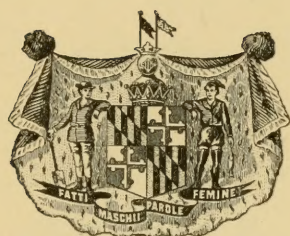


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MARYLAND GEOLOGICAL SURVEY



MIOCENE

TEXT

BALTIMORE
THE JOHNS HOPKINS PRESS
1904

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Order FORAMINIFERA.

Suborder VITRO-CALCAREA.

Family NUMMULINIDÆ.

Genus NONIONINA d'Orbigny.

The genus *Nonionina* is so closely related to *Polystomella* that some authors consider that it should be allowed to lapse or at best be considered as only a subgeneric group of the true *Polystomella* type. Typically the shell is convolute with equilateral compression as in *Anomalina* so that it presents a symmetrical nautiloid form in which the final volution embraces all the others. The umbilicus is either depressed, flush, or filled with exogenous substance as in *N. asterizans*, and the septal markings are more or less depressed though the amount of depression varies with every species. The shell substance is hyaline, and distinctly perforate, often finely so. The aperture is situated on the inner margin of the ultimate segment and is either an arched fissure or subdivided into a number of porous openings as by some *Polystomella*. The genus does not seem to be recorded prior to the beginning of the Tertiary. At the present time it occurs at all depths and is cosmopolitan in distribution occurring in every latitude.

NONIONINA SCAPHA (Fichtel and Moll).

Plate CXXXI, Figs. 1, 2, 3.

Nautilus scapha Fichtel and Moll, 1803, Test. Microsc., p. 105, pl. xix, figs. d-f.

Nonionina scapha Brady, 1884, Chal. Rept., vol. ix, p. 730, pl. cix, figs. 14, 15 (and 16 ?).

Nonionina scapha Bagg, 1898, Bull. Amer. Pal., No. 10, p. 41, pl. iii, figs. 4a, 4b.

Description.—Test free hyaline, finely perforated, elongate, rather strongly compressed, peripheral margin broadly rounded, chambers numerous, narrow, long, rapidly increasing in size toward the ultimate chamber and separated by nearly straight septal lines; sutural liminations becoming more marked towards the ultimate chamber which is the largest and longest and extends fully two-thirds the length of the entire shell. Septal plane broadly oval or cordate; convolutions about three, twelve to fourteen chambers in the final volution; aperture a small concentric slit situated on the inner margin of the ultimate chamber.

This species is a common form in the Maryland and Virginia Miocene. Seguenza records it in the Miocene of Calabria and d'Orbigny described it from the Vienna Basin Miocene. It becomes more abundant in the later Tertiary.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Genus POLYSTOMELLA Lamarck.

The shells of this beautiful and delicate genus consist of regular, equilateral, nautilus-shaped, convolute type in which but the final convolution is visible externally. The complex structure of the interior of the chambers is admirably worked out and portrayed by Dr. Carpenter in his Introduction to the Study of the FORAMINIFERA. Prof. Brady in the Challenger Report briefly but clearly defines the genus as follows: "The test of *Polystomella* is, as a rule, of lenticular or discoidal form. In the weaker modifications (e. g., *Polystomella striatopunctata*) the segments are more or less inflated, and the external furrows by which they are separated are bridged over at intervals by extensions of the inner margins of the segments, leaving rows of depressions or 'fossettes' to mark the septal lines. These marginal extensions of the segments are called 'retral processes' or in connection with their external shelly investment 'septal bridges' and throughout a considerable section of the genus their presence to a greater or less extent is the only advance in structure upon that of the *Nonionina*." This author adds that in more typical forms the septa are limbate externally and the retral processes develop into a series of transverse ridges which almost or completely connect the septa of contiguous chambers. It is this feature which characterizes the Miocene forms of the Maryland deposits. Dr. Uhlig records it as early as the Middle Jurassic but it is not well represented until late Tertiary time. We have but one specimen from the Miocene of Maryland but in the overlying Pleistocene of Cornfield Harbor further southward it becomes the most abundant foraminifera of the region.

POLYSTOMELLA STRIATOPUNCTATA (Fichtel and Moll).

Plate CXXXI, Fig. 4.

Nautilus striatopunctata Fichtel and Moll, 1803, Test. Microsc. p. 61, pl. iv, figs. a-c.

Description.—Test rounded, convolute, both sides equally compressed as in *Nonionina* types, peripheral margin obliquely rounded, becoming somewhat lobulated near the ultimate chamber; segments triangular, twelve in the last volution, separated by nearly straight septal depressions in the form of bridges which mark the retral processes of the shell. Septal plane is nearly round and the aperture is in the form of a series of pores or openings along the inner margin of the ultimate segment.

Its earliest occurrence is from the Eocene of the Paris Basin (Terquem).

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

Family ROTALIDÆ.

Genus DISCORBINA Parker and Jones.

The typical test of *Discorbina* consists of a trochoid spire with nearly flat base and sharp margin. Parker and Jones suggested a grouping of the various forms under three heads, namely, the conical, the vesicular and the outspread, complanate forms. The shell is hyaline and in larger forms is coarsely perforate though often small specimens and certain species have small pores. The superior surface is usually raised into a spire which shows the entire chambering of the shell and the arched septa, while the inferior face is quite flat or even depressed and only the final convolution is visible. The margin is generally well defined and sharp though by some few species it assumes the rounded or even squarely set borders found in other types. The aperture is usually protected by an overhanging fringe and is sometimes not apparent, while tubercles occur very rarely as in *Asteriginæ* types.

The genus does not make its appearance until near the close of Cretaceous time. In existing seas it is found in every clime being dredged from Davis Strait, to the Equator and from the Equator to Magellans Strait. It is more usually found in shoal waters and is quite scarce below 200 fathoms.

DISCORBINA ORBICULARIS (Terquem).

Plate CXXXI, Fig. 5.

Rosalina orbicularis Terquem, 1876, Anim. sur la Plage de Dunkerque, p. 75, pl. ix, fig. 4, a, b.

Description.—Test minute, trochoid, consisting of several rotaliform convolutions; marginal keel sharp, angular; superior surface conical, inferior, depressed and approximately flat. The chambers are remarkably curved and overlap in such a way as to make it rather difficult to clearly mark the several volutions. The septa are visible as graceful curved lines but are not depressed and the shell is finely porous in our specimens.

As a fossil we find it recorded in the Miocene of southern Italy and in the Upper Pliocene sands of Rome. At the present time it is best known, according to Brady, as a coral reef species but it is not confined to reefs. It ranges in depth from the littoral zone to about 400 fathoms.

