Hubach.

REPORT ON A COLLECTION OF LARGER FORAMINIFERA FROM VENEZUELA

BY

R. WRIGHT BARKER

Bogotá, Colombia
September 1938.

CONTENTS

INTRODUCTION

Early in 1938 a collection of slides of larger foraminifera was received from Venezuela for examination by the writer. The work was carried out at intervals as routine work in Tampico permitted and was approaching completion when the offices were taken over by Petroleos Mexicanos on March 19th. The collection could not be taken out of the office but an arrangement was made with the local manager of Petroleos Mexicanos that as soon as possible all the Venezuelan material should be returned to Maracaibo as it was not the property of the Compañia de Petroleo "El Aguila".

Fortunately, the notes made were removed from the office shortly before the property was seized, with the greater part of the necessary photographs. From this rather scanty material the present report has been compiled, but owing to the writer being moved from Mexico, there has been considerable delay in completing the account. It should be pointed out that it was not possible to revise the results with a final re-examination of the material, and as a result of this, the report leaves much to be desired as a great deal of the material was in the form of rock sections which require considerable study for accurate determinations.

Nothing has been heard of the material and a letter to Tampico has not yet been answered, but it is hoped that the collection will eventually be recovered and forwarded to Maracaibo.

PART I.

COLLECTION OF SLIDES FROM THE SUCRE DISTRICT

1. - THE SUCRE DISTRICT

A number of slides and loose larger foraminifera (Lepidocyclina, Operculinoides and Asterocyclina) collected by Dr. E. P. Schlaich, Dr. Blumenthal and Dr. Dufour from various localities make up the collection from the Sucre District. These, with the exception of the sample labelled Dr. Blumenthal, Outcrop No. 89, have been determined as Upper Eocene, and are probably to be referred to the Mene Grande Series referred to by Gorter and van der Vlerk (Lit. No. 7, 1932) and by L.W.F. Nuttall (Lit. No. 15, 1935) which is probably of the same age as the Guayaval Series (Cerro Campaña Limestone) of D. W. Gravell (Lit. No. 9, 1933).

The following species have been identified from the samples referred to the Upper Eocene:

Amphistegina sp. (may be A.lessonii d'Orb.)
Amphistegina aff. cubensis Palmer
Asterocyclina maracaibensis Gorter and v.der Vlerk
Camerina jacksonensis Gravell and Hanna var.globosa Barker (in the press)

Carpenteria sp.
Discocyclina flintensis (Cushman)
Discocyclina floridana (Cushman)
Gypsina globulus (Reuss)
Helicolepidina spiralis Tobler
Lepidocyclina kugleri Gorter and v.der Vlerk
Lepidocyclina cf. macdonaldi Cushman
Lepidocyclina schotborghi Rutten and Vermunt
Lepidocyclina sp. of group L.peruviana Cushman and L.r. douvillei Lisson.

Lepidocyclina trinitatis Douvillé
Operculinoides n.sp. allied to O.jennyi Barker ms.

The assemblage as a whole is very clearly Upper Eocene in age, agreeing well with similar assemblages in Mexico and in the Caribbean region as a whole.

SUCRE DISTRICT - DR. DUFOUR'S COLLECTION

Sample No. 9: (7 slides)

Helicolepidina spiralis Tobler
?Lepidocyclina sp.
Operculinoides sp.
Amphistegina cf. cubensis Palmer

Age: Upper Eocene

Sample No. 16: Upper Rio San Juan

Amphistegina sp.
Camerina jacksonensis Gravell and Hanna
Carpenteria sp.
Gypsina globulus (Reuss)
Helicolepidina spiralis Tobler
Lepidocyclina cf. r.douvillei Lisson
Archaeolithothamnium sp.

Age: Upper Eocene

Sucre District - Dr. Dufour's Collection (cont'd.)

Sample No. 16 R.1 (3 slides)

Amphistegina sp.
Carpenteria sp.
Lepidocyclina cf. r.douvillei Lisson.
Operculinoides sp.
Archaeolithothamnium sp.

Age: Upper Eocene?

Sample No. 16 R.2

Amphistegina sp.
Camerina sp.
Carpenteria sp.
Gypsina globulus (Reuss)
Helicolepidina spiralis Tobler
Archaeolithothamnium sp.

Age: Upper Eocene

SUCRE DISTRICT - DR. SCHLAICH'S COLLECTION

Outcrop No. 173

Asterocyclina maracaibensis Gorter and van der Vlerk
Lepidocyclina kugleri Gorter and van der Vlerk
Lepidocyclina cf. maracaibensis Hodson
Lepidocyclina trinitatis Douvillé
Operculinoides aff. jennyi Barker Ms.

Age: Upper Eocene

Outcrop No. 182 (5 thin sections)

Amphistegina aff. cubensis Palmer
Archaias aduncus (F. & M.)
Asterocyclina maracaibensis Gorter and van der Vlerk
Discocyclina cf. floridana (Cushman)
Lepidocyclina schotborghi Rutten and Vermunt
Lepidocyclina trinitatis Douvillé
Planularia sp.

