

Report of the Biological Survey of Mutsu Bay.
19. Notes on the Recent Foraminifera
from Mutsu Bay.*

By

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(With 95 text-figures.)

INTRODUCTION.

The present paper deals with the results of observations on the recent Foraminifera from Mutsu Bay. The materials on which the examinations were based, were collected by myself by means of a dredge and a surface net tow during the months of August, 1927 and June, 1928 at about thirty stations, the depth of any one which does not exceed thirty three fathoms.

The classification adopted in this report is that arranged by J. A. CUSHMAN in his excellent work entitled "Foraminifera. Their Classification and Economic Use" (1928).

I have recognized in all one hundred distinguishable forms, the species and varieties numbering respectively ninety four and six. Of the said ninety four species and six varieties, eleven of the species are regarded new to science. Those one hundred forms represented in this paper are contained in forty genera belonging to seventeen families.

Here I wish to express my sincere thanks to Professor S. HATTA under whose supervision the work was carried out. In identification of some of the species I have received a great deal of help from Dr. J. A. CUSHMAN and Mr. S. HANZAWA, to whom I am very grateful and make a special acknowledgement here. In publishing the present report I am indebted much to Professor Dr. S. HATAI and

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Professor Dr. S. HÔZAWA. For their kindness I thank them heartily.

The following is the list of the species dealt with in the present paper.

Family	Page.
Family Astrorhizidae	
1. <i>Crithionina pisum</i> GOËS	50
Family Saccamminidae	
Subfamily PSAMMOSPHAERINAE	
2. <i>Psammosphaera fusca</i> F. E. SCHULZE	51
3. <i>Psammosphaera parva</i> FLINT	52
Subfamily SACCAMMININAE	
4. <i>Proteonina difflugiformis</i> (H. B. BRADY).....	52
5. <i>Proteonina crassa</i> , n. sp.	54
Family Reophacidae	
Subfamily REOPHACINAE	
6. <i>Reophax scorpiurus</i> MONTFORT	55
7. <i>Reophax pilulifer</i> H. B. BRADY	56
8. <i>Reophax curtus</i> CUSHMAN	57
9. <i>Reophax bilocularis</i> FLINT	57
10. <i>Reophax excentricus</i> CUSHMAN	58
11. <i>Reophax dentaliniformis</i> H. B. BRADY	59
12. <i>Reophax enormis</i> HADA	60
13. <i>Reophax gracilis</i> (KIAER)	61
Family Ammodiscidae	
Subfamily AMMODISCINAE	
14. <i>Glomospira gordialis</i> (JONES and PARKER).....	62
Family Lituolidae	
Subfamily HAPLOPHRAGMIINAE	
15. <i>Haplophragmoides emaciatum</i> (H. B. BRADY)	63
16. <i>Haplophragmoides subglobosum</i> (G. O. SARS)	64
17. <i>Ammobaculites agglutinans</i> (D'ORBIGNY)	65
18. <i>Ammobaculites pseudospirale</i> (WILLIAMSON)	66
19. <i>Ammobaculites cassis</i> (PARKER).....	67
20. <i>Ammobaculites calcareum</i> (H. B. BRADY)	68
21. <i>Ammobaculites americanus</i> CUSHMAN	69
Family Textulariidae	
Subfamily TEXTULARIINAE	
22. <i>Textularia candeiana</i> D'ORBIGNY	70

	Page.
23. <i>Textularia hauerii</i> D'ORBIGNY	71
24. <i>Textularia cuneata</i> , n. sp.	71
25. <i>Textularia parvula</i> CUSHMAN.....	72
26. <i>Bigenerina nodosaria</i> D'ORBIGNY.....	73
Family Verneuilinidae	
27. <i>Verneuilina polystropha</i> (REUSS)	74
Family Miliolidae	
28. <i>Quinqueloculina seminulum</i> (LINNÉ)	76
29. <i>Quinqueloculina vulgaris</i> D'ORBIGNY	76
30. <i>Quinqueloculina pygmaea</i> REUSS	77
31. <i>Quinqueloculina subquadra</i> , n. sp.	78
32. <i>Quinqueloculina lamarckiana</i> D'ORBIGNY	79
33. <i>Quinqueloculina curta</i> CUSHMAN	80
34. <i>Massilina secans</i> (D'ORBIGNY)	81
35. <i>Spiroloculina depressa</i> D'ORBIGNY	82
36. <i>Spiroloculina cushmani</i> , n. sp.	83
37. <i>Spiroloculina costata</i> , n. sp.	84
38. <i>Triloculina trigonula</i> (LAMARCK)	85
39. <i>Triloculina tricarinata</i> D'ORBIGNY	86
40. <i>Triloculina circularis</i> BORNEMANN	87
41. <i>Triloculina terquemiana</i> (H. B. BRADY)	88
Family Ophthalmidiidae	
Subfamily CORNUSPIRINAE	
42. <i>Cornuspira involvens</i> (REUSS)	89
Family Trochamminidae	
Subfamily TROCHAMMININAE	
43. <i>Trochammina inflata</i> (MONTAGU)	90
44. <i>Trochammina globigeriniformis</i> (PARKER and JONES)	91
Subfamily GLOTEXTULARIINAE	
45. <i>Nouria polymorphinoides</i> HERON-ALLEN and EARLAND	93
46. <i>Nouria textulariformis</i> , n. sp.	93
47. <i>Nouria tenuis</i> , n. sp.	94
Family Lagenidae	
Subfamily NODOSARIINAE	
48. <i>Dentalina communis</i> D'ORBIGNY	95
49. <i>Dentalina consobrina</i> D'ORBIGNY, var. <i>emaciata</i> REUSS	96
50. <i>Dentalina mutsui</i> , n. sp.	97
51. <i>Nodosaria simplex</i> SILVESTRI.....	98
52. <i>Nodosaria pyrula</i> D'ORBIGNY	98
53. <i>Nodosaria pyrula</i> D'ORBIGNY, var. <i>semirugosa</i> D'ORBIGNY	99

	Page.
54. <i>Nodosaria scalaris</i> (BATSCH)	100
55. <i>Glandulina rotundata</i> REUSS	100
56. <i>Amphicoryne falx</i> JONES and PARKER	101
Subfamily LAGENINAE	
57. <i>Lagena laevis</i> (MONTAGU)	102
58. <i>Lagena clavata</i> (D'ORBIGNY)	103
59. <i>Lagena gracillima</i> (SEGUENZA)	103
60. <i>Lagena elongata</i> (EHRENBERG)	104
61. <i>Lagena semistriata</i> WILLIAMSON	105
62. <i>Lagena gracilis</i> WILLIAMSON	106
63. <i>Lagena distoma</i> PARKER and JONES	106
64. <i>Lagena striata</i> (D'ORBIGNY)	107
65. <i>Lagena striata</i> (D'ORBIGNY), var. <i>strumosa</i> REUSS	108
66. <i>Lagena substriata</i> WILLIAMSON	108
67. <i>Lagena sulcata</i> (WALKER and JACOB)	109
68. <i>Lagena sulcata</i> (WALKER and JACOB), var. <i>interrupta</i> WILLIAMSON	109
69. <i>Lagena orbignyana</i> (SEGUENZA), var.	110
Family Polymorphinidae	
Subfamily POLYMORPHININAE	
70. <i>Guttulina communis</i> D'ORBIGNY	111
71. <i>Guttulina regina</i> H. B. BRADY, PRAKER and JONES	112
72. <i>Guttulina gibba</i> D'ORBIGNY	112
73. <i>Pseudopolymorphina soldanii</i> (D'ORBIGNY)	113
74. <i>Dimorphina tuberosa</i> (D'ORBIGNY)	114
75. <i>Sigmomorpha ozawai</i> , n. sp.	115
76. <i>Sigmoidella kagaensis</i> CUSHMAN and OZAWA	116
Family Nonionidae	
77. <i>Nonion boueana</i> (D'ORBIGNY)	117
78. <i>Nonion scapha</i> (FICHTEL and MOLL)	118
79. <i>Nonion turgida</i> (WILLIAMSON)	119
80. <i>Nonionella pulchella</i> , n. sp.	120
81. <i>Eliphidium striato-punctatum</i> (FICHTEL and MOLL)	121
82. <i>Eliphidium crispum</i> (LINNÉ)	123
83. <i>Eliphidium subnodosum</i> (MÜNSTER)	123
84. <i>Eliphidium macellum</i> (FICHTEL and MOLL)	124
85. <i>Eliphidium fabum</i> (FICHTEL and MOLL)	125
86. <i>Eliphidium decipiens</i> (COSTA)	126
Family Buliminidae	
Subfamily BULIMININAE	
87. <i>Bulimina aculeata</i> D'ORBIGNY	127
88. <i>Entosolenia globosa</i> (MONTAGU)	128
89. <i>Entosolenia lucida</i> WILLIAMSON	129

	Page.
Subfamily VIRGULININAE	
90. <i>Virgulina schreibersiana</i> CZJEK	130
91. <i>Bolivina robusta</i> H. B. BRADY	131
92. <i>Bolivina seminuda</i> CUSHMAN	132
Subfamily REUSSINAE	
93. <i>Reussia spinulosa</i> (REUSS)	133
Subfamily UVIGERININAE	
94. <i>Siphogenerina raphanus</i> (PARKER and JONES)	134
Family Rotaliidae	
Subfamily ROTALIINAE	
95. <i>Rotalia papillosa</i> H. B. BRADY	136
96. <i>Rotalia papillosa</i> H. B. BRADY, var. <i>compressiuscula</i> H. B. BRADY	136
97. <i>Rotalia japonica</i> , n. sp.	137
Subfamily BAGGININAE	
98. <i>Cancris auricula</i> (FICHTEL and MOLL)	139
Family Globigerinidae	
Subfamily GLOBIGERININAE	
99. <i>Globigerina bulloides</i> D'ORBIGNY	140
Family Anomalinidae	
Subfamily CIBICIDINAE	
100. <i>Cibicides lobatulus</i> (WALKER and JACOB)	141

DESCRIPTION OF THE SPECIES.

Order FORAMINIFERA.

Family **Astrorhizidae.**

Test free, consisting of a central chamber from which radiate tubular channels to the exterior, either simple or branching; wall with a thin chitinous inner layer on all or part of which is agglutinated arenaceous material; apertures formed by the peripheral ends of the arms or by openings in the peripheral wall.

Genus **CRITHIONINA** GOËS, 1894.

Test free, spherical, lenticular or variously shaped, interior either with a large chamber and thin wall, usually perforated, or with a

small chamber and thick wall with the communication to the surface by means of numerous branching tubes; wall of sponge spicules and very fine sand, often chalky in appearance, soft, with little cement; color white or grayish.

1. *Crithionina pisum* GOËS.

(Text-fig. 1)

Crithionina pisum, GOËS, 1896, p. 24, pl. 2, figs. 1, 2; FLINT, 1897, p. 266, pl. 6, fig. 1; MILLETT, 1899, p. 250, pl. 4, fig. 3; RHUMBLER, 1904, p. 230, text-fig. 57; CUSHMAN, 1918, p. 68, pl. 25, figs. 4, 5, pl. 26, figs. 1-3.

Description.—Test usually globular, somewhat compressed; wall thick, subcavernous, consisting of fine sand grains and of sponge spicules agglutinated loosely, giving a chalky appearance, without distinct apertures; surface nearly smooth, slightly uneven; color greyish white.



Text-fig. 1. *Crithionina pisum* GOËS. $\times 20$.

Diameter, about 1.50 mm.

Locality.—Off Futagojima, 23 fathoms.

Remarks.—Of this species only a single specimen was found in the material taken from the bottom of Mutsu Bay, and thus rare in this region.

Family Saccamminidae.

Test free or attached, composed typically of a single chamber or occasionally with chamber of the same sort loosely united; wall lined with chitin, the exterior of agglutinated material of various sorts, sand grains, sponge spicules, or other foraminiferal tests; aperture usually single, of various shapes.

Subfamily PSAMMOSPHAERINAE.

Test without a definite aperture.

Genus PSAMMOSPHAERA F. E. SCHULZE, 1875.

Test free or attached, globular; wall composed of a thin layer of

chitin with an outer wall of sand grains, mica flakes, sponge spicules, or other foraminiferal tests, firmly cemented; aperture indefinite.

2. *Psammosphaera fusca* F. E. SCHULZE.

(Text-fig. 2)

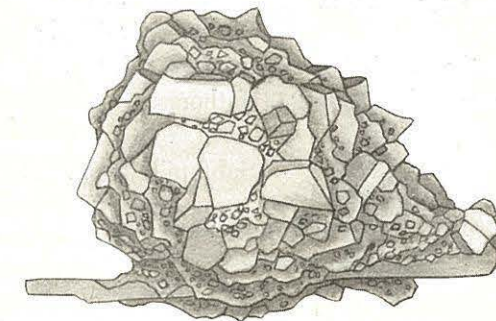
Psammosphaera fusca, F. E. SCHULZE, 1875, p. 113, pl. 2, figs. 8a-f; H. B. BRADY, 1879, p. 27, pl. 4, fig. 1; 1884, p. 249, pl. 18, fig. 1, 5-8; GOËS, 1894, p. 14, pl. 3, fig. 19; CHAPMAN, 1895, p. 13; FLINT, 1897, p. 268, pl. 8, fig. 1; MILLETT, 1899, p. 251; KIAER, 1900, p. 14; RHUMBLER, 1904, p. 242, text-fig. 75; SIDEBOTTOM, 1905, p. 1, pl. 1, fig. 1; CUSHMAN, 1910, p. 36, text-figs. 25-28; HERON-ALLEN and EARLAND, 1913 (a), p. 16, pl. 2, figs. 3-6, 10-16; 1913 (c) p. 40; PEARCEY, 1914, p. 1000; HERON-ALLEN and EARLAND, 1915, p. 609; 1916 (a) p. 219; CUSHMAN, 1918, p. 34, pl. 13, figs. 1-6, pl. 14, figs. 1-3; 1920 (b), p. 594; 1921, p. 64; LACROIX, 1929, p. 8, text-figs. 13-15.

Description.—Test free or attached, nearly spherical; chamber built of a single layer of comparatively large and coarse sand grains firmly cemented; aperture indefinite; color varying with the material of the test.

Diameter, 0.60-0.95 mm.

Localities.—Off Yunoshima, 15 fathoms; off Futagojima, 20 fathoms.

Remarks.—I have a few specimens of this species taken from the localities above mentioned, and they are comparatively small in size. BRADY (1884) reported this species from the deep water in the western sea of Japan. Judging from the records referring to this species, this species seems to be widely distributed in the cold waters. But HERON-ALLEN and EARLAND (1915) recorded this species also from the warm and shallow water of the Kerimba Archipelago.



Text-fig. 2. *Psammosphaera fusca* F. E. SCHULZE. $\times 50$.

3. *Psammosphaera parva* FLINT.

(Text-fig. 3)

Psammosphaera fusca (part), H. B. BRADY, 1879, p. 27, pl. 4, fig. 2; 1884, p. 249, pl. 18, figs. 2-4.

Psammosphaera parva, FLINT, 1897, p. 268, pl. 9, fig. 1; RHUMBLER, 1904, p. 242, text-fig. 77; CUSHMAN, 1910, p. 36, text-figs. 29, 30; 1918, p. 35, pl. 12, figs. 4-6; 1920 (b), p. 594, pl. 75, fig. 3; 1921, p. 47, pl. 2, fig. 7.

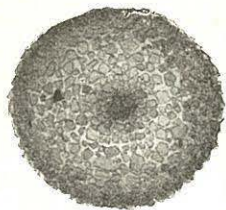
Description. — Test free or adherent, usually penetrated by a sponge spicule, small, spherical, single chambered, without a definite aperture, being replaced by numerous fine pores scattered among the sand grains; wall composed of sand grains firmly united by the cementing substance; color usually greyish brown.

Diameter, about 0.50 mm.

Locality. — Off Yunoshima, 18 fathoms.

Remarks. — The species is exceedingly rare in Mutsu Bay. The specimens in my hand are of rather small size and none of them was penetrated by a sponge spicule as reported by CUSHMAN (1910) in the case

of the specimens which were taken off the southern coast of Hondo from a depth of 943 fathoms.



Text-fig. 3. *Psammosphaera parva* FLINT. $\times 55$.

Subfamily SACCAMMININAE.

Test free, with a definite aperture; wall of firmly agglutinated sand or sponge spicules.

Genus PROTEONINA WILLIAMSON, 1858.

Test free, a fusiform or flask-shaped undivided chamber; wall of coarse sand grains, mica flakes, or other agglutinated material with a thin inner layer of chitin; aperture usually circular, often with a slight neck which may become elongate.

4. *Proteonina difflugiformis* (H. B. BRADY).

(Text-fig. 4)

Reophax difflugiformis, H. B. BRADY, 1879, p. 51, pl. 4, fig. 3a, b; 1881 (b), p. 11;

1884, p. 289, pl. 30, figs. 2-4; GOËS, 1894, p. 26, pl. 6, figs. 196-198; CHAPMAN, 1895, p. 14; GOËS, 1896, p. 28; FLINT, 1897, p. 272, pl. 16, fig. 2; MILLETT, 1899, p. 252; KIAER, 1900, p. 15; SIDEBOTTOM, 1905, p. 2; HERON-ALLEN and EARLAND, 1913 (c), p. 42; 1915, p. 612; 1916 (a), p. 222; 1916 (b), p. 40.

Saccammina difflugiformis, EIMER and FICKERT, 1899, p. 671.

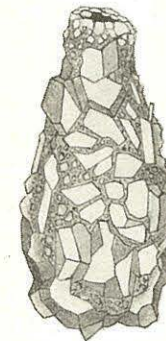
Proteonina difflugiformis, RHUMBLER, 1904, p. 245, text-fig. 80a, b; CUSHMAN, 1910, p. 42, text-figs. 40, 41; RHUMBLER, 1911, pl. 2, figs. 7-14; 1913, p. 378; PEARCEY, 1914, p. 1000; CUSHMAN, 1918, p. 47, pl. 21, figs. 1, 2; 1921, p. 49; 1927 (a), p. 130; HADA, 1929, p. 10; LACROIX, 1929, p. 9, text-figs. 16, 17.

Description. — Test free, composed of a single, elongate, oval, or pyriform chamber with a slightly produced tubular neck; wall arenaceous, consisting of sand grains firmly cemented; surface rather rough, occasionally more or less smooth; aperture simple, terminal, rounded; color usually light grey or yellow.

Length, about 0.55 mm.

Localities. — Off Yunoshima, 10-18 fathoms; off Mourajima, 20 fathoms; off Futagojima, 15-25 fathoms; between Ōshima and Bentenjima, 27-33 fathoms.

Remarks. — This species was found in nearly every collection from the various stations in Mutsu Bay. CUSHMAN (1910) reported this species from the south-east coast of Japan, while I (1929) have found it also in the shallow waters of Hokkaido. Judging from the records previously published, it may be assumed that the present species is restricted to comparatively cold water and is fairly widely distributed. In the case of the specimens which were obtained at the stations situated between Ōshima and Bentenjima in Mutsu Bay, the test has a thin and somewhat translucent wall built up of mica scales and sand grains smoothly cemented, but in those from other stations in this bay the wall of the test is beset with shiny quartz grains.



Text-fig. 4. *Proteonina difflugiformis* (H. B. BRADY). $\times 100$.

5. *Proteonina crassa*, n. sp.

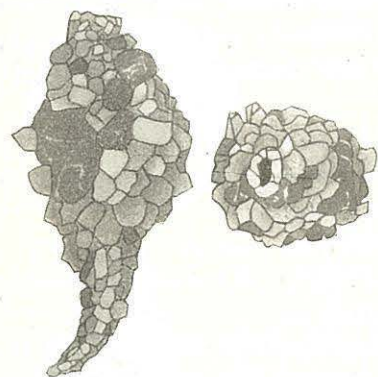
(Text-fig. 5)

Description.—Test elongate, fusiform, about twice as long as broad, usually somewhat curved, tapering into a long projection at the base, apertural end slightly drawn out; wall composed of comparatively large sand grain loosely cemented; aperture simple, rounded, terminal at the short tubular neck produced from the main body; color dark or blackish grey.

Length, 1.28–1.95 mm; diameter, 0.65–0.85 mm.

Localities.—Off Yunoshima, 10–18 fathoms; between Ōshima and Bentenjima, 27–33 fathoms.

Remarks.—This species seems to be rather common at the localities above mentioned, but it is difficult to obtain complete specimens as they easily fall into pieces, the connection among the agglutinated materials of the test being very loose. In regard to the shape of the test the present species closely resembles *Proteonina helenae*. But the materials of the test are different in both species, viz. in the present species



Text-fig. 5. *Proteonina crassa*, n. sp. × 25.

a, side view. b, apertural view.

the test is composed of coarse sand grains, while in *Proteonina helenae* it is made up of fragments of the broken tests of the other Foraminifera.

