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THE FORAMINIFERA OF THE BYRAM CALCAREOUS MARL AT BYRAM, MISSISSIPPI.

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INTRODUCTION.

The lower Oligocene of the southeastern Coastal Plain of the United States is in Mississippi divisible into several distinct members. Farther east these divisions are not so clearly distinguishable. Of the divisions in Mississippi the Byram calcareous marl is the youngest. The type section for the Byram marl is an exposure at the bridge over Pearl River at Byram, Hinds County, Miss. The formation is mainly a sandy glauconitic marl with thin beds of impure limestone, clay and sand.

Small lots of the marl from the type section, United States Geological Survey station 6455, collected by E. N. Lowe in 1912, were examined after careful washing. Although but a few cubic centimeters of the original material was taken it has given 68 species and varieties of Foraminifera. More species will probably be added by a further search of the material, but it is probable that all the common species are described in this paper. An examination of the Byram marl from other localities will undoubtedly greatly increase the fauna, but it is very desirable in close stratigraphic studies to have the type section very definitely worked up for comparison with sections in other areas, and in this paper it has been the aim to furnish data for such comparisons.

RELATIONSHIPS OF THE BYRAM FAUNA.

Of the 68 species and varieties which are here recorded from the type section of the Byram calcareous marl, 28 appear to have been previously undescribed, and 8 of these are recorded under the genus only, as the available material was not abundant enough to warrant specific determination. This statement may be compared with the data given in the accompanying paper by Cooke, who lists 134 species of mollusks, 5 corals, and 2 echinoderms, 54 of which are peculiar to the marl at Byram.

One of the most interesting features disclosed in the study of the Foraminifera of this collection has been their relationships with other faunas. The different species are very definitely related both to the fossil Foraminifera so far known from the Atlantic and Gulf Coastal Plain of the United States and to the living Foraminifera of certain regions, especially the Indo-Pacific.

By far the larger proportion of the species and varieties are identical with or closely related to species now living in the Indo-Pacific. Such species as *Textularia folium* Parker and Jones, *Bolivina amygdalaeformis* H. B. Brady, *Bolivina nitida* H. B. Brady, and *Hauerina fragilissima* H. B. Brady are now living in the Indo-Pacific region but are not recorded elsewhere nor have they been previously recognized in the fossil form. They show rather conclusively that there is a very close relationship between the fossil fauna at Byram and the living fauna of the Indo-Pacific.

Of the species here described as new there are several that are also clearly related to the living Indo-Pacific fauna. For example, *Discorbis byramensis* Cushman, n. sp., is nearest in its affinities to *D. corrugata* Millett, described from specimens collected in the Malay Archipelago and recorded by Heron-Allen and Earland from the Kerimba Archipelago, off the southeastern coast of Africa, from the coast of Burma, and from West Australia, thus having a wide Indo-Pacific range. In the characters of its ventral surface *D. byramensis* Cushman is also related to *D. patelliformis* H. B. Brady and *D. tabernacularis* H. B. Brady, both typical Indo-Pacific species. The Byram species is then a fossil representative of a small well-distinguished group of species, the others of which are now living in the Indo-Pacific.

Polymorphina regina H. B. Brady, Parker, and Jones also shows a definite faunal relation. As a recent species it is known from the shallow

waters of the tropical and subtropical parts of the Pacific and Indian oceans. As a fossil it is also known from the Miocene of the Coastal Plain of the United States, from the Calvert formation of Chesapeake Beach, Md., and from the Duplin marl of Mayesville, S. C. This form thus represents a group which lived in this region in early Oligocene time and persisted into the Miocene but then apparently died out here, though it continued in the Indo-Pacific region, to which it may have migrated during the Oligocene.

Certain other species, such as *Truncatulina byramensis* Cushman, n. sp., are evidently characteristic of the Miocene and may not have persisted later than that time. *Truncatulina byramensis* is closely related to *T. basiloba* Cushman and *T. concentrica* Cushman, from the Miocene of South Carolina and Florida.

Lepidocyclina supera (Conrad) is characteristic of a group which so far as known is limited to this horizon and not known elsewhere. *L. supera* seems to be an index fossil of the Byram marl.

RELATION OF BYRAM FAUNA TO FAUNAS OF OTHER LOWER OLIGOCENE FORMATIONS.

The foraminiferal faunas of the other divisions of the lower Oligocene have not been thoroughly studied except at the type stations. Evidence is therefore incomplete as to the definite relationships of the several faunas. Enough is known, however, to show that a number of the species of the Byram marl are found also in the Mint Spring marl and a lesser number in the Red Bluff clay, both of which lie below the Byram marl in Mississippi. Some of these species are also found in the Marianna limestone of Alabama and Florida, but the ecologic conditions of Florida and Mississippi in early Oligocene time were evidently very different, and that alone would account for a considerable difference in the faunas.

ECOLOGIC CONDITIONS UNDER WHICH THE BYRAM MARL WAS DEPOSITED.

From a comparison of the records for those species which are found fossil in the marl at Byram and also living in the Indo-Pacific region it is evident that the Byram marl was deposited in comparatively shallow water (10 to 25 fathoms). As nearly all these species occur in the tropical and subtropical waters of the Indo-Pacific, it would seem that the water at Byram must have had at least subtropical temperature (between 20° and 24° C.). As the Miocene climate was evidently colder, especially along the Atlantic coast, this alone is probably sufficient reason for the extinction of those species which persisted in the general region until that time.

SPECIES INCLUDED.

Figures are given of most of the species here described. A close study of the material has shown how little is the variation of any particular species in this marl, and it may be questioned whether I am right in the specific references of certain forms, such as those of *Polymorphina*. However, until a comparative study of recent and fossil material can be made they may best be left as at present. It will undoubtedly become possible at some future time to distinguish the fossil species of our Coastal Plain and to divide them much more closely and definitely.

Something of the known distribution of the species is given as well as full descriptions. A list of the species is given below and is followed by the systematic presentation of the fauna.

Textulariidae:
- Textularia agglutinans D'Orbigny.
- Textularia tumidulum Cushman, n. sp.
- Textularia subhauerii Cushman, n. sp.
- Textularia mississippiensis Cushman, n. sp.
- Textularia folium Parker and Jones.
- Bolivina amygdalaeformis H. B. Brady.
- Bolivina nitida H. B. Brady.
- Bolivina robusta H. B. Brady.
- Bolivina mississippiensis Cushman, n. sp.
- Verneuilina spinulosa Reuss var. glabrata Cushman, n. var.
- Clavulina byramensis Cushman, n. sp.
- Virgulina sp.
- Bulimina ovata D'Orbigny?
- Ehrenbergina glabrata Cushman, n. sp.

Lagenidae:
- Nodosaria sp.
- Nodosaria sp.?
- Cristellaria sp.
- Vaginulina legumen (Linnaeus) D'Orbigny var. elegans D'Orbigny?
- Polymorphina gibba D'Orbigny.
- Polymorphina gibba D'Orbigny, fistulose form.
- Polymorphina regina H. B. Brady, Parker, and Jones.
- Polymorphina byramensis Cushman, n. sp.
- Polymorphina problema D'Orbigny?
- Polymorphina amygdaloides (Reuss) Reuss.
- Uvigerina byramensis Cushman, n. sp.

Globigerinidae:
- Globigerina bulloides D'Orbigny.
- Globigerina triloba Reuss.

Rotaliidae:
- Spirillina subdecorata Cushman, n. sp.
- Discorbis byramensis Cushman, n. sp.
- Discorbis orbicularis (Terquem) Berthelin.

Rotaliidæ—Continued.
Truncatulina lobatula (Walker and Jacob) D'Orbigny.
Truncatulina byramensis Cushman, n. sp.
Truncatulina americana Cushman.
Truncatulina pseudoungeriana Cushman, n. sp.
Anomalina bilateralis Cushman, n. sp.
Anomalina grosserugosa (Gümbel) H. B. Brady? var.
Anomalina mississippiensis Cushman, n. sp.
Siphonina advena Cushman, n. sp.
Gypsina rubra (D'Orbigny) Heron-Allen and Earland.
Pulvinulina byramensis Cushman, n. sp.
Pulvinulina advena Cushman, n. sp.
Pulvinulina glabrata Cushman, n. sp.
Rotalia byramensis Cushman, n. sp.
Rotalia dentata Parker and Jones.
Asterigerina subacuta Cushman, n. sp.
Nummulitidae:
Nonionina umbilicatula (Montagu) Parker, Jones, and H. B. Brady.
Nonionina scapha (Fichtel and Moll) Parker and Jones.
Nummulites sp.
Lepidocyclina supera (Conrad) H. Douvillé.
Miliolidae:
Cornuspira involvens (Reuss) Reuss.
Spiroloculina grateloupi D'Orbigny.
Spiroloculina byramensis Cushman, n. sp.
Spiroloculina imprimata Cushman, n. sp.
Vertebralina advena Cushman, n. sp.
Vertebralina sp.?
Quinqueloculina crassa D'Orbigny?
Quinqueloculina bicostata D'Orbigny, var.
Quinqueloculina cuvieriana D'Orbigny.
Quinqueloculina venusta Karrer?, var.
Quinqueloculina sp.?
Hauerina fragilissima (H. B. Brady) Millett.
Hauerina sp.?
Articulina byramensis Cushman, n. sp.
Massilina crusta Cushman, n. sp.
Massilina occlusa Cushman, n. sp.
Massilina occlusa Cushman, n. sp., var. costulata Cushman, n. var.
Triloculina rotunda D'Orbigny.
Triloculina oblonga (Montagu) D'Orbigny.
Triloculina trigonula (Lamarck) D'Orbigny.
Biloculina sp.?

DESCRIPTIONS.

Family TEXTULARIIDAE.

Genus TEXTULARIA Defrance, 1824.

Textularia agglutinans D'Orbigny.

Plate XIV, figures 1a, 1b.

Textularia agglutinans D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 136, pl. 1, figs. 17, 18, 32–34, 1839.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 363, pl. 43, figs. 1, 2, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 9, figs. 10a, b (in text), 1911.

Test elongate, large and stout, gradually tapering from the initial end, chambers nearly as high as wide, tumid; sutures depressed, distinct, early portion somewhat compressed; wall coarsely arenaceous, but in section with a calcareous base; aperture in a well-marked depression at the base of the inner margin of the last-formed chamber; early chambers usually rougher than the later ones. Length 2 millimeters or less.

Textularia agglutinans is rather common in the Byram marl. The specimens are closely similar to the types from Cuba described by D'Orbigny.

This name has been used for a great variety of forms, but it should be limited to the one described by D'Orbigny, which has a generally tapering form and very rounded chambers, with the surface arenaceous but rather smoothly finished.

Textularia tumidulum Cushman, n. sp.

Plate XV, figures 1, 2a, 2b.

Test large, elongate, compressed, thickest in the central region, thence thinning toward the periphery, initial end rapidly broadening in the adult, the sides nearly parallel to a point near the apertural end, where the breadth of the test is reduced; chambers numerous, in the adult about three times as wide as high, and the last-formed chamber in many old-age specimens somewhat distinctly set off from the others, the inner portion of each chamber much thicker than the other portions and in the rapid decrease in thickness often leaving a channel running lengthwise of the test between this central tumid area and the gradually sloping outer portion, usually very well marked in adult specimens; sutures not very distinct; wall arenaceous but smoothly finished. Largest specimens 2.5 millimeters in length.

This is one of the most common and most conspicuous of the species of the Byram marl at Byram. It is very well characterized by its central tumid area with longitudinal channels at each side, and the general slope to the rounded periphery. The figures show a typical adult (except that the sutures are more distinct than is typical) and a specimen in its earlier stage before the tumid central portions are so strongly developed.

Textularia subhauerii Cushman, n. sp.

Plate XIV, figures 2a, 2b.

Test large, stout, elongate, early portion rapidly increasing in width with each newly added chamber, later adult portion with the

sides nearly parallel, slightly lobulated; periphery rounded but the median portion nearly flat; chambers eighteen to twenty, increasing in height as added, those of the later portion nearly as high as broad, sutures usually rather indistinct; wall coarsely arenaceous but smoothly finished on the exterior; aperture at the base of the inner margin of the chamber. Length 2 millimeters or less.

This species is represented by a few specimens from the Byram marl of rather uniform size and general character.

Heron-Allen and Earland[1] figure a *Textularia* from the Kerimba Archipelago, off the southeastern coast of Africa, which they refer to *T. hauerii* D'Orbigny. In some of its characters our Byram marl species resembles this. A similar form from the Philippines I have referred to *T. hauerii*. A study of D'Orbigny's *T. hauerii* from the Vienna Basin, however, shows that it is very different from the Byram species and apparently also different from the Philippine and Kerimba species.

Textularia mississippiensis Cushman, n. sp.

Plate XIV, figure 4.

Test elongate, fairly broad, thickest in the middle, thence thinning toward the periphery, in end view biconvex, central portion curved; chambers rather low and broad, especially in the early stages, becoming higher in the adult and often less broad so that the later chambers in the adult make a test less wide than at earlier stages; sutures covered by a coarsely arenaceous layer meeting in the center and at the periphery, leaving the central portion of each chamber uncovered, periphery irregular, not definitely or regularly spinose; chamber walls smooth and finely perforate. Length 0.40 to 0.55 millimeter.

This is a common small species in the Byram marl. It is in general character very uniform in the material studied and also very constant in size. In some of its features it resembles *T. pseudocarinata* Cushman (*T. carinata* H. B. Brady; not *T. carinata* D'Orbigny), but it is much smaller and lacks the strongly rhomboidal shape in end view, and the carinae and especially the spines are not so definitely developed. *T. pseudocarinata* is especially characteristic of the Philippine region. The Byram species also resembles very much the form I have described as *T. sagittula* var. *atrata*,[2] which came from the eastern channel of Korea Strait, in 59 fathoms.

Textularia folium Parker and Jones.

Plate XIV, figure 3.

Textularia folium Parker and Jones, Roy. Soc. Philos. Trans., vol. 155, pp. 370, 420, pl. 18, fig. 19, 1865.
Moebius, Beiträge zur Meeresfauna der Insel Mauritius, p. 92, pl. 8, figs. 16, 17, 1880.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 357, pl. 42, figs. 1–5, 1884.
Egger, K. bayer Akad. Wiss. München Abh., Cl. 2, vol. 18, p. 272, pl. 6, figs. 27, 28, 1893.
Chapman, Linnean Soc. London Jour. (Zoology), vol. 28, p. 184, 1900 [1902]; Quekett Micr. Club Jour., 2d ser., vol. 10, p. 127, pl. 9, fig. 4, 1907 [1909].
Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, p. 59, pl. 5, figs. 51, 52, 1906.
Bagg, U. S. Nat. Mus. Proc., vol. 34, p. 130, 1908.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 19, figs. 31–33 (in text), 1911.
Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 623, 1915.

Test small, very much flattened, broad, in front view triangular, in edge view narrow, tapering toward the acute margins; chambers, especially in later development, broad and low, somewhat recurved, the inner and distal margins thickened, prolonged at the periphery into short backward-pointing spinose processes, smooth; wall fairly thick. Length not usually exceeding 0.5 millimeter.

This species is rare in the Byram marl at Byram (U. S. G. S. station 6455). The only difference between this and living specimens lies in its more regular development of spinose projections. It is very interesting, however, in showing the relationship of the Byram marl fauna to existing faunas. At the present time the species seems to be confined to the Indo-Pacific region and is more abundant in the south Pacific than elsewhere. It is known from rare specimens obtained in Mauritius (Moebius) and in the Kerimba Archipelago, off southeastern Africa (Heron-Allen and Earland). It was originally described from specimens collected in the shore sands of Melbourne, Australia, by Parker and Jones. H. B. Brady gives the following localities in the *Challenger* report: Off East Moncoeur Island, Bass Strait, 38 fathoms; off Raine Island, Torres Strait, 155 fathoms; off Kandavu, Fiji, 255 fathoms; off Levuka, Fiji; Nares Harbor, Admiralty Islands, 17 fathoms; Honolulu coral reefs,

[1] Zool. Soc. London Trans., vol. 20, p. 628, pl. 47, figs. 21–23, 1915.

[2] U. S. Nat. Mus. Bull. 71, pt. 2, p. 7, figs. 2–5 (in text), 1911.

40 fathoms. It has also been found in the lagoon of Funafuti and off the coast of Victoria (Chapman); off Laysan (Rhumbler); and at several localities off the Hawaiian Islands (Bagg, Cushman).

Most of the recorded specimens of the species were obtained in 40 fathoms or less, although off Fiji it was found at a depth of 255 fathoms, and off the Hawaiian Islands at 249 to 305 fathoms. It is evidently most abundant on tropical coral reefs of the south Pacific.

Genus BOLIVINA D'Orbigny, 1839.

Bolivina amygdalaeformis H. B. Brady.

Plate XV, figure 3.

Bolivina amygdalaeformis H. B. Brady, Quart. Jour. Micr. Sci., vol. 21, p. 59, 1881; *Challenger* Rept., Zoology, vol. 9, p. 426, pl. 53, figs. 28, 29, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 42, figs. 69a, b (in text), 1911.

Test elongate, somewhat fusiform, thickest in the middle, periphery well rounded, chambers comparatively few; sutures hidden by the ornamentation of the surface, consisting of numerous longitudinal irregularly anastomosing costae; the last-formed chambers lacking the costae but with numerous large depressions; aperture terminal, elongate-oval, somewhat constricted near the middle. Length 0.80 millimeter or less.

This species is rare in the Byram marl, yet it is very distinct. In its recent distribution it is decidedly a Pacific form. It was originally described by Brady from specimens obtained off the Philippines at 95 fathoms, off the Admiralty Islands at 16 to 25 fathoms, off the north coast of New Guinea at 1,070 fathoms, and in Torres Strait at 155 fathoms. I have recorded specimens from two *Albatross* stations—D4875, in 59 fathoms, eastern channel of Korea Strait, and D4964, in 37 fathoms, off the southern coast of Japan.

This is one of the species which shows the relation of the Byram marl fauna to the existing fauna of the south Pacific, Australian, East Indian, and Philippine regions.

Bolivina nitida H. B. Brady.

Plate XV, figure 4.

Bolivina nitida H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 420, pl. 52, figs. 30a, b, 1884.
Bolivina laevigata H. B. Brady (not *B. laevigata* D'Orbigny), Quart. Jour. Micr. Sci., vol. 21, p. 57, 1881.

Test elongate, thin, complanate, broadest at the center, tapering and rounded toward the ends. Segments few in number, regularly textularian in arrangement; broad, flattened on both faces, and bordered both at sutures and periphery by a narrow band of clear shell substance. Sutures even; aperture large, irregularly oval, oblique. Length 1/60th inch (0.42 millimeter).

The above description, quoted from the *Challenger* report, is very accurate for the species as found in the Byram marl. The specimen figured here is one of the most extreme, the majority of the specimens being very close to the figure given by Brady. The large oblique aperture and the flattened test, carinate, with the carinae continued between and separating the chambers, are distinguishing characters.

Brady's material came from two *Challenger* stations off Australia—off East Moncoeur Island, Bass Strait, at 38 fathoms, and off Raine Island, Torres Strait, at 155 fathoms. The species was rare at both these stations, and the lack of records elsewhere seems to show that it is either local or rare. Its occurrence in the Byram marl is therefore decidedly interesting.

Bolivina robusta H. B. Brady.

Bolivina robusta H. B. Brady, Quart. Jour. Micr. Sci., vol. 21, p. 57, 1881; *Challenger* Rept., Zoology, vol. 9, p. 421, pl. 53, figs. 7–9, 1884.
Egger, K. bayer. Akad. Wiss. München Abh., Cl. 2, vol. 18, p. 294, pl. 8, figs. 31, 32, 1893.
Millett, Roy. Micr. Soc. Jour., p. 543, 1900.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 36, figs. 59, 60 (in text), 1911.
Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 646, 1915.

Test small, in front view rhomboid, thickest along the median line, thence gradually sloping to the sides; chambers numerous, usually much lower than wide, slightly tumid, especially in the last-formed portion, sutures distinct, curved, slightly depressed, in the later chambers often with the posterior side of the chamber crenulate with numerous reentrants; wall with numerous rather coarse perforations. Length usually less than 0.5 millimeter.

Small specimens of this species are common in the Byram marl material examined. None of the specimens have the stout apical spine which appears in at least one form of the species in its living form.

There is probably more than one form or variety of this species in recent seas. Most of the specimens recorded by Brady were found in the Pacific, especially the south Pacific. Later records add numerous stations from the Pacific, and Heron-Allen and Earland record it

from the western part of the Indian Ocean, off the coast of Africa. In spite of other records the typical form of the species occurs mainly in the Indo-Pacific region.

Bolivina mississippiensis Cushman, n. sp.

Plate XV, figure 5.

Test elongate, slender, gradually tapering from the subacute initial end to the broadly rounded apertural end; thickest in the median line; chambers numerous, wider than high, curved, sutures marked by limbate lines, broadly curved and somewhat broken near the inner end, not depressed; surface of test smooth and even. Length about 0.4 millimeter.

This species is rare in the Byram marl. It may be distinguished by the narrow, tapering form, the peculiarly marked sutures, and the very even smooth surface.

Genus VERNEUILINA D'Orbigny, 1840.

Verneuilina spinulosa Reuss var. glabrata Cushman, n. var.

Test pyramidal, three-sided, widest above the middle, generally triangular in transverse section, the sides somewhat concave; angles of the test bluntly angled or even rounded, without spines; surface smooth; aperture small, at the inner side of the last-formed chamber. Length 0.75 millimeter or less.

This variety of the species is fairly common in the typical Byram marl. It differs from the typical form of the species in its lack of spines, the edges often being rounded and thickened. No specimens approaching the typical form were found.

The species is very characteristic of shallow tropical and subtropical waters of the Indo-Pacific region.

Genus CLAVULINA D'Orbigny, 1826.

Clavulina byramensis Cushman, n. sp.

Plate XVI, figure 1.

Test elongate, subcylindrical, the early chambers triserial, forming but a small portion of the test; later ones uniserial, both portions rounded; sutures slightly depressed, often not very distinct otherwise; aperture terminal, central, rounded; wall coarsely arenaceous but smoothly finished. Length 2 millimeters or less.

This form is very common in the Byram marl and one of the characteristic species.

The early portion is small in proportion to the whole test and consists of a considerable number of rounded chambers in a triserial arrangement, but the resulting mass with rounded angles forms a bulbous tip to the otherwise tapering test. The sutures of this early portion are usually very indistinct.

This resembles certain tropical Pacific species and probably has its affinities in that region. It is quite likely that Pacific forms which have been referred by authors to *C. parisiensis* D'Orbigny are closer to this species.

Genus VIRGULINA D'Orbigny, 1826.

Virgulina sp.

Plate XVI, figures 2a, 2b, 3.

A rare species in the marl at Byram is figured. It is much compressed, the later chambers resembling those of *Bolivina* in being elongate and curved. The surface is smooth, and in some of its characters this form resembles *V. subsquamosa* Egger, but it does not have the curved axis of that species. Certain specimens from the Indo-Pacific region suggest this form from Byram. Some of the figures of the Kerimba Archipelago material which Heron-Allen and Earland[3] assign to *V. schreibersiana* Czjzek are very similar to this. They note that the typical form is very rare and then say: "The form generally assumed throughout the gatherings is a broad-mouthed, somewhat compressed but regular-chambered type, varying greatly in proportionate length and breadth." Our specimens in certain respects resemble this form.

Genus BULIMINA D'Orbigny, 1826.

Bulimina ovata D'Orbigny?

Plate XVI, figure 4.

Bulimina ovata D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 185, pl. 11, figs. 13, 14, 1846.

H. B. Brady, *Challenger* Rept., Zoology, vol 9, p. 400, pl. 50, figs. 13a, b, 1884.

This species is very rare in the Byram marl, and the correctness of the identification is very questionable. The specimen figured is elongate, oval, and has a smooth surface and somewhat elongate chambers with fairly depressed sutures.

[3] Zool. Soc. London Trans., vol. 20, p. 643, pl. 49, figs. 1–12, 1915.

Genus EHRENBERGINA Reuss, 1850.

Ehrenbergina glabrata Cushman, n. sp.

Plate XVII, figures 4a–4c.

Test small, in front view broadly triangular, chambers numerous, distinct, low and broad, sutures distinct, on the ventral side at the bottoms of deep rounded depressions, on the dorsal side but slightly depressed below the general surface, periphery lobulate; surface smooth, aperture elliptical at the base of the inner margin of the last-formed chamber. Length 0.4 millimeter.

This species is rare in the Byram marl at the type station. It differs from the widely distributed deep-water species *E. serrata* Reuss in the rounded chambers, smooth surface, and lack of spines or sharp angles.

A form that occurs in comparatively shallow water in the Australian region is very similar to the species figured here and may be the same. The identity would not be surprising, in view of the relationships of other species already noted.

Family LAGENIDAE.

Genus NODOSARIA Lamarck, 1812.

Nodosaria sp.

Plate XVI, figure 5.

A single specimen of *Nodosaria* in the material from the Byram marl is incomplete, showing only the last four chambers. It has a tapering form, well-defined chambers, and the surface ornamented by ten to twelve longitudinal costae. This specimen is here figured but not identified specifically, as the material is not well enough preserved.

Nodosaria sp.?

Plate XVI, figure 6.

The figured specimen shows the characters of a single, fragmentary specimen with both ends missing. It is smaller than the specimen described above but has nearly twice as many costae, and the chambers are not well marked. It can not be identified specifically until more material is available.

Genus CRISTELLARIA Lamarck, 1812.

Cristellaria sp.

A single specimen of the genus *Cristellaria* is included in the Byram marl material examined from the type locality. It has very few chambers, seven or eight in the visible coil; the surface is generally smooth, except on the sutures, which are marked by rather broad, curved, raised ridges, those near the earlier part of the coil broken into rounded knobs, the later ones more continuous; periphery angled but not carinate, the apertural face smooth and somewhat concave; aperture at the angle of the chamber. Length about 0.65 millimeter.

As this is a unique form its specific assignment should await the finding of more material.

Genus VAGINULINA D'Orbigny, 1826.

Vaginulina legumen (Linnaeus) D'Orbigny var. elegans (D'Orbigny) Fornasini.

Plate XVII, figure 1.

A single specimen from the marl at Byram shows the earlier chambers with a fairly well developed spine, the chambers as long as wide, surface smooth, sutures somewhat oblique, and showing a ventral side where the suture runs backward somewhat. This is not unlike certain forms now found living in the Philippine region.

Genus POLYMORPHINA D'Orbigny, 1826.

Polymorphina gibba D'Orbigny.

Plate XVII, figure 3.

Polymorphina subcordiformia vel oviformia Soldani, Testaceographiae, vol. 1, pt. 2, p. 114, pl. 113, figs. zz, C, etc., 1791.

Polymorphina (Globulina) gibba D'Orbigny, Annales sci. nat., vol. 7, p. 226, No. 20, Modèles, No. 63, 1826.

Egger, Neues Jahrb., 1857, p. 288, pl. 13, figs. 1–4.

Polymorphina gibba H. B. Brady, Parker, and Jones (part), Linnean Soc. London Trans., vol. 27, p. 216, pl. 39, figs. 2a–d, 1870.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 561, pl. 71, figs. 12a, b, 1884.

Sidebottom, Manchester Lit. and Philos. Soc. Mem. and Proc., vol. 51, No. 9, p. 10, pl. 2, figs. 15–17, 1907.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 85, pl. 41, fig. 4, 1913; U. S. Geol. Survey Bull. 676, p. 11, pl. 2, fig. 4, p. 52, pl. 11, fig. 5, 1918.

Test rotund, in front view nearly circular, in end view broadly oval; chambers few, distinct, sutures distinct, but little if at all excavated; wall smooth and translucent; aperture slightly produced, radiate. Length 0.75 millimeter or less.

Specimens that seem identical with this species are common in the Byram marl. They have usually not more than three chambers. The earliest one, the proloculum before the later chambers are added, is very similar to *Lagena globosa* in form and could easily be mistaken for it, even the aperture not having clearly developed its radiate character at this stage. Specimens that would be classed as *L. globosa* are found in the Byram marl, but with them are specimens in the two and three chambered stages, showing that they are the young of *Polymorphina gibba*.

This is a widely distributed species, both in recent seas and in the fossil series. I have already recorded it from the Pliocene and Miocene of the Coastal Plain.

Polymorphina gibba D'Orbigny, fistulose form.

Plate XVIII, figures 3a, 3b.

The figured specimen shows a fistulose form which may be referred to *P. gibba*. It has numerous branched, semicylindrical processes, mostly from the last-formed chamber.

Polymorphina regina H. B. Brady, Parker, and Jones.

Plate XVIII, figure 4.

Polymorphina regina H. B. Brady, Parker, and Jones, Linnean Soc. London Trans., vol. 27, p. 241, pl. 41, figs. 32a, b, 1870.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 571, pl. 73, figs. 11–13, 1884.

Egger, K. bayer. Akad. Wiss. München Abh., Cl. 2, vol. 18, p. 310, pl. 9, figs. 45, 50, 51, 1893.

Millett, Roy. Micr. Soc. Jour., p. 265, 1903.

Bagg, Maryland Geol. Survey, Miocene, p. 478, pl. 133, fig. 7, 1904; U. S. Nat. Mus. Proc., vol. 34, p. 149, 1908.

Chapman, Quekett Micr. Club Jour., 2d ser., vol. 10, p. 132, pl. 10, fig. 4, 1907 [1909]; Roy. Soc. Victoria Proc., vol. 22, p. 281, 1910.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 91, pl. 41, figs. 6, 7, 1913; U. S. Geol. Survey Bull. 676, p. 54, pl. 11, figs. 3, 4, 1918.

Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 673, 1915.

Test elongate, fusiform; chambers tumid, distinct, especially in the later portion, sutures deep; wall ornamented by numerous longitudinal costae, usually continuing unbroken across several chambers; aperture radiate, somewhat produced. Length 1 millimeter or less.

This species is rare in the Byram marl. It is known from the Miocene of the Coastal Plain in the Calvert formation of Chesapeake Beach, Md. (Bagg), and the Duplin marl of Mayesville, S. C. (Cushman). It is not known to occur in the Tertiary of Europe but is a typical species in the shallow water of the tropical and subtropical Pacific and Indian oceans.

This is another of the species by which the foraminiferal fauna of the Byram marl is correlated with the living fauna of the Indo-Pacific.

The specimen here figured is a young one with but a few chambers developed, not showing the typical adult form.

Polymorphina byramensis Cushman, n. sp.

Plate XVII, figures 2a, 2b.

Test short and broad, triangular, composed of a few chambers, usually only four, all except a final fifth chamber extending back to the base of the proloculum, forming a truncate test; chambers inflated, sutures deep and distinct; surface smooth; aperture radiate, only slightly produced. Length 0.75 millimeter or less.

This is one of the most common species in the Byram marl. It is characterized by its truncate base and triangular form. It resembles the group of *Polymorphina* represented by *P. trigonula* Reuss. Sidebottom[4] has figured a specimen which he refers to *P. lactea* but states that it is not typical. It is near this species.

The proloculum alone strongly resembles that of *P. gibba* in being spherical and translucent. Most of the specimens have the three or four chambers with the triangular, truncate test, but a few have a fifth chamber, usually smaller than the rest and near the upper part of the test. This seems to mark the full development of the species.

Polymorphina problema D'Orbigny?

Plate XVIII, figure 1.

Polymorphina (Guttulina) problema D'Orbigny, Annales sci. nat., vol. 7, p. 266, No. 14, Modèles, No. 61, 1826.

Guttulina problema D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 224, pl. 12, figs. 26–28, 1846.

The form of *Polymorphina problema* found in the Byram marl is not unlike that figured by Brady[5] but is even more like recent specimens

[4] Manchester Lit. and Philos. Soc. Mem. and Proc., vol. 51, No. 9, p. 9, pl. 2, fig. 11, 1907.

[5] *Challenger* Rept., Zoology, vol. 9, p. 568, pl. 72, fig. 20; pl. 73, fig. 1, 1884.

from the Philippine region, where this species attains a large size. This is by far the largest of the Byram species but is not so common as some of the others. The truncate apertural end is the usual character in both the fossil and recent material of this form.

Polymorphina amygdaloides (Reuss) Reuss.

Plate XVIII, figures 2a, 2b.

Globulina amygdaloides Reuss, Deutsch. geol. Gesell. Zeitschr., vol. 3, p. 82, pl. 6, fig. 47, 1851.

Polymorphina amygdaloides (Reuss) Reuss, Akad. Wiss. Wien Sitzungsber, vol. 18, p. 250, pl. 8, fig. 84, 1855.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 560, pl. 71, fig. 13 (?), 1884.

Millett, Roy. Micr. Soc. Jour., p. 261, 1903.

Sidebottom, Manchester Lit. and Philos. Soc. Mem. and Proc., vol. 51, No. 9, p. 9, pl. 2, figs. 12–14, 1907.

