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DISTRIBUTION OF OSTRACODA IN THE NEOGENE
OF CENTRAL HAITI

By

W. A. VAN DEN BOLD

1981

Paleontological Research Institution
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DISTRIBUTION OF OSTRACODA IN THE NEOGENE OF CENTRAL HAITI

W. A. VAN DEN BOLD
Louisiana State University
Baton Rouge, LA 70803

ABSTRACT

The ostracode fauna of Neogene deposits from the the Central Plateau and the Artibonite Valley of Haiti is described. From more than 400 samples more than 100 ostracode species are recognized, of which 60 are illustrated. Five brackish-water species are described as new: *Hemicyprideis agoiadiomensis*, *Cyprideis maissadensis*, *Cyprideis* n. sp.?, *Perissocytheridea cahobensis* and *Perissocytheridea?* *haitensis*. Central Haiti formed a single depositional basin during the Neogene in which pencontemporaneous environments ranged from continental to deep marine. The sea regressed in a southeasterly direction; marine deposition ceased in the northeast near the end of the early Miocene and persisted in the west until the Pliocene. The stratigraphic and paleobathymetric distributions of species of the genera *Krithe* and *Costa* are discussed.

INTRODUCTION

In Central Haiti the Neogene is exposed on the Plateau Central and in the Artibonite Valley, which are bordered on the north by the Massif du Nord, and on the south by the Chaîne des Matheux, and are partially separated in the west by the Montagnes Noires (Text-fig. 1). The deep marine origin of the early and middle Miocene sediments close to the Montagnes Noires and the Chaîne des Matheux suggests that during the early and middle Miocene the Plateau Central and the Artibonite Valley formed a continuous basin that probably was connected to the Cul-de-Sac basin in the south. This large basin gradually became shallower and parts of it became emergent between the middle Miocene and the Pliocene.

Text-figure 1.—Geologic map of Central Haiti, simplified after Butterlin (1956), showing approximate position of studied sections.

- A. Rivière Agoiadiome
- B. Rivière Fond Bleu and Fond Gras
- C. Dufailly-Capucin area
- D. Rivière Dormante
- F. Río Frio
- F'. Rivière Abriots
- G. Rivière Grande
- M. Rivière Jobelle (area of St. Michel de l'Atalaye)
- P. Rivière Bouyaha (Pignon area)
- S. St. Marc area (South St. Marc dome and Morne des Guepes)
- T. Thomonde-Savanette area

Table 1.—Correlation of the planktic foraminiferal zonations of Bolli (1957), and Lamb and Beard (1972) with the numerical system ("N" zones) of Blow (1969), as used in Central Haiti.

Thus, deep-marine, shallow-marine and brackish-water environments, in part contemporaneous (Bold, 1974a, p. 537), can be studied in the same basin.

Determination of the age of these beds is therefore of prime importance and is mainly based on the succession of faunas of planktic foraminifera. The zones of planktic foraminifera of Blow (1969) have been used as a basis of reference because they can be conveniently shown on maps and charts. However, I have slightly adjusted these zones (hereafter called "N" zones) to coincide with the zones for the Oligocene and Miocene of Trinidad published by Bolli (1957) (For later information also compare Stainforth *et al.* (1975); See Table 1.). The zones shown on the maps (Text-figs. 7-9) and used in Tables 2-15, are based on more samples than indicated, because only the 436 samples containing ostracodes have been identified by number. "N" zones for the Fond Bleu, Fond Gras, Thomonde and Rivière Dormante sections (sects. B, T, and D) were determined by A. E. Hunermann (unpublished M. S. thesis, Louisiana State University). I made the determinations of planktic foraminifera for the other Central Haitian sections; for other areas that are compared to formations in Central Haiti, determinations were made in part by the author, and in part by others (*e.g.*, Bermúdez, Bolli, Lamb, Robinson and Seiglie). Some of the data are unpublished.

In the late Miocene and Pliocene where Blow's zonation has been questioned by other specialists, I have used the zonation of Lamb and Beard (1972), but have used Blow's "N" zones as shown in Table 1, in accordance with the correlations suggested by Lamb and Beard (1972) and Stainforth *et al.* (1975).

Contacts between the formations appear to be gradual everywhere, and evidence for angular unconformities is lacking in all areas. In the the northeastern part of the Plateau Central the Las Cahobas Formation overlies the early Miocene "Arc" Formation, whereas in the southern part it overlies the middle Miocene Thomonde Formation, so that an unconformable relationship might be expected. However, all strikes are more or less parallel and all dips are of the same order of magnitude (28-30°) (see Text-fig. 5). Faunal evidence indicates a gradual shoaling (Table 2). On the south flank of the Plateau Central a similar relationship is found for the attitude of the beds around the Thomonde - Las Cahobas

boundary (Text-figs. 7-9). Some steeper dips are observed near this boundary, but this must be attributed to post-Miocene faulting. In no case does there appear to be a hiatus between the basal Las Cahobas beds and the underlying formations. Everywhere there is a gradual change in fauna from a shallow-marine to a restricted lagoonal environment. This change may take place at the boundary, but more commonly occurs slightly to considerably higher in the Las Cahobas Formation.

MATERIAL AND ACKNOWLEDGEMENTS

The material on which this study is based, was loaned to the author by the Paleontological Research Institution in Ithaca, N.Y., and I am very grateful for the kind help I received from Dr. Katherine V. W. Palmer and the staff of the institution in locating samples and paleontological reports. The material was collected by geologists of the Atlantic Refining Company in Haiti (for further details see Bold, 1974a, 1975a). I am deeply indebted to Atlantic Refining's geologists, especially to chief geologist H. M. Kirk. Weekly paleontological reports by R. C. Harris and D. Palmer cover most of the material and many locality and sample descriptions were taken from these reports (see Appendix). Unfortunately they do not cover all the material. Some reports appear to be missing, and consequently the information is not complete, with the result that some promising samples could not be included in this study for lack of pertinent data.

I am also indebted to A. E. Hunermann, Türkiye Petrolieri, Ankara, Turkey, who studied the foraminifera of part of the material for his M.S. thesis at Louisiana State University (submitted 1972) and whose unpublished information has been used throughout this report.

Types and figured specimens are deposited in the H. V. Howe collections [abbreviated HVH] in the Department of Geology, Louisiana State University at Baton Rouge, Louisiana.

LITHOSTRATIGRAPHY

Woodring (1922) included all five Neogene Formations of Central Haiti in the Artibonite Group. Three of these formations are

discussed in this report: the Madame Joie Formation, the Thomonde Formation and the Las Cahobas Formation. A fourth, the Maïssade Formation, is considered as a local facies of the Las Cahobas Formation (Butterlin, 1960, p. 87); a fifth unit, the Hinche Formation, is unfossiliferous and therefore is not discussed here.

Two additional formations have been recognized by geologists of the Atlantic Refining Company, but have not yet received formal recognition. One of them, the Bassin Zim limestone, has not been included here, because no washable samples of this unit were available. Another, the Arc Formation, is recognized here informally, and is cited as the "Arc" Formation. (For more information see Butterlin, Ramírez and Hoffstetter, 1956, Butterlin, 1960, and Bold, 1974a, or the original descriptions referred to below.)

"ARC" FORMATION

[= Madame Joie Fm. of Bold, 1965b, table 5]

Original reference. — Kirk, 1940 (Atlantic Refining Company report, unpublished).

Type section. — not designated. The Agoiadiome River section (A; Text -figs. 1, 4) is used for reference.

Thickness. — about 1300 m.

Lithology. —

upper part. — reef limestone, conglomerate and interbedded marl.

middle part. — sandy marl with flaggy limestone layers (only partly exposed in the Agoiadiome section).

lower part. — bedded limestone with shale partings and a basal conglomerate containing small pebbles.

MADAME JOIE FORMATION

Original reference. — Woodring, 1922, p. 6, 7.

Type section. — Morne Madame Joie, about 1 km southwest of the hamlet of Madame Joie (Text-fig. 7, about 2.5 km due E from where the Rivière Fond Gras enters the map).

Thickness. — 700 - 800 m.

Lithology. —

upper part. — interbedded marl, sandstone and sandy marl with bedded limestone.

lower part. — interbedded marl and argillaceous limestone with characteristic chalky weathering.

THOMONDE FORMATION

Original reference. — Jones, 1918, p. 736.

Type section. — near village of Thomonde (Text-fig. 8).

Thickness. — 600-700 m.

Lithology. —

upper part. — gray massive marl.

middle part. — massive marl with a few beds of hard marly limestone.

lower part. — calcareous shale with thin (2-10 cm) brown limestone beds with sandy partings; some thicker sandstone beds near the base.

LAS CAHOBAS FORMATION

Original reference. — Jones, 1918, p. 737.

Type section. — near village of Las Cahobas (Text-fig. 9), not precisely identified.

Thickness. — 1400-1800 m.

Lithology. —

upper part. — soft, cross-bedded, conglomeratic sandstone with mottled and variegated beds of argillaceous sandstone.

middle part. — Conglomerate, sandstone with mottled clay beds and marls, some lignite seams.

lower part. — basal conglomerate, sandstone and marl with coralline limestone and mudstone. Conglomerate, calcareous sandstone and limestone form the characteristic "Rimrock" of the Thomonde and Belladère structures.

MAÏSSADE FORMATION

Original reference. — Jones, 1918*, p. 739 (Maïssade beds).

Type section. — outcrops in the Rivière Blanche (between Rivière Jobelle and Rivière Fond Gras).

Thickness. — up to 200 m (Butterlin, 1960, p. 88).

Lithology. — shale, siltstones and sandstones with intercalated liginites, especially in the middle part. See Woodring *et al.*, (1924, p. 169-173) for more detailed descriptions.

Remarks. — Because the Maïssade Formation is found outcropping over only 100 km² on the south side of the Plateau Central, and because it appears to occur at different levels above the Thomonde-Las Cahobas contact, it is considered here to be a facies of the Las Cahobas Formation. Lithologic boundaries within the Las Cahobas Formation are probably time-transgressive. Although they can be used locally to subdivide the formation into three parts, they are not usable over longer distances.

In the Thomonde Formation no direct relation between litho- and biostratigraphy has been found. In the Madame Joie Formation the subdivision into lower and upper parts is biostratigraphic, based entirely on the presence or absence of *Orbulina*.

In the "Arc" Formation a correlation between faunal distribution and lithology is only present in the reference section.

BIOSTRATIGRAPHY AND PALEOECOLOGY

Text-figures 1, 2, 3

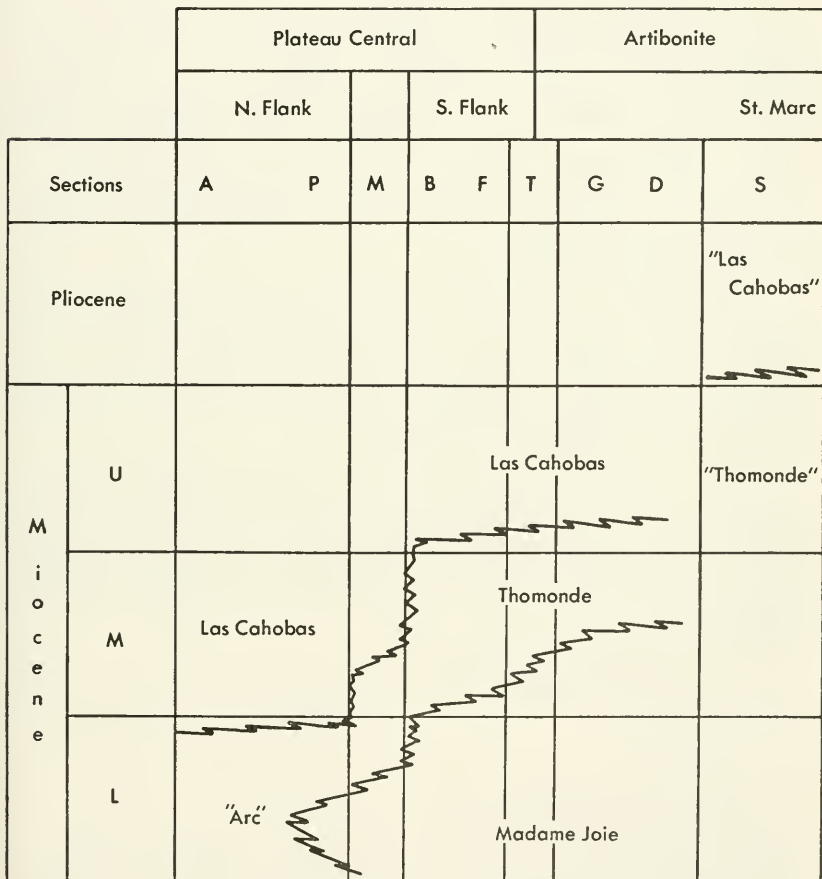
"ARC" FORMATION

In the Rivière Agoiadiome section (Text-fig. 1, sect. A) the lithologic subdivision into three parts corresponds to a faunal subdivision that can be recognized outside the reference section, whereas the lithologic subdivision appears of only local value.

*Jones considered the Maïssade beds to be younger than the Las Cahobas Formation. Woodring (1922), and Woodring *et al.*, (1924, p. 165, fig. 11), on the other hand, thought the Maïssade "tongue" to be a lateral equivalent of the Thomonde Formation. Butterlin (1954, p. 423) raised these beds to formational status, but remarked later (Butterlin, 1960, p. 88), that he agreed with Atlantic Refining Company geologists (Bermúdez, 1949, p 29), who considered it as a facies of the Las Cahobas Formation.

Lower part. — About 200 m thick; age early Miocene, on the basis of planktic foraminifera (“N” zone 5 of Blow, 1969). Depth of deposition 100 to 800 m, based on a planktic/benthic ratio varying from 25-60% and on the occurrence of *Uvigerina* of the *hispidocostata* type in areas of deeper deposition. The foraminiferal biofacies is, in many instances, similar to that of the Thomonde Formation. Ostracoda recovered include:

- Cytherella* sp. aff. *C. vulgata**
- Argilloecia* spp.*



Text-figure 2. — Schematic correlation of rock- and time-stratigraphic units in the Neogene of Central Haiti. Symbols for sections are as in Text-figure 1.

*Bairdia oarion**
*B. cassida**
*Krithe hiwanneensis**
*Parakrithe vermunti**
*Costa maquayensis**
*Trachyleberidea mammidentata**
Jugosocythereis wicksburgensis
*Ambocythere subreticulata**
*A. sp. aff. A. elongata**
*Agrenocythere hazelae**
Procythereis? sp.
Neocauditex macertus
*Loxococoncha sp. aff. L. woodwardsensis**

The list shows the predominance of species indicative of a deeper-water facies (with asterisks) over shallow-water species. Ostracod depth-ranges are less well established than those of foraminifera (see Benson, 1972, Morkhoven, 1972, Bold, 1977), and merely suggest a maximum water-depth of more than 600 m. At the top of the lower interval in the reference section, there is a sudden influx of very shallow-water forms, e.g. *Hemicyprideis stephensoni* and *Cytherella polita*.

Middle part.—About 800 m thick, not fully exposed. Here deeper-water ostracoda are replaced by shallower-water ones. *Costa maquayensis* is replaced by *C. cubana* somewhere below 600 m water-depth (see Text-fig. 15). Planktic foraminifera are not very common and represent long-ranging species. The age of the beds cannot be more narrowly defined than early Miocene.

Upper part.—Occurrence of such foraminiferal genera as *Amphistegina*, *Sorites*, *Heterostegina* and *Miogypsina* in the uppermost 300 m, and a low planktic/benthic ratio indicate shallowing upward. No age determination is possible on the basis of planktic foraminifera.

Ostracoda recovered include:

Cytherella sp. aff. C. pulchra
Paracypris sp.
Bairdia antillea
B. willisensis
B. condylus
Paranesidea elegantissima
Trichelina crumena
Aurila amygdala
A. galerita
Procythereis? deformis
P.? calhounensis
Cativalva sp. aff. C. moriahensis
Puriana rugipunctata gatunensis
Quadracythere antillea

Q. sparsa
Hermanites tschoppi
H. hutchisoni
Jugosocythereis wicksburgensis
Loxoconcha antillea
L. banesensis
Pontoleberis dactylotypa

For more details see Rivière Agoiadiome section (Text-fig. 1, sect. A).

Maximum waterdepth for these deposits, if compared to bathymetric ranges of comparable genera and species in the Gulf of Mexico (Morkhoven, 1972) is about 100-200 m. Most species are restricted to shallow water and a depth 0-100 m seems indicated for the uppermost 300 m of the section. *Loxoconcha banesensis* is the only species belonging to the deeper-water assemblages (*Loxoconcha* gr. 3 under systematic descriptions).

The stratigraphic range of *Procythereis? deformis* has previously been established as middle early to early late Miocene ("N" zones 6-16); *Triebelina crumena* is restricted to the early Miocene ("N" zones 5-6). Hence an age of middle early Miocene ("N" zone 6) seems indicated for part of the section. The co-occurrence of *Hermanites hutchisoni* (Pl. 4, fig. 7) and *H. tschoppi* (Pl. 4, fig. 3) is also found in the Ste. Croix limestone of Trinidad, "N" zone 7 (Bold, 1957b; see also Bold, 1970b, table 3). In Haiti this is found in the upper part of the "Arc" Formation in the Rivière Bouyaha section (Text-fig. 1, sect. P). The ostracode fauna of the upper part of the "Arc" Formation has strong similarity with zone IIA of the La Boca Formation, Panama (Bold, 1972b) and with the upper Lares and lower Cibao Formations of northern Puerto Rico (Bold, 1965b), whereas the overlying Las Cahobas Formation has many species in common with the Anguilla Formation, Anguilla (Bold, 1970b). In all areas the partial overlap of the ranges of *Procythereis? deformis*, *Triebelina crumena*, *Aurila galerita* and *Aurila amygdala* appears significant.

MADAME JOIE FORMATION

Age, established on the basis of the distribution of planktic foraminifera, is early to early middle Miocene ("N" zone 5-12). Depth of deposition: 1000-1500 m, based on the presence in the

deeper-facies parts of *Melonis pompiloides*, *Uvigerina rustica*, *Fontbotia wuellerstorffi* and *Uvigerina* of the *hispidata* type; planktic/benthic ratio 75-100%. See Steineck, 1974, p. 227-230 for comparison with the Montpelier group of Jamaica. Ostracoda recovered include:

*Cardobairdia glabra**
*Abyssocypris pykna**
*A. tipica**
Cytherella spp.
Argilloecia sp.*
Macrocypris sp.
*Bairdia oarion**
*B. cassida**
Bythocypris sp.*
Krithe hiwanneensis
K. lambi
K. morkhoveni
K. proluxa
*K. trinidadensis**
Messinella guanajayensis
Henryhowella ex. gr. *asperrima*
*Bradleya dictyon**
*Agrenocythere hazelae**
*Abyssocythere trinidadensis**
Costa maquayensis
C. cubana
Digmocythere russelli
*Ambocythere subreticulata**
Loxococoncha sp. aff. *L. woodwardsensis**
Cytheropteron? *trinidadensis*
*Trachyleberis bermudezi bermudezi**
*T. bermudezi crebripustulosa**
Paracytheridea sp. aff. *P. hispidata*

The ostracode assemblages are generally in accordance with the postulated depth of deposition. Comparison with the range of closely-related or identical species from the Gulf of Mexico, suggests a depth-range of 900-1200 m for the typical assemblage (These species are indicated by an asterisk.).

THOMONDE FORMATION

Age, middle Miocene, based on the distribution of planktic foraminifera, "N" zones 9-15. Depth of deposition varying from about 1000 m in the lower part of the sections to about 200 m in the upper part, based on the occurrence of *Uvigerina hispidocostata*, *Bulimina pagoda* and a planktic/benthic ratio of 25-75%; toward the top shallow-water facies predominate: in some sections these

may have been shallower than the minimum depth indicated above.
Ostracoda recovered include:

- Cardobairdia glabra**
*C. asymmetrica**
Cytherella sp. aff. *C. vulgata**
*Cytherella postdenticulata**
Argilloecia spp.*
Macrocypris sp.
Paracypris sp.
Bairdia antillea
B. willisensis
*B. cassida**
*Krithe lambi**
*K. trinidadensis**
*K. proluxa**
K. dolichodeira
*Parakrithe vermunti**
Cytheromorpha? sp. aff. *C.?* *caudata*
Procythereis deformis
P. calhounensis
*Trachyleberis bermudezi crebripustulosa**
*Trachyleberidea mammidentata**
*Costa cubana**
*Agrenocythere hazelae**
*Bradleya dictyon**
Henryhowella ex gr. *asperrima**
Jugosocythereis vicksburgensis
Quadracythere antillea
Puriana rugipunctata gatunensis
Orionina vaughani
Caudites nipeensis
Coquimba congestocostata
*Ambocythere subreticulata**
*Loxoconcha banesensis**
L. aff. *L. cubensis*
L. aff. *L. forda*
L. antillea
Cytheropteron sp. aff. *C. palton*
C. sp. aff. *C. bichense*
C. sp.
Paracytheridea sp.
Xestoleberis sp.
Pellucistoma sp. aff. *P. magniventra*

Species with an asterisk belong to the deeper-water facies (lower part) of the formation, and indicate a minimum depth of deposition of about 600 m. At the very top rapid shallowing to a waterdepth of less than 100 m is indicated.

LAS CAHOBAS FORMATION

The basal beds of the Las Cahobas Formation, in my opinion, vary considerably in age from one part of the Central Haitian basin

to the other. In the north they overlie the "Arc" Formation (of early Miocene age) without apparent unconformity. These basal beds carry a fauna that is similar in many respects to that of the Anguilla Formation of Anguilla (Bold, 1970b), and the Cibao Formation of Puerto Rico (Bold, 1965b), and are probably early middle Miocene in age. On the south flank of the Plateau Central they conformably overlie the Thomonde Formation, dated here as early late Miocene or late middle Miocene ("N" zone 15).

The upper part of the Las Cahobas Formation is mostly of continental facies and barren of ostracodes. In the Fond Bleu - Fond Gras sections, (Text-fig. 1, sect. B), however, fresh-water ostracodes were found. In the area between the Plateau Central and the Artibonite Valley (Savanette syncline; see Text-fig. 1, sect. T) a marine to brackish-water fauna has been identified (Table 10). These beds have been dated as Pliocene ("N" zone 18) on the presence of *Radimella confragosa* (Bold, 1975b) and *Cyprideis salebrosa* (Bold, 1976), and a few specimens of the planktic foraminifer *Globorotalia margaritae*.

The depth of deposition was from 0-50 m, based on the occurrence of *Ammonia* ex gr. *beccarii* and *Protelphidium crispum*, plant remains, shallow marine and brackish-water ostracodes and the absence or extreme rarity of planktic foraminifera. Ostracoda recovered include:

- Cytherella polita*
- C.* sp.
- Bairdia antillea*
- B. willisensis*
- B.* sp.
- Cyprideis pascagoulaensis*
- C. bensoni*
- C. salebrosa*
- C. ovata*
- C. maissadensis*
- C. similis*
- Hemicyprideis cubensis cubensis*
- H. cubensis chicoyensis*
- H?* sp. aff. *H? texana*
- H. agoiadiomensis*
- Perissocytheridea matsoni*
- P. alata*
- P. cahobensis*
- P?* *haitensis*
- Cytheromorpha* sp.
- Procythereis? deformis*
- Aurila galerita*
- A.* sp. aff. *A. cicatricosa*

Radimella confragosa
R. confragosa form A
Quadracythere antillea
Q. sparsa
Limnocythere? sp.
Caudites medialis
C. sacer
Jugosocythereis vicksburgensis
Puriana rugipunctata gatunensis
Loxoconcha runa
L. cubensis
L. sp.
Xestoleberis sp.
Pellucistoma sp. aff. *P. magniventra*

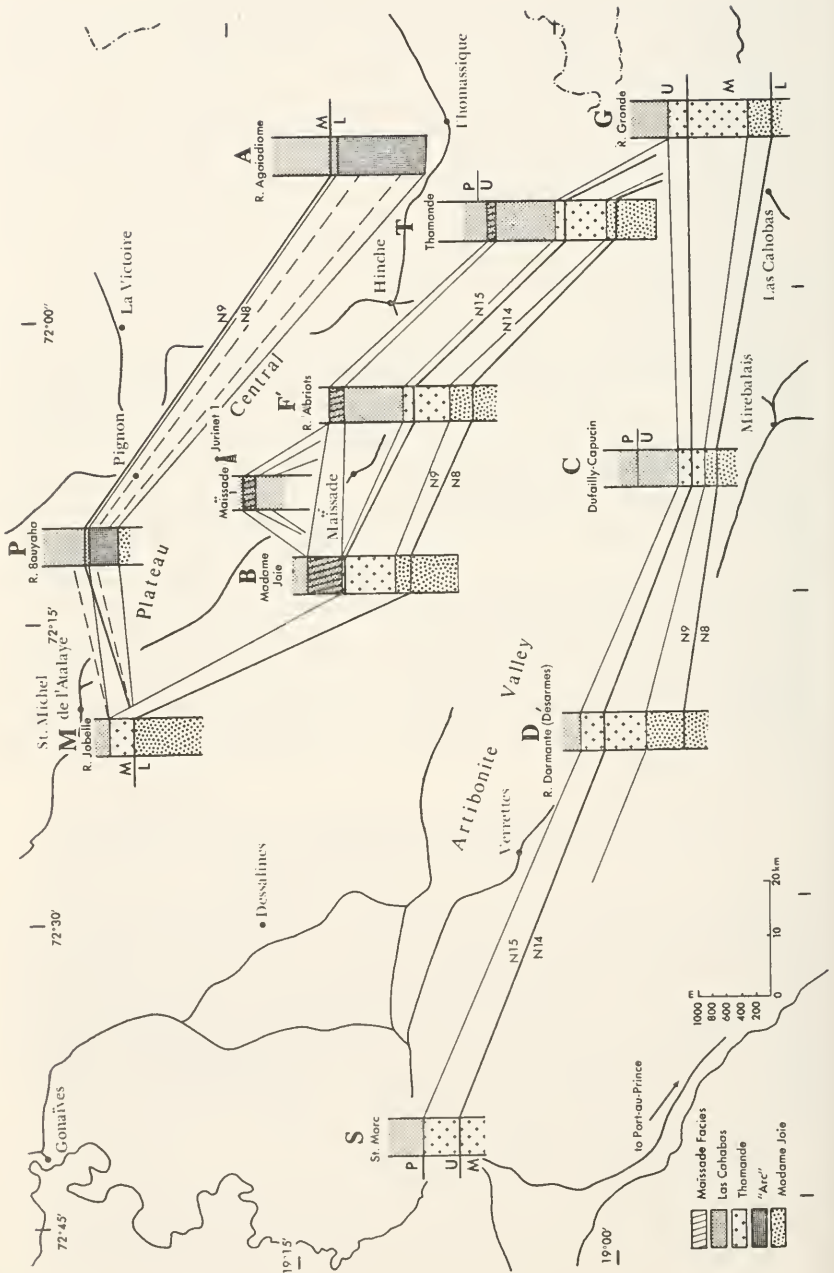
The Maïssade facies is recognized lithologically by the development of lignites and paleontologically by the presence of mollusk-faunas containing *Ostrea*, *Potamides*, *Melongena*, *Scapharca* and others, and ostracode-faunas containing *Cyprideis maissadensis*.

The Maïssade facies is found in the southern part of the Plateau Central from the Rivière Blanche through Rivières Fond Gras and Fond Bleu, Rivière Abriots to the Rivière Thomonde (see Text-figs. 1 and 3, sects. B, F and T). In the western part (e.g. Rivière Fond Gras) these brackish-water beds occur at or near the base of the Las Cahobas Formation, whereas towards the east they become progressively younger and higher in the section (e.g., at Rivière Abriots) above the contact between the Thomonde and Las Cahobas Formations, which in turn becomes progressively younger to the east (see Text-fig. 3).

"THOMONDE" FORMATION (= ? RIVIERE GRISE FORMATION)
 OF THE ST. MARC STRUCTURE

Lowest exposed layers are composed of fine-grained calcareous sandstone, overlain by a monotonous series of light gray to tan marls. The age, on the basis of planktic foraminifera ("N" zones 13-17), is late middle to late Miocene. Depth of deposition varied from 200-1200 m, based on samples containing *Uvigerina rustica* and *U. hispidocostata*, and having a planktic/benthic ratio of 25-90%. Ostracoda recovered include:

Cytherella sp. aff. *C. vulgata*
Argilloecia spp.
*Bairdia oarion**
B. sp.
Krithe prolixa
K. lambi



*K. trinidadensis**
*K. reversa**
K. dolichodeira
*Agrenocythere hazelae**
Henryhowella ex gr. *asperimma**
*Trachyleberis bermudezi crebripustulosa**
*Trachyleberidea mammidentata**
*Costa cubana**
C. dohmi
Puriana rugipunctata gatunensis
*Bradleya dictyon**
Orionina serrulata
Caudites rectangularis
*Ambocythere exilis**
Loxococoncha sp. aff. *L. forda*
Cytheropteron sp.
Pseudocythere sp.
Paracytheridea sp.
*Loxococoncha banesensis**

Species with an asterisk are identical or very similar to species found in the Gulf of Mexico from a depth-range of 200-1200 m. Presence of *Krithe reversa*, *Agrenocythere* and *Bradleya* indicates local deposition in water deeper than 1000 m (see "Systematic Paleontology").

"LAS CAHOBAS" FORMATION (= ? MORNE DELMAS FORMATION)
 OF THE ST. MARC STRUCTURE

(Text-fig. 1, sect. S)

The base of this formation is formed by coral limestone with interbedded marls, similar in appearance to the typical "rimrock" of the basal Las Cahobas Formation in the Thomonde area. Higher in the section calcareous shales with intercalated fine-grained sandstones predominate. The depth of deposition was from 0-100 m, generally very shallow, based on the occurrence of corals, brackish-water ostracodes and, in one sample, Characea. The age of the unit is Pliocene, but basal layers may be of late Miocene age. This is based on the presence of *Radimella confragosa* throughout most of the section. In the basal beds *Cyprideis pascagoulaensis* occurs,

Text-figure 3. — Fence diagram, showing rock- and bio-stratigraphic correlation in the Neogene of Central Haiti. Heavy lines indicate the boundaries between "N" zones 8 and 9 (corresponding to the boundary between lower and middle Miocene) and "N" zones 14 and 15 (boundary between middle and upper Miocene). Thin lines indicate formational boundaries. Dashed lines on the north flank of the Plateau Central indicate local correlation of faunal units. Symbols for sections as in Text-figure 1.

L: lower Miocene; M: middle Miocene; U: upper Miocene; P: Pliocene.

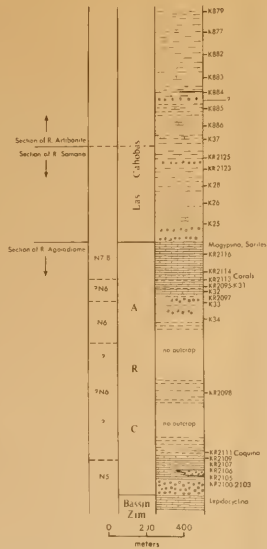
which shows the same overlap in range with *R. confragosa* as in the Morne Delmas and Las Salinas Formations of southern Hispaniola (Bold, 1975a, text-fig. 18). Higher in the section are brackish-water deposits containing *Cyprideis* n. sp.?. Absence of *Cyprideis salebrosa* prevents direct correlation with the Cul-de-Sac basin. This upper part of the "Las Cahobas" Formation is tentatively correlated with the Jimaní Formation of the Dominican Republic (see discussion under "Section S"). Ostracoda recovered include:

- Cytherella* sp.
- Macrocyprina* sp.
- Bairdia* sp.
- B. willisensis*
- Hemicyprideis* sp.
- Cyprideis Pascagoulaensis*
- C. n. sp.?*
- Perissocytheridea bicelliforma?*
- P. matsoni*
- P. sp.*
- Krithe lambi*
- K. dolichodeira*
- Munseyella* sp.
- Radimella confragosa*
- R. confragosa* form A
- Caudites rectangularis*
- Costa dohmi*
- Paracytheretta dominicana*
- Ambocythere exilis*
- Loxococoncha dorsotuberculata*
- L. levis*
- L. rugosa*
- L. forda*
- Paracytheridea tschoppi*
- P. sp.*
- Xestoleberis* sp.