Family Reophacidae.

Test consisting of either an irregular or a generally rectilinear series of chambers, typically increasing in size as added, simple or labyrinthic; wall chitinous with usually an exterior of agglutinated material, sand grains, sponge spicules, or the tests of other foraminifera; aperture usually terminal, simple or multiple.

Subfamily REOPHACINAE.

Chambers typically in a regular rectilinear series.

Genus REOPHAX MONTFORT, 1808.

Test free, elongate, composed of several undivided chambers, ranging from overlapping to remotely separated ones connected by stolon-like necks, in a straight or curved linear series; wall single, of agglutinated material, firmly cemented, sand grains, mica scales, sponge spicules, or other foraminifera; aperture simple, terminal, sometimes with a slight neck.

6. *Reophax scorpiurus* MONTFORT.

(Text fig. 6)

Lituola scorpiurus, H. B. BRADY, 1864, p. 467, pl. 48, fig. 5; 1870, p. 291; DAWSON, 1871, p. 86, fig. 4.

Lituola nautiloida, var. *scorpiurus*, BÜTSCHLI, 1880–1882, p. 192, pl. 5, fig. 18.

Reophax scorpiurus, H. B. BRADY, 1881 (b), p. 11; 1884, p. 291, pl. 30, figs. 12, 15–17; EGGER, 1893, p. 65, pl. 4, fig. 18, pl. 5, figs. 45, 46; GOËS, 1894, p. 24, pl. 5, figs. 158, 159, pl. 6, figs. 164–167; CHAPMAN, 1895, p. 14; GOËS, 1896, p. 26; FLINT, 1897, p. 273, pl. 16, fig. 3; MILLETT, 1899, p. 254; BAGG, 1908, p. 126; CUSHMAN, 1910, p. 83, text-figs. 114–116; RHUMBLER, 1911, pl. 8, figs. 2–5; 1913, p. 470; HERON-ALLEN and EARLAND, 1913 (c), p. 43; PEARCEY, 1914, p. 1006; HERON-ALLEN and EARLAND, 1916 (a), p. 222; CUSHMAN, 1920 (a), p. 6, pl. 1, figs. 5–7; 1920 (b), p. 598; 1921, p. 65, pl. 6, fig. 6.

Nodulina scorpiura, KIAER, 1900, p. 23.

Description.—Test free, composed of several somewhat inflated chambers increasing in size as added, usually curved in the early portion; wall consisting of comparatively coarse sand grains and of other foreign matters; aperture simple at the slightly produced end of the last-formed chamber; color varying with the



Text-fig. 6. *Reophax scorpiurus* MONTFORT. × 25.

agglutinated material of the wall.

Length, up to 2.40 mm.

Localities.—The depth at the stations at which the material was obtained was 4–33 fathoms.

Remarks.—Various forms of irregular shape are included under this specific name. In Mutsu Bay this species is rather common, and the test is usually elongated, tapering and slightly curved. In general features the species looks like *Reophax dentaliniformis*, but the absence of a distinct cylindrical neck separates the present species from a fore said species.

7. *Reophax pilulifer* H. B. BRADY.

(Text-fig. 7)

Reophax pilulifer, H. B. BRADY, 1884, p. 292, pl. 30, figs. 18–20; FLINT, 1897, p. 273, pl. 18, fig. 1.

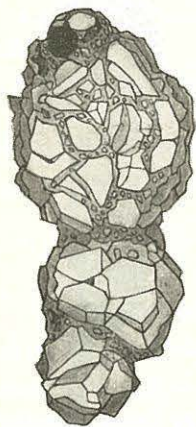
Reophax pilulifer, GOËS, 1894, p. 25, pl. 6, figs. 176–180; CHAPMAN, 1895, p. 15; GOËS, 1896, p. 27; CUSHMAN, 1910, p. 85, text-figs. 117, 118; 1920 (a), p. 7, pl. 2, fig. 1; 1921, p. 66, pl. 12, fig. 1.

Description.—Test usually curved and sometimes straight, composed of three to seven subglobular chambers, increasing rapidly in size as added; wall consisting of coarse sand grains, but presenting a rather smooth exterior; aperture simple, terminal at the end of the last-formed chamber; color grey or brown.

Length, about 1.50 mm.

Localities.—Off Yunoshima, 15 fathoms; off Futagojima, 18–25 fathoms; near Ōshima, 23 fathoms.

Remarks.—This species was hitherto obtained only from the deep sea. In the Challenger Report H. B. BRADY (1884) recorded it from a depth of 1875 fathoms in the eastern sea of Japan, and CUSHMAN (1910) reported this species at a depth of 437 fathoms off the southern coast of Japan. It seems rather peculiar that several specimens of this species have been found in such shallow waters as in Mutsu Bay.



Text-fig. 7. *Reophax pilulifer* H. B. BRADY. ×30.

8. *Reophax curtus* CUSHMAN.

(Text-fig. 8)

Reophax scarpiurus (part), GOËS, 1894, p. 24, pl. 5, figs. 160–163.

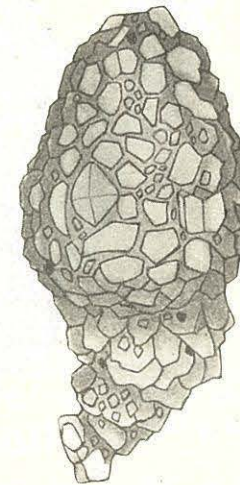
Reophax curtus, CUSHMAN, 1920 (a), p. 8, pl. 2, figs. 2, 3.

Description.—Test somewhat fusiform, tapering, straight or often slightly curved in the early portion, composed of three or four chambers, each larger than its predecessor, last-formed chamber oval or fusiform, occupying a large proportion of the test; wall constructed of sand grains cemented neatly with a considerable amount of brown cementing material; aperture simple, terminal, situated at the produced end of the chamber without definite neck; color usually brown.

Length, up to 1.50 mm.

Localities.—Off Yunoshima, 10–18 fathoms; off Futagojima, 18–25 fathoms; near Ōshima 23 fathoms.

Remarks.—I have identified the specimens from Mutsu Bay as *Reophax curtus* as they show the features identical with those of this species except for the color of the test. The color of the test is brown in the case of the specimen from Mutsu Bay while it is grey in the specimens reported by CUSHMAN (1920). However, the color of the test usually varies in great deal with that of the cementing material, and thus is not to be taken as one of the characteristics which distinguish the arenaceous Foraminifera.



Text-fig. 8. *Reophax curtus* CUSHMAN. ×50.

9. *Reophax bilocularis* FLINT.

(Text-fig. 9)

Reophax bilocularis, FLINT, 1897, p. 273, pl. 17, fig. 2; CUSHMAN, 1910, p. 90, text-fig. 127a, b; 1920 (a), p. 10, pl. 3, figs. 3, 4; 1921, p. 74, pl. 12, fig. 7.

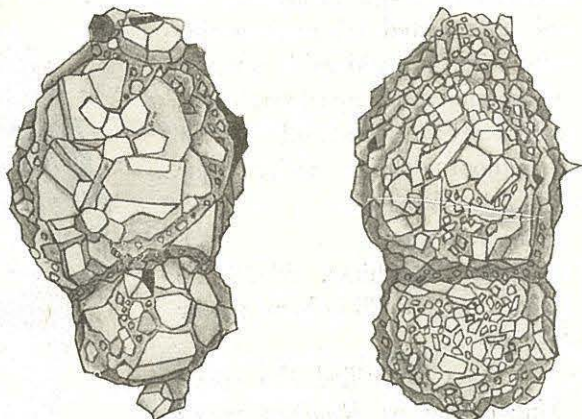
Description.—Test composed of two inflated chambers arranged in a straight or a curved line, initial end rounded or occasionally with a very small chamber, apertural end produced into a short

cylindrical neck; wall built up of rather coarse sand grains cemented firmly with yellowish grey cement; aperture simple, nearly circular at the end of a short tubular neck.

Length, up to 1.50 mm.

Localities.—It was obtained at nearly all stations, 8–30 fathoms.

Remarks.—This species is rather common in Mutsu Bay. As shown in figures, the specimens from this bay differ from those figured



Text-fig. 9. *Reophax bilocularis* FLINT. ×50.

by FLINT 1) in the rather short test composed of chambers not strongly elongated, 2) in the suture which is not strongly depressed, and 3) in the material of the wall consisting mainly of coarse sand grains and not being mixed with cast tests of other Foraminifera. I have identified the specimens from Mutsu Bay as *Reophax bilocularis* on the basis of the test consisting of two chambers.

10. *Reophax excentricus* CUSHMAN.

(Text-fig. 10)

Reophax excentricus, CUSHMAN, 1910, p. 92, text-fig. 143; 1927 (a), p. 133, p. 1, fig. 3.

Description.—Test straight or slightly curved, composed of four to six inflated chambers increasing rapidly in size from the first as added; wall consisting of coarse sand grains cemented firmly together; aperture rounded, at the end of a short tubular neck, slightly produced

from the last-formed chamber; color varying with the agglutinated material of the test.

Length, up to 2.60 mm.

Localities.—It is obtained at the most of the stations, at depths of 8–30 fathoms.

Remarks.—The species seems to be common in Mutsu Bay. The type-specimen was obtained from the stomach of *Holothurians*, which was dredged by the U. S. Fish Commission Steamer "Albatross" in the Bering Sea from a depth of 1771 fathoms. The specimens from Mutsu Bay are rather larger than the type, but they resemble it very closely in general features.



Text-fig. 10 *Reophax excentricus* CUSHMAN. ×30.

11. *Reophax dentaliniformis* H. B. BRADY.

(Text-fig. 11)

Reophax dentaliniformis, H. B. BRADY, 1881 (a), p. 49; 1884, p. 293, pl. 30, figs. 21, 22; GOËS, 1894, p. 25, pl. 6, figs. 172–175; SCHLUMBERGER, 1894, p. 239; CHAPMAN, 1895, p. 15; GOËS, 1896, p. 27; FLINT, 1897, p. 274, pl. 18, fig. 2; MILLETT, 1899, p. 254; CUSHMAN, 1908, p. 23; 1910, p. 87, text-fig. 121; RHUMBLER, 1911, pl. 8, figs. 21, 22; 1913, p. 473; PEARCEY, 1914, p. 1006; CUSHMAN, 1920 (a), p. 18, pl. 5, figs. 4, 5; 1921, p. 68, pl. 12, fig. 4; 1927 (a), p. 132.

Nodulina dentaliniformis, KLAER, 1900, p. 24.

Description.—Test slender, cylindrical, tapering, straight or more or less curved, composed of rather coarse sand grains, but neatly cemented; aperture simple at the end of a short tubular neck; color usually grey.

Length, up to 1.80 mm.

Localities.—Near Futagojima, 18 fathoms; between Ōshima and Bentenjima, 30–33 fathoms.

Remarks.—This species is comparatively



Text-fig. 11. *Reophax dentaliniformis* H. B. BRADY. ×40.

rare in Mutsu Bay. Its occurrence was also reported by SCHLUMBERGER (1894) from the Sea of Okhotsk.

12. *Reophax enormis* HADA.

(Text-fig. 12)

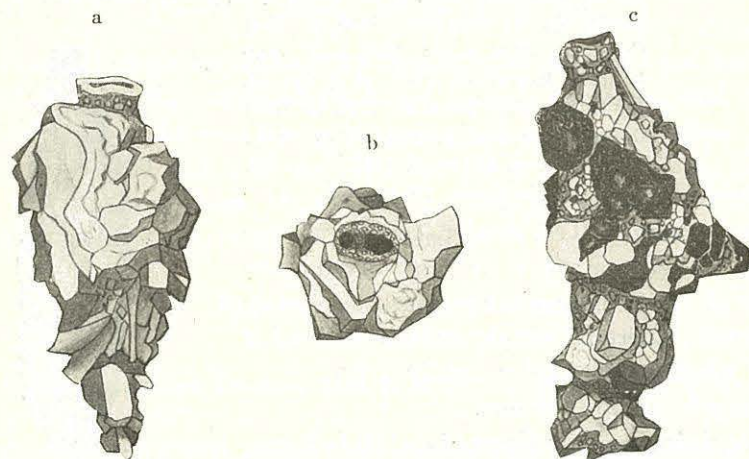
Reophax enormis, HADA, 1929, p. 10, text-figs. a-d.

Description.—Test typically tapering, composed usually of three chambers arranged in a nearly straight series, showing an irregular contour, apertural end drawn out into a short tubular neck; wall constructed of sharp edged sand grains giving an irregular appearance; sutures often indistinct due to incomplete septa; aperture simple, at the end of a short neck; color variable in accordance with that of material forming the wall.

Length, up to 0.95 mm.

Localities.—Off the Marine Biological Station, 10-18 fathoms; off Futagojima, 18-25 fathoms; near Ōshima, 23 fathoms; between Ōshima and Bentenjima, 30-33 fathoms.

Remarks.—This species occurs not very abundantly, but is widely distributed in Mutsu Bay. I (1929) have also collected some specimens of it in the inlet of Oshoro, Hokkaido. The species is more or less



Text-fig. 12. *Reophax enormis* HADA. $\times 60$.

a, side view of a specimen. b, apertural view of the same. c, side view of the other specimen.

similar to *Reophax scorpiurus* in general appearance, but it may be distinguished from the latter by the ill-defined sutures and by the surface which is very coarse.

13. *Reophax gracilis* (KIAER).

(Text-fig. 13)

Nodulina gracilis, KIAER, 1900, p. 24, text-figs. (without No.).

Description.—Test elongate, composed of about nineteen loosely connected chambers in an irregularly curved linear series, but separated by distinct sutures, tapering gradually to the initial end; wall finely arenaceous, thin and delicate; aperture rounded, terminal; color light or yellowish grey.

Length, about 0.55 mm.

Locality.—Off Yunoshima, 18 fathoms.

Remarks.—A few specimens of this species were found in my material obtained from the above station. They are closely similar to the Norwegian specimens figured by KIAER (1900), but on the whole they are smaller than the latter.



Text-fig. 13. *Reophax gracilis* (KIAER). $\times 120$.

Family Ammodiscidae.

Test composed of a globular proloculum and long, undivided, tubular, second chamber, usually close coiled, at least in the young, planispiral, conical spiral, or irregularly winding; wall of fine arenaceous material with much cement, usually of a yellowish or reddish-brown color; aperture formed by the open end of the tubular chamber.

Subfamily AMMODISCINAE.

Test free.

Genus GLOMOSPIRA RZEHAK, 1888.

Test free, consisting of a proloculum and long, tubular, second

chamber winding about its earlier coils in various planes; wall of fine arenaceous material with a large proportion of yellowish or reddish-brown cement; aperture at the end of the tube.

14. *Glomospira gordialis* (JONES and PARKER).

(Text-fig. 14)

Trochammina gordialis, CARPENTER, PARKER and JONES, 1862, p. 141, pl. 11, fig. 4.
Ammodiscus gordialis, H. B. BRADY, 1881 (b), p. 12; 1884, p. 333, pl. 38, fig. 7-9;
 EGGER, 1893, p. 72, pl. 5, figs. 39, 40; FLINT, 1897, p. 279, pl. 24, fig. 1.
Gordiammina gordialis, KIAER, 1900, p. 21; RHUMBLER, 1904, p. 282, text-fig. 132;
 CUSHMAN, 1910, p. 76, text-figs. 88-90; PEARCEY, 1914, p. 1005; LACROIX, 1929, p. 21, text-fig. 31.

Glomospira gordialis, CUSHMAN, 1918, p. 99, pl. 36, figs. 7-9.

Description. — Test free, variable in shape, asymmetrical, composed of a proloculum and a long, tubular, undivided chamber of nearly uniform diameter coiled up in an irregular manner and in varying directions; wall arenaceous, neatly cemented with fine material; aperture simple, rounded, at the end of the tube; color reddish brown in the central coil, fading gradually into yellowish brown.

Diameter, about 0.38 mm.

Locality. — Near Futagojima, 18 fathoms.

Text-fig. 14. *Glomospira gordialis*.
 (JONES and PARKER). $\times 110$.

Remarks. — This species seems to be rare; only two comparatively small specimens have been seen.

Family *Lituolidae*.

Test free, planispiral at least in the young, later portion in some genera uncoiled, divided into chambers, either simple or labyrinthic; wall arenaceous with varying proportions of cement in different genera and species, usually with a yellowish or reddish-brown cement, the last-formed chamber in the adult often white; aperture simple or compound.

Subfamily HAPLOPHRAGMINAE.

Test composed of simple chambers, not labyrinthic.

Genus HAPLOPHRAGMOIDES CUSHMAN, 1910.

Test of several coils, planispiral, usually not completely involute, chambers simple; wall single, arenaceous or with sponge spicules, firmly cemented, amount of cement varying greatly in different species; aperture simple, at the base of the apertural face of the chamber or in the face of the chamber.

15. *Haplophragmoides emaciatum* (H. B. BRADY).

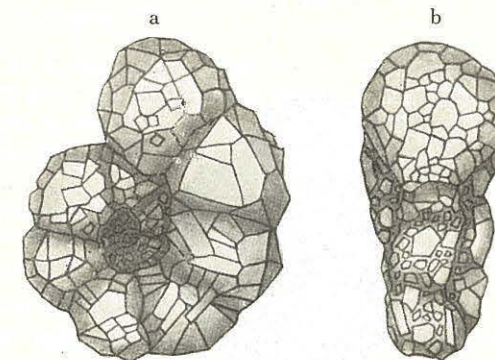
(Text-fig. 15)

Haplophragmium emaciatum, H. B. BRADY, 1884, p. 305, pl. 33, figs. 26-28; EGGER, 1893, p. 70, pl. 5, figs. 53, 54; CHAPMAN, 1895, p. 16; FLINT, 1897, p. 276, pl. 19, fig. 5.

Haplophragmium compressum, MILLETT, 1899, p. 359, pl. 5, fig. 8; HERON-ALLEN and EARLAND, 1915, p. 613, pl. 46, figs. 20, 21.

Haplophragmoides emaciatum, CUSHMAN, 1910, p. 102, text-figs. 150-152; 1920 (a), p. 40, text-figs. 1-3, pl. 8, fig. 4; 1921, p. 80; HADA, 1929, p. 11.

Description. — Test nearly discoidal, planispiral, both faces concave, composed of two or more convolutions, of which the outer one consists of about seven inflated chambers, rapidly increasing in size; peripheral margin rounded; wall constructed of sand grains cemented neatly; sutures well marked externally; aperture slit-like, arched, at the base of the apertural face of the chamber; color brown in the larger individuals, greyish white in the smaller ones, dark color in the central portion of the test, fading gradually towards



Text-fig. 15. *Haplophragmoides emaciatum* (H. B. BRADY). $\times 65$.
 a, side view. b, apertural view.

the last-formed chamber.

Diameter, about 0.65 mm.

Localities.—Off Yunoshima, 10–18 fathoms; near Ōshima, 23 fathoms.

Remarks.—This species is rather rare in Mutsu Bay, and is represented by specimens of comparatively small size. Several specimens examined showed great diversity in color of the test and the material forming the wall. As already mentioned above, in larger specimens the test is brown in color and its wall is thick being composed of fine sand, while in smaller ones, it is greyish white in color and, moreover, is somewhat translucent, the wall being comparatively thin. In my previous paper (1929) I have reported on the occurrence of the present species in the waters of Hokkaido.

16. *Haplophragmoides subglobosum* (G. O. SARS).

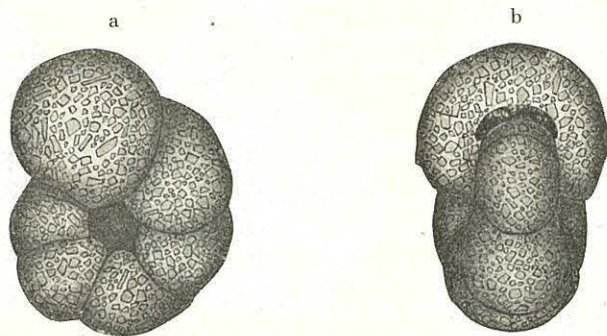
(Text-fig. 16)

Haplophragmium subglobosum, H. B. BRADY, 1881 (b), p. 12.

Haplophragmium latidorsatum, H. B. BRADY, 1884, p. 307, pl. 34, figs. 7, 8, 10;

GOËS, 1894, p. 21, pl. 5, figs. 102–123; CHAPMAN, 1895, p. 15; GOËS, 1896, p. 29; FLINT, 1897, p. 276, pl. 20, fig. 1; KIAER, 1900, p. 43; MILLETT, 1899, p. 360; HERON-ALLEN and EARLAND, 1911, p. 309; 1913 (c), p. 46, pl. 2, figs. 15, 16.

