FORAMINIFERA
Families: Globigerinidae and Globorotaliidae
(By A.W. H. Bé) *
1967

*) Lamont Geological Observatory of Columbia University, Palisades, New York. Contr. No. 982. This study received support from National Science Foundation, Grant GB-4219.
PLANKTONIC FORAMINIFERA

There are about 30 described species of planktonic Foraminifera living in the world oceans. They occur primarily in the euphotic zone. The few deep water-species probably spend their earlier stages in near-surface waters. Most of the species (22) are tropical-subtropical; five are cold-temperate or subpolar species. Three species are found in Antarctic waters and of these one is also present in the Arctic Ocean. The Indo-Pacific fauna except for its greater species diversity, is essentially similar to that of the Atlantic.

The classification and key used here agrees in most respects with that of Parker (1962). The presence or absence of spines is a major criterion in distinguishing the two families. The morphological terms in this key have been defined in a publication by Bolli, Loeblich, and Tappan (1957).

Order FORAMINIFERIDA

Family Globigerinidae Carpenter, Parker and Jones, 1862

Description (after Parker, 1962): Test trochospiral in the adult or in ontogeny, streptospiral, or globular; chambers spherical, ovate or clavate; wall calcareous, perforate, radial in structure, hispid, spino-se when living either in the adult or in ontogeny; primary aperture umbilical, umbilical-extraumbilical, equatorial or spiroumbilical; may have secondary apertures; may have bullae with accessory infralaminal apertures.

Family Globorotaliidae Cushman, 1927

Description (emended from that of Parker, 1962): Coiling of test trochospiral; chambers angular to ovate or spherical; may have a keel; wall calcareous, perforate, radial in structure, smooth, pitted; non-spinose when living both in the adult and in ontogeny; primary aperture extraumbilical-umbilical or umbilical.

KEY TO GENERA

1. Trochospiral test (spines simple, if present) ................................................................. 2
2. Planispiral test with triradiate spines (gerontic stage streptospiral) ......................... 3
3. Primary aperture (and, if present, secondary apertures). ......................................... 3
4. Sutural apertures, smooth surface ............................................................................. 3
5. Non-spinose tests ........................................................................................................ 7–10 Family Globorotaliidae
6. Spinose tests .............................................................................................................. 7–10 Family Globorotaliidae
7. Trochospiral coiling throughout life ........................................................................ 6
8. Streptospiral coiling in adult .................................................................................... 6
9. Hemispherical chambers with umbilical aperture; coarsely pitted surface texture; umbilical tooth ................................................................. 7–10 Family Globorotaliidae
10. Spherical chambers and umbilical aperture frequently covered by bulla with infralaminal apertures; smooth surface texture Globigerinita
11. Primary aperture only ............................................................................................... 8
12. Primary aperture and one or more secondary apertures ........................................ 9
13. Aperture umbilical, chambers spherical to ovate .................................................. 7–10 Family Globorotaliidae
14. Aperture from umbilicus to periphery; trochospiral in ontogeny becoming nearly planispiral in adult ................................................................. 7–10 Family Globorotaliidae
15. Multi-chambered test ............................................................................................... 7–10 Family Globorotaliidae
16. One-chambered spherical test (juvenile stage is multi-chambered with secondary apertures) ................................................................. 7–10 Family Globorotaliidae
17. Cancellate, honeycomb-like surface ...................................................................... 7–10 Family Globorotaliidae
18. Pitted to smooth, translucent texture; chamber flanges ........................................ 7–10 Family Globorotaliidae

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KEY TO GENERA

1. Trochospiral test (spines simple, if present) ................................................................. 2
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PLANISPIRAL—Triradiate Spines—Transparent Test—Hastigerina

Hastigerinella digitata

Orbulina universa
Globigerinoides congobatus
Globigerinoides ruber
Globigerinoides sacculifer
Sphaeroidinella dehiscens

Orbulina universa
Globigerinoides congobatus
Globigerinoides ruber
Globigerinoides sacculifer
Sphaeroidinella dehiscens

Globigerina rubescens
Globigerina digitata
Globigerina quinqueloba
Globigerina pachyderma
Globigerina humilis
Globigerina falconensis
Globigerina bulloides
Globigerina calida
Globigerinella aequilateralis
Globigerinella adamsi

Globigerinata glutinata
Globigerinita bradyi

Glooquadrina dumerrei
Glooquadrina conglomerata
Glooquadrina hexagona
Pulleniatina obliquiloculata

Globorotalia inflata
Globorotalia truncatulinoides
Globorotalia crassaformis
Globorotalia hirsuta
Globorotalia scitula
Globorotalia menardii
Globorotalia tumida

Candeina—Candeina nitida

Each species in the Key and in the diagram above is given a number and the same number is used in the figures, different views of the same species being lettered a, b, c.