Age: Upper Eocene

Outcrop No. 183 (28 thin sections, 7 slides)

Amphistegina aff. cubensis Palmer
Asterocyclina maracaibensis Gorter and van der Vlerk
Camerina jacksonensis Gravell and Hanna var.Globosa Barker ms.
Carpenteria sp.
Discocyclina cf. floridana (Cushman)
Gypsina globulus (Reuss)
Lepidocyclina cf. macdonaldi Cushman
Lepidocyclina r. douvillei Lisson
Lepidocyclina schotborghi Rutten and Vermunt
Lepidocyclina trinitatis Douvillé
?Pliolepidina tobleri Douvillé

Age: Upper Eocene

Sucre District - Dr. Schlaich's Collection (cont'd.)

Outcrop No. 185

Asterocyclina maracaibensis Gorter & van der Vlerk
Lepidocyclina kugleri Gorter and van der Vlerk
Lepidocyclina trinitatis Douvillé
Operculinoides aff. jennyi Barker Ms.

Age: Upper Eocene

Outcrop No. 186

Lepidocyclina cf. kugleri Gorter & van der Vlerk
Lepidocyclina trinitatis Douvillé
Lepidocyclina pustulosa Douvillé (Microspheric L.trinitatis)

Age: Upper Eocene

Outcrop No. 187

Lepidocyclina kugleri Gorter and van der Vlerk
Lepidocyclina trinitatis Douvillé
Lepidocyclina pustulosa Douvillé
Operculinoides aff. jennyi Barker Ms.

Age: Upper Eocene

Outcrop No. 188 (4 thin sections)

Lepidocyclina schotborghi Rutten and Vermunt
Lepidocyclina trinitatis Douvillé

Age: Upper Eocene

Outcrop No. 215

Lepidocyclina schotborghi Rutten and Vermunt

Age: Upper Eocene

Outcrop No. 241 (2 cardboard slides)

Lepidocyclina trinitatis Douvillé
Lepidocyclina cf. kugleri Gorter and van der Vlerk

Age: Upper Eocene

Outcrop No. 242

Camerina jacksonensis Gravell and Hanna var.globosa Barker Ms.
Carpenteria sp.
Gypsina globulus (Reuss)
Lepidocyclina cf. peruviana Cushman
Lepidocyclina trinitatis Douvillé and vars.
Operculinoides aff. jennyi Barker Ms.
Archaeolithothamnium sp.

Age: Upper Eocene

SUCRE DISTRICT - DR. BLUMENTHAL'S COLLECTION

Sample No. 85 - consisting of five slides marked 85a - 85e

Slides 85a, 85b, show the following:

Sucre District - Dr. Blumenthal's Collection (cont'd.)

Camerina sp.
Carpenteria sp.
Gypsina globulus (Reuss)
Gypsina aff. vesicularis (P.& J.) var. discus Goës
Helicolepidina paucispira Barker and Grimsdale
Lepidocyclina of L.peruviana-l.r.douvillei Group
Operculinoides sp.

Slide 85c:-

Lepidocyclina sp.indet
Operculinoides sp.

Slides 85d, 85e (Rio San Juan):-

Camerina sp.
Helicolepidina spiralis Tobler (cf.var.tenuis Hodson)
Lepidocyclina sp.

Age: Upper Eocene

Note: Helicolepidina spiralis and H.paucispira are considered to be sufficient indication of the Upper Eocene age of slides 85a, 85b, 85d and 85e. Slide 85c must be considered as indeterminate in the opinion of the writer.

Sample No. 89, consisting of seven thin sections.

The slides show only transverse sections of several species of Discocyclina, and the absence of median sections renders specific identification difficult and uncertain. It seems, however, that we are dealing with the following species:

Discocyclina cf. advena (Cushman)
Discocyclina cf. clarki (Cushman)
Discocyclina nov.spp.

D.advena (Pl.II,pgs. 1, 2, 6-8) was originally described from the St. Maurice Formation (Claiborne) of Louisiana and has since been found in the Cook Mountain Eocene (Claiborne) in Northeastern Mexico and in the Guayabal (also Claiborne) of the southern part of the Tampico Embayment (San Pedro Miradores area). D.clarki (Pl.I, pgs.5-8) was originally described from the Middle Eocene of California and has since been found by the writer in beds of Cook Mountain age in Northeastern Mexico. The age of the sample in question is therefore considered to be Middle Eocene.

