CHAPTER 3

SYSTEMATIC PALEONTOLOGY
3.1 CLASSIFICATION

In the present work, the classification of Loeblich and Tappan (1988) entitled "Foraminiferal Genera and their Classification" is followed. Although numerous other publications in recent years have emphasized planktic genera and their classification, agglutinated taxa, or other selected groups from limited geographic regions or geologic periods, the most recent compilation of all described genera was that of Loeblich and Tappan (1988).

In this foraminiferal classification, they gave importance in denoting relationships—the genetically controlled test composition, mineralogy, ultrastructure, and method of test formation; hence these characteristics delimit the suborders.

The unilocular, bilocular or multilocular character of the test, presence or absence of wall perforations, canaliculi, alveoli or canal systems and major apertural features rank next in importance and separate superfamilies.

The free or attached nature of the foraminifer, mode of chamber addition, simple or undivided chamber, interior and apertural modifications separate families.

Subfamilies are also recognized in some but not all families.

According to Loeblich and Tappan (1988), "Wall composition and ultra structural modifications appear more fundamental than number and arrangement of chambers, both of which may change during ontogeny; hence evolutionary relationships appear to be best indicated by such a hierarchial classification. Although individual species are not discussed in this book, even surface ornamentation may show phylectic importance at the species level". As regards to planktic foraminifera the work of Toumarkine & Luterbacher entitled "Paleocene & Eocene planktic foraminifera" in Bolli et al., 1985 has been adopted.

For the classification, identification and description of Uvigerinids, "Handbook of common Tertiary Uvigerina" by Boersma (1984), "Atlantic-European Oligocene to Recent Uvigerina taxonomy, paleoecology and paleogeography" by Zwann et al. (1986) is followed.
For taxonomic descriptions the available published literatures from different parts of the world have been referred.

In this chapter, 56 species belonging to 29 genera, 23 families, 17 superfamilies and 5 suborders are described and illustrated.

Of the total species, 16 are planktic forms and 40 are benthic forms. Ranges for each species of planktic forms are given. Benthic forms' ranges are not given as they are long ranging. Identifications for each species were carried out with the comparisons of faunas reported by previous workers from Nagaland, Assam, Meghalaya, Cauvery Basin and Cambay Basin and other parts of the world.

All the illustrated foraminiferal species are lodged in Wadia Institute of Himalayan Geology, Dehradun.

3.2 SYSTEMATIC DESCRIPTIONS

Order FORAMINIFERIDA Eichwald, 1830
Suborder TEXTULARIINA Delage and Hérouard, 1896
Superfamily LOFTUSIACEA Brady, 1884
Family CYCLAMMINIDAE Marie, 1941
Subfamily CYCLAMMININAE Marie, 1941
Genus Cyclammina Brady, 1879

*Cyclammina* sp.

pl. 6, figs. 4-5.

**Description:** Test planispirally coiled and involute, somewhat flattened, numerous broad and low chambers per whorl, whorls increasing rapidly in height, sutures nearly radial, periphery broadly rounded; wall agglutinated, with very thin imperforate outer layer; aperture is a curved slit at the base of the apertural face, supplementary pores indistinct.

**Remarks:** The specimen from the Disang Group of Nagaland is not preserved satisfactorily. Few specimens are encountered in the present study area at Leshemi section.
Description: Test is ovate in outline, compressed through the midpoint of the opposing chambers, periphery angular to carinate, chambers one-half coil in length, microspheric generation with early quinqueloculine to cryptoquinqueloculine arrangement, adult biloculine; wall calcareous, imperforate porcellaneous, aperture at the end of the final chamber, ovate with a short bifid tooth.

Remarks: The specimen from the Disang Group of Nagaland has an ovate test, periphery sub-rounded, chambers one-half coil in length, wall calcareous, imperforate. Aperture at the end of final chamber and the bifid tooth is not seen due to ill preservation. Few specimens have been recovered from Chobama 1 section.

Genus *Triloculina* (d’Orbigny, 1826)

*Triloculina* sp.
pl. 9, figs. 9, 10

Description: Test ovate in outline, equilaterally triangular or sub-triangular in section, chambers one-half coil in length, only three chambers visible from the exterior; wall calcareous, imperforate, porcellaneous, aperture rounded at the end of the final chamber.

Remarks: The specimen from the present study is not well preserved. Moderate amount of specimens are found at Chobama 1 and Leshemi section.
**Miliola sp.**

pl. 9, figs. 7-8.

**Description:** Test narrow and elongate fusiform, chambers one-half coiled in length, quinqueloculine, wall calcareous, porcellaneous, surface pitted by numerous pseudopores and has longitudinal costae, aperture terminal on the final chamber.

**Remarks:** Only a few specimens are observed in the present study. The preservation is not satisfactory and sediments have filled most of the pits; a few specimens have been found at Chobama 2 section.

Suborder **LAGENINA** Delage and Hérouard, 1896
Superfamily **NODOSARIACEA** Ehrenberg, 1838
Family **NODOSARIIDAE** Ehrenberg, 1838
Subfamily **NODOSARIINAE** Ehrenberg, 1838
Genus **Dentalinoides** Marie, 1941

**Dentalinoides** sp.

pl. 8, fig. 9

**Description:** Test narrow and elongate fusiform, chambers one-half coiled in length, quinqueloculine, wall calcareous, porcellaneous, surface pitted by numerous pseudopores and has longitudinal costae, aperture terminal on the final chamber.

**Remarks:** Only a few specimens are observed in the present study. The preservation is not satisfactory and sediments have filled most of the pits; a few specimens have been found at Chobama 2 section.

Genus **Pseudonodosaria** Boomgaart, 1949

**Pseudonodosaria** sp.

pl. 6, fig. 6

**Description:** Test elongate, cylindrical, base broadly rounded, sutures straight, horizontal, flush with the surface, wall calcareous, surface smooth; aperture terminal, radiate.
Remarks: Due to poor preservation, no characteristic features are clearly definable. Few specimens are found at Chobama 1 section.

Family VAGINULINIDAE Reuss, 1860
Subfamily LENTICULININAE Chapman, Parr and Collins, 1934
Genus Lenticulina Lamarck, 1804

*Lenticulina* sp.
Pl. 7 fig. 6

Description: Test planispiral, lenticular, biumbonate, periphery angled to carinate, chambers increase slowly in size as added, sutures straight to curved; wall calcareous, hyaline, perforate radial, surface smooth other than the sutural nodes; aperture radiate or slit like at the peripheral angle.

Remarks: The specimen from Disang Group of rocks in Nagaland is not satisfactorily preserved. It occurs at Pfutsero 1 section.

Family LAGENIDAE Reuss, 1862
Genus Lagena Walker and Jacob, 1798

*Lagenacuticosta* Reuss var. *proboscidialis* Bandy, 1951
pl. 7, fig. 1

Description: Test unilocular, globular to ovate, base rounded, aperture terminal with a shoulder and short cylindrical neck, surface ornamented with 10-12 costae, which blend into the shoulder at the apertural end and extend to the basal apex at the other end. Neck short and cylindrical.

Selected reference and locality:

1993 *Lagenacuticosta* Reuss, Boltovskoy and Watanabe, p. 11, pl. 1, fig. 24, DSDP Site 25, South Atlantic
**Remarks:** The present specimen has an ovate, sub-globular test, a short cylindrical neck, surface ornamented with 10-12 costae. Since the apertural part is not preserved well, it cannot be described in detail. It is found at Chobama 1 section.

*Lagena striata* (d’Orbigny)

pl. 7, fig. 2

**Description:** Test unilocular, spherical; wall calcareous, finely perforate with many delicate longitudinal striae from the base of the test to the neck; aperture rounded on a surface with numerous longitudinal striae or costae.

**Selected references and localities:**
- 1992 *Lagena striata* (d’Orbigny), Kaiho, p. 377, pl. 2, fig. 7, Hokkaido, Japan
- 1996 *Lagena striata* (d’Orbigny), Dave, p. 25, pl. 1, fig. 9; Cauvery and Krishna-Godavari Basins, India

**Remarks:** The specimens referred by Kaiho from the Upper Eocene of Hokkaido, Japan have the same characters with the present specimen from the Disang Group; a spherical test with 18-20 longitudinal striae. Necks of specimens are generally broken. The specimen is recorded from Chobama 1 & 3 sections.