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

Genus PLANORBULINA d'Orbigny.

The genus *Planorbulina* occupies a close relationship with two other generic types, namely, *Truncatulina* and *Anomalina*. It is typically characterized by its wide spreading flattened form, with coarse perforate shell and it is subject to great variation in aperture, marginal fringe, limbation of sutures and in sometimes possessing exogenous tubercles. It is at the present time common to seas of all latitudes and occurs from the littoral zone down to depths of 3000 fathoms. As a fossil it is known as early as the Carboniferous, is rare in the Lias, common again in the Cretaceous and is well represented throughout Tertiary time.

PLANORBULINA MEDITERRANENSIS d'Orbigny.

Plate CXXXI, Fig. 6.

Planorbulina mediterranensis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii, p. 280, pl. xiv, figs. 4-6; Modele No. 79.

Description.—Test much flattened, wide-spread, consisting of a number of irregular vaulted chambers with depressed umbilical center. Mar-

gin is lobulated and no two specimens are identical in contour, number of chambers, etc.; all showing more or less variation as in *Truncatulina variabilis*.

D'Orbigny records the form from the Vienna Miocene; Seguenza, Parker and Jones mention it from the later Tertiaries of Italy and Sicily, and it is known in the English Crag and the Post Tertiary of Norway as well as in many other localities of Tertiary age.

It is commonest in depths of less than 50 fathoms at the present time and is not confined to any zone.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Genus TRUNCATULINA d'Orbigny.

The genus *Truncatulina* finds its typical representation in the species *T. lobatula* in which the superior surface is flat or nearly so and all the segments are visible, while the inferior surface is somewhat vaulted and the form is so involute that only the last chambers of the final convolution become apparent. The amount of vaulting and even the flat superior surface is subject to considerable variation and in *Truncatulina variabilis* no two specimens are alike.

Under the group of *Planorbulina* forms belong a large number of species described under the names of *Planorbulina*, *Anomalina*, *Rosalina*, *Rotalia*, etc. It is one of the most abundant of all living species and is common in fossil deposits of later geologic age though its earliest appearance is in rocks of Carboniferous age.

TRUNCATULINA LOBATULA (Walker and Jacob).

Plate CXXXI, Fig. 7, 8.

Nautilus lobatulus Walker and Jacob, 1798 (*Idc* Kammacher's Ed.), Adam's Essays Microsc., p. 642, pl. xiv, fig. 36.

Truncatulina lobatula Brady, 1884, Chal. Rept., vol. ix, p. 660, pl. xcii, fig. 10; pl. xciii, figs. 1, 4, 5; pl. cxv, figs. 4, 5.

Truncatulina lobatula Bagg, 1898, Bull. Amer. Pal., No. 10, p. 35.

Truncatulina lobatula Bagg, 1901, Md. Geol. Survey, Eocene, p. 252, pl. lxiv, fig. 3.

Description.—Test plano-convex, moderately vaulted, last volution consisting of seven, eight, or nine chambers with slightly depressed septa;

septal lines being more curved on the superior surface; aperture a small neatly shaped arch at the inferior margin of the ultimate segment.

These characters are subject to considerable variation and when the forms become highly convex the species grade over into the *Truncatulina refulgens* type, while those forms more flattened constitute *Truncatulina wuellerstorfi*. Those regularly and symmetrically developed constitute *Truncatulina boueana* d'Orbigny and the less regular form the *Truncatulina variabilis* of the same author. Both of these forms *T. lobatula* and *T. variabilis* are abundant in the Atlantic coast Miocene deposits.

As a fossil it is one of the most abundant types and is very widely distributed over existing oceans. It is also of great range bathymetrically speaking, occurring at all depths down to 3000 fathoms.

Its geological appearance dates from the Carboniferous period.

Occurrence.—CHIOPTANK FORMATION. Jones Wharf, Pawpaw Point, Governor Run, Peach Blossom Creek. CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

TRUNCATULINA VARIABILIS d'Orbigny.

Plate CXXXI, Figs. 9, 10.

Truncatulina variabilis d'Orbigny, 1826, Ann. Sci. Nat., vol. vii, p. 279, No. 8.

Truncatulina variabilis Terquem, 1878, Mém. Soc. Geol. France, ser. 3, vol. ii, Mem. iii, p. 1, figs. 18-25.

Truncatulina variabilis Baggs, 1898, Bull. Amer. Pal., No. 10, p. 36, pl. ii, fig. 5.

Description.—Test consisting of a depressed, plano-convex, exceedingly variable form, the segments of which are never uniform or regular in arrangement as in *Truncatulina lobatula* but are more or less evolute and vary also in the amount of compression and form. The shell is coarsely perforate. The aperture is a wide gaping arch extending along the inner margin of the final convolution.

This species is very abundant in the Miocene deposits of Maryland and Virginia. Its first recorded appearance as a fossil is from the Eocene of the Paris basin though it is probably of much earlier occurrence.

Occurrence.—CHIOPTANK FORMATION. Jones Wharf, Pawpaw Point, Governor Run, Peach Blossom Creek. CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

Genus ANOMALINA d'Orbigny.

The genus *Anomalina* embraces a small section of *Planorbulinæ* forms which become so symmetrically convoluted that both sides of the shell are similar and the type becomes a true umbilicated nautiloid organism. This perfect symmetry does not always attain and d'Orbigny used the word to apply to two different types, one of which was a nearly equilateral compressed, subnautiloid *Planorbulina* while the other was plano-convex with sunken umbilicus. The forms are closely allied to *Truncatulina* and the distinction between the two is not very clear. It is unfortunate to still retain the name, but as it has some difference in method of growth, perhaps it is well to use the name making it to include all truly nautiloid forms which are symmetrical and with centrally located aperture.

ANOMALINA GROSSERUGOSA (Gümbel).

Plate CXXXI, Fig. 11.

Truncatulina grosserugosa Gümbel, 1868, Abhand. d. k. bayer. Akad. Wiss., ii, cl, vol. x, p. 660, pl. ii, fig. 104, a, b.

Description.—Test nautiloid, very coarsely porous; pores larger and more numerous upon the inferior surface; both sides convex; umbilici distinct; peripheral margin round; chambers large, inflated, septal lines nearly straight, depressed, aperture situated on inner margin, medial.

Gümbel's specimens were from the Eocene of the Bavarian Alps. In present oceans the species seems to occur sporadically at different localities and at various depths down to 2000 fathoms.

