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Cainozoic larger foraminifers from Dominican Republic

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ABSTRACT

This work describes the Cainozoic larger foraminifers from Dominican Republic and discuses their biostratigraphic application to the construction of a lithostratigraphic framework. We have differentiated the following associations:

a. *Ranikothalia bermudezi* and Neodiscocyclina grimsdalei, which characterizes the Late Paleocene (Thanetian).
b. *Eoconuloides wellsi, Eoconuloides lopeztrigoi* and *Neodiscocyclina barkeri* from the Early Eocene reworked in Middle Eocene strata.
c. *Coleiconus elongatus, Fallotella cookei, Cushmania puilboreauensis, Cushmania americana, Fabiania cassis, Eoconuloides lopeztrigoi, Amphistegina parvula, Discocyclina marginata, Polylepidina antillea* and *Penoperculinoides cubensis*, that characterizes the Middle Eocene
d. *Fallotella cookei, Cushmania americana, Fabiania cassis, Amphistegina parvula, Lepidocyclina (Lepidocyclina) macdonaldi, Lepidocyclina (Nephrolepidina)* cf. *chaperi, Lepidocyclina (Pliolepidina)* cf. *peruviana* and *Nummulites* cf. *willcoxi*, that characterizes the Middle-Late Eocene interval.
e. *Nummulites* cf. panamensis, *Heterostegina* cf. *antillea, Lepidocyclina (Lepidocyclina) mantelli, Lepidocyclina (Lepidocyclina) canellei, Lepidocyclina (Eulepidina) undosa* and *Lepidocyclina (Nephrolepidina) tournoueri*, characteristic from the Oligocene in middle shelf environments.
f. *Archiasinids, Praerhapydionina* cf. *delicata* and *Discorinopsis* sp., characteristic from the Oligocene in shallow carbonate shelves.
g. *Miogypsina* cf. *antillea* and *Miarchaias floridanus* that indicates an Early-Middle Miocene age.
h. *Miarchaias floridanus*, *Miosorites americanus, Annulosorites spiralis* and *Operculinoides* cf. *bullbrooki*, characteristic from the Early-Late Miocene.

Key words: Cainozoic, Dominican Republic, larger foraminifers, systematics.

Macroforaminíferos cenozoicos de la República Dominicana

RESUMEN

Este trabajo describe los macroforaminíferos del Cenozoico de la República Dominicana y estudia su aplicación biostratigráfica en la construcción de un marco litostratigráfico. Se han diferenciado las siguientes asociaciones:

a. Ranikothalia bermudezi *y* Neodiscocyclina grimsdalei*, que caracteriza al Paleoceno Superior (Thanetiense).*
b. Eoconuloides wellsi, Eoconuloides lopeztrigoi *y* Neodiscocyclina barkeri *del Eoceno Inferior, retrabajados en estratos del Eoceno Medio.*
c. Coleiconus elongatus, Fallotella cookei, Cushmania puilboreauensis, Cushmania americana, Fabiania cassis, Eoconuloides lopeztrigoi, Amphistegina parvula, Discocyclina marginata, Polylepidina antillea *y* Penoperculinoides cubensis*, que caracteriza al Eoceno Medio.*
d. Fallotella cookei, Cushmania americana, Fabiania cassis, Amphistegina parvula, Lepidocyclina (Lepidocyclina) macdonaldi, Lepidocyclina (Nephrolepidina) *cf.* chaperi, Lepidocyclina (Pliolepidina) *cf.* peruviana *y* Nummulites *cf.* willcoxi*, que caracteriza al intérvalo Eoceno Medio-Superior.*
e. Nummulites *cf. panamensis,* Heterostegina *cf.* antillea, Lepidocyclina (Lepidocyclina) mantelli, Lepidocyclina (Lepidocyclina) canellei, Lepidocyclina (Eulepidina) undosa *y* Lepidocyclina (Nephrolepidina) tournoueri*, característica del Oligoceno en ambientes de plataforma media.*
f. Archiasinids, Praerhapydionina *cf.* delicata *y* Discorinopsis *sp., característica del Oligoceno en ambientes de plataforma somera.*
g. Miogypsina *cf.* antillea *y* Miarchaias floridanus *que indica una edad Mioceno Inferior-Medio.*
h. Miarchaias floridanus, Miosorites americanus, Annulosorites spiralis *y* Operculinoides *cf.* bullbrooki*, característica del Mioceno Inferior-Superior.*

Palabras clave: Cenozoico, macroforaminíferos, República Dominicana, sistemática.

Introduction

This paper deals with the biostratigraphic characterization of the Cainozoic shelf facies outcropping in the Dominican Republic. Despite their scientific and economic interest there are only scarce references on Dominican Republic larger foraminifers (Maurrasse, 1982 in Haiti; Bourdon, 1985 in the Oriental Cordillera of Dominican Republic) lacking detailed descriptions and illustration of the species, with the exception of the paper by Hottinger (2001) on the soritids from the Miocene.

This work presents a first systematics of Cainozoic larger foraminifers (description and figuration). In eastern Dominican Republic (Fig. 1) several foraminiferal associations of Late Paleocene (Thanetian) to Middle Miocene age have been recognized overlying the Maastrichtian containing *Sulcoperculina globosa* DE CIZANCOURT, 1949 and *Orbitoides* sp. (Pl. 1, figs. 1-3). Some of the Cainozoic foraminiferal associations are found both *in situ* and reworked (Thanetian association) or exclusively reworked (Early Eocene association) into younger deposits of the Middle Eocene. In western Dominican Republic the biostratigraphic data allowed building a lithostratigraphic and paleoenvironmental framework from the shelf to slope for the Paleocene-Middle Miocene interval (Fig. 2) and characterize the succession of carbonate shelves. Besides, the defined associations of species are similar to those found in Yucatán-Chiapas (México), pointing out that they belong to the same bioprovince.

Summary of the lithostratigraphic formations sampled

The studied samples were obtained during the elaboration of the Geological Maps at 1:50.000 scale of the Dominican Republic Geothematic Mapping Project (2002-2004), sheets of Monte Plata, Miches and Rincón Chavón in the Oriental Cordillera; Jimaní, La Descubierta and Galván in the Neiba and Bahoruco Sierras; Bánica, Arroyo Limón, Monción, Mao, Monte Cristi and Pepillo Salcedo in the Central and Septentrional cordilleras (Fig. 1). Samples were col-

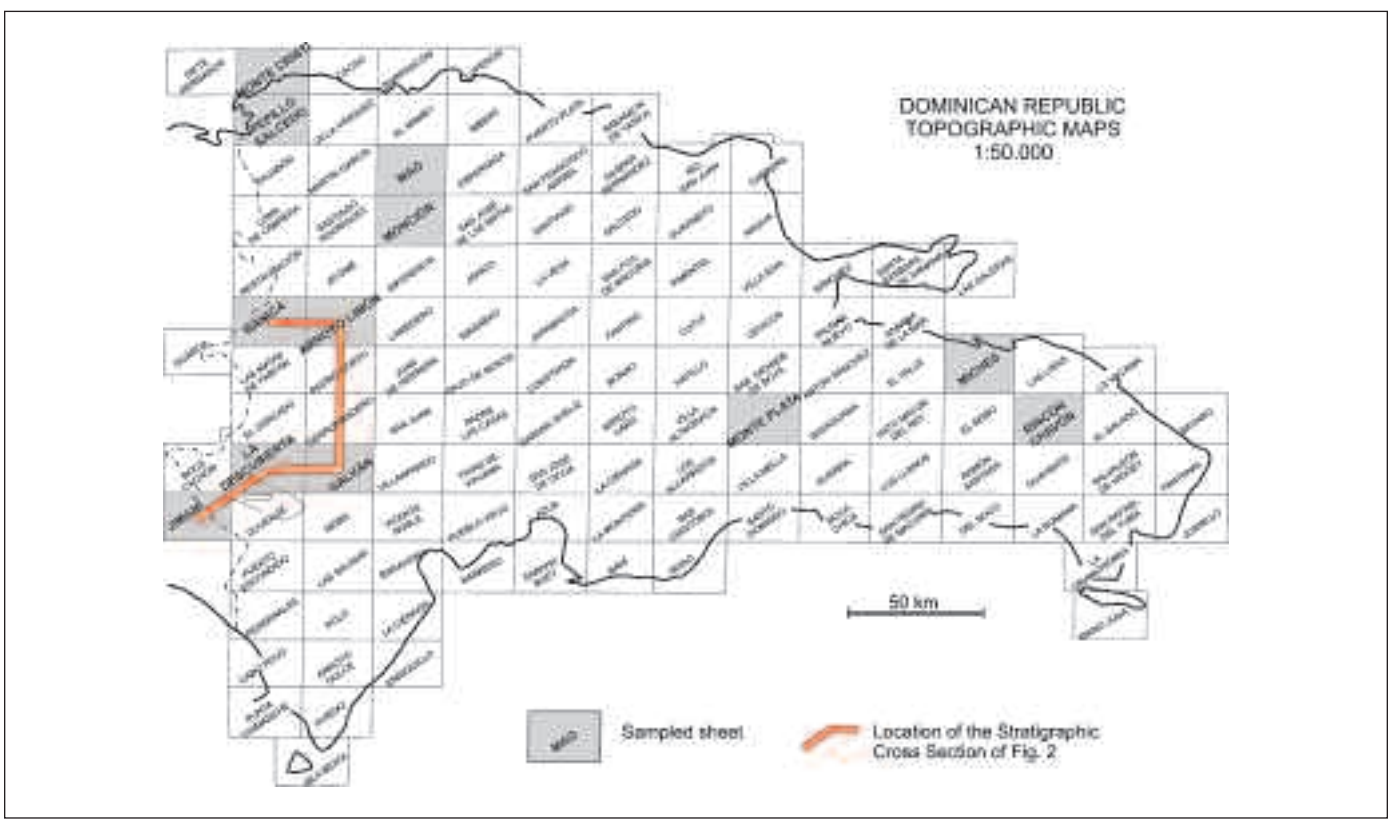


Fig. 1. Areas sampled in Dominican Republic with location of the chronostratigraphic diagram of Figure 2
Fig.1. Areas muestreadas en la República Dominicana y situación del esquema cronostratigráfico de la Figura 2

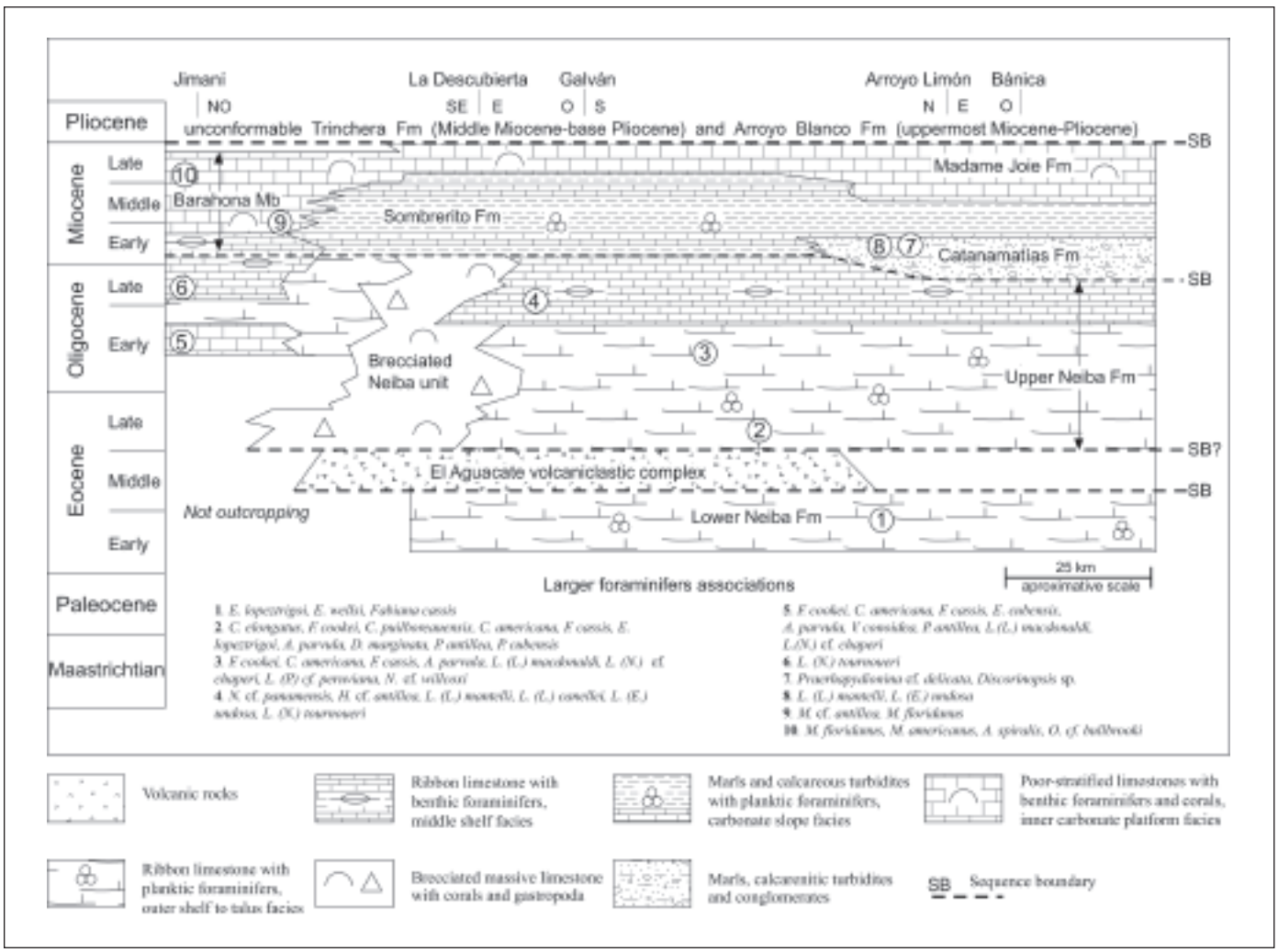


Fig. 2. Chronostratigraphic diagram showing lithology, facies, larger foraminifer associations and depositional sequences in the Cainozoic of western Dominican Republic (location in Fig. 1)

Fig.2. Diagrama cronostratigráfico que muestra la litología, facies, asociaciones de macroforaminíferos y las secuencias deposicionales del Cainozoico del oeste de la República Dominicana (situación en Fig. 1)

