

# FORAMINIFERA FROM THE UPPER PART OF THE LOWER ARIYALUR STAGE OF TRICHINOPOLY CRETACEOUS

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**ABSTRACT**—The paper embodies the results of the study of the foraminifera from the Kallankurichchi Yellow Marls outcropping in a tributary of Kallar stream-cutting. Fifty-seven foraminiferal species, belonging to twenty-three genera and twelve families, are described and figured of which six species are new. The Kallankurichchi Yellow Marls have been assigned to Lower Maestrichtian and have also been correlated to Kallakudy (Cullygoody) Limestone, and this fact is suggestive of both belonging to the upper part of the typical Ariyalurs.

## INTRODUCTION

THE first detailed account of the Cretaceous rocks of Trichinopoly was furnished by H. F. Blanford as far back as 1865 in his memoir dealing with the nature, distribution and classification of these beds together with a record of important fossils noticed at different stratigraphic horizons. Stoliczka (1871) studied in detail the numerous fossils (both invertebrates including foraminifera as well as vertebrates) collected by Blanford. Since then mega-fossils particularly vertebrates received attention from time to time by Kosmat (1897), Matley (1929), Narayana Rao C. R. (1927, 30), Rama Rao (1927,32) but no adequate attempt was made towards the study of foraminifera. During the last three decades, however, some important contributions have been made by Rama Rao (1953, 54, 56), Narayana Rao (1941), Jacob and Sastry (1951), Sharma (1953) and Rasheed (1962) on the foraminiferal assemblage of these beds.

According to Blanford, the Ariyalur group consisting of shallow water deposits, is divided into three sub-divisions—the Lower, the Middle,

and the Upper, of which the Lower and Upper are highly fossiliferous while the Middle zone is practically devoid of invertebrate fossils. The paper embodies the results of the study of the smaller foraminifera from the compact yellow marls outcropping in a tributary of the Kallar stream-cutting about one and a half miles west of the village Kallankurichchi (Long.  $79^{\circ} 9'$ : Lat.  $11^{\circ} 9'$ ) near the hamlet of Konerirayapuram. The beds named here as Kallankurichchi Yellow Marls are dipping at a low angle of about 4-5 degrees due NE. The field evidence indicates that the Kallankurichchi Yellow Marls belong to the uppermost part of the Lower Ariyalurs of Blanford. An attempt has also been made to fix precisely the stratigraphic position of the Kallankurichchi Yellow Marls on the basis of their micro-faunal contents.

In the present paper, the widely employed system of Cushman's classification, has been followed with the separation of the genus *Enantiotalina* Marie, 1941 from the family Polymorphinidae to the family Enantiomorphinidae adopted by Marie and the genus *Trocholina* Paalzow 1922 from the family

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Rotaliidae to the family Ophthalmitidae amended by Henson (1948). Fifty seven foraminiferal species belonging to twenty four genera and twelve families are described and figured, of which six species are new, namely *Dorothia wadiai*, *Trocholina sahnii*, *Nodosaria ariyalurensis*, *Entosolenia blanfordi*, *E. stoliczkai* *Bolivina indica*. The genus *Siderolites* and *Lepidorbitoides* will be dealt with under a separate paper.

#### STRATIGRAPHIC POSITION AND CORRELATION

The foraminiferal assemblage, in general, resembles that of the Upper Cretaceous of the Caribbean region and as such an Upper Cretaceous age for the Yellow Marls of Kallankurichchi may undoubtedly be assigned. In fact, the field evidence, that the beds dip eastwards at a low angle and underlie the barren whitish and nodular shales etc. forming badlands, also indicates them constituting the Lower Ariyalurs of Blanford. Consequently, the Yellow Marls of Kallankurichchi may be inferred to belong to the uppermost part of the Lower Ariyalurs of Blanford. Moreover, this view is further supported by the occurrence of *Lepidorbitoides blanfordi* Rama Rao, *L. inornata* Rama Rao, and *Siderolites calcitrapoides* Lamarck, in abundance in our material which has been earlier reported by Stoliczka (1861-73), Narayana Rao (1941), Rama Rao (1953). It seems, however, that the Kallankurichchi Yellow Marls are synchronous with the Orbitoid-bearing Chokanadapuram Limestone and Coothoor beds assigned to Maestrichtian by Narayana Rao (1941). This lends support to the view held by Rama Rao (1956) that portions of one and the same Orbitoid-bearing band representing a distinct Maestrichtian horizon forming the youngest part of Blanford's 'Lower Ariyalur group' runs from near Chokanadapuram in the north to near Ariyalur in the south. In addition to these, the presence of widely distributed *Globotruncana arca* (Cushman) and *G. gansseri* Bolli, pinpoint the age of

Kallankurichchi Yellow Marls as Lower Maestrichtian.

Similarly an earlier report on the occurrence of *Lepidorbitoides* and *Globotruncana arca* (Cushman) from Kallakudy (Cullygoody) Limestone by Thalmann for which Rama Rao (1956) opines that "if Thalmann's identification are correct (as they are likely to be) the particular Limestone near Kallakudy which contains these forms is not a Cenomanian bed but is much younger probably Maestrichtian". enables us to correlate Kallakudy Limestone with the Kallankurichchi Yellow Marls, and this evidence indirectly suggests the possibility of the former being a part of the youngest horizon of Blanford's Lower Ariyalur group.

The Kallankurichchi Yellow Marls are also correlatable to the Chalk beds of Farafra Oasis, Egypt, containing *Globotruncana arca* (Cushman) and *G. gansseri* Bolli.

#### ECOLOGY

The characteristic faunal assemblage of the Kallankurichchi Yellow Marls suggests that the deposits were laid down in a shallow basin under warm water environment.

#### REPOSITORY

The specimens figured in the accompanying plates are deposited as types in the collections of the Department of Geology, Lucknow University, India.

#### TYPE LOCALITY

Tributary of Kallar Stream-cutting near the hamlet of Konerirayapuram, Trichinopoly district, Madras, India.

#### TYPE LEVEL

Upper Cretaceous (Lower Maestrichtian).

#### ACKNOWLEDGEMENTS

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## SYSTEMATIC PALAEOZOOLOGY

## Order FORAMINIFERA

## Family TEXTULARIIDAE

## Subfamily TEXTULARIINAE

## Genus TEXTULARIA DeFrance, 1824

## TEXTULARIA PSEUDOGRAMEN Chapman and Parr.

Plate 12, figs. 1 a, b, c.

*Textularia gramen* Brady (not d'Orbigny). 1884, *Challenger Report; Zoology.*, Vol. 9, Pl. 43, figs. 9-10, p. 365; Cushman, J. A., 1924, *Carnegie Inst. Washington Publ.*, Vol. 342, Pl. 1, figs. 7-8, p. 15.

*Textularia pseudogramen* Chapman and Parr, 1937, *Sci Repts., Sydney, Australia*, Ser. C (Zool. Botany), Vol. 1, Pt. 2, p. 153; Tewari and Bhargava, 1959, *Jour. Pal. Soc. India*, Vol. 4.

*Remarks*—This species which is already reported from Kutch by Tewari and Bhargava from Aquitanian of Kutch, is characterised by the twisted early subtriangular apical end, greatest thickness along the median line and general slope towards the subacute flat periphery.

*Length*—1.00-1.06mm; *Breadth* 0.51-0.54mm; *thickness* 0.44-0.45 mm.

Abundant

TEXTULARIA PSEUDOGRAMEN Chapman and Parr.

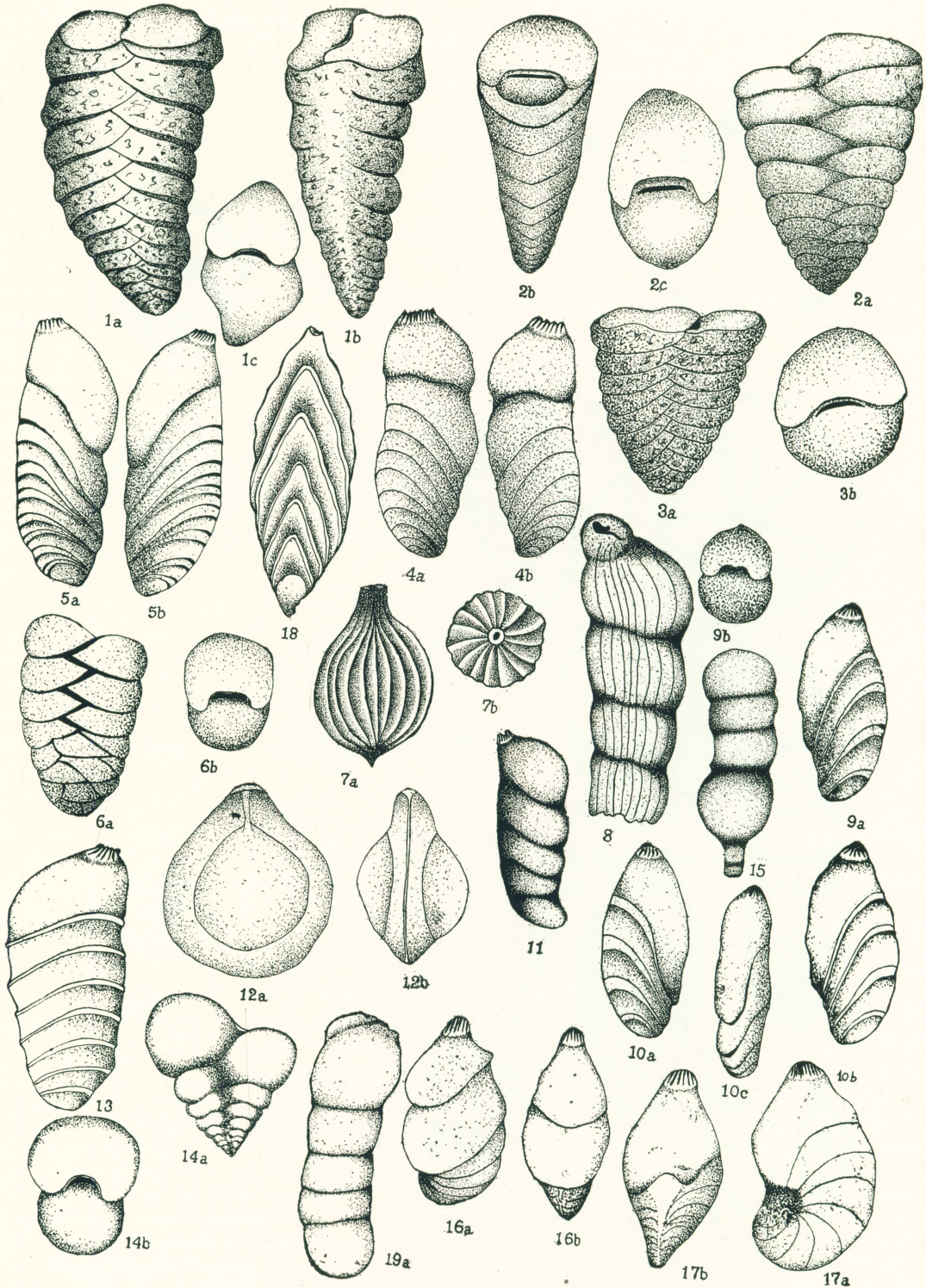
var. GLABRATA n. var.