Occurrence.—CHOPTANK FORMATION. Peach Blossom Creek. CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Genus ROTALIA Lamarck.

The genus *Rotalia* forms but a small division of the series of ROTALIDÆ forms. The walls of the test are finely perforate while the allied genus *Planorbulina* has coarsely perforate walls.

The general type is that of a turbinate spire which in typical forms like *R. beccarii* is nearly equally convex on both sides. Again by some

the superior surface is trochoid while the inferior remains nearly flat and again the lower side becomes the arched and the superior the depressed area. In the normal Rotaliform arrangement of chambers the whole of the segments appear upon the superior surface and only those of the last volution on the lower aspect. Prof. Brady states that while the umbilicus is sometimes depressed more usually there is an exogenous deposit of shell substance over it. The aperture is normally a curved fissure on the inferior face of the final segment.

The present distribution of the genus is in tropical and temperate zones, and it is typically developed in shallow waters of tropical seas. Its first geological occurrence is in the Gault of England.

ROTALIA BECCARII (Linné).

Plate CXXXI, Figs. 12, 13.

Nautilus beccarii Linné, 1767, Syst. Nat., 12th ed., p. 1162; 1788, Syst. Nat., 13th (Gmelin's) edit., p. 3370, No. 4.

Description.—Test trochoid, shell wall finely porous and the form built into a compact low nearly circular spire; peripheral margin lobulated, obtusely rounded, chambers numerous, ten to forty, somewhat inflated, about ten in the final convolution. Septal lines depressed below and nearly straight; curved above and the whole number of chambers visible on the superior side. Convolutions about three, inferior surface thickened, and often beaded with exogenous granules at the umbilicus. Aperture a notched subdivided opening or a series of pores at the inner margin of the ultimate chamber. This foraminifer rare in the Miocene becomes plentiful in the Pleistocene of Cornfield Harbor, Md. Its fossil form begins with the middle Tertiary.

Occurrence.—ST. MARY'S FORMATION. Cove Point. CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

ROTALIA BECCARII VAR. BRECKKHIANA Karrer.

Plate CXXXI, Fig. 14.

Rotalia breckkhiana Karrer, 1878, Drasche's Geol. d. Insel Luzon, p. 98, pl. v, fig. 26.

Description.—This variety of the *Rotalia beccarii* is only a thickened form of the type species and differs from the latter in the more convex

spire and inferior surfaces. It seems to lack the surface umbilical tubercles and is somewhat more compactly built than the larger forms of the type. Only a few forms were dredged by the Challenger expedition from off the Ki Islands at a depth of 500 fathoms.

Occurrence.—CHOPTANK FORMATION. 1 mile north of Governor Run, Peach Blossom Creek.

Collection.—Maryland Geological Survey.

Family GLOBIGERINIDÆ.

Genus GLOBIGERINA d'Orbigny.

D'Orbigny in his "Tableau Methodique" describes the genus as follows: "Test free, trochoid, irregular; spire confused, formed of spherical chambers more or less distinct; aperture in the form of a more or less depressed hollow situated near the axis of the spire in the umbilical angle."

The shell substance is porous and the shell walls hyaline, and the several chambers connect with each other by the opening at the umbilical vestibule. The number of segments varies from three to as many as twenty. The genus is one of the most cosmopolitan known and exists in every latitude, and at every depth, but the forms are all found living at the surface of the sea except *G. pachyderma*. It dates from the Jurassic age in the fossil world and became so abundant in the Cretaceous as to form extensive beds of chalk of great thickness.

GLOBIGERINA BULLOIDES d'Orbigny.

Plate CXXXII, Figs. 1, 2.

Globigerina bulloides d'Orbigny, 1826, Ann. Sci. Nat., vol. vii, p. 277, No. 1—Modele No. 17 (young) and No. 76.

Globigerina bulloides Brady, 1884, Chal. Rept., vol. ix, p. 593, pl. lxxvii, lxxix, figs. 3-7.

Globigerina bulloides Baggs, 1898, Bull. Amer. Pal., No. 10, p. 33.

Globigerina bulloides Baggs, 1901, Md. Geol. Survey, Eocene, p. 250, pl. lxiii, figs. 15, 16, 16a.

Description.—"Test spiral, subtrochoid; superior face convex, inferior more or less convex but with deeply sunken umbilicus, periphery rounded, lobulated; adult specimens composed of about seven globose

segments, of which four form the outer convolution; the apertures of the individual chambers opening independently into the umbilical vestibule. Diameter, sometimes 1-40th inch (0.63 mm.), but oftener much less." Brady, 1884.

This species is not uncommon in the Maryland Miocene. Its first geological appearance dates from the Cretaceous epoch. At the present time it exists in seas of all latitudes and at all depths.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Peach Blossom Creek. CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

GLOBIGERINA CRETACEA d'Orbigny.

Plate CXXXII, Fig. 3.

Globigerina cretacea d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv, p. 34, pl. iii, figs. 12-14.

Description.—Test rotaliform but strongly depressed; superior surface flattened or but slightly convex, inferior side depressed toward the center and excavated at the umbilicus; periphery obtuse and lobulated; shell typically composed of three fairly distinct convolutions; the outermost consisting of from five to seven segments, the later relatively small, subglobular; the aperture opening into the umbilical vestibule.

This species, which is most abundant in the Cretaceous deposits of the globe, is very rare in our Maryland Miocene. Brady in the Challenger Report states that he never found typical forms of this species in any localities examined by the Challenger, but a few stoutly built modifications exist.

Occurrence.—CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Family TEXTULARIDÆ.

Genus TEXTULARIA DeFrance.

"The shell of *Textularia* essentially consists of a binary series of segments arranged symmetrically on the two sides of a longitudinal axis; the segments of one side alternating with those of the other, and each segment communicating with the segments anterior and posterior to it

on the opposite side. As the size of the segments usually increases progressively, the outline of the shell is generally more or less triangular, the apex of the triangle being formed by the first segment, and its base by the last two." (Carpenter, Introduction to the Study of the Foraminifera.) The shells of this genus show great variation in structure, shape, and composition of the shell substance. Typical forms are hyaline with large, closely set pores, but the larger varieties are often composed of arenaceous grains and either have a siliceous base or calcareous matrix. The best examples come from shallow waters of temperate and tropical seas, but the genus is very widespread and is found at considerable depths. Its geological distribution is interesting since it is one of the earliest types we find developed and it is known from the Paleozoic deposits.

TEXTULARIA ABBREVIATA d'Orbigny.