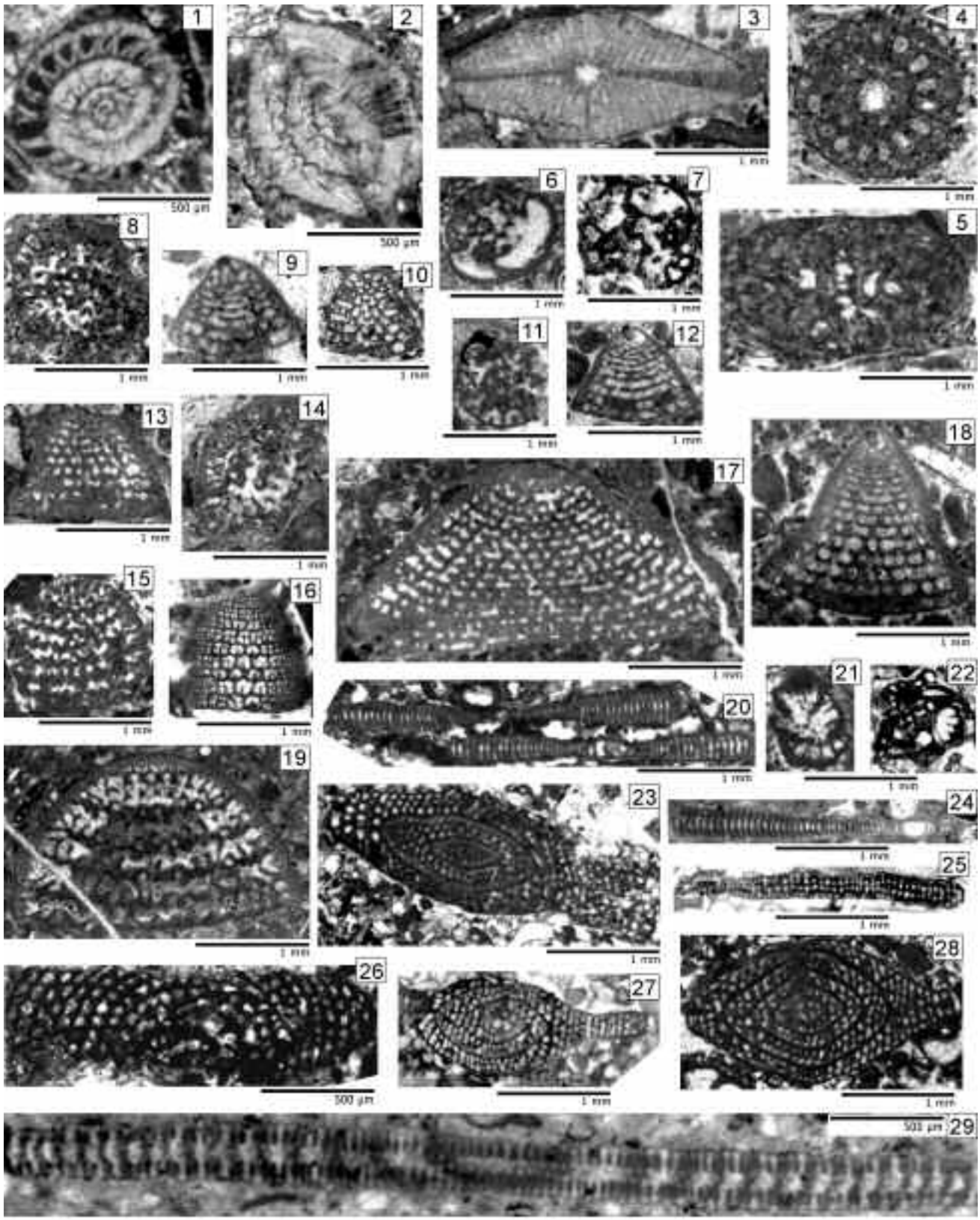
lected referred to geographical coordinates and the stratigraphic framework of the geological map and deposited in the collections of the Dirección General de Minería in Santo Domingo. Although the sampling lacks rigorous stratigraphic succession, it is enough for local biostratigraphic resolution. More sampling is needed for regional correlation with other Caribbean biozones.

The following lithostratigraphic units have been studied:

— Don Juan Fm (Bowin, 1966). It is composed of siltstones, sandstones and greywackes with intercalations of conglomerates, breccias, tuffs, cinerites and grey limestones. The ages provided by different authors are heterochronous ranging from the Paleocene to the Middle Eocene (Bowin, 1966; Boisseau, 1987; Bourdon, 1985). Samples examined in this paper were acquired in the Don Juan basin, Monteplata sheet.

— La Luisa Fm (Hernaiz Huerta, 2004). It is composed of siltstones, sandstones with chert and micritic limestones. La Luisa Fm is ascribed by the same author to the Middle Eocene. Samples examined in this paper were acquired in the Don Juan Basin, Monteplata sheet.

— Loma Peñón Fm (Bourdon, 1985; Lebrón and Mann, 1991). It is composed of calcarenites and calcirudites. These autors recognize reworked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fauna of the Paleocene and ascribed the Loma Peñón Fm to the Middle Eocene. Samples examined in this paper were acquired in the Bejucal Basin, Rincón Chavón sheet.

— Río Yabón Fm (Bourdon, 1985; Lebrón and Mann, 1991). It is composed of massive limestones. The Río Yabón Fm is ascribed by the same authors to the Middle Eocene. Samples examined in this paper were acquired in the Río Yabón basin, Miches sheet.

— Haitises Fm (Brouwer and Brouwer, 1982). It is composed of reefal limestones. The Haitises Fm is ascribed to the Middle to Late Miocene on the basis of its stratigraphic position a top of the Early-Middle Miocene Yanigua Fm (Iturralde-Vinent, 2001). Samples examined in this paper were acquired in the Hato Mayor and Monte Plata sheets.

— Cercado Fm (Maury, 1919). It is composed of lutites, marls, sandstones, conglomerates, bioclastic and reefal limestones. The Cercado Fm is ascribed to the Late Miocene (Saunders *et al*., 1986). Samples examined in this paper were acquired in the Cibao basin, Monción sheet.

— Gurabo Fm (Maury, 1919). It is composed of marls, lutites, sandy limestones, calcareous sandstones, limestones, limestones with corals. The Gurabo Fm is ascribed to the Late Miocene-Middle Pliocene (Saunders *et al*., 1986; Akers in Vokes, 1989; Hottinger, 2001). Samples examined in this paper were acquired in the Cibao basin, Mao and Pepillo Salcedo sheets.

— Las Lavas Fm (Zoeten and Mann, 1999). It is composed of calcareous breccias with blocks of volcanic rocks, marls and limestones (turbidite facies). Las Lavas Fm is ascribed to the Late Oligocene-Early Miocene (Zoeten and Mann, 1999) and to the Late Oligocene-Middle Miocene by Bernárdez (2004). Samples examined in this paper were acquired in the Septentrional Cordillera, Monte Cristi sheet.

— Monte Cristi unit (Bernárdez, 2004). It is composed of greywackes and limolites (turbidite facies). The Monte Cristi unit is ascribed by the same author to the Middle-Late Miocene. Samples examined in this paper were acquired in the Cibao basin, Monte Cristi sheet.

— Neiba Fm (Vaughan *et al*., 1921; Bermúdez, 1949). Micritic pelagic limestone with chert. The Neiba Fm is ascribed by these authors to the Middle-Late Eocene. In the Neiba Sierra, Hernaiz Huerta 2004a, 2004b; expand this range to the Early Eocene-Early Miocene, and define the following informal units (see also Hernaiz Huerta *et al.,* 2007):

Plate 1. Systematics (I)
Plancha 1. Sistemática (I)

1.- *Sulcoperculina globosa* DE CIZANCOURT, 1949. Rincón Chavón 6472-III-IG JG 9027, x40
2.- *Sulcoperculina globosa* DE CIZANCOURT, 1949. Axial section. Rincón Chavón 6472-III-IG JG 9004, x40
3.- *Orbitoides* sp. Rincón Chavón 6472-III-IG JG 9027, x20
4.- *Cubanina* sp., transversal section. Monción 5974-II-BR FC 9064, x20
5.- *Cubanina* sp., oblique section. Mao 5974-I-BR EB 9031, x20.
6, 7.- *Discorinopsis* sp. Jimaní 5871-III-IG JG 9003, x20
8.- *Coleiconus elongatus* (COLE, 1942). La Descubierta 5871-I-IG HH 9021, x20
9.- *Coleiconus elongatus* (COLE, 1942). La Descubierta 5871-I-IG HH 9038, x20
10.- *Coleiconus elongatus* (COLE, 1942). Galván 5971-IV-IG HH 9030, x20
11.- *Fallotella* sp. 1. Rincón Chavón 6472-III-IG JG 9002, x20
12.- *Cushmania puilboreauensis* (WOODRING, 1924). La Descubierta 5871-I-IG HH 9020, x20
13.- *Fallotella cookei* (MOBERG, 1928). Bánica 5873-II-BR JS 9029, x20
14.- *Fallotella cookei* (MOBERG, 1928). Arroyo Limón 5973-III-BR EB 9048, x20
15.- *Fallotella cookei* (MOBERG, 1928). Bánica 5873-II-BR JS 9030, x20
16.- *Cushmania puilboreauensis* (WOODRING, 1924). La Descubierta 5871-I-IG HH 9020, x20
17.- *Cushmania americana* (CUSHMAN, 1919). Arroyo Limón 5973-III-BR EB 9048, x20
18.- *Cushmania puilboreauensis* (WOODRING, 1924). La Descubierta 5871-I-IG HH 9020, x20
19.- *Cushmania americana* (CUSHMAN, 1919). La Descubierta 5871-I-IG HH 9021, x20
20.- *Annulosorites spiralis* HOTTINGER, 2001. Bánica 5873-II-BR JS 9017, x20
21, 22.- *Praerhapydionina* cf. delicata HENSON, 1950. Jimaní 5871-III-IG JG 9003, x20
23.- *Miarchaias floridanus* (CONRAD, 1846). Bánica 5873-II-BR JS 9017, x20
24.- *Annulosorites spiralis* HOTTINGER, 2001. Monte Plata 6272-III-IG HH 9037, x20
25.- *Miarchaias floridanus* (CONRAD, 1846). Pepillo Salcedo 5875-II-EB 9002, x20
26.- *Miosorites americanus* (CUSHMAN, 1918). Bánica 5873-II-BR JS 9023, x40
27.- *Miarchaias floridanus* (CONRAD, 1846). Pepillo Salcedo 5875-II-EB 9002, x20
28.- *Miarchaias floridanus* (CONRAD, 1846). Bánica 5873-II-BR JS 9017, x20
29.- *Miosorites americanus* (CUSHMAN, 1918). Hato Mayor 6372-III-IG JG 9004, x40

- Lower Neiba Fm (Early-Middle Eocene). It is composed of regular, frecuently thick bedded limestones with chert. Samples examined in this paper were acquired in La Descubierta and Galván sheets.
- Brecciated Neiba unit (Late Eocene-Early Miocene). It is composed of brecciated massive limestones with corals and gastropoda. Samples examined in this paper were acquired in La Descubierta and Galván sheets.
- El Aguacate de Neiba Volcanosedimentary Complex (Middle-¿Late Eocene?). It is composed of basalt and andesite flows, volcanic breccias and tuffs, calcarenites and marls. Samples examined in this paper were acquired in La Descubierta sheet.
- Upper Neiba Fm (Late Eocene-Early Miocene). It is composed of regular, thin bedded limestones with chert, and intercalations of marly limestones and marls to the top. Samples examined in this paper were acquired in the Jimaní, La Descubierta and Galván Arroyo Limón and Bánica sheets.

— Catanamatías Fm (Bernárdez and Soler, 2004). Defined in the southwest margin of the Central Cordillera as a transitional unit between the Neiba and Sombrerito Fms, it is composed of marls, calcarenites, sandy and bioclastic limestones, calcarenitic turbidites, breccias, conglomerates. The Catanamatías Fm is ascribed by the same authors to the Late Oligocene. Samples examined in this paper were acquired in the Arroyo Limón and Bánica sheets.

— Sombrerito Fm (Olson, en Bermúdez, 1949). It is composed of marls/marly limestones, calcarenites, conglomerates, breccias with calcareous and volcanic clasts. McLaughlin *et al*. (1991) ascribed the Sombrerito Formation to the late Early Miocene-earliest part of the Late Miocene. The base of the Sombrerito crosses time lines, becoming older (Oligocene) toward the northwest (Hernaiz Huerta *et al*., 2007). Samples examined in this paper were acquired in the Bánica sheet.

— Barahona Mb of Sombrerito Fm (Hernaiz Huerta *et al*., 2007). It is composed of massive limestones with sporadic corals. The Barahona Mb is ascribed by the same author to the Miocene. Samples examined in this paper were acquired in the Jimaní and La Descubierta sheets.

— Madame Joie Fm (Woodring, 1922). It is composed of coral and bioclastic limestones, sandy and conglomeratic limestones. The Madame Joie Fm is ascribed to the Early Miocene by Woodring (1922), Woodring *et al*. (1924) and Maurrasse (1982) among others. Butterlin (1954) expand the age range to the Late Oligocene. Samples examined in this paper were acquired in the Bánica sheet.

SYSTEMATICS

Family GLOBOTEXTULARIIDAE Cushman, 1927
Genus *Cubanina* Palmer, 1936
Pl. 1, figs. 4 and 5

Samples. Gurabo Fm (Mao 5974-I-BR EB 9031), Cercado Fm (Monción 5974-II-BR FC 9064).

Remarks. Agglutinated form with initial biserial growth that changes to uniserial. The chambers have an endoskeleton composed of radial partitions perpendicular to the septum. We found one transversal section and an oblique one. This form differs to *Cubanina alavensis* defined in the Oligocene of Cuba (Palmer 1936) because of its larger dimensions and a higher number of exoskeletal partitions in each chamber.

Distribution. This form occurs in Gurabo Fm associated with *Operculinoides* cf. *bullbrooki, Miosorites americanus* and *Sphaerogypsina globula,* and in Cercado Fm associated with *Operculinoides* cf. *bullbrooki.*

Age. The associated foraminifers indicate a Miocene age.

Family VALVULAMMINIDAE Loeblich and Tappan, 1987
Genus *Discorinopsis* Cole, 1941
Pl. 1, figs. 6 and 7

Samples. Upper Neiba Fm (Jimaní 5871-III-IG JG 9003).

Remarks. Agglutinated form with a high-trochospiral test, with an endoskeleton composed of pillars. In our material we have only two oblique sections and the specific determination is not possible.

Distribution. This form occurs in the Upper Neiba Fm associated with archaiasinids, peneroplids and *Praerhapydionina* cf. *delicata*.

Age. According to Cole (1941) and Robinson and Wright (1993) stratigraphic range of the genus *Discorinopsis* is Middle Eocene to Oligocene.

Family COSKINOLIDAE Moullade, 1965
Genus *Coleiconus* Hottinger and Drobne, 1980
Coleiconus elongatus (Cole, 1942)
Pl. 1, figs. 8, 9 and 10

1956 *Coskinolina elongata* Cole, Cole, p. 215; Pl. 24, figs. 6-11; Pl. 31, figs. 1-2

1960 *Coskinolina elongata* COLE, Butterlin and Bonet, p. 9-14; Pl. 1, figs. 1-3
1964 *Coskinolina elongata* COLE, Cole and Applin, p. 24-25; Pl. 1, fig. 12; Pl. 2, fig. 9; Pl. 3, figs. 4, 8
1980 *Coskinolina* (*Coleiconus*) *elongata* COLE, Hottinger and Drobne, p. 233, 235; Pl. 13, figs. 7-14; Text figs. 11A, B, C, D
1993 *Coskinolina* sp. cf. *C. douvillei* (DAVIES), Robinson and Wright, p. 289; Figs 7.1-3

Samples. Upper Neiba Fm (Galván 5971-IV-IG HH 9030), Brecciated Neiba Fm (La Descubierta 5871-I-IG HH 9021 and 9038).
Remarks. The morphology of the test is high-conical to conical. The growth is pfenderinid-type (Pl. 1, fig. 9) in the early stages and uniserial at the adult stage. The basal diameter reaches 1.25 mm in the 7th uniserial chamber. The endoskeleton consists of a few pillars, 7 pillars in the 8th uniserial chamber. The exoskeleton consists of simple radial beams. In the marginal zone the chambers are inflated.
Distribution. *Coleiconus elongata* occurs in the Upper Neiba Fm associated with *Fallotella cookei*, *Eoconuloides lopeztrigoi, Discocyclina marginata* and *Amphistegina parvula*. In the Brecciated Neiba Fm it is associated with *Cushmania americana, Fabiania cassis, Amphistegina parvula* and *Eoconuloides lopeztrigoi.*
Age. According to Cole (1956), Cole and Applin (1964), and Hottinger and Drobne (1980) *Coleiconus elongata* ranges from the latest Early Eocene to the Middle Eocene.