The new species seem to be two in number, for convenience termed Discocyclina A and Discocyclina B. Discocyclina A is a large, very thin species, reaching a diameter of 14.0 mm. or more, and showing many rather well developed pillars (see Pl.II, pgs. 3-5). The test thickens toward the centre and the test may be slightly umbonate. It is quite distinct from any other American species of Discocyclina seen by the writer. Discocyclina B (Pl.II, pg. 9) shows sections not unlike very large specimens of D.flintensis (Cushman) which may be allied to D.cloptoni

Vaughan, but no material of the latter was available for comparison and in the absence of median sections it is not possible to identify this form. Transverse sections of a small complanate Operculina were also observed but were not identified.

In the accompanying photographs some Mexican specimens are figured for comparison with the material from Venezuela.

Age: Middle Eocene.

NOTES ON SOME SPECIES FROM THE SUCRE DISTRICT (UPPER EOCENE)

The following short notes summarise a few of the more important points regarding the principal species observed in the collection of Upper Eocene foraminifera from the Sucre District.

ASTEROCYCLINA MARACAIBENSIS

Gorter and v.d.Vlerk

Plate III figs.1-4

1932. Asterocyclina maracaibensis Gorter and v.d.Vlerk, Leidsche Geol.Meded.,Dl.IV,Afl.2,p.113,pl.xvii figs.1-3.

This species seems to be readily distinguishable in a number of the sections examined, agreeing quite well with the original figures and description, but there is some doubt as to its relation to other American species of Asterocyclina. It seems very probable that A.maracaibensis should be grouped with A.chipolensis Vaughan, 1928, and A.monticellensis Cole and Ponton, 1934. In a recent personal communication Vaughan and Cole give their opinion that A.maracaibensis may be synonymous with "Cisseis" aurarensis Hodson, 1926, but the writer regards this as uncertain, since the latter species shows longer 'arms', stronger papillation and other variations. A.chipolensis is from the Upper Eocene of Florida, A.monticellensis from Eocene of uncertain horizon in Florida and A.aurarensis is presumably from Upper Eocene in Venezuela, judging from the associated assemblage.

It is not considered necessary to add to the original description of Gorter and van der Vlerk, beyond pointing out the similarity of A.maracaibensis to other American species of Asterocyclina, and emphasise the restriction of the species (on available evidence) to Upper Eocene.

OPERCULINOIDES aff. JENNYI Barker Ms.

Plate I, figs. 1-3

A common form in the collection of Dr. Schlaich was a species of Operculinoides, which, in spite of considerable work on American members of this genus, could not be identified specifically. In many ways there is a resemblance to a Middle Eocene species from Mexico, which has been given a manuscript name of O.jennyi by the writer, but the two are not identical. It is a rather primitive type, very compressed, completely involute but showing the volutions on the exterior, diameter approximately 5.0mm.

Sections show the presence of between three and four whorls, the

spiral opening gradually, with 20 to 23 chambers in the final whorl. The septa are somewhat irregular but in general are slightly oblique, curved throughout their length, and enter the outer wall of the whorl at a very oblique angle (see figures).

Operculinoides jennyi is a very irregular species and examples have been found which approach very closely to the Venezuelan material. O.jennyi, however, ranges throughout the Middle Eocene, and to the writer's knowledge has never been reported from the Upper Eocene. There is some resemblance to the species from Venezuela erroneously compared to O.cookei by Gravell but the specimens examined in Dr. Schlaich's collection show consistently fewer chambers per whorl. A closer resemblance is shown by figures of an Upper Eocene species from Ecuador which Dr. Vaughan has referred to O.nummulitiformis Rutten, but which is actually distinct from that species and may very probably be new. From the assemblage there is no doubt that the species considered here is Upper Eocene in age, and it may prove to be new.

LEPIDOCYCLINA

The abundant Lepidocyclina in the Upper Eocene of Venezuela appear to fall into two principal groups:

(A) Group of Lepidocyclina trinitatis Douvillé
- L.trinitatis H.Douvillé
- L.pustulosa H.Douvillé (microspheric form of trinitatis)
- L.r.douvillei Lisson
- L.peruviana Cushman
- L.kugleri Gorter and van der Vlerk

(B) Group of Lepidocyclina schotborghi Rutten and Vermunt.
- L.schotborghi Rutten and Vermunt
- L.ariana Cole and Ponton
- L.maracaibensis Hodson
- L.weeksi Hodson
- L.Zuliana Hodson

Unfortunately, the poor descriptions and inadequate figures for the greater part of these species has led to a great confusion in both groups, the synonymies being contradictory and uncertain. Vaughan has done much towards elucidating the identity of many of the American species and has recently dealt at length with some of the Ecuadorean and Peruvian forms (see G. Sheppard, "Geology of South Western Ecuador", London, 1937). But the situation has been plunged into further confusion by van der Geyn and van der Vlerk in a recent monograph on American Orbitoididae (Lit. No. B(8)).