Bagg, U. S. Nat. Mus. Proc., vol. 34, p. 148, 1908.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 85, pl. 41, fig. 5, 1913.

Test elongate-oval, much compressed, composed of few chambers which are elongate and narrow; sutures rather indistinct, not depressed; surface smooth; aperture somewhat produced. Length 0.65 millimeter or less.

A few compressed, elongate specimens from the Byram marl may best be referred to this species.

An examination of the figures of specimens referred to this species by different authors will show a very considerable range of forms.

Genus UVIGERINA D'Orbigny, 1826.

Uvigerina byramensis Cushman, n. sp.

Plate XVIII, figure 5.

Test minute, elongate, somewhat fusiform, initial end pointed, chambers numerous, distinct, sutures depressed, surface ornamented by longitudinal costae, rather thin and sharp, the last-formed chamber more distinct than the rest, the inner side concave, the other two sides slightly convex, giving a generally triangular section, the surface of this last-formed chamber smooth, the apertural end produced into a short cylindrical neck with a slight lip, the aperture circular. Length 0.25 to 0.35 millimeter.

This species, which is the only one of the genus in the Byram marl at its type locality, is very distinct and constant in its characters. The size is very uniform, and the peculiar shape of the last-formed chamber in the adult is characteristic.

Family GLOBIGERINIDAE.

Genus GLOBIGERINA D'Orbigny, 1826.

Globigerina bulloides D'Orbigny.

Plate XIX, figures 1–3.

Globigerina bulloides D'Orbigny, Annales sci. nat., vol. 7, p. 277, No. 1, Modèles, Nos. 17, 76, 1826; in Barker, Webb, and Berthelot, Histoire naturelle des îles Canaries, pt. 2, Foraminifères, p. 132, pl. 2, figs. 1–3 28, 1839.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 593, pl. 77; pl. 79, figs. 3–7, 1884.

There are in the typical Byram marl but few specimens of either this species or *G. triloba*, listed below. The specimens referred to *G. bulloides* are very constant in their characters and are of the form shown in the figures given. They are very similar except in their lower spire to the form figured by Brady in the *Challenger* report, plate 79, figure 7. There are but four visible chambers from the ventral side.

Globigerina triloba Reuss.

Globigerina triloba Reuss, Akad. Wiss. Wien Denkschr., vol. 1, p. 374, pl. 47, figs. 11a–e, 1849.

Globigerina bulloides D'Orbigny var. *triloba* H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 595, pl. 81, figs. 2, 3, 1884.

Specimens which are very similar to the species described by Reuss and figured by Brady are found rarely in the Byram marl. In all the specimens the three visible chambers make up the whole of the exterior of the test. The walls are very thin and translucent.

Family ROTALIIDAE.

Genus SPIRILLINA Ehrenberg, 1841.

Spirillina subdecorata Cushman, n. sp.

Plate XIX, figures 4, 5.

Test discoidal, much flattened, consisting of eight or more coils, slightly embracing, dorsal side slightly convex, ventral side strongly concave in the middle, chamber broad, the periphery with a broad, thin keel, the main surface of the chamber on the dorsal side granular, ventral side more nearly smooth; aperture at the end of the tube. Diameter about 0.5 millimeter.

Several specimens of this same character were found in the marl at Byram. One of these is attached to a shell fragment by the ventral side.

This species is perhaps nearest in character to *S. decorata* H. B. Brady, an Indo-Pacific species.

Genus DISCORBIS Lamarck, 1804.

Discorbis byramensis Cushman, n. sp.

Plate XIX, figures 6–8.

Test pyramidal, low, octagonal, ventral side slightly concave, peripheral margin subacute; eight chambers in each of the four or more coils, their margins uniting to form a series of eight ribs extending radially from the apex of the test to the periphery, the lateral sutures much less distinct, surface between the ridges concave but smooth; ventral surface composed of numerous radiating rounded costae broken up transversely to form a beaded surface; umbilical area hollow; aperture at the base of the last-formed chamber. Diameter 0.35 to 0.40 millimeter, height 0.10 millimeter.

This well-characterized species is very rare in the marl at Byram. It is probably nearest in its affinities to *D. corrugata* Millett, described from specimens obtained in the Malay Archipelago and recorded by Heron-Allen and Earland from the Kerimba Archipelago, off the southeastern coast of Africa. *D. corrugata* seems to have but half as many chambers to a coil as *D. byramensis* and is much higher in proportion. The Kerimba specimens show the sutural lines, but the Malay specimens do not. This species is also recorded by Heron-Allen and Earland from Sandoway, Arakan coast, Burma, and Rottnest Island, West Australia, thus having a wide Indo-Pacific range. In the characters of the ventral surface it is also related to *D. patelliformis* H. B. Brady and *D. tabernacularis* H. B. Brady, both typical Indo-Pacific species.

With the geographic relationships of *D. byramensis* its occurrence in the lower Oligocene of Mississippi is very interesting.

Discorbis orbicularis (Terquem) Berthelin.

Plate XIX, figures 9, 10.

Rosalina orbicularis Terquem, Essai sur le classement des animaux qui vivent sur la plage de Dunkerque, fasc. 2, p. 75, pl. 9, figs. 4a, b, 1876.

Discorbis orbicularis (Terquem) Berthelin, Liste des foraminifères recueillis dans la baie de Borgneuf et à Pornichet, p. 39, No. 63, 1878.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 5, p. 16, pl. 11, fig. 1; figs. 18a–c (in text), 1915.

Discorbina orbicularis (Terquem) H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 647, pl. 88, figs. 4–8, 1884 (and numerous subsequent authors).

A few specimens of the broad, flat, scalelike form that is common in shallow water of tropical and subtropical seas were found in the marl at Byram. They are here referred to *D. orbicularis* Terquem, although the number of chambers is much less than in the usual form of that species. All the specimens are of similar size and character. Diameter 0.55 millimeter or less.

The figures of specimens referred to this species by various authors show a considerable range of form and character.

Genus TRUNCATULINA D'Orbigny, 1826.

Truncatulina lobatula (Walker and Jacob) D'Orbigny.

Plate XX, figures 1–3.

"Nautilus spiralis lobatus, etc.," Walker and Boys, Testacea minuta rariora, p. 20, pl. 3, fig. 71, 1784.

Nautilus lobatula Walker and Jacob, Adams's Essays on the microscope, Kanmacher's ed., p. 642, pl. 14, fig. 36, 1798.

Truncatulina lobatula (Walker and Jacob) D'Orbigny, in Barker, Webb, and Berthelot, Histoire naturelle des îles Canaries, vol. 2, pt. 2, Foraminifères, p. 134, pl. 2, figs. 22–24, 1839; Foraminifères fossiles du bassin tertiaire de Vienne, p. 168, pl. 9, figs. 18–23, 1846.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 660, pl. 92, fig. 10; pl. 93, fig. 1, 1884.

Specimens of an abundant form in the Byram marl are referred to this species. In most of them the last half of the final whorl is somewhat angled so that a shallow depression is formed on the dorsal surface. The ventral surface is well rounded. This is a very widespread species, but from the appearance of the fossil forms from various horizons it may have more than one form.

It has been recorded from the Pliocene (Waccamaw formation) at Cronly, N. C.,[6] from several Miocene formations in Maryland, Virginia, South Carolina, and Florida,[7] and from the Miocene of Santo Domingo.[8]

Truncatulina byramensis Cushman, n. sp.

Plate XX, figures 4–6.

Test planoconvex, dorsal side slightly convex, ventral side flattened, peripheral margin subcarinate; about eight chambers in the last-formed whorl, chambers on the ventral side failing to reach the center of the test, leaving a definite umbilical area which is filled with clear shell material; on the dorsal side each chamber at its inner border has the angles somewhat produced and a broad, rounded reentrant near the middle; on the ventral side the inner half of the chamber is rather in-

[6] U. S. Geol. Survey Bull. 676, p. 16, pl. 1, fig. 10, 1918.
[7] Idem, p. 60, pl. 17, figs. 1–3.
[8] Carnegie Inst. Washington Pub. 291, p. 41, 1919.

tricately lobed, the chambers themselves of lighter color, the sutures darker, of clear shell material; surface finely granular; aperture an elongate opening at the base of the last-formed chamber near its inner ventral border. Diameter 0.35 to 0.75 millimeter.

This species is rather common in the marl at Byram. In the form of the lobed chambers it is related to two other Miocene species I have described—*T. basiloba*, from South Carolina, and *T. concentrica*, from the Choctawhatchee marl of Florida. In the peculiar labyrinthic form of the chamber it is not unlike some forms of *Pulvinulina elegans* D'Orbigny, but the shape of the test, chambers, and aperture is different.

Truncatulina americana Cushman.

Plate XX, figures 7, 8.

Truncatulina americana Cushman, U. S. Geol. Survey Bull. 676, p. 63, pl. 20, figs. 2, 3; pl. 21, fig. 1, 1918; U. S. Nat. Mus. Bull. 103, p. 68, pl. 23, figs. 2a–c, 1918.

Test planoconvex, dorsal side nearly flat, ventral side slightly convex, chambers numerous, ten to fifteen in the last-formed coil, rather rapidly increasing in size, peripheral margin subangular, dorsal side with the last few chambers failing to meet the umbilicus, ventral side similar in this respect in most specimens; sutures distinct, slightly limbate on the dorsal side, depressed on the ventral side; wall smooth, punctate, aperture peripheral with a slight lip. Diameter 0.75 millimeter or less.

This species is not so common in the Byram marl as in the Miocene deposits. It is known from the Choctawhatchee marl at Coes Mills and Jackson Bluff, Fla., the Duplin marl at Mayesville, S. C., and Wilmington, N. C., the Yorktown formation at Yorktown, Va., and the Choptank formation at Jones Wharf, Md. I have also recorded it from the lower Miocene of Florida and from the upper Oligocene Culebra formation of the Canal Zone. It is found in the Miocene penetrated by wells in different parts of the peninsula of Florida.

Truncatulina pseudoungeriana Cushman, n. sp.

Plate XX, figure 9.

Truncatulina ungeriana H. B. Brady (not *Rotalina ungeriana* D'Orbigny, 1826), *Challenger* Rept., Zoology, vol. 9, pl. 94, figs. 9a–c, 1884.

Cushman, U. S. Nat. Mus. Bull. 103, p. 69, pl. 24, fig. 1, 1918.

Test biconvex, almost equally so; periphery subacute, chambers nine to eleven in the last-formed whorl, those of the earlier whorls not showing on the dorsal side because they are hidden by the roughness of the surface, or on the ventral side because of the involute character; periphery lobulated; sutures distinct above in the last whorl and very distinct below, as the sutures are somewhat tumid on the ventral side; umbilical region filled nearly flush with the chambers by clear shell material, last few chambers on the dorsal side slightly above the surface on the inner margin; surface dorsally with coarse punctae, below smooth and more finely punctate; aperture at the periphery. Diameter 1 millimeter or less.

In the Byram marl the same form appears that is figured by Brady as *T. ungeriana*. Brady says of his figure, "The drawing (Pl. XCIV, fig. 9) is not a good illustration of the species, the specimen being relatively thicker and altogether more stoutly built than the typical form." A comparison of Brady's figure with that given by D'Orbigny in the Vienna Basin monograph will show the numerous differences in the two. Brady does not give the locality for the specimen from which his drawing was made, but I have seen identical material from the Philippine and Australian regions. The occurrence of this same form in the Byram marl seems to show that the species is distinct and that discrimination will show it to have a definite geographic range in the present ocean. Material from the Oligocene Culebra formation of the Canal Zone that I have referred to *T. ungeriana* may be this new species.

Genus ANOMALINA D'Orbigny.

Anomalina bilateralis Cushman, n. sp.

Plate XXI, figures 1, 2.

Test of about four coils, bilateral or nearly so, composed of numerous chambers, ten or more in the last-formed whorl, umbilical region on both sides with a knob of clear shell material, more pronounced on the dorsal side, chambers smooth but coarsely punctate, more coarsely so on the ventral side, sutures broad and somewhat limbate with clear shell material; aperture a narrow curved opening at the base of the final chamber. Diameter 1 millimeter or less.

This form is rare in the Byram marl. It is close to *A. ammonoides* Reuss but differs from that species as figured by Reuss. It is very close to the form figured in the *Challenger* report by Brady (pl. 94, fig. 2). The *Challenger* material in which Brady found it was almost entirely

from the south Pacific, and it may be predicted that a study of the rather shallow-water material from that region will show that the species there is closely related to if not identical with this one from the Byram marl.

Reuss's original material was from the Cretaceous of Europe. A critical study of the various figures assigned to *A. ammonoides* will show that several forms have been included under the one name.

Anomalina grosserugosa (Gümbel) H. B. Brady? var.

Plate XXI, figures 3–5.

A form in the Byram marl may questionably be referred to this species. It is very close to the form figured by Brady in the *Challenger* report (pl. 94, fig. 4), which is very different from the original of Gümbel, as a comparison of the two will show.

Millett records this species with *A. ammonoides* as widely distributed in the Malay Archipelago, and as both are recorded from a number of stations off the Hawaiian Islands a review of tropical Pacific material should be made to see just what forms are really present there.

Anomalina mississippiensis Cushman, n. sp.

Plate XXI, figures 6–8.

Test small, planoconvex, of about two and one-half coils, periphery slightly lobulate, bluntly rounded, dorsal side very much flattened, even slightly concave, ventral side very convex; chambers comparatively few, six to eight in the last-formed coil, sutures curved, on the dorsal side broad and limbate, even with the surface of clear shell material, on the ventral side narrower and depressed; the last-formed two or three chambers on the inner margin on the dorsal side slightly above the general surface; wall thin and translucent, especially on the dorsal side, smooth; on the ventral side finely punctate and not so clear; aperture a curved opening at the inner margin at the periphery. Length 0.25 to 0.35 millimeter, breadth 0.20 to 0.30 millimeter.

This species is fairly common in the marl at Byram but might easily be overlooked on account of its small size. It is very constant in its chambers and in size and seems to be a well-distinguished little species. In some respects it has affinities with *Truncatulina americana* Cushman, and in others with *Anomalina grosserugosa* (Gümbel) ? var., already mentioned, but it is very distinct from either.

Genus SIPHONINA Reuss, 1849.

Siphonina advena Cushman, n. sp.

Plate XXII, figures 1, 2.

Test unequally biconvex, dorsal side usually less convex than the ventral, periphery subacute, chambers in three or more coils, four chambers making up the last-formed coil, sutures distinct, on the dorsal side flush with the surface, on the ventral side slightly depressed, on the dorsal side somewhat broadened and limbate, ventrally narrow, surface smooth but punctate; aperture with a short neck, compressed, with a phialine lip and elliptical aperture; color even in the fossil specimens somewhat brownish, wall thin and translucent. Diameter 0.50 millimeter or less.

This species is common in the marl at Byram but never shows any of the characters of *S. reticulata* (Czjzek), to which it is related. It is nearer to *S. pulchella* Cushman, from the Miocene of Yumuri River gorge, near Matanzas, Cuba, but differs in the size and shape of the chambers and the character of the sutures.

Genus GYPSINA Carter, 1877.

Gypsina rubra (D'Orbigny) Heron-Allen and Earland.

Plate XXII, figure 3.

Planorbulina rubra D'Orbigny, Annales sci. nat., vol. 7, p. 280, No. 4, 1826.
Fornasini, Acad. sci. Ist. Bologna Mem., 6th ser., vol. 5, p. 44, pl. 2, fig. 3, 1908.
Gypsina rubra (D'Orbigny) Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 725, pl. 53, figs. 35–37, 1915.

A number of specimens of this species were collected in the marl at Byram.

Although in the fossil specimens the color is of course lacking, the characteristic secondary growth seems to be developed.

This is an Indo-Pacific species recorded by D'Orbigny from the South Seas and Sarawak. Heron-Allen and Earland note its occurrence in the Kerimba Archipelago, off the southeastern coast of Africa. They also record it in shore sands from Fremantle, West Australia, from Lord Howe Island, and from Apia Beach and the Lufi-lufi reef, Samoa, and note that "it is probably widely distributed in shallow water across the Indo-Pacific region."

Genus PULVINULINA Parker and Jones, 1862.

Pulvinulina byramensis Cushman, n. sp.

Plate XXII, figures 4, 5.

Test small, biconvex, rotaliform, consisting of about three coils, seven or eight chambers in the last-formed coil; on the dorsal side sutures oblique and at a considerable angle with the periphery, somewhat limbate; on the ventral side the chambers extend in to the center, which is usually not umbilicate; sutures nearly straight; surface polished, punctations appearing as light tubules against the translucent wall; aperture near the inner end of the chamber on the ventral side, with a definite valvular lip, the aperture hidden below but when examined found to be composed, in the adult, of several adjacent small rounded openings. Diameter 1.5 millimeters or less.

This is a common species in the marl at Byram.

The features of the aperture in this species are peculiar, and with its other characters it seems to be well defined.

Pulvinulina advena Cushman, n. sp.

Plate XXII, figure 8.

Test minute, planoconvex, composed of two and a half coils, periphery deeply lobulate, chambers few, elongate, broadest at the outer end, six or seven in the last-formed whorl, periphery of the chambers somewhat tubulated, remainder of surface slightly papillose on the dorsal side, which is flat, ventral side with each chamber more tumid, sutures depressed and distinct, the surface granulose with coarse, almost spinose projections, chambers continuing in to the umbilicus, where they meet; aperture near the periphery of the test at the base of the last-formed chamber. Diameter 0.20 millimeter.

This species is rare in the Byram marl. It finds its nearest ally, so far as ornamentation shows, in *Rotalia schroeteriana* Parker and Jones var. *inflata* Millett. It has a similar surface ornamentation in the spinose or granular surface and in the fimbriated character of the peripheral margins of the chambers. This variety, described by Millett from specimens obtained in the Malay Archipelago, was found again by Heron-Allen and Earland in the material from the Kerimba Archipelago, off the southeastern coast of Africa.

Pulvinulina glabrata Cushman, n. sp.

Plate XXII, figures 6, 7.

Test biconvex, elongate, somewhat lobulate, composed of about two coils, seven chambers in the last-formed coil, dorsal side convex, the sutures depressed, curved, chambers convex between, rapidly increasing in size as added; dorsal side very coarsely punctate, the sutures somewhat limbate; ventral side umbilicate, surface smooth and with very fine punctations; sutures distinct, last-formed chamber with a long, straight valvular lip across the whole of the depressed umbilicus; aperture beneath the lip. Length 0.5 millimeter.

P. glabrata is rare in the marl at Byram. It differs from such closely related species as *P. auricula*, *P. sagra*, and *P. oblonga* in its very coarsely punctate dorsal surface and the shape of the test. From *P. oblonga*, which has a somewhat similar aperture, it differs in the shorter form of the test. There are a number of records for *P. oblonga* from the Indo-Pacific region, and it would be interesting to know the relation of this Byram marl species to that from the Indo-Pacific.

Genus ROTALIA Lamarck, 1804.

Rotalia byramensis Cushman, n. sp.

Plate XXIII, figure 1.

Test unequally biconvex, rotaliform, in the last-formed coil six or seven chambers, dorsally with the chambers somewhat triangular, the sutures oblique, limbate, broad, of clear shell material; ventral side with a large circular mass in the umbilical region, with the sutures deep and ending in a depressed ring about it; aperture with a somewhat valvular lip often divided into several teeth; surface on the dorsal side somewhat roughened, on the ventral side scrobiculate near the periphery, smoother near the center. Diameter 2 millimeters or less.

This species is not common in the marl at Byram. While it belongs to the *Rotalia beccarii* group, it is much more like the tropical species now living in the Indo-Pacific than those of temperate regions. *R. beccarii* itself is used as a name to cover a great variety of things, and the forms now passing under that name should be more critically treated if their geographic and geologic distribution is to be of value.

Rotalia dentata Parker and Jones.

Plate XXIII, figure 2.

Rotalia dentata Parker and Jones, Philos. Trans., vol. 155, p. 387, pl. 19, fig. 13, 1865.

Several specimens from the marl at Byram are very close to this species from Bombay figured by Parker and Jones. They are also close to the figure given by Brady in the *Challenger* report (pl. 108, fig. 4). *R. dentata* is a different species from *R. calcar*, though probably included under that name by several authors.

As shown in the figure of the type, the sutures are limbate with clear shell material, and the outer border of each whorl is marked in a like manner. The spinose projections from the edge are very much like those in the figure given by Brady and seem to be different from those ordinarily seen in *R. calcar*.

Genus ASTERIGERINA D'Orbigny, 1839.

Asterigerina subacuta Cushman, n. sp.

Plate XXIV, figures 1–3.

Test planoconvex or unequally biconvex, composed of about three and one-half coils, the dorsal side slightly convex, smooth, the chambers all visible in well-preserved specimens, even those of the earlier coils showing through the layer of transparent shell material covering them; chambers about ten in the last-formed coil, the sutures oblique and curved backward but not depressed below the surface, slightly thickened and clear, joining at the periphery with the slight keel; from below, the chambers of the last coil only visible; sutures ending at a point about one-third of the way in from the periphery, from which a secondary chamber is developed to the umbilical region, where the sutures come together in a central boss of clear shell material; aperture elongate, curved, at the base of the inner margin on the ventral side. Diameter about 1 millimeter.

Specimens of this species are fairly common in the marl at Byram. It is clearly related to *Asterigerina carinata* D'Orbigny and *A. angulata* Cushman. From the former it differs in the larger number of chambers and the narrower coils, and from the latter in the smaller number of the chambers, simpler aperture, and much narrower coils. *A. subacuta* is nearer *A. carinata* than *A. angulata* but is very constant in its characters. From above it has the appearance of a *Pulvinulina*, but an examination of the ventral side shows the typical characters of *Asterigerina*. It shows traces of granules on the ventral side near the aperture.

Family NUMMULITIDAE.

Genus NONIONINA D'Orbigny, 1826.

Nonionina umbilicatula (Montagu) Parker, Jones, and H. B. Brady.

Plate XXIII, figures 3, 4.

There are several specimens from the marl at Byram that at present may be referred to this species. It should be noted, however, that the specimens described by Montagu are different from many of the forms later assigned to his species and that there are apparently several species or varieties which occur in different regions which should be distinguished. The specimens from the Byram marl are very constant in all their characters and are very close to one of the forms figured by Brady in the *Challenger* report (pl. 109, fig. 8). This species is common in comparatively shallow water in the Indo-Pacific region, but in the north Atlantic it is found largely in deeper water. It is to be suspected, therefore, that the species from the Byram marl and that from the Indo-Pacific may be found to be closely allied.

Nonionina scapha (Fichtel and Moll) Parker and Jones.

Plate XXIII, figures 5–7.

Nautilus scapha Fichtel and Moll, Testacea microscopica, p. 105, pl. 19, figs. d–f, 1803.

Nonionina scapha (Fichtel and Moll) Parker and Jones, Annals and Mag. Nat. Hist., 3d ser., vol. 5, p. 102, No. 4, 1860.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 730, pl. 109, figs. 14, 15, 16?, 1884.

There are two forms of *Nonionina* in the Byram marl, both of which are referred to *N. scapha*. One of them is very close to two of the figures given by Brady in the *Challenger* report (pl. 109, figs. 14, 15). The other is somewhat more elongate. Both forms are figured here to facilitate subsequent reference when the various forms of *Nonionina* found in the Tertiary of the Coastal Plain may be studied as a whole.

Genus NUMMULITES Lamarck, 1801.

Nummulites sp.

Plate XXIV, figure 4.

There are a few specimens of *Nummulites* from the marl at Byram of the character

shown in the figure. Definite placing of these forms under a specific name is left until the study of the various species of our Coastal Plain Tertiary is undertaken.

Genus LEPIDOCYCLINA Gümbel, 1868.

Lepidocyclina supera (Conrad) H. Douvillé.

Orbitolites supera Conrad, Acad. Nat. Sci. Philadelphia Proc., No. 2, p. 74, 1865.
Orbitoides supera Conrad, Am. Jour. Sci., 2d ser., vol. 43, p. 31, 1867.
Lepidocyclina supera (Conrad) H. Douvillé, Compt. Rend., 1918, pp. 263, 264, figs. 6–8, 11.
Cushman, U. S. Geol. Survey Prof. Paper 125, p. 69, pl. 26, figs. 5–7, 1920.

Test flattened or slightly sellaeform, typically circular but occasionally irregular with lobes at one side or elongated oval; thickest in the central region but not distinctly umbonate, gradually decreasing in thickness to the periphery; surface apparently smooth but with slight enlargement becoming papillate, the papillae, which are the ends of the pillars, rounded and projecting above the general surface slightly, or where the test is eroded becoming more prominent. Diameter as much as 18 millimeters in adult specimens, thickness about 2 millimeters.

This species is abundant in the Byram marl, of which it is one of the index fossils.

Family MILIOLIDAE.

Genus CORNUSPIRA Schultze, 1854.

Cornuspira involvens (Reuss) Reuss.

Plate XXV, figure 1.

Operculina involvens Reuss, Akad. Wiss. Wien Denkschr., vol. 1, p. 370, pl. 45, fig. 20, 1849.
Cornuspira involvens (Reuss) Reuss, Akad. Wiss. Wien Sitzungsber., vol. 48, p. 39, pl. 1, fig. 2, 1863 [1864].
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 200, pl. 11, figs. 1–3, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 6, p. 25, pl. 1, fig. 2; pl. 2, fig. 2, 1917.

There are but a few specimens of this species in the Byram marl. They are smooth and of small size, only about 0.4 millimeter.

The species is very widely distributed. It is common in the shoal waters of the Tropics and reaches a large size in the warm waters of the Indo-Pacific region, as, for example, in the Philippines. Elsewhere it seems to be of small size.

Genus SPIROLOCULINA D'Orbigny, 1826.

Spiroloculina grateloupi D'Orbigny.

Plate XXV, figure 2.

Spiroloculina grateloupi D'Orbigny, Annales sci. nat., vol. 7, p. 298, 1826.
Terquem, Soc. géol. France Mém., 3d ser., vol. 1, p. 52, pl. 5, figs. 5, 6, 1878.
Weisner, Archiv Protisten-Kunde, vol. 25, p. 208, 1912.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 6, p. 31, pl. 4, figs. 4, 5, 1917.
Spiroloculina excavata H. B. Brady (not D'Orbigny), *Challenger* Rept., Zoology, vol. 9, p. 151, pl. 9, figs. 5, 6, 1884.

The marl from Byram contains a number of specimens which seem nearer to this species than to any other. The periphery, however, is not greatly rounded, but the sides of the test are deeply excavated, and there is a strong keel at the outer edge of each chamber, the neck is produced, and the surface is smooth. One specimen exhibits the series of openings at either end of each coil seen in a number of other species. This is a microspheric specimen.

The species is widely distributed and is especially abundant in the Indo-Pacific, occurring in great numbers in certain parts of the Philippine region and elsewhere in shallow warm waters.

Spiroloculina byramensis Cushman, n. sp.

Plate XXV, figures 4a, 4b.

Test compressed, broadly rounded in side view; peripheral margin squarely truncate, sides of the chambers sloping in somewhat toward the center, surface with a beautiful ornamentation consisting of fine hexagonal depressed areas with very narrow thin ridges between covering the entire surface. Length 0.85 millimeter.

This is rare in the marl at Byram, but its beautifully ornamented surface is very distinctive. It resembles Terquem's figures of *Quinqueloculina variolata* D'Orbigny, from the Pliocene of the Isle of Rhodes.

Spiroloculina imprimata Cushman, n. sp.

Plate XXV, figures 3a, 3b.

Test broad and flat, complanate, nearly circular in outline, composed of numerous chambers, those of the last-formed coil failing to extend to the base of the preceding chamber, leaving a gap; periphery square, lateral faces nearly flat; the surface ornamented by a

series of pits in a more or less linear arrangement. Length about 1 millimeter.

Plate XXV, figure 3b, shows the character of this ornamentation, much enlarged. This is not a common species in the Byram marl, but several specimens were found.

Genus VERTEBRALINA D'Orbigny, 1826.

Vertebralina advena Cushman, n. sp.

Plate XXV, figures 5, 6.

Test compressed, in the adult with three chambers in the final whorl, the chamber angled, surface with numerous strong longitudinal costae, aperture elongate, with a flaring everted lip. Diameter 1 millimeter.

This species is rare in the Byram marl. It may be that some of the specimens which have been assigned to *Articulina sulcata*, based on the figure given by Brady, are *V. advena*. Heron-Allen and Earland record *A. sulcata* from the Kerimba Archipelago. Sidebottom records the species from the Mediterranean, and his figures show that his specimens were evidently *Articulina*. The specimen from the Abrolhos Bank figured by Brady, Parker, and Jones is apparently not the same.

Forms similar to this should be looked for in the tropical Indo-Pacific. A specimen I have figured as *Articulina sulcata*[9] is very close to if not identical with the Byram marl species.

Vertebralina sp.

Plate XXV, figure 7.

In the marl at Byram was found a single specimen of a very thin, complanate species with numerous distinct anastomosing costae as a surface ornamentation.

It is very distinct from *V. advena*, described above, but the single specimen is not enough for specific determination and description.

Genus QUINQUELOCULINA D'Orbigny.

Quinqueloculina crassa D'Orbigny?

Plate XXVII, figures 1, 2.

Quinqueloculina crassa D'Orbigny, Annales sci. nat., vol. 7, p. 301, No. 14, 1826.
Terquem, Soc. géol. France Mém., 3d ser., vol. 2, pt. 3, p. 186, pl. 20 (28), figs. 20, 21, 1882.
Fornasini, Accad. sci. Ist. Bologna Mem., 6th ser., vol. 2, p. 65, pl. 3, fig. 5, 1905.
Miliolina crassa Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 572, pl. 42, figs. 37–41, 1915.

A species that is fairly common in the marl at Byram is rather close to *Q. crassa* as figured by Heron-Allen and Earland from their Kerimba Archipelago material. It is referred questionably to this species. The Byram specimens have perhaps a little finer costae but are otherwise similar to the Kerimba form.

Quinqueloculina bicostata D'Orbigny, var.

Plate XXVI, figures 2–4.

A form of *Quinqueloculina* which is one of the most common fossils in the Byram marl may be referred to *Q. bicostata* D'Orbigny. The specimens are, however, more elongate than the types,[10] or those of Heron-Allen and Earland, from the Kerimba Archipelago.[11]

The Byram specimens are referred to this species provisionally, but they may represent a distinct variety or species, their main resemblance to the typical form being in the bicostate character of the periphery of the chambers.

The species which perhaps comes nearest to this Byram marl material is that figured by D'Orbigny[12] as *Q. juleana*.

Quinqueloculina cuvieriana D'Orbigny.

Plate XXVI, figure 1.

Quinqueloculina cuvieriana D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 164, pl. 11, figs. 19–21, 1839.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 6, p. 47, pl. 12, fig. 2, 1917.

The typical form of this species described by D'Orbigny from specimens obtained from the shore sands of Cuba occurs very rarely in the marl at Byram. Several authors cite the figures in the *Challenger* report, which do not represent this species but rather *Q. lamarckiana* D'Orbigny. The typical form is found, however, in eastern waters. I have had it from shallow water in Hongkong Harbor, and it occurs elsewhere in the Indo-Pacific region.

The accessory costae at either side of the sharp margin are characteristic of the species.

Quinqueloculina venusta Karrer?, var.

Plate XXVI, figure 5.

This elongate, angled form is somewhat like the form figured by Brady in the *Challenger*

[9] U. S. Nat. Mus. Bull. 71, pt. 6, pl. 22, figs. 5*a*, *b*, 1917.

[10] D'Orbigny, A. D., in De la Sagra, Ramón, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 195, pl. 12, figs. 8–10, 1839.

[11] Zool. Soc. London Trans., vol. 20, p. 572, pl. 42, figs. 42–45, 1915.

[12] Foraminifères fossiles du bassin tertiaire de Vienne, pl. 20, figs. 1–3, 1846.

report (pl. 5, fig. 5) and placed as *Miliolina venusta* Karrer. The specimens from the Byram marl are even longer and more slender and may not be this species at all. They are figured and noted here so that the form may be made available for later comparisons.

Quinqueloculina sp.?

Plate XXVI, figure 6.

A few specimens from the Byram marl are large (1.50 to 1.75 millimeters long) and have much the form of *Triloculina oblonga* (Montagu) but are quinqueloculine. The surface is in most of them worn and smooth, but in one of the largest, best-preserved specimens there is a faint longitudinal striation. In this connection the note which Heron-Allen and Earland give under *Miliolina oblonga* in their Kerimba work (p. 567) is interesting. "At stations 9 and 12 the specimens were large and showed signs of superficial markings linking the species with *M. striata.*"

Genus HAUERINA D'Orbigny, 1846.

Hauerina fragilissima (H. B. Brady) Millett.

Plate XXVII, figure 3.

