NOAA Technical Report NMFS Circular 439

Marine Flora and Fauna of the Northeastern United States. Protozoa: Sarcodina: Benthic Foraminifera

Ruth Todd and Doris Low

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U.S. DEPARTMENT OF COMMERCE
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(427.) Bottom-water temperatures in the Gulf of Maine and on Georges Bank during spring and autumn, 1976. By Clarence W. Davis. July 1979, p. 353-362, 6 figs., 3 tables.

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U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and Atmospheric Administration

National Marine Fisheries Service
Terry L. Leitzell, Assistant Administrator for Fisheries

FOREWORD

This NMFS Circular is part of the subseries "Marine Flora and Fauna of the Northeastern United States," which consists of original, illustrated, modern manuals on the identification, classification, and general biology of the estuarine and coastal marine plants and animals of the northeastern United States. The manuals are published at irregular intervals on as many taxa of the region as there are specialists available to collaborate in their preparation.

Geographic coverage of the "Marine Flora and Fauna of the Northeastern United States" is planned to include organisms from the headwaters of estuaries seaward to approximately the 200 m depth on the continental shelf from Maine to Virginia, but may vary somewhat with each major taxon and the interests of collaborators. Whenever possible representative specimens dealt with in the manuals are deposited in the reference collections of major museums of the region.

The "Marine Flora and Fauna of the Northeastern United States" is being prepared in collaboration with systematic specialists in the United States and abroad. Each manual is based primarily on recent and ongoing revisionary systematic research and a fresh examination of the plants and animals. Each major taxon, treated in a separate manual, includes an introduction, illustrated glossary, uniform originally illustrated keys, annotated checklist with information when available on distribution, habitat, life history, and related biology, references to the major literature of the group, and a systematic index.

These manuals are intended for use by biology students, biologists, biological oceanographers, informed laymen, and others wishing to identify coastal organisms for this region. Often they can serve as guides to additional information about species or groups.

The manuals are an outgrowth of the widely used "Keys to Marine Invertebrates of the Woods Hole Region," edited by R. I. Smith in 1964, and produced under the auspices of the Systematics Ecology Program, Marine Biological Laboratory, Woods Hole, Mass. After a sufficient number of manuals of related taxonomic groups have been published, the manuals will be revised, grouped, and issued as special volumes, which will consist of compilations for phyla or groups of phyla.

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Marine Flora and Fauna of the Northeastern United States. Protozoa: Sarcodina: Benthic Foraminifera

RUTH TODD and DORIS LOW[1]

ABSTRACT

An illustrated key to nearshore and shelf species includes 133 taxa. Seventy-nine genera are represented. In an annotated list, the distribution and ecology of each species are recorded within the area of Cape Hatteras to Nova Scotia and out to a depth of 50 m on the continental shelf. The key is intended to aid the nonspecialist in identification of the species to be expected in the marshes, estuaries, littoral zone, bays, and inner parts of the continental shelf.

INTRODUCTION

Foraminifera, an order within the class Sarcodina, are single-celled animals characterized by having a rigid or flexible test, or shell, and pseudopodia consisting of threads of protoplasm. They primarily occupy marine waters, although a few species are able to tolerate brackish conditions and extend into the intertidal and estuarine zones.

The floors of the outer continental shelf, the continental slope, and the ocean basins (exclusive of the deepest parts of the oceans where calcareous materials are dissolved because of the undersaturation of calcium carbonate) are covered by vast deposits of the empty shells of planktonic Foraminifera. Planktonic Foraminifera, floating during life, shed their empty shells onto the sea floor when the animals reproduce or die. This deposit is known as *Globigerina* ooze in reference to one of the principal genera involved. Planktonic Foraminifera are very rare over the inner parts of the continental shelf, and none are included in the present key.

This key refers only to the bottom-dwelling or benthonic species. Most of the species in the key are geographically wide ranging. Some, such as *Cibicides lobatulus* and *Miliammina fusca*, are recorded worldwide, within the limits of their respective environments. A few others, such as *Hopkinsina atlantica* and *Pseudopolymorphina phaleropei*, seem to be restricted to a small part of the area studied. A few of the commoner ones, such as *Elphidium bartletti* and *Cribrostomoides jeffreysii*, are characteristic of Arctic and Subarctic regions. These seem not to extend much farther south than Cape Cod, Mass. For a few others, such as *Elphidium galvestonense* and *Poroeponides lateralis*, Cape Cod appears to be the northern limit. Very few of the species in this area, other than those having worldwide distributions, are found in waters south of Cape Hatteras, N.C.

Several reports describe and illustrate assemblages from specific facies or areas of coastal regions along the northeastern United States. Among the most useful of these are Bailey (1851); Buzas (1965, 1968); Cushman (1944); Ellison and Nichols (1970); Murray (1969); Parker (1948, 1952a, b); Parker and Athearn (1959); Phleger and Walton (1950); Poag et al. (1980); Ronai (1955); Schafer and Sen Gupta (1969[2]); Schnitker (1971); Scott and Medioli (1980); Shupack (1934); Tapley (1969); and Todd and Low (1961). In addition, the following references provide useful records of distribution and details of morphology pertaining to certain of the species of the northeastern United States: Brady (1881c); Cushman (1918b, 1920, 1922a, 1923, 1929, 1930, 1931); Cushman and Ozawa (1930); Rhumbler (1904); and Schultze (1854).

MORPHOLOGY

The morphology of Foraminifera is diverse. In shape they range from a simple spherical or saclike chamber, with or without a single opening, to many-chambered forms in which the chambers succeed one another in a variety of ways, such as in a straight or coiled sequence. The coiling may be complicated by differences in the plane of coiling and by consisting of a single or a double row of chambers. In addition, these shapes and structures can be found combined with any of several kinds of wall structure. Walls may be built of 1) various kinds of foreign material gathered by the animal, or 2) calcium carbonate extracted from seawater and then secreted by the animal, either as solid layers or layers perforated by fine or coarse pores.

CLASSIFICATION

The shells of Foraminifera have been studied for some 150 yr, initially as a hobby. Interest in them was greatly stimulated shortly before 1920 when they began to be used in the search for petroleum. Because of their small size and abundance in well cores, they served as convenient means of working out geologic structures. Foraminifera continue to be important in geologic investigations, particularly in biostratigraphy, paleoecology, and paleobiology. Very few species of Foraminifera have been cultured for study as living animals, and these studies reveal how little has been learned thus far about life cycles and the natural classification of this highly plastic group of animals.

Many classification systems have been applied to the order. Loeblich and Tappan (1964), in addition to proposing the classification currently in favor, summarized the earlier ones.

[1]U.S. Geological Survey, Woods Hole, MA 02543.

[2]Schafer, C. T., and B. K. Sen Gupta. 1969. Foraminiferal ecology in polluted estuaries of New Brunswick and Maine. Unpubl. manuscr., 24 p. Atl. Oceanogr. Lab., Bedford Inst., Dartmouth, N.S., Can., Rep. A.O.L. 69-1.

No attempt is made to classify systematically the taxa in this key. Instead they are listed alphabetically for ease in locating any specific one.

This key separates, as species, several forms that may not be true biologic species but only phenotypes of a single species, i.e., variant forms that reflect the influence of environment upon the genetic constitution of that species. The two species of *Miliammina*, the two species of *Spiroplectammina*, and the two species of *Buccella* may fall into this category of phenotypes. This key separates, as species within different genera, some forms that may belong together as a single species. This feature is especially to be expected in the miliolids, a group that is mutable in a single environment as well as highly variable under different environments. As an example, *Quinqueloculina lata* and *Triloculina brevidentata* could probably be regarded as, respectively, quinqueloculine and triloculine forms of a single species. The solving of such questions is beyond the scope of this key, and it seems convenient to have separate names by which to refer to these distinct forms, whether or not they eventually prove to be distinct species.

COLLECTION AND STUDY METHODS

In the intertidal zone, Foraminifera can be collected easily by simple apparatus. Surface sediment can be collected in nested sieves—a 20-mesh screen above and 200-mesh screen below (having openings of 0.850 and 0.0074 mm)—between which the finer sand is caught and concentrated by washing in the ocean water. Sediment clinging to the roots of marsh plants or scraped off slime-coated cobbles can likewise be washed into and concentrated between the two nested sieves. A plastic syringe, such as an oven baster, can be used to draw up material carefully, with a minimum disturbance of the surface sediment in or on which Foraminifera live. In fine-grained sediments, a plastic core-barrel liner can be forced several inches into the muddy bottom and then withdrawn to remove an undisturbed segment of sediment. In water too deep to use these means, Foraminifera are generally collected by grab samples or corers. More precise details about collecting and culturing have been described by Arnold (1974).

Foraminifera can be treated by the protein stain Rose Bengal (Walton 1952) in order to determine which of the many specimens in the collection were alive and which were merely empty shells that remained after reproduction or death.

To prepare a wet sample for study, the sample is washed by a delicate stream of freshwater on a 200-mesh screen, then dried and separated by use of several nested screens into size fractions for ease in examination. Each fraction is spread out thinly on a tray and scanned, using a binocular microscope having magnifications of about $\times 10$-$\times 90$ for the coarser to finer fractions. The specimens are picked out from among the sediment grains by use of a moistened sable brush (sizes 000 to 00000 are desirable) and transferred to a cardboard, glass, or plastic slide that has been lightly coated with the water-soluble gum tragacanth. By the use of the moistened brush, an individual specimen can be placed in the most advantageous position for study, or moved into various positions for examination from all aspects.

BIOLOGY

The littoral species of Foraminifera are easily maintained alive in small jars or bowls kept under cool and low light conditions, and loosely covered to retard evaporation. It is not necessary to add food. The bowl is a self-contained unit in which the Foraminifera live on food materials in the sediment and original seawater in which they were collected. Freshwater should be added occasionally to compensate for evaporation.

The food of Foraminifera consists of diatoms, filamentous algae, other microscopic algae, and probably also bacteria. Many species contain, within the protoplasm inside the chamber walls, symbiotic algae which provide food for the Foraminifera by photosynthesis. Those species that do not contain symbiotic algae generally feed by ingestion of food outside the test. Some capture their food from the surrounding seawater (filter feeding), others by grazing on the bottom sediment or on slime-covered shells, rocks, plant stems, or other supports that rise above the sea floor (deposit feeding).

Reproduction in Foraminifera has been studied in only a very few species. Asexual reproduction is accomplished by multiple fission of the parent protoplasm, i.e., the breaking up of the nucleus into many parts so that each embryo receives a part of the parent nucleus. This process leaves the parent test empty. Reproduction normally involves alternation of an asexual and a sexual generation, the two generations having certain differences in their test morphology. The individuals resulting from the asexual phase generally have a larger initial chamber but a smaller adult size than those resulting from the sexual phase.

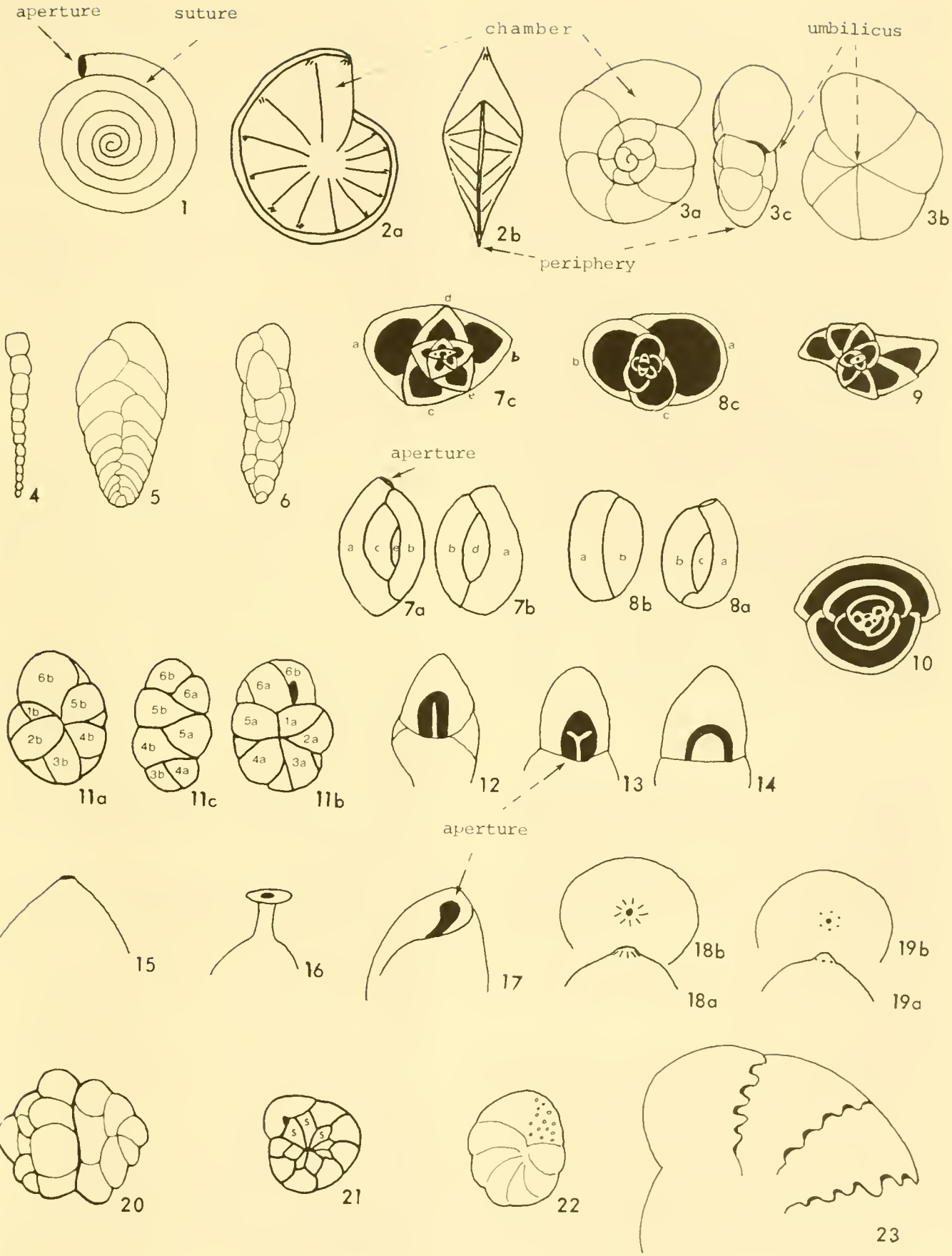
USE OF THE KEY

This key is designed as a finding key, not a classification key. It therefore disregards a natural classification and, in a few places, groups together genera that may have little phylogenetic relationship to one another. Moreover, this key applies only to the species of the inshore waters along the northeastern coast of the United States. Because of this restriction, some dichotomous separations are made on combinations of features that elsewhere could not be combined.

In setting up the key we have tried to use easily recognizable features and to explain, in diagrams and words, the differences between features that are not so easily recognizable.

The initial dichotomy between agglutinated and secreted tests may become a problem when the agglutination is very fine

Figures 1,2.—Planispiral coiling. 3.—Trochospiral coiling. 4-6.—Uniserial, biserial, and triserial chamber arrangements. 7.—Milioline coiling and quinqueloculine chamber arrangement. 7a, b, opposite sides; 7c, chambers in transverse section. Chamber a is the last formed; chamber b is the next to last; chamber c is the third from last, etc. Each chamber as added continues from the aperture of the previous one; thus, the previous aperture, not visible, is at the opposite end of the test. 8.—Milioline coiling and triloculine chamber arrangement comparable with that shown in Figure 7. 9.—Sigmoiline chamber arrangement in transverse section. 10.—Biloculine chamber arrangement in transverse section. 11.—Coiling of a double row of chambers, i.e., as if a biserial test (Fig. 5) were bent into a coil. 11a, lateral view; 11b, lateral view opposite to that of 11a; 11c, edge view. Chambers are identified by numbers (to indicate the sequence of pairs) and letters (to indicate right and left chambers in each pair). 12-14.—Simple tooth, bifid tooth, and valvelike tooth. 15.—Simple terminal aperture. 16.—Terminal aperture at the end of a neck surrounded by a phialine lip. 17.—Comma-shaped aperture. 18.—Radiate aperture, consisting of a terminal aperture surrounded by a ring of radial slits. a, side view; b, top view. 19.—Vasiglobuline aperture, consisting of a terminal aperture surrounded by a ring of small pores. a, side view; b, top view. 20.—Two specimens attached by their umbilical surfaces in plastogamy. 21.—Supplementary chambers (s), a whorl of smaller chambers, each covering the inner (umbilical) part of each larger chamber. 22.—Supplementary pores, an area of large openings over the face of the final chamber. 23.—Septal bridges, a series of prolongations of the chamber extending backward over the depressed suture.


aperture
suture
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1
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aperture
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18b
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19b
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23

grained, or when the secreted test is coarsely porous or its wall surface rugose. High magnifications, to ×90 or even more, are useful in determining the true nature of the wall. Another method for recognizing presence or absence of porosity is to touch the specimen with a lightly moistened brush and to watch (under the microscope) the water as it either evaporates around the imperforate test or sinks into the finely porous one.