The writer regards L.trinitatis, L.kugleri and L.peruviana as distinct, though L.kugleri may perhaps be a mutant of trinitatis. L.r.douvillei is regarded as a synonym of L.peruviana but owing to taxonomic difficulties it is uncertain which name has priority. The group as a whole is of Upper Eocene age and generally shows a distinct tendency towards duplication of the median layer, a character which is seen at its best in L.kugleri. It has also been observed in L.trinitatis but to a less and more variable degree (specimens referred to L.trinitatis by Vaughan, Lit.A(2), pl.xlix, figs.10-13, showing marked duplication are believed to be L.kugleri). This duplication is more strongly developed in two new genera, Pseudolepidina, Barker and Grimsdale, from the Middle Eocene, and Triplalepidina Vaughan from the

Upper Eocene of Mexico, both of which, but especially the latter, are probably related to the group under discussion. It is believed that the species, which are all very variable, may be said to intergrade to some extent and the specific identification is in many cases extremely difficult. As all the species have approximately the same range, however, the question of specific differentiation is of little importance in economic work.

Group B shows similar difficulties in specific differentiation and the various 'species' listed in this group are thought by the writer to be variants or mutants of one specific stock. This has been named L.schotborghi since this species has been well described and figured by Rutten and Vermunt, although if the five names mentioned under Group B are synonyms then priority must be given to one of the names put up by Hodson in 1926. Vaughan has given an opinion that L.kugleri is synonymous with L.maracaibensis and van der Geyn and van der Vlerk also use this synonymy and in addition place L.ariana and L.schotborghi in the synonymy of L.trinitatis, thus confusing Group A with Group B. It will be clear from the above that the writer is not in agreement with Vaughan and van der Geyn and van der Vlerk on these points, but the differentiation is left to the figures given (see Pls. IV-VII and published figures of the various species) as the detailed discussion of the various synonymies and specific differences would occupy too much space in the present report. It is believed that both groups may be considered typical of Central and South American Upper Eocene.

LEPIDOCYCLINA cf. MACDONALDI Cushman

1918. Lepidocyclina macdonaldi Cushman, U.S.Nat.Mus., Bull. 103, p.94, pl. xl figs.1-6.

1933. Lepidocyclina macdonaldi Cushman; Gravell, Smithson. Misc.Coll. Vol.LXXXIX, No.11, p.25,pl. v figs. 1-3 (see for further references).

Some sections in the rock slices examined may perhaps belong to this species, judging from the figures given by Cushman but unfortunately, the original description is somewhat inadequate. Gravell's later figures are unaccompanied by a description and the figures themselves appear to represent two species, of which one (pl.v, figs. 1 and 3) may be L.macdonaldi Cushman and the other perhaps L.trinitatis Douvillé, but from the figures alone these identifications are open to doubt.

Large numbers of a species identified as L.macdonaldi were found in beds of Upper Eocene age in Mexico (San José de Acateno area, etc.) and these appear to be the same as those seen in some of the Venezuelan sections, but as the latter are rather poor the identification is to be regarded as tentative only.

PART II

COLLECTION OF SLIDES FROM LAS PAVAS AND LA LAJA

STATE OF TRUJILLO

LAS PAVAS AND LA LAJA, STATE OF TRUJILLO

The age of Discocyclina-bearing beds from the above areas was discussed by the writer in an earlier report, the conclusions being based on the study of a series of rather poor sections. More recently a large number of much better slides has been received which, while confirming the earlier views, have necessitated a slight chance in some of the details. The collection now examined consists of a series of slides labelled State of Trujillo, La Laja, Lot II, slides labelled a-n, p, q, s-w and z (23 slides, including two labelled p); and a second series of 29 slides labelled Las Pavas, I, II and III, State of Trujillo (I, a-o; II, a-i; III, a-e).

It was found that all the slides from La Laja with the exception of e, j and m showed good sections of Discocyclina flintensis (Cushman), thus confirming the earlier tentative identification of this species.

All the slides from Las Pavas contained numbers of specimens of Camerina jacksonensis Gravell and Hanna and a rather globose variety, and abundant material of Discocyclina. The Discocyclina in the previous report was considered to belong to two species, namely D.perpusilla Vaughan and a new species allied to D.flintensis (Cushman). With the much better sections in the new collection it becomes clear that the so-called new species is Discocyclina floridana (Cushman) and it is considered that the sections previously referred to D.perpusilla are possibly immature specimens of D.floridana. This is discussed at length under notes on D.floridana. The removal of D.perpusilla and the discovery of D.floridana makes it certain that the beds are Jackson in age, but do not change the conclusion that the Las Pavas beds are older in all probability than those of La Laja. Camerina jacksonensis occurs plentifully in the Moody's Branch marl (basal Jackson) of Texas, Louisiana and Mississippi, and in the basal Tantoyuca (basal Jackson) and possibly in topmost Claiborne in Mexico. Discocyclina flintensis occurs typically in the younger Ocala Limestone, and it is thought that the specimens identified as D.flintensis by Gravell and Hanna from the Moody's Branch Marl should probably be assigned to the superficially similar D.floridana. In Mexico D.flintensis is of rare occurrence but is found at a higher horizon in the Tantoyuca (Jackson) than Camerina jacksonensis.