Haplophragmoides subglobosum, CUSHMAN, 1910, p. 105, text-figs. 162–164; PEARCEY, 1914, p. 1008; CUSHMAN, 1920 (a), p. 45, pl. 8, fig. 5; 1921, p. 81, pl. 15, fig. 1a, b.



Text-fig. 16. *Haplophragmoides subglobosum* (G. O. Sars). ×50.

a, side view. b, apertural view.

Description.—Test free, planispiral, depressed at the umbilical region, six to eight subglobular chambers forming the outer whorl; sutures marked with the deep depressions; wall thick, consisting of fine sand grains cemented neatly with a considerable amount of cementing material, giving a rather smooth appearance; aperture arched slit-like or irregularly formed at the base of the apertural face of the final chamber; color reddish brown or yellowish brown, often fading from the first visible chamber to the last-formed one.

Diameter, up to 0.80 mm.

Localities.—Off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms.

Remarks.—A few specimens of small size occur in my collections obtained at the above localities. In each of these specimens the test is strongly depressed at the inner coil, but this feature was not noticed in the specimens hitherto described.

Genus AMMOBACULITES CUSHMAN, 1910.

Test free, the early chambers close coil, later ones uncoiling with typically a linear series of chambers, simple; wall arenaceous with a chitinous lining; aperture in the early stages at the base of the apertural face, in the adult circular and terminal.

17. *Ammobaculites agglutinans* (D'ORBIGNY).

(Text-fig. 17)

Haplophragmium agglutinans, H. B. BRADY, 1884, p. 301, pl. 32, figs. 19, 20, 24–26;

EGGER, 1893, p. 68, pl. 4, figs. 16, 36; GOËS, 1894, p. 23, pl. 5, figs. 140, 141; CHAPMAN, 1895, p. 16; GOËS, 1896, p. 32; MILLETT, 1899, p. 357, pl. 5, fig. 1; BAGG, 1908, p. 126; HERON-ALLEN and EARLAND, 1909, p. 322; 1915, p. 612.

Ammobaculites agglutinans, CUSHMAN, 1910, p. 115, text-fig. 176; PEARCEY, 1914, p. 1010; CUSHMAN, 1920 (a), p. 60, pl. 12, fig. 3; 1920 (b), p. 600; 1921, p. 89, pl. 17, fig. 4.

Description.—Test elongate, planispiral and compressed in the early portion, consisting of one and more visible convolutions, the later portion in a linear series composed of cylindrical chambers; wall arenaceous with a considerable amount of cementing material; sutures indistinct in the early portion, but distinct in the later; aperture



Text-fig. 17. *Ammobaculites agglutinans* (D'ORBIGNY). $\times 80$.

simple, terminal; color usually dark grey.

Length, about 0.55 mm.

Locality. — Off Yunoshima, 15 fathoms.

Remarks. — This species is widely distributed throughout temperate waters, and may be obtained from every depth. The species shows a great diversity in its size, color and texture. It seems highly probable that the specimens taken from deep water are greater in size than those obtained from shallow water close the coast. In Mutsu Bay the species is rather rare and is represented by specimens of comparatively small size.

18. *Ammobaculites pseudospirale* (WILLIAMSON).

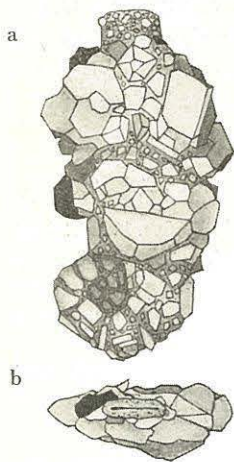
(Text-fig. 18)

Protonina pseudospiralis, WILLIAMSON, 1858, p. 2, pl. 1, figs. 2, 3.

Haplophragmium pseudospirale, H. B. BRADY, 1884, p. 302, pl. 33, figs. 1-4; EGGER, 1893, p. 68, pl. 5, figs. 41, 42; GOËS, 1894, p. 23, pl. 5, figs. 146, 147; MILLETT, 1899, p. 358; KIAER, 1900, p. 44; SIDEBOTTOM, 1905, p. 3; RHUMBLER, 1911, pl. 2, fig. 15; 1913, p. 379; HERON-ALLEN and EARLAND, 1913 (c), p. 45; 1916 (a), p. 223, pl. 40, fig. 14.

Ammobaculites pseudospirale, CUSHMAN, 1920 (a), p. 62, pl. 12, fig. 4; 1921, p. 94, pl. 19, figs. 1, 2.

Description. — Test thin, elongate, compressed, early portion showing a spiral growth, but later portion forming a nearly straight linear series; chambers separated by scarcely perceptible sutural lines; wall composed of coarse sand grains united together with much cementing material; aperture irregular, sometimes oblong or slit-like either at the end of the produced portion of the final chamber or at the end of a short neck; color reddish



Text-fig. 18. *Ammobaculites pseudospirale* (WILLIAMSON). $\times 35$.
a, side view.
b, apertural view.

brown in the commencement, gradually fading into light yellow towards the last-formed chamber.

Length, about 1.30 mm.

Localities. — Off Yunoshima, 18 fathoms; off Futagojima, 18-25 fathoms.

Remarks. — Judging from the records previously published the species seems to be distributed in comparatively shallow waters. In Mutsu Bay I have secured several specimens which are fairly variable in contour of the test.

19. *Ammobaculites cassis* (PARKER).

(Text-fig. 19)

Haplophragmium cassis, H. B. BRADY, 1884, p. 304, pl. 33, figs. 17-19; EGGER, 1893, p. 69, pl. 5, figs. 55, 56; GOËS, 1894, p. 24, pl. 5, figs. 152-157; FLINT, 1897, p. 275, pl. 19, fig. 4; MILLETT, 1899, p. 359, pl. 5, figs. 4-6.

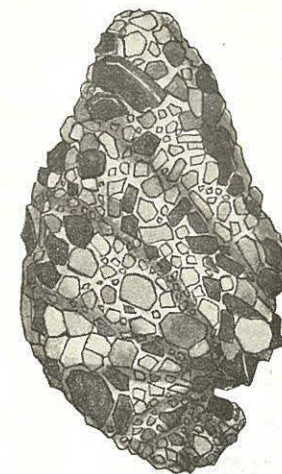
Ammobaculites cassis, CUSHMAN, 1920 (a), p. 63, pl. 12, fig. 5; 1921, p. 91, pl. 14, fig. 4; HADA, 1929, p. 11.

Description. — Test elongate, arcuate, strongly compressed, outer margin rounded, but inner margin more or less acute; early chambers arranged spirally, later ones uncoiled but obliquely placed, somewhat inflated; wall composed of coarse sand grains with much cement, forming rather smooth surface; sutures comparatively obvious in the later uncoiled portion; aperture simple at the distal end; color grey or dark grey.

Length, up to 1.80 mm.

Localities. — Off Futagojima, 23 fathoms, near Ōshima, 23 fathoms.

Remarks. — From previous records it appears that the present species seems to have its home in the Arctic Ocean, and occurs in most cases in cold water. I (1929) have formerly obtained several specimens of this species from the port of Nemuro, Hokkaido.



Text-fig. 19. *Ammobaculites cassis* (PARKER). $\times 40$.

20. *Ammobaculites calcareum* (H. B. BRADY).

(Text-fig. 20)

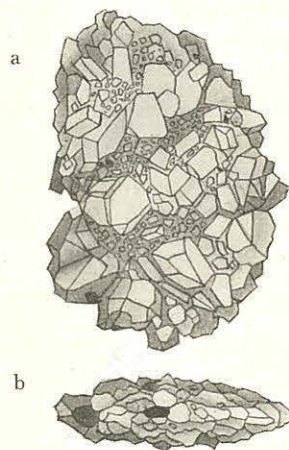
Haplophragmium calcareum, H. B. BRADY, 1884, p. 302, pl. 33, figs. 5-12.
Ammobaculites calcareum, CUSHMAN, 1921, p. 90, pl. 17, fig. 3.

Description.—Test more or less elongate, compressed, at first exhibiting a single convolution consisting of three to five visible chambers, afterwards showing a nearly straight linear series; sutures rather distinct; wall composed of sand grains cemented with rich cement; aperture simple, terminal; color light grey, more deeply colored at the coiled portion.

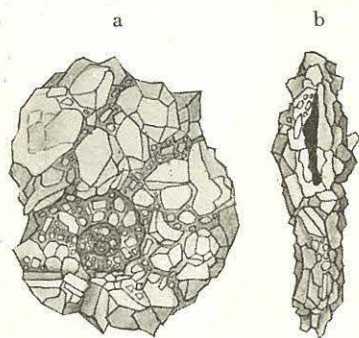
Length, 1.13 mm.

Locality.—Off Yunoshima, 18 fathoms.

Remarks.—This is exceedingly rare species in Mutsu Bay, so far as I investigated; a single specimen being found in the material taken from the bottom of the bay.



Text-fig. 20. *Ammobaculites calcareum* (H. B. BRADY). $\times 40$.
 a, side view. b, apertural view.



Text-fig. 21. *Ammobaculites americanus* CUSHMAN. $\times 50$.
 a, side view. b, apertural view.

21. *Ammobaculites americanus*

CUSHMAN.

(Text-fig. 21)

Haplophragmium fontinense, H. B. BRADY, 1884, p. 305, pl. 34, figs. 1-4; EGGER, 1893, p. 69, pl. 5, fig. 47; GOËS, 1896, p. 31.

Ammobaculites americanus, CUSHMAN, 1910, p. 117, text-figs. 184, 185; PEARCEY, 1914, p. 1010; CUSHMAN, 1920 (a), p. 64, pl. 12, figs. 6, 7.

Description.—Test planispiral, much compressed, composed of numerous flattened chambers, forming

three or four convolutions in the commencement and showing a tendency to form a straight linear series in the fully developed individuals; sutures not very distinct, slightly depressed; wall rather coarsely arenaceous, firmly cemented; aperture elongate, irregularly formed; color grey in the central coil, gradually fading towards the outer ones.

Length, about 0.75 mm.

Locality.—Off Yunoshima, 18 fathoms.

Remarks.—Only two specimens of this species have been secured from Mutsu Bay, and they are of small size, as compared with the specimens recorded by H. B. BRADY (1884) and CUSHMAN (1920) from the other seas.

Family Textulariidae.

Test in the earliest stages, at least in primitive forms, planispiral, later in all but the most accelerated forms developing a biserial stage, final development taking various forms, usually becoming uniserial in the more specialized types; wall arenaceous, with a varying proportion of cement in different genera and species; aperture typically at the inner margin of the last-formed chamber in the biserial forms, becoming terminal and sometimes multiple in the uniserial forms.

Subfamily TEXTULARIINAE.

Test typically biserial or becoming uniserial, usually free; chambers simple or labyrinthic; wall arenaceous, usually perforate; aperture simple or cribrate.

Genus TEXTULARIA DEFRANCE, 1824.

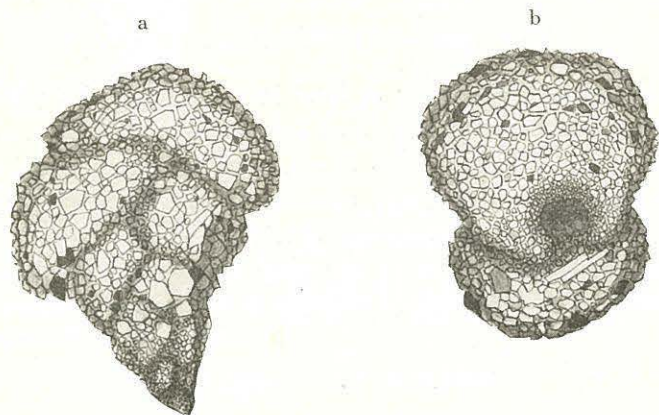
Test free, elongate, tapering, usually compressed with the zig-zag line between the chambers on the middle of the flattened sides, early chambers in the microspheric form usually planispirally coiled, later biserial, chambers simple, not labyrinthic; wall arenaceous, the relative amount of cement varying much; aperture, typically an arched slit at the inner margin of the chamber, occasionally in the apertural face.

22. *Textularia candeiana* D'ORBIGNY.

(Text-fig. 22)

Textularia sagittula, var. *candeiana*, MILLET, 1899, p. 562, pl. 7, fig. 2.
Textularia candeiana, CUSHMAN, 1911, p. 12, text-figs. 14-17; 1921, p. 109; 1922 (a), p. 8, pl. 1, figs. 1-3; 1922 (b), p. 23, pl. 2, fig. 2; 1922 (c), p. 50, pl. 11, figs. 7, 8; 1926 (a), p. 76.

Description.—Test somewhat pyramidal, tapering rather sharply to the initial end, marginal edges slightly curved, more or less acute in the commencement, but rounded distally; chambers numerous arranged biserially, increasing rapidly in size in the final portion which consists of highly inflated chambers; sutures marked deeply; texture



Text-fig. 22. *Textularia candeiana* D'ORBIGNY. $\times 50$.
 a, side view. b, apertural view.

neatly arenaceous, firmly cemented; aperture forming an arched sinus at the base of the inner margin of the last-formed chamber; color grey.

Length, about 0.85 mm.

Localities.—Off Yunoshima, 10-18 fathoms; off Futagojima, 18-25 fathoms.

Remarks.—In Mutsu Bay this species is not so common as other species of *Textularia*, and it is represented by specimens of rather small size.

23. *Textularia hauerii* D'ORBIGNY.

(Text-fig. 23)

Textularia hauerii, HERON-ALLEN and EARLAND, 1915, p. 628, pl. 47, figs. 21-23; CUSHMAN, 1921, p. 105, pl. 19, fig. 6.

Description.—Test elongate, slightly compressed, apical end rounded, composed of about six chambers in each row of the biserial arrangement; chambers indistinct in the aboral portion, gradually becoming more inflated towards the oral portion, being separated by sutures, increasing rapidly in height as added; texture coarsely arenaceous, firmly united together with a considerable amount of cementing material; aperture irregular, nearly oblong; color grey.

Length, up to 1.60 mm.

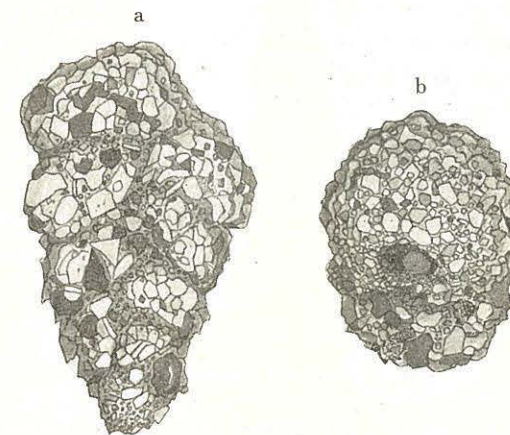
Localities.—Off Yunoshima, 10-18 fathoms; off Futagojima, 18-25 fathoms.

Remarks.—In the reports previously published by CUSHMAN (1921) this species was recorded from shallow water of tropical seas, whereas it seems to occur also in rather cold water as in Mutsu Bay.

24. *Textularia cuneata*, n. sp.

(Text-fig. 24)

Description.—Test compressed, elongate, two and one-half times as long as broad, slightly tapering, both ends blunt, peripheral margin irregular, rounded, apertural face truncate; chambers arranged biserially, usually six to eight forming each series, increasing in height towards the oral extremity; sutures distinct, set obliquely; wall com-



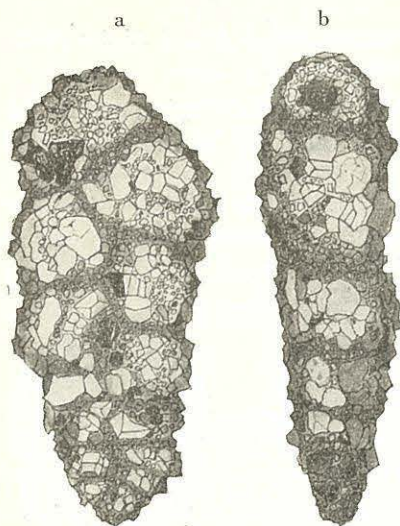
Text-fig. 23. *Textularia hauerii* D'ORBIGNY. $\times 35$.
 a, side view. b, apertural view.

posed of coarse sand grains cemented firmly with grey cementing material; aperture rather large, nearly circular, and almost at the center of the apertural face; color varying with the agglutinated material of the wall.

Length, up to 1.85 mm; breadth, about 0.65 mm; thickness, about 0.36 mm.

Localities. — Off Yunoshima, 10–18 fathoms; off Futagojima, 18–25 fathoms; near Ōshima, 23 fathoms.

Remarks. — This new species is very common in Mutsu Bay, and represents one of the larger forms among arenaceous Foraminifera found in this bay. It shows a close resemblance to *Textularia luculenta* in the outline of the test and in the character of the aperture, but differs from the latter in texture of the wall and in number of the chambers.



Text-fig. 24. *Textularia cuneata*, n. sp. ×40.
a, side view. b, peripheral view.

25. *Textularia parvula* CUSHMAN.

(Text-fig. 25)

Textularia parvula, CUSHMAN, 1922 (a), p. 11. pl. 6, figs. 1, 2.

Description. — Test small, much elongate, somewhat compressed, tapering towards the apical end, composed of numerous chambers arranged biserially; sutures distinct; wall neatly delicate, arenaceous; aperture forming an arched opening at the base of the inner margin of the final chamber; color brown.

Length, up to 0.55 mm.

Localities. — Off Futagojima, 25 fathoms; near Ōshima, 23 fathoms; between Ōshima and Bentenjima, 30–33 fathoms.

Remarks. — This small arenaceous form is commonly found in the

deeper area of Mutsu Bay. It is somewhat similar to *Textularia stricta* in the outline of the test, but differs remarkably from the latter in size of the test. It resembles *Textularia parvula* in its small size and in the general contour of the test, but seemingly varies from that species in the structure of the aperture. The aperture in our specimens is narrowly arched, while in CUSHMAN's (1922) figures it seems to form a more rounded opening.

Genus BIGENERINA D'ORBIGNY, 1826.

Test free, the early chambers biserial, later ones uniserial in a rectilinear series, not labyrinthic; wall usually thick, arenaceous, usually coarse but often smooth finished; aperture in the young biserial stage at the base of the inner margin of the chamber, in the adult uniserial stage terminal, rounded or oval simple.

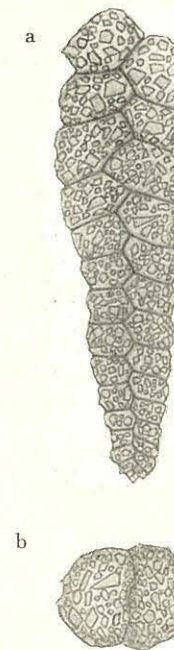
26. *Bigenerina nodosaria* D'ORBIGNY.

(Text-fig. 26)

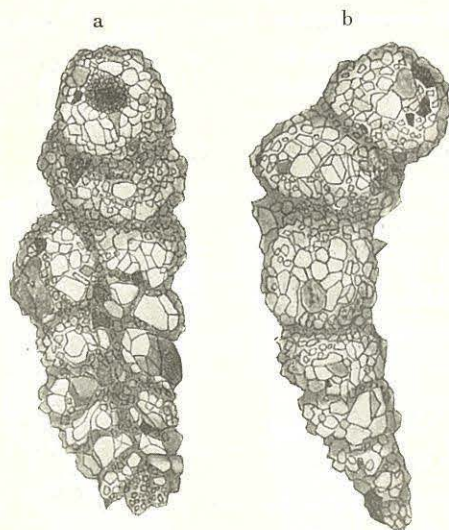
Textularia sagittula, forma *bigenerina*, GOËS, 1882, p. 78, pl. 5, figs 159–161.

Bigenerina nodosaria, H. B. BRADY, 1884, p. 369, pl. 44, figs. 14–18; GOËS, 1894, p. 37, pl. 7, figs. 313–323; 1896, p. 44; FLINT, 1897, p. 286, pl. 31, fig. 4; KIAER, 1900, p. 30; CUSHMAN, 1911, p. 27, text-figs. 46–48; 1920 (b), p. 603; 1921, p. 125, p. 26, fig. 2; 1922 (a), p. 24; 1922 (b), p. 25, pl. 2, figs. 5, 6; 1922 (c), p. 51.

