

**Some Calcareous Foraminifera belonging to the  
Families Rotaliidae, Globigerinidae, Globorotaliidae  
and Anomalinidae from the Cullygoody  
(Dalmiapuram) Limestone, Trichinopoly Cretaceous  
of South India**

PART III

BY

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*Introduction:*

This is the third in a series on the Cullygoody Foraminifera of the Trichinopoly Cretaceous. It is mainly concerned with the systematic descriptions of some trochoid foraminifera, which are grouped into four families namely Rotaliidae, Globigerinidae, Globorotaliidae and Anomalinidae. Of these, Rotaliidae is most varied and abundant representing 5 genera namely *Trocholina*, *Discorbis*, *Gyroidina*, *Parrella*, and *Rotalia*. Globigerinidae and Globorotaliidae are represented by *Globigerina* and *Globorotalites* respectively while *Anomalina* and *Cibicides* represent the family Anomalinidae.

In the following pages are described and figured 14 species and one variety of which two species namely *Rotalia cullygoodiensis* and *Trocholina raoii* are new. All the figured specimens are deposited provisionally in the Geology Department, University of Madras, Madras.

*Systematic descriptions*

Family Rotaliidae

Subfamily Turrispirillininae

Genus *Trocholina* paalzou, 1922

*Trocholina raoii* sp. nov.

Pl. 4, Figs. 11-13

The trochoid test is plano-convex with its conical dorsal and almost flattened ventral side. Externally all the whorls are visible on the dorsal side whereas only the last whorl is visible on the ventral. Only one tubular chamber of 8 to 10 coils in length gra-

dually increases in size towards its apertural end. ' In small specimens the distinct spiral sutures are flush with the surface but depressed in large specimens. On the ventral side the umbilicus is covered by the secondary shell material. The calcareous wall is typically green. On the dorsal side it is smooth but ornamented on the ventral side, with an inner circular row of pustules and an outer circular row of pillars. At the distal end the chamber opens out ventrally into a semi-circular aperture.

*Remarks:* This commonly occurring species resembles *T. lithographica* (Gumbel) reported from the Jurassic of Germany in its convexity of the dorsal surface but differs from the latter in having more number of whorls.

This species is named in honour of Prof. L. Rama Rao, who has done extensive research-work in this area.

*Type-level:*—Lower Cretaceous

*Type locality:*—Occurs abundantly in the Cullygoody limestone quarries.

*Type specimens:*—Provisionally deposited in the Geology Department of University of Madras.

*Specimen Number:*—The Register number will be given later.

*Sub family Discorbinae*

Genus *Discorbis* Lamarck, 1804

*Discorbis minima* Vieaux

Pl. 1, Figs. 10-13

*Discorbis minima* Vieaux, 1941, *J. Paleont.*, Vol. 15, No. 6, p. 627, Pl. 85. Figs. 10 a-c.; *Discorbis* cf. *D. minima* Vieaux., Loeblich and Tappan, 1949, *J. Paleont.*, Vol. 23, p. 265, pl. 51, Figs. 12-13.

The longer than broad trochoid test is concavo-convex with its convex dorsal side and concave ventral side. It consists of about 2 whorls which are visible on the dorsal side but only the last whorl is visible on the ventral side. A depressed umbilicus is present on the ventral side. In the earlier whorl, the chambers are small and rather distinct whereas in the later whorl, they are about 6 to 7 in number, rapidly increasing in size, more inflated on the dorsal side than on the ventral and broader at the outer margins than at the inner. The sutures of the earlier whorl are indistinct but those of the latter whorl are distinct, depressed and oblique. The periphery is acutely angled. The finely perforate

calcareous wall' is smooth and sub-transparent. On the ventral side, a long curved aperture occurs at the inner margins of the last two chambers.

*Remarks:* A few specimens occurring in my material are similar to the figures of *D. minima* reported by Vieaux and Loeblisch and Tappan from the Lower Cretaceous of America.

*Discorbis* sp.

Pl. 3, Figs. 14-16

*Description:* The subcircular trochoid test is biconvex. Usually it is almost equally biconvex but rarely, its dorsal side is more convex than the ventral. It consists of about  $2\frac{1}{2}$  whorls. Externally all the whorls are visible on the dorsal side but only the last whorl is visible on the ventral. A depressed umbilicus occurs on the ventral side. In the earlier whorls, the chambers are indistinct but distinct when wet. In the final whorl, they are distinct, 5 in number, inflated and rapidly increasing in size. On the dorsal side, they are elliptical in shape, less inflated and much broader than high whereas on the ventral side, they are triangular with their bases at the periphery and pointed ends at the umbilicus, more inflated and higher than broad. In the earlier whorls, the sutures are indistinct but in the final whorl, they are distinct and much depressed. On the dorsal side, they are oblique but straight on the ventral. The broadly rounded periphery is lobulate. The calcareous wall is cancellated but sometimes smooth and polished. The slit-like aperture occurs near the umbilicus at the base of the apertural face.

*Remarks:* Such specimens are commonly found in my material.