Pl. 12, figs. 2a, b, c.

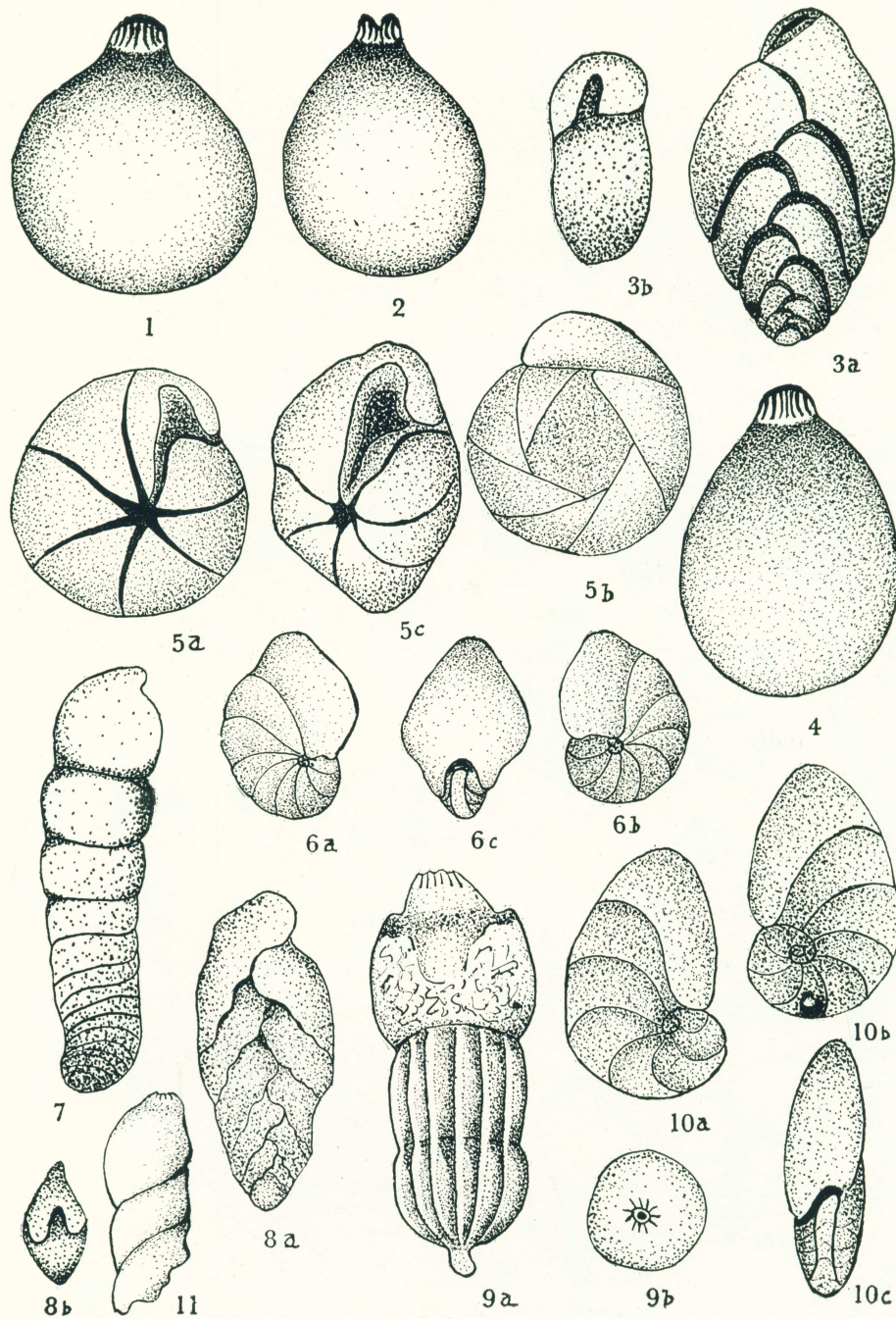
*Description*—Test thick rather small and subtriangular, tapering evenly from the greatest breadth at the apertural end, width and length nearly equal; periphery rounded, ovate on top view; chambers distinct, 11 or 12 pairs in number, very low in early stages, later increasing rapidly but uniformly in relative height; sutures distinct, slightly depressed, much curved, extremely wavy along the median line; wall smooth, finely arenaceous, translu-

## EXPLANATION OF PLATE 12

1. *Textularia pseudogramen* Chapman & Parr. X76 a. Front view, b. edge view. c. apertural view.
2. *Textularia pseudogramen* Chapman & Parr var. *glabrata*, n. var. X76 a. front view, b. apertural view. c. edge view.
3. *Textularia nacataensis* White var. *rajnathi*, n. var. X76 a. front view, b. apertural view.
4. *Vaginulina taylorana* Cushman var. *vredenburgi*, n. var. X76 a-b. side views.
5. *Polymorphinella* cf. *vaginulinaeformis* Cushman & Hanzawa, X76 a. and b. opposite sides.
6. *Gaudryina arguta* Bandy, X152. a. side view, b. apertural view.
7. *Lagena* cf. *tenuistriata* Stache, X76. a. side view, b. apertural view.
8. *Nodosaria sceptriformis* Olszewski var. *stoliczkai*, n. var. X76.
9. *Gaudryina subrotundata* Schwager var. *lobulata*, n. var. X76. a. side view, b. apertural view.
10. *Vaginulina inflata* Parr, X76. a, b. side views, c. lateral view.
11. *Marginulina* cf. *compressa* d'Orbigny, X28.
12. *Entosolenia blanfordi* n. sp. X114 a. side view, b. apertural view.
13. *Marginulina jarvisi* Cushman var. *mankudiensis*, n. var. X76.
14. *Gumbelina ultimatumida* White, X152. a. side view, b. apertural view.
15. *Nodosaria* cf. *adenuens* Olszewski, X76.
16. *Lenticulina* sp. indt. X114. a. side view, b. apertural view.
17. *Lenticulina planiuscula* Reuss, X114. a. side view, b. apertural view.
18. *Fronicularia goldfussi* Reuss, X76.
19. *Dentalina* cf. *baggi* Galloway & Wissler, X76. a. side view, b. apertural view.



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cent; aperture elongate, slit like at the inner margin of the last formed chamber.

Length—0.82 mm; Breadth 0.54 mm; Thickness 0.36 mm.

*Comparison and Remarks*—The variety exhibits close similarity to *Textularia pseudogramen* Chapman and Parr, but differs from it in having sutures much curved and extremely wavy along the median line, and finely arenaceous translucent wall. From *Textularia dolljussi* Lalicker reported from France, it is distinguished in having small dimension, lack of coarsely arenaceous wall with much cement, and aperture with a lip.

Abundant

*Type No*—Holotype L. U. 172; Paratype L. U. 173.

TEXTULARIA NACATAENSIS White var. RAJNATHI n. var.

Pl. 12, figs. 3a, b.

*Description*—Test conical, elongate, rapidly tapering from the greatest breadth at the apertural end which is flat on top; chambers 10-15 in number; low and flat; sutures flush and somewhat indistinct; wall somewhat coarsely arenaceous; aperture semilunar at the base of the last formed chamber.

Length 0.67-0.79 mm; Breadth 0.40-0.50 mm; Thickness 0.40-0.46 mm.

*Comparison and Remarks*—The distinguishing characters of the form like somewhat coarsely arenaceous wall, less rounded periphery, more

conical test, tapering rapidly from greatest breadth at flat apertural end, and greater number of chambers 10-15, suffice to make it a variety of *Textularia nacataensis* White, recorded from Tampico embayment area of Mexico.

Abundant.

*Type No*—Holotype. L. U. 174; Paratype L. U. 175.

TEXTULARIA cf. GRAVENORI Stelk and Wall

Pl. 15, figs. 2a, b.

*Textularia gravenori* Stelk and Wall, 1954, *Alberta Res. Coun. Rept.* 6, No. 68, p. 11 (nomen nudum); Stelk and Wall, 1955, *Alberta Res. Coun. Rept. Edmonton., Alberta.,* No. 70, p. 55.

*Remarks*—This species is closely similar to that of Stelk and Wall recorded from Alberta, Canada, but differs in having parallel sides in the later three fourth part of the test, apical end more bluntly rounded, strongly oblique but slightly curved sutures.

Length 0.29-0.31 mm; Breadth 0.09-0.1 mm; Thickness 0.07 mm.

Common.

TEXTULARIA WASHITENSIS Carsey

Pl. 14, figs. 5a, b, c.

*Textularia washitensis* Carsey, 1926, *Texas Univ. Bull. Austin. Texas U. S. A.,* No. 2612, p. 24.

#### EXPLANATION OF PLATE 13

1. *Lagena simplex* Reuss, X114.
2. *Lagena simplex* Reuss var *lacrima* White, X76.
3. *Bolivina cretosa* Cushman var *ariyalurensis*, n. var. X152. a. front view, b. apertural view.
4. *Lagena simplex* Reuss var *ovalis*, n. var. X28.
5. *Gyroidina tendami* Cushman, X76. a. dorsal view, b. ventral view, c. apertural view.
6. *Nonionella robusta* Plummer var *marudaiyarica*, n. var. X114. a. dorsal view, b. ventral view, c. apertural view.
7. *Marginulina* cf. *dorsata* Cushman, X28.
8. *Boliviondes texana* Cushman, X152. a. side view, b. apertural view.
9. *Nodosaria ariyalurensis* n. sp., X76. a. side view, b. apertural view.
10. *Nonionell cretecea* Cushman var *tamilensis*, n. var. X152. a. dorsal view, b. ventral view, c. apertural view.
11. *Dentalina* sp. indt. X28.

*Remarks*—The present form bears close similarity to the form reported from Del Rio formation Texas by Carsey.

Length 0.75-0.78 mm; Breadth 0.27 mm; Thickness 0.18-0.29 mm.

Rare.