Description. — Test elongate, at first compressed, composed of the biserially arranged chambers increasing progressively in breadth, then altered into the linear series consisting of cylindrical chambers narrower than the alternating portion; sutures distinct, slightly depressed in the biserial portion, but much more depressed in the uniserial; wall coarsely arenaceous with yellowish grey cement; aperture simple, rounded, at the center of the distal face of the last-formed chamber in the adult individuals; color grey.



Text-fig. 25. *Textularia parvula* CUSHMAN. ×120.
a, side view.
b, apertural view.



Text-fig. 26. *Bigenerina nodosaria* D'ORBIGNY.
×40.
a, side view. b, peripheral view.

Length, about 1.45 mm.
Locality.— Off Futagojima, 23 fathoms.

Remarks.— The occurrence of this species in the waters surrounding Japan was first reported by H. B. BRADY (1884) in the Challenger Report, the specimens being obtained from Inland Sea. Only a single specimen was secured in Mutsu Bay at the station alluded to above.

Family Verneulinidae.

Test, at least in the early stages, triserial, later biserial in some genera, and in most

specialized ones becoming uniserial; wall arenaceous, the amount of cement varying in different genera and species; aperture simple or multiple.

Genus VERNEULINA D'ORBIGNY, 1840.

Test usually free, sometimes attached, more or less elongate, tapering, transverse section rounded or triangular; chambers spirally arranged with three chambers marking a whorl, and the chambers arranged in three vertical columns; wall arenaceous; aperture, a low opening at the base of the inner margin of the chamber.

27. *Verneulina polystropha* (REUSS).

(Text-fig. 27)

Verneulina polystropha, H. B. BRADY, 1870, p. 301; 1878, p. 436, pl. 20, fig. 9a-c; 1881 (b), p. 13; 1884, p. 386, pl. 47, figs. 15-17; EGGER, 1893, p. 88, pl. 7, figs. 17, 18; KIAER, 1900, p. 32; SIDEBOTTOM, 1905, p. 10; CUSHMAN, 1908, p. 27; 1911, p. 53, text-fig. 85a, b; 1921, p. 139, pl. 32, fig. 1; HADA, 1929, p. 11.

Description.— Test elongate, conical, rounded at the oral end, pointed bluntly at the initial end, composed of the subglobular chambers in triserial arrangement; sutures marked with the deep depressions; texture rather coarsely arenaceous, cemented firmly with much cement; surface somewhat rough; aperture arched, distinct, at the base of the inner margin of the chamber; color reddish brown or yellowish white, usually fading distally.

Length, up to 0.62 mm.

Localities.— Widely distributed in Mutsu Bay.

Remarks.— This species is rather common in Mutsu Bay, and seems also to be common in the shallow waters off Hokkaido. It is variable not only in color, but also in the shape of the test.

Family Miliolidae.

Test typically coiled about an elongate axis in various planes, at least in the microspheric young of even the specialized genera; chambers usually a half coil in length, simple in most genera, in a few with complex interiors, in the adult of many forms variously arranged; wall normally calcareous, imperforate, in some species of the more primitive genera with included sand grains on the exterior, under acid conditions developing a siliceous or chitinous test; aperture terminal, simple or cribrate, usually with a tooth.

Genus QUINQUELOCULINA D'ORBIGNY, 1826.

Test with the coiling in five planes, the chambers a half coil in length and added successively in planes 144° apart, five chambers completing a cycle, each chamber 72° from its adjacent one, but 144° from the immediately preceding one; wall imperforate, calcareous, often with arenaceous material on the exterior and in deep or brackish water occasionally becoming siliceous; aperture usually with a simple tooth.



Text-fig. 27. *Verneulina polystropha* (REUSS). ×75.
a, side view.
b, apertural view.

28. *Quinqueloculina seminulum* (LINNÉ).

(Text-fig. 28)

Miliolina seminulum, WILLIAMSON, 1858, p. 86, pl. 7, figs. 183-185; H. B. BRADY, 1881 (b), p. 9; 1884, p. 157, pl. 5, figs. 6a-c; EGGER, 1893, p. 40, pl. 2, figs. 38-40; GOËS, 1894, p. 18, figs. 838-838n, pl. 19, figs. 840-843; 1896, p. 81; FLINT, 1897, p. 297, pl. 43, fig. 2; SIDEBOTTOM, 1904, p. 10; CUSHMAN, 1908, p. 25, pl. 5, fig. 2; WIESNER, 1912, p. 231; HERON-ALLEN and EARLAND, 1915, p. 569, pl. 42, fig. 31.

Quinqueloculina seminulum, H. B. BRADY, 1870, p. 285; KIAER, 1900, p. 27; CUSHMAN, 1917 (a), p. 44, text-fig. 29, pl. 11, fig. 2; 1921, p. 416, text-figs. 19, 20, pl. 88, fig. 4a-c; 1929 (a), p. 24, pl. 2, figs. 1, 2; 1929 (b), p. 59; HADA, 1929, p. 14.

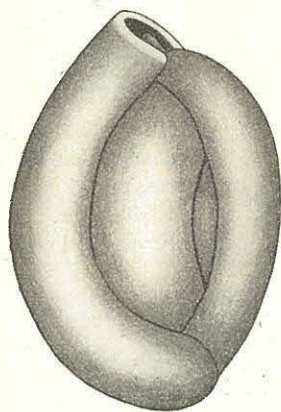
Description.—Test more or less longer than broad, peripheral margin rounded; chambers elongate, inflated; sutures distinct; surface smooth; aperture usually circular with a single tooth.

Length, about 1.00 mm.

Localities.—Near the Marine Biological Station, 5-10 fathoms; off Yunoshima, 10-18 fathoms; off Futagojima, 17-25 fathoms.

Remarks.—This species occurs frequently in Mutsu Bay. CUSHMAN (1917) reported it from numerous stations in the adjacent sea of Japan, and I (1929) have also collected it from the coast of Hokkaido. *Quinqueloculina seminulum* is the name that has been universally adopted

by many well-known authors for the quinqueloculine forms having smooth but rather variably shaped test.



Text-fig. 28. *Quinqueloculina seminulum* (LINNÉ).
×50.

29. *Quinqueloculina vulgaris* D'ORBIGNY.

(Text-fig. 29)

Quinqueloculina vulgaris, SCHLUMBERGER, 1893, p. 207, text-figs. 13, 14, pl. 2, figs. 65, 66; CUSHMAN, 1917 (a), p. 46, pl. 11, fig. 3; 1921, p. 417, text-fig. 21a, b, pl. 87, fig. 1a-c; 1925 (a), p. 138; 1929 (a), p. 25, pl. 2, fig. 3a-c; CUSHMAN and WICKENDEN, 1929, p. 2, pl. 1, fig. 7a-c; HADA, 1929, p. 15.

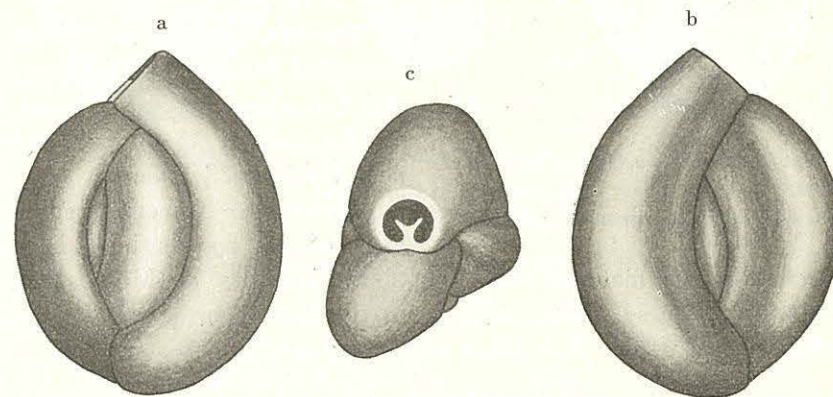
Miliolina vulgaris, SIDEBOTTOM, 1904, p. 11; HERON-ALLEN and EARLAND, 1913 (c), p. 28; 1915, p. 569; 1916 (a), p. 212.

Description.—Test nearly circular in front view, as long as broad, triangular in transverse section, periphery rounded; sutures distinct, depressed; surface smooth; aperture oval with a tooth bifid at the tip.

Length, about 0.65 mm.

Locality.—Off Yunoshima, 15 fathoms.

Remarks.—It is one of the rare species in Mutsu Bay, but it seems to be widely distributed in the neighbouring sea of Japan



Text-fig. 29. *Quinqueloculina vulgaris* D'ORBIGNY. ×70.

a, b, side view. c, apertural view.

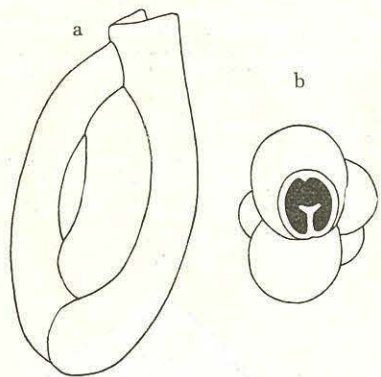
judging from CUSHMAN's records and from my examination (1929) of the species collected from shallow waters off Hokkaido. The species has a close resemblance to *Quinqueloculina seminulum* in the general contour of the test. However, it is not difficult to distinguish them by the ratio between length and breadth of the test. In this species the test is nearly as long as broad, while in *Q. seminulum* it is longer than broad.

30. *Quinqueloculina pygmaea* REUSS.

(Text-fig. 30)

Miliolina pygmaea, H. B. BRADY, 1884, p. 163, pl. 113, fig. 16a, b; EGGER, 1893, p. 38, pl. 2, figs. 23-25; SIDEBOTTOM, 1904, p. 13, pl. 4, figs. 4-6.
Quinqueloculina pygmaea, CUSHMAN, 1917 (a), p. 54; 1929 (a), p. 35.

Description — Test elongate, twice or more as long as broad, peripheral margin rounded; chambers long, curved, cylindrical, five chambers visible from the exterior; sutures distinctly marked; surface more or less rough; aperture oval, usually with a single bifid tooth, sometimes provided with a small additional upper tooth.



Text-fig. 30. *Quinqueloculina pygmaea* REUSS.

a, side view. b, apertural view.

detected in the material from the above localities of Mutsu Bay. From the Japanese waters H. B. BRADY (1884) reported this species from south of Japan.

31. *Quinqueloculina subquadra*, n. sp.

(Text-fig. 31)

Description. — Test elongate, compressed, about one and one-half times as long as broad, neither side strongly inflated, peripheral margin broadly rounded; chamber long, curved, five chambers externally visible; sutures slightly depressed; surface smooth; aperture nearly circular, usually provided with two teeth, the upper one short and pointed, the lower one bifid at the tip.

Length of the figured specimen, 1.10 mm; breadth, 0.71 mm; thickness, 0.34 mm.

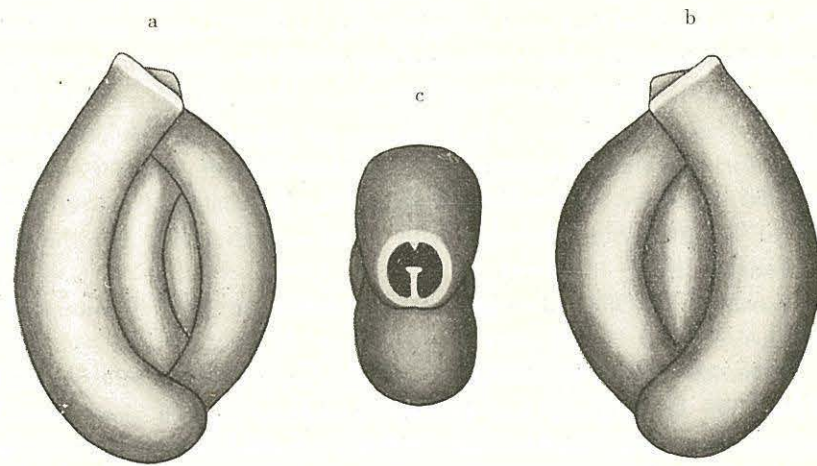
Localities. — Off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms.

Remarks. — This new species is commonly obtainable from comparatively shallow water in Mutsu Bay. In side view this species is similar to *Quinqueloculina seminulum*, but differs from the latter in having two teeth and in the nearly parallel sides in apertural view.

Length, about 1.00 mm.

Localities. — Near the Marine Biological Station, 5–10 fathoms; off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms; near Ōshima, 23 fathoms.

Remarks. — Numerous specimens of this species have been



Text-fig. 31. *Quinqueloculina subquadra*, n. sp. ×50.

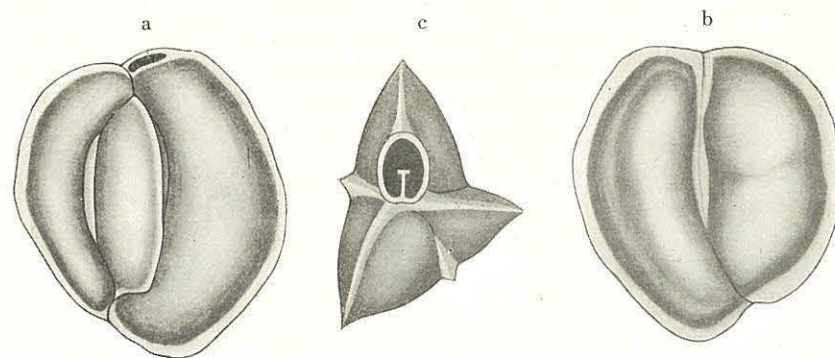
a, b, side view. c, apertural view.

32. *Quinqueloculina lamarckiana* D'ORBIGNY.

(Text-fig. 32)

Miliolina cuvieriana, H. B. BRADY, 1884, p. 162, pl. 5, fig. 12a-c; FLINT, 1897, p. 298, pl. 43, fig. 4.

Quinqueloculina lamarckiana, CUSHMAN, 1921, p. 418, text-figs. 22, 23, pl. 87, figs. 2, 3a-c; 1922 (b), p. 64; 1922 (c), p. 65, text-fig. 5, pl. 15, figs. 14, 15; 1924 (b), p. 63; 1925 (a), p. 139; 1926 (a), p. 81; 1929 (a), p. 26, pl. 2, fig. 6a-c.



Text-fig. 32. *Quinqueloculina lamarckiana* D'ORBIGNY. ×30.

a, b, side view. c, apertural view.

Description.—Test oval in side view, a little longer than broad, as nearly triangular seen from the apertural side; five chambers externally visible, of which three are large, forming respectively the curved triangular prisms with a sharp carinate edge, the other two small, forming sharp angular ridges; sutures distinct; surface smooth, polished; aperture oval with a T-shaped tooth, situated at the terminal end of the last-formed chamber, with or without the neck and the lip.

Length, up to 1.95 mm.

Localities.—Off Futagojima, 17–25 fathoms; near Ōshima, 23 fathoms.

Remarks.—This species may be commonly found at the stations located off Futagojima, and in the specimens secured there are of comparatively large size. FLINT (1897) recorded this species from the Gulf of Tokyo.

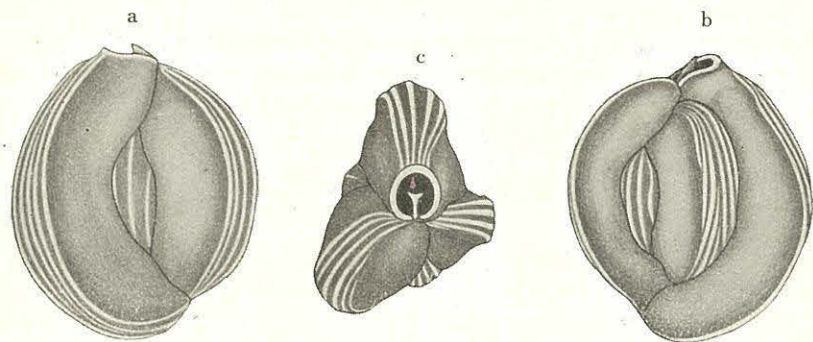
33. *Quinqueloculina curta* CUSHMAN.

(Text-fig. 33)

Quinqueloculina disparilis, var. *curta*, CUSHMAN, 1917 (a), p. 49, text-figs. 30, pl. 14, fig. 2.

Quinqueloculina curta, CUSHMAN, 1921, p. 426, pl. 100, figs. 1, 2; HADA, 1929, p. 15.

Description.—Test nearly circular in side view, as long as broad or a little longer than broad, somewhat triangular in apertural view; chambers polygonal in apertural view, their outer surface rounded and marked with several longitudinal prominent costae, five chambers



Text-fig. 33. *Quinqueloculina curta* CUSHMAN. ×30.

a, b, side view. c, apertural view.

visible from the exterior; sutures distinct; wall generally smooth; aperture oval with a single tooth, surrounded with a thickened lip, and situated at the apertural end of the final chamber.

Length, about 1.35 mm.

Localities.—Near the Marine Biological Station, 5–10 fathoms; off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms; near Ōshima, 23 fathoms.

Remarks.—This species is rather common in Mutsu Bay and is represented often by comparatively large specimens (1.35 mm.), but they are smaller than those (2.00 mm.) reported by CUSHMAN (1917) from Albatross station D. 4900, in 139 fathoms, off the coast of Japan. The specimens (1.10 mm.) which were formerly obtained by myself (1929) from off the coast of Hokkaido are smaller than those dealt with in the present paper.

Genus MASSILINA SCHLUMBERGER, 1893.

Test with the early chambers quinqueloculine, later ones added on opposite sides in a single plane, the quinqueloculine stage present in both megalospheric and microspheric forms; aperture simple, with a bifid tooth.

34. *Massilina secans* (D'ORBIGNY).

(Text-fig. 34)

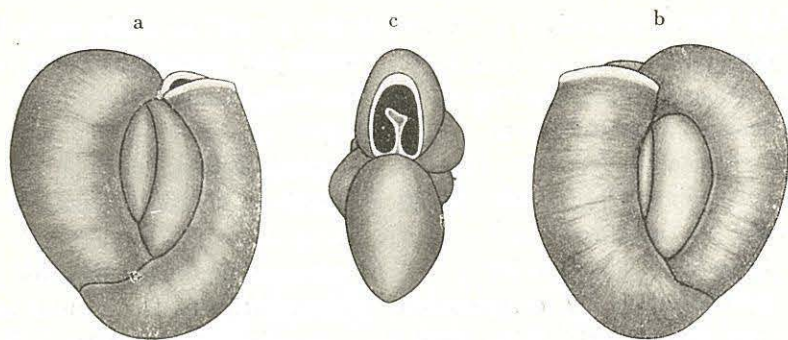
Miliolina seminulum, var. *disciformis*, WILLIAMSON, 1858, p. 86, pl. 7, figs. 188, 189.

Quinqueloculina secans, H. B. BRADY, 1870, p. 288; KIAER, 1900, p. 28.

Miliolina secans, H. B. BRADY, 1884, p. 167, pl. 6, figs. 1, 2; EGGER, 1893, p. 45, pl. 2, figs. 59, 60; GOËS, 1894, p. 112, pl. 20, figs. 856–856g.

Massilina secans, SCHLUMBERGER, 1893, p. 218, text-figs. 31–34, pl. 4, figs. 82, 83; MILLET, 1898, p. 608, pl. 13, fig. 3; SIDEBOTTOM, 1904, p. 18; HERON-ALLEN and EARLAND, 1909, p. 317; 1913 (c), p. 34; 1915, p. 582, pl. 44, figs. 24–27; 1916 (a), p. 215; CUSHMAN, 1917 (a), p. 57; 1929 (a), p. 37, pl. 7, figs. 3, 4; HADA, 1929, p. 15.

Description.—Test nearly discoidal, compressed, peripheral margin subacute; earlier chambers smooth, ovoidal, arranged in a quinqueloculine manner, followed distally by transversely plicated, compressed chambers in a single plane; aperture elongate, oval, with a single tooth bifid at the end, situated at the terminal end of the last-formed chamber.

Text-fig. 34. *Massilina secans* (D'ORBIGNY). ×30.

a, b, side view. c, apertural view.

Diameter, up to 1.25 mm.

Localities.—Between Asamushi and Yunoshima, 4 fathoms; near Gomejima, 7 fathoms.

Remarks.—I have obtained a single adult specimen from the sea-weed attached to the rock near Hadakajima in front of the Marine Biological Station, but the smaller young forms are frequently found in the material from a depth less than ten fathoms in Mutsu Bay. Formerly I have secured young specimens of this species in the inlet of Oshoro, Hokkaido (1929).

Genus SPIROLOCULINA D'ORBIGNY, 1826.

Test with the early chambers in the microspheric form quinqueloculine, later ones in a single plane, chambers a half coil in length; apertural end usually with a neck and lip, simple, with a simple or bifid tooth.