Genus *Gyroidina* d'Orbigny, 1826

*Gyroidina loetterlei* Tappan

Pl. 1, Figs. 4-6

*Gyroidina loetterlei* Tappan, 1940, *J. Paleont.*, Vol. 14, p. 120, Pl. 19, Figs. 10 a-c; *Ibid.*, 1943, Vol. 17, p. 512, Pl. 82, Figs. 9 a-c.

The sub-circular trochoid test is plano-convex with an almost flattened dorsal side and a convex ventral side and consists of about  $1\frac{1}{2}$  to 2 whorls. Dorsally all the whorls are visible but ventrally only the last whorl is visible. The chambers of the last whorl are about 6 to 7 in number, increasing more rapidly in size than those of the earlier whorls and the last two to three are

inflated. On the dorsal side, the chambers are as broad as high and slightly broader at the outer margins than at the inner. On the ventral side, they are triangular with their bases at the outer margins and pointed ends at the depressed umbilicus. The sutures of the earlier whorls are indistinct but those of the final whorls are distinct and depressed. On the dorsal side, the spiral suture is depressed. The periphery is broadly rounded and lobulate. The calcareous smooth wall is polished. A long narrow slit-like aperture with a thin lip occurs at the base of the apertural face between the periphery and the umbilicus.

*Remarks:* My commonly occurring specimens are identical with the description and figures of Tappan's species reported from the Grayson and Duck Creek Formations of Texas and Oklahoma.

*Gyroidina globosa* (Hagenow)

Pl. 1, Figs. 1-3

*Nonionina globosa* Hagenow, Neues. Jahrb., 1842, p. 574. *Rotalia globosa* Reuss, 1862, K. Akad. Wiss. Wien., Math. Naturwiss. Kl. Sitzungsber, Vol. 44, Pt. 1, p. 330, Pl. 7, Figs. 2 a-b.

*Gyroidina globosa* (Hagenow) Cushman, 1946, U.S. Geol. Surv. Prof. Paper 206, p. 140, Pl. 58, Figs. 6-8.

The plano-convex trochoid test is subcircular in top-view with a flattened evolute dorsal side and a convex involute ventral side and consists of about two whorls. Sometimes the earlier whorls are slightly raised above the final whorl. The chambers of the earlier whorl are indistinct but those of the final whorl are distinct, about 7 in number and rather gradually increasing in size. On the dorsal side, they are narrow and higher than broad and subrectangular whereas on the ventral side, they are much broader than high and triangular with their broad outer margins and pointed inner margins. The sutures are indistinct except the last few which are depressed. On the dorsal side the spiral suture is depressed. The calcareous smooth wall is polished. On the ventral side, a depressed umbilicus is present. The periphery is rounded. Between the periphery and the umbilicus, a long narrow slit-like aperture with a distinct lip occurs on the ventral side at the base of the elliptical apertural face.

*Remarks:* My abundantly occurring specimens are identical with *G. globosa* described by Hagenow and figured by Reuss & Cushman.

This species closely resembles *G. loetterlei* Tappan but differs in having a more convex ventral side, uninflated and dorsally narrower chambers, less depressed sutures and in having less broadly rounded periphery.

*Subfamily Rotaliinae*  
Genus *Rotalia* Lamarck, 1804  
*Rotalia umbonella* Reuss.  
Pl. 2, Figs. 1-4

*Rotalia umbonella* Reuss, 1860, K. Akad. Wiss. Wien, Math.-Naturw. Cl. Sitzber, Wien., Osterreich, Bd. 40, p. 221, Pl. 11, Fig. 5 a-c.

•The subcircular trochoid test is plano-convex with a convex dorsal side and a plane ventral side. Dorsally the initial whorls are indistinct and appear as a central raised boss or umbo. Ventrally only the last whorl is visible and has an umbilicus covered by a solid plug. Variation occurs in number and size of the chambers of the final whorl. In the final whorl of small specimens, the arcuate rectangular chambers are 7 to 8 in number and increasing rapidly in breadth but gradually in height, whereas in large specimens, they are about 10 to 12 in number, increasing more rapidly in breadth and flaring. In the earlier whorls, the sutures are indistinct but in the later whorls, they are curved backwards, limbate and flush with the surface except the last few which are raised. The periphery is acutely rounded. The calcareous smooth wall is often covered by a fine secondary shell-material. On the ventral side the curved slit-like aperture occurs at the base of the end chamber near the periphery.

*Remarks:* The raised boss-like early chambers, the flaring later chambers, the distinct plug on the umbilicus and the backwardly curved limbate sutures are the distinguishing characters of this species.

My abundantly occurring specimens are similar to *R. umbonella* Reuss.

*Rotalia cullygoodiensis* sp. nov.  
Pl. 2, Figs. 5-7

*Truncatulina falcata* Chapman (not Reuss), Quart. J. Geol. Soc., Vol. 50, pp. 721-2, Pl. 34, Figs. 15 a-c.