*Lagena sulcata* (Walker and Jacobs) var. *spicata*

Cushman and McCulloch, 1950

pl. 7, fig. 4

**Description:** Variety differing from the typical *Lagena sulcata*, in having the basal end drawn out into a stout spine, the apertural end with a tapering cylindrical neck with a phialine lip, usually without other ornamentation, body of the test with numerous longitudinal costae as in the typical form.
Selected reference and locality:

1950  *Lagena sulcata* (Walker and Jacob) var. *spicata* Cushman and McCulloch, no. 6, p. 360; Los Angeles, California, North America.

**Remarks:** The specimen from Disang Group of Nagaland is poorly preserved. The basal end drawn out into a stout spine is prominent with numerous longitudinal costae. This variety is fairly common in the Pacific in fairly deep water. One or two specimens are encountered at Chobama 1 section.

*Lagena* sp.

pl. 7, figs. 3 and 5

**Description:** Test unilocular, globular to ovate; wall calcareous, hyaline, surface with numerous delicate longitudinal striae; aperture terminal, rounded produced on a short neck.

**Remarks:** Only few specimens are encountered at Leshemi section.

Family ELLIPSOLAGENIDAE A. Silvestri, 1923
Subfamily PARAFISSURININAE R.W. Jones, 1984
Genus *Parafissurina* Parr, 1947

*Parafissurina* sp.

pl. 10, figs. 7-9

**Description:** Test unilocular, peripheral margin rounded, wall calcareous, surface smooth, aperture crescentic, sub-terminal.

**Remarks:** Few specimens are found at Chobama 1 and Leshemi sections. The preservation is poor.

Suborder GLOBIGERININA Delage and Hérouard, 1896
Superfamily HETEROHELICACEA Cushman, 1927
Family CHILOGUEMBELINIDAE Reiss, 1963
Genus *Chiologuembelina* Loeblich and Tappan, 1956
**Chiloguembelina** sp.

pl. 3, fig. 4

**Description:** Test sub-triangular in outline, narrow to flaring, chambers slightly inflated and compressed, biserial throughout with a tendency to be slightly twisted, sutures distinct, depressed; wall calcareous, finely perforate, surface granulate, aperture a simple and arched opening, with inturned narrow narrow bordering rim.

**Remarks:** The genus *Chiloguembelina* was described by Loeblich and Tappan (Nov, 1956) to include those Tertiary species, originally referred to *Guembelina* Egger, which were characterized by the absence of an early coiled stage, the presence of neck-like aperture extensions and the tendency to develop a twisted test and an asymmetrical aperture. The genus was placed in the family Heterohelicidae. *Guembelina venezuelana* Nuttal, one of the several Tertiary species of *Guembelina* included by Loeblich and Tappan in their genus *Chiloguembelina*, had earlier been placed in the genus *Virguilina* d’Orbigny by Hofker (1954), who stated that he observed a tri-serially arranged initial part of the test and a well-developed tooth plate in Nuttall’s form. In July 1956, Hofker transferred Nuttall’s form to his newly erected genus *Stainforthia*. Beckmann (1957), in the course of his detailed study on the genus *Chiloguembelina* from Trinidad, remarked (p.83): “The presence of a tri-serial stage in *Guembelina venezuelana* Nuttall, recorded by Hofker (1954), could not be confirmed”. He regarded *Chiloguembelina* as a valid genus (Samanta, 1969). Few specimens are found at Choba ma 1 and 3 sections. In the study area, about four species of *Chiloguembelina* are found. Most of them have the general characters of *Chiloguembelina* with some variations for individual species. Hence, only remarks are presented for each species.

**Chiloguembelina cubensis** (Palmer, 1934)

pl. 3, fig. 2

**References and localities:**

1968 *Chiloguembelina cubensis* (Palmer), Raju, pl. 1, Figs. 4a, b; Cauvery Basin, South India.
1974 *Chiloguembelina cubensis* (Palmer), Fleisher, p. 1016, pl. 4, Fig. 8; Arabian Sea, Deep Sea Drilling Project (DSDP), LEG 23 A.

1991 *Chiloguembelina cubensis* (Palmer), Qianyu and Radford, fig. 12 (*C. cubensis* is one of the few omnipresent Chiloguembelinids).

1991 *Chiloguembelina cubensis* (Palmer), Spezzaferri and Silva, p. 253, pl. 10, figs. 5a, 6a, 7a, 8a, 9a-b; Hole 538A, DSDP LEG 77, Gulf of Mexico.

2002 *Chiloguembelina cubensis* (Palmer), Galeotti et al., pl. 3, fig. 5, pl. 5, fig. 15, Agulhas Ridge, South Africa.

2003 *Chiloguembelina cubensis* (Palmer), Mukhopadhyay, p. 84, pl. 3, Fig. 11-13, Cambay Basin, India.

**Remarks:** The *Chiloguembelina cubensis* from Disang Group of Nagaland are small in size (Length 0.02mm and width 0.01mm). It occurs in few numbers at Chobama 1 and 2 and Leshemi sections. The slowly expanding elongate test, rough surface and a low basal aperture characterizes the species.

**Stratigraphic range:** Beckmann (1957) gave the range of this species from *Porticolulasphaera mexicana* Zone to *G. opima opima* Zone in Trinidad. The species has also been reported from various parts of the world in sections of Upper Eocene to Oligocene. Blow (1969) gave the range of *Chiloguembelina ex group cubensis* from Zone P13 to be very close to the Zone N4/Zone N3 (=P22) boundary. In Cauvery basin, this species is common from the *G. mexicana* Zone to *G. amphipertura* Zone (Raju, 1971, p.39).

*Chiloguembelina martini* (Piijpers, 1933)

pl. 3 fig.1

**References and localities:**

1968 *Chiloguembelina martini* (Piijpers), Raju, pl. 1, fig. 12, Cauvery Basin, India.

1969 *Chiloguembelina martini* (Piijpers), Mohan and Soodan, pl. 1, fig. 3, Kutch, India.

1981 *Chiloguembelina martini* (Piijpers), Nath and Choubey, p. 100, pl. 2, figs. 19a, b, Cambay Basin, Gujarat.

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**Remarks:** The small specimen of *Chiloguembelina martini* has 0.2 mm length and 0.1 mm width, with slowly expanding elongate test, rough surface and a low basal aperture characterizes the species. This species is encountered at Chobama 1 and 3 sections.

**Stratigraphic range:** Beckmann (1957) gave the range of this species from the *Globorotalia aragonensis* Zone to the top of *G. cocoensis* Zone (= *G. cerroazulensis* Zone) in Trinidad. In Cauvery Basin, this species is recorded from the *Globorotalia spinuloinflata* subzone (Lower Eocene) to the top of *G. cerroazulensis* Zone (Raju, 1971).

*Chiloguembelina cf. tenuis* (Todd, 1957)

pl.3, fig.3

**Selected references and localities:**

1969 *Chiloguembelina tenuis* (Todd), Samanta, p. 329, pl. 1, figs. 8a-b; Garo Hills, Assam, India

1970 *Chiloguembelina* sp. cf. *C. tenuis* (Todd), Samanta, p. 189, pl. 1, figs. 8-9;

Lakhpam, Cutch, Western India

**Remarks:** With their small elongate compressed test 5-6 pairs of inflated chambers between depressed inclined sutures, finely perforate smooth surface. The specimens from Nagaland are comparable with *Chiloguembelina tenuis* (Todd) of Samanta (1970) from Cutch. The outer surfaces of the specimens are generally corroded or damaged may be due to transportation and the slit-like apertures are filled with matrix. In the present study, it occurs at Leshemi, Chobama 1 and Pfutsero 2 sections.

**Stratigraphic range:** The upper limit of the range of the genus is not well established. Loeblich and Tappan (1956) described it as a Paleocene and Eocene genus.