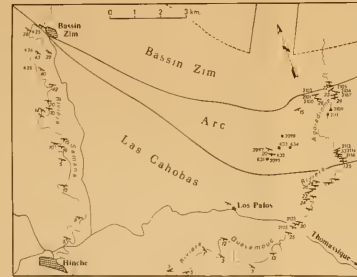
This fauna is very similar to that of the Gurabo and Mao Formations of the Cibao valley in the northern Dominican Republic (Bold, 1968). Depth of deposition ranges from very shallow marine in the basal and top parts (partly brackish-water) to 100 m in the middle part of the formation. This is similar to the paleoenvironmental sequence in the Gurabo and Mao Formations in the western part of the Cibao valley, and to that in the Cul-de-Sac boreholes north of Port-au-Prince, Haiti (Bold, 1975a).

DISCUSSION OF INDIVIDUAL SECTIONS

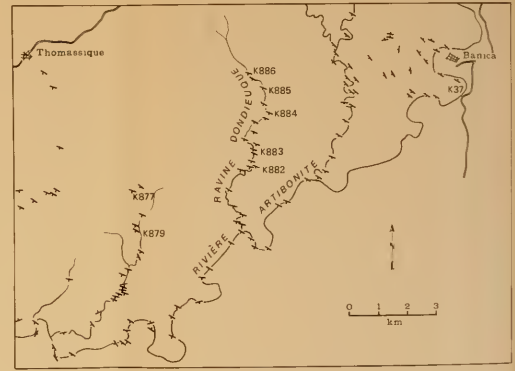
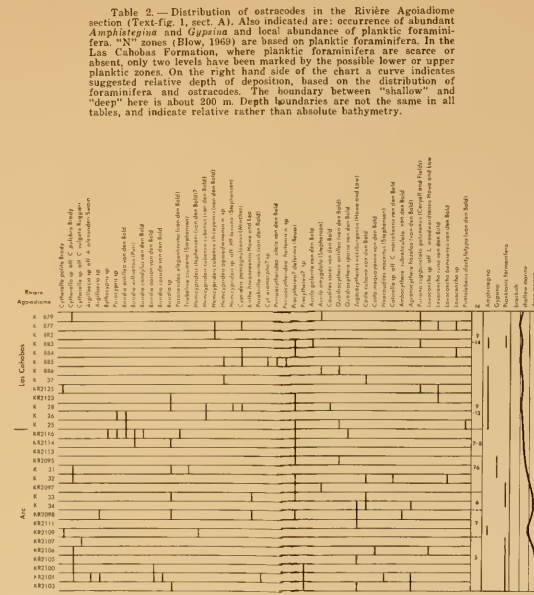
SECTION A: RIVIERE AGOADIOME (Table 2, Text-figs. 4, 5, 6)



Text-figure 4.—Stratigraphic column of the Rivière Agoiadome section (see Text-fig. 1, sect. A). Ostracode-bearing samples taken by H. M. Kirk (K) and H. M. Kirk and A. F. Richardson (KR).



Text-figure 5.—Locality map of the area between Hinche and the Rivière Agoiadome. Samples collected by H. M. Kirk and A. F. Richardson (KR in Text-fig. 4) without prefix; where available dip measurements are indicated.



Text-figure 6.—Locality map of the northeast corner of the Plateau Central between Thomassique and Banica.

"Arc" Formation. — In this section the "Arc" Formation has been divided into three lithological units, the boundaries of which coincide with changes in faunal distribution.

Apparently conformably above the Oligocene-Miocene Bassin Zim Limestone containing *Lepidocyclina favosa*, the lowest lithological unit of the "Arc" Formation is a deep-marine interval about 200 m thick, where planktic foraminifera indicate an early Miocene age ("N" zone 5).

Above this is a shallow-marine middle unit 800 m thick, with *Amphistegina* dominating the foraminiferal fauna; this interval does not contain enough planktic marker-species to establish its exact position in the foraminiferal zonation. The ostracode species, *Procythereis? deformis*, which has a stratigraphic range of "N" zones 6-16, first appears in this interval. *Procythereis? sp.* (Pl. 4, fig. 2), which is present in the basal interval is also found in the Oligocene Bonnygate Formation (Montpelier Group) in Jamaica. The uppermost 200 m of this middle unit was probably deposited under slightly deeper-water conditions (about 400 m water depth).

In the upper interval about 300 m thick the foraminiferal fauna is dominated by *Gypsina sp.* In the lower part of this unit the co-occurrence of *Procythereis? deformis* and *Triebelina crumena* is thought to be indicative of "N" zone 6 (Bold, 1974b, p. 35, text-figs. 4, 5). The ostracode fauna is dominated by species of *Bairdia*. This pattern continues upward in the basal Las Cahobas Formation, suggesting continuous sedimentation in shallow-marine waters. The lithofacies, however, changes from predominantly carbonate to clastic.

Las Cahobas Formation. — The basal 700 m was deposited in shallow seas. Planktic foraminifera occur sparsely but regularly; all are long-ranged forms, most of which seem to indicate a middle Miocene age, although the absence of *Orbulina* suggests that part of it may be early Miocene. The presence of such ostracodes as *Quadracythere sparsa* (Pl. 4, fig. 4) and *Caudites sacer* Bold, 1970b would also indicate early to early middle Miocene (Bold, 1970b, tables 1 and 3). In this marine interval the single occurrence of *Cyprideis pascagoulaensis*, may have been washed in from a nearly brackish-water environment.

The section studied is continuous along the Rivière Agoiadiome up to locality KR 2125 (Text-fig. 5). The upper part of the section is taken along the Rivière Artibonite and its tributaries (Text-fig. 6) and is reasonably continuous in outcrop. However, the connection between the two sections is uncertain and part of the sequence may be missing (not represented by samples). The effect of this would be an increase in thickness of the lower marine interval.

Above the basal marine beds of the Las Cahobas Formation is a brackish-water interval 600 m thick, with some lignites in the lower portion. A marine intercalation (Text-fig. 6, locs. K 883, K 884) containing *Cassigerinella chipolensis*, *Globigerina praebuloides*, *G. venezuelana*, *Globigerinoides trilobus* and *Orbulina universa* indicates that it still represents middle Miocene ("N" zones 9-14). The presence of *Aurila amygdala* in the uppermost part suggests the lower middle Miocene. On the other hand, *Hemicypriideis agoiadiomensis*, described from this section, has also been found in the basal Las Cahobas Formation of the Dufailly anticline, where it overlies the Thomonde Formation [assigned to "N" zone 15 (latest middle Miocene)]. Although the occurrence of lignite tends to point to correlation with the Maïssade facies of the south flank of the Plateau Central (late Miocene in age), the absence of typical Maïssade species (e.g., *Potamides* spp. and *Cypriideis maïssadensis*) argues against such a correlation.

SECTION P: RIVIERE BOUYAHA (SOUTHWEST OF PIGNON)
(Table 3)

The lithology of most of this section is monotonous (gray-tan, sandy marl or calcareous shale), so that a threefold subdivision like that used in the Agoiadiome section, is not possible. However, the ostracode distribution suggests correlation with the three subdivisions of the Agoiadiome section, as indicated by dashed lines in Text-figure 3 (also of Tables 2, 3). In section P, the Madame Joie Formation plus a portion of the "Arc" Formation (up to locality R 1377) corresponds to the lowest unit of the "Arc" Formation in section A; the interval including localities R 1378-1382 corresponds to the middle unit of the "Arc" Formation, and the interval including localities R 1383-1388 corresponds to the upper unit of the "Arc" Formation plus the basal, marine Las Cahobas Formation in the reference section.

Formation of the Agoiadiome section, and which locally contains some mollusks. Depth of deposition is initially of the order of 300 m. Rare planktic foraminifera indicate late early Miocene ("N" zones 6-8). Of interest is the shallow-water ostracode fauna (Table 2; locs. R 1383-1386) with co-occurrence of *Hermanites tschoppi* (Bold) (Pl. 4, fig. 3), *Hermanites hutchisoni* Bold (Pl. 4, fig. 7) and others, typical of the Ste. Croix limestone of Trinidad ("N" zone 7; Bold, 1970b, table 3).

Above this a slight deepening of the environment takes place, which seems to continue into what has been mapped as Las Cahobas Formation by geologists of the Atlantic Refining Company. This basal part of the Las Cahobas Formation contains the following planktic foraminifera, which suggest that this interval probably belongs to "N" zone 8:

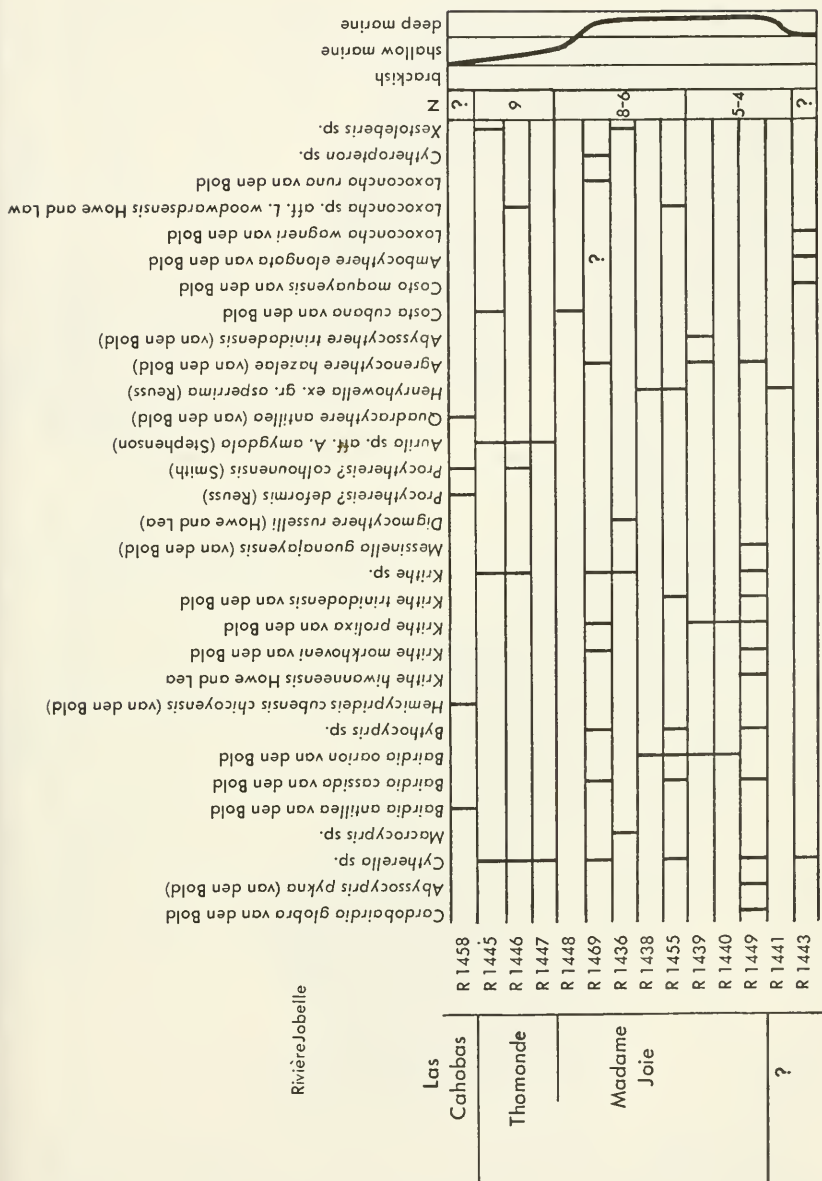
Globoquadrina altispira
G. venezuelana
Globigerina praebulloides
Globigerinoides sicanus
G. subquadratus
G. trilobus
Globorotalia siakensis

The highest beds in this section carry *Hemicyprideis cubensis chicoyensis* and *Perissocytheridea alata*, indicating very shallow-water, possibly brackish, conditions. This fauna is similar to that of the basal Paso Real Formation of Cuba (Bold, 1973). Dips in the beds of this area are flat and have erratic directions so that it is difficult to construct a composite columnar section and measure the exact thickness of the "Arc" Formation, which is at least 400 m. In Table 2 the samples approximate stratigraphic order as closely as possible using available data.

SECTION M: RIVIERE JOBELLE (SOUTH OF ST. MICHEL DE L'ATALAYE) (Table 4)

Strata in this area have been mapped by geologists of the Atlantic Refining Company as Madame Joie, Thomonde and Las Cahobas Formations. The Madame Joie Formation ranges from "N" zones 4-8 in the lower Miocene and was deposited in water

Table 4. — Distribution of ostracodes in the Rivière Jobelle section (Text-fig. 1, sect. M). The boundary between shallow and deep marine environments is at about 300 m. The samples were taken by A. F. Richardson.



about 1000 m deep, as indicated by the presence of the following ostracodes. Ostracoda recovered include:

Agrenocythere hazelae
Abyssocythere trinidadensis
Henryhowella ex gr. *asperrima*
Krithe spp.
Bairdia oarion
B. cassida
Cardobairdia glabra
Abyssocypris pykna

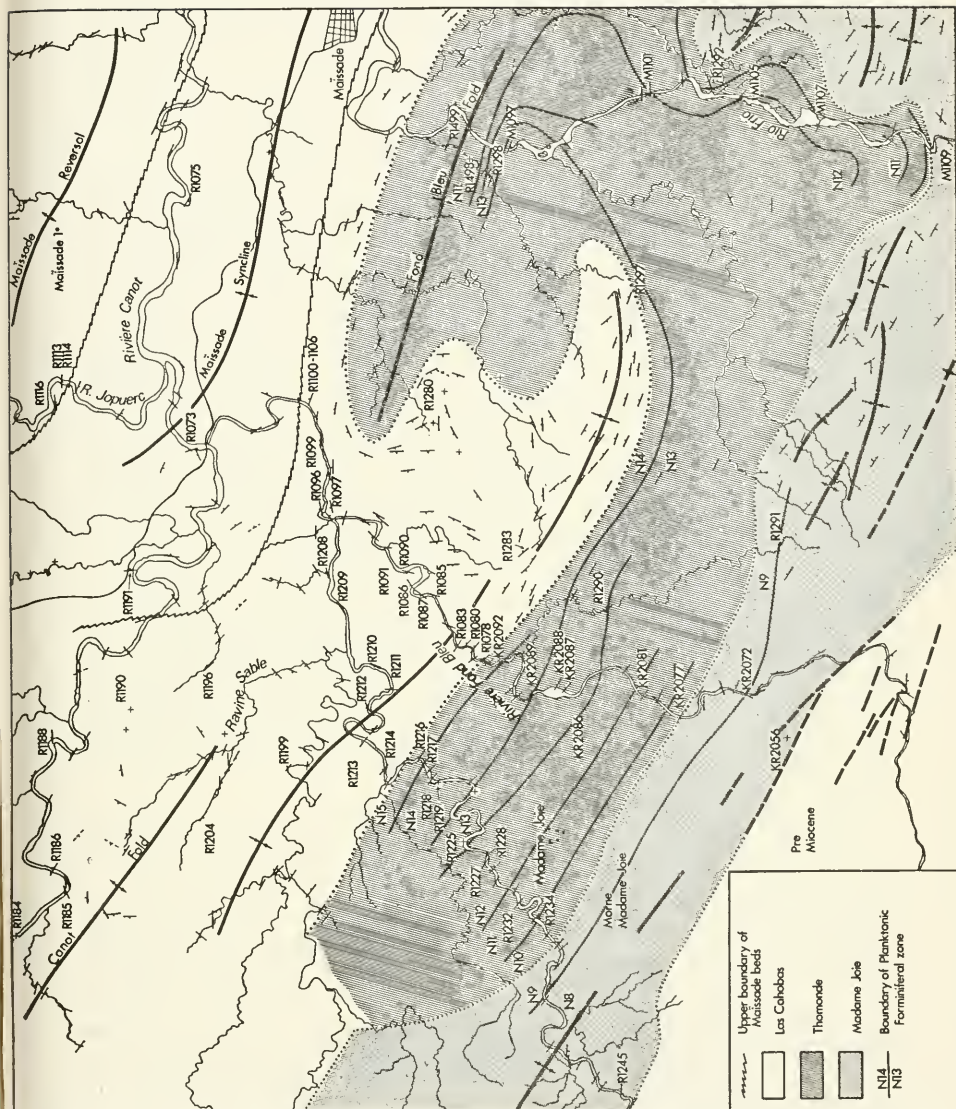
This fauna from the basal part of the Madame Joie Formation is similar in composition to that of samples in the Gulf of Mexico between 1000 and 1200 m depth [e.g., sample R 1449 (see "Appendix")]. The Thomonde Formation consists of bluish to tan, slightly sandy marls and appears to be early middle Miocene in age (e.g., "N" zone 9) and to represent a much shallower depositional environment than the Madame Joie Formation.

Only one sample of the Las Cahobas Formation yielded any ostracodes. These are similar to those of the Bouyaha section and include, *Hemicyprideis cubensis chicoyensis* and *Procythereis? deformis* (recovered from bluish-gray calcareous shale).

The series of tan marls, similar to those of the Bouyaha section, is more than 800 m thick in the Madame Joie Formation, but is faulted at the base. Some sample localities here could only be plotted from their description, which makes their position in the section, and therefore the thickness of the formation, less certain. The Thomonde Formation on the other hand is thin (not more than 250 m) and appears to pass laterally into beds mapped as Las Cahobas Formation on the Atlantic Refining Company maps. It is paleontologically similar to the upper part of the "Arc" Formation and the lower part of the Las Cahobas in the Rivière Bouyaha section, as indicated by dashed lines in Text-figure 3.

SOUTH SIDE OF THE PLATEAU CENTRAL (Text-fig. 7)

Text-figure 7. — Geologic map of part of the south flank of the Plateau Central, west of Maissade. Formation boundaries are after [unpublished] maps of the Atlantic Refining Company, with some slight modifications. Heavy lines indicate boundaries between "N" zones. Scale: 1: 100,000.



Sections have been studied along the Rivière Fond Gras (sect. B, Tab. 5), the Rivière Fond Bleu (sect. B, Tab. 6), Río Frío (sect. F, Tab. 7) and Rivière Abriots (sect. F', Tab. 8). Also some samples were available from Maïssade well no. 1 (Tab. 9). No great difference between the individual sections has been found.

The Madame Joie Formation, about 800 m of marls and marly limestones, is variably fossiliferous. Ostracodes are absent in the Fond Gras section, present in the upper part in the Fond Bleu section, but well represented in the Rivière Abriots (sect. F'). A depositional depth of 1000 m or more is indicated. In all sections the top of the formation is of middle Miocene age and lies above the *Orbulina*-level: "N" zones 9-10 in the Fond Bleu and Fond Gras, slightly higher in the Abriots section. However, along the Rivière Abriots, dips steepen close to the contact between the Madame Joie and Thomonde Formations, and the latter is slightly thinner (550 m, compared to 650-750 m in the Fond Bleu and Fond Gras sections), which may mean that this part of the section is faulted.

The Thomonde Formation consists of gray, clayey marls. Hunermann (unpublished M.S. thesis, Louisiana State University), on the basis of the occurrence of benthic foraminifera (*Uvigerina hispidocostata*, *U. hispida*, *U. rustica*, *Fontbotia wuellerstorfi*), inferred depositional depths of 2000-1000 m in the Rivière Fond Gras section. Ostracode evidence suggests a less deep environment (deeper than 400 m). However, it is possible that some of the shallower-water species were redeposited downslope.

In all sections of the South Central Plateau deposition of the Las Cahobas Formation begins in the late middle Miocene ("N" zone 15). The formation is composed of gray to blue-gray, sandy, calcareous shales with shell debris and some well-preserved mollusks. In original field work, the Las Cahobas-Thomonde contact was mapped in the Rivière Fond Gras section between localities R 1226 and R 1227 and in the Rivière Fond Bleu section between localities KR 2091 and KR 2092. R. C. Harris (Paleo-Report Hispanola, no. 152 of Nov. 4, 1942) suggested the slightly higher position in the Rivière Fond Gras that has been adopted in Text-figure 7). Here, as in the Thomonde section (sect. T) it is difficult to pinpoint the boundary, because it is lithologically transitional.

In the Fond Bleu-Fond Gras areas part of the Las Cahobas Formation is developed in the Maïssade facies with shell beds of

Ostrea, *Potamides*, *Melongena* and *Scapharca* and with lignites. The typical Maïssade facies contains a brackish-water ostracode fauna characterized by *Cyprideis maïssadensis* n. sp.. In the Rivière Fond Gras the Maïssade facies begins immediately above the basal conglomerate of the Las Cahobas Formation (at loc. R 1214, Tab. 5). In the Rivière Fond Bleu the lowest beds of the Maïssade facies occur a little higher in the section. They are not developed between localities R 1086 and 1097. This part of the section may represent basal Las Cahobas beds in the plunging nose of the Fond Bleu Fold (Text-fig. 7) Basal "Rimrock" (calcareous sandstone) is reported from the flanks of this structure and also occurs in the syncline southwest of this fold. The boundary between basal Las Cahobas and Maïssade beds (middle Las Cahobas Formation of the Atlantic Refining Company) is difficult to place and may be affected by faulting in the area of an apparent offset of the two synclines south of the Fond Bleu and Canot folds (Text-fig. 7). Faulting in this area is also suggested by a shift in the boundaries between "N" zones 12, 13 and 14 just east of the Rivière Fond Bleu.

In the Abriots section (Text-fig. 1, sect. F') the Maïssade beds are found about 300 m above the base of the Las Cahobas Formation. In Maïssade well no. 1, the Thomonde was not represented in the samples available [down to 1712 ft (ca. 550 m)], but the appearance of marine species suggests the proximity of the contact at this depth. *Cyprideis maïssadensis* occurs some 700 ft (\pm 230 m) higher. The presence of *Cyprideis ovata* in the Maïssade beds here suggests a late Miocene to early Pliocene age (Bold, 1976).

SECTION T: THOMONDE-SAVANETTE SECTION (Table 10, Text-fig. 8)

This section runs roughly WNW - ESE through the nose of the plunging Thomonde anticline, then turns south at the Thomonde river near the type locality for the Upper Thomonde Formation (loc. K 420), and runs more or less parallel to the general course of the river, ending in the Savanette syncline.

Only the upper part of the Madame Joie Formation ("N" zones 9, 10) contains ostracodes. The Madame Joie Formation is about 850 m thick and consists of tan marls and sandy marls. Benthic foraminifera suggest a depositional environment deeper than 1000 m.

The Thomonde Formation, about 750 m of gray marls and sandy marls begins in "N" zone 10. The distribution of benthic foraminifera suggests a shallower environment in "N" zone 12. Among the ostracodes in this section no reliable depth-indicators were found, but no deep-water species (e.g., *Bairdia cassida*, *Ambo-cythere subreticulata*) were found above "N" zone 12. The upper part of the Thomonde Formation ("N" zones 14-15) contains only shallow-water ostracodes, and the boundary with the Las Cahobas Formation again appears to be transitional, as the basal part of this formation ("Rim rock") contains marine shallow-water foraminifera among which *Amphistegina* and *Sorites* are abundant. The lowest occurrence of the Las Cahobas Formation was mapped at locality K 452, but R. C. Harris (Paleo. Report Hispanola, no. 152, 1942 [unpublished]) found *Elphidium* typical of the Las Cahobas Formation from KR 2001 up. Accordingly, the base of the Las Cahobas Formation would correspond to "N" zone 14. Brackish-water ostracodes only appear some 500 m higher in the section (loc. K 464). The Maïssade facies, containing *Cyprideis maïssadensis*, is found about 800 m above the base of the Las Cahobas Formation. Faunas with abundant *Melongena*, *Scapharca*, *Chama* and *Cypraea*, and also containing *Sorites* appear to be confined to intervals of slightly higher paleosalinity.

In the deepest part of the Savanette syncline *Cyprideis pasca-goulaensis*, which is everywhere the most abundant ostracode-species in the Las Cahobas Formation, is replaced by *Cyprideis salebroso* and *C. bensoni*, indicative of late (or middle?) Pliocene (Bold, 1976). Here they occur at least 1500 m above the base of the Las Cahobas Formation.

South of the Savanette syncline and the fault displacing the Chamouscadille anticline, the basal Las Cahobas Formation is developed in a marginal marine facies with *Amphistegina* and *Sorites* limestones ("Rim rock"), which occupies here a wider band than in the Thomonde structure. On the north side of the Thomonde anticline the basal "Rim rock" appears to overlie older parts of the Thomonde Formation (Text-fig. 8). Part of this is the result of faulting (steeper dips in the basal Las Cahobas Formation than in the Thomonde Formation). This could be an extension of the fault which causes steeper dips in the Rivière Abriots section (Text-fig. 1, sect. F').

SECTION G: RIVIERE GRANDE - RIVIERE LAS CAHOBAS
(Text. fig. 9, Table 11)

As in section T, only the upper part of the Madame Joie Formation (gray marl and limestone) contains ostracodes. Planktic foraminifera place the top of the formation in the middle Miocene ("N" zone 12). The Thomonde Formation (gray, sandy, calcareous shales) about 1000 m thick, was deposited in shallower water than was the case in previous sections. The Thomonde Formation was deposited in an environment that gradually shallowed in an easterly direction from the Rivière Jobelle (Text-fig. 1, sect. M) across the south flank of the Plateau Central to the Belladère structure near the border with the Dominican Republic. In this section the brackish-water ostracode *Cyprideis pascagoulaensis* was recovered from the Thomonde Formation ("N" zone 14) in an otherwise holomarine fauna (loc. M 1184). This suggests that the species may have been washed in from contemporaneous brackish-water deposits farther north. The depositional environment deepens in a westerly direction in the Artibonite valley over the Capucin-Dufailly structure and the Rivière Dormante section. Only the lower part of the Las Cahobas was studied in the Rivière Grande area, which may explain why *Cyprideis maissadensis* was not found.

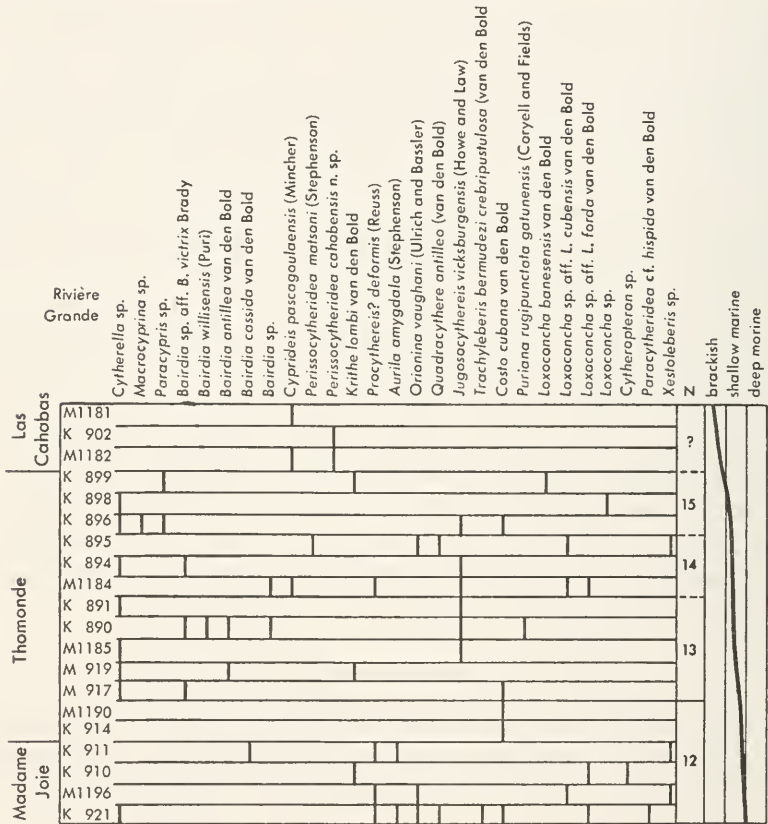
BETWEEN BELLADERE AND MIREBALAIS

In several areas there are insufficient samples or lithologic descriptions to construct maps or charts of faunal distribution. Some samples, however, yield information on age and depth of deposition.

Belladère structure
(Text-fig. 1, SE corner)

In the extreme southeast of the Plateau Central at the border with the Dominican Republic, marls with deep-water fauna (Madame Joie Formation?) are dated as middle Miocene ("N" zone 12), while the Thomonde-Las Cahobas transition appears to take place in sandy calcareous shales, dated as late middle Miocene ("N" zone 14). These beds were mapped as Thomonde Formation, but they carry a fauna that includes *Hemicyprideis cubensis chicoyensis* and

Table 11.—Distribution of ostracodes in the Rivière Grande-Rivière Las Cahobas sections (Text-fig. 1, sect. G). The boundary between deep and shallow marine environments lies at about 200 m.

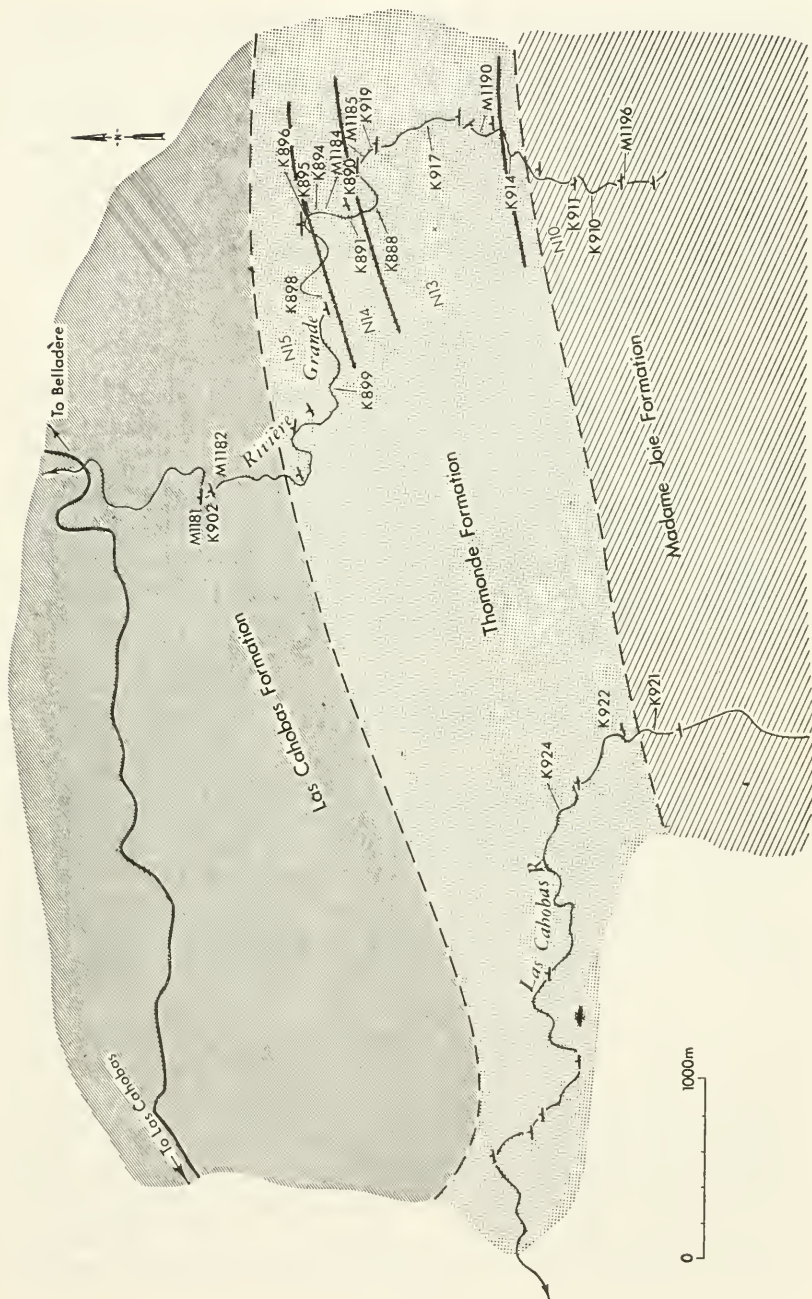


Cyprideis pascagoulaensis, indicating that in the late middle Mio-cene the shoreline must have been close to the Belladère area.

The Morne Beguin section

This section was sampled by B. N. Moore (Atlantic Refining Company) on the crest and north slope of the Morne Beguin, 3½ km east of the confluence of the Rivière Fer-à-Cheval and Rivière Gascogne, about 10½ km southeast of Mirebalais. There is one

Text-figure 9.—Geologic map of the area between the Rivière Grande and the Rivière Las Cahobas, after maps of the Atlantic Refining Company. Heavy lines indicate boundaries between "N" zones.



sample (loc. M 1293) that represents deep-water deposits of probable middle Miocene age (? Madame Joie Formation). In the uppermost beds of the section there is a shallow-marine fauna, containing *Bairdia longisetosa*, *Radimella confragosa*, *Costa dohmi* and *Uroleberis torquata*, that closely resembles the fauna of the upper part of the Gurabo Formation in the Rio Gurabo, northern Dominican Republic (Bold, 1968, table 13, zones 2-3; cf. Bold, 1975a, text-fig. 18 for the correlation of this zone with the Pliocene of other areas in the Caribbean).

