin of the shell is broken and the anal slit appears too short. This species resembles *E. pilsbryi* Dall (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 492, pl. 21, figs. 8, 8*a*, 1892), a species from the Caloosahatchee formation of Florida and the only Tertiary representative of the genus known on the American mainland, but the shell is narrower and has cruder and stronger sculpture. It also is represented only by the holotype.

Type material.—Holotype (U. S. Nat. Mus. No. 369591).

RIMULA Defrance

Defrance, 1827, Dictionnaire des Sciences Naturelles, vol. 45, p. 472.

Type (by subsequent designation, Gray, 1847, Proc. Zool. Soc. London, pt. 15, p. 147).—*Rimula blainvillii* Defrance (cited by Gray as "*Rimularia*"). Eocene, France.

Shell small, broadly conical, ovate. Apex lying near posterior end, curved backward. Anal perforation consisting of a hole lying about halfway up anterior slope. Anal fasciole extending from hole to apex. Sculpture consisting of radial ribs and concentric threads. (Based on original figures of genotype, Dict. Sci. Nat., vol. 45, pl. 48 bis, figs. 1, 1*a*, 1*b*, 1827.)

Gray's designation of "*Rim. blainvillii*" is considered a valid type designation, though he gives the generic name as *Rimularia*, a Latinized rendering of Defrance's Rimulaire. Gray apparently overlooked the Latinized name "*rimula*" given by Defrance for the two species cited under the genus.

In this genus the anal perforation is closed instead of open as in *Puncturella*. Miocene and Pliocene species of *Rimula* are recorded from southeastern United States, but heretofore no Tertiary species were known from tropical America. The living species are found on both the Atlantic and Pacific coasts of tropical America and in the Oriental seas.

Rimula pilsbryi, new species

(Plate 40, Figures 4, 5)

Rimula sp., Dall, 1903, Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, p. 1585 (list).

Shell small, apex lying close to posterior end. Anal perforation a narrow ovate hole. Anal fasciole sculptured with concentric threads, slightly arched upward. Sculpture consisting of relatively heavy radial ribs, between which secondary ribs may lie, and of concentric threads overriding the ribs.

Length 3.7 mm.; width 2.3 mm.; height 2 mm. (holotype).

Rimula pilsbryi, which is represented only by the holotype, is larger than a species from the lower Miocene Chipola formation of Florida described in manuscript by Gardner, and has much heavier sculpture.

Its sculpture is not so reticulate as in *R. caroliniana* (Dall) (Trans. Wagner Inst. Philadelphia, vol. 3, pt. 2, p. 249, pl. 20, fig. 10, 1892), from the Pliocene Waccamaw formation of South Carolina.

Type material.—Holotype (U. S. Nat. Mus. No. 135359).

HEMITOMA Swainson

Subgenus HEMITOMA s. s.

Swainson, 1840, Treatise on Malacology, p. 356.

Type (*by monotypy*).—*Hemitoma tricostata* (Sowerby) (? =*Patella octoradiata* Gmelin; see Pilsbry, Man. Conchology, vol. 12, p. 274, 1890). Recent, Florida and West Indies.

Shell thick, medium-sized, broadly conical, ovate. Apex lying near middle of shell, curved backward. Anal notch short, lying at anterior margin on a prominent rib generally to right of middle of shell. From the notch a groove extends upward on interior of shell. Sculpture consisting of radial ribs and, on some species, of concentric threads. Muscle scar trilobed, the lobes extending toward anterior end, the middle lobe much larger than others. (Based on *Patella octoradiata* Gmelin.)

The short anal notch lying on a rib that has the same sculpture as the other ribs is a characteristic feature of the genus *Hemitoma*, more generally known as "*Subemarginula* Blainville" (Les Subémarginules). Living species of the subgenus *Hemitoma* s. s. are found in the West Indian and Oriental regions. Heretofore no Tertiary species of *Hemitoma* were known from tropical America, and the oldest species on the mainland (*H. retiporosa* (Dall), Trans. Wagner Inst. Philadelphia, vol. 3, pt. 6, pl. 55, fig. 3; pl. 60, fig. 17; 1903, Caloosahatchee formation, Florida) is of Pliocene age. The specimen from Cuba figured by d'Orbigny (in Sagra's Hist. phys. polit. nat. Cuba, Paléont., pp. 40–41, pl. 3, figs. 11–12, "1852") as *Emarginula clausa* d'Orbigny probably is of Pleistocene age and seems to represent *Hemitoma octoradiata* (Gmelin).

Hemitoma (Hemitoma) sclera, new species

(Plate 40, Figures 6, 7)

Shell relatively small, apex slightly curved backward. Anal notch lying on rib slightly to right of middle of shell. Sculpture crude, consisting of lumpy radial ribs and irregular concentric bands, visible for the most part as lumps on the ribs.

Length 13.1 mm.; width 9.9 mm.; height 7.2 mm. (holotype).

The only specimen of this species is partly coated with a calcareous crust, like that seen on some specimens of the Recent *H. octoradiata* (Gmelin), possibly deposited by calcareous algae. In general features it closely resembles this living West Indian species, but it is smaller and has cruder sculpture. The only other American fossil species, *H. retiporosa* (Dall), mentioned above, has more elegant sculpture than either of these species.

Type material.—Holotype (U. S. Nat. Mus. No. 369592).

SCUTIBRANCHIATA DOCOGLOSSA

ACMAEIDAE

ACMAEA Eschscholtz

Eschscholtz, 1830, in Kotzebue, Neue Reise um die Welt in den Jahren 1823, 24, 25 und 26, Weimar, vol. 2, appendix, p. 24. (English translation, A new voyage round the world, vol. 2, appendix, p. 350, London, 1830.) (Genus without species.) Eschscholtz, 1833, in Rathke, Zoologischer Atlas, pt. 5, p. 16.

Type (*by subsequent designation, Dall, 1871, Am. Jour. Conchology, vol. 6, pt. 3, p. 238*).—*Acmaea mitra* Eschscholtz. Recent, Pacific coast of North America from Aleutian Islands to San Diego, California.

Shell conical or bowl-shaped, of varying height. Apex erect or leaning toward anterior end, lying in front of middle of shell. Shell smooth or sculptured with low radial ribs and fine concentric threads. Muscle impression horseshoe-shaped, open toward anterior end of shell, ends of horseshoe joined by scar of mantle, which loops over head of animal. Edge of aperture generally marked by a border due to a difference in color and texture of shell.

The genera and subgenera of this family are based on the presence or absence of eyes and on characters of the gills and radula. The shells of these genera and subgenera, and also of other limpets, are very similar, but *Acmaea* generally can be distinguished by the border at the edge of the aperture. *Acmaea* and other limpets live in the littoral and laminarian zones attached to rocks or algae. According to Pilsbry (Man. Conchology, vol. 13, p. 5, 1891), only one species is known to live in brackish water.

Heretofore no Tertiary limpets were described from tropical America. The fossil from the Dominican Republic called "*Scurria mitra* Esch." by Gabb (Trans. Am. Philos. Soc., n. s., vol. 15, p. 245, 1873) is referred to *Hipponyx pilosa* (Deshayes) by Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 73, p. 384, 1922). Another fossil mentioned by Gabb on the same page as "*Nacella ?* sp." can be disregarded as an incorrect identification, although it is not mentioned by Pilsbry in his revision of Gabb's collection.

Key to the Bowden species of Acmaea

Shell low, radial sculpture weak ..... *A. actina*
Shell high, radial sculpture strong ..... *A. acra*

Acmaea actina, new species

(Plate 40, Figures 8 to 12)

Shell small, very low, aperture ovate. Apex leaning toward anterior end, lying at about anterior third of length. Sculpture consisting of low, obscure radial ribs, a wide one alternating with one or two narrow ones, all of which are more prominent on posterior part of shell, and of fine closely spaced concentric threads. Faint blotches, which apparently are traces of brownish rays, are visible. Interior edge of shell bordered by a narrow non-chalky band, part of which is broken on type specimen.

Length 13.5 mm.; width 9.8 mm.; height 2.9 mm. (holotype).

This limpet is represented by four specimens in the Henderson collection. The type is larger than any other specimen, and is the only one that shows the non-chalky band at the edge of the aperture. It resembles on a small scale *A. antillarum* (Sowerby), also known as *A. candeana* (d'Orbigny), a living West Indian species.

Type material.—Holotype (U. S. Nat. Mus. No. 135345).

Acmaea acra, new species

(Plate 40, Figures 13 to 15)

Shell small, conical, high, aperture elliptical. Apex slightly leaning toward anterior end, lying a little in front of middle of shell. Sculpture consisting of relatively high narrow radial ribs, the crests of which undulate in an irregular fashion. A very narrow rib generally alternates with a slightly wider rib. Non-chalky band surrounding the aperture is almost completely broken away on type specimen. Traces of brownish rays are visible between ribs, and upper edge of muscle scar is bordered by a brownish band.

Length 9.1 mm.; width 7.7 mm.; height 4.8 mm. (holotype).

Acmaea acra, which is represented by two shells, resembles small specimens of *A. leucopleura* (Gmelin), a living West Indian species, but is not so elongate. These small specimens of *Acmaea* from Bowden may be misleading, and both species here described may be more similar to living species than is apparent.

Type material.—Holotype (U. S. Nat. Mus. No. 135346).

DESCRIPTION OF PLATES

(Unless otherwise designated, all specimens are from Bowden, Jamaica)

PLATE 1

FIG. 1. *Tralia (Tralia) vetula,* n. sp. Holotype, × 6; Acad. Nat. Sci. Philadelphia No. 12506; page 110.

FIGS. 2, 3. *Siphonaria* species. Two views of same specimen, × 6; U. S. Nat. Mus. No. 135344; page 111.

FIGS. 4, 5. *Williamia parva,* n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369311; page 111.

FIGS. 6, 7. *Cavolina telemus* (Linné). (6) Dorsal and (7) ventral parts originally belonging to same specimen, × 6; U. S. Nat. Mus. No. 369312; page 113.

FIGS. 8, 9. *Cavolina ventricosa* (Guppy). (8) Dorsal and (9) ventral views of same specimen, × 6; U. S. Nat. Mus. No. 369313; page 114.

FIGS. 10, 11. *Cavolina digitata* (Guppy). (10) Dorsal and (11) ventral views of same specimen, × 6; U. S. Nat. Mus. No. 369315; p. 114.

FIGS. 12, 13. *Cavolina vendryesiana* (Guppy). (12) Dorsal and (13) ventral views of same specimen, × 6; U. S. Nat. Mus. No. 369315; page 115.

FIGS. 14 to 17. *Diacria bisulcata* Gabb. (14) Dorsal and (15) ventral views of small specimen, × 6; U. S. Nat. Mus. No. 135474; (16) dorsal and (17) ventral views of large specimen, × 6; U. S. Nat. Mus. No. 369316; page 116.

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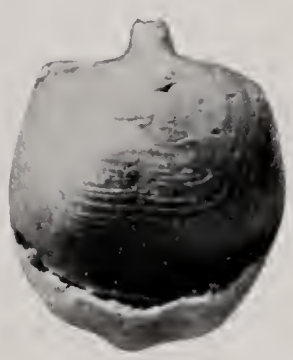

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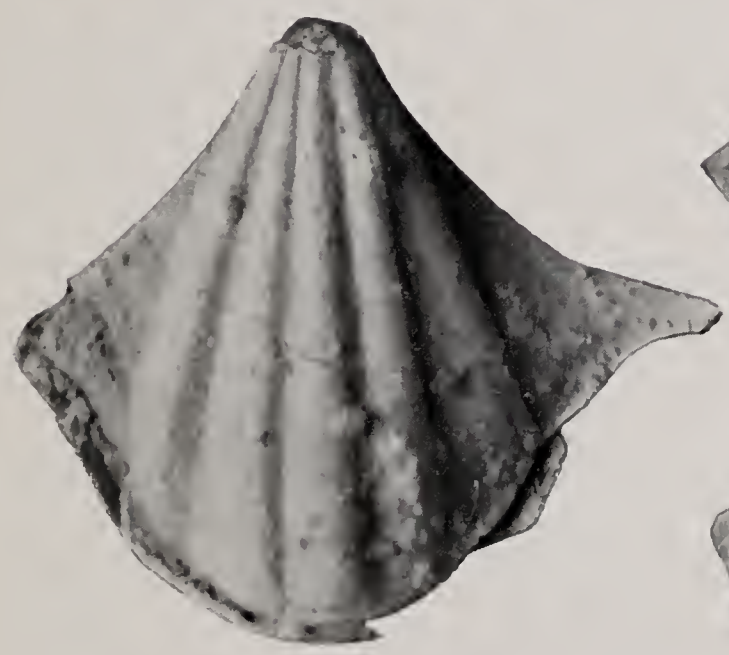

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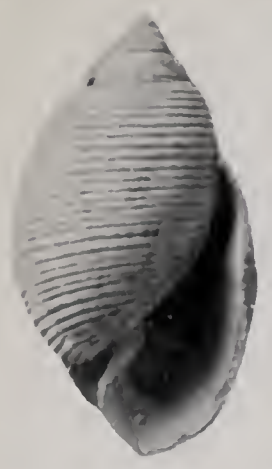
1. Tralia (Tralia) vetula, × 6
2, 3. Siphonaria sp., × 6
4, 5. Williamia parva, × 6
6, 7. Cavolina telemus, × 6
8, 9. Cavolina ventricosa, × 6
10, 11. Cavolina digitata, × 6
12, 13. Cavolina vendryesiana, × 6
14 to 17. Diacria bisulcata, × 6

PLATE 2

FIG. 1. *Acteon textilis* (Guppy). Holotype, × 2; U. S. Nat. Mus. No. 115434; page 117.
FIG. 2. *Acteon eurystoma*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369317; page 118.
FIG. 3. *Acteon riomaensis* Maury, × 6; U. S. Nat. Mus. No. 369318; page 118.
FIG. 4. *Acteocina subbullata* Pilsbry and Johnson, × 4; U. S. Nat. Mus. No. 369319; page 120.
FIG. 5. *Acteocina lepta*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369320; page 121.
FIG. 6. *Acteocina anetaspira*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369321; page 121.
FIG. 7. *Acteocina coixlacryma* (Guppy). Neotype, × 6; U. S. Nat. Mus. No. 369322; page 122.
FIG. 8. *Sulcularia lipara*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369323; page 123.
FIG. 9. *Cylichnella atacata*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369324; page 124.
FIG. 10. *Volvula oxytata* Bush, × 6; posterior spine broken; U. S. Nat. Mus. No. 369325; page 125.
FIGS. 11, 12. *Volvula ornata* Pilsbry and Johnson, × 6; posterior spine broken on both specimens; U. S. Nat. Mus. No. 369326; page 126.
FIGS. 13, 14. *Scaphander nannus*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369327; page 126.
FIGS. 15, 16. *Atys* (*Aliculastrum*) *morantensis*, n. sp. (15) Holotype, × 6; U. S. Nat. Mus. No. 369328; (16) larger, more cylindrical specimen, × 6; U. S. Nat. Mus. No. 369329; page 128.
FIGS. 17, 18. *Atys* (*Aliculastrum*) *dalli*, n. sp. (17) Holotype, × 6; U. S. Nat. Mus. No. 369330; (18) larger, more imperfect specimen, × 6; U. S. Nat. Mus. No. 369331; page 128.
FIG. 19. *Cylichna aula*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369332; page 129.
FIGS. 20, 21. *Bulla vendryesiana* Guppy. (20) Holotype, × 1.5; U. S. Nat. Mus. No. 115432; (21) larger broken specimen, × 1.5; U. S. Nat. Mus. No. 369333; page 130.
FIG. 22. *Ringicula* (*Ringiculella*) *tridentata* Guppy. Neotype, × 8; U. S. Nat. Mus. No. 369334; page 132.
FIGS. 23 to 25. *Atlanta* (*Atlanta*) *diamesa*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369335; page 133.
FIGS. 26, 27. *Atlanta* (*Atlantidea*) *lissa*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369336; page 134.



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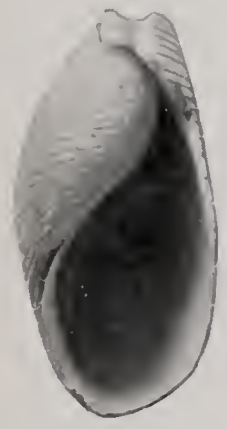

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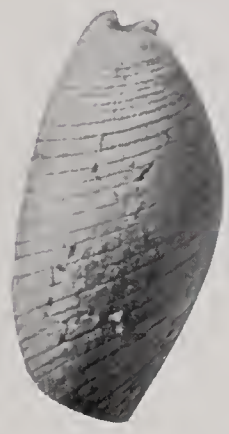

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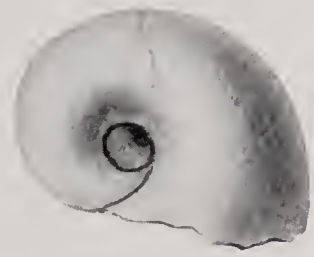

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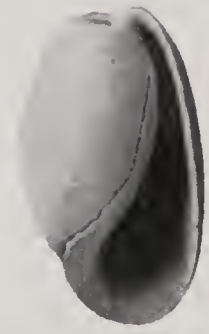

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1. Acteon textilis, × 2
2. Acteon eurystoma, × 4
3. Acteon riomaensis, × 6
4. Acteocina subbullata, × 4
5. Acteocina lepta, × 8
6. Acteocina anetaspira, × 8
7. Acteocina coixlacryma, × 6
8. Sulcularia lipara, × 8
9. Cylichnella atacata, × 8
10. Volvula oxytata, × 6
11, 12. Volvula ornata, × 6
13, 14. Scaphander nannus, × 6
15, 16. Atys (Aliculastrum) morantensis, × 6
17, 18. Atys (Aliculastrum) dalli, × 6
19. Cylichna aula, × 8
20, 21. Bulla vendryesiana, × 1.5
22. Ringicula (Ringiculella) tridentata, × 8
23 to 25. Atlanta (Atlanta) diamesa, × 8
26, 27. Atlanta (Atlantidea) lissa, × 8

PLATE 3

FIG. 1. *Terebra* (*Paraterebra*) *lepta*, n. sp. Holotype, × 1.5; U. S. Nat. Mus. No. 369337; page 136.