Superfamily GLOBOROTALIACEA Cushman, 1927

Family GLOBOROTALIIDAE Cushman, 1927

Genus *Turborotalia* Cushman and Bermudez, 1949
**Turborotalia cerroazulensis cerroazulensis** (Cole), 1928

pl. 2, figs. 7-9

**Remarks:** Test globose to inflated, trochospiral, closely coiled, chambers ovate, somewhat flattened on the slightly convex spiral side, umbilical side strongly convex, suture radial, slightly depressed, periphery broadly rounded without a keel; wall calcareous, finely perforate, surface smooth, aperture a curved low interiomarginal arch, umbilical-extraumbilical, with bordering lip.

**References and localities:**

1968 *Turborotalia cerroazulensis* (Cole), Raju, pl. 3, figs. 7a-c, Cauvery Basin, South India

1969 *Turborotalia cerroazulensis* (Cole), Samanta, p. 333, pl. 2, fig. 1a-c, Garo Hills, Assam

1974 *Turborotalia cerroazulensis cerroazulensis* (Cole), Fleisher, p. 1035, pl. 19, fig. 1; Arabian Sea, Deep Sea Drilling Project, Leg 23A

1985 *Turborotalia cerroazulensis cerroazulensis*; Toumarkine and Luterbacher, p. 137, Fig. 34, 3-4.

1988 *Turborotalia cerroazulensis cerroazulensis* (Cole); Nocchi et al., pl. 3, figs. 6, 7, Se Umbria, Italy.

2003 *Turborotalia cerroazulensis cerroazulensis* (Cole); Warraich and Nishi, p. 228, pl. 2, 3a-c, Sulaiman range, Indus Basin, Pakistan.

2003 *Turborotalia cerroazulensis cerroazulensis* (Cole); Mukhopadhyay, pl. 1, fig. 1, Cambay Basin, India.

**Description:** Test globose to inflated, trochospiral, closely coiled, chambers ovate, somewhat flattened on the slightly convex spiral side, umbilical side strongly convex, suture radial, slightly depressed, periphery broadly rounded without a keel; wall calcareous, finely perforate, surface smooth, aperture a curved low interiomarginal arch, umbilical-extraumbilical, with bordering lip.
**Stratigraphic range:** Toumarkine and Luterbacher, (1985) placed the range of *Tuborotalia cerroazulensis cerroazulensis* to a probable range from upper part of Zone P12 to P13 and definite range from Zone P14 to P17.

*Tuborotalia cerroazulensis cocoaensis* (Cushman, 1928)

* pl. 2, figs. 3 and 5

**Description:** *Tuborotalia cerroazulensis cocoaensis* shares the general characters of the subspecies *cerroazulensis* on the flat spiral side, but in lateral view, its periphery is considerably more acute. The aperture is a high arch between the umbilicus and the periphery but does not reach the latter.

**References and localities:**

1987  *Globorotalia (Tuborotalia) cerroazulensis* (Cole), Baruah et al., fig. 6 (5-7), Nagaland

1988 *Tuborotalia cerroazulensis cerroazulensis* (Cole), Nocchi et al., pl. 3, figs. 10, Se Umbria, Italy

2002 *Tuborotalia cerroazulensis cocoaensis* (Cushman), Abdelghany, p. 214, pl. 1, figs. 1-2, Dammam Formation, west of Northern Oman Mountains

**Remarks:** The specimen from Disang Group of Nagaland is very much comparable with the figures of *T. c. cocoaensis* of Toumarkine & Luterbacher (1985). It is found at Chobama 3 section.

**Stratigraphic range:** In Toumarkine and Luterbacher, 1985 probable range starts from Zone P14 and definite range starts from Zone P15 to P17.

*Tuborotalia cerroazulensis pomeroli* (Toumarkine and Bolli, 1970)

* pl. 2, figs. 1-2 and 4.

**Description:** *Tuborotalia cerroazulensis pomeroli* differs from its ancestor *Tuborotalia cerroazulensis possagnoensis* by the larger number of chambers in the last whorl (4-6 instead of 3½), and by its larger size and more rounded periphery.
P. nauguewichiensis and P. barbadoensis are very close in appearance (Toumarkine and Luterbacher, 1985 p.119, Fig. 21.17). P. nauguewichiensis has possibly a
This planispiral, bi-umbilicate, rather small species is more laterally compressed. The periphery of *P. micra* is generally rounded but it becomes sub-acute in larger specimens.

**References and localities:**

1969 *Pseudohastigerina barbadoensis* Blow; Raju, p. 35, fig. 12-14, Cauvery Basin, India.

1971 *Pseudohastigerina barbadoensis* Blow; Raju, p. 35, figs. 12-14, Cauvery Basin, India.

1985 *Pseudohastigerina barbadoensis*; Toumarkine and Luterbacher, p. 119, fig. 21.17a-b.

1991 *Pseudohastigerina barbadoensis* Blow; Spezzaferri and Silvia, p. 253, pl. 14, fig. 3a-b, Hole 538A, DSDP Leg 77, Gulf of Mexico.

2003 *Pseudohastigerina barbadoensis*; Mukhopadhyay, p. 82-83, pl. 2, fig. 6.

**Remarks:** With its small size and six chambers, the specimen from Disang Group of Nagaland is very well comparable with illustrations and description of the type. In the present study, it occurs in Chobama 1 section.

**Stratigraphic range:** In Cauvery Basin, this species is very common in *G. gortanii* Zone and very rare in the *G. cerroazulensis* Zone (Raju, 1971). According to Toumarkine and Luterbacher (1985) *P. naguewichiensis* range from Zone P16 to P17. As *P. naguewichiensis* and *P. barbadoensis* have the same stratigraphic range, it has the range have from Zone P16 to Zone P17.

*Pseudohastigerina micra* (Cole, 1927)

pl. 1, fig. 8

**Description:** This planispiral, bi-umbilicate, rather small species is more laterally compressed. The periphery of *P. micra* is generally rounded but it becomes sub-acute in larger specimens.

**References and localities:**
1968 *Pseudohastigerna micra* (Cole), Raju, p. 36, pl. 13, Fig. 9 a, b; Cauvery Basin, South India

1969 *Pseudohastigerna micra*; Samanta, p. 342, pl. 1, Fig. 6 a, b, Garo Hills, Assam, India.

1970 *Pseudohastigerna micra* (Cole), Mohan and Soodan, pl. 2, fig. 9, Kutch, India

1981 *Pseudohastigerna micra* (Cole), Nath and Choubey, p. 101, pl. 2, figs. 20a-c, Cambay Basin, Gujarat

1985 *Pseudohastigerna micra* (Cole), Toumarkine and Luterbacher, p. 118, figs. 21(1-8)

1987 *Pseudohastigerna micra* (Cole), Baruah et al., fig. 6 (12, 13), Nagaland

1988 *Pseudohastigerna micra* (Cole), Nocchi et al., p. 190, 193, pl. 4, fig. 7, Se Umbria, Italy

1991 *Pseudohastigerna micra* (Cole), Spezzaferri and Silva, p. 253, pl. 14, figs. 4a, b, Hole 538A, Deep sea drilling project (DSDP) Leg 77, Gulf of Mexico.

1997 *Pseudohastigerna micra* (Cole), Mukhopadhyay, p. 220, pl. 2, figs. 24-25; Kotadru nala section, Bharuch District, Gujarat.

2003 *Pseudohastigerina micra* (Cole), Mukhopadhyay, p. 82-83, pl. 2, figs. 1-3; Cambay Basin, India.

**Remarks:** This apparently fragile species is in fact very resistant to bad ecologic conditions and is a dominant species in the study area. With its small size and six chambers, the specimen from Disang Group of Nagaland is very well comparable with the illustrations and description of *P. micra* of Toumarkine and Luterbacher. It is found in fairly large numbers at Pfutsero 1, 2 and Chobama 1, 3 sections.

**Stratigraphic range:** In Cauvery Basin, this species is very common in *G. gortanii* Zone and very rare in the *G. cerroazulensis* Zone (Raju, 1971). Toumarkine and Luterbacher gave the range of *P. naguewichiensis* to the Zone of P16 to P17. As *P. naguewichiensis* and *P. barbadoensis* have the same stratigraphic range, *P. barbadoensis* have the range from Zone P16 to P17.