The subcircular trochoid test is plano-convex with a conical dorsal side and a plane ventral side. It consists of about 2 to 3 rather distinct whorls. Dorsally all the whorls are visible but ventrally only the last whorl is visible and has an umbilicus covered by a solid plug. The chambers of the earlier whorl are indistinct but those of the last whorl are more visible on the ventral side than on the dorsal. On the dorsal side, the gradually increasing chambers are sub-rectangular and higher than broad whereas on the ventral side, they are triangular with their bases at the periphery and their thickened pointed ends at the umbilicus and broader than high except the last chamber which is as high as broad. The sutures are indistinct except the last few. Dorsally they are oblique but slightly arcuate and depressed ventrally. The periphery is acutely angled. The smooth calcareous wall is covered by a fine secondary shell material making the chambers and sutures obscure. On the ventral side, a long slit-like aperture occurs at the base of the final chamber between the periphery and the umbilicus.

*Remarks:* My abundantly occurring specimens are similar to the figures of Chapman who has wrongly identified his species from the Gault of Folkestone as *Truncatulina falcata* Reuss. However it is found on comparison that my specimens and Chapman's figures differ considerably from the species of Reuss reported from the Oligocene. The latter is evolute both dorsally and ventrally and has no plug.

This species is similar to *R. umbonella* Reuss but differs in having a more conical dorsal side, higher than broad chambers dorsally and in the absence of much arcuate limbate sutures.

*Type-level:* Lower Cretaceous.

*Type locality:* Occurs abundantly in the Culygoody Limestone quarries.

*Type specimens:* Provisionally deposited in the Geology Department of University of Madras.

*Specimen number:* The Register number will be given later.

Genus *Parrella* Finlay, 1939  
*Parrella navarroana* (Cushman)  
Pl. 3, Figs. 7-9

*Pulvinulinella navarroana* Cushman, 1938, contr. Cushman Lab. Foram. Res., Vol. 14, p. 66, Pl. 11, Fig. 5.

*Pseudoparrella navarroana* (Cushman), Fizzell, B. Econ. Geol., Univ., Texas, Austin, Rept. Invest. 22, p. 126, Pl. 19, Figs. 16 a-c.

The suboval trochoid test is equally biconvex and consists of about 2 whorls. On the dorsal side, the chambers of all the whorls are visible but on the ventral side, only those of the final whorl, which are about 10 to 12 in number, are visible. The sub-rectangular chambers are broader than high, oblique and gradually increasing in size. The limbate sutures are flush with the surface and curve backwards. The acutely angled periphery is keeled. The sub-transparent calcareous wall is smooth, polished and rather coarsely perforate. Ventrally, the umbilical area is closed with a solid mass of shell material. On the ventral side, a narrow slit-like aperture occurs at the base of the triangular apertural face and extends at a distinct angle into the apertural face.

*Remarks:* Since this species has the umbilicus covered with a solid mass of shell material and the aperture being extended at a distinct angle into the apertural face, it is included under the genus *Parrella*.

The figures of *P. navarroana* (Cushman) are similar to my commonly occurring specimens.

Family Globigerinidae

Subfamily Globigerininae

Genus *Globigerina* d'Orbigny, 1826

*Globigerina cretacea* d'Orbigny

Pl. 4, Figs. 1-4

*Globigerina cretacea* d'Orbigny, 1840, *Mem. Soc. Geol. France*, Paris, Ser. 1. to 4, p. 34, Pl. 3, Figs. 12-14; *Ibid*, Tappan, 1943; *J. Paleont*, Vol. 17, p. 512, Pl. 82, Figs. 16-17.

The suboval trochoid test is concavo-convex with the convex dorsal side and the concave ventral side and consists of about 2 whorls. Dorsally all the whorls are visible but ventrally only the final whorl is visible. The globular chambers of the initial whorl are rather distinct and small, whereas those of the final whorl are distinct, 5 in number, large and rapidly increasing in size and inflation particularly the end chamber. The distinct sutures are deeply excavated. The broadly rounded periphery is lobulate. The calcareous wall is cancellated. On the ventral side, a depressed umbilicus is present. At the base of the end chamber, the aperture opens out ventrally into the umbilicus.

*Remarks:* The specimens which occur quite abundantly in my samples are identical with *G. cretacea* d'Orbigny.

*Globigerina cretacea* var. *plana* Schacko  
Pl. 3, Figs. 4-6

*Globigerina cretacea* var. *plana* Schacko, 1897, Ver. 'Treunde Naturg. Mecklenburg, Archiv. Gunstrow Jahrg. 50 (1896), pp. 184, 288.

The suboval trochoid test is concavo-convex with the dorsal side being convex and the ventral side being concave and consists of about  $1\frac{1}{2}$  whorls. Dorsally all the whorls are visible but only the final whorl having 4 chambers is visible ventrally. The globular chambers are rapidly increasing in size and inflation particularly the end chamber which occupies about  $\frac{1}{3}$  of the size of the test. The distinct sutures are depressed. The lobulate periphery is broadly rounded. The calcareous wall is smooth and polished but not cancellated. On the ventral side, the depressed umbilicus is present and a semicircular plate is attached at the inner margin of the end chamber. On the ventral side, the aperture opens out from below the plate into the umbilicus.

*Remarks:* The distinguishing features of this species are its large end chamber occupying about  $\frac{1}{3}$  of the size of the test and the presence of a semicircular plate attached ventrally at the inner margin of the end chamber.