35. *Spiroloculina depressa* D'ORBIGNY.

(Text-fig. 35)

Spiroloculina depressa, WILLIAMSON, 1858, p. 82, pl. 7, fig. 117; H. B. BRADY, 1870, p. 285; WIESNER, 1912, p. 210; CUSHMAN, 1917 (a), p. 29, pl. 3, figs. 6-10; 1921, p. 394, pl. 81, fig. 2, pl. 100, figs. 4, 5; 1929 (a), p. 44, pl. 9, figs. 8, 9.

Spiroloculina limbata, H. B. BRADY, 1884, p. 150, pl. 9, figs. 15-17.

Description.—Test more or less elongate, both faces concave,

elliptical in side view, elongated and somewhat rectangular in end view; peripheral margin flattened; chambers long, curved, arranged in a single plane; terminal end of the last-formed chamber often slightly drawn out into a short neck with a thickened lip; aperture nearly circular, or oval, with a single bifid tooth, or two teeth: the upper one small and angular, the lower one bifid at the tip.

Length, up to 1.25 mm.

Localities.—Near the Marine Biological Station, 5-10 fathoms; off Yunoshima, 10-18 fathoms; off Futagojima, 17-25 fathoms.

Remarks.—This is a comparatively common species in Mutsu Bay. CUSHMAN (1917) reported this species from the following stations distributed among the waters surrounding Japan: 44 fathoms off Hokkaido; 66 fathoms in the eastern channel of Korea Strait; 139 fathoms in the eastern sea of Japan and 77 fathoms in Suruga Gulf.

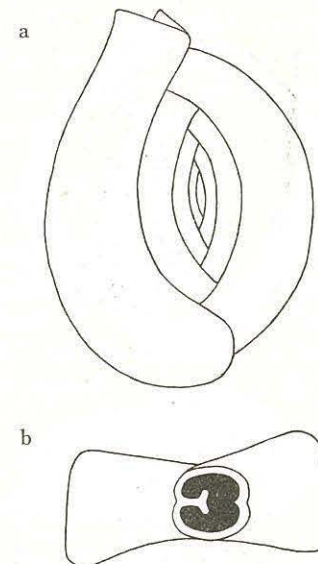
36. *Spiroloculina cushmani*, n. sp.

(Text-fig. 36)

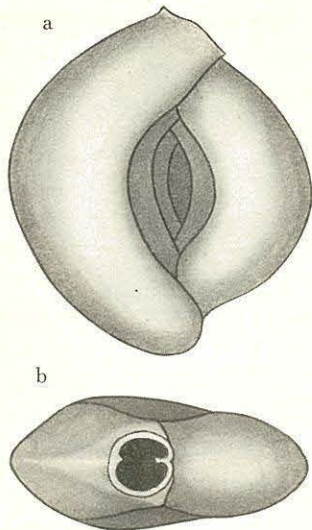
Description.—Test biconcave, nearly circular or oval in side view, typically a little longer than broad, peripheral margin rounded; several chambers visible, arranged in one plane, outer two chambers occupying comparatively the larger portion of the test; wall smooth without any ornamentation; apertural end not drawn out, but with a lip; aperture more or less circular, with two teeth: upper one in form of a short wedge, lower one bifid at the tip.

Length, 1.00-1.57 mm; breadth, 0.87-1.21 mm; thickness, 0.36-0.50 mm.

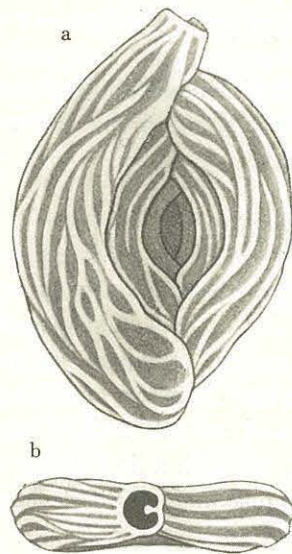
Localities.—Near the Marine Biological Station, 3-10 fathoms;

Text-fig. 35. *Spiroloculina depressa* D'ORBIGNY. ×50.

a, side view. b, apertural view.



Text-fig. 36. *Spiroloculina cushmani*, n. sp. × 30.
a, side view. b, apertural view.



Text-fig. 37. *Spiroloculina costata*, n. sp. × 50.
a, side view. b, apertural view.

off Yunoshima, 10–18 fathoms.

Remarks.— In the collections from Mutsu Bay I have examined several specimens of this species more or less varying in shape, and these generally occur in the shallow water of this bay. It is similar to *Spiroloculina planissima* figured by CUSHMAN (1921, pl. 80, fig. 5a) in side view, but differs from that in the thicker test and in the rounded periphery.

37. *Spiroloculina costata*, n. sp.
(Text-fig. 37)

Description.— Test elongate, compressed, both faces concave, elliptical in side view; peripheral margin rounded; chambers nearly circular in transverse section; surface ornamented with numerous costae running longitudinally or irregularly; apertural end usually produced into a short neck with a slightly expanded lip; aperture circular with a simple tooth, usually bifid at the tip.

Length, about 1.15 mm; breadth, about 0.75 mm; thickness, about 0.20 mm.

Localities.— Near the Marine Biological Station, 3–10 fathoms; off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms.

Remarks.— In Mutsu Bay the new species occurs rather frequently. The breadth of the test is fairly variable with the individuals and sometimes

broader than that of the figured specimen. The characteristic feature of the costae on the test makes it distinguishable from the other species, and it differs from *Spiroloculina antillarum* in the broader test and in the irregular costae on the surface.

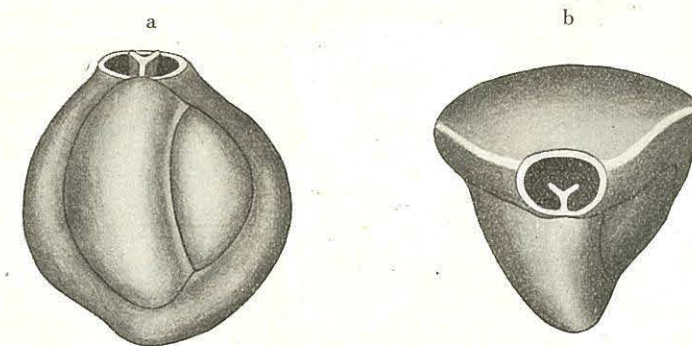
Genus TRILOCULINA D'ORBIGNY, 1826.

Test with the early chambers quinqueloculine, at least in the microspheric form, later ones added in planes 120° from one another, the third of each series added in the plane of the third preceding and covering it so that the surface of the test is composed of but three visible chambers, interior not labyrinthic; aperture simple, typically with a bifid tooth.

38. *Triloculina trigonula* (LAMARCK).
(Text-fig. 38)

Miliolina trigonula, WILLIAMSON, 1858, p. 84, pl. 7, figs. 180–182; H. B. BRADY, 1884, p. 164, pl. 3, figs. 14–16; EGGER, 1893, p. 41, pl. 2, figs. 64–66; GOËS, 1894, p. 115, pl. 22, fig. 870; CHAPMAN, 1895, p. 9; FLINT, 1897, p. 298, pl. 44, fig. 3; WIESNER, 1912, p. 227; HERON-ALLEN and EARLAND, 1915, p. 561; 1924, p. 405; IKARI, 1927, p. 10, pl. 1, figs. 2a–c. *Triloculina trigonula*, H. B. BRADY, 1870, p. 285; KIAER, 1900, p. 27; CUSHMAN 1917 (a), p. 65, text-fig. 31, pl. 25, fig. 3; 1920 (b), p. 638; 1921, p. 452; 1922 (b), p. 72; 1922 (c), p. 69; 1926 (a), p. 82; 1929 (a), p. 56, pl. 12, figs. 10, 11, pl. 13, figs. 1, 2; HADA, 1929, p. 15.

Description.— Test nearly circular or ovate in front view, triangular



Text-fig. 38. *Triloculina trigonula* (LAMARCK). × 40.
a, front view. b, apertural view.

with rounded angles in apertural view; in full developed individuals three chambers visible from the exterior, somewhat inflated; sutures distinct; surface smooth; aperture transversely elliptical with a Y-shaped tooth.

Diameter, up to 1.20 mm.

Localities.—Near the Marine Biological Station, 5–10 fathoms; off Yunoshima, 10–18 fathoms; near Ōshima, 23 fathoms.

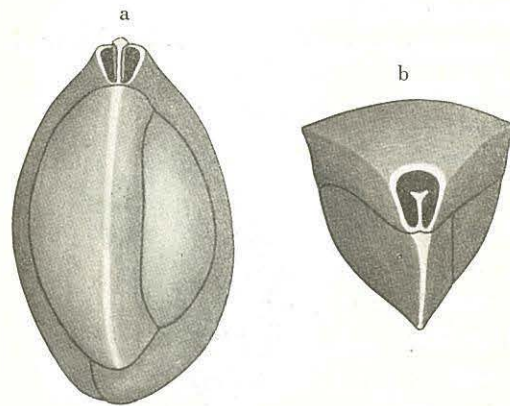
Remarks.—This species is frequently secured in the bottom-sand from Mutsu Bay. CUSHMAN (1917) recorded it from two Albatross stations off Japan and from one station in Suruga Gulf. IKARI (1927) reported this form also from the vicinity of the Misaki Marine Biological Station, and I have examined some specimens from the coast of Hokkaido.

39. *Triloculina tricarinata* D'ORBIGNY.

(Text-fig. 39)

Triloculina tricarinata, H. B. BRADY, 1864, p. 446, pl. 48, fig. 3; KIAER, 1900, p. 27; CUSHMAN, 1917 (a), p. 66, text-fig. 32, pl. 25, figs. 1, 2; 1920 (b), p. 638; 1921, p. 454, text-figs. 35, 36; 1922 (b), p. 72; 1927 (a), p. 139; 1929 (a), p. 56, pl. 13, fig. 3a-c.

Miliolina tricarinata, H. B. BRADY, 1881 (b), p. 9; 1884, p. 165, pl. 3, fig. 17a, b; EGGER, 1893, p. 42, figs. 35-37; GOËS, 1894, p. 114, pl. 21, figs. 866-869; 1896, p. 83; FLINT, 1897, p. 298, pl. 44, fig. 4; WIESNER, 1912, p. 228; HERON-ALLEN and EARLAND, 1924, p. 605; IKARI, 1927, p. 10, pl. 1, fig. 1a, b.



Text-fig. 39. *Triloculina tricarinata* D'ORBIGNY.
×50.
a, front view. b, apertural view.

Description.—Test in an adult somewhat elongate, triangular in apertural view, composed of three visible chambers; three angles sharply produced, keeled; surface smooth; aperture oval with a bifid tooth.

Length, up to 1.10 mm.

Localities.—Near the Marine Biological Station, 4–10 fathoms; off Yunoshima, 10–18 fathoms.

Remarks.—It is a rather rare species in Mutsu Bay. CUSHMAN (1917) reported it from a number of stations off Japan, and IKARI (1927) recorded it from bottom-sand taken at Misaki.

40. *Triloculina circularis* BORNEMANN.

(Text-fig. 40)

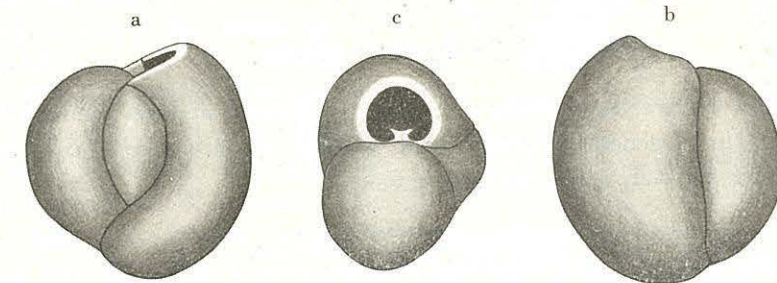
Miliolina circularis, H. B. BRADY, 1884, p. 169, pl. 4, fig. 3a-c, pl. 5, figs. 13, 14; EGGER, 1893, p. 43, pl. 2, figs. 61-63; CHAPMAN, 1895, p. 9; GOËS, 1896, p. 82; FLINT, 1897, p. 298, pl. 44, fig. 1; SIDEBOTTOM, 1904, p. 8; CUSHMAN, 1908, p. 26, pl. 5, figs. 5, 6, 10; HERON-ALLEN and EARLAND, 1909, p. 313; WIESNER, 1912, p. 230; HERON-ALLEN and EARLAND, 1913 (c), p. 26; PEARCEY, 1914, p. 995; HERON-ALLEN and EARLAND, 1915, p. 557; 1916 (a), p. 209; 1924, p. 604.

Triloculina circularis, CUSHMAN, 1917 (a), p. 67, text-figs. 33, 34, pl. 25, fig. 4, pl. 26, fig. 1; 1920 (b), p. 638; 1921, p. 462, pl. 92, figs. 1, 2; 1922 (b), p. 73; 1922 (c), p. 69; 1924 (b), p. 69, pl. 25, figs. 5, 6; 1925 (a), p. 141; 1926 (a), p. 82; 1929 (a), p. 58, pl. 13, figs. 6, 7, pl. 14, figs. 1, 2.

Description.—Test usually globular, nearly circular in side view, slightly compressed; three chambers externally visible in an adult; wall smooth, sometimes polished in a small young specimen; aperture oval with a short bifid tooth.

Diameter, up to 1.70 mm.

Remarks.—This species is abundant in the bay. CUSHMAN (1917) has recorded this species from numerous stations distributed among the seas adjacent to Japan and from comparatively shallow water.



Text-fig. 40. *Triloculina circularis* BORNEMANN. ×30.
a, b, side view. c, apertural view.

41. *Triloculina terquemiana* (H. B. BRADY).

(Text-fig. 41)

Miliolina terquemiana, H. B. BRADY, 1884, p. 166, pl. 114, fig. 1a, b; HERON-ALLEN and EARLAND, 1915, p. 563, pl. 41, figs. 29-31.

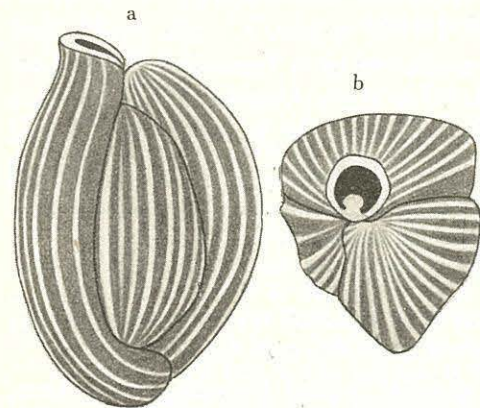
Triloculina terquemiana, CUSHMAN, 1917 (a), p. 72, pl. 27, fig. 2; 1921, p. 458; HADA, 1929, p. 15.

Description.—Test more or less elongate, composed of three visible chambers, triangular in apertural view, angles somewhat acute; surface ornamented with numerous longitudinal costae; aperture oval with a single rounded tooth.

Length, 0.40–0.80 mm.

Localities.—Near the Marine Biological Station, 7 fathoms; off Yunoshima, 15 fathoms.

Remarks.—The species is comparatively rare in Mutsu Bay. Of this species there are only a few re-



Text-fig. 41. *Triloculina terquemiana* (H. B. BRADY). $\times 80$.

a, side view. b, apertural view.

corded and these deal with the specimens obtained chiefly from shallow, warm water of the tropical sea. However, I have obtained specimens of this species also from shallow but rather cold water of Hokkaido (1929).

Family Ophthalmidiidae.

Test calcareous, imperforate; early chambers at least planispiral, except in degenerate forms; wall without an arenaceous coating; aperture typically open, without a tooth.

Subfamily CORNUSPIRINAE.

Test made up of a proloculum and an elongate, planispiral, tubular second chamber.

Genus CORNUSPIRA SCHULTZE, 1854.

Test consisting of proloculum followed by a long, planispirally coiled, second chamber, rounded or complanate; wall calcareous, imperforate; aperture formed by the open end of the chamber, sometimes constricted and with a thickened lip.

42. *Cornuspira involvens* (REUSS).

(Text-fig. 42)

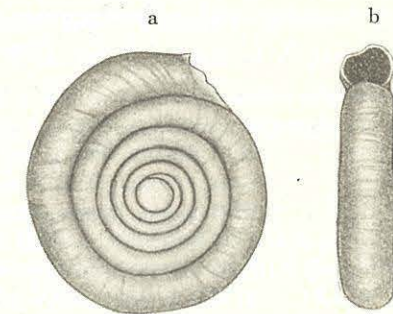
Cornuspira involvens, H. B. BRADY, 1881 (b), p. 8; 1884, p. 200, pl. 11, figs. 1-3; EGGER, 1893, p. 54, pl. 3, figs. 18, 19; FLINT, 1897, p. 303, pl. 48, fig. 3; MILLETT, 1898, p. 612; KIAER, 1900, p. 22; RHUMBLER, 1904, p. 285, text-fig. 137; 1907, p. 30, pl. 2, fig. 6; BAGG, 1908, p. 123; HERON-ALLEN and EARLAND, 1909, p. 318; RHUMBLER, 1911, pl. 5, fig. 4; 1913, p. 425; HERON-ALLEN and EARLAND, 1913 (c), p. 36; PEARCEY, 1914, p. 996; HERON-ALLEN and EARLAND, 1915, p. 593; 1916 (a), p. 217; CUSHMAN, 1917 (a), p. 25, pl. 1, fig. 2, pl. 2, fig. 2; 1920 (b), p. 634; 1921, p. 389, pl. 77, figs. 3, 4; 1922 (b), p. 58; 1922 (c), p. 62; 1924 (b), p. 51, pl. 18, figs. 1, 2; HERON-ALLEN and EARLAND, 1924, p. 610; CUSHMAN, 1925 (b), p. 44; 1926 (a), p. 80; 1929 (a), p. 80, pl. 20, figs. 6, 8; CUSHMAN and WICKENDEN, 1929, p. 4, pl. 2, fig. 3; HADA, 1929, p. 14.

Description.—Test formed of a proloculum and a planispirally coiled chamber, circular in side view, concave in both sides; wall rather thin, sometimes more or less translucent, showing numerous fine lines of growth; aperture at end of the coiled second chamber.

Diameter, about 0.30 mm.

Localities.—Near the Marine Biological Station, 5–10 fathoms; off Futagojima, 23 fathoms.

Remarks.—Of this species several specimens of small size (0.30 mm.) and with somewhat translucent test have been detected in the material from Mutsu Bay. CUSHMAN (1917) examined large specimens (1.00 mm.) of this species in the Albatross collections obtained from off the



Text-fig. 42. *Cornuspira involvens* (REUSS). $\times 120$.

a, side view. b, peripheral view.

coast of Japan. The specimens formerly reported by myself from the coast of Hokkaido were smaller than those recorded by CUSHMAN, and were as large as those obtained from Mutsu Bay this time.

Family Trochamminidae.

Test in general trochoid, of numerous chambers, or irregular; wall arenaceous, with much cement, usually of yellowish- or reddish-brown color.

Subfamily TROCHAMMININAE.

Test trochoid, chambers in spiral whorls; aperture ventral.

Genus TROCHAMMINA PARKER and JONES, 1860.

Test free or adherent, spiral, trochoid, all chambers visible from the dorsal side, only those of the last-formed coil from the ventral; wall arenaceous; aperture, an arched slit on the inner margin of the ventral side of the chamber.

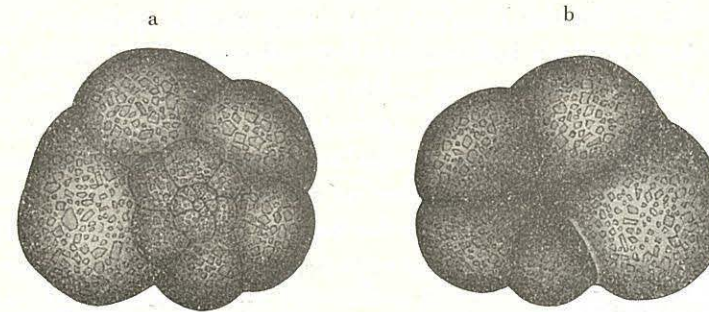
43. *Trochammina inflata* (MONTAGU).

(Text-fig. 43)

Rotalia inflata, WILLIAMSON, 1858, p. 50, pl. 4, figs. 93, 94.