The Mirebalais section

This section was sampled by B. N. Moore (Atlantic Refining Company) along the Croix-des-Bouquets - Mirebalais road from a perennial spring north of Terre Rouge to the Rivière Jean Bas. It includes middle Miocene deep-water deposits ("N" zone 12) and Pliocene shallow-water deposits that contain *Radimella confragosa*.

These two sections indicate the long duration of marine deposition in the Mirebalais area, which is also evident in the Dufailly structure and the Savanette syncline (Text-fig. 1, sect. T).

SECTION C: DUFAILY-CAPUCIN STRUCTURE (Table 12)

On the crest of this structure thin and strongly faulted deposits of the Madame Joie Formation are exposed in the form of white, marly limestone and massive, gray marl. The Thomonde Formation consists of gray, calcareous shales, covered on the flanks by the Las Cahobas Formation with typical "Rimrock" (coralline limestone with mollusks, calcareous algae, and the foraminifera *Sorites* and *Amphistegina*) at the base. The basal Las Cahobas Formation here also contains *Hemicyprideis agoiadiomensis*. Locality K 642, placed highest in the section on faunal evidence, is almost on the crest of the structure, apparently along strike from locality K 644, which lithologically resembles the Thomonde Formation (middle Miocene). Samples from locality K 642 contain *Globorotalia margaritae* and *Globigerinoides conglobatus*, which indicate an early Pliocene age. A single specimen of *Radimella confragosa* form A (Bold, 1975b) supports this. Locality K 588 was mapped as Thomonde Formation, but it carries a typical brackish-

Table 12. — Distribution of ostracodes in samples of the Dufailly-Capucin structure.

Dufailly-Capucin		Cytherella sp.	Argilloecia sp.	Bairdia antillea van den Bold	Bairdia sp.	Hemicyprideis agoiadiomensis n. sp.	Cyprideis pascagoulaensis (Mincher)	Kriithe hiwanneensis Howe and Lea	Kriithe lambi van den Bold	Kriithe dolichodeira van den Bold	Kriithe sp.	Perissocytheridea cahobensis n. sp.	Radimella confragosa (Edwards) form A	Trachyleberidea mamidentata (van den Bold)	Ambocythere sp. aff. A. elongata van den Bold	Bradleya ex gr. dictyon (Brady)	Henryhowella ex gr. asperrima (Reuss)	Z
Las Cabohas	K 642																	18
	K 583																	
	K 581																	
Thomonde	K 588																	15
	K 592																	
	K 654																	
Madame Joie?	K 651																	
	K 607																	12
	K 644																	
Joie?	K 585																	6
	K 586																	

water assemblage. Complex faulting in this structure makes detailed interpretation impossible without further field study.

SECTION D: RIVIERE DORMANTE
(Table 13)

The age of the Madame Joie Formation extends into the middle Miocene ("N" zone 12). Deep-water facies prevail, and include such ostracodes as:

Cardobairdia glabra
Abyssocypris pykna

Krithe sp.
Argilloecia sp.
Bairdia oarion
B. cassida
Agrenocythere hazelae
Abyssocythere trinidadensis
Bradleya dictyon
Henryhowella ex gr. *asperrima*
Cytheropteron? *trinidadensis*

This assemblage indicates a depth of deposition approaching 1000 m. Some of these taxa continue into the Thomonde Formation, which in addition contains such deep-water forms as *Trachyleberis bermudezi crebripustulosa*, *Trachyleberidea mammidentata* and *Ambocythere subreticulata*. These species suggest a depth of deposition in excess of 500 m for the middle part of the Thomonde Formation. Only in the upper part ("N" zones 14-15) do shallow-water forms become dominant. There is some indication of shallowing at the base of the Thomonde Formation, but these shallow-water ostracodes may have been redeposited down-slope. The Las Cahobas Formation is not exposed in continuity with the Thomonde Formation, which in this section is covered by Quaternary alluvium.

SECTION S: ST. MARC
(Text-figs. 10, 11; Tables 14, 15)

Two doubly-plunging anticlines occur in this area: the south St. Marc dome and the Morne des Guêpes, north of St. Marc. In the latter a core of "Thomonde" Formation is surrounded by reefal limestones of the basal "Las Cahobas" Formation. In the south St. Marc dome, the "Thomonde" Formation consists of light-cream to tan marl of late Miocene age ("N" zones 13-17) with some intercalations of fine sand. The environment of deposition was in deep water and such genera as *Krithe*, *Agrenocythere*, *Henryhowella*, *Bradleya*, *Ambocythere* and *Trachyleberis* occur here. The presence of large specimens of *Krithe* with reversed valve overlap (*Krithe reversa*) may suggest water-depths of more than 1000 m (see "Paleobathymetry of the genus *Krithe* in the Neogene of the Caribbean"). This confirms the interpretation of deepening in a westerly direction of the depositional environment of the Thomonde Formation in the Artibonite valley. In Table 14 the fauna of the South St. Marc dome is compared to that of some of the north St. Marc boreholes because of a general faunal similarity.

Table 13.—Distribution of ostracodes and lithological column of the Rivière Dormante section (Text-fig. 1, sect. D). Depth of deposition varies from about 1000 m in the lower part of the Madame Jole Formation to less than 200 m near the top of the Thomonde Formation.

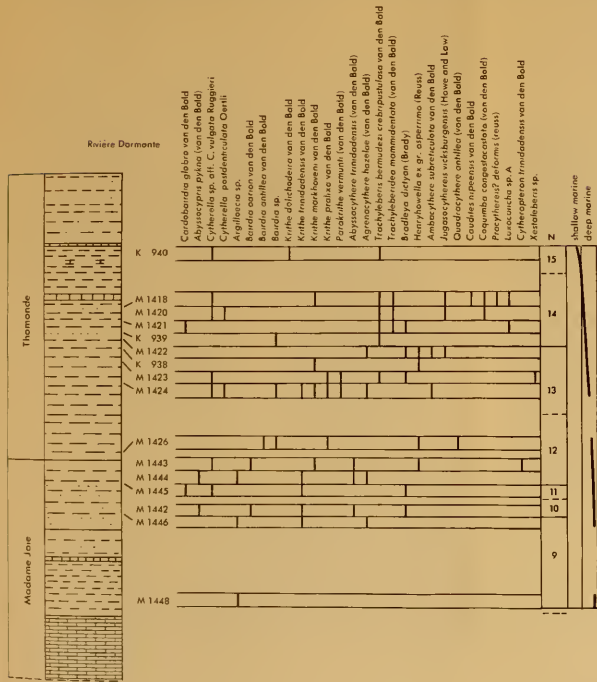
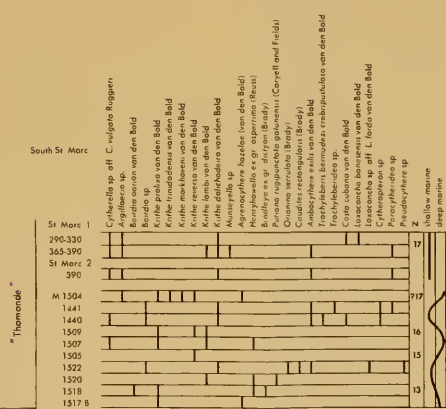


Table 14.—Distribution of ostracodes in samples of the South St. Marc dome (Text-fig. 1, sect. S) and St. Marc borehole no. 1 (Text-fig. 1, sect. S; Morne des Guepes). Note the strong fluctuation of the depth of deposition suggested by alternations of samples containing *Krithe dolichodeira* and *Krithe reversa*. This alternation may also be an indication of strong downslope movement of sediment. As no location-map for the area was available, the arrangement of the samples is based on the "N" zones.



In the Morne des Guêpes (Tab. 15) the "Thomonde" beds are more than 300 m thick, of late Miocene age ("N" zone 17) and are representative of slightly shallower facies than equivalent deposits of the South St. Marc dome. They are overlain by at least 250 m of alternating shallow-marine and brackish-water marls and calcareous clays with some sand, of Pliocene age. Unfortunately lithologic descriptions are lacking for most samples. Occurrence of *Radiomella confragosa* in the uppermost "Thomonde" beds suggests that these may be of Pliocene age (Bold, 1975b). The highest "Las Cahobas" beds exposed contain an unnamed species of *Cyprideis*, and the basal beds contain *Cyprideis pascagoulaensis*. Comparison of Table 14, with table 14 of Bold (1975a) shows a close similarity of the fauna of the "Thomonde" beds of the St. Marc area with that of the Rivière Grise Formation of the Cul-de-Sac plain, both of late Miocene age. Comparison of Table 15 with tables 7 and 9 of Bold (1975a) shows the similarity of the fauna of the lower brackish-water beds of the "Las Cahobas" with that of the bottom beds in Cul-de-Sac borehole # 2 (lower Las Salinas equivalent). The fauna of the marine middle part (locs. P 1562-1563) is similar to that of the Morne Delmas Formation (= Gurabo Fm. equivalent in Cul-de-Sac borehole # 2). There is little similarity in fauna of the upper, brackish-water, part of the "Las Cahobas" formation in the Morne des Guêpes with the upper part of the Cul-de-Sac boreholes, which is decidedly more limnic in facies, and that contains *Cyprideis salebrosa* and *Cytheridella boldi*. (*Cytheridella ilosvayi*? of these beds and the Jimaní Formation = *Cytheridella boldi* Purper, 1974, p. 654, pl. 10, figs. 1-4). However, if the *Cyprideis* n. sp.? of the "Las Cahobas" Formation is in reality a variant of *Cyprideis portusprospectuensis* (see discussion under *Cyprideis* n. sp.?), then these beds could be of the same age as the Jimaní Formation and its equivalent in the Cul-de-Sac plain. They contain facies similar to the Harbour View beds of Jamaica from which *C. portusprospectuensis* was named, and where *Cyprideis salebrosa* is also absent, whereas it is present in the Jimaní Formation. This tentative correlation is shown in Text-figure 12.

Cyprideis salebrosa, which is conspicuously absent from these beds, has been found on the flank of the South St. Marc structure together with a typical Morne Delmas fauna (loc. P 1546). Consequently late Pliocene brackish-water beds are postulated to occur

above the marine interval and below the brackish-water beds which are now tentatively correlated with the Jimaní Formation of the Enriquillo basin. Age and faunal relations suggest equivalence of the marine and lower brackish-water interval of the "Las Cahobas" Formation of the Morne des Guêpes with the Morne Delmas Formation of the Cul-de-Sac plain and the latter name appears more appropriate for these beds. The name "Rivière Grise Formation" appears more appropriate for the "Thomonde" Formation of the St. Marc area, of approximately the same age, and of deeper-water facies than is normal in the upper part of the Thomonde Formation of the Artibonite Valley.

PALEOBATHYMETRY AND POSITION OF SHORELINES

I have attempted to relate the distribution of different groups of ostracodes to salinity and depth of deposition. I assume that the position of the thermocline remained fairly constant during this portion of the Neogene in the Caribbean. A cooling trend during the Neogene, postulated from paleotemperatures measured by various paleontologists (*e.g.* Stainforth *et al.*, 1975, fig. 22), would not influence the picture of upward shallowing seen in Central Haiti.

The following list relates the occurrence of ostracodes reported from the Neogene of Haiti, to six environmental regimes: lagoonal, littoral, upper shelf, lower shelf, upper and middle slope, and lower slope and bathyal regions. Some genera that have broad bathymetric distributions have been divided into groups of species with a more restricted distribution (*e.g.*, *Cytherella*, *Bairdia* and *Loxiconcha*).

Bathyal and lower slope (deeper than 800 m)

Abyssocypris
Cardobairdia
Cytherella gr. 2 (*C. postdenticulata*, *C. vulgata*)
Argilloecia
Bairdia gr. 2 (*B. oarion*, *B. cassida*)
Bythocypris
 large (and reversed) *Krithe*
Messinella
Trachyleberis (*T. bermudezi bermudezi* or subsp. *crebripustulosa*)
Agrenocythere
Abyssocythere
Bradleya

Upper slope
(800-200 m)

Cytherella gr. 2
Argilloecia
Bairdia gr. 2
Bythocypris
Krithe (large but not reversed)
Parakrithe
Trachyleberis
Trachyleberidea
Costa
Ambocythere
Loxoconcha gr. 3 (*L. banesensis*, *L. aff. woodwardsensis*, *L. sp. A*)

Lower shelf
(200-100 m)

None of the abyssal groups, disappearance of most of the upper slope groups and introduction of groups of typical shelf genera and species such as:

Cytherella gr. 1 (*C. polita*, *C. aff. pulchra*)
Paracypris
Bairdia gr. 1 (*B. antillea*, etc.)
Munseyella
 smaller species of *Krithe*
Parakrithe
Caudites
Orionina
Jugosocythereis
Xestoleberis

Upper shelf
(100-30 m)

Cytherella gr. 1
Paracypris
Macrocyprina
Bairdia gr. 1
 small species of *Krithe*
Radimella
Procythereis?
Aurila
Hermanites
 smaller species of *Costa*
Puriana
Jugosocythereis
Neocaudites
Pellucistoma

Littoral
(30-0 m)

Triebclina
Pseudopsammocythere
Quadracythere
Loxoconcha gr. 2 (*L. forda*, *L. runa*, *Loxocornuculum* group)
 most species from the upper shelf

Lagoonal
(brackish-water)

Hemicyprideis
Cyprideis
Perissocytheridea
Loxoconcha gr. 1 (especially *L. lewis*)
Cytheromorpha
 some littoral species

Possible depth-ranges of some individual genera and species groups are given in Table 17. For the stratigraphic range of the deeper-water species, see Table 16.

This fossil bathymetry compares well with the distribution of Recent ostracode genera in the Gulf of Mexico (Morkhoven, 1972, text-fig. 2) and the Caribbean (Bold, 1977). However, some discrepancies occur [e.g. the distribution of *Aurila*, which Morkhoven indicates as middle to outer neritic (from 30 to about 200 m)].

These depositional environments have been recorded in the following formations and stages:

Bathyal. Madame Joie Formation (early Miocene, south flank, Plateau Central), (middle Miocene, Artibonite Valley), "Thomonde" Formation (late Miocene, St. Marc).

Upper slope. Lower "Arc" Formation (early Miocene, north flank, Plateau Central), Madame Joie Formation (early Miocene, west end, Plateau Central), Lower Thomonde Formation (early middle Miocene, south flank, Plateau Central), Thomonde Formation (late middle Miocene, Artibonite Valley).

Lower shelf. Middle "Arc" Formation (early Miocene, north flank, Plateau Central), Thomonde Formation (late middle Miocene, south flank, Plateau Central), "Thomonde" Formation (late Miocene, St. Marc).

Upper shelf. Upper "Arc" Formation (late early Miocene, north flank, Plateau Central), Thomonde Formation (early middle Miocene, west end, Plateau Central), (late Miocene, south flank, Plateau Central), "Thomonde" Formation (late Miocene, St. Marc).

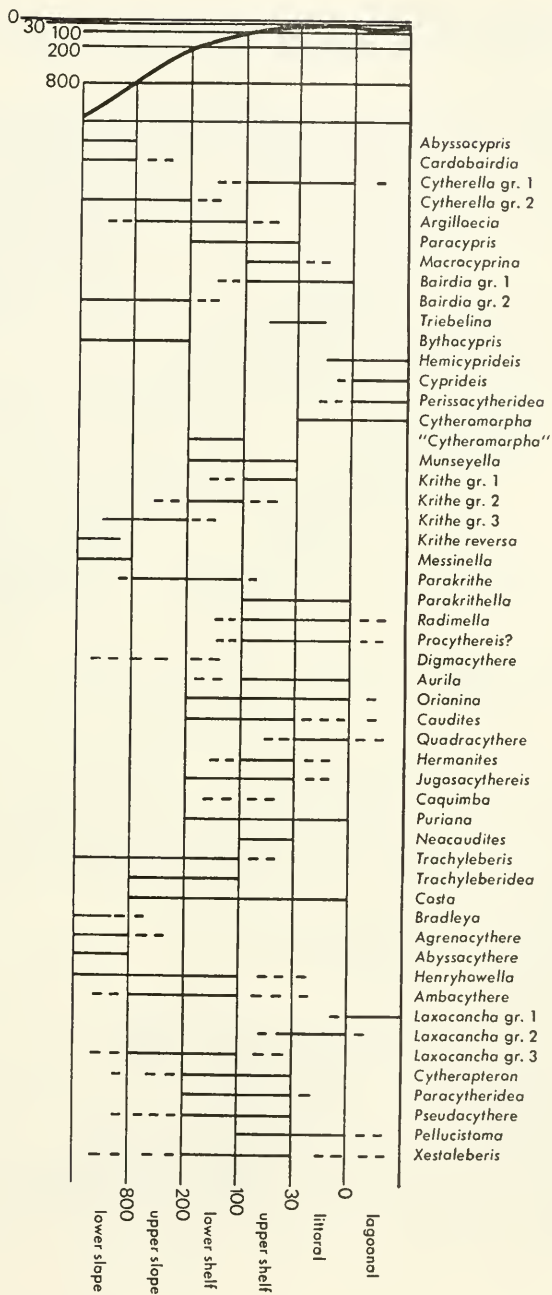
Littoral. Upper "Arc" Formation (early Miocene, north flank, Plateau Central), Las Cahobas (early middle Miocene, north flank, Plateau Central), (early late Miocene, south flank, Plateau Central), Pliocene (Artibonite Valley), "Las Cahobas" (Pliocene, St. Marc).

Lagoonal. Las Cahobas (middle Miocene, north flank, Plateau Central, and Belladère structure; late Miocene, south flank, Plateau

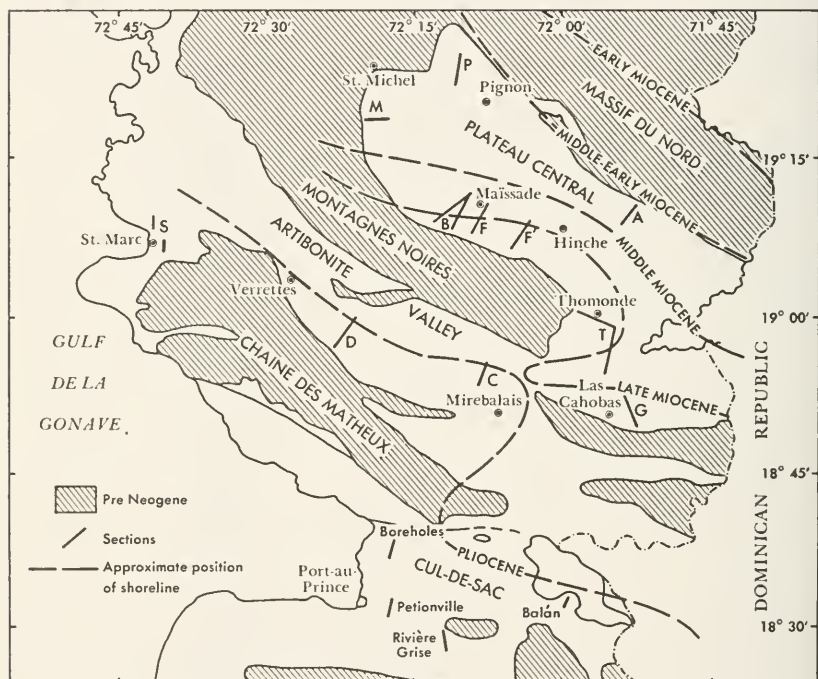
Thomonde structure, however, the brackish to shallow marine character of the Las Cahobas Formation is preserved until the late Pliocene, when in most of the other areas this formation is developed in continental facies. This could be a result of incipient folding of the Thomonde anticline and the Savanette syncline during middle and late Miocene and Pliocene.

In Text-figure 13 an attempt has been made to interpret these data by plotting the approximate position of suggested shorelines from early Miocene to Pliocene. In the early Miocene with deep-water conditions in the south and only slightly shallower water-depth in the north of the Plateau Central, the shoreline must have been well to the north of the present outcrops of lower Miocene rocks. During the early Miocene, the shoreline moved in a southerly direction and in the early middle Miocene, shallow marine and brackish-water conditions prevailed on the north and south flanks of the Plateau Central. In the Artibonite valley, still farther south, the depth of deposition remained about the same, except in the east where shallow marine beds have been reported (see "Belladère structure"). In the late Miocene, shallow marine and lagoonal environments approximated present-day outcrops of rocks of that age on the south flank of the Plateau Central, so that the shoreline must have followed this trend closely. South of the Thomonde structure, marine conditions lasted longer and lagoonal environments were present in late Pliocene times. Hence, in the Pliocene the shoreline must have curved into this area. Because there was littoral zone deposition in the Cul-de-Sac region as well (Bold, 1975a), the shoreline must have been very sinuate in shape, an indication that folding of the present structures had reached considerable magnitude. As the Massif du Nord supplied sediment to the "Arc" Formation in the early Miocene it must have been a high area at that time. The Montagnes Noires do not appear to have affected the position of shorelines until late Miocene to early Pliocene and were therefore a low area prior to that time. Evidence from the Thomonde structure suggests, however, some early movements in the middle Mio-

Table 17. — Suggested depth-ranges of ostracode genera in the Neogene of Haiti. Compare these with the distribution of Holocene ostracodes in the Gulf of Mexico (Morkhoven, 1972). The genera *Cytherella*, *Bairdia*, *Krithe* and *Loxococoncha* have been subdivided into two to four groups of species on the basis of depth distribution.



cene. The Chaîne des Matheux appears to have remained submerged until late or post Pliocene times.



Text-figure 13. — Outline of Neogene areas in Central Haiti, showing the location of sections studied and the approximate position of shorelines in early, middle and late Miocene, and in the Pliocene. Symbols for sections:

- A. Rivière Agoiadiome
- B. Rivières Fond Bleu and Fond Gras
- C. Dufailly-Capucin area
- D. Rivière Dormante
- F. Río Frío
- F'. Rivière Abriots
- G. Rivière Grande and Rivière Las Cahobas
- M. Rivière Jobelle (St. Michel de l'Atalaye)
- P. Rivière Bouyaha (Pignon area)
- S. St. Marc area
- T. Thomonde area (section extending southward to the Savanette syncline).

In the Cul-de-Sac area reference is made to the sections of the Cul-de-Sac boreholes, Petionville, Balán and Rivière Grise (Bold, 1975a). Scale 1:300,000.

PALEOBATHYMETRY OF THE GENUS *KRITHE*
IN THE NEOGENE OF THE CARIBBEAN

I have tried to relate the distribution of species of *Krithe* to the depth of deposition of the sediments in which they occur. In Text-figure 14, the size range of different species is compared to the range of depth of deposition. The depositional depth of the sediments is estimated from the distribution of benthic foraminifera and the planktic/benthic ratio (Text-fig. 14 B). Text-figure 14 A is adapted from Morkhoven's chart showing the distribution of 14 species of *Krithe* from the Gulf of Mexico (Morkhoven, 1972, text-fig. 3). I have assumed that the phenomenon of reversal of valve size and hinge structure, which in Recent species of *Krithe* from the Gulf of Mexico takes place around 1000 m, took place at a similar depth in the Neogene of the Caribbean. Both charts show a direct relation of valve size with depth, and the similarity of the two plots is striking. The slightly steeper slopes in Text-figure 14 A are probably caused by the treatment of males and females of the same species as separate units, whereas in Text-figure 14 B they were combined.

It appears possible to base a depth zonation on a mutual exclusiveness in the distribution of some species of *Krithe*. This exclusiveness is not absolute, as downslope movement has certainly taken place and has brought species from different depth environments into the same thanatocoenosis. However, some species never, or hardly ever, are found together. Whereas combinations of *Krithe reversa* and *K. trinidadensis*, or of *K. trinidadensis* and *K. morkhoveni* or *K. proluxa*, or again of *K. dolichodeira* with *K. lambi*, *K. morkhoveni* and *K. proluxa*, are regularly found, the combination of *K. reversa* with *K. dolichodeira* or *K. lambi*, or of *K. trinidadensis* with *K. lambi* or *K. hiwanneensis* is extremely rare (exceptions are loc. R 1449 (Table 2), loc. M 1509 (Table 14)).

The following rough bathymetric zonation can be established:

- 100- 400 m: *Krithe* spp. of group 1 (*K. hiwanneensis*, *K. lambi*) and group 2 (*K. proluxa*, *K. morkhoveni*, *K. dolichodeira*).
- 400- 700 m: *Krithe* spp. of group 2
- 700-1000 m: *Krithe* spp. of group 2 and group 3 (*K. trinidadensis*)

1000-1500 m: *Krithe* spp. of group 3 and group 4 (*K. reversa*), occasionally group 2.

below 1500 m: *Krithe* spp. of group 4

On or close to the shelf several species of *Krithe* may occur together and a detailed study is needed to arrive at a zonation of the environment above 400 m. In Text-figure 14 B the upper depth limits of *K. dolichodeira* and *K. proluxa* are assumed to be 200 m, and those of *K. lambi*, *K. hiwanneensis* and *K. morkhoveni* are assumed to be 100 m. However, their upper depth limits could be approximately the same, and the 100-400 m depth zone might in fact extend from 70-300 m. (See also Table 16).

After the two plots (Text-figs. 14 A and B) had been compared, I obtained from Morkhoven the type-slides for species from the Gulf of Mexico. Comparison of these types with Caribbean fossil material reveals the following relationships: *Krithe* sp. 12 is identical to *K. dolichodeira*. *Krithe* sp. 7 is identical to a rare and unnamed species from the Pliocene of Jamaica; *Krithe* sp. 3 is identical to *K. morkhoveni*. *Krithe* sp. 3 was found at great depth in the Eastern Gulf of Mexico and was not used on his chart (Morkhoven, 1972, text-fig. 3), which is based on western Gulf occurrences only (this could possibly indicate a change of depth-preference for this species). *Krithe* sp. 1 is identical to *K. trinidadensis*, and smaller, but possibly identical forms are represented by his *Krithe* sp. 13. *Krithe reversa* is identical to *Krithe* sp. 2 and sp. 14, which in my opinion represent males and females of the same species. If this is true, it is interesting that Morkhoven found no males below 2000 m depth.

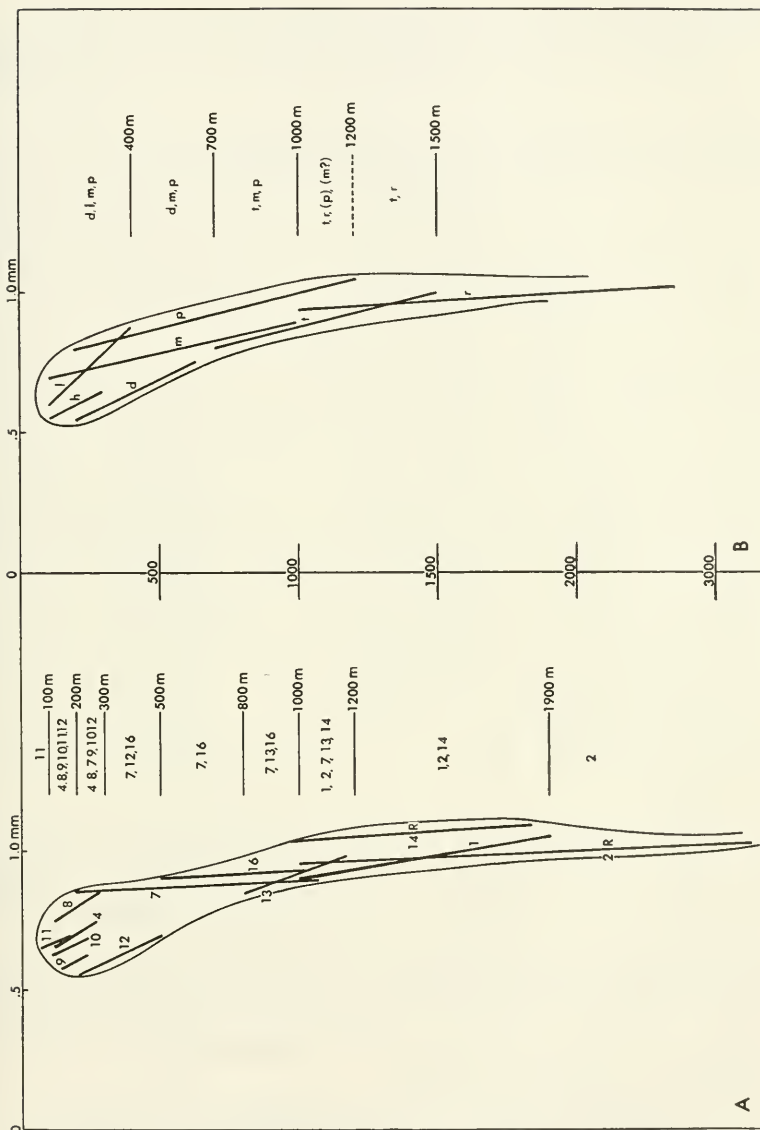
Krithe spp. 4, 6, 9, 10, 11, 13, 15, 17 and 18 of Morkhoven are not known from the Caribbean Neogene; conversely, I have seen no

Text-figure 14. — Relationship between specimen length (in mm; x-axis) and depth range (in m; y-axis) of species of the genus *Krithe*. A: In the Holocene of the Gulf of Mexico (after Morkhoven, 1972) Numerical species designations correspond to those used by Morkhoven.

B: In the Neogene of the Caribbean.

d: *Krithe dolichodeira*; h: *K. hiwanneensis*; l: *K. lambi*; m: *K. morkhoveni*; p: *K. proluxa*; r: *K. reversa*; t: *K. trinidadensis*.

The similarity of the two plots is striking. The steeper slopes of individual species in A may be caused by the fact that in B the males and females of (supposedly) the same species were combined, whereas in A they were plotted separately.



Recent species that resemble *Krithe lambi* in the Gulf of Mexico.

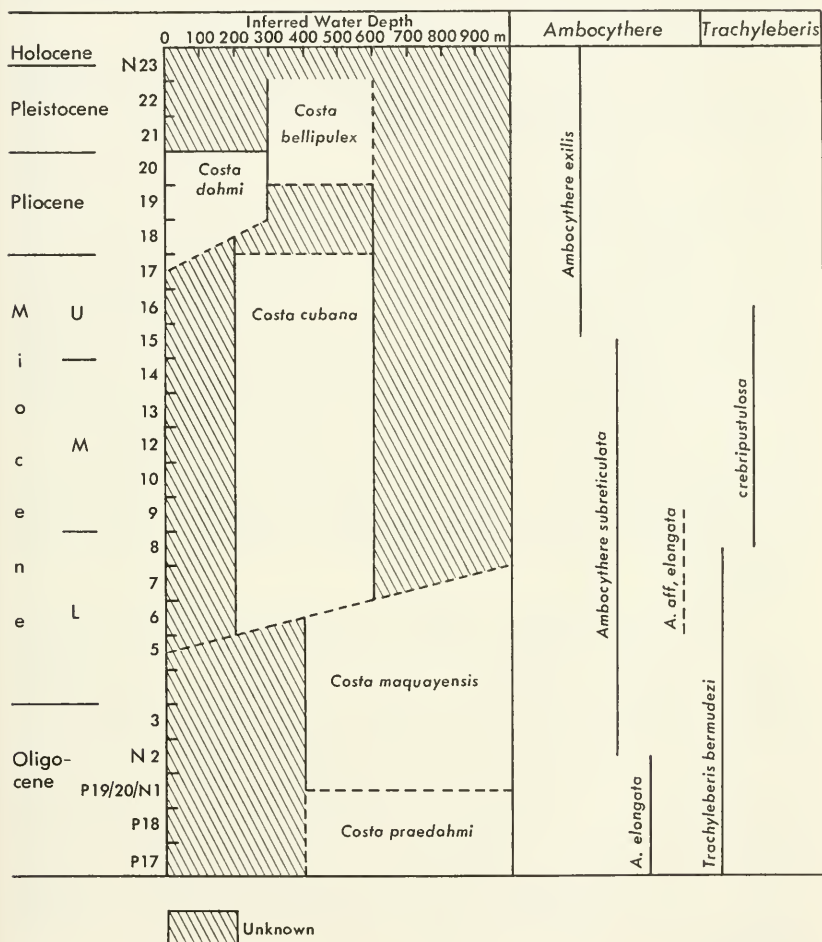
In Haiti the maximum depth of deposition of the Madame Joie Formation, based on the distribution of species of *Krithe* is uncertain, due to the absence of "reversed" *Krithe*. The earliest known occurrence of *K. reversa* is in the earliest middle Miocene (Tab. 16). Therefore, in the Rivière Dormante section, the maximum depth of deposition was probably less than 1000 m in the upper part of the Madame Joie Formation. In the Thomonde Formation the depositional depth apparently varied between 100 and 700 m, whereas in the St. Marc section depths between 1000 and 1500 m seem indicated. In the Rivière Grise Formation (Bold, 1975a, tab. 13) depths appear to range between 700 and 1000 m (*K. dolichodeira* may have been washed in from up-slope deposits). In the Trinchera Formation of the Dominican Republic (Bold, 1975a, tab. 14) depths of deposition between 1000 and 1500 m are suggested. A similar depth-distribution prevails in Jamaica in the Montpelier Group and in parts of the Lower Coastal Group. The same range is found in the Cipero and Lengua Formations of Trinidad and in the Kingshill marl of St. Croix. The valve-lengths of *K. trinidadensis* (0.93 and 1.00 mm) and *K. reversa* (1.04 and 1.09 mm) in the same sample of the Cipero Formation of Trinidad, which suggest a depth of deposition of near 1500 m (cf. Text-fig. 14) also suggest that the increase in size with depth is not linear (as suggested by Morkhoven, 1972).