*Pseudohastigerina naguewichiensis* (Myatliuk, 1950)

pl. 1 Fig. 7

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Remarks: *Pseudohastigerina naguewichiensis* has more lobate equatorial outline with numerous chambers in the last whorl (often 8), sutures straight, periphery rounded. It is found at Chobama 1 and Pfutsero 2 sections.

References and localities:

1985 *Pseudohastigerina naguewichiensis* (Myatliuk) Toumarkine & Luterbacher, p. 119, figs. 10-16.

1991 *Pseudohastigerina naguewichiensis* (Myatliuk), Spezzaferri and Silvia, p. 253, pl.10, figs. 1a-c, 2a-b, 5a-c, Hole 538A, DSDP Leg 77, Gulf of Mexico.

1997 *Pseudohastigerina naguewichiensis* (Myatliuk), Mukhopadhyay, pl. 2, fig. 26, Kotardu Nala Section, Bharuch District, Gujarat.

Stratigraphic range: It starts from Zone P16 and continues to Oligocene.

Family HANTKENINIDAE Cushman, 1927

Genus *Cribrohantkenina* Thalmann, 1942

*Cribrohantkenina inflata* (Howe, 1928)
pl. 1, figs. 5-6

Description: This species is readily recognized by its 4-6 inflated chambers, each carrying a stout spine in the last whorl and by its peculiar accessory areal apertures. The primary aperture is trilobate as in *Hankenina* whereas the accessory areal apertures are tuberculate holes (Toumarkine and Luterbacher, 1985, p.125).

Selected references and localities:

1968 *Cribrohantkenina inflata* (Howe), Raju, pl. 1, fig. 7, Cauvery Basin, South India.

1969 *Cribrohantkenina inflata* (Howe), Samanta, p. 337, pl. 1, fig. 11a, b; Garo Hills, Assam, India.

1971 *Cribrohantkenina inflata* (Howe), Raju, p. 37, pl. 13, figs. 2, 3, 4, 5, 6, 7, 8a, b; Cauvery Basin, South India.
Description: Test planispirally enrolled, involute, biconvex, and biumbilicate, chambers are globular, most chambers of the final whorl characterized with a single long hollow tubulospine arising slightly anterior to the chamber mid point on the periphery and in the plane of coiling, tubulospines with tiny distal opening, sutures depressed, radial, (Loeblich

1985 *Cribrohantkenina inflata* (Howe), Toumarkine and Luterbacher, p. 125.

1987 *Cribrohantkenina inflata* (Howe), Baruah *et al.*, p. 317, fig. 6, 3-4; Disang and Barai Groups, Nagaland.

2002 *Cribrohantkenina inflata* (Howe), Abdelghany, p. 215, pl. 2, fig. 3-6; Damman Formation, west of the Northern Oman Mountains.

2003 *Cribrohantkenina inflata* (Howe), Coxall, p. 87, fig. 2; Ocean Drilling Project (ODP) site 865.

Remarks: The genus *Cribrohantkenina* with its peculiar cribrate aperture is thought to be monospecific. With its large planispirally coiled involute test, 4-5 strongly inflated rapidly enlarging chambers in the last whorl, one short tubulospine in each chamber and multiple aperture, *Cribrohantkenina inflata* (Howe) is a distinctive planktonic foraminifera in the study area. According to Toumarkine and Luterbacher (1985 p. 121), the evolutionary trends within the genus *Hantkenina* lead from strongly stellate forms to more and more compact tests and to a narrowing of the initially rather wide triradiate aperture and finally to transitional form to *Cribrohantkenina*. The specimens from the study area are not well preserved. The spines are either partially or completely broken. In the present study, it is found at Chobama 1 and 3 sections.

Stratigraphic range: This species is known to be an important worldwide index fossil of Upper Eocene. This species is common throughout the *G. cerroazulensis* in Cauvery Basin (Raju, 1971). Toumarkine and Luterbacher, 1985, placed the range of this species to upper most part of Zone P15 to P17.

**Genus Hantkenina** Cushman, 1924

*Hantkenina alabamensis* Cushman 1925

pl. 1, figs.1-2.

Description: Test planispirally enrolled, involute, biconvex, and biumbilicate, chambers are globular, most chambers of the final whorl characterized with a single long hollow tubulospine arising slightly anterior to the chamber mid point on the periphery and in the plane of coiling, tubulospines with tiny distal opening, sutures depressed, radial, (Loeblich
and Tappan 1988, p. 487). Wall calcareous, hyaline, finely perforate, except for the apertural flanges and tubulospines. *Hantkenina alabamensis* is the most advanced representative of the genus *Hantkenina*. Its chambers increase slowly in size and are closely pressed against each other. The contour of the periphery is rounded (Toumarkine and Luterbacher, 1985).

**Selected references and localities:**

1959  
*Hantkenina alabamensis* Cushman; Nagappa, pl. 2, fig. 14, Garo Hills, Assam, India.

1968  
*Hantkenina alabamensis* Cushman; Raju, p. 291, pl. 1, fig. 11; Cauvery Basin, South India.

1969  
*Hantkenina alabamensis* Cushman; Samanta, p. 338, pl. 3, Fig. 3a, b; Garo Hills, Assam, India.

1971  
*Hantkenina alabamensis* Cushman; Raju, p. 36, pl. 11, figs. 8, 9a, b; Cauvery Basin, South India.

1985  
*Hantkenina alabamensis* Cushman; Toumarkine and Luterbacher, p. 123, fig. 25, 1-10.

1987  
*Hantkenina alabamensis* Cushman, Baruah et al., fig. 6 (1-2), Nagaland.

1988  
*Hantkenina* cf. *alabamensis* Cushman; Nocchi et al., p. 190-193, pl. 4, figs. 9-16; Se Umbria, Italy.

1997  
*Hantkenina* cf. *alabamensis* Cushman, Mukhopadhyay, p. 220, pl. 2, fig. 21; Kotadru nala section, Bharuch district, Gujarat.

2003  
*Hantkenina alabamensis* Cushman, Mukhopadhyay, pl. 1, fig. 5; Cambay Basin, India.

**Remarks:** The specimens from the study area are comparable with the illustrations and description of Toumarkine and Luterbacher, 1985. Successive chambers are progressively larger and are closely pressed against each other. The contour of the periphery is rounded. The specimens are characterised by the presence of a thin tubulospine at the forward margin of each chamber. The present specimens are similar to the specimen identified by Samanta (1969, pl. 3, Fig. 3a, b) from Garo Hills, Assam in which the spines are not preserved and the aperture is filled with matrix. In the present study, it is found at Chobama 3 and Leshemi sections.
Remarks: The small tests of *Hantkenina liebusi*, characterized by four to five clearly separated chambers with slender spines situated much below the anterior sutures, are quite distinctive and easily recognized, although the preservation of the material is not completely satisfactory. The aperture is filled with matrix and the details cannot be described. The slender spines are in most cases partly broken. In the present study, it occurs at Chobama 1 and 3 sections.

**Stratigraphic range:** In Cauvery basin typical forms of this species are recorded so far from the *G. mexicana* Zone and *G. cerroazuleasis* Zone (Raju, 1971). Toumarkine and Luterbacher, 1985 gave the range of this species from upper part of Zone P12 to P17.

*Hantkenina liebusi* Shokhina, 1937

pl. 1, figs. 3-4.

**Description:** The test of *H. liebusi* is characterized by four to five clearly separated chambers with slender spines situated close to anterior suture with triangular chamber morphology, and planispiral coiling, is quite distinctive, and easily recognized (Coxall et al., 2003, p. 239).

**Selected references and localities:**

1969 *Hantkenina liebusi* (Shokhina), Samanta, p. 339, pl. 1, fig. 10a, Garo Hills, Assam, India.

1970 *Hantkenina liebusi* (Shokhina), Mohan and Soodan, pl. 2, figs. 6, 7, 8, Kutch, India.