Plate CXXXII, Fig. 4.

Textularia abbreviata d'Orbigny, 1846, Foram. Fossiles Vienne, p. 249, pl. xv, figs. 9-12 (error for 7-12).

Textularia abbreviata Bagg, 1898, Bull. Amer. Pal., No. 10, p. 18.

Description.—Test short and thick, sharply pointed at the posterior end, rapidly enlarging above, laterally compressed, but not strongly so, being broadly elliptical in outline, with narrowly rounded margins approaching angularity. The chambers are narrow and increase in size rapidly towards the ultimate chamber; septal lines straight, apparent as fine lines, not depressed; aperture a semilunar arch on interior margin of final segment.

Occurrence.—CHOPTANK FORMATION. Governor Run.

Collection.—Maryland Geological Survey.

TEXTULARIA AGGLUTINANS d'Orbigny.

Plate CXXXII, Fig. 5.

Textularia agglutinans d'Orbigny, 1839, Foram. Cuba, p. 136, pl. i, figs. 17, 18; 32-34.

Textularia agglutinans Bagg, 1898, Bull. Amer. Pal., No. 10, p. 19.

Description.—Test agglutinous, elongated, tapering but slightly; of a dull gray color; laterally convex; peripheral margin lobulated, rounded;

chambers numerous, nine or ten in each series; septa somewhat curved, short. It is the most common variety of the *Textulariæ*. As a fossil it dates back to the Cretaceous period. It occurs at all depths and latitudes at the present time and is one of the most widely distributed of the Foraminifera.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, 1 mile north of Governor Run. CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

TEXTULARIA ARTICULATA d'Orbigny.

Plate CXXXII, Figs. 6, 7.

Textularia articulata d'Orbigny, 1846, Foram. Fossiles Vienne, p. 250, pl. xv, figs. 16-18.

Textularia articulata Bagg, 1898, Bull. Amer. Pal., No. 10, p. 19.

Description.—Test rather broad and laterally compressed; tapering only slightly towards the posterior end, which is somewhat rounded; peripheral margin sharp, provided with a marginal keel encircling the sides of the entire shell; chambers numerous, about ten in each series, separated by nearly straight depressed septal lines. Aperture a small median opening along the inner margin of the final segment. This species is closely related to *T. carinata* but differs in not possessing the marginal spines and irregularity and the sutures and is not quite so limbate.

Some of the specimens assume irregular shapes and are more or less bent or deformed.

Occurrence.—CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

TEXTULARIA GRAMEN d'Orbigny.

Plate CXXXII, Figs. 8, 9.

Textularia gramen d'Orbigny, 1846, Foram. Fossiles Vienne, p. 248, pl. xv, figs. 4-6.

Textularia gramen Bagg, 1898, Bull. Amer. Pal., No. 10, p. 19.

Description.—Test arenaceous, rough, stoutly built, laterally compressed; margin subangular; five to seven wide chambers in each series; very slightly convex; posterior end neatly rounded, general outline similar to *Textularia hauerii* d'Orb. but distinguished from that species by

its more angular lateral edges, and differing from *Textularia abbreviata* d'Orb., which it also resembles, in being less short and thick.

Occurrence.—CHOPTANK FORMATION. Governor Run, Jones Wharf.

Collection.—Maryland Geological Survey.

TEXTULARIA CARINATA d'Orbigny.

Plate CXXXII, Fig. 10.

Textularia carinata d'Orbigny, 1846, *Foram. Fossiles Vienne*, p. 247, pl. xiv, figs. 32-34.

Description.—Test arenaceous, rather stoutly built and somewhat compressed, but tapering rather narrowly at the posterior end so that it is almost acuminate. The lateral margins are strongly carinate as in *Textularia articulata*, from which it is with difficulty distinguished, and it may well be doubted whether it is wise to separate the two as d'Orbigny has done. It has somewhat strongly marginal extensions, however, and these extensions are more broken and the sutures are less depressed. It is closely allied to *Textularia marginata* but differs from it in the flanged sides.

D'Orbigny's specimens were from Nussdorf, Austria.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

TEXTULARIA SAGITTULA Defrance.

Plate CXXXII, Figs. 11, 12.

Textularia sagittula Defrance, 1824, *Dict. Sci. Hist.*, vol. xxxii, p. 177; vol. liii, p. 344; *Atlas Conch.*, pl. xiii, fig. 5.

Textularia sagittula Bagg, 1898, *Bull. Amer. Pal.*, No. 10, p. 20.

Textularia sagittula Bagg, 1901, *Md. Geol. Survey, Eocene*, p. 234, pl. lxii, fig. 2.

Description.—Test elongated, strongly compressed with sharp-angled peripheral margins; chambers numerous, closely set, separated by short, straight septal lines visible externally but not depressed. The aperture is linear, terminal. Its geological distribution is from the Cretaceous to the present time.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

TEXTULARIA SUBANGULATA d'Orbigny.

Plate CXXXII, Fig. 13.

Textularia subangulata d'Orbigny, 1846, Foram. Fossiles Vienne, p. 274, pl. xv, figs. 1-3.

Textularia subangulata Bagg, 1898, Bull. Amer. Pal., No. 10, p. 20.

Description.—Test consisting of a relatively small number of chambers which increase very rapidly in size from the posterior to the anterior end; peripheral margins sharp-angled. The sides of the shell are laterally compressed and parallel, only their extremities forming the sharp periphery. The posterior end is acuminate, anterior broad, obtusely rounded; ultimate chamber much elevated and larger than any other segment. The aperture is a median arched slit situated on the inner margin of the final segment.

Occurrence.—CHOPTANK FORMATION. Governor Run.

Collection.—Maryland Geological Survey.

Genus BOLIVINA d'Orbigny.

The genus *Bolivina* possesses the biserial or Textulariform development of its chambers, but it never loses the elongation and inversion of its lip so characteristic of the Bulimine type and this aperture is usually somewhat oblique. While possessing characters similar to both Textulariform and Bulimine types as above mentioned it also is allied closely with the genus *Valvulina* which has the same segment arrangement. Its earliest occurrence as a fossil is in the Cretaceous and it becomes more frequent in subsequent deposits. At the present time the genus is very evenly distributed over every latitude and Prof. Brady states that it is found at from a few to 2000 fathoms, but usually on bottoms of less than 300 or 400 fathoms.

BOLIVINA BEYRICHHII VAR. ALATA Seguenza.

Plate CXXXII, Fig. 14.