For these reasons it is stated that if the ranges of the various species may be considered to be the same in Venezuela as in Mexico and the southeastern United States, then the series from La Laja should be considered as slightly younger than that from Las Pavas.

DISCOCYCLINA FLORIDANA (Cushman)

Pl. III

1917. Orthophragmina floridana Cushman, U.S.Geol.Survey, Prof. Paper 108-G, p.116, pl.xl fig. 3

1923. Pseudophragmina floridana (Cushman) H.Douvillé, Bull.Soc. géol.France, 4th.sér.,Vol.XXIII,p.373, pl. xiii,figs.1-3.

1928. Discocyclina floridana (Cushman) Vaughan, in Cushman, Foraminifera, Their Classification and Economic Use, p.341, pl. lvi fig. 2

1935(?) Discocyclina flintensis (Cushman) Gravell and Hanna, Journ.Pal., Vol.IX, p.335, pl.xxxii figs. 11, 12.

1936. Discocyclina floridana (Cushman) Vaughan, Journ.Pal., Vol. X, pp. 258-259, pl.xliii figs. 3-7.

Discocyclina floridana, from the various descriptions and the present sections, appears to be as follows:

Test large, very compressed, reaching a diameter of as much as 12-14 mm., the surface ornamented with concentric rows of fine papillae which are partly formed by the strong curvature of the roofs of the lateral chambers and partly by the ends of the pillars. Sections show the median chambers to be rectangular, becoming narrower in proportion to their length as the periphery is approached, eventually in large specimens showing chambers with the length as much as seven to eight times the width, though this is exceptionally high. Near the embryonic apparatus, which was not well seen in the Venezuelan material, the chambers are occasionally nearly square. The lateral layers are very irregular, this constituting one of the most characteristic features of the species and showing its close relationship with D.perpusilla. As in the latter species D.floridana shows distally placed stolons connecting chambers of the same annulus.

From the Venezuelan material it seems that the broken nature of the septa (i.e. walls between adjacent chamberlets of the same annulus) as described for D.floridana is due to the state of preservation of the material examined by Vaughan and Douvillé.

D.floridana differs from D.flintensis in the following characteristics:-

(a) D.floridana is a considerably larger species.

(b) The radial walls of adjacent annuli in general are in alignment in D.floridana and only occasionally so in D.flintensis.

(c) The lateral chambers are irregular, with convex roofs, in D.floridana, and are smaller, more regular, and with continuous rather thick roofs in D.flintensis.

(d) There are more tiers of lateral chambers in D.floridana.

The same characters serve to distinguish immature specimens of D.floridana from adult specimens of D. perpusilla, more especially the elongation of the chamberlets as the periphery is approached in the former species. Good median sections could be readily separated by the much smaller size of the embryonic apparatus in D.perpusilla but where the sections are imperfect and generally oblique in rock slices distinction may be difficult, and one is handicapped by the lack of good figures of these species. The transverse sections of D.perpusilla and D.floridana may be remarkably similar, but in general, the tiers of lateral chambers are slightly fewer in number and the separating roofs and floors thicker in the former species. (See figures in the earlier

report on the Las Pavas-La Laja material).

The best description and figures of this species are those given by Vaughan, Journ.Pal., 1936, Vol.X, pp.258-259, Pl.xliii figs. 3-7.

COLLECTION FROM QUEBRADA GRANDE

This collection consists of thirty-six thin sections which contain nothing definitely indicative of any horizon known to the writer. The examination was unfortunately interrupted by the seizure of the collection in Mexico and the writer's departure for Colombia. It is suggested that the sections may include the following:

Archaeolithothamnium spp.
Amphistegina cubensis Palmer
Gypsina Globulus (Reuss)
Helicolepidina vichayalensis (Rutten)?
?Eulinderina sp.-?Helicostegina sp.
Operculina sp. indet.

On this very doubtful and fragmentary evidence it is suggested that the outcrop may be of Middle Eocene age, since Eulinderina and Helicostegina are characteristically Middle Eocene and Amphistegina cubensis occurs in beds of that age in Cuba and in Mexico, though in the latter place (as apparently in Venezuela) it may also occur in the lower part of the Upper Eocene.

PART III

COLLECTION OF DR. E. GEVAERTS FROM THE

STATE OF TRUJILLO

DR. E. G. GEVAERTS

No. 17: Lepidocyclina trinitatis Douvillé
Helicolepidina spiralis Tobler
Lepidocyclina cf. macdonaldi Cushman
?Pliolepidina sp.