Trochammina inflata, CARPENTER, PARKER and JONES, 1862, p. 141, pl. 11, fig. 5; H. B. BRADY, 1864, p. 467; 1870, p. 289; 1884, p. 338, pl. 41, fig. 4a-c; GOËS, 1894, p. 29, pl. 6, figs. 222-224; MILLETT, 1899, p. 364; KIAER, 1900, p. 44; SIDEBOTTOM, 1905, p. 6, pl. 1, fig. 9; HERON-ALLEN and EARLAND, 1909, p. 324; CUSHMAN, 1910, p. 121, text-fig. 188a, b; HERON-ALLEN and EARLAND, 1913 (c), p. 52; 1915, p. 620; 1916 (a), p. 227; CUSHMAN, 1920 (a), p. 73.

Description.—Test free, dorsal face flattened, ventral one concave with an umbilical region, composed of about three convolutions, of which the outer one has five or six inflated subglobular chambers, all chambers visible from the dorsal side, but only those of the last-formed coil visible from the ventral side; sutures distinct with deep depressions; wall consisting of fine sand grains smoothly united together with much cement; aperture elongate, arched, opening at the ventral side of the final chamber; color reddish brown or yellowish



Tex-fig. 43. *Trochammina inflata* (MONTAGU). $\times 50$.

a, dorsal view. b, ventral view.

grey, dark color at the central portion, fading gradually towards the last-formed chamber.

Diameter, up to 0.80 mm.

Localities.—All stations, 4-33 fathoms.

Remarks.—This species is common in Mutsu Bay, and is represented by specimens of two types of color of the test: in the first type it is reddish brown on the whole and is dark greyish in the initial portion, while in the second it is light grey in general and is dark in the central coils. CUSHMAN (1910) formerly detected this species in the Nero material taken from off the coast of Japan.

44. *Trochammina globigeriniformis* (PARKER and JONES).

(Text-fig. 44)

Globigerina bulloides, WILLIAMSON, p. 1858, p. 56, pl. 5, figs. 116-118.

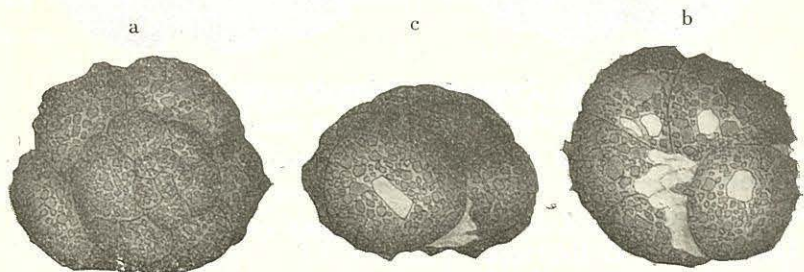
Haplophragmium globigeriniforme, H. B. BRADY, 1881 (b), p. 12; 1884, p. 312, pl. 35, figs. 10, 11; EGGER, 1893, p. 681, pl. 51, figs. 30, 31; GOËS, 1894, p. 22, pl. 5, figs. 128-133; CHAPMAN, 1895, p. 16; GOËS, 1896, p. 30; FLINT, 1897, p. 277, pl. 21, fig. 1; MILLETT, 1899, p. 361; KIAER, 1900, p. 43; BAGG, 1908, p. 126; HERON-ALLEN and EARLAND, 1913 (c), p. 46; 1915, p. 614; 1916 (a), p. 224.

Ammoglobigerina bulloides, EIMER and FICKERT, 1899, p. 704.

Trochammina globigeriniformis, CUSHMAN, 1910, p. 24, text-figs. 193-195; PEARCEY, 1914, p. 1011; CUSHMAN, 1920 (a), p. 78, pl. 16, figs. 5, 6; 1921, p. 96, pl. 11, figs. 4, 5; 1927 (a), p. 141; HADA, 1929, p. 11.

Description.—Test free or adherent, dorsal face convex, ventral one nearly flattened, consisting of about three convolutions composed

of a series of globular chambers increasing rapidly in size as added, four or five chambers building up the outer whorl and visible from below, while all chambers are visible from above; sutures depressed; wall coarsely arenaceous, but cemented firmly with an excess of cementing material; aperture somewhat arched, slit-like; at the central margin of the last-formed chamber on the ventral side, often covered with the clear shell substance; color reddish brown.



Text-fig. 44. *Trochammina globigeriniformis* (PARKER and JONES). $\times 50$.
a, dorsal view. b, ventral view. c, side view.

Diameter, about 0.70 mm.

Localities.—It was found at all stations, 4–33 fathoms, where the collections were made.

Remarks.—This species has been widely reported from comparatively deep waters. It is very common in Mutsu Bay, and is found either free or attached to foreign substance. The free forms are in most cases larger than the attached. For this species CUSHMAN (1910) reported a great number of localities distributed in the waters adjacent to Japan. I (1929) have also obtained this species from the inlet of Oshoro and from the port of Nemuro in Hokkaido.

Subfamily GLOBOTEXTULARIINAE.

Test irregularly spiral, the chamber globose; aperture in the open umbilical area.

Genus NOURIA HERON-ALLEN and EARLAND, 1914.

Test free, of several chambers, irregularly arranged; wall arenaceous; aperture simple, terminal.

45. *Nouria polymorphinoides* HERON-ALLEN and EARLAND. (Text-fig. 45)

Nouria polymorphinoides, HERON-ALLEN and EARLAND, 1914, p. 376, pl. 37, figs. 1–15;
CUSHMAN, 1920 (b), p. 601, pl. 75, figs. 4, 5; 1927 (a), p. 142.

Description.—Test elongate, oblong, somewhat compressed, the apertural end produced; chambers few, irregular, asymmetrically arranged, separated by scarcely visible sutures; cavities partitioned by imperfect septa; wall composed of sand grains, rather neatly cemented with dark greyish brown cement; aperture opening as a narrow elliptical orifice.

Length, up to 0.95 mm.

Localities.—All stations, 4–33 fathoms.

Remarks.—A few specimens of this species have been found in the material from every station of Mutsu Bay, where collections were made. They are not so large and are not so irregular in shape as the specimens of the Kerimba Archipelago first described by HERON-ALLEN and EARLAND (1914).

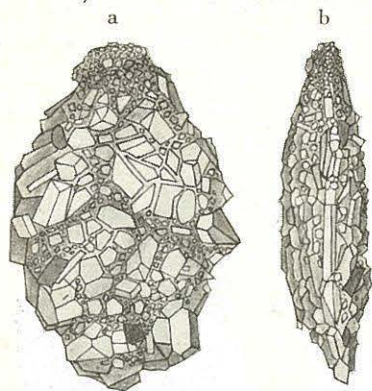


Text-fig. 45. *Nouria polymorphinoides* HERON-ALLEN and EARLAND. $\times 60$.
a, side view.
b, apertural view.

46. *Nouria textulariformis*, n. sp. (Text-fig. 46)

Description.—Test usually oblong in side view, much compressed, broadest in the middle, apertural end somewhat drawn out into a short neck; periphery acute; chambers several, arranged biserially; sutures scarcely depressed; wall rather thin and delicate, composed of sand grains finely united together with yellowish grey cement; aperture a long, narrow opening; color generally light grey, yellowish brown at the apertural end.

Length, about 1.15 mm; breadth, about 0.60 mm; thickness, about 0.22 mm.



Text-fig. 46. *Nouria textulariformis*,
n. sp. × 40.
a, side view. b, peripheral view.

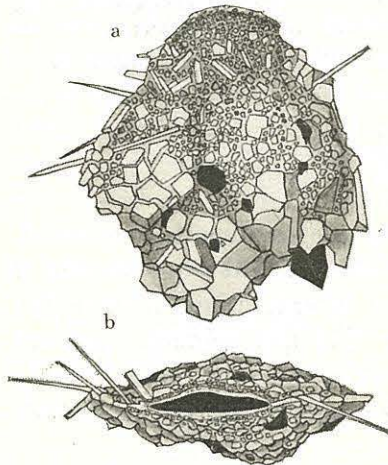
Localities.—Off Yunoshima, 18 fathoms; off Futagojima, 17–25 fathoms.

Remarks.—This new species is comparatively rare in Mutsu Bay. Several specimens have been detected in the bottom material from that region. The test is so fragile that it is difficult to obtain complete individuals. This species is easily distinguishable from other allied forms by the compressed test and by the chambers arranged in a *Textularia*-like manner.

47. *Nouria tenuis*, n. sp.

(Text-fig. 47)

Description.—Test irregular in shape, much compressed, a little longer than broad, broadest about in the middle, composed of a few chambers arranged biserially, partitioned by imperfect septa; peripheral margin sharply angular, from which long spicules usually projecting out; sutural lines indistinct, slightly depressed; wall neatly arenaceous, sometimes thin; aperture comparatively large, elongate, situated transversely at the terminal end of the last-formed chamber; color usually light grey.



Text-fig. 47. *Nouria tenuis*, n. sp. × 40.
a, side view. b, apertural view.

Length, 0.73–1.00 mm; breadth, 0.62–0.81 mm; thickness, about 0.27 mm.

Localities.—This form is commonly found in the material

from Mutsu Bay. It is not close to any of the established species, so far as I am aware. The wall in the specimens obtained from rather deep water of the bay is thin and somewhat translucent probably being composed of mica flakes. It is striking that a number of long sponge spicules are projected from the periphery of the test in various directions in most individuals. This new species differs from *Nouria textulariformis* in the broader test and in the longer aperture.

Family **Lagenidae.**

Test vitreous, with a glassy lustre; chambers simple, neither biserial, trochoid, nor irregularly spiral, planispiral when coiled; wall calcareous with very fine perforations; aperture typically radiate but in a few genera simple, in the radiate apertured forms with a small chamberlet below the radiate aperture opening into the main chamber by a simple rounded orifice.

Subfamily **NODOSARIINAE.**

Test multilocular.

Genus **DENTALINA** D'ORBIGNY, 1826.

Test arcuate, elongate, of numerous chambers in a linear series; sutures usually oblique, at least in the early portion; aperture radiate, at least early stages, at or near the periphery but approaching to the center in the last chambers.

48. *Dentalina communis* D'ORBIGNY.

(Text-fig. 48)

Dentalina communis, H. B. BRADY, 1870, p. 295.

Nodosaria communis, GOËS, 1882, p. 26, pl. 1, figs. 11–16; H. B. BRADY, 1884, p. 504, pl. 62, figs. 19–22; EGGER, 1893, p. 150, pl. 11, figs. 22–24; GOËS, 1894, p. 67, pl. 12, figs. 667–669; CHAPMAN, 1895, p. 30; GOËS, 1896, p. 61, pl. 6, fig. 1; FLINT, 1897, p. 310, pl. 56, fig. 2; KIAER, 1900, p. 35; SIDEBOTTOM, 1907, p. 1; CUSHMAN, 1913, p. 54, pl. 28, figs. 1, 2; HERON-ALLEN and EARLAND, 1913 (c), p. 92; 1916 (a), p. 256; 1916 (b), p. 47; CUSHMAN, 1920 (b), p. 611; 1921, p. 192, pl. 34, fig. 7; 1923, p. 75, pl. 12, figs. 3, 4, 15–17.

Description.—Test elongate, slender, slightly curved, composed of numerous chambers; sutures oblique; surface smooth, occasionally translucent; aperture radiate, terminal.

Length, up to 3.60 mm.

Localities.—Off Yunoshima, 15 fathoms; off Futagojima, 23 fathoms.

Remarks.—This is one of the comparatively rare species in Mutsu Bay, but is widely distributed in other seas. CUSHMAN (1913) recorded the specimens obtained at many stations off the coast of Japan. As *Dentalina communis* is the name applied to the species which has a smooth test with the oblique sutural lines. Several forms of somewhat different nature, however, are included under this name. Some diversities in this feature of the test are noticeable also among the specimens taken from Mutsu Bay. In the typical form the test consists of thin and translucent wall and is provided with an eccentric aperture situated at the tip of a short, neck-like projection, while in those from our collections the test consists of a series of unequal chambers, with wall thick and opaque.



Text-fig. 48. *Dentalina communis* D'ORBIGNY. $\times 50$.

49. *Dentalina consobrina* D'ORBIGNY, var. *emaciata* REUSS.
(Text-fig. 49)

Nodosaria consobrina, var. *emaciata*, H. B. BRADY, 1884, p. 502, pl. 62, figs. 25, 26; FLINT, 1897, p. 310, pl. 56, fig. 1; CUSHMAN, 1913, p. 56, pl. 27, fig. 9; 1921, p. 195, pl. 34, fig. 8, pl. 35, fig. 1; 1923, p. 78, pl. 15, figs. 3-5.

Description.—Test elongate, slender, slightly arcuate, consisting of numerous short chambers, sometimes the first one tapering into a spine; sutures nearly transverse, slightly depressed; surface smooth; aperture radiate, terminal.

Length, 1.00-2.00 mm.

Localities.—Off Yunoshima, 18 fathoms; off Futagojima, 17-25 fathoms.

Remarks.—This variety is of rare occurrence in Mutsu Bay. As shown in the figure, the specimens taken from Mutsu Bay are provided with a short spine at the initial end, but the most specimens previously recorded from other localities are rounded at this end lacking the spine. Moreover, the specimens from Mutsu Bay are smaller than those obtained from other seas. CUSHMAN (1913) noted this variety without a spine from the Albatross material collected at two stations off Japan.

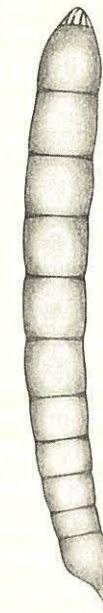
50. *Dentalina mutsui*, n. sp.
(Text-fig. 50)

Description.—Test slender, elongate, tapering gradually towards the initial end which has a stout spine, usually slightly curved; apertural end drawn out into a short neck; sutures impressed, distinct; surface ornamented by about ten raised longitudinal costae which do not run along the entire length of the test; aperture radiate, terminal, usually eccentric.

Length, up to 3.65 mm.

Localities.—Off Yunoshima, 15 fathoms; off Futagojima, 17-25 fathoms; near Ōshima, 23 fathoms.

Remarks.—This species is common in Mutsu Bay. It is closely allied with *Dentalina flintii* in the general contour, but differs from the latter in fewer costae which do not cover the entire length of the test but fade out on the final chambers. *D. mutsui* has also a somewhat longer spine more abruptly set off from the initial chamber.



Text-fig. 49. *Dentalina consobrina* D'ORBIGNY, var. *emaciata* REUSS. $\times 45$.



Text-fig. 50. *Dentalina mutsui*, n. sp. $\times 40$.

Genus *NODOSARIA* LAMARCK, 1812.

Test with the chambers in a straight linear series, the chambers distinct, not strongly embracing; sutures normally at right angles to the axis; wall calcareous, finely perforate, glassy; aperture central and terminal, radiate, often with a chamberlet below with a rounded opening into the main cavity of the chamber.

51. *Nodosaria simplex* SILVESTRI.

(Text-fig. 51)

Nodosaria simplex, H. B. BRADY, 1884, p. 496, pl. 62, figs. 4, 5; EGGER, 1893, p. 148, pl. 11, fig. 6; FLINT, 1897, p. 309, pl. 55, fig. 2; CUSHMAN, 1913, p. 49, pl. 28, fig. 5; 1921, p. 186; 1923, p. 68, pl. 12, fig. 14, pl. 14, fig. 10.

Description.—Test usually composed of two chambers, the first subglobular with a short spine, the second elongate and drawn out into a slender neck with the radiate aperture; sutures depressed; wall smooth, somewhat translucent.

Length, about 0.45 mm.

Localities.—Off Yunoshima, 18 fathoms; off Futagojima, 23 fathoms.

Remarks.—This species is rather rare in Mutsu Bay. I have obtained three specimens dealt with in the present report. The one which is shown in the figure is typical in shape, but other two are of very small size and it is doubtful whether they are certainly the adult form of this species or the young forms of other species.



Text-fig. 51. *Nodosaria simplex* SILVESTRI. $\times 120$.

52. *Nodosaria pyrula* D'ORBIGNY.

Nodosaria pyrula, H. B. BRADY, 1884, p. 497, pl. 62, figs. 10-12; EGGER, 1893, p. 153, pl. 11, figs. 14, 15; CHAPMAN, 1895, p. 30; FLINT, 1897, p. 309, pl. 55, fig. 4; KIAER, 1900, p. 35; MILLETT, 1902, p. 514; CUSHMAN, 1913, p. 49, pl. 26, figs. 1-3; HERON-ALLEN and EARLAND, 1913 (c), p. 92; 1916 (a), p. 256; 1916 (b), p. 47; CUSHMAN, 1920 (b), p. 611; 1921, p. 187, pl. 33, figs. 3-5; 1923, p. 69, pl. 16, figs. 1-4; 1927 (a), p. 143.

Description.—Test elongate, slender, composed of numerous pyriform chambers with the long tubular connections; initial chamber spindle-shaped, differing from the others; circular in transverse section; surface smooth; aperture usually rounded, situated at the tip of the long neck.

Diameter, 0.12-0.14 mm.

Localities.—Off Futagojima, 25 fathoms; near Ōshima, 23 fathoms.

Remarks.—Of this species the test is exceedingly delicate and moreover is very long at the stoloniferous connection. On account of this structural weakness the specimen is very easily broken into fragments, and thus it very difficult to obtain the complete specimens. H. B. BRADY (1884) and CUSHMAN (1913) already reported this species from off the coast of Japan.

53. *Nodosaria pyrula* D'ORBIGNY, var. *semirugosa* D'ORBIGNY.

(Text-fig. 52)

Nodosaria costulata, H. B. BRADY, 1884, p. 515, pl. 63, figs. 23-27; FLINT, 1897, p. 312, pl. 58, fig. 1.

Nodosaria semirugosa, MILLETT, 1902, p. 515, pl. 11, fig. 5; CUSHMAN, 1913, p. 50, pl. 26, figs. 4-8.

Nodosaria pyrula, var. *semirugosa*, CUSHMAN, 1921, p. 187, pl. 33, figs. 6, 7; 1923, p. 70, pl. 16, fig. 5.

Description.—This variety differs from the typical form in the ornamentation of the test, which is provided with several costae of varying length, covering the basal portion of each chamber.

Diameter, about 0.13 mm.

Localities.—Off Futagojima, 25 fathoms.

Remarks.—In Mutsu Bay the variety is more rarely found than the typical form. I was also unable to obtain complete specimens in the material from the bay.



Text-fig. 52. *Nodosaria pyrula* D'ORBIGNY, var. *semirugosa* D'ORBIGNY. $\times 70$.

a, side view.
b, apertural view.

54. *Nodosaria scalaris* (BATSCH).

(Text-fig. 53)

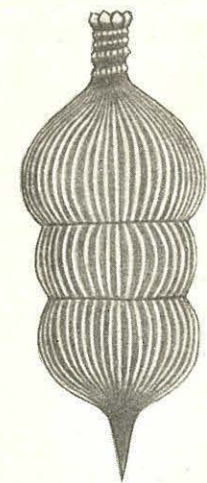
Nodosaria scalaris, H. B. BRADY, 1870, p. 295; 1884, p. 510, pl. 63, figs. 28-31; EGGER, 1893, p. 152, pl. 11, figs. 40, 41; GOËS, 1894, p. 73, pl. 13, figs. 716-718; CHAPMAN, 1895, p. 32; GOËS, 1896, p. 60; KIAER, 1900, p. 36; MILLETT, 1902, p. 520, pl. 11, fig. 2; CUSHMAN, 1913, p. 58, pl. 24, fig. 7; HERON-ALLEN and EARLAND, 1913 (c), p. 93; 1916 (a), p. 257; 1916 (b), p. 47; CUSHMAN, 1920 (b), p. 613; 1921, p. 199, pl. 35, fig. 6; 1923, p. 81; IKARI, 1927, p. 12, pl. 1, fig. 17.

Description.—Test straight, composed of a few subglobular chambers, usually increasing rapidly in size as added, initial chamber with a short spine, final one drawn out into a cylindrical neck ornamented with several spiral ridges; sutures much depressed; surface marked with numerous fine longitudinal costae; aperture terminal.

Length, about 1.20 mm.

Localities.—Off Yunoshima, 15 fathoms; off Futagojima, 17-25 fathoms; near Ōshima, 23 fathoms.

Remarks.—This species which has a world-wide distribution also occurs in Mutsu Bay. Previous records on the occurrence of this species off Japan were made by H. B. BRADY (1884) and by IKARI (1927). The former author obtained his specimens among the Challenger material from the Hyalonema-ground off the southern coast of Japan, while the later author secured his material from bottom sand taken at Misaki.



Text-fig. 53. *Nodosaria scalaris* (BATSCH).
×50.

Genus GLANDULINA D'ORBIGNY, 1826.

Test similar to *Nodosaria*, but the chambers embracing, the last-formed one making up a large proportion of the surface of the test.

55. *Glandulina rotundata* REUSS.