1993 *Hantkenina liebusi* (Shokhina), Pearson et al., pl. 3, figs. 8-10; Deep Sea Drilling Project (DSDP) Site 523.

2000 *Hantkenina liebusi* (Shokhina), Coxall et al., p. 87, fig. 2; Ocean drilling project (ODP) Site 865.

2003 *Hantkenina liebusi* (Shokhina), Coxall et al., pl. 4, figs. 1-3, 7-9, Helvetikum section of Austria.

**Remarks:** The small tests of *Hantkenina liebusi*, characterized by four to five clearly separated chambers with slender spines situated much below the anterior sutures, are quite distinctive and easily recognized, although the preservation of the material is not completely satisfactory. The aperture is filled with matrix and the details cannot be described. The slender spines are in most cases partly broken. In the present study, it occurs at Chobama 1 and 3 sections.

**Stratigraphic range:** *H. liebusi* was established on specimens from the Middle Eocene of the Caucasus, U.S.S.R. Earlier, Liebus (1911) reported it as *Pullenia Kochj* (Hantken) from the Middle Eocene of North Dalmatia. The reported stratigraphic range of *H. liebusi* in
Assam is Middle and Upper Eocene (Samanta, 1969). In Coxali, 2003 gave the range of *H. liebusi* from Zone P11 early Middle Eocene to lower part of P14 late Middle Eocene.

Superfamily GLOBIGERINACEA Carpenter, Parker and Jones, 1862
Family GLOBIGERINIDAE Carpenter, Parker and Jones, 1862
Subfamily GLOBIGERININAE Carpenter, Parker and Jones, 1862
Genus *Globigerina* d’Orbigny 1826

*Globigerina* sp.
pl. 3, figs. 7-9

Description: Test globose, trochospirally coiled, chambers spherical to ovate, enlarging rapidly as added, commonly only three to five chambers in the final whorl, sutures distinct, depressed, umbilicus open, periphery rounded; wall calcareous, perforate; primary aperture a high umbilical arch that may be bordered by an imperforate rim, no secondary apertures.

Stratigraphic range: Upper Eocene to Holocene (Loeblich and Tappan, 1988). It is found in moderate amount in all the studied sections.

Subfamily PORTICULASPHAERINAE Banner, 1982
Genus *Globigerinatheka* Bronnimann 1952

*Globigerinatheka semiinvoluta* Keijzer, 1954
pl. 3, figs. 5-6

Description: Test globular, early chamber spherical to ovate, trochospirally coiled, later chambers with changed directions with of coiling so that the final chamber completely cover the foramen umbilical side of the test. Suture distinct, depressed; wall calcareous perforate aperture interiomarginal.

References and localities:
1968 *Globigerapsis semiinvoluta* (Keijzer); Raju, pl. 2, figs. 4-5, Cauvery Basin, South India.
Description: Test elongate, ovate to triangular in outline, compressed, biserial throughout; septa flush to slightly depressed, wall calcareous, hyaline, perforate. Surface ornamented with imperforate costae. Aperture a narrow loop at the base of the apertural face. With the mentioned characters, the present specimen is identified as Bolivina sp. Due to ill preservation of the specimen; it is not identifiable to species level. It occurs at Chobama 2 section in few numbers.

Remarks: The main character of G. semiinvoluta is the final hemispherical chamber, which embraces nearly half of the earlier test and the high-arched to circular sutural apertures with distinct rims. The specimen from Disang Group of Nagaland is very well comparable with the description and illustration of the Toumarkine and Luterbacher (1985). In the present study, it occurs at Chobama 1 section.

Stratigraphic range: Toumarkine and Luterbacher (1985) gave the range of the species from Zone P15 to lower part of Zone P16.
Superfamily TURRILINACEA Cushman, 1927

Description: Test elongate, ovate to triangular in outline, compressed, biserial throughout; septa flush to slightly depressed, wall calcareous, hyaline, perforate. Surface ornamented with imperforate costae. Aperture a narrow loop at the base of the apertural face. With the mentioned characters, the present specimen is identified as Bolivina sp. Due to ill preservation of the specimen, it is not identifiable to species level. It occurs at Chobama 2 section in few numbers.

Suborder ROTALIINA Delage and Hérouard, 1896
Superfamily BOLIVINACEA Glaessner, 1937
Family BOLIVINIDAE Glaessner, 1937
Genus Bolivina d'Orbigny, 1839

Bolivina sp.
pl. 8, fig. 7

Remarks: The main character of G. semiinvoluta is the final hemispherical chamber, which embraces nearly half of the earlier test and the high-arched to circular sutural apertures with distinct rims. The specimen from Disang Group of Nagaland is very well comparable with the description and illustration of the Toumarkine and Luterbacher (1985). In the present study, it occurs at Chobama 1 section.

Stratigraphic range: Toumarkine and Luterbacher (1985) gave the range of the species from Zone P15 to lower part of Zone P16.

1985 Globigerinathecata semiinvoluta (Keijzer), Toumarkine and Luterbacher, p. 144-145, fig. 39, 1-17
1988 Globigerinathecata semiinvoluta (Keijzer), Nocchi et al., pl. 4, fig. 11, Se Umbria, Italy
2002 Globigerinathecata cf. semiinvoluta (Keijzer), Galeotti et al., pl. 3, fig. 3, Agulhas Ridge, South Africa

2002 Globigerinathecata cf. semiinvoluta (Keijzer); Galeotti et al., pl. 3, fig. 3, Agulhas Ridge, South Africa
Selected references and localities:

1991  *Turritina robertsi* (Howe and Ellis, 1939), Müllar-Merz and Oberhansli, p. 161-162, pl. 2, figs. 23-24, South Atlantic transect at 20-30° S.

Description: Test is fusiform, sub-circular in cross section; periphery rounded, chambers are tri-serially arranged, rapidly flaring from the more or less pointed initial part; sutures slightly depressed; aperture sub-terminal, comma-shaped; wall calcareous and smooth.

Remarks: *Praebulimina reussi* (Morrow) is distinguished from *Sitella cushmani* (Sandige) by its triserial test and, when visible, by its comma-shaped aperture. The variability in this species is expressed in the degree of elongation of the tests, ranging from low and globular to elongate and fusiform. The specimen of Alegret and Thomas from northeastern Mexico and my specimen from Nagaland have the same characters with its fusiform test and comma shape aperture. The specimen has recorded from Pfutsero 1 section in few numbers.

Genus *Turritina* Andreae, 1884

*Turritina robertsi* (Howe and Ellis, 1939)

pl. 10, figs. 1-2

Description: Test elongate, trochospirally enrolled in the early stage, later triserial, with rapidly enlarging and inflated chambers strongly overlapping those preceding, spiral nearly horizontal, intercameral sutures nearly vertical, depressed; wall calcareous, finely perforate, surface smooth; aperture ovate bordered by an elevated narrow lip.
Remark: The specimen of Müller-Merz from Atlantic transect and my specimen from Disang Formation of Nagaland have the same characters with an elongate test with rapidly enlarging and inflated chambers strongly overlapping those proceeding. Wall calcareous, finely perforate; aperture an ovate opening, wider near the midpoint and bordered by an elevated narrow lip. The species is recorded from Chobama 1 and 3 sections.

**Turrilina** sp.
pl.10, figs. 3-6

Description: Test elongate with rapidly enlarging and inflated chambers strongly overlapping those preceding, spiral nearly horizontal, intercamlar sutures nearly vertical, depressed; wall calcareous; aperture an ovate opening, wider near the midpoint, a part of the lip bends downward joining the aperture to the previous foramen. Moderate amount of specimen is encountered at Chobama 1, 2 and 3 sections.

Superfamily BULIMINACEA Jones, 1875
Family SIPHOGENERINOIDIDAE Saidova, 1981
Subfamily SIPHOGENERINOIDINAE Saidova, 1981
Genus *Rectobolivina* Cushman, 1927

**Rectobolivina** sp.
pl. 8, fig.8

Description: Two broken fragments of *Rectobolivina* sp. are found at Leshemi section. The specimen has an incomplete elongate, oval test, chambers broad and low; sutures straight in juvenile stage and later ones arched, depressed, wall calcareous. The other characters are not seen due to ill preservations of the specimen. It is found at Pfutsero 1 section.