Age: UPPER EOCENE (Jackson)

No. 44: Camerina jacksonensis Gravell and Hanna
Discocyclina cf. flintensis (Cushman)

Age: UPPER EOCENE (Jackson)

No. 130 B: Lepidocyclina
Helicolepidina spiralis Tobler
Discocyclina flintensis (Cushman)
Asterocyclina sp.
Operculina (O.cookei type)

Age: UPPER EOCENE (Jackson)

STATE OF TRUJILLO, SURFACE SAMPLE EG.165

Sample of marly sandstone, hard and fine textured, which on washing yielded a rather poor fauna of smaller foraminifera with much quartz. The following species of foraminifera were identified:

Carpenteria sp.
Discorbis aff. araucana (d'Orbigny)
Discorbis sp.
Eponides cf. mexicana (Cushman)
Gaudryina (Pseudogaudryina) jacksonensis Cushman
Globigerina sp.
Globorotalia crassaformis (Galloway and Wissler)
Gumbelina venezuelana Nuttall
Planularia thalmanni Pijpers
Plectofrondicularia sp. ?new.aff.interrupta (Karrer)
Pullenia bulloides (d'Orbigny)
Rzehakina venezuelana Hedberg
Sigmoilina celata (Costa)
Textularia agglutinans d'Orbigny
Textularia martini Pijpers
Textulariella barrettii (Parker and Jones)

The age is considered to be Upper Eocene from the close similarity to the fauna described from the upper part of the Pauji Shale by Nuttall (Journ.Pal., 1935, Vol.IX, pp.121-131).

Age: UPPER EOCENE (Jackson)

DR. E. GEVAERTS

STATE OF TRUJILLO, SURFACE SAMPLE EG 240.

This sample, consisting of a fairly hard marl, was washed and found to contain a moderately good fauna of smaller foraminifera. By comparison with the figures given by Nuttall, it seems that the fauna showed a tendency towards dwarfing. The following species were found:

Ammodiscus cf. parianus Hedberg (Siliceous cement)
Bathysiphon sp.
\# Bolivina restinensis Berry(compared with material from Restin)
Bolivina tongi (Cushman)
Bolivina aff. ouachitaensis Howe and Wallace
\# Bolivinopsis clotho (Grzybowski) MacFadyen
\# Bulimina jacksonensis Cushman
\# Cyclammina cancellata Brady
Discorbis mirandensis Nuttall
Discorbis sp. ?new.
Gümbelina venezuelana Nuttall
Haplophragmoides emaciatum (Brady)
Planularia thalmanni Pijpers
\# Plectofrondicularia mexicana (Cushman) (Fragments only)
Plectofrondicularia vaughani Cushman
Rzehakina venezuelana Hedberg (Siliceous test)
Uvigerina aff. cocoaensis Cushman.(Not unlike U.pigmea d'Orb.)

It will be seen that there is a very close similarity to the Pauji Shale fauna described by Dr. Nuttall (Journ.Pal., Vol.IX, pp.121-131; 1935) and there is also a strong resemblance to the rather poor micro fauna of the Red Shales of Restin, Northwest Peru. Both these formations are considered to be of Upper Eocene age, though Hantkenina, which characterises most Eocene deposits in America, appears to be lacking. This may be due to the facies and conditions of deposition. The Upper Eocene age of the Red Shales of Restin was originally concluded from the presence of Operculinoides wilcoxii (Heilprin) and Bulimina jacksonensis Cushman.

Age: UPPER EOCENE (JACKSON)

Note: # Indicates species commonly found in the Red Shales of Restin, Peru.

LIST OF LITERATURE

In any work dealing with foraminifera the literature is necessarily extensive, but it has not been thought necessary to list here in detail all the works made use of in compiling the present account. When dealing with larger foraminifera from Central America or the Caribbean region in general, one usually has to consult the numerous papers dealing with this region by Cushman, Vaughan, Douvillé, L.Rutten and several of his students, Nuttall, Storrs Cole, Hanzawa, Palmer and others.

In the course of the work, however, a number of references were accumulated dealing with the larger and smaller foraminifera of Northern South America which it is felt may be worth including. The list should perhaps contain the papers on the Panama Canal Zone by Cushman (1919, U.S.Nat.Mus., Bull.103) and Coryell and Embich (Journ. Pal., Vol.XI, 289-305,1937) and the various papers on Peru and Ecuador by Willard Berry, Vaughan, A. Tobler, L. Rutten, J.U. Todd and the writer. These have been omitted, however, as being outside of the area concerned and for the sake of brevity only papers specifically referred to in the text or dealing with Colombia and Venezuela have been included. For the same reason, the numerous papers of R.J.L. Guppy have been excluded.

(A). Papers referred to in the text.

(1). DOUVILLE, H., 1923. "Les Orbitoides et leur évolution en Amérique". Bull.Soc.Géol. France,Sér.4,Tom.XXIII, pp.369-376, pl. xiii.

(2). VAUGHAN, T.W., 1928. "Species of Large Arenaceous and Orbitoidal foraminifera from the Tertiary Deposits of Jamaica". Journ. Pal., Vol.I, pp.277-298, pls. xliii-l.