Spiroloculina fragilissima H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 149, pl. 9, figs. 12–14, 1884.
Hauerina fragilissima (H. B. Brady) Millett, Roy. Micr. Soc. Jour., p. 610, pl. 13, figs. 8–10, 1898.
Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 587, pl. 46, figs. 1, 2, 1915.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 6, p. 64, pl. 24, fig. 4, 1917.

A number of very typical specimens of this species have been identified from the marl at Byram.

All the known records for this species are Indo-Pacific. Brady's original localities are off Tahiti, Society Islands, 420 and 620 fathoms; off Kandavu, Fiji Islands, 255 fathoms; south coast of New Guinea, 3 to 28 fathoms; north coast of New Guinea, 16 to 25 fathoms. Millett records it from the Malay Archipelago. Heron-Allen and Earland found it in material from the Kerimba Archipelago, off the southeastern coast of Africa. I have found the species in material collected off the Hawaiian Islands in 271 fathoms.

This record from the lower Oligocene Byram marl confirms the Indo-Pacific relations of the Byram fauna.

The test of this species is very thin and of a peculiar opalescent character, the surface smooth or slightly pitted, the sutures usually appearing as whitish lines in the test.

Hauerina sp.?

Plate XXVII, figure 4.

A single somewhat broken specimen in the marl from Byram belongs to the genus *Hauerina*. It differs from *H. fragilissima* in the sharp edge to the peripheral borders of the chambers, even carinate, and the character of the wall, which though thin and transparent seems to have deep pits or possibly perforations at wide but regular intervals, in a single irregular line down the curved part of the chamber.

Genus ARTICULINA D'Orbigny, 1826.

Articulina byramensis Cushman, n. sp.

Plate XXVII, figures 5, 6.

Test of two portions, a basal triloculine portion followed by a single linear chamber, the earlier portion with the lip of the antepenultimate chamber standing out free at the base, that of the penultimate chamber covered by the base of the last-formed one, last chamber rounded in transverse section or slightly compressed, with a broadly flaring, slightly downward-curved lip; aperture rounded, slightly longer than wide; surface of the test with numerous longitudinal costae, sharp, sometimes, especially in the final chamber, anastomosing. Length 1.25 millimeters.

This is a fairly common species in the marl at Byram and is very constant in its characters. The free lip of the chamber projecting at the base is peculiar and constant in all specimens, and the single linear chamber with very wide lip and the sharply cut, often anastomosing costae are also points that distinguish the species.

A. byramensis is allied to certain of the species usually classed under *A. conico-articulata*. It is close to the specimen from waters off the Hawaiian Islands I have referred to *A. conico-articulata*[13] and is even more strikingly like the specimens from the Kerimba Archipelago figured by Heron-Allen and Earland[14] as *Articulina sagra* D'Orbigny. This suggests that we have here a definite species, fossil in the Byram marl and living in the Indo-Pacific.

[13] U. S. Nat. Mus. Bull. 71, pt. 6, pl. 22, figs. 5, 6, 1917.
[14] Zool. Soc. London Trans., pl. 45, figs. 22–25, 1915.

Genus MASSILINA Schlumberger, 1893.

Massilina crusta Cushman, n. sp.

Plate XXVIII, figure 1.

Test elliptical, compressed, periphery carinate, early chambers quinqueloculine, later ones 180° from one another, making a flat test, sutures distinct, central portion of each chamber elliptical in transverse section, surface with a slight secondary thickening, the test itself ornamented by a series of very short longitudinal pits, apertural and basal ends of each chamber strongly projecting, the basal end rounded, the aperture rounded with a bifid tooth; surface dull. Length 1.60 millimeters or less.

A few specimens in various stages occurred in the marl at Byram. This species in some ways resembles the figures of *Spiroloculina planissima* (Lamarck) from the Kerimba Archipelago given by Heron-Allen and Earland.[15] Our specimens are, however, much more involute and belong to *Massilina*. The shape of the apertural end and the carinate periphery are very similar in the two forms.

Massilina occlusa Cushman, n. sp.

Plate XXVIII, figure 2.

Test elongate, narrowly elliptical in face view, involute, the peripheral margins squarely truncate, initial end of the chamber projecting backward beyond the former aperture, rounded, apertural end somewhat produced, whole chamber nearly square in transverse section; sutures distinct; aperture rounded, neck square; surface dull, smooth. Length 0.75 millimeter or less.

This species is represented in the marl at Byram by several specimens, all of this same shape and character.

The involute character of the last-formed chambers hides the early chambers almost completely. The whole test has a squarish form that is continued even to the apertural neck. The shape of the initial end of the last-formed chamber is also very constant and characteristic.

Massilina occlusa Cushman, n. sp., var. costulata Cushman, n. var.

Test differing from the typical form in the surface, which instead of being smooth and polished as in the type has an ornamentation of several longitudinal, more or less irregular costae, running out on the neck of the last-formed chamber, the angles of the chambers sharp and carinate, the periphery of the test concave.

This form is rare in the marl at Byram and seems to be either a distinct species or a variety of *M. occlusa*. It may be compared to such forms as *Spiroloculina costigera* Terquem, *S. costata* Terquem, *S. striata* Terquem, and *S. semi-ovata* Terquem, from the Eocene of the Paris Basin, though it is unlike any of these.

[15] Zool. Soc. London Trans., vol. 20, pl. 41, figs. 1–5, 1915.

Genus TRILOCULINA D'Orbigny, 1826.

Triloculina rotunda D'Orbigny.

Triloculina rotunda D'Orbigny, Annales sci. nat., vol. 7, p. 299, No. 4, 1826.
Schlumberger, Soc. zool. France Mém., vol. 6, p. 206, pl. 1, figs. 48–50, figs. 11, 12 (in text), 1893.

Several specimens from the marl at Byram are here referred to this species. They are triloculine, smooth, nearly as broad as long, and the chambers rounded. The longest are about 0.75 millimeter in length.

T. rotunda is recorded from widely separated localities, but there are various forms, as noted in the literature on the species.

Triloculina oblonga (Montagu) D'Orbigny.

Plate XXVIII, figures 3, 4.

Vermiculum oblongum Montagu, Testacea Britannica, p. 522, pl. 14, fig. 9, 1803.
Triloculina oblonga (Montagu) D'Orbigny, Annales sci. nat., vol. 7, p. 300, No. 16, Modèles, No. 95, 1826; in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 155, pl. 10, figs. 3–5, 1839.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 6, p. 69, pl. 26, fig. 3, 1917.
Miliolina oblonga (Montagu) H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 160, pl. 5, figs. 4*a*, *b*, 1884.
Millett, Roy. Micr. Soc. Jour., p. 267, pl. 5, fig. 14, 1898.
Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 566, 1915.

A few small but otherwise typical specimens of this species were found in the marl at Byram. They are widest near the base and thence taper to the narrower apertural end; the surface is smooth and polished. Length about 0.35 millimeter.

The specimen figured by Brady seems to be a *Quinqueloculina* and to lack the characteristic shape of the tropical specimens in shallow

water. It may be that the Byram specimens and the one I have figured from waters off the Hawaiian Islands, together with that figured by Millett, really constitute a tropical species different from that of British waters.

Triloculina trigonula (Lamarck) D'Orbigny.

Miliolites trigonula Lamarck, Annales du Mus., vol. 5, p. 351, No. 3, 1804; Animaux sans vertèbres, vol. 7, p. 612, No. 3, 1822.

Triloculina trigonula (Lamarck) D'Orbigny, Annales sci. nat., vol. 7, p. 299, No. 1, pl. 16, figs. 5–9, Modèles, No. 93, 1826.

A single specimen of this species was found in the marl at Byram. It is a short, rather rotund form.

Genus BILOCULINA D'Orbigny, 1826.

Biloculina sp.?

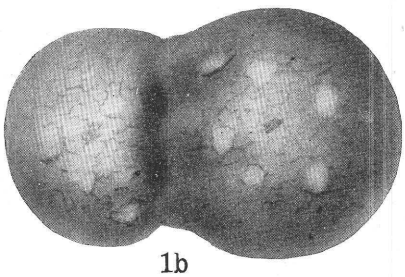
Plate XXVIII, figures 5, 6.

There are a very few specimens of a small rotund *Biloculina* in the Byram marl. They are smooth with a large aperture and a tooth very small in comparison, as shown in the figure.

PLATES XIV-XXVIII.

PLATE XIV.

FIGURE 1. *Textularia agglutinans* D'Orbigny. *a*, Front view; *b*, apertural view. × 30.
2. *Textularia subhauerii* Cushman, n. sp. *a*, Front view; *b*, apertural view. × 50.
3. *Textularia folium* Parker and Jones. Front view of a typical specimen. × 100.
4. *Textularia mississippiensis* Cushman, n. sp. Front view showing the darker secondary covering of the sutures and the periphery. × 80.



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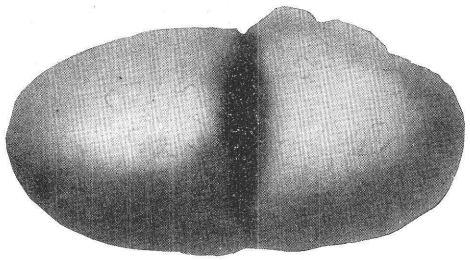

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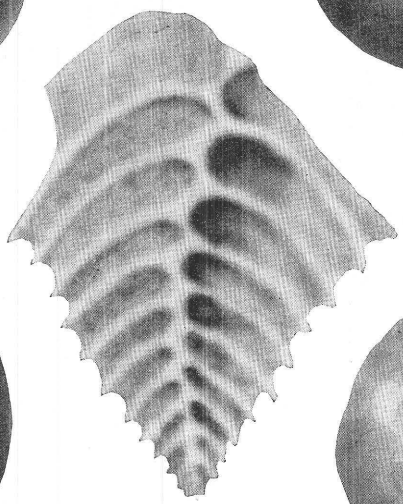

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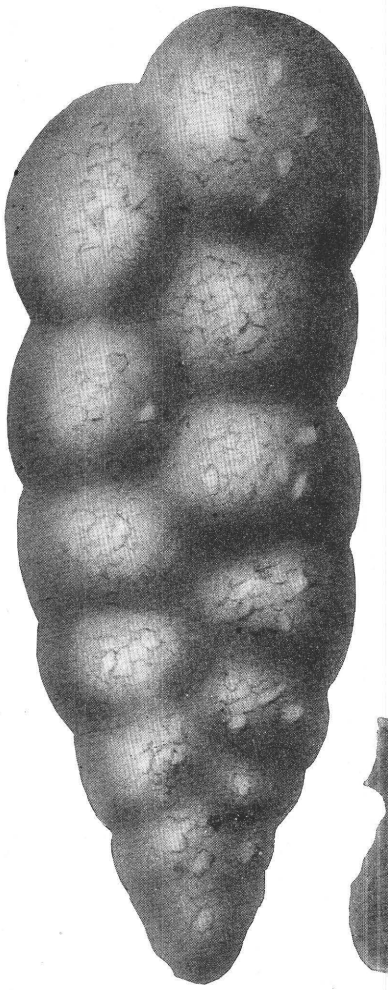

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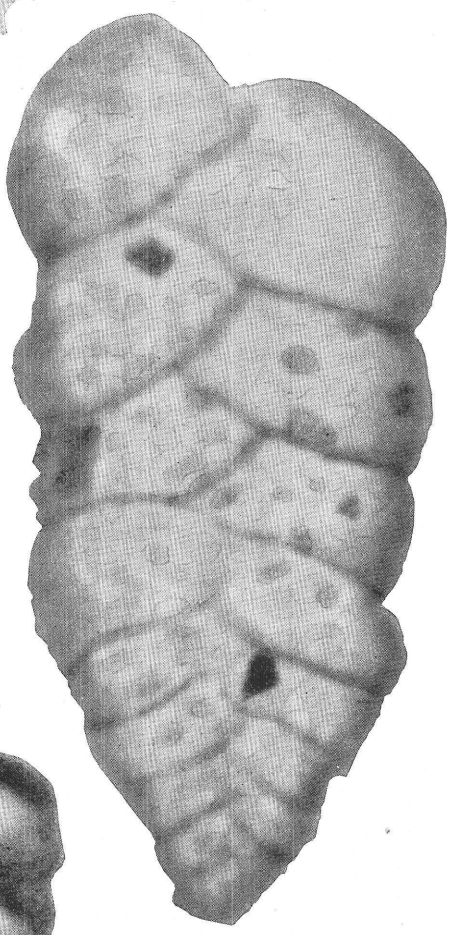

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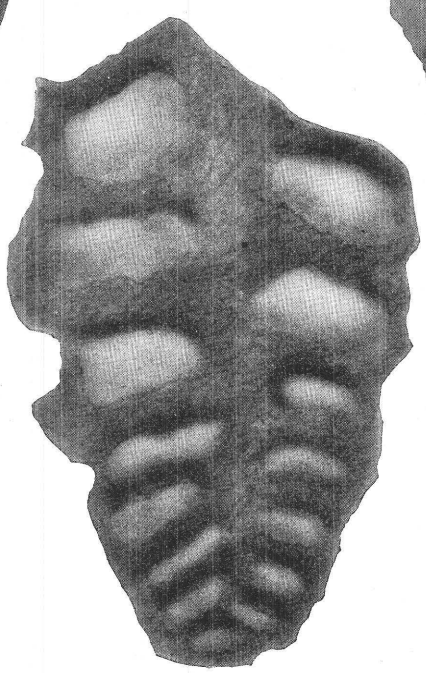

4

FORAMINIFERA OF THE BYRAM MARL.

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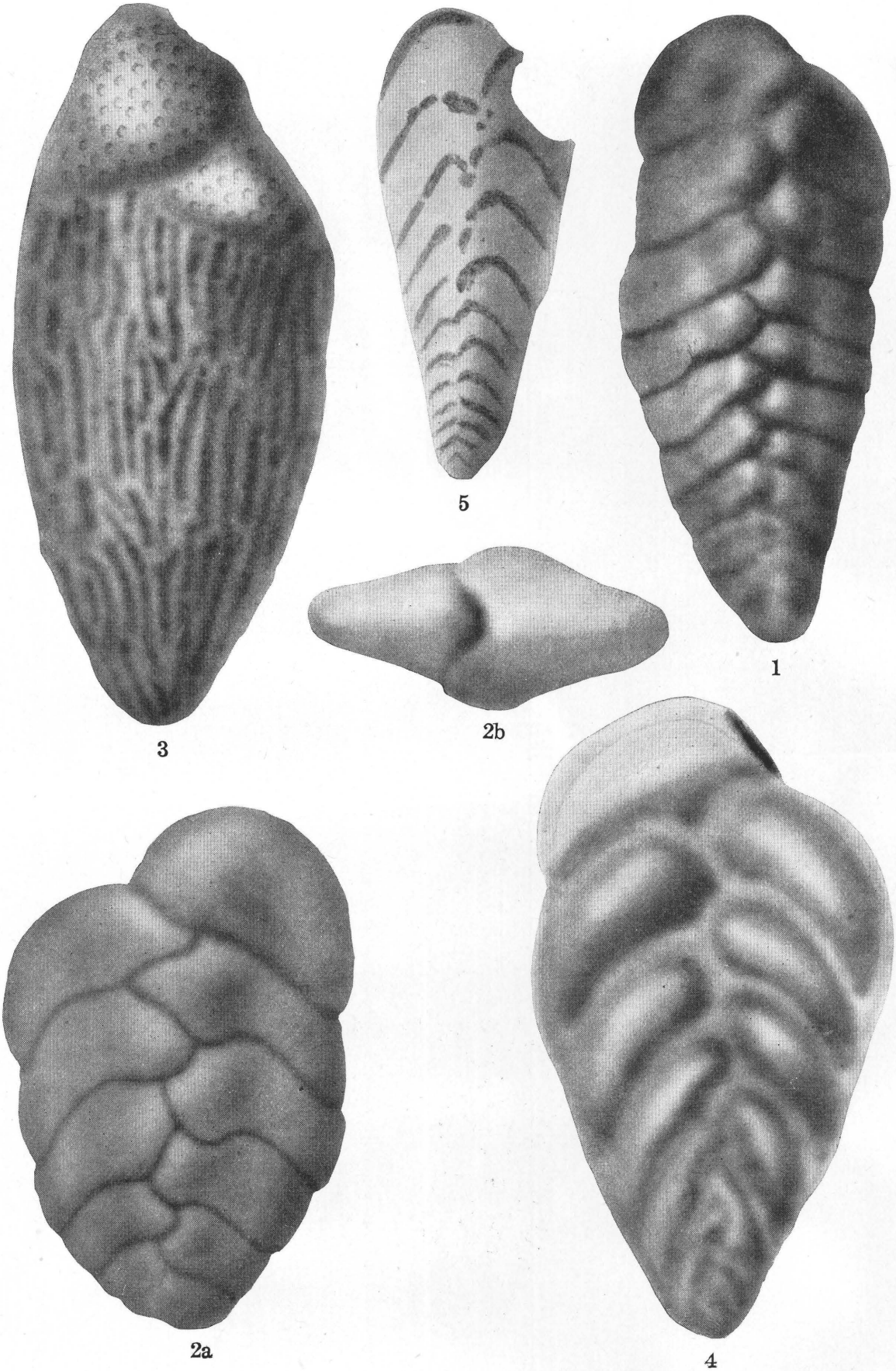

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2b

2a

4

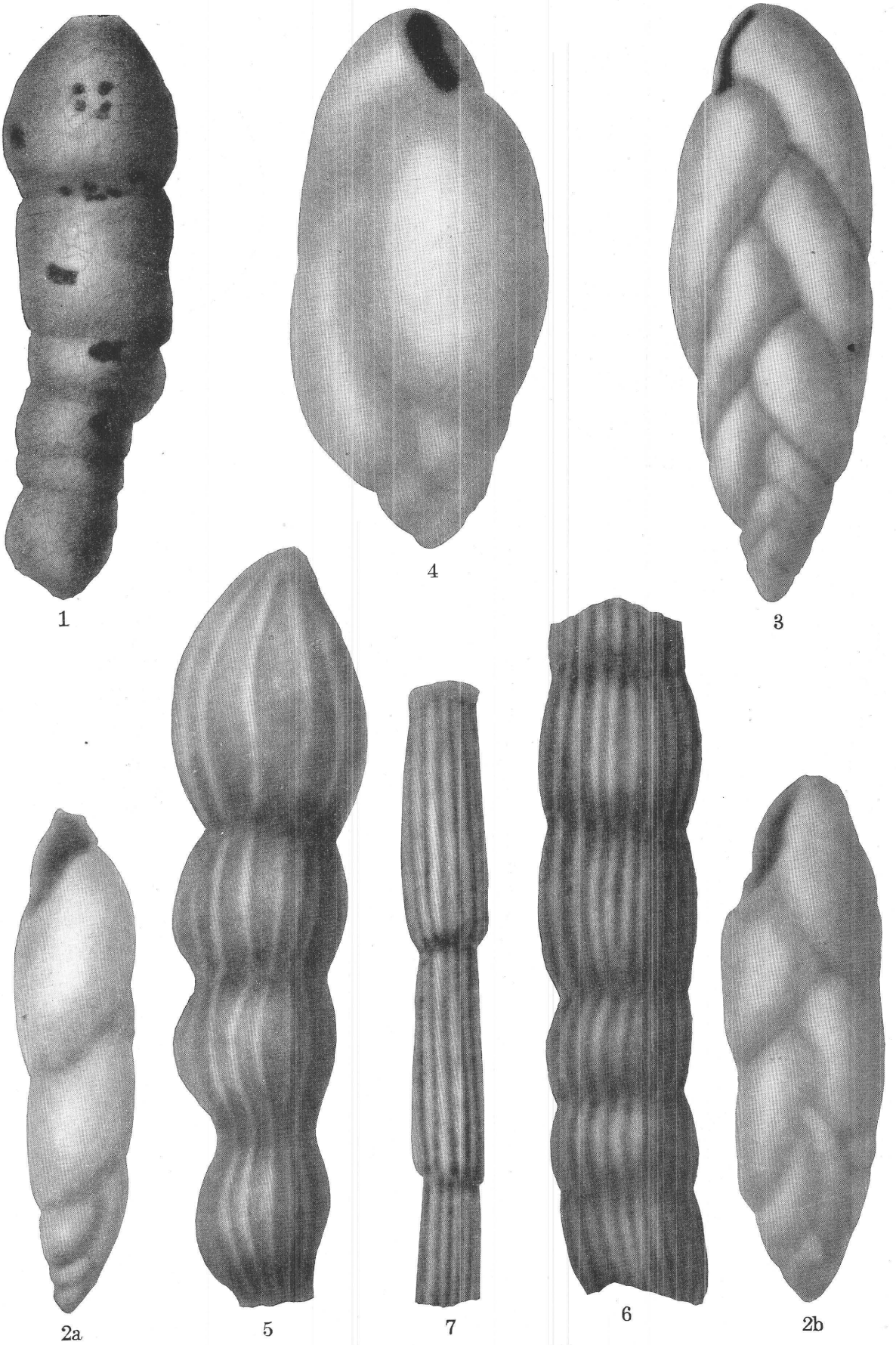
FORAMINIFERA OF THE BYRAM MARL.

PLATE XV.

FIGURE 1. *Textularia tumidulum* Cushman, n. sp. Front view of adult showing central tumid area. × 25.
2. *Textularia tumidulum* Cushman, n. sp. *a*, Front view; *b*, apertural view of young specimen. × 40.
3. *Bolivina amygdalaeformis* H. B. Brady. Front view, showing the anastomosing ornamentation of the early portion and the coarsely pitted last chambers. × 120.
4. *Bolivina nitida* H. B. Brady. Front view. × 120.
5. *Bolivina mississippiensis* Cushman, n. sp. Front view. × 160.

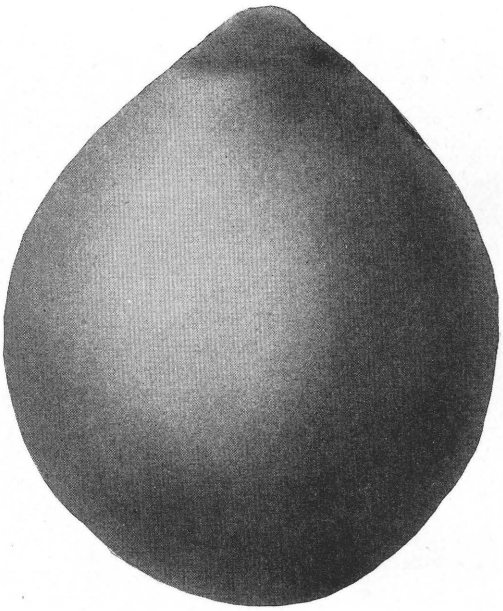
PLATE XVI.

FIGURE 1. *Clavulina byramensis* Cushman, n. sp. Front view. × 30.
2. *Virgulina* sp.? *a*, Side view; *b*, front view. × 120.
3. *Virgulina* sp.? Front view of another specimen. × 120.
4. *Bulimina ovata* D'Orbigny? Front view. × 120.
5. *Nodosaria* sp. Incomplete specimen, with but four chambers, showing form and sculpture. × 60.
6. *Nodosaria* sp. Middle portion of an incomplete specimen with a different surface ornamentation from the preceding. × 100.
7. *Nodosaria?* sp.? Broken specimen of a *Nodosaria* or possibly the linear portion of an *Articulina*.



1 4 3 2a 5 7 6 2b

FORAMINIFERA OF THE BYRAM MARL.



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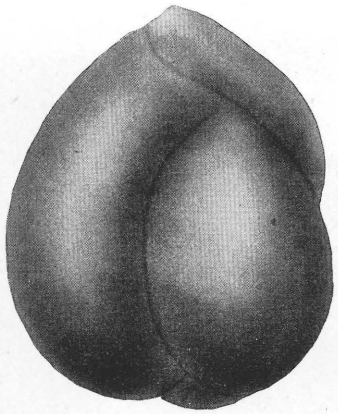

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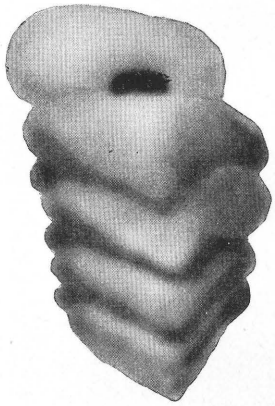

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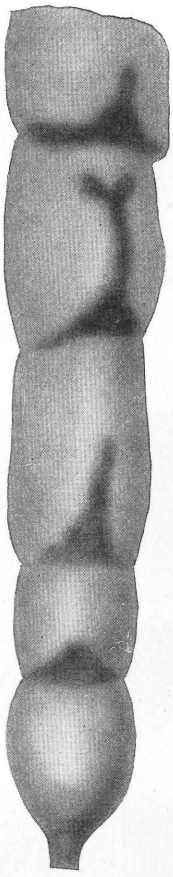

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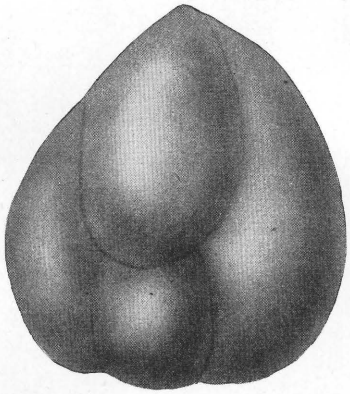

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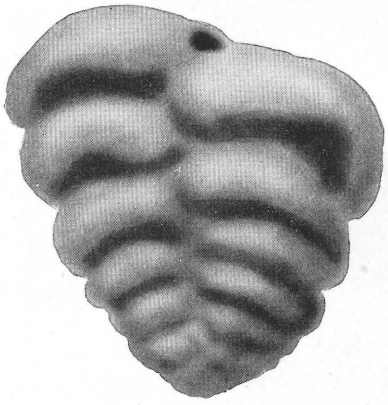

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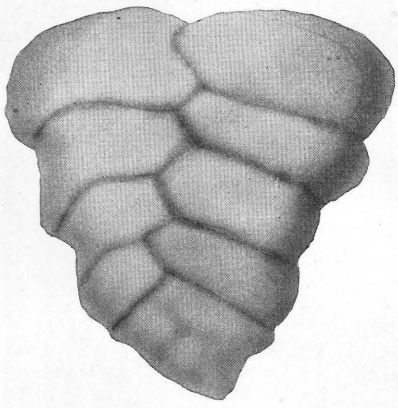

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FORAMINIFERA OF THE BYRAM MARL.

PLATE XVII.

FIGURE 1. *Vaginulina legumen* (Linnaeus) D'Orbigny var. *elegans* (D'Orbigny) Fornasini? Basal five chambers of an incomplete specimen. × 100.

2. *Polymorphina byramensis* Cushman, n. sp. *a*, View of one side; *b*, opposite side. × 60.

3. *Polymorphina gibba* D'Orbigny. Young specimen. × 120.

4. *Ehrenbergina glabrata* Cushman, n. sp. *a*, Ventral view; *b*, dorsal view; *c*, side view. × 120.

PLATE XVIII.

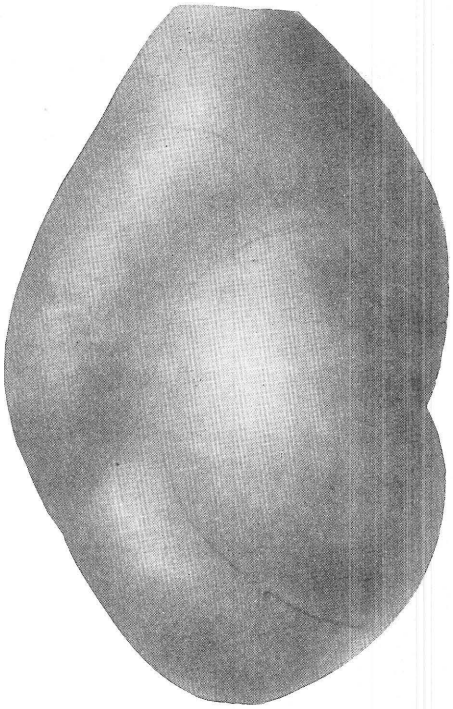
FIGURE 1. *Polymorphina problema* D'Orbigny? Front view. × 60.

2. *Polymorphina amygdaloides* Reuss. *a*, Front view; *b*, side view. × 80.

3. *Polymorphina gibba* D'Orbigny, fistulose form. *a*, Front view; *b*, opposite side. × 60.

4. *Polymorphina regina* H. B. Brady, Parker and Jones. Front view. × 40.

5. *Uvigerina byramensis* Cushman, n. sp. Front view of a specimen without fully developed last chambers. × 120.



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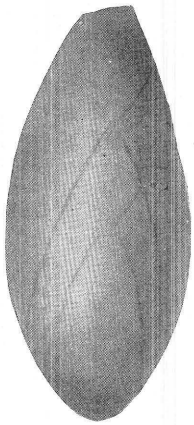

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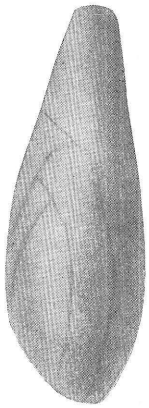

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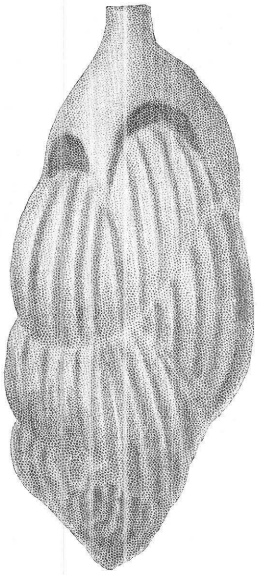

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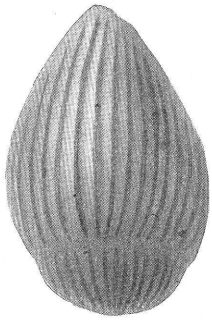

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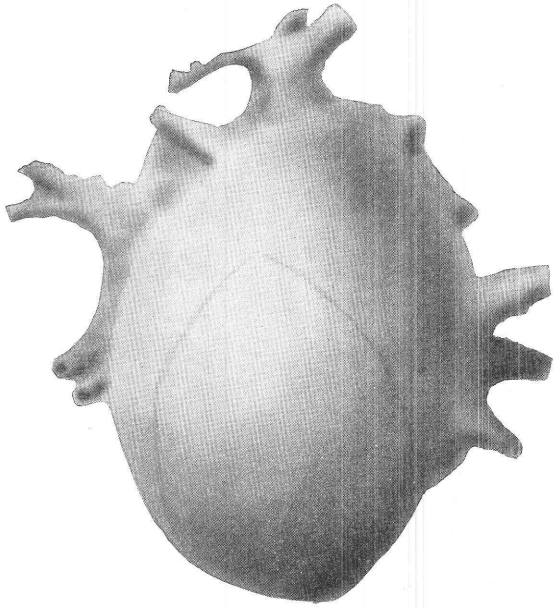

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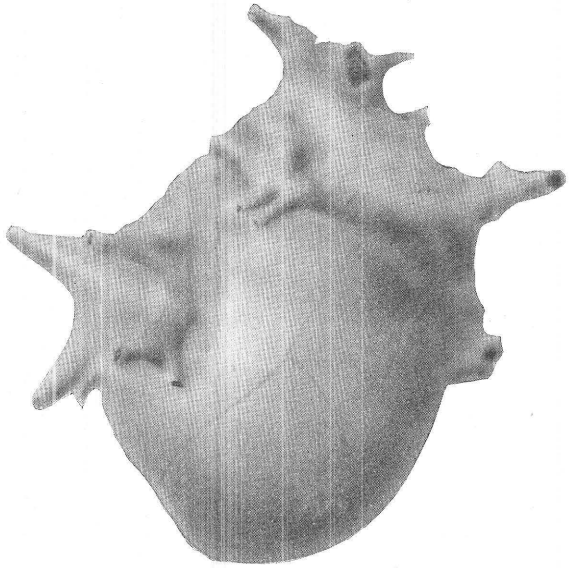

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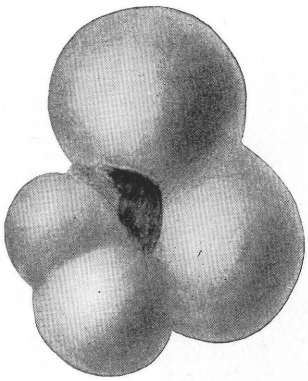
FORAMINIFERA OF THE BYRAM MARL.