Internal structures, such as tubes and septa, and chamber arrangements can be observed by use of transmitted light, rather than the reflected light customarily used for study of Foraminifera. To do this, the specimen must be transferred from the usual cardboard slide to a glass slide. Glycerine or clarifying oils such as those used for petrographic study are useful aids in observing internal features of Foraminifera without the necessity of breaking the tests.

The tests of some species are described as flexible or collapsible. This feature is demonstrable only when the animal is first collected and is still in seawater. As soon as it is dried, the test collapses into a flattened shape or shows concavities instead of convexities over the empty chambers. Some of these collapsed tests may reinflate when wetted. By observation of these sorts of deformity, one can conclude that the test was flexible.

At the many final dichotomies in this key, the separations are often made between species on the basis of imprecise features that, if only one species is under study, are very difficult to assess. Such imprecise features include slight differences in shape of test, length of septal bridges, or angle of sutures; small differences in number of chambers; differences in degree of inflation or compression, of roughness of wall, or of coarseness of pores; and differences of rigidity and flexibility. The subjective judgment required to choose between such nonspecific separations can be aided by two specific factors: size of the specimen and its habitat. Size is included in the key descriptions and habitat is included in the annotated list following the key.

GLOSSARY

acute Sharp, angled.

agglutinated, arenaceous Test composed of foreign material, such as mud, sediment grains, shell fragments, spicules, or other Foraminifera, gathered by the animal.

annular Arranged in a ring.

apertural face A flattened area on the edge of the test upon which or at the base of which, the aperture is situated (see Figs. 2b, 3c, 11b, 17, 22).

aperture Main (largest) opening or openings from the interior to exterior of the final chamber of the test (see Figs. 1, 3c, 11b, 12, 13, 14, 16, 17, 18b, 19b, 21, 22).

apical end Initial end, basal, referring to the beginning of the test.

arched-shaped aperture (see Fig. 3c).

arenaceous, agglutinated Test composed of foreign material, such as mud, sediment grains, shell fragments, spicules, or other Foraminifera, gathered by the animal.

attached Test is cemented to a foreign object.

biconvex Bulging on both sides.

bifid tooth Having two prongs or branches (see Fig.13).

biloculine coiling In which two chambers constitute a whorl, each chamber is half a coil long, and the chambers are added at intervals of 180° around the axis of coiling so that each succeeding chamber completely encloses the next to the last preceding chamber, and only two chambers are visible from the exterior—one from one side of the test and both from the other (see Fig. 10).

biserial Chambers arranged in two adjacent rows (see Fig. 5).

calcareous Composed of lime ($CaCO_3$).

chamber Subdivision of the test making an enclosure or cavity, inside which the animal lives (see Figs. 2a, 3a).

coil (or *whorl*) A ring of chambers or, in a single-chambered test, a complete rotation of the single chamber (see Figs. 1, 2a, 3a, 11a, b, 21, 22).

coiled (or *spiral*) *side* The side of the test on which the earlier whorls are visible (see Fig. 3a).

comma-shaped aperture In which the aperture is rounded at one end and pinched together at the opposite end (see Fig. 17).

complex aperture Aperture consisting of more than one opening (see Figs. 18, 19, 22).

compressed Flattened.

concavo-convex Hollowed out on one side and bulging on the other.

costae; costate Raised ribs; covered with raised ribs.

crenulated Notched.

cribrate aperture Consisting of a group of large pores (see Fig. 22).

depressed Indented, incised, lower than the surrounding surface (said of sutures or umbilicus)(see Fig. 3c).

equatorial aperture Opening on the edge of the test.

evolute coiling Coiling in which all the earlier whorls of the test are visible and not hidden under later whorls (see Fig. 1).

excavated Lower than the surrounding area.

flush Level with the surface of the surrounding area.

friable Crumbly, easily broken apart.

granular; granules Finely roughened; grainy.

hispid Very finely spinose, hairy.

hyaline Transparent or translucent; having a luster like glass.

imperforate (or *porcellaneous*) *wall* Solid, lacking pores; having a luster like porcelain.

incised Indented.

initial end The beginning of the test.

involute coiling Coiling in which all the earlier whorls are hidden under the final whorl (see Figs. 2a, b).

keel A distinct rim (see Figs. 2a, b).

limbate Thickened.

lobe An inflated part of the chamber.

lobulate Scalloped in outline (said of the periphery as observed in side view) (see Figs. 3a, b).

miliolids Specimens belonging in the family Miliolidae, characterized by having an imperforate wall.

milioline coiling Coiling in which two chambers make up each whorl (see Figs. 7, 8, 9, 10).

multiserial Chambers arranged in more than a single row (see Figs. 5, 6).

neck A slender tubular end of the final chamber (see Fig. 16).

ovate Egg-shaped, having a larger diameter toward one end than toward the other.

papillae; papillate Small, blunt, raised knobs; covered by small, blunt raised knobs.

perforate wall Penetrated by very fine pores; porous.

periphery; peripheral Edge; at the edge (see Figs. 2b, 3c).

phenotypes Two or more forms of a species that differ in their visible characters.

phialine lip Surrounded by an outward-flaring rim, like that on a vial (see Fig. 16).

planispiral coiling Coiling in a single plane (see Figs. 1, 2a, b).

planoconvex Flat on one side and bulging on the other.

plastogamy Reproductive stage in which two specimens have their umbilical surfaces cemented together (see Fig. 20).

plug A massive deposit of shell material within or filling the umbilical area.

porcellaneous (or *imperforate*) *wall* Solid, lacking pores; having a luster like porcelain.

pore Small opening from interior to exterior of the test.

primary aperture The major opening of the final chamber of the test.

pseudochitinous Composed of a flexible organic compound, secreted by the animal, that makes up the wall or serves as cement in certain species.

pseudopodia Slender threads of protoplasm extending outward from the living animal through the aperture (and pores if any) of the test.

quadrangular Roughly four-sided.

quinqueloculine coiling Coiling in which five chambers constitute a whorl; each chamber is half a coil long and the chambers are added at intervals of 144° around the axis of coiling (but 72° from the adjacent chamber) so that three chambers are visible from one side and four from the opposite side (see Fig. 7).

radiate aperture Terminal aperture characterized by radiating slits (see Figs. 2a, b, 18).

reticulated Appearing as a meshwork or network.

ribs Ridges of thickened shell material.

rotaline (or *trochospiral*) *coiling* Coiling in a rising spire rather than a single plane (see Figs. 3a-c).

rugose Rough.

sac A simple sacklike form.

secreted Derived from the metabolic functions of the animal.

septal bridges A series of fingerlike bridges across the suture (see Fig. 23).

septum, septa Internal wall or walls separating or subdividing chambers.

sigmoiline coiling Coiling in which each chamber is half a coil long and the chambers are added at intervals of slightly more than 180° around the axis of coiling, resulting in a sigmoid transverse section (see Fig. 9).

siliceous Composed of quartz grains (silica) cemented together with a silica cement.

spine, spines A needlelike projection (or projections) of shell material at the initial end of the test, along the basal parts of chambers, or completely covering the test.

spiral Coiling in a ring.

spiral (or *coiled*) *side* The side of the test on which the earlier whorls are visible (see Fig. 3a).

striae; striated Fine grooves or channels; covered with fine grooves or channels.

subglobular Approaching the shape of a sphere.

supplementary aperture An opening or openings other than the major opening into the test; larger than pores (see Fig. 22).

supplementary chambers Smaller chambers covering or in addition to the larger chambers (see Fig. 21).

suture Line between adjacent chambers; intersection of internal septum and exterior wall (see Figs. 1, 2a, 3a, 4, 5, 6, 7a, b, 8a, b, 20, 21, 22).

taxa Units of any rank in taxonomy, such as genus, species, or subspecies (singular *taxon*).

terminal aperture At then end, rather than at the side, of the test (see Figs. 15, 16, 18, 19).

test Shell, or housing, in which the animal lives.

tooth A protuberance or projection within the aperture (see Figs. 12, 13, 14).

triloculine coiling Coiling in which three chambers constitute a whorl; each chamber is half a coil long, and the chambers are added at intervals of 120° around the axis of coiling so that two chambers are visible from one side and three from the opposite side (see Fig. 8).

triserial Chambers arranged in three adjacent rows (see Fig. 6).

trochoid; trochospiral (or *rotaline*) *coiling* Coiling in a rising spire rather than a plane (see Figs. 3a-c, 20).

truncate As if cut off.

umbilical side The side of the test on which only the final whorl is visible (see Fig. 3b).

umbilicus; umbilical The central area (usually a depression) where the sutures that separate the chambers come together (see Figs. 2a, 3b).

uniserial Chambers arranged in a single row (see Fig. 4).

valvelike tooth A broad plate that partly blocks the aperture (see Fig. 14).

vasiglobuline aperture Terminal aperture characterized by a ring of small openings (see Fig. 19).

wall Rigid or flexible material, porous or nonporous, that surrounds the living animal.

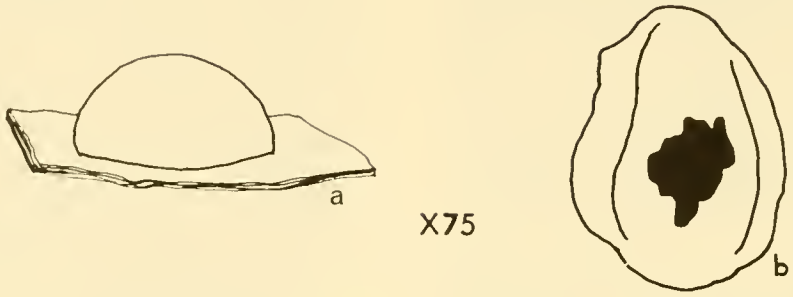
whorl (or *coil*) A ring of chambers or, in a single-chambered test, a complete revolution of the single chamber (see Figs. 1, 2a, 3a, 11a, b, 21, 22).

KEY TO SPECIES OF FORAMINIFERA

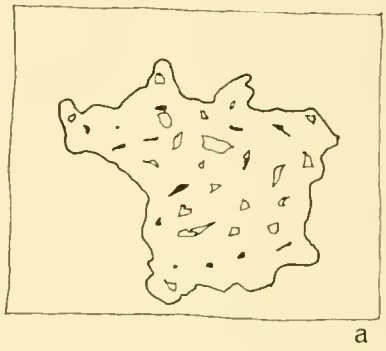
1	Test agglutinated	2
1	Test secreted	52
2 (*1*)	Test is single-chambered	3
2 (*1*)	Test has more than one chamber	19
3 (*2*)	Test is attached	4
3 (*2*)	Test is not attached	10

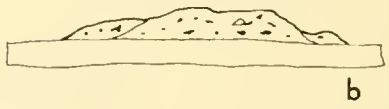
4 (3) Test has no aperture 5

4 (3) Test has one or more apertures 6



5 (4) Wall is thick, rigid, and fine grained; shape is hemispherical. Diameter 0.30-0.50 mm. a, Oblique view; b, basal view of detached specimen ..... *Hemisphaerammina bradyi*

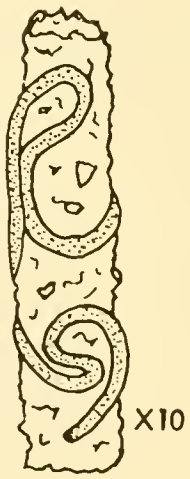




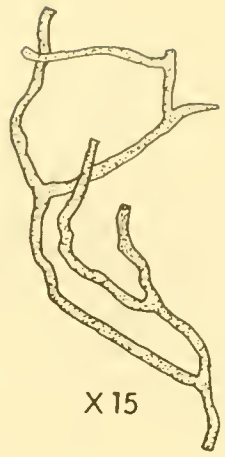
5 (4) Wall is thin, flexible, coarse grained; shape is variable, low, spreading. Areal extent is variable, usually >1 mm across; wall thickness about 0.02 mm. a, Top view; b, side view ..... *Iridia diaphana*

6 (4) Test is a slender tube 7

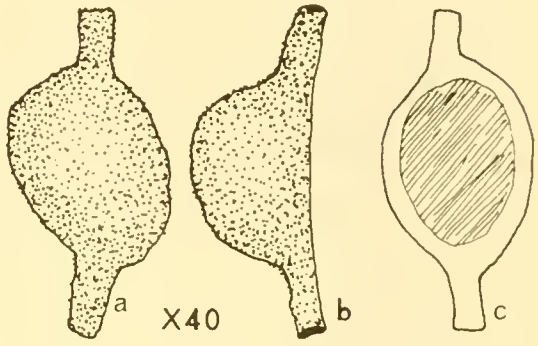
6 (4) Test is hemispherical 8



7 (6) Test consists of a slender winding tube of uniform width, normally encrusted upon shell fragments, pebbles, or other Foraminifera. Diameter of tube about 0.10 mm. (Specimen attached to a fragment of *Rhabdammina*.) ..... *Tolypammina vagans*

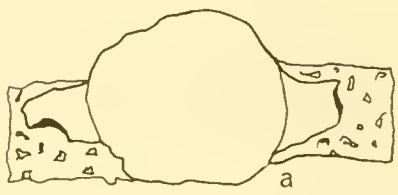


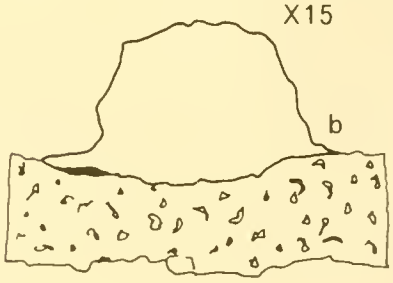
7 (*6*) Test is branching and slender, growing upward from an attached base. Normally observed as fragments. Diameter of tube 0.08–0.10 mm. ..... *Dendrophrya arborescens*



8 (*6*) Test is flexible; apertures are at the ends of short stalks, usually one at each end of the slightly elongate hemisphere; wall is fine grained, roughened, orange in color. Diameter exclusive of apertural stalks 0.50-0.70 mm. a, Top view; b, side view showing apertural stalks; c, basal view of detached specimen showing filamentous floor of test ..... *Thurammina? limnetis*

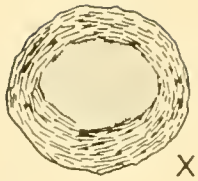
8 (*6*) Test is rigid 9





9 (*8*) Apertures are indistinct, consisting of low irregular openings between the test and its support; wall is fine grained. Diameter exclusive of apertural extensions 0.50-2.50 mm. a, Top view of specimen attached to a fragment of *Rhabdammina*; b, side view ..... *Tholosina bulla*

9 (*8*) Apertures are distinct, consisting of several radiating tubes that are also attached to the supporting object. Diameter exclusive of apertural tubes 0.20-0.70 mm. Top view ..... *Tholosina vesicularis*



10 (*3*) Test is spherical, lacks an aperture; wall is thick, consisting of matted sponge spicules. Diameter 0.70-1.00 mm. Broken section ..... *Crithionina pisum*

10 (*3*) Test has one or more apertures 11

11 (*10*) Test has one aperture 12

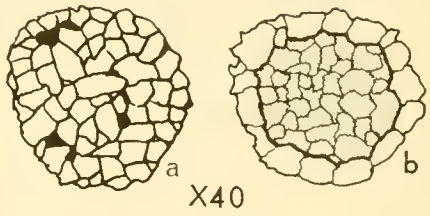
11 (*10*) Test has two or more apertures 13

12 (*11*) Aperture is simple 14

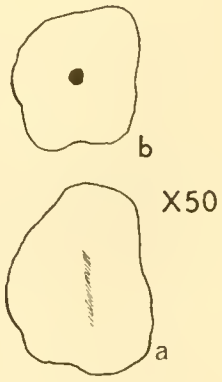
12 (*11*) Aperture is at the end of a neck 15

13 (*11*) Test is an elongate tube open at both ends 17

13 (*11*) Test is generally globular 18

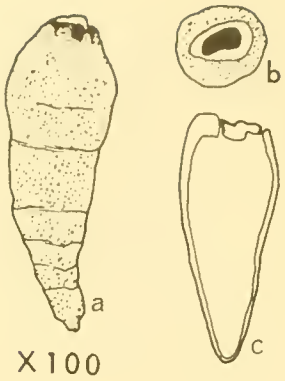


14 (*12*) Aperture is usually obscured by mud filling; wall is thin, rigid, consisting of a single layer of large sand grains neatly fitted together. Diameter 0.60-1.00 mm. a, Exterior; b, broken section ..... *Psammosphaera fusca*



14 (*12*) Test is elongate subspherical; aperture is a round opening; wall is flexible, outer layer consisting of fine sand. Diameter 0.40-0.50 mm. a, Side view; b, top view ..... *Saccammina*? sp.