NOTE: Information regarding Helicolepidina, Helicostegina and Eulinderina may be found in Barker (J.Pal., Vol.VIII,1934) and Barker and Grimsdale (J.Pal.,Vol.X, 1936).

(B). Papers dealing with Venezuela and Colombia.

(1). CUSHMAN, J.A., 1919. Note on Eocene with larger foraminifera near Arroyo Hondo,Dpto.Bolivar,Colombia, in U.S.Nat. Mus.,Bull.103.p.197.

(2). CUSHMAN, J.A.,1929. "Some Species of Siphogenerinoides from the Cretaceous of Venezuela". C.C.L.F.R.,Vol.V,pp.55-59, pl.ix.

(3). CUSHMAN, J.A.,1929. "A Late Tertiary Fauna of Venezuela and other related regions."

(4). CUSHMAN, J.A., and H.D.HEDBERG, 1930. "Notes on Some Foraminifera from Venezuela and Colombia". C.C.L.F.R.,Vol. VI.pp.64-69, pl.ix (part).

(B) Papers dealing with Venezuela and Colombia (cont'd.)

(5) DIETRICH, W.O., 1935. "Stratigraphie der Kolumbianischen Ostkordillere". Zentralblatt.f.Min.Geol.u.Pal.,Jhrg. 1935,Abt.B,No.3,pp.78-81 (6 figures of foraminifera).

(6) GALLOWAY,J.A., and M.MORREY,1929. "A Lower Tertiary Foraminiferal Fauna from Manta, Ecuador". Bull.Amer.Pal.,Vol.XV, No. 55, pp.1-56, pls. i-vi.

(7) GORTER, N.E. and I.M.v.d.VLERK, 1932. "Larger Foraminifera from Central Falcon, Venezuela". Leidsche Geol.Meded., Dl.IV, pp.94-122, pls. xi-xvii.

(8) GEYN, W.v.d. and I.M.v.d.VLERK, 1935. "A Monograph on the Orbitoididae occurring in the Tertiary of America". Leidsche Geol.Meded.,Dl.VII,pp.221-272, 8 pls.

(9) GRAVELL, D.W., 1933. "Tertiary Larger Foraminifera of Venezuela". Smithson.Misc.Coll.,Vol.89,No.11, 44 pp., 6 pls.

(10) HEDBERG, H.D., 1937. "Foraminifera of the Middle Tertiary Carapita Formation of Northeastern Venezuela". Journ.Pal. Vol.XI,pp.661-697, pls.xc-xcii.

(11) HODSON, H.K., 1926. "Foraminifera from Venezuela and Trinidad". Bull.Amer.Pal., Vol.XII,No. 47, 46 pp., 8 pls.

(12) KARSTEN, H., 1856. "Uber die Verhältnisse des westlichen Columbien, etc.". 32 Versamml.deutsch.Naturforscher und Arzte zu Wien, 1856, pp.80-116, 2 maps, 6 pls. (Republished as "Géologie de l'ancienne Colombie bolivarienne, Venezuela, Nouvelle Grenade et Ecuador", Berlin, 1886).

(13) KOCH, R.E., 1926. "Miogypsina staufferi nov.spec. from North-Western Venezuela". Eclog.geol.Helvet.,Vol.XIX, pp. 751-753, pl.xxviii.

(14) NUTTALL, W.L.F.,1928. "Tertiary Foraminifera from the Naparima Region of Trinidad (British West Indies)". Q.J.G.S., Vol.LXXXIV, pp.58-115, pls. iii-viii.

(15) NUTTALL, W.L.F., 1935. "Upper Eocene Foraminifera from Venezuela", Journ.Pal.,Vol.IX,pp.121-131, pls.xiv-xv.

(16) SENN, A., 1935. "Die Stratigraphische Verbreitung der tertiären Orbitoiden, mit spezieller Berücksichtigung ihres Vorkommens in Nord-Venezuela und Nord-Marokko". Eclog.geol.Helvet.,Vol.XXVIII, pp.51-113, 369-373, pls. viii-ix.

(17) TASH, G.E., 1937. "Estratigrafía y Paleontología de Mene Grande y sus Cercanías". Bol. de Geología y Minería, Tomo I, pp. 167-180.

(18) TOBLER, A., 1922. "Die Jacksonstufe (Priabonien) in Venezuela und Trinidad". Eclog.geol.Helvet.,Vol.XVII,pp.342-346, pl.xix.

(B) Papers dealing with Venezuela and Colombia (cont'd.)

(19) TOLMACHOFF, I.P., 1934. "A Miocene microfauna and flora from the Atrato River, Colombia, S.America." Annals of the Carnegie Museum, Vol.XXIII, pp.275-356.

(20) VAUGHAN, T.W., 1932. "The Foraminiferal Genus Orbitolina in Guatemala and Venezuela". Proc.Nat.Acad.Sci., Vol. XVIII, pp.609-610.