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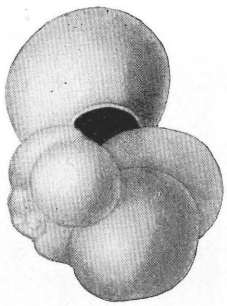

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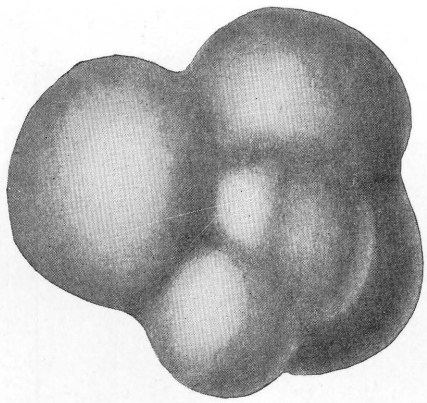

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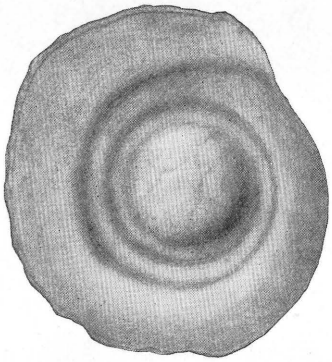

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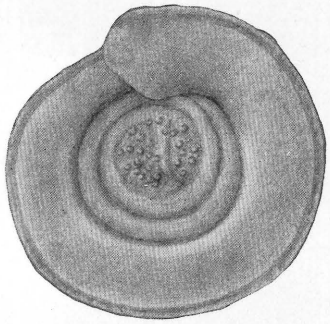

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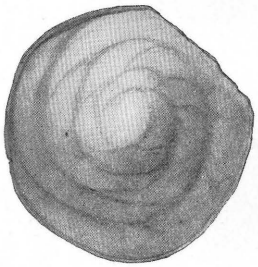

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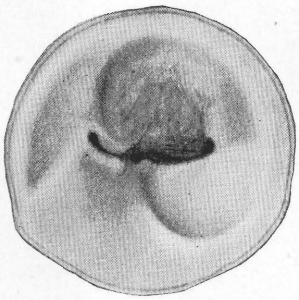

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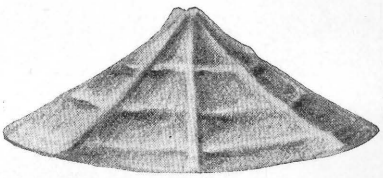

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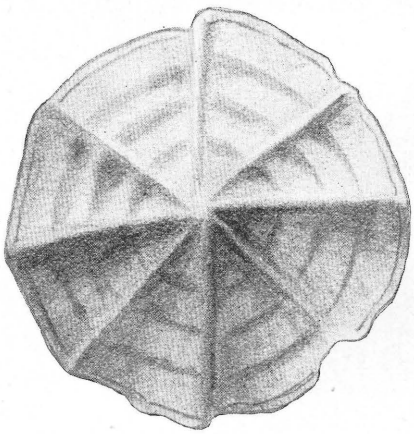

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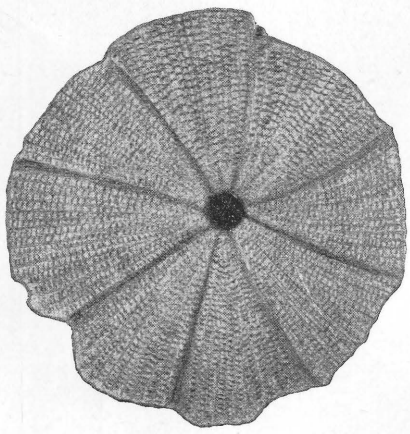

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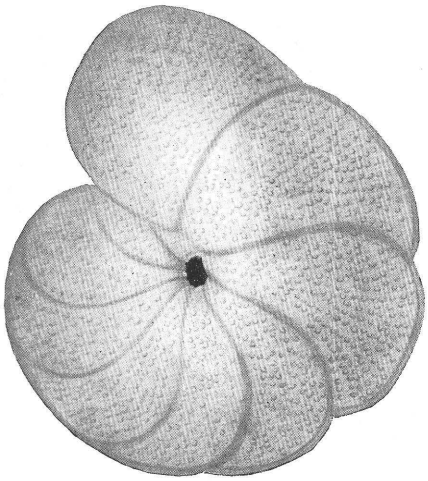
FORAMINIFERA OF THE BYRAM MARL.

PLATE XIX.

FIGURE 1. *Globigerina bulloides* D'Orbigny. Ventral view. × 80.
2. *Globigerina bulloides* D'Orbigny. Apertural view of another specimen. × 80.
3. *Globigerina bulloides* D'Orbigny. Dorsal view of another specimen. × 80.
4. *Spirillina subdecorata* Cushman, n. sp. Dorsal view. × 80.
5. *Spirillina subdecorata* Cushman, n. sp. Ventral view. × 80.
6. *Discorbis byramensis* Cushman, n. sp. Dorsal view. × 100.
7. *Discorbis byramensis* Cushman, n. sp. Side view. × 100.
8. *Discorbis byramensis* Cushman, n. sp. Ventral view. × 100.
9. *Discorbis orbicularis* (Terquem) Berthelin. Dorsal view. × 80.
10. *Discorbis orbicularis* (Terquem) Berthelin. Ventral view of another specimen.

PLATE XX.

FIGURE 1. *Truncatulina lobatula* (Walker and Jacob) D'Orbigny. Ventral view. × 80.
2. *Truncatulina lobatula* (Walker and Jacob) D'Orbigny. Apertural view of another specimen.
3. *Truncatulina lobatula* (Walker and Jacob) D'Orbigny. Dorsal view of another specimen. × 80.
4. *Truncatulina byramensis* Cushman, n. sp. Dorsal view. × 80.
5. *Truncatulina byramensis* Cushman, n. sp. Apertural view of another specimen. × 80.
6. *Truncatulina byramensis* Cushman, n. sp. Ventral view of a young specimen, showing the peculiar lobes at the base of the chambers.
7. *Truncatulina americana* Cushman, n. sp. Ventral view. × 80.
8. *Truncatulina americana* Cushman, n. sp. Dorsal view of another specimen. × 80.
9. *Truncatulina pseudoungeriana* Cushman, n. sp. Ventral view. × 100.



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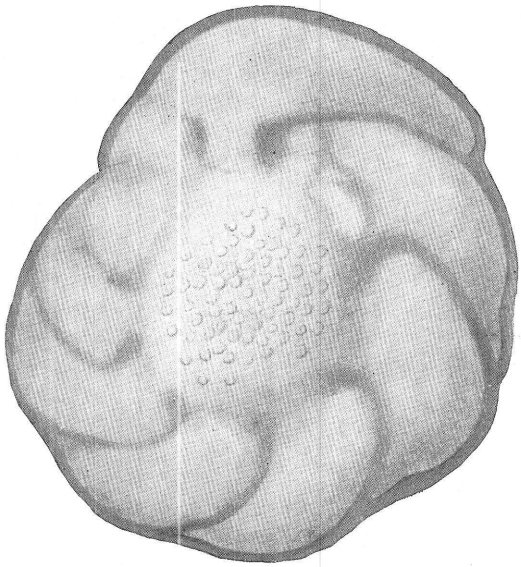

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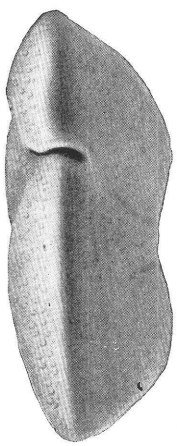

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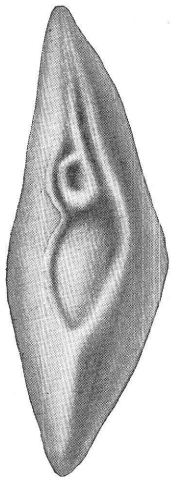

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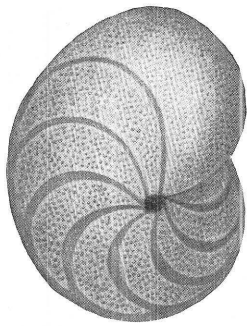

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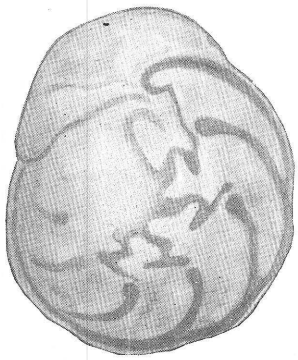

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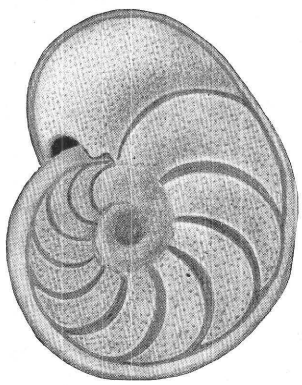

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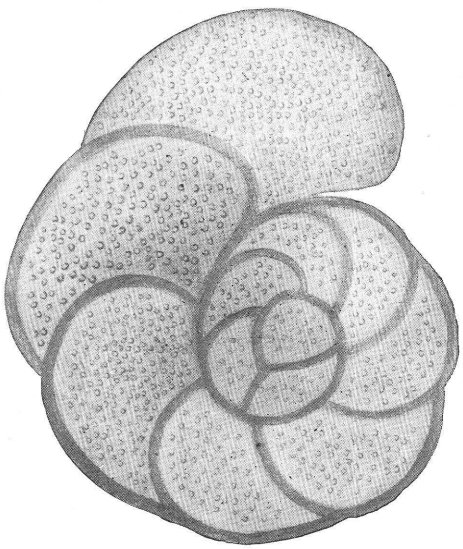

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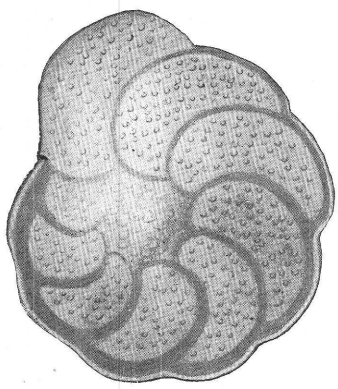

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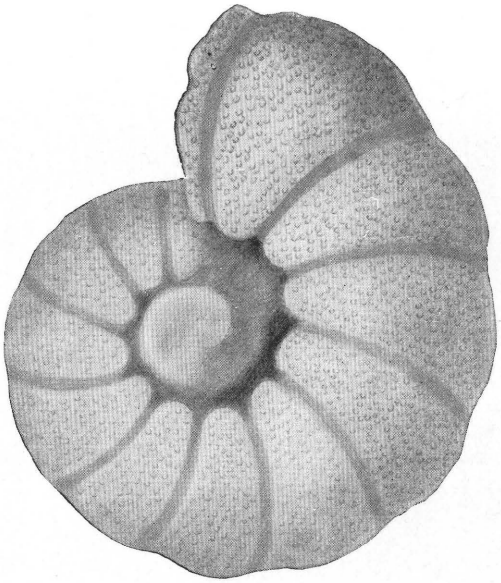
FORAMINIFERA OF THE BYRAM MARL.



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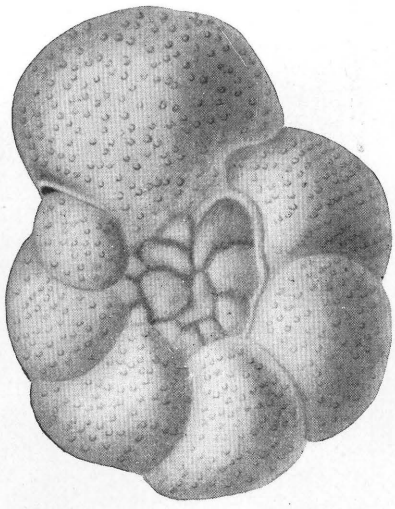

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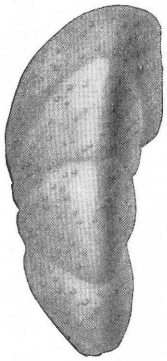

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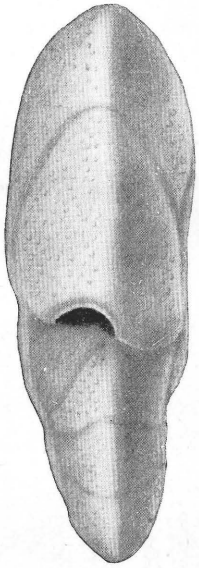

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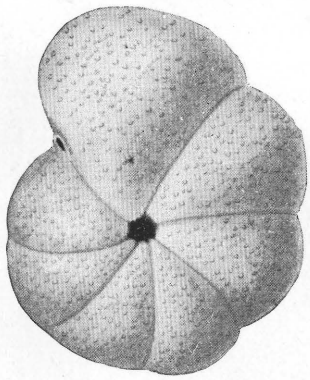

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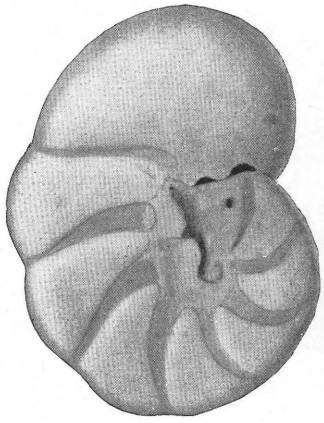

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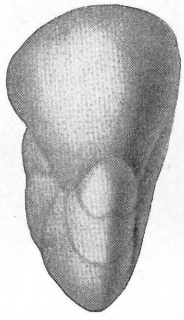

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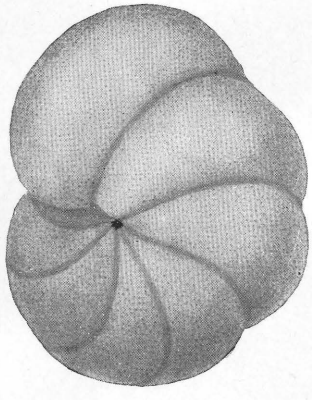

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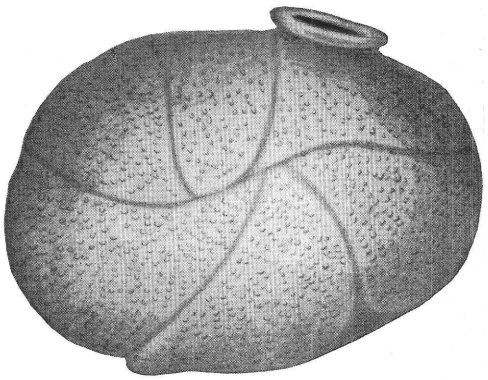
FORAMINIFERA OF THE BYRAM MARL.

PLATE XXI.

FIGURE 1. *Anomalina bilateralis* Cushman, n. sp. Dorsal view. × 80.
2. *Anomalina bilateralis* Cushman, n. sp. Apertural view of another specimen. × 80.
3. *Anomalina grosserugosa* (Gümbel) H. B. Brady? var. Dorsal view. × 80.
4. *Anomalina grosserugosa* (Gümbel) H. B. Brady? var. Apertural view of another specimen. × 80.
5. *Anomalina grosserugosa* (Gümbel) H. B. Brady? var. Ventral view of another specimen. × 80.
6. *Anomalina mississippiensis* Cushman, n. sp. Ventral view. × 80.
7. *Anomalina mississippiensis* Cushman, n. sp. Apertural view of another specimen. × 80.
8. *Anomalina mississippiensis* Cushman, n. sp. Dorsal view of another specimen. × 80.

PLATE XXII.

FIGURE 1. *Siphonina advena* Cushman, n. sp. Side view. × 80.
2. *Siphonina advena* Cushman, n. sp. Apertural view of another specimen. × 80.
3. *Gypsina rubra* D'Orbigny. Dorsal view. × 80.
4. *Pulvinulina byramensis* Cushman, n. sp. Ventral view. × 40.
5. *Pulvinulina byramensis* Cushman, n. sp. Dorsal view. × 40.
6. *Pulvinulina glabrata* Cushman, n. sp. Dorsal view. × 80.
7. *Pulvinulina glabrata* Cushman, n, sp. Ventral view of a larger specimen, showing the smooth polished surface of the ventral side. × 80.
8. *Pulvinulina advena* Cushman, n. sp. Dorsal view. × 100.



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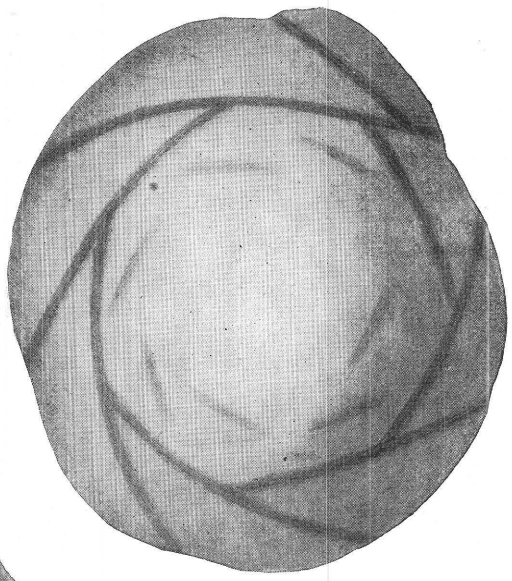

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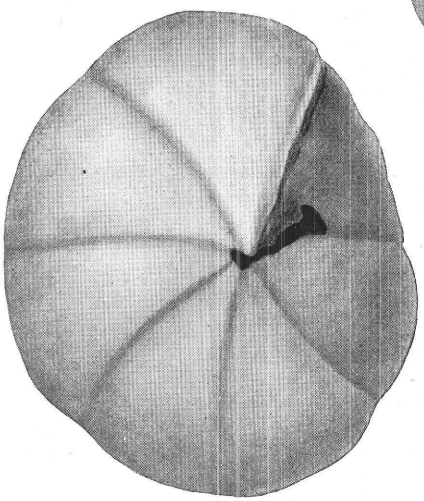

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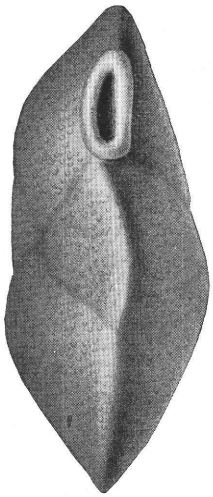

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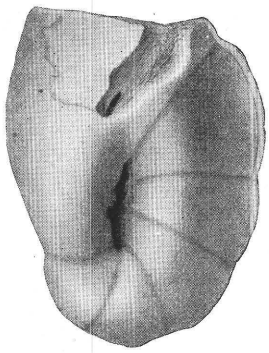

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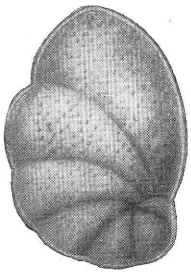

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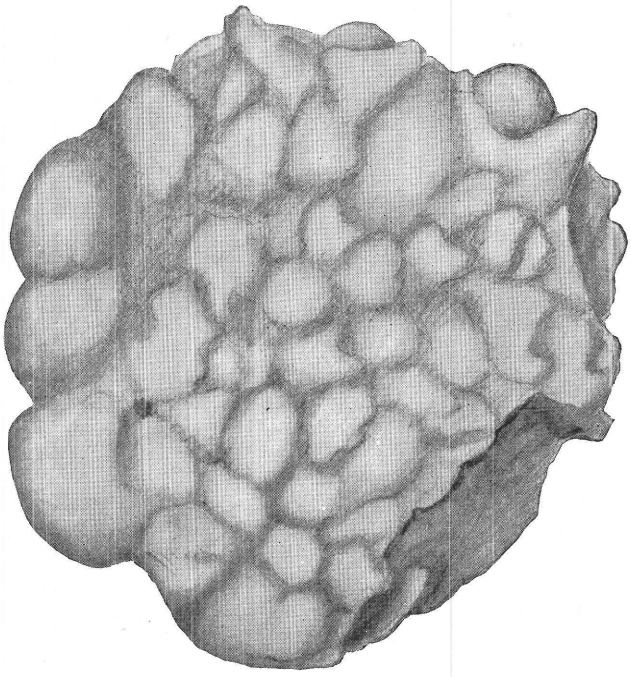

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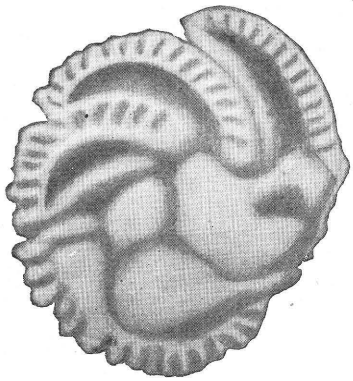

8

FORAMINIFERA OF THE BYRAM MARL.

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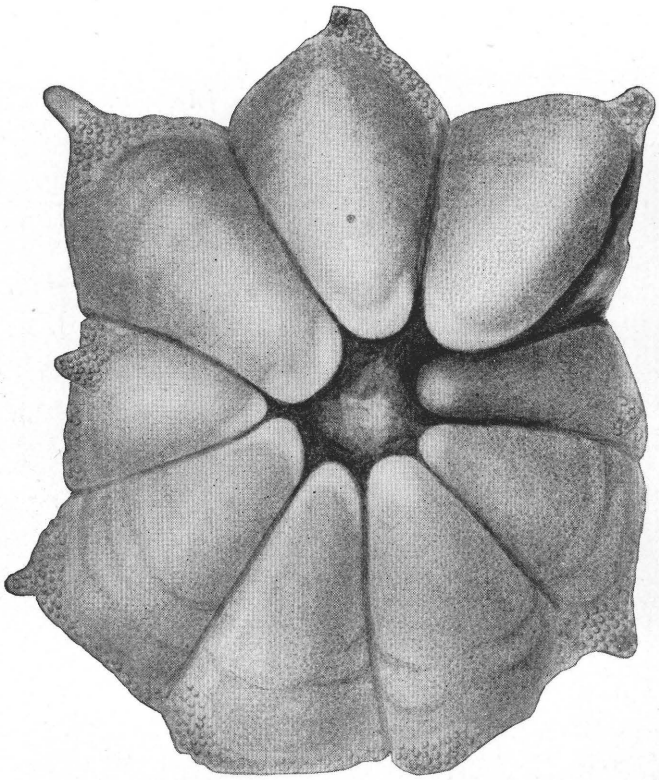

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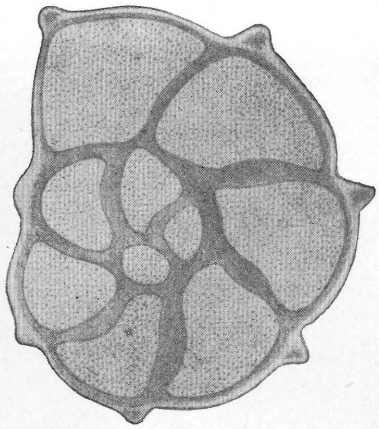

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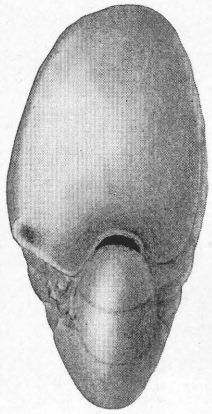

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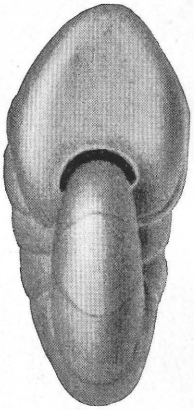

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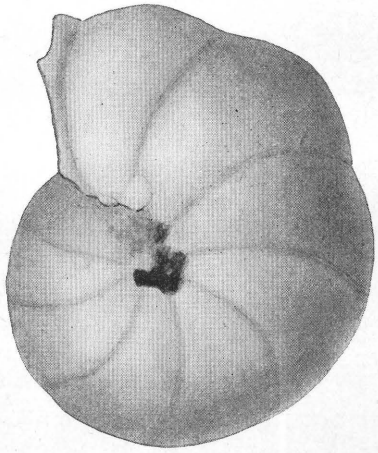

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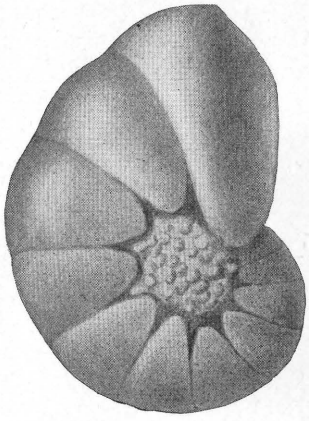

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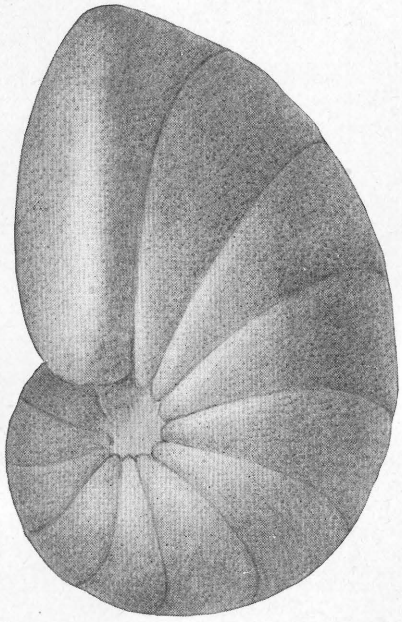


7

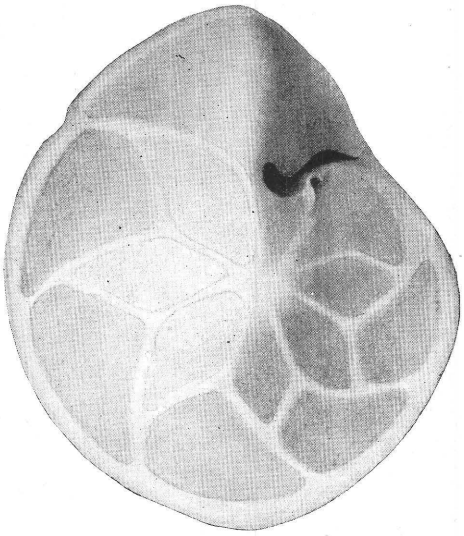
FORAMINIFERA OF THE BYRAM MARL.

PLATE XXIII.

FIGURE 1. *Rotalia byramensis* Cushman, n. sp. Ventral view. × 80.
2. *Rotalia dentata* Parker and Jones? Dorsal view. × 80.
3. *Nonionina umbilicatula* (Montagu) Parker, Jones, and H. B. Brady. Side view. × 80.
4. *Nonionina umbilicatula* (Montagu) Parker, Jones, and H. B. Brady. Apertural view ofa nother specimen. × 80.
5. *Nonionina scapha* (Fichtel and Moll) Parker and Jones. Apertural view. × 80.
6. *Nonionina scapha* (Fichtel and Moll) Parker and Jones. Side view of another specimen. × 80.
7. *Nonionina scapha* (Fichtel and Moll) Parker and Jones. Side view of a larger, more elongate specimen. × 80.

PLATE XXIV.

FIGURE 1. *Asterigerina subacuta* Cushman, n. sp. Ventral view. × 80.
2. *Asterigerina subacuta* Cushman, n. sp. Dorsal view of a small specimen. × 80.
3. *Asterigerina subacuta* Cushman, n. sp. Side view of another specimen showing the general shape. × 80.
4. *Nummulites* sp. Side view of a somewhat eroded specimen. × 40.



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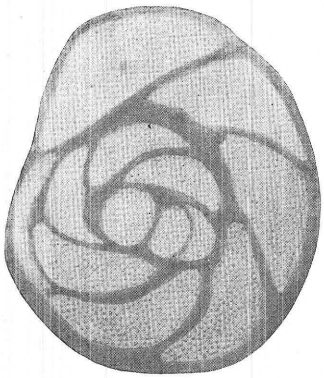

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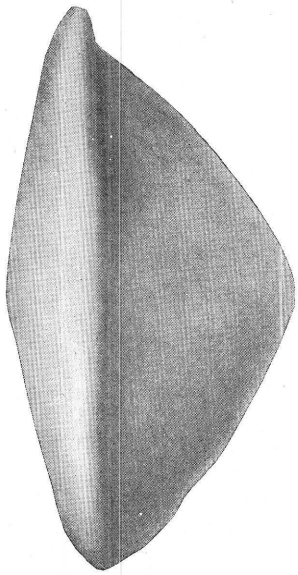

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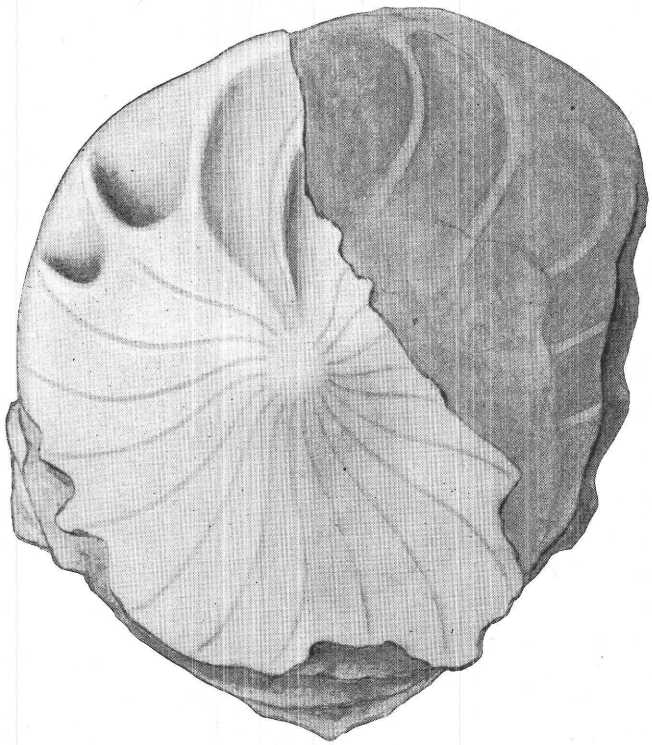

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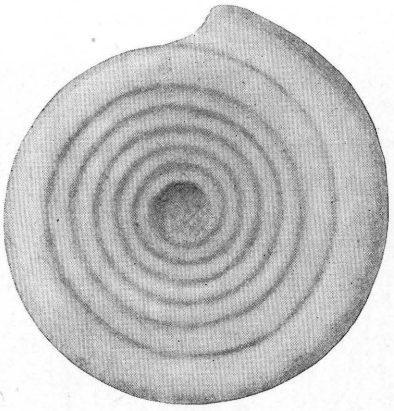
FORAMINIFERA OF THE BRYAM MARL.



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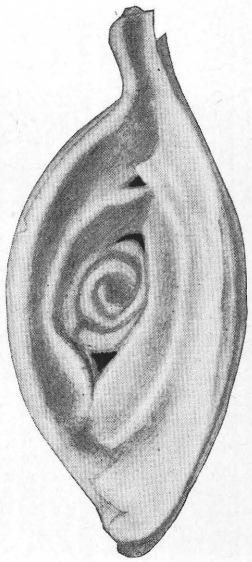

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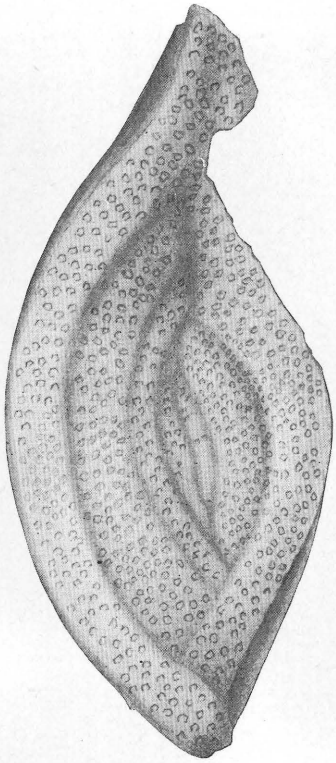

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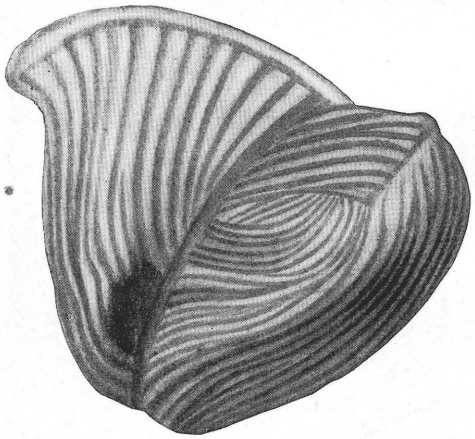

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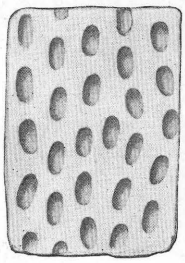

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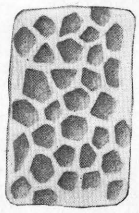

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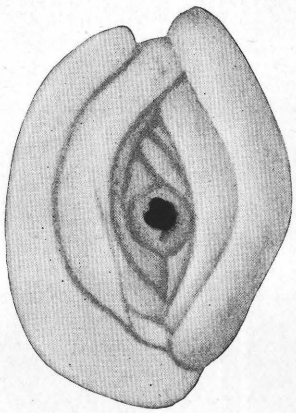

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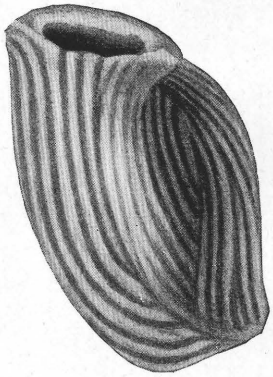

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7

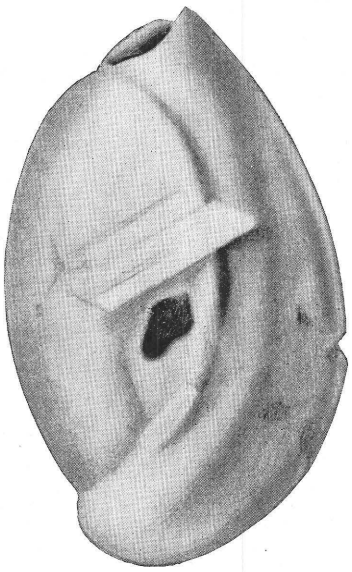
FORAMINIFERA OF THE BRYAM MARL.