FIG. 2. *Terebra* (*Paraterebra*) species, × 1; specimen turned too far to left, distorting appearance of anterior canal; U. S. Nat. Mus. No. 135282; page 137.

FIGS. 3 to 8. *Terebra* (*Strioterebrum*) *bowdenensis*, n. sp. (3) Holotype, × 2; U. S. Nat. Mus. No. 369338; (4) specimen with moderately stout nucleus, × 10; U. S. Nat. Mus. No. 369339; (5) specimen with stout nucleus, × 6; U. S. Nat. Mus. No. 135286; (6) and (7) slender specimens, × 2; (8) large specimen with crowded and curved axials, × 2; U. S. Nat. Mus. No. 369340; page 138.

FIGS. 9 to 11. *Terebra* (*Strioterebrum*) *eleutheria*, n. sp. (9) Holotype, × 2; U. S. Nat. Mus. No. 369341; (10) apical whorls, × 10; U. S. Nat. Mus. No. 369342; (11) strongly sculptured specimen, × 3; U. S. Nat. Mus. No. 369343; page 139.

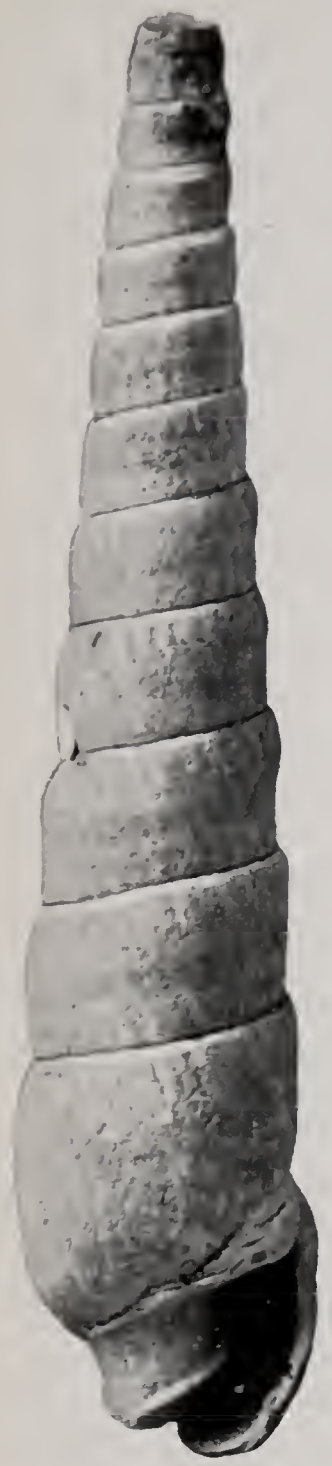
FIGS. 12 to 14. *Terebra* (*Strioterebrum*) species *a*. (12) and (13) same specimen, × 3; U. S. Nat. Mus. No. 369344; (14) doubtfully identified specimen showing nuclear whorls, × 6; U. S. Nat. Mus. No. 369345; page 140.

FIG. 15. *Terebra* (*Strioterebrum*) species *b*, × 3; U. S. Nat. Mus. No. 369346; page 140.

FIG. 16. *Terebra* (*Strioterebrum*) species *c*, × 2; U. S. Nat. Mus. No. 369620; page 140.

FIG. 17. *Terebra* (*Strioterebrum*) *monida*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 369347; page 141.

FIG. 18. *Terebra* (*Strioterebrum*) *ischna*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369609; page 142.



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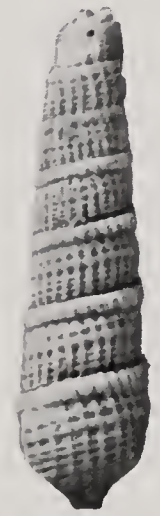

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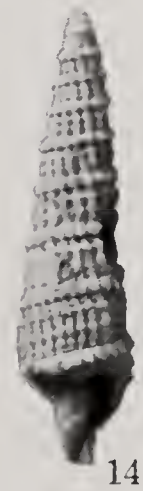

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1. Terebra (Paraterebra) lepta, × 1.5
2. Terebra (Paraterebra) sp., × 1
3. Terebra (Strioterebrum) bowdenensis, × 2
4. Terebra (Strioterebrum) bowdenensis, × 10
5. Terebra (Strioterebrum) bowdenensis, × 6
6 to 8. Terebra (Strioterebrum) bowdenensis, × 2
9. Terebra (Strioterebrum) eleutheria, × 2
10. Terebra (Strioterebrum) eleutheria, × 10
11. Terebra (Strioterebrum) eleutheria, × 3
12, 13. Terebra (Strioterebrum) sp. *a*, × 3
14. Terebra (Strioterebrum) sp. *a* ?, × 6
15. Terebra (Strioterebrum) sp. *b*, × 3
16. Terebra (Strioterebrum) sp. *c*, × 2
17. Terebra (Strioterebrum) monida, × 2
18. Terebra (Strioterebrum) ischna, × 4

PLATE 4

FIG. 1. *Terebra* (*Strioterebrum*) *ischna*, n. sp. Specimen with obscure spiral sculpture, × 4; U. S. Nat. Mus. No. 369610; page 142.

FIGS. 2, 3. *Terebra* (*Strioterebrum*) *cambiarsoi nugatoria*, n. subsp. (2) Holotype, × 2; U. S. Nat. Mus. No. 369348; (3) smaller specimen showing nuclear whorls and the two strong columellar folds, × 3; U. S. Nat. Mus. No. 369349; page 142.

FIG. 4. *Hastula jamaicensis*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 369350; page 143.

FIG. 5. *Hastula homala*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 135287; page 143.

FIGS. 6, 7. *Polystira barretti* (Guppy). (6), × 1.5; (7) apical whorls, × 10; U. S. Nat. Mus. No. 369361; page 146.

FIG. 8. *Crassispira jamaicensis* (Guppy), × 2; U. S. Nat. Mus. No. 115579; page 149.

FIG. 9. *Crassispira ponida*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 135365; page 150.

FIG. 10. *Crassispira lomata*, n. sp. Holotype, × 3; U. S. Nat. Mus. No. 369362; page 150.

FIG. 11. *Crassispira annella*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369363; page 151.

FIG. 12. *Crassispira aegis*, n. sp. Holotype, × 1.5; U. S. Nat. Mus. No. 369364; page 151.

FIG. 13. *Clathrodrillia tityra*, n. sp. Holotype, × 1.5; U. S. Nat. Mus. No. 369365; page 153.

FIGS. 14, 15. *Carinodrillia elocata meta*, n. subsp. (14) Holotype, × 2; U. S. Nat. Mus. No. 115576; (15) specimen with very fine secondary threads that fail to show, × 2; U. S. Nat. Mus. No. 369366; page 154.

FIG. 16. *Carinodrillia bocatoroensis* (Olsson), × 1.5; U. S. Nat. Mus. No. 135362; page 155.

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1. Terebra (Strioterebrum) ischna, × 4
2. Terebra (Strioterebrum) cambiarsoi nugatoria, × 2
3. Terebra (Strioterebrum) cambiarsoi nugatoria, × 3
4. Hastula jamaicensis, × 2
5. Hastula homala, × 4
6. Polystira barretti, × 1.5
7. Polystira barretti, × 10
8. Crassispira jamaicensis, × 2
9. Crassispira ponida, × 2
10. Crassispira lomata, × 3
11. Crassispira annella, × 4
12. Crassispira aegis, × 1.5
13. Clathrodrillia tityra, × 1.5

14, 15. Carinodrillia elocata meta, × 2

16. Carinodrillia bocatoroensis, × 1.5

PLATE 5

FIGS. 1, 2. *Compsodrillia urceola*, n. sp. (1) Holotype, × 4; U. S. Nat. Mus. No. 369367; (2) specimen with bulging nuclear whorls, × 4; U. S. Nat. Mus. No. 369368; page 156.

FIG. 3. *Compsodrillia catherina*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369369; page 156.

FIGS. 4 to 6. *Compsodrillia senaria*, n. sp. (4) Holotype, × 4; U. S. Nat. Mus. No. 369370; (5) unusually slender specimen, × 4; (6) specimen with 5 spiral cords, × 4; U. S. Nat. Mus. No. 135397; page 157.

FIG. 7. *Agladrillia* (*Agladrillia*) *callothyra*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 369371; page 158.

FIG. 8. *Agladrillia* (*Agladrillia*) *leptalea*, n. sp. Holotype, × 3; U. S. Nat. Mus. No. 369372; page 158.

FIG. 9. *Agladrillia* (*Eumetadrillia*) *serra*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369373; page 159.

FIG. 10. *Leptadrillia parkeri* (Gabb), × 2; U. S. Nat. Mus. No. 369374; page 160.

FIGS. 11 to 14. *Syntomodrillia espyra*, n. sp. (11) Holotype, × 6; U. S. Nat. Mus No. 135400; (12) specimen with larger nuclear whorls, × 6; (13) specimen with rather strong microscopic spirals, × 6; U. S. Nat. Mus. 369375; (14) immature specimen with rather stout, two-whorled nucleus, × 6; U. S. Nat. Mus. No. 135400; page 161.

FIG. 15. *Syntomodrillia iphis*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369376; page 161.

FIG. 16. *Globidrillia ula*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369378; page 163.

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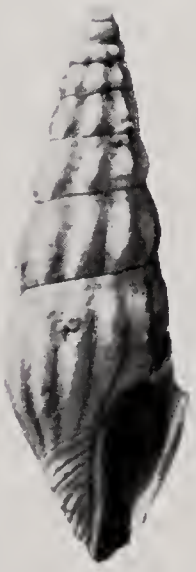

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1, 2. Compsodrillia urceola, × 4
3. Compsodrillia catherina, × 6
4 to 6. Compsodrillia senaria, × 4
7. Agladrillia (Agladrillia) callothyra, × 2
8. Agladrillia (Agladrillia) leptalea, × 3
9. Agladrillia (Eumetadrillia) serra, × 4
10. Leptadrillia parkeri, × 2
11 to 14. Syntomodrillia espyra, × 6
15. Syntomodrillia iphis, × 6
16. Globidrillia ula, × 6

PLATE 6

FIGS. 1 to 3. *Ancistrosyrinx miranda* (Guppy). (1) Holotype, × 4; U. S. Nat. Mus. No. 115584; (2) and (3) larger specimen, × 4; U. S. Nat. Mus. No. 135372; page 165.

FIG. 4. *Fusiturricula iole*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 369379; page 167.

FIGS. 5, 6. *Fusiturricula panola*, n. sp. (5) Holotype, × 1.5; U. S. Nat. Mus. No. 115578; (6) larger specimen with broken anterior canal, × 2; U. S. Nat. Mus. No. 369380; page 167.

FIG. 7. *Ithycythara psiloides*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369381; page 169.

FIG. 8. *Ithycythara ischna*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 135413; page 169.

FIG. 9. *Ithycythara maera*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369382; page 170.

FIG. 10. *Ithycythara scissa*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369383; page 170.

FIG. 11. *Adelocythara primolevis*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369385; page 171.

FIG. 12. *Pyrgocythara eminula*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369386; page 172.

FIG. 13. *Platycythara eurystoma*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 135388; page 172.

FIG. 14. *Thelecythara mucronata* (Guppy). Holotype, × 8; U. S. Nat. Mus. No. 107087; page 173.

FIGS. 15, 16. *Bactrocythara obtusa* (Guppy). (15) Holotype, × 8; U. S. Nat. Mus. No. 107088; (16) smaller specimen with relatively strong spiral cords, × 6; U. S. Nat. Mus. No. 369387; page 174.

FIG. 17. *Pachycythara cryptonata*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369388; page 175.

FIG. 18. *Brachycythara gibba* (Guppy). Holotype, × 8; U. S. Nat. Mus. No. 107144; page 176.

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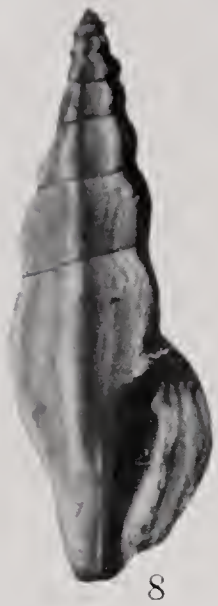

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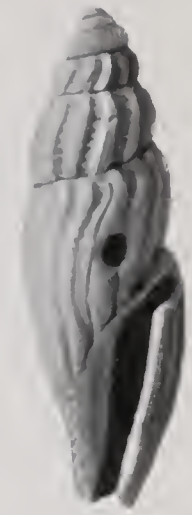

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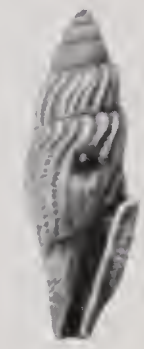

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1 to 3. Ancistrosyrinx miranda, × 4
4. Fusiturricula iole, × 2
5. Fusiturricula panola, × 1.5
6. Fusiturricula panola, × 2
7. Ithycythara psiloides, × 6
8. Ithycythara ischna, × 6
9. Ithycythara maera, × 8
10. Ithycythara scissa, × 6
11. Adelocythara primolevis, × 8
12. Pyrogocythara eminula, × 6
13. Platycythara eurystoma, × 8
14. Thelecythara mucronata, × 8
15. Bactrocythara obtusa, × 8
16. Bactrocythara obtusa, × 6
17. Pachycythara cryptonata, × 6
18. Brachycythara gibba, × 8

PLATE 7

FIG. 1. *Brachycythara* species, × 8; U. S. Nat. Mus. No. 369390; page 176.
FIG. 2. *"Cythara"* species, × 6; U. S. Nat. Mus. No. 369391; page 176.
FIG. 3. *Glyphoturris lampra*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369392; page 178.
FIG. 4. *Cryoturris engonia*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 135406; page 180.
FIG. 5. *Cryoturris euengonia*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 135391; page 180.
FIG. 6. *Cryoturris nexilis*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369393; page 180.
FIG. 7. *Cryoturris nisis*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369393; page 181.
FIG. 8. *Cryoturris etrema*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369395; page 181.
FIG. 9. *Cryoturris dianema*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 135407; page 182.
FIG. 10. *Cryoturris aptera*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369397; page 182.
FIG. 11. *Saccharoturris consentanea* (Guppy). Holotype, × 8; U. S. Nat. Mus. No. 107091; page 183.
FIG. 12. *Acmaturris comparata*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369399; page 184.
FIG. 13. *Acmaturris brisis*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369400; page 184.
FIGS. 14, 15. *Acmaturris scalida*, n. sp. (14) Holotype, × 6; U. S. Nat. Mus. No. 135379; (15) specimen with relatively broad ribs and narrow spirals, × 4; U. S. Nat. Mus. No. 369401; page 185
FIG. 16. *Tenaturris guppyi* (Dall). Holotype, × 6; U. S. Nat. Mus. No. 107145; page 186.
FIG. 17. *Tenaturris terpna*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369402; page 186.
FIG. 18. *Tenaturris isiola*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369403; page 187.

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1. Brachycythara sp., × 8
2. "Cythara" sp., × 6
3. Glyphoturris lampra, × 6
4. Cryoturris engonia, × 6
5. Cryoturris euengonia, × 6
6. Cryoturris nexilis, × 6
7. Cryoturris nisis, × 6
8. Cryoturris etrema, × 6
9. Cryoturris dianema, × 6
10. Cryoturris aptera, × 4
11. Saccharoturris consentanea, × 8
12. Aematurris comparata, × 6
13. Aematurris brisis, × 6
14. Aematurris scalida, × 6
15. Aematurris scalida, × 4
16. Tenaturris guppyi, × 6
17. Tenaturris terpna, × 4
18. Tenaturris isiola, × 4

PLATE 8

FIG. 1. *Euclathurella vendryesiana* (Dall). Holotype, × 4; U. S. Nat. Mus. No. 107086; page 189.

FIGS. 2 to 4. *Miraclathurella vittata*, n. sp. (2) Holotype, × 4; U. S. Nat. Mus. No. 135376; (3) slender specimen with weak sutural cord on body whorl, × 4; U. S. Nat. Mus. No. 369404; (4) unusually stout specimen, × 4; U. S. Nat. Mus. No. 369405; page 190.

FIGS. 5, 6. *Miraclathurella entemna*, n. sp. (5) Holotype, × 4; U. S. Nat. Mus. No. 135374; (6) small specimen, × 4; U. S. Nat. Mus. No. 369406; page 190.

FIGS. 7, 8. *Glyphostoma exopitatum*, n. sp. (7) Holotype, × 2; U. S. Nat. Mus. No. 369408; (8) small specimen with moderately constricted anal fasciole, × 2; U. S. Nat. Mus. No. 369409; page 192.