TEXTULARIA CHAPMANI Lalicker

Plate 16, figs. 3a, b.

*Textularia conica* Chapman (not d'Orbigny), 1892, *Jour. Roy. Micro. Soc.*, Pl. 6, fig. 20, p. 329.

*Textularia chapmani* Lalicker, 1935, *Contr. Cush. Lab. Foram. Res., Sharon, Mass, U. S. A.* Vol. 11, Pt. 1, p. 13.

*Remarks*—The present form resembles with that of Lalicker recorded from Gault bed, England.

Length—0.42 mm; Breadth 0.33 mm; Thickness 0.21 mm.

Rare.

Family VERNEULINIDAE

Genus GAUDRYINA d'Orbigny, 1826  
GAUDRYINA SUBROTUNDATA Schwager var.

LOBULATA n. var.

Plate 12, figs. 9a, b.

*Description*—Test very much elongate, slender, subcompressed with rounded and crenulated margins, acute initial end tapering gradually with sides nearly parallel, earlier short portion triserial and triangular in cross section, later becoming biserial, making up the test, periph-

ery lobulate; chambers subglobular, biserial portion quite distinct 6 or 8 pairs, somewhat inflated, increasing gradually and rather evenly in size as added; sutures in triserial portion indistinct while fairly distinct in biserial portion, depressed and slightly oblique; wall finely arenaceous smoothly finished; apertural chamber strongly curved, aperture a low elongate opening at the base of the inner margin of the last formed chamber.

Length 1.2-1.4 mm; Breadth 0.35-0.36 mm; Thickness 0.31 mm.

*Comparison and Remarks*—From *Gaudryina praelonga* Karrer, recorded from Germany the present variety is distinguished by its typical lobulate periphery, strongly curved apertural chamber, and aperture a low elongate opening. It exhibits great similarity to *Gaudryina subrotundata* Schwager, described from the Nikobar, Novara Exped, but it has been ascribed to a new variety on account of its characteristic lobulate periphery.

Abundant.

*Type No*—Holotype. L. U. 176; Paratype L. U. 177.

GAUDRYINA ARGUTA, Bandy

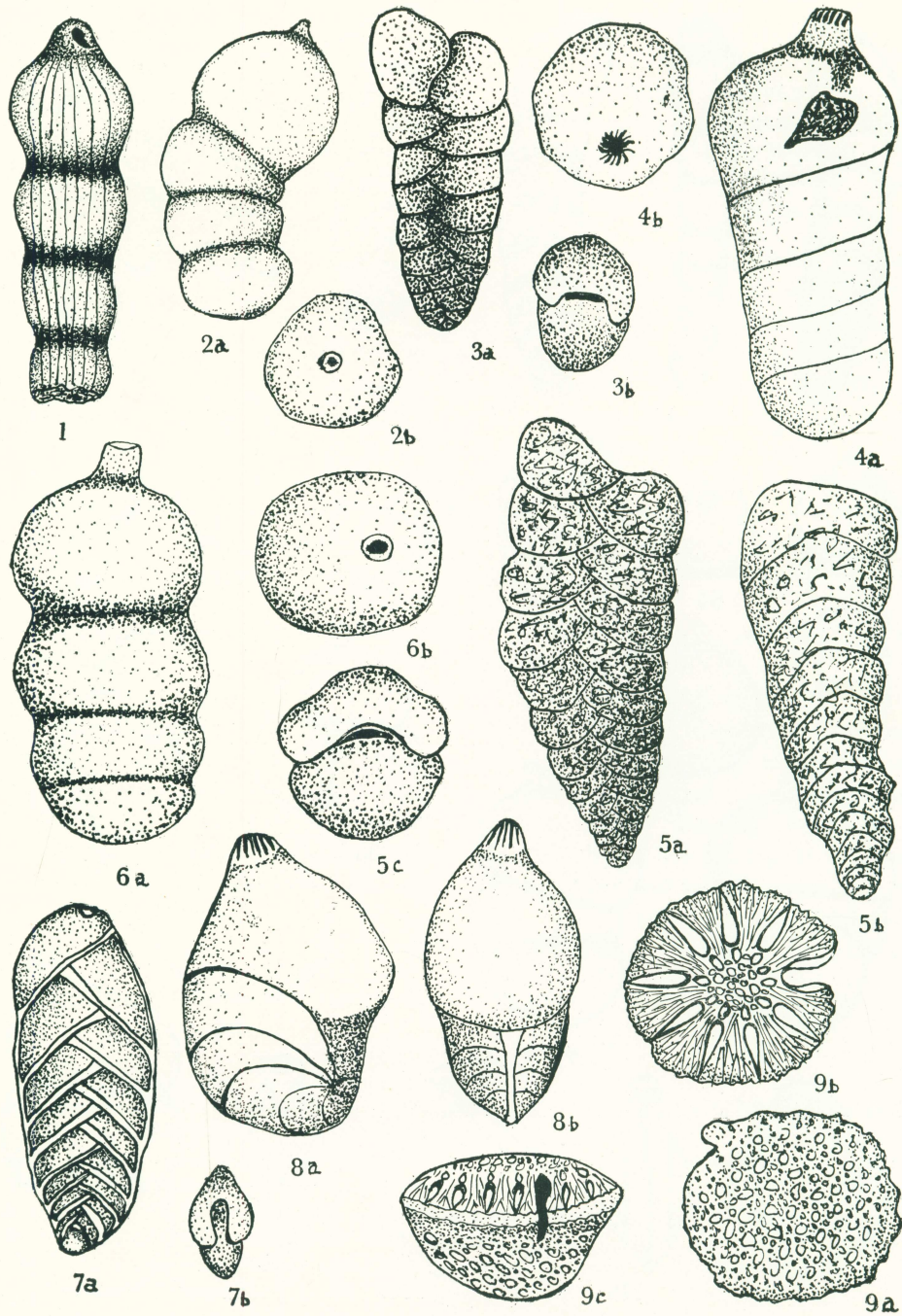
Plate 12, figs. 6a, b.

*Gaudryina arguta* Bandy, 1951, *Jour. Pal., Tulsa. Okla.*, Vol. 25, No. 4, p. 492.

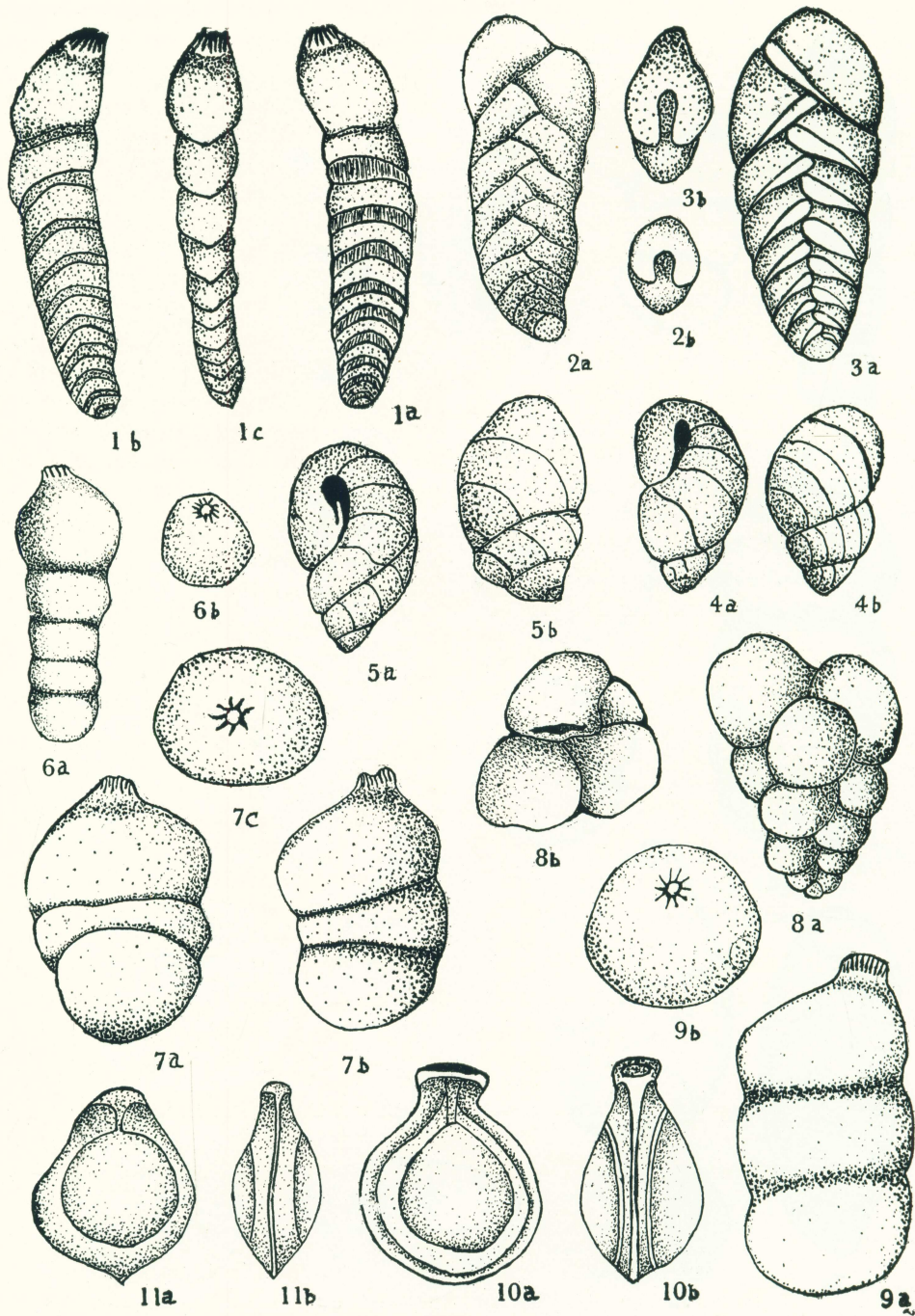
*Remarks*—The form is similar to that of Bandy described from Nikobar. From *Gaudryina koimetercola* Hadley reported from Mississippi, it is distinguished by the nature of aperture

EXPLANATION OF PLATE 14

1. *Nodosaria sceptriformis* Olszewski, X76.
2. *Dentalina* cf. *natchitochensis* Howe, X76. a. side view, b. apertural view.
3. *Dorothia Wadiai*, n. sp., X152. a. side view, b. apertural view.
4. *Dentalina* cf. *monroei* Todd, X152. a. side view, b. apertural view.
5. *Textularia washitensis* Carsey, X76. a. front view, b. edge view c. apertural view.
6. *Nodosaria* cf. *rugosa* ten Dam, X76. a. side view, b. apertural view.
7. *Bolva indica*, n. sp., X152. a. front view, b. apertural view.
8. *Lenticulina* cf. *navicula* (d'Orbigny) Cushman & Jarvis, X114. a. side view, b. apertural view.
9. *Trocholina sahmii*, n. sp., X152. a. dorsal view, b. ventral view, c. peripheral view.