PLATE XXV.

FIGURE 1. *Cornuspira involvens* Reuss. Side view. × 100.
2. *Spiroloculina grateloupi* D'Orbigny. Side view. × 80.
3. *Spiroloculina imprimata* Cushman, n. sp. *a*, Side view. × 40. *b*, Surface detail. × 200.
4. *Spiroloculina byramensis* Cushman, n. sp. *a*, Side view of a partly broken specimen. × 40. *b*, Surface detail. × 200.
5. *Vertebralina advena* Cushman, n. sp. Side view of an adult specimen. × 80.
6. *Vertebralina advena* Cushman, n. sp. Side view of a young specimen. × 80.
7. *Vertebralina* sp.? Side view showing ornamentation. × 80.

PLATE XXVI.

FIGURE 1. *Quinqueloculina cuvieriana* D'Orbigny. Side view. × 80.
2. *Quinqueloculina bicostata* D'Orbigny. Side view. × 80.
3. *Quinqueloculina bicostata* D'Orbigny. Apertural view of a third specimen. × 80.
4. *Quinqueloculina bicostata* D'Orbigny. Opposite side of another specimen. × 80.
5. *Quinqueloculina venusta* Karrer? var. Side view. × 80.
6. *Quinqueloculina* sp.? Side view. × 40.



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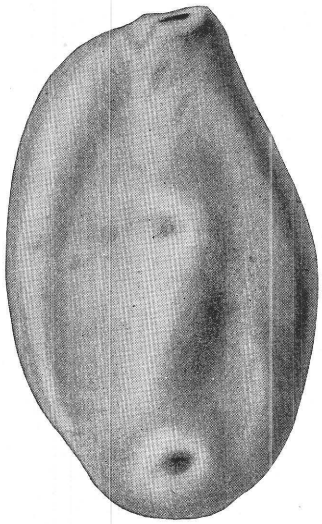

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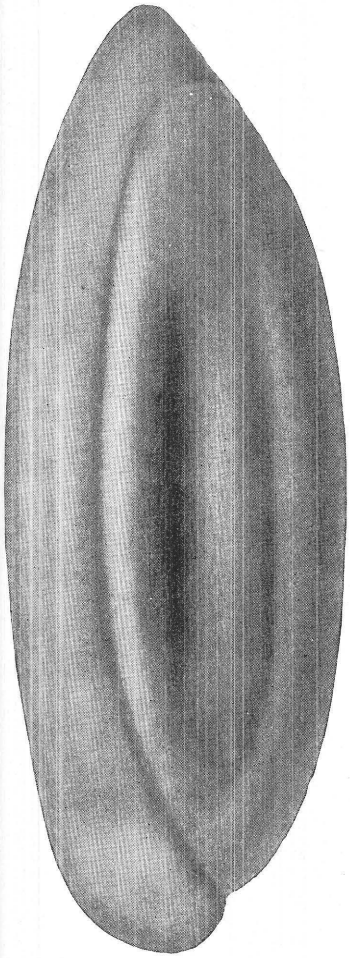

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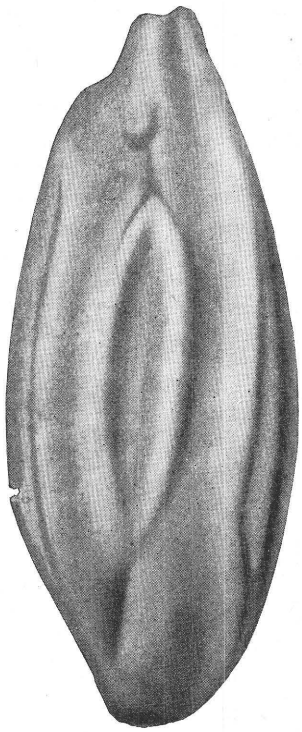

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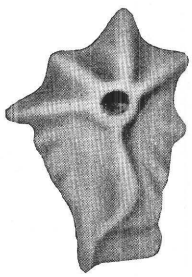

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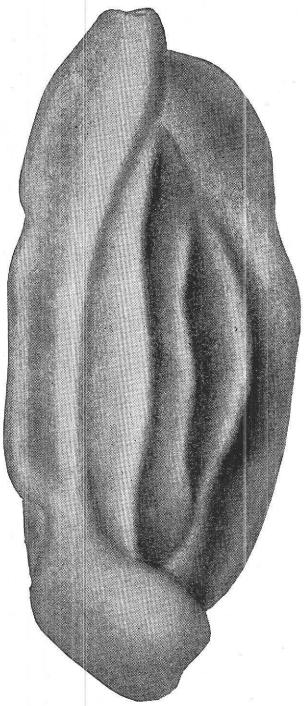

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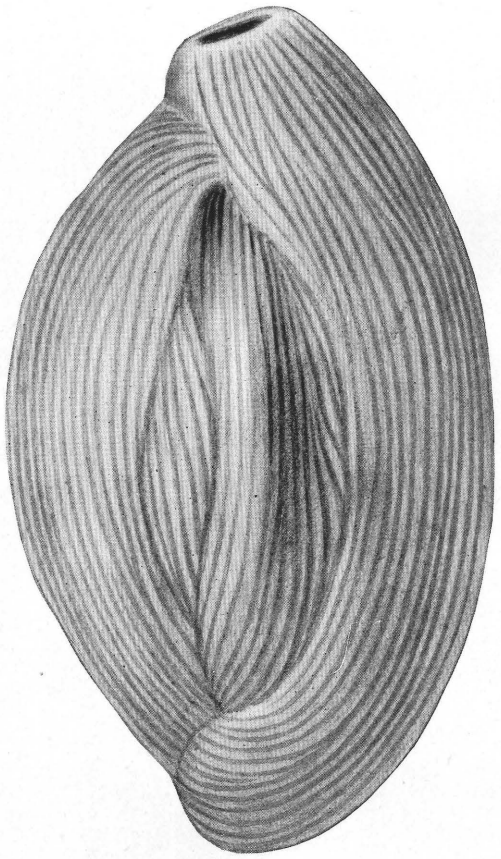
FORAMINIFERA OF THE BRYAM MARL.



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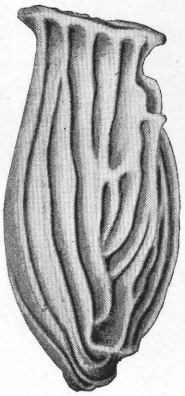

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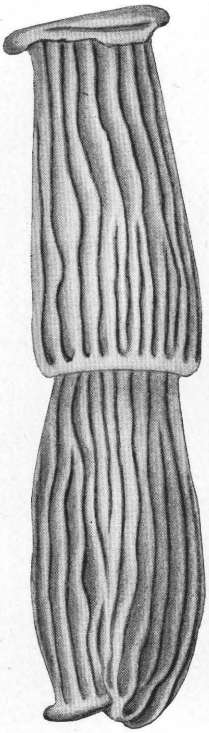

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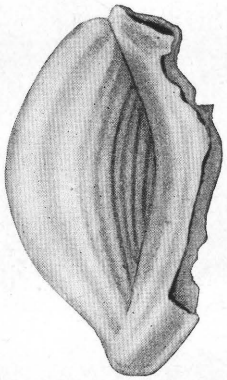

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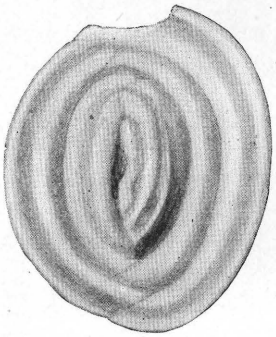

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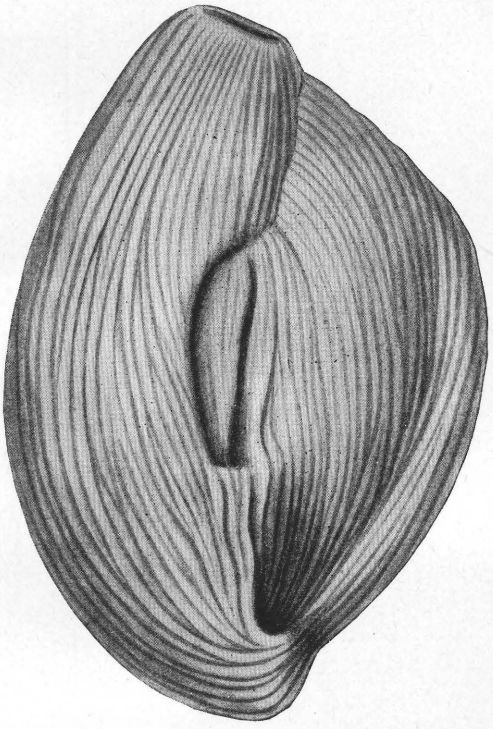


2

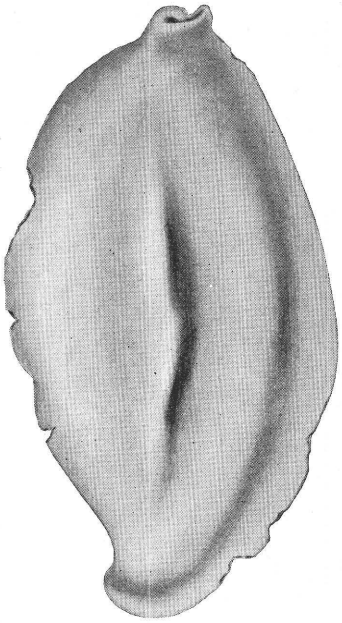
FORAMINIFERA OF THE BRYAM MARL.

PLATE XXVII.

FIGURE 1. *Quinqueloculina crassa* D'Orbigny. Side view. × 80.
2. *Quinqueloculina crassa* D'Orbigny. Opposite side of another specimen. × 80.
3. *Hauerina fragilissima* Brady. Side view. × 80.
4. *Hauerina* sp. Side view of a broken specimen showing peculiar pitted ornamentation of the surface. × 80.
5. *Articulina byramensis* Cushman, n. sp. Side view of specimen which has not yet reached the adult stage. × 80.
6. *Articulina byramensis* Cushman, n. sp. Side view of adult specimen. × 80.

PLATE XXVIII.

FIGURE 1. *Massilina crusta* Cushman, n. sp. Side view. × 40.
2. *Massilina occlusa* Cushman, n. sp. Side view. × 80.
3. *Triloculina oblonga* (Montagu) D'Orbigny. Side view. × 80.
4. *Triloculina oblonga* (Montagu) D'Orbigny. Opposite side of another specimen. × 80.
5. *Biloculina* sp.? Apertural view, showing aperture and tooth. × 40.
6. *Biloculina* sp.? Side view of another specimen. × 40.



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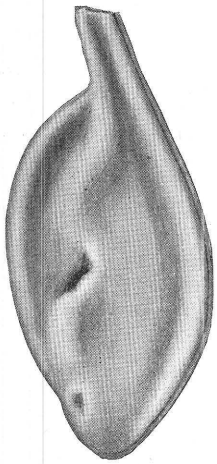

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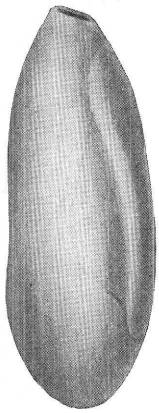

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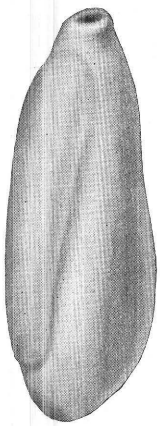

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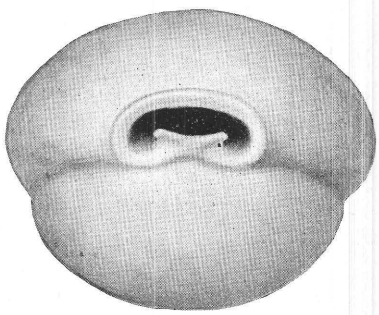

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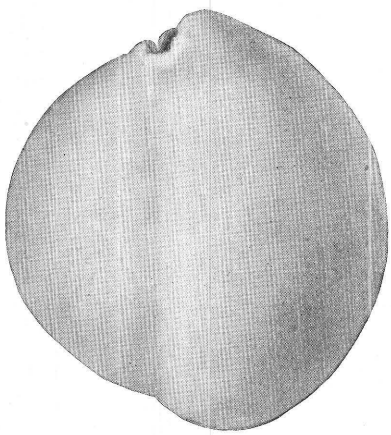


6

FORAMINIFERA OF THE BRYAM MARL.

THE FORAMINIFERA OF THE MINT SPRING CALCAREOUS MARL MEMBER OF THE MARIANNA LIMESTONE.

By JOSEPH A. CUSHMAN.

INTRODUCTION.

The Mint Spring calcareous marl member of the Marianna limestone, a lower Oligocene series of beds of the Coastal Plain region, was defined by C. Wythe Cooke[1] as follows:

The "chimney rock" facies of the Marianna limestone is replaced in western Mississippi by sands and shell marls for which the name Mint Spring calcareous marl is here proposed. The name is derived from Mint Spring Bayou, a small stream entering Centennial Lake just south of the National Cemetery at Vicksburg. The strata to which the name is applied are exposed beneath a waterfall in the lower course of the stream.

Between Vicksburg and Pearl River the Mint Spring marl occupies the entire interval between the Forest Hill sand and the Glendon limestone, but east of Pearl River it is overlain by a thickening wedge of the Marianna "chimney rock." It has not been recognized east of Chickasawhay River, on which it is exposed 1¼ miles northwest of the mouth of Limestone Creek. Other important exposures are along Glass Bayou at Vicksburg and at Haynes Bluff, 14 miles north of Vicksburg, where it is 25 feet thick.

The type station may be taken as U. S. G. S. station 6452, shell and sand bed at foot of high waterfall, Mint Spring Bayou, Vicksburg, Miss.; C. W. Cooke, collector.

The other stations represented in the collections here described are as follows:

6451. Same locality as station 6452; E. N. Lowe and C. W. Cooke, collectors.

6447, 6448. Foot of a high waterfall in Glass Bayou, near Vicksburg, Miss.

6647. Chickasawhay River 1¼ miles northwest of Limestone Creek, 4 miles northwest of Waynesboro, and 1¼ miles southwest of Boice, Wayne County, Miss.; C. W. Cooke, collector.

7671. "Brown's Cave," east bluff of Leaf River half a mile above the bridge on Bay Springs-Raleigh road, in sec. 13, T. 2 N., R. 8 E., Smith County, Miss.; C. W. Cooke, collector.

The distribution of the species at these stations and of those species which also occur in the younger Byram calcareous marl at its type station is indicated in the accompanying table.

As noted in my paper on the Byram marl,[2] many of the species are closely related to those now found living in the Indo-Pacific region. An added example of this relation is *Spirillina limbata* H. B. Brady var. *bipunctata* Cushman, n. var., which is a variety in the Mint Spring marl of a species that is characteristic of the Indo-Pacific.

The fauna evidently represents more than a shoal-water deposit, as it lacks certain of the genera present in the Byram marl which indicate shallow water and has a greater abundance of species which indicate deeper water. The occurrence of numerous Lagenidae indicates a depth of perhaps 50 fathoms, and the lack of such genera as *Heterostegina*, *Operculina*, and *Amphistegina* indicates a depth of more than 20 or 30 fathoms. This statement is based on data obtained from a study of Foraminifera in the Tortugas region in the Gulf of Mexico as well as of their distribution in the Philippine region.

A systematic treatment of the species follows.

[1] Washington Acad. Sci. Jour., vol. 8, No. 7, p. 195, 1918.

[2] U. S. Geol. Survey Prof. Paper 129-E, 1922.

Distribution of Foraminifera of the Mint Spring marl and Byram marl.

	Mint Spring marl.						Byram marl.
	6452	6451	6447	6448	6647	7671	6455
Textularia tumidulum Cushman	×	×	×	×		×	×
mississippiensis Cushman	×	×	×	×	×	×	×
subhauerii Cushman					×		×
Bolivina cf. B. punctata D'Orbigny		×					
cookei Cushman, n. sp			×		×	×	
vicksburgensis Cushman, n. sp		×					
frondea Cushman, n. sp					×		
Verneuilina rectimargo Cushman, n. sp	×	×	×	×			
Gaudryina triangularis Cushman						×	
sp. ?		×					
Bulimina pupoides D'Orbigny					×	×	
Buliminella subteres H. B. Brady var. angusta Cushman, n. var	×		×		×	×	
contraria (Reuss)					×		
Cassidulina crassa D'Orbigny		×	×				
Lagena laevigata (Reuss)		×					
striata (D'Orbigny) var. substriata Williamson						×	
orbignyana (Seguenza) var. flintii Cushman, n. var.			×				
hexagona (Williamson)	×						
Nodosaria communis D'Orbigny		×				×	
filiformis D'Orbigny				×		×	
obliqua (Linnaeus)	×				×	×	?
sp. ?						×	
Cristellaria convergens Bornemann					×	×	
cultrata (Montfort)						×	
rotulata (Lamarck)						×	
vicksburgensis Cushman, n. sp					×	×	×
Vaginulina legumen (Linnaeus) var. elegans (D'Orbigny)			×				×
Polymorphina byramensis Cushman	×	×	×	×	×	×	×
regina H. B. Brady, Parker, and Jones	×			×		×	×
problema D'Orbigny	×				×	×	×
gibba D'Orbigny		×	×		×	×	×
amygdaloides Reuss?	×	×	×	×		×	×
equalis D'Orbigny		×		×			
advena Cushman, n. sp		×					
cuspidata H. B. Brady			×				
var. costulata Cushman, n. sp	×						
vicksburgensis Cushman, n. sp		×		×			
spinosa (D'Orbigny)		×	×		×	×	
Uvigerina byramensis Cushman	×	×	×		×	×	×
pigmea D'Orbigny	×		×		×	×	
Globigerina bulloides D'Orbigny	×	×	×			×	×
dutertrei D'Orbigny		×			×	×	
Spirillina limbata H. B. Brady var. bipunctata Cushman, n. var	×	×	×		×	×	
Patellina advena Cushman, n. sp	×						
Discorbis auracana (D'Orbigny)			×				
bertheloti (D'Orbigny)	×	×					
Truncatulina lobatula (Walker and Jacob)	×	×		×	×	×	×
byramensis Cushman	×	×	×	×			×
americana Cushman, var	×	×	×	×			×
pseudoungeriana Cushman		×	×		×	×	×
vicksburgensis Cushman, n. sp				×			
Anomalina bilateralis Cushman		×		×	×	×	×
mississippiensis Cushman	×	×	×	×	×	×	×
vicksburgensis Cushman, n. sp	×						
Siphonia advena Cushman	×	×	×	×	×	×	×
Gypsina rubra (D'Orbigny)	×				×	×	×
Pulvinulina byramensis Cushman	×	×	×	×	×	×	×
glabrata Cushman	×	×		×		×	×
Rotalia byramensis Cushman			×	×			×
dentata Parker and Jones var. parva Cushman, n. var	×	×	×	×			
vicksburgensis Cushman, n. sp	×	×		×	×	×	
Nonionina umbilicatula (Montagu)	×		×	×	×	×	×
scapha (Fichtel and Moll)	×	×	×	×		×	×
advena Cushman, n. sp			×		×		
Cornuspira involvens (Reuss)	×	×	×				×

Distribution of Foraminifera of the Mint Spring marl and Byram marl—Continued.

	Mint Spring marl.						Byram marl.
	6452	6451	6447	6448	6647	7671	6455
Spiroloculina imprimata Cushman		×					×
antillarum D'Orbigny	×	×					
Vertebralina sp. ?		×					
Quinqueloculina bicostata D'Orbigny		×		×			×
cuvieriana D'Orbigny	×		×				×
vicksburgensis Cushman, n. sp			×				×
cookei Cushman, n. sp		×					
glabrata Cushman, n. sp	×	×	×				
lustra Cushman, n. sp				×			
tessellata Cushman, n. sp		×	×				
vulgaris D'Orbigny	×	×	×	×			
seminulum (Linnaeus)	×	×	×				
contorta D'Orbigny	×	×	×	×			
lamarckiana D'Orbigny			×				
Articulina byramensis Cushman	×	×					×
Massilina decorata Cushman, n. sp	×				×	×	
Triloculina peroblonga Cushman, n. sp		×					
sculpturata Cushman, n. sp		×	×				
Biloculina ornata D'Orbigny	×	×					

DESCRIPTIONS.

Family TEXTULARIIDAE.

Genus TEXTULARIA Defrance, 1824.

Textularia tumidulum Cushman.

Textularia tumidulum Cushman, U. S. Geol. Survey Prof. Paper 129, p. 89, pl. 15, figs. 1, 2a, 2b, 1922.

Test large, elongate, compressed, thickest in the central region, thence thinning toward the periphery, initial end rapidly broadening in the adult, the sides nearly parallel to a point near the apertural end, where the breadth of the test is often reduced; chambers numerous, in the adult about three times as wide as high, and often the last-formed chamber in old-age specimens somewhat distinctly set off from the others, the inner portion of each chamber much thicker than the other portions and in the rapid decrease in thickness often leaving a channel running lengthwise of the test between this central tumid area and the gradually sloping outer portion, usually well marked in adult specimens; sutures not very distinct; wall arenaceous, but smoothly finished. Length 2.5 millimeters or less.

This is the most common species of *Textularia* in the Mint Spring marl, occurring at the type station (6452, Mint Spring Bayou, Vicksburg, Miss.) and also at the following stations:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

There is a considerable variation in relative length and breadth in the two forms of the species, the megalospheric form being usually broader and shorter, the microspheric form narrower but longer. The species was originally described from specimens obtained in the Byram marl at Byram, Miss.

Textularia mississippiensis Cushman.

Textularia mississippiensis Cushman, U. S. Geol. Survey Prof. Paper 129, p. 90, pl. 14, fig. 4, 1922.

Test elongate, fairly broad, thickest in the middle, thence thinning toward the periphery, in end view biconvex, central portion curved; chambers rather low and broad, especially in the early stages, becoming higher in the adult and often less broad so that the later chambers in the adult make a test less wide than at earlier stages; sutures covered by a coarsely arenaceous layer meeting in the center and at the periphery, leaving the central portion of each chamber uncovered; periphery irregular, not definitely or regularly spinose; chamber walls smooth and finely perforate. Length 0.40 to 0.75 millimeter.

This species, which was originally described from specimens obtained in the Byram marl at Byram, Miss, occurs at all six stations of the Mint Spring marl, as follows:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

The sutures are not always covered with a coarsely arenaceous layer but are typically so; this layer is often darker than the test and very distinct. Both megalospheric and microspheric forms occur. None of the specimens seem to have any definite regular spinose edge, and this is also true of the Byram specimens. The specimens in the Mint Spring marl seem to run slightly larger than those in the Byram marl; otherwise they are very similar.

Textularia subhauerii Cushman.

Textularia subhauerii Cushman, U. S. Geol. Survey Prof. Paper 129, p. 89, pl. 14, figs. 2a, 2b, 1922.

Test large, stout, elongate, early portion rapidly increasing in width with each newly added chamber, later adult portion with the sides nearly parallel, slightly lobulate; periphery rounded but the median portion nearly flat; chambers eighteen to twenty, increasing in height as added, those of the later portion nearly as high as broad, sutures usually rather indistinct; wall coarsely arenaceous but smoothly finished on the exterior; aperture at the base of the inner margin of the chamber. Length 2 millimeters or less.

The only station at which this species was obtained in the Mint Spring marl is station 6647 (Chickasawhay River 1¼ miles southwest of Boice, Miss.), at which there were numerous specimens. This is the only station of the six at which *Textularia tumidulum* did not occur. The specimens agree well with those from the Byram marl described in the paper cited.

Genus BOLIVINA D'Orbigny, 1839.

Bolivina cf. B. punctata D'Orbigny.

Test small, elongate, slightly tapering, composed of about twenty chambers; periphery slightly rounded; sutures distinct; wall finely punctate. Length about 0.25 millimeter.

A single specimen was obtained at station 6451, Mint Spring Bayou, Vicksburg, Miss. It is very small and in its general characters is like the recent material of the Gulf of Mexico which I have referred to *Bolivina punctata* D'Orbigny.

Bolivina cookei Cushman, n. sp.

Plate XXIX, figure 1.

Test elongate, tapering, the early portion with the periphery slightly rounded, thick, the later portion with the periphery subacute and the whole test broader and thinner: chambers numerous; sutures indistinct; surface of the earlier thickened portion ornamented by numerous fine longitudinal costae; later portion smooth but finely punctate. Length 0.25 to 0.35 millimeter.

Type specimen from station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss. Single specimens also occur at stations 6447 (Glass Bayou, Vicksburg, Miss.) and 7671 ("Brown's Cave," Leaf River, Miss.).

This is a small species but distinct in its general character. The last-formed portion differs from the early part in its broader form and smooth surface, the early part being much thicker and ornamented by fine longitudinal costae. Young specimens do not show the later characters.

The species is named for C. Wythe Cooke, of the United States Geological Survey, who has collected most of the material used in the present paper.

Bolivina vicksburgensis Cushman, n. sp.

Plate XXIX, figure 2.

Test elongate, tapering, apical end bluntly pointed, gradually increasing in breadth for several chambers, after which the sides are nearly parallel during the remainder of the growth: chambers distinct; sutures excavated; proximal angle of the periphery of each chamber somewhat projecting beyond the general line of the test, forming a serrate edge; chambers distinctly triangular; sutures oblique; surface with numerous punctations arranged generally in longitudinal lines. Length 0.45 millimeter.

Type specimen from station 6451, Mint Spring Bayou, Vicksburg, Miss. This species seems to be rare, not being found at any of the other stations. It is distinct from any others found in the Mint Spring marl or the Byram marl. It can be distinguished by the peculiar serrate periphery and the ornamentation.

Bolivina frondea Cushman, n. sp.

Plate XXIX, figure 3.

Test much compressed, broad, composed of several chambers, those of the early portion elongate, forming a narrow test, those of the adult extending back, forming a broad test similar to that seen in certain species of *Frondicularia*; sutures distinct; wall smooth; periph-

ery broadly rounded. Length slightly more than 1 millimeter.

Type specimen from station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

This is a very peculiar species which at first glance would be taken for the young of *Frondicularia,* but a further study shows that the chambers are alternating throughout, as in *Bolivina;* in some respects it remotely resembles *B. semialata* Bagg, which occurs off the Hawaiian Islands.

Genus VERNEUILINA D'Orbigny, 1840.

Verneuilina rectimargo Cushman, n. sp.

Plate XXIX, figures 4, 5.

Test elongate, triangular in cross section, early portion tapering, adult portion with the sides nearly parallel and straight; chambers numerous, arranged triserially; sutures not depressed, often slightly limbate; sides of the test flattened or very slightly concave; peripheral angles rounded; aperture slightly elongate at the base of the inner margin of the last-formed chamber; wall finely punctate. Length 1 millimeter or less.

Type specimen from station 6452, Mint Spring Bayou, Vicksburg, Miss. Specimens were also found in the Mint Spring marl at the following stations:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451. Mint Spring Bayou, Vicksburg, Miss.

This is a much longer species than *V. spinulosa glabrata,* which occurs in the Byram marl, and can be easily distinguished from it.

Genus GAUDRYINA D'Orbigny, 1839.

Gaudryina triangularis Cushman.

Gaudryina triangularis Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 65, figs. 104 a–c (in text), 1911; U. S. Nat. Mus. Bull. 103, p. 56, pl. 20, fig. 3, 1918; Carnegie Inst. Washington Pub. 291, p. 35, 1919.

Test slightly longer than broad, for the most part triangular, the angles rather acute, composed of a series of chambers triserially arranged, the later chambers rotund, biserially arranged, few in number; walls coarsely arenaceous, more or less smoothly finished; sutures plainly visible on the exterior; aperture narrow, between the inner border of the chamber and the preceding chamber; color gray. Length about 1 millimeter.

A single specimen from station 7671 ("Brown's Cave," Leaf River, Miss.) may belong to this species. It was originally described from specimens obtained off the Hawaiian Islands and is recorded as occurring near the Bonin Islands. I have also identified it in the Miocene marl from the gorge of Yumuri River, Matanzas, Cuba, and in the Oligocene from the lower part of the Culebra formation in the Canal Zone.

Gaudryina sp.?

Plate XXIX, figure 6.

There is a specimen from U. S. G. S. station 6451 (waterfall in Mint Spring Bayou, Vicksburg, Miss.; E. N. Lowe and C. W. Cooke, collectors) which is apparently a *Gaudryina,* but it is not well enough characterized for description.

Genus BULIMINA D'Orbigny, 1826.

Bulimina pupoides D'Orbigny.

Plate XXIX, figure 7.

Bulimina pupoides D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 185, pl. 11, figs. 13, 14, 1846.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 400, pl. 50, figs. 15*a*, *b*, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 80, figs. 132 a–c (in text), 1911.

Test ovate, broadest near the apertural end; apical end bluntly pointed, tapering; end view nearly circular; visible chambers numerous, much inflated; sutures rather deeply depressed; wall smooth; aperture long and narrow, with a narrow platelike tooth; color white. Length about 1 millimeter.

There are single specimens which may be referred to this species from the following stations:

6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

They are much longer than *B. ovata,* which occurs in the Byram marl.

Genus BULIMINELLA Cushman, 1911.

Buliminella subteres H. B. Brady var. angusta Cushman, n. var.

Plate XXIX, figures 8, 9.

Variety differing from the typical species in the more elongate, narrower shape of the test and the larger number of chambers; aperture elongate, nearly in the long axis of the test;

sutures not depressed, marked by darker lines of shell material. Length 0.6 millimeter.

Type specimen from station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss. It also occurred at these stations:

6447. Glass Bayou, Vicksburg, Miss.
6452. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

Specimens were very rare at all these stations. The typical form of the species occurs in the present oceans in the warmer parts of the Atlantic and in the Indo-Pacific. It has not been recorded as a fossil in the American Tertiary.

Buliminella contraria (Reuss) Cushman.

Rotalina contraria Reuss, Deutsch. geol. Gesell. Zeitschr., vol. 3, p. 76, pl. 5, fig. 37, 1851.
Buliminella contraria (Reuss) Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 89, figs. 143 a–c (in text), 1911.
Bulimina contraria (Reuss) H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 409, pl. 54, figs. 18 a-c, 1884.

Test coiled in a depressed spire, umbilicate, the chambers numerous, slightly inflated; sutures distinct, slightly depressed; wall smooth, calcareous; aperture distinctly bulimine, loop-like, rather long and narrow, extending to the umbilicus; color white. Length 0.65 millimeter.

There is a single specimen from station 6647 (Chickasawhay River 1¼ miles southwest of Boice, Miss.) which seems to be nearer to this than to any other species of the genus. The records for *B. contraria* are mostly from the south Pacific. Brady records one specimen from off the Azores, and I have recorded it from off the Hawaiian Islands. Bagg records very small specimens from the Pliocene sands of San Pedro, Calif. This is another of the species which seems to show the relation of the lower Oligocene of the Coastal Plain of the United States to the recent fauna of the Indo-Pacific.

Genus CASSIDULINA D'Orbigny, 1826.

Cassidulina crassa D'Orbigny.

Cassidulina crassa D'Orbigny, Voyage dans l'Amérique méridionale, Foraminifères, p. 56, pl. 7, figs. 18–20, 1839.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 429, pl. 54, figs. 4, 5, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 97, figs. 151 a–c (in text), 1911.

Outline subcircular or oval, biconvex, with a broadly rounded peripheral border; chambers rather few, short, and inflated, the surface depressed at the sutures; wall calcareous, perforate, smooth; aperture a long, narrow slit just below and nearly parallel to the periphery of the test. Diameter 0.4 millimeter.