In the Key overleaf species marked ** are commonly found in the northeastern Atlantic between 40°N and 65°N lat. and between 25°W long. and Western Europe. Species marked * occur less commonly in this area.

Unless otherwise marked all the bar scales (placed underneath the middle specimen) are 500 μ.

References

### Key to Species

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<td>Smooth</td>
<td>&gt;1 mm</td>
<td>4-5 in juvenile; 6 in adult</td>
<td>Spherical</td>
<td>Equatorial</td>
<td>Triradiate spines</td>
<td>Transparent test, triradiate spines</td>
<td>Subtropical, tropical</td>
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<td><em>Hastigerina digitata</em> (Rhumbler)</td>
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<td>Equatorial becoming spirorbital</td>
<td>Triradiate spines</td>
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<tr>
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<td>Spinose</td>
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<td>Two</td>
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<td>Single spherical chamber</td>
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<td>Globigerinoides conglobatus (Brady)</td>
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<td>Two secondary apertures per chamber; primary aperture over 3 chambers; round outline</td>
<td>Subtropical, tropical surface waters</td>
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<td>Coarsely Spinose; spherical</td>
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<td>5 in juvenile; 3 in adult</td>
<td>Umbilical</td>
<td>Two Spinose</td>
<td>Spinose</td>
<td>Pink to red pigment; two secondary apertures per chamber; primary aperture over two chambers</td>
<td>Tropical, subtropical surface waters</td>
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<tr>
<td>Globigerinoides sacculifer (Brady) [≡ Globigerinoides tripus (Reuss)]</td>
<td>Trochospiral ovate</td>
<td>Spinose, honeycomb texture</td>
<td>~1.3 mm</td>
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<td>Spherical</td>
<td>Umbilical One</td>
<td>Spinose</td>
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<td>Dominant species in tropical surface water; common also in subtropical regions</td>
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<tr>
<td>Sphaeroidinae dehiscens (Parker and Jones) ≡ a terminal form of Globigerinoides sacculifer (Brady)</td>
<td>Trochospiral ovate</td>
<td>Smooth to pitted</td>
<td>~1.3 mm</td>
<td>4 in adult</td>
<td>Spherical with chamber flanges</td>
<td>Umbilical (observed)</td>
<td>One (concealed)</td>
<td>Spinose in juvenile; non-spinose in adult</td>
<td>Great wall thickening producing smooth, glassy layer; chamber flanges coalesce and obscure apertures</td>
<td>Tropical, subtropical below 500 m depth</td>
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<td>Globigerina rubescens Hofker</td>
<td>Trochospiral</td>
<td>Spinose Hapld</td>
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<td>5 in juvenile; 4 in adult</td>
<td>Spherical</td>
<td>Umbilical</td>
<td>Spinose</td>
<td>Light orange-pink pigment in test</td>
<td>Tropical, subtropical surface waters</td>
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<tr>
<td>Globigerina digitata Brady</td>
<td>Trochospiral</td>
<td>Spinose Hapld</td>
<td>~0.65 mm</td>
<td>4-5 in juvenile; 4-6 in adult</td>
<td>Spherical</td>
<td>Umbilical spiro-umbilical in adult</td>
<td>Spinose</td>
<td>Digitate final chamber(a)</td>
<td>Tropical, subtropical surface waters</td>
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<td><strong>Globigerina quinquedoba</strong> Natland</td>
<td>Trochospiral</td>
<td>Spinose; smooth</td>
<td>~0.27 mm</td>
<td>5-6 in juvenile and adult</td>
<td>Hemispherical; ovate flap-like final chamber</td>
<td>Umbilical; sometimes modified into infralaminal apertures</td>
<td>Spinose</td>
<td>Final chamber a lobed extension over umbilicus, but not always present</td>
<td>Subarctic and subantarctic cold-temperate surface waters; left-coiling population in colder waters</td>
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<tr>
<td><strong>Globigerina pachyderma</strong> (Ehrenberg)</td>
<td>Trochospiral</td>
<td>Coarse</td>
<td>~0.47 mm</td>
<td>5 in juvenile; 4 in adult</td>
<td>Spherical</td>
<td>Umbilical becoming extra-umbilical; distinct lip</td>
<td>May be present in juvenile; absent in adult</td>
<td>Subquadrat, coarse-crystalline compact test; aperture is a narrow slit with distinct lip</td>
<td>Left-coiling in sub-polar; right-coiling in cold-temperate waters</td>
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**Note:** The table conveys information about different species of foraminifera, detailing their morphological characteristics, distribution, and diagnostic features. The species are listed alongside descriptions of their outline, test, chambers, apertures, spines, and diagnostic characters. Each species is categorized according to its distribution within the ocean, from tropical to subantarctic regions.
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<th>Species</th>