Family UVIGERINIDAE Haeckel, 1894
Subfamily UVIGERININAE Haeckel, 1894
Genus *Uvigerina* d’Orbigny, 1826
**Uvigerina cocoensis** Cushman, 1925  
pl. 12, fig. 1

**Description:** Elongate test medium in size, test about 2 times as long as broad in 3 to 3½ whorls; sides sub-parallel so test is somewhat rectangular; coiling triserial, with some specimens developing a tendency toward uniserial coiling; chambers increase in size very regularly; sutures only distinct on unornamented chambers; periphery slightly lobulate; porous walls ornamented with platy, longitudinal costae, costae reduced in height and number on the final whorl or usually absent in the final few chambers; neck terminal set into a slight depression in the final chamber.

**References:**

1980 *Uvigerina cocoensis* (Cushman), Tipton, fig. 8, California, USA.

1984 *Uvigerina cocoensis* (Cushman), Boersma, p.33; pl. 1, fig. 1-4; pl.2, figs.1-4.

**Remarks:** Elongate test, almost rectangular in shape chambers increase in size; porous wall ornamented with longitudinal costae; costae altogether absent on the final whorl; neck terminal. In the present study, it is found at Pfutsero 1 and 2 sections.

**Stratigraphic range:** In Boersma (1984), stratigraphic range of *Uvigerina cocoensis* is from Zone P16 to P22.

**Ecology:** It occurs in the upper bathyal zone in lower to middle latitudes. It demonstrates a tendency towards uniserial chamber arrangement in both clay and carbonate rich areas, but this trend is most frequently found in sediment of Late Eocene age.

*Uvigerina continuosa* Lamb, 1964  
pl. 11, figs. 1, 4

**Description:** Test large, elongate fusiform, about 2½ to 3 times as long as broad with greatest breadth in the mid portion of the test; chambers gradually increase in size, coiling triserial, chambers mildly inflated, sutures indistinct, periphery not lobulate; porous wall
ornamented with a few, continuous longitudinal costae, about 2 to 4 per chambers; short neck terminal, situated in slightly round depression in the final chamber.

References:
1984  *Uvigerina continuosa* (Lamb), Boersma, p. 36-38, figs. 1-4.

Remarks: The present specimen is very well comparable with the description and illustrations of the type species except that my specimen is shorter in length and breadth i.e. 0.5 mm and 0.3 mm respectively. In the present study, it occurs at Chobama 3 section and Pfitsero 1, 2 sections.

Stratigraphic range: The stratigraphic range of *Uvigerina continuosa* given by Boersma (1984) is from Zone P14 to P20.

Ecology: *Uvigerina continuosa* is an upper bathyal species most frequently found in lower latitude carbonate marls where it develops a larger number of costae per chamber and more costae, which traverse only two chambers rather than the entire length of the test. In clay, quartz and organic-rich sediments it tends to add more uniserial final chambers.

*Uvigerina* cf. *eocaena* Guembel, 1870
pl. 11 figs. 2-3 and 5-6

Description: Stout costae *Uvigerina*. The aperture has a very distinct, smooth neck, and a lip, and is situated in a slight depression. The basal part of the costae may be connected with the costae of earlier chambers. The individual chambers are often obscured by the ornamentation.

References:
1976  *Uvigerina eocaena* (Guembel), Berggren and Aubert, p. 316-317, pl. 3, 15-18, Rockall Bank (Deep Sea Drilling Project Site 117) and Hatton-Rockall Basin (DSDP Site 116).
1984  *Uvigerina eocaena* (Guembel), Boersma, p. 52-55, figs. 1-4.
1986  *Uvigerina eocaena* (Guembel), Zwann et al., p. 130, pl. 1, figs. 1-6.
Remarks: The specimen from Disang Group of Nagaland is similar to the specimens illustrated by Boersma (1984) in all the characters except it is smaller in size. It has a length of 0.4mm and about 0.2mm breadth. In the area studied, it occurs at Pfutsero 2 section.

Stratigraphic range: *Uvigerina eocaena* has been identified from the late Eocene Zone P15 through the Oligocene. It may range further back in the Eocene.

Ecology: *Uvigerina eocaena* occurs in planktic foraminiferal marls and clays rich in benthic foraminifera in the lowermost-upper to upper-middle bathyal zone.

*Uvigerina glabrans* Cushman, 1933
pl. 12, figs. 7-8

Description: Test medium to large, twice as long as broad, chambers relatively few, in 3 to 4 whorls; chambers increase in size gradually, so greatest breadth in the mid portion of the test is greatest; coiling triserial throughout; chambers slightly inflated, periphery very slightly lobulate; porous wall unornamented and appearing smooth; final chamber rounded, terminal neck ends in a reverted lip.

References:

Remarks: The specimen from Disang Formation of Nagaland is comparatively small in length and width, i.e. 0.4mm and 0.3mm respectively. The other characteristic features of the specimen are comparable with the illustrations and description of Boersma, 1984. It occurs at Pfutsero 1 section.

Stratigraphic Range: Boersma 1984 gave the range of this species from Zone P16-18.

Ecology: *Uvigerina glabrans* occurs in carbonate rich upper bathyal foraminiferal sands and marls with a large percentage of the benthic rather than planktonic foraminifera. It is not typical in sediments rich in clay or glauconite.
**Uvigerina jacksonensis** Cushman, 1925

*pl. 12, figs. 5, 6*

**Description:** Test large, stout, broadly fusiform with the greatest width at the middle; chambers increasing gradually in size, final chamber often smaller than those in penultimate whorl; coiling compact and tri-serial throughout; chambers are inflated; sutures somewhat depressed; periphery lobulate to robust, wall ornamented with longitudinal costae, most of which are restricted to individual chambers, final chambers somewhat rounded; aperture ends in a terminal neck with reverted lip.

**References:**

1984  
*Uvigerina jacksonensis* (Cushman), Boersma, p. 88-89, pl. 1, figs 1-5, pl. 2, figs 1-4.

1986  
*Uvigerina jacksonensis* (Cushman), Zwann et al; p. 194.

**Remarks:** The present specimen is smaller than the specimen described by Boersma (1984) having a length of 0.4mm and a breadth of 0.2mm. Wall ornamented with 7 costae per whorl. Aperture ends in a terminal neck with a reverted lip. In the present study it occurs at Pfutsero 2 section.

**Stratigraphy range:** *Uvigerina jacksonensis* ranges from Early Eocene Zone P7 through Late Oligocene Zone P22. It is found first in the Early Eocene of North Africa and the Middle East. In early Eocene Zone P7, it occurs in Russia. Not until the Late Eocene has it been found in the American Gulf Coast, Mexico and the American West Coast. It continues into the Oligocene of the Caribbean area and Mexico and the American West Coast.

**Ecology:** *Uvigerina jacksonensis* is found in upper bathyal marls and clays representing marginal bays and in carbonate shelf sediments. These facies contains some planktic foraminifera, but benthics are much more abundant. Land-derived materials such as mica are often abundant. In more carbonate-rich sediments, *Uvigerina jacksonensis* is accompanied by a plexus of coarsely costae forms such as *Uvigerina cocoensis*, *Uvigerina multistriata* and at the shallowest end of its depth spectrum, *U. mutalli* Cushman and Edward. In more
**Uvigerina jacksonensis** Cushman, 1925
pl. 12, figs. 5, 6

**Description:** Test large, stout, broadly fusiform with the greatest width at the middle; chambers increasing gradually in size, final chamber often smaller than those in penultimate whorl; coiling compact and tri-serial throughout; chambers are inflated; sutures somewhat depressed; periphery lobulate to robust, wall ornamented with longitudinal costae, most of which are restricted to individual chambers; final chambers somewhat rounded; aperture ends in a terminal neck with reverted lip.

**References:**

1984  
*Uvigerina jacksonensis* (Cushman), Boersma, p. 88-89, pl. 1, figs 1-5, pl. 2, figs 1-4.