Peypouquet (1975) made a study of variations in the size of the anterior vestibule and the width of the marginal area of species of *Krithe* from the Holocene of the Golfe de Gascogne and the Rockall Basin. In the Haitian material the large number of closed carapaces made examination of internal features difficult. It appears, however, that the majority of deeper water species of *Krithe* in the Caribbean Neogene had large marginal areas and narrow vestibules, which may indicate a well-oxygenated environment, as suggested by Peypouquet (1975).

STRATIGRAPHIC AND PALEOBATHYMETRIC DISTRIBUTION OF SOME TRACHYLEBERIDIDAE IN THE CARIBBEAN NEOGENE

Five species of the genus *Costa*, belonging to one lineage (*C. maquayensis* group, Bold, 1970a, p. 70), lived in the Greater An-

tillean region from Oligocene to Pliocene. In the Caribbean they disappeared in the late Pliocene, but they have persisted to the Recent in the Gulf of Mexico (see Text-fig. 15).



Text-figure 15.—Depth- and stratigraphic distribution of species of the genus *Costa* that belong to the *Costa maquayensis* group of species, and stratigraphic distribution of species of *Ambocythere* and *Trachyleberis* in the late Paleogene and Neogene of the Caribbean area. Stratigraphic zonation ("N" zones) is based on the occurrence of planktic foraminifera.

Originally (Bold, 1970a) I believed that they all lived at approximately the same water depth (minimum about 200 m, upper slope), but later investigations have shown that *Costa maquayensis* has a preference for greater depths than *C. cubana*, its immediate successor, and that *C. dohmi* belongs to the shelf fauna.

Costa dohmi appears to have developed directly from *C. cubana* by a reduction in size, and crowding of the costae. The misidentification of some specimens of *C. bellipulex* as *C. dohmi* (see "Systematic Paleontology") resulted in a misrepresentation of both the stratigraphic range and the depth-tolerance of the latter species. *C. cubana* appears to have persisted in Jamaica to the end of the Miocene, wherever the water was deep enough, but it is replaced by *C. dohmi* during the late Miocene ("N" zone 17) in shallower environments. In the St. Marc area of Haiti, where the deeper marine environment persisted longer, this replacement occurred near the Miocene-Pliocene boundary, the result of shallowing of the area at this time. In Jamaica, on the other hand, *C. cubana*'s descendant *C. bellipulex* is present in the San San Clay of late Pliocene age. *C. dohmi* was originally described from the Pliocene (reported as late Miocene) of the northern Dominican Republic (Bold, 1968). Water depths there were insufficient for either *C. cubana* or *C. bellipulex*.

A similar relationship at greater depths seems to exist between *Costa maquayensis* and *C. cubana*. In Haiti the change from *C. maquayensis* to *C. cubana* generally takes place near the boundary between the Madame Joie and Thomonde Formations, generally in the early middle Miocene, but it is always accomplished before "N" zone 10. It occurs earlier in the "Arc" Formation where it also takes place at the onset of shoaling, around "N" zone 6. *C. maquayensis* appears restricted to deeper-water with an upper depth limit of about 600 m. *C. cubana*, on the other hand, occurs in deposits of suggested depths of 200-800 m. This relationship is shown in Text-figure 15.

The depth-relationship between *C. maquayensis* and its ancestor *C. praedohmi* is insufficiently documented. There appears to be some variability in size within each species that may be related to water-depth, as has been reported by Morkhoven (1972) for *Echinocythereis*. However, there is not enough fossil material of *C. praedohmi* to establish a definite pattern.

Some other, unrelated, ostracode lineages show evolutionary changes that are penecontemporaneous in different areas, possibly because the species of these lineages have greater depth tolerance. For instance, in Haiti *Trachyleberis bermudezi bermudezi* (Bold) (Pl. 4, fig. 9) changes to *T. bermudezi crebripustulosa* (Bold) (Pl. 4, fig. 10, 11) around "N" zone 8, in accordance with the observed range of these subspecies in Venezuela and Trinidad (Bold, 1966b, table 1; 1972a, tables 2, 4). In the Gulf of Mexico the depth-range of *T. b. crebripustulosa* or a very closely related form is from about 200 to about 3000 m.

In the *Ambocythere elongata* - *A. subreticulata* - *A. exilis* lineage (Bold, 1965a), the change from *A. subreticulata* (Pl. 3, fig. 6) to *A. exilis* (Pl. 3, fig. 7) takes place in "N" zone 16. The change from *A. elongata* to *A. subreticulata* occurs within the Oligocene, therefore outside the scope of this paper. Morkhoven (1972) indicates that *Ambocythere* is typical of slope deposits, but may occasionally be present on the lower shelf (see also Table 17).

The deep-water genera *Bradleya*, *Abyssocythere* and *Agrenocythere* occur fairly regularly in the Madame Joie Formation and occasionally in the Thomonde Formation, usually together with *Ambocythere* and *Henryhowella*. Recent specimens of *Abyssocythere* occur predominantly between 500 and 1000 m depth (Benson, 1971); recent specimens of *Agrenocythere* between 800 and 3300 m (Benson, 1972) but between 1100 and 1500 m in the Gulf of Mexico. Their distribution in Trinidad, Jamaica and Haiti may indicate a depth-distribution for fossil species around 1000 m; a shallowest occurrence of *Agrenocythere hazelae* in the Neogene of about 500 m seems probable. The only species of *Bradleya* that occurs in Haiti and Jamaica is *B. dictyon* (Brady) (Pl. 4, fig. 17). In Trinidad, however, this species is accompanied over most of its stratigraphic range by another species of *Bradleya* that resembles *B. normani* (Brady) in ornamentation, but is much smaller than *B. dictyon* whereas *B. normani* is the most robust of the species of *Bradleya* (Benson, 1972). Recent species of *Bradleya* appear to occur mostly between 500 and 4000 m depth.

Trachyleberidea mammidentata (Bold) (Pl. 4, fig. 14) often accompanies the deep-water assemblage, but is generally absent in samples that contain the above-named deep-water species. It is normally found in the lower Thomonde Formation (middle

Thomonde of the Rivière Dormante section), and appears to occur mostly in upper slope to (?) outer shelf sediments. The same, or a very closely related species has been found in the Gulf of Mexico between 100 and 1200 m.

SYSTEMATIC PALEONTOLOGY

More than 600 species from 124 genera have been mentioned, described or illustrated from the Tertiary of the Caribbean Region. Of these I have described almost 300 new species and 12 new genera. I do not want to describe any more taxa, unless this is necessary as a basis for discussion of stratigraphy or environment, or, as in the case of *Perissocytheridea? haitensis*, if a species presents some interesting taxonomic aspects. Therefore, of the 132 species mentioned in the text and tables of this paper, 24 remain unnamed and 16 are compared to related species by *aff.* or *cf.* Only 5 new species are described. Some of the unnamed species are described and illustrated.

Dimensions given are in mm and are from illustrated specimens, and, in the case of new species, from holotypes (L = length; H = height; W = width). For the genus *Krithe* the range of length of the specimens is indicated and used in the tabulation (Text-fig. 14 B) in order to compare them to similar measurements by Morkhoven (1972) of Recent specimens from the Gulf of Mexico (Text-fig. 14 A).

Subclass OSTRACODA Latreille, 1806

Order PODOCOPIDA Müller, 1894

Suborder PLATYCOPINA Sars, 1866

Family **CYTHERELLIDAE** Sars, 1866

Genus **CYTHERELLA** Jones, 1849

Remarks.— In the Caribbean several shallow-water species (group 1) and several other deeper-water species (group 2) can be distinguished. Among the species found in Haiti *Cytherella polita* Brady (1868), *C. aff. pulchra* Brady (1866), *C. burcki* Bold (1946) and *C. sp. aff. C. semitalis* Brady (see below) belong to group 1, while *C. postdenticulata* Oertli (see below) and *C. sp. aff. C. vulgata* Ruggieri (see below) belong to group 2.

Cytherella sp. aff. **C. semitalis** Brady

Pl. 1, fig. 1

Diagnosis. — A small species of *Cytherella*, subovate in side view and with deeply punctate surface. Fossae rounded and of almost equal size over most of the carapace, but absent in an elongate patch in the center, just below the muscle scar. Greatest width at 2/7 of the length from posterior end. Wedge-shaped and slightly compressed anterior to the middle in dorsal view.

Dimensions. — L: 0.54 mm; H: 0.31 mm; W: 0.28 mm.

Remarks. — *Cytherella semitalis* Brady (1868b, p. 72, pl. 8, figs. 23, 24; 1880, p. 175, pl. 44, fig. 2, respectively from the Java sea, and from Papua and the Admiralty Islands) is more quadrate in outline, but exhibits the same distribution of fossae.

Distribution. — Only found at loc. K 529, Thomonde section, Table 10.

Cytherella postdenticulata Oertli

Pl. 1, fig. 2

Cytherella postdenticulata Oertli, 1961, p. 19, pl. 1, figs. 1-11; Ruggieri, 1962, pp. 8, 9, text-figs. 3, 3a; Dieci and Russo, 1964, p. 42, 53, pl. 8, fig. 2; Russo, 1964, p. 232, pl. 40, figs. 2 a, b; Bold, 1966d, p. 159, pl. 2, figs. 8 a, b.

Cytherella (Cytherella) postdenticulata Oertli, Sissingh, 1972, p. 68, pl. 2, fig. 1.

Remarks. — The Haitian specimens have been compared to material from the type Langhian from where Oertli originally described the species. They are almost indistinguishable; the Haitian specimens show a broader rounding of the posterior end, which in itself does not seem a sufficient criterion for separating the two forms.

Distribution. — *C. postdenticulata* ranges in Italy from the Aquitanian to the Tortonian; in Haiti it has been found so far only in the upper part of its range ("N" zones 13-14).

Cytherella sp. aff. **C. vulgata** Ruggieri

Pl. 1, fig. 3

Cytherella sp. aff. *C. vulgata* Ruggieri, Bold, 1968, p. 40, pl. 2, fig. 2; 1972a, table 4; 1975a, table 13.

Distribution. — This species in Haiti has been found in rocks that range in age from early Miocene to Pliocene. This range is different from that reported for its Italian counterpart (middle Miocene to Quaternary). See Tables 2, 12, 14, 15.

Cytherella sp.

Pl. 1, fig. 4a, b

Description. — Female: Right valve elongate-ovate, highest at $\frac{1}{3}$ of the length from the anterior extremity. Anterior end broadly rounded, dorsal margin slightly convex, straight in middle third and converging gently backwards towards the venter; ventral margin straight; posterior end slightly obliquely rounded with narrower rounding above the middle. Left valve elongate subrectangular; anterior end broadly rounded, dorsal and ventral margins straight and parallel, posterior end broadly rounded, slightly more narrowly rounded subventrally. Right valve overlapping the left along almost the entire periphery, except at the posteroventral corner; strongest overlap ventrally and anterodorsally, the overlap diminishing behind the greatest height; only very slight overlap along the anterior end. Dorsal view wedge-shaped, widest at about $\frac{1}{4}$ of the length from the posterior, tapering regularly towards the anterior, slightly compressed in front of the middle; posterior end blunt. Male: smaller and more elongate than female, with same general shape and overlap.

Dimensions. — Female: L: 0.68 mm; H: 0.39 mm; W: 0.29 mm; male: L: 0.65 mm; H: 0.33 mm; W: 0.26 mm.

Remarks. — This species is similar to *Cytherella* sp. aff. *C. vulgata* Ruggieri (Pl. 1, fig. 3) especially in the faint rows of punctae parallel to the anterior outline, but differs in its straight ventral margin.

Distribution. — Present as a rare element throughout the Madame Joie, "Arc", and Thomonde Formations.

Suborder PODOCOPINA Sars, 1866

Superfamily unknown

Family SIGILLIIDAE Mandelstam, 1960

pro Sigilliuminae Mandelstam, 1960, *nom. corr. et emend.* Schornikov and Gramm, 1974, p. 93 (= Saipanettidae McKenzie, 1969).

Remarks. — Schornikov and Gramm (1974, p. 98, text-figs. 1 a-d, f-i, 2 a-c, 3 a-g) redescribed *Saipanetta bensoni* Maddocks (1972, p. 30, text-figs. 1 a-h, 2-6) [see also Maddocks, 1973, p. 198, pl. 1, figs. 1-3, pl. 2, figs. 9, 13-16, pl. 4, figs. 12, 16-17] and questioned its generic assignment. The shape of *Saipanetta? bensoni* suggests that this species might belong instead to the genus *Cardo*

bairdia. This might account for the differences between the structure of some appendages in this species and those previously described from other species of *Saipanetta* (Schornikov and Gramm, 1974, table 1). It should also be noted that these other species (McKenzie, 1967, 1970) were collected from shallow water whereas *S.?* *bensoni* was dredged from deep water, both in the North Pacific and off the Galapagos Islands.

Genus **CARDOBAIRDIA** Bold, 1960

Remarks.—*Cardobairdia glabra* Bold and *C. asymmetrica* (Bold) are discussed in Bold, 1974c (p. 73, pl. 1, figs. 1, 2 a, b, text-figs. 2 e, f, and p. 74, pl. 1, figs. 6, 7, ?8, respectively). *C. glabra* has now been identified in the Gulf of Mexico from depths between 900 and 1200 m. For distribution of the two species see Tables 4, 6, 8, 10 and 13.

Superfamily **CYPRIDACEA** Baird, 1850

Family **PONTOCYPRIDIDAE?** Müller, 1894

Genus **ABYSSOCYPRIS** Bold, 1974c

Remarks.—Maddocks (1977) has argued that *Abyssoocypris* is morphologically so similar to *Australoecia* McKenzie (1967) that it should be considered a junior synonym. As *Australoecia* was originally described from Recent shallow water, and because its generic diagnosis was emended by Maddocks to include two deep water species, we have here a situation very similar to that of *Cardobairdia* and *Saipanetta*. For the time being I, therefore, consider them as separate, but probably closely related genera. *Abyssoocypris pykna* (Bold) and *A. tipica* Bold (1974c, p. 77, pl. 1, fig. 12, text-figs. 7 a, b, and p. 75, pl. 1, figs. 9-11, text-figs. 2 p-v, respectively) both occur in Haiti in what are considered to be deep-water deposits (see Tables 4 and 13).

Subfamily **PONTOCYPRIDIDINAE** Müller, 1894

Genus **ARGILLOECIA** Sars, 1866

Remarks.—At least four species of *Argilloecia* occur in the material from Central Haiti. Only one, a very elongate species, has been separated as *Argilloecia* sp. cf. *A. alexanderi* Swain (Swain,

1948, p. 192, pl. 12, fig. 7). The others have not been differentiated, because they occur as specimens scattered throughout rocks representing the deeper-water environment of the Neogene. Some specimens are identical to *Argilloecia* sp. 1 or sp. 4 from Jamaica (Bold, 1971b, pl. 3, figs. 1 a-c, pl. 4, figs. 1 a, b, pl. 1, figs. 2 a, b).

Family **CANDONIDAE** Kaufmann, 1900

Subfamily **PARACYPRIDINAE** Sars, 1923

Genus **PARACYPRIS** Sars, 1866

Remarks. — At least two species are present in Haiti, but their occurrence is rare and scattered and they have not been separated in the tables. One is identical to *Paracypris* sp. Bold, 1970b (p. 43, pl. 2, fig. 9) from the Anguilla Formation of the Lesser Antilles.

Family **MACROCYPRIDIDAE** Müller, 1912

Genus **MACROCYPRIS** Brady, 1868

Remarks. — A few specimens of a single species probably belonging to this genus have been found in samples from deeper water sediments (Table 4).

Genus **MACROCYPRINA** Triebel, 1960

Macrocyprina sp.

Remarks. — This species has previously been referred to *Macrocypris* aff. *decora* (Brady) (e.g., Bold, 1946, p. 65, pl. 1, fig. 14; 1958, p. 397, pl. 1, fig. 2). It is certainly not conspecific with this species. As Maddocks is currently working on this group, I am leaving it undescribed.

Superfamily **BAIRDIACEA** Sars, 1888

Family **BAIRDIIDAE** Sars, 1888

Subfamily **BAIRDIINAE** Sars, 1888

Genus **BAIRDIA** M'Coy, 1844

Remarks. — Species of this genus that occur in shallow water (group 1) are: *Bairdia antillea* Bold, 1946, *Bairdia willisensis* (Puri, 1954), *Bairdia condylus* Bold, 1965b, and *Bairdia* sp. aff. *B. victrix* Brady. *B. antillea* (Bold, 1975c, p. 138, pl. 15, fig. 1) and *B.* sp. aff.

B. victrix (Bold, 1975c, p. 139, pl. 15, fig. 8) occur in the Pliocene La Cruz Formation, Oriente Prov., Cuba. *B. condylus* is confined to lower and lower middle Miocene (Bold, 1965b, 1972b, 1973).

Two other species are characteristic of deeper water (group 2): *Bairdia cassida* Bold (Pl. 1, fig. 7) and *B. oarion* Bold (Pl. 1, fig. 6). Both are widespread in the lower and middle Miocene of the Caribbean (e.g., Bold, 1972b, p. 1034), and have been found in the Gulf of Mexico at depths of 1000-1500 m and 600-1500 m, respectively.

Genus **PARANESIDEA** Maddocks, 1969

Paranesidea elegantissima (Bold)

Paranesidea elegantissima (Bold) Bold, 1974b, pl. 1, fig. 3.

Remarks.— Typical of early to middle Miocene shallow-water environments.

Genus **TRIEBELINA** Bold, 1946

Triebelina crumena (Stephenson)

Triebelina crumena (Stephenson) Bold, 1974b, p. 34, pl. 1, figs. 1, 2.

Distribution.— Only found in the Rivière Agoiadiome section, "Arc" Formation (Table 2), late early Miocene, shallow-water.

Subfamily **BYTHOCYPRIDINAE** Maddocks, 1969

Genus **BYTHOCYPRIS** Brady, 1880

Bythocypris sp.

Pl. 1, fig. 5

Remarks.— This species is related to *Bythocypris* sp. cf. *B. bosquetiana* (Brady) (Bold, 1970b, p. 43, pl. 2, figs. 2 a-b) from the middle Miocene of Cuba, Jamaica and St. Croix, and could be its ancestor. It is more elongate and its posterior end is more narrowly rounded.

Distribution.— So far this species has only been found in the Madame Joie Formation of the Riv. Jobelle (sect. M).

Superfamily **CYThERACEA** Baird, 1850

Family **CYThERIDEIDAE** Sars, 1925

Subfamily **CYThERIDEIDINAE** Sars, 1925

Tribe **CYPRIDEIDINI** Kollmann, 1960

Genus **HEMICYPRIDEIS** Malz and Triebel, 1970

Hemicyprideis agoiadiomensis n. sp.

Pl. 2, figs. 1-3

?*Cyprideis* aff. *reversa* (v. d. Bold), Lubimova and Sánchez, 1974 (part?), pl. 9, figs. 5, 5a.

Cyprideis sp., Bold, 1976, p. 26, pl. 4, fig. 14, text-fig. 11 k, l.

Holotype. — HVH 10005, from loc. K 855, left valve (Pl. 2, fig. 1).

Paratypes. — HVH 10006, 10007.

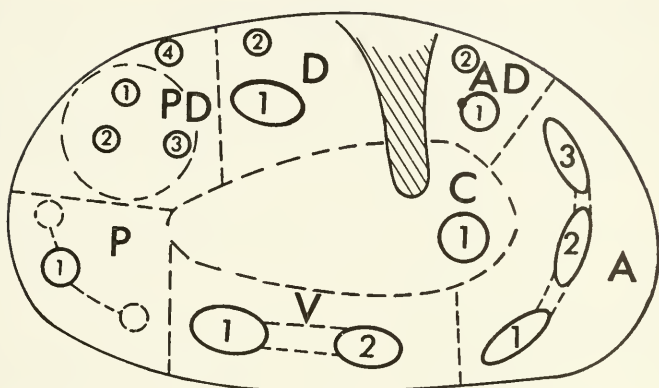
Type locality. — K 885, third outcrop from headwaters down in the Rav. Dondieuque, 7350 m from its confluence with the Artibonite river, about 10 km (in straight line) downstream (SW) from Bánica. The outcrop of gray-tan, finely sandy, calcareous shale with shell fragments, lies 1000 m due S from a W-E line from Thomassique to Banica at 8250 m from Thomassique (see Text-figs. 4, 6; Table 2).

Stratigraphic horizon. — Las Cahobas Formation, "*Elphidium/Rotalia*" facies of Atlantic Refining Co. paleontologists.

Distribution. — Basal Las Cahobas Formation.

Description. — Carapace subrectangular, nodose. Anterior end broadly rounded, very finely denticulate; dorsal margin almost straight and parallel to ventral margin, which is distinctly concave, with especially the posteroventral corner projecting; posterior end very steeply truncate, almost vertical, straight to very slightly convex.

Surface covered with small tubercles, with the exception of the broad, anterior rim, which coincides with the marginal area, and some patches on the sides. These tubercles are concentrated in groups or nodes (see Bold, 1976; text-fig. 10; Text-fig. 16 here): Posterior node (P), consisting of 4-5 small tubercles, almost vertically arranged; posterodorsal node (PD), consisting of a spiral row of about 10 tubercles, the spiral starts near the posterior cardinal angle, and the initial part almost parallels the posterior margin; dorsal node (D), consisting of an irregular group of tubercles of which three in the ventral part are slightly enlarged; anterodorsal node (AD), consisting of two intergrown tubercles of which the posterior one is larger and partly envelops the anterior one; central node (C), consisting in most cases of three subequal tubercles; ventral row of nodes (V), consisting of 2-4 tubercles, the last one much larger and possibly consisting of two individual tubercles, sometimes forming a ridge in which the individual tubercles are



Text-figure 16. — Position of nodes in the Cyprideidini.

A = anterior

AD = anterodorsal (in front of sulcus)

D = dorsal

PD = posterodorsal

P = posterior

V = ventral

Numbered circles indicate node positions.

hardly visible; anterior groups: ventral group (A 1) as continuation of the ventral row, middle group (A 2), consisting of two of the tubercles slightly behind the other two rows and a very irregular group of tubercles (A 3), varying from 5 tubercles in a single row to many in triple rows. A deep sulcus separates the dorsal and anterodorsal nodes, passes behind the central node, ends just above the anterior tubercle of the ventral row, and contains on the inside the adductor muscle-scars.

The marginal area is broad; radial pore canals are long, often branching, and they emerge in the spacings between the minute, flattened teeth on the anterior margin. Hinge holomerodont, consisting in the right valve of an elongate dental area with about 10 heart-shaped cusps, a posterior dental area with about 6 cusps, and a finely crenulate ridge in between. Adductor muscle-scars consist of a vertical row of four scars of which the top two are slightly elongate and oblique. In front of the uppermost scar is a fulcral scar and a single frontal scar, which appears to be heart-shaped. In front of and ventral to the adductor scars, and vertically below the frontal scar, is a single, elongate mandibular scar.

Dimensions. — HVH No. 10005, Holotype, left valve, female: L: 0.61 mm; H: 0.44 mm. HVH No. 10006, left valve, female: L: 0.59 mm; H: 0.43 mm; right valve, female: L: 0.57 mm; H: 0.42 mm; HVH 10007, right valve, male: L: 0.63 mm; H: 0.43 mm.

Remarks. — In the explanation of pl. 9, figs. 5 and 5a, Lubimova and Sánchez (1974) mention that *Cyprideis* aff. *reversa* comes from the Miocene-Pliocene, but on their distribution charts and in the text they indicate that it has been found in the Miocene (Bijabo well # 5 at depths of 212-214 m) of Las Villas province (Lubimova and Sánchez, 1974, p. 40) and in the Oligocene (Cabrieles well # 3 at depths of 578-698 m) of Camagüey province (p. 37). The figured specimen shows the rows of small nodes in the posterior half that are typical of *Hemicyprideis agoiadiomensis* and that do not occur in *Haplocytheridea reversa* Bold (1946) [= *Hemicyprideis cubensis chicoyensis* (Bold), see Pl. 2, figs. 4 a, b]. *H. agoiadiomensis* also has a more abruptly truncate posterior end.

Genus **CYPRIDEIS** Jones, 1857

Remarks. — For details and synonymies of *Cyprideis salebrosa* Bold (Pl. 2, figs. 5 a, b), *C. bensoni* Sandberg, *C. pascagoulaensis* (Mincher) (Pl. 2, figs. 7 a-c) and *C. ovata* (Mincher), see Bold, 1976, p. 22-25.

Cyprideis maissadensis n. sp.

Pl. 3, figs. 1-5

Cyprideis sp., Bold, 1976, p. 26, pl. 4, figs. 1, 2.

Holotype. — HVH 10009, left valve, female (Pl. 3, figs. 1 a-c).

Paratypes. — HVH 10010-10013.

Type locality. — R 1083, Riv. Fond Bleu, Text-figure 7, Table 6.

Stratigraphic horizon. — Las Cahobas Formation (Maïssade tongue), gray, tan, sandy marl with mollusk-casts, 8 feet above a lignite seam ["*Rotalia*" facies of Atlantic Refining Co. paleontologists].

Distribution. — Apparently restricted to the Maïssade facies of the Las Cahobas Formation.

Description. — Female: Carapace small, ovate, generally rather coarsely punctate; greatest height at 3/8 of the length from the anterior end. Anterior end very slightly obliquely rounded, denticu-

late in both valves; dorsal margin slightly convex, sloping down behind the greatest height; in the right valve the greatest height lies more posteriorly at about $5/9$ of the length from the anterior end; ventral margin convex in the left valve, sinuate in the right, with a concavity behind the middle; posterior end steeply truncate in the left valve, rather more oblique in the right. Dorsal view wedge-shaped, greatest width at about $7/10$ of the length from the anterior end, but only slightly wider than at about $2/5$ from the anterior; between these points the valves are compressed. Anterior end pointed; posterior end rounded. Male: more elongate than the female; greatest height at $2/5$ of the length from the anterior end. Anterior end almost evenly rounded; posterior end obliquely rounded in the left valve, obliquely truncate in the right; dorsal margin straight in the left valve, strongly bent at the greatest height in the right, where the anterior part of the dorsal margin is parallel to the ventral margin; dorsal and ventral margins strongly converging posterior to the greatest height in the right valve. In dorsal view the sides are parallel in the middle third of the carapace; the anterior end is only slightly more acuminate than the posterior.

Valves in both sexes are covered with coarse, subangular punctations, except for smooth zones near the anterior and posterior margins. A few broad nodes may occur; the most persistent of these is the posterior node (P in Text-fig. 16), which is situated well forward, near the anterior limit of the posterior region (Pl. 3, fig. 4.) A flat, posterodorsal node (PD 3 in Text-fig. 16) and a weak subcentral node may also occur.

About 20 anterior marginal pore canals; half bifurcating into false radial canals. They characteristically end between the marginal dentitions. The hinge is typical for the genus, with an elongate anterior dental area. Muscle scars in a vertical row of four, of which the bottom three are elongate; the upper one is oblique and tilted over the fulcral scar. Anterior to this is a V-shaped frontal scar.

Dimensions. — HVH No. 10009, holotype, left valve, female: L: 0.75 mm; H: 0.43 mm. HVH No. 10010, females: L: 0.68-0.75 mm; H: 0.36-0.43 mm; W: 0.23-0.24 mm. male: L: 0.77 mm; H: 0.41 mm; W: 0.23 mm.

Remarks. — This species occurs together with *Cyprideis pasagoulaensis* (Mincher) (Pl. 2, figs. 7 a-c), which is similar in shape, but somewhat larger.

Cyprideis n. sp.?

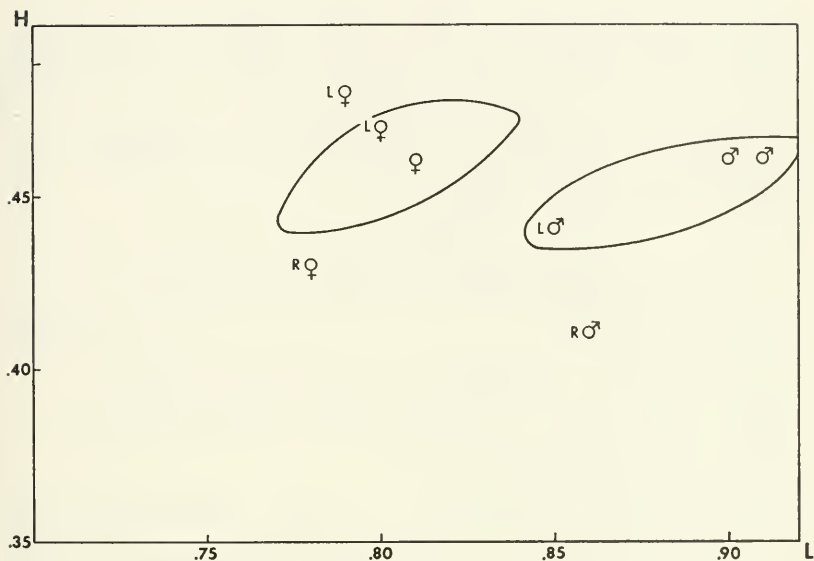
Pl. 2, fig. 6 a-f

Description. — Female: Carapace elongate ovate, highest just in front of the middle. Anterior end evenly rounded; dorsal margin flatly arched; ventral margin convex; posterior end obliquely rounded, almost truncate. Left valve strongly overlapping the right along the whole periphery, least in the posteroventral corner. The anterior end bears a thin, narrow carina. Dorsal view wedge-shaped, greatest width at about $\frac{1}{3}$ of the length from the posterior end; the concave sides converge slowly to a point about $\frac{1}{3}$ of the length from the anterior extremity, then converge more rapidly to a pointed anterior end; posterior end broadly rounded. Male: Carapace elongate trapezoid, highest at $\frac{1}{3}$ of the length from the anterior end. Anterior end evenly rounded with a narrow carina; dorsal margin slightly, but distinctly sinuate, with a convex median portion and two slightly concave portions, near the greatest height and near the posterior cardinal angle; dorsal and very slightly convex ventral margins converging posteriorly; posterior end obliquely rounded. Dorsal view lenticular, widest at $\frac{1}{3}$ of the length from the posterior end, but almost of equal width from there to a point slightly less than $\frac{1}{3}$ of the length from the anterior extremity; sides between these points are concave. Anterior end acuminate with convex sides; posterior end tapering to a truncate point.

Hinge typical for the genus; in the right valve, a long anterior dental area bears about 16 cusps; posterior dental area very short with 5 cusps. Anterior marginal area with about 30 radial canals, a few bifurcating into false radial canals.

Dimensions. — HVH 10050, female: L: 0.81 mm; H: 0.46 mm; W: 0.39 mm. HVH 10051, male: L: 0.91 mm; H: 0.46 mm; W: 0.36 mm (See also Text-fig. 17).