Family ORBITOLINIDAE Martin, 1980
Genus *Fallotella* Mangin, 1954
Fallotella sp. 1
Pl. 1, fig. 11

Samples. Loma Peñón Fm (Rincón Chavón 6472-III-IG JG 9002).
Remarks. We found a basal section of a small specimen of *Fallotella* sp. The diameter of this section is 0.9 mm and shows 8 marginal partitions per quadrant.
Distribution. This form occurs, together with *Ranikothalia bermudezi*, as Paleocene forms reworked into the Loma Peñón Fm, associated to Eocene larger foraminifera as *Eoconuloides lopeztrigoi* and *Discocyclina marginata.*
Age. We consider this species as Paleocene in age because of its small size and because it occurs with other Paleocene species.

Fallotella cookei (MOBERG, 1928)
Pl. 1, figs. 13, 14 and 15

1941 *Dictyoconus cookei* (MOBERG), Cole, Pl. 18, figs. 11-12
1947 *Dictyoconus cookei* (MOBERG), Cole and Bermúdez, p. 7; Pl. 1, fig. 6
1952 *Dictyoconus cookei* (MOBERG), Cole and Gravell, p. 711-712; Pl. 90, figs. 5, 8, 13, 15
1956 *Dictyoconus cookei* (MOBERG), Cole, Pl. 25, figs. 6-7
1968 *Heterodictyoconus cookei* (MOBERG), Butterlin and Moullade, p. 13; Pl. 2, figs. 1-11; Pl. 3, figs. 1-3
1980 *Fallotella* (*Fallotella*) *cookei* (MOBERG), Hottinger and Drobne, p. 53, 54-56; Pl. 1, fig. 3; Pl. 16, figs. 1-14; Text fig. 9D, E, 12A
1993 *Fallotella cookei* (MOBERG), Robinson and Wright, p. 281; Figs. 9.1-6; 10.3-4

Samples. Upper Neiba Fm (Galván 5971-IV-IG HH 9030, Bánica 5873-II-BR JS 9029 and 9030; Arroyo Limón 5973-III-BR EB 9052), Catanamatías Fm (Arroyo Limón 5973-III-BR EB 9048), Rio Yabón Fm (Miches 6372-I-IG AD 9016).
Remarks. The test is conical to high-conical. The basal diameter reaches 1.35 mm in the 12th uniserial chamber. In basal section of 1.25 mm of diameter shows 12 partitions per quadrant. The endoskeleton is composed of pillars and the exoskeleton of beams and rafters (Pl.1, fig. 14).
Distribution. This form occurs in the Upper Neiba Fm associated with *Coleiconus elongatus, Cushmania americana, Eoconuloides lopeztrigoi, Amphistegina parvula, Fabiania cassis, Eodictyoconus cubensis, Discocyclina marginata, Polylepidina antillea, Lepidocyclina* (*Lepidocyclina*) *macdonaldi, Lepidocyclina* (*Nephrolepidina*) cf. *chaperi* and *Lepidocyclina* (*Pliolepidina*) cf. *peruviana*. In the Rio Yabón Fm *Fallotella cookei* occurs associated with *Fabiania cassis, Eoconuloides lopeztrigoi, Amphistegina parvula* and *Lepidocyclina* (*Lepidocyclina*) *macdonaldi.* Finally, in the breccias of the Catanamatías Fm this form is associated with *Cushmania americana, Fabiania cassis, Amphistegina parvula* and *Lepidocyclina* (*Nephrolepidina*) cf. *chaperi.*
Age. According to Hottinger and Drobne (1980) *Fallotella cookei* occurs from the latest Early to the Middle Eocene, whereas according to Robinson and Wright (1993), and Robinson (1995) this species occurs from the early Middle Eocene to, possibly, the earliest Oligocene.

Genus *Cushmania* Silvestri, 1925
Cushmania americana (CUSHMAN, 1919)
Pl. 1, figs. 17 and 19

1928 *Cushmania americana* (CUSHMAN), Vaughan, 281-282; Pl. 44, figs. 1-2
1944 *Dictyoconus americanus* (CUSHMAN), Cole, p. 36-37; Pl. 4, figs 1-6; Pl. 18, fig. 11
1944 *Dictyoconus americanus* (CUSHMAN), Cole and Bermúdez, p. 6; Pl. 3, figs. 6-10
1947 *Dictyoconus americanus* (CUSHMAN), Cole and Bermúdez, p. 195; Pl. 14, figs. 5, 8
1952 *Dictyoconus americanus* (CUSHMAN), Cole and Gravell, p. 711; Pl. 90, figs. 1-2, 12, 14
1956 *Dictyoconus americanus* (CUSHMAN), Cole, p. 217-218; Pl. 25, figs. 10-11
1964 *Dictyoconus americanus* (CUSHMAN), Cole and Applin, p. 25; Pl. 2, figs. 3, 6-7 *non* 5, 7-8
1968 *Heyerodictyoconus americanus* (CUSHMAN), Butterlin and Moullade, p. 12-13; Pl. 1, figs. 4-9
1980 *Dictyoconus* (*Cushmania*) *americanus* (CUSHMAN), Hottinger and Drobne, p. 61-62; Pl. 1, figs. 1, 4-9; Pl. 20, figs. 1-10; Text figs. 9A, B, 12C
1993 *Cushmania americana* (CUSHMAN), Robinson and Wright, p. 293, 295; Figs. 10.5-8; 11.2, 11.4-5
1999 *Cushmania Americana* (CUSHMAN), Blanco-Bustamante *et al.*, Pl. 2, fig. 5

Samples. Upper Neiba Fm (Bánica 5873-II-BR JS 9013, 9029 and 9030), Brecciated Neiba Fm (La Descubierta 5871-I-IG HH 9021), Catanamatías Fm (Arroyo Limón 5973-III-BR EB 9048).
Remarks. The endoskeleton in *Cushmania* consists of pillars (Pl. 1, figs. 12, 17, 18). The exoskeleton consists of beams and rafters, forming a subepidermal network in the marginal zone (Pl. 1, fig. 12). In megalospheric forms the proloculus is positioned at the apex. In *Cushmania americana* the test has a low conical form. When the test reaches a diameter of 3.5 mm the axial section shows 18-22 pillars in the last chamber.
Distribution. *Cushmania americana* occurs in the Brecciated Neiba Fm associated with *Coleiconus elongatus* and *Penoperculinoides cubensis*. In the Upper Neiba Fm this form occurs associated with *Amphistegina parvula, Fabiania cassis, Eodictyoconus cubensis, Lepidocyclina* (*Lepidocyclina*) *macdonaldi, Lepidocyclina* (*Pliolepidina*) cf. *peruviana* and *Polylepidina antillea*. Finally in the breccias of the Catanamatías Fm this form is associated with *Fallotella cookei, Fabiania cassis, Amphistegina parvula* and *Lepidocyclina* (*Nephrolepidina*) cf. *chaperi.*
Age. *Cushmania americana occurs* in the Middle Eocene according to Hottinger and Drobne (1980), and in Jamaica it ranges from the latest Early Eocene to the earliest Late Eocene according to Robinson and Wright (1993).

Cushmania puilboreauensis (WOODRING, 1924)
Pl. 1, figs. 12, 16 and 18

1928 *Dictyoconus puilboreauensis* WOODDRING, Vaughan, p. 281; Pl. 43, fig. 6
1944 *Dictyoconus americanus* (CUSHMAN), Cole, Pl. 8, figs 12-13
1952 *Dictyoconus americanus* (CUSHMAN), Cole and Gravell, p. 711, Pl. 90, figs. 6-8
1956 *Dictyoconus americanus* (CUSHMAN), Cole, Pl. 25, figs. 8-9
1980 *Dictyoconus* (*Cushmania*) *puilboreauensis* (WOODDRING), Hottinger and Drobne, p. 62, 64; Pl. 1, fig. 2; Pl. 21, fig. 1-15; text fig. 9C; 12D

Samples. Brecciated Neiba Fm (La Descubierta 5871-I-IG HH 9020).
Remarks. Robinson and Wright (1993) and Butterlin and Moullade (1968) consider this form as synonymy of *Cushmania americana*. Following Hottinger and Drobne (1980) *Cushmania puilboreauensis* differs from *Cushmania americana* because of the high-conical morphology of its test. When the test reaches a diameter of 1.7 mm the axial section shows 14-17 pillars in the last chamber.
Distribution. This form occurs in the Brecciated Neiba Fm associated with *Amphistegina parvula* and *Fabiania cassis.*
Age. According to Hottinger and Drobne (1980) *Cushmania puilboreauensis* occurs in the Middle Eocene.

Family SORITIDAE Ehrenberg, 1839
Genus *Praerhapydionina* van Wessem, 1943
Praerhapydionina cf. *delicata* HENSON, 1950
Pl. 1, figs. 21 and 22

1963 *Praerhapydionina delicata* HENSON, Hottinger, p. 964-965; Pl. 1, fig. 3; Pl. 2, figs. 1-10
1993 *Praerhapydionina delicata* HENSON, Robinson and Wright, p. 303, 305; Figs. 15.1-6

Samples. Upper Neiba Fm (Jimaní 5871-III-IG JG 9003).

Remarks. We found two oblique sections where the endoskeletal partitions could be seen. The dimensions of the uniserial chambers are similar to those in *Praerhapydionina delicata*, but neither the pattern of apertures nor the early growth stages can be seen, and we prefer to maintain this form as *confer.*
Distribution. This form occurs associated with archaiasinids, peneroplids and *Discorinopsis* sp. in the Upper Neiba Fm.
Age. In Jamaica, according to Robinson and Wright (1993) and Robinson (1995), *Praerhapydionina delicata* occurs in beds of Oligocene age.

Genus *Miosorites* Seiglie and Rivera, 1976
Miosorites americanus (CUSHMAN, 1918)
Pl. 1, figs. 26 and 29

1929 *Amphisorus americanus* (CUSHMAN), Vaughan, p. 380-382; Pl. 41, fig. 5
1977 *Miosorites americanus* (CUSHMAN), Seiglie *et al.*, p. 867; Pl. 1, figs. 1-4, 5?, 6; Pl. 3, figs. 2?, *non* Pl. 3, fig.1
1981 *Archaias* (*Archaias*) *floridanus* (CONRAD), Butterlin, p. 133; Pl. 8, fig. 1
2001 *Miosorites americanus* (CUSHMAN), Hottinger, 491, 495, 499; Figs. 7-8, 9.1-9.4, 10.1-10.5

Samples. Haitises Fm (Hato Mayor 6372-III-IG JG 9004), Madame Joie Fm (Bánica 5873-II-BR JS 9016, 9017, 9018 and 9023), Barahona Mb (Jimaní 5871-III-IG JG 9040), Gurabo Fm (Mao 5974-I-BR EB 9031).
Remarks. Porcellaneous test with discoidal biplanar-biconvex morphology. The diameter of the test reaches 1 cm. The annular chambers are evolute except for the initial stage, where they may be involute. In each annular chamber the endoskeleton is made up of partitions interpreted as septula (Hottinger, 2001), alternating in radial position from one chamber to the next. The inner chambers have two alternating apertures, the external chambers present multiples apertures. The diameter of the proloculus ranges 0.300-0.400 mm.
Distribution. *Miosorites americanus* occurs in the Haitises, Barahona and Madame Joie formations associated with *Miarchaias floridanus* and *Annulosorites spiralis*. In the Gurabo Fm it is associated with *Sphaerogypsina globula, Cubanina* sp. and *Operculinoides* cf. *bullbrooki.*
Age. According to Hottinger (2001) this species is Late Miocene in age, but the presence of the *Operculinoides* cf. *bullbrooki* in Gurabo Fm extends down its range to the Early-Middle Miocene according to Butterlin (1981) and Caudri (1996).

Genus *Annulosorites* Hottinger, 2001
Annulosorites spiralis HOTTINGER, 2001
Pl. 1, figs. 20 and 24

2001 *Annulosorites spiralis* n. sp., Hottinger, p. 489, 491; Figs. 5.3-5.11, 6.1-6.5

Samples. Haitises Fm (Monte Plata 6272-III-IG HH 9037; Hato Mayor 6372-III-IG JG 9004), Madame Joie Fm (Bánica 5873-II-BR JS 9017), Barahona Mb (Jimaní 5871-III-IG JG 9002), Gurabo Fm (Pepillo Salcedo 5875-II-EB 9002).
Remarks. Porcellaneous test with discoidal-biconvex morphology. The growth changes from planispiral, evolute or involute, in the initial stages to annular. The annular chambers are subdivided by alternating partitions (septula) in radial position. The septula of consecutive chambers are continuous in early stages and alternate later. The initial, spiral chambers show only one row of apertures, whereas the annular chambers have two rows. The diameter of the proloculus ranges 0.250-0.275 mm.
Distribution. *Annulosorites spiralis* occurs in the Haitises, Barahona, Madame Joie and Gurabo formations associated with *Miosorites americanus*, *Miarchaias floridanus* and *Sphaerogypsina globula.*
Age. According to Hottinger (2001) this species is Late Miocene in age, but the presence of the *Operculinoides* cf. *bullbrooki* in Gurabo Fm extends down its range to the Middle Miocene (according to Butterlin, 1981) or to the Early Miocene (according to Caudri, 1996).

Genus *Miarchaias* Hottinger, 2001
Miarchaias floridanus (CONRAD, 1846)
Pl. 1, figs. 23, 25, 27 and 28

2001 *Miarchaias floridanus* (CONRAD), Hottinger, p. 506; Figs. 19.1-19.5, 20.1-20.5, 21.1-21.6

Samples. Haitises Fm (Monte Plata 6272-III-IG HH 9037; Hato Mayor 6372-III-IG JG 9004), Madame Joie Fm (Bánica 5873-II-BR JS 9016, 9017 and 9018), Gurabo Fm (Pepillo Salcedo 5875-II-EB 9002), Barahona Mb (Jimaní 5871-III-IG JG 9002 and 9040; La Descubierta 5871-I-IG HH 9061).
Remarks. Porcellaneous test with planispiral-involute growth. The test morphology, lenticular in the early chambers, changes to discoidal. The chambers present pillars in radial position and the exoskeleton consists in short radial partitions (beams). There are marginal apertures between beams in the lateral walls (Hottinger, 2001). The diameter of the test for 2 whorls

is 1.25-1.60 mm, for 3 whorls is 1.7-2.0 mm. The proloculus is about 0.250 mm in diameter.

Distribution. *Miarchaias floridanus* occurs associated with *Miosorites americanus*, *Annulosorites spiralis* and *Sphaerogypsina globula* in the follow lithostratigraphic units: Haitises, Barahona, Madame Joie and Gurabo formations.