(Text-fig. 54)

Nodosaria rotundata, H. B. BRADY, 1884, p. 491, pl. 61, figs. 17-19; FLINT, 1897,

p. 308, pl. 54, fig. 6; CUSHMAN, 1913, p. 47, pl. 28, fig. 6; HERON-ALLEN and EARLAND, 1916 (a), p. 255; CUSHMAN, 1921, p. 185; 1922 (b), p. 32, pl. 4, fig. 1; 1923, p. 63.

Description.—Test oval, composed of a few chambers overlapping the predecessors, broadest in the middle; sutures not depressed, usually indistinct; aperture radiate at the slightly produced end of the terminal chamber; surface smooth and white.

Length, 0.66 mm; diameter, 0.45 mm.

Locality.—Off Yunoshima, 18 fathoms.

Remarks.—A single specimen has been found in the material from above station in Mutsu Bay. From the sea of Japan this species was only once reported by CUSHMAN (1913) from an Albatross station in 44 fathoms off Japan.

Genus AMPHICORYNE SCHLUMBERGER, 1881.

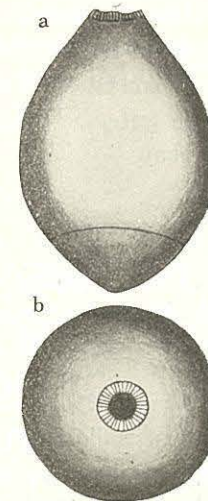
Test in the young like a compressed *Lenticulina* loosely coiled, the last-formed chambers like *Nodosaria*.

56. *Amphicoryne falx* JONES and PARKER.

(Text-fig. 55)

Amphicoryne falx, H. B. BRADY, 1884, p. 556, pl. 65, figs. 7-9.

Description.—Test elongate, composed of several chambers, early chambers somewhat compressed, having tendency to coil planispirally, last-formed chamber subglobular; sutures almost indistinct in the early portion; wall ornamented with numerous longitudinal costae less in number in the early compressed portion; aperture terminal, opening at the end of a tubular neck.



Text-fig. 54. *Glandulina rotundata* REUSS.
×60.

a, front view.
b, apertural view.



Text-fig. 55. *Amphicoryne falx* JONES and PARKER. ×75.

Length, about 0.75 mm.

Locality.—Off Futagojima, 23 fathoms.

Remarks.—It seems to be a rare species in Mutsu Bay as in other waters. I have found only two specimens in the material from this bay.

Subfamily LAGENINAE.

Test consisting of a single chamber; aperture typically radiate, but elliptical or rounded in many species.

Genus LAGENA WALKER and JACOB, 1798.

Test unilocular; aperture typically radiate, rounded or elliptical, terminal, central; wall vitreous, very finely perforate, variously ornamented; chambers typically without an internal tube.

57. *Lagena laevis* (MONTAGU).

(Text-fig. 56)

Lagena laevis, WILLIAMSON, 1848, p. 12, pl. 1, figs. 1, 2; H. B. BRADY, 1870, p. 292; 1881 (b), p. 14; 1884, p. 455, pl. 56, figs. 7, 9, 12; EGGER, 1893, p. 131, pl. 10, figs. 3-5; GOËS, 1894, p. 74, pl. 13, figs. 719-722; CHAPMAN, 1895, p. 26; GOËS, 1896, p. 51; FLINT, 1897, p. 306, pl. 53, fig. 6; KIAER, 1900, p. 37; CUSHMAN, 1913, p. 5, pl. 1, fig. 3, pl. 38, fig. 5; 1920 (b), p. 607; 1921, p. 173; 1923, p. 29, pl. 5, fig. 3; HERON-ALLEN and EARLAND, 1924, p. 624; HADA, 1929, p. 12.

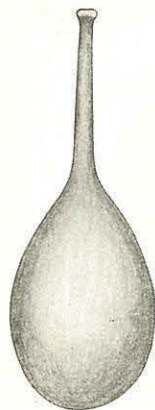
Lagena vulgaris, WILLIAMSON, 1858, p. 4, pl. 1, figs. 5, 5a.

Description.—Test typically flask-shaped, nearly circular in transverse section; wall usually smooth and translucent, sometimes opaque; aperture rounded at the end of a long tubular neck with a hyaline lip.

Length, 0.68 mm.

Locality.—Off Futagojima, 25 fathoms.

Remarks.—A single specimen shown in Text-fig. 56 was secured at the above station. Of this species there are many reports which



Text-fig. 56. *Lagena laevis* (MONTAGU). $\times 65$.

show its wide distribution. CUSHMAN (1913) recorded it at several of the Nero and of the Albatross stations located off the coast of Japan. I (1929) have also collected the species from the shallow water of Oshoro, Hokkaido.

58. *Lagena clavata* (D'ORBIGNY).

(Text-fig. 57)

Lagena laevis, var. *amphora*, WILLIAMSON, 1848, p. 12, pl. 1, figs. 3, 4.

Lagena vulgaris, var. *clavata*, WILLIAMSON, 1858, p. 5, pl. 1, fig. 6.

Lagena clavata, H. B. BRADY, 1884, p. 456; EGGER, 1893, p. 132, pl. 10, fig. 68; GOËS, 1894, p. 75, pl. 13, figs. 725-727; KIAER, 1900, p. 38; MILLETT, 1901, p. 490; CUSHMAN, 1913, p. 9, pl. 2, fig. 3; HERON-ALLEN and EARLAND, 1913 (c), p. 80; 1915, p. 660, pl. 50, fig. 23; 1916 (a), p. 248; 1916 (b), p. 45; CUSHMAN, 1921, p. 174; 1923, p. 10, pl. 1, fig. 15.

Description.—Test elongate, fusiform, possessing a long slender neck with a hyaline lip at the oral end, sharp-pointed at the basal end, nearly circular in cross section; surface smooth; wall thin and translucent; aperture rounded at the end of the neck.

Length, 0.51 mm.

Remarks.—This species is very rare in Mutsu Bay: I have found only one specimen shown in Text-fig. 57. The test is slightly curved, and is not so slender as in the specimen obtained from off Great Britain and figured by WILLIAMSON (1858) and also in that reported by CUSHMAN (1923) from the Atlantic Ocean, but it is very similar in appearance to the specimens which were secured by CUSHMAN (1913, pl. 2, fig. 3) from the North Pacific.



Text-fig. 57. *Lagena clavata* (D'ORBIGNY). $\times 90$.

59. *Lagena gracillima* (SEGUENZA).

(Text-fig. 58)

Lagena gracillima, H. B. BRADY, 1870, p. 292, pl. 11, figs. 6a-c; BÜTSCHLI, 1880-1882, p. 197, pl. 7, fig. 20; H. B. BRADY, 1881 (b), p. 14; 1884, p. 456, pl. 56, figs. 21, 22, 24-26; EGGER, 1893, p. 138, pl. 10, fig. 12; GOËS, 1894, p. 75, pl. 15, fig. 729; 1896, p. 52; FLINT, 1897, p. 306, pl. 53,

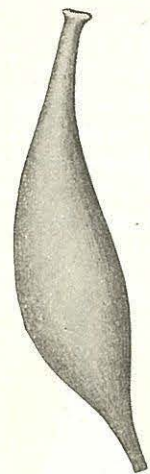
fig. 3; KIAER, 1900, p. 38; MILLETT, 1901, p. 491; CUSHMAN, 1913, p. 11, pl. 1, fig. 4; HERON-ALLEN and EARLAND, 1915, p. 660; 1916 (a), p. 248; 1916 (b), p. 45; CUSHMAN, 1921, p. 175; 1923, p. 23, pl. 4, fig. 5; 1927 (a), p. 144; IKARI, 1927, p. 12, pl. 1, fig. 13; HADA, 1929, p. 12.

Description.— Test elongate, fusiform, straight or slightly curved, broadest near the middle, each end tapering into a long tube and one with a hyaline lip, nearly circular in transverse section; wall more or less translucent; surface smooth.

Length, about 0.85 mm.

Localities.— Off Yunoshima, 18 fathoms; off Futagojima, 17–25 fathoms; near Ōshima, 23 fathoms; between Ōshima and Bentenjima, 30–33 fathoms.

Remarks.— This species is rare but widely distributed in all depths in Mutsu Bay. It comprises two diverse forms: one shown in Text-fig. 58 is comparatively short and curved, while the other is slender and straight. From the Japanese waters, it is formerly reported by CUSHMAN (1913) at two Albatross stations, by IKARI (1927) from the bottom sand taken at Misaki, and by myself from Oshoro and Nemuro in Hokkaido.



Text-fig. 58. *Lagena gracillima* (SEGUENZA).
×80.

60. *Lagena elongata* (EHRENBERG).

(Text-fig. 59)

Lagena elongata, H. B. BRADY, 1884, p. 457, pl. 56, fig. 29; GOËS, 1894, p. 75, pl. 13, fig. 713; FLINT, 1897, p. 306, pl. 53, fig. 1; CUSHMAN, 1913, p. 12, p. 1, fig. 5; 1920 (b), p. 608; 1921, p. 175; 1923, p. 15, p. 3, fig. 4; 1927 (a), p. 144.

Lagena gracillima, H. B. BRADY, 1884, pl. 56, figs. 27, 28; GOËS, 1894, pl. 13, figs. 728, 730.

Description.— Test elongate, slender, main portion nearly cylindrical, both ends drawn out into a long tube, apertural one with a lip; wall smooth, somewhat translucent; aperture usually rounded.

Length, up to 1.50 mm.

Localities.— Off Yunoshima, 10–18 fathoms; off Futagojima, 17–

25 fathoms; between Ōshima and Bentenjima, 30–33 fathoms.

Remarks.— This species is rather rare. It is longer than any other species of *Lagena* found in Mutsu Bay, as far as examined in the present work. CUSHMAN (1913) obtained this species from several stations off Japan, ranging in depth from 44 to 649 fathoms.

61. *Lagena semistriata*

WILLIAMSON.

(Text-fig. 60)

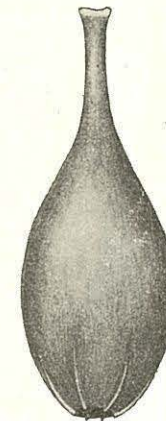
Lagena striata, var. *semistriata*, WILLIAMSON, 1848, p. 14, pl. 1, figs. 9, 10.

Lagena vulgaris, var. *semistriata*, WILLIAMSON, 1858, p. 6, pl. 1.

Lagena semistriata, H. B. BRADY, 1870, p. 293; 1881 (b), p. 14; 1884, p. 465, pl. 57, figs. 14, 16, 17; EGGER, 1893, p. 135, pl. 10, figs. 34, 39; GOËS, 1894, p. 76, pl. 13, fig. 737; KIAER, 1900, p. 38; MILLETT, 1901, p. 486, pl. 8, figs. 2, 3; SIDEBOTTOM, 1906, p. 3; HERON-ALLEN and EARLAND, 1909, p. 424; 1913 (c), p. 78; PEARCEY, 1914, p. 1018; HERON-ALLEN and EARLAND, 1915, p. 658; 1916 (a), p. 245; 1916 (b), p. 45; CUSHMAN, 1920 (b), p. 610; 1921, p. 179; 1923, p. 50, pl. 9, fig. 15.



Text-fig. 59. *Lagena elongata* (EHRENBERG).
×70.



Text-fig. 60. *Lagena semistriata* WILLIAMSON.
×90.

Description.— Test elongate, fusiform or oval, apertural end drawn out into a slender tubular neck with a hyaline lip, opposite end rounded, or truncate, circular in cross-section; wall usually translucent; surface ornamented with raised costae at the basal portion, those not reaching the middle of the test; aperture simple, nearly rounded at the end of a long neck.

Length, up to 0.68 mm.

Localities.— Off Futagojima, 25 fathoms; between Ōshima and

Bentenjima, 30–33 fathoms.

Remarks.—I have a few specimens taken from Mutsu Bay: each differing in the features of the costae found at the base of the test.

62. *Lagena gracilis* WILLIAMSON.

(Text-fig. 61)

Lagena vulgaris, var. *gracilis*, WILLIAMSON, 1858, p. 7, pl. 1, figs. 12, 13.

Lagena gracilis, WILLIAMSON, 1848, p. 13, pl. 1, fig. 5; H. B. BRADY, 1881 (b), p. 14; 1884, p. 464, pl. 58, figs. 2, 3, 7–9, 19, 22, 23; EGGER, 1893, p. 136, pl. 10, figs. 25, 49; GOËS, 1894, p. 77, pl. 13, fig. 738; CHAPMAN, 1895, p. 27; KIAER, 1900, p. 38; MILLETT, 1901, p. 482, pl. 8, figs. 12–14; CUSHMAN, 1913, p. 24, pl. 8, figs. 5, 6; HERON-ALLEN and EARLAND, 1913 (c), p. 81; 1916 (a), p. 248; 1916 (b), p. 45; CUSHMAN, 1921, p. 181; 1923, p. 22, pl. 4, figs. 3, 4; 1927 (a), p. 144.

Description.—Test elongate, fusiform, straight or curved, broadest in the middle, drawn out into a long tubular neck at the oral end, pointed at the basal end; nearly circular in transverse section; on the surface about twelve fine longitudinal costae extending from the apertural end to the basal end; aperture terminal, rounded.

Length, about 0.75 mm.

Localities.—Off Futagojima, 17–25 fathoms; near Ōshima, 23 fathoms; between Ōshima and Bentenjima, 30–33 fathoms.

Remarks.—This species is found everywhere in Mutsu Bay. From the sea surrounding Japan it was recorded by CUSHMAN (1913) from many Nero stations distributed between Yokohama and Guam.



Text-fig. 61. *Lagena gracilis* WILLIAMSON. ×70.

63. *Lagena distoma* PARKER and JONES.

(Text-fig. 62)

Lagena laevis, var. *striata*, PARKER and JONES, 1857, p. 278, pl. 11, fig. 24.

Lagena distoma, H. B. BRADY, 1864, p. 467, pl. 48, fig. 6; 1870, p. 293; 1881 (b), p. 14; 1884, p. 461, pl. 58, figs. 11–15; GOËS, 1894, p. 77, pl. 13, figs. 739, 740; CHAPMAN, 1895, p. 27; GOËS, 1896, p. 53; FLINT, 1897, p. 306, pl. 53, fig. 5; KIAER, 1900, p. 38; CUSHMAN, 1913, p. 22, pl. 13,

figs. 1, 2; PEARCEY, 1914, p. 1017; HERON-ALLEN and EARLAND, 1916 (a), p. 248; CUSHMAN, 1923, p. 14, pl. 13, figs. 2, 3.

Description.—Test elongate, cylindrical or fusiform, sides of the test nearly parallel in the middle part, drawn out into long slender tube at both ends, apertural end with a hyaline lip; wall somewhat translucent; surface marked with numerous fine longitudinal costae; aperture terminal, rounded.

Length, about 0.85 mm.

Localities.—Off Futagojima, 25 fathoms; between Ōshima and Bentenjima, 30–33 fathoms.

Remarks.—I have obtained several specimens from the bottom material taken from Mutsu Bay. This species is reported by H. B. BRADY (1884) from the Challenger material and by CUSHMAN (1913) from Nero material, both being collected from off Japan.



Text-fig. 62. *Lagena distoma* PARKER and JONES. ×120.

64. *Lagena striata* (D'ORBIGNY).

Lagena striata, H. B. BRADY, 1870, p. 293; 1884, p. 460, pl. 57, figs. 22, 24; EGGER, 1893, p. 135, pl. 10, figs. 21–23; GOËS, 1894, p. 75, pl. 13, figs. 735, 736; KIAER, 1900, p. 38; MILLETT, 1901, p. 487; SIDEBOTTOM, 1906, p. 2; CUSHMAN, 1913, p. 19, pl. 7, figs. 4, 5; HERON-ALLEN and EARLAND, 1913 (c), p. 78; PEARCEY, 1914, p. 1017; HERON-ALLEN and EARLAND, 1916 (a), p. 246; 1916 (b), p. 45; CUSHMAN, 1920 (b), p. 609; 1921, p. 177; 1923, p. 54, pl. 10, fig. 9; CUSHMAN and WICKENDEN, 1929, p. 6, pl. 3, figs. 4a, b; HADA, 1929, p. 12.

Description.—Test flask-shaped, chamber globular, oral end tapering into long tubular neck with a hyaline lip, aboral end rounded; circular in transverse section; surface ornamented with numerous longitudinal costae extending from the base to the apertural end; neck often having a spiral costa; aperture terminal, rounded.

Length, about 0.35 mm.

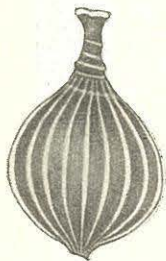
Localities.—Off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms; between Ōshima and Bentenjima, 30–33 fathoms.

Remarks.—This species is less common in Mutsu Bay. Judging

from numerous records of this species it seems to be widely distributed and common in comparatively shallow waters. CUSHMAN (1913) reported specimens of this species from three Albatross stations off Japan.

65. *Lagena striata* (D'ORBIGNY), var. *strumosa* REUSS.
(Text-fig. 63)

Lagena striata, var. *strumosa*, CUSHMAN, 1913, p. 20, pl. 7, figs. 7-10; 1921, p. 178.



Text-fig. 63. *Lagena striata* (D'ORBIGNY), var. *strumosa* REUSS. $\times 100$.

Description.— This variety differs from the typical species in having a stout spine at the basal end, in the smaller number of costae, and in the shorter neck.

Length, about 0.40 mm.

Localities.— Off Yunoshima, 10-18 fathoms; off Futagojima, 17-25 fathoms.

Remarks.— The variety usually occurs in company with the typical form in Mutsu Bay, where the specimens show some variation in size and shape. From the North Pacific about Japan CUSHMAN (1913) frequently obtained this variety from Albatross stations ranging in depth from 84 to 440 fathoms.

66. *Lagena substriata* WILLIAMSON.
(Text-fig. 64)

Lagena substriata, WILLIAMSON, 1848, p. 15, pl. 2, fig. 12; CUSHMAN, 1923, p. 56, pl. 10, fig. 11; 1927 (a), p. 145.

Lagena vulgaris, var. *substriata*, WILLIAMSON, 1858, pl. 1, fig. 14; CUSHMAN, 1913, p. 20, pl. 8, figs. 1-3.



Text-fig. 64. *Lagena substriata* WILLIAMSON. $\times 120$.

Description.— Test elongate, main portion of the test nearly cylindrical, broadest in the middle, basal end rounded; circular in cross section; wall thin, somewhat translucent; surface ornamented with numerous fine longitudinal costae; aperture terminal, opening at the end of a long and slender neck.

Length, about 0.40 mm.

Locality.— Between Ōshima and Bentenjima, 33 fathoms.

Remarks.— It seems to be a very rare species in Mutsu Bay judging from the fact that only two specimens were obtained there. In so far as I am aware, this is the first record of this species from the neighbouring seas of Japan.

67. *Lagena sulcata* (WALKER and JACOB).
(Text-fig. 65)

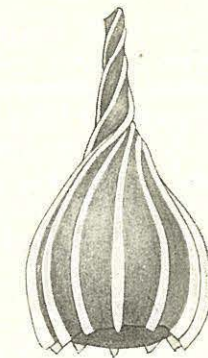
Lagena sulcata, H. B. BRADY, 1870, p. 291; 1881 (b), p. 141; 1884, p. 462, pl. 57, figs. 23, 34; EGGER, 1893, p. 136, pl. 10, fig. 73; GOËS, 1894, p. 78, pl. 13, fig. 744; CHAPMAN, 1895, p. 27; FLINT, 1897, p. 307, pl. 53, fig. 7; KIAER, 1900, p. 39; SIDEBOTTOM, 1906, p. 3; HERON-ALLEN and EARLAND, 1909, p. 423; CUSHMAN, 1913, p. 22, pl. 9, fig. 2; HERON-ALLEN and EARLAND, 1913 (c), p. 79; 1916 (a), p. 246; 1916 (b), p. 45; CUSHMAN, 1920 (b), p. 609; 1921, p. 179; 1923, p. 57, pl. 11, fig. 1; 1927 (a), p. 145.

Description.— Test flask-shaped, chamber subglobular, ornamented with plate-like costae running along the entire length of the chamber, some of them often extending even into a long cylindrical neck; aperture terminal, usually rounded, surrounding by a lip.

Length, up to 0.63 mm.

Localities.— Off Yunoshima, 10-18 fathoms; off Futagojima, 17-25 fathoms; between Ōshima and Bentenjima, 33 fathoms.

Remarks.— This species is common in Mutsu Bay, the specimens being more easily found than in the case of any other species of the genus. The existence of this species in the adjacent waters of Japan has been reported by only CUSHMAN (1913) from two Albatross stations, respectively 44 and 282 fathoms deep.