Remarks. — This species may be conspecific with *Cyprideis portusprospectuensis* Bold (1971b, p. 337, pl. 1, figs. 9 a-c, pl. 4, figs. 5 a, b) [see also Bold, 1975a, p. 608, pl. 68, figs. 6 a-d; 1976, p. 22]. The difference between the two is the “normal” overlap of the left valve over the right, instead of the “reversed” overlap of the right over the left in *C. portusprospectuensis*. Side views appear to be almost mirror-images of each other and dorsal views are very similar. Text-figure 17 shows that height and length measurements of the left valves fall almost completely within the scatter of height/



Text-figure 17.—Length-height ratio of carapaces, left (L) and right (R) valves of females and males of *Cyprideis* n. sp.?, compared to the right valves of *Cyprideis portusprospectuensis* (circled areas).

length measurements on right valves of *C. portusprospectuensis*. The question remains, however, whether this species should be regarded as a different species, a subspecies of *C. portusprospectuensis*, or identical to the latter. In a similar case *Hemicyprideis cubensis* and its subspecies *chicoyensis* (see Bold, 1965b, p. 390) were considered to be subspecies because they appear to be confined to different environments. Also the reversed overlap is here combined with the development of nodes on *H. cubensis chicoyensis* in environments of lower salinity. Neither *Cyprideis* n. sp.? nor *C. portusprospectuensis* show any development of nodes and both species appear to occur in variable and partly overlapping environments. They have never been found together. Because of this uncertainty in classification the species has been left in open nomenclature.

Distribution.—*Cyprideis portusprospectuensis* was originally described from the Harbour View beds of Jamaica, where it occurs together with a marine/brackish water ostracode fauna (Bold, 1971b, table 6). In the Jimaní Formation of the Enriquillo basin (Dominican Republic) it is accompanied in places by an almost completely fresh water fauna, in other places by a brackish marine

fauna (Bold, 1975a, tables 2 and 4), and in the Cul-de-Sac boreholes north of Port-au-Prince (Haiti) it is found with a brackish/marine fauna (Bold, 1975a, tables 8 and 10). *Cyprideis* n. sp? is accompanied in the "Las Cahobas" beds of the Morne des Guêpes (north of St. Marc) by a brackish/marine fauna similar to the fauna of the Harbour View beds (see Table 15).

Subfamily **KRITHINAE** Mandelstam, 1958

Genus **KRITHE** Brady, Crosskey and Robertson, 1874

Krithe dolichodeira Bold

Pl. 1, fig. 12

Krithe pretexta (Sars) Bold, 1946, p. 75, pl. 4, figs. 16 a, b (female).

Not *Ilyobates praetexta* Sars, 1866, p. 60.

Krithe dolichodeira Bold, 1946, p. 75, pl. 4, figs. 14 a, b (male).

?*Krithe bartonensis* (Jones), Tressler, 1954, p. 435; Hulings, 1967a, p. 92, table 1; Hulings, 1967b, p. 643, fig. 5 a.

Krithe n. sp., Bold, 1966a, p. 138.

Krithe dolichodeira Bold, 1966d, p. 161, pl. 4, fig. 4; 1968, p. 37, pl. 6, figs. 2 a-d, pl. 8, fig. 5; 1971b, tables 1-5; 1972a, table 4; 1973, table 1; 1975a, table 13.

Krithe aff. *K. dolichodeira* v. d. Bold, Lubimova and Sánchez, 1974, pl. 8, figs. 5, 5 a.

Krithe sp. 12, Morkhoven, 1972, text-fig. 3.

?*Krithe* sp. A2, Peypouquet, 1975, pl. 1, fig. 4.

Dimensions. — Total range in length 0.50-0.75 mm (females 0.50-0.68 mm, males 0.63-0.75 mm).

Distribution. — Trinidad: Lengua Formation ("N" zone 15); Dominican Republic: Gurabo and Mao Formations ("N" zones 18-19); Haiti: Rivière Grise Formation ("N" zones 17-18), Thomonde Formation ("N" zone 15); "Thomonde" Formation ("N" zones 15-17); Jamaica: Buff Bay, Bowden and Manchioneal Formations ("N" zones 15-22); Cuba: Nipe Formation ("N" zone 15); Recent in Gulf of Mexico, ?Gulf of Gascogne and Rockall Basin.

Depth-distribution (modern). — 200-800 m (Morkhoven, 1972).

Stratigraphic range. — late middle Miocene ("N" zone 15) — Recent.

Krithe hiwanneensis Howe and Lea

Pl. 1, fig. 10a, b

Krithe hiwanneensis Howe and Lea, in Howe and Law, 1936, p. 72, pl. 5, figs. 32-34; Bold, 1946, p. 76, pl. 4, fig. 20; 1957b, p. 257; 1958, p. 395; 1960, p. 160; 1964, p. 12; Deboo, 1965, pl. 11, fig. 9; Bold, 1966a, p. 138, pl. 44, fig. 7; 1967a, table 1; Laurencich, 1969, p. 497 (part, *not* pl. 1, fig. 14 = *Krithe cubensis* Bold); Huff, 1970, p. 110, pl. 10, figs. 4, 5; Howe and

Howe, 1973, p. 640, pl. 2, figs. 1-3; Bold, 1972a, table 4; 1973, table 1; Poag, 1974, p. 54, pl. 3, fig. 6.

?*Krithe hiwanneensis* Howe and Lea, Lubimova and Sánchez, 1974, pl. 8, figs. 2, 2 a.

Dimensions. — Range in length 0.55-0.65 mm. .

Distribution. — Panama: Lower Caimito Formation ("N" zone 4); Colombia: Siamana and Huitpa Formations ("N" zones 5-6); Venezuela: Menecito, Husito Formations ("N" zones 6-9), Lower Carapita Formation; Trinidad: Ciperio Formation ("N" zones 6-9), Brasso Formation ("N" zones 3-7); Haiti: "Arc" Formation ("N" zone 6), Madame Joie Formation ("N" zones 5-6); Cuba: Tinguaro, Jaruco and Maquey Formations ("N" zones 1-8).

Paleo depth distribution. — 100-400 m.

Stratigraphic range. — late Eocene to early middle Miocene ("N" zone 9).

***Krithe lambi* Bold**

Pl. 1, fig. 11

Krithe aff. *hiwanneensis* Howe and Lea, Bold, 1964, pp. 9, 10.

Krithe lambi Bold, 1966b, p. 180, pl. 22, figs. 1 a-c, text-fig. 1; 1967a, table 1; 1971b, tables 1-5; 1972a, table 4; 1972b, p. 424; 1973, table 1.

Dimensions. — length range 0.60-0.88 mm.

Distribution. — Costa Rica: Lower Gatun Formation (Reventazon area) ?("N" zone 14), Uscari Formation ("N" zone 9); Panama: upper La Boca Formation ("N" zone 7); Venezuela: Menecito-Husito-Huso Formations ("N" zones 7-17), Cubagua Formation ("N" zone 16), Carenero Formation ("N" zone 16); Trinidad: Ciperio and Lengua Formations ("N" zones 7-15), Brasso Formation ("N" zones 8-12); St. Croix: Kingshill Formation ("N" zones 11-12); Haiti: Thomonde Formation ("N" zones 11-15), "Thomonde" Formation of St. Marc ("N" zones 13-17), Rivière Grise Formation ("N" zones 13-17); "Arc" Formation ("N" zones ?6-8); Jamaica: Montpelier, Buff Bay and Bowden Formations ("N" zones 9-19); Cuba: Cojimar Formation ("N" zones 9-13).

Paleo depth distribution (estimated). — 100-400 m.

Stratigraphic range. — early Miocene ("N" zone 7) — late Pliocene ("N" zone 19).

***Krithe morkhoveni* Bold**

Krithe sp. aff. *K. producta* Brady, Bold, 1958, p. 398 (part), pl. 2, figs. 3 a, c, d (not fig. 3 b = *Krithe proluxa* Bold).

Krithe morkhoveni Bold, 1960, p. 160, pl. 3, fig. 6; 1966a, p. 138, pl. 44, fig. 4; 1967a, table 1; 1968, tables 7, 11, 12; 1971b, tables 1-4; 1972a, table 4; 1973, table 1; 1975a, tables 13, 14.

?*Krithe* aff. *morkhoveni* Bold, Russo, 1968, p. 39, pl. 6, figs. 4 a-d, pl. 8, fig. 6.
Krithe sp. 3, Morkhoven, 1972.

?*Krithe* sp. D2, Peypouquet, 1975, pl. 2, fig. 7.

Dimensions. — Length varying from 0.75 to 0.90 mm.

Distribution. — Costa Rica: Uscari Formation ("N" zone 8); Venezuela: Menecito - Husito Formations ("N" zones 6-9); Trinidad: Ciperó - Lengua Formations ("N" zones 8-15), Brasso Formation; St. Croix: Kingshill Formation ("N" zones 11-13); Dominican Republic: Trincherá Formation ("N" zone 15), Gurabo-Mao Formations ("N" zones 18, 19); Haiti: Rivière Grise Formation ("N" zones 16-18), Madame Joie Formation ("N" zones 5-12); Thomonde Formation ("N" zones 13-14), "Thomonde" Formation of St. Marc ("N" zone 17); Jamaica: Montpelier-Bowden-Manchioneal Formations ("N" zones 14-22); Cuba: Cojímar Formation ("N" zones 9-13). Recent: Gulf of Mexico (rare and deep only), ? Golfe de Gascogne (1500-2500 m)?

Paleo depth distribution (estimated). — 100-1000 m, possibly deeper.

Stratigraphic range. — early Miocene ("N" zone 5) — Recent.

Krithe prolixa Bold

Krithe cubensis Bold, 1946 (part), p. 75, pl. 4, fig. 13 a.

Krithe sp. aff. *producta* Brady, Bold, 1958, p. 398 (part), pl. 2, fig. 3 b (not figs. 3 a, c, d = *K. morkhoveni* Bold).

Krithe trinidadensis Bold, 1958 (part), pl. 1, fig. 3 g.

Krithe elongata Bold, 1960, p. 159, pl. 3, figs. 5 a-c; 1966a, p. 138, pl. 44, fig. 11. Not *Krithe elongata* Jones and Kirkby, 1898, p. 195, pl. 12, fig. 19.

Krithe prolixa Bold, 1966b, p. 180; 1967a, table 1; 1968, tables 7, 11, 12; 1971b, tables 1-4; 1972a, table 4; 1972b, p. 434; 1973, table 1; 1975a, table 13.

Krithe aff. *caudata* Bold, Lubimova and Sánchez, 1974 (part?), pl. 8, fig. 4.

Dimensions. — length varying from 0.80-1.06 mm.

Distribution. — Costa Rica: Uscari Formation ("N" zone 8); Panama: Lower Caimito Formation ("N" zone 4), Upper La Boca Formation ("N" zone 7); Colombia: Huitpa Formation ("N" zone 6); Venezuela: Husito Formation ("N" zone 10); Trinidad: Ciperó - Lengua Formations ("N" zones 6-15), Brasso Formation; Antigua: Antigua Formation (? "N" zone 4); St. Croix: Kingshill Formation ("N" zones 11, 12); Dominican Republic: Gurabo-Mao Formations ("N" zones 18-19), Trincherá Formation ("N" zone 15); Haiti:

Rivière Grise Formation ("N" zones 15-18), Madame Joie Formation ("N" zones 5-8), Thomonde Formation ("N" zones 12, 13), "Thomonde" Formation of St. Marc ("N" zones 13-17); Jamaica: Montpelier-Buff Bay-Bowden Formations ("N" zones 12-18); Cuba: Tinguaro-Jaruco-Cojímar Formations ("N" zones 1-13).

Paleo depth distribution (estimated). — 200-1200 m.

Stratigraphic range. — Oligocene ("N" zone 1) — late Pliocene ("N" zone 19).

***Krithe trinidadensis* Bold**

Krithe trinidadensis Bold, 1958, p. 398, pl. 1, figs. 3 a-f (not fig. 3 g = *K. proluxa*); 1960, p. 159, table 2; 1966a, p. 138, pl. 44, fig. 8; 1967a, table 1; 1968, pl. 2, figs. 10 a-d, tables 7, 11, 12; 1971b, tables 1, 2, 5; 1972a, table 4; 1973, table 1; 1975a, tables 13, 14.

Krithe sp. 1, Morkhoven, 1972, text-fig. 3.

Dimensions. — Length varying from 0.80 to 1.00 mm.

Distribution. — Costa Rica: Uscari Formation ("N" zones 8-?13); Venezuela: Husito-Huso Formations ("N" zones 10-15); Trinidad: Cipero-Lengua Formations ("N" zones 3-15), Brasso Formation; St. Martin: Lowlands Formation (? "N" zone 9); St. Croix: Kingshill Formation ("N" zones 11, 12); Dominican Republic: Trinchera Formation ("N" zone 15), Gurabo-Mao Formations ("N" zones 18, 19); Haiti: Rivière Grise Formation ("N" zones 15-17); Madame Joie Formation ("N" zones 5-9); Thomonde Formation ("N" zones 10-14), "Thomonde" Formation of St. Marc ("N" zone 17); Jamaica: Buff Bay-Bowden Formations ("N" zones 14-18); Cuba: Jaruco Formation ("N" zone 8), Cojímar Formation ("N" zones 9-13). Recent: Gulf of Mexico.

Paleo depth distribution (estimated). — 700-1500 m.

Stratigraphic range. — late Oligocene ("N" zone 3) — Recent.

***Krithe reversa* Bold**

Pl. 1, fig. 13 a-d

Krithe reversa Bold, 1958, p. 399, pl. 1, figs. 4 a-g; 1966a, p. 138, pl. 44, fig. 9; ?1966b, table 1; 1971b, tables 1, 2, 4; 1972a, table 4; 1975a, table 14.

?*Krithe sarwancensis* Hanai, 1959, p. 301, pl. 18, figs. 3-7, text-figs. 3, 4.

Krithe sp. 2, Morkhoven, 1972, text-fig. 3.

Krithe sp. 14, Morkhoven, 1972, text-fig. 3.

Dimensions. — length varying from 0.95-1.10 mm.

Distribution. — Venezuela: Cubagua Formation ("N" zone 16); Trinidad: Cipero-Lengua Formations ("N" zones 12-15), Bras-

so Formation ("N" zones 12, 13); St. Croix: Kingshill Formation ("N" zones 11, 12); Dominican Republic: Trinchera Formation ("N" zone 15); Haiti: "Thomonde" Formation of St. Marc ("N" zones 15-17); Jamaica: Montpelier-Buff Bay-Bowden Formations ("N" zones 9-18); Recent: Gulf of Mexico.

Depth distribution (modern). — deeper than 1000 m.

Stratigraphic range. — early middle Miocene ("N" zone 9) to Recent. I have not been able to substantiate the reported occurrence in the Menecito Formation of Venezuela (Bold, 1966b) in "N" zone 7. This is well below the other intervals from which this species has been reported and until the specimens can be found, I must assume this determination to be erroneous.

Genus **MESSINELLA** Bold, 1969b

Messinella guanajayensis (Bold)

Pl. 1, fig. 9

Cytheridea (*Doloccytheridea*) *guanajayensis* Bold, 1946, p. 83, pl. 7, figs. 10 a-d.
Messinella guanajayensis (Bold) Bold, 1969b, p. 398, pl. 1, figs. 1 a-e; 1973, p. 152, table 1.

Distribution. — Jaruco, Tinguaro Formation (Cuba), Lower Montpelier group (Jamaica), Madame Joie Formation (Haiti).

Stratigraphic range. — Oligocene - early Miocene ("N" zones 1-8).

Subfamily **CUSHMANIDEINAE**

Genus **CUSHMANIDEA** Blake, 1933

Cushmanidea howei (Bold)

Pl. 1, fig. 8

Cytherideis sp. Howe and Law, 1936, p. 69, pl. 4, fig. 29.
Cytherideis howei Bold, 1946, p. 88, pl. 7, figs. 9 a-c; 1950, p. 82 (part). 1964, pp. 8, 10 (part).
Cushmanidea howei (Bold), Bold, 1965b, p. 392, pl. 2, fig. 4; 1970b, table 1; 1972a, tables 2, 7, 8, 17; 1972b, tables 1, 2, 4, 5; 1973, table 1.

Remarks. — Some specimens attributed to this species show a less abruptly truncate posterior end and a somewhat lower anterior end, with the dorsal margin slightly more convex than in typical specimens from the Paso Real Formation of Cuba. They could possibly be the males of the same species; no sexual dimorphism was observed in the original material, nor in that from the Lares and Cibao Formations of Puerto Rico.

Family **CYTHERIDAE** Baird, 1850

Subfamily **CYTHERINAE** Baird, 1850

Genus **CYTHEROMORPHA** Hirschmann, 1909

Cytheromorpha? sp.

Pl. 5, fig. 10

Remarks. — Only a few carapaces of a general shape suggesting this genus have been found in the basal Las Cahobas Formation of the north flank of the Plateau Central (loc. K 885). Their internal morphology is unknown and therefore the generic assignment cannot be confirmed.

Dimensions. — L: 0.45 mm; H: 0.23 mm; W: 0.20 mm.

Cytheromorpha? sp. aff. **C? caudata** Bold

Pl. 3, fig. 13

Cytheromorpha? sp. Bold, 1963, p. 384, pl. 5, fig. 6; 1966b, table 1; 1972a, tables 2, 7, 9, 13.

Remarks. — This very small species is assigned here to *Cytheromorpha*, although it probably belongs to a new genus. Similar forms have been described from the Cubagua Formation of Venezuela under the name *Cytheromorpha caudata* (Bold, 1966c, p. 20, pl. 2, figs. 3 a-c) and from the Quaternary mudlumps of the Mississippi river under the name «new genus, sp. aff. "*Cytheromorpha*" *caudata*» (Howe and Bold, 1975, pl. 3, fig. 7). They resemble *Cytheromorpha* in hinge and marginal area, but differ widely from typical species in the sharp, ventrally situated, caudal process.

Dimensions. — L: 0.35 mm; H: 0.17 mm; W: 0.11 mm.

Distribution. — This species was originally found in the upper Brasso Formation of Trinidad and later in the Pozón group of Falcón (Venezuela) both middle Miocene in age ("N" zone 13). In Haiti it occurs in an almost similar position near the top of the Thomonde Formation ("N" zones 14-15) on the south flank of the Plateau Central syncline.

Subfamily **PECTOCYTHERINAE** Hanai, 1957a

Genus **MUNSEYELLA** Bold, 1957b

Munseyella sp.

Pl. 5, fig. 12

Remarks. — This species closely resembles *Cytheromorpha subminuta* Puri (1954, p. 267, pl. 6, figs. 9, 10, text-figs. 11 i, j), which has also been encountered in the Caribbean (Bold, 1958, pl. 5, fig.

3; 1963, pl. 5, fig. 3). The specimens from the St. Marc dome have a smaller knob in the posterodorsal region. As species of *Munseyella* have been found over a broad depth range (Morkhoven, 1972) it is very likely that slight changes in ornamentation may be produced by different environments. However, specimens of *Munseyella* usually occur in such small quantities that a standard for infra- or inter-specific variation cannot be established.

Subfamily **PERISSOCYThERIDEINAE** Bold, 1963

Genus **PERISSOCYThERIDEA** Stephenson, 1938

Perissocytheridea matsoni (Stephenson)

Pl. 6, fig. 6 a-d

Cytheridea? *matsoni* Stephenson, 1935, p. 192, pl. 5, figs. 1, 2, 7, 8.

Perissocytheridea matsoni (Stephenson), Stephenson, 1938, p. 145, pl. 23, fig. 10, pl. 24, figs. 3, 4, text-figs. 4, 7, 11; Mincher, 1941, p. 343, pl. 47, figs. 3 a, b; Bold, 1946, p. 84 (part), pl. 9, figs. 9 a, b; 1957b, p. 237, pl. 3, fig. 3; 1958, p. 71; Kollmann, 1960, p. 136, pl. 4, figs. 2 a-c; Bold, 1963, p. 698; ?1969a, p. 121, pl. 1, figs. 10 a-d; 1972a, table 2, p. 1009.

Perissocytheridea aff. *matsoni* (Stephenson), Bold, 1971c (part?), text-figs. 2, 4; 1972a, table 7; 1973, table 1; 1975d, table 1.

?*Perissocytheridea* cf. *matsoni* (Stephenson), Bold, 1946, pl. 4, figs. 11 a-d, pl. 14, figs. 3 a-c.

Not *Perissocytheridea matsoni* (Stephenson), Malkin, 1960, p. 479, 484, text-fig. 5, pl. 3 (bottom), figs. 3, 5; Gordon, 1961, p. 610; Puri and Vanstrum, 1969, p. 74:

Remarks.—Female specimens from the *Potamides matsoni* zone (Stephenson, 1935), show strongly converging dorsal and ventral outlines. Specimens from the Pascagoula Formation (Mincher, 1941) show less convergence and stronger inflation of the posterodorsal portion with consequent deeper submedian sulcus. Specimens from the Paso Real Formation of Cuba, and the Las Cahobas Formation of Haiti are also less convergent posteriorly, but otherwise conform exactly to the types. However, there are some specimens (*e.g.* Bold, 1946, pl. 4, figs. 11 a-d, pl. 14, figs. 3 a-c) from Cuba and Guatemala that do not exhibit the reticulate pattern of the type. It is not known whether this (1) is an artifact of preservation, (2) reflects growth in a more calcite-saturated environment (Bold, 1976, p. 17), or (3) reflects a real specific difference. Specimens from Trinidad and Venezuela (although rare) show the typical rather strong convergence of dorsal and ventral outlines. However, no similar specimens have been found, so far, in the intermediate area from Puerto Rico to the Lesser Antilles and from Guatemala to Colom-

bia, which makes these isolated South American occurrences difficult to account for.

Dimensions. — HVH 10018 (loc. K 443), female: L: 0.45 mm; H: 0.26 mm; male, L: 0.50 mm; H: 0.26 mm. HVH 10017 (loc. R 1190), female: L: 0.49 mm; H: 0.28 mm; male, L: 0.55 mm; H: 0.28 mm.

***Perissocytheridea cahobensis* n. sp.**

Pl. 6, figs. 4, 5

Holotype. — HVH 10015, female carapace.

Paratypes. — HVH 10016.

Type locality. — M 1182, outcrop in Riv. Grande, 3.3 km downstream from Belladère-Las Cahobas Highway-crossing.

Stratigraphic horizon. — Las Cahobas Formation.

Description. — Female: Carapace short, ovate, highest at $\frac{1}{3}$ of the length from the anterior. Anterior end obliquely rounded; dorsal margin almost straight; ventral margin sinuate and swinging upward into the short, pointed posterior end, which is angled in the middle, rounded below, truncate or slightly concave above; posterior cardinal angle pronounced. Left valve overlapping the right along entire periphery; strongest overlap midventrally and dorsoposteriorly.

Carapace bomb-shaped in dorsal view, widest at about $\frac{4}{7}$ of the length from the anterior. Anterior end short, tapering to a projecting rim, with concave sides; posterior end convex, tapering. From the greatest width the sides converge only slightly forward until near the anterior end. Ventrally there is a small knob-like ala at about $\frac{3}{4}$ of the length from the anterior end; if well-developed it may project beyond the greatest width. There is no ornamentation to speak of. Orifices of normal, seive-type pore canals are widely scattered and may become slightly depressed, forming pits that may be arranged in slightly irregular longitudinal rows in the posterior half of the carapace.

Male: Carapace elongate oval, highest at about $\frac{3}{8}$ of the length from the anterior. Anterior end obliquely rounded; dorsal margin sinuate; ventral margin sinuate, almost parallel, very slightly converging posteriorly; posterior end narrowly rounded subventrally, obliquely truncate above. Ventrally, at about $\frac{7}{10}$ of the length from the anterior end there is a small, knob-like ala; posterodorsally

there is a flattish swelling of the carapace, which extends down into the rather wide posterior end. Between ala and swelling the carapace is slightly compressed, and the ornamentation in this depression is slightly more pronounced. It consists of pits in irregular rows. In front of the swelling and behind the greatest height a sulcus occurs. Both sulcus and compressed area die out towards the center of the valve.

Pod-shaped in dorsal view, widest at about 0.65 of the length from the anterior extremity; sides converging forward towards the acute anterior end, which bears a faint rim; posterior end rounded with a more strongly projecting rim.

Dimensions. — Holotype, female: L: 0.43 mm; H: 0.28 mm; W: 0.22 mm. Paratype, male: L: 0.48 mm; H: 0.26 mm; W: 0.22 mm. Range: females: L: 0.40-0.45 mm; H: 0.24-0.29 mm; W: 0.21-0.23 mm; males: L: 0.44-0.48 mm; H: 0.24-0.26 mm; W: 0.20-0.22 mm.

Remarks. — The lack of ornamentation sets this species apart from most other species of *Perissocytheridea*. The closest is *Perissocytheridea* sp. (Bold, 1975c, p. 145, pl. 18, figs. 5-8) from the La Cruz Formation (Pliocene) of Cuba, which, however, is wider and more egg-shaped in dorsal view and has a more pronounced sexual dimorphism.

Distribution. — throughout the Las Cahobas Formation.

***Perissocytheridea? haitensis* n. sp.** Pl. 6, figs. 1a-e, 2a-c, Text-fig. 18

Holotype. — HVH 9170, complete carapace.

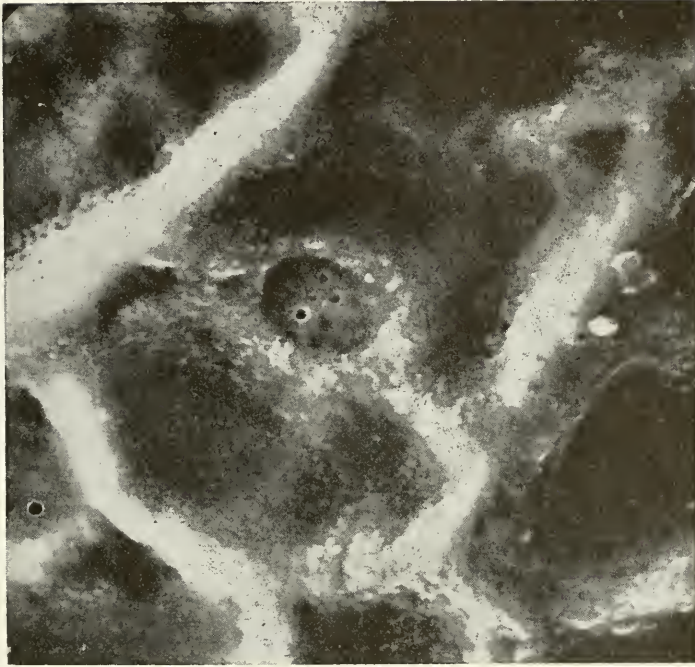
Paratypes. — HVH 10047, 3 carapaces, 1 right valve.

Type locality. — K 885, Riv. Agoiadiome section, (see Text-fig. 10).

Stratigraphic horizon. — Las Cahobas Formation.

Distribution. — Found only at type locality.

Description. — Carapace squat, height $2/3$ of the length, sub-square. Anterior end obliquely rounded, dorsal margin almost straight (cardinal angles at respectively $1/3$ and $1/10$ of the length from anterior and posterior end); ventral margin sinuate, parallel to dorsal; posterior end bluntly angled in the middle, very short, margins straight above and below. The ventral part is somewhat compressed to form a keel, which continues ventrally and into the anterior end. Ventral surface flattened, except for the slight keel.



Text-figure 18. — *Perissocytheridea? haitensis* n. sp., HVH 9170, from loc. K 885, Las Cahobas Formation, section A. Detail of the reticulation in the dorsal part of the carapace, just above the center, shows position of simple and seive-type porecanals. $\times 1600$.

Dorsal view lenticular, widest at $3/5$ of the length from the anterior; anterior end slightly more pointed than posterior. There is an inconspicuous knob-like ala near the posteroventral corner, about $1/5$ of the length from the posterior extremity. Surface finely reticulate; the reticulation consists of relatively large tetragonal, pentagonal and hexagonal meshes, that are subdivided into very small, subrounded fossae, numbering from two to five or six. Some of these minute fossae are actually seive-type pore canals (Text-fig. 18). Simple pore canals are scattered on the ridges surrounding the larger meshes. The pattern of the larger meshes is generally subparallel to the nearest periphery, but diverges from it farther inside, so that the rows are almost vertical above the alate knob and in the muscle-scar area, from where they curve upward and backward into the dorsal portion of the carapace. Hinge in the right valve consists of

short, terminal dental areas each with about six cusps, and an intermediate, rather deep, straight, crenulate groove. Marginal area of moderate width in the anterior end, with about eight radial and five to six false-radial pore canals. Muscle-scar not quite distinctly observed: posterior row of 4 scars with at least one frontal scar.

Dimensions. — L: 0.51 mm; H: 0.26 mm; W: 0.19 mm.

Remarks. — The generic assignment is questionable. Although hinge and marginal area closely conform to that of other species of *Perissocytheridea*, the general shape does not. In fact it is reminiscent of some Loxoconchidae, especially *Hirschmannia* and *Elofsonella*, but *Hirschmannia* has a gongyodont hinge and *Elofsonella* (cf. Wagner, 1957, pls. 31, 32) has longer terminal dental areas and a smooth median hinge element. Although only few specimens were found, this species merits a distinct specific name because of its transitional taxonomic position.

***Perissocytheridea alata* Bold**

Pl. 6, fig. 7 a-c

Perissocytheridea alata Bold, 1946, p. 84, pl. 14, figs. 4 a-c; 1970b, p. 45, pl. 1, figs. 8 a-d; 1972b, p. 427; 1973, table 1.

Perissocytheridea? sp., Bold, 1965b, p. 392, pl. 3, figs. 7 a-e, pl. 7, fig. 3.

Remarks. — Bold (1972b) combined within a single species the more ornate specimens from Puerto Rico (Bold, 1965b) with the smoother ones from Cuba (Bold, 1946), St. Croix and Anguilla (Bold, 1970b) and Panama (Bold, 1972b). In the basal Las Cahobas of the north flank of the Plateau Central both ornate and smooth forms occur. This species is probably confined to the lower and middle Miocene ("N" zones 5-13).

***Perissocytheridea* sp.**

Perissocytheridea sp. Bold, 1975c, p. 145, pl. 18, figs. 5-8.

Remarks. — Differences from *Perissocytheridea cahobensis* n. sp. are mentioned in the description of that species.

Distribution. — The species was originally described from the La Cruz Formation (Pliocene) of Cuba. It occurs in Haiti in the "Las Cahobas" Formation of the Morne des Guêpes (locs. P 1565 and 1563, and M 1439).

Family **LIMNOCYtherIDAE** Klie, 1938

Genus **LIMNOCYthere** Brady, 1868a

Limnocythere? sp.

Pl. 6, fig. 3

Description.—Carapace subrectangular, highest at anterior cardinal angle, which lies at about 1/5 of the length from the anterior extremity. Anterior end obliquely rounded, dorsal margin almost straight, ventral margin concave, posterior end blunt and obliquely rounded. Surface punctate with an anteromedian double sulcus; the two branches of the sulcus separated by two small nodes, one near the dorsal margin, the other at about median height. Posterior to the sulcus the valves exhibit dorsal and ventral swellings, separated by a shallow depression. The ventral swelling terminates abruptly at about 1/4 of the length from the posterior end of the carapace. The dorsal swelling extends to the posterior cardinal angle and then curves down towards the slightly thickened postero-ventral corner, where it is separated from the ventral swelling by a strong compression of the valve.

In dorsal view the carapace is widest just behind the middle in the anterior part of the dorsal swelling; the posterior end tapers gently, and the anterior end is strongly compressed, with a concave outline. The sulci are visible, and are separated by the median node.

Remarks.—As only closed carapaces have been found, the interior could not be studied. Muscle-scars are not visible from the outside and the marginal area was only poorly visible. The generic assignment is based on the apparent presence of a broad zone of concrescence. The shape and type of ornamentation apply equally well to the genus *Ilyocypris*. (Brady and Norman, 1889, p. 106).

Distribution.—This species is found only in the upper part of Las Cahobas Formation, Riv. Canot, locality R 1073 (see Text-fig. 7, Tables 5 and 6.)

Family **TRACHYLEBERIDIDAE** Sylvester-Bradley, 1948Subfamily **TRACHYLEBERIDINAE** Sylvester-Bradley, 1948Genus **COSTA** Neviani, 1928**Costa praedohmi** Bold

Costa praedohmi Bold, 1970a, p. 70, pl. 1, figs. 2 a-c; 1973, table 1; 1975a, table 1.

Costa n. sp. Bold, 1971a, table 1.

Distribution.—Juana Diaz Formation (Puerto Rico), Tinguaro Formation (Cuba).