Valvulina alata Seguenza, 1862, Atti dell' Accad. Gioenia, ser. ii, vol. xviii, p. 113, pl. ii, figs. 5, 5a.

Description.—This species is a modification of *B. beyrichii* and is closely related to *B. gramen* (*Valvulina gramen* d'Orb.). The former is, however, more slender and somewhat narrower and has greater depth

and subtriangular outline of its later chambers. In the variety "*alata*" there is a well defined wing or keel around the periphery and the test is rather more flattened than in the *Bolivina beyrichii* types.

The prolongation of the aperture, together with its marginal keel, furnishes a sure key to the identification of the species. It is found in existing seas at depths from 50 to 800 fathoms.

Occurrence.—CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Family LAGENIDÆ.

Subfamily NODOSARINÆ.

Genus CRISTELLARIA Lamarck.

The genus *Cristellaria* is represented in its typical form by a plano-spiral lenticular shell with the aperture always at the outer margin of the periphery. Sometimes, however, the later chambers of the shell become enlarged and drawn out so that the shell becomes very oblong and when the primary chambers are very small and the later ones extremely developed it resembles the Nodosarian type. The genus makes its first appearance in the Triassic. It is very widespread at the present time and occurs at all depths but is most common at depths of less than 300 fathoms.

CRISTELLARIA CULTRATA (Montfort).

Plate CXXXII, Fig. 15.

Robulus cultratus Montfort, 1808, Conch. Syst., vol. i, p. 214, 54th genre.

Cristellaria cultrata Bagg, 1898, Bull. Amer. Pal., No. 10, p. 26.

Description.—Test circular, biconvex, smooth and glistening; margin sharp and broadly keeled; chambers seven to eleven in the last volution, somewhat convex, either smooth or costate; aperture radiate. The width of the marginal keel is very variable, though always more or less developed, and this constitutes the essential feature of the species.

Occurrence.—ST. MARY'S (?) FORMATION. Crisfield Well (776 feet).

Collection.—Maryland Geological Survey.

CRISTELLARIA WETHERELLII (Jones).

Plate CXXXII, Fig. 16.

Marginulina wetherellii Jones, 1854, Morris's Cat. Brit. Foss., Ed. 2, p. 37.*Cristellaria wetherellii* Brady, 1884, Chal. Rept., vol. ix, p. 537, pl. cxiv, fig. 14.*Cristellaria wetherellii* Baggs, 1898, Bull. Amer. Pal., No. 10, p. 27.

Description.—Test elongate, compressed, pod-like, primordial segments more or less involute, ultimate segments extending into a straight or nearly straight series. The surface of the shell ornamented externally by raised tubercles more or less regularly arranged between the septal lines of some of the chambers and also upon the septal lines. Transverse sections are elliptical and show in some forms an angular periphery and when so they approach *Cristellaria decorata* Reuss in outline.

Occurrence.—ST. MARY'S (?) FORMATION. Crisfield well (776 feet).

Collection.—Maryland Geological Survey.

Subfamily POLYMORPHINÆ.

Genus POLYMORPHINA d'Orbigny.

The genus *Polymorphina* shows remarkable variation in its biserial arrangement of lageniform chambers. Usually the segments are arranged somewhat oblique to the principal axis and the segments are prolonged and overlap each other in such a manner as to render the whole shell very unsymmetrical. Sometimes the chambers are flattened, at other times they are nearly round and their surface decoration is equally varied.

The genus is closely related to *Textularia* in its method of growth, but it also presents strong affinities to *Uvigerina* and *Nodosaria*. The aperture is typically a radiating fissure.

It is most common at the present time in shoal waters and is known in waters of the arctic, temperate and tropical zones. Its earliest appearance as a fossil is in the Trias and it is especially plentiful in Tertiary strata. In the Maryland Miocene, however, it does not seem to be at all abundant and but few specimens occur.

POLYMORPHINA COMPRESSA d'Orbigny.

Plate CXXXIII, Fig. 1.

Polymorphina compressa d'Orbigny, 1846, Foram. Fossiles Vienne, p. 233, pl. xii, figs. 32-34.

Polymorphina compressa Bagg, 1898, Bull. Amer. Pal., No. 10, p. 29, pl. iii, figs. 1a, 1b.

Polymorphina compressa Bagg, 1901, Md. Geol. Survey, Eocene, p. 246, pl. lxiii, fig. 10.

Description.—"Shell oblong, inequilateral, compressed, more or less fusiform; chambers numerous, arranged in two unequal series, somewhat inflated; septal lines depressed; surface smooth or faintly striated; aperture variable, usually simple, circular, coronate; sometimes labyrinthic, or porous." Brady, Parker and Jones.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, 1 mile north of Governor Run. CALVERT FORMATION. Plum Point, Chesapeake Beach.

Collection.—Maryland Geological Survey.

POLYMORPHINA COMPRESSA VAR. STRIATA n. var.

Plate CXXXIII, Fig. 2.

Description.—Test similar in size, amount of compression, arrangement of chambers and in their number to *P. compressa*, but it differs from the latter in having a number of definite costæ running over every chamber. There would be some doubt about the validity of this variety were it not for the fact that the amount of striation is so great and so entirely different from the common *P. compressa*. It is no doubt easy to find in Brady's illustrations of the species indications of costæ, but when these become constant and well-defined there is good reason to regard the forms as a variety.

Occurrence.—CHOPTANK FORMATION. Jones Wharf, Governor Run.

Collection.—Maryland Geological Survey.

POLYMORPHINA ELEGANTISSIMA Parker and Jones.

Plate CXXXIII, Fig. 3.

Polymorphina elegantissima Parker and Jones, 1865, Philos. Trans. of Roy. Soc., vol. clv, table x, p. 438.

Description.—Test ovoidal, anterior end acute, posterior obtusely rounded; chambers four or five, elongate, arranged in an inequilateral

biserial manner and overlapping in such a way that while one side remains nearly flat the opposite is more or less irregularly vaulted and shows all the chambers in parallel arrangement; final segment broad below, embracing, and bearing the mammillate aperture upon the anterior end. Shell surface smooth; finely perforate. *Polymorphina anceps* Reuss, and *P. problema* var. *deltoidea* Reuss are probably identical with this species. The same species is found in the Eocene at Woodstock, Virginia.

Occurrence.—CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

POLYMORPHINA GIBBA (d'Orbigny).

Plate CXXXIII, Fig. 4.

Globulina gibba d'Orbigny, 1846, Foram. Foss. Vienne, p. 227, pl. xiii, figs. 13, 14.