Such specimens are quite abundant in my material. They may be the same as *G. cretacea* var. *plana* Schacko

*Globigerina planispira* Tappan  
Pl. 4, Figs. 8-10

*Globigerina planispira* Tappan, 1940, 'J. Paleont., Vol. 14, No. 2, p. 122, Pl. 19, Figs. 12 a-c.

The small circular test consists of 2 whorls and is subtrochoid with the final whorl being almost planispiral. On the dorsal side, all the chambers are visible but on the ventral side, only those of the final whorl are visible. They are globular, increasing gradually in size and inflation towards the apertural end and are about 7 in the final whorl. The distinct sutures are deeply excavated. The broadly rounded periphery is lobulate. The white calcareous wall is cancellated. On the ventral side, the umbilicus is often covered with fine secondary shell material. Between the

periphery and the umbilicus, a slit-like aperture occurs ventrally with a thin plate attached to the base of the end chamber.

*Remarks:* The figures of Tappan's species reported from the Grayson Formation, Texas, are identical with my abundantly occurring specimens.

*Globigerina* sp.

Pl. 4, Figs. 5-7

The small subtrochoid test is almost oval in shape, longer than broad and consists of  $1\frac{1}{2}$  whorls. On the dorsal side, all the whorls are visible but only the final whorl having 5 chambers is visible on the ventral side. The globular chambers are increasing rapidly in size and inflation. The distinct sutures are deeply excavated. The broadly rounded periphery is lobulate. On the ventral side, a deeply depressed umbilicus is present. The calcareous wall is cancellated. A spine-like projection occurs at the outer margin of the end chamber. Ventrally a large arch-shaped aperture occurs between the periphery and the umbilicus.

*Remarks:* The characteristic features of the species are the longer than broad sub-trochoid test, a large arch-shaped aperture occurring between the periphery and the umbilicus and the spine-like projection at the outer margin of the end chamber.

Only three but well preserved specimens are found in my samples.

Family Globorotalidae

Genus *Globorotalites* Brotzen, 1942

*Globorotalites michelmiana* (d'Orbigny)

Pl. 3, Figs. 1-3

*Rotalina michelmiana* d'Orbigny 1840 *Mem. Soc. geol. France*. Ser. 1, Vol. 4, p. 31, Pl. 3, Figs. 1-3.

*Eponades michelmiana* Plummer, 1931, *Texas Univ., Bull.* 3101, p. 192, Pl. 14, Fig. 11.

*Globorotalia michelmiana* (D'Orbigny) Cushman, 1946. *U. S. geol. surv. Prof. Paper* 206, p. 152, Pl. 63, Figs. 2 a-c (not Figs. 3 a-c).

The plano-convex trochoid test is almost circular from top view and has a flattened dorsal side and a conical ventral side with a closed umbilicus. On the dorsal side, about 2 to  $2\frac{1}{2}$  whorls are

visible but on the ventral side only the last whorl is visible and consists of about 7 to 8 chambers. Dorsally the gradually increasing chambers are obliquely set, broader than high and broader at the outer margins than at the inner whereas ventrally they are triangular with their bases at the periphery and pointed ends at the umbilicus. On the dorsal side, the limbate sutures are strongly oblique and slightly raised but on the ventral side, they are straight and the last few become slightly depressed. The periphery is acutely angled with a thin keel. The sub-transparent finely perforate calcareous wall is smooth, and polished. Sometimes it is brownish red in the earlier whorls. The long curved slit like aperture occurs at the base of the apertural face between the periphery and the umbilicus.

*Remarks:* My commonly occurring specimens are identical with *G. micheliniana* (d'Orbigny). Cushman (1946) gave two types of Figures (2 a-c and 3 a-c). In one of his types (i.e. 2 a-c), the umbilicus is closed whereas in the other type (i.e. 3 a-c) it is open. However my specimens are exactly similar to the former.

Family Anomalinidae

Subfamily Anomalininae

Genus *Anomalina* d'Orbigny, 1826

*Anomalina intermedia* Berthelin

Pl. 3, Figs. 10-13

*Anomalina intermedia* Berthelin, 1880 *Mem. Soc. Geol. France*, Paris, Ser. 3, tome 1, No. 5, p. 67, Pl. 4, Figs. 14 a-c.

The almost oval subtrochoid test varies in convexity. Some are unequally biconvex and others are plano-convex. The dorsal side is always convex and evolute whereas the ventral side is either flat or less convex and partially involute. On the dorsal side, the earlier whorls often appear as a central raised boss but in some specimens they are depressed. The final whorl is slightly embracing the earlier whorls and consists of about 8 to 10 chambers. The chambers of the earlier whorls are indistinct but those of the final whorl are broader than high, broader at the outer margins than at the inner and gradually increasing in size and inflation. In the earlier whorls the sutures are indistinct but in the final whorl, they are distinct, depressed and curving backwards. On the dorsal side the spiral suture is much depressed. The periphery is angled. The smooth calcareous wall shows dull lustre. The low arch-shaped aperture is peripheral, extending

slightly towards the ventral side and occurs at the base of the sub-triangular apertural face.