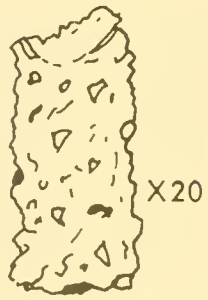
15 (*12*) Wall is coarsely agglutinated 16



15 (*12*) Wall is finely agglutinated, thin, test consists of a tapering tube; surface fine grained, creased by transverse wrinkles. Length 0.35-0.55 mm. a, Exterior; b, top view; c, section ..... *Hippocrepina indivisa*

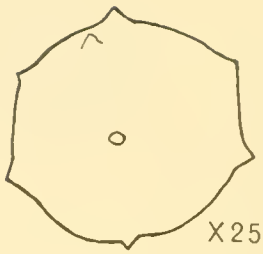
16 (*15*) Neck is distinct from the main body of the test; wall consists of a mixture of fine and coarse grains. Length 0.42-0.65 mm ..... *Saccammina difflugiformis* forma *typica*

16 (*15*) Neck tapers to the apertural opening; wall consists of relatively large grains, smoothly finished by the addition of finer grains in the interstices. Length 0.60-0.80 mm ..... *Saccammina difflugiformis* forma *atlantica*



17 (*13*) Test is rigid, relatively large; wall thin, consists of a mixture of coarse and fine sand grains, both exterior and interior surfaces rough. Length indeterminate because specimens are fragmentary; diameter about 0.80 mm ..... *Rhabdammina*? sp.

17 (*13*) Test is collapsible; wall consists mostly of mud with the addition of minor amounts of coarse grains or shell fragments. Length as much as 3 mm or more; diameter 0.4 mm or more ..... *Pelosina cylindrica*



18 (*13*) Apertures are at the ends of protruding nipples; wall is thin, very fine grained, parchmentlike. Diameter about 1 mm ..... *Thurammina papillata*

18 (*13*) Apertures are at the ends of radiating arms; test has a discoid center; wall is coarse and friable. Diameter exclusive of arms 2-4 mm ..... *Astrorhiza limicola*

19 (*2*) Test consists of two chambers—a spherical initial chamber and a long undivided second chamber; coiling is planispiral; wall is fine grained; color reddish or yellowish brown. Diameter about 0.30 mm ..... *Ammodiscus minutissimus*

19 (*2*) Test consists of more than two chambers 20

20 (*19*) Chambers, in the later part of the test, are arranged in a row or rows 21

20 (*19*) Chambers are arranged in a coil 35

21 (*20*) Test is uniserial 22

21 (*20*) Test is multiserial 30

22 (*21*) Test is not coiled at the beginning 23

22 (*21*) Test has a coiled beginning 26

23 (*22*) Test is flexible, minute, later chambers overhanging earlier ones. Length 0.30-0.55 mm ..... *Reophax scottii*

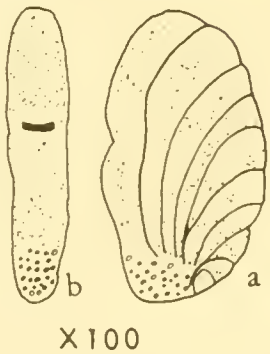
23 (*22*) Rigid test 24

24 (*23*) Test is compressed; chambers are broader than high. Length 0.35-0.42 mm. a, Side view; b, top view ..... *Reophax arcticus*

24 (*23*) Test is circular in transverse section; wall is rough owing to relatively large sand grains 25

25 (*24*) The last several chambers are nearly equal in size. Length 0.65-0.90 mm ..... *Reophax scorpiurus*

25 (*24*) Final chamber makes up most of the test. Length 1.3-1.7 mm ..... *Reophax curtus*

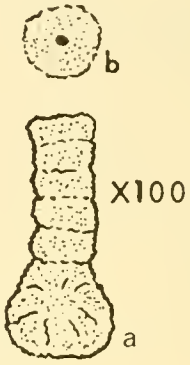


26 (*22*) Test is composed entirely of coiled chambers; aperture is a transverse slit in the middle of the apertural face; pores at the base of the coil constitute supplementary apertures; wall is finely arenaceous, smoothly finished. Length about 0.4 mm. a, Side view; b, edge view ..... *Ammoastuta inepta*

26 (*22*) Test has an initial coil and an uncoiled part 27

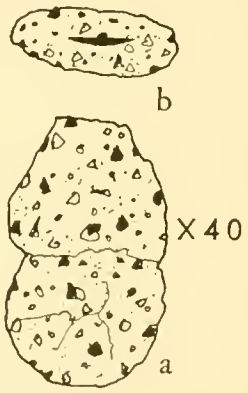
27 (*26*) Test is only partly uncoiled, i.e., the later chambers reach back toward the initial coil; test is compressed throughout; wall is coarsely arenaceous. Length as much as 1.90 mm, breadth 0.55-0.70 mm, thickness 0.40-0.50 mm ..... *Ammotium cassis*

27 (*26*) Test has a coiled initial stage followed by a straight uniserial part 28

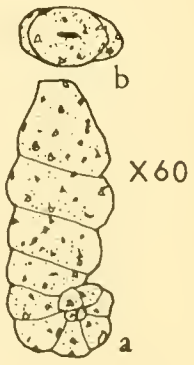


28 (*27*) Test is cylindrical; uniserial chambers are low; sutures are horizontal and inconspicuous. Length 0.30-0.35 mm. a, Side view; b, top view ..... *Ammobaculites exiguus*

28 (*27*) Test is compressed; apertural end is contracted 29



29 (*28*) Coiled part constitutes the major part of the test; sutures indistinct, not deeply depressed. Length as much as 1.00 mm, width of coiled part about 0.60 mm. a, Side view; b, top view ..... *Ammobaculites dilatatus*



29 (*28*) Coiled part constitutes a minor part of the test; sutures distinct, slanting, depressed. Length 0.50-0.70 mm. a, Side view; b, top view ..... *Ammobaculites crassus*

30 (*21*) Multiserial part is inconspicuous; test is minute, slender, initial end sharply tapering. Length about 0.42 mm. a, Side view; b, top view ..... *Pseudoclavulina gracilis*

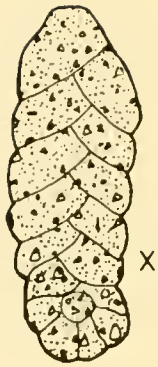
30 (*21*) Multiserial part makes up most of the test 31

31 (*30*) Test is triserial; wall is finely arenaceous, smoothly finished, usually orange. Length 0.40-0.70 mm. a, Side view; b, top view ..... *Eggerella advena*

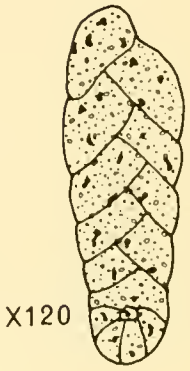
31 (*30*) Test is biserial 32

32 (*31*) Test has a conspicuous coil at its beginning 33

32 (*31*) Test is tapering from its initial point 34



33 (*32*) Test is minute, narrow but thick, of nearly equal breadth throughout. Length about 0.30 mm ..... *Spiroplectammina biformis*



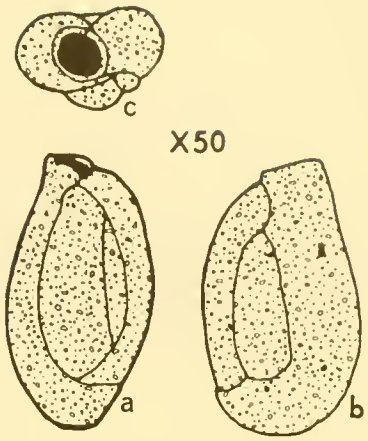
33 (*32*) Test is compressed, somewhat tapering. Length about 0.42 mm ..... *Spiroplectammina typica*

34 (*32*) Test is thick; chambers are in a plane, sutures are generally horizontal. Length 0.40-0.50 mm ..... *Textularia earlandi*

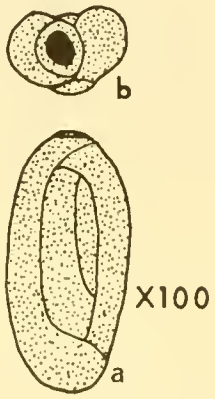
34 (*32*) Test is minute, delicate, compressed; chambers are in a warped plane, as if the test were twisted around its elongate axis; sutures generally slanting at about 45°. Length about 0.30 mm. a, Side view; b, top view ..... *Textularia torquata*

35 (*20*) Coiling is milioline; wall is finely arenaceous, smoothly finished, siliceous, hence insoluble in hydrochloric acid 36

35 (*20*) Coiling is spiral 37



36 (*35*) Test is relatively large and robust. Length 0.60-0.80 mm. a, b, Opposite sides; c, top view ..... *Miliammina fusca*



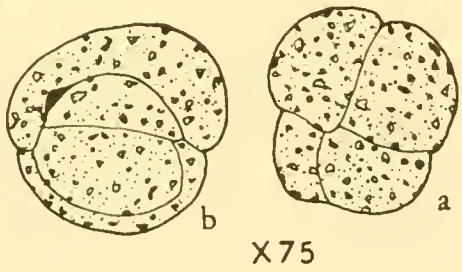
36 (*35*) Test is relatively small, slender, and elongate. Length 0.32-0.40 mm. a, Side view; b, top view ..... *Miliammina petila*

37 (*35*) Spiral coiling is approximately in a plane (planispiral) and involute 38

37 (*35*) Spiral coiling is trochoid (rotaline) and evolute on one side 42

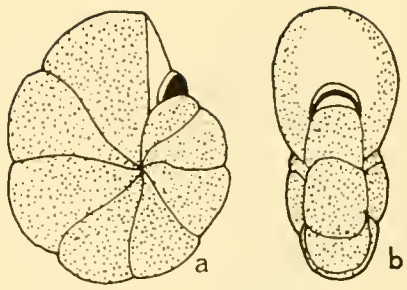
38 (*37*) Aperture is at the base of the final chamber 39

38 (*37*) Aperture is within the face of the final chamber 41

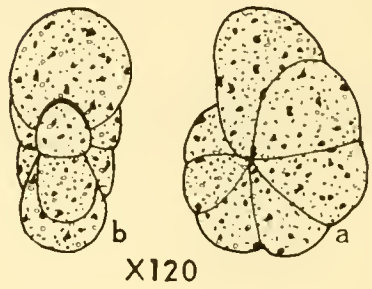


39 (*38*) Coiling is slightly asymmetrical; test is subglobular; aperture is low and inconspicuous, at one side of the apertural face. Diameter 0.25-0.45 mm. a, Side view; b, front view ..... *Adercotryma glomeratum*

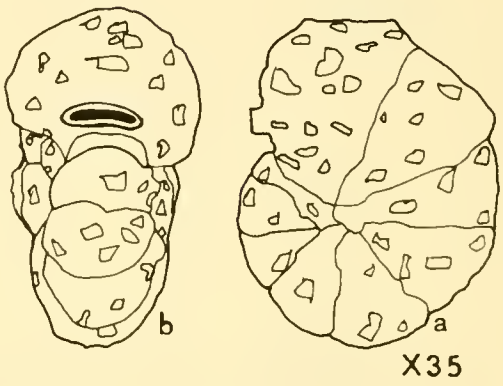
39 (*38*) Coiling is strictly planispiral 40



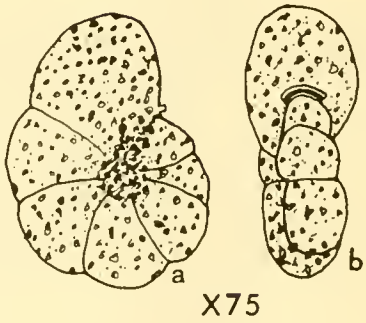
40 (*39*) Chambers are not inflated; umbilicus is not well developed; wall is finely arenaceous, smooth, glossy. Diameter 0.25-0.40 mm. a, Side view; b, edge view ..... *Haplophragmoides hancocki*



40 (*39*) Chambers are few (7 or less), inflated; umbilicus is well developed; wall is coarsely arenaceous and smoothly finished. Diameter 0.25-0.30 mm. a, Side view; b, edge view ..... *Haplophragmoides bonplandi*



41 (*38*) Test is large, robust, coarse surfaced, usually orange. Diameter 0.90-1.30 mm; thickness about 0.50 mm. a, Side view; b, edge view ..... *Cribrostomoides crassimargo*



41 (*38*) Test is delicate, smooth surfaced. Diameter 0.45-0.60 mm. a, Side view; b, edge view ..... *Cribrostomoides jeffreysii*

42 (*37*) Aperture is simple 43

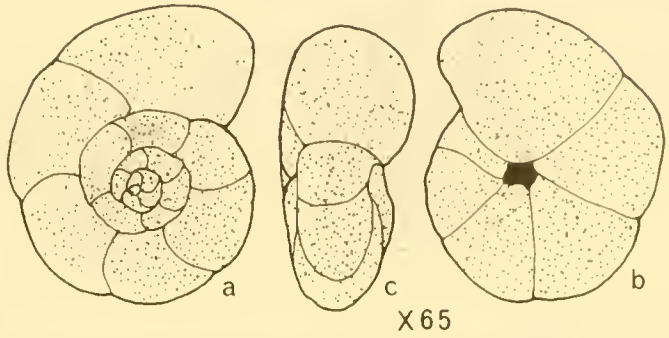
42 (*37*) Aperture is complex 50

43 (*42*) Fine grained, smooth surfaced 44

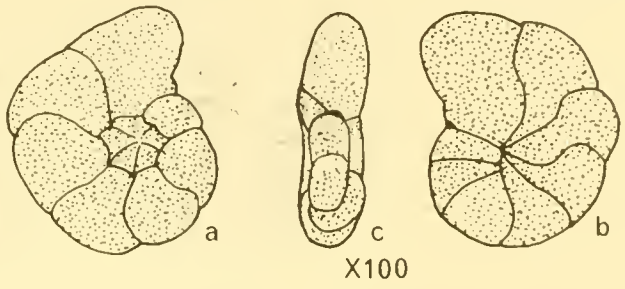
43 (*42*) Medium to coarse grained 47

44 (*43*) Of normal to large size 45

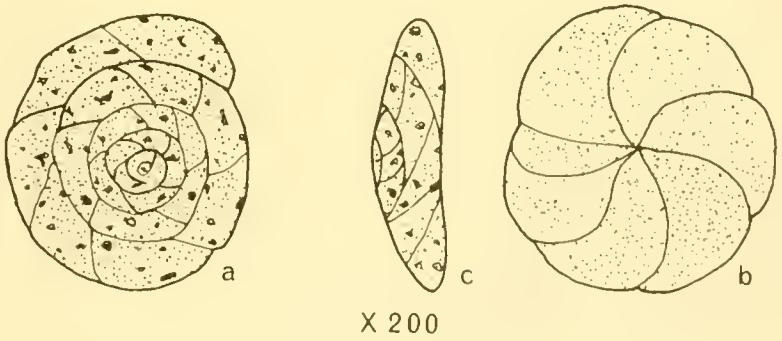
44 (*43*) Minute, scalelike 46



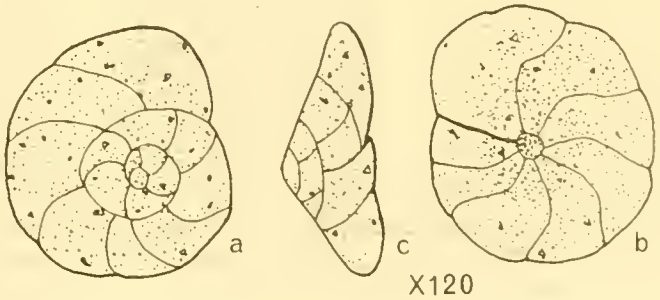
45 (*44*) Early chambers are usually accentuated by a dark filling beneath the wall surface; sutures are distinct, incised on the umbilical side; umbilicus is deep and open. Diameter 0.50-0.80 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Trochammina inflata*