Polymorphina gibba Bagg, 1901, Md. Geol. Survey, Eocene, p. 248, pl. lxiii, fig. 12.

Description.—Test subglobular, apex slightly produced, base obtusely rounded, consisting of from two to four chambers compactly joined and overlapping. The surface is smooth, unmarked by any septal constriction. Septa visible as fine oblique lines. In transverse section the shell appears almost circular. The aperture is mammillate and the specimens we have are rather small. It occurs in the Eocene of Maryland but is never a common species.

Occurrence.—CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

POLYMORPHINA LACTEA (Walker and Jacob).

Plate CXXXIII, Figs. 5, 6.

Serpula lactea Walker and Jacob, 1798 (*vide* Kanmacher's Ed.), Adams Essays, Microsc., p. 634, pl. xiv, fig. 4.

Polymorphina lactea Bagg, 1898, Bull. Amer. Pal., No. 10, p. 31.

Polymorphina lactea Bagg, 1901, Md. Geol. Survey, Eocene, p. 248, pl. lxiii, fig. 13.

Description.—This rather common form of *Polymorphina* has an ovate or subpyriform test, only slightly compressed and has but three or four chambers with flush sutures and faint septal lines. The aperture is terminal, radiate. It occurs as a fossil as early as the Jurassic and is present from there on with increasing numbers.

Occurrence.—CHOPTANK FORMATION. Jones Wharf. CALVERT FORMATION. Plum Point.

Collection.—Maryland Geological Survey.

POLYMORPHINA REGINA Brady, Parker and Jones.

Plate CXXXIII, Fig. 7.

Polymorphina regina Brady, Parker and Jones, 1870, Trans. Linn. Soc. London, vol. xxvii, p. 241, pl. xli, fig. 32, a, b.

Description.—The external ornament of closely set, regular longitudinal costæ serve to separate this species from its congenitors, *P. problema* and *P. oblonga*. There are six or seven chambers clustered about a central axis and with deeply depressed septal lines. Species of striate *Polymorphina* are comparatively rare and but few occur. In present oceans this species is confined to shallow waters near islands in the Pacific.

Occurrence.—CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

Genus UVIGERINA d'Orbigny.

The essential features of the genus *Uvigerina* consist of an elongated spire of irregular shaped chambers arranged in three series and terminating in an elongated tubular neck upon which is situated the everted lip around the aperture. The normal triserial arrangement is not always adhered to and biserial forms occur as well as those with more than three chambers in one series. The surface of the shell is also variously ornamented and in other cases the chambers are smooth.

Morphologically it is related to the *Polymorphinæ* but the aperture alone is sufficient to distinguish the two. It dates from the Eocene period and exists in present oceans at all depths and over all seas.

UVIGERINA CANARIENSIS d'Orbigny.

Plate CXXXIII, Fig. 8.

Uvigerina canariensis d'Orbigny, 1839, Foram. Canaries, p. 138, pl. i, figs. 25-27.

Uvigerina canariensis Bagg, 1898, Bull. Amer. Pal., No. 10, p. 31.

Description.—The test of *Uvigerina canariensis* is recognized by its smooth surface although faint indications of striæ are sometimes seen here and in the form described by d'Orbigny under the name of *U. urnula*

which is apparently the same species. The shell is of triserial arrangement of unequal lengths and chambers and ends in the characteristic tubular neck. The segments are more or less globose and distinct with definite suture with flaring aperture.

Occurrence.—ST. MARY'S FORMATION (?). Crisfield well (776 feet).

Collection.—Maryland Geological Survey.

UVIGERINA PYGMÆA d'Orbigny.

Plate CXXXIII, Fig. 9.

Uvigerina pygmæa d'Orbigny, 1826, Ann. Sci. Nat., vol. vii, p. 269, pl. xii, figs. 8, 9;
Modele No. 67.

Uvigerina pygmæa Bagg, 1898, Bull. Amer. Pal., No. 10, p. 32.

Description.—Test more or less broadly ovate, stoutly built, with thick shell wall. The chambers are numerous, large and globose, separated by depressed septal lines. The surface is marked by a number of prominent longitudinal costæ which are less numerous and larger than in the longer and more tapering *Uvigerina tenuistriata* Reuss. The primordial end is rounded and the anterior extended into a short tubular neck with flaring aperture. This interesting little species occurs quite frequently in the well-boring at Crisfield. Its geological range is from the Miocene to Recent.

Occurrence.—ST. MARY'S (?) FORMATION. Norfolk well (645 feet).

Collection.—Maryland Geological Survey.

UVIGERINA TENUISTRIATA Reuss.

Plate CXXXIII, Fig. 10.

Uvigerina tenuistriata Reuss, 1870, Sitzungsab. d. k. Akad. Wiss. Wien, vol. lxii, p. 485, pt. i.

Uvigerina tenuistriata von Schlicht, 1870, Foram. Septar. Pietzpubl, pl. xxii, figs. 34-37.

Uvigerina tenuistriata Bagg, 1898, Bull. Amer. Pal., No. 10, p. 32.

Description.—Test much more finely striate than *Uvigerina pygmæa*, more slender, tapering to a small well-rounded end below and gradually increasing in size above. The chambers are not so globose and the septa are not so depressed as in *Uvigerina pygmæa*. The aperture at the end of a tubular neck as in typical *Uvigerina* forms. The species is less

common than its near relative above referred to. Its geological range is from the Upper Oligocene to Recent.

Occurrence.—ST. MARY'S (?) FORMATION Crisfield well (776 feet).

Collection.—Maryland Geological Survey.

Genus SAGRINA d'Orbigny.

D'Orbigny first used the generic term *Sagrina* for a biserial variety of *Uvigerina* with longitudinal costæ. Later he placed under the same a rough dimorphous Textularian which was distinguished from the genus *Gaudryina* in possessing a terminal raised aperture.

Parker and Jones have more recently applied the name *Sagrina* to a group of dimorphous *Uvigerina* which are typically textulariform in their primordial segments and nodosariform in their later ones. This dimorphous character is, however, not always followed and Brady has shown in the Challenger Report a number of forms wholly nodosarian in their growth. The shell is hyaline, perforate, and the exterior is subject to great variation of surface decoration. The aperture is in the form of a tubular raised neck with an everted phialine neck.

In existing oceans Brady says the genus is common in shallow waters of tropical seas. As a fossil it is not known prior to the Miocene epoch.

SAGRINA SPINOSA n. sp.

Plate CXXXIII, Fig. 11.