1986  
*Uvigerina jacksonensis* (Cushman), Zwann et al., p. 194.

**Remarks:** The present specimen is smaller than the specimen described by Boersma (1984) having a length of 0.4mm and a breadth of 0.2mm. Wall ornamented with 7 costae per whorl. Aperture ends in a terminal neck with a reverted lip. In the present study it occurs at Pfutsero 2 section.

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**Ecology:** *Uvigerina jacksonensis* is found in upper bathyal marls and clays representing marginal bays and in carbonate shelf sediments. These facies contains some planktic foraminifera, but benthics are much more abundant. Land-derived materials such as mica are often abundant. In more carbonate-rich sediments, *Uvigerina jacksonensis* is accompanied by a plexus of coarsely costae forms such as *Uvigerina cocoensis*, *Uvigerina multistriata* and at the shallowest end of its depth spectrum, *U. mutalii* Cushman and Edward. In more
organic-rich, shallow water or lagoonal or bay facies, *U. jacksonensis* may be accompanied by *Uvigerina vicksburgensis*.

**Uvigerina longa** Cushman and Bermudez, 1937

pl. 11, figs. 7-8

**Description:** *Uvigerina longa* has most of the characters of *Uvigerina* sp. It is elongate with a tendency towards uniseriality, ornamented with plate-like costae.

**Reference:**

1996 *Uvigerina longa* (Cushman and Bermudez), Raju and Dave, p. 197, pl. 3, figs. 3, 7, Cauvery Basin, South India.

**Remarks:** The present specimen measures a length of 0.5mm and a breadth of 2mm. It has 7-10 costae per chamber. Aperture ends in a terminal neck with a reverted lip. In the present work, *U. longa* is found at Chobama 3 section.

**Stratigraphic range:** It ranges from Late Eocene through Oligocene (Boersma, 1984).

**Ecology:** The species is common in the lower upper bathyal and uppermost middle bathyal depths in Italy, Caribbean, Atlantic and Mediterranean area.

**Uvigerina moravia** Boersma, 1984

pl. 12, fig. 2

**Description:** Test medium to large, oblong and broadly fusiform in shape; about twice as long as broad with greatest breadth in upper half of the test, coiling triserial throughout; chambers increase in size gradually; sutures depressed, porous wall ornamented with few longitudinal low costae; Neck, is short in the final chamber, ends in a reverted lip.

**Reference:**

Remarks: The present specimen has 0.5mm length and 0.2-0.3mm breadth. Surface ornamentation has 4-5 costae per chamber. A short neck ends in a reverted lip. In the area studied, it occurs at Pfutsero 2 section.

Ecology: *Uvigerina moravia* occurs in clay and quartz rich detrital environments of the upper bathyal zone. Less commonly, it is found in marls with moderate amounts of planktonic foraminifera.

Stratigraphic range: *Uvigerina moravia* ranges from Late Eocene Zone P16 through Zones N4 (and possibly into Zone N5) or the Early Miocene. Its first occurrence is found in Northern Italy, but is most common in Europe in the Early to Mid-Oligocene, and spreads to western South America in the Mid-Oligocene. Its last occurrence is found in the Early Miocene of the Para-Tethys.

*Uvigerina steyeri* Papp, 1975
pl. 12, fig.4

Description: Test medium-sized, stout and robust, fusiform; coiling triserial throughout, chambers inflated and outline slightly lobulate; sutures indistinct costae restricted to individual chambers; terminal neck thick, short, ending in a reverted lip.

Reference:
1984 *Uvigerina steyeri* (Papp), Boersma, p. 166-168, figs. 1-4.

Remarks: The specimen from our study material has 0.6mm length and 0.3mm breadth and has an asymmetrically fusiform shape. It has about 6 costae per chamber and all the costae are restricted to individual chambers. It has a terminal, thick and short lip. In the present study, it is found at Pfutsero 1 and 2 sections.

Ecology: *Uvigerina steyeri* is representative of upper bathyal marly clays and quartz rich clays primarily in the Mediterranean bio-province where it occurs through both lower and middle Latitudes. It is usually associated with large amounts of detrital minerals, dark clays
and rich, highly ornamented benthic foraminiferal faunas. It occurs less commonly in marly sediments with moderate numbers of planktonic foraminifera.

**Stratigraphic range:** *Uvigerina steyeri* ranges from the Early Eocene through the Late Oligocene. It was first found in zone P7 in the Aral Sea region of Russia, then in the Middle Eocene of western Africa. It is most common in the Late Eocene of the Circum-Mediterranean, but persists through Late Oligocene Zone P22 in both North Africa and in the Para-Tethys.

*Uvigerina vicksburgensis* Cushman and Ellisor, 1931

pl. 12, fig. 3

**Description:** Test medium to large; chambers enlarging rapidly width near the mid portion of the test is greatest; coiling triserial throughout, chambers slightly inflated, periphery slightly lobulate; finely porous wall ornamented with longitudinal, coarse platy costae, all of which are restricted to individual chambers; neck set into a depression in final Chamber, ends in a reverted lip.

**Reference:**

1980 *Uvigerina vicksburgensis* (Cushman and Ellisor), Tipton, p.270, fig. 8.

1984 *Uvigerina vicksburgensis* (Cushman and Ellisor), Boersma, p. 186-187, figs. 1-4.

**Remarks:** In our study material, the specimen has about 7-9 costae per chamber. It is 0.4mm length and 0.3mm breadth. Neck is not visible. It may be broken. In the present study, it is found in Chobama 3 section.

**Ecology:** *Uvigerina vicksburgensis* occurs in clay and carbonate-rich shallow water sediments deposited at upper bathyal to shelf depths. It is most typical during regression.

**Stratigraphic range:** *Uvigerina vicksburgensis* ranges from the Middle Eocene into the Early Oligocene. It is first found in Mid-Eocene Zone P9 in Tunisia, but is most common from Late Eocene into Early Oligocene in the southeastern United States, in the Alazan formation of Mexico, and in Venezuela.
Superfamily DISCORBACEA Ehrenberg, 1838
Family BAGGINIDAE Cushman, 1927
Subfamily BAGGININAE Cushman, 1927
Genus Baggina Cushman, 1926

Baggina cojimarensis Palmer, 1941
pl 5, figs. 1 and 3

**Description:** Small test, sub-globular, 4-5 chambers in the final whorl. The chambers increase rapidly in size so that the final one occupies nearly half of the dorsal surface, dorsal sutures gently depressed, periphery broad and rounded, lobate in side view, ventral sutures radial, gently depressed, aperture a narrow slit opening into the umbilical depression. Surface finely; conspicuously perforate with the exception of a large clear area above the aperture on the final chamber.

**Selected reference and locality:**
1994 Baggina cojimarensis (Palmer), Bolli et al., p. 361, pl. 55, figs. 1, 2, South Caribbean region

**Remarks:** The present specimen from Disang Group of Nagaland is similar to the specimen described by Bolli et al. (1994) with 4-5 chambers in the final whorl, the final chamber occupies about half of the dorsal surface, aperture a narrow slit opening into the umbilical depression. It has a perforate surface but the area near the aperture is smooth. It is found at Chobama section in fairly large amount.

Baggina denata Hagn, 1956
pl 5, figs. 4-5

**Description:** Test small, oval in outline, sub-globular, both dorsal and ventral side flat, four chambers in the last whorl, enlarging gradually in size as added, the last chamber comprising
about one third of the test, sutures depressed, wall perforate, aperture a narrow slit, opening into the wide umbilical depression.

**Selected reference and locality:**

1956 *Baggina dentata* Hagn, pl. 15, fig. 7a-b; Lake Garda, Italy

**Remarks:** The chamber size increases as added; wall perforate and the aperture at the umbilicus depression. It is found at Chobama section. A fair number of *Baggina dominicana* specimens are found at Chobama 1, 2 and 3 sections.