45 (*44*) Test is flexible, collapses when dry. Diameter 0.25-0.35 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Trochamminа macrescens*



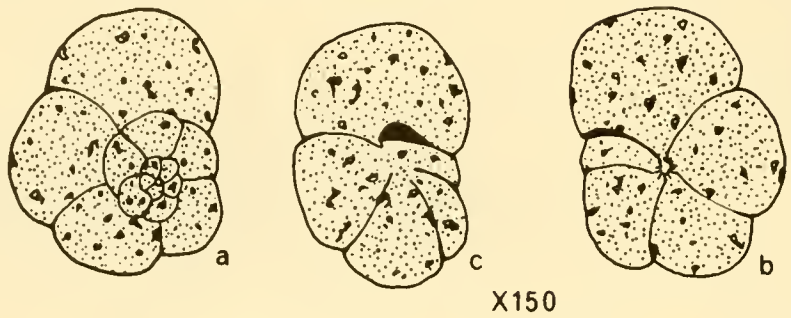
46 (*44*) Whorls are many and narrow; umbilical surface is finer grained than spiral surface. Diameter 0.15-0.22 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Trochammina ochracea*



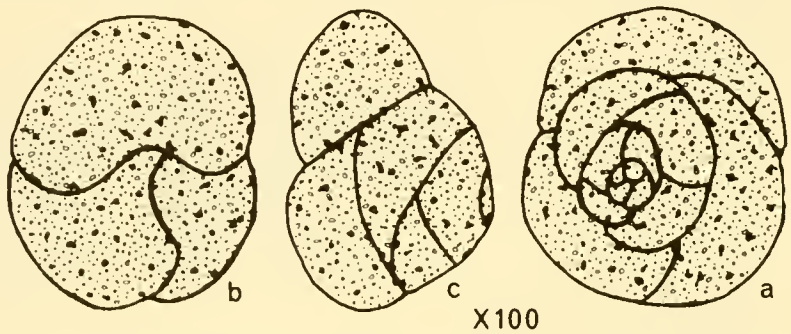
46 (*44*) Whorls are few and wide. Diameter 0.20-0.40 mm. a, Spiral view; b, umbilical view; c, edge view.. *Trochammina squamata*

47 (*43*) Chambers are few (3 or 4); test is relatively thick 48

47 (*43*) Chambers are many (6 or more), not inflated; test is relatively flat 49

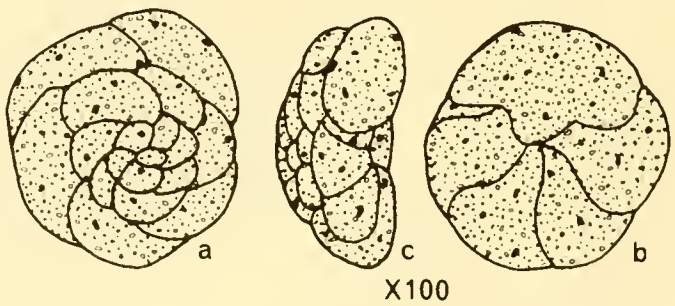


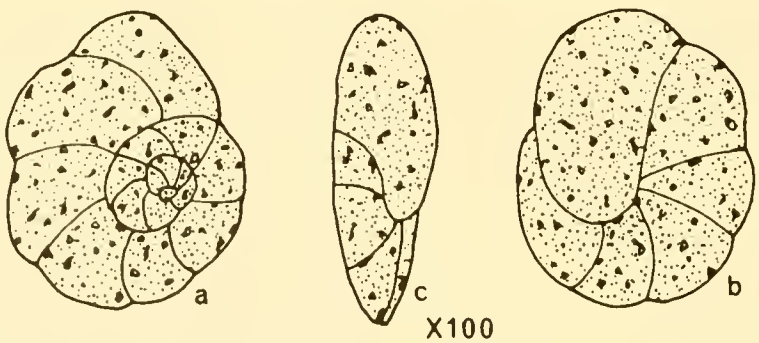
48 (*47*) Test is moderately compressed; chambers are inflated and periphery lobulate. Diameter 0.22-0.25 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Trochammina advena*



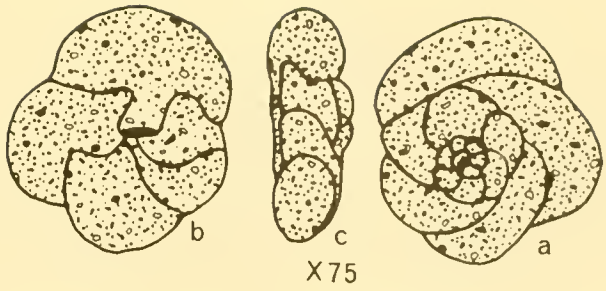
48 (*47*) Test is compact, subglobular; chambers are not inflated and periphery not lobulate. Diameter 0.30-0.40 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Trochammina compacta*

49 (*47*) Umbilical side is concave, umbilicus is open; chambers are many, not much increasing in size as added. Diameter 0.30-0.55 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Trochammina rotaliformis*



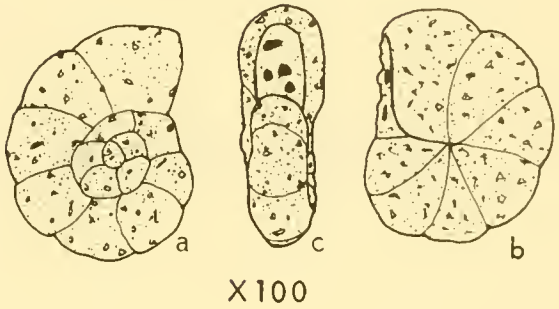


49 (*47*) Final chamber is extended as a bulging lobe covering the umbilical area; whorls are few; chambers increase rapidly in size as added. Diameter 0.40-0.50 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Trochammina nana*

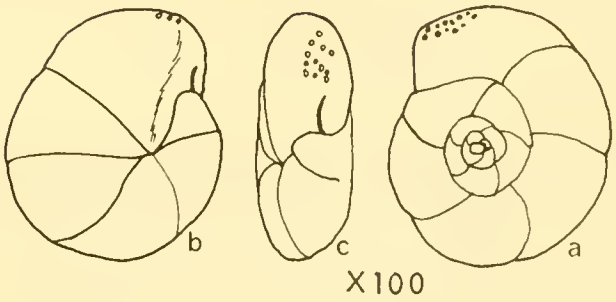


50 (*42*) Apertures are sutural openings on the concave umbilical side, plus an opening in the final chamber at the end of the umbilical lobe. Diameter 0.35-0.45 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Tiphotrocha comprimata*

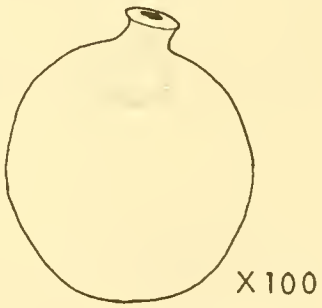
50 (*42*) Apertures are pores on the face of the final chamber 51



51 (*50*) Primary aperture is equatorial rather than umbilical. Diameter 0.30-0.35 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Jadammina polystoma*



51 (*50*) Primary aperture is a slit extending into the apertural face; wall is very finely arenaceous, smooth, glossy. Diameter 0.32-0.35 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Arenoparrella mexicana*



52 (*1*) Test is pseudochitinous; wall is flexible, collapses when dry; shape is ovoid, with an inner and outer collar surrounding the apertural opening. Diameter 0.16-0.45 mm ..... *Allogromia laticollaris*

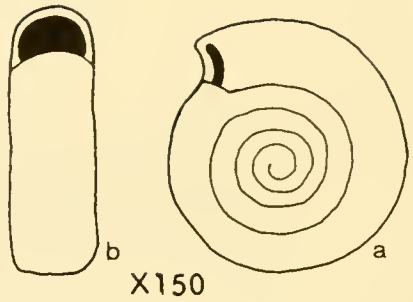
52 (*1*) Test is calcareous 53

53 (*52*) Wall is imperforate and opaque, porcellaneous, usually milky white 54

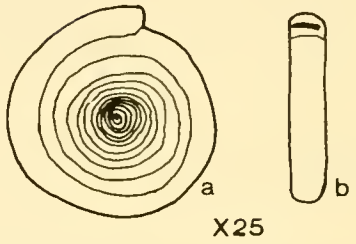
53 (*52*) Wall is perforate and glassy or translucent 68

54 (*53*) Coiling is planispiral 55

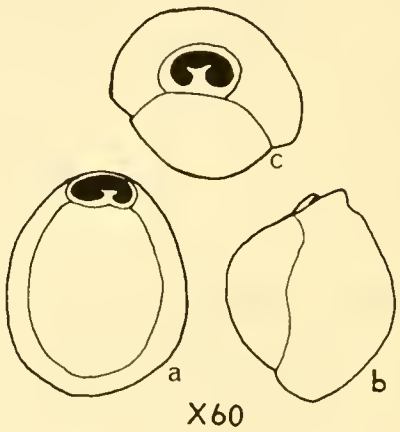
54 (*53*) Coiling is milioline 56



55 (*54*) Test is relatively small with few whorls of equal size; wall is translucent and glossy. Diameter 0.20-0.22 mm. a, Side view; b, edge view ..... *Cornuspira planorbis*



55 (*54*) Test is relatively large with many overlapping whorls; wall is opaque. Diameter 1.00 mm or larger. a, Side view; b, edge view ..... *Cornuspira involvens*

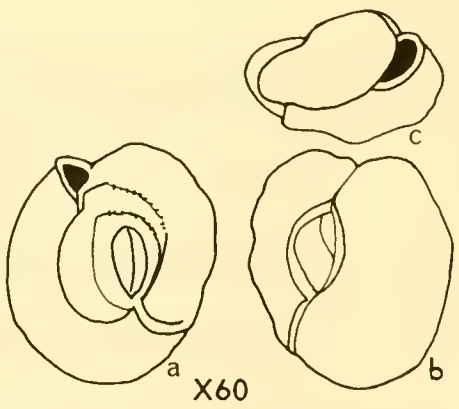


56 (*54*) Two chambers only are visible from the exterior; test is subglobular; aperture is large, rounded, with a low bifid tooth. Length 0.40-0.60 mm. a, Front view; b, side view; c, top view ..... *Pyrgo subsphaerica*

56 (*54*) More than two chambers are visible from the exterior 57

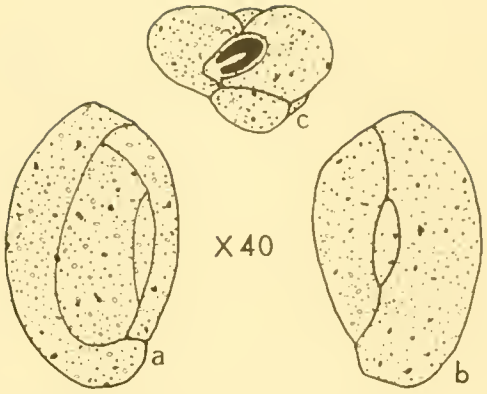
57 (*56*) Four chambers are visible from one side and three from the other (quinqueloculine) 58

57 (*56*) Three chambers are visible from one side and two from the other (triloculine) 64



58 (*57*) Aperture lacks a tooth; test is flattened, nearly circular in outline, rounded on the periphery. Length 0.30-0.55 mm. a, b, Opposite sides; c, top view ..... *Pateoris hauerinoides*

58 (*57*) Aperture has a tooth 59

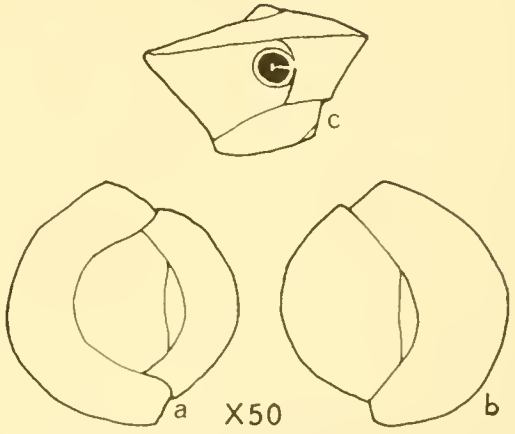


59 (*58*) Wall is coated with sand grains; periphery is rounded. Length 0.80-1.15 mm. a, b, Opposite sides; c, top view ..... *Quinqueloculina frigida*

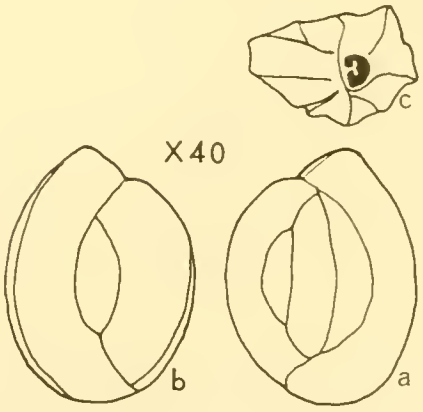
59 (*58*) Wall is smooth or striate 60

60 (*59*) Test is angled on the periphery 61

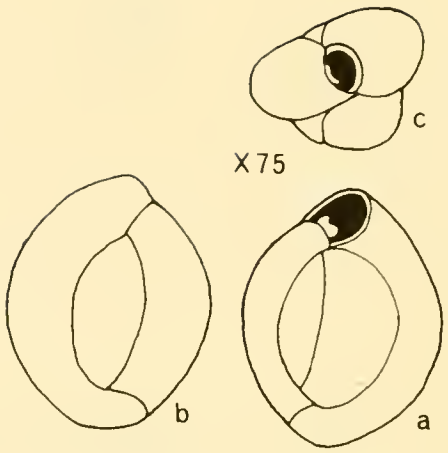
60 (*59*) Test is rounded on the periphery 62



61 (*60*) Periphery is sharply angled; test is short and broad, lacks an apertural neck. Length 0.55-0.75 mm. a, b, Opposite sides; c, top view ..... *Quinqueloculina auberiana*

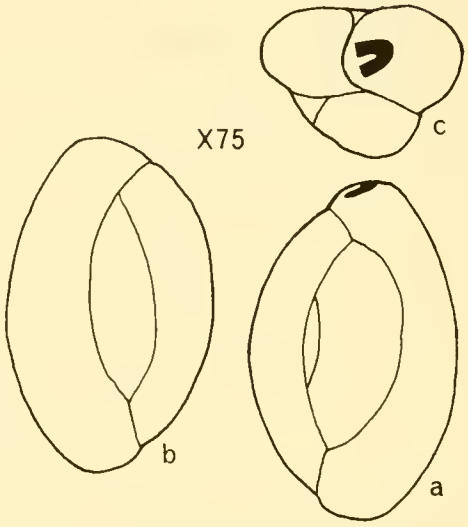


61 (*60*) Periphery is truncate; test is bulky; in some specimens wall is ornamented by fine costae. Length 0.55-1.00 mm. a, b, Opposite sides; c, top view ..... *Quinqueloculina bicornis*

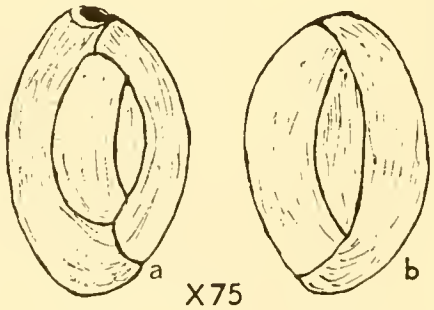


62 (*60*) Test is thin-walled, highly variable in shape, ovate or elongate, smooth or costate; the final chamber overhangs the widely open aperture in a hoodlike fashion, the apertural tooth is generally low. Length 0.40-0.50 mm. a, b, Opposite sides; c, top view ..... *Quinqueloculina lata*

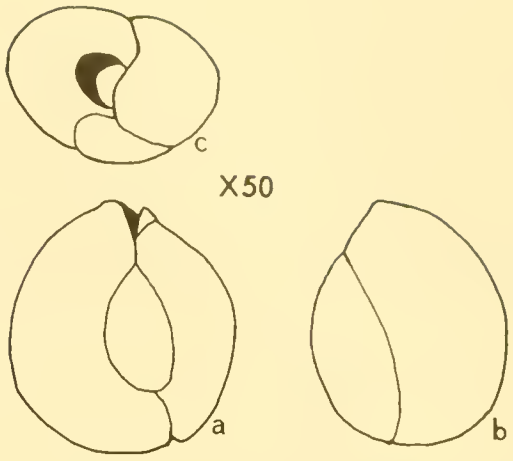
62 (*60*) Test is robust, rounded quadrangular in outline, rounded on the periphery, has a slightly protruding neck 63