Description.—This peculiar and interesting species somewhat resembles *S. raphanus* Parker and Jones, but differs from the latter in several particulars. The surface ridges in our specimen end in a series of projecting points which at the distal end become definite spines, though these are short and stubby. Again there are arched cross ridges between these costæ which while they may not indicate the internal structure of the chambers serve to mark their location. The aperture ends in a neatly raised phialine everted lip with central rounded orifice.

Occurrence.—CHOPTANK FORMATION. Jones Wharf.

Collection.—Maryland Geological Survey.

Suborder PORCELLANEA.

Family MILIOLIDÆ.

Genus MILIOLINA Williamson.

"Shell free; convoluted; inequilateral; usually oblong; consisting of numerous segments, each of which in turn extends over the entire length of the shell. Convolutions not disposed in the same plane, but constantly changing their direction, so that parts of from three to six visible segments contribute in various proportions to form the external surface of the shell. Septal orifice large, alternately occupying opposite extremities of the shell; furnished with an appendicular tooth." Williamson.

MILIOLINA SEMINULUM (Linné).

Plate CXXXIII, Fig. 12.

Serpula seminulum Linné, 1767, Syst. Nat., 12 edit., p. 1264, No. 791; 15 edit. (Gmelin's), 1788, p. 3739, No. 2.

Miliolina seminulum Williamson, 1858, Rec. Foram. Gt. Brit., p. 85, pl. vii, figs. 183-185.

Miliola Marylandica Lea, 1833, Contrib. to Geol., p. 215, pl. 6, fig. 227.

Miliolina seminulum Bagg, 1898, Bull. Amer. Pal., No. 10, p. 23.

Description.—Test free, calcareous, imperforate; elliptical or oblong in outline; consisting of five visible elongate, smooth segments. The segments are arranged in an inequilateral manner around a *Miliolina* axis. The two outer ones extend the entire length of the shell with ends overlapping and the aperture in the extremity of the larger segment forms a horseshoe-shaped opening with appendicular tooth in its center.

This species does not extend back prior to the Eocene. It is in existing oceans one of the most cosmopolitan species, extending from the extreme Arctic regions through the equator to the Antarctic region in the south and it is present at all depths from shallow pools to 3000 fathoms.

It is more abundant in Virginia than in Maryland. This species of *Miliolina* was the first foraminifer described from the Maryland Miocene. It was figured and described by Isaac Lea under the name *Miliola marylandica* in his "Contributions to Geology." From his description and figure there can be no doubt about the species referred to as a typical example of *M. seminulum*.

Occurrence.—ST. MARY'S FORMATION. St. Mary's River. CHOPTANK FORMATION. Jones Wharf, Governor Run.

Collection.—Maryland Geological Survey.

Genus SPIROLOCULINA d'Orbigny.

In the genus *Spiroloculina* the segments are arranged in one plane and the chambers extend the entire length of the shell in alternating series with the aperture successively changing from end to end as the form enlarges. This fact of the appearance of all the chambers upon both sides of the shell serves to distinguish the genus from *Miliolina* types of two or more overlapping chambers and the *Biloculina* type in which only two chambers ever appear externally. The genus is subject to considerable variation and the symmetry of the shell is not always followed. The genus inhabits shallow waters of tropical and temperate zones and is rarely met with at depths beyond 600 fathoms. As a fossil the genus is known from the several portions of the Lias and it has been recognized in almost every succeeding formation.

SPIROLOCULINA GRATA Terquem.

Plate CXXXIII, Fig. 14.

Spiroloculina grata Terquem, 1878, Mém. Soc. géol. France, ser. iii, vol. i, p. 55, pl. x, figs. 14-15.

Description.—Test broadly oval or almost circular in outline; chambers, four, Milioline, covered with definite striations upon their outer surface which is the chief characteristic of the species. The umbilical region is depressed and the outer chambers are somewhat enlarged towards their margin, suggesting a thickening of the shell as well as an increase in size. The surface striations are in our specimen nearly parallel to the several chambers, but Brady mentions the fact that these are sometimes oblique and often irregular. While in typical forms the aperture ends in an elongated neck. In our specimen it appears broken so that this feature is not apparent.

The only specimen we have of this peculiar tropical form is from the sands at Chesapeake Beach, where the Foraminifera are best developed in the Maryland beds. It is a coral reef species in existing seas and is a shallow water form. It is not known before the middle Tertiary.

Occurrence.—CALVERT FORMATION. Chesapeake Beach.

Collection.—Maryland Geological Survey.

SPIROLOCULINA TENUIS (Czjzek).

Plate CXXXIII, Fig. 13.

Quinqueloculina tenuis Czjzek, 1847, Haidinger's Naturw. Abhandl., vol. ii, p. 149, pl. xiii, figs. 31-34.

Description.—The test of *Spiroloculina tenuis* is in small delicate specimens Spiroloculine from beginning to end, but in larger forms it shows a thickening at the center on account of the earliest segments not being set in one plane, and it is probably on this account that the species has so often been grouped with *Quinqueloculina*. It has a rather broadly oval contour in our Miocene specimen and the several chambers are smooth and run in alternate series from end to end.

Fossil specimens are met with throughout the European Tertiaries and in existing seas it inhabits all great ocean basins and according to Brady it is especially abundant in the South Pacific. It occurs at all depths and good specimens are met with at considerable depths.

Occurrence.—CHOPTANK FORMATION. Pawpaw Point.

Collection.—Maryland Geological Survey.

PLANTÆ.

PHANEROGAMIA.

CLASS ANGIOSPERMÆ.

Subclass DICOTYLEDONEÆ.

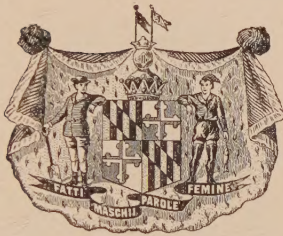
Order FAGACEÆ.

Genus QUERCUS Linné.

QUERCUS LEHMANII n. sp.