There are specimens from stations 6447 (Glass Bayou, Vicksburg, Miss.) and 6451 (Mint Spring Bayou, Vicksburg, Miss.) which seem rather to belong to this species than to *C. laevigata* D'Orbigny. The periphery has no keel and is lobulate, and the specimens are not so thick as most recent ones.

Family LAGENIDAE.

Genus LAGENA Walker and Boys, 1784.

Lagena laevigata (Reuss) Terrigi.

Fissurina laevigata Reuss, Akad. Wiss. Wien Denkschr., vol. 1, p. 366, pl. 46, fig. 1, 1849.
Lagena laevigata (Reuss) Terrigi, Accad. pont. Nuovi Lincei Atti, vol. 33, p. 177, pl. 1, fig. 6, 1880.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 473, pl. 114, figs. 8 a, b, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 7, pl. 2, fig. 1, 1913.

Test subglobose, compressed, somewhat pyriform in front view, elliptical in cross section; wall smooth, transparent in thin specimens or opaque in more thickened ones, along the lateral margins usually clear, even in thickened specimens; aperture elongate, fairly narrow, connecting with the interior by a fairly long entosolenian neck. Length 0.45 millimeter.

A single specimen from station 6451 (Mint Spring Bayou, Vicksburg, Miss.) can be referred to this species. It is small and has the characteristic shape.

Lagena striata (D'Orbigny) Reuss var. substriata Williamson.

Plate XXIX, figure 10.

Lagena substriata Williamson, Annals and Mag. Nat. Hist., 2d ser., vol. 1, p. 15, pl. 2, fig. 12, 1848.
Lagena vulgaris var. *substriata* Williamson, Recent Foraminifera of Great Britain, p. 7, pl. 1, fig. 14, 1858.
Lagena striata (D'Orbigny) Reuss var. *substriata* Williamson. Cushman, U. S. Nat. Mus. Bull. 71, pt. 2, p. 20, pl. 8, figs. 1–3, 1913.

Variety differing from the typical species in the more elongate body, long tapering neck, costulate surface extending up onto the neck, often to its end, and usually spirally arranged on the neck. Length 0.4 to 0.5 millimeter.

A single very typical specimen of this variety was found at station 7671, "Brown's Cave," Leaf River, Miss. The neck is somewhat broken, but the general form of the test and the ornamentation are those of the variety.

Lagena orbignyana (Seguenza) H. B. Brady var. flintii Cushman, n. var.

Plate XXIX, figure 11.

Lagena castrensis Flint (not Schwager), U. S. Nat. Mus. Ann. Rept. for 1897, p. 308, pl. 54, fig. 5, 1899.

Variety with a secondary keel at each side near the periphery and a series of two or three concentric lines of lacunae or pitted areas of uniform size inside the inner carina, the central part of the test being nearly smooth. Length 0.45 millimeter.

Type specimen from station 6447, Glass Bayou, Vicksburg, Miss. This is very similar to specimens from off the eastern coast of the United States figured by Flint, as cited above. The ornamentation is much more distinct on the peripheral portion than in the center, which is nearly smooth.

Lagena hexagona (Williamson) Siddall.

Plate XXIX, figure 12.

Entosolenia squamosa Montagu var. *hexagona* Williamson, Annals and Mag. Nat. Hist., 2d ser., vol. 1, p. 20, pl. 2, fig. 23, 1848; Recent Foraminifera of Great Britain, p. 13, pl. 1, fig. 31, 1858.

Lagena hexagona (Williamson) Siddall, Catalogue of British Recent Foraminifera, p. 6, 1879.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 472, pl. 58, figs. 32, 33, 1884.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 17, pl. 6, figs. 2, 3, 1913.

Test subglobular, broadly rounded at the apical end, bluntly pointed at the apertural end, surface ornamentation consisting of a reticulate pattern, the areoles of which are hexagonal, either arranged in vertical rows or irregular. Length 0.5 millimeter.

The only record for this species in this lot of material is from station 6452, Mint Spring Bayou, Vicksburg, Miss. It is similar to the specimen I have figured.[3]

Genus NODOSARIA Lamarck, 1812.

Nodosaria communis D'Orbigny.

Plate XXX, figure 4.

Nodosaria (Dentalina) communis D'Orbigny, Annales sci. nat., vol. 7, p. 254, No. 35, 1826.

Nodosaria communis H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 504, pl. 62, figs. 19–22, 1884.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 54, pl. 28, figs. 1, 2, 1913.

Test elongate, slender, tapering, straight or more often slightly curved, composed of numerous chambers, slightly inflated toward the apical end but later ones becoming more inflated; sutures oblique; aperture radiate, slightly eccentric, somewhat elongate; surface smooth. Length 3 millimeters or more.

Single specimens of this species were found at two stations:

6451. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

Nodosaria filiformis D'Orbigny.

Plate XXX, figures 1–3.

Nodosaria filiformis D'Orbigny, Annales sci. nat., vol. 7, p. 253, No. 14, 1826.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 500, pl. 63, figs. 3–5, 1884.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 55, pl. 27, figs. 1–4, 1913.

Test elongate, slender, arcuate; chambers numerous, elliptical or ovate, elongate, tumid, sutures usually oblique; chambers increasing in length toward the apertural end; aperture radiate, slightly eccentric; wall smooth. Length 5 millimeters or less.

Specimens showing a few chambers which seem to belong to this species were collected at three stations:

6448. Glass Bayou, Vicksburg, Miss.
6451. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

They are elongate, cylindrical, and slightly contracted at the ends, and the apertural end, where shown, is long and tapering.

Nodosaria obliqua (Linnaeus) H. B. Brady.

Plate XXX, figures 6, 7.

Nautilus obliquus Linnaeus, Systema naturae, 10th ed., p. 711, 1758; 13th ed. (Gmelin's), p. 3372, No. 14, 1788.

Nodosaria obliqua (Linnaeus), H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 513, pl. 64, figs. 20–22, 1884.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 59, pl. 25, fig. 5, 1913.

Nodosaria (Dentalina) obliqua (Linnaeus) Parker and Jones, Annals and Mag. Nat. Hist., 3d ser., vol. 3, p. 482, 1859.

Test elongate, tapering, apical end often with a spine; chambers numerous, in the early portion not distinct, in the later portion tumid; sutures depressed; surface ornamented with numerous rounded costae, fairly broad, as many as forty in the adult chambers of some of the specimens, costae continuous on the apical spine to the apertural end, additional ones added between those already formed;

[3] Cushman, J. A., op. cit., pl. 6, fig. 2.

aperture radiate. Length as much as 10 millimeters when complete.

Specimens were present in material from the following stations:

6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

This is quite possibly the same as the species from the Byram marl noted as a "single fragmentary specimen." [4]

Nodosaria sp.?

Plate XXX, figure 5.

There is a single specimen of *Nodosaria* from station 7671 ("Brown's Cave," Leaf River, Miss.) which may possibly be the young of *Nodosaria obliqua* but is here noted and figured that it may be on record for comparisons with forms from other horizons.

Genus CRISTELLARIA Lamarck, 1812.

Cristellaria convergens? Bornemann.

Cristellaria convergens Bornemann, Deutsch. geol. Gesell. Zeitschr., vol. 7, 1855, p. 327, pl. 13, figs. 16, 17.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 546, pl. 69, figs. 6, 7, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 68, pl. 34, fig. 3, 1913.

Test oval, biconvex, closely coiled; chambers triangular, the last-formed one drawn out to a point at the apertural end; sutures hardly visible, the chambers embracing to the umbo; wall smooth and thick. Length about 1 millimeter.

Single specimens that seem to be at least questionably this species were found at two stations:

6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

Cristellaria rotulata (Lamarck) D'Orbigny.

Plate XXXII, figure 1.

Lenticulites rotulata Lamarck, Annales du Muséum, vol. 5, p. 188, No. 3, 1804; vol. 8, pl. 62, fig. 11, 1806.
Cristellaria rotulata (Lamarck) D'Orbigny, Soc. géol. France Mém., 1st ser., vol. 4, p. 26, pl. 2, figs. 16–18, 1840.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 547; pl. 69, figs. 13*a*, *b*, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 66, pl. 35, fig. 3, 1913.

[4] Cushman, J. A., U. S. Geol. Survey Prof. Paper 129, p. 93, 1922 (Prof. Paper 129–E).

Test large, closely coiled; chambers numerous, lenticular, biconvex; wall smooth, thick; peripheral margin rather acute but not distinctly carinate; apertures of all chambers of visible test usually apparent. Length 1.5 to 2 millimeters.

Specimens that may be referred to this and the following species occurred in considerable numbers at station 7671, "Brown's Cave," Leaf River, Miss.

Cristellaria cultrata (Montfort) Parker and Jones.

Plate XXXI, figure 8.

Robulus cultratus Montfort?, Conchyliologie systématique, vol. 1, p. 214, 54e genre, 1808.
Cristellaria cultrata (Montfort) Parker and Jones, Philos. Trans., vol. 155, p. 344, pls. 13, 17, 18; pl. 16, fig. 5, 1865.
H. B. Brady, *Challenger* Rept., vol. 9, p. 550, pl. 70, figs. 4–6, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 64, pl. 29, fig. 5, 1913.
Robulina cultrata (Montfort) D'Orbigny, Annales sci. nat., vol. 7, p. 287, No. 1, Modèles, No. 82, 1826; Foraminifères fossiles du bassin tertiaire de Vienne, p. 96, pl. 4, figs. 14, 15, 1846.

Test very similar to that of *C. rotulata*, but with the added character of a peripheral keel of greater or less extent. Diameter 2 millimeters or less.

Specimens that may be considered *C. cultrata*, having a broader keel and somewhat different shape, with fewer chambers than *C. rotulata*, occurred with that species at station 7671, "Brown's Cave," Leaf River, Miss.

Cristellaria vicksburgensis Cushman, n. sp.

Plate XXXI, figures 6, 7.

Test composed of few chambers, seven to eight in the visible coil; surface generally smooth, except on the sutures, which are marked by rather broad, curved, raised ridges, those near the earlier part of the coil broken into rounded knobs, especially near the umbilical area, the later ones more continuous; periphery angled, the early portion carinate; apertural face smooth and somewhat concave with acute projecting angles; aperture radiate at the angle of the chamber. Length 0.65 to 1 millimeter.

Type specimen from station 6647, Chickasawhay River 1¼ miles southwest of Boice,

Miss. This species was also found at station 7671, "Brown's Cave," Leaf River, Miss.

This is undoubtedly the same as the species found in the Byram marl and recorded without a specific name.[5] It seems to be very constant in its characters and can be distinguished by the peculiar ornamentation, the uncoiling of the later portion of the test, and the concave apertural face.

Genus VAGINULINA D'Orbigny, 1826.

Vaginulina legumen (Linnaeus) D'Orbigny var. *elegans* (D'Orbigny) Fornasini.

Vaginulina legumen (Linnaeus) D'Orbigny var. elegans (D'Orbigny) Fornasini, Soc. geol. italiana Boll., vol. 5, p. 25, pl. 1, figs. 1?, 2–8, 1886.
Cushman, U. S. Geol. Survey Prof. Paper 129, p. 93, pl. 17, fig. 1, 1922.

There is a single broken specimen of this variety from station 6447 (Glass Bayou, Vicksburg, Miss.), similar in form to that which I have seen from the Philippines. This has also been recorded from the Byram marl.

Genus POLYMORPHINA D'Orbigny, 1826.

Polymorphina byramensis Cushman.

Polymorphina byramensis Cushman, U. S. Geol. Survey Prof. Paper 129, p. 94, pl. 17, figs. 2a, 2b, 1922.

Test short and broad, triangular, composed of a few chambers, usually only four, all except a final fifth chamber extending back to the base of the proloculum, forming a truncate test; chambers inflated; sutures deep and distinct; surface smooth; aperture radiate, only slightly produced. Length 0.75 millimeter or less.

This species, which is common in the Byram marl, has been found at all the stations in the Mint Spring marl studied in this collection, as follows:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

The specimens are very typical. A large proportion of them have three or four chambers with a triangular test, truncate at the base, the fifth chamber when present being added at a higher level.

[5] Cushman, J. A., U. S. Geol. Survey Prof. Paper 129, p. 93, 1922 (Prof. Paper 129–E).

Polymorphina regina H. B. Brady, Parker, and Jones.

Plate XXX, figure 8.

Polymorphina regina H. B. Brady, Parker, and Jones, Linnean Soc. London Trans., vol. 27, p. 241, pl. 41, figs. 32*a*, *b*, 1870.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 571, pl. 73, figs. 11–13, 1884.
Egger, K. bayer. Akad. Wiss. München Abh., Cl. 2, vol. 18, p. 310, pl. 9, figs. 45, 50, 51, 1893.
Millett, Roy. Micr. Soc. Jour., 1903, p. 265.
Bagg, Maryland Geol. Survey, Miocene, p. 478, pl. 133, fig. 7, 1904; U. S. Nat. Mus. Proc., vol. 34, p. 149, 1908.
Chapman, Quekett Micr. Club Jour., 2d ser., vol. 10, p. 132, pl. 10, fig. 4, 1907 [1909]; Roy. Soc. Victoria Proc., vol. 22, p. 281, 1910.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 91, pl. 41, figs. 6, 7, 1913.
Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 673, 1915.
Cushman, U. S. Geol. Survey Bull. 676, p. 54, pl. 11, figs. 3, 4, 1918; U. S. Nat. Mus. Proc., vol. 56, p. 619, 1919; U. S. Geol. Survey Prof. Paper 129, pl. 18, fig. 4, 1922.

Test elongate, fusiform; chambers tumid, distinct, especially in the later portion; sutures deep; wall ornamented by numerous longitudinal costae, usually continuing unbroken across several chambers; aperture radiate, somewhat produced. Length 1 millimeter or less.

This species was found at three of the Mint Spring marl stations, as follows:

6448. Glass Bayou, Vicksburg, Miss.
6452. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

It also occurs in the Byram marl and has been recorded from the Miocene of the Coastal Plain of the United States, in the Calvert formation of Chesapeake Beach, Md. (Bagg), and the Duplin marl of Mayesville, S. C. (Cushman). It is a fairly common species in recent seas in the Indo-Pacific region.

Polymorphina problema D'Orbigny.

Polymorphina (*Guttulina*) *problema* D'Orbigny, Annales sci. nat., vol. 7, p. 266, No. 14, Modèles, No. 61, 1826.
Cushman, U. S. Geol. Survey Prof. Paper 129, p. 94. pl. 18, fig. 1, 1922.
Guttulina problema D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 224, pl. 12, figs. 26–28, 1846.

Test elongate, fusiform, composed of few chambers, tumid; sutures slightly depressed;

apical end bluntly pointed, apertural end tapering; surface smooth; aperture radiate. Length 1 millimeter or less.

A few specimens have been collected in the Mint Spring marl at the following stations:

6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

Polymorphina gibba D'Orbigny.

Polymorphina (Globulina) gibba D'Orbigny, Annales sci. nat., vol. 7, p. 226, No. 20, Modèles, No. 63, 1826.
Polymorphina gibba H. B. Brady, Parker, and Jones (part), Linnean Soc. London Trans., vol. 27, p. 216, pl. 39, figs. 2a–d, 1870.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 561, pl. 71, figs. 12a, b, 1884.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 85, pl. 41, fig. 4, 1913; U. S. Geol. Survey Bull. 676, p. 11, pl. 2, fig. 4; p. 52, pl. 11, fig. 5, 1918; U. S. Geol. Survey Prof. Paper 129, p. 93, pl. 17, fig. 3, 1922.

Test rotund, in front view nearly circular, in end view broadly oval; chambers few, distinct; sutures distinct, but little if at all excavated; wall smooth and translucent; aperture slightly produced, radiate. Length 0.75 millimeter or less.

Very rotund specimens which are here referred to this species were found in the Mint Spring marl at the following stations:

6447. Glass Bayou, Vicksburg, Miss.
6451. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

This species also occurs in the Byram marl, and I have recorded it from the Pliocene Caloosahatchee marl on Shell Creek, Fla., and from the Miocene Calvert formation at Chesapeake Beach, Md. (Bagg), and Duplin marl at Mayesville, S. C.

Polymorphina amygdaloides (Reuss) Reuss?

Globulina amygdaloides Reuss, Deutsch. geol. Gesell. Zeitschr., vol. 3, p. 82, pl. 6, fig. 47, 1851.
Polymorphina amygdaloides (Reuss) Reuss, Akad. Wiss. Wien Sitzungsber., vol. 18, p. 250, pl. 8, fig. 84, 1855.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 560, pl. 71, fig. 13(?), 1884.
Bagg, U. S. Nat. Mus. Proc., vol. 34, p. 148, 1908.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 85, pl. 41, fig. 5, 1913; U. S. Geol. Survey Prof. Paper 129, p. 95, pl. 18, figs. 2a, 2b, 1922.

Test elongate-oval, much compressed, composed of few chambers, which are elongate and narrow; sutures rather indistinct, not depressed; surface smooth; aperture somewhat produced. Length 0.65 millimeter or less.

Elongate specimens somewhat like those figured in the paper on the Byram marl were found in the Mint Spring marl at the following stations:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

The specimens are very doubtfully identical with the species of Reuss.

Polymorphina equalis D'Orbigny.

Plate XXXI, figure 3.

Polymorphina equalis D'Orbigny, Annales sci. nat., vol. 7, p. 265, No. 13, 1826.
Polymorphina aequalis D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 227, pl. 13, figs. 11, 12. 1846.
Polymorphina gibba var. *aequalis* H. B. Brady, Parker, and Jones, Linnean Soc. London Trans., vol. 27, p. 216, pl. 39, figs. 2c, d, 1870.

Test compressed, broadly oval; periphery rather evenly curved, rounded, composed of few chambers; sutures distinct but very slightly depressed; wall smooth; aperture radiate. Length 0.7 to 0.8 millimeter.

This species described by D'Orbigny occurs sparsely in the Mint Spring marl at two stations:

6448. Glass Bayou, Vicksburg, Miss.
6451. Mint Spring Bayou, Vicksburg, Miss.

Polymorphina advena Cushman, n. sp.

Plate XXXI, figure 4.

Test much compressed, broadly ovate; chambers numerous, elongate, alternating, much the broadest near the peripheral end; sutures slightly depressed; surface ornamented with numerous fine longitudinal costae, except the last-formed one of two chambers, which are smooth, at least at the apertural end; aperture radiate. Length 1 millimeter.

Type specimen from station 6451, Mint Spring Bayou, Vicksburg, Miss.

This species is an unusual one for this genus, appearing much more like a *Bolivina*, but it has the characteristic aperture of *Polymorphina*. It is perhaps closest related to *Polymorphina complanata* D'Orbigny.

Polymorphina cuspidata H. B. Brady.

Plate XXX, figures 9, 10.

Polymorphina sororia Reuss var. *cuspidata* H. B. Brady, *Challenger* Rept., p. 563, pl. 71, figs. 17–19; pl. 72, fig. 4, 1884.

Test elongate, fusiform, composed of a few chambers, initial end with a prominent sharp, elongate spine, apertural end bluntly pointed; surface smooth; sutures somewhat depressed; aperture radiate. Length 1.5 millimeters or less.

There are several specimens from station 6447 (Glass Bayou, Vicksburg, Miss.) which are very close to this form as figured by Brady in the *Challenger* report. The relation of this form to *P. sororia* Reuss seems very problematic, and I have given it specific rank. It is also represented in the Mint Spring marl by the variety described below.

Polymorphina cuspidata H. B. Brady var. costulata Cushman, n. var.

Plate XXXI, figure 1.

Variety differing from the typical species in the surface ornamentation, which consists of a few longitudinal costae, rather widely separated from each other.

Type specimen from station 6452, Mint Spring Bayou, Vicksburg, Miss.

Polymorphina vicksburgensis Cushman, n. sp.

Plate XXXI, figure 2.

Test elongate, fusiform, broadest near the initial end, which is subcircular in transverse section, the later portion becoming compressed and narrower, initial end bluntly pointed, or with a short spine; chambers becoming shorter toward the apertural ends in the adult; surface smooth, or with very slight longitudinal costae; sutures not depressed but often standing out as clearer areas in side view; aperture radiate. Length 1.5 millimeters or less.

Type specimen from station 6451, Mint Spring Bayou, Vicksburg, Miss. This species occurs also at station 6448, Glass Bayou, Vicksburg, Miss.

This seems to be different from the other described species of this genus and may be distinguished especially by the cuspidate initial end and the peculiar change in shape from the rounded early portion to the narrow, compressed last-formed portion.

Polymorphina spinosa (D'Orbigny) Egger.

Plate XXXI, figure 5.

Globulina spinosa D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 230, pl. 13, figs. 23, 24, 1846.

Polymorphina spinosa (D'Orbigny) Egger, Neues Jahrb., 1857, p. 292, pl. 14, figs. 9, 10,

H. B. Brady, Parker, and Jones, Linnean Soc. London Trans., vol. 27, p. 243, pl. 42, figs. 36a, b, 1870.

Test rounded, irregular; chambers few; surface covered with numerous short, projecting spines which seem to be hollow where broken. Length 1 millimeter or less.

Rare specimens were obtained at the following stations:

6447. Glass Bayou, Vicksburg, Miss.

6451. Mint Spring Bayou, Vicksburg, Miss.

6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.

7671. "Brown's Cave," Leaf River, Miss.

This species was originally described by D'Orbigny from specimens collected in the Vienna Basin, and the specimens from the Mint Spring marl, except that they are more irregular in form, agree at least in the ornamentation of the surface.

Genus UVIGERINA D'Orbigny, 1826.

Uvigerina byramensis Cushman.

Uvigerina byramensis Cushman, U. S. Geol. Survey Prof. Paper 129, p. 95, pl. 18, fig. 5, 1922.

Test minute, elongate, somewhat fusiform, initial end pointed; chambers numerous, distinct; sutures depressed; surface ornamented by longitudinal costae, rather thin and sharp; the last-formed chamber more distinct than the rest, the inner side concave, the other two sides slightly convex, giving a generally triangular section, the surface of the last-formed chamber smooth; the apertural end produced into a short cylindrical neck witn a slight lip, the aperture circular. Length 0.25 to 0.40 millimeter.

This species, originally described from specimens collected in the Byram marl, has been found at all but one of the stations in the Mint Spring marl, as follows:

6447. Glass Bayou, Vicksburg, Miss.

6451, 6452. Mint Spring Bayou, Vicksburg, Miss.

6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.

7671. "Brown's Cave," Leaf River, Miss.

The characters that distinguish this species seem to be very constant, and the last-formed

chambers, especially where they are not closeset, have the distinct triangular shape which characterizes the type specimens.

Uvigerina pigmea D'Orbigny.

Plate XXXII, figure 2.

Uvigerina pigmea D'Orbigny, Annales sci. nat., vol. 7, p. 269, pl. 12, figs. 8, 9, Modèles, No. 67, 1826.

Uvigerina pygmaea D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienna, p. 190, pl. 11, figs. 25, 26, 1846.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 575, pl. 74, figs. 11–14, 1884.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 96, pl. 42, fig. 1; pl. 44, fig. 5, 1913; U. S. Nat. Mus. Bull. 103, p. 63, pl. 22, fig. 4, 1918; U. S. Geol. Survey Bull. 676, p. 55, 1918.

Test subcylindrical, triserially spiral; chambers numerous, inflated; sutures deep; wall ornamented by numerous longitudinal costae, those of each chamber usually independent of those of adjacent chambers; aperture with a short cylindrical neck and phialine lip. Length 0.75 to 1 millimeter.

Specimens that may be referred to this species were found at the following stations:

6447. Glass Bayou, Vicksburg, Miss.
6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

It has occurred in the Miocene of Maryland (Bagg), and in the St. Marys (?) formation in a well at Norfolk, Va. (depth 645 feet). I have also recorded it from the Culebra formation of the Canal Zone, and it may occur in the Miocene of the Gatun formation of the Canal Zone.

Family GLOBIGERINIDAE.

Genus GLOBIGERINA D'Orbigny, 1826.

Globigerina bulloides D'Orbigny.

Globigerina bulloides D'Orbigny, Annales sci. nat., vol. 7, p. 277, No. 1, Modèles, Nos. 17 and 76, 1826.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 593, pl. 77; pl. 79, figs. 3–7, 1884.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 4, p. 5, pl. 2, figs. 7–9; pl. 9, 1914; U. S. Nat. Mus. Bull. 103, p. 64, 1918; U. S. Geol. Survey Bull. 676, p. 12, pl. 3, fig. 2; p. 56, pl. 3, figs. 4, 6, 1918; Carnegie Inst. Washington Pub. 291, p. 38, 1919; U. S. Geol. Survey Prof. Paper 129, p. 95, pl. 19, figs. 1–3, 1922.

Test subglobose, spiral, made up of a few inflated chambers, all visible from the dorsal side, three to four visible from the ventral side; sutures deep, surface reticulate.

This common species, which has been recorded in the Pliocene, Miocene, and Oligocene, occurs in the Mint Spring marl at four stations, as follows:

6447. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

Globigerina dutertrei D'Orbigny.

Globigerina dutertrei D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 95, pl. 4, figs. 19–21, 1839.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 601, pl. 81, figs. 1a–c, 1884.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 4, p. 8, 1914.

Test rounded, the dorsal side slightly convex, the ventral side more strongly convex, composed of about three whorls, the last one consisting of four to five chambers, much inflated, especially the later ones, umbilicate; aperture comparatively small, a single arched opening near the umbilical edge of the last-formed chamber. Diameter 0.60 millimeter or less.

Specimens apparently belonging to this species, which D'Orbigny described from material collected in the West Indies, occurred at three stations, as follows:

6451. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

Family ROTALIIDAE.

Genus SPIRILLINA Ehrenberg, 1841.

Spirillina limbata H. B. Brady var. bipunctata Cushman, n. var.

Plate XXXII, figures 3–5.

Test very similar in general to that of *Spirillina limbata* but differing in the character of the ornamentation, the area of the dorsal surface being ornamented in the adult of this variety by a double series of deep punctations inside the raised carina.

Type specimen from station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss. This variety is also present in the Mint Spring marl at the following stations:

6447. Glass Bayou, Vicksburg, Miss.
6451, 6482. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

In recent seas *S. limbata* is known from the Pacific, being one of the forms that are characteristic of the Indo-Pacific region, and it is also

characteristic of the lower Oligocene of the Coastal Plain of the United States.

The young of this species has only a single row of pits, becoming double in the adult. The ornamentation of the ventral side is shown in figure 5.

Genus PATELLINA Williamson, 1858.

Patellina advena Cushman, n. sp.

Plate XXXI, figure 9.

Test plano-convex, early portion composed of chambers spirally arranged, later ones elongate and becoming nearly annular; chambers partly divided by numerous longitudinal internal septa, visible from the exterior, forming what seems to be a radiating pattern; ventral side with numerous radiating lines. Diameter 0.4 millimeter.

Type specimen from station 6452, Mint Spring Bayou, Vicksburg, Miss.

This species differs from *Patellina corrugata* Williamson in the much finer division by internal septa. The spire is low, making a broad, flaring test.

Genus DISCORBIS Lamarck, 1804.

Discorbis auracana (D'Orbigny) Cushman.

Plate XXXII, figure 6.

Rosalina auracana D'Orbigny, Voyage dans l'Amérique méridionale, Foraminifères, p. 44, pl. 6, figs. 16–18, 1839.

Discorbis auracana (D'Orbigny) Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 15, pl. 9, fig. 3; fig. 15 (in text).

Discorbina auracana (D'Orbigny) Parker and Jones, Geol. Soc. London Quart. Jour., vol. 28, p. 115, 1872.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 645, pl. 86, figs. 10, 11, 1884.

Test small, plano-convex, dorsal side slightly convex, ventral side flat or slightly concave, peripheral margin rather acutely rounded; chambers six to nine in the last-formed whorl; sutures slightly depressed, often limbate with clear shell material; early chambers often carinate with similar material; wall finely punctate; aperture a narrow curved slit at the margin of the ventral side of the chamber; color brownish, especially in the earlier chambers. Diameter 0.3 to 0.5 millimeter.

Specimens that are referred to this species were rare at a single station, 6447, Glass Bayou, Vicksburg, Miss. The sutures are limbate, and the last-formed chamber has a projecting lip above the aperture.

Discorbis bertheloti (D'Orbigny) Cushman.

Plate XXXII, figure 7.

Rosalina bertheloti D'Orbigny, in Barker, Webb, and Berthelot, Histoire naturelle des îles Canaries, vol. 2, pt. 2, Foraminifères, p. 135, pl. 1, figs. 28–30, 1839.

Discorbis bertheloti (D'Orbigny) Cushman, U. S. Nat. Mus. Bull. 71, pt. 3, p. 20, pl. 7, fig. 3, 1913; U. S. Geol. Survey Bull. 676, p. 58, pl. 15, figs. 1–3, 1918.

Discorbina bertheloti (D'Orbigny) H. B. Brady, Linnean Soc. London Trans., vol. 24, p. 469, pl. 48, figs. 10a, b, 1864; *Challenger* Rept., Zoology, vol. 9, p. 650, pl. 89, figs. 10–12, 1884.

Test unequally biconvex, usually six to seven chambers in the last-formed coil, dorsal side usually flattened, ventral side more convex; sutures curved, fairly distinct on both sides, occasionally slightly limbate; aperture usually extending into the dorsal side so that a portion of the aperture is peripheral. Diameter 0.80 millimeter or less.

This species occurs at two Mint Spring marl stations:

6451, 6452. Mint Spring Bayou, Vicksburg, Miss.

I have also recorded it from the Miocene of the Coastal Plain in the Choctawhatchee marl 1 mile south of Red Bay, Fla.; in the Duplin marl (?) of South Carolina (locality unknown); and in the Yorktown formation at Suffolk, Va.

Genus TRUNCATULINA D'Orbigny, 1826.

Truncatulina lobatula (Walker and Jacob) D'Orbigny.

Nautilus lobatulus Walker and Jacob, Adams's Essays on the microscope, Kanmacher's ed., p. 642, pl. 14, fig. 36, 1798.

Truncatulina lobatula (Walker and Jacob) D'Orbigny, in Barker, Webb, and Berthelot, Histoire naturelle des îles Canaries, vol. 2, pt. 2, Foraminifères, p. 134, pl. 2, figs. 22–24, 1839; Foraminifères fossiles du bassin tertiaire de Vienne, p. 168, pl. 9, figs. 18–23, 1846.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 660, pl. 92, fig. 10; pl. 93, fig. 1, 1884.

Cushman, U. S. Geol. Survey Bull. 676, p. 16, pl. 1, fig. 10; p. 60, pl. 17, figs. 1–3; U. S. Geol. Survey Prof. Paper 129, p. 26, pl. 20, figs 1–3, 1922.

Test plano-convex, flattened on the ventral face, moderately convex dorsally, peripheral margin rounded; chambers numerous, seven or eight in the last-formed whorl; sutures depressed, especially on the dorsal face; wall smooth, punctate.

Specimens were obtained at five of the six Mint Spring marl stations, as follows:

6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

This species is common both in the Tertiary and in the present oceans. I have recorded it from the Pliocene and the Miocene of the Coastal Plain of the United States and the Oligocene (Byram marl) at Byram, Miss.

Truncatulina byramensis Cushman.

Truncatulina byramensis Cushman, U. S. Geol. Survey Prof. Paper 129, p. 96, pl. 20, figs. 4–6, 1922.

Test plano-convex, dorsal side slightly convex, ventral side flattened, peripheral margin subcarinate; about eight chambers in the last-formed whorl, chambers on the ventral side failing to reach the center of the test, leaving a definite umbilical area, which is filled with clear shell material; on the dorsal side each chamber at its inner border has the angles somewhat produced and a broad, rounded reentrant near the middle; on the ventral side the inner half of the chamber is rather intricately lobed, the chambers themselves of lighter color; the sutures darker, of clear shell material; surface finely granular; aperture an elongate opening at the base of the last-formed chamber near its inner ventral border. Diameter 0.35 to 0.75 millimeter.

Specimens of this species were collected at the following stations:

6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
6447, 6448. Glass Bayou, Vicksburg, Miss.

This species was described from specimens obtained in the Byram marl, where it is common. It is a peculiar species, easily distinguished by the unusual lobed chambers.

Truncatulina americana Cushman var.

Truncatulina americana Cushman, U. S. Geol. Survey Bull. 676, p. 63, pl. 20, figs. 2, 3; pl. 21, fig. 1, 1918; U. S. Nat. Mus. Bull. 103, p. 68, pl. 23, figs. 2 a–c, 1918; U. S. Geol. Survey Prof. Paper 129, p. 97, pl. 20, figs. 7, 8, 1922.

Test plano-convex, dorsal side nearly flat, ventral side slightly convex; chambers numerous, ten to fifteen in the last-formed coil, rather rapidly increasing in size, peripheral margin subangular, dorsal side with the last few chambers failing to meet the umbilicus, ventral side similar in this respect in most specimens; sutures distinct, slightly limbate on the dorsal side, depressed on the ventral side; wall smooth, punctate, aperture peripheral with a slight lip. Diameter 0.75 millimeter or less.