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which is a low arch, located in the centre of the distal end at the base of the last chamber. It also differs from *Gaudryina crassa*, Marsson, which is characterised by its elongate, low and slightly re-entrant aperture.

Length 0.03-0.38 mm; Breadth 0.19-0.21 mm; Thickness 0.16 mm.

Abundant

GAUDRYINA ARGUTA Bandy var. KALLARENSIS n. var.

Plate 16, figs. 5a, b.

*Description*—Test short, stout, cylindrical, moderately compressed, tapering gradually towards the subacute apical end, apertural end slightly truncated, periphery broadly rounded, early-portion triserial, later biserially arranged, the sides of the adult nearly parallel, width remaining constant; chambers translucent, not inflated; sutures distinct not depressed, somewhat flush with the periphery, opaque; wall thick, finely arenaceous, smoothly finished; aperture an elongate low arched opening at the base of the septal face.

Length 0.43-0.52 mm; Breadth 0.21-0.25 mm; Thickness 0.16 mm.

*Comparison and Remarks*—Variety is characterized by its much compressed somewhat larger test, with apertural end slightly truncated, chambers translucent but sutures opaque unlike *Gaudryina arguta* whose test is more cylindrical, apertural end rounded, and chambers are opaque but the suture is translucent.

*Type No*—Holotype. L. U. 178; Paratype L. U. 179.

Rare.

Family VALVULINIDAE

Subfamily EGGERELLINAE

Genus DOROTHIA Plummer, 1931

DOROTHIA WADIAI n. sp.

Plate 14, figs. 3a, b.

*Description*—Test large, stout, elongate, initial portion tapering, adult with sides nearly parallel, usually distinctly twisted, earliest whorl with 4-5 chambers triserial, adult biserially arranged; periphery broadly rounded; chambers quite distinct, somewhat inflated, of rather uniform shape and size in adult; sutures distinct, depressed, nearly horizontal in the adult; wall distinctly arenaceous but smoothly finished; aperture a low broad opening at the base of the last formed chamber at the inner margin.

Length 0.47-0.75 mm; Breadth 0.25 mm; Thickness 0.16 mm.

*Comparison and Remarks*—The species differs from the *Dorothia alabamensis* Cushman, which is having more tapering test and more inflated chambers that tend to increase in size as added. From *Dorothia bradyana* Cushman reported from West Indies it is distinguished by its short and less stout test and absence of wall with large angular grains. *Dorothia elongata* Finlay, described from the Cretaceous

#### EXPLANATION OF PLATE 15

1. *Enantiodontalina cummunis* (d'Orbigny) forma *typica* Marie, X76. a. dorsal view, b. left profile, c. front view.
2. *Textularia* cf. *gravenori* Stelk & Wall, ×154, a. front view, b. apertural view.
3. *Bolivina gemma* Cushman var. *trichinopolensis*, n. var. X76, a. front view, b. apertural view.
4. *Buliminella pulchra* (Terquem), emend, Le Calvez, X76, a & b, side view.
5. *Buliminella colonensis* Cushman & Hedberg, X152, a and b, side views.
6. *Dentalina* cf. *inepta* Cushman X76, a. side view, b. apertural view.
7. *Pseudoglandulina marginuliniformis*, Frizzell, X76. a. side view, b. front view, c. apertural view.
8. *Gumbelitria harrisi* Tappan, X114. a. side view, b. apertural view.
9. *Marginulina aequalis* Franke, X76. a. side view, b. apertural view.
10. *Entosolenia stoliczkai*, n. sp., X114. a. side view, b. apertural view.
11. *Entosolenia blanfordi* var. *marginata*, n. var., X114. a. side view, b. apertural view.

Whangai beds, differs by its characteristic subglobular chambers and deep suture, rounded aperture. Recent species of *Dorothia existis* Cushman, reported from off Island is distinct by its small, slender test, with small, arched aperture.

This species is named in honour of Dr. D. N. Wadia, the pioneer geologist of India.

Fairly common.

*Type No*—Holotype. L. U. 180; Paratype L. U. 181.

Family OPTHALMIDIIDAE

Subfamily CORNUSPIRINAE

Genus TROCHOLINA Paalzow emend Henson, 1948

TROCHOLINA SAHNII n. sp.

Plate 14, figs. 9a, b, c.

*Description*—Test lenticular, subglobular, margin subrounded, ventral surface flat, dorsal swollen at the poles, only the last whorl forming the margin of the test is externally visible; chamber walls are calcareous, and microgranular, dorsal side is filled with superficial deposits of crystalline calcite which forms at the surface a mass of small granules lacking any systematic arrangement, and give rise to a pitted appearance; the umbilicus on the ventral side is filled with a similar deposits of crystalline calcite, producing on the surface a pattern of reticulate ridges over the poles, merging into fine radial ridges towards the margin, the ridges bifurcate and continue upto the margin, completely disappearing on the dorsal side; aperture a simple terminal opening at the end of the spiral tube, situated on the periphery and extending to ventral side.

Diameter 0.52 mm; Thickness 0.13 mm.

*Comparison and Remarks*—This species is quite distinct from *Trocholina lenticularis* Henson reported from Dukhan, Arabia, in the absence of radial ridges on the dorsal side.

The species is named in honour of Prof. M. R. Sahni, the pioneer palaeontologist of India.

Abundant

*Type No*—Holotype. L. U. 182; Paratype L. U. 183.

Family LAGENIDAE

Subfamily NODOSARIINAE

Genus MARGINULINA d'Orbigny, 1826

MARGINULINA cf. DORSATA Cushman

Plate 13, figs. 7.

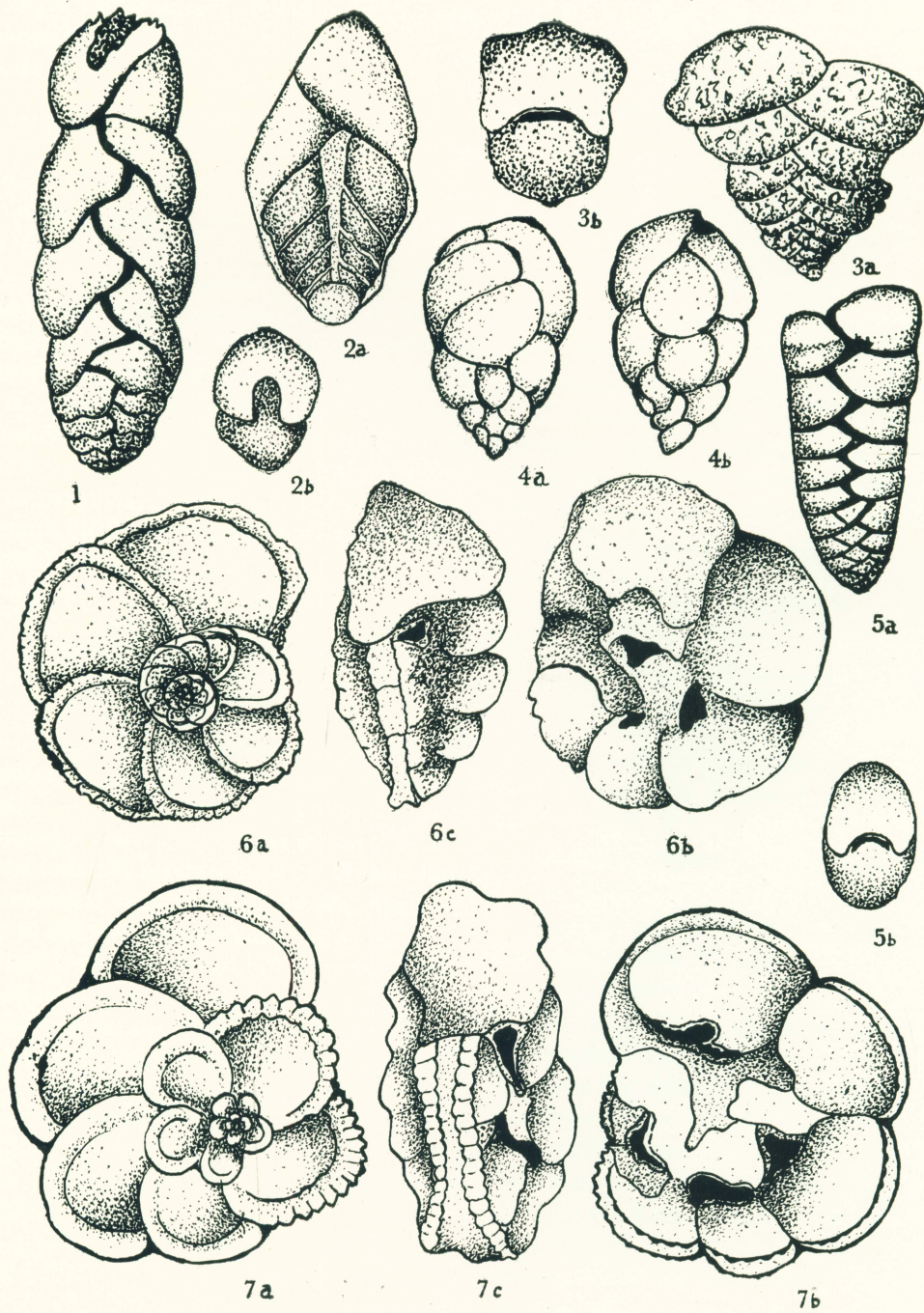
*Marginulina dorsata* Cushman 1937, *Contr. Cush Lab. Res., Sharon, Mass, U. S. A.*, Vol. 13, Pt. 4, p. 94.

*Remarks*—This species is characterised by having a peculiar dorsal ridge, large number of chambers and less prominent apertural neck.

The present specimens exhibit, similarity to that of Cushman reported from Texas, but differ in their elongate, arcuate test, and much larger dimension. From *Marginulina gardnerae* Plummer described from Eocene, Basal Midway formation, Texas, it differs in the absence of dark band constricted sutures, greater length, and lack of blunt tapering test towards initial extremity. It is again distinguished from *Marginulina plummerae* Cushman, recorded from Navarro group, Texas, in the absence of raised thickened sutures in the middle portion.