FIG. 9. *Glyphostoma guppyi*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 369410; page 193.

FIG. 10. *Lioglyphostoma adematum*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369411; page 193.

FIG. 11. *Lioglyphostoma moinica* (Olsson), × 6; U. S. Nat. Mus. No. 369412; page 194.

FIG. 12. *Nannodiella amicta* (Guppy). Holotype, × 10; U. S. Nat. Mus. No. 107142; page 195.

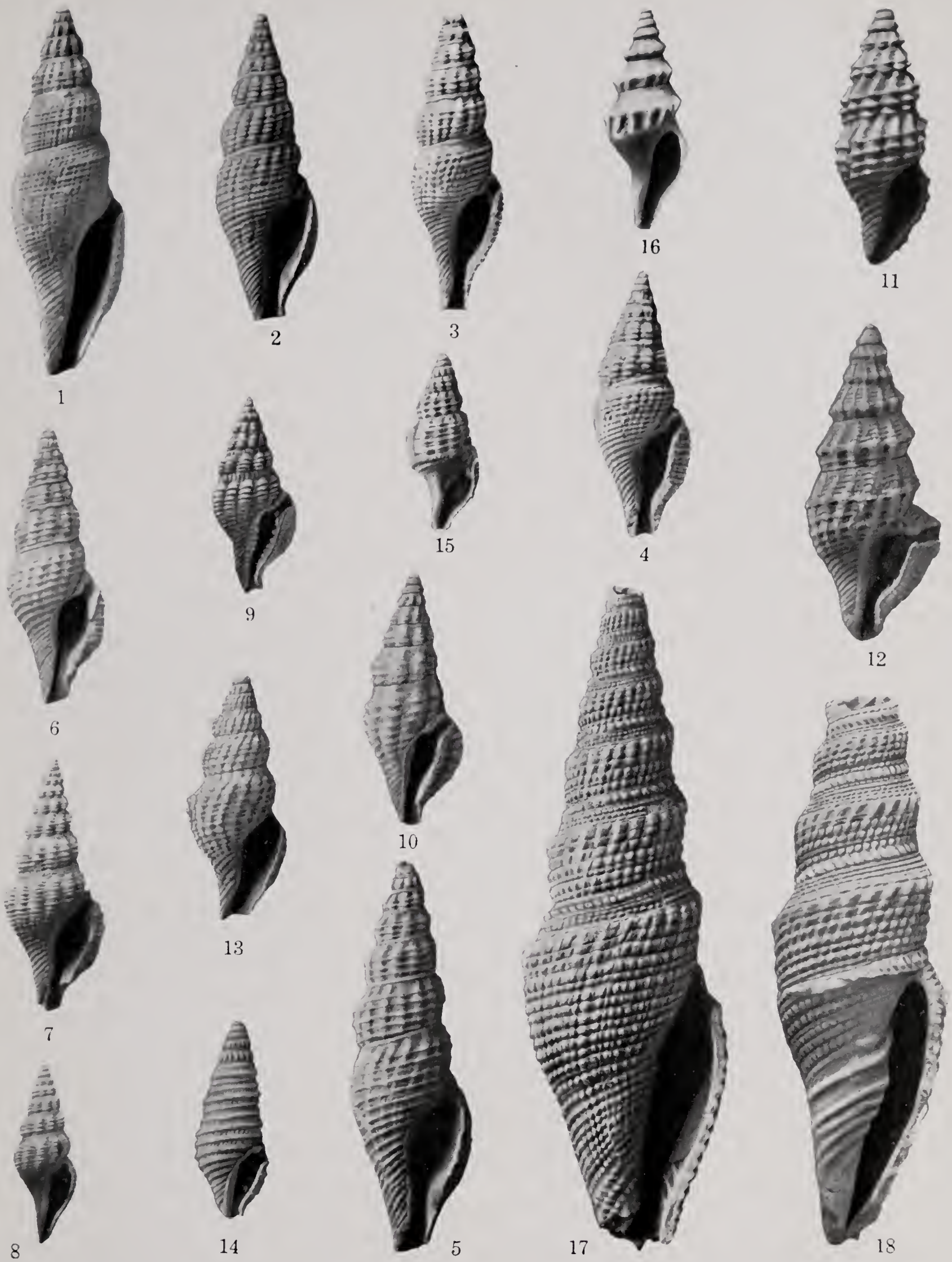
FIG. 13. *Euryentmema cigclis*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369413; page 196.

FIG. 14. *Microdrillia tersa*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369415; page 197.

FIG. 15. *Daphnella ?* species, × 4; U. S. Nat. Mus. No. 135404; page 198.

FIG. 16. "*Daphnella*" species, × 8; U. S. Nat. Mus. No. 369313; page 199.

FIGS. 17, 18. *Scobinella magnifica* (Gabb), × 2. (17) U. S. Nat. Mus. No. 135364; (18) U. S. Nat. Mus. No. 369417; page 200.



1. Euclathurella vendryesiana, × 4
2 to 4. Miraclathurella vittata, × 4
5, 6. Miraclathurella entemna, × 4
7, 8. Glyphostoma exopitatum, × 2
9. Glyphostoma guppyi, × 2
10. Lioglyphostoma adematum, × 4
11. Lioglyphostoma moinica, × 6
12. Nannodiella amicta, × 10
13. Euryentmema cigelis, × 4
14. Microdrillia tersa, × 8
15. Daphnella ? sp., × 4
16. "Daphnella" sp., × 8
17, 18. Scobinella magnifica, × 2

PLATE 9

FIGS. 1, 2. *Vaughanites leptus*, n. sp. (1) Holotype, × 4; U. S. Nat. Mus. No. 369418; (2) small specimen, × 4; U. S. Nat. Mus. No. 369419; page 201.

FIG. 3. *Conus* (*Dendroconus*) *apium*, n. sp. Holotype, × 1.5; U. S. Nat. Mus. No. 369351; page 202.

FIG. 4. *Conus* (*Lithoconus*) *proteus* Hwass, × 1.5; U. S. Nat. Mus. No. 369352; page 204.

FIG. 5. *Conus* (*Lithoconus*) *ancylus*, n. sp. Holotype, × 1.5; U. S. Nat. Mus. No. 135280; page 205.

FIG. 6. *Conus* (*Lithoconus*) *nannus*, n. sp. Holotype, × 1.5; U. S. Nat. Mus. No. 369611; page 206.

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1, 2. Vaughanites leptus, × 4
3. Conus (Dendroconus) apium, × 1.5
4. Conus (Lithoconus) proteus, × 1.5
5. Conus (Lithoconus) ancylus, × 1.5
6. Conus (Lithoconus) nannus, × 1.5

PLATE 10

FIG. 1. *Conus* (*Lithoconus*) *nannus*, n. sp., × 1.5; U. S. Nat. Mus. No. 115585; page 206.

FIG. 2. *Conus* (*Lithoconus*) *guppyi*, n. sp. Holotype, × 1.5; U. S. Nat. Mus. No. 369353; page 206.

FIG. 3. *Conus* (*Chelyconus*) *oniscus*, n. sp. Holotype, × 1.5; U. S. Nat. Mus. No. 369354; page 207.

FIG. 4. *Conus* (*Leptoconus*) *stenostoma* Sowerby, × 1.5; U. S. Nat. Mus. No. 369355; page 209.

FIGS. 5, 6. *Conus* (*Leptoconus*) *imitator lius*, n. subsp. (5) Holotype, × 1.5; (6) small specimen, × 1.5; U. S. Nat. Mus. No. 135276; page 209.

FIGS. 7 to 9. *Conus* (*Leptoconus*) *planiliratus* Sowerby. (7) and (8) Specimens with bulging shoulders, × 1.5; U. S. Nat. Mus. No. 369356; (9) specimen with broad spiral bands, flat anal fasciole, and obscure spirals on anal fasciole, × 1.5; U. S. Nat. Mus. No. 61529; page 210.

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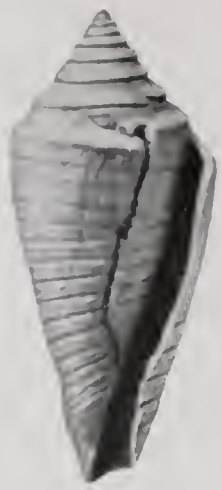

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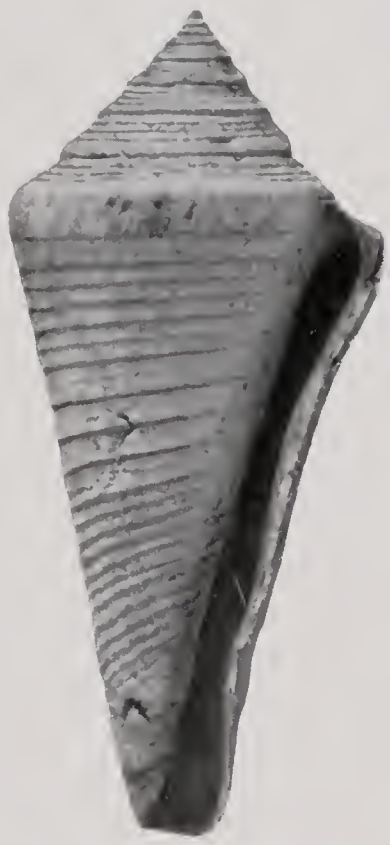

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1. Conus (Lithoconus) nannus, × 1.5
2. Conus (Lithoconus) guppyi, × 1.5
3. Conus (Chelyconus) oniscus, × 1.5
4. Conus (Leptoconus) stenostoma, × 1.5
5, 6. Conus (Leptoconus) imitator lius, × 1.5
7 to 9. Conus (Leptoconus) planiliratus, × 1.5

PLATE 11

FIGS. 1, 2. *Conus* (*Leptoconus*) *planiliratus* Sowerby. (1) Specimen with broad spiral bands, axial wrinkles, flat and fasciole, and weak spirals on anal fasciole, × 1.5; U. S. Nat. Mus. No. 135274; (2) specimen with broad spiral bands, axial wrinkles, flat anal fasciole, and strong spirals on anal fasciole, × 1.5; U. S. Nat. Mus. No. 135277; page 210.

FIG. 3. *Conus* (*Leptoconus*) *multiliratus gaza* Johnson and Pilsbry, × 1.5; U. S. Nat. Mus. No. 369357; page 212.

FIGS. 4, 5. *Conus* (*Leptoconus*) *catenatus* Sowerby, × 1.5; (4) U. S. Nat. Mus. No. 369358; (5) U. S. Nat. Mus. No. 115588; page 213.

FIGS. 6, 7. *Conus* (*Leptoconus*) *consobrinus* Sowerby; (6) × 1.5; U. S. Nat. Mus. No. 369359; (7) young shell, × 1.5; U. S. Nat. Mus. No. 115587; page 214.

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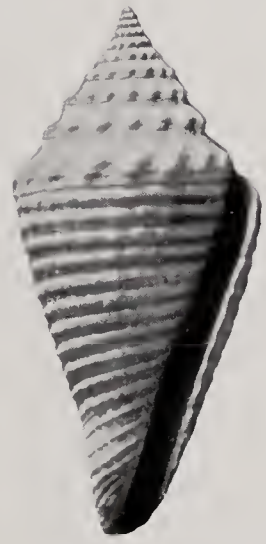

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1, 2. Conus (Leptoconus) planiliratus, × 1.5
3. Conus (Leptoconus) multiliratus gaza, × 1.5
4, 5. Conus (Leptoconus) catenatus, × 1.5
6, 7. Conus (Leptoconus) consobrinus, × 1.5

PLATE 12

FIGS. 1, 2. *Conus* (*Leptoconus*) *granozonatus* Guppy, × 2; (1) U. S. Nat. Mus. No. 369360; (2) specimen from Guppy collection; U. S. Nat. Mus. No. 115587; page 215.

FIGS. 3, 4. *Conus* (*Leptoconus*) *gracilissimus* Guppy, × 1.5; (3) U. S. Nat. Mus. No. 115589; (4) small specimen, with weak tubercles on shoulder; U. S. Nat. Mus. No. 115586; both specimens from Guppy collection; page 216.

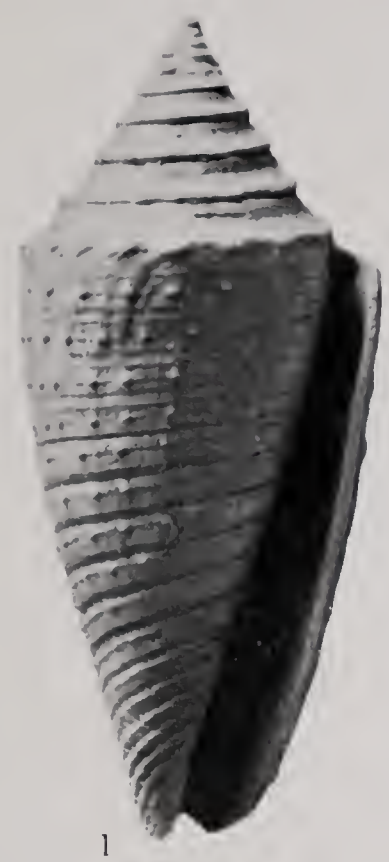
FIG. 5. *Conus* (*Leptoconus*) *stibarus*, n. sp. Holotype, × 1.5; U. S. Nat. Mus. No. 369612; page 217.

FIG. 6. *Cancellaria* (*Cancellaria*) *barretti* Guppy, × 2; specimen from Guppy collection; U. S. Nat. Mus. No. 115471; page 219.

FIGS. 7, 8. *Cancellaria* (*Cancellaria*) *laevescens* Guppy. Two views of same specimen from Guppy collection, × 2; U. S. Nat. Mus. No. 115470; page 220.

FIG. 9. *Cancellaria* (*Bivetopsis*) *moorei* Guppy, × 2; U. S. Nat. Mus. No. 61535; page 222.

FIG. 10. *Tribia epomis*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 135418; page 223.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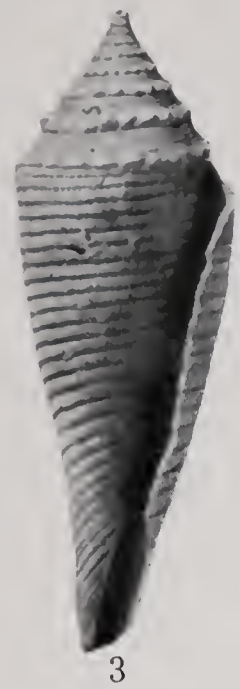
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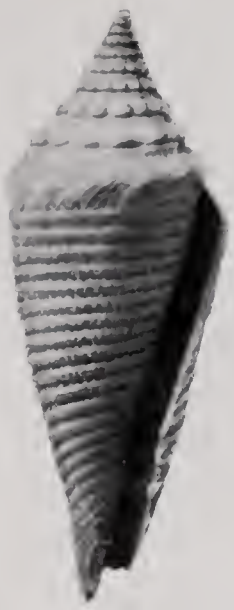
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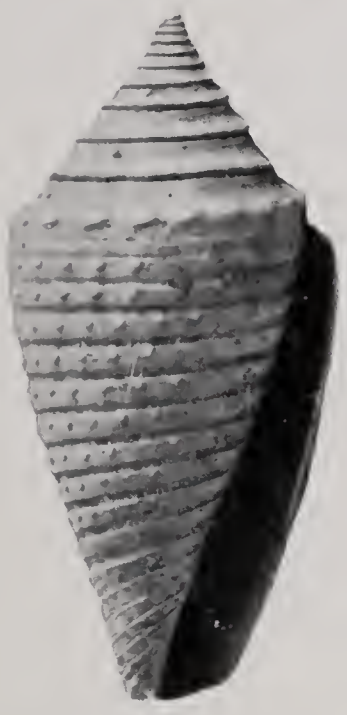
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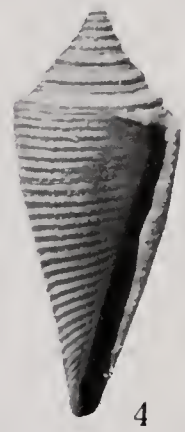
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1, 2. Conus (Leptoconus) granozonatus, × 2
3, 4. Conus (Leptoconus) gracilissimus, × 1.5
5. Conus (Leptoconus) stibarus, × 1.5
6. Cancellaria (Cancellaria) barretti, × 2
7, 8. Cancellaria (Cancellaria) laevescens, × 2
9. Cancellaria (Bivetopsis) moorei, × 2
10. Tribia epomis, × 4

PLATE 13

FIG. 1. *Trigonostoma scalatella* (Guppy). Holotype, × 4; U. S. Nat. Mus. No. 115474; page 224.

FIG. 2. *"Cancellaria"* species, × 6; U. S. Nat. Mus. No. 135432; page 224.

FIGS. 3 to 5. *Oliva* (*Oliva*) *reticularis trochala*, n. sp. (3) Holotype, × 1.5; U. S. Nat. Mus. No. 369420; (4) small specimen, × 1.5; U. S. Nat. Mus. No. 369421; (5) high-spired specimen, × 1.5; U. S. Nat. Mus. No. 369422; page 226.

FIGS. 6, 7. *Oliva* (*Oliva*) *plicata* Guppy. (6) Holotype, × 4; U. S. Nat. Mus. No. 107090; (7) large specimen, × 1; U. S. Nat. Mus. No. 135333; page 228.

FIGS. 8 to 10. *Olivella* (*Olivella*) *acra*, n. sp. (8) Holotype, × 3; U. S. Nat. Mus. No. 369423; (9) unusually stout, heavily callused specimen, × 3; (10) slender, high-spired specimen, × 3; U. S. Nat. Mus. No. 369424; page 230.