Costa maquayensis Bold

Pl. 4, fig. 13

Cythercis polytrema (Brady) Bold, 1946, p. 89 (part), pl. 10, fig. 6 (not Pl. 9, fig. 4, Not *Cythere polytrema* Brady, 1878, p. 363, pl. 66, fig. 1).

Costa maquayensis Bold, 1961, p. 629, text-figs. 3 a-b, 4; 1970a, p. 70; 1971a, table 1; 1973, table 1; 1975d, table 3.

Costa aff. *meka* Bold, 1966e, table.

Distribution. — Tinguaro, Jaruco and Maquey Formations (Cuba), Madame Joie and "Arc" Formations (Haiti), Antigua Formation (Antigua), Angola Limestone (Puerto Rico).

Costa cubana Bold

Pl. 4, fig. 12 a-c

Costa cubana Bold, 1970a, p. 70, pl. 1, figs. 3 a-c; 1971a, table 1; 1973, table 1; 1975a, tables 11, 15.

Costa sp. Bold, 1971c, table 2.

Distribution. — Cojímar Formation (Cuba), Montpelier Group (Jamaica), Rivière Grise Formation, Thomonde Formation (Haiti); Lowlands Formation (St. Martin); Kingshill Formation (St. Croix).

Costa dohmi Bold

Costa dohmi Bold, 1968, p. 59, pl. 3, figs. 9 a-d, pl. 9, figs. 1 a, b; 1970a, p. 71; 1971b, p. 338 (part; not pl. 2, fig. 7 = *C. bellipulex* Levinson).

Distribution. — Gurabo Formation (Dominican Republic), Bowden Formation (Jamaica), "Las Cahobas" Formation of St. Marc (Haiti).

Costa bellipulex Levinson

Costa dohmi Bold, 1971b (part), pl. 2, fig. 7.

Costa bellipulex Levinson, in Leroy and Levinson, 1974, p. 20, pl. 13, fig. 6.

Distribution. — Pliocene, San San Clay (Jamaica); middle Pleistocene (unnamed unit), Gulf of Mexico; Recent, Gulf of Mexico (rare at about 460 m depth).

Genus **ABYSSOCYHERE** Benson, 1971**Abyssocythere trinidadensis** (Bold)

Pl. 4, fig. 15

Cythercis ? *trinidadensis* Bold, 1957a, p. 8, pl. 3, figs. 1 a-d; 1960, p. 165.

Abyssocythere trinidadensis (Bold) Benson, 1971, pp. 11, 13, text-figs. 8, 9, pl. 3, figs. 4, 5, 6 (with synonymy).

"*Cythercis*" *trinidadensis* Bold, 1972a, table 4.

Cythercis contramaestrens Lubimova and Sánchez, 1974, p. 94, pl. 12, figs. 3, 3a.

Distribution. — Trinidad: U. Lizard Springs, Navet, Hospital Hill, Cipero and Lengua Formations (early Eocene to middle Miocene) ("N" zone 15); Cuba: late Eocene; Dominican Republic: Trincheras Formation ("N" zone 15); Haiti: Madame Joie Formation ("N" zones 10-12).

Genus **AGRENOCYTHERE** Benson, 1972

Agrenocythere hazelae (Bold)

Pl. 4, fig. 16

Cythereis hazeli Bold, 1946, p. 92, pl. 10, figs. 4 a-c.

Agrenocythere hazelae (Bold), Benson, 1972, pp. 62-73, text-figs. 31-38 (with synonymy); 1977, p. 870, pl. 1, fig. 6.

Cythereis acceptabilis Lubimova and Sánchez, 1974 (part), p. 94, pl. 13, figs. 1, 1a, 1b (Not pl. 12, figs. 6, 6a, 6b = *Bradleya* ex gr. *dictyon* (Brady)).

Distribution. — Cuba: (Oligocene - middle Miocene); Haiti: Rivière Grise Formation ("N" zone 17), Madame Joie Formation ("N" zones 4-6, 9-12), Thomonde Formation (Riv. Dormante) ("N" zone 13); "Thomonde" Formation of St. Marc ("N" zones 13-17); Dominican Republic: Trincheras Formation ("N" zone 15); Jamaica: Montpelier group ("N" zones 9-12), Buff Bay Formation ("N" zones 14-16); St. Croix: Kingshill Formation ("N" zones 10-12); Trinidad: Cipero and Lengua Formations ("N" zones 5-15).

Subfamily **HEMICYTHERINAE** Puri, 1953

Genus **PROCYTHEREIS** Skogsberg, 1923

Procythereis? sp.

Pl. 4, fig. 2

Description. — Carapace ovate, highest in the middle; left valve overlapping the right along the entire dorsal margin. Anterior end blunt, obliquely rounded; dorsal margin convex; ventral margin sinuate; posterior end rounded below the middle, concave above; posterior cardinal angle conspicuous. The slightly thickened rim of the anterior margin diverges upwards from the margin and continues for a short distance towards the middle of the valve, below the anterior cardinal angle.

Dimensions. — L: 0.71 mm; H: 0.48 mm.

Remarks. — Differences from *P?* *deformis* (Bold, 1973, pl. 1, fig. 4a) are the absence of an eyespot and the presence of a thickened anterior ridge. The specimen figured is from the Oligocene Bonnygate Formation of the Montpelier Group of Jamaica ("N"

zone 1 of Blow, 1969), as all specimens from Haiti were slightly damaged.

Distribution.—Bonnygate Formation (Oligocene) of Jamaica, basal "Arc" Formation of Haiti ("N" zone 5).

Genus **AURILA** Pokorný, 1955

Aurila sp. aff. **A. cicatricosa** (Reuss)

Pl. 4, fig. 1 a, b

?*Aurila* sp. aff. *cicatricosa* (Reuss) Bold, 1966c, p. 26, pl. 3, figs. 6 a-b.

Aurila sp. aff. *cicatricosa* (Reuss) Bold, 1969a, p. 122, pl. 2, figs. 6 a, b; 1975a, table 9; 1975d, table 1.

Description.—Carapace ovate, highest in the middle. Anterior end broadly and obliquely rounded; dorsal margin arched, almost straight and sloping down behind the middle, bluntly angled at posterior margin; posterior end narrowly rounded below the middle, straight above, rounded below; ventral outline almost regularly convex with only a very weak sinuation in front of the middle, vertically below the eyespot, which is situated at 3/10 of the length from the anterior extremity and about 1/4 of the height below the greatest height.

Dimensions.—L: 0.63 mm; H: 0.43 mm.

Remarks.—This species is rather similar to *Aurila amygdala* (Stephenson) (Stephenson, 1944, p. 158, pl. 28, figs. 8, 9), but both anterior and posterior dorsal slopes are steeper. The ventral margin is less concave, the posterior end is blunter and the eye-spot is more pronounced. Specimens from the Pliocene of Puerto Rico and the Cul-de-Sac coreholes are almost identical, but those from the Pleistocene of Venezuela have more convex and steeper dorsal slopes.

Distribution.—Haiti: Las Cahobas Formation (middle Miocene and younger), Morne Delmas Formation (Pliocene); Puerto Rico: Ponce Formation (Pliocene).

Genus **QUADRACYTHERE** Hornibrook, 1952

Quadracythere antillea (Bold)

Pl. 4, figs. 5-6

Hemicythere antillea Bold, 1946, p. 101, pl. 5, figs. 8 a-e.

Archocythereis antillea Bold, 1946, p. 104, pl. 5, figs. 7 a-b.

Hemicythere antillea Bold, Bold, 1957b, p. 238, pl. 1, figs. 9 a-b.

Quadracythere antillea (Bold), Bold, 1965b, p. 396, pl. 6, fig. 5; 1972b, p. 428; 1973, table 1.

Distribution.—This species is widely distributed in shallow

water sediments of the late early and middle Miocene of the Caribbean. In Haiti it has been found in the Las Cahobas Formation, the upper part of the Thomonde and "Arc" Formations and on one occasion in the upper part ("N" zone 9) of the Madame Joie Formation.

Subfamily **COQUIMBINAE** Ohmert, 1968

Genus **COQUIMBA** Ohmert, 1968

Coquimba congestocostata (Bold)

Pl. 4, fig. 8

Puriana? congestocostata Bold, 1963, p. 300, pl. 7, figs. 5 a-b, pl. 12, fig. 9;
Bold, 1968, pl. 5, figs. 3 a-c.

Coquimba congestocostata (Bold), Bold, 1971b, p. 337; 1975a, tables 3, 4;
1975b, tables 2, 11.

Distribution. — This species has been found in the late Miocene and Pliocene of Trinidad and the Greater Antilles. Its occurrence in the upper part of the Thomonde Formation of the Riv. Dormante section (sect. D) ("N" zone 14) is the earliest reported so far.

Family **LOXOCONCHIDAE** Sars, 1925

Genus **LOXOCONCHA** Sars, 1866

Remarks. — In the West Indian Neogene three groups of species can be recognized, which consistently occur in different environments.

Group 1 occurs in very shallow, mostly brackish-lagoonal environments:

Loxochoncha levis Brady, 1870 (Pl. 5, figs. 11 a, b)

L. ocellata Bold, 1972b

Group 2 occurs in shallow marine environments (0-200 m):

Loxoconcha cubensis Bold, 1946

Loxoconcha forda Bold, 1968 (Pl. 5, fig. 7)

Loxoconcha sp. aff. *L. forda* Bold (see below)

L. runa Bold, 1970b (Pl. 5, figs. 5 a, b)

L. sp. B (see below), and the "Loxocornuculum" group of

L. antillea Bold, 1946

L. fischeri (Brady, 1869)

L. dorsotuberculata (Brady, 1866)

L. rugosa Bold, 1946 (Pl. 5, fig. 8).

Group 3 occurs in deeper water environments (below 200 m):

- Loxoconcha banesensis* Bold, 1946 (Pl. 5, figs. 4 a, b)
L. sp. aff. L. woodwardsensis Howe and Law (see below)
L. sp. A (see below).

Of the second group *L. forda* may appear in deeper-water sediments; this is also true of its possible ancestor, *L. sp. aff. L. forda*.

***Loxoconcha sp. aff. L. forda* Bold** Pl. 5, figs. 6 a, b

Loxoconchu sp. aff. L. forda Bold, 1970b, pl. 2, fig. 10; 1971a, table 2; 1973, table 1.

Remarks.—This species differs from *L. forda* Bold (1968, p. 70, pl. 3, figs. 3 a-e), by the less tumid ventral portion of its carapace, but is very similar to that species in lateral outline.

Distribution.—St. Croix: Kingshill marl; St. Martin: upper part of the Lowlands Formation; Haiti: Madame Joie and Thomonde Formations; Cuba: Maquey and Cojímar Formations.

***Loxoconcha sp. aff. L. woodwardsensis* Howe and Law** Pl. 5, fig. 3

Loxoconcha cf. corrugata Alexander, Bold, 1946, p. 112, pl. 15, figs. 10 a, b; 1971a, table 1 (Not *Loxoconcha corrugata* Alexander, 1934, p. 228, pl. 33, fig. 13).

Loxoconcha sp. aff. L. woodwardsensis Howe and Law, Laurencich, 1969, p. 4.5, pl. 1, fig. 24; Bold, 1968, table 4; 1973, p. 156, table 1; 1975d, table 3.

Remarks.—This species differs from *L. banesensis* Bold (1946) by its straight dorsal margin. All these deeper-water species of *Loxoconcha* show similar development of strongly curved, often sharply-keeled ridges on the tumid ventral portion of the valves:

- L. banesensis* Bold, 1946, p. 112, pl. 15, figs. 11 a, b
L. sp. aff. L. banesensis Bold, Bold, 1972b, p. 431, pl. 1, figs. 13-16
L. wagneri Bold, 1960, p. 173, pl. 7, figs. 4 a-b
L. sp. aff. L. woodwardsensis Howe and Law
L. sp. A (see below).

Distribution.—Mexico: Oligocene; Puerto Rico: Oligocene and early Miocene; Cuba: Oligocene and early Miocene; Haiti: early Miocene to earliest middle Miocene ("N" zones 5-9).

Loxoconcha sp. A

Pl. 5, figs. 1 a, b

Remarks. — This species differs from *L.* sp. aff. *L. woodwardensis* Howe and Law, and *L. banesensis* Bold by its shape (highest at the anterior cardinal angle and tapering towards the posterior end), and by a slight projection in the middle of the dorsal margin of the left valve. Moreover, the punctations form distinct grooves in the dorsal middle part of the valves, which tend to disappear towards the anterior end. In this respect the species resembles *L. wagneri* Bold, 1960.

Dimensions. — Left valve (HVH No. 10046): L: 0.63 mm; H: 0.37 mm; Right valve (HVH No. 10047): L: 0.61 mm; H: 0.35 mm.

Distribution. — Upper Thomonde Formation of the Riv. Dormante section. The same species may occur in the upper part of the Madame Joie Formation of the Riv. Bouyaha section (see Pl. 5, fig 2).

Loxoconcha sp. B

Pl. 5, figs. 9 a-c

Description. — Carapace ovate to subrectangular, dorsal and ventral margin almost parallel. Anterior end obliquely rounded; dorsal margin very faintly convex; ventral margin almost straight, curving upward in posterior part; posterior end narrowly rounded above the middle. Surface gently punctate; distinct eyespots, situated below anterior cardinal angle, placed well away from the dorsal margin in dorsal view. There is a faint indication of a posterodorsal ridge.

Dimensions. — Females: L: 0.48 mm; H: 0.29 mm and L: 0.52 mm; H: 0.30 mm. Male: L: 0.52 mm; H: 0.27 mm (all HVH No. 10075).

Remarks. — The species is very similar to *Loxoconcha* sp. B (Bold, 1970b, p. 48, pl. 1, figs. 4 a-b; 1971a, table 2), which, however, has a straighter dorsal margin and distinct antero- and posterodorsal tubercles. The latter species, although different from the holotype of *Loxoconcha anderseni* Puri (1954, 269, pl. 10, fig. 4, text-fig. 10c) may be identical to some of the paratypes of that species and to the specimens assigned by Butler (1963, p. 49, pl. 2, figs. 3, 4) to *L. anderseni*. The male is similar to *Loxoconcha runa* Bold (1970b, p. 47, pl. 1, figs. 9a-d), but lacks the ventral tubercle (cf. Pl. 5, figs. 5 a, b).

Distribution. — Las Cahobas and upper Thomonde Formations ("N" zones 13-16), Haiti.

Family **PARACYTHERIDEIDAE** Puri, 1957

Genus **PARACYTHERIDEA** Müller, 1894

Paracytheridea sp. cf. **P. hispida** Bold

Pl. 3, fig. 14

Not *Paracytheridea hispida* Bold, 1946, p. 87, pl. 9, figs. 10 a-c.

Not *Paracytheridea* sp. aff. *P. hispida* Bold, 1968, p. 76, pl. 4, figs. 6 a, b.

Remarks. — This species has been compared to *P. hispida*, because of its extremely hispid exterior, although not so extreme as the species from the Gurabo Formation in the northern Dominican Republic (*P.* sp. aff. *P. hispida*), from which it differs by its less elongate ventral spine (the central spine may be of the same size, but is broken), and by its two posterodorsal bosses compared to one in the two species mentioned above.

Distribution. — This species is found only in the Madame Joie Formation of the Riv. Grande section.

Family **CYTHERURIDAE** Müller, 1894

Subfamily **CYTHEROPTERINAE** Hanai, 1957b

Genus **CYTHEROPTERON** Sars, 1866

Cytheropteron sp. aff. **C. palton** Bold

Pl. 3, fig. 8

Cytheropteron sp. Bold, 1958, p. 414, pl. 4, figs. 4 a, b.

Remarks. — This species differs from *C. palton* Bold (1966c, p. 33, pl. 1, figs. 7 a, b) by its higher anterior end and broader ala, which (in side view) obscures more of the ventral margin. *Cytheropteron nipeensis* (Bold, 1967b, p. 312, pl. 1, fig. 11) from the Gatun Formation of Panama is identical to *Cytheropteron palton*, not to *C. nipeensis*.

Distribution. — Upper Thomonde Formation ("N" zones 12-14), Haiti; Brasso Formation ("N" zones 12), Trinidad.

Cytheropteron sp. aff. **C. bichense** Bold

Pl. 3, fig. 9

Remarks. — This species is larger and considerably higher than *C. bichense* (Bold, 1963, p. 400, pl. 9, figs. 9 a, b), and the alae are less rounded at the tip. The dorsal margin of the right valve is arched instead of almost straight.

Dimensions. — L: 0.42 mm; H: 0.25 mm.

Distribution. — Thomonde Formation, Haiti.

Cytheropteron? *trinidadensis* Bold

Pl. 3, fig. 10

Cytheropteron? *trinidadensis* Bold, 1960, p. 176, pl. 5, figs. 5 a-c; 1968, p. 73, pl. 7, figs. 9 a-d, pl. 8, figs. 5 a, b; 1971b, table 4.

Distribution. — Trinidad: Navet Formation (middle to upper Eocene), Ciperó Formation (Oligocene-middle Miocene), Lengua Formation (middle to upper Miocene); Jamaica: Montpelier Group, Spring Garden Formation (middle Miocene), Lower Coastal Group, Buff Bay Formation (middle to upper Miocene); Haiti: Madame Joie Formation (middle Miocene), Riv. Dormante section ("N" zone 12).

Cytheropteron sp.

Pl. 3, fig. 12

Remarks. — This species from the "Thomonde" Formation ("N" zones 16-17) of South St. Marc is similar in shape to *Cytheropteron* (*Aversovalva*) *pinarense* Bold, 1946 (see also Bold, 1973, p. 157, pl. 1, fig. 8) from the Oligocene of Cuba, Puerto Rico and Trinidad, but differs in the degree of curvature of the dorsal margin in the right valve.

Family **BYTHOCYATHERIDAE** Sars, 1926

Genus **PSEUDOCYATHERE** Sars, 1866

Pseudocythere sp.

Pl. 3, fig. 11

Pseudocythere caudata Sars, Bold, 1946, p. 115.

Not *Pseudocythere caudata* Sars, 1866, p. 88.

Pseudocythere sp. Bold, 1968, (part) p. 77, not pl. 6, fig. 1.

Dimensions. — L: 0.62 mm; H: 0.33 mm.

Remarks. — This species differs from *Pseudocythere caudata* by its marked anterior cardinal angle and weakly sinuate dorsal margin. The anterior end is more obliquely rounded.

Distribution. — "Thomonde" Formation, St. Marc.

Family **PARADOXOSTOMATIDAE** Brady and Norman, 1889

Genus **PELLUCISTOMA** Coryell and Fields, 1937

Pellucistoma sp. aff. *P. magniventra* Edwards

Pl. 3, fig. 15

Dimensions. — L: 0.47 mm; H: 0.25 mm.

Remarks. — Some small specimens that may represent a variant of *Pellucistoma magniventra* Edwards (1944, p. 528, pl. 88, figs. 33-35) occur in the upper Thomonde Formation and the Las Cahobas Formation. They are somewhat blunter anteriorly and in this respect resemble *Pellucistoma spurium* (Bold, 1963, p. 404, pl. 10, fig. 7), but are less elongate and smaller.

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APPENDIX

SAMPLE LOCATIONS AND LITHOLOGIC DESCRIPTIONS

In this summary description of localities and lithologies of samples from Central Haiti all reported data are from the (unpublished) paleontological reports of the Atlantic Refining Company. The only new additions are the numbers of the "N" zones (see Table 1 for correlation with this established planktic foraminiferal zonation) and, for samples that could not be related to the sections covered in Tables 2-15, a list of ostracode species found in the sample. Rivière and Ravine are abbreviated Riv. and Rav., respectively.

SECTION A: RIV. AGOADIOME, RIV. ARTIBONITE AND TRIBUTARIES
IN THE NORTHEAST CORNER OF THE PLATEAU CENTRAL
(Text-figs. 5 and 6)

- K 25 — Riv. Samana, 200 m downstream from Bassin Zim; gray, calcareous sandstone: Las Cahobas Formation.
- K 26 — 800 m downstream from K 25, about 10 km N of Hinche; tan, calcareous shale: Las Cahobas Formation.
- K 28 — 1000 m downstream from K 26; gray, fine sandy, calcareous mudstone: Las Cahobas Formation.
- K 31, 32,
33 — NE of Los Palos; no lithology: Upper "Arc" Formation ["N" zone 6].
- K 34 — "Mouth of Canyon of Riv. Agoiadiome; massive limestone". This description is surprising in view of the fact, that on the map the location is at least 1200 m W of the river; also the lithology appears doubtful from the wash-residue.
- K 37 — Riv. Artibonite, 2000 m below Bánica; gray, calcareous clay.
- K 877 — Near head of Rav. Atelcut, SE of Thomassique; tan, finely sandy, calcareous clay: Las Cahobas Formation.
- K 879 — Rav. Atelcut; gray, finely sandy, calcareous clay with *Turritella*: Las Cahobas Formation.
- K 882 — Rav. Dondieuque [Text-fig. 5]; gray, finely sandy, calcareous clay or marl, associated with lignitic clay; numerous mollusks (*Ostrea*, *Scapharca*, *Turritella*, *Architectonia*, *Natica*, *Phos*, etc.): Las Cahobas Formation.
- K 883 — Rav. Dondieuque, stratigraphically below K 882; gray, fine-grained, calcareous sandstone with *Amphistegina* and abundant mollusks: Las Cahobas Formation.
- K 884 — Rav. Dondieuque, stratigraphically about 500 m below K 883; gray, fine-grained, calcareous sandstone, associated with pebbly, calcareous shale or argillaceous marl with carbonaceous material: Las Cahobas Formation.
- K 885 — Rav. Dondieuque; gray-tan, finely sandy, calcareous shale or argillaceous marl with shell-fragments: Las Cahobas Formation.
- K 886 — Rav. Dondieuque; gray, very fine, calcareous sandstone with small mollusks and *Amphistegina*: Las Cahobas Formation.

- KR 2095 — About 2300 m NE of Gendarme station at Los Palos (same loc. as K 3); tan, finely sandy marl: Upper "Arc" Formation ["N" zone 6].
- KR 2097 — About 300 m N of KR 2095, on N flank of prominent ridge; tan, finely sandy, calcareous clay-shale.
- KR 2098 — About 650 m NE of KR 2097, no lithology.
- KR 2100 — 2000 m NE of KR 2097, in flank of ravine; tan marl: Lower "Arc" Formation.
- KR 2101 — same loc. as KR 2100, but just below; grayish tan marl: Lower "Arc" Formation.
- KR 2103 — same loc. but 5 m below KR 2101; gray marl: Lower "Arc" Formation.
- KR 2105 — Riv. Agoiadiome, 150 m downstream from highest outcrop of Bassin Zim limestone; *Heterostegina-Lepidocyclina* limestone: Basal "Arc" Formation.
- KR 2106 — About 40 m downstream from KR 2105; grayish tan marl: Lower "Arc" Formation.
- KR 2107 — 100 m SE of KR 2106; dark gray fossiliferous marl: Lower "Arc" Formation.
- KR 2109 — About 200 m downstream from KR 2107; tan, calcareous sandstone with *Amphistegina*, *Archaias* and *Sorites*, interbedded with conglomerate: Lower to Middle "Arc" Formation.
- KR 2111 — Same loc. at KR 2109; gray marl: Lower to Middle "Arc" Formation.
- KR 2113 — Northern (upstream) end of Agoiadiome canyon; gray marl with shell debris: Upper "Arc" Formation.
- KR 2114 — 150 m downstream from KR 2113; light gray marl with small coral patches: Upper "Arc" Formation.
- KR 2116 — 300 m S of KR 2114; tan marl.
- KR 2123 — Riv. Agoiadiome, 550 m N of crossing of Thomassique-Hinche road; finely sandy, bluish-gray marl with *Orthaulax*, below 6 feet of conglomerate: Las Cahobas Formation.
- KR 2125 — In curve of road, just west of Agoiadiome crossing of Thomassique-Hinche road; tan, finely sandy marl with mollusks: Las Cahobas Formation.

SECTION P: RIV. BOUYAHA, SW OF PIGNON

- R 1262 — see R 1389
- R 1352 — Riv. Gouape, about 200 m upstream from its confluence with Riv. Bouyaha; greenish gray, very finely sandy, calcareous shale with shell fragments: Mapped as Las Cahobas. *Globigerinoides sicanus* present ["N" zone 8].
- R 1353 — Riv. Gouape, 700 m upstream from R 1352: grayish tan, calcareous clay.
- R 1355 — At sharp bend in Riv. Gouape, 3 km downstream from crossing of main Hwy. E of Pignon.; light greenish gray, very finely sandy, calcareous shale with shell fragments: Las Cahobas Formation.
- R 1356 — 500 m downstream from crossing of Hwy. with Riv. Gouape; lithology as at R 1355: Las Cahobas Formation.
- R 1375 — Riv. Bouyaha; tan, very finely sandy marl with *Turritella*. Madame Joie Formation?
- R 1377 — Riv. Bouyaha, 2 km downstream from R 1375; tan, very finely sandy, calcareous clay or marl. Madame Joie equivalent. ["N" zones 6-8].
- R 1378 — 800 m downstream from R 1377; tan marl.

- R 1379 — Riv. Bouyaha, 1800 m in straight line from R 1378 in E loop of river; grayish tan, calcareous shale to finely sandy marl.
- R 1382 — At the end of a long straight stretch in a sharp bend of Riv. Bouyaha; compact, light tan, argillaceous marl. ["N" zone 8?].
- R 1383 — In crooked bend of Riv. Bouyaha, 400 m in straight line from R 1382: high in "Arc" Formation. ["N" zone 8?].
- R 1384 — Riv. Bouyaha, 300 m downstream from R 1383; greenish gray, moderately coarse, calcareous sandstone with shell fragments: "Arc" Formation.
- R 1386 — In crooked bend of Riv. Bouyaha, 400 m downstream from R 1384; light gray-tan, finely sandy calcareous shale with shell fragments: "Arc" Formation ["N" zone 8].
- R 1388 — 1100 m downstream from R 1386; bluish-gray marl with abundant shell fragments; "Arc" Formation ["N" zone 8?].
- R 1389 — In small bend of Riv. Bouyaha; R 1262 is 100 m W (upstream) on north side of same bend; tan, very finely sandy calcareous shale: Lower Madame Joie Formation ["N" zone 8?].
- R 1392 — On trail, crossing a small ravine, 700 m from R 1389; grayish tan, very finely sandy marl: Lower Madame Joie Formation ["N" zones 6-8].
- R 1393 — Same ravine, 300 m W of R 1392; tan, finely sandy, calcareous shale ["N" zones 6-8].
- R 1397 — Same ravine; same lithology, 1 km upstream: "Arc" Formation.
- R 1403 — North tributary of Rav. Sable; grayish tan marl with *Heterostegina* and *Miogypsina* ["N" zones 5-6].
- R 1404 — Riv. Guaguata (W tributary of Riv. Bouyaha), 150 m W of R 1493: ?Lower Madame Joie Formation.
- R 1405 — Riv. Guaguata, 1 km WNW of R 1404; grayish tan marl: ?Lower Madame Joie Formation.
- M 1065 — Riv. Guaguata, no description. ?Lower Madame Joie Formation ["N" zones 5-6]. *Costa cubana*.
- M 1066 — no location or description: *Costa cubana*, *Cyprideis pascagoulaensis*, *Cytherella* sp.
- M 1116 — No location or description: *Cytherella* sp., *Argilloecia* sp., *Krithe lambi*, *Trachyleberidea mammidentata*, *Ambocythere subreticulata*, *Loxococoncha antillea*, *Cytherura* sp. ["N" zone 8].

SECTION M: RIV. JOBELLE, S OF ST. MICHEL DE L'ATALAYE

- R 1436 — Riv. Jobelle, 7 km SW of St. Michel, greenish gray marl.
- R 1438 — Riv. Jobelle, 500 m NW of R 1436; tan marl: Lower Madame Joie Formation ["N" zones 6-8].
- R 1439 — Riv. Jobelle, 900 m NW of of R 1438; grayish tan marl. ["N" zone 5?].
- R 1440 — Riv. Jobelle, 600 m WNW of R 14439; grayish tan marl. ["N" zones 4-5].
- R 1441 — 1300 m WNW upstream from R 1440; compact grayish tan marl; Lower Madame Joie Formation.
- R 1443 — 350 m NNW upstream from R 1441, grayish tan calcareous shale, underlying tan, clastic limestone (Plaissance? Formation): Eocene.
- R 1445 — Rav. Corosse, 300 m S 70°E of R 1436; grayish tan, very finely sandy, calcareous shale: Middle Thomonde Formation.
- R 1446 — Rav. Corosse, 580 m SSW of R 1445, gray marl; Lower Thomonde Formation.
- R 1447 — Rav. Corosse, 500 m SSW of R 1446; grayish tan marl and sandy shale: Lower Thomonde Formation ["N" zone 9].

- R 1448 —Rav. Corosse, 1330 m S of R 1447, bluish gray marl: Upper Madame Joie Formation. ["N" zones 6-8].
- R 1449 —Rav. Corosse, 760 m W of R 1448; grayish tan marl: Lower Madame Joie Formation. ["N" zone 5].
- R 1455 —Eremitte-Gonaive trail; tan marl: Lower Madame Joie Formation.
- R 1458 —Riv. Jobelle, 450 m NE of R 1455, near upper end of Bassin Citadel; bluish gray clay-shale with Mollusk fragments: *Arca*, *Chione*, *Turritella*, etc.: Lower Las Cahobas Formation.
- R 1469 —100 m W of St. Michel-La Citadelle trail, about 7 km SSW of St. Michel; light grayish tan marl; Lower Madame Joie Formation.

RIV. BLANCHE (TYPE SECTION OF THE MAISSADE BEDS)

AND [ITS TRIBUTARY] RAV. BOUCASAUCIT

(BETWEEN RIV. JOBELLE AND RIV. FOND GRAS)

(not on available maps [just beyond NW corner of Text-fig. 7])

- M 1120 —Gray, calcareous shale, near top of Las Cahobas Formation. *Cyprideis pascagoulaensis*, *Perissoocytheridea cahobensis*, Characea.
- M 1126 —Tan marl, just above the middle of the Las Cahobas Formation. *Cyprideis pascagoulaensis*.
- M 1127 —*Cyprideis pascagoulaensis*, *Perissoocytheridea cahobensis*.
- M 1129 —*Cyprideis maissadensis*, *Perissoocytheridea* sp. aff. *P. matsoni*, *Aurila* sp. aff. *A. cicatricosa*, *Loxoconcha* sp. B, *Xestoleberis* sp.
- M 1132 —light gray, calcareous shale: middle Thomonde. *Cytherella* sp. aff., *C. vulgata*, *Argilloecia* sp., *Krithe lambi*, *Costa cubana?* (molt).
- M 1133 —Just below 1132, same lithology. *Cytherella* sp. aff. *C. vulgata*.
- M 1136 —same lithology, base of Thomonde Formation. *Cytherella* sp., *Bairdia cassida*, *Costa cubana*.
- M 1138 —same lithology: top of Madame Joie Formation. *Cytherella* sp. aff. *C. vulgata*, *Bairdia cassida*, *Costa cubana*.
- R 1501 —Rav. Boucasauvit, west tributary to Riv. Blanche; tan shale: Upper Thomonde Formation. *Aurila* sp. aff. *A. cicatricosa*.
- R 1502 —500 m downstream from R 1501; tan calcareous shale with shell fragments: Lower Las Cahobas Formation. *Cytherella* sp. aff. *C. pulchra*, *Cytherelloidea* sp., *Hemicyprideis cubensis chicoyensis*, *Cyprideis maissadensis* [This is the most westerly occurrence of *Cyprideis maissadensis*.]

SOUTH SIDE OF THE PLATEAU CENTRAL

(see Text-fig. 7)

Section B: Riv. Fond Bleu and Riv. Fond Gras

- R 1073 —Riv. Canot at Maïssade-St. Michel road crossing; greenish gray, slightly calcareous shale: Las Cahobas Formation.
- R 1075 —Riv. Canot, 300 m downstream from mouth of Riv. Jopuerc; greenish gray shale: Las Cahobas Formation.
- R 1078 —Riv. Fond Bleu at crossing by Maïssade-Madame Joie trail; gray, very finely sandy marl with shell fragments: Las Cahobas Formation.
- R 1080 —Riv. Fond Bleu, 350 m downstream from R 1708, gray marl with mollusks, above lignite bed: Las Cahobas Formation.
- R 1083 —Riv. Fond Bleu, 8 ft above lignite seam; greenish tan, sandy marl with mollusk casts: Las Cahobas Formation.