EXPLANATION OF PLATE 16

1. *Laxostomum* sp. indt., X152.
2. *Bolivina* sp. indt. X152 a. front view, b. apertural view.
3. *Textularia chapmani* Lalicker, X76. a. front view, b. apertural view.
4. *Buliminella carseyae* Plummer, X152. a, b. side views.
5. *Gaudryina arguta* Bandy var. *kallarensis*, n. var. X76. a. side view, b. apertural view.
6. *Globotruncana ganseri* Bolli, X114. a. dorsal view, b. ventral view, c. side view.
7. *Globotruncana arca* (Cushman) X114. a. dorsal view, b. ventral view, c. side view.



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Length 2.09 mm; Breadth 0.45 mm;  
Thickness 0.40 mm.

Rare.

MARGINULINA cf. COMPRESSA d'Orbigny

Plate 12, fig. 11.

*Marginulina compressa* d'Orbigny, 1840, *Soc. Geol. France, Mem'., Paris, France., Tome. 4, No. 1, p. 17.*

*Remarks*—This specimen has approach in resemblance with *Marginulina gussensis* Schwager described from Eocene of Egypt, but differs in the shape of the earlier whorls which are in the form of a coil in the former. From *Marginulina modesta*, Reuss reported from Germany it differs in the more straight sutures and comparatively more rounded anterior end.

Length 2.02 mm; Breadth 0.67 mm; Thickness 0.60 mm.

Frequent.

MARGINULINA JARVISI Cushman var.

MANKKUDIENSIS n. var.

Plate 12, fig. 13

*Description*—Test compressed, elongate, earliest portion coiled, later uncoiled, periphery rounded, ventral margin slightly concave, dorsal margin convex; chambers distinct, rather few, not inflated; sutures distinct, slightly limbate, somewhat curved; wall smooth; aperture radiate at the dorsal peripheral angle.

Length 0.84 mm; Breadth 0.42 mm; Thickness 0.33 mm.

*Comparison and Remarks*—The variety is distinguished from *Marginulina jarvisi* Cushman, reported from British West Indies, by its characteristic raised sutures.

Fairly Common.

*Type No*—Holotype. L. U. 184; Paratype L. U. 185.

MARGINULINA AEQUALIS Franke

Plate 15, figs. 9 a, b.

*Marginulina aequalis* Franke, 1925, *Greifswald, Univ., Geol. Pal. Inst., Abh., Greifswald, Deutschland., No. 6. pp. 53-55.*

*Remarks*—The present form is identical to that recorded from Germany by Franke.

Length 0.59 mm; Breadth 0.30 mm; Thickness 0.31 mm.

Rare.

Genus DENTALINA d'Orbigny, 1826

DENTALINA cf. NATCHITOCHEMENSIS Howe.

Plate 14, figs. 2 a, b.

*Dentalina natchitochensis* Howe, 1939, *Geol. Bull., New Orleans, U. S. A. No. 14, p. 45.*

*Remarks*—The species is characterised by its very much globular terminal chamber as compared to the preceding ones. The earlier three chambers are somewhat compressed and the third chamber is slightly constricted.

Length 0.54 mm; Breadth 0.27 mm; Thickness 0.25 mm.

Rare.

DENTALINA cf. INEPTA Cushman

Plate 15, figs. 6 a, b.

*Dentalina* sp., Cushman and Todd, 1946, *Contr. Cush. Lab. Foram. Res., Vol. 22, Pl. 8, fig. 10, P. 51.*

*Dentalina inepta* Cushman, 1947, *Cush. Lab. Foram. Res., Contr., Sharon. Mass., Vol. 23, p. 83.*

*Remarks*—The terminal chamber is much higher than broad and more inflated than the previous chambers.

The present form has close similarity to that of Cushman described from Palaeocene of Arkansas but differs in the presence of unequal chambers, more inflated apertural chambers and earlier part of the uncompressed test. *Dentalina niobrarenensis* Loetterle, characteristic of Niobrare formation of Upper Cretaceous of Nebraska U. S. A. is distinguished from the present form in the initial chamber being bulbous.

Length 0.50 mm; Breadth 0.16 mm; Thickness 0.16 mm.

Abundant.

DENTALINA cf. MONROEI Todd  
Plate 14, figs. 4 a, b.

*Dentalina monroei* Todd, 1952, *U. S. Geol. Survey. Prof. Paper. Washington, D. C.*, No. 241, p. 12.

*Remarks*—The present form differs from *Dentalina monroei* Todd described from Mississippi, by its cylindrical test, more uniform breadth and thickness and smooth periphery throughout the test. It can be also distinguished from *Dentalina inepta* Cushman, which is characterised by a more slender test which is slightly compressed.

Length 0.75 mm; Breadth 0.26 mm; Thickness 0.29 mm,

Frequently Common.

DENTALINA cf. BAGGI Galloway and Wissler  
Plate 12, figs. 19 a, b.

*Nodosaria paupertata* Bagg, 1912, *U. S. Geol. Surv. Bull.* 513, Pl. 16, figs. 2a-f, p. 57.

*Dentalina baggi* Galloway and Wissler, 1927, *Jour. Pal.*, Vol. 1. No. 1, Pl. 8, figs. 14, 15, p. 49; Cushman and Gray, 1946, *Spec. Publ.* 19, *Cush. Lab. Foram. Res.*, Pl. 2, figs. 26-27, p. 13; Martin, 1952, *Contr. Cush. Found. Foram. Res.*, Vol. 3, Pts. 3 and 4, Pl. 17, fig. 6a-b, p. 118.

*Remarks*—The form is closely identical to that of Galloway and Wissler, but differs in having smaller test.

Length 0.98-1.1 mm; Breadth 0.31-0.44 mm;  
Frequent.

DENTALINA sp. indet.  
Plate 13. fig. 11.

This species is broken and only three chambers are present including the apertural one. It is closely comparable with *Dentalina communis* (d'Orbigny) Cushman and Ponton, which has an elongated and inflated chambers, lobulate periphery, radiate, terminal and produced aperture, oblique sutures, finely calcareous wall.

Genus NODOSARIA Lamarck, 1812  
NODOSARIA SCEPTRIFORMIS Olszewski  
Plate 14, fig. 1.

*Nodosaria sceptriformis* Olszewski, 1875, *Żapiski Palaeontologiczne. Akad. Umiej. Krakowie, Sprawozd. Kom. Fisijogr., Krakow.*, Vol. 9, p. 98

*Nodosaria (Nodosaria) sceptriformis*. Friedberg, 1898, *Kosmos, LVOV*, Vol. 22, p. 272.

*Remarks*—The species occurs in fragments without initial end and is completely identical to the typical forms described from the Senonian of Poland by Olszewski.

Length 0.64-0.78 mm; Width 0.16-0.29 mm.  
Frequently Common.

NODOSARIA SCEPTRIFORMIS Olszewski var.  
STOLICZKAI n. var.  
Plate 12, fig. 8.

*Description*—Test large, gently curved, composed of 4 or 5 chambers which are separated by distinct depressions, initial chambers broken; lobate periphery, chambers distinct, inflated, final one terminates excentrically in a rather long and wide neck; distinct but curved sutures; wall ornamented by continuous fine longitudinal somewhat raised costae; aperture radiate, excentrically placed on a short protruding neck on last formed chamber.

Length 1.1 mm; Breadth 0.33 mm.

*Comparison and Remarks*—The variety differs from *Nodosaria vertebralis*, Batsch, in the total absence of typical enlarged initial chamber and presence of characteristic excentric radiate aperture, but resembles in the presence of raised longitudinal costae. It is distinguished from *Nodosaria sceptriformis*, by slightly arcuate test, more inflated chambers separated by deep depression, final chamber terminates excentrically in a rather long and wide neck; lobate periphery,

Rare.

Type No—Holotype. L. U. 186; Paratype L. U. 187.

## NODOSARIA cf. ADTENUENS Olszewski

Plate 12, fig. 15.

*Nodosaria adtenuens* Olszewski: 1875, *Zapiski Palaeontologiczne., Akad. Umiej. Krakowie, Sprawozd. Kom., Fisijogr. Krakow., Vol. 9* (1874), p. 103.

*Remarks*—The form closely resembles with that of Olszewski described from Senonian of Poland, but differs in having adult chambers more broad than long and distinctly inflated, whereas in *Nodosaria adtenuens* the chambers are always longer than broad.

Length 0.73 mm; Breadth 0.21 mm.

Rare.

## NODOSARIA cf. RUGOSA ten Dam

Plate 14, figs. 6 a, b.

*Dentalina* sp. (n. sp.) Eichenberg, 1935, *Niedersachs. Geol. Ver. 26 er Jahresber*, Pl. 12, fig. 3, p. 166.

*Nodosaria* sp. Eichenberg, 1935 *Ibid*, Pl. 12, fig. 4, p. 172.

*Nodosaria rugosa* ten Dam, 1946, *Jour. Pal., Tulsa, Okla.*, Vol. 20, p. 575.

*Remarks*—This form differs from that of ten Dam described from Netherlands, by its less depressed sutures, much projected neck.

Length 0.72 mm; Breadth 0.33 mm; Thickness 0.33 mm.

Rare.

## NODOSARIA ARIYALURENSIS n. sp.

Plate 13, figs. 9 a, b.

*Description*—Test small, straight, slightly cylindrical, somewhat compressed, composed of three chambers of which first is slightly inflated and tapers rapidly into an acute spine directed forward; the middle chamber is elongate, cylindrical, rather much depressed than others, merging with the youngest; last chamber, elongate, elliptical, much inflated and tapering obliquely on the edge of which the radiate aperture is situated; wall calcareous, finely perforate; surface ornamented by longitudinal

thin plate like raised costae running throughout the surface of the test; sutures distinct slightly depressed.

Length 0.67-0.75 mm; Breadth 0.16-0.28 mm; Thickness 0.21 mm.

*Comparison and Remarks*—The present specimen is characterised by its peculiar aperture lying to one side and the initial end tapering rapidly into an acute spine somewhat curved towards the front. The surface is ornamented by longitudinal thin plate like raised costae running throughout the surface of the test, which makes it different from that of *Nodosaria marginulina* Olszewski described from the Senonian of Poland.

This species has been named after the stage of Ariyalur, Cretaceous of South India.

Frequently Common.

*Type No* Holotype. L. U. 188; Paratype L. U. 189.

## Genus PSUEDOGLANDULINA Cushman, 1929

PSUEDOGLANDULINA MARGINULIFORMIS Frizzell

Plate 15, figs. 7 a, b, c.

*Pseudoglandulina marginuliformis* Frizzell, 1943, *Journ. Pal., Tulsa, Okla.*, Vol. 17, p. 347.