FIG. 11. *Olivella* (*Olivella*) *clarki*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369425; page 231.

1. Trigonostoma scalatella, × 4
2. "Cancellaria" sp., × 6
3 to 5. Oliva (Oliva) reticularis trochala, × 1.5
6. Oliva (Oliva) plicata, × 4
7. Oliva (Oliva) plicata, × 1
8 to 10. Olivella (Olivella) acra, × 3
11. Olivella (Olivella) clarki, × 4

PLATE 14

FIG. 1. *Olivella* (*Olivella*) *clarki*, n. sp. Smaller specimen, × 6; U. S. Nat. Mus. No. 369426; page 231.

FIG. 2. *Olivella* (*Callianax*) *unica*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369613; page 231.

FIG. 3. *Olivella* (*Dactylidia*) *indivisa* Guppy. Holotype, × 6; U. S. Nat. Mus. No. 107087; page 232.

FIGS. 4, 5. *Olivella* (*Dactylidella*) *colpus*, n. sp. (4) Holotype, × 4; U. S. Nat. Mus. No. 369427; (5) specimen with obscure lirations on interior of outer lip, × 4; U. S. Nat. Mus. No. 369428; page 234.

FIGS. 6, 7. *Ancilla* (*Eburna*) *pinguis* Guppy. Paratype, × 2; U. S. Nat. Mus. No. 115567; page 235.

FIGS. 8, 9. *Marginella* (*Leptegouana*) *coniformis* Sowerby. (8), × 2; U. S. Nat. Mus. No. 369429; (9) small specimen, × 6; U. S. Nat. Mus. No. 135343; page 238.

FIG. 10. *Marginella* (*Serrata*) *glaphyra*, n. sp. Holotype, × 3; U. S. Nat. Mus. No. 369430; page 240.

FIG. 11. *Marginella* (*Serrata*) *mauryae*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369431; page 240.

FIG. 12. *Cypraeolina pycna*, n. sp. Holotype, × 10; apex tilted forward; U. S. Nat. Mus. No. 369432; page 241.

FIG. 13. *Mitra* (*Tiara*) *henekeni illacidata*, n. subsp. Holotype, × 2; U. S. Nat. Mus. No. 369433; page 243.

FIG. 14. *Mitra* (*Tiara*) *rhadina*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 369434; page 243.

FIG. 15. *Vexillum* (*Costellaria*) *dasaplurum*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 369435; page 245.

FIG. 16. *Vexillum* (*Costellaria*) *micramadum*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369436; page 245.

FIG. 17. *Vexillum* (*Costellaria*) *cryptidulum*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369437; page 246.

FIG. 18. *Vexillum* (*Costellaria*) *leurum*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 135434; page 246.

FIG. 19. *Vexillum* (*Uromitra*) *syntomum*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 369438; page 247.

FIG. 20. *Vexillum* (*Uromitia*) *callipictum*, n. sp. Holotype, × 3; U. S. Nat. Mus. No. 369439; page 248.

FIG. 21. *Vexillum* (*Uromitra*) *voraginosum*, n. sp. Holotype, × 3; U. S. Nat. Mus. No. 135437; page 248.


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1. Olivella (Olivella) clarki, × 6
2. Olivella (Callianax) unica, × 4
3. Olivella (Dactylidia) indivisa, × 6
4, 5. Olivella (Dactylidella) colpus, × 4
6, 7. Ancilla (Eburna) pinguis, × 2
8. Marginella (Leptegouana) coniformis, × 2
9. Marginella (Leptegouana) coniformis, × 6
10. Marginella (Serrata) glaphyra, × 3
11. Marginella (Serrata) mauryae, × 6
12. Cypraeolina pycna, × 10
13. Mitra (Tiara) henekeni illacidata, × 2
14. Mitra (Tiara) rhadina, × 2
15. Vexillum (Costellaria) dasaplurum, × 2
16. Vexillum (Costellaria) micramadum, × 8
17. Vexillum (Costellaria) cryptidulum, × 4
18. Vexillum (Costellaria) leurum, × 4
19. Vexillum (Uromitra) syntomum, × 2
20. Vexillum (Uromitra) callipictum, × 3
21. Vexillum (Uromitra) voraginosum, × 3

PLATE 15

FIG. 1. *Vexillum* (*Uromitra*) *uncidum*, n. sp. Holotype, × 3; U. S. Nat. Mus. No. 369440; page 248.

FIG. 2. *Mitromorpha* species, × 8; U. S. Nat. Mus. No. 135414; page 249.

FIG. 3. *Xancus textilis* (Guppy). Holotype, × 1; U. S. Nat. Mus. No. 115482; page 250.

FIGS. 4, 5. *Latirus* (*Polygona*) *infundibulum polius*, n. subsp. (4) Holotype, × 1.5; U. S. Nat. Mus. No. 135460; (5) small specimen, × 1; U. S. Nat. Mus. No. 369441; page 253.

FIG. 6. *Latirus* (*Polygona*) *nematus*, n. sp. Holotype, × 1; U. S. Nat. Mus. No. 369442; page 254.

FIG. 7. *Fasciolaria semistriata leura*, n. subsp. Holotype, × 1; U. S. Nat. Mus. No. 107007; page 255.

FIG. 8. *Fusinus* species, × 1.5; U. S. Nat. Mus. No. 115485; page 257.

FIG. 9. *Fusinus engonius*, n. sp. Holotype, × 1; U. S. Nat. Mus. No. 369443; page 258.

FIGS. 10, 11. *Tritiaria* (*Antillophos*) *moorei* (Guppy). Two views of same specimen from Guppy collection, × 2; U. S. Nat. Mus. No. 115489; page 261.

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1. Vexillum (Uromitra) uncidum, × 3
2. Mitromorpha sp., × 8
3. Xancus textilis, × 1
4. Latirus (Polygona) infundibulum polius, × 1.5
5. Latirus (Polygona) infundibulum polius, × 1
6. Latirus (Polygona) nematus, × 1
7. Fasciolaria semistriata leura, × 1
8. Fusinus sp., × 1.5
9. Fusinus engonius, × 1
10, 11. Tritiaria (Antillophos) moorei, × 2

PLATE 16

FIG. 1. *Tritiaria* (*Antillophos*) *elegans* (Guppy), × 2; specimen from Guppy collection; U. S. Nat. Mus. No. 115488; page 262.

FIGS. 2, 3. *Engoniophos erectus* (Guppy). (2) Holotype, × 2; U. S. Nat. Mus. No. 115487; (3) specimen with strongly angulated whorls and strong body sculpture, lower part of outer lip broken back, × 2; U. S. Nat. Mus. No. 369444; page 264.

FIG. 4. *Nassarius* (*Uzita*) *cercadensis* (Maury), × 6; base of inner lip broken; U. S. Nat. Mus. No. 369445; page 266.

FIGS. 5, 6. *Nassarius* (*Uzita*) *gurabensis* (Maury). (5) Stout specimen, × 4; (6) slender specimen, × 4; U. S. Nat. Mus. No. 369446; page 267.

FIGS. 7, 8. *Trachypollia sclera*, n. sp. (7) Holotype, × 6; U. S. Nat. Mus. No. 135320; (8) small specimen, canal broken, × 4; U. S. Nat. Mus. No. 369447; page 269.

FIG. 9. *Columbella submercatoria* Olsson, × 4; U. S. Nat. Mus. No. 369448; page 270.

FIG. 10. *Columbella platynema*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 369449; page 271.

FIGS. 11, 12. *Pyrene* (*Eurypyrene*) *eurynotum*, n. sp. (11) Holotype, × 3; U. S. Nat. Mus. No. 135512; (12) larger, badly worn specimen, × 3; U. S. Nat. Mus. No. 369450; page 272.

FIG. 13. *Mitrella* (*Mitrella*) *ocellata bowdenensis*, n. subsp. Holotype, × 4; U. S. Nat. Mus. No. 135522; page 273.

FIG. 14. *Mitrella* (*Columbellopsis*) *lissa*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369451; page 275.

FIG. 15. *Mitrella* (*Columbellopsis*) *lepta*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369452; page 275.

FIG. 16. *Anachis* (*Costoanachis*) *orthopleura*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369454; page 277.

FIG. 17. *Anachis* (*Costoanachis*) *aulata*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369455; page 277.

FIGS. 18, 19. *Nassarina orna*, n. sp. (18) Holotype, × 6; U. S. Nat. Mus. No. 369614; (19) doubtfully identified slender specimen with strong spiral threads, × 6; U. S. Nat. Mus. No. 135518; page 280.

FIG. 20. *Nassarina* species, × 6; base of outer lip and base of canal broken; U. S. Nat. Mus. No. 369456; page 280.

FIG. 21. *Cigclirina sigma*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 135389; page 281.

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1. Tritiaria (Antillophos) elegans, × 2
2, 3. Engoniophos erectus, × 2
4. Nassarius (Uzita) cercadensis, × 6
5, 6. Nassarius (Uzita) gurabensis, × 4
7. Trachypollia sclera, × 6
8. Trachypollia sclera, × 4
9. Columbella submercatoria, × 4
10. Columbella platynema, × 2
11, 12. Pyrene (Eurypyrene) eurynotum, × 3
13. Mitrella (Mitrella) ocellata bowdenensis, × 4
14. Mitrella (Columbellopsis) lissa, × 4
15. Mitrella (Columbellopsis) lepta, × 6
16. Anachis (Costoanachis) orthopleura, × 4
17. Anachis (Costoanachis) aulata, × 4
18, 19. Nassarina orna, × 6
20. Nassarina sp., × 6
21. Cigclirina sigma, × 6

PLATE 17

FIG. 1. *Cigclirina sigma*, n. sp., × 6; U. S. Nat. Mus. No. 369457; page 281.
FIG. 2. *Strombina guppyi*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 115514; page 282.
FIGS. 3, 4. *Strombina gradata* (Guppy). Two views of same specimen from Guppy collection, × 2; U. S. Nat. Mus. No. 115515; page 283.
FIG. 5. *Strombina caribaea* Gabb, × 4; U. S. Nat. Mus. No. 369458; page 284.
FIG. 6. *Metula* species. Composite photograph of two fragments, × 2; U. S. Nat. Mus. No. 135523; page 287.
FIGS. 7, 8. *Murex* (*Murex*) *recurvirostris* Broderip. (7) × 1.5; canal broken; (8) × 1.5, tip of canal broken; U. S. Nat. Mus. No. 369459; page 288.
FIG. 9. *Murex* (*Phyllonotus*) *pomum* Gmelin, × 1; U. S. Nat. Mus. No. 369460; page 290.
FIGS. 10, 11. "*Muricopsis*" *collatus* (Guppy). Holotype, × 2; U. S. Nat. Mus. No. 115479; page 291.

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1. Cigclirina sigma, × 6
2. Strombina guppyi, × 2
3, 4. Strombina gradata, × 2
5. Strombina caribaea, × 4
6. Metula sp., × 2
7, 8. Murex (Murex) recurvirostris, × 1.5
9. Murex (Phyllonotus) pomum, × 1
10, 11. "Muricopsis" collatus, × 2

PLATE 18

FIG. 1. "*Muricopsis*" species, × 2; U. S. Nat. Mus. No. 369621; page 292.

FIG. 2. *Typhis* (*Typhinellus*) *siphon*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 115495; page 293.

FIGS. 3, 4. *Typhis* (*Talityphis*) *alatus obesus* Gabb. Two views of same specimen, × 2; U. S. Nat. Mus. No. 369461; page 294.

FIGS. 5, 6. *Coralliophila miocenica* (Guppy). Holotype, × 2; U. S. Nat. Mus. No. 115493; page 296.

FIGS. 7 to 9. *Distorsio* (*Distorsio*) *decussatus simillimus* (Sowerby). (7) and (8), two views of same specimen, × 1.5; U. S. Nat. Mus. No. 115512; (9) small specimens with strongly divided cord on shoulder, × 2; U. S. Nat. Mus. No. 369462; page 300.

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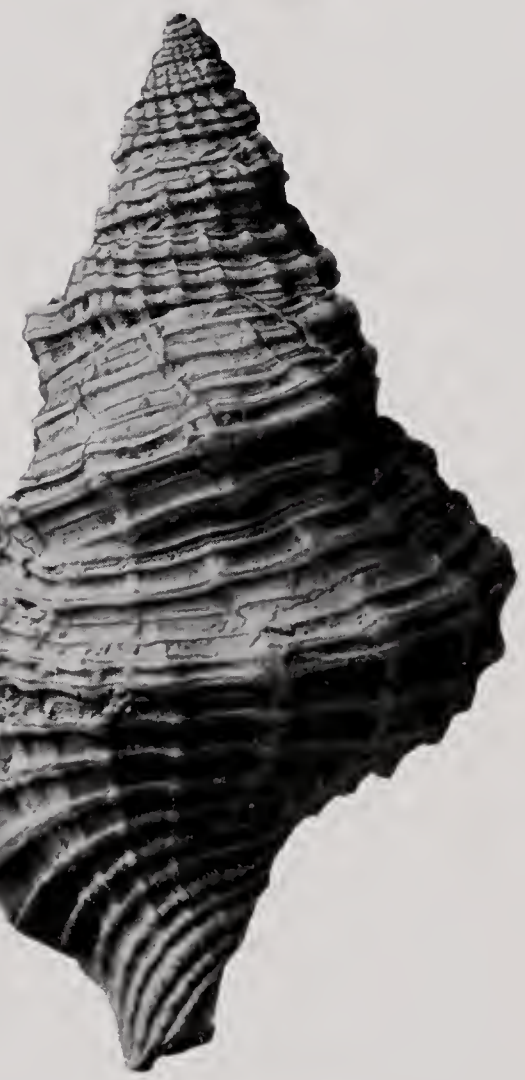

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1. "Muricopsis" sp., × 2
2. Typhis (Typhinellus) siphon, × 2

3, 4. Typhis (Talityphis) alatus obesus, × 2

5, 6. Coralliophila miocenica, × 2

7, 8. Distorsio (Distorsio) decussatus simillimus, × 1.5

9. Distorsio (Distorsio) decussatus simillimus, × 2

PLATE 19

FIG. 1. *Distorsio* (*Distorsio*) *decussatus simillimus* (Sowerby), × 2. Dorsal view of specimen shown in fig. 9, pl. 18; page 300.

FIGS. 2, 3. *Distorsio* (*Distorsio*) *clathratus gatunensis* (Toula). Two views of same specimen, × 1.5; U. S. Nat. Mus. No. 369463; page 300.

FIG. 4. *Bursa* (*Marsupina*) *proavus bowdenensis* Pilsbry, × 1; specimen turned too far to left; U. S. Nat. Mus. No. 369464; page 303.

FIGS. 5, 6. *Cassis sulcifera* Sowerby. Small specimen, × 1; U. S. Nat. Mus. No. 115499; page 304.

FIGS. 7 to 9. *Semicassis* (*Tylocassis*) *reclusa* (Guppy). (7) and (8) Specimen with varix on body whorl, × 2; (9) specimen with strong nodes on shoulder, × 2; U. S. Nat. Mus. No. 115504; page 307.

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1. Distorsio (Distorsio) decussatus similli-
mus, × 2
2, 3. Distorsio (Distorsio) clathratus gatu-
nensis, × 1.5

4. Bursa (Marsupina) proavus bow-
denensis, × 1
5, 6. Cassis sulcifera, × 1
7 to 9. Semicassis (Tylocassis) reclusa, × 2

PLATE 20

FIGS. 1, 2. *Semicassis* (*Tylocassis*) *reclusa* (Guppy). Holotype, × 2; U. S. Nat. Mus. No. 115505; page 307.

FIGS. 3 to 6. *Sconsia* (*Sconsia*) *striata sublaevigata* (Guppy). (3) and (4) Two views of same specimen, × 1; U. S. Nat. Mus. No. 115502; (5) and (6) small specimen, × 1; U. S. Nat. Mus. No. 369465; page 309.

FIGS. 7, 8. *Malea camura* Guppy. Two views of same specimen, × 1.5; U. S. Nat. Mus. No. 115506; page 311.

FIG. 9. *Ficus pilsbryi* (B. Smith). Broken specimen, × 2; U. S. Nat. Mus. No. 115510; page 313.