Age. According to Hottinger (2001) this species is Late Miocene in age, but the presence of the *Operculinoides* cf. *bullbrooki* in Gurabo Fm extends down its range to the Middle Miocene (according to Butterlin, 1981) or to the Early Miocene (according to Caudri, 1996).

Family CYMBALOPORIDAE Cushman, 1927

Genus *Fabiania* Silvestri, 1924

Fabiania cassis (Oppenheim, 1896)

Pl. 2, figs. 1 and 2

1944 *Pseudorbitolina cubensis* Cushman and Bermúdez, Cole, p. 35-36; Pl. 13, figs. 1-2

1944 *Eodictyoconus cubensis* (Cushman and Bermúdez), Cole and Bermúdez, Pl. 3, figs. 2-3

1981 *Fabiania cassis* (Oppenheim), Butterlin, p. 35-36; Pl. 13, figs. 1-3

1993 *Fabiania cassis* (Oppenheim), Robinson and Wright, p. 307; Figs. 17. 1, 17. 3-6

Samples. Lower Neiba Fm (Bánica 5873-II-BR JS 9026), Brecciated Neiba Fm (La Descubierta 5871-I-IG HH 9038), Upper Neiba Fm (Bánica 5873-II-BR JS 9013, 9029 and 9030), Catanamatías Fm (Arroyo Limón 5973-III-BR EB 9048), Rio Yabón Fm (Miches 6372-I-IG AD 9016).

Remarks. Typified by having a conical test with thin wall, and with exo- and endoskeleton structures within each chamber. See Deloffre and Hamaoui (1973) for an extended description.

Distribution. *Fabiania cassis* occurs in Lower Neiba Fm associated with *Eoconuloides wellsi.* In the Brecciated Neiba Fm it is associated with *Coleiconus elongatus, Amphistegina parvula, Cushmania puilboreauensis* and *Eoconuloides lopeztrigoi*. In the Upper Neiba Fm it is associated with *Amphistegina parvula, Cushmania americana, Fallotella cookei, Polylepidina antillea, Eodictyoconus cubensis, Lepidocyclina* (*Pliolepidina*) cf. *peruviana* and *Lepidocyclina* (*Lepidocyclina*) *macdonaldi.* In the Rio Yabón Fm it is associated with *Fallotella cookei, Amphistegina parvula, Eoconuloides lopeztrigoi* and *Lepidocyclina* (*Lepidocyclina*) *macdonaldi.* Finally in the breccias of the Catanamatías Fm this form is associated with *Fallotella cookei, Cushmania americana, Amphistegina parvula* and *Lepidocyclina* (*Nephrolepidina*) cf. *chaperi.*

Age. According to Butterlin (1981) and Robinson and Wright (1993) the range of this species is from Middle Eocene to Late Eocene in age.

Genus *Eodictyoconus* Cole and Bermúdez, 1944

Eodictyoconus cubensis (Cushman and Bermúdez, 1944)

Pl. 2, figs. 3, 4 and 5

1944 *Eodictyoconus cubensis* (Cushman and Bermúdez), Cole and Bermúdez, p. 6-10; Pl. 1, fig.1; Pl. 2, figs. 1-12; Pl. 3, figs. 1, 4-5

Samples. Upper Neiba Fm (Bánica 5873-II-BR JS 9029), Catanamatías Fm (Bánica 5873-II-BR JS 9009).

Remarks. According to Robinson and Wright (1993) *Eodictyoconus cubensis* is a synonymy of *Fabiania cassis*. We prefer to maintain it as a different genera and species because it can be easily distinguished by its thicker wall and more simple exo- and endoskeletal structures.

Distribution. *Eodictyoconus cubensis* occurs in the Upper Neiba Fm associated with *Fallotella cookei, Fabiania cassis* and *Polylepidina antillea.* In the breccias of the Cantanamatías Fm it is associated with *Victoriella conoidea, Lepidocyclina* (*Lepidocyclina*) *macdonaldi, Lepidocyclina* (*Nephrolepidina*) cf. *chaperi* and *Polylepidina antillea.*

Age. According to Robinson and Wright (1993) *Eodictyoconus cubensis* is a synonymy of *Fabiania cassis* and occurs from Middle to Late Eocene in Jamaica.

Fabianiinae indeterminated

Pl. 2, figs. 6 and 7

Samples. Las Lavas Fm (Monte Cristi 5875-I-EB 9010), Monte Cristi Fm (Monte Cristi 5875-I-EB 9012), Barahona Mb (La Descubierta 5871-I-IG HH 9009 and 9061).

Remarks. Hyaline attached form. It is similar to *Gunteria floridana*, defined by Cushman and Ponton (1933) in Eocene rocks of Cuba, but is structurally more complex. We found only three sections that do not allow observing the chamber arrangement. The wall is perforated and has exoskeletal structures, probably beams.

Distribution. This form occurs in the Barahona Mb

associated with *Miogypsina* cf. *antillea, Operculinoides* sp. and *Miarchaias floridanus.*
Age. The larger foraminifers associated with this form are Miocene in age (see the discussion on *Miogypsina* cf. *antillea*).

Family VICTORIELLIDAE Chapman and Crespin, 1930
Genus *Victoriella* Chapman and Crespin, 1930
Victoriella conoidea (RUTTEN, 1914)
Pl. 2, figs. 8 and 9

1993 *Victoriella conoidea* (RUTTEN), Robinson and Wrigth, p. 307, 309: Figs. 16.5-6

Samples. Catanamatías Fm (Bánica 5873-II-BR JS 9009.)
Remarks. Test conical with trochospiral growth, the wall of the chambers is thick and coarsely perforated.
Distribution. *Victoriella conoidea* occurs in the breccias of the Cantanamatías Fm associated with *Eodictyoconus cubensis, Lepidocyclina* (*Lepidocyclina*) *macdonaldi, Lepidocyclina* (*Nephrolepidina*) cf. *chaperi* and *Polylepina antillea*.
Age. According to Robinson and Wrigth (1993) in Jamaica *Victoriella conoidea* ranges from Late Eocene to Oligocene.

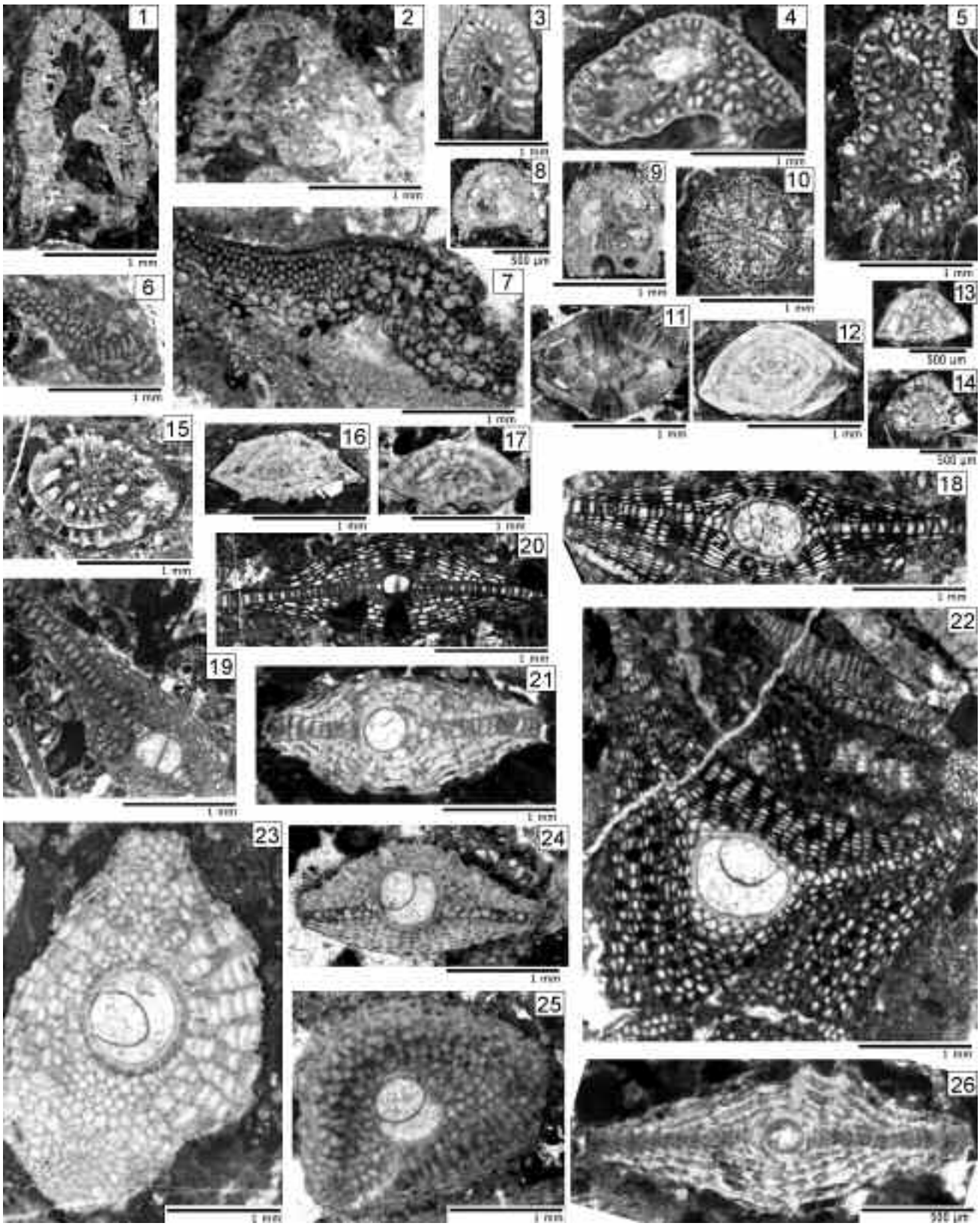
Family ACERVULINIDAE Schultze, 1854
Genus *Sphaerogypsina* Galloway, 1933
Sphaerogypsina globula s.l.
Pl. 2, fig. 10

1993 *Sphaerogypsina globula* (REUSS), Robinson and Wright, p. 309; Figs. 16. 1-2
Samples. Upper Neiba Fm (Galván 5971-IV-IG HH 9012), Gurabo Fm (Mao 5974-I-BR EB 9031), Barahona Mb (Jimaní 5871-III-IG JG 9002).
Remarks. According to Caudri (1975), we assigned to this generic and specific name all the globular "Gypsinas" waiting to further detailed studies.
Distribution. *Sphaerogypsina globula* occurs in Gurabo Fm associated with *Operculinoides* cf. *bullbrooki, Miosorites americanus* and *Cubanina* sp. In the Barahona Mb it is associated with *Annulosorites spiralis* and *Miarchaias floridanus*. In the Upper Neiba Fm it is associated with *Miogypsina* sp., and *Heterostegina* cf. *antillea.*
Age. According to Robinson and Wright (1993) this species occurs from the latest Early Eocene to the Late Oligocene, but in Dominican Republic we found this form in Miocene rocks according to the associated larger foraminifers.

Family AMPHISTEGINIDAE Cushman, 1927
Genus *Amphistegina* d'Orbigny, 1826
Amphistegina parvula (CUSHMAN, 1918)
Pl. 2, figs. 11, 12 and 15

1934 *Amphistegina cubensis* n. sp., Palmer, p. 256; Pl. 15, fig. 2
1971 *Amphistegina cubensis* PALMER, Cole, p. 35-37; Pl. 3, figs. 1-8, 12
1974 *Amphistegina parvula* (CUSHMAN), Caudri, Pl. 4, fig. 7-9; Pl. 5, figs. 2-5, 10-11
1981 *Amphistegina parvula* (CUSHMAN), Butterlin, p. 39; Pl. 15, figs. 11-12
1993 *Amphistegina parvula* (CUSHMAN), Robinson and Wright, p. 309-311; Figs. 18.3-5

Samples. Catanamatías Fm (Arroyo Limón 5973-III-BR EB 9048), Upper Neiba Fm (Bánica 5873-II-BR JS 9013 and 9030; Arroyo Limón 5973-III-BR EB 9053), Brecciated Neiba Fm (La Descubierta 5871-I-IG HH 9020 and 9038; Galván 5971-IV-IG HH 9030), Rio Yabón Fm (Miches 6372-I-IG AD 9016), El Aguacate Fm (La Descubierta 5871-I-IG HH 9028).
Remarks. This species has a robust test with thick walls without piles and presents a great variability. In our specimens, the diameter of the test ranges from 1.5 to 1.8 mm and the thickness from 0.8 to 1 mm. We consider *Amphistegina cubensis* PALMER in Cole (1971, Pl. 1, fig. 1-8, 12) as a synonymy because it shows the same features although with larger dimensions.
Distribution. *Amphistegina parvula* occurs in the Brecciated Neiba Fm associated with *Coleiconus elongatus, Cushmania puilboreauensis, Fabiania cassis, Eoconuloides lopeztrigoi.* In the Upper Neiba Fm it is associated with *Coleiconus elongatus, Fallotella cookei, Cushmania americana, Fabiania cassis, Eoconuloides lopeztrigoi, Discocyclina marginata, Lepidocyclina* (*Lepidocyclina*) *macdonaldi, Lepidocyclina* (*Pliolepidina*) cf. *peruviana* and *Nummulites* cf. *willcoxi.* In the Rio Yabón Fm it is associated with *Fallotella cookei, Fabiania cassis, Eoconuloides lopeztrigoi* and *Lepidocyclina* (*Lepidocyclina*) *macdonaldi*. Finally, in the breccias of the Catanamatías Fm this form is associated with *Fallotella cookei, Cushmania americana, Fabiania cassis* and *Lepidocyclina* (*Nephrolepidina*) cf. *chaperi.*
Age. According to Butterlin (1981) and Robinson and Wright (1993) this species ranges from the early Middle Eocene to the Late Eocene.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Family BORELOIDIDAE Reiss, 1963
Genus *Eoconuloides* Cole and Bermúdez, 1944
Eoconuloides lopeztrigoi (PALMER, 1934)
Pl. 2, figs. 16, and 17; Pl. 3, fig. 3

1934 *Amphistegina lopeztrigoi* n. sp., Palmer, p. 255; Pl. 15, figs. 6, 8
1936 *Amphistegina lopeztrigoi* PALMER, Baker and Grimsdale, p. 233; Pl. 32, figs. 1-3
1944 *Amphistegina lopeztrigoi* PALMER, Cole, p. 55; Pl. 1, fig. 17; Pl. 8, fig. 16; Pl. 9, figs. 10-13
1952 *Amphistegina lopeztrigoi* PALMER, Cole and Gravell, p. 714; Pl. 91, figs. 6-8
1957 *Amphistegina lopeztrigoi* PALMER, Levin, p. 146-147; Pl. 4, figs. 8-9, 13-14
1981 *Eoconuloides lopeztrigoi* (PALMER), Butterlin, Pl. 15, figs. 9-10
1993 *Eoconuloides lopeztrigoi* (PALMER), Robinson and Wright, p. 311; Figs. 19.6-9
1996 *Eoconuloides lopeztrigoi* (PALMER), Caudri, p. 1229-1230; Pl. 27, fig. 1
2003 *Amphistegina lopeztrigoi* PALMER, De Mello e Sousa *et al.*, Pl. 3, fig. 4

Samples. Lower Neiba Fm (Galván 5971-IV-IG HH 9005 and 9032), Upper Neiba Fm (Galván 5971-IV-IG HH 9030), Brecciated Neiba Fm (La Descubierta 5871-I-IG HH 9038), Rio Yabón Fm (Miches 6372-I-IG AD 9016), Loma Peñón Fm (Rincón Chavón 6472-III-IG JG 9002 and 9023).
Remarks. This form has a lenticular test with low-trochospiral growth and strong piles in both dorsal and ventral sides. The diameter ranges from 1.15 to 1.40 mm and the height from 0.625 to 0.825 mm.
Distribution. *Eoconuloides lopeztrigoi* occurs in the Brecciated Neiba Fm associated with *Coleiconus elongatus, Fabiania cassis* and *Amphistegina parvula*; this form occurs also in the Lower Neiba Fm associated with *Eoconuloides wellsi.* In the Upper Neiba Fm this species is associated with *Coleiconus elongatus, Fallotella cookei, Amphistegina parvula* and *Discocyclina marginata.* In the Rio Yabón Fm it is associated with *Fallotella cookei, Fabiania cassis, Amphistegina parvula* and *Lepidocyclina* (*Lepidocyclina*) *macdonaldi.* In the Loma Peñón Fm this form is associated with *Discocyclina marginata* and *Eoconuloides wellsi* and also with reworked Paleocene larger foraminifers such as *Ranikothalia bermudezi* and *Fallotella* sp.
Age. According to Robinson and Wright (1993) and Blanco-Bustamante *et al.* (1999) *Eoconuloides lopeztrigoi* occurs from the Late Paleocene to the Middle Eocene.