(21) WARING, G.A., 1926. "Geology of the Island of Trinidad, B.W.I." Johns Hopkins Studies in Geology, No.7, 180 pp., 20 pls. (Notes on palaeontology, including larger foraminifera by Prof. Harris).

(22) WOODRING, W.P., 1927. "Marine Eocene Deposits on the East Slope of the Venezuelan Andes". B.A.A.P.G., Vol.XI, pp.992-996.

- - - - - - - - - - - - - - - - -

PLATE I

Figs. 1-3 - Operculinoides aff. jennyi Barker Ms.
Figs. 1, 2, median sections, x 10, Fig.3 exterior, x 6; all specimens from Schlaich No. 173.

Figs. 4-6 - Discocyclina clarki (Cushman).
Fig. 4, transverse section, x 15.
Fig. 5, Median section, x 15.
Fig. 6, exterior, x 6.
All specimens from Middle Eocene, N.E.Mexico.

Fig. 7 - Discocyclina clarki (Cushman).
Transverse section, x 14, from Blumenthal No. 89, Venezuela.

- - - - - - - - - - - -

PLATE II

Figs. 1,2,6 - Discocyclina advena (Cushman). Specimens from the Middle Eocene of Northeast Mexico.
Fig.1 - Exterior, x 8: Fig.2 - Median section, x 10: Fig.3 - Transverse section, x 12.5.

Figs. 7,8. - Discocyclina cf. advena (Cushman) from Blumenthal, No.89, Venezuela. Transverse sections, x 14.

Figs. 3-5 - Discocyclina A. Blumenthal No. 89, Venezuela.
Figs. 3,5 - Transverse sections: Fig.4 - Median section, all figures x 14.

Fig.9 - Discocyclina B. From Blumenthal No. 89, Venezuela. Transverse sections x 14.

- - - - - - - - - - - - - -

PLATE III

Figs. 1-4 - *Asterocyclina maracaibensis* Gorter and van der Vlerk.
Fig. 1 - Partial median section, Schlaich 182, x 30.
Fig. 2 - Transverse section, Schlaich 183, x 16.
Fig. 3 - Transverse section, Schlaich 183, x 30 app.
Fig. 4 - Transverse section, Schlaich 185, x 30.

Fig. 5 - *Discocyclina* cf. *floridana* (Cushman)
Median section, Sucre District, x 30.

Fig. 6 - *Discocyclina floridana* (Cushman)
Part of a transverse section, Slide k, Lot I, Las Pavas, Trujillo, x 32

Fig. 7 - *Discocyclina floridana* (Cushman)
Transverse section, Slide k, Lot I, Las Pavas, Trujillo, x 16.

- - - - - - - - - - - - -

PLATE IV

Figs. 1-6 - *Lepidocyclina trinitatis* Douvillé

Figs. 1,5,6 - from the Upper Eocene of Mexico, x 20
Fig. 1. - Median section.
Figs. 5,6 - Transverse sections

Figs. 2, 3 - Specimens from Upper Eocene, Soldado Rock, Trinidad, B.W.I.
Fig. 2, - Median section, x 22.
Fig. 3, - Transverse section, x 24.

Fig. 4, - Median section, from Schlaich No.173 Venezuela, x 18 approx.

- - - - - - - - - - -

PLATE V

Lepidocyclina kugleri Gorter and van der Vlerk

Figs. 1,3 - Transverse sections of specimens from Upper Eocene of Lagunitas, Peru. Fig.1 x 27.5: Fig. 3 (microspheric), x 14.

Figs. 2,5 - Sections of specimens from Soldado Rock, Trinidad, B.W.I. Fig.2, x 25; Fig.5, x 19.

Fig. 4 - Transverse section of microspheric specimen from Schlaich 173, Venezuela, x 12 approx.

- - - - - - - - - - - - - - - -

PLATE VI

Figs. 1-6 - *Lepidocyclina schotborghi* Rutten and Vermunt.
Figs. 1,3,4 - Median sections from Schlaich 188, x 25.
Figs. 2,5 - Transverse sections from Schlaich 183, x 30.
Fig. 6, - Median section, x 30, from Schlaich 182.

Figs. 7,9 - *L.schotborghi* Rutten and Vermunt
Specimens from Upper Eocene of Mexico
Fig. 7 - Median section, x 17.
Fig. 9 - Transverse section, x 17.

Fig. 8 - *Lepidocyclina trinitatis* Douvillé
Rock section, x 16, from Schlaich 183.

- - - - - - - - - - - - - - - -

PLATE VII

Figs. 1,2 - *Lepidocyclina peruviana* Cushman
Fig. 1 - Median section, x 30 app. from Organos Chicos, N.W.Peru.
Fig. 2 - Transverse section, x 30, from near Santa Elena, S.W.Ecuador.

(For comparison with Venezuelan sections)

Figs. 3,4 - *Lepidocyclina trinitatis* Douvillé
Rock sections, x 16, from Schlaich 183.

- - - - - - - - - - - - - - -