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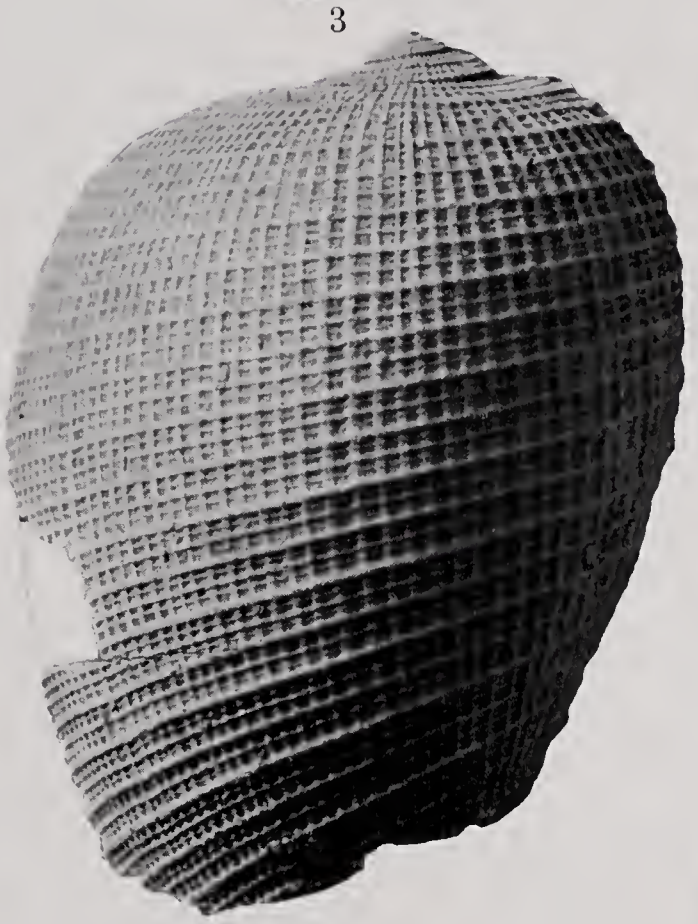

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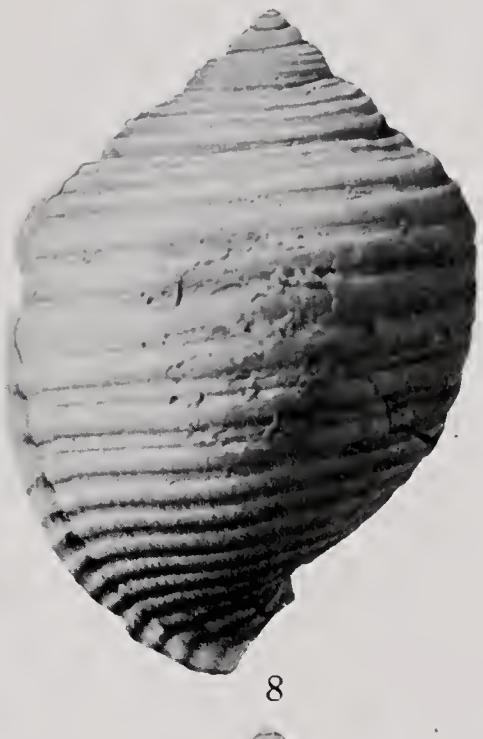

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1, 2. Semicassis (Tylocassis) reclusa, × 2
3 to 6. Sconsia (Sconsia) striata sublaevigata, × 1

7, 8. Malea camura, × 1.5
9. Ficus pilsbryi, × 2

PLATE 21

FIGS. 1, 2. *Ficus pilsbryi* (B. Smith). Small, badly worn specimen, × 3; U. S. Nat. Mus. No. 369466; page 313.

FIGS. 3 to 8. *Simnia* (*Calpurna*) *immunita* (Guppy). (3) and (4) Holotype, × 4; U. S. Nat. Mus. No. 115598; (5) and (6) medium sized specimen, × 4; (7) and (8) small specimen, × 4; U. S. Nat. Mus. No. 369467; page 315.

FIG. 9. *Cypraea* (*Talparia*) *isabella patrespatriae* Maury, × 2; U. S. Nat. Mus. No. 135478; page 317.

FIGS. 10, 11. *Cypraea* (*Zonaria*) *raymondrobertsi bowdenensis* Pilsbry, × 2; U. S. Nat. Mus. No. 364968; page 318.

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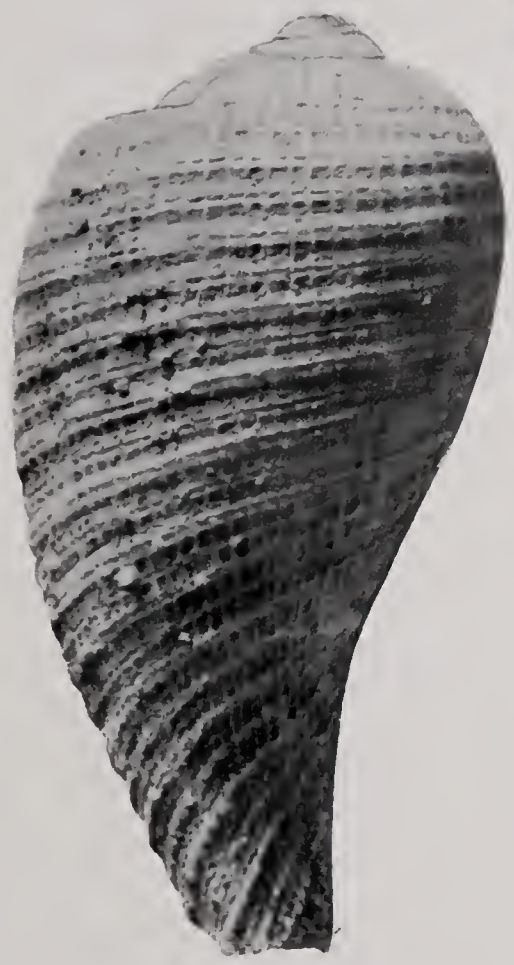

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1, 2. Ficus pilsbryi, × 3
3 to 8. Simnia (Calpurna) immunita, × 4

9. Cypraea (Talparia) isabella patrespatriae, × 2
10, 11. Cypraea (Zonaria) raymondrobertsi bowdenensis, × 2

PLATE 22

FIG. 1. *Cypraea* (*Zonaria*) *raymondrobertsi bowdenensis* Pilsbry, × 2. Lateral view of specimen shown in figs. 10, 11, pl. 21; page 318.

FIGS. 2, 3. *Trivia* (*Trivia*) *cypha*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369469; page 319.

FIGS. 4, 5. *Trivia* (*Trivia*) *globosa* ("Gray") Sowerby, × 6; apex tilted backward in fig. 4 and forward in fig. 5; U. S. Nat. Mus. No. 369470; page 319.

FIGS. 6 to 11. *Trivia* (*Trivia*) *pediculus* (Linné). (6) and (7) Small, finely sculptured specimen, × 4; U. S. Nat. Mus. No. 369471; (8) and (9) large, finely sculptured specimen, × 4; U. S. Nat. Mus. No. 369472; (10) and (11) large, coarsely sculptured specimen, × 4; U. S. Nat. Mus. No. 115605; page 320.

FIG. 12. *Erato* (*Erato*) *domingensis trochala*, n. subsp. Holotype, × 6; U. S. Nat. Mus. No. 135338; page 321.

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1. Cypraea (Zonaria) raymondrobertsi bowdenensis, × 2
2, 3. Trivia (Trivia) cypha, × 4
4, 5. Trivia (Trivia) globosa, × 6
6 to 11. Trivia (Trivia) pediculus, × 4
12. Erato (Erato) domingensis arochala, × 6

PLATE 23

FIGS. 1, 2. *Strombus pugiloides* Guppy. Lectotype, × 1.5; U. S. Nat. Mus. No. 115477; page 322.

FIGS. 3, 4. *Strombus bifrons* Sowerby. Stout specimen, × 1.5; U. S. Nat. Mus. No. 369473; page 324.

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1, 2. Strombus pugiloides, × 1.5

3, 4. Strombus bifrons, × 1.5

PLATE 24

FIG. 1. *Strombus bifrons* Sowerby. Slender specimen, × 1.5; U. S. Nat. Mus. No. 135289; page 324.

FIG. 2. *Strombus* species. Outer lip and part of body whorl, × 1; U. S. Nat. Mus. No. 135291; page 326.

FIGS. 3 to 5. *Strombus leurus*, n. sp. (3) and (4) Holotype, × 1.5; U. S. Nat. Mus. No. 369474; (5) larger, more imperfect specimen, × 1.5; U. S. Nat. Mus. No. 369622; page 326.

FIGS. 6, 7. *Seguenzia hapala*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369475; page 327.

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1. Strombus bifrons, × 1.5
2. Strombus sp., × 1

3 to 5. Strombus leurus, × 1.5
6, 7. Seguenzia hapala, × 10

PLATE 25

FIG. 1. *Triphora tritreta*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369476; page 328.
FIG. 2. *Triphora apania*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369477; page 329.
FIG. 3. *Cerithiopsis compsa*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369478; page 330
FIG. 4. *Cerithiopsis cigclis*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369479; page 330.
FIG. 5. *Dizoniopsis vaughani*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369480; page 331.
FIG. 6. *Thericium* species *b*, × 1.5; U. S. Nat. Mus. No. 369484; page 334.
FIGS. 7, 8. *Clava* (*Ochetoclava*) *costaricana stena*, n. subsp. (7) Holotype, × 2, and (8) small, finely sculptured specimen, × 3; U. S. Nat. Mus. No. 369485; page 335.
FIG. 9. *Clava* (*Ochetoclava*) *terpna*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369486; page 336.
FIG. 10. *Bittium praeformatum* Guppy. Holotype, × 8; U. S. Nat. Mus. No. 107124; page 337.
FIG. 11. *Bittiolum* species, × 8; U. S. Nat. Mus. No. 369488; page 337.
FIG. 12. *Bittiolum properatum*, n. sp. Holotype, × 8; outer lip broken back; U. S. Nat. Mus. No. 369488; page 338.
FIG. 13. *Alabina curta*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 135329; page 339.
FIGS. 14, 15. *Alaba turrita* Guppy. (14) Holotype, × 8; U. S. Nat. Mus. No. 107128; (15) larger specimen, × 8; U. S. Nat. Mus. No. 369489; page 340.
FIG. 16. *Planaxis ame*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 115639; page 342.
FIG. 17. *Modulus modulus basileus* (Guppy). Holotype, high-spired specimen with strong peripheral cord, × 6; U. S. Nat. Mus. No. 115469; page 343.

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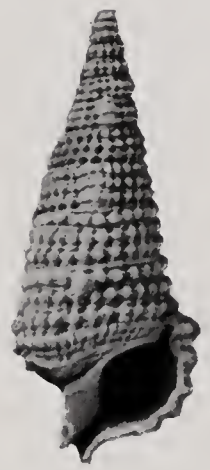

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1. Triphora tritreta, × 10
2. Triphora apania, × 10
3. Cerithiopsis compsa, × 10
4. Cerithiopsis cigclis, × 10
5. Dizoniopsis vaughani, × 10
6. Thericium sp. *b*, × 1.5
7. Clava (Ochetoclava) costaricana stena, × 2
8. Clava (Ochetoclava) costaricana stena, × 3
9. Clava (Ochetoclava) terpna, × 4
10. Bittium praeformatum, × 8
11. Bittiolum sp., × 8
12. Bittiolum properatum, × 8
13. Alabina curta, × 8
14, 15. Alaba turrita, × 8
16. Planaxis ame, × 4
17. Modulus modulus basileus, × 6

PLATE 26

FIGS. 1 to 4. *Modulus modulus basileus* (Guppy). (1) and (2) High-spired specimen with strong peripheral cord, × 4; U. S. Nat. Mus. No. 369490; (3) high-spired, strongly ribbed specimen, × 4; U. S. Nat. Mus. No. 369491; (4) low-spired, strongly ribbed specimen, × 4; U. S. Nat. Mus. No. 369492; page 342.

FIG. 5. *Vermicularia spirata* (Philippi), × 3; U. S. Nat. Mus. No. 369493; page 344.

FIG. 6. *Lemintina papulosa* (Guppy), × 2; U. S. Nat. Mus. No. 135319; page 346.

FIGS. 7 to 9. *Turritella guppyi* Cossmann. (7) Holotype, × 4; labeled "Cumana, Venezuela," but apparently a Bowden shell; U. S. Nat. Mus. No. 115451; (8) specimen from Bowden closely resembling holotype, ×4; U. S. Nat. Mus. No. 369495; (9) weakly beaded specimen, × 2; U. S. Nat. Mus. No. 369496; page 349.

FIG. 10. *Caecum* species, × 10; U. S. Nat. Mus. No. 369497; page 350.

FIGS. 11, 12. *Meioceras apanium*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369498; page 351.

FIGS. 13, 14. "*Fossarus*" species, × 8; U. S. Nat. Mus. No. 369499; page 352.

FIG. 15. "*Fossarus* (*Gottoina*)" *mundulus* Guppy. Holotype, × 6; U. S. Nat. Mus. No. 107093; page 353.

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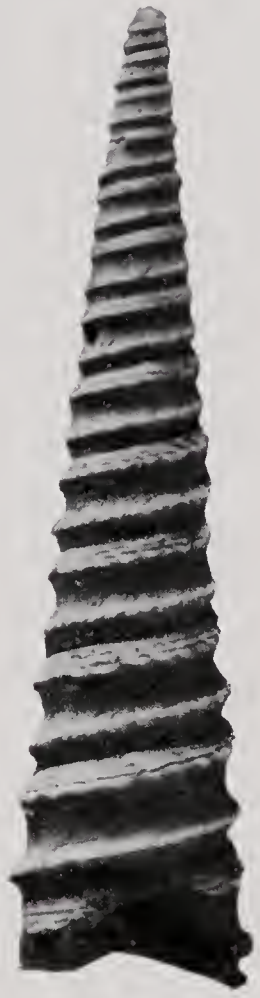

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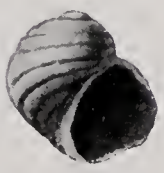

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1 to 4. Modulus modulus basileus, × 4
5. Vermicularia spirata, × 3
6. Lemintina papulosa, × 2
7, 8. Turritella guppyi, × 4
9. Turritella guppyi, × 2
10. Caecum sp., × 10
11, 12. Meioceras apanium, × 10
13, 14. "Fossarus" sp., × 8
15. "Fossarus (Gottoina)" mundulus, × 6

PLATE 27

FIGS. 1, 2. *"Fossarus (Gottoina)" mundulus* Guppy, × 6; U. S. Nat. Mus. No. 369500; page 353.

FIGS. 3, 4. *"Fossarus (Gottoina)" comptus*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369501; page 353.

FIGS. 5 to 7. *Architectonica (Architectonica) nobilis quadriseriata* (Sowerby). Three views of same specimen, × 1.5; U. S. Nat. Mus. No. 369502; page 354.

FIGS. 8 to 11. *Architectonica (Psilaxis) krebsii lampra*, n. subsp. (8) to (10) Holotype, × 4; U. S. Nat. Mus. No. 369503; (11) small specimen showing sculpture of early whorls, × 4; U. S. Nat. Mus. No. 135538; page 356.

FIGS. 12 to 14. *Architectonica (Psilaxis) araea*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369504; page 356.

FIGS. 15 to 17. *Architectonica (Pseudotorinia) euprepes*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369505; page 357.

FIGS. 18 to 20. *Spirolaxis exquisita* (Dall and Simpson), × 6; U. S. Nat. Mus. No. 369506; page 359.

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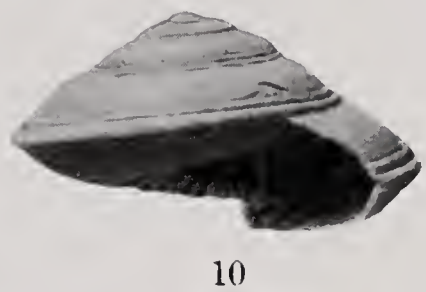

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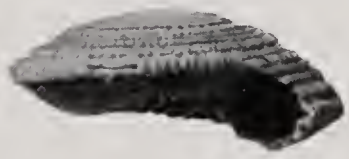

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1, 2. "Fossarus (Gottoina)" mundulus, × 6
3, 4. "Fossarus (Gottoina)" comptus, × 8
5 to 7. Architectonica (Architectonica) nobilis quadriseriata, × 1.5
8 to 11. Architectonica (Psilaxis) krebsii lampra, × 4
12 to 14. Architectonica (Psilaxis) araea, × 4
15 to 17. Architectonica (Pseudotorinia) euprepes, × 4
18 to 20. Spirolaxis exquisita, × 6

PLATE 28

FIGS. 1 to 3. *Crepitacella cepula* (Guppy). Three views of same specimen, × 4; probably one of original type lot; U. S. Nat. Mus. No. 115513; page 361.

FIG. 4. *Crepitacella aresca*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 135574; page 362.

FIG. 5. *Rissoina* (*Zebinella*) *ame*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369508; page 363.

FIG. 6. *Rissoina* (*Zebinella*) *oligoplura*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 135568; page 364.

FIGS. 7, 8. *Rissoina* (*Mirarissoina*) *lepida*, n. sp. (7) Holotype, × 10; (8) outline drawing to show turrid notch on outer lip; U. S. Nat. Mus. No. 369509; page 365.

FIG. 9. *Rissoina* (*Mirarissoina*) *xesta*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369597; page 366.

FIG. 10. *Rissoina* (*Phosinella*) *guppyi*, Cossmann, × 10; U. S. Nat. Mus. No. 369510; page 366.

FIG. 11. *Rissoina* (*Phosinella*) *rituola*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369511; page 367.

FIG. 12. *Rissoina* (*Phosinella*) *pyrgus*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369512; page 367.

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1 to 3. Crepitacella cepula, × 4
4. Crepitacella aresca, × 10
5. Rissoina (Zebinella) ame, × 10
6. Rissoina (Zebinella) oligoplura, × 10
7, 8. Rissoina (Mirarissoina) lepida, × 10
9. Rissoina (Mirarissoina) xesta, × 10
10. Rissoina (Phosinella) guppyi, × 10
11. Rissoina (Phosinella) rituola, × 10
12. Rissoina (Phosinella) pyrgus, × 10

PLATE 29

FIG. 1. *Rissoina* (*Phosinella*) *debussa*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369513; page 368.

FIGS. 2 to 5. *Rissoina* (*Eurissolina*) *ditomus*, n. sp. (2) and (3) Holotype, × 10; U. S. Nat. Mus. No. 135573; (4) and (5) immature specimen, × 10; U. S. Nat. Mus. No. 369514; page 369.