*Baggina dominicana* Bermudez, 1949  
pl. 5, fig. 2

**Description:** Test small, sub globular, dorsal side flat, ventral side slightly concave; five chambers in the last whorl, inflated, enlarging rapidly in size as added; the last chamber comprising about one-third of the test, sutures depressed, the ventral ones converging toward the umbilical region where the bases of the chambers form low knobs of clear shell material, wall smooth, opaque, finely perforate, except on the ventral side of the last chamber which is vitreous, smooth and imperforate; aperture a narrow slit, opening into the wide umbilical depression.

**Selected reference:**

1949 *Baggina dominicana* Bermudez, no. 25, p. 260

**Remarks:** The apertures are not clearly preserved due to ill preservation of the specimen. A fair number of *Baggina dominicana* specimen are found at Chobama sections.

*Baggina* sp.  
pl. 5, fig. 6

**Description:** Test large, inflated, rotaliform, longer than broad, periphery rounded, chambers distinct, five to six in last formed coil, increasing rapidly in size, last chamber large and flaring with apex extended and rather sharp, sutures distinct, depressed but not strongly,
slightly curved, wall smooth, aperture a large opening at base of ultimate chamber near umbilicus than periphery. Few species are recorded from Chobama 1, 2, 3 sections.

Genus *Cancris* de Montfort, 1808

*Cancris mauyae* Cushman & Renz, 1942
pl. 6, fig. 1

**Description:** Test elongate, articulate in outline, chambers increasing as added, sutures depressed, arched on the spiral side and radial around the umbilicus; wall calcareous and perforate with a peripheral keel.

**Selected reference:**
1994  *Cancris mauyae* (Cushman and Renz), Bolli et al., p. 240, fig. 55, 3a-c.

**Remarks:** Typical for the species is its size, strongly elongate test shape, five chambers forming the lost whorl, rapidly increasing in size and the presence of a distinct peripheral keel. In the present study, it is occurring at Chobama 1 section in few numbers.

**Stratigraphic range:** In Bolli et al., 1994, it is recorded in Trinidad from the Paleocene to Early Eocene Soldado Formation.

Superfamily DISCORBINELLACEA Sigal, 1952
Family PARRELLOIDIDAE Hoñker, 1956
Genus *Cibicidoides* Thalmann, 1939

*Cibicidoides* sp.
pl. 5, figs. 7-9; pl. 6, fig. 3

**Description:** Few specimens of the *Cibicidoides* occur at Chobama section. The specimen has a lenticular, biconvex trochospiral test; periphery is angular and carinate; wall calcareous, coarsely perforate on the spiral side, umbilical sparsely perforate. As the specimens are not
satisfactorily preserved, other characters cannot be described and it cannot be identified to the species level.

Superfamily PLANORBULINACEA Schwager, 1877
Family CIBICIDIDAE Cushman, 1927
Subfamily CIBICIDINAE Cushman, 1927
Genus *Cibicides* de Montfort, 1808

*Cibicides* sp.
pl. 6, figs. 7-9

**Description:** Test trochospiral and planoconvex, spiral side flat to concave, evolute, sutures thickened and may be elevated, strongly convex and involute, umbilical side with depressed sutures, apertural face angular periphery carinate; wall calcareous, spiral side coarsely perforate; aperture a low interiomarginal equatorial opening. Few specimens are found at Chobama 1, 3 sections.

Superfamily NONIONACEA Schultze, 1854
Family NONIONIDAE Schultze, 1854
Subfamily NONIONINAE Schultze, 1854
Genus *Nonionella* Cushman, 1926

*Nonionella* sp.
pl. 6, fig. 2

**Description:** The specimen from Disang Group of Nagaland characterizes *Nonionella* genus with its trochospiral test, chambers increase in size as added with an inflated basal lobe at the umbilicus, periphery sub angular to rounded, wall calcareous, surface smooth. Aperture is not clear due to poor preservation. It is found at Chobama section in few numbers.

Superfamily CHILOSTOMELLACEA Brady, 1881
Superfamily ROTALIACEA Ehrenberg, 1839

Family ELPHIDIIIDAE Galloway, 1933

Subfamily ELPHIDIINAE Galloway, 1933

Family OSANGULARIIDAE Loeblich and Tappan, 1964

Genus Osangularia Brotzen, 1940

Osangularia plummerae Brotzen, 1940
pl. 8, figs. 2-3 and 6

Description: Test trochospiral, planoconvex, sub-circular in outline, periphery a thin prominent keel; dorsal side flat to slightly convex, chambers not clearly visible; sutures broad, curved and slightly elevated, ventral side convex, 8 chambers visible in the last whorl, sutures radial and curved, depressed between the chambers; aperture a short interiomarginal slit on ventral side; wall calcareous.

Selected reference and locality:
2001 Osangularia plummerae Brotzen, Alegret and Thomas, p. 292, pl. 9, fig. 11a, b, c, Northeastern Mexico.

Remarks: The present specimen from Disang Group of Nagaland is similar with the specimen reported by Alegret and Thomas from northeastern Mexico with its plane convex test, keeled periphery and number of chambers in the last whorl. The specimen is found at Chobama 1 section in large amount.

Osangularia sp. Brotzen, 1940
pl. 8, figs. 1 and 4-5

Description: Test trochospiral, lenticular, biumbonate, spiral side evolute, whorls enlarging gradually, sutures thickened, oblique and curved; umbilical side involute, sutures radial and depressed, periphery carinate; wall calcareous, finely perforate, surface smooth; aperture areal, at an acute angle to the base of the chamber. Few specimens are encountered at Leshemi and Chobama 1, 2, 3 sections in the study area.
Genus *Elphidiella* Cushman, 1936

*Elphidiella sp.*
pl. 9, figs. 1-6

**Description:** Test large, planispiral, involute and bilaterally symmetrical, from ten to twenty chambers in the final whorl, no true ponticuli or fossettes but may have retral processes; wall calcareous, perforate, optically radial or less commonly optically granular, aperture and foramina interiomarginal, single or multiple, and may also have multiple areal openings. Moderate number of specimens is found at Leshemi and Chobama 1, 2, 3 sections.

Superfamily NUMMULITACEA de Blainville, 1827
Family NUMMULITIDAE de Blainville, 1827
Genus *Nummulites* Lamarck, 1801

*Nummulites pengaronensis* Verbeek, 1871
pl. 4, figs. 5-8

**Description:** Test globular, lenticular or discoidal, commonly large, up to about 12cm in diameter, planispirally enrolled, commonly involute but may be evolute in the later stage. Proloculus and deuterococonch separated by an imperate common wall with a single central round pore and with a row of pores at the base of the septum, septa curved back at the periphery and may be sigmoidal, distinct marginal cord on the periphery, directed obliquely backward and forward on both sides of the septa, pillars may be interspersed between septal filaments and appear at the surface as pustules; aperture in all post-procural chambers consists of a row of pores at the base of the face.

**Selected references and localities:**

1959   *Nummulites pengaronensis* Verbeek; Nagappa, pl. 10, figs. 3-5, Jaintia Hills, Assam, India.

1987   *Nummulites pengaronensis* Verbeek; Baruah *et al.*, fig. 7 (7-9), fig. 8 (1-2), Nagaland.
Remarks: The present specimen is characterized in hand specimen by a swollen test at center and flat at margin, septal filaments radial, spots in polar region, spine small, septa close and arcuate. In thin section it is characterized by tight coiling of a spiral wall, all the septa projecting backward. Therefore, the present specimen is referred as *N. chavannesii*. In the present study, it is found at Leshemi section.

Stratigraphic range: Loeblich and Tappan (1988) recorded as Paleocene to Holocene.

*Nummulites chavannesii* De La Harpe, 1878
pl. 4, figs. 1-4

Selected reference and locality:

1972 *Nummulites chavannesii* (De La Harpe), Blondeau, p. 146, pl. 22, figs. 1-3.

Remarks: The present specimen is characterized in hand specimen by a swollen test at center and flat at margin, septal filaments radial, spots in polar region, spine small, septa close and arcuate. In thin section it is characterized by tight coiling of a spiral wall, all the septa projecting backward. Therefore, the present specimen is referred as *N. chavannesii*. In the present study, it is found at Leshemi section.
Stratigraphic range: Blondeau, 1972 recorded the range as from the top of Lutetian to Upper Priabonian.