*Remarks:* Such specimens are abundantly found in my samples and are similar to the figures of Berthelin's species reported from the Lower Cretaceous of France.

Subfamily Cibicidinae  
Genus *Cibicides* Montfort, 1808  
*Cibicides sandidgei* Brotzen  
Pl. 1, Figs. 7-9

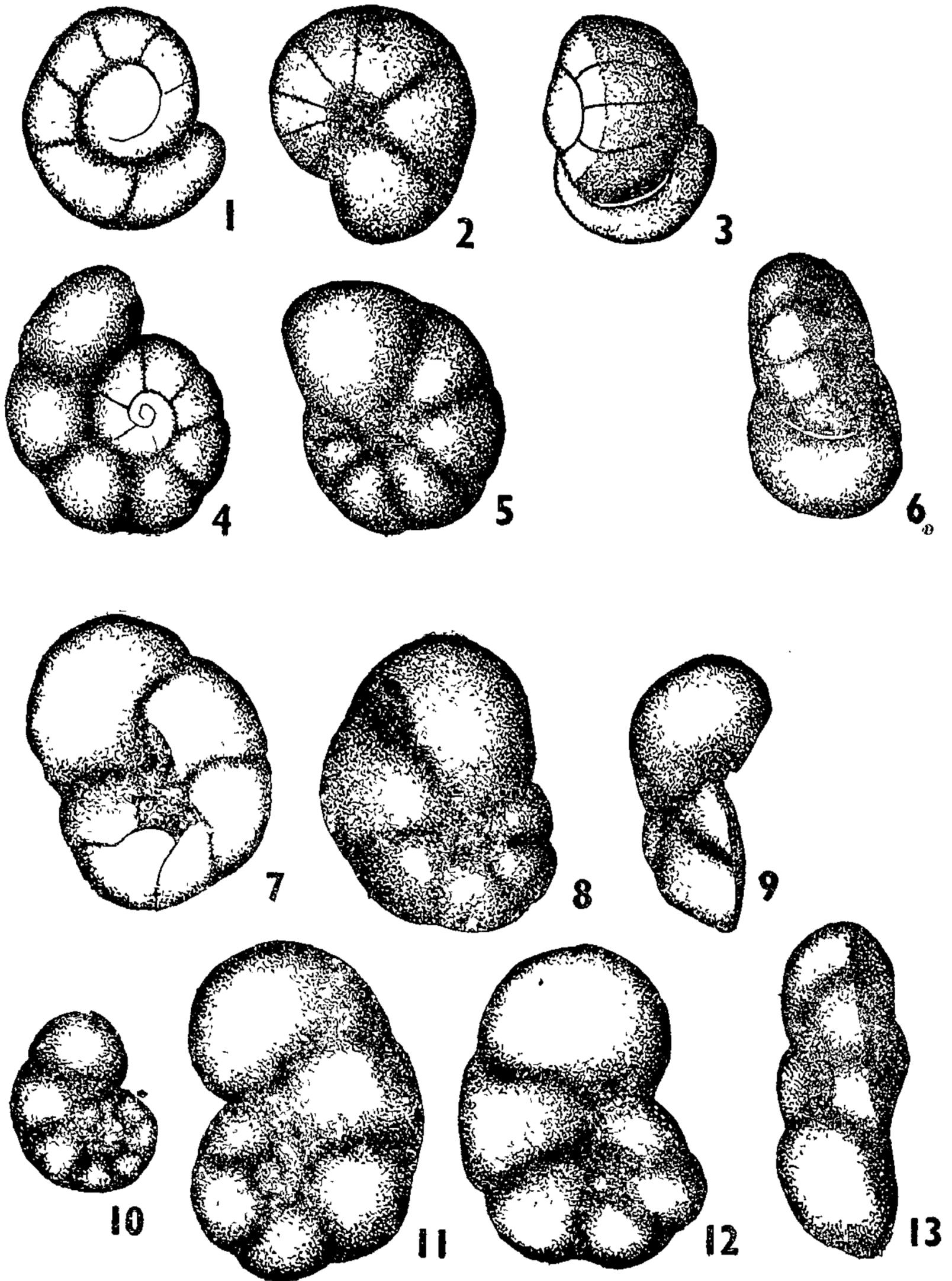
*Cibicides sandidgei* Brotzen, 1936, Sver. Geol. Unders. Avh., Stockholm, Ser.C., No. 396 (Arsb. 30), p. 191, Pl. 14, Figs. 3-4 (not Fig. 2).

The oval trochoid test is plano-convex with a flattened dorsal side and a convex ventral side having a deep narrow umbilicus. On the dorsal side, the chambers of the earlier whorls are covered by the extensions of the inner margins of the chambers of the final whorl and by the fine secondary shell material. The 6 chambers of the final whorl are broader at the outer margins and pointed at the inner. On the dorsal side, they are as broad as high, non-inflated and less rapidly increasing in size whereas on the ventral side, they are broader than high, inflated and more rapidly increasing in size. On the dorsal side, the sutures are less distinct, arcuate, and flush with the surface but on the ventral side, they are more distinct, straight and depressed. The periphery is angled. The thin calcareous wall is smooth and somewhat coarsely perforate. The arch-shaped aperture with a thin lip is peripheral occurring at the base of the suboval apertural face and extends on the ventral side and typically on the dorsal side between the inner margins of the chambers and earlier whorls.