Eoconuloides wellsi COLE and BERMÚDEZ, 1944
Pl. 2, figs. 13, and 14

1944 *Eoconuloides wellsi* n. gen. n. sp., Cole and Bermúdez, p. 11; Pl. 1, figs. 4-10
1952 *Eoconuloides wellsi* COLE and BERMÚDEZ, Cole and Gravell, p. 713; Pl. 92, figs. 1-10
1981 *Eoconuloides wellsi* COLE and BERMÚDEZ, Butterlin, Pl. 17, figs. 3-4

Plate 2. Systematics II
Plancha 2. Sistemática II

1, 2.- *Fabiania cassis* (OPPENHEIM, 1896). Bánica 5873-II-BR JS 9029, x20
3-5.- *Eodictyoconus cubensis* CUSHMAN and BERMÚDEZ, 1944. 3, 4: Bánica 5873-II-BR JS 9029, x20; 5: Bánica 5873-II-BR JS 9009, x20
6, 7.- Fabianiinae indeterminated. 6: Monte Cristi 5875-I-EB 9012, x20; 7: Monte Cristi 5875-I-EB 9010, x20
8, 9.- Victoriella conoidea (RUTTEN, 1914). Bánica 5873-II-BR JS 9009, x20
10.- Sphaerogypsina globula s.l. Galván 5971-IV-IG HH 9012, x20
11.- Amphistegina parvula (CUSHMAN, 1918). Bánica 5873-II-BR JS 9030, x20
12.- Amphistegina parvula (CUSHMAN, 1918). Miches 6372-I-IG AD 9016, x20
13.- Eoconuloides wellsi COLE and BERMÚDEZ, 1944. Galván 5971-IV-IG HH 9032, x20
14.- Eoconuloides wellsi COLE and BERMÚDEZ, 1944. Bánica 5873-II-BR JS 9026, x20
15.- Amphistegina parvula (CUSHMAN, 1918). Miches 6372-I-IG AD 9016, x20
16.- Eoconuloides lopeztrigoi (PALMER, 1934).Galván 5971-IV-IG HH 9005, x20
17.- Eoconuloides lopeztrigoi (PALMER, 1934). Rincón Chavón 6472-III-IG JG 9002, x20
18.- Lepidocyclina (Lepidocyclina) mantelli MORTON, 1883. La Descubierta 5871-I-IG HH 9057, x20
19.- Lepidocyclina (Lepidocyclina) macdonaldi CUSHMAN, 1919. Arroyo Limón 5973-III-BR EB 9053, x20
20.- Lepidocyclina (Lepidocyclina) canellei LEMOINE and R. DOUVILLÉ, 1904, axial section. Bánica 5873-II-BR JS 9048, x20
21.- Lepidocyclina (Lepidocyclina) canellei LEMOINE and R. DOUVILLÉ, 1904, "ariana type". Bánica 5873-II-BR JS 9020, x20
22.- Lepidocyclina (Eulepidina) undosa CUSHMAN, 1919. Jimaní 5871-III-IG JG 9007, x20
23.- Lepidocyclina (Eulepidina) undosa CUSHMAN, 1919. Arroyo Limón 5973-III-BR EB 9050, x20
24.- Lepidocyclina (Nephrolepidina) cf. chaperi LEMOINE and R. DOUVILLÉ, 1904. Bánica 5873-II-BR JS 9009, x20
25.- Lepidocyclina (Nephrolepidina) cf. chaperi LEMOINE and R. DOUVILLÉ, 1904. Bánica 5873-II-BR JS 9009, x20
26.- Lepidocyclina (Pliolepidina) cf. peruviana CUSHMAN, 1922. Bánica 5873-II-BR JS 9030, x40

1993 *Eoconuloides wellsi* COLE and BERMÚDEZ, Robinson and Wright, Figs. 18.1-2, 19.1-5
1999 *Eoconuloides wellsi* COLE and BERMÚDEZ, Blanco-Bustamante *et al.*, Pl. 2, fig. 4

Samples. Lower Neiba Fm (Galván 5971-IV-IG HH 9032; Bánica 5873-II-BR JS 9026), Loma Peñón Fm (Rincón Chavón 6472-III-IG JG 9023).
Remarks. This form varies from high conical to low conical trochospiral growth with flat base and subacuate peripheral angle. In the ventral side it has short piles. The diameter of the test ranges from 1.60 to 1.90 mm and its height from 1.0 to 1.3 mm
Distribution. *Eoconuloides wellsi* occurs in the Loma Peñón Fm associated with *Eoconuloides lopeztrigoi* and *Discocyclina marginata* and *Neodiscocyclina barkeri*. In the Lower Neiba Fm this species is associated with *Eoconuloides lopeztrigoi* and *Fabiania cassis.*
Age. According to Blanco-Bustamante *et al.* (1999) this species occurs in Cuba from the *Morozovella subbotinae* plancktonic foraminiferal biozone (P 6) of Berggren *et al.* (1995) through the *Morozovella aragonensis* biozone (P 8), thus being Early Eocene in age. According to Robinson and Wrigth (1993) in Jamaica *Eoconuloides wellsi* ranges from the latest Early Eocene to the early Middle Eocene.

Family LEPIDOCYCLINIDAE Scheffen, 1932
Genus *Lepidocyclina* Gümbel, 1970
Subgenus *Lepidocyclina* Gümbel, 1970
Lepidocyclina (*Lepidocyclina*) *canellei* LEMOINE and R. DOUVILLÉ, 1904
Pl. 2, figs. 20 and 21

1933 *Lepidocyclina* (*Lepidocyclina*) *canellei*, LEMOINE and R. DOUVILLÉ, Vaughan, p. 14; Pl. 6, figs. 1-5
1935 *Lepidocyclina canellei* LEMOINE and R. DOUVILLÉ, van de Geyn and van der Vlerk, p. 230, figs. 43-45
1961a *Lepidocyclina* (*Lepidocyclina*) *canellei*, LEMOINE and R. DOUVILLÉ, Cole, Pl. 30, figs. 1-13; Pl. 31, figs. 1-5; Pl. 32, figs. 1-4; Pl. 33, figs. 1-4; Pl. 34, figs. 1-8; Pl. 35, figs. 1, 2, 4, 5; Pl. 36, figs. 1-5; Pl. 37, figs. 1-5; Pl. 38, figs. 1-7
1968 *Lepidocyclina* (*Lepidocyclina*) *canellei* LEMOINE and R. DOUVILLÉ, Eames *et al.*, p. 297; Pl. 59, fig. 7
1996 *Lepidocyclina* (*Lepidocyclina*) *canellei* LEMOINE and R. DOUVILLÉ, Caudri, p. 1227 ; Pl. 18, figs. 1-2
2003 *Lepidocyclina* (*Lepidocyclina*) *canellei* LEMOINE and R. DOUVILLÉ, De Mello e Sousa *et al.*, Pl. 2, figs. 9-10

Samples. Upper Neiba Fm (Bánica 5873-II-BR JS 9020, 9048 and 9049).
Remarks. This species shows a considerable variability in size and shape, with or without piles. It is characterised by a thick walled isolepidine embryo, of 150-300 µm, with two embryonic chambers of a similar size, separated by a thinner flat wall. After studying the variability of this species, some authors recognized many synonymies. Thus, for example, Cole (1957a, 1961a) considered that *Lepidocyclina* (*Lepidocyclina*) *giraudi* R. DOUVILLÉ 1907, *Lepidocyclina miraflorensis* VAUGHAN 1923, *Lepidocyclina asterodisca* NUTALL 1932, and *Lepidocyclina* (*Lepidocyclina*) *waylandvaughani* COLE 1928, are junior synonyms of *Lepidocyclina* (*Lepidocyclina*) *canellei*. See Cole (1961a) for an extended description and figuration of this species.
Distribution. This form occurs in the Upper Neiba Fm associated with *Lepidocyclina* (*Eulepidina*) *undosa* and *Nummulites* cf. *panamensis.*
Age. According to Butterlin (1981, 1984), Robinson and Wright (1993), Caudri (1996), De Mello e Sousa *et al.* (2003) the range of this species is Oligocene to Early Miocene.

Lepidocyclina (*Lepidocyclina*) *macdonaldi* CUSHMAN, 1919
Pl. 2, fig. 19

1944 *Lepidocyclina* (*Pliolepidina*) *ariana* COLE and PONTON, Cole, p. 61; Pl. 1, fig. 14; Pl. 14, figs. 1-8; Pl. 16, figs. 11-13; Pl. 17, fig. 13.
1974 *Lepidocyclina* (*Lepidocyclina*) *macdonaldi* CUSHMAN, Frost and Langenheim, p. 143; Pl. 38, figs 1-9; Pl. 39, figs. 1-7; Pl. 40, figs. 1-13; Pl. 41, figs. 1-4; Pl. 42, figs. 1-6
1981 *Lepidocyclina* (*Neolepidina*) *macdonaldi* CUSHMAN, Butterlin, p. 72, 75; Pl. 47, figs. 1-2
1981 *Lepidocyclina* (*Neolepidina*) *ariana* COLE and PONTON, Butterlin, p. 72, 75; Pl. 47, figs. 3-5
1990 *Lepidocyclina macdonaldi* CUSHMAN, Butterlin, Pl. 3, figs.3-6
1993 *Lepidocyclina* (*Lepidocyclina*) *macdonaldi* CUSHMAN, Robinson and Wright, p. 317; Figs. 23.5-7

Samples. Upper Neiba Fm (Arroyo Limón 5973-III-BR EB 9053; Bánica 5873-II-BR JS 9030), Catanamatías Fm (Bánica 5873-II-BR JS 9009), Rio Yabón Fm (Miches 6372-I-IG AD 9016).
Remarks. *Lepidocyclina* (*Lepidocyclina*) *macdonaldi* is very similar to *Lepidocyclina ariana* COLE and PONTON 1934. Cole (1944, 1945) thought that the two species could be synonymous, although latter (Cole,

1956) he considered them as two valid species. Butterlin (1981) remarks that this two species are sometimes difficult to distinguish, but considers them to be two separate species, statistically different, that he called *Lepidocyclina* (*Neolepidina*) *ariana* and *Lepidocyclina* (*Lepidocyclina*) *macdonaldi*.

However, after studying more than 600 specimens, Frost and Langenheim (1974) concluded that *Lepidocyclina* (*Lepidocyclina*) *ariana*, and *Lepidocyclina* (*Pliolepidina*) *proteiformis* VAUGHAN 1924, are synonyms of *Lepidocyclina* (*Lepidocyclina*) *macdonaldi*, because they found a morphological gradation between these three forms (even in a single specimen) in size, number and arrangement of lateral chamberlets and piles. Robinson and Wright (1993) reached the same conclusion. Both Frost and Langenheim (1974) and Robinson and Wright (1993) related this variability to the environmental conditions from observations of the facies where they find the specimens, in Chiapas and Jamaica respectively. Thus, the specimens of the types "*ariana*" and "*macdonaldi* s.s.", with low lateral chamberlets with thick walls, tend to predominate in populations associated to shelf carbonates, particularly algal-foraminiferal biosparites, whereas the specimens of the type "*proteiformis*", with high lateral chamberlets with thin walls, are most common in basin-slope facies, with planktonic and benthonic foraminifers, in biomicrite or calcareous clays or shales. According to Frost and Langenheim (1974), the depositional environment would affect basically the morphology of the lateral chamberlets and the thickness of the walls, affecting very few the size or number of piles and nothing the features of the embryonic chambers.

Following Cole (1944, p.62) *Lepidocyclina* (*Lepidocyclina*) *claibornensis* GRAVELL and HANNA 1940, is a synonym of *Lepidocyclina* (*Pliolepina*) *ariana* COLE and PONTON 1934, for what the former would be another synonym of *Lepidocyclina* (*Lepidocyclina*) *macdonaldi*.

Following Frost and Langenheim (1974) the group of *Lepidocyclina* (*Lepidocyclina*) *macdonaldi-ariana-proteiformis* is a species lineage. It is morphologically similar to the *Lepidocyclina ocalana-montgomeriensis-gubernacula* lineage, both groups having isolepidine embryos. They differ in the shape of the equatorial chamberlets (arcuate to short-spatulate in the *Lepidocyclina* (*Lepidocyclina*) *macdonaldi* group; rhombic, spatulate, or hexagonal in the *Lepidocyclina ocalana* group, and in the lateral chamberlets (with fewer layers and smaller chamberlets not arranged in tiers in the *Lepidocyclina ocalana* group).

Remarks-ariana. *Lepidocyclina ariana* has also been assigned to the genera *Pliolepidina* H. DOUVILLÉ 1915 and *Neolepidina* BRÖNNIMANN 1947. Both genera have been discussed and considered to be synonyms of *Lepidocyclina* by different authors. *Pliolepidina* is characterized by a megalospheric embryo subdivided in three or more chambers, with no further differences from *Lepidocyclina*. Some authors (e.g. Vaughan and Cole, 1940, 1941; Butterlin, 1981) considered that the type species of *Pliolepidina* H. DOUVILLÉ 1915, *Lepidocyclina* (*Pliolepidina*) *tobleri* H. DOUVILLÉ 1917, as a teratological form of *Lepidocyclina pustulosa* H. DOUVILLÉ 1917, and thus that *Pliolepidina* was not a valid genus. This caused Brönnimann (1947, p. 376) to consider the genus *Pliolepidina* as "nomen caducum", proposing another new genus, *Neolepidina*, with *Lepidocyclina pustulosa* as the type species. Vaughan and Cole (1941) put *Lepidocyclina trinitatis* H. DOUVILLÉ 1924 in the synonymy of *Lepidocyclina pustulosa*, which is the type species of *Isorbitoina* THALMANN 1938, for what, according to Grimsdale and van der Vlerk (1959), *Neolepidina* is a synonym of *Isorbitoina,* which was proposed as a subgenus of *Orbitoina*, a subjective synonym of *Lepidocyclina* (Eames et al, 1962).