Small specimens of this species with a slightly broader form than the typical occur in the Mint Spring marl at the following stations:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.

This species is found in the Miocene and Oligocene of the Coastal Plain and in the upper Oligocene of the Canal Zone.

Truncatulina pseudoungeriana Cushman.

Truncatulina ungeriana H. B. Brady (not *Rotalina ungeriana* D'Orbigny, 1826), *Challenger* Rept., Zoology, vol. 9, pl. 94, figs. 9 a–c, 1884.
Cushman, U. S. Nat. Mus. Bull. 103, p. 69, pl. 24, fig. 1, 1918.
Truncatulina pseudoungeriana Cushman, U. S. Geol. Survey Prof. Paper 129, p. 97, pl. 20, fig. 9, 1922.

Test biconvex, almost equally so, periphery subacute; chambers nine to eleven in the last-formed whorl, those of the earlier whorls not showing on either the ventral or the dorsal side, on the dorsal because they are hidden by the roughness of the surface, and on the ventral because of the involute character; periphery lobulate; sutures distinct above in the last whorl and very distinct below, as the sutures are somewhat tumid on the ventral side; umbilical region filled nearly flush with the chambers by clear shell material, last few chambers on the dorsal side slightly above the surface on the inner margin; surface dorsally with coarse punctae, below smooth and more finely punctate; aperture at the periphery. Diameter 1 millimeter or less.

Specimens of this species were common in the Mint Spring marl at station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss. It occurred more rarely at the following stations:

6447. Glass Bayou, Vicksburg, Miss.
6451. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

Truncatulina vicksburgensis Cushman, n. sp.

Plate XXXV, figures 7, 8.

Test plano-convex, dorsal side with the sutures very obscure, low-spired, periphery subacute, ventral side with a central raised area and the inner angle of each chamber ending in a raised knob, ventral side of the cham-

bers somewhat irregularly granular, especially toward the inner margin; otherwise the chambers are not distinct from one another. Diameter 0.50 to 0.60 millimeter.

Type specimen from station 6448, Glass Bayou, Vicksburg, Miss.

This differs from the other species of the genus found in the lower Oligocene of the Coastal Plain in its form, its indistinct chambers, and the peculiar ornamentation of the ventral side.

Genus ANOMALINA D'Orbigny, 1826.

Anomalina bilateralis Cushman.

Anomalina bilateralis Cushman, U. S. Geol. Survey Prof. Paper 129, p. 97, pl. 21, figs. 1, 2, 1922.

Test of about four coils, bilateral or nearly so, composed of numerous chambers, ten or more in the last-formed whorl, umbilical region on both sides with a knob of clear shell material, more pronounced on the dorsal side; chambers smooth but coarsely punctate, more coarsely so on the ventral side; sutures broad and somewhat limbate with clear shell material; aperture a narrow curved opening at the base of the final chamber. Diameter 1 millimeter or less.

This is one of the species described from specimens collected in the Byram marl, where it was rare, at least at the type station. In the Mint Spring marl it occurred sparsely at the following stations:

6448. Glass Bayou, Vicksburg, Miss.
6451. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

Anomalina mississippiensis Cushman.

Anomalina mississippiensis Cushman, U. S. Geol. Survey Prof. Paper 129, p. 98, pl. 21, figs. 6–8, 1922.

Test small, plano-convex, of about two and one-half coils, periphery slightly lobulate, bluntly rounded, dorsal side very much flattened, even slightly concave, ventral side very convex; chambers comparatively few, six to eight in the last-formed coil; sutures curved, on the dorsal side broad and limbate, even with the surface of clear shell material, on the ventral side narrower and depressed; the last-formed two or three chambers on the inner margin on the dorsal side slightly above the general surface; wall thin and translucent, especially on the dorsal side, smooth; on the ventral finely punctate and not so clear; aperture a curved opening at the inner margin at the periphery. Length 0.25 to 0.35 millimeter; breadth 0.20 to 0.30 millimeter.

This small species is fairly common in the Byram marl and is common in the Mint Spring marl at all the stations, as follows:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

Anomalina vicksburgensis Cushman, n. sp.

Plate XXXV, figures 5, 6.

Test unequally biconvex, dorsal side more flattened than the ventral; chambers numerous, ten to twelve in the last-formed coil; sutures slightly limbate; periphery rounded, not lobulate; wall between the sutures finely granular or punctate, ventral side with a clear mass of shell material at the umbilicus. Diameter 0.35 millimeter.

Type specimen from station 6452, Mint Spring Bayou, Vicksburg, Miss. This is a peculiar species of the genus; it is rare at the type station and was not found in any other Mint Spring material.

Genus SIPHONINA Reuss, 1849.

Siphonina advena Cushman.

Siphonina advena Cushman, U. S. Geol. Survey Prof. Paper 129, p. 98, pl. 22, figs. 1–2, 1922.

Test unequally biconvex, dorsal side usually less convex than the ventral; periphery subacute; chambers in three or more coils, four chambers making up the last-formed coil; sutures distinct, on the dorsal side flush with the surface, on the ventral side slightly depressed, on the dorsal side somewhat broadened and limbate, ventrally narrow; surface smooth but punctate; aperture with a short neck, compressed, with a phialine lip and elliptical aperture; color, even in the fossil specimens, somewhat brownish; wall thin and translucent. Diameter 0.50 millimeter or less.

Specimens of this species occurred at all six of the Mint Spring marl stations, as follows:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

It was common in the marl at Byram, Miss.

Genus GYPSINA Carter, 1877.

Gypsina rubra (D'Orbigny) Heron-Allen and Earland.

Planorbulina rubra D'Orbigny, Annales sci. nat., vol. 7, p. 280, No. 4, 1826.
Fornasini, Accad. sci. Ist. Bologna Mem., 6th ser., vol. 5, p. 44, pl. 2, fig. 3, 1908.
Gypsina rubra (D'Orbigny) Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 725, pl. 53, figs. 35–37, 1915.
Cushman, U. S. Geol. Survey Prof. Paper 129, p. 98, pl. 22, fig. 3, 1922.

This species, recorded from the Byram marl, has also been found at three of the stations in the Mint Spring marl, as follows:

6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

This is a species from the Indo-Pacific which occurs in the lower Oligocene of the Coastal Plain of the United States.

Genus PULVINULINA Parker and Jones, 1862.

Pulvinulina byramensis Cushman.

Pulvinulina byramensis Cushman, U. S. Geol. Survey Prof. Paper 129, p. 99, pl. 22, figs. 4, 5, 1922.

Test small, biconvex, rotaliform, consisting of about three coils, seven to eight chambers in the last-formed coil; on the dorsal side sutures oblique and at a considerable angle with the periphery, somewhat limbate; on the ventral side the chambers extend in to the center, which is usually not umbilicate; sutures nearly straight; surface polished, punctations appearing as light tubules against the translucent wall; aperture near the inner end of the chamber on the ventral side with a definite valvular lip, the aperture hidden below but when examined found to be composed, in the adult, of several adjacent small rounded openings. Diameter 1.5 millimeters or less.

This species, which was described from abundant specimens obtained in the Byram marl at Byram, Miss., has occurred at all six of the stations in the Mint Spring marl, as follows:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice; Miss.
7671. "Brown's Cave," Leaf River, Miss.

At many of these stations it is common and corresponds closely to the description given above.

Pulvinulina glabrata Cushman.

Pulvinulina glabrata Cushman, U. S. Geol. Survey Prof. Paper 129, p. 99, pl. 22 figs. 6, 7, 1922.

Test biconvex, elongate, somewhat lobulate, composed of about two coils, seven chambers in the last-formed one, dorsal side convex; sutures depressed, curved; chambers convex between, rapidly increasing in size as added; dorsal side very coarsely punctate, the sutures somewhat limbate, ventral side umbilicate; surface smooth and with very fine punctations; sutures distinct; last-formed chamber with a long, straight valvular lip across the whole of the depressed umbilicus; aperture beneath the lip. Length 0.5 millimeter.

This species, which was rare in the marl at Byram, Miss., has been found at four of the stations in the Mint Spring marl, as follows:

6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

It is in some ways related to the species described and figured by Brady in the *Challenger* report as *Discorbina ventricosa* H. B. Brady. It is more elongate than that form, and the last-formed chamber especially gives it an entirely different shape. It is one of the most striking species in this lower Oligocene material.

Genus ROTALIA Lamarck, 1804.

Rotalia byramensis Cushman.

Rotalia byramensis Cushman, U. S. Geol. Survey Prof. Paper 129, p. 99, pl. 23, fig. 1, 1922.

Test unequally biconvex, rotaliform, in the last-formed coil six to seven chambers, dorsally with the chambers somewhat triangular; sutures oblique, limbate, broad, of clear shell material; ventral side with a large circular mass in the umbilical region, with the sutures deep and ending in a depressed ring about it; aperture with a somewhat valvular lip, often divided into several teeth; surface on the dorsal side somewhat roughened, on the ventral side scrobiculate near the periphery, smoother near the center. Diameter 2 millimeters or less.

Specimens that may be referred to this species were found at stations 6447 and 6448, Glass Bayou, Vicksburg, Miss.

The species is perhaps closest to *Rotalia armata* D'Orbigny. The chambers are triangular, and where there is a spinose projection it is at the angle rather than at the middle portion of the chamber, as in *R. armata*.

Rotalia dentata Parker and Jones var. parva Cushman, n. var.

Plate XXXV, figures 1, 2.

Variety differing from the typical species in the size and the number of chambers, having usually but five chambers in the last-formed coil, each with a single spine from the periphery at the center of each chamber. Diameter 0.65 millimeter.

Type specimen from station 6451, Mint Spring Bayou, Vicksburg, Miss. This also occurs at the following stations:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6452. Mint Spring Bayou, Vicksburg, Miss.

Rotalia vicksburgensis Cushman, n. sp.

Plate XXXV, figures 3, 4.

Test spiral, dorsal side flattened, ventral side strongly convex, umbilicate, about eight chambers in the last-formed coil; chambers distinct, inflated; sutures distinct, slightly depressed; surface smooth, finely punctate. Diameter 0.75 millimeter or less.

Type specimens from station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss. It also occurred at the following stations:

6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

This species is apparently related to *R. soldanii* D'Orbigny, but it does not have nearly so great a height, the line between adjacent whorls is not channeled, and in general it has a much more primitive form.

Family NUMMULITIDAE.

Genus NONIONINA D'Orbigny, 1826.

Nonionina umbilicatula (Montagu) Parker, Jones, and H. B. Brady.

Nautilus umbilicatulus Montagu, Testacea Britannica, p. 191, 1803; Suppl., p. 78, pl. 18, fig. 1, 1808.
Nonionina umbilicatula (Montagu) Parker, Jones, and H. B. Brady, Annals and Mag. Nat. Hist., 4th ser., vol. 8, p. 242, pl. 12, fig. 157, 1871.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 726, pl. 109, figs. 8, 9, 1884.
Cushman, U. S. Geol. Survey Prof. Paper 129, p. 100, pl. 23, figs. 3, 4, 1922.

Test biconvex, peripheral margin rounded; chambers ten or more in the last-formed coil; sutures limbate but not depressed, deep, umbilicate; wall smooth, punctate toward the periphery; aperture a very narrow curved opening at the base of the chamber, peripheral. Diameter 0.5 to 0.6 millimeter.

Specimens that may be referred to this species occurred at all but one of the Mint Spring marl stations, as follows:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6452. Mint Spring Bayou, Vicksburg, Miss.
6647. Chickasawhay River 1¼ miles southwest of Boice, Miss.
7671. "Brown's Cave," Leaf River, Miss.

Specimens were not common, however, at any of these stations. I have already recorded the species from the Miocene near Centerville, Md.

Nonionina scapha (Fichtel and Moll) Parker and Jones.

Nautilus scapha Fichtel and Moll, Testacea microscopica, p. 105, pl. 19, figs. d–f, 1803.
Nonionina scapha (Fichtel and Moll), Parker and Jones, Annals and Mag. Nat. Hist., 3d ser., vol. 5, p. 102, No. 4, 1860.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 730, pl. 109, figs. 14, 15, 16?, 1884.
Cushman, U. S. Nat. Mus. Bull. 103, p. 73, pl. 25, figs. 6a, b, 1918; U. S. Geol. Survey Prof. Paper 129, p. 100, pl. 23, figs. 5–7, 1922.

Test in side view longer than wide, about ten chambers in the last-formed coil, rapidly increasing in length as added; sutures evenly curved, slightly depressed; periphery broadly rounded, in apertural view the face of the last-formed chamber making up a large part of the visible surface; wall smooth, finely punctate, somewhat umbilicate; aperture an arched slit at the base of the chamber. Length 0.60 millimeter.

Specimens of this species were more common than those of *N. umbilicatula*. They occurred at all but one of the stations in the Mint Spring marl, as follows:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

I have recorded the species as occurring in the Gatun formation of the Canal Zone.

Nonionina advena Cushman, n. sp.

Plate XXXII, figure 8.

Test small, circular in side view, biconvex; periphery rounded, nine to eleven chambers in the last-formed coil, inflated; sutures curved,

slightly sigmoid, the inner portion excavated and broadened; umbilical region at each side of the test occupied by a large projecting knob of clear shell material; aperture at the base of the last-formed chamber. Diameter 0.75 millimeter or less.

Type specimen from station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss. It also occurred at station 6447, Glass Bayou, Vicksburg, Miss.

This is an unusual form and may perhaps not belong to the genus *Nonionina*. It seems more like some species of *Polystomella*, but there appear to be no retral processes.

Family MILIOLIDAE.

Genus CORNUSPIRA Schultze, 1854.

Cornuspira involvens (Reuss) Reuss.

Operculina involvens Reuss, Akad. Wiss. Wien Denkschr., vol. 1, p. 370, pl. 45, fig. 30, 1849.

Cornuspira involvens (Reuss) Reuss, Akad. Wiss. Wien Sitzungsber., vol. 48, p. 39, pl. 1, fig. 2, 1863 (1864).

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 200, pl. 11, figs. 1–3, 1884.

Cushman, U. S. Nat. Mus. Bull. 71, pt. 6, p. 25, pl. 1, fig. 2; pl. 2, fig. 2, 1917; U. S. Geol. Survey Prof. Paper 129, p. 101, pl. 25, fig. 1, 1922.

Specimens similar to the tropical form of this species occur at three stations, as follows:

6447. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.

The adults among these specimens are unlike the typical form of the species in having the last coil somewhat broadened and flattened, giving somewhat the appearance of *C. carinata* (Costa). The species was recorded from the Byram marl, but the specimens there were very small, measuring only 0.4 millimeter. Some of those from the Mint Spring marl measure 2 millimeters in diameter. This larger form of the species is common in the shoal waters of the Tropics, especially in the Indo-Pacific.

Genus SPIROLOCULINA D'Orbigny, 1826.

Spiroloculina imprimata Cushman.

Spiroloculina imprimata Cushman, U. S. Geol. Survey Prof. Paper 129, p. 101, pl. 25, figs. 3a, 3b, 1922.

Test broad and flat, complanate, nearly circular in outline, composed of numerous chambers, those of the last-formed coil failing to extend to the base of the preceding chamber, leaving a gap; periphery square, lateral faces nearly flat; the surface ornamented by a series of pits in a more or less linear arrangement. Length about 1 millimeter.

A single specimen, much like that from the Byram marl, already described, occurred at station 6451 (Mint Spring Bayou, Vicksburg, Miss.), but this species was not found elsewhere in the material from the Mint Spring marl.

Spiroloculina antillarum D'Orbigny.

Plate XXXIII, figure 1.

Spiroloculina antillarum D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 166, pl. 9 figs. 3, 4, 1839.

H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 155, pl. 10, fig. 21, 1884.

Cushman, U. S. Geol. Survey Bull. 676, p. 21, pl. 8, fig. 2, 1918.

Spiroloculina grata Terquem, Soc. géol. France Mém., 3d ser., vol. 1, p. 55, pl. 5, figs. 14a–15b, 1878 (and subsequent authors).

Test elongate, twice as long as broad; chambers subtriangular; peripheral margin broadly rounded, ornamented by numerous longitudinal costae; apertural end extended. The costae are distinct and continue from one end to the other of the chambers without any trace of branching or anastomosing. Length 1 millimeter or less.

As noted in a paper on the recent Foraminifera from the shallow water of Jamaica[6] this species, described by D'Orbigny from specimens obtained in Cuba and other West Indian localities as *S. antillarum*, is very similar to Terquem's *S. grata*, if not identical, and has priority of date. Specimens from the Mint Spring marl are very close to this form now living in the West Indies; they were found at stations 6451 and 6452, Mint Spring Bayou, Vicksburg, Miss.

Genus VERTEBRALINA D'Orbigny, 1826.

Vertebralina sp.

A single specimen from station 6451 (Mint Spring Bayou, Vicksburg, Miss.) is evidently the young of a species of *Vertebralina*, but the specimen is worn and can not be specifically identified.

[6] Cushman, J. A., U. S. Nat. Mus. Proc., vol. 59, p. 63, pl. 14, figs. 14, 15, 1921.

Genus QUINQUELOCULINA D'Orbigny, 1826.

Quinqueloculina bicostata D'Orbigny.

Quinqueloculina bicostata D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 195, pl. 12, figs. 8–10, 1839.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 6, p. 47, pl. 13, fig. 1, 1917; U. S. Geol. Survey Prof. Paper 129, p. 102, pl. 26, figs. 2–4, 1922.
Miliolina bicostata Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 572, pl. 42, figs. 42–45, 1915.

The Mint Spring marl specimens referred to this species are considerably longer than those shown in D'Orbigny's type figures and resemble more those specimens from the Byram marl which I have referred to this species. These pecimens came from the following stations:

6448. Glass Bayou, Vicksburg, Miss.
6451. Mint Spring Bayou, Vicksburg, Miss.

Quinqueloculina cuvieriana D'Orbigny.

Quinqueloculina cuvieriana D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 164, pl. 11, figs. 19–21, 1839.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 6, p. 47, pl. 12, fig. 2, 1917; U. S. Geol. Survey Prof. Paper 129, p. 102, pl. 26, fig. 1, 1922.

Test slightly longer than wide; chambers sharply angled, those of the adult with a secondary carina at each side of the periphery of the chamber; remainder of the surface smooth; aperture somewhat elongated with a simple tooth. Length 1 millimeter or less.

This species, which was found in the Byram marl, also occurred sparsely in the Mint Spring marl at the following stations:

6447. Glass Bayou, Vicksburg, Miss.
6452. Mint Spring Bayou, Vicksburg, Miss.

Quinqueloculina cookei Cushman, n. sp.

Plate XXXIII, figures 2, 3.

Test much elongate, somewhat fusiform; chambers narrow, widest near the base, rounded, apertural end extended, forming a subcylindrical neck with a simple tooth and slight lip; periphery of the test broad, carinate at each angle, slightly concave between the carinae; sutures distinct; surface smooth, shiny, except the carinae, which are dull. Length 1.5 millimeters or less, diameter 0.35 millimeter.

Type specimen from station 6451, Mint Spring Bayou, Vicksburg, Miss.

This species in some ways resembles *Q. bicostata*, but it is very elongate and slender, and its general form is entirely different.

Quinqueloculina vicksburgensis Cushman, n. sp.

Plate XXXIV, figure 6.

Quinqueloculina venusta Karrer? var., Cushman, U. S. Geol. Survey Prof. Paper 129, p. 102, pl. 26, fig. 5, 1922.

Test much elongate, narrow; chambers distinct; basal end broadly rounded, projecting; apertural end also projecting, forming a cylindrical neck and rounded aperture; periphery of the test subacute; surface smooth, dull. Length nearly 2 millimeters, width 0.5 millimeter.

Type specimens from station 6447, Glass Bayou, Vicksburg, Miss.

This is probably the same as the form recorded from the Byram marl as *Q. venusta* Karrer? var. It is a long, narrow species of peculiar form, as shown in the figure.

Quinqueloculina glabrata Cushman, n. sp.

Plate XXXIV, figure 8.

Test elongate, elliptical in side view, basal end of the chambers somewhat rounded; aperture slightly extending beyond the preceding chamber, aperture ovate with a simple tooth, tending to become bifid toward the tip; periphery of the test with an outside carina, the sides slightly concave; sutures distinct; surface smooth but not shiny. Length 1.5 millimeters, breadth 0.75 millimeter.

Type specimen from station 6447, Glass Bayou, Vicksburg, Miss. Several specimens of this species were also found at stations 6451 and 6452, Mint Spring Bayou, Vicksburg, Miss.

This species is very constant in its characters at all these stations.

Quinqueloculina lustra Cushman, n. sp.

Plate XXXIII, figure 6.

Test broadly elliptical, somewhat compressed; chambers broadly curved, of uniform width, at the basal end slightly projecting, the apertural end only slightly extending beyond

the outline of the chamber; surface smooth, shiny; sutures not very distinct; aperture nearly circular with a short, simple tooth. Length 1.25 millimeter, breadth 1 millimeter.

Type specimen from station 6448, Glass Bayou, Vicksburg, Miss.

This species has a peculiar rounded form, a smooth, shiny surface, and the periphery slightly angled.

Quinqueloculina tessellata Cushman, n. sp.

Plate XXXIII, figure 8; Plate XXXIV, figure 1.

Test elongate, fusiform, in transverse section much angled; periphery rather sharply angled, sides flat and very slightly convex, apertural end very little extended; sutures not very distinct; surface ornamented by longitudinal rows of rather large pits, five or six rows on each side of the largest chamber. Length 1.25 millimeters, breadth 0.5 millimeter.

Type specimen from station 6447, Glass Bayou, Vicksburg, Miss. This form also occurred at station 6451, Mint Spring Bayou, Vicksburg, Miss. It was rare at both stations.

This is a peculiarly ornamented species, reminding one somewhat of the pattern found in some of the Miliolidae of the Eocene of the Paris Basin.

Quinqueloculina vulgaris D'Orbigny.

Plate XXXII, figures 9, 10.

Quinqueloculina vulgaris D'Orbigny, Annales sci. nat., vol. 7, p. 302, No. 33, 1826.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 6, p. 46, pl. 11, fig. 3, 1917.
Miliolina vulgaris Heron-Allen and Earland, Zool. Soc. London Trans., vol. 20, p. 569, 1915.

Test short and stout, about as long as wide, in front view orbicular; chambers in transverse section roughly triangular, the periphery bluntly angled, sides straight or slightly convex; sutures distinct, wall smooth; apertural end not contracted or produced; aperture elongate, narrow, with a tooth bifid at the tip, in front view projecting slightly above the border of the aperture. Length about 0.75 millimeter.

Specimens were common in the Mint Spring marl at station 6448, Glass Bayou, Vicksburg, Miss., and less so at the following stations:

6447. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.

Quinqueloculina seminulum (Linnaeus) D'Orbigny.

Serpula seminulum Linnaeus, Systema naturae, 10th ed. p. 786, 1758; 13th ed. (Gmelin's), pp. 37, 39, 1788.
Quinqueloculina seminulum D'Orbigny, Annales sci. nat., vol. 7, p. 303, No. 44, 1826.
Cushman, U. S. Nat. Mus. Bull. 71, pt. 6, p. 44, pl. 11, fig. 2, 1917.
Miliolina seminulum Williamson, Recent Foraminifera of Great Britain, p. 85, pl. 7, figs. 183–185, 1858.
H. B. Brady, *Challenger* Rept., Zoology, vol. 9, p. 157, pl. 5, figs. 6a–c, 1884.

Test somewhat longer than broad, smooth, peripheral margins rounded; sutures distinct; apertural end not exserted; aperture fairly large, oval, with a simple tooth becoming bifid at the free end. Length 1.5 millimeters or less.

Specimens that may be referred to this common species were collected at three stations in the Mint Spring marl, as follows:

6447. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.

Quinqueloculina contorta D'Orbigny.

Plate XXXIV, figures 2, 3.

Quinqueloculina contorta D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 298, pl. 20, figs. 406, 1846.

Test elongate, oval; chambers narrow, of uniform width; periphery flattened, especially in the middle; sides flat or slightly concave, very slightly if at all extended at the apertural end; aperture rounded with a simple tooth; sutures distinct; surface smooth, flattened, periphery dull, sides somewhat glossy. Length 1 millimeter or less.

Specimens that can be referred to this species were fairly common at four stations in the Mint Spring marl, as follows:

6447, 6448. Glass Bayou, Vicksburg, Miss.
6451, 6452. Mint Spring Bayou, Vicksburg, Miss.

This species was described by D'Orbigny in his report on the Foraminifera from the Tertiary Vienna Basin. Our specimens are very similar to those figured by him.

Quinqueloculina lamarckiana D'Orbigny.

Quinqueloculina lamarckiana D'Orbigny, in De la Sagra, Histoire physique, politique et naturelle de l'île de Cuba, Foraminifères, p. 187, pl. 11, figs. 14, 15, 1839.

Test short and broad; chambers with a sharp peripheral angle, sides slightly convex; aperature not produced; sutures distinct; surface smooth and shiny. Length 1 millimeter.

The only specimens from the Mint Spring marl that can be referred to this species were found at station 6447, Glass Bayou, Vicksburg, Miss.

Genus ARTICULINA D'Orbigny, 1826.

Articulina byramensis Cushman.

Articulina byramensis Cushman, U. S. Geol. Survey Prof. Paper 129, p. 103, pl. 27, figs. 5, 6, 1922.

Test of two portions, a basal triloculine portion followed by a single linear chamber, the earlier portion with the lip of the antepenultimate chamber standing out free at the base, that of the penultimate chamber covered by the base of the last-formed one, the last chamber rounded in transverse section or slightly compressed, with a broadly flaring, slightly downward curved lip; aperture rounded, slightly longer than wide; surface of the test with numerous longitudinal costae, sharp, sometimes, especially in the final chamber, anastomosing. Length 1.25 millimeters.

This species, which I have described and figured from specimens obtained in the Byram marl, also occurred in the Mint Spring marl at stations 6451 and 6452, Mint Spring Bayou, Vicksburg, Miss. The specimens are very similar to those from Byram, Miss., and show the specific characters.

Genus MASSILINA Schlumberger, 1893.

Massilina decorata Cushman, n. sp.

Plate XXXIV, figure 7.

Test much flattened, elliptical or oval, slightly longer than wide, basal and apertural ends projecting, the apertural end narrowed to a small cylindrical neck, nearly in the longitudinal axis of the test; sutures rather indistinct; surface dull white; periphery rounded, the sides ornamented by very fine pits, giving a finely granular appearance to the test. Length 1 millimeter or less.

Type specimens from station 6647, Chickasawhay River 1¼ miles southwest of Boice, Wayne County, Miss. This species also occurred at the following stations:

6452. Mint Spring Bayou, Vicksburg, Miss.
7671. "Brown's Cave," Leaf River, Miss.

This species in some ways resembles some of the specimens referred by Brady to *Spiroloculina tenuis* (Czjzek).

Genus TRILOCULINA D'Orbigny, 1826.

Triloculina peroblonga Cushman, n. sp.

Plate XXXIV, figures 4, 5.

Test much elongate, periphery rounded; chambers rounded at the base; the apertural end coming to or extending slightly beyond the base of the previous chamber; aperture rounded with a simple tooth and a slightly thickened lip; sutures distinct; wall dull white, smooth. Length 1.5 millimeters or less.

Type specimen from station 6451, Mint Spring Bayou, Vicksburg, Miss.

One of the specimens figured shows the aperture at each end, the last-formed chamber evidently having failed to cover the aperture of the preceding chamber, an unusual occurrence in this group.

Triloculina sculpturata Cushman, n. sp.

Plate XXXIII, figures 4, 5.

Test about twice as long as wide; periphery rounded or truncate; sutures indistinct; surface peculiarly sculptured, in general formed of longitudinal costae with broad surfaces, together with irregular connections, forming areolae; aperture rounded, with a simple tooth. Length 0.5 millimeter.

Type specimen from station 6451, Mint Spring Bayou, Vicksburg, Miss. This species was also found at station 6447, Glass Bayou, Vicksburg, Miss.

In its quinqueloculine stage this species has a somewhat extended neck, but in its adult character the aperture does not usually extend beyond the base of the previously formed chamber.

Genus BILOCULINA D'Orbigny, 1826.

Biloculina ornata D'Orbigny.

Plate XXXIII, figure 7.

Biloculina ornata D'Orbigny, Foraminifères fossiles du bassin tertiaire de Vienne, p. 266, pl. 16, figs. 7–9, 1846.

Test slightly longer than wide, each chamber broadest toward the basal end; aperture broadly rounded, the tooth somewhat bifid; surface smooth, dull. Length 0.40 millimeter.

Specimens that may be referred to this species occurred in the Mint Spring marl at stations 6451 and 6452, Mint Spring Bayou, Vicksburg, Miss.

PLATES XXIX-XXXV.

PLATE XXIX.

FIGURE 1. *Bolivina cookei* Cushman, n. sp. Front view of type specimen, × 120. Station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

2. *Bolivina vicksburgensis* Cushman, n. sp. Side view of type specimen, × 120. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

3. *Bolivina frondea* Cushman, n. sp. Side view of type specimen, × 120. Station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

4. *Verneuilina rectimargo* Cushman, n. sp. View of flat face, × 100. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

5. *Verneuilina rectimargo* Cushman, n. sp. View of two faces, × 100. Station 6447, Glass Bayou, Vicksburg, Miss.

6. *Gaudryina* sp. Front view, × 120. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

7. *Bulimina pupoides* D'Orbigny. Side view, × 100. Station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

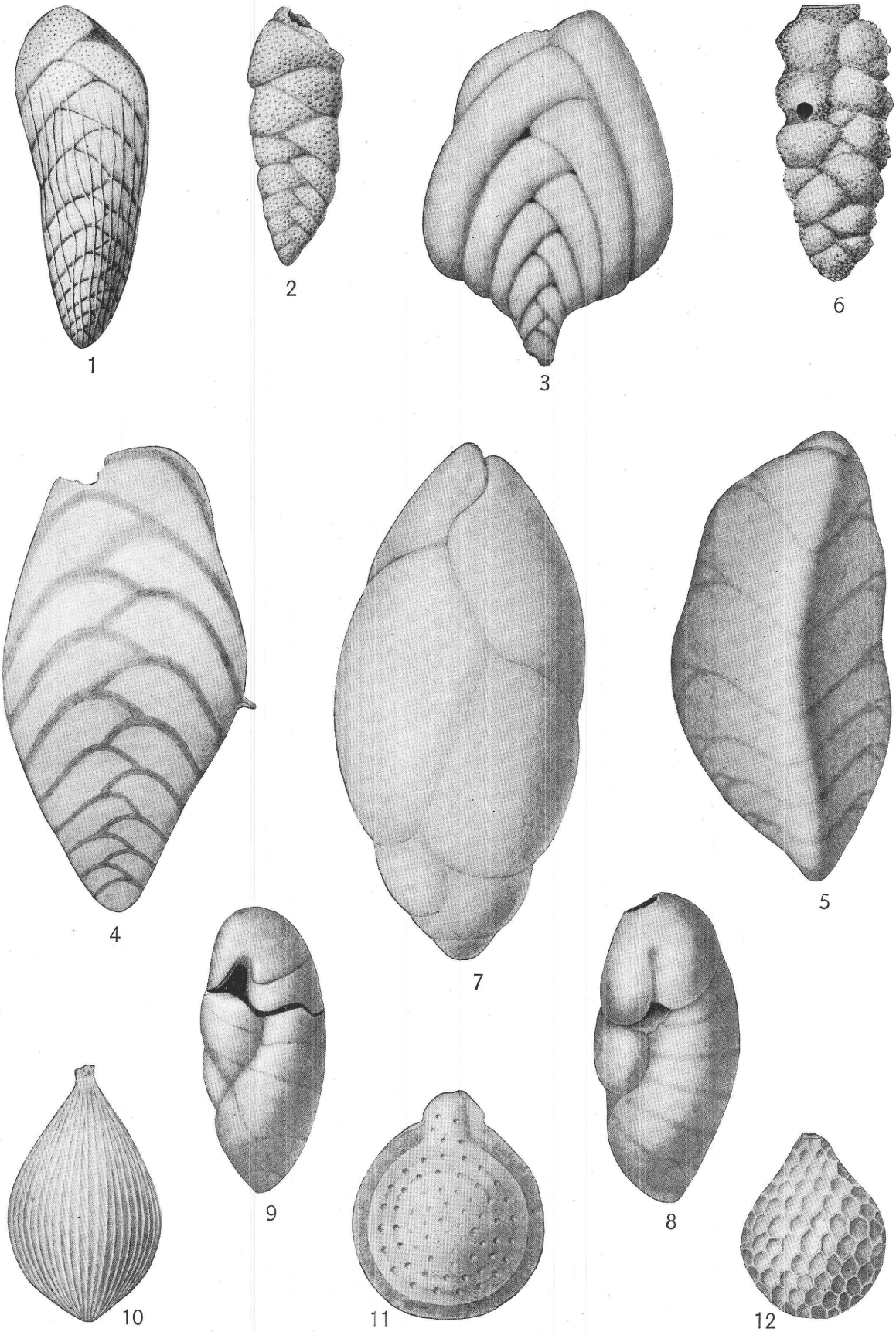
8. *Buliminella subteres* H. B. Brady var. *angusta* Cushman, n. var. Front view, × 120. Type specimen, station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

9. *Buliminella subteres* H. B. Brady var. *angusta* Cushman, n. var. × 120. Station 6447, Glass Bayou, Vicksburg, Miss.