63 (*62*) Wall is smooth and polished. Characteristic of surf-washed shores. Length 0.50-0.85 mm. a, b, Opposite sides; c, top view ..... *Quinqueloculina seminulum* forma *typica*

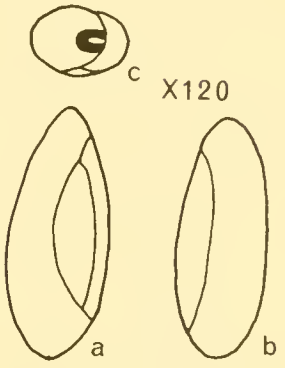


63 (*62*) Wall is costate. Characteristic of bays and inlets. Length 0.40-0.75 mm. a, b, Opposite sides .... *Quinqueloculina seminulum* forma *jugosa*



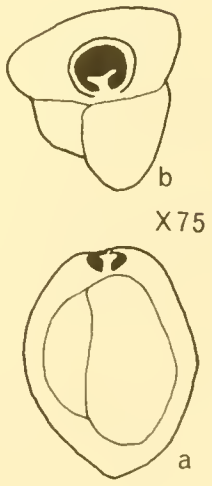
64 (*57*) Aperture is partly blocked by a valvelike plate; test is thick, nearly circular in outline; periphery rounded. Length 0.35-0.65 mm. a, b, Opposite sides; c, top view ..... *Miliolinella subrotunda*

64 (*57*) Aperture has a tooth 65



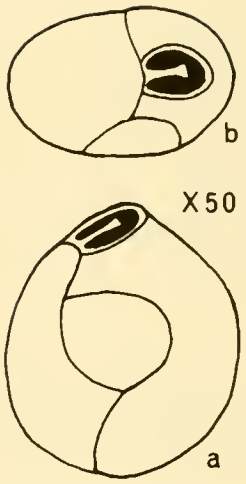
65 (*64*) Test is small, elongate and slender, rounded at base and top and on the periphery. Length 0.20-0.35 mm. a, b, Opposite sides; c, top view ..... *Triloculina oblonga*

65 (*64*) Test is compact 66

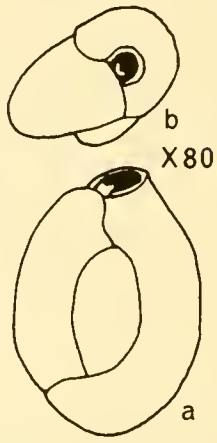


66 (*65*) Test is triangular in section, rounded on the periphery, truncate at the apertural end. Length 0.32-0.40 mm. a, Front view; b, top view ..... *Triloculina trigonula*

66 (*65*) Test is compressed 67



67 (*66*) Apertural tooth is long, broader at free end than at base; test is nearly circular in outline. Length 0.55-0.80 mm. a, Side view; b, top view..... *Triloculina concisa*



67 (*66*) Apertural tooth is short and bifid; test is longer than broad; the final chamber overhangs the widely open aperture in a hoodlike fashion. Length 0.35-0.45 mm. a, Side view; b, top view..... *Triloculina brevidentata*

68 (*53*) Test is single chambered..... 69

68 (*53*) Test has more than one chamber..... 77

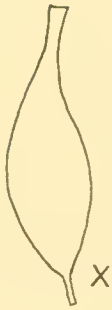
69 (*68*) Test is a simple sac..... 70

69 (*68*) Saclike test possesses an internal tube (observable by use of clarifying oil and transmitted light)..... 73

70 (*69*) Wall is unornamented..... 71

70 (*69*) Wall is ornamented..... 72

71 (*70*) Sac is rounded; wall is smooth. Length about 0.35 mm..... *Lagena laevis*



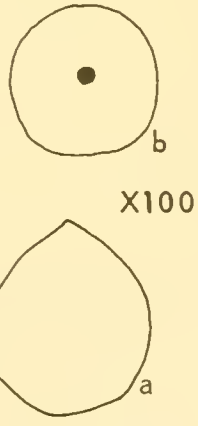
71 (*70*) Sac is elongate, has an apical spine; neck is typically set at a slight angle. Length 0.50-0.55 mm ..... *Lagena clavata*

72 (*70*) Wall is finely striate; neck is ornamented by concentric rings. Diameter 0.20 mm ..... *Lagena striata*

72 (*70*) Test consists of an elongate tube, closed at one end and swollen in the central part; wall is finely striate. Length > 0.70 mm; diameter 0.12-0.18 mm ..... *Lagena mollis*

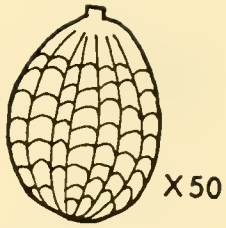
73 (*69*) Sac is circular in section 74

73 (*69*) Sac is compressed 76

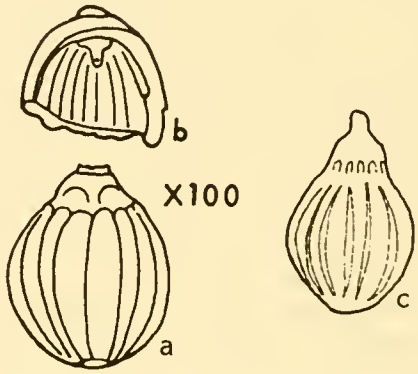


74 (*73*) Sac is unornamented. Length about 0.30 mm; diameter about 0.22 mm. a, Side view; b, top view ..... *Oolina globosa*

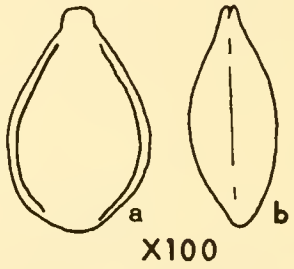
74 (*73*) Sac is ornamented 75



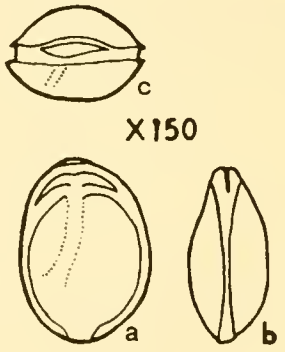
75 (*74*) Ornamentation consists of a reticulated pattern, in which the cells are in vertical rows. Length about 0.40 mm; diameter about 0.40 mm ..... *Oolina melo*



75 (*74*) Sac is globular or elongate; ornamentation consists of blunt ribs that end at the base of a thick collar around the apertural end. Length 0.30-0.42 mm; diameter 0.20-0.30 mm. a, Side view; b, oblique upward view of interior of broken specimen; c, side view of a more elongate specimen ..... *Oolina borealis*



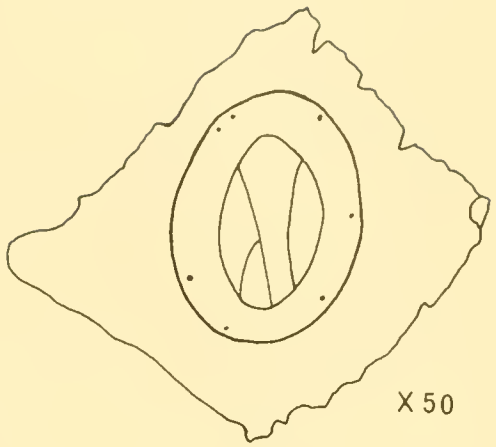
76 (*73*) Periphery is angled but not keeled; apertural end is protruding. Length 0.25-0.30 mm. a, Front view; b, side view ..... *Fissurina laevigata*



76 (*73*) Periphery has a double keel; test outline is nearly circular. Length 0.12-0.18 mm. a, Front view; b, edge view; c, top view ..... *Fissurina marginata*

77 (*68*) Chambers are in multiple rows 78

77 (*68*) Chambers are in a single row 96

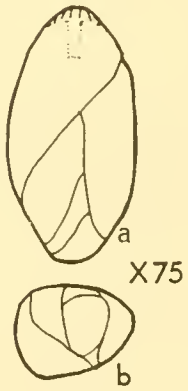


78 (*77*) Test is attached, consisting of a laterally affixed polymorphinid surrounded by a broad flange by which it is cemented to its shell or rock support; apertures are a few small mounded pores on the peripheral flange. Diameter 0.45-0.75 mm. Illustrated specimen is attached to shell fragment ..... *Webbinella concava*

78 (*77*) Test is not attached 79

79 (*78*) Aperture is radiate 80

79 (*78*) Aperture is not radiate 86

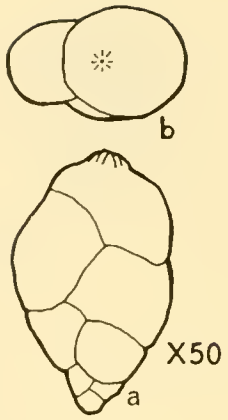


80 (*79*) Test has an internal tube; coiling is sigmoiline; chambers are not inflated. Length about 0.50 mm. a, Side view; b, basal view ..... *Laryngosigma williamsoni*

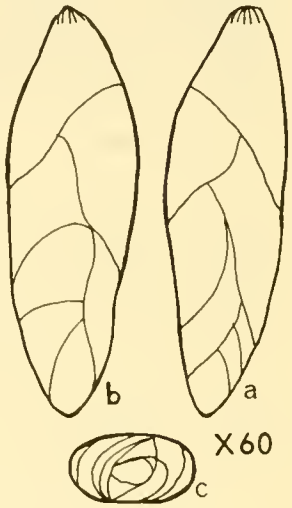
80 (*79*) Test lacks an internal tube 81

81 (*80*) Test is elongate or flattened; chambers are little overlapping; coiling is biserial 82

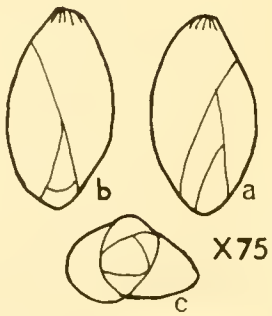
81 (*80*) Test is compact and chambers are much overlapping 83



82 (*81*) Chambers are inflated; sutures are depressed. Length 0.70 mm. a, Side view; b, top view ..... *Pseudopolymorphina phaleropei*

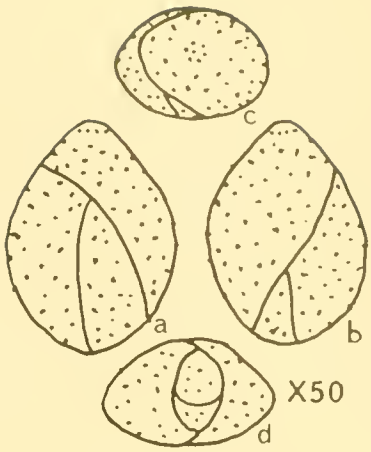


82 (*81*) Test is relatively large and elongate, compressed; chambers are not inflated. Length 0.60-1.15 mm. a, b, Opposite sides; c, basal view . *Pseudopolymorphina novangliae*



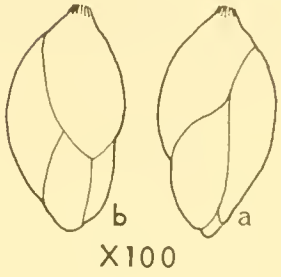
83 (*81*) Coiling is quinqueloculine; chambers are not inflated, final two composing most of the test. Length 0.30-0.40 mm. a, b, Opposite sides; c, basal view ..... *Guttulina lactea*

83 (*81*) Coiling is triloculine 84

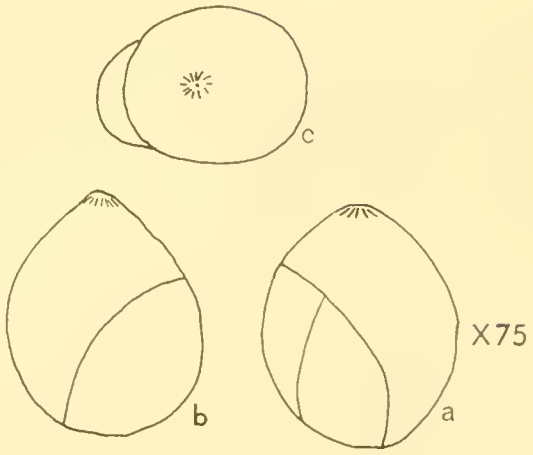


84 (*83*) Wall is ornamented by coarse spines by which some specimens may be attached to sand grains or shells; aperture consists of a ring of pores rather than radiating slits. Length 0.50-0.75 mm. a, b, Opposite sides; c, top view; d, basal view ..... *Vasiglobulina* sp.

84 (*83*) Wall is smooth 85



85 (*84*) Test is elongate, broadest near the middle, basal and apertural ends pointed; sutures are depressed. Length 0.25-0.30 mm. a, b, Opposite sides ..... *Globulina glacialis*



85 (*84*) Test is bag-shaped, broadest near the base; sutures are not depressed. Length 0.32-0.50 mm. a, b, Opposite sides; c, top view ..... *Globulina gibba*

86 (*79*) Test is biserial 87

86 (*79*) Test is triserial or multiserial 92

87 (*86*) Test is twisted around its elongate axis; aperture is comma-shaped; sutures are distinct and depressed. Length 0.20-0.32 mm. a, Side view; b, top view ..... *Fursenkoina fusiformis*

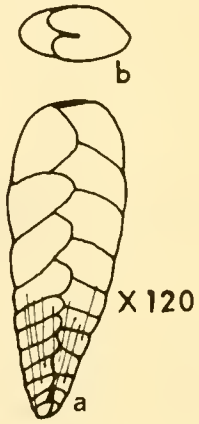
87 (*86*) Plane of the test is flat 88

88 (*87*) Suture lines are simple 89

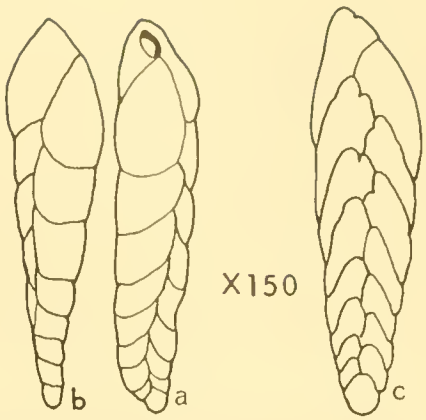
88 (*87*) Suture lines are slightly crenulated, i.e., the walls of the later chambers overlap the earlier chambers 91

89 (*88*) Periphery is acute; test is relatively large, broadly tapering and in some specimens keeled, ornamented with 2-4 conspicuous basal costae. Length about 0.70 mm. a, Side view; b, top view ..... *Brizalina subaenariensis*

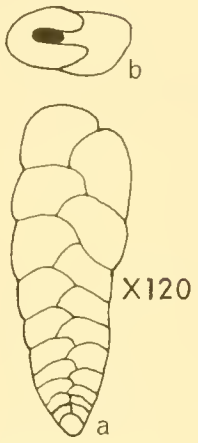
89 (*88*) Periphery is rounded 90



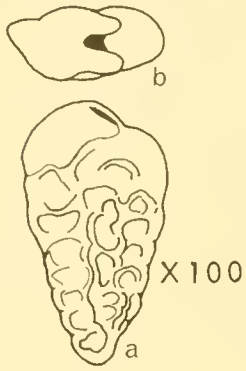
90 (*89*) Ornamented with barely visible costae, test is relatively small, narrowly tapering. Length about 0.35 mm. a, Side view; b, top view ..... *Brizalina striatula*



90 (*89*) Unornamented, sutures are slanting, test thick, slightly twisted; fine wall perforations are present only over the lower part of each chamber, leaving the upper part clear. Length about 0.35 mm. a, b, Side views 90° apart; c, Side view as seen by transmitted light ..... *Brizalina pseudopunctata*



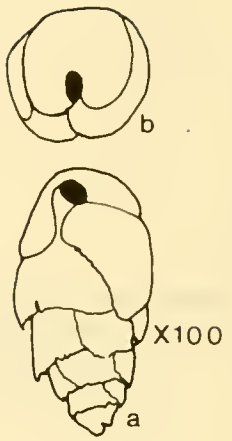
91 (*90*) Wall is smooth, coarsely perforate. Length 0.35-0.40 mm. a, Side view; b, top view ..... *Bolivina variabilis*



91 (*90*) Wall is rugose. Length 0.30-0.40 mm. a, Side view; b, top view ..... *Bolivina pseudoplicata*

92 (*86*) Test is multiserial, small, slender, ovate; as many as 10 chambers in one whorl; aperture is relatively large. Length 0.18 mm ..... *Buliminella elegantissima*