*Remarks:* A few specimens found in my samples are similar to *C. sandidgei* Brotzen.

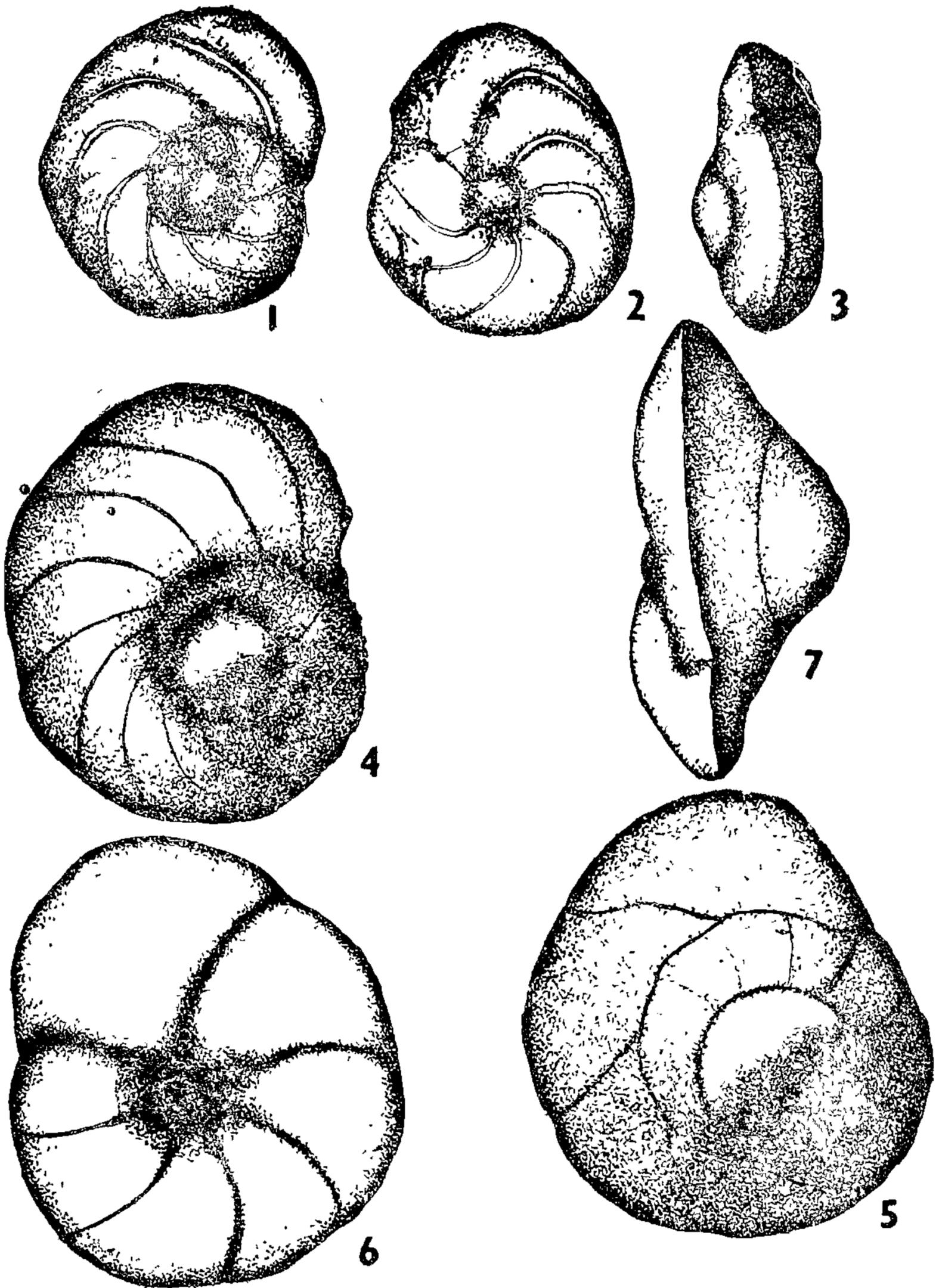
#### ACKNOWLEDGEMENTS

I am grateful to the Vice-Chancellor of the Madras University for providing me the opportunity and facilities to conduct research. My thanks are due to the Geological Survey of India for having given me facilities in their magnificent Library at Calcutta.