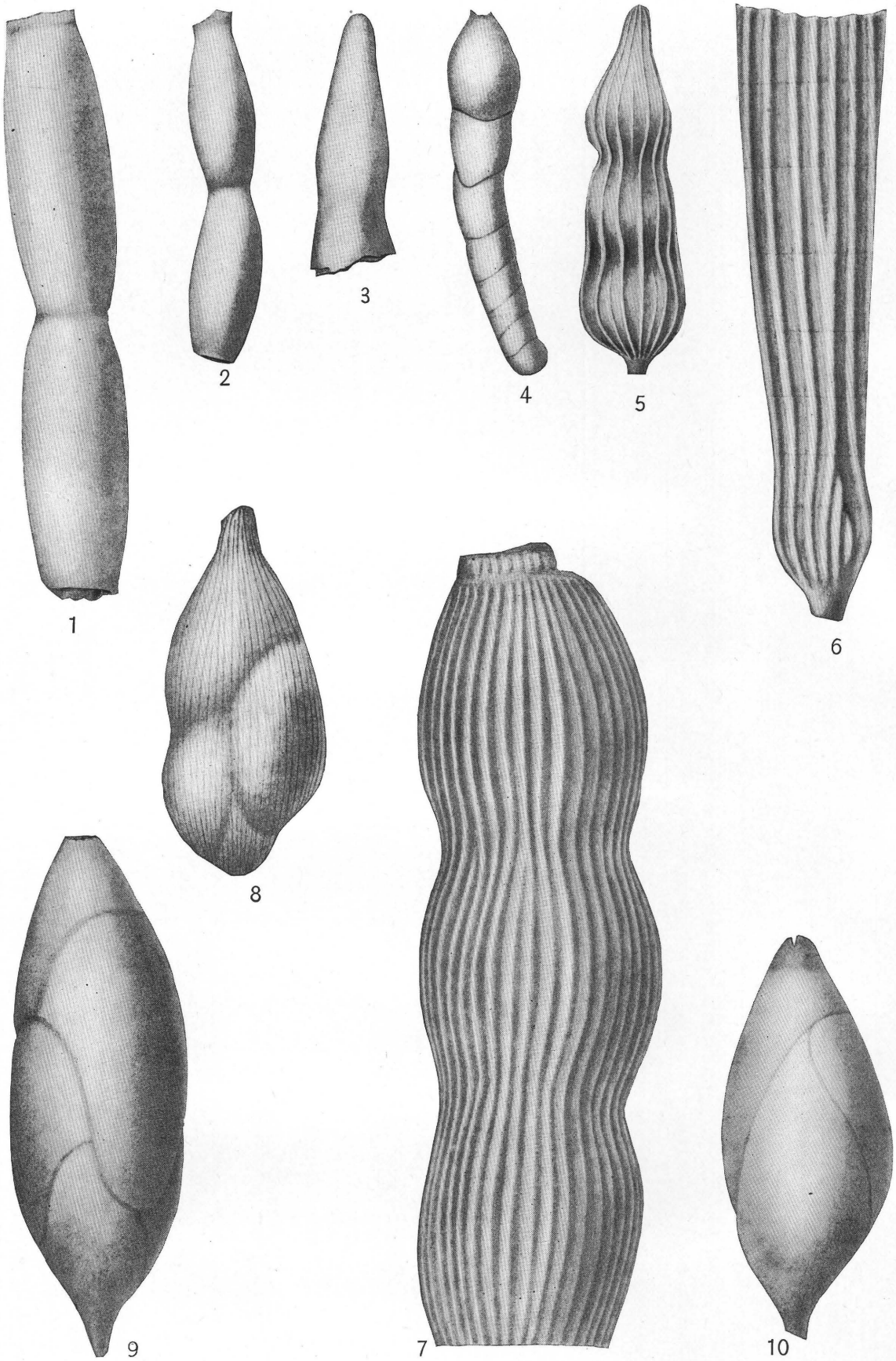
10. *Lagena striata* (D'Orbigny) Reuss var. *substriata* Williamson. × 100. Station 7671, "Brown's Cave," Leaf River, Miss.

11. *Lagena orbignyana* (Seguenza) H. B. Brady var. *flintii* Cushman, n. var. Front view of type specimen, × 100. Station 6447, Glass Bayou, Vicksburg, Miss.

12. *Lagena hexagona* (Williamson) Siddall. Front view, × 100. Station 6452, Mint Spring Bayou, Vicksburg, Miss.



FORAMINIFERA OF THE MINT SPRING CALCAREOUS MARL.



FORAMINIFERA OF THE MINT SPRING CALCAREOUS MARL.

PLATE XXX.

FIGURE 1. *Nodosaria filiformis* D'Orbigny. Side view of two chambers, × 100. Station 6447, Glass Bayou, Vicksburg, Miss.

2. *Nodosaria filiformis* D'Orbigny. Side view of two chambers near the aperture, × 100. Station 7671, "Brown's Cave," Leaf River, Miss.

3. *Nodosaria filiformis* D'Orbigny. View of broken apertural end, × 100. Station 7671, "Brown's Cave," Leaf River, Miss.

4. *Nodosaria communis* D'Orbigny. × 100. Station 7671, "Brown's Cave," Leaf River, Miss.

5. *Nodosaria* sp. Side view, × 100. Station 7671, "Brown's Cave," Leaf River, Miss.

6. *Nodosaria obliqua* (Linnaeus) H. B. Brady. View of early portion of specimen, × 75. Station 7671, "Brown's Cave," Leaf River, Miss.

7. *Nodosaria obliqua* (Linnaeus) H. B. Brady. View of terminal portion of larger specimen, × 75. Station 7671, "Brown's Cave," Leaf River, Miss.

8. *Polymorphina regina* H. B. Brady, Parker, and Jones. Side view, × 125. Station 7671, "Brown's Cave," Leaf River, Miss.

9. *Polymorphina cuspidata* H. B. Brady. Side view, × 125. Station 6447, Glass Bayou, Vicksburg, Miss.

10. *Polymorphina cuspidata* H. B. Brady. Side view, × 125. Station 6447, Glass Bayou, Vicksburg, Miss.

PLATE XXXI.

FIGURE 1. *Polymorphina cuspidata* H. B. Brady var. *costulata* Cushman, n. var. Front view of type specimen, × 125. Station 6452, Mint Spring Bayou, Vicksburg, Miss.

2. *Polymorphina vicksburgensis* Cushman, n. sp. Front view of type specimen, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

3. *Polymorphina equalis* D'Orbigny. Front view, × 125. Station 6448, Glass Bayou, Vicksburg, Miss.

4. *Polymorphina advena* Cushman, n. sp. Front view of type specimen, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

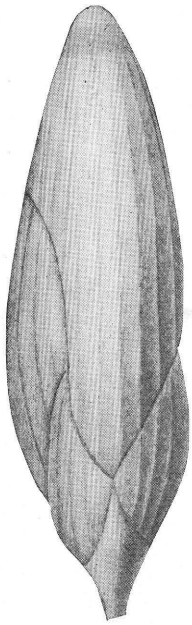
5. *Polymorphina spinosa* D'Orbigny, × 125. Station 7671, "Brown's Cave," Leaf River, Miss.

6. *Cristellaria vicksburgensis* Cushman, n. sp. Side view of type specimen, × 100. Station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

7. *Cristellaria vicksburgensis* Cushman, n. sp. Side view of more complete specimen, × 100. Station 7671, "Brown's Cave," Leaf River, Miss.

8. *Cristellaria cultrata* (Montfort) Parker and Jones. Side view, × 50. Station 7671, "Brown's Cave," Leaf River, Miss.

9. *Patellina advena* Cushman, n. sp. Dorsal view of type specimen, × 125. Station 6452, Mint Spring Bayou, Vicksburg, Miss.



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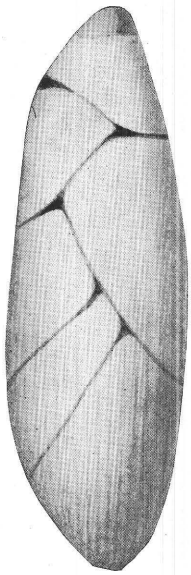

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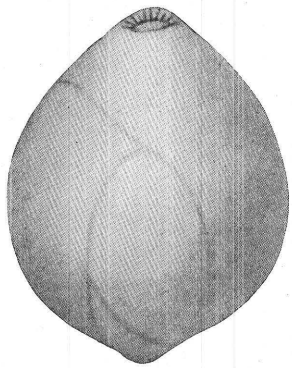

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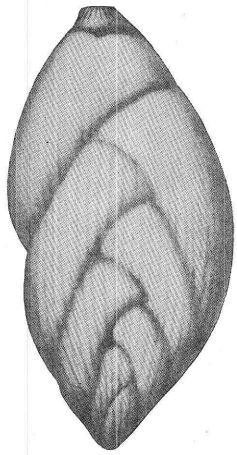

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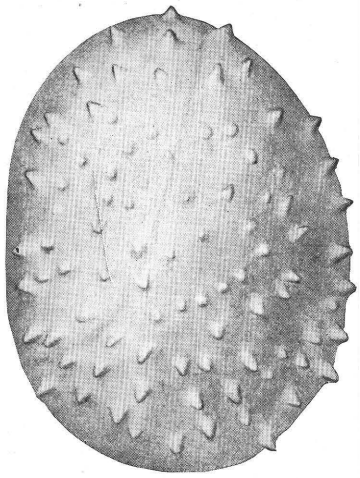

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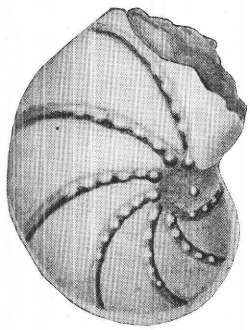

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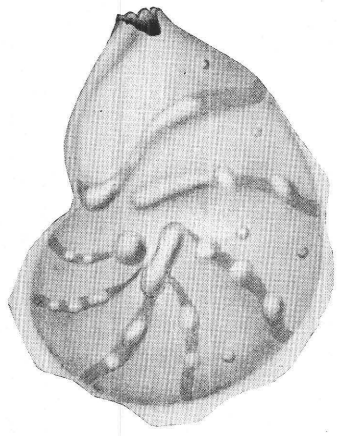

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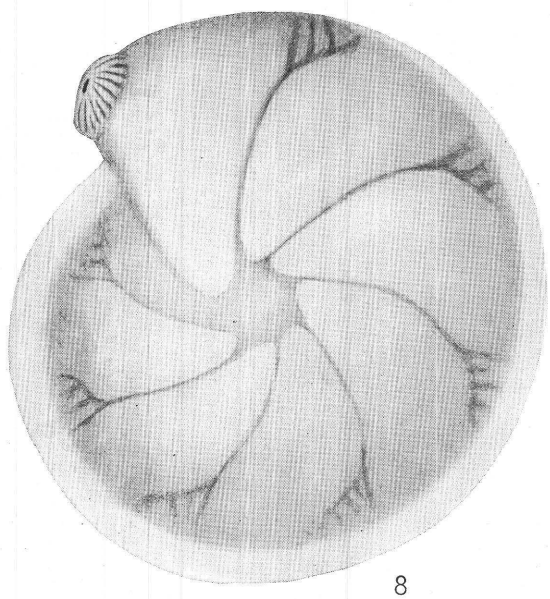

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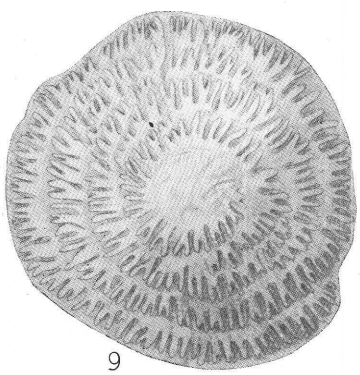

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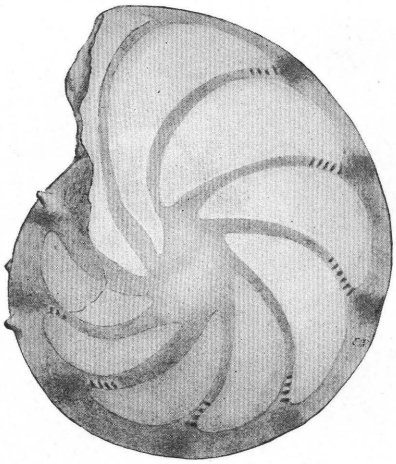
FORAMINIFERA OF THE MINT SPRING CALCAREOUS MARL.



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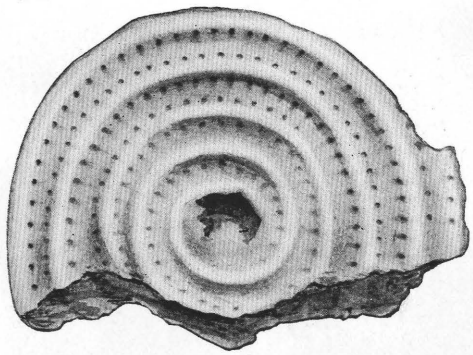

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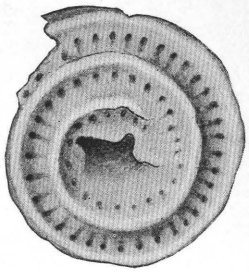

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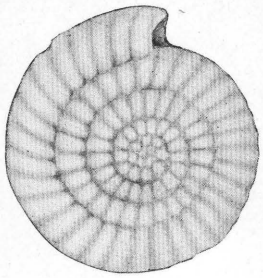

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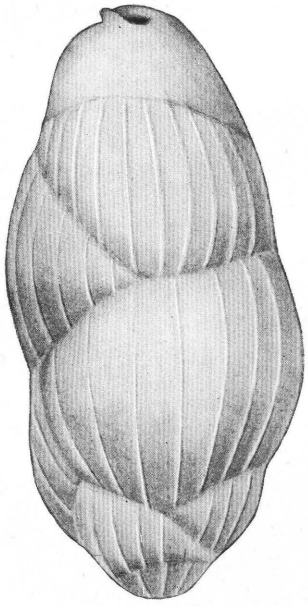

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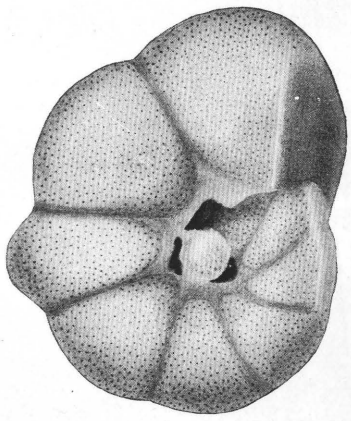

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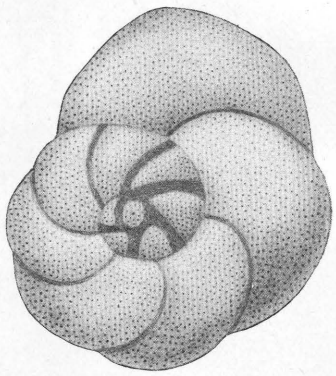

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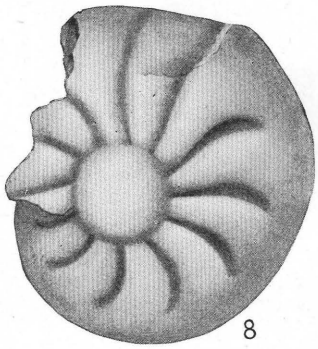

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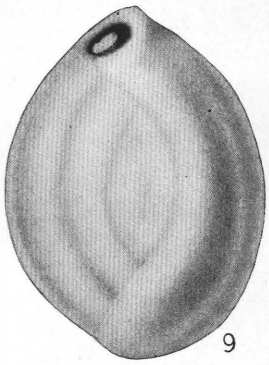

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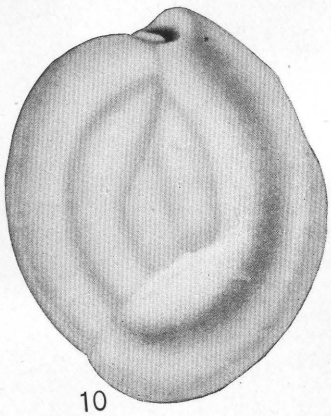

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FORAMINIFERA OF THE MINT SPRING CALCAREOUS MARL.

PLATE XXXII.

FIGURE 1. *Cristellaria rotulata* (Lamarck) D'Orbigny. Side view, × 50. Station 7671, "Brown's Cave," Leaf River, Miss.

2. *Uvigerina pigmea* D'Orbigny. Side view, × 125. Station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

3. *Spirillina limbata* H. B. Brady var. *bipunctata* Cushman, n. var. Dorsal view of type specimen, × 125. Station 7671, "Brown's Cave," Leaf River, Miss. Specimen showing the adult character of the double row of punctations.

4. *Spirillina limbata* H. B. Brady var. *bipunctata* Cushman, n. var. Dorsal view of young specimen, showing but a single row of punctations, × 125. Station 6447, Glass Bayou, Vicksburg, Miss.

5. *Spirillina limbata* H. B. Brady var. *bipunctata* Cushman, n. var. Ventral view, × 125. Station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

6. *Discorbis auracana* (D'Orbigny) Cushman. Ventral view, × 125. Station 6447, Glass Bayou, Vicksburg, Miss.

7. *Discorbis bertheloti* (D'Orbigny) Cushman. Dorsal view, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

8. *Nonionina advena* Cushman, n. sp. Side view of type specimen, × 125. Station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

9. *Quinqueloculina vulgaris* D'Orbigny. Side view, × 125. Station 6448, Glass Bayou, Vicksburg, Miss.

10. *Quinqueloculina vulgaris* D'Orbigny. Side view of another specimen from the opposite side. Station 6448, Glass Bayou, Vicksburg, Miss.

PLATE XXXIII.

FIGURE 1. *Spiroloculina antillarum* D'Orbigny. Side view, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

2. *Quinqueloculina cookei* Cushman, n. sp. Side view of type specimen, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

3. *Quinqueloculina cookei* Cushman, n. sp. Side view of another specimen from opposite side, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

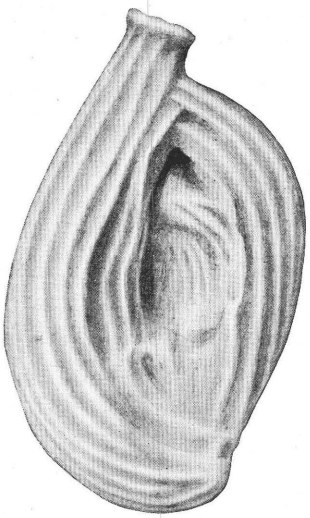
4. *Triloculina sculpturata* Cushman, n. sp. Side view of type specimen, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

5. *Triloculina sculpturata* Cushman, n. sp. Viewed from the side of the last-formed chamber, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

6. *Quinqueloculina lustra* Cushman, n. sp. Side view of type specimen, × 125. Station 6448, Glass Bayou, Vicksburg, Miss.

7. *Biloculina inornata* D'Orbigny. Front view, × 100. Station 6452, Mint Spring Bayou, Vicksburg, Miss.

8. *Quinqueloculina tessellata* Cushman, n. sp. Side view of type specimen, × 125. Station 6447, Glass Bayou, Vicksburg, Miss.



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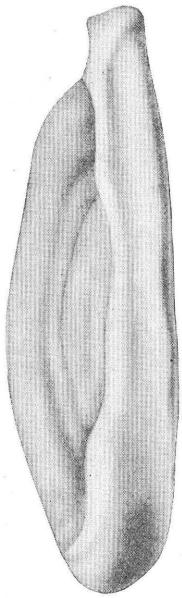

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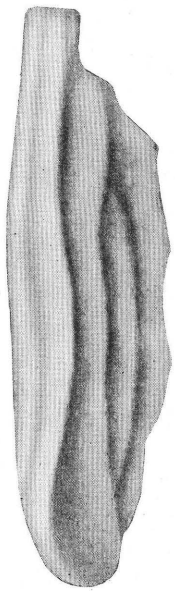

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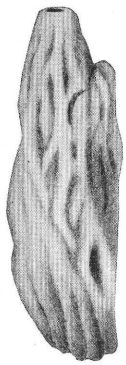

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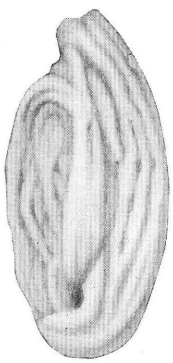

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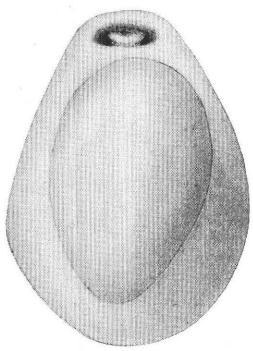

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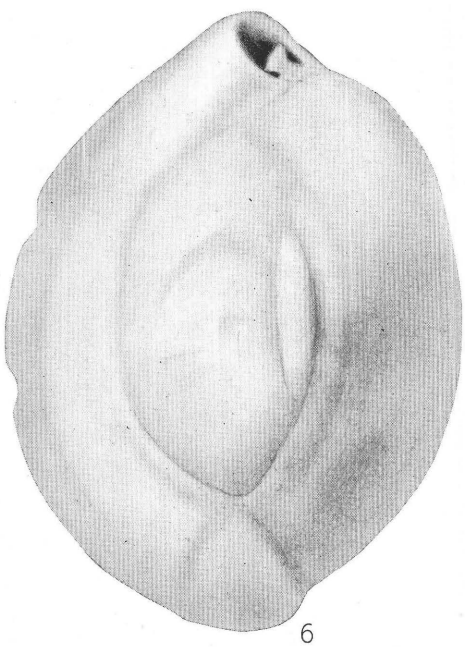

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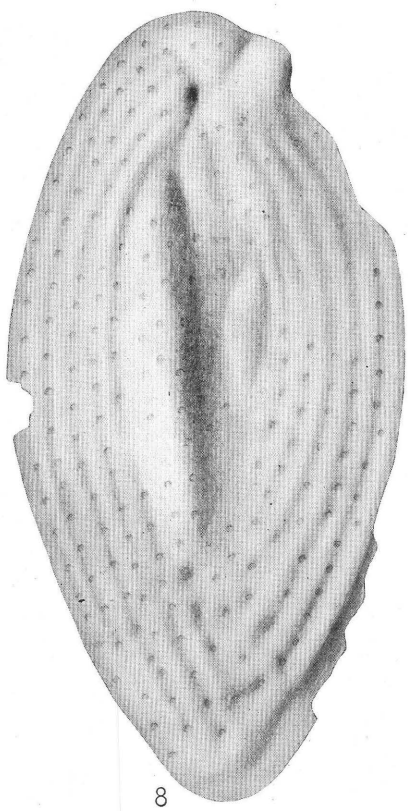

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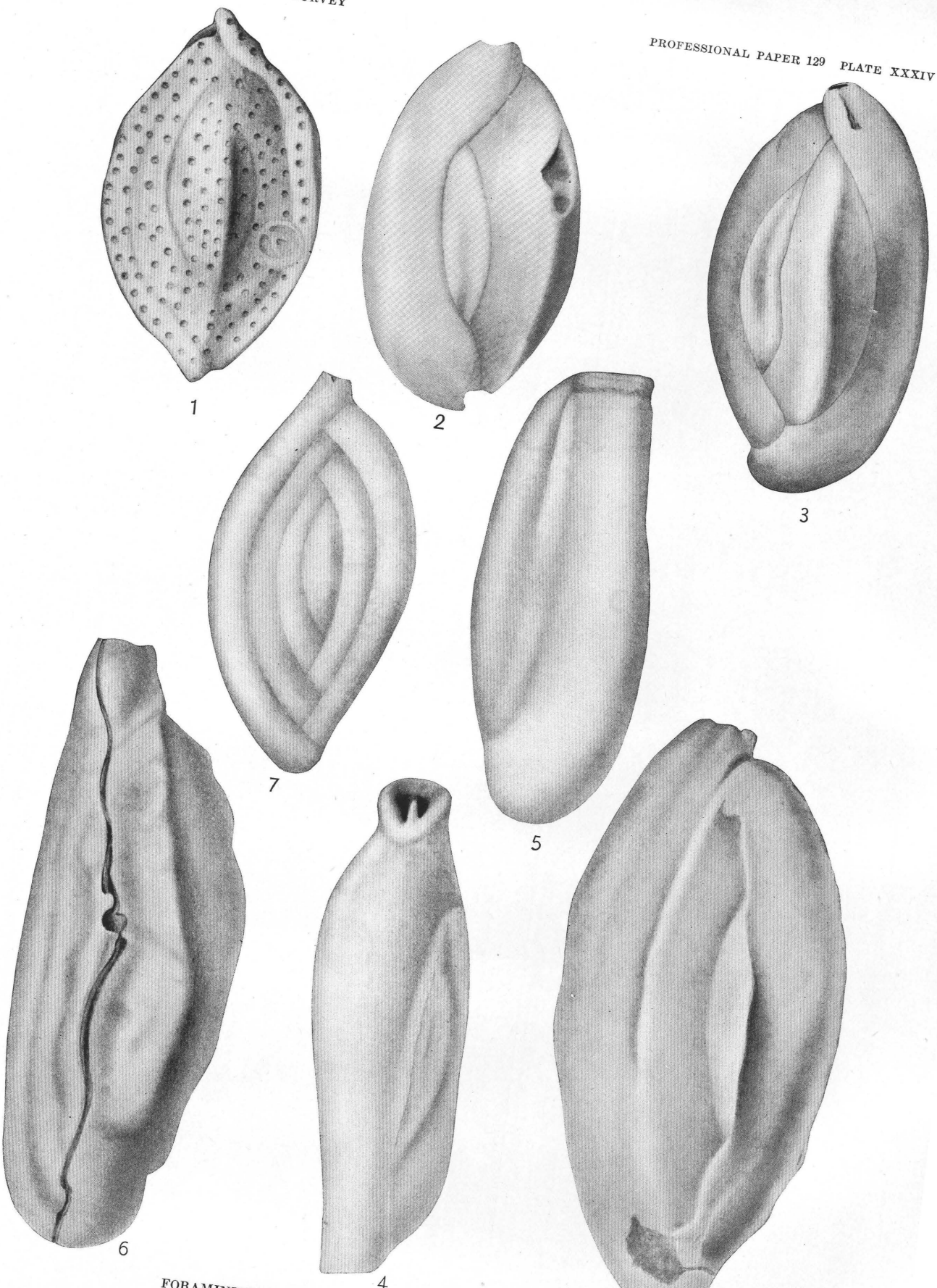
FORAMINIFERA OF THE MINT SPRING CALCAREOUS MARL.



FORAMINIFERA OF THE MINT SPRING CALCAREOUS MARL.

PLATE XXXIV.

FIGURE 1. *Quinqueloculina tessellata* Cushman, n. sp. Side view, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

2. *Quinqueloculina contorta* D'Orbigny. Side view, × 125. Station 6448, Glass Bayou, Vicksburg, Miss.

3. *Quinqueloculina contorta* D'Orbigny. Side view, × 125. Station 6448, Glass Bayou, Vicksburg, Miss.

4. *Triloculina peroblonga* Cushman, n. sp. Specimen with double aperture, one at each end, through failure of the last-formed chamber to cover the preceding chamber completely, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

5. *Triloculina peroblonga* Cushman, n. sp. Type specimen, × 125. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

6. *Quinqueloculina vicksburgensis* Cushman, n. sp. Side view of type specimen, × 125. Station 6447, Glass Bayou, Vicksburg, Miss.

7. *Massilina decorata* Cushman, n. sp. Side view of type specimen, × 125. Station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

8. *Quinqueloculina glabrata* Cushman, n. sp. Side view of type specimen, × 125. Station 6447, Glass Bayou, Vicksburg, Miss.

PLATE XXXV.

FIGURE 1. *Rotalia dentata* Parker and Jones var. *parva* Cushman, n. var. Ventral view, × 100. Station 6451, Mint Spring Bayou, Vicksburg, Miss.

2. *Rotalia dentata* Parker and Jones var. *parva* Cushman, n. var. Dorsal view, × 100. Station 6448, Glass Bayou, Vicksburg, Miss.

3. *Rotalia vicksburgensis* Cushman, n. sp. Ventral view, × 100. Station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

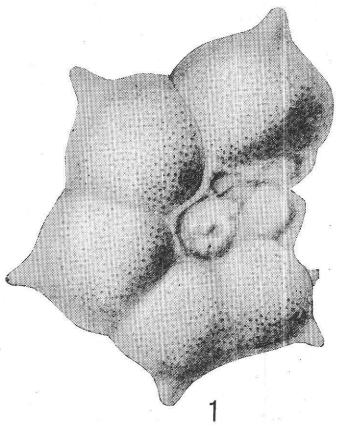
4. *Rotalia vicksburgensis* Cushman, n. sp. Dorsal view, × 100. Station 6647, Chickasawhay River 1¼ miles southwest of Boice, Miss.

5. *Anomalina vicksburgensis* Cushman, n. sp. Dorsal view, × 100. Station 6452, Mint Spring Bayou, Vicksburg, Miss.

6. *Anomalina vicksburgensis* Cushman, n. sp. Ventral view, × 100. Station 6452, Mint Spring Bayou, Vicksburg, Miss.

7. *Truncatulina vicksburgensis* Cushman, n. sp. Dorsal view, × 100. Station 6448, Glass Bayou, Vicksburg, Miss.

8. *Truncatulina vicksburgensis* Cushman, n. sp. Ventral view, × 100. Station 6448, Grass Bayou, Vicksburg, Miss.



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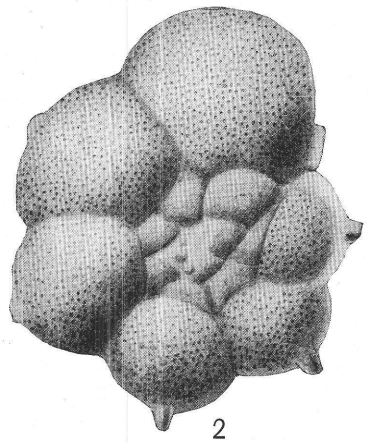

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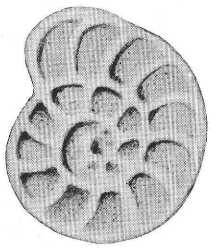

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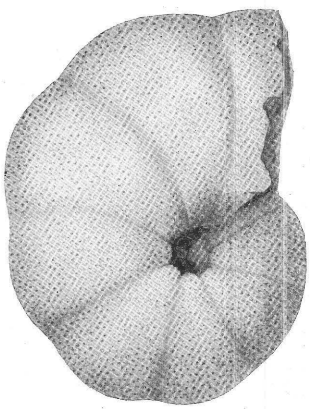

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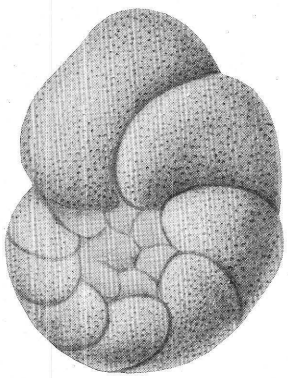

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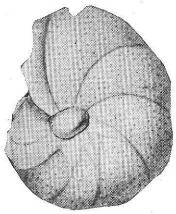

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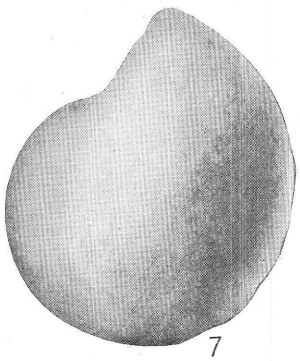
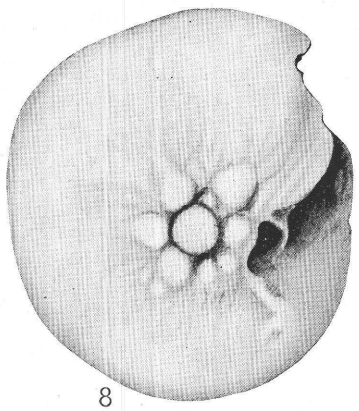


7



8

FORAMINIFERA OF THE MINT SPRING CALCAREOUS MARL.