*Remarks*—The present form is similar to that described by Frizzell from the Upper Cretaceous of Peru.

Length 0.46 mm; Breadth 0.26 mm; Thickness 0.29 mm.

Rare.

## Genus VAGINULINA d'Orbigny, 1826

VAGINULINA INFLATA Parr.

Plate 12, figs. 10 a, b, c.

*Vaginulina inflata* Parr, 1950, *Repts., Adelaide, Ser. B*, Vol. 5, Pt. 6, p. 327.

*Remarks*—The form is identical to that of Parr described from the Indian Ocean off Antarctica, but differs, from *Vaginulina pliocenica* Cushman and Grey in its less rounded initial, end, absence of straight dorsal border; and ventral side convex. From *Vaginulina wright* Cole, recorded from the Eocene of

Mexico, it is distinguished by its radiate aperture, while in the former aperture is produced.

Length 0.70 mm; Breadth 0.26 mm; Thickness 0.18.

Frequently Common.

VAGINULINA TAYLORANA Cushman var.

VREDENBURGI n. var.

Plate 12, figs. 4 a, b.

*Description*—Test elongate, somewhat compressed, slightly curved, periphery subacute, initial end rounded, dorsal side even, ventral side lobulate; chambers distinct, broader than high increasing gradually in size as added, terminal chamber is more inflated, the early ones showing a slight tendency towards coiling, sutures distinct, limbate, slightly depressed; wall smooth, thin, translucent; aperture radiate at the dorsal margin.

Length 0.88 mm; Breadth 0.27 mm; Thickness 0.17 mm.

*Comparison and Remarks*—The variety is characterized by the absence of central areas above the sutures which are characteristic of *Vaginulina taylorana* Cushman reported from Texas.

Rare.

*Type No*—Holotype. L. U. 190; Paratype L. U. 191.

Genus FRONDICULARIA Defrance, 1824

FRONDICULARIA GOLDFUSSI Reuss

Plate 12, fig. 18.

*Frondicularia goldfussi* (Reuss) Cushman, 1946, *U. S. Geol. Surv. Prof. Paper* 206, Pl. 34, figs. 19-20, Pl. 35, figs. 1-2; Nakkady, 1952, *Bull. Inst. Egypte.*, Vol. 33, Pl. 428, Pl. 8, fig. 3; Said and Kenawy 1956, *Micropaleontology*, Vol. 2, No. 2, p. 1-136, Pl. 2, fig. 36.

*Remarks*—Well preserved, single form met with; is identical to that described by Reuss and others.

Length 1.12 mm; Breadth 0.36 mm; Thickness 0.18 mm.

Rare.

Genus LENTICULINA Lamarck, 1804

LENTICULINA cf NAVICULA (d'Orbigny)

Cushman and Jarvis

Plate 14, figs. 8 a, b.

*Cristellaria navicula* d'Orbigny, 1840, *Mem. Soc. Geol. France*, Ser. 1, Vol. 4, Pl. 2, figs. 19-20, p. 27.

*Lenticulina navicula* (d'Orbigny)-Cushman, 1946, *U. S. Geol. Surv. Prof. Paper* 206, Pl. 18, fig. 16, p. 56; Nakkady, 1952, *Bull. Inst. Egypte*, Vol. 33, Pl. 5, fig. 1, p. 412; Said and Kenawy, 1954, *Micropaleontology*, Vol. 2, No. 2, Pl. 2, fig. 9, p. 131.

*Remarks*—This form has small test and lesser number of chambers than that of Cushman and Jarvis.

Length 0.37 mm; Thickness 0.16 mm.

Rare.

LENTICULINA PLANIUSCULA Reuss

Plate 12, figs. 17 a, b.

*Cristellaria planiuscula* Reuss, 1962, *K. Akad. Wien, Math-Naturw. Cl.; Sitzber., Wien, Osterreich*, Bd. 46, Abth. 1, p. 71; Chapman, 1894, *Jour. Roy. Micr. Soc.* Pl. 10, figs. 14a-b, p. 654.

*Remarks*—The form is identical to that of the European species described by Reuss.

Length 0.52 mm; Thickness 0.22 mm.

Rare.

LENTICULINA sp. indt.

Plate 12, figs. 16 a, b.

Only a solitary specimen has been met with, making identification difficult.

Length 0.47 mm; Thickness 0.21 mm.

Subfamily LAGENINAE

Genus LAGENA Walker and Jacob. 1798

LAGENA SIMPLEX Reuss

Plate 13, fig. 1,

*Oolina simplex* Reuss, 1851, *Naturw. Abh. Wien, Osterreich*, Bd. 4, Abth. 1, p. 22.

*Remarks*—A related form is *Lagena maxima* Reuss (*Oolina simplex*) which is not conically elongated but regularly spherical in shape.

Diameter 0.25 mm; Height 0.29 mm.

Common.



LAGENA SIMPLEX Reuss var. OVALIS n. var.

Plate 13, fig. 4.

*Description*—Test unilocular, elongate and oval, compressed, produced; surface entirely smooth, rounded at both ends; with radiating striae around the aperture.

Diameter 0.33 mm; Thickness 0.25 mm; Height 0.45-0.56 mm.

*Comparison and Remarks*—The variety closely resembles with *Lagena elongata* Dunikowski in the elongate oval shape but differs by its radiating striae around the aperture. With *Lagena globosa* (Montagu) var. *Ovalis* Reuss, it is distinguished by its elongate, compressed, and oval test, while the latter has more globular chamber and larger in dimension.

Frequently Common.

*Type No*—Holotype. L. U. 192; Paratype L. U. 193.

LAGENA SIMPLEX Reuss var. LACRIMA White

Plate 13, fig. 2.

*Lagena simplex* Reuss var. *Lacrima* White, 1928, *Jour. Pal., Menasha. Wis., U. S. A.*, Vol. 2, p. 211.

*Remarks*—It is characterised by its tear shaped but more globular chamber and larger in dimension. It resembles with *Lagena maxima* Dunikowski in shape but it is distinguished by the lack of black spot on the spherically rounded lower end and decrease in dimension. *Lagena maxima* is conically elongated.

Diameter 0.33 mm; Height 0.37 mm.

Common.

LAGENA cf. TENUSTRIATA Stache

Plate 12, figs. 7 a, b.

*Lagena tenuistriata* Stache, 1865, *Wien. Osterreich, Geol. Theil*, Bd. 1, Abt. 2, p. 184.

*Remarks*—This species is identical to that of Stache but is comparatively smaller in dimensions.

Diameter 0.17 mm; Height 0.29 mm.

Abundant.

Family POLYMORPHINIDAE

Subfamily POLYMORPHININAE

Genus POLYMORPHINELLA Cushman and Hanzawa, 1936

POLYMORPHINELLA cf. VAGINULINAEFORMIS Cushman and Hanzawa

Plate 12, figs. 5 a, b

*Polymorphinella vaginulinaeformis* Cushman and Hanzawa, 1936, *Contr. Cush. Lab. Foram. Res., Sharon. Mass., U. S. A.*, Vol. 12, Pt. 2, p. 47.

*Remarks*—This form resembles with that of Cushman and Hanzawa described from Japan.

Length 1.00 mm; Breadth 0.33 mm; Thickness 0.21 mm.

Rare.

Family ENANTIOMORPHINIDAE

Genus ENANTIODENTALINA Marie, 1941

ENANTIODENTALINA COMMUNIS (d'Orbigny) forma TYPICA Marie

Plate 15; figs. 1 a, b, c.

*Enantiotalina communis* (d'Orbigny) forma *typica* Marie, 1941, *Mem. Mus. Nat. Hist. Nat.*, n. s., Tome 12.

*Remarks*—This form is identical to that of Marie described from Paris and is characterised by its elongate arcuate form, and by its strongly limbate sutures.

Length 0.68 mm; Breadth 0.12 mm; Thickness 0.1 mm.

Rare.

Family NONIONIDAE

Genus NONIONELLA Cushman, 1926

NONIONELLA ROBUSTA Plummer var.

MARUDIARICA n. var.

Plate 13, figs. 6 a, b, c.

*Description*—Test small, about equally binconvex, nearly as broad as long, periphery broadly rounded; chambers distinct, eight in the last formed volution, rather rapidly increasing in size as added; sutures distinct, somewhat curved, slightly depressed and flush with the test; wall smooth, finely perforate, aperture a

low elongate slit on the periphery at the base of the last formed chamber.

Height 0.22-0.3 mm; Diameter 0.15-0.20 mm; Thickness 0.12-0.20 mm.

*Comparison and Remarks*—This form is distinguished by *Nonionella cretacea* Cushman, recorded from Selma Chalk, Tennessee, by the much more rounded test, very broadly rounded periphery while *Nonionella cretacea* is more elongated and has the periphery narrowly rounded and bluntly angular. From *Nonionella austinana* Cushman reported from Upper Cretaceous of Texas, it differs in having typically eight chambers.

Its characteristic eight chambers in the last whorl and broadly rounded periphery distinguish it as a variety of *Nonionella robusta*, Plummer described from Upper Cretaceous of Texas. It has been named after the Marudiyar river in Madras state.

Frequently Common.

*Type No*—Holotype. L. U. 194; Paratype L. U. 195.

NONIONELLA CRETACEA Cushman var.  
TAMIENSIS n. var.  
Plate 13, figs. 10 a, b, c.

*Description*—Test very small, moderately compressed, biconvex, periphery narrowly rounded, chambers eight in the final convolution, rapidly increasing in length in the adult, gently inflated, distinctly but not coarsely punctate; sutures distinct, slightly depressed and flush with test, somewhat curved; wall smooth; aperture a low slit on the base of the apertural face.

Length 0.23 mm; Breadth 0.12-0.13 mm; Thickness 0.06 mm.

*Comparison and Remarks*—The variety bears great similarity to that of *Nonionella cretacea* Cushman but differs in nature of the whorls, and measurement of the test. From *Nonionella robusta* Plummer, it is distinguished by the presence of bluntly angular periphery in maturity and non-visibility of inner whorls in

the umbilical depressions and in the higher ratios of length to breadth and length to thickness.

It is distinguished by its greater dimension from the Texas forms and as such considered a variety of that species.

Fairly Common.

*Type No*—Holotype. L. U. 196; Paratype L. U. 197.

Family HETEROHELICIDAE  
Subfamily BOLIVINITINAE  
Genus BOLIVINOIDES Cushman, 1927  
BOLIVINOIDES TEXANA Cushman  
Plate 13, figs. 8 a, b.