FIG. 6. *Rissoina* (*Cibdezebina*) *browniana* d'Orbigny, × 10; U. S. Nat. Mus. No. 369515; page 370.

FIG. 7. *Capulus* (*Capulus*) *epicranum*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369517; page 372.

FIGS. 8, 9. *Capulus* (*Malluvium*) *lius*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369518; page 372.

FIG. 10 to 13. *Hipponix ceras*, n. sp. (10) and (11) Holotype, × 3; U. S. Nat. Mus. No. 369519; (12) and (13) coarsely sculptured specimen, × 3; U. S. Nat. Mus. No. 369520; page 374.

FIGS. 14, 15. *"Hipponix" tortilis* Guppy. Holotype, × 4; U. S. Nat. Mus. No. 107147; page 374.

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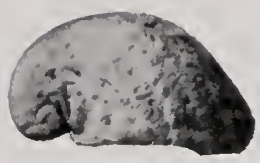

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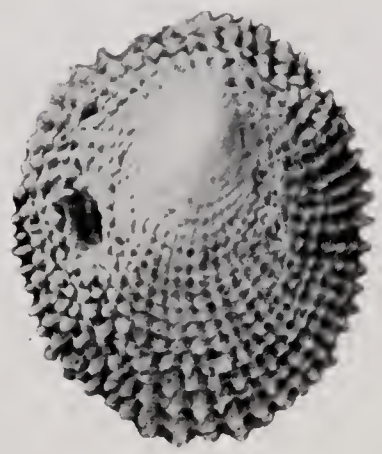

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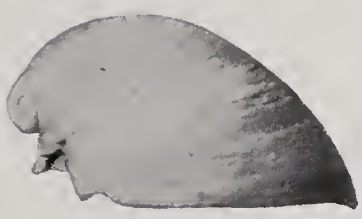

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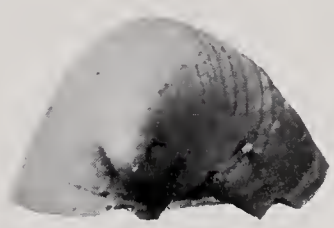

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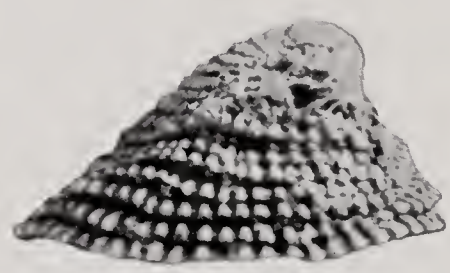

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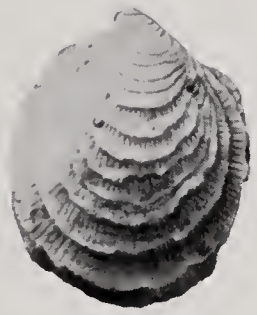

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1. Rissoina (Phosinella) debussa, × 10
2 to 5. Rissoina (Eurissolina) ditomus, × 10
6. Rissoina (Cibdezebina) browniana, × 10
7. Capulus (Capulus) epicranum, × 4
8, 9. Capulus (Malluvium) lius, × 4
10 to 13. Hipponix ceras, × 3
14, 15. "Hipponix" tortilis, × 4

PLATE 30

FIGS. 1, 2. *Cheilea "equestris* (Linné)." Two views of same specimen, × 3; U. S. Nat. Mus. No. 369521; page 375.

FIGS. 3, 4. *Xenophora delecta* (Guppy). Two views of same specimen, × 1.5; specimen apparently lost; page 376.

FIG. 5. *Natica* (*Natica*) *castrenoides,* n. sp. Holotype, × 4; U. S. Nat. Mus. No. 61519; page 377.

FIGS. 6 to 8. *Natica* (*Naticarius*) *canrena antinacca* Cossmann. (6) and (7) Two views of same specimen, × 1.5; U. S. Nat. Mus. No. 369522; (8) operculum assumed to represent this species, × 1.5; U. S. Nat. Mus. No. 369523; page 380.

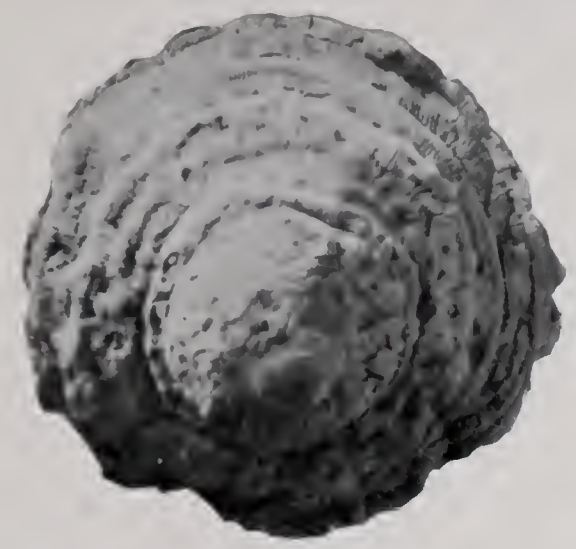
FIG. 9. *Natica* (*Naticarius*) species. Operculum, × 2; U. S. Nat. Mus. No. 135310; page 382.

FIGS. 10, 11. *Stigmaulax vererugosum* (Cossmann). (10), × 1.5; U. S. Nat. Mus. No. 369524; (11) operculum assumed to represent this species, × 2; U. S. Nat. Mus. No. 135309; page 382.

FIG. 12. *Tectonatica pusilla* (Say), × 6; outer shell layer peeled off; U. S. Nat. Mus. No. 369525; page 384.

FIG. 13. *Polinices brunnea subclausa* (Sowerby), × 1.5; U. S. Nat. Mus. No. 135304; page 385.

FIGS. 14, 15. *Eunaticina regia* (Guppy). (14) Holotype, × 2; U. S. Nat. Mus. No. 115450; (15) specimen with smaller umbilicus, × 2; U. S. Nat. Mus. No. 369526; page 387.



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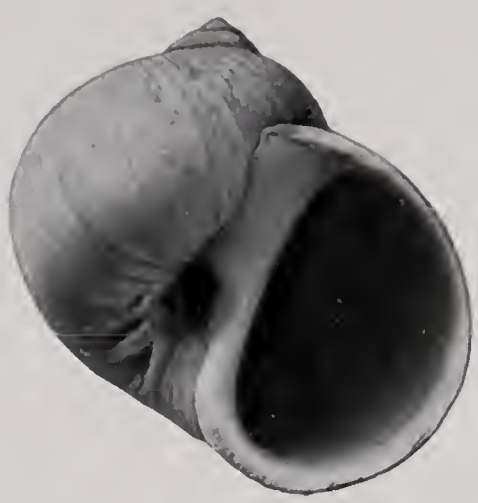

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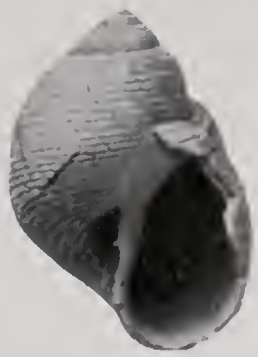

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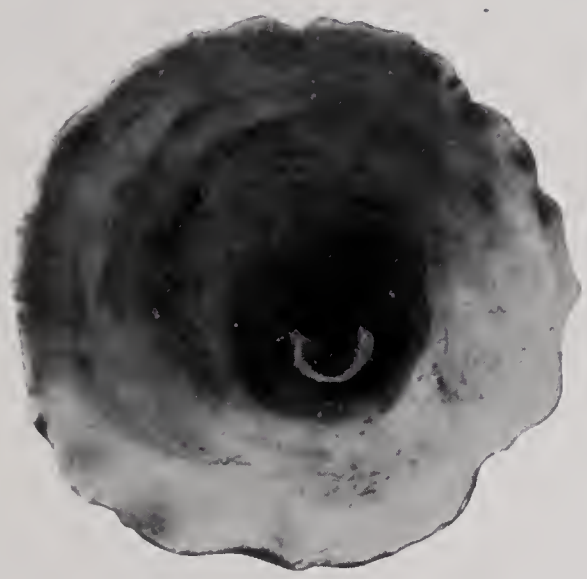

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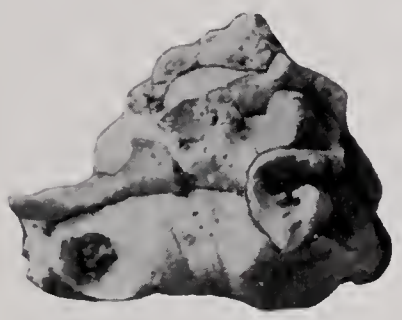

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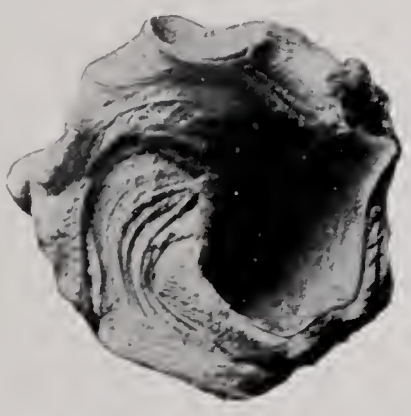

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1, 2. Cheilea "equestris," × 3
3, 4. Xenophora delecta, × 1.5
5. Natica (Natica) castrenoides, × 4
6 to 8. Natica (Naticarius) canrena antinacca, × 1.5
9. Natica (Naticarius) sp., × 2
10. Stigmaulax vererugosum, × 1.5
11. Stigmaulax vererugosum, × 2
12. Tectonatica pusilla, × 6
13. Polinices brunnea subclausa, × 1.5
14, 15. Eunaticina regia, × 2

PLATE 31

FIG. 1. *Eunaticina regia* (Guppy), × 2. Dorsal view of specimen shown in fig. 15, pl. 30; page 387.

FIG. 2. *Sigatica semisulcata bathyora*, n. subsp. Holotype, × 6; U. S. Nat. Mus. No. 369527; page 388.

FIGS. 3, 4. *Sinum gatunense* (Toula). Two views of same specimen, × 2; U. S. Nat. Mus. No. 369528; page 390.

FIGS. 5, 6. *Sinum excentricum* (Guppy). Two views of same specimen, × 2; U. S. Nat. Mus. No. 369529; page 391.

FIGS. 7, 8. *Pachycrommium guppyi* (Gabb). (7) Small specimen, outer shell layer peeled off, × 1.5; U. S. Nat. Mus. No. 369530; (8) larger and more perfect specimen from Gurabo formation, Dominican Republic, U. S. G. S. station 8519, × 1.5; page 393.

FIG. 9. *Epitonium* (*Cycloscala*) *vetulum*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369531; page 395.

FIG. 10. *Epitonium* (*Cycloscala*) *eumetrum*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369532; page 396.

FIGS. 11, 12. *Epitonium* (*Spiniscala*) *gabbi* (de Boury). (11) Stout specimen, × 6; (12) slender specimen with more closely spaced lamellae, × 6; U. S. Nat. Mus. No. 369533; page 397.

FIGS. 13, 14. *Epitonium* (*Spiniscala*) *etolium*, n. sp. (13) Holotype, × 6; U. S. Nat. Mus. No. 369534; (14) small specimen with more closely spaced lamellae, × 8; U. S. Nat. Mus. No. 369535; page 398.

FIG. 15. *Epitonium* (*Spiniscala ?*) *alidotum*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369536; page 398.

FIGS. 16, 17. *Epitonium* (*Striatascala*) *anlanum*, n. sp. (16) Holotype, × 6; U. S. Nat. Mus. No. 369537; (17) larger specimen with more closely spaced lamellae and stronger spiral sculpture, × 4; U. S. Nat. Mus. No. 369538; p. 399.

FIG. 18. *Epitonium* (*Striatascala*) *callipictum*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369539; page 399.

FIG. 19. *Epitonium* (*Nitidiscala*) *aduncum*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369540; page 400.

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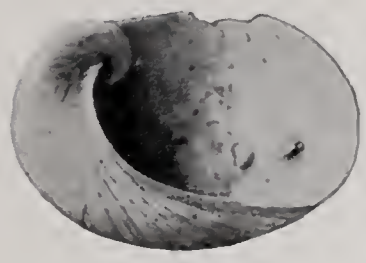

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1. Eunaticina regia, × 2
2. Sigatica semisulcata bathyora, × 6
3, 4. Sinum gatunense, × 2
5, 6. Sinum excentricum, × 2
7, 8. Pachycrommium guppyi, × 1.5
9. Epitonium (Cycloscala) vetulum, × 8
10. Epitonium (Cycloscala) eumetrum, × 6
11, 12. Epitonium (Spiniscala) gabbi, × 6
13. Epitonium (Spiniscala) etolium, × 6
14. Epitonium (Spiniscala) etolium, × 8
15. Epitonium (Spiniscala ?) alidotum, × 6
16. Epitonium (Striatascala) anlanum, × 6
17. Epitonium (Striatascala) anlanum, × 4
18. Epitonium (Striatascala) callipictum, × 4
19. Epitonium (Nitidiscala) aduncum, × 6

PLATE 32

FIG. 1. *Epitonium* (*Nitidiscala*) *ventulum*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369541; page 401.

FIG. 2. *Epitonium* (*Pictoscala*) *leptum*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 135425; page 401.

FIGS. 3, 4. *Ferminoscala pseudoleroyi* (Maury). (3) Holotype, × 2; U. S. Nat. Mus. No. 115437; (4) small specimen, × 2; U. S. Nat. Mus. No. 369542; page 402.

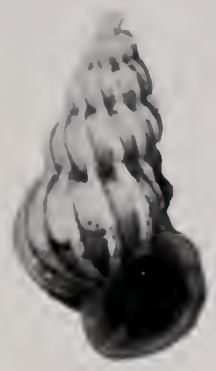
FIG. 5. *Ferminoscala spathe*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 115437; page 403.

FIG. 6. "*Pliciscala* (*Nodiscala*)" *dasystoma*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369543; page 404.

FIGS. 7, 8. *Mathilda plexita* Dall. (7) Part of holotype, × 4; U. S. Nat. Mus. No. 115436; (8) small specimen, × 4; U. S. Nat. Mus. No. 369544; page 406.

FIGS. 9 to 13. *Turbo* (*Taeniaturbo*) *dominicensis* Gabb. (9) Large specimen, × 2; U. S. Nat. Mus. No. 369545; (10) very young specimen, × 6; U. S. Nat. Mus. No. 369547; (11) operculum with strong grooves, assumed to represent this species, × 2; U. S. Nat. Mus. No. 135505; (12) and (13) operculum with weak grooves assumed to represent this species, × 1.5; U. S. Nat. Mus. No. 369546; page 409.

FIG. 14. *Turbo* (*Taeniaturbo*) species, × 1; U. S. Nat. Mus. No. 135504; page 411.



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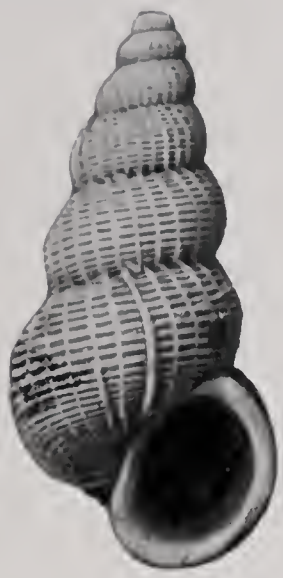

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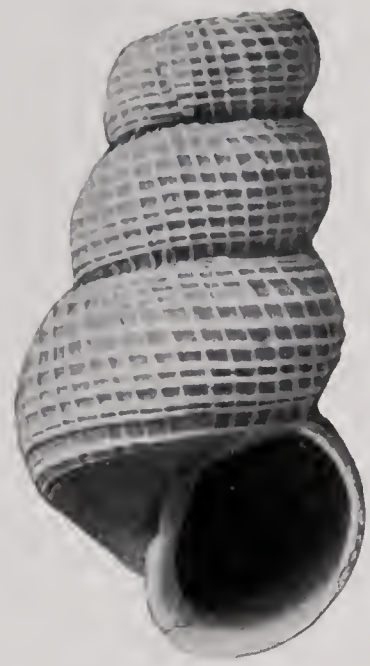

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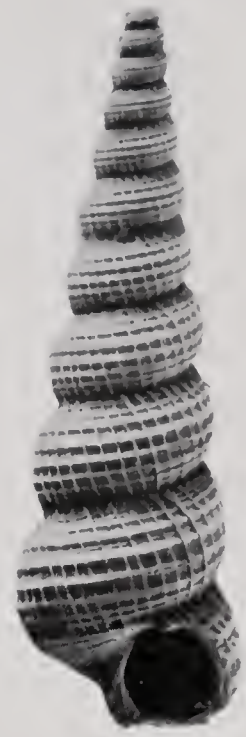

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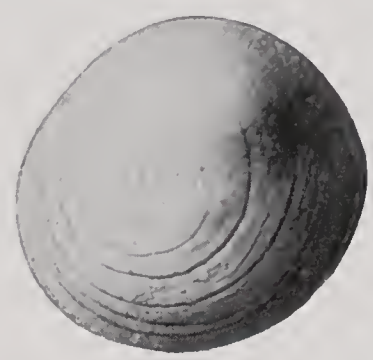

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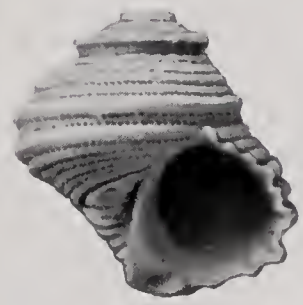

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1. Epitonium (Nitidiscala) ventulum, × 8
2. Epitonium (Pictoscala) leptum, × 6
3, 4. Ferminoscala pseudoleroyi, × 2
5. Ferminoscala spathe, × 4
6. "Pliciscala (Nodiscala)" dasystoma, × 6
7, 8. Mathilda plexita, × 4
9, 11. Turbo (Taeniaturbo) dominicensis, × 2
10. Turbo (Taeniaturbo) dominicensis, × 6
12, 13. Turbo (Taeniaturbo) dominicensis, × 1.5
14. Turbo (Taeniaturbo) sp., × 1

PLATE 33

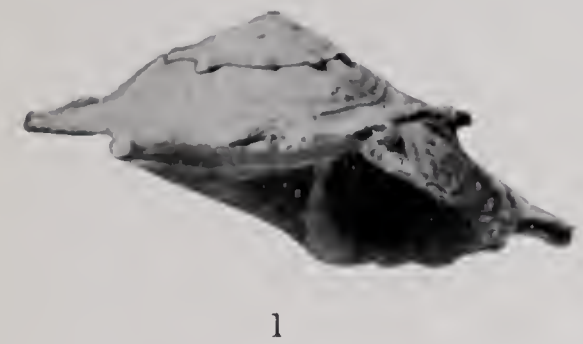
FIGS. 1 to 3. *Astraea* (*Astralium*) *sublongispina acosmeta*, n. subsp. Holotype, × 4; U. S. Nat. Mus. No. 369548; page 412.