- R 1085 —Riv. Fond Bleu, 700 m downstream from R 1083, gray, finely sandy marl with abundant shell fragments, below thin lignite seam with *Arca* bed: Las Cahobas Formation (presence of Characea).
- R 1086 —200 m downstream from R 1085, clayey marl with shell fragments and lignite: Las Cahobas Formation.
- R 1087 —Same loc. as R 1086, 5 ft. lower; gray, very finely sandy, calcareous clay with abundant mollusk fragments: Las Cahobas Formation.
- R 1090 —800 m downstream from R 1086, gray, finely sandy, marly shale: Las Cahobas Formation.
- R 1091 —400 m downstream from R 1090, gray, finely sandy, marly shale: Las Cahobas Formation.
- R 1096 —Riv. Fond Bleu, 400 m below junction with Riv. Fond Gras; gray, very finely, sandy marl or calcareous shale with mollusk fragments: Las Cahobas Formation.
- R 1097 —150 m downstream from R 1096; greenish gray, very finely sandy, calcareous shale with abundant mollusk debris: Las Cahobas Formation.
- R 1100 —Riv. Fond Bleu, gray, very finely sandy, calcareous shale with shell fragments: Las Cahobas Formation.
- R 1103 —Riv. Fond Bleu, 10 ft. above lignite seam; blue-gray marl with abundant mollusk fragments: Las Cahobas Formation.
- R 1105 —Riv. Fond Bleu, just below oyster bed in clay matrix; blue-gray marly clay with abundant shell debris: Las Cahobas Formation.
- R 1113 —Riv. Jopuerc, 320 m above confluence with Riv. Canot; gray, calcareous clay with abundant shell fragments: Las Cahobas Formation.
- R 1114 —same loc. as R 1113; gray, calcareous clay with small mollusks: Las Cahobas Formation.
- R 1116 —Riv. Jopuerc, 650 m upstream from R 1113; gray, calcareous shale with small mollusks: Las Cahobas Formation.
- R 1172 —Rav. Waneg [*sic.*], 1 km upstream from confluence with Riv. Jopuerc, green, calcareous clay with oysters: Las Cahobas Formation. *Cyprideis maissadensis*.
- R 1179 —Rav. Maringouin, 4 km upstream from confluence with Riv. Canot; gray, calcareous shale with shell fragments and carbonaceous matter: Las Cahobas Formation. *Cyprideis pascagoulaensis*, *C. maissadensis*, *Perissocytheridea matsoni*.
- R 1183 —Riv. Canot, near confluence with Riv. Cabute, 2 km W of Billiguy; greenish gray, calcareous shale: Las Cahobas Formation. *Cyprideis pascagoulaensis*, *C. maissadensis*.
- R 1184 —Riv. Canot, 1800 m downstream from R 1183; mottled clay-shale: Las Cahobas Formation.
- R 1185 —Riv. Canot, 1 km downstream from R 1185; compact, blue-gray, calcareous shale: Las Cahobas Formation.
- R 1186 —Riv. Canot, downstream from R 1185; same lithology: Las Cahobas Formation.
- R 1188 —Riv. Canot, 2 km downstream from R 1186; dark gray, sandy shale with abundant shell fragments and lignite: Las Cahobas Formation (Maissade).
- R 1190 —200 m downstream from R 1188; compact, blue-gray, calcareous shale and coquina: Las Cahobas Formation.
- R 1191 —Riv. Canot, 2 km upstream from crossing of Maïssade-St. Michel road; gray, finegrained, calcareous shale with shell fragments: Las Cahobas Formation.
- R 1196 —On trail along ridge, 2200 m in straight line NW of confluence of Riv. Fond Bleu and Riv. Fond Gras; tan, calcareous clay with oysters: Las Cahobas Formation.

- R 1199 — Riv. La Pied, about 2800 m above confluence with Riv. Fond Gras; light gray, argillaceous marl with shell fragments: Las Cahobas Formation (Maïssade).
- R 1204 — Rav. Sable, 1200 m upstream from R 1197; no lithology: Las Cahobas Formation.
- R 1208 — Riv. Fond Gras, 600 m above confluence with Riv. Fond Bleu; clay-shale with mollusk-bed: Las Cahobas Formation (Maïssade).
- R 1209 — Riv. Fond Gras, 1 km upstream from R 1209; gray, finely sandy, calcareous shale: Las Cahobas Formation (Maïssade).
- R 1210 — 1 km upstream from R 1209; light gray marl with abundant mollusks: Las Cahobas Formation.
- R 1211 — 350 m upstream from R 1210; bluish gray, argillaceous marl with mollusk debris: Las Cahobas Formation (Maïssade).
- R 1212 — 200 m upstream from R 1211; bluish gray, argillaceous marl with mollusk debris: Las Cahobas Formation (Maïssade).
- R 1213 — Riv. Fond Gras, 500 m in straight line due W of R 1212; gray, calcareous shale with mollusk debris and lignite: Las Cahobas Formation (base of Maïssade).
- R 1214 — Riv. Fond Gras, 350 m upstream from R 1213; calcareous sandstone with shell fragments in conglomerate: Basal Las Cahobas Formation.
- R 1216 — 425 m upstream from R 1214; compact gray marl: Las Cahobas Formation ["N" zone 15].
- R 1217 — 200 m upstream from R 1216; compact gray, argillaceous marl: Uppermost Thomonde Formation ["N" zone 14].
- R 1218 — 100 m upstream from R 1217; compact gray, argillaceous marl with shell fragments: Middle Thomonde Formation.
- R 1219 — 75 m upstream from R 1218, stratigraphically about 60 m below R 1217; compact, gray, argillaceous marl with shell fragments: Lower Thomonde Formation ["N" zone 14].
- R 1225 — 250 m upstream from R 1224; compact, gray marl with shell fragments: Lower Thomonde Formation ["N" zone 13].
- R 1227 — 150 m upstream from R 1225; compact, gray marl: Lower Thomonde Formation ["N" zone 12].
- R 1228 — 100 m upstream from R 1227; compact, gray, argillaceous marl: Lower Thomonde Formation.
- R 1232 — 350 m upstream from R 1228; compact, gray, calcareous shale: Lower Thomonde - Upper Madame Joie Formation ["N" zone 10].
- R 1234 — 200 m upstream from R 1232; compact, gray, argillaceous marl: Upper Madame Joie Formation ["N" zone 10].
- R 1249 — Riv. Baye, about 2 km upstream from confluence with Riv. Canot; light grayish tan, marly limestone. *Hemicyprideis cubensis chicoyensis*, *Loxoconcha antillea*.
- R 1255 — Riv. Baye, 200 m upstream from R 1254; gray, calcareous shale: Lower Madame Joie Formation. ["N" zone 8]. *Cytherella* sp., *Bairdia* sp., *Trachyleberidea mammidentata*.
- R 1256 — Riv. Baye, 2 km upstream from R 1255; compact gray marl: Lower Madame Joie Formation ["N" zone 8]. *Bairdia cassida*, *Henryhowella* ex gr *asperima*.
- R 1279 — Rio Frio; no lithology. ["N" zone 9]. *Cytheropteron* sp.
- R 1280 — Branch of Savana Grande, about N80°W in straight line from where this tributary of Rav. Paradis crosses the trail from Madame Joie to the lower Rio Frio, or about 1 km N80°W from R 1249; compact, light grayish tan, calcareous shale. *Loxoconcha* sp. B.
- R 1283 — near head of small tributary of Riv. Fond Bleu; compact, grayish-tan, calcareous shale: Lower Las Cahobas Formation.

- R 1290 —Rav. Roc Blanc, 500 m upstream from junction with Rav. Blanco, east tributary of Riv. Fond Bleu, E of Madame Joie: Thomonde Formation ["N" zone 13].
- R 1291 —On trail from Maïssade to Bois Rouge, near head of Rav. Roc Blanc; tan, very finely sandy, calcareous shale: Madame Joie Formation ["N" zone 9].
- R 1292 —Rav. Madrecita, 100 m above junction with Rio Frío; gray, calcareous shale: Upper Madame Joie Formation ["N" zone 10].
- R 1297 —Rav. Bangain, W tributary of Río Frío, about 3 km above confluence; blue-gray, calcareous shale: Upper Thomonde or basal Las Cahobas Formation ["N" zone 14].
- R 1298 —Rav. Bangain, about 1200 m from junction with Río Frío; tan, calcareous shale: ?Middle Thomonde Formation ["N" zone 13?].
- R 1498 —Rav. Bangain, 300 m downstream from R 1298, 2½ km SW of Maïssade, just S of the axis of the Fond Bleu Fold; compact, grayish tan marl: Lower Thomonde Formation ["N" zone 11].
- R 1499 —Rav. Bangain, 300 m downstream from R 1498; grayish marl: Lower Thomonde Formation.
- KR 2056 —First ridge S of Madame Joie village, W. of Riv. Fond Bleu; light tan marl: Lower Madame Joie Formation ["N" zone 8].
- KR 2072 —Riv. Fond Bleu; marly limestone: Lower? Madame Joie Formation ["N" zone 8?].
- KR 2077 —Riv. Fond Bleu, 200 m upstream from Madame Joie - Río Frío trail; grayish tan marl: Lower Madame Joie Formation ["N" zone 8?].
- KR 2079 —200 ft. upstream from R 2078; gray calcareous shale.
- KR 2081 —Riv. Fond Bleu at Madame Joie - Río Frío trail; gray marl ["N" zone 11].
- KR 2086 —Riv. Fond Bleu; greenish gray, marly shale.
- KR 2087 —Riv. Fond Bleu; light gray marl.
- KR 2088 —Riv. Fond Bleu; light grayish tan, calcareous shale.
- KR 2089 —Riv. Fond Bleu; gray, calcareous shale ["N" zone 14].
- KR 2092 —Riv. Fond Bleu, 100 m upstream from Madame Joie - Maïssade trail; gray, very finely sandy, calcareous shale with mollusk fragments ["N" zone 15].
- M 1082 —Riv. Fond Bleu. No lithology. *Cyprideis maïssadensis*.
- M 1083 —Riv. Fond Bleu. No lithology. *Cyprideis maïssadensis*.
- M 1084 —Riv. Fond Bleu. No lithology. *Cyprideis* sp.
- M 1089 —Riv. Fond Bleu. No lithology. *Cytherella* sp., *Krithe lambi*, *Munseyella* sp. aff. *M. subminuta*, *Argilloecia* sp. ["N" zone 18?].
- M 1077 —no description or lithology. *Cyprideis pascagoulaensis*, *Perissocytheridea* sp. aff. *P. matsoni*, *Loxoconcha* sp., *Hemicytherura* sp.
- M 1101 —Río Frío.
- M 1105 —Río Frío ["N" zone 12].
- M 1107 —Río Frío ["N" zone 11].
- M 1109 —Río Frío.
- A 855 —Riv. Fond Bleu, tan calcareous shale: Lower? Madame Joie Formation. *Cytherella* sp., *Argilloecia* sp., *Cardobairdia glabra*.
- A 859 —Riv. Fond Bleu; grayish tan, calcareous shale: Lower Madame Joie Formation ["N" zone 8]. *Bairdia* sp., *Parakrithe vermunti*, *Loxoconcha antillea*.

Section F': Riv. Abriots (Abuillot)
(Table 7)

On maps and in reports the Atlantic Refining Company geolo-

gists have referred to this river as R. Abouillot. In this paper Butterlin's spelling has been followed.

- K 498 — Riv. Abouillot, 9 m above first conglomerate bed in basal Las Cahobas; gray, very finely sandy, calcareous shale with abundant mollusk fragments.
- K 499 — 13 m above K 498; gray, calcareous shale with abundant mollusk fragments.
- K 500 — 8 m higher, same lithology.
- K 501 — 15 m higher, same lithology.
- K 502-506 — same lithology: Las Cahobas Formation.
- K 509 — first bend in river-channel below lower falls; gray massive, argillaceous marl with mollusk fragments: Las Cahobas Formation.
- K 510 — 300 m below lower falls; dark gray, argillaceous marl with abundant mollusk fragments and pieces of lignite: Las Cahobas Formation (Maïssade).
- K 723 — just below lower falls, no lithology: Las Cahobas Formation.
- KR 2005 — At first waterfall above trail; gray marl ["N" zone 13].
- KR 2006 — First bend below middle falls; gray marl ["N" zone 14].
- KR 2007 — Second bend below middle falls; no lithology.
- KR 2008 — Bend above trail to highway; gray marl: Upper Thomonde Formation.
- KR 2009 — First bend above trail to highway; massive, gray, calcareous shale: Upper Thomonde Formation.
- KR 2010 — same locality as KR 2009; massive, gray, slightly sandy, calcareous shale with shell fragments ["N" zone 15].
- KR 2014 — massive, gray, calcareous shale with shell fragments.
- KR 2015 — first conglomerate bed of Las Cahobas; calcareous shale matrix.
- KR 2017 — Below limestone rapids; gray calcareous shale: Lower Madame Joie Formation ["N" zone 5].
- KR 2019 — same lithology (slumped bank).
- KR 2022-2025 — same lithology.
- KR 2032 — same lithology.
- KR 2035 — First outcrop going up-section, halfway between the two upper limestone members of the Madame Joie Formation.
- KR 2037 — Near bottom of massive shale section; gray calcareous shale ["N" zone 10].
- KR 2038-2039 — no lithology ["N" zones 11-12].
- KR 2041 — 60 m upstream from upper shale-falls; gray calcareous shale: Thomonde Formation.
- KR 2042 — At upper falls; gray, calcareous shale with shell fragments: Thomonde Formation ["N" zone 13].
- KR 2044 — 100 m downstream from falls below underground channel; gray shale: Eocene.
- M 1151 — gray, calcareous shale: Middle Thomonde Formation ["N" zone 8?]. *Bairdia cassida*, *Costa cubana*, *Cytheropteron* sp.
- M 1154 — gray, calcareous shale: Madame Joie-Thomonde contact ["N" zone 9?]. *Bairdia cassida*, *Costa cubana*, *Cytheropteron* sp.
- M 1157 — no lithology. *Bairdia cassida*.
- M 1177 — no lithology: Middle Las Cahobas. *Cytherella* sp. aff. *C. pulchra*, *Cyprideis maïssadensis*, *Perissocytheridea cahobensis*.
- A 843 — no lithology: Thomonde Formation ["N" zone 12].

SOME SAMPLES FROM THE FLANK OF THE PLATEAU CENTRAL,
NOT ON ANY AVAILABLE MAPS

- R 1510 —Rav. Guillerme, tributary to Riv. Mandan, 1600 m from confluence in straight line (SW); gray marl with shell fragments: Upper Madame Joie Formation. *Cytherella* sp. aff. *C. vulgata*, *Argilloecia* sp., *Bairdia* sp., *Krithe lambi*, *Ambocythere* sp. aff. *A. elongata* ["N" zone 9?].
- R 1512 —Rav. Guillerme, 175 m downstream from loc. R 1510; bluish gray marl: Lower Thomonde Formation. *Costa cubana*.
- R 1519 —On SW trail, just E of Riv. Blanche; bluish gray marl: Upper Madame Joie Formation ["N" zone 9]. *Cardobairdia glabra*, *Cytherella* sp., *Costa cubana*.
- R 1520 —Rav. Gaspar, 2 km due E in straight line from R 1519; blue-gray, calcareous shale with shell fragments: Middle Thomonde Formation. *Cytherella* sp., *Hemicyprideis cubensis chicoyensis*, *Munseyella* sp., *Puriana rugipunctata gatunensis*, *Loxoconcha* sp.
- R 1524 —Rav. Gaspar, 2300 m ESE of R 1520; bluish gray calcareous clay: Las Cahobas Formation. *Cytherella polita*, *Cyprideis pascagoulaensis*.
- R 1525 —Rav. Gaspar, 850 m ESE of R 1524. *Cyprideis pascagoulaensis*.
- R 1527 —Riv. La Pied, at main fork, about 500 m straight SW of R 1525; bluish gray, compact marl: lower to middle Thomonde Formation. *Cytherella* sp., *Costa cubana*.
- R 1528 —Riv. La Pied, 250 m SW of R 1527; gray marl: lower Thomonde Formation. *Cytherella* sp., *Bairdia cassida*, *Krithe lambi*, *Ambocythere subreticulata*, *Costa cubana*, *Trachyleberidea mammidentata*.
- R 1547 —No location, lithology or formation indicated ["N" zone 9]. *Krithe morkhoveni*.
- R 1548 —No location, lithology or formation indicated ["N" zone 13]. *Krithe trinidadensis*, *Agrenocythere hazelae*.
- R 1549 —No location, lithology or formation indicated ["N" zone 12]. *Bairdia oarion*, *Krithe morkhoveni*, *Agrenocythere hazelae*.
- R 1551 —No location, lithology or formation indicated ["N" zone 12]. *Krithe prolixa*, *Abyssocythere trinidadensis*, *Trachyleberidea mammidentata*, *Procytheris? calhounensis*.
- R 1552 —No location, lithology or formation indicated ["N" zone 12]. *Abyssocypris pykna*, *Argilloecia* sp., *Krithe morkhoveni*, *K. trinidadensis*, *Agrenocythere hazelae*.
- R 1556 —No location, lithology or formation indicated ["N" zone 15?]. *Cytherella* sp., *Ambocythere subreticulata*.
- R 1559 —No location, lithology or formation indicated ["N" zone 15]. *Cytherella* sp., *Bairdia antillea*, *Orionina vaughani*, *Trachyleberis bermudezi crebripustulosa*.
- R 1561 —No location, lithology or formation indicated. *Macrocypris* sp., *Bairdia* sp., *Krithe morkhoveni*, *K. trinidadensis*, *Henryhowella* ex gr. *asperrima*, *Agrenocythere hazelae*.

Section T: Thomonde-Savanette section
(Text-fig. 8)

- K 381 —5 km S of Chamouscadille village; light gray, silty, calcareous clay.
- K 382 —same area, N limb of Chamouscadille fold; light gray, sandy marl with *Sorites*.

- K 383 —same area, axis of Chamouscadille structure; light gray, silty, slightly calcareous clay with *Sorites*: Las Cahobas Formation.
- K 384 —7 km S of Chamouscadille village; light gray, fossiliferous marl.
- K 388 —5 km upstream from Thomonde, S side of Thomonde river; light gray, calcareous shale: Thomonde Formation.
- K 393 —500 m N of backbone ridge of Chamouscadille anticline; light gray, silty, calcareous clay with mollusks, below oyster horizon. *Cyprideis pascagoulaensis*, *Perissocytheridea cahobensis*, *Jugosocythereis vicksburgensis*.
- K 395 —2 km W of Savanette, in small ravine S of Ostica ridge; shale: Thomonde Formation? *Cytherella* sp., *Bairdia willisensis*, *Aurila* sp.
- K 398 —Where Riv. Thomonde south-escarpment leaves the mountains; no lithology. *Aurila* sp., *Loxoconcha* sp.
- K 400 —No description. *Bairdia willisensis*, *Procythereis? calhounensis*, *Aurila galerita*, *Puriana rugipunctata gatunensis*, *Orionina vaughani*, *Quadracythere* sp., *Loxoconcha* sp.
- K 420 —Riv. Thomonde, 400 ft. downstream from Hwy. bridge S of Thomonde; gray marl: Type section of Upper Thomonde Formation.
- K 421 —1500 m downstream from Hwy. bridge; gray, silty, calcareous shale: Transition between Thomonde and Las Cahobas Formations.
- K 432 —Riv. Thomonde, S limb of Thomonde structure; gray, calcareous shale with mollusk fragments.
- K 434 —Riv. Thomonde, S. flank of Thomonde structure; gray, finely sandy marl with shell fragments.
- K 435 —Riv. Thomonde, same area and lithology.
- K 436 —Riv. Thomonde, same area; gray marl with patches of fine sand and shell fragments.
- K 437 —Riv. Thomonde; greenish gray marl with *Melongena* and *Scapharca chiriquirensis websteri*.
- K 440 —Riv. Thomonde; gray, fine-grained, calcareous sandstone with large amount of marly material.
- K 441 —Riv. Thomonde; gray marl or calcareous mudstone with patches of sandy marl with abundant mollusks.
- K 443 —Riv. Thomonde; gray marl with sandy patches with mollusk fragments.
- K 446A —Riv. Thomonde, downstream from Peligre bridge; tan, medium fine, calcareous sandstone. *Cyprideis pascagoulaensis*.
- K 447 —Riv. Thomonde, on Chamouscadille fold; bluish gray marl with abundant mollusks.
- K 450 —Rav. S of Thomonde escarpment, 4 km S of Thomonde; gray marl with abundant mollusk fragments, above conglomerate of basal Las Cahobas Formation.
- K 452 —Riv. Thomonde; gray marl with abundant mollusks.
- K 464 —Riv. Thomonde; gray marl with abundant mollusk fragments.
- K 465 —Riv. Thomonde, 50 ft above K 464; gray marl with mollusks.
- K 472 —Rav. Blanco, NE of Thomonde; massive, gray marl with occasional mollusk fragments.
- K 473 —Rav. Blanco, NE of Thomonde; massive gray marl: Upper Thomonde or basal Las Cahobas Formation.
- K 478 —Riv. Ayaya; gray, very finely sandy marl with patches of coarser sand and abundant shell fragments. *Perissocytheridea cahobensis*.
- K 479 —Riv. Ayaya; gray, very finely sandy marl with branching corals. *Bairdia antillea*, *B. willisensis*, *B. condylus*, *Macrocyprina* sp., *Jugosocythereis vicksburgensis*.
- K 481 —Riv. Ayaya, slightly below K 479; light tan, very finely sandy marl or marly limestone with scattered mollusk-casts. *Cytherella* sp., *Jugosocythereis vicksburgensis*.

- K 482 — Riv. Ayaya; gray, sandy marl with *Amphistegina* and mollusk fragments. *Cyprideis pascagoulaensis*.
- K 485-486 — Small ravine, 4 km W of Thomonde; tan, very finely sandy marl.
- K 489 — On trail crossing N end of small ravine, 3 km W of Thomonde; gray, very finely sandy, calcareous shale: Lower Thomonde Formation.
- K 490 — Same ravine as at K 489, below upper trail; gray, calcareous shale: Lower Thomonde Formation.
- K 492 — Riv. Thomonde, 1 km SE of town; no lithology.
- K 512 — Rav. crossing road to Hinche, 1 km N of Thomonde church; gray, argillaceous marl: Lower Thomonde Formation.
- K 514 — Head of Rav. Guayab, W. of Thomonde; gray marl with mollusk fragments, underlying conglomerate and oyster bed: Upper Madame Joie Formation.
- K 516 — Rav. Guayab, below upper fork; gray marl: Upper Madame Joie Formation.
- K 521 — Thomonde river, 3 km upstream from Thomonde; gray marl: Thomonde Formation.
- K 522 — 0.5 km upstream from Thomonde, at laundry crossing; gray marl. *Cytherella* sp., *Cytheropteron* sp.
- K 523 — Just upstream from laundry crossing, Thomonde. *Costa cubana*.
- K 527 — Riv. Carabal; gray marl.
- K 529 — Riv. Felicianne, 0.5 km below junction with Riv. Carabal; gray, finely sandy marl with *Melongna*, *Chama*, *Cypridea*, *Sorites*, *Elphidium*, *Ammonia* and Miliolids.
- K 532 — Riv. l'Eaudara; greenish gray, marly limestone. *Cytherelloidea* sp., *Bairdia antillea*, *Paranesidea elegantissima*, *Macrocyprina* sp., *Jugosocythereis wicksburgensis*.
- K 534 — Upper tributary of Riv. Ayaya; greenish gray, very fine, calcareous sandstone. *Cytherella* sp., *Acuticythereis elongata*, *Aurila* sp. aff. *A. cicatricosa*, *Jugosocythereis wicksburgensis?*, *Loxoconcha* ex gr. *antillea*, *Puriana rugipunctata gatunensis*.
- K 535 — Head of Riv. Ayaya W branch; greenish gray marl. *Bairdia* sp., *Macrocyprina* sp., *Procythereis? deformis*, *P.? calhounensis*, *Xestoleberis* sp.
- K 536 — W branch of Riv. Ayaya; gray marl with fossils. *Bairdia antillea*, *B. condylus*.
- K 537 — Chamouscadille fold; gray, very finely sandy marl. *Cytherella* sp. *Bairdia* sp.
- K 539 — Head of Rav. Barac, tributary to Riv. Ayaya; gray, very finely sandy, calcareous shale. *Bairdia antillea*, *Procythereis? calhounensis*.
- K 540 — Rav. Barac; gray, fine-grained sandstone with abundant shell fragments. *Bairdia antillea*, *Cyprideis* sp., *Perissocytheridea alata*, *Aurila* sp. aff. *A. cicatricosa*, *Puriana rugipunctata gatunensis*, *Quadracythere sparsa*, *Jugosocythereis wicksburgensis*, *Loxoconcha* sp. B.
- K 542 — Rav. Barac; gray marl with finely sandy streaks and shell fragments. *Cyprideis pascagoulaensis*, *C. locketti*, *Perissocytheridea matsoni*.
- K 559 — Ravine that cuts through basal Las Cahobas escarpment just S of Savanette church; gray marl with mollusk fragments: Thomonde Formation. *Bairdia* sp., *Procythereis? calhounensis*.
- K 564 — Bois Joli trail, 2 km N of divide; white, chalky limestone: Lower Madame Joie Formation. *Bairdia* sp., *Bythocypris* sp., *Cytherella* sp. aff. *C. vulgata*, *Bradleya dictyon*.
- K 565 — Bois Joli trail, 2.5 km N of divide; light gray marl. *Henryhowella* ex gr. *asperrima*, *Bairdia oarion*.

- K 578 — Riv. Thomonde at mouth of gorge, 15 km W of Thomonde; grayish tan, marly limestone with mollusk casts. *Cytherella* sp., *Bairdia willisensis*, *Quadracythere antillea*.
- K 638 — Rav. Mula, tributary of Artibonite river; gray, finely sandy, calcareous shale with shell fragments, underlying red mottled beds and conglomerate: Las Cahobas Formation. *Cytherella* sp., *Procythereis? deformis*.
- K 668 — Rav. NW of Thomonde: gray marl.
- K 675 — Rav. Roches Blanches; tan, very finely calcareous shale: Upper Madame Joie Formation.
- K 686 — Rav. Boucant; gray marl or marly limestone: Thomonde Formation ["N" zone 12]. *Bairdia cassida*, *Ambocythere subreticulata*, *Loxocochca* sp.
- K 689 — Rav. Boucant, 0.5 km from Riv. Thomonde; light, tan, marly shale: Thomonde Formation.
- K 696 — Rav. Guyave (Guave); gray, argillaceous marl: Thomonde Formation.
- K 707 — Rav. Roches Blanches, W of highway; light tan marl with shell fragments: Thomonde Formation. *Costa cubana*.
- K 712 — Rav. on NE drainage of north limb of Thomonde structure; greenish gray marl with abundant shell fragments: high in Las Cahobas Formation. *Cyprideis maissadensis*, *Cyprideis pascagoulaensis*.
- K 715 — Branch of Rav. Roches Blanches; light tan marl: Upper Madame Joie Formation.
- K 717 — Branch of Rav. Roches Blanches; light tan, marly shale: Thomonde Formation?
- KR 2000 — Thomonde River, 2 km downstream from bridge; gray marl: U. Thomonde Formation.
- KR 2001 — 3 km downstream from bridge, gray marl.
- R 1052 — Riv. La Gosin, 2 km upstream from mouth; grayish tan, calcareous shale: Las Cahobas Formation. *Perissocytheridea cahobensis*.
- R 1054 — Riv. Dohaha, N. of Las Cahobas; gray, massive, calcareous shale. *Cyprideis maissadensis*.
- R 1055 — Riv. Dohaha, 0.5 km S of R 1054; gray, sandy, calcareous shale. *Cyprideis pascagoulaensis*, *Perissocytheridea cahobensis*.
- R 1060 — Riv. Felicianne; gray, calcareous shale with shell fragments: Las Cahobas Formation.
- R 1062 — Tributary near head of Riv. La Gosin; gray, sandy shale with shell fragments. *Cyprideis pascagoulaensis*.
- R 1072 — Rav. Jarvis, about 3 km from mouth; gray, finely sandy marl with shell fragments. *Cytherella* sp., *Cyprideis maissadensis*, *Perissocytheridea cahobensis*.

Section G: Riv. Grande, Riv. Las Cahobas
(Text-fig. 9)

- K 888 — Riv. Grande; gray argillaceous marl: Middle Thomonde Formation. *Cytherella* sp.
- K 890 — Riv. Grande; tan, sandy marl with shell debris and branching corals: Middle Thomonde Formation.
- K 891 — Riv. Grande; greenish gray marl with shell fragments: Upper Thomonde Formation - Las Cahobas Formation contact.
- K 894 — Riv. Grande; massive, gray, argillaceous marl with Gastropods: Upper Thomonde Formation.

- K 895 —Riv. Grande; grayish tan, finely sandy, calcareous shale: Las Cahobas (Upper Thomonde) Formation.
- K 896 —Riv. Grande; grayish tan, finely sandy marl with shell debris, interbedded with marl with branching corals: Lower Las Cahobas (Upper Thomonde) Formation.
- K 898 —Riv. Grande; massive, greenish gray, calcareous mudstone with concretionary layer: Las Cahobas (Upper Thomonde) Formation ["N" zone 15].
- K 899 —Riv. Grande; greenish gray, calcareous mudstone with small mollusks: Lower Las Cahobas Formation.
- K 902 —Riv. Grande; compact, gray, calcareous clay: Middle or Upper Las Cahobas Formation.
- K 910 —Riv. Grande; first bend below canyon; compact, gray marl, underlying intermediate limestone member: Upper Madame Joie Formation.
- K 911 —Riv. Grande; gray marl: Upper Madame Joie Formation (Trinchera Formation affinity) ["N" zone 12].
- K 914 —Riv. Grande; gray, finely sandy marl with shell fragments: Lower Thomonde - Upper Trinchera Formation.
- K 917 —Riv. Grande; compact, gray marl with shell fragments: Lower Thomonde Formation.
- K 919 —Riv. Grande; no lithology: Lower Thomonde Formation ["N" zone 13?].
- K 921 —Riv. Las Cahobas, mouth of canyon: Madame Joie Formation ["N" zone 12].
- K 922 —Riv. Las Cahobas; base of Thomonde Formation. *Bairdia cassida*.
- K 924 —Lower Thomonde Formation. *Cytherella* sp.
- M 1181 —Riv. Grande: Las Cahobas Formation.
- M 1182 —Riv. Grande: Las Cahobas Formation.
- M 1184 —Riv. Grande: Thomonde Formation.
- M 1185 —Riv. Grande: Lower Thomonde Formation.
- M 1190 —Riv. Grande: Lower Thomonde Formation.
- M 1196 —Riv. Grande: Madame Joie Formation ["N" zone 9?].

BETWEEN BELLADERE AND MIREBALAIS

Belladère structure

- R 1305 —trail, 300 m S of center of Belladère; bluish gray, calcareous shale with shell fragments (Trinchera or Lower Thomonde Formation), ["N" zone 12]: *Trachyleberidea mammidentata*.
- R 1309 —W limit of village of Belladère in curve of Hwy; tan, very finely sandy, calcareous shale (Upper Thomonde Formation), ["N" zone 13]: *Cytherella* sp., *Hemicyprideis cubensis chicoyensis*, *Cyprideis pascagoulaensis*.
- R 1314 —At group of four houses on trail along Riv. Roche Majeure, about 2 km SSW of Belladère; grayish tan, very calcareous shale or marl (Lower Thomonde Formation), ["N" zones 12-13]: *Quadracythere antillea*.
- R 1317 —Arroyo Carrizal, along border with Dominican Republic; blue-gray, argillaceous marl (Upper Madame Joie Formation), ["N" zones 11-12]: *Cytherella* sp., *Krithe lambi*, *Bairdia cassida*.
- R 1325 —Light tan calcareous shale (Lower Thomonde Formation) ["N" zone ?13]: *Trachyleberis bermudezi crebripustulosa*.
- R 1333 —Base of western Roche Majeure ridge, on car road. Light tan, finely sandy, calcareous shale (Upper Trinchera Formation = Middle Thomonde Formation): *Costa cubana*.

- R 1348 — North flank of Belladère structure, \pm 3 km from bridge of Belladère-Cahobas road over Río Las Guas. Tan, sandy, calcareous shale with shells (Lower Las Cahobas Formation): *Perissocytheridea cahobensis*.