92 (*86*) Test is triserial 93

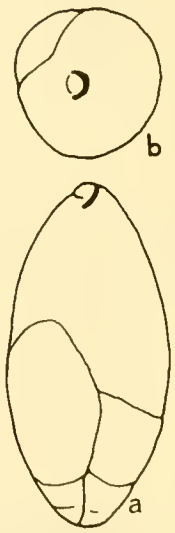


93 (*92*) Chambers are strongly overhanging, not inflated, rimmed by short, sharp, downward-extending spines. Length 0.30-0.45 mm. a, Side view; b, top view ..... *Bulimina marginata*

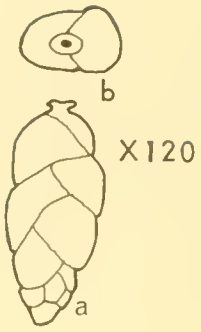
93 (*92*) Aperture is terminal 94

94 (*93*) Test is roughly triangular in section; wall is ornamented by fine low costae that are not continuous across the sutures. Length 0.35-0.55 mm. a, Side view; b, top view ..... *Angulogerina angulosa*

94 (*93*) Test is roughly circular in section 95



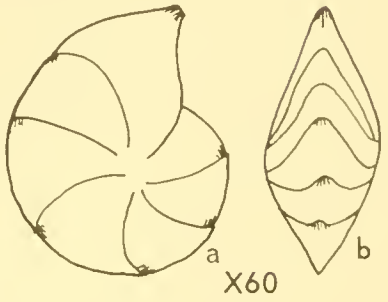
95 (*94*) Terminal aperture contains a large, projecting curved tooth; test is large, elongate, subglobular; wall is glassy, transparent; chambers are inflated, later ones nearly enclosing earlier ones. Length 0.75-0.95 mm. a, Side view; b, top view ..... *Globobulimina auriculata*



95 (*94*) Terminal aperture lacks a protruding tooth and is surrounded by a phialine lip; test becomes biserial toward the apertural end; wall is finely hispid. Length about 0.25 mm. a, Side view; b, top view ..... *Hopkinsina atlantica*

96 (*77*) Test is not coiled (uniserial), long axis of the test is slightly arcuate; chambers are little inflated; aperture is radiate, slightly protruding. Length about 1.00 mm..... *Dentalina communis*

96 (*77*) Test is coiled 97



97 (*96*) Aperture is radiate and situated at the periphery; chambers are few, not inflated; sutures are not depressed. Length 0.45-0.75 mm. a, Side view; b, edge view..... *Lenticulina occidentalis*

97 (*96*) Aperture is not radiate 98

98 (*97*) Coiling is planispiral and hence the same on both sides 99

98 (*97*) Coiling is trochoid and hence different on the two sides 115

99 (*98*) Coiled chambers are in a single row 100

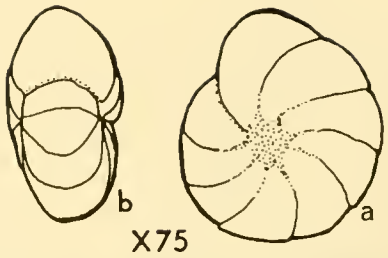
99 (*98*) Coiled chambers are in a double row 113

100 (*99*) Sutures are simple..... 101

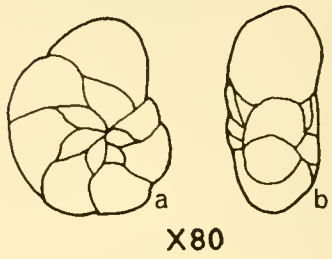
100 (*99*) Sutures are crossed by septal bridges 105

101 (*100*) Coiling is tight..... 102

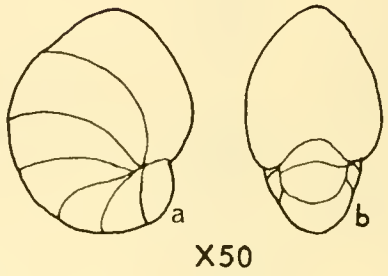
101 (*100*) Coiling is expanding 103



102 (*101*) Wall is uncomplicated by surface structures; chambers are slightly inflated, periphery is bluntly rounded; umbilicus is slightly depressed, obscured by fine papillae. Diameter 0.32-0.52 mm. a, Side view; b, edge view ..... *Haynesina germanica*

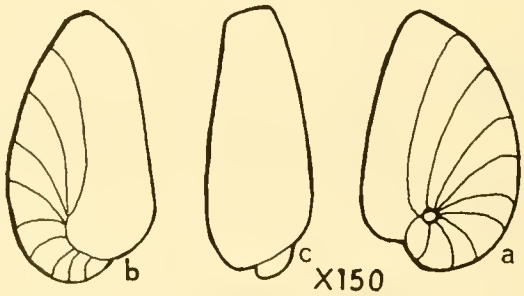


102 (*101*) Umbilicus is covered by a star pattern of flaps. Diameter 0.30-0.35 mm. a, Side view; b, edge view..... *Astrononion gallowayi*

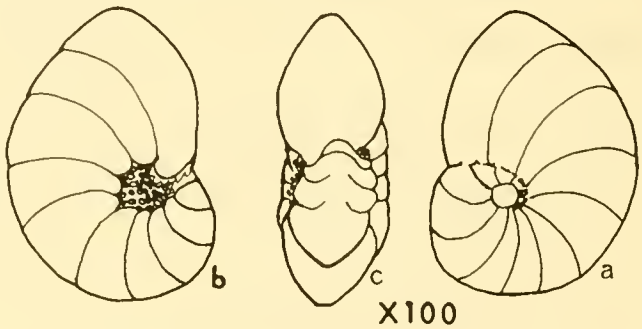


103 (*101*) Test is the same on both sides; chambers increase rapidly in thickness as added. Length 0.40-0.70 mm. a, Side view; b, edge view..... *Nonionellina labradorica*

103 (*101*) The two sides of the test are different..... 104



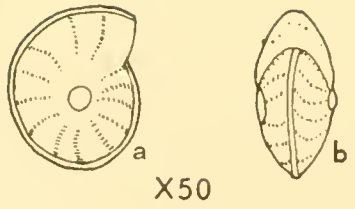
104 (*103*) Test has a bulging lobe that covers the umbilicus on one side; chambers are narrow and elongate. Length about 0.22 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Nonionella turgida*



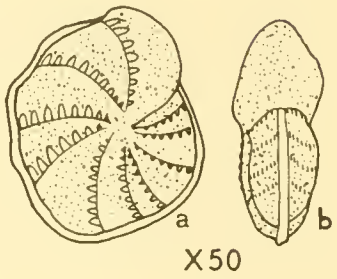
104 (*103*) Test shows early coil on one side, but no lobe; umbilicus is papillate. Length 0.32-0.52 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Pseudononion atlanticum*

105 (*100*) Periphery is angled and limbate 106

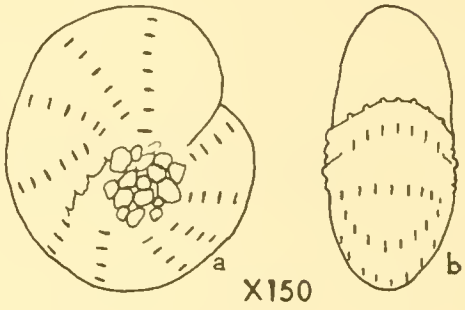
105 (*100*) Periphery is rounded 107



106 (*105*) Surface is smooth; umbilicus has one or more plugs. Diameter 0.25-0.50 mm. a, Side view; b, edge view ..... *Elphidium advena*



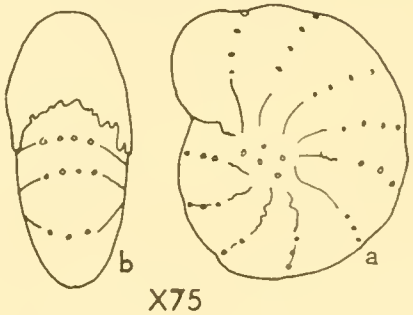
106 (*105*) Surface looks sugary; umbilicus lacks plugs. Diameter 0.40-0.60 mm. a, Side view; b, edge view ..... *Elphidium margaritaceum*



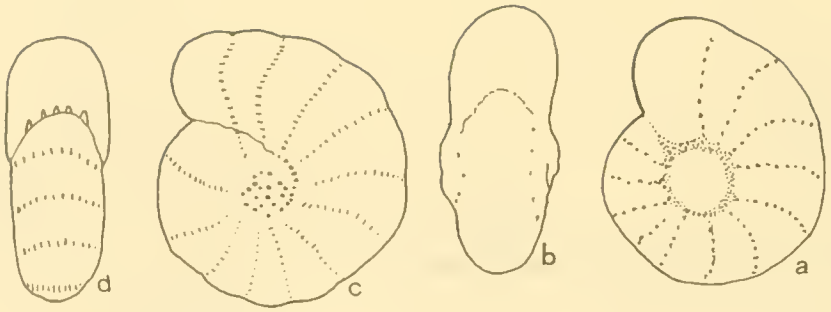
107 (*105*) Wall is coarsely porous and rugose. Diameter 0.20-0.32 mm. a, Side view; b, edge view ..... *Elphidium gunteri*

107 (*105*) Wall is finely perforate and smooth 108

108 (*107*) Septal bridges are regular 109



108 (*107*) Septal bridges are irregular; sutures are crenulated, especially so toward the umbilicus; test is thickest through the umbilical area. Diameter 0.40-0.75 mm. a, Side view; b, edge view. ..... *Elphidium clavatum*



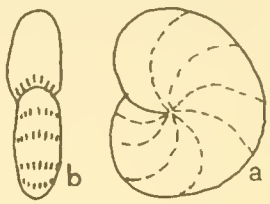
X 75

109 (*108*) Sutures look beaded; umbilicus is occupied by a large and slightly raised plug. Diameter 0.45-0.60 mm. Variant forms illustrated: a, b, side and edge views of specimen with prominent umbilical plug; c, d, side and edge views of specimen with depressed and granular umbilical area ..... *Elphidium galvestonense*

109 (*108*) Sutures look pitted; umbilicus is flush or slightly depressed 110

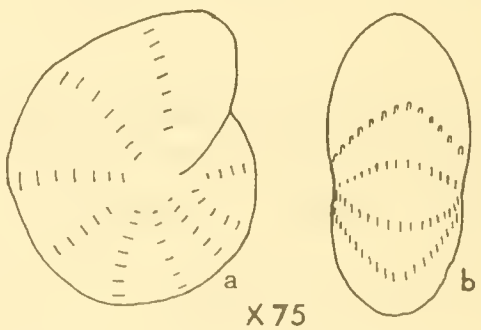
110 (*109*) Sutures and septal bridges are distinct 111

110 (*109*) Septal bridges are inconspicuous 112



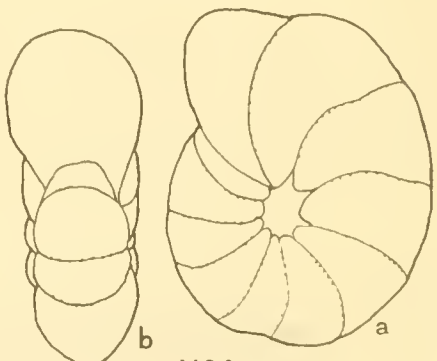
X100

111 (*110*) Sutures are flush; septal bridges are short and clearly visible. Diameter 0.22-0.32 mm. a, Side view; b, edge view ..... *Elphidium incertum*



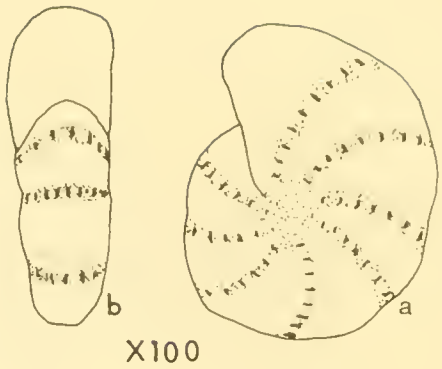
X 75

111 (*110*) Sutures and umbilicus are slightly excavated; septal bridges are short compared with width of chambers. Diameter 0.50-0.60 mm. a, Side view; b, edge view ..... *Elphidium excavatum*

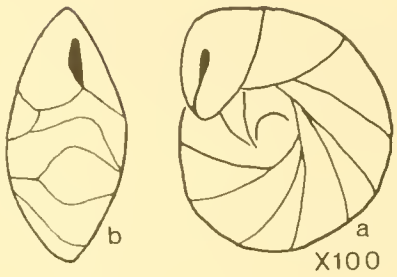


X80

112 (*110*) Sutures are simple, moderately depressed. Diameter 0.45-0.75 mm. a, Side view; b, edge view ..... *Elphidium bartletti*

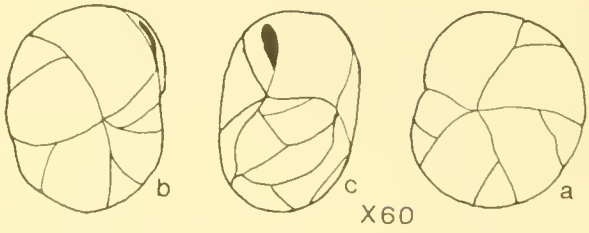


112 (*110*) Sutures are bordered by a wide opaque band of micropapillae. Diameter 0.40-0.60 mm. a, Side view; b, edge view ..... *Elphidium frigidum*

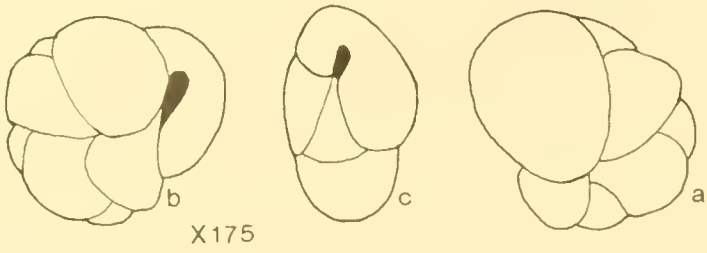


113 (*99*) Periphery is angled; aperture is comma-shaped; alternating chambers (as seen from either side) are nearly equal in size. Diameter 0.25-0.35 mm. a, Side view; b, edge view ..... *Cassidulina norcrossi*

113 (*99*) Periphery is rounded; alternating chambers (as seen from either side) are distinctly unequal in size 114



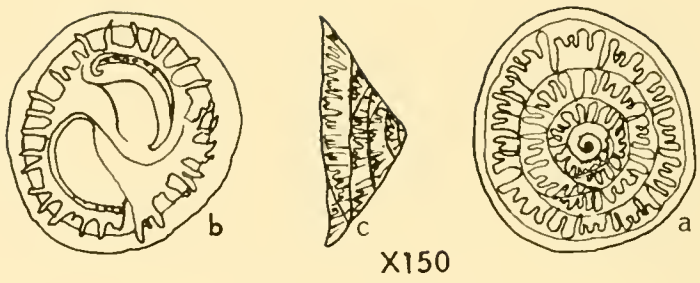
114 (*113*) Test is large, thick. Diameter 0.32-0.45 mm. a, b, Opposite views; c, edge view ..... *Cassidulina algida*



114 (*113*) Test is small, compressed. Diameter 0.15-0.20 mm. a, b, Opposite views; c, edge view ..... *Cassidulina islandica minuta*

115 (*98*) Coiled side is convex 116

115 (*98*) Coiled side is flat; wall is coarsely porous 128

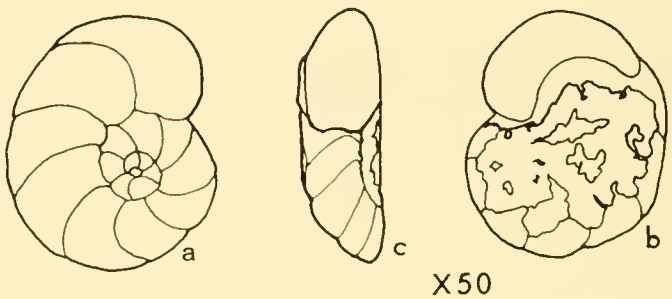


116 (*115*) Outline of the test is essentially circular; periphery is sharp; chambers are obscured by incomplete transverse septa that result in a reticulated appearance of the spiral surface and a narrow fluting around the outer rim of the umbilical surface. Diameter 0.18-0.25 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Patellina corrugata*