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<th>Spine Type</th>
<th>Size</th>
<th>Description</th>
<th>Distribution</th>
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<td><em>Globigerina umilis</em> (Brady)</td>
<td>Trochospiral</td>
<td>Left+Right</td>
<td>Spinose smooth</td>
<td>~ 0.21 mm 5-6 in juvenile; 6-8 in adult</td>
<td>Six to eight chambers per whorl, and bulla-like final chamber</td>
</tr>
<tr>
<td><em>Globigerina falconensis</em> Blow</td>
<td>Trochospiral</td>
<td>Left+Right</td>
<td>Spinose smooth</td>
<td>~ 0.43 mm 5 in juvenile; 4 in adult</td>
<td>Spherical, sometimes modified into infra-laminal apertures</td>
</tr>
<tr>
<td><em>Globoquadrina d'Orbignyi</em></td>
<td>Trochospiral</td>
<td>Left+Right</td>
<td>Spinose smooth</td>
<td>~ 0.8 mm 5 in juvenile; 4-6 in adult</td>
<td>Spherical, becoming elongate</td>
</tr>
<tr>
<td><em>Globoquadrina conglomera</em> (Brady)</td>
<td>Trochospiral</td>
<td>Left+Right</td>
<td>Spinose smooth</td>
<td>~ 0.9 mm 5 in juvenile; 5-6 in adult</td>
<td>Spherical, becoming radially elongate</td>
</tr>
<tr>
<td><em>Globoquadrina adami</em> (Banner and Blow)</td>
<td>Trochospiral</td>
<td>Left+Right</td>
<td>Spinose smooth</td>
<td>~ 1.48 mm 5 in juvenile; 5-7 in adult</td>
<td>Spherical, becoming intero-marginal equatorial</td>
</tr>
<tr>
<td><em>Globoquadrina glutinata</em> (Egger)</td>
<td>Trochospiral</td>
<td>Left+Right</td>
<td>Smooth finely hispid</td>
<td>~ 0.48 mm 5 in juvenile; 4 in adult</td>
<td>Bulla and infralaminal apertures; smooth test</td>
</tr>
<tr>
<td><em>Globoquadrina bradyi</em> Wiesner (= <em>Globoquadrina uvula</em> (Ehrenberg))</td>
<td>Trochospiral</td>
<td>Left+Right</td>
<td>Smooth finely hispid</td>
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<td>Bulla and infralaminal apertures; high spire and numerous chambers</td>
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<td><em>Globoquadrina d'Orbignyi</em> (d'Orbignyi) (= <em>Globoquadrina siphonifera</em> (d'Orbignyi))</td>
<td>Trochospiral</td>
<td>Left+Right</td>
<td>Coarse pitted</td>
<td>~ 0.68 mm 5 or 6 in juvenile; 4-6 in adult</td>
<td>Hemispherical, with umbilical tooth</td>
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<tr>
<td><em>Globoquadrina conglomerata</em> (Schwager)</td>
<td>Trochospiral</td>
<td>Left+Right</td>
<td>Coarse, pitted</td>
<td>~ 0.86 mm 6 in juvenile; 4 in adult</td>
<td>Hemispherical, with umbilical tooth</td>
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<tr>
<td><em>Globoquadrina hexagona</em> (Natland)</td>
<td>Compressed trochosoral becoming nearly planispiral</td>
<td>Left+Right</td>
<td>Coarse, pitted</td>
<td>~ 0.58 mm 5 in juvenile; 5-6 in adult</td>
<td>Hemispherical, becoming extra umbilical with tooth</td>
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<td><em>Pulleniatina obliquicolecta</em> (Parker and Jones)</td>
<td>Trochospiral</td>
<td>Right mostly</td>
<td>Pitted in juvenile; very smooth in adult</td>
<td>~ 0.8 mm 4-5 in juvenile; 3½ in adult</td>
<td>Hemispherical, later overlapping earlier chambers</td>
</tr>
<tr>
<td>Species</td>
<td>Outline</td>
<td>Test</td>
<td>Maximum length</td>
<td>Number per whorl</td>
<td>Shape</td>
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<tr>
<td><em>=Globorotalia inflata</em> (d'Orbigny)</td>
<td>Trochospiral; flat spiral side; inflated apertural side</td>
<td>Left mostly</td>
<td>~0.65 mm</td>
<td>5 in juvenile; 4 in adult</td>
<td>Inflated, hemispherical</td>
</tr>
<tr>
<td><em>=Globorotalia truncatulinoides</em> (d'Orbigny)</td>
<td>Trochospiral conical</td>
<td>Left + Right</td>
<td>~0.9 mm</td>
<td>6 in juvenile; 5-6 in adult</td>
<td>Angular conical</td>
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<td><em>Globorotalia crassaformis</em> (Galloway and Wissler) [= <em>Globorotalia punctulata</em> (d'Orbigny)]</td>
<td>Trochospiral planoconvex</td>
<td>Left mostly</td>
<td>~0.65 mm</td>
<td>5-6 in juvenile; 4-5 in adult</td>
<td>Angular rhomboid</td>
</tr>
<tr>
<td><em>Globorotalia hirsuta</em> (d'Orbigny)</td>
<td>Compressed trochospiral; biconvex or apertural side flat</td>
<td>Right mostly</td>
<td>~1.0 mm</td>
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<td>Angular rhomboid</td>
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<td><em>Globorotalia scitula</em> (Brady)</td>
<td>Compressed trochospiral biconvex</td>
<td>Left + Right</td>
<td>~0.66 mm</td>
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<td><em>Globorotalia menardii</em> (d'Orbigny) [= <em>Globorotalia cultrata</em> (d'Orbigny)]</td>
<td>Compressed trochospiral subcircular outline</td>
<td>Left mostly</td>
<td>~1.3 mm</td>
<td>5-6 in adult</td>
<td>Angular rhomboid</td>
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<td>Compressed trochospiral elongate oval outline</td>
<td>Left mostly</td>
<td>~1.4 mm</td>
<td>5-6 in adult</td>
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<td><em>Candeina nitida</em> d'Orbigny</td>
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<td>Right mostly</td>
<td>~0.76 mm</td>
<td>4 in juvenile; 3 in adult</td>
<td>Spherical</td>
</tr>
</tbody>
</table>