FIGS. 4 to 6. *Astraea* (*Astralium*) *brevispina basilis* (Olsson). Three views of same specimen, × 1.5; U. S. Nat. Mus. No. 369549; page 413.

FIG. 7. *Astraea* (*Lithopoma*) *aora*, n. sp. Holotype, × 1; U. S. Nat. Mus. No. 369550; page 414.

FIGS. 8 to 11. *Homalopoma* (*Leptothyropsis*) *philipiana oedemata*, n. subsp. (8) to (10) Holotype, × 6; U. S. Nat. Mus. No. 369551; (11) specimen with operculum in place, × 6; U. S. Nat. Mus. No. 369552; page 415.

FIGS. 12 to 14. *Otollonia siderea* (Guppy). (12) Holotype, × 8; umbilical features obscured by glue and sediment; U. S. Nat. Mus. No. 107095; (13) and (14) two views of same specimen, × 6; U. S. Nat. Mus. No. 369553; page 417.



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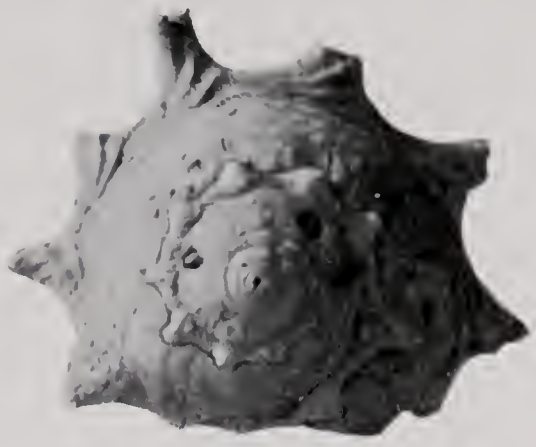

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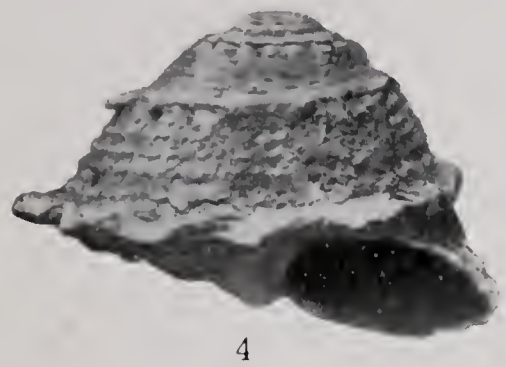

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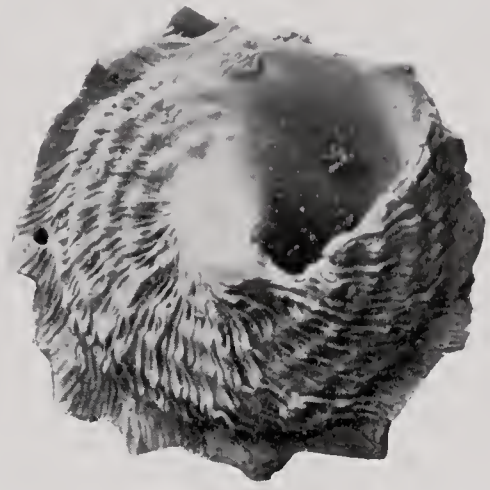

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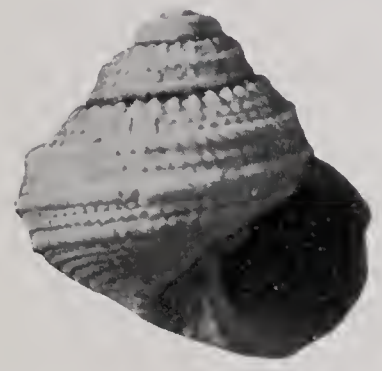

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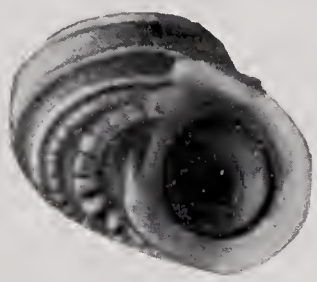

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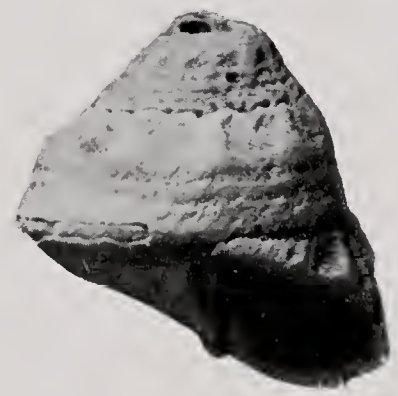

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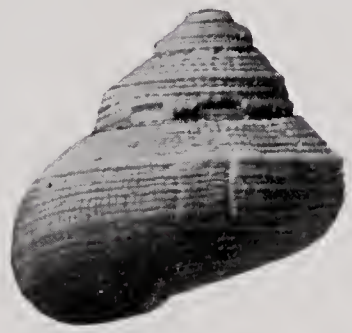

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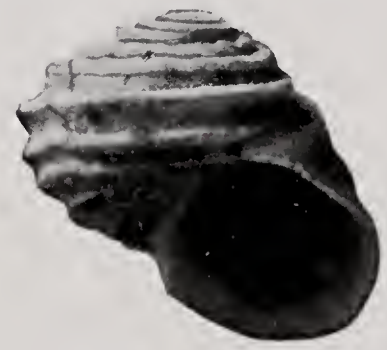

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1 to 3. Astraea (Astralium) sublongispina acosmeta, × 4

4 to 6. Astraea (Astralium) brevispina basilis, × 1.5

7. Astraea (Lithopoma) aora, × 1

8 to 11. Homalopoma (Leptothyropsis) philipiana oedemata, × 6

12. Otollonia siderea, × 8

13, 14. Otollonia siderea, × 6

PLATE 34

FIG. 1. *Otollonia siderea* (Guppy), × 6. Basal view of specimen shown in figs. 13, 14, pl. 33; page 417.

FIGS. 2 to 6. *Coanollonia ambla*, n. sp. (2) and (3) Holotype, × 6; U. S. Nat. Mus. No. 369554; (4) to (6) small specimen, × 6; U. S. Nat. Mus. No. 369621; page 418.

FIGS. 7 to 9. *Tricolia* (*Tricolia*) *umbilicata* (d'Orbigny). (7) and (8) Stout specimen, × 6; (9) slender specimen, × 6; U. S. Nat. Mus. No. 369555; page 419.

FIGS. 10, 11. *Tricolia* (*Eulithidium*) *hadra*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369556; page 420.

FIGS. 12 to 14. *Liotia* (*Liotia*) *strebla*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369557; page 421.

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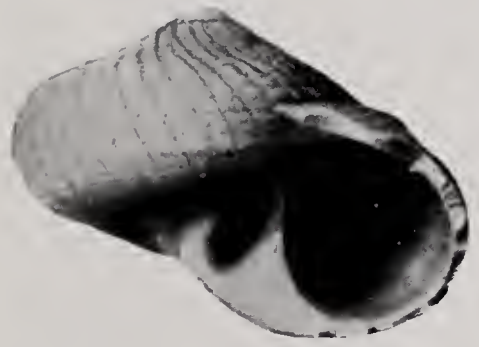

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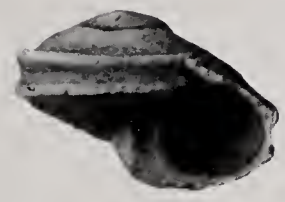

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1. Otollonia siderea, × 6
2 to 6. Coanollonia ambla, × 6
7 to 9. Tricolia (Tricolia) umbilicata, × 6
10, 11. Tricolia (Eulithidium) hadra, × 6
12 to 14. Liotia (Liotia) strebla, × 6

PLATE 35

FIGS. 1 to 3. *Liotia* (*Arene*) *lepidota*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369558; page 422.

FIGS. 4 to 6. *Liotia* (*Arene*) *venusta*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369559; page 423.

FIGS. 7 to 9. *Neritina* (*Nereina*) *woodwardi* Guppy. (7) Specimen with corroded spire from Guppy collection, × 2; U. S. Nat. Mus. No. 115616; (8) and (9) badly corroded specimen, × 2; U. S. Nat. Mus. No. 369560; page 424.

FIGS. 10 to 12. *Neritina* (*Clypeolum*) *pterota*, n. sp. (10) Holotype, × 2; U. S. Nat. Mus. No. 135475; (11) and (12) small specimen with fresh color pattern, × 2; apex tilted forward in fig. 11; U. S. Nat. Mus. No. 369561; page 426.

FIG. 13. *Smaragdia* (*Smaragdia*) *viridis viridemaris* (Maury), × 8; U. S. Nat. Mus. No. 135477; page 426.

FIG. 14. *Calliostoma* (*Calliostoma*) *pulcher bowdenense*, n. subsp. Holotype, × 4; U. S. Nat. Mus. No. 369562; page 429.

FIGS. 15, 16. *Calliostoma* (*Calliostoma*) *roseoloide*, n. sp. Holotype, × 4; U. S. Nat. Mus. No. 369563; page 429.

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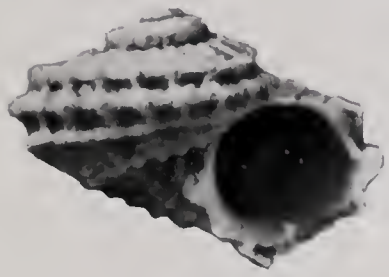

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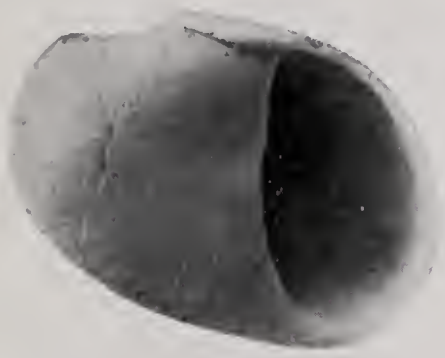

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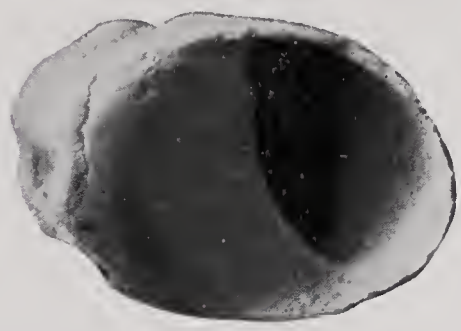

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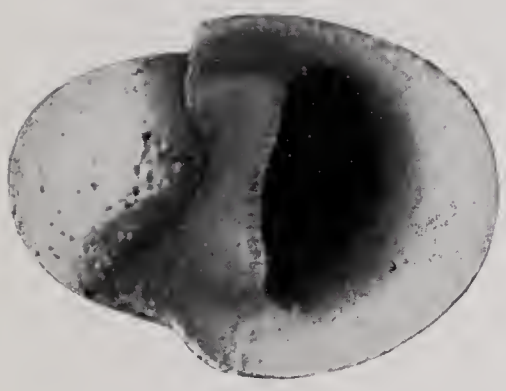

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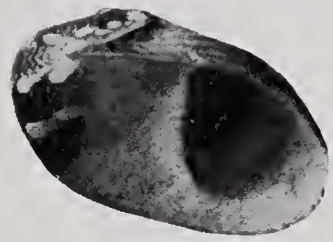

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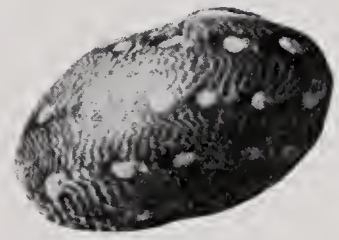

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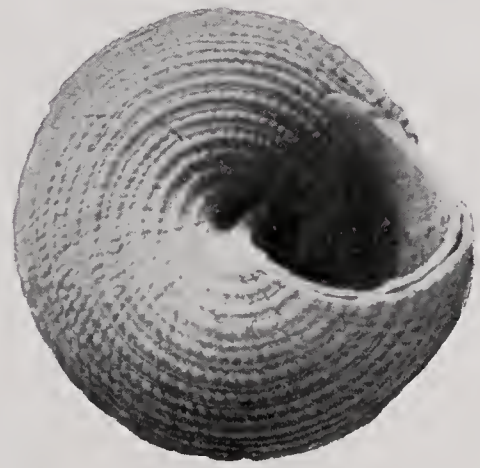

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1 to 3. Liotia (Arene) lepidota, × 6
4 to 6. Liotia (Arene) venusta, × 10
7 to 9. Neritina (Nereina) woodwardi, × 2
10 to 12. Neritina (Clypeolum) pterota, × 2
13. Smaragdia (Smaragdia) viridis viridemaris, × 8
14. Calliostoma (Calliostoma) pulcher bowdenense, × 4
15, 16. Calliostoma (Calliostoma) roseoloide, × 4

PLATE 36

FIGS. 1 to 3. *Calliostoma* (*Calliostoma*) *roseoloide*, n. sp. (1) Specimen with narrow umbilical groove, × 4; (2) and (3) specimen with smoothly conical spire, × 4; U. S. Nat. Mus. No. 369564; page 429.

FIGS. 4, 5. *Calliostoma* (*Dentistyla*) *guppyi*, n. sp. Holotype, × 8; U. S. Nat. Mus. No. 369565; page 431.

FIGS. 6 to 8. *Solariella altiusulca* Guppy. (6) Holotype, × 6; U. S. Nat. Mus. No. 107125; (7) and (8) larger specimen, × 6; U. S. Nat. Mus. No. 369566; page 432.

FIGS. 9 to 11. *Solariella veresimilis* (Guppy), × 10; U. S. Nat. Mus. No. 369567; page 432.

FIGS. 12 to 14. *Antillachelus vaughani*, n. sp. (12) and (13) Holotype, × 6; U. S. Nat. Mus. No. 107097; (14) larger, badly crushed specimen, × 6; U. S. Nat. Mus. No. 369568; page 433.

FIGS. 15, 16. *Mirachelus precorbis*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369569; page 434.