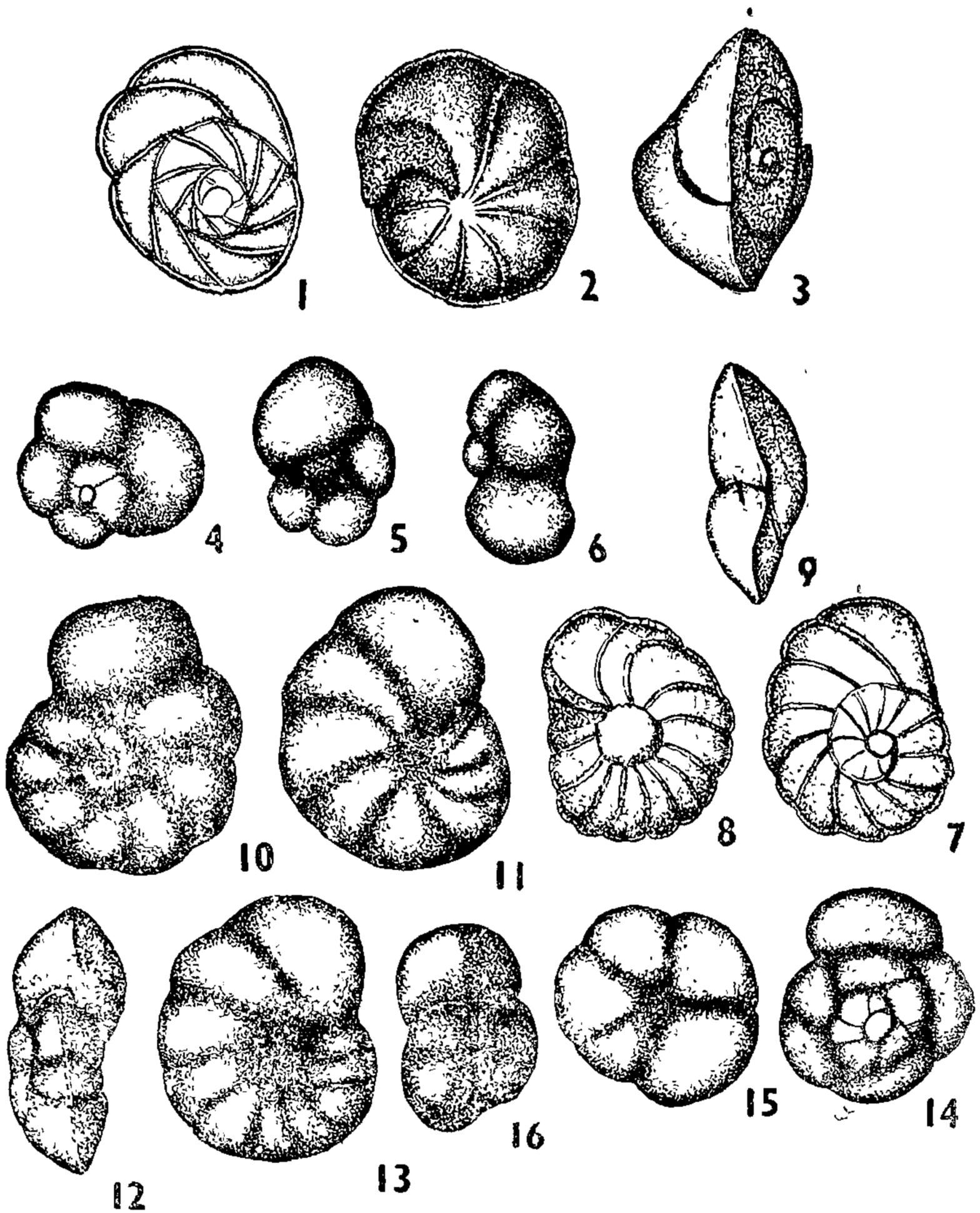
## PLATE I

1-3 *Gyroidina globosa* (Hagenow)  $\times 62.5$ . FIG. 1. Dorsal side; FIG. 2. Ventral side; FIG. 3. Peripheral view. 4-6 *Gyrodina loetterlei* Tappan.  $\times 62.5$ . FIG. 4. Dorsal side; FIG. 5. Ventral side; FIG. 6. Peripheral view. 7-9 *Cibicides sandidgei* Brotzen  $\times 62.5$ . FIG. 7. Dorsal side; FIG. 8. Ventral side; FIG. 9. Peripheral view. 10-13 *Discorbis minima* Vieaux  $\times 62.5$ . FIG. 10. Dorsal side of a small specimen; FIG. 11. Dorsal side; FIG. 12. Ventral side. FIG. 13. Peripheral view.