Spines are absent in all species listed on this page.
Unless otherwise marked, all the bar scales (placed underneath the middle specimen) are 500μ.
There are about 30 species of planktonic Foraminifera living in the world oceans, and they can be grouped into three major distributional zones — a warm-water belt between approximately 40° N and 40° S Latitudes, which divides the northern cold-water region from its southern counterpart. The bipolar nature of the species distributions is evident from the striking similarity of the foraminiferal faunas in reciprocal latitudinal zones between the northern and southern hemispheres.

The majority of the species (22) belong to the warm-water province. Its faunal diversity suggests that here evolution proceeded more rapidly than in the colder areas. The warm-water species can be grouped into (a) the Equatorial or Tropical species (e.g., *Globigerinoides sacculifer*, *Globorotalia menardii*, *Globobaculina dutertrei*, *Pulleniatina obliquiloculata*, and *Globorotalia tumida*), which are transported to mid-latitudes via the warm currents (Gulf Stream, Kuroshio Currents, etc.) along the eastern margins of the continents; and (b) the Central-water or Subtropical species (e.g., *Globorotalia hirsuta*, *G. truncatulinoides* and *Hastigerina pelagica*) which occur in the central oligotrophic areas of the oceans. Some species (*Globigerinoides ruber*, *Globigerinella aequilaterialis* and *Orbulina universa*) occur abundantly in both tropical as well as subtropical waters. The seasonal succession of these foraminiferal assemblages was documented in the Sargasso Sea off Bermuda from plankton tows collected biweekly between 1958 and 1962.

There are at least three warm-water species that occur in the Indo-Pacific region, but which are no longer present in the Atlantic Ocean. They are *Globobaculina hexagona*, *G. conglomerata* and *Globigerinella adamsi*. The former two species are known from Pleistocene deep-sea sediments, but they have apparently disappeared since from the Atlantic.

The cold-water fauna can be divided into Subpolar species (*Globigerina quinqueloba*, right-coiling *G. pachyderma*, *G. bulloides sensu stricto* and *Globigerinita bradyi*) and a single Polar species (left-coiling *G. pachyderma*). The bipolarity in the faunal zonations is clearly observed in the distributional patterns of the coiling directions of *G. pachyderma* and *G. truncatulinoides* in the North and South Atlantic.

The two transitional zones between the warm-water and cold-water faunas are characterized by the prolific occurrence of *Globorotalia inflata*. Its distribution is generally limited to the middle latitudes, with the exception of incursions equator-ward along the western margins of continents, where upwelling takes place.

Planktonic Foraminifera apparently spend their earlier stages in the euphotic zone and later descend to deeper depths. Life at great depths is accompanied by considerable shell thickening in most species which is estimated to add about 50% or more CaCO$_3$ by weight to the foraminiferal test (e.g., *Globorotalia menardii*, *G. truncatulinoides*, *Globigerinoides sacculifer* — «S. dehiscens»). Some species such as *Globorotalia crassiformis*, *G. scitula*, and *Hastigerinella digitata* appear to be truly meso- or bathypelagic. The spinose species are generally epipelagic, whereas the non-spinose ones exhibit a great range in depth habitats.