Eames *et al.* (1962) regarded *Neolepidina* a junior synonym of *Lepidocyclina* (*s.s*) because the "four stolon system" which characterizes this genus is found, together with the "six stolon system", in different ontogenetic stages of the same specimens of some *Lepidocyclina* species.

Following Cole (1960a, 1961b, 1962, 1963) multilocular embryos (which characterize the genera *Pliolepidina* and *Multilepidina*) are due to irregularities of the reproductive cycle, sometimes are found together with bilocular embryos, and thus cannot be used to characterize genera. However, Eames *et al.* (1962) claim that *Pliolepidina* is "in no way monstrous or teratoid" and consider it a valid subgenus of *Lepidocyclina*.

Distribution. *Lepidocyclina* (*Lepidocyclina*) *macdonaldi* occurs in the Upper Neiba Fm associated with *Fallotella cookei, Cushmania americana, Fabiania cassis, Amphistegina parvula, Nummulites* cf. *wilcoxi* and *Lepidocyclina* (*Pliolepidina*) cf. *peruviana.* In the breccias of the Cantanamatías Fm it is associated with *Eodictyoconus cubensis, Victoriella conoidea, Polylepidina antillea* and *Lepidocyclina* (*Nephrolepidina*) cf. *chaperi.* Finally in the Rio Yabón Fm it is associated with *Fallotella cookei, Amphistegina parvula, Eoconuloides lopeztrigoi* and *Fabiania cassis.*

Age. According to Butterlin (1963, 1984), Butterlin and Moullade (1968), Frost and Langenheim (1974), Robinson and Wright (1993) and De Mello e Sousa *et al.* (2003) this species ranges from the Middle Eocene to the Late Eocene.

Lepidocyclina (*Lepidocyclina*) *mantelli* MORTON, 1883
Pl. 2, fig. 18

1935 *Lepidocyclina mantelli* (MORTON) Lemoine and R. Douvillé, van de Geyn and van der Vlerk, p. 237; Figs. 37 (after Vaughan 1928), 38
1944 *Lepidocyclina* (*Lepidocyclina*) *mantelli* (MORTON), Cole, p. 70; Pl. 22, figs. 13-15
1957a *Lepidocyclina* (*Lepidocyclina*) *mantelli* (MORTON), Cole, p. 38-40 ; Pl. 1, figs. 1-5, 7-9 ; Pl. 2, figs. 1, 6 ; Pl. 3, figs. 1-4 ; Pl. 4, figs. 1, 4, 6-7 ; Pl. 5, figs. 3-5 ; Pl. 6, figs. 3-7
1974 *Lepidocyclina* (*Lepidocyclina*) *mantelli* (MORTON), Frost and Langenheim, p. 15 ; Pl. 43, figs. 1-9; Pl. 44, figs. 1-6

Samples. Upper Neiba Fm (Bánica 5873-II-BR JS 9022), Brecciated Neiba Fm (La Descubierta 5871-I-IG HH 9057), Sombrerito Fm (Bánica 5873-II-BR JS 9008), Catanamatías Fm (Bánica 5873-II-BR JS 9010), Barahona Mb (Jimaní 5871-III-IG JG 9009).

Remarks. Large, flat species, with poorly developed or without piles. The megalospheric embryo is similar to that of *Lepidocyclina* (*Lepidocyclina*) *canellei* (two thick-walled chambers separated by a flat thinner wall), but of larger dimensions, of about half a millimetre. See Frost and Langenheim (1974, p.155-160) for a detailed description of this species.

Distribution. *Lepidocyclina* (*Lepidocyclina*) *mantelli* occurs in the Brecciated Neiba Fm. In the Upper Neiba Fm it is associated with *Lepidocyclina* (*Eulepidina*) *undosa* and *Nummulites* cf. *panamensis* and in the Catanamatías Fm and Barahona Mb it is associated with *Lepidocyclina* (*Eulepidina*) *undosa*.

Age. Some authors such as Eames *et al.* (1968) and Cole (1957c) place it in Oligocene, while others (Butterlin, 1981, 1984; Frost and Langenheim 1974) extend its range up to the Early Miocene.

Subgenus *Eulepidina* H. Douvillé, 1911
Lepidocyclina (*Eulepidina*) *undosa* CUSHMAN, 1919
Pl. 2, figs. 22, and 23

1933 *Lepidocyclina (Eulepidina) favosa* CUSHMAN, Vaughan, p. 37; Pl. 19, figs. 1, 2; Pl 20, figs. 1-3
1968 *Eulepidina undosa* (CUSHMAN), Eames *et al.*, p. 285; Pl. 49, figs. 6, 7 (topotypes)
1968 *Eulepidina favosa* (CUSHMAN), Eames *et al.*, p. 296; Pl. 57, fig. 6
1968 *Eulepidina undosa* (CUSHMAN) nov. subsp. *laramblaensis*, Eames *et al.*, p. 296; Pl. 57, figs. 7, 8
1974 *Lepidocyclina (Eulepidina) undosa* CUSHMAN, Frost and Langenheim, p. 165; Pl. 46, figs. 1, 2; Pl 47, figs. 1-7; Pl. 48, figs. 1-4; Pl. 49, figs. 1-4; Pl. 50, figs. 1-4
1993 *Lepidocyclina* (*Eulepidina*) *undosa* CUSHMAN, Robinson and Wright, p. 323, 325; Figs. 22.1-2
1996 *Lepidocyclina undosa* CUSHMAN, Caudri, p. 1224; Pl. 20, fig. 1; Pl. 21, fig. 1
1996 *Lepidocyclina favosa* CUSHMAN, Caudri, p. 1224; Pl. 20, figs. 2, 3; Pl. 21, fig. 2

Samples. Upper Neiba Fm (Arroyo Limón 5973-III-BR EB 9047, 9049 and 9050; Bánica 5873-II-BR JS 9022 and 9048; Jimaní 5871-III-IG JG 9007), Brecciated Neiba Fm (La Descubierta 5871-I-IG HH 9057, 9062, 9064 and 9065), Sombrerito Fm (Bánica 5873-II-BR JS 9008 and 9010) Barahona Mb (Jimaní 5871-III-IG JG 9009).

Remarks. *Lepidocyclina* (*Eulepidina*) *undosa* and *Lepidocyclina favosa*, two species defined by Cushman (1919, pp. 65-66), are always found together and show a complete morphological gradation. They are considered as morphotypes of the same species, *Lepidocyclina* (*Eulepidina*) *undosa* (Vaughan, 1928; Cole, 1952; Cole y Applin, 1961 - who formally defined *Lepidocyclina favosa* as a synonym- Frost and Langenheim 1974; Caudri, 1996). The morphotype "*favosa*" has a more inflated test, with a higher number of lateral chamberlets.

Similarly, *Lepidocyclina gigas* CUSHMAN 1919 is found always associated to *Lepidocyclina undosa* and it is considered its microspheric form (Vaughan, 1924, 1928; Cole, 1952; Frost and Langenheim 1974; Caudri, 1996), and thus, another synonym (Sachs and Gordon, 1962). Only few authors (e.g. Eames *et al.* 1968) consider them three different species.

Frost and Langenheim (1974) described a complete gradation between the two types, which they considered related to the environment. They find the "*undosa*" type in reef facies and the "*favosa*" type in inter-reef or back-reef facies. Following Frost and Langenheim (1974) the "*undosa*" type has few (7-8) layers of lateral chamberlets and reduced embryo dimensions (diameter of the deuteroconch between 500 and 875 µm), whereas the "*favosa*" type has a higher number of lateral layers (12-15), larger embryos (diameter of the deuteroconch between 975 and 1500 µm), a larger test size, larger equatorial chamberlets, and a selliform morphology. In their Text-figure 24, a plot of embryo dimensions, two groups (the inter-reef facies "*favosa*" type and the reef facies "*undosa*" type) are clearly differentiated,

but the supposed "complete morphologic gradation" is not so evident because they do not overlap, and the existence of two separate species cannot be discarded.

Distribution. In the Brecciated Neiba Fm *Lepidocyclina* (*Eulepidina*) *undosa* occurs with *Lepidocyclina* (*Lepidocyclina*) *mantelli.* In the Upper Neiba Fm it is associated with *Lepidocyclina* (*Lepidocyclina*) *mantelli* and *Nummulites* cf. *panamensis*. In the Barahona Mb it is associated with *Lepidocyclina* (*Lepidocyclina*) *mantelli.*

Age. Authors such as Vaughan (1933) Butterlin (1963) and Caudri (1996) place it in Oligocene. Others as Cole and Applin (1961), Eames *et al.* (1968), Butterlin (1981, 1984), Frost and Langenheim (1974), Robinson and Wright (1993) and De Mello e Sousa *et al.* (2003) extend its range up to the Early Miocene.

Subgenus *Nephrolepidina* H. Douvillé, 1911

Lepidocyclina (*Nephrolepidina*) cf. *chaperi* LEMOINE and R. DOUVILLÉ, 1904

Pl. 2, figs. 24 and 25

1952 *Lepidocyclina* (*Nephrolepidina*) *chaperi* LEMOINE and R. DOUVILLÉ, Cole, Pl. 8, figs. 5-8; Pl. 9, figs. 3-19; Pl. 10, figs. 1-10; Pl. 11, figs. 1-8; Pl. 12, figs 3-10; Pl. 20, figs. 8-10; Pl. 23, figs. 11-12

1974 *Lepidocyclina* (*Nephrolepidina*) *chaperi* LEMOINE and R. DOUVILLÉ, Frost and Langenheim, p. 161-165; Pl.45, figs. 1-6; Pl. 46, figs. 3, 4

1981 *Lepidocyclina* (*Nephrolepidina*) *chaperi* LEMOINE and R. DOUVILLÉ, Butterlin, p. 73, 75; Pl. 50, figs. 1-5

1993 *Lepidocyclina* (*Nephrolepidina*) *chaperi* LEMOINE and R. DOUVILLÉ, Robinson and Wright, p. 321; Figs. 22.5; 25.1-5

Samples. Upper Neiba Fm (Arroyo Limón 5973-III-BR EB 9052), Catanamatías Fm (Arroyo Limón 5973-III-BR EB 9048; Bánica 5873-II-BR JS 9009).

Remarks. This species has been included in the subgenera *Eulepidina* (e.g. Cole, 1963) and *Nephrolepidina* (e.g. Butterlin, 1981). See Cole (1952), Frost and Langenheim (1974), and Robinson and Wright (1993) for detailed description, figuration and discussion. The specimens from Sombrerito Fm (Bánica 9009) are larger than those from Neiba Superior Fm (Arroyo Limón 9052).

Distribution. *Lepidocyclina* (*Nephrolepidina*) cf. *chaperi* occurs in the breccias of the Cantanamatías Fm associated with *Fallotella cookei, Cushmania americana, Fabiania cassis, Amphistegina parvula, Eodictyoconus cubensis, Victoriella conoidea, Polylepidina antillea* and *Lepidocyclina* (*Lepidocyclina*) *macdonaldi*. In the Upper Neiba Fm it is associated with *Fallotella cookei*.

Age. The age of this form is Late Eocene according to Cole (1963) Butterlin (1963, 1981), Butterlin and Moullade (1968) and Robinson and Wright (1993), also latest Middle Eocene according to Frost and Langenheim (1974) and De Mello e Sousa *et al.* (2003).

Lepidocyclina (Nephrolepidina) tournoueri LEMOINE and R. DOUVILLÉ, 1904

1933 *Lepidocyclina* (*Nephrolepidina*) *tournoueri* LEMOINE and R. DOUVILLÉ, Vaughan, p. 25; Pl. 13, figs. 1, 2

1961a *Lepidocyclina* (*Eulepidina*) *tournoueri* LEMOINE and R. DOUVILLÉ, Cole, Pl. 32, fig. 5; Pl. 34, fig. 9; Pl. 35, fig. 3

1981 *Lepidocyclina* (*Nephrolepidina*) *tournoueri* Lemoine and R. Douvillé, Butterlin, p. 73-75 ; Pl. 51, figs. 1, 2, 4

Samples. Upper Neiba Fm (Arroyo Limón 5973-III-BR EB 9054), Sombrerito Fm (Bánica 5873-II-BR JS 9010).

Remarks. It is similar to small morphotypes of *Lepidocyclina* (*Lepidocyclina*) *canellei,* because it has similar morphology, equatorial section and an embryo of similar size. It can be distinguished form this species by the embryo, of nephrolepidine configuration, with a spherical protoconch embraced by a kidney-shaped deuteroconch, whereas *Lepidocyclina* (*Lepidocyclina*) *canellei* has two embryonic chambers of a similar size separated by a flat wall. Another characteristic of *Lepidocyclina* (*Nephrolepidina*) *tournoueri* is the tendency to form wavy to stellate annuli. According to Cole (1961a, p. 388) the stellate pattern of annuli is an intraspecific species, and as long it is the only character that differentiates "*Lepidocyclina* (*Eulepidina*) *tournoueri*" from *Lepidocyclina* (*Eulepidina*) *dartoni* VAUGHAN 1933, this latter species must be considered as a junior synonym of the first.

Distribution. *Lepidocyclina* (*Nephrolepidina*) *tournoueri* occurs in the Upper Neiba. In the Sombrerito Fm it is associated with *Lepidocyclina* (*Eulepidina*) *undosa* and *Lepidocyclina* (*Lepidocyclina*) *mantelli.*

Age. According to Vaughan (1933), Van de Geyn and van der Vlerk (1935), Cole (1952), and Eames *et al.* (1968) this form is Oligocene in age. Other authors such as Cole (1961a) and Butterlin (1984) extend its range up to the Early Miocene, or also to the Middle Miocene (Butterlin, 1981).

Subgenus *Pliolepidina* H. Douvillé, 1915
Lepidocyclina (*Pliolepidina*) cf. *peruviana* CUSHMAN, 1922
Pl. 2, figs. 26

1937 *Lepidocyclina* (*Pliolepidina*) *peruviana* CUSHMAN, Vaughan, Pl. 117, figs. 1-3; Pl. 118, figs. 2-8; Pl. 119, figs. 1-6; Pl. 120, figs. 1-4
1944 *Lepidocyclina* (*Pliolepidina*) *peruviana* CUSHMAN, Cole, p. 62; Pl. 15, figs. 11-10
1975 *Lepidocyclina peruviana* CUSHMAN, Caudri, p. 573-574; Pl. 25, figs. 5-14; Pl. 26, figs. 1-14
1996 *Lepidocyclina peruviana* CUSHMAN, Caudri, p. 1217; Pl. 6, fig. 12; Pl. 15, figs. 4, 6

Samples. Upper Neiba Fm (Bánica 5873-II-BR JS 9030).
Remarks. This species is difficult to distinguish from *Lepidocyclina* (*Lepidocyclina*) *pustulosa* in axial section, both species have the same stratigraphic range and have been put in synonymy by some authors (e.g. Cole, 1963). This species has been assigned to the subgenus *Pliolepidina* by some authors (e.g. Vaughan, 1937; Cole, 1944). For a discussion on the genus *Pliolepidina* see *Remarks* in *Lepidocyclina* (*Lepidocyclina*) *macdonaldi*.
Distribution. This form occurs in the Upper Neiba Fm associated with *Cushmania americana*, *Fallotella cookei, Amphistegina parvula, Fabiania cassis* and *Lepidocyclina (Lepidocyclina) macdonaldi.*
Age. According to Cole (1944), Klugler and Caudri (1975), Caudri (1975) this species occurs in the Late Eocene. Caudri (1996) extends its range to the latest Middle Eocene.