*Bolivinoides texana* Cushman, 1937, *Contr. Cush Lab. Foram. Res., Sharon, Mass, U. S. A.*, Vol. 13, Pt. 4, p. 104.

*Remarks*—This well preserved form is identical to that described by Cushman from Cretaceous of Texas.

Length 0.55-0.67 mm; Breadth 0.2-0.23 mm; Thickness 0.11 mm.

Common.

Subfamily GUMBELININAE  
Genus GUMBELITRIA Cushman, 1933.  
GUMBELITRIA HARRISI Tappan  
Plate 15, figs. 8a, b.

*Gumbelitria harrisi* Tappan, 1940, *Jour. Pal., Tulsa, Okla.*, Vol. 14, p. 115.

*Remarks*—The present form is identical to that described by Tappan, but differs from *Gumbelitria cretacea* Cushman reported from Upper Navarro formation, Texas, by its low aperture.

Length 0.15 mm; Breadth 0.21-0.1 mm; Thickness 0.1 mm.

Frequently Common.

Genus GUMBELINA Egger, 1899  
GUMBELINA ULTIMATUMIDA White  
Plate 12, figs. 14 a, b.

*Gumbelina ultimatumida* White, 1929, *Jour. Pal., Menasha, Wis. U. S. A.*, Vol. 3, p. 39;

Cushman, 1946, *U. S. Geol. Surv. Prof. Paper* 206, p. 107, Pl. 469, figs. 6-7; Said and Kenawy, 1956, *Micropaleontology* Vol. 2; No. 2, p. 139.

*Remarks*—This form is similar to that described from Mendez formation, Upper Cretaceous, Mexico, by White.

Length 0.16-0.25 mm; Breadth 0.12-0.29 mm; Thickness 0.08-0.21 mm.

Fairly Common.

Family BULIMINIDAE

Subfamily TURRILININAE

Genus BULIMINELLA Cushman, 1911

BULIMINELLA PULCHRA (Terquem) emend, Le Calvez,

Plate 15, figs. 4 a, b.

*Bulimina pulchra* Terquem, 1882, *Mem. Soc. Geol. France, Ser. 3.*, Vol. 2, Pl. 12, fig. 9, p. 114.

*Buliminella pulchra* (Terquem)-Cushman et. Parker, 1947, *U. S. Geol. Surv. Prof. Paper*, 210-D, Pl. 16, figs. 5-6, p. 61.

*Buliminella pulchra* (Terquem), emend., Le Calvez, 1950, *France, Service, Carte Geol., Mem. Paris.*, p. 33.

*Remarks*—This form resembles to that described by Le Calvez from Paris and in India it has been found by Tewari and Kumar from Eocene of Kutch.

Diameter 0.33 mm. Thickness 0.16 mm; Frequently Common.

BULIMINELLA COLONENSIS Cushman and Hedberg  
Plate 15, figs. 5 a, b.

*Buliminella colonensis* Cushman and Hedberg, 1930, *Contr. Cush. Lab. Foram. Res., Sharon, Mass.*, U. S. A. Vol. 6, Pt. 3, No. 95, p. 65.

*Remarks*—The present form bears close similarity to that described from Upper Cretaceous of Venezuela by Cushman and Hedberg.

Diameter 0.12 mm; Height 0.18 mm.  
Abundant.

BULIMINELLA CARSEYAE Plummer  
Plate 16, figs. 4 a, b.

*Bulimina compressa* Carsey (not Bailey,

1851), 1926, *Uni. Texas. Bull.* 2612, Pl. 29, fig. 14, p. 29.

*Buliminella carseyae* Plummer, 1931, *Texas. Uni. Bull.* No. 3101, p. 179; Cushman and Parker, 1947, *U. S. Geol. Surv., Prof. Paper*. 210-D, Pl. 15, fig. 8, p. 58; Said and Kenawy, 1956, *Micropaleontology*, Vol. 2, No. 2, Pl. 4, fig. 8, p. 142.

*Remarks*—The form closely resembles with that described from the Upper Cretaceous of Texas by Plummer.

Diameter 0.13 mm; Height 0.68 mm.  
Rare.

Subfamily BULIMININAE

Genus ENTOSOLENIA Ehrenberg, 1848

ENTOSOLENIA BLANFORDI n. sp.

Plate 12, figs. 12 a, b.

*Description*—Test elongate, pyriform with an internal short tube free at the inner end, the centre of the convex faces with a prominent boss, the peripheral keel sharp, thin, translucent, the area between the peripheral and secondary keels usually small and remaining constant throughout the test; wall very thick, calcareous finely perforate but slightly punctuate; the apertural end rounded, with a short broad neck.

Diameter 0.37-0.39 mm; Height 0.42-0.46 mm; Thickness 0.21-0.25 mm.

*Comparison and Remarks*—This species has close resemblance with *Lagena heinzi* Matthes, but differs from it by its more thick test, and presence of prominent central boss on the convex surface of the test.

Fairly Common.

This species has been named in honour of late H. F. Blanford, who studied for the first time the Cretaceous rocks of South India.

*Type No*—Holotype. L. U. 198; Paratype L. U. 199.

ENTOSOLENIA BLANFORDI var MARGINATA n. var.  
Plate 15, figs. 11, a, b.

*Description*—Test minute, elongate, pyriform, compressed, transparent, with an internal short,

but straight tube free at the bottom end, the central body part being elliptical but inflated; peripheral and lateral keels being sharp, thin, translucent, peripheral keel is slightly pointed at the base, the area between the keels usually opaque; wall thin, smooth, calcareous, finely perforate; aperture a narrow slit.

Diameter 0.17 mm; Height 0.21 mm; Thickness 0.10 mm.

*Comparison and Remarks*—This variety is similar to *E. blanfordi* but differs from it by its pointed peripheral keel at the base.

Fairly Common.

*Type No*—Holotype L. U. 200; Paratype L. U. 201.

ENTOSOLENIA STOLICZKAI n. sp.

Plate 15, figs. 10 a, b.

*Description*—Test elongate with an internal tube extending straight, just upto the bottom of the central chamber, consisting of a circular chamber with short produced neck, which is compressed, the central portion being transparent; the superior and inferior faces of the chambers are slightly convex and its edges are furnished with a thickened margin forming the outer carina of the test; wall smooth, thick, calcareous, finely perforate; apertural neck is extended with a narrow lip.

Diameter 0.18 mm; Height 0.25 mm; Thickness 0.13 mm.

*Comparison and Remarks*—The form somewhat resembles with *Entosolenia orbignyana* described by Seguenza from the Cretaceous rocks of Tennessee, but differs in the general shape of the test, chamber faces more convex with a thickened margin and apertural neck extended with a narrow lip.

Fairly Common.

This species has been named in honour of late F. Stoliczka who for the first time, made a detailed study of the fossil collections of the Cretaceous rocks of South India.

*Type No*—Holotype. L. U. 202, Paratype L. U. 203.

Subfamily VIRGULININAE

Genus BOLIVINA d'Orbigny, 1839

BOLIVINA CRETOSA Cushman var.

ARIYALURENSIS n. var.

Plate 13, figs. 3 a, b.

*Description*—Test tapering at both ends, megalospheric, compressed with rounded periphery, twice as long as broad, the broadest portion of the test is about one fourth length away from the aperture; chambers seven, distinct, overlapping, low and about twice as long as broad, increasing uniformly in size as they are added; sutures distinct, almost flush with the surface or slightly depressed, oblique; wall smooth, ornamentation indistinct; aperture narrow, elongate at the end of the last chamber.

Length 0.31-0.62 mm; Breadth 0.26 mm; Thickness 0.16 mm.

*Comparison and Remarks*—The variety resembles somewhat with that of Cushman described from the Selma Chalk, Tennessee, but differs from it by fewer number of chambers, comparatively broader terminal end and lack of ornamentation. As such it is made a variety of the species after the locality in Madras state.

Abundant.

*Type No*—Holotype L. U. 204; Paratype L. U. 205.

BOLIVINA INDICA n. sp.

Plate 14, figs. 7 a, b.

*Description*—Test minute, elongate, very much compressed, periphery acute sometimes with a very narrow keel, apical end sharply acute in the microspheric, obtusely rounded in the megalospheric form, tapering very regularly but gradually enlarging from the initial end to the greatest breadth formed by the last pair of chambers; Chambers 8-10 in numbers, very distinct, low and broad, slightly overlapping, not inflated, increasing very regularly and gradually in size as added, with very slight increment in relative height towards the

apertural end only in some specimens otherwise remaining more or less of the constant thickness throughout; suture distinct slightly raised thin and plate like, slightly curved, strongly oblique, with a very striking roughly triangular clear area at the inner end; wall smooth, finely perforate; aperture narrow, elongate slitlike.

Length 0.26-0.47 mm; Breadth 0.1-0.16 mm; Thickness 0.06-0.08 mm

*Comparison and Remarks*—This species has close affinity to *Bolivina mantaensis* Cushman described from Ecuador, but differs in the absence of basal, irregularly broken longitudinal ridges. From *Bolivina bottgeri* Spandel it is distinguished by lesser number of chambers. It is distinguished by its much compressed test, distinct, raised, thin and plate like, more oblique sutures, triangular mass of clear shell substance at the rounded upper corner of the chambers, from *Bolivina incrassata* Reuss recorded from the Upper Cretaceous of Poland.

Abundant.

This species is named after the country.

*Type No.*—Holotype. L. U. 206; Paratype L. U. 207.

*BOLIVINA GEMMA* Cushman var. *TRICHINOPOLENSIS* n. var.  
Plate 15, figs. 3 a, b.

*Description*—Test elongate, rather stout, slender, somewhat compressed, periphery broadly rounded, very gradually tapering from the rounded initial end, sides of the later three fourth of the test nearly parallel; chambers distinct nearly as high as broad in the adult, very slightly overlapping, not inflated, of rather uniform shape throughout; increasing gradually and regularly in size as added; sutures very distinct, somewhat limbate, nearly straight; very slightly depressed near the periphery, the inner margin raised forming a row of bead like ornamentation of clear shell material; wall thick, smooth, very finely perforate; aperture elongate.

Length 0.63-0.73 mm; Breadth 0.26-0.28 mm; Thickness 0.16-0.18 mm.

*Comparison and Remarks*—This variety has similarity to that of Cushman described from the Upper Cretaceous of Arkansas but is distinguished by its row of bead like ornamentation of sutures, whereas in *Bolivina gemma* Cushman, the bead is only confined in the inner margin. Moreover, the chambers are less in number, not inflated, and test is not twisted in the present species at all.

Frequent.

*Type No.*—Holotype. L. U. 208; Paratype L. U. 209.