Morne Beguin section

- M 1293 — Light gray marly limestone: *Argilloecia* sp., *Krithe morkhoveni*, *K. reversa*.
 M 1302 — Tan calcareous shale: *Radimella confragosa*, *Costa dohmi*.
 M 1306 — Light tan marl: *Cytherella* sp., *Bairdia* sp., *B. longisetosa*, *Pseudopsammocythere* sp., *Macrocyprina* sp., *Quadracythere producta*, *Radimella confragosa*.
 M 1309 — Light tan marl, near Dufailly anticline: *Propontocypris* sp., *Bairdia antillea*, *Loxoconcha* sp. *Xestoleberis* sp., *Uroleberis torquata*.

Mirebalais section

- M 1235 — Grayish-tan calcareous shale ["N" zone 12]: *Macrocypris* sp., *Henryhowella* ex gr. *asperrima*, *Bairdia cassida*, *B.* sp., *Krithe morkhoveni*, *K. lambi*, *K. proluxa*, *Costa cubana*.
 M 1238 — Tan marl: *Bairdia* sp., *B. cassida*, *Krithe morkhoveni*, *K. trinidadensis*, *K. proluxa*, *Hermanites* sp., *Loxoconcha banesensis*, *Xestoleberis* sp.
 M 1242 — Tan calcareous shale: ["N" zone 15]: *Cytherella* sp., *Argilloecia* sp.
 M 1243 — Tan calcareous shale: *Parakrithe vermunti*, *Agrenocythere hazelae*.
 M 1244 — Tan calcareous shale: just S of Petit Trianon on Terre Rouge-Mirebalais Hwy: *Bairdia oarion*, *Henryhowella* ex gr. *asperrima*, *Trachyleberis bermudezi crebriputulosa*, *Agrenocythere hazelae*.
 M 1251 — Tan marl (?Thomonde Formation): mixed fauna: *Limnocythere* sp., *Cyprideis* sp., *Ambocythere* aff. *elongata*, *Krithe trinidadensis*.
 M 1252 — Tan marl: *Bairdia oarion*, *Hemicyprideis?* sp., *Krithe dolicho-deira?*, *Trachyleberis bermudezi crebriputulosa*.
 M 1275 — marly limestone. *Cytherella* sp., *Bairdia cassida*, *B.* sp., *Krithe trinidadensis*, *Argilloecia* sp., *Loxoconcha* sp. aff. *L. forda*.
 M 1277 — tan marl ["N" zones 7-8]: *Krithe* sp., *Bythocypris* sp.
 M 1280 — tan, calcareous shale. *Cytherella* sp., *Bairdia antillea?*, *Radimella confragosa*.
 M 1285 — light grayish-tan, marly limestone. *Radimella confragosa*, *Loxoconcha* sp.
 M 1291 — tan marl ["N" zone 12]. *Krithe morkhoveni*, *Bradleya* ex gr. *dictyon*, *Trachyleberis bermudezi crebriputulosa?* (immature).

SECTION C: DUFAILY-CAPUCIN STRUCTURE

- K 581 — Rav. through E end of Dufailly anticline: light gray, very finely sandy, calcareous shale with abundant *Amphistegina*: Lower Las Cahobas Formation ["N" zone 15].
 K 583 — Tan marl with mollusks, overlying coral limestone with calcareous algae. Common *Amphistegina*: Las Cahobas Formation.
 K 585 — Trail cutting upper Capucín River, no lithology: Upper Thomonde Formation ["N" zone 6].
 K 586 — Trail W of upper Capucín river; white marly limestone: Middle Thomonde Formation ["N" zone 6?].
 K 588 — Capucín river, N flank of Dufailly anticline; light gray very calcareous shale: Upper Thomonde Formation ["N" zone 15].

- K 592 —Rav. Guillaume; greenish gray marl, underlying conglomerate: Upper? Thomonde Formation ["N" zone 15].
- K 607 —W end of Dufailly anticline; compact, gray marl: Las Cahobas Formation in angular unconformity with Eocene (Sombrerito Formation equivalent?) ["N" zone 12].
- K 642 —Riv. Ti-Fond on N side of Dufailly anticline; gray, calcareous shale and sandy shale: Trinchera? Formation equivalent ["N" zone 18].
- K 644 —Riv. Ti-Fond; gray compact marl: Upper Madame Joie Formation ["N" zone 12].
- K 651 —Rav. in SE part of Dufailly anticline; gray marl: Lower Thomonde Formation or Trinchera Formation equivalent ["N" zone 13?].
- K 654 —Riv. Ti-Fond, 1 km from where it cuts through "rim rock"; compact gray marl: Upper Thomonde Formation or Trinchera Formation equivalent ["N" zone 15?].

SECTION D: RIV. DORMANTE

- K 938 —Riv. Dormante; gray, compact marl: Thomonde? Formation (equivalent of Lower Trinchera Formation, according to Atlantic Refining Co. reports) ["N" zone 14?].
- K 939 —Light tan marl.
- K 940 —In small Rav. E of Riv. Dormante: basal Las Cahobas Formation (Trinchera Formation).
- K 942 —Same ravine; light cream marl: Las Cahobas Formation: *Cytherella* sp., *Bradleya dictyon*.
- K 944 —On trail from Desarmes to La Chapelle, 2 km E of Riv. Dormante; light cream marl: Upper Thomonde Formation (Lower Trinchera Formation). *Bairdia* sp., *Munseyella* sp., *Agrenocythere hazelae*, *Aurila galerita*.
- M 1404 —La Calvaire trail to Couyeau, S. of Dessalines (Hill E of Petite Rivière); tan marl: Thomonde Formation (Trinchera Formation equivalent). *Krithe lambi*, *Cardobairdia glabra*.
- M 1405 —Riv. Estere, 5.5 km by trail of Petite Rivière); greenish gray marl: Madame Joie Formation?. *Krithe trinidadensis*, *Xestoleberis* sp.
- M 1412 —1.9 km W of La Chapelle; white marl: Madame Joie Formation? *Krithe* sp., *Agrenocythere hazelae*.
- M 1413 —Trail S of La Chapelle at 1.7 km; light tan marl: Thomonde Formation? *Krithe proluxa*, *Henryhowella* ex gr. *asperrima*, *Bairdia* sp. ["N" zones 12-13].
- M 1415 —On same trail, 1.5 km from La Chapelle; grayish tan, calcareous shale: Trinchera Formation? *Bairdia oarion*, *Aurila* sp. aff. *A. cicatricosa*, *Costa* sp., *Puriana rugipunctata gatunensis*, *Cytheropteron trinidadensis*. ["N" zone 12].
- M 1416 —Same trail, same lithology: Trinchera Formation? *Krithe proluxa*, *K. morkhoveni*, *Henryhowella* ex gr. *asperrima*. ["N" zone 9?].
- M 1417 —Same trail, same lithology. *Ambocythere subreticulata*, *Caudites nipeensis*, *Henryhowella* ex gr. *asperrima*. ["N" zone 9?].
- M 1418 —Crossing of this trail by the Riv. Dormante: Upper Thomonde Formation? ["N" zone 14?].
- M 1420 —E bank of Riv. Dormante, 150 m upstream from crossing of Désarmes-La Chapelle trail; greenish gray, calcareous shale.
- M 1421 —400 m above this crossing [M 1418].
- M 1422 —600 m above crossing [M 1418] ("N" zone 13).
- M 1423 —At forking of stream, 700 m above crossing [M 1418].
- M 1424 —900 m above crossing [M 1418].

- M 1426 —Just below a local unconformity, on top of siltstone series; gray, calcareous shale: Thomonde Formation ["N" zone 12].
- M 1442 —Grayish tan, calcareous shale: Thomonde Formation ["N" zone 10].
- M 1443,
1444 —Grayish tan, calcareous shale: Thomonde Formation ["N" zone 12].
- M 1445 —Gray, calcareous shale: Thomonde Formation ["N" zone 11].
- M 1446 —Gray, calcareous shale: Thomonde Formation ["N" zone 9].
- M 1448 —Gray, calcareous shale: Madame Joie Formation?

SECTION S: ST. MARC

(Text-figs. 10, 11)

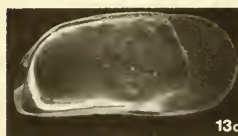
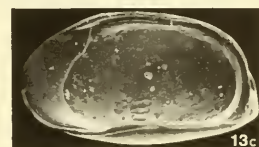
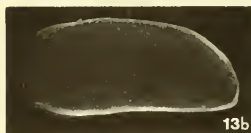
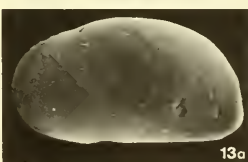
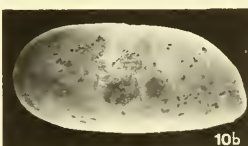
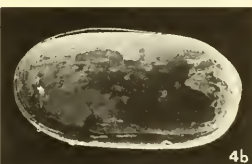
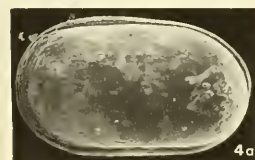
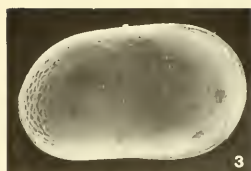
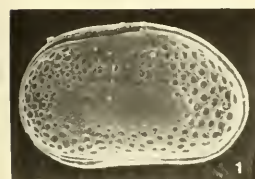
- K 742-744—Rav. l'Hommiere, about 2 km S of Pont Sande, where the railroad and the Artibonite river come close together; white, porous, chalky limestone: Madame Joie Formation? *Krithe* sp., *Bythocypris* sp.
- K 750 —Rav. Grand Fond, about 2 km S of railroad, 1800 m WNW of K 742; white, porous, marly limestone: Las Cahobas Formation or younger. *Bairdia* sp., *Loxoconcha* sp.
- K 761 —In small Rav. E of Hwy, NE of St. Marc; alternating soft sandstone and soft, light tan, calcareous shale.
- K 764 —North Rav. cutting Morne des Guêpes; soft, light tan marl: Las Cahobas Formation.
- K 767 —Rav. le Comte, 100 m W of Hwy in core of Morne des Guêpes; compact, light tan marl: Thomonde Formation.
- K 771 —In small Rav. E of Hwy, Morne des Guêpes; light tan marl.
- K 774 —In cliff near top of Rav. W of same Hwy; light tan coral limestone.
- KP 2130,
2131 —S limb of S St. Marc dome. *Krithe lambi*, *Bairdia* sp., *Costa dohmi*.
- KP 2133, —N limb of S St. Marc dome. *Bairdia* sp., *Argilloccia* sp., *Radimella*
2134 *confragosa*, *Loxoconcha* sp.
- M 1431 —4 km SE of St. Marc on trail to Goavier; weathered white limestone. *Krithe morkhoveni*.
- M 1432 —Rav. Liocand, bridge abutment, 4 km NE of St. Marc.
- M 1433 —Rav. Liocand; 150 m downstream from bridge: High? in Thomonde Formation ["N" zone 15].
- M 1435 —Rav. Liocand; coralline limestone with interbedded marls and tan calcareous shale.
- M 1436 —Rav. Liocand, at Hwy 3 km N of St. Marc; tan calcareous shale.
- M 1438 —Hwy, 2 km NE of St. Marc; tan, calcareous shale.
- M 1439 —Hwy, NE of St. Marc; light tan, calcareous shale.
- M 1440 —Haut de St. Marc, 3 mi S of St. Marc; gray marl.
- M 1441 —Hill, S. of St. Marc; grayish tan marl: Thomonde Formation.
- M 1504 —On Hwy at junction of road to Bois Neuf dam, 14.6 km by road from St. Marc; tan, fine-grained marl.
- M 1505 —8.7 km S of St. Marc along Hwy; tan marl: Upper Middle Thomonde Formation ["N" zone 16].
- M 1507 —Mont Rouvis river syncline, 6 km E of Mont Rouvis; tan marl: Thomonde Formation ["N" zone 16].
- M 1508 —Roadcut, 4 km S of St. Marc; marl below thin calcareous sand with larger foraminifera: Upper Thomonde Formation.
- M 1517B —light cream, fine-grained, calcareous sandstone: Lower Thomonde Formation.

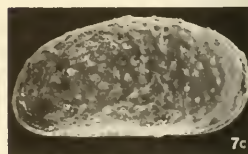
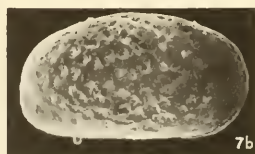
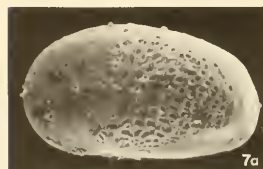
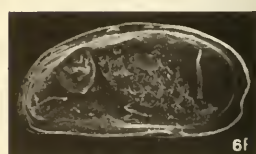
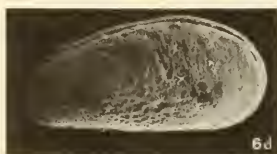
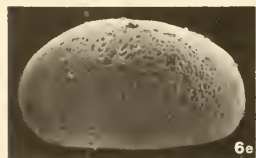
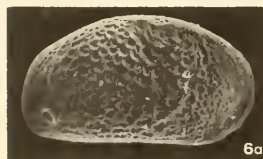
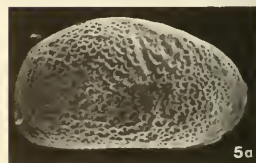
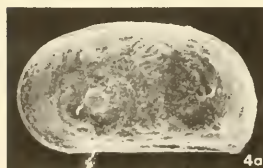
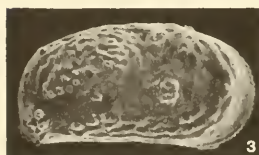
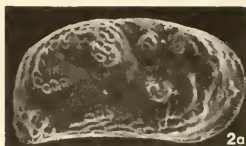
- M 1518 —light gray, calcareous shale: Lower Thomonde Formation ["N" zone 12].
- M 1520 —tan, marly limestone, above first conglomerate bed at the top of the lowermost member (or base of the middle member) of the Thomonde Formation.
- M 1522 —S St. Marc; light cream marl: top of Middle Thomonde Formation.
- P 1525 —Central St. Marc ["N" zone 15]. *Cytherella* sp.
- P 1530 —Central St. Marc ["N" zone 15]. *Krithe dolichodeira*, *Trachyleberidea mammidentata*.
- P 1533 —Central St. Marc ["N" zone 15]. *Trachyleberidea mammidentata*.
- P 1534 —Central St. Marc ["N" zone 15]. *Krithe dolichodeira*.
- P 1535 —Central St. Marc ["N" zone 15]. *Cytherella* sp., *Argilloecia* sp.
- P 1536 —Central St. Marc ["N" zones 16-17]. *Cytherella* sp., *Bairdia* sp., *Krithe dolichodeira*.
- P 1541 —S St. Marc ["N" zones 17-18]. *Bairdia* sp., *Radimella confragosa*, *Costa dohmi*.
- P 1542 —S St. Marc. *Cytherella* sp., *Bairdia* sp., *Hemicyprideis cubensis?*, *Perissocytheridea* sp., *Radimella confragosa*, *Costa dohmi*, *Puriana rugipunctata gatunensis*, *Loxoconcha* sp., *Pellucistoma* sp., *Uroleberis* sp.
- P 1543 —S St. Marc. *Bairdia* sp., *Cushmanidea* sp., *Pterygocythereis* sp.
- P 1544 —S St. Marc. *Bairdia* sp., *Hemicyprideis* sp., *Cushmanidea* sp.
- P 1546 —S St. Marc. *Cytherella* sp., *Cyprideis salebroso*, *Radimella confragosa*, *Costa dohmi*, *Jugosocythereis pannosa*, *Costa* sp., *Paracytheretta dominicana*.
- P 1548 —S St. Marc. *Cytherella* sp., *Bairdia* sp., *Cyprideis* sp., *Costa dohmi*, *Orionina serrulata*, *Radimella confragosa*, *Xestoleberis* sp.
- P 1549 —S St. Marc. *Cytherella* sp., *Costa dohmi*, *Xestoleberis* sp.
- P 1550 —S St. Marc. *Bairdia* sp., *Puriana* sp.
- P 1552-1569 —S limb of Morne des Guèpes, no lithology.

PLATES

EXPLANATION OF PLATE 1

Figure	Page
1. <i>Cytherella</i> sp. aff. <i>C. semitalis</i> Brady	55
HVH No. 9998, from loc. K 529, Las Cahobas Formation (sect. T), left valve view of complete carapace, \times 60.	
2. <i>Cytherella postdenticulata</i> Oertli	55
HVH No. 9999, from loc. M 1420, Thomonde Formation (sect. D), right valve, \times 30.	
3. <i>Cytherella</i> sp. aff. <i>C. vulgata</i> Ruggieri	55
HVH No. 10000, from loc. M 1423, Thomonde Formation (sect. D), right valve, \times 30.	
4. <i>Cytherella</i> sp.	56
HVH No. 10001, from loc. R 1388, "Arc" Formation (sect. P); a, left valve view of female carapace, \times 50; b, left valve view of male carapace, \times 50.	
5. <i>Bythocypris</i> sp.	59
HVH No. 10004, from loc. R 1469, Madame Joie Formation (sect. M), left valve, \times 35.	
6. <i>Bairdia oarion</i> Bold	59
HVH No. 10002, from loc. M 1444, Madame Joie Formation (sect. D), right valve view of complete carapace, \times 20.	
7. <i>Bairdia cassida</i> Bold	59
HVH No. 10003, from loc. R 1460, Madame Joie Formation (sect. D), right valve view of complete carapace, \times 20.	
8. <i>Cushmanidea howei</i> (Bold)	70
HVH No. 10022, from loc. R 1356, Las Cahobas Formation (sect. P), right valve view of complete carapace, \times 40.	
9. <i>Messinella guanajayensis</i> (Bold)	70
HVH No. 10009, from loc. KR 2019, Madame Joie Formation (sect. F'), right valve view of complete carapace, \times 75.	
10. <i>Krithe hiwanneensis</i> Howe and Lea	66
HVH No. 10070, from loc. R 1403, Madame Joie Formation (sect. P); a, left valve, female, \times 45; b, left valve, male, \times 45.	
11. <i>Krithe lambi</i> Bold	67
HVH No. 10071, from St. Marc-1, borehole at 365-390 ft, "Thomonde" Formation (sect. S), left valve, female, \times 50.	
12. <i>Krithe dolichodeira</i> Bold	66
HVH No. 10076, from St. Marc-1, borehole at 365-390 ft, "Thomonde" Formation (sect. S), left valve, female, \times 55.	
13. <i>Krithe reversa</i> Bold	69
HVH No. 10072, from loc. M 1505, "Thomonde" Formation (sect. S); a, left valve, female, \times 40; b, left valve, male, \times 35; c, interior of right valve, female, \times 40; d, interior of left valve, male, \times 35.	



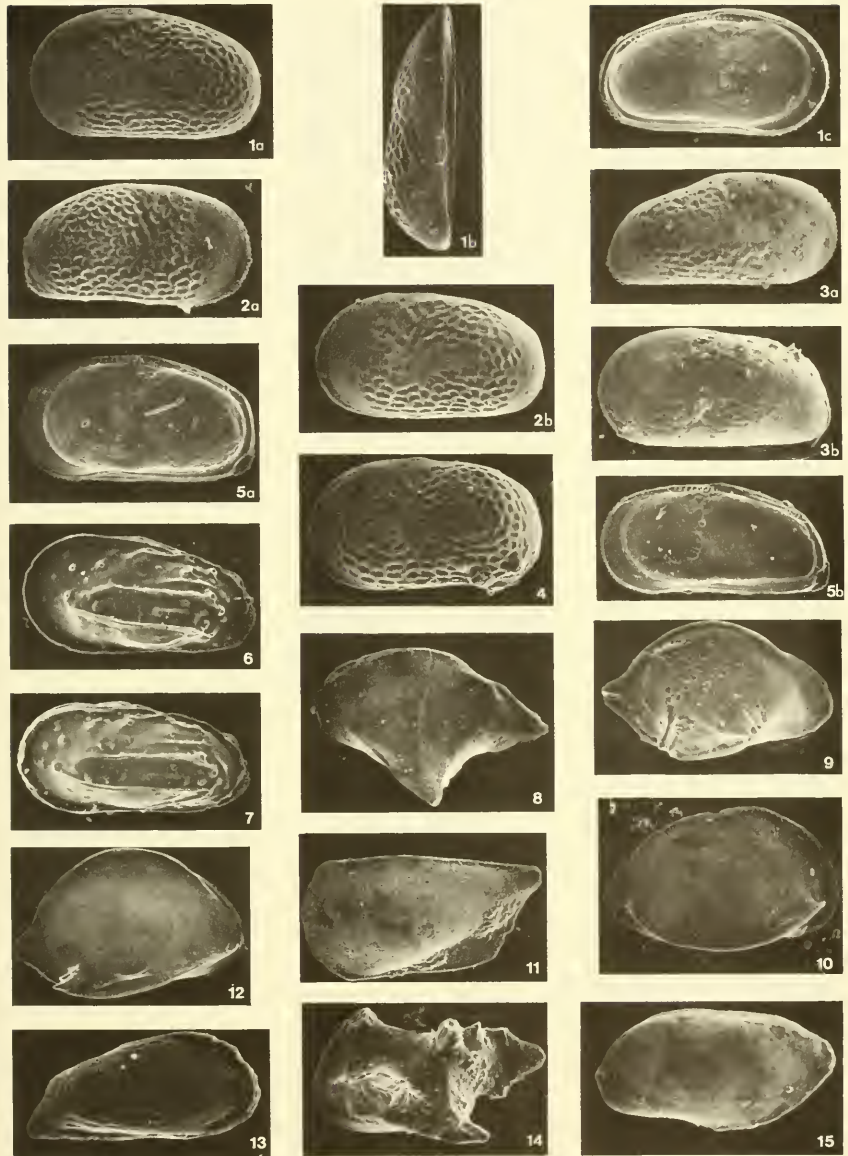


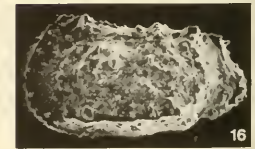
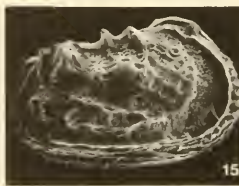
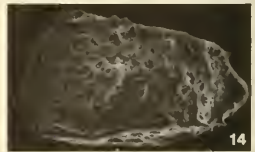
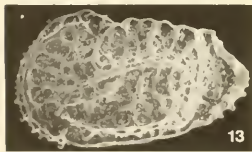
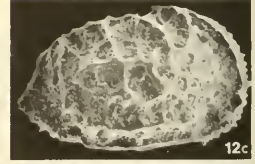
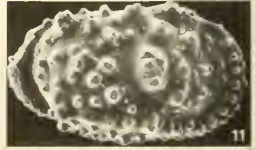
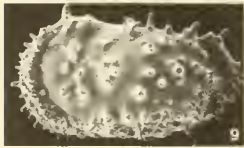
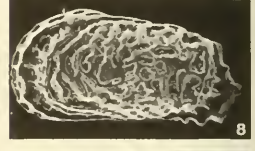
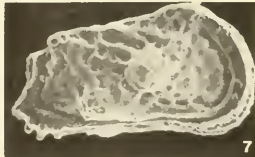
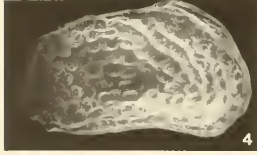
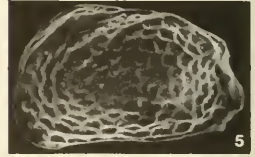
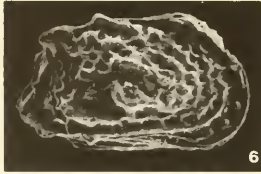
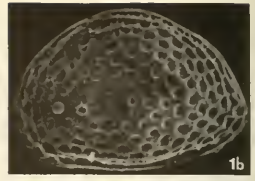
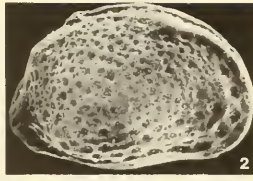
EXPLANATION OF PLATE 2

Figure	Page
1-3. Hemicyprideis agoiadiomensis n. sp.	60
1. HVH No. 10005, Holotype, from loc. K 885, Las Cahobas Formation (sect. A), left valve, female, \times 55.	
2. HVH No. 10006, Paratypes, from loc. K 885, Las Cahobas Formation, (sect. A); a, right valve, female, \times 60; b, left valve, female, \times 55; c, interior of right valve, female, \times 55.	
3. HVH No. 10007, Paratypes, from loc. K 37, Las Cahobas Formation (sect. A), right valve, male, \times 60.	
4. Hemicyprideis cubensis chicoyensis (Bold)	62
HVH No. 10008, from loc. R 1356, Las Cahobas Formation (sect. P); a, left valve view, \times 50; b, dorsal view, \times 50.	
5. Cyprideis salebrosa Bold	62
HVH No. 10014, from loc. K 527, Las Cahobas Formation (sect. T); a, right valve, female, \times 35; b, left valve, male, \times 30.	
6. Cyprideis n. sp.?	64
a-e from loc. P 1563, f from loc. M 1439, "Las Cahobas" Formation (sect. S); a, HVH No. 10052, right valve, female, \times 40; b, HVH No. 10050, dorsal view, female, \times 40; c, HVH No. 10051, dorsal view, male, \times 40; d, HVH No. 10052, right valve view, male carapace, \times 40; e, HVH No. 10052, left valve, female, \times 40; f, HVH No. 10053, interior of left valve, male, \times 40.	
7. Cyprideis pascagoulaensis (Mincher)	62, 63
a, HVH No. 10048, from loc. K 501, Las Cahobas Formation (sect. F'), left valve, female, \times 40; b, HVH No. 10049, from loc. K 450, Las Cahobas Formation (sect. F'), right valve, female, \times 35; c, HVH No. 10049, from loc. K 450, Las Cahobas Formation (sect. F'), right valve, male, \times 35.	

EXPLANATION OF PLATE 3

Figure	Page
1-5. Cyprideis maissadensis n. sp.	62
1. HVH No. 10009, Holotype, from loc. R 1083, Las Cahobas Formation (sect. B, Riv. Fond Bleu); a, left valve, female, $\times 40$; b, dorsal view of same specimen, $\times 50$; c, interior of same left valve, $\times 40$.	
2. HVH No. 10011, Paratypes, from loc. R 1179, Las Cahobas Formation; a, right valve, female, $\times 55$; b, left valve, female, $\times 55$.	
3. HVH No. 10010, Paratypes, from loc. R 1083, Las Cahobas Formation (sect. B, Riv. Fond Bleu); a, right valve, male, $\times 40$; b, left valve, female, $\times 40$.	
4. HVH No. 10012, from loc. K 510, Las Cahobas Formation (sect. F'), left valve, female, $\times 55$.	
5. HVH No. 10013, from loc. R 1213, Las Cahobas Formation (sect. B, Riv. Fond Gras); a, interior of right valve, female, $\times 50$; b, interior of right valve, male, $\times 50$.	
6. Ambocythere subreticulata (Bold)	53
HVH No. 10042, from loc. R 1388, Thomonde Formation (= "Arc" Formation), (sect. P), left valve, $\times 65$.	
7. Ambocythere exilis Bold	53
HVH No. 10041, from loc. K 771, "Thomonde" Formation (sect. S), left valve, $\times 50$.	
8. Cytheropteron sp. aff. C. palton Bold	84
HVH No. 10065, from loc. K 388, Thomonde Formation (sect. T), left valve, $\times 55$.	
9. Cytheropteron sp. aff. C. bichense Bold	84
HVH No. 10064, from loc. K 388, Thomonde Formation (sect. T), right valve, $\times 80$.	
10. Cytheropteron? trinidadensis Bold	85
HVH No. 10063, from loc. M 1443, Madame Joie Formation (sect. D), right valve, $\times 65$.	
11. Pseudocythere sp.	85
HVH No. 10068, from loc. M 1522, "Thomonde" Formation (sect. S), left valve, $\times 55$.	
12. Cytheropteron sp.	85
HVH No. 10062, from loc. M 1441, "Thomonde" Formation (sect. S), right valve, $\times 65$.	
13. Cytheromorpha? sp. aff. C.? caudata Bold	71
HVH No. 10024, from loc. R 1216, Thomonde Formation (sect. B, Riv. Fond Gras), right valve view of complete carapace, $\times 90$.	
14. Paracytheridea sp. cf. P. hispida Bold	84
HVH No. 10066, from loc. K 921, Thomonde Formation (sect. G), left valve, $\times 75$.	
15. Pellucistoma sp. aff. P. magniventis Edwards	85
HVH No. 10067, from loc. K 437, Las Cahobas Formation (sect. T), left valve view of complete carapace, $\times 70$.	



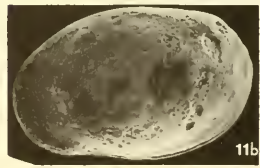
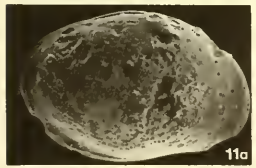
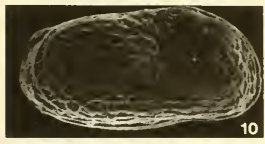
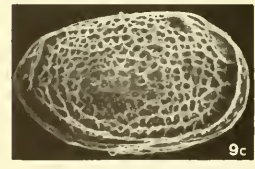
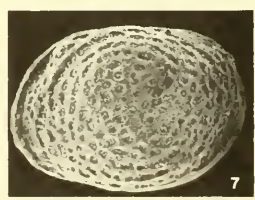
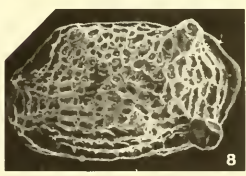
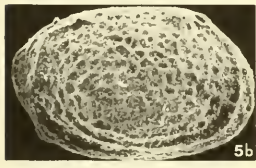
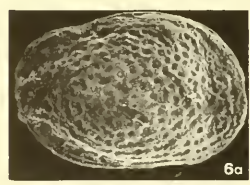
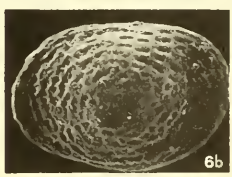
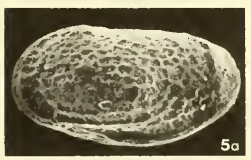
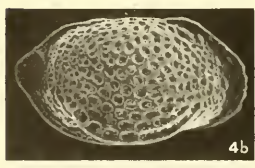
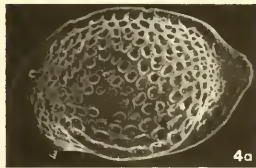
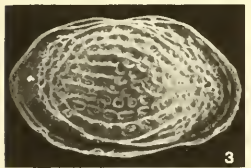
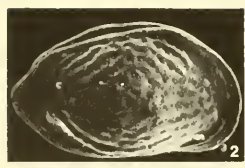
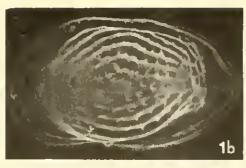
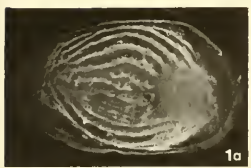


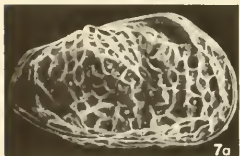
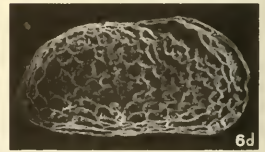
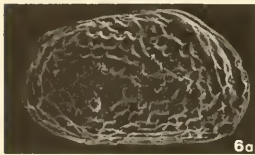
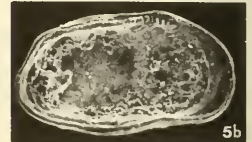
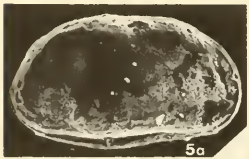
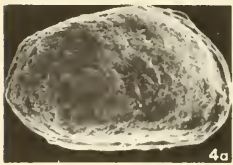
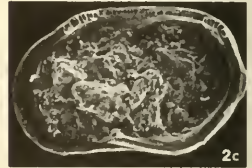
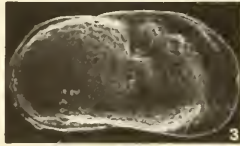
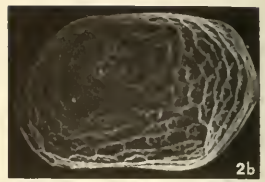
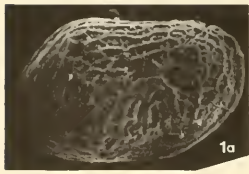
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PREPARATION OF MANUSCRIPTS

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