Genus *Polylepidina* Vaughan, 1924
Polylepidina antillea VAUGHAN, 1924
Pl. 3, fig. 1

1944 *Lepidocyclina* (*Polylepidina*) *antillea* VAUGHAN, Cole, p. 57; Pl. 1, figs. 18, 19; Pl. 6, figs. 10, 16; Pl. 10, figs. 1-8; Pl. 11, figs. 1-9; Pl. 12, figs. 1-4; Pl. 13, fig. 4
1956 *Lepidocyclina* (*Polylepidina*) *antillea* VAUGHAN, Cole, Pl. 27, fig. 9; Pl. 30, figs. 7, 8
1960a *Lepidocyclina* (*Polylepidina*) *antillea* VAUGHAN, Cole, Pl. 12, figs 1-8
1963 *Lepidocyclina* (*Polylepidina*) *antillea* VAUGHAN, Cole, Pl. 1, fig. 3; Pl. 6, fig. 1; Pl. 7, figs. 5-6
1964 *Lepidocyclina* (*Polylepidina*) *antillea* VAUGHAN, Cole, Pl. 5, fig. 2; Pl. 7, fig. 2, 4-6; Pl. 9, fig. 5-6
1981 *Lepidocyclina* (*Polylepidina*) *antillea* VAUGHAN, Butterlin, p. 69, 72; Pl. 44, figs. 1-3
1974 *Lepidocyclina* (*Polylepidina*) *antillea* Cushman, Frost and Langenheim, p. 121, Pl. 29, figs. 1-13; Pl 30, figs. 1-6; Pl. 31, figs. 1-6

Samples. Upper Neiba Fm (Bánica 5873-II-BR JS 9029), Catanamatías Fm (Bánica 5873-II-BR JS 9009).
Remarks. Cole (1944) considers as synonyms of *Lepidocyclina* (*Polylepidina*) *antillea* (defined in St Bartholomew) the following species: *adkinsi, chiapasensis, chiapasensis* var. *subplana* (from Mexico), *kinlossensis* (from Jamaica), and *gardnerae* (from Texas, Louisiana, Mississippi and Alabama), to which he adds later (Cole 1960a) *Eulinderina guayabalensis* (NUTALL 1930) and *Eulinderina semiradiata* BARKER and GRIMSDALE 1936. Robinson and Wright (1993) consider *Eulinderina antillea* (CUSHMAN 1919) and *Polylepidina chiapasensis* VAUGHAN 1924, to be two different species, differentiated by the kind of initial growth. The forms figured by Frost and Langenheim (1974) are compressed with few lateral chamberlets. However, studying topotypes of *Lepidocyclina* (*Polylepidina*) *antillea* and their variability in a single population ("in the number of periembryonic chambers, the size of these chambers, the length of the periembryonic coil and the thickness of the revolving wall adjacent to the embryonic chambers"), Cole (1960a) concluded that the genus *Eulinderina* (Barker and Grimsdale 1936) is a synonym of *Polylepidina*.
Distribution. *Polylepidina antillea* occurs in the Upper Neiba Fm associated with *Fallotella cookei, Eodictyoconus* cubensis, *Fabiania cassis* and *Polylepidina antillea*. In the breccias of the Cantanamatías Fm it is associated with *Eodictyoconus cubensis, Victoriella conoidea, Lepidocyclina* (*Nephrolepidina*) cf. *chaperi, Lepidocyclina* (*Lepidocyclina*) *macdonaldi* and *Polylepidina antillea*.
Age. According to Cole (1944, 1956), Butterlin and Moullade (1968), Butterlin (1981) and Frost and Langenheim (1974) this species occurs in the Middle Eocene.

Family LEPIDORBITOIDIDAE Vaughan, 1933
Genus *Penoperculinoides* Cole and Gravell, 1952
Penoperculinoides cubensis COLE and GRAVELL, 1952
Pl. 3, fig. 2

1952 *Penoperculinoides cubensis* n. gen. n. sp., Cole and Gravell, p. 714 ; Pl. 91, figs. 9-12
1981 *Penoperculinoides cubensis* COLE and GRAVELL, Butterlin, p. 36; Pl. 15, figs. 6-7

Samples. Brecciated Neiba Fm (La Descubierta 5871-I-IG HH 9060).
Remarks. The test is slightly trochoidal. The septa are straight and the roof of the chambers is rounded. The

diameter the proloculus is of about 0.60 mm, and the diameter of the test is about 1 mm for three whorls.
Distribution. *Penoperculinoides cubensis* occurs in the Brecciated Neiba Fm.
Age. According to Cole and Gravell (1952) and Butterlin (1981) this form occurs in the Middle Eocene.

Family MIOGYPSINIIDAE Vaughan, 1928
Genus *Miogypsina* Sacco, 1893
Miogypsina cf. *antillea* (CUSHMAN, 1919)
Pl. 3, fig. 4

1957b *Miogypsina* (*Miogypsina*) *antillea* CUSHMAN, Cole, p. 320-321; Pl. 26, figs. 6-7; Pl. 28, figs. 1-9; Pl. 29, figs. 1-9
1961 *Miogypsina* (*Miogypsina*) *antillea* CUSHMAN, Cole and Applin, p. 133; Pl. 7, figs. 1-7
1961b *Miogypsina* (*Miogypsina*) *antillea* CUSHMAN, Cole, p. 145; Pl. 8, figs. 7-11; Pl. 9, figs. 3, 4; Pl. 10, fig.1
1967 *Miogypsina antillea* CUSHMAN, Cole, Pl. 8, fig. 4; Pl. 9, figs. 6, 9
1981 *Miogypsina antillea* CUSHMAN, Butterlin, p. 43; Pl. 21, figs. 3-5

Samples. Barahona Mb (La Descubierta 5871-I-IG HH 9009).
Remarks. Species with embryo in marginal position, with well-developed lateral chamberlets, in tiers of up to 5 superposed chamberlets. Caudri (1996) reported a similar form from the Lower Miocene of Trinidad that she name *Miogypsina (Miogypsina) bramletti* GRAVELL 1933.
Distribution. This form occurs in the Barahona Mb associated with *Operculinoides* sp.
Age. According to Cole (1961b), Drooger (1952), Cole and Applin (1961), Butterlin (1963) this form occurs in the Early Miocene, Butterlin (1981) and De Mello e Sousa *et al.* (2003) extends its range up to Middle Miocene.

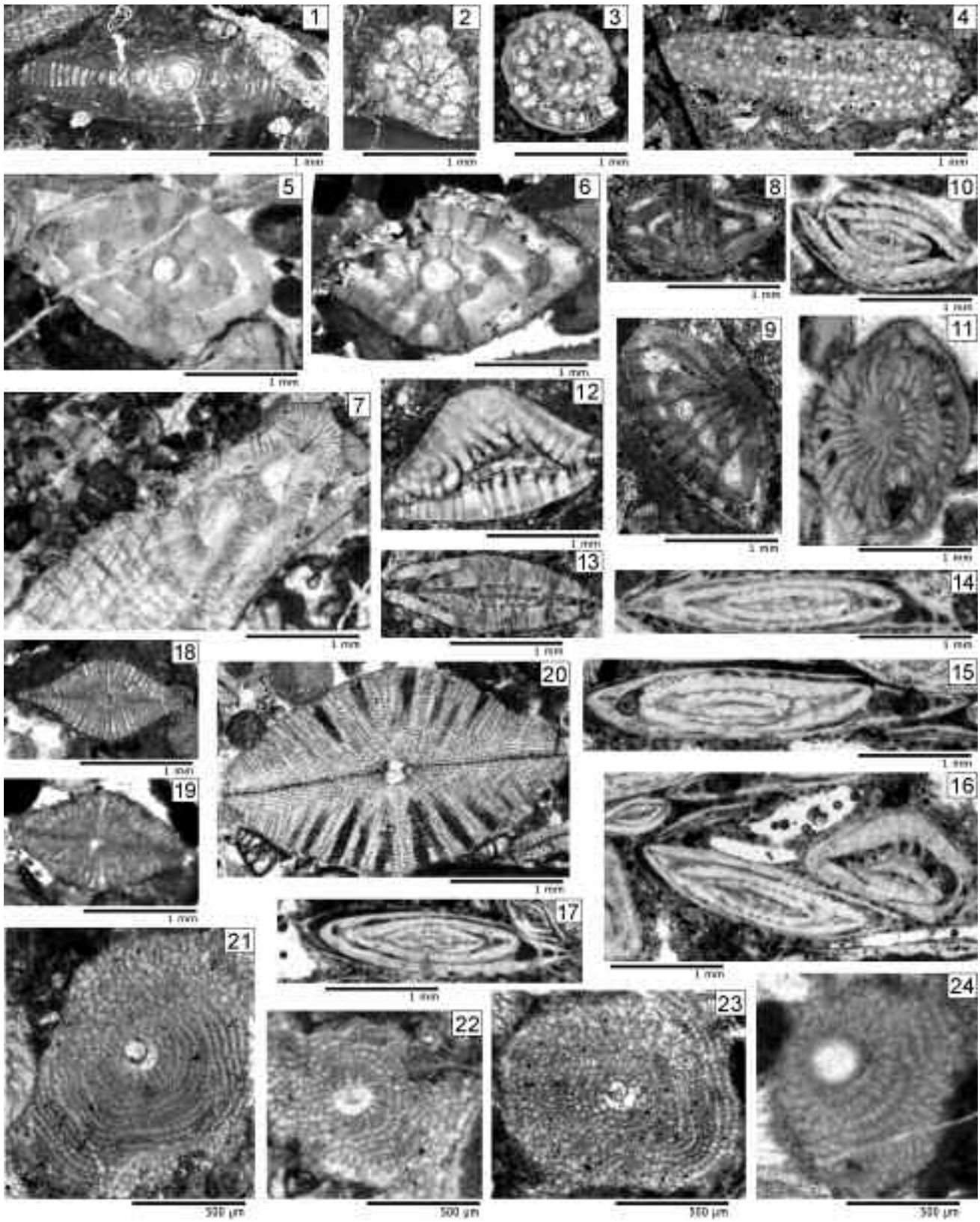
Family NUMMULITIDAE de Blainville, 1827
Genus *Ranikothalia* Caudri, 1944
Ranikothalia bermudezi (PALMER, 1934)
Pl. 3, figs. 5, 6 and 7

1934 *Operculina bermudezi* n. sp., Palmer, p. 238-240; Pl. 12, figs. 3, 6-9
1947 *Miscellanea antillea* (HANZAWA), Cole and Bermúdez, p. 195-196; Pl. 2, figs. 10-11
1953 *Operculinoides bermudezi* (PALMER), Cole, p. 35-37; Pl. 1, fig. 5-7; Pl. 2, fig. 4; Pl. 3, figs. 2-12
1960b *Camerina catenula* (CUSHMAN and JARVIS), Cole, Pl. 25, fig. 6
1966 *Camerina catenula* (CUSHMAN and JARVIS), Cole, Pl. 23, fig. 5; Pl. 26, figs. 1, 6
1981 *Ranikothalia bermudezi* (PALMER), Butterlin, p. 30, 33; Pl. 9, figs. 1-3
1993 *Ranikothalia catenula* (CUSHMAN and JARVIS), Robinson and Wright, p. 329-331; Figs 28.1-7
1997 *Ranikothalia bermudezi* (PALMER), Berlanga, p. 136-144; Pl. 28, figs. 1-6; Pl. 29, figs. 1-5
1999 *Ranikothalia catenula* (CUSHMAN and JARVIS), Blanco-Bustamante *et al.*, Pl. 1, figs. 1-3

Samples. Don Juan Fm (Monte Plata 6272-III-IG HH 9008), Loma Peñón Fm (Rincón Chavón 6472-III-IG JG 9002).
Remarks. Following Berlanga (1997), *Ranikothalia bermudezi* is characterized by a lenticular robust test with a great marginal cord and some piles in the umbonal zone. The diameter of the megalospheric test ranges from 1.90 to 2.75 mm and its height ranges from 1.25 to 1.35 mm. The diameter the proloculus ranges between 0.250-0.350 mm.
Distribution. *Ranikothalia bermudezi* occurs in the Don Juan Fm associated with *Neodiscocyclina grimsdale*. In the Loma Peñón Fm this form is associated with reworked Paleocene larger foraminifer as *Fallotella* sp., and with Eocene larger foraminifers as *Eoconuloides lopeztrigoi* and *Discocyclina marginata.*
Age. According to Berlanga (1997), Robinson and Wright (1993) and Serra-Kiel *et al.* (1998) *Ranikothalia bermudezi* is Late Paleocene.

Genus *Nummulites* Lamarck, 1801
Nummulites cf. *willcoxi* (HEILPRIN, 1882)
Pl. 3, figs. 8 and 9

1953 *Operculinoides willcoxi* (HEILPRIN), Cole, Pl. 1, figs. 8-10; Pl. 2, fig. 2
1958a *Operculinoides willcoxi* (HEILPRIN), Cole, p.273-276; Pl. 33, figs. 1, 3-12
1961b *Camerina willcoxi* (HEILPRIN), Cole, Pl. 17, figs. 1, 10
1964 *Camerina willcoxi* (HEILPRIN), Cole and Applin, p. 24; Pl. 4, figs. 9, 14-16
1966 *Camerina willcoxi* (HEILPRIN), Cole, Pl. 20, fig. 11; Pl. 22, fig. 3
1974 *Nummulites* (*Paleonummulites*) *willcoxi* HEILPRIN, Frost and Langenheim, p. 79-83; Pl. 13; Pl. 14
1981 *Nummulites willcoxi* HEILPRIN, Butterlin, p. 32; Pl. 11
1993 *Paleonummulites willcoxi* (HEILPRIN), Robinson and Wright, p. 333, 335; Figs. 29.6, 30.4-5
1997 *Nummulites* cf. *willcoxi* HEILPRIN, Berlanga, p. 165; Pl. 35, fig. 8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1 mm
500 µm

Samples. Upper Neiba Fm (Arroyo Limón 5973-III-BR EB 9053).

Remarks. We have only axial and oblique sections. The axial section is lenticular, slightly rhomboidal in outline and shows a marked marginal cord and some piles in the polar zone

Distribution. This form occurs in the Upper Neiba Fm associated with *Amphistegina parvula* and *Lepidocyclina* (*Lepidocyclina*) *macdonaldi*.

Age. According to Cole (1964, 1966), Butterlin (1971, 1981), Frost and Langenheim (1974) and Robinson and Wright (1993) this form ranges from the Middle to the Late Eocene.

Nummulites cf. *panamensis* CUSHMAN, 1918
Pl. 3, figs. 10 and 11

1958b *Operculinoides panamensis* (CUSHMAN), Cole, Pl. 25, figs. 1-2, 14-15
1966 *Camerina panamensis* (CUSHMAN), Cole, Pl. 20, figs. 1-10, 12; Pl. 25, fig. 5
1974 *Nummulites* (*Paleonummulites*) *panamensis* CUSHMAN, Frost and Langenheim, p. 84-89; Pls. 15, 16, 17
1981 *Nummulites panamensis* CUSHMAN, Butterlin, p. 12; Pl. 10, figs. 11-12

Samples. Brecciated Neiba Fm (Galván 5971-IV-IG HH 9034); Upper Neiba Fm (Bánica 5873-II-BR JS 9022 and 9048).