*BOLIVINA* sp. indt.  
Plate 16, figs. 2 a, b.

This is a distinct species reminding one of *Bolivina draco* Marsson, recorded from the Upper Cretaceous of Europe and *Bolivina rhombodea* Cushman, described from Mexico. This is, however, clearly different, by its typical ornamentation, shape of the test, and arrangement of the chambers.

Length 0.26-0.29 mm; Breadth 0.16 mm; Thickness 0.09 mm.

Only two specimens have been met with making comparison difficult.

Genus *LOXOSTOMUM*, Ehrenberg, 1854  
*LOXOSTOMUM* sp. indt.  
Plate 16, fig. 1.

It resembles *Loxostomum plaitum* (Carsey) var. *limbosum* Cushman reported from Tennessee, characterised by clear aperture which is broken, in the present form.

Length 0.41 mm; Breadth 0.11 mm.

Frequent.

Family *ROTALIIDAE*  
Subfamily *DISCORBINAE*  
Genus *GYROIDINA* d'Orbigny, 1826  
*GYROIDINA TENDAMI* Schijfsma  
Plate 13, figs. 5 a, b, c.

*Gyroidina tendami* Schijfsma, 1946, *Geol. Strichting. Meded. Haarlem*. Ser. C, Sec. 5, No. 7, p. 86.

*Remarks*—The present form is identical to that described from the Upper Senonian of Netherlands by Schijfsma. It also resembles with *Gyroidina beisseli* White, but differs in the presence of deep and distinct sutures on the ventral side and aperture with a lip extending from periphery to umbilicus. From *Gyroidina mendenzensis* White, it is distinguished by the absence of over-hang of the terminal face and curved sutures in the ventral side and radial on the dorsal side.

Diameter 0.40 mm, Thickness 0.28 mm.

Abundant.

#### Family GLOBOROTALIIDAE

Genus GLOBOTRUNCANA Cushman, 1927

GLOBOTRUNCANA ARCA (Cushman)

Plate 16, figs. 7 a, b, c.

*Pulvinulina arca* Cushman, 1926, *Cush Lab. Foram. Res., Contr.*, Vol. 2, Pl. 3, figs. 1a-c, p. 23.

*Rosalinella rugosa* Marie, 1941, *Paris, Mus. Nat., Hist. Nat., Mem.*, new ser., Vol. 12, p. 241, Pl. 35, figs. 340a-c.

*Globotruncana arca* (Cushman)-Cushman, 1946 (Part), *U. S. Geol. Surv. Prof. Paper*. No. 206, Pl. 62, figs. 4-a-c. p. 150; Sacal and Debourle, 1957, *Mem. de la Soc. Geol. de France.*, Vol. 38, No. 78, Pl. 27, fig. 6-8, 10-12, p. 59; Edgell, 1957, *Micropaleontology* Vol. 3, No. 2, Pl. 1, figs. 10-12, Pl. 3, fig. 4-6, p. 110; Pessagno (Jr), 1960, *Ibid.* Vol. 6, No. 1, p. 102; Said and Kerdany, 1961, *Ibid.* Vol. 7, No. 3, Pl. 2, fig. 14, p. 330.

*Remarks*—This species has been recorded from Parguera Limestone and Rio Yauco mudstone; Navarro of the Gulf Coast. Campanian and Maestrichtian of the Caribbean region and the Near East, In northwest Australia this species is common in beds of Maestrichtian and Campanian age. In India it has been reported by Jacob and Sastry from Utatur stage and by Tewari and Tandom from Niti.

Diameter 0.31-0.43 mm; Thickness 0.21 mm.  
Frequent.

GLOBOTRUNCANA GANSSERI Bolli  
Plate 16, figs. 6 a-c.

*Globotruncana gansseri* Bolli, 1951, *Jour. Pal.*, Vol. 25, Pl. 35, fig. 1-3, p. 196; Said and Kenawy, 1956, *Micropaleontology*, Vol. 2, No. 2, Pl. 5, fig. 17, p. 150; Pessagno (Jr), 1960, *Ibid.*, Vol. 6, No. 1, Pl. 4, fig. 11, p. 102; Said and Kerdany, 1961, *Ibid.*, Vol. 7, No. 3, Pl. 2, Fig. 16, p. 331.

*Rugotruncana gansseri* (Bolli)-Bronnimann and Brown, 1956, *Eclogae Geol. Helv.*, Vol. 48 (1955) No. 2, Pl. 23, figs. 7-9, text fig. 23, p. 549-50.

*Remarks*—This species has been reported from Parguera Limestone and Rio Yauco mudstone. Middle Maestrichtian and early Maestrichtian occurrence in the Tethyan faunal province. Common in Navarro group and Chalk samples from Farafra Oasis, Egypt.

Diameter 0.38 mm. Thickness. 0.20 mm.

Rare.

#### REFERENCES

- BOLLI, H., 1951, The genus *Globotruncana* in Trinidad, B.W.I., Notes on occurrence, nomenclature and relationships between species. *Jour. Pal.*, Vol. 25, Pls. 34-35, pp. 187-199.
- BRONNIMANN, P., and BROWN, N.K., Jr., 1955, Taxonomy of the Globotruncanidae. *Eclogae Geol. Helv.* Vol. 48 (1955), No. 2, pp. 503-561.
- BLANFORD, H. F., 1862, On the Cretaceous and other rocks of the South Arcot and Trichinopoly Districts. *Mem. Geol. Surv. Ind.*, Vol. 4, pp. 23-125.
- CUSHMAN, J. A. 1950, *Foraminifera, their classification and economic use.* 3rd Edition, Harv. Uni. Press., Cambridge, Massachusetts.
- IDEM. 1946, Upper Cretaceous foraminifera of the Gulf Coastal region of the United States and adjacent areas. *U. S. Geol. Surv., Prof. Paper*. No. 206, Pls. 1-66, p. 1-160.
- ELLS, B. F., and MASINA, A. R., (Upto 1957), Catalogue of Foraminifera. *Spec. Publ. Amer. Mus. Nat. Hist., New York.*
- EDGELL, H. S. 1957, The genus *Globotruncana* in Northwest Australia, *Micropaleontology*, Vol. 3, No. 2, Pls. 1 and 3, Figs. 10-12, 4-6, p. 101-126.
- GLAESSNER, M. F., 1945, *Principles of Micropalaontology.* Melbourne University Press. Pls. 1-14, text figs. 1-64, pp. 3-296.
- JACOB, K., and SASTRY, M. V. A., 1951, On the occur-

- ence of *Globotruncana* in the Utatur stage of the Trichinopoly Cretaceous, South India. *Science and Culture* Vol. 16, No. 6.
- KOSSMAT, F., 1897, The Cretaceous deposits of Pondicherry. *Rec. Geol. Surv. Ind.* Vol. 30, Pt. 2.
- MATLEY, C. A., 1929, The Cretaceous Dinosaurs of the Trichinopoly District and rocks associated with them. *Rec. Geol. Surv. Ind.* Vol. 61, Pt. 4.
- NARAYANA RAO, C. R. and SESHACHAR, B. R., 1927, A short note on certain fossils taken in the Ariyalur area. *Mys. Uni. jour.* Vol. 1, Pt. 2.
- NARAYANA RAO, C. R. and RAMA RAO, L., 1930, Some Dinosaurian vertebrate. *Proc. Ind. Scie. Cong. Allahabad.* (Abstracts)
- NARAYANA RAO, S. R., 1941, Cretaceous Orbitoids from the Upper Ariyalur beds (Maestrichtian) of the Trichinopoly District, South India. *Jour. Mys. Univ.* Sec. B, Vol. 2, Pt. 9.
- PESAGNO, E. A. Jr., 1960, Stratigraphy and micropalaeontology of the Cretaceous and Lower Tertiary of Puerto Rico. *Micropalaeontology.* Vol. 6, No. 1, Pls. 1-5, pp. 87-110.
- POKORNY, V., 1963, *Principles of Zoological Micropalaeontology*, Vol. 1, Pergamon Press, Oxford.
- RAMA RAO, L., 1953, Orbitoids from the Cretaceous rocks near Ariyalur. *Current Science.* Vol. 22, No. 9.
- Idem. 1854, *Siderolites* from the Cretaceous rocks near Ariyalur. *Ibid.* Vol. 23, No. 1.
- Idem. 1956, Recent contribution to our knowledge of the Cretaceous rocks of South India. *Proc. Ind. Acad. Sci.*, Vol. 44, No. 4, p. 185-245.
- Idem. 1927, On a reptilian vertebra from the Cretaceous rocks of the Trichinopoly District, *Proc. Geol. Soc.* London.
- Idem. 1932, On a reptilian vertebra from the South Indian Cretaceous. *Amer. Jour. Scie.* Vol. 24 (Sept.).
- RASHEED, D. A., 1962, Some Arenaceous & Calcareous Procellaneous Foraminifera from the Cullygoody (Dalmiapuram) Limestone, Trichinopoly Cretaceous, Madras State, India, Part. I. *Jour. Madras. Univ.*, B. 32, No. 1, pp. 21-47.
- Idem. 1962, Some Calcareous Foraminifera belonging to Lagenidae, Ellipsoidinidae, & Heterohelicidae from the Cullygoody (Dalmiapuram) Limestone, Trichinopoly Cretaceous of South India. Part. II, *Jour. Madras. Univ.*, B. 32, Nos. 2 & 3, pp. 199-266.
- REICHEL, M., 1949, Observations sur *Globotruncana*. *Eclogae Geol. Helv.* Vol. 42, No. 2, Pls. 16-17, text-figs. 1-7, p. 596-617.
- SHARMA, R. S., 1953, On the occurrence of *Siderolites* sp. and *Globotruncana* cf. *arca* from the Upper Cretaceous of Pondicherry. *Current Science.* Vol. 22, No. 1.
- STOLICZKA, F., 1861-71 Cretaceous Fauna of Southern India. *Mem. Geol. Surv. India. Pal. Indica.* Vols. 1-4.
- SAID, R., & KERDANY, M. T., 1961, The geology and micropalaeontology of Farafra Oasis, Egypt. *Micropalaeontology*, Vol. 7, No. 3, Pls. 1-2, pp. 317-36.
- SAID, R., & KENAWY, A., 1956, Upper Cretaceous and Lower Tertiary foraminifera from northern Sinai, Egypt. *Micropalaeontology*, Vol. 2, No. 2, Pls. 1-7, pp. 105-173.
- VREDENBURG, E., 1908, Cretaceous Orbitoides of India. *Rec. Geol. Surv. Ind.* Vol. 36, Part. 3.