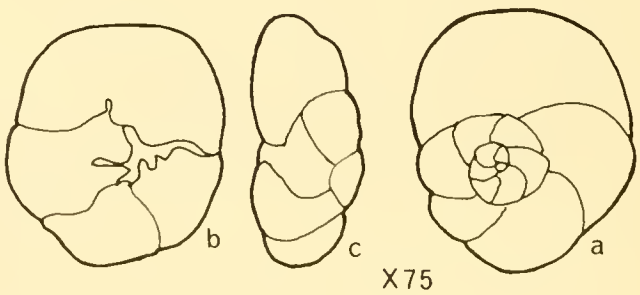
116 (*115*) Outline of the test is not circular, but is notched at the final chamber 117

117 (*116*) Test wall is distinctly porous 118

117 (*116*) Test wall is finely porous 119



118 (*117*) Umbilical (flat) side is covered by spongelike overgrowth. Diameter 0.25-0.50 mm. a, Spiral view; b, umbilical view; c, edge view ..... *"Discorbis" aguayoi*

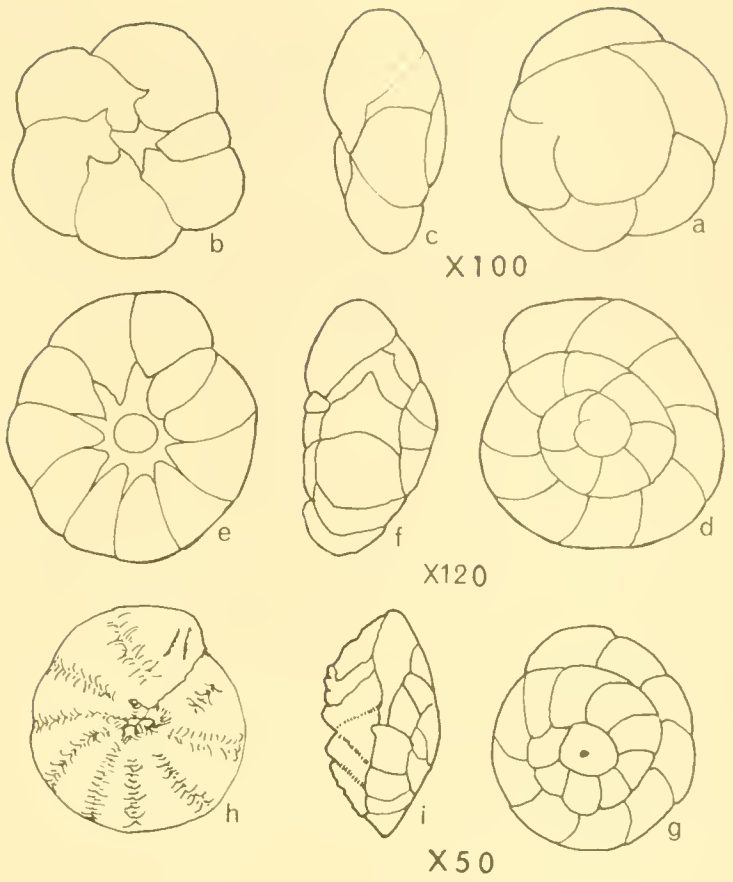


118 (*117*) Umbilical (flat) side is not obscured; living specimens are normally attached; umbilical surface is unornamented; umbilical sutures are irregular toward their inner ends. Diameter 0.32-0.60 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Rosalina floridana*

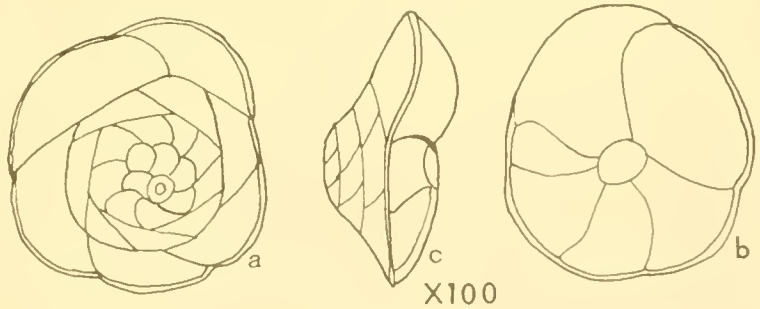
119 (*117*) Test has an umbilical plug[3] 120

119 (*117*) Test lacks an umbilical plug 121

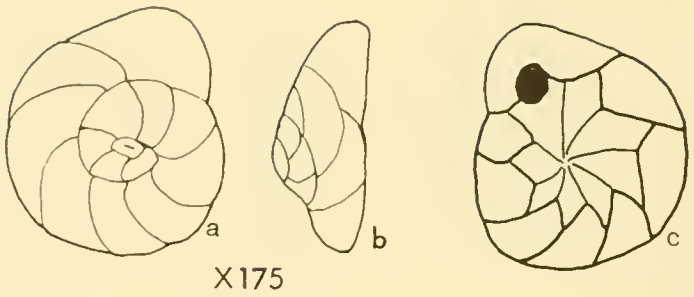
[3]Absence of umbilical plug in some specimens of a species that is characterized by an umbilical plug may be due to breakage and in other specimens, due to environmental influences. For example, see the variant forms of *Ammonia beccarii*.



120 (*119*) Test is rounded on the periphery. According to its environment, the species is highly variable in size, thickness, number of chambers, prominence or absence of umbilical plug, presence or absence of limbation or other ornamentation of sutures. a, b, c, Spiral, umbilical, and edge views of *A. beccarii tepida*, characteristic of quiet, brackish water; diameter 0.25-0.30 mm. d, e, f, Spiral, umbilical, and edge views of the form of *A. beccarii* that is characteristic of bays and inlets; diameter 0.22-0.40 mm. g, h, i, Spiral, umbilical, and edge views of the form of *A. beccarii* that is characteristic of surf-washed coasts; diameter 0.40-0.70 mm. . . . . *Ammonia beccarii* (variant forms)

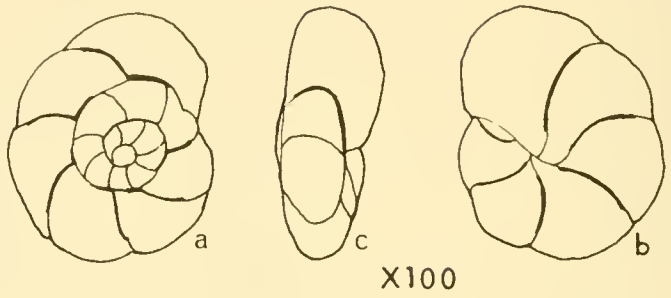


120 (*119*) Test is angled and keeled on the periphery; umbilical plug is flat. Diameter about 0.35 mm. a, Spiral view; b, umbilical view; c, edge view. . . . . *Gavelinopsis praegeri*



121 (*119*) Test has supplementary chambers; size is minute. Diameter about 0.20 mm. a, Spiral view; b, umbilical view; c, edge view . *Eoeponidella pulchella*

121 (*119*) Test lacks supplementary chambers 122

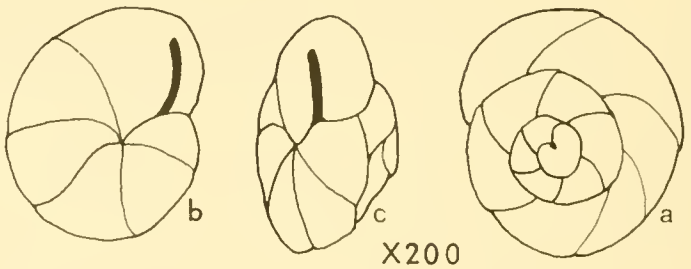


122 (*121*) Apertures, consisting of sutural slits, are present on both spiral and umbilical surfaces. Diameter 0.25-0.35 mm. a, Spiral view; b, umbilical view; c, edge view .... *Helenina anderseni*

122 (*121*) Aperture is confined to the umbilical side 123

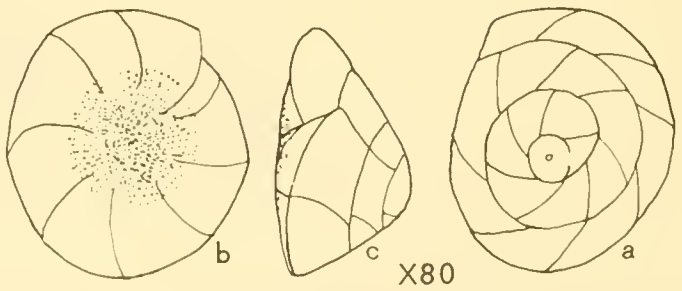
123 (*122*) Aperture is single 124

123 (*122*) Apertures are multiple or complex 126

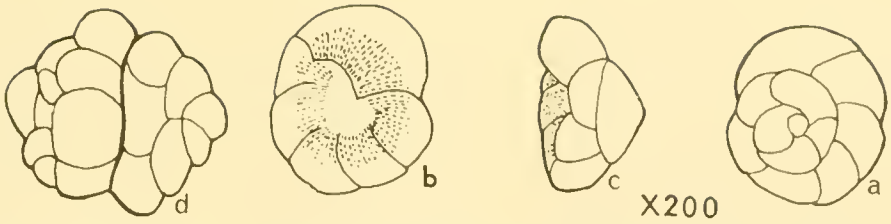


124 (*123*) Aperture is a curved slit extending into the apertural face. Diameter about 0.15 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Epistominella vitrea*

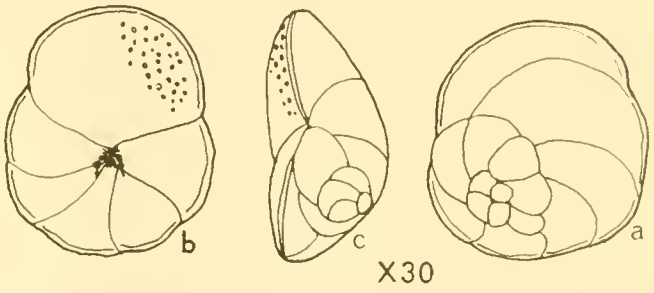
124 (*123*) Aperture is obscured 125



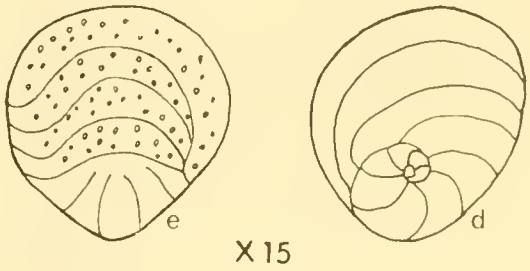
125 (*124*) Aperture is an opening in the center of the umbilicus, obscured by a radiating pattern of fine papillae. Diameter about 0.40 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Glabratella wrightii*



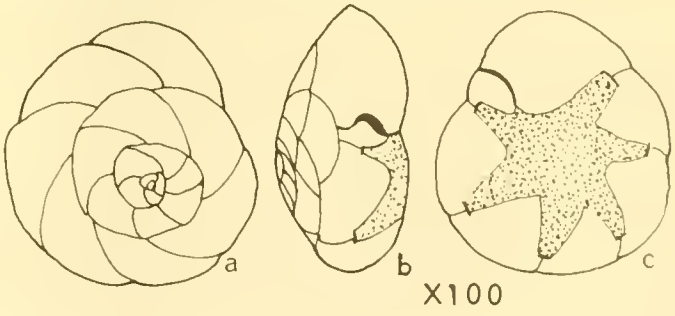
125 (*124*) Ventral surface is ornamented by fine radial striae; aperture is under a tongue-shaped projection of the final chamber into the umbilical depression; the minute specimens are frequently found attached in plastogamy. Diameter 0.10-0.13 mm. a, Spiral view; b, umbilical view; c, edge view; d, two specimens in plastogamy. .*Glabratellina lauriei*



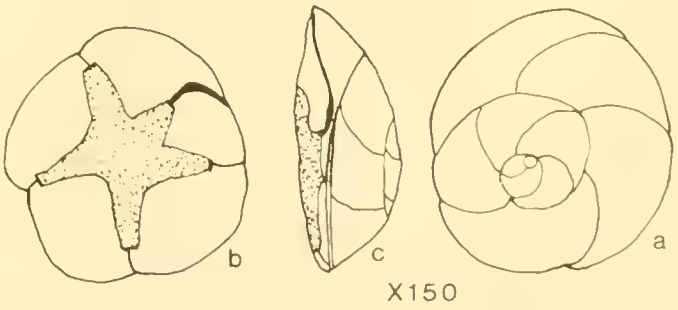
126 (*123*) Besides the opening under the edge of the final chamber, supplementary apertures appear as large pores on the apertural face. Diameter 0.60-1.00 mm. a, Spiral view; b, umbilical view; c, edge view; d, e, spiral and umbilical views of large form which may be either gerontic (old age) or a breeding stage ..... *Poroeponides lateralis*



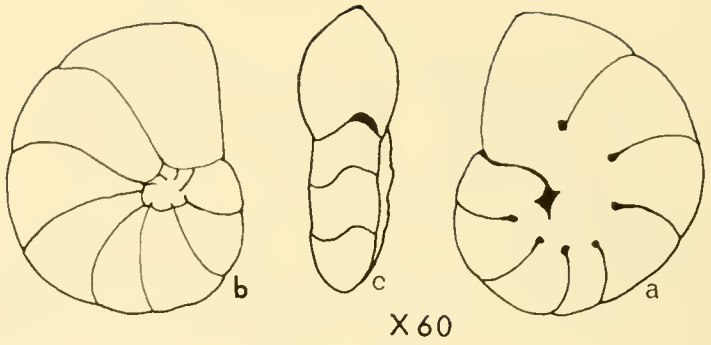
126 (*123*) Besides the opening under the edge of the final chamber, supplementary apertures consist of an opening at the outer end of each branch of the bulging coating of fine granules that fills the umbilical region 127



127 (*126*) Test is equally biconvex; periphery is rounded. Diameter 0.30-0.40 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Buccella frigida*

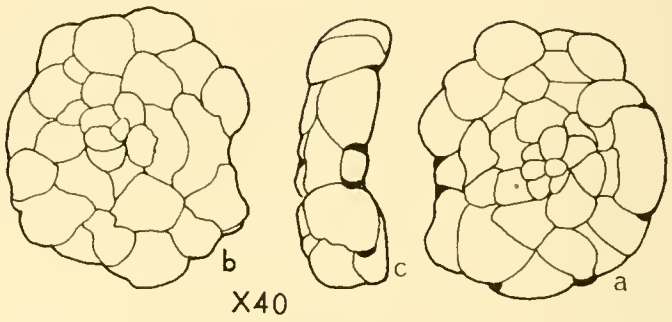


127 (*126*) Test is flattened on the umbilical side; periphery is angled. Diameter 0.20-0.30 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Buccella* sp.



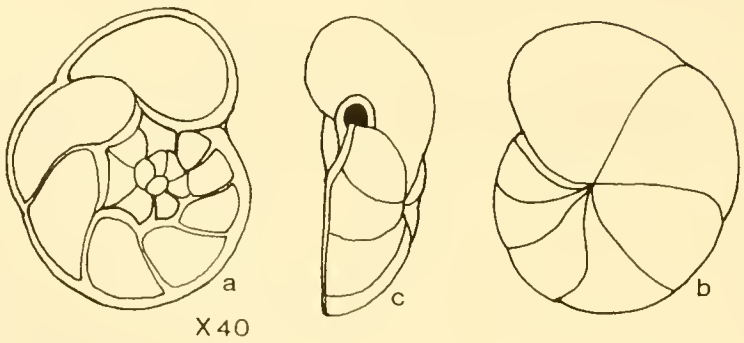
128 (*115*) Coiling of the flat side is partly obscured by flaps from the inner ends of the chambers; aperture is an arch on the periphery and extends under the coalescing umbilical flaps. Diameter 0.45-0.70 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Hanzawaia concentrica*

128 (*115*) Coiling of the flat side is exposed 129

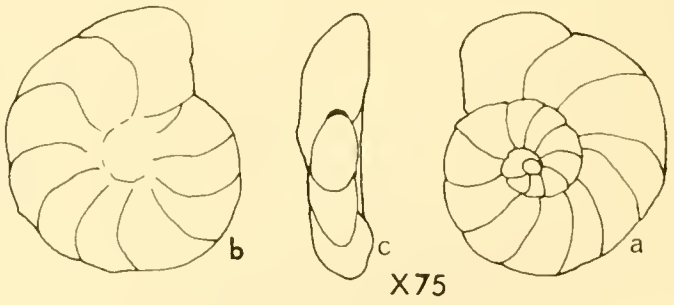


129 (*128*) The coiled chambers are surrounded by annular chambers. Diameter 0.80 mm or more. a, Spiral view; b, umbilical view; c, edge view ..... *Planorbulina acervalis*

129 (*128*) The coiled chambers make up the entire test 130



130 (*129*) The umbilical side is involute; test is planoconvex; only the sutures of the spiral side are limbate; wall is more coarsely perforate on the spiral (flat) side than on the umbilical (convex) side; aperture is a rimmed arch on the periphery. Diameter 0.55-1.00 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Cibicides lobatulus*



130 (129) The umbilical side is partly evolute; test is strongly compressed; wall is coarsely porous. Diameter 0.45-0.50 mm. a, Spiral view; b, umbilical view; c, edge view ..... *Planulina mera*

ANNOTATED LIST OF SPECIES

As an aid to their location, species are listed alphabetically without reference to family affiliation. The date following the author or authors of each scientific name refers to the item in the selected bibliography where that species was described. References to monographic works on pertinent taxonomic groups are also included. Notes on ecology and, for some species believed to have limited distribution within the area studied, notes on distribution off the northeastern United States are included. Distribution of other species is not necessarily complete throughout the entire area studied, Nova Scotia to Cape Hatteras.