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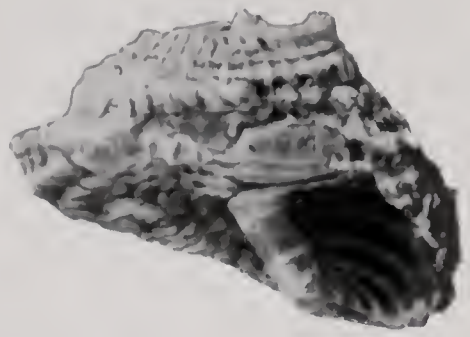

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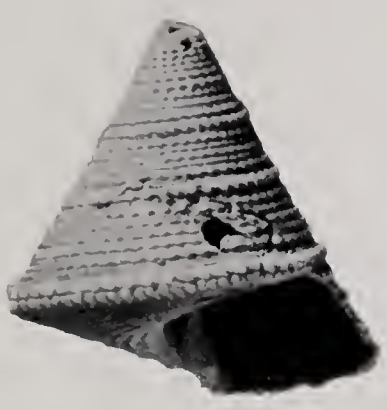

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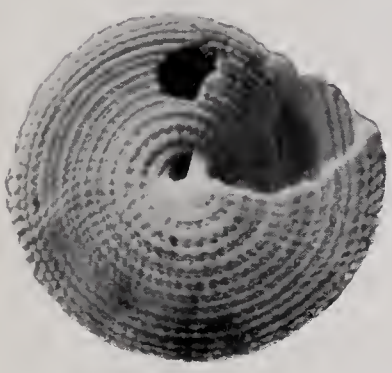

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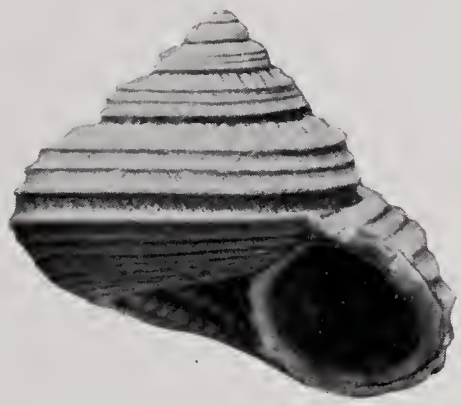

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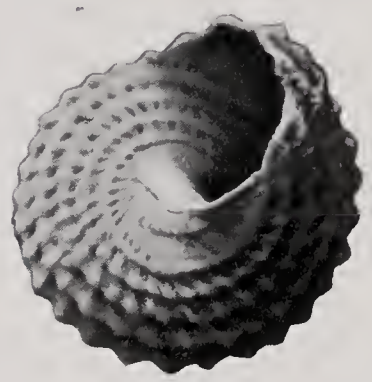

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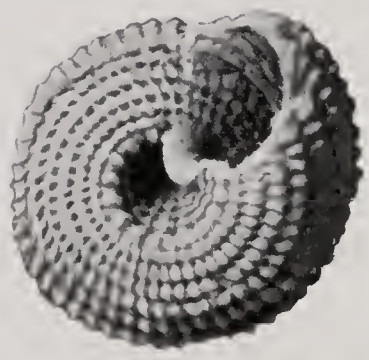

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1 to 3. Calliostoma (Calliostoma) roseoloide, × 4
4, 5. Calliostoma (Dentistyla) guppyi, × 8
6 to 8. Solariella altiusulca, × 6
9 to 11. Solariella veresimilis, × 10
12 to 14. Antillachelus vaughani, × 6
15, 16. Mirachelus precorbis, × 6

PLATE 37

FIGS. 1 to 3. *Microgaza* (*Microgaza*) *rotella retula*, n. subsp. Holotype, × 4; U. S. Nat. Mus. No. 369570; page 435.

FIGS. 4 to 6. *Microgaza* (*Bowdenagaza*) *cossmanni*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369571; page 436.

FIGS. 7 to 9. *Virtrinella gabbi*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369572; page 438.

FIGS. 10 to 12. *"Circulus" bicarinatus* (Guppy). Neotype, × 6; umbilicus lined with glue in fig. 12; U. S. Nat. Mus. No. 115621; page 439.

FIGS. 13 to 15. *"Circulus" partulus*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 369573; page 440.

FIGS. 16 to 18. *"Circulus" pentagonus* (Gabb), × 10; U. S. Nat. Mus. No. 369574; page 441.

FIGS. 19 to 21. *Episcynia naso* (Pilsbry and Johnson), × 10; U. S. Nat. Mus. No. 135501; page 442.

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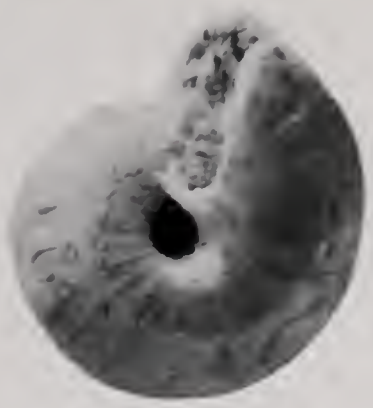

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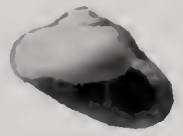

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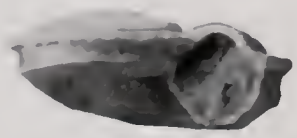

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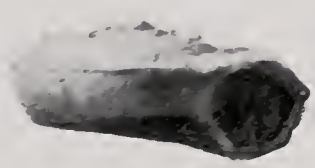

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1 to 3. Microgaza (Microgaza) rotella vetula, × 4
4 to 6. Microgaza (Bowdenagaza) cossmanni, × 6
7 to 9. Vitrinella gabbi, × 10
10 to 12. "Circulus" bicarinatus, × 6
13 to 15. "Circulus" partulus, × 6
16 to 18. "Circulus" pentagonus, × 10
19 to 21. Episcynia naso, × 10

PLATE 38

FIGS. 1 to 3. *Solariorbis clypeatus* Guppy, × 8; U. S. Nat. Mus. No. 369575; page 443.

FIGS. 4 to 6. *Solariorbis colpus*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369576; page 444.

FIGS. 7 to 9. *Teinostoma* (*Teinostoma*) *laccus*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369577; page 445.

FIGS. 10 to 12. *Pseudorotella pycna*, n. sp. Holotype, × 15; U. S. Nat. Mus. No. 135502; page 446.

FIGS. 13 to 15. *Pseudorotella homala*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369578; page 447.

FIGS. 16 to 18. *Didianema tytha*, n. sp. Holotype, × 10; U. S. Nat. Mus. No. 369579; page 448.

FIGS. 19 to 21. *Cocculina decussata*, n. sp. Holotype, × 6; specimen oriented incorrectly in fig. 19; U. S. Nat. Mus. No. 369580; page 449.

FIGS. 22, 23. *Cocculina pustulata*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 364581; page 449.

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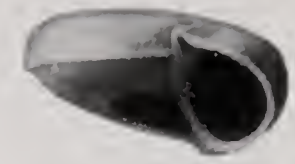

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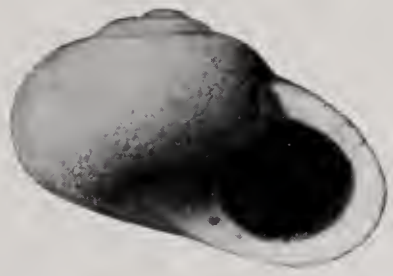

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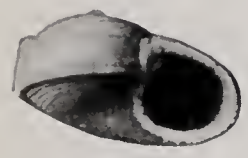

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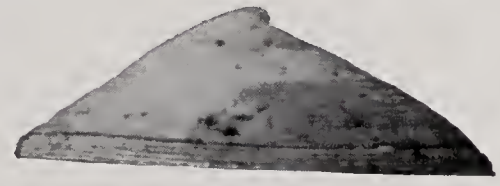

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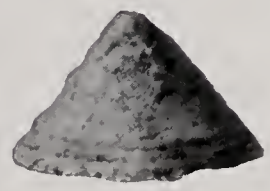

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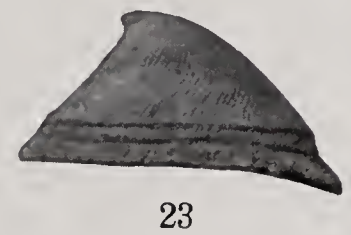

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1 to 3. Solariorbis clypeatus, × 8
4 to 6. Solariorbis colpus, × 10
7 to 9. Teinostoma (Teinostoma) laccus, × 10
10 to 12. Pseudorotella pycna, × 15
13 to 15. Pseudorotella homala, × 10
16 to 18. Didianema tytha, × 10
19 to 21. Cocculina decussata, × 6
22, 23. Cocculina pustulata, × 6

PLATE 39

FIGS. 1 to 3. *Fissurella (Fissurella) arguta*, n. sp. Holotype, × 3; U. S. Nat. Mus. No. 369582; page 450.

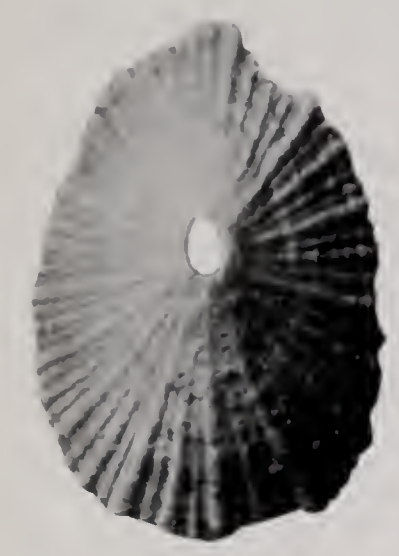
FIGS. 4 to 7. *Lucapina lipara*, n. sp. (4) and (5) Holotype, × 3; U. S. Nat. Mus. No. 135356; (6) and (7) small specimen, × 3; U. S. Nat. Mus. No. 369585; page 451.

FIGS. 8 to 10. *Lucapinella limatula vetula*, n. subsp. Holotype, × 3; U. S. Nat. Mus. No. 369584; page 452.

FIGS. 11 to 17. *Diodora alternata henekeni* (Maury). (11) to (13) Coarsely sculptured specimen, × 3; U. S. Nat. Mus. No. 369585; (14) and (15) coarsely sculptured specimen, × 3; U. S. Nat. Mus. No. 369586; (16) and (17) finely sculptured specimen, × 3; U. S. Nat. Mus. No. 369587; page 452.

FIGS. 18 to 20. *Diodora compsa*, n. sp. Holotype, × 2; U. S. Nat. Mus. No. 369588; page 454.

FIGS. 21, 22. *Puncturella (Fissurisepta) vetula*, n. sp. Holotype, × 6; apex tilted backward in fig. 21; specimen oriented incorrectly in fig. 22; U. S. Nat. Mus. No. 369589; page 455.



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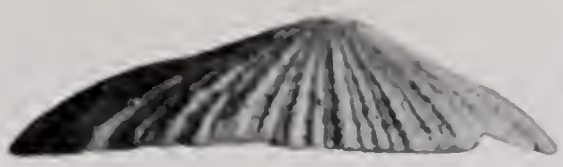

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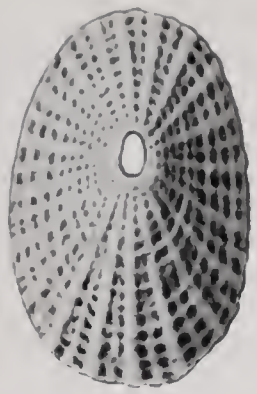

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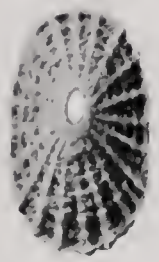

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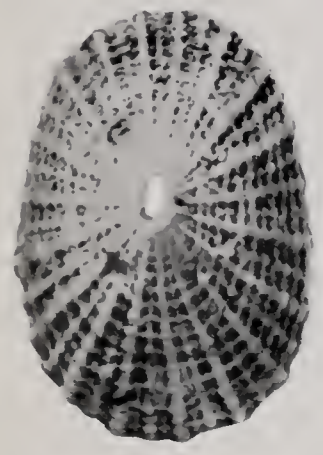

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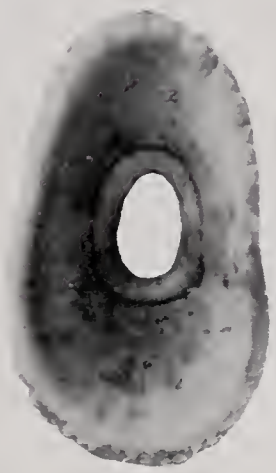

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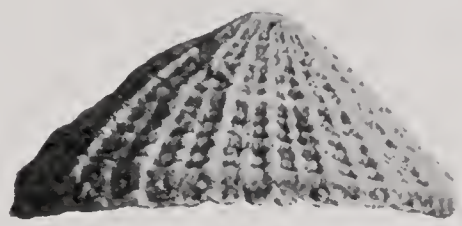

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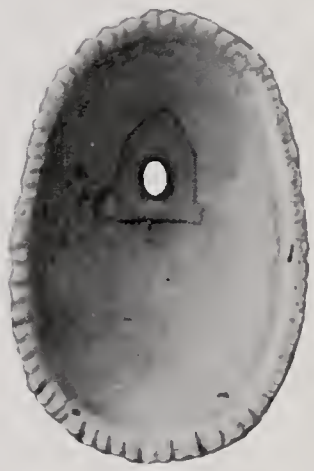

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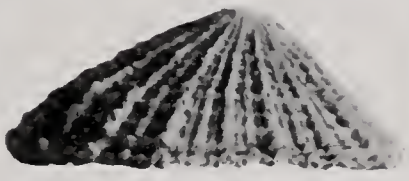

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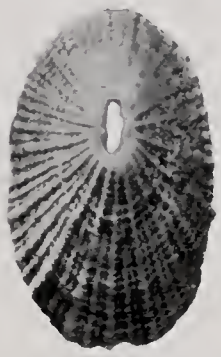

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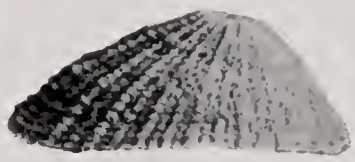

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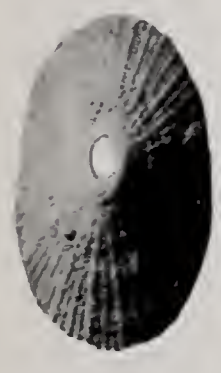

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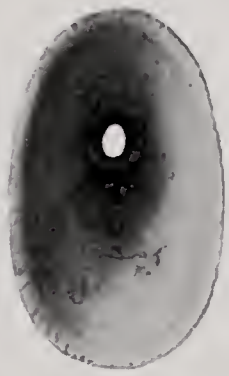

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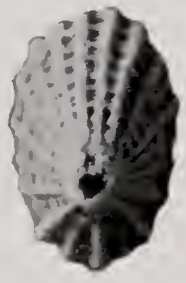

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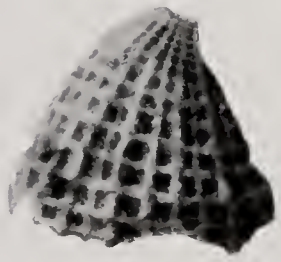

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1 to 3. Fissurella (Fissurella) arguta, × 3
4 to 7. Lucapina lipara, × 3
8 to 10. Lucapinella limatula vetula, × 3
11 to 17. Diodora alternata henekeni, × 3
18 to 20. Diodora compsa, × 2
21, 22. Puncturella (Fissurisepta) vetula, × 6

PLATE 40

FIG. 1. *Puncturella* (*Fissurisepta*) *vetula*, n. sp. Interior of different specimen, × 8; U. S. Nat. Mus. No. 369590; page 455.

FIGS. 2, 3. *Emarginula* (*Emarginula*) *palia*, n. sp. Holotype, × 3; specimen oriented incorrectly in fig. 2; U. S. Nat. Mus. No. 369591; page 455.

FIGS. 4, 5. *Rimula pilsbryi*, n. sp. Holotype, × 6; U. S. Nat. Mus. No. 135359; page 456.

FIGS. 6, 7. *Hemitoma* (*Hemitoma*) *sclera*, n. sp. Holotype, × 3; specimen oriented incorrectly in fig. 6; U. S. Nat. Mus. No. 369592; page 457.

FIGS. 8 to 12. *Acmaea actina*, n. sp. (8) and (9) Holotype, × 3; U. S. Nat. Mus. No. 135345; (10) to (12) smaller specimen, × 6; specimen oriented incorrectly in fig. 11; U. S. Nat. Mus. No. 369593; page 458.

FIGS. 13 to 15. *Acmaea acra*, n. sp. Holotype, × 3; U. S. Nat. Mus. No. 135346; page 459.

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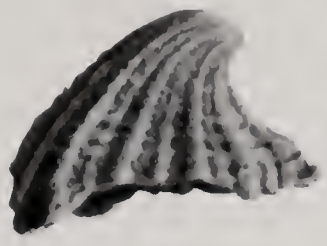

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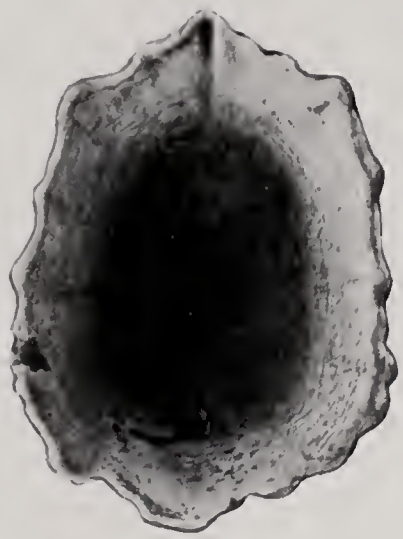

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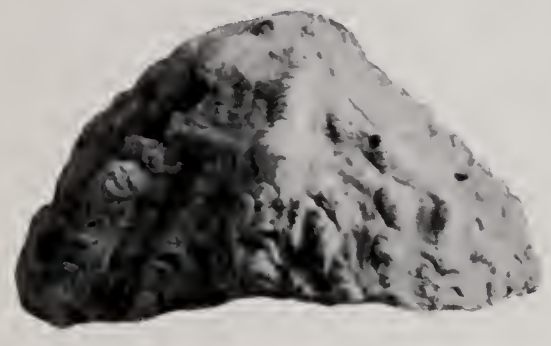

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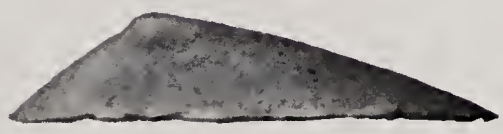

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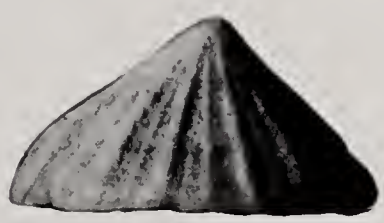

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1. Puncturella (Fissurisepta) vetula, × 8
2, 3. Emarginula (Emarginula) palia, × 3
4, 5. Rimula pilsbryi, × 6
6, 7. Hemitoma (Hemitoma) sclera, × 3
8, 9. Acmaea actina, × 3
10 to 12. Acmaea actina, × 6
13 to 15. Acmaea acra, × 3

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