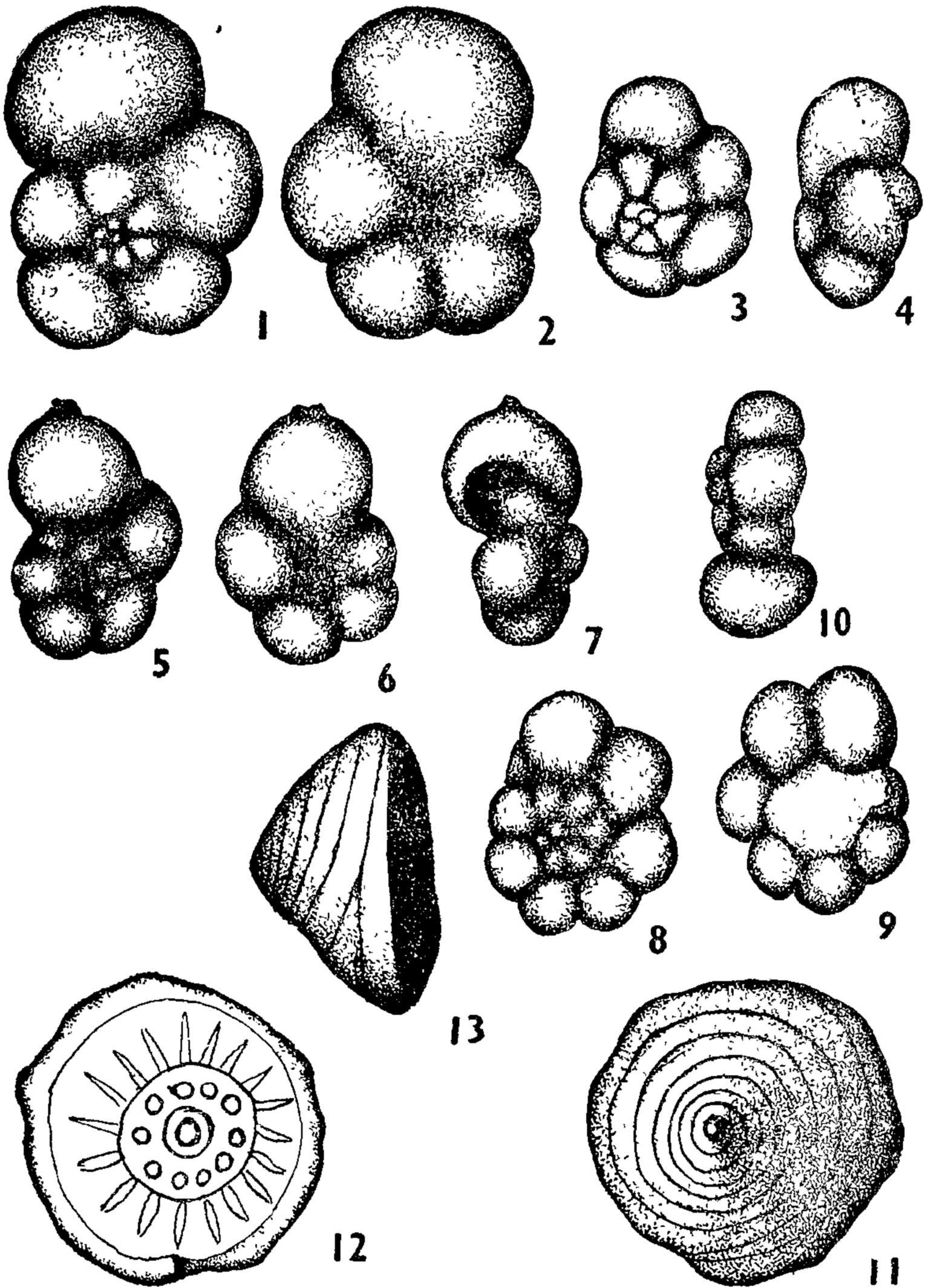
## PLATE II

1-4 *Rotalia umbonella* Reuss.  $\times 625$ . FIG. 1. Dorsal side; FIG. 2. Ventral side; FIG. 3. Peripheral view; FIG. 4. Dorsal side of a large specimen. 5-7 *Rotalia cullygooidiensis* sp. nov.  $\times 625$ . FIG. 5 Dorsal side; FIG. 6. Ventral side; FIG. 7. Peripheral view



## PLATE III

1-3 *Globorotalites micheliniana* d' Orbigny,  $\times 62.5$ . FIG. 1. Dorsal side; FIG. 2. Ventral side; FIG. 3. Peripheral view. 4-6 *Globigerina cretacea* var. *plana* Schacko  $\times 100$  FIG. 4 Dorsal side; FIG. 5. Ventral side; FIG. 6 Peripheral view. 7-9 *Parrella navarroana* (Cushman)  $\times 62.5$ . FIG. 7 Dorsal side; FIG. 8. Ventral side; FIG. 9. Peripheral view. 10-13 *Anomalina intermedia* Berthelin FIG 10 Dorsal side; FIG. 11. Ventral side; FIG. 12. Peripheral view;  $\times 40$  FIG. 13. Dorsal side of a specimen with depressed whorls  $\times 625$  14-16 *Discorbis* sp  $\times 100$  FIG. 14. Dorsal side; FIG 15. Ventral side; FIG. 16. Peripheral view.



## PLATE IV

1-4 *Globigerina cretacea* d'Orbigny FIG. 1. Dorsal side of a large specimen. FIG. 2. Ventral side of a large specimen.  $\times 62.5$  FIG. 3. Dorsal side of a small specimen; FIG. 4. Peripheral view.  $\times 100$ . 5-7 *Globigerina* sp.  $\times 100$ . FIG. 5. Dorsal side; FIG. 6. Ventral side; FIG. 7. Peripheral view. 8-10 *Globigerina planispira* Tappan  $\times 100$ . FIG. 8. Dorsal side, FIG. 9. Ventral side; FIG. 10. Peripheral view. 11-13. *Trocholin raou* sp. nov.  $\times 62.5$  FIG. 11. Dorsal side; FIG. 12. Ventral side; FIG. 13. Peripheral view.

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