Adercotryma glomeratum (Brady, 1878), Höglund 1947.
Continental shelf. Gulf of Maine.

Allogromia laticollaris Arnold, 1948.
Littoral zone, tide pools, quiet bays and inlets.

Ammoastuta inepta (Cushman and McCulloch, 1939).
Brackish, estuarine.

Ammobaculites crassus Warren, 1957. Ellison and Nichols 1970.
Brackish, estuarine. Virginia and Maryland.

Ammobaculites dilatatus Cushman and Bronnimann, 1948.
Brackish, estuarine.

Ammobaculites exiguus Cushman and Bronnimann, 1948.
Brackish, estuarine. Virginia to Cape Cod.

Ammodiscus minutissimus Cushman and McCulloch, 1939.
Continental shelf.

Ammonia beccarii (Linné, 1758).
Bays, inlets, littoral zone of protected coasts.

Ammonia beccarii (Linné) *tepida* (Cushman, 1926).
Quiet and brackish water.

Ammonia beccarii (Linné) variant.
Littoral zone of exposed coasts.

Ammotium cassis (Parker, 1870)(in Dawson 1870).
Brackish inlets, surface of submerged bogs, quiet bays.

Angulogerina angulosa (Williamson, 1858).
Continental shelf.

Arenoparrella mexicana (Kornfeld, 1931).
Brackish inlets, surface of submerged bogs. Virginia to Cape Cod.

Astrononion gallowayi Loeblich and Tappan, 1953.
Continental shelf.

Astrorhiza limicola Sandahl, 1857.
Continental shelf.

Bolivina pseudoplicata Heron-Allen and Earland, 1930.
Littoral zone and continental shelf.

Bolivina variabilis (Williamson, 1858).
Littoral zone and continental shelf.

Brizalina pseudopunctata (Höglund, 1947).
Continental shelf.

Brizalina striatula (Cushman, 1922). (See reference 1922c.)
Continental shelf.

Brizalina subaenariensis (Cushman, 1922). (See reference 1922a.)
Continental shelf.

Buccella frigida (Cushman, 1922). (See reference 1922b.) Andersen 1952.
Brackish inlets and littoral zone, New York northward and as a fossil at least as far south as Maryland.

Buccella sp.
Continental shelf.

Bulimina marginata d'Orbigny, 1826.
Continental shelf.

Buliminella elegantissima (d'Orbigny, 1839). (See reference 1839a.)
Littoral zone and continental shelf.

Cassidulina algida Cushman, 1944.
Continental shelf. Georges Bank northward.

Cassidulina islandica minuta Nørvang, 1945.
Continental shelf. Georges Bank northward.

Cassidulina norcrossi Cushman, 1933.
Continental shelf.

Cibicides lobatulus (Walker and Jacob, 1798), in Kanmacher 1798.
Littoral zone and continental shelf.

Cornuspira involvens (Reuss, 1850).
Continental shelf.

Cornuspira planorbis Schultz, 1854.
Brackish, estuarine, surface of submerged bogs, continental shelf

Cribrostomoides crassimargo (Norman, 1892). Loeblich and Tappan 1953.
Continental shelf.

Cribrostomoides jeffreysii (Williamson, 1858). Loeblich and Tappan 1953.
Continental shelf. Cape Cod northward.

Crithionina pisum Goës, 1896.
Continental shelf.

Dendrophrya arborescens (Norman, 1881) (in Brady 1881b).
Continental shelf. Maine.

Dentalina communis d'Orbigny, 1826.
Continental shelf.

"*Discorbis*" *aguayoi* Bermúdez, 1935.
Brackish, estuarine.

Eggerella advena (Cushman, 1922). (See reference 1922b.) Loeblich and Tappan 1953.
Brackish, estuarine, continental shelf.

Elphidium advena (Cushman, 1922) (See reference 1922c.)
Littoral zone, bays, inlets, continental shelf. Rare north of Maryland.

Elphidium bartletti Cushman, 1933.
Continental shelf. Maine.

Elphidium clavatum Cushman, 1930. Loeblich and Tappan 1953, Ellison and Nichols 1970.
Littoral zone of open coasts, continental shelf.

Elphidium excavatum (Terquem, 1875).
Brackish, estuarine, continental shelf.

Elphidium frigidum (Cushman, 1933).
Brackish, estuarine, continental shelf.

Elphidium galvestonense Kornfeld, 1931.
Brackish inlets, Cape Cod southward.

Elphidium gunteri Cole, 1931.
Brackish inlets, Cape Cod southward.

Elphidium incertum (Williamson, 1858).
Brackish, estuarine, continental shelf.

Elphidium margaritaceum Cushman, 1930.
Brackish, estuarine, continental shelf.

Eoeponidella pulchella (Parker, 1952). (See reference 1952a.)
Continental shelf. New Hampshire and North Carolina.

Epistominella vitrea Parker, 1953; in Parker et al. 1953.
Continental shelf. Off New Jersey.

Fissurina laevigata Reuss, 1850.
Littoral zone of open coasts, bays having good circulation, continental shelf.

Fissurina marginata Seguenza, 1862.
Littoral zone, continental shelf.

Fursenkoina fusiformis (Williamson, 1858).
Continental shelf.

Gavelinopsis praegeri (Heron-Allen and Earland, 1913).
Continental shelf. Off New Jersey.

Glabratella wrightii (Brady, 1881). (See reference 1881b.)
Continental shelf.

Glabratellina lauriei (Heron-Allen and Earland, 1924). Seiglie and Bermudez 1965
Littoral zone protected coasts, bays, inlets, surface of submerged bogs.

Globobulimina auriculata (Bailey, 1851).
Continental shelf.

Globulina gibba d'Orbigny, 1826.
Continental shelf.

Globulina glacialis Cushman and Ozawa, 1930.
Continental shelf. Cape Cod northward.

Guttulina lactea (Walker and Jacob, 1798); in Kanmacher 1798. Cushman and Ozawa 1930.
Continental shelf. cape Cod southward.

Hanzawaia concentrica (Cushman, 1918). (See reference 1918a.)
Littoral zone, continental shelf. Cape Cod southward.

Haplophragmoides bonplandi Todd and Bronnimann, 1957.
Estuarine and littoral zones.

Haplophragmoides hancocki Cushman and McCulloch, 1939.
Brackish, estuarine, surface of submerged bogs, bays having good circulation.

Haynesina germanica (Ehrenberg, 1840), Ehrenberg 1841. Banner and Culver 1978.
Brackish and littoral zones, bays and inlets.

Helenina anderseni (Warren, 1957).
Brackish and estuarine zones. Martha's Vineyard and Cape Cod.

Hemisphaerammina bradyi Loeblich and Tappan, 1957.
Continental shelf.

Hippocrepina indivisa Parker, 1870; in Dawson 1870.
Continental shelf. Maine.

Hopkinsina atlantica Cushman, 1944.
Inner part of continental shelf. Vineyard Sound, Buzzards Bay, Narragansett Bay, Gardiners Bay, and Long Island Sound.

Iridia diaphana Heron-Allen and Earland, 1914.
Brackish, estuarine, and littoral zone. Martha's Vineyard.

Jadammina polystoma Bartenstein and Brand, 1938.
Brackish, estuarine. Martha's Vineyard and Cape Cod.

Lagena clavata (d'Orbigny, 1846).
Continental shelf.

Lagena laevis (Montagu, 1803).
Littoral zone of open coasts, continental shelf.

Lagena mollis Cushman, 1944.
Inner part of continental shelf. Maine and Rhode Island.

Lagena striata (d'Orbigny, 1839). (See reference 1839a.)
Littoral zone of open coasts and continental shelf.

Laryngosigma williamsoni (Terquem, 1878). Loeblich and Tappan 1953.
Continental shelf.

Lenticulina occidentalis (Cushman, 1923).
Continental shelf, more abundant beyond 50 m depth.

Miliammina fusca (Brady, 1870). Ellison and Nichols 1970.
Brackish, estuarine, bays, inlets.

Miliammina petila Saunders, 1958.
Estuarine.

Miliolinella subrotunda (Montagu, 1803).
Littoral zone, bays, inlets, continental shelf.

Nonionella turgida (Williamson, 1858).
Continental shelf.

Nonionellina labradorica (Dawson, 1860).
Continental shelf. North of Cape Cod.

Oolina borealis Loeblich and Tappan, 1954. Loeblich and Tappan 1953.
Continental shelf. North of Cape Cod.

Oolina globosa (Montagu, 1803).
Continental shelf. Maine and Rhode Island.

Oolina melo d'Orbigny, 1839. (See reference 1839a.)
Continental shelf.

Patellina corrugata Williamson, 1858.
Littoral zone of protected coasts, continental shelf.

Pateoris hauerinoides (Rhumbler, 1936). Loeblich and Tappan 1953.
Littoral zone, bays, inlets, continental shelf.

Pelosina cylindrica Brady, 1884.
Littoral zone and continental shelf.

Planorbulina acervalis Brady, 1884.
Littoral zone of open coasts, continental shelf.

Planulina mera Cushman, 1944.
Littoral zone of open coasts, continental shelf.

Poroeponides lateralis (Terquem, 1878).
Littoral zone and inner part of continental shelf, south of Cape Cod.

Psammosphaera fusca Schulze, 1875.
Continental shelf.

Pseudoclavulina gracilis Cushman and Bronnimann, 1948.
Brackish, estuarine. Cape Cod and southward.

Pseudononion atlanticum (Cushman, 1947).
Littoral zone of open coasts, continental shelf, Cape Cod and southward.

Pseudopolymorphina novangliae (Cushman, 1923). Cushman and Ozawa 1930.
Littoral zone, bays, inlets, continental shelf.

Pseudopolymorphina phaleropei Cushman and Ozawa 1930.
Off Woods Hole, Mass. (the only record).

Pyrgo subsphaerica (d'Orbigny, 1839). (See reference 1839b.)
Littoral zone, bays, inlets, continental shelf.

Quinqueloculina auberiana d'Orbigny, 1839. (See reference 1839b.) Le Calvez 1977.
Littoral zone of open coasts. Martha's Vineyard, Mass.

Quinqueloculina bicornis (Walker and Jacob, 1798); in Kanmacher 1798. Cushman 1929.
Littoral zone of open coasts, continental shelf, south of Cape Cod.

Quinqueloculina frigida Parker, 1952. (See reference 1952a.)
Continental shelf. New Hampshire and Maine.

Quinqueloculina lata Terquem, 1876.
Brackish, estuarine, and littoral zones, bays, inlets, continental shelf.

Quinqueloculina seminulum forma *typica* (Linné, 1758).
Littoral zone of open coasts, bays having good circulation, continental shelf.

Quinqueloculina seminulum forma *jugosa* Cushman, 1944.
Littoral zone, bays, inlets. South of Cape Cod.

Reophax arcticus Brady, 1881. (See reference 1881b.)
Continental shelf.

Reophax curtus Cushman, 1920.
Continental shelf. Cape Cod northward.
Reophax scorpiurus Montfort, 1808.
Continental shelf.
Reophax scottii Chaster, 1892.
Continental shelf.
Rhabdammina? sp.
Continental shelf. Cape Cod Bay and Maine.
Rosalina floridana (Cushman, 1922.) (See reference 1922c.)
Littoral zone, bays, inlets, continental shelf.
Saccammina difflugiformis forma *typica* (Brady, 1879).
Continental shelf.
Saccammina difflugiformis forma *atlantica* (Cushman, 1944).
Continental shelf.
Saccammina? sp.
Brackish, estuarine. Maine and Martha's Vineyard.
Spiroplectammina biformis (Parker and Jones, 1865).
Continental shelf.
Spiroplectammina typica Lacroix, 1931.
Continental shelf. New Hampshire.
Textularia earlandi Parker, 1952, in Phleger 1952.
Brackish and estuarine zones, quiet bays, continental shelf.
Textularia torquata Parker, 1952. (See reference 1952a.)
Continental shelf. Cape Cod northward.
Tholosina bulla (Brady, 1881). (See reference 1881a.) Rhumbler, 1895.
Continental shelf.
Tholosina vesicularis (Brady, 1879).
Littoral zone, continental shelf.
Thurammina papillata Brady, 1879.
Continental shelf. Cape Cod Bay.
Thurammina? *limnetis* Scott and Medioli, 1980.
Brackish and estuarine zones. Nova Scotia, Maine, Martha's Vineyard, Virginia.
Tiphotrocha comprimata (Cushman and Bronnimann, 1948). Saunders 1957.
Brackish and estuarine zones.
Tolypammina vagans (Brady, 1879). Rhumbler 1895.
Continental shelf. Maine.
Triloculina brevidentata Cushman, 1944.
Littoral zone of open coasts, bays, inner part of continental shelf. Massachusetts to Maine.
Triloculina concisa Cushman, 1944.
Littoral zone. Newport, Rhode Island.
Triloculina oblonga (Montagu, 1803).
Bays, quiet inlets.
Triloculina trigonula (Lamarck, 1804).
Continental shelf.
Trochammina advena Cushman, 1922. (See reference 1922c.)
Continental shelf.
Trochammina compacta Parker, 1952. (See reference 1952b.)
Bays having good circulation, continental shelf.
Trochammina inflata (Montagu, 1808).
Brackish and estuarine zones, surface of submerged bogs, bays, inlets.
Trochammina macrescens Brady, 1870.
Brackish and estuarine zones, surface of submerged bogs, bays, inlets.
Trochammina nana (Brady, 1881). (See reference 1881b.)
Littoral zone of open coasts, continental shelf.
Trochammina ochracea (Williamson, 1858).
Brackish zone, bays, inlets, continental shelf.
Trochammina rotaliformis Wright, 1911, in Heron-Allen and Earland 1911. Balkwill and Wright 1885.
Brackish and estuarine zones, bays, inlets, continental shelf.
Trochammina squamata Jones and Parker, 1860. Parker 1952a.
Bays, inlets, continental shelf.
Vasiglobulina sp. Poag, 1969. Poag et al. 1980. Littoral zone of open coasts, continental shelf.
Webbinella concava (Williamson, 1858). Poag et al. 1980.
Littoral zone of open coasts, continental shelf.

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SYSTEMATIC INDEX

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The Board established the format for the "Marine Flora and Fauna of the Northeastern United States," invites systematists to collaborate in the preparation of manuals, reviews manuscripts, and advises the Scientific Editor of the National Marine Fisheries Service.

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COORDINATING EDITOR'S COMMENTS

Publication of the "Marine Flora and Fauna of the Northeastern United States" is most timely in view of the growing universal emphasis on environmental work and the urgent need for more precise and complete identification of coastal organisms than has been available. It is mandatory, wherever possible, that organisms be identified accurately to species. Accurate scientific names unlock the great quantities of biological information stored in libraries, obviate duplication of research already done, and often make possible prediction of attributes of organisms that have been inadequately studied.

Ruth Todd began her studies of Foraminifera in 1940 as research assistant to Joseph A. Cushman at the former Cushman Laboratory for Foraminiferal Research in Sharon, Mass., and continued there until 1950. Following the death of the Director of the Laboratory and the consequent transfer of the Laboratory to the U.S. National Museum of Natural History in Washington, D.C., Ruth Todd continued her studies of Foraminifera at the National Museum as a member of the Paleontology and Stratigraphy Branch of the U.S. Geological Survey. Following her retirement in 1973, she resumed her collection and studies of the Foraminifera of the Atlantic coastal regions.

Doris Low began work on and studies of Foraminifera in 1951, working with Ruth Todd as a member of the Paleontology and Stratigraphy Branch of the U.S. Geological Survey. With collections made around the island of Martha's Vineyard during the summers of 1957 and 1958, she began intensive study of the Foraminifera of coastal New England.

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