Description.—Leaves small, narrow, about 1.3 in. long by 0.5 in. maximum width, irregularly lobed; lobes short, acuminate or wedge-

MARYLAND GEOLOGICAL SURVEY



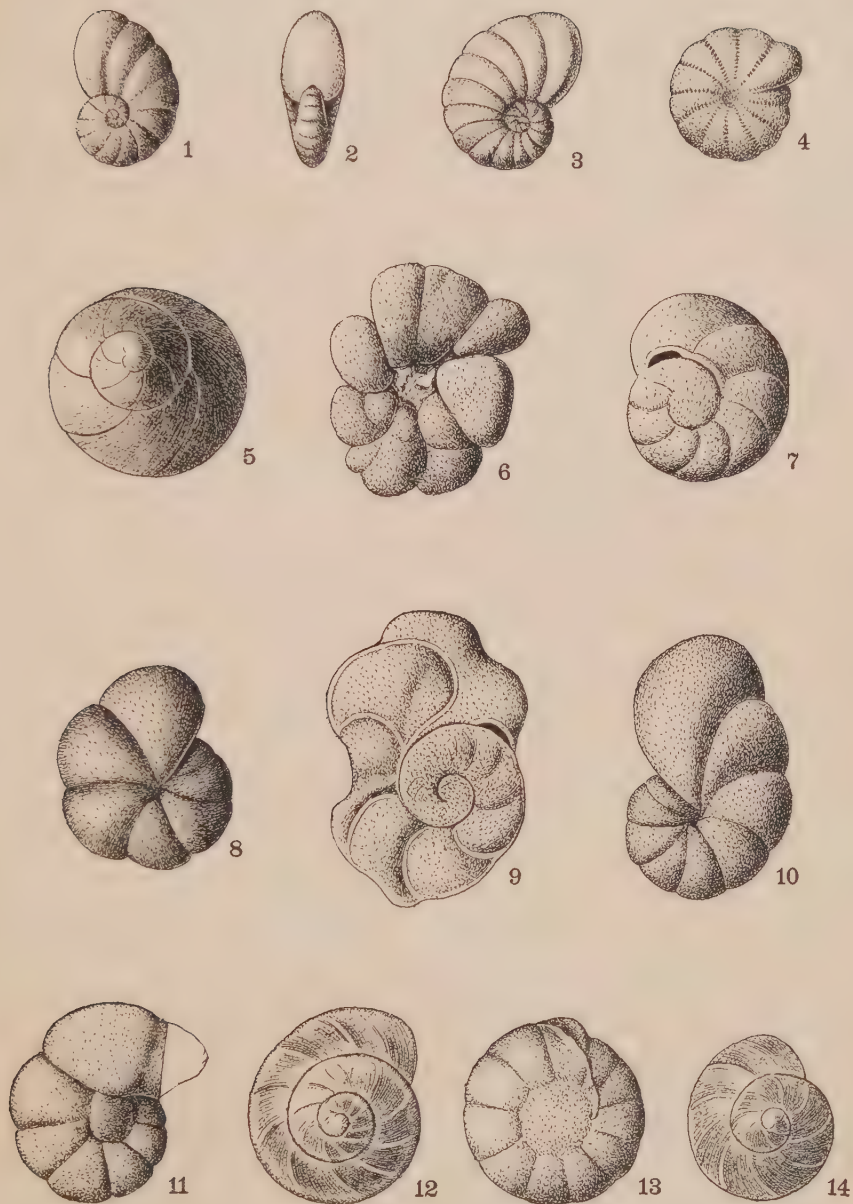
MIOCENE

PLATES

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PLATE CXXXI.

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PROTOZOA—FORAMINIFERA.

PLATE CXXXII.

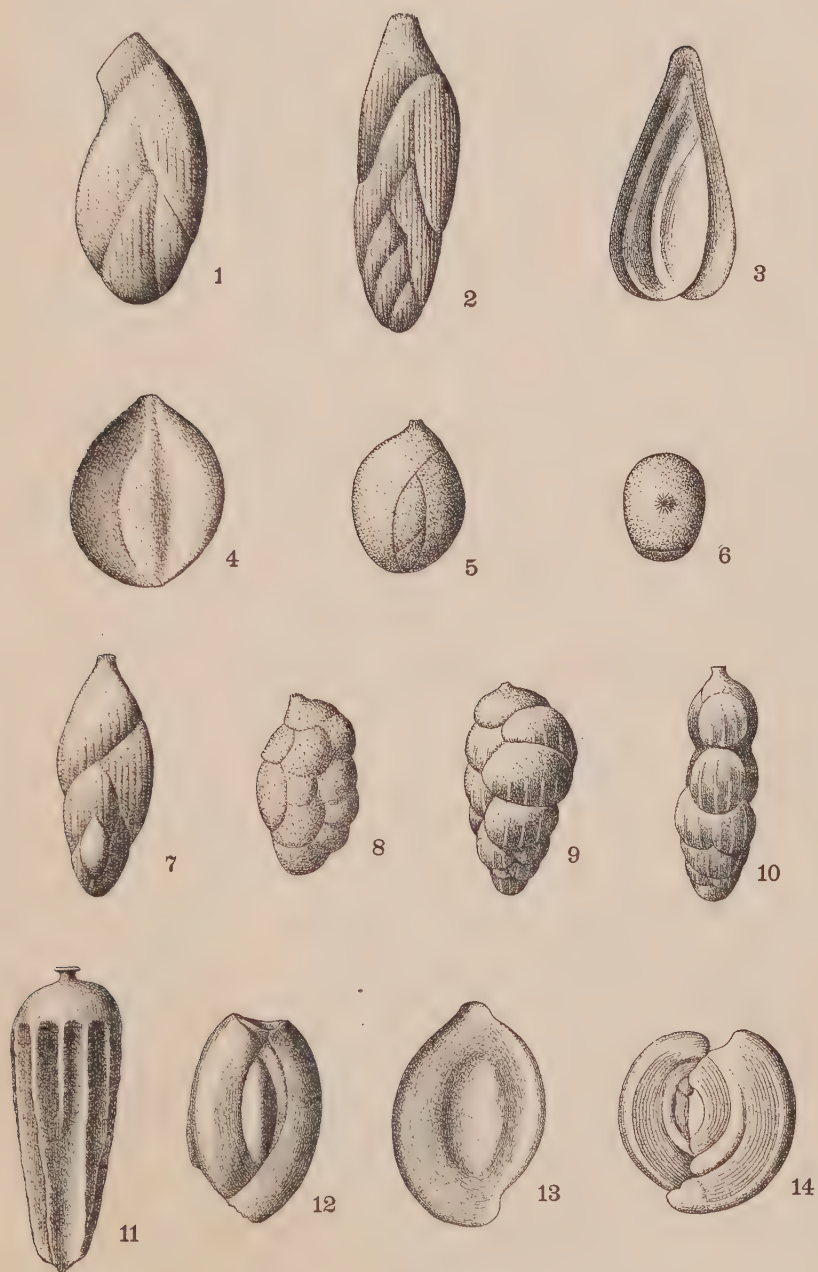
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PLATE CXXXIII.

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