Remarks. Planispiral-involute forms with slightly operculiniform growth. The chambers are higher that wide. The septa are straight in the bottom and middle part and strongly oblique in the top of the chamber. The specific determination is not confirmed because of the absence of centred equatorial sections.

Distribution. This species occurs in the Brecciated Neiba Fm associated with *Heterostegina* cf. *antillea.* In the Upper Neiba Fm it is associated with *Lepidocyclina* (*Eulepidina*) *undosa*, *Lepidocyclina* (*Lepidocyclina*) *mantelli* and *Lepidocyclina* (*Lepidocyclina*) *canellei.*

Age. According to Cole (1966), Butterlin (1981), Frost and Langenheim (1974) and De Mello e Sousa *et al.* (2003) this species occurs in the Oligocene.

Genus *Heterostegina* d'Orbigny, 1826
Heterostegina cf. *antillea* CUSHMAN, 1919
Pl. 3, figs. 12 and 13

1957b *Heterostegina antillea* CUSHMAN, Cole, p. 327; Pl. 25, figs. 3-5
1974 *Heterostegina antillea* CUSHMAN, Frost and Langenheim, p. 90-92; Pl. 18
1971 *Heterostegina antillea* CUSHMAN, Butterlin, Pl. 5, figs. 1-4
1981 *Heterostegina antillea* CUSHMAN, Butterlin, p. 32; Pl. 12, figs. 1-2
1993 *Heterostegina* (*Vlerkina*) *antillea* CUSHMAN, Robinson and Wright, p. 337; Figs. 31.3, 31.5
1996 *Heterostegina antillea* CUSHMAN, Caudri, Pl. 8, fig. 6; Pl. 11, fig. 8
2003 *Heterostegina antillea* CUSHMAN, De Mello e Sousa *et al.*, Pl. 1, figs. 8-9

Samples. Brecciated Neiba Fm (Galván 5971-IV-IG HH 9034), Upper Neiba Fm (Bánica 5873-II-BR JS 9001; Galván 5971-IV-IG HH 9012; La Descubierta 5871-I-IG HH 9023).

Remarks. Nummulitid that shows chambers subdivided into chamberlets in equatorial section. Because of the lack of centred equatorial sections it could not be determined at the specific level.

Distribution. *Heterostegina* cf. *antillea* occurs in the Brecciated Neiba Fm associated with *Nummulites* cf.

Plate 3. Systematics III
Plancha 3. Sistemática III

1.- *Polylepidina antillea* VAUGHAN, 1924. Bánica 5873-II-BR JS 9009, x20
2.- *Penoperculinoides cubensis* COLE and GRAVELL, 1952. La Descubierta 5871-I-IG HH 9060, x20
3.- *Eoconuloides lopeztrigoi* (PALMER, 1934). Galván 5971-IV-IG HH 9032, x20
4.- *Miogypsina* cf. *antillea* (CUSHMAN, 1919). La Descubierta 5871-I-IG HH 9009, x20
5, 6.- *Ranikothalia bermudezi* (PALMER, 1934). Monte Plata 6272-III-IG HH 9008, x20
7.- *Ranikothalia bermudezi* (PALMER, 1934). Rincón Chavón 6472-III-IG JG 9002, x20
8, 9.- *Nummulites* cf. *willcoxi* (HEILPRIN, 1882). Arroyo Limón 5973-III-BR EB 9053, x20
10, 11.- *Nummulites* cf. *panamensis* CUSHMAN, 1918. Galván 5971-IV-IG HH 9034, x20
12, 13.- *Heterostegina* cf. *antillea* CUSHMAN, 1919. 12: La Descubierta 5871-I-IG HH 9023, x20; 13: Bánica 5873-II-BR JS 9001, x20
14, 15, 16, 17.- *Operculinoides* cf. *bullbrooki* VAUGHAN and COLE, 1941. Mao 5974-I-BR EB 9031, x20
18-19.- *Neodiscocyclina barkeri* (VAUGHAN and COLE, 1941). Monte Plata 6272-III-IG HH 9008, x20
20.- *Discocyclina marginata* (CUSHMAN, 1919). Rincón Chavón 6472-III-IG JG 9002, x20
21-23.- *Neodiscocyclina barkeri* (VAUGHAN and COLE, 1941). Rincón Chavón 6472-III-IG JG 9023, x40
24.- *Neodiscocyclina grimsdalei* VAUGHAN and COLE, 1941. Monte Plata 6272-III-IG HH 9008, x40

panamensis. In the Upper Neiba Fm it is associated with *Miogypsina* sp. and *Sphaerogypsina globula.*
Age. According to Cole (1957b), Butterlin (1971), Robinson and Wright (1993) and Caudri (1996) this species occurs in the Oligocene. Others (Butterlin 1963, 1981; Frost and Langenheim 1974 and De Mello e Sousa *et al.* 2003) extend its range up to the top of the Early Miocene.

Genus *Operculinoides* Hanzawa, 1935
Operculinoides cf. *bullbrooki* VAUGHAN and COLE, 1941
Pl. 3, figs. 14, 15, 16 and 17

1941 *Operculinoides bullbrooki* VAUGHAN and COLE, Vaughan and Cole, p. 44; Pl. 11, figs. 6-7; Pl. 12, figs. 4-5
1957a *Amphistegina bullbrooki* VAUGHAN and COLE, Cole, p. 37-38; Pl. 5, figs. 6-7
1996 *Operculinoides bullbrooki* VAUGHAN and COLE, Caudri, p. 1191; Pl. 10, figs. 13-14

Samples. Gurabo Fm (Mao 5974-I-BR EB 9031), Cercado Fm (Monción 5974-II-BR FC 9064).
Remarks. Planispiral-involute forms with slightly operculiniform growth. The axial section is flat lenticular. The absence of centred equatorial sections did not allow us to verify the specific determination.
Distribution. This form occurs in the Gurabo Fm associated with *Sphaerogypsina globula, Cubanina* sp. and *Miosorites americanus*. In the Cercado Fm it is associated with *Cubanina* sp.
Age. According to Butterlin (1981) this species ranges from the Middle Miocene to the Pliocene, Caudri (1996) extends the range to the Early Miocene.

Family DISCOCYCLINIDAE Galloway, 1928
Genus *Discocyclina* Gümbel, 1870
Discocyclina marginata (CUSHMAN, 1919)
Pl. 3, figs. 20

1952 *Discocyclina (Discocyclina) marginata* (CUSHMAN), Cole and Gravell, p. 714; Pl. 93, figs. 1-9; Pl. 94, figs. 1-8; Pl. 95, figs. 7, 8
1964 *Discocyclina (Discocyclina) marginata* (CUSHMAN), Cole, Pl. 10, figs. 1-8

Samples. Loma Peñón Fm (Rincón Chavón 6472-III-IG JG 9002 and 9023), Upper Neiba Fm (Galván 5971-IV-IG HH 9030).
Remarks. This species originally was described by Cushman (1919) as *Orthophragmina marginata* from the Eocene of Saint Bartholomew. Vaughan (1945) reassigned this species to *Pseudophragmina (Proporocyclina) marginata* because of the alignment of the radial septula. However, as pointed out by Cole and Gravell (1952), this is a feature visible only in the external annuli whereas the inner ones show the alternate arrangement of septula usual in *Discocyclina*. A revision of the species can be found in Cole and Gravell (1952), who regard *Discocyclina crassa* (CUSHMAN 1919), *Discocyclina harrisoni* VAUGHAN 1945, and *Discocyclina californica* (SCHENCK 1929) as junior synonym of *Discocyclina marginata*.
Distribution. This form occurs as well as *Fallotella* sp. and *Ranikothalia bermudezi* as reworked Paleocene forms in the Loma Peñón Fm associated with larger Eocene larger foraminifers such as *Eoconuloides lopeztrigoi, Eoconuloides wellsi* and *Neodiscocyclina barkeri*. In the Upper Neiba Fm this form is associated with *Coleiconus elongatus, Fallotella cookei, Eoconuloides lopeztrigoi* and *Amphistegina parvula.*
Age. According to Vaughan (1945), Cole and Gravell (1952), Cole (1964) and Butterlin and Moullade (1968) the age of this species is Middle Eocene.

Family ORBITOCLYPEIDAE Brönnimann, 1946
Genus *Neodiscocyclina* Caudri, 1972
Neodiscocyclina barkeri (VAUGHAN and COLE, 1941)
Pl. 3, figs. 18, 19, 21-23

1941 *Discocyclina barkeri* n. sp. Vaughan and Cole, Pl. 18, figs. 4-7; Pl. 21, figs 1-2
1945 *Discocyclina* (*Discocyclina*) *barkeri* VAUGHAN and COLE, Vaughan, p. 31-32; Pl. 6, figs. 1-10
1947 *Discocyclina* (*Discocyclina*) *barkeri* VAUGHAN and COLE, Cole and Bermúdez, p. 12-14; Pl. 4, figs. 1-5; Pl. 5, figs. 7-10
1975 *Neodiscocyclina barkeri* (VAUGHAN and COLE), Caudri, p. 550-551; Pl. 3, figs. 7, 9; Pl. 14, figs.1-4, 6-10; Pl. 23, fig. 1
1996 *Neodiscocyclina barkeri* (VAUGHAN and COLE), Caudri, p. 1205; Pl. 12, fig. 11

Samples. Loma Peñón Fm (Rincón Chavón 6472-III-IG JG 9023).
Remarks: Detailed description and figures of this species can be found in Cole and Bermúdez (1947) and Vaughan (1945).
Distribution. This species occurs in the Loma Peñón Fm associated with *Eoconuloides lopeztrigoi, Eoconuloides wellsi* and *Discocyclina marginata.*
Age. The age of this form is Paleocene according to Vaughan (1945), Caudri (1975, 1996) and Kugler and Caudri (1975), also Early Eocene according to Vaughan

and Cole (1941), Cole and Bermúdez (1947), Butterlin (1981) and Blanco-Bustamante *et al.* (1999, no fig.)

Neodiscocyclina grimsdalei VAUGHAN and COLE, 1941
Pl. 3, fig. 24

1945 *Discocyclina grimsdalei* VAUGHAN and COLE, Vaughan 1945, p. 39-42; Pl. 6, figs. 11-12; Pl. 13, Figs 1-6
1975 *Neodiscocyclina grimsdalei* (VAUGHAN and COLE), Caudri, p. 552-553; Pl. 3, figs. 8; Pl. 15; Pl. 23, fig. 2
1996 *Neodiscocyclina grimsdalei* (VAUGHAN and COLE), Caudri, p. 1203, Pl. 12, fig. 7

Samples. La Luisa Fm (Monte Plata 6272-III-IG HH 9008).
Remarks: This species is similar, in equatorial section, to the also Paleocene species *Discocyclina weaveri* VAUGHAN 1929, from which it differs in the number of chamberlets of the first annulus, higher in *Neodiscocyclina grimsdalei*, and in the morphology of the equatorial chamberlets, rectangular in *Neodiscocyclina grimsdalei*, and quadrangular in *Discocyclina weaveri* VAUGHAN 1929.
Distribution. This form occurs in the La Luisa Fm associated with *Ranikothalia bermudezi.*
Age. According to Vaughan (1945), Caudri (1975, 1996) and Kugler and Caudri (1975) this species occurs in the Paleocene

Conclusions

The systematic and biostratigraphic study of the Cainozoic larger foraminifers from the Dominican Republic allowed to recognize associations and to define chronostratigraphic intervals.

In the Don Juan basin (La Luisa Fm, Monte Plata sheet, Fig. 1) the presence of *Ranikothalia bermudezi* and *Neodiscocyclina grimsdalei* permits to identify the Late Paleocene (Thanetian). The same association is found reworked within Middle Eocene rocks in the Bejucal basin (Loma Peñón Fm, Rincón Chavón sheet, Fig. 1). The Loma Peñón Fm also contains *Eoconuloides wellsi, Eoconuloides lopeztrigoi* and *Neodiscocyclina barkeri,* an association typical of the Early Eocene. However, the presence of *Discocyclina marginata* in the same samples indicates that this association is reworked within the Middle Eocene.

A chronostratigraphic framework for the western Dominican Republic has been elaborated from the following larger foraminifer associations (Fig. 2):

Lower Neiba Fm

The association of *Eoconuloides wellsi, Eoconuloides lopeztrigoi* and *Fabiania cassis* characterizes the Middle Eocene

Upper Neiba Fm and the Brecciated Neiba Fm

The association of *Coleiconus elongatus, Fallotella cookei, Cushmania puilboreauensis, Cushmania americana, Fabiania cassis, Eoconuloides lopeztrigoi, Amphistegina parvula, Discocyclina marginata, Polylepidina antillea* and *Penoperculinoides cubensis* characterizes the Middle Eocene in the lower part of these units.

The association of *Fallotella cookei, Cushmania americana, Fabiania cassis, Amphistegina parvula, Lepidocyclina (Lepidocyclina) macdonaldi, Lepidocyclina (Nephrolepidina)* cf. *chaperi, Lepidocyclina (Pliolepidina)* cf. *peruviana* and *N.* cf. *willcoxi* characterizes the Middle-Late Eocene in the middle part of these units.

The upper part of these units renders an association composed of *Nummulites* cf. *panamensis, Heterostegina* cf. *antillea, Lepidocyclina* (*Lepidocyclina*) *mantelli, Lepidocyclina* (*Lepidocyclina*) *canellei, Lepidocyclina* (*Eulepidina*) *undosa* and *Lepidocyclina* (*Nephrolepidina*) *tournoueri,* typical of the Oligocene in middle shelf facies.

In the shallow carbonate environments, the same lithostratigraphic units are characterized by archaiasinids, *Praerhapydionina* cf. *delicata* and *Discorinopsis* sp., which indicate an Oligocene age.

The association of *Lepidocyclina* (*Lepidocyclina*) *mantelli* and *Lepidocyclina* (*Eulepidina*) *undosa* indicates an Oligocene-Early Miocene age in middle-outer shelf.

Catanamatías Fm and Sombrerito Fm

Reworked casts and blocks within the Catanamatías Fm contain *Fallotella cookei, Cushmania americana, Fabiania cassis, Eodictyoconus cubensis, Amphistegina parvula, Victoriella conoidea, Polylepidina antillea, Lepidocyclina* (*Lepidocyclina*) *macdonaldi* and *Lepidocyclina* (*Nephrolepidina*) cf. *chaperi,* which indicate a Middle-Late Eocene age.
The presence of *Lepidocyclina* (*Nephrolepidina*) *tournoueri* in turbidites of the Catanamatías Fm and Sombrerito Fm indicates an Oligocene-earliest Middle Miocene age.

Barahona Mb of Sombrerito Fm

The Barahona Mb of Sombrerito Fm is ascribed to the Early-Middle Miocene by the presence of *Miogypsina* cf. *antillea* and *Miarchaias floridanus.*
The association of *Miarchaias floridanus, Miosorites americanus, Annulosorites spiralis* and *Operculinoides* cf. *bullbrooki* in the upper part of this formation indicates a Middle-Late Miocene age.

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