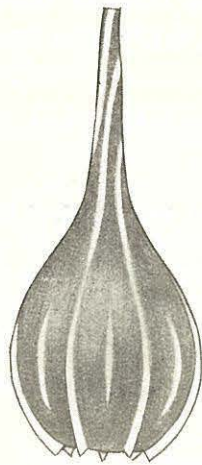
Text-fig. 65. *Lagena sulcata* (WALKER and JACOB). $\times 80$.

68. *Lagena sulcata* (WALKER and JACOB), var. *interrupta* WILLIAMSON.
(Text-fig. 66)

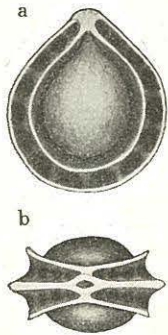
Lagena vulgaris, var. *interrupta*, WILLIAMSON, 1858, p. 7, pl. 1, fig. 11.

Lagena sulcata, var. *interrupta*, H. B. BRADY, 1884, p. 463, pl. 57, figs. 25, 27; SIDEBOTTOM, 1906, p. 3.

Lagena interrupta, EGGER, 1893, p. 136, pl. 10, fig. 32.



Text-fig. 66. *Lagena sulcata* (WALKER and JACOB), var. *interrupta* WILLIAMSON. ×110.



Text-fig. 67. *Lagena orbignyana* (SEGUENZA), var. ×100.

a, side view.

b, apertural view.

or irregularly branching; chambers simple, not labyrinthic; wall cal-

Description.— This variety differs from the typical species in the unequal length of costae, shorter costae usually being interposed between longer ones and not more than half the length of the longer costae.

Length, about 0.55 mm.

Localities.— Off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms.

Remarks.— In Mutsu Bay the variety is less frequently found than the typical form, and is represented by variously shaped specimens. Hitherto there were no records on the occurrence of this variety in the waters adjacent to Japan.

69. *Lagena orbignyana* (SEGUENZA) var. (Text-fig. 67)

Description.— Test compressed, nearly circular in front view, oral end slightly tapering; central portion smooth, convex; periphery surrounded by three raised keels connected with each other by many short ridges; aperture small, opening at the scarcely produced oral end.

Length, about 0.25 mm.

Locality.— Between Futagojima and Ōshima, 18–21 fathoms.

Remarks.— This variety is rarely found in Mutsu Bay.

Family Polymorphinidae.

Test spiral or sigmoid in the earlier stages, later in some genera becoming biserial, uniserial, or irregularly branching; chambers simple, not labyrinthic; wall cal-

careous, very finely perforate; aperture radiate except in the more degenerate genera where there is a simple, rounded opening.

Subfamily POLYMORPHININAE.

Test with the chambers in a closed spiral or sigmoid series at least in the early stages, later becoming in some genera biserial or uniserial.

Genus GUTTULINA D'ORBIGNY, 1826.

Test rounded, spherical to fusiform; chambers spheroidal to ellipsoidal or clavate, not at all compressed, arranged more or less in an elongate spiral series so that they form generally a clockwise close sigmoid series viewed from the base, successive chambers added in planes less than 180°, three or four chambers in a cycle; sutures distinct; aperture radiate.

70. *Guttulina communis* D'ORBIGNY.

(Text-fig. 68)

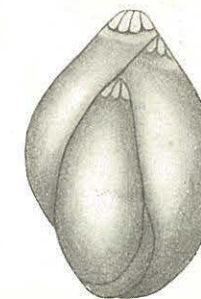
Polymorphina communis, H. B. BRADY, PARKER and JONES, 1870, p. 224, pl. 39, fig. 10a, b; H. B. BRADY, 1870, p. 297; 1884, p. 568, pl. 72, fig. 19; CHAPMAN, 1895, p. 34; FLINT, 1897, p. 319, pl. 67, fig. 6; SIDEBOTTOM, 1907, p. 11; HERON-ALLEN and EARLAND, 1913 (c), p. 101; 1916 (a), p. 265; 1916 (b), p. 48; CUSHMAN, 1923, p. 147, pl. 40, figs. 1, 2; HADA, 1929, p. 12.

Description.— Test ovate, slightly compressed, apertural end somewhat drawn out, initial end rounded; chambers few in number, inflated; sutures distinct, depressed; surface smooth; aperture terminal, radiate.

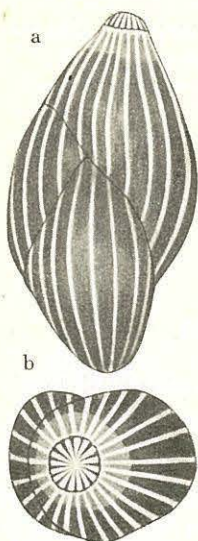
Length, about 0.60 mm.

Locality.— Off Futagojima, 25 fathoms.

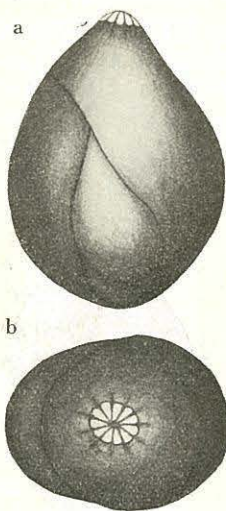
Remarks.— Only two small specimens have been found in the collection from Mutsu Bay. The specimens (1929) from the inlet Oshoro, Hokkaido, which I have previously reported were also of small size.



Text-fig. 68. *Guttulina communis* D'ORBIGNY. ×65.



Text-fig. 69. *Guttulina regina* H. B. BRADY, PARKER and JONES. $\times 45$.
a, side view.
b, apertural view.



Text-fig. 70. *Guttulina gibba* D'ORBIGNY. $\times 90$.
a, side view.
b, apertural view.

71. *Guttulina regina* H. B. BRADY,
PARKER and JONES.

(Text-fig. 69)

Polymorphina regina, H. B. BRADY, PARKER and JONES, 1970, p. 241, pl. 41, fig. 32a, b; H. B. BRADY, 1884, p. 571, pl. 73, figs. 11-13; EGGER, 1893, p. 118, pl. 9, figs. 45, 50, 51; MILLETT, 1903, p. 265; BAGG, 1908, p. 139; HERON-ALLEN and EARLAND, 1909, p. 435; CUSHMAN, 1913, p. 91, pl. 41, figs. 6, 7; HERON-ALLEN and EARLAND, 1915, p. 673; CUSHMAN, 1920 (b), p. 619; 1921, p. 263; 1922 (b), p. 33, pl. 4, figs. 5, 6; 1923, p. 159.

Description.—Test elongate, ovate or fusiform; chambers several, inflated; sutures distinct, deeply depressed; wall ornamented with numerous longitudinal costae on the surface of each chamber; aperture radiate, terminal.

Length, 0.85-1.20 mm.

Localities.—Off Yunoshima, 10-18 fathoms; off Futagojima, 23 fathoms.

Remarks.—This characteristic species is commonly found in the materials from above mentioned stations in Mutsu Bay. There exists no previous published record on the occurrence of this species in the waters off Japan.

72. *Guttulina gibba* D'ORBIGNY.

(Text-fig. 70)

Polymorphina gibba, H. B. BRADY, PARKER and JONES, 1870, p. 216, pl. 39, fig. 2a, b; H. B. BRADY, 1884, p. 561, pl. 71, fig. 12a, b; GOËS, 1894, pl. 9, figs. 520, 522; KIAER, 1900, p. 41; SIDEBOTTOM, 1907, p. 10, pl. 2, figs. 15-17; CUSHMAN, 1913, p. 90, pl. 38, fig. 1; HERON-ALLEN and EARLAND, 1913 (c), p. 100; PEARCEY,

1914, p. 1023; HERON-ALLEN and EARLAND, 1916 (a), p. 265; 1916 (b), p. 48; CUSHMAN, 1920 (b), p. 618; 1921, p. 267; 1922 (b), p. 34, pl. 4, fig. 9; 1923, p. 150.

Description.—Test globular nearly circular in front view, very slightly compressed, composed of a few visible chambers; sutures distinct, but not depressed; surface smooth, sometimes polished; aperture radiate, situated at the apertural end slightly drawn out from the main body.

Length, about 0.45 mm.

Localities.—Off Yunoshima, 10-18 fathoms; between Ōshima and Bentenjima, 33 fathoms.

Remarks.—A few specimens of this species were found in the material taken from Mutsu Bay, showing some variation. CUSHMAN (1913) reported the specimens of this species from a single station in 44 fathoms off Japan.

Genus PSEUDOPOLYMORPHINA CUSHMAN and OZAWA, 1928.

Test elongate, often somewhat compressed; chambers rounded, generally as long as broad, arranged in a closed sigmoid series in the earlier stages, becoming biserial in the adult; sutures distinct, depressed; aperture radiate.

73. *Pseudopolymorphina soldanii*

(D'ORBIGNY).

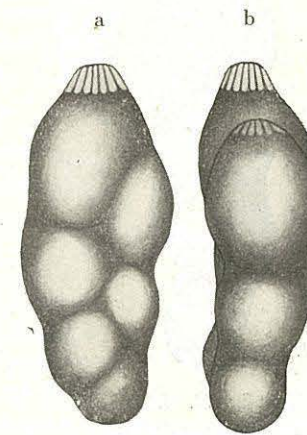
(Text-fig. 71)

Polymorphina soldanii, H. B. BRADY, PARKER and JONES, 1870, p. 235, pl. 40, fig. 20; HADA, 1929, p. 12.

Description.—Test elongate, compressed, early chambers arranged in a closed sigmoid series, later ones arranged biserially; chambers usually numerous, inflated; sutures distinct, depressed; wall opaque or somewhat translucent; aperture radiate, terminal.

Length, up to 2.00 mm.

Localities.—Off Yunoshima, 10-18



Text-fig. 71. *Pseudopolymorphina soldanii* (D'ORBIGNY). $\times 30$.
a, side view. b, peripheral view.

fathoms; off Futagojima, 17-25 fathoms; near Ōshima 23 fathoms.

Remarks.—This species is exceedingly common, and is the largest form among the members of the family *Polymorphinidae* found in Mutsu Bay. The young forms somewhat resemble the species of the genus *Guttulina*, but the adult specimens differ obviously from these in the arrangement of the later chambers which is biserial.

Genus DIMORPHINA D'ORBIGNY, 1826.

Test cylindrical; chambers rounded, arranged at first in a close sigmoid series, becoming uniserial in the adult; sutures distinct, depressed.

74. *Dimorphina tuberosa* D'ORBIGNY.

(Text-fig. 72)

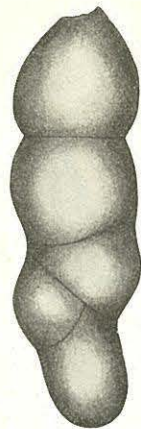
Dimorphina tuberosa, H. B. BRADY, PARKER and JONES, 1870, p. 249, pl. 42, figs. 39a, b.

Description.—Test elongate, nearly straight; chambers few in number, arranged in a closed sigmoid series in the early portion, later portion uniserial, inflated; sutures distinct, depressed; surface smooth; aperture terminal, radiate.

Length, about 0.85 mm.

Locality.—Off Futagojima, 23-25 fathoms.

Remarks.—Rare, only two specimens referred to this species have been found in the bottom material from Mutsu Bay.



Text-fig. 72. *Dimorphina tuberosa* D'ORBIGNY. × 65.

Genus SIGMOMORPHA CUSHMAN and OZAWA, 1928.

Test flattened, oval to subelliptical in side view; chambers elongate, angular in transverse section, arranged at first like *Guttulina*, then open sigmoidal; sutures distinct, depressed.

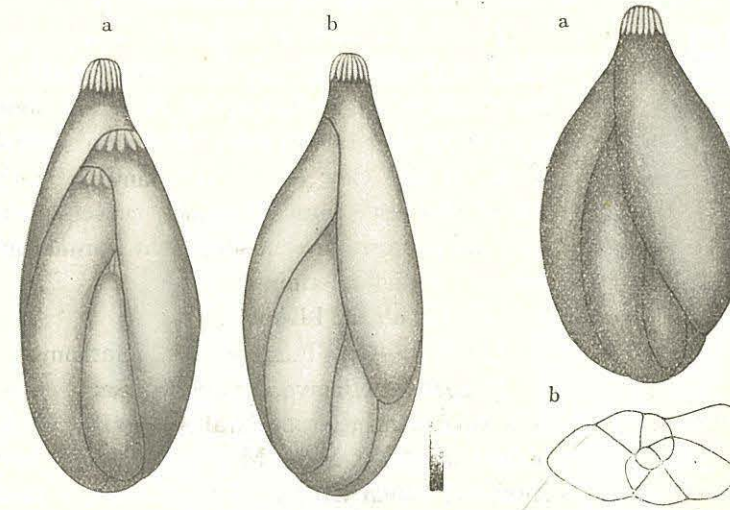
75. *Sigmomorpha ozawai*, n. sp.

(Text-figs. 73, 74)

Description.—Test elongate, compressed, usually twice as long as broad, broadest nearly at the middle, basal end rounded, tapering to the apertural end, which somewhat drawn out in a neck-like process; chambers elongate, narrow, curved, angular in transverse section, later chambers arranged in an open sigmoid series and in the adult sometimes not reaching the base; sutures distinct, depressed; wall smooth, translucent; aperture terminal, radiate, sometimes more or less eccentric.

Length, up to 0.95 mm; breadth, up to 0.44 mm; thickness, about 0.22 mm.

Localities.—Off Yunoshima, 10-18 fathoms; off Futagojima, 17-25 fathoms; between Ōshima and Bentenjima, 30-33 fathoms.



Text-fig. 73. *Sigmomorpha ozawai*, n. sp. a, b, side view.

Text-fig. 74. *Sigmomorpha ozawai*, n. sp. × 65. a, side view. b, basal view.

Remarks.—This new species is abundant in Mutsu Bay, and shows a little variation in breadth. It differs from *Sigmomorpha sadoensis* in the elongate and compressed test and from *S. sawanensis* in the depressed sutures and in the features of the chambers, the

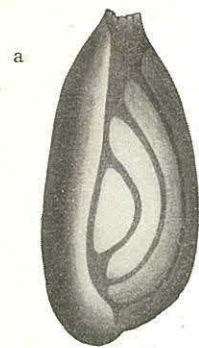
later ones not reaching to the base of the test. It may also be distinguished from *S. trilocularis* in the shape of the test and in the shapes of the chambers forming the test.

Genus SIGMOIDELLA CUSHMAN and OZAWA, 1928.

Test ovate to elliptical in side view, compressed; chambers elongate, angular, regularly arranged in open sigmoid series, gradually increasing in length in the later ones which include the earlier ones, but often the adult chambers not reaching the base; sutures distinct.

76. *Sigmoidella kagaensis* CUSHMAN and OZAWA.
(Text-fig. 75)

Sigmoidella kagaensis, CUSHMAN and OZAWA, 1928, p. 19, pl. 2, fig. 14; 1929, p. 76, pl. 13, fig. 15, pl. 16, fig. 9.



Text-fig. 75. *Sigmoidella kagaensis* CUSHMAN and OZAWA. $\times 35$.

a, side view.
b, basal view.

Description.—Test elongate, compressed, basal end rounded, apertural one produced, peripheral margin subacute; chambers long, narrow, arranged in an open clock-wise sigmoid series, in side view one large chamber on the left of the test; sutures distinct, curved, generally not depressed; wall somewhat translucent; aperture radiate, terminal.

Length, about 1.34 mm.

Locality.—Off Futagojima, 25 fathoms.

Remarks.—I have secured a single specimen broken at the apertural extremity in the bottom material from Mutsu Bay, and have identified it with *Sigmoidella kagaensis*, a fossil species described by CUSHMAN and OZAWA from Okuwa in Province Kaga, and thus it may be possible that the present species is of both fossil and recent occurrence.

Family Nonionidae.

Test typically planispiral, more or less involute; wall calcareous,

finely perforate; aperture simple or cribrate, if simple, at the base of the apertural face.

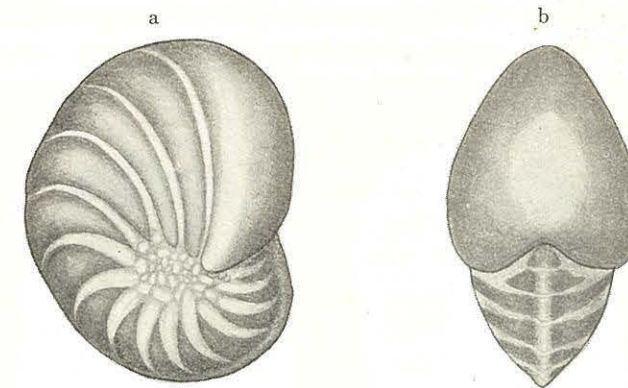
Genus NONION MONTFORT, 1808.

Test free, planispiral, more or less involute, bilaterally symmetrical, periphery broadly rounded to acute; chambers numerous; wall finely perforate; aperture, an arched, usually narrow opening between the base of the apertural face and the preceding coil.

77. *Nonion boueana* (D'ORBIGNY).
(Text-fig. 76)

Nonionina boueana, H. B. BRADY, 1884, p. 729, pl. 109, figs. 12, 13; EGGER, 1893, p. 234, pl. 19, figs. 34, 35; GOËS, 1894, p. 104, pl. 17, fig. 829; FLINT, 1897, p. 337, pl. 79, fig. 5; MILLETT, 1904, p. 602; CUSHMAN, 1914, p. 28, pl. 16, fig. 1; 1921, p. 366; IKARI, 1927, p. 14, pl. 2, fig. 15a, b; HADA, 1929, p. 14.

Description.—Test oval, compressed, bilaterally symmetrical in apertural view, outer convolution composed of about fifteen narrow, curved visible chambers; umbilical region covered with granular shell



Text-fig. 76. *Nonion boueana* (D'ORBIGNY). $\times 60$.

a, side view. b, peripheral view.

material, from which region wide, limbate, curved sutures radiate; wall smooth, finely perforate; aperture forming a narrow curved slit at the basal margin of the apertural face, often covered with the clear shell material.

Length, up to 0.80 mm.

Localities.—At all stations where collections were made in depths of 4–33 fathoms.

Remarks.—According to the published records we know that the species is common in the waters surrounding Japan. FLINT (1897) reported it from a depth of 9 fathoms in the Gulf of Tokyo, and CUSHMAN (1914) found it in the Albatross material in 37 fathoms off Japan and in the Nero collection in 631 fathoms off Yokohama. IKARI (1927) recorded it from the vicinity of Misaki, and I (1929) have obtained specimens from shallow water off the coast of Hokkaido. It is also commonly found everywhere in Mutsu Bay.

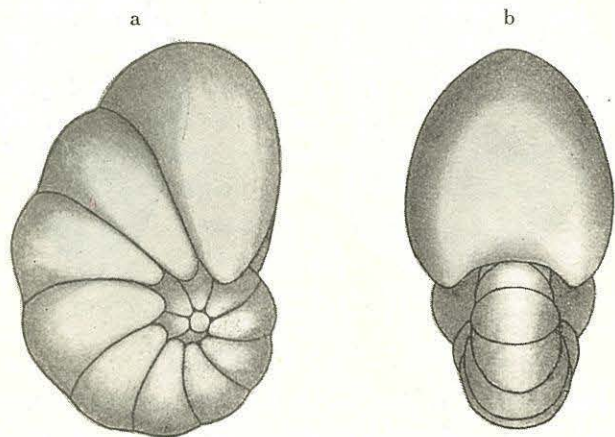
78. *Nonion scapha* (FICHTEL and MOLL).

(Text-fig. 77)

Nonionina scapha, H. B. BRADY, 1884, p. 730, pl. 109, figs. 14, 15; EGGER, 1893, p. 232, pl. 19, figs. 42, 43; GOËS, 1894, p. 104, pl. 17, fig. 830; 1896, p. 79; FLINT, 1897, p. 337, pl. 80, fig. 1; KIAER, 1900, p. 50; MILLETT, 1904, p. 601; BAGG, 1908, p. 164; SIDEBOTTOM, 1909, p. 13; CUSHMAN, 1914, p. 28, pl. 15, fig. 1, pl. 16, figs. 3, 4; HADA, 1929, p. 14.

Nonion scapha, CUSHMAN, 1927 (a), p. 147.

Description.—Test oval, somewhat compressed, bilaterally symmetrical in apertural view, composed of less than two nautiloid con-



Text-fig. 77. *Nonion scapha* (FICHTEL and MOLL). ×110.
a, side view. b, peripheral view.

volutions, peripheral margin rounded; chambers elongate, increasing rapidly in size as added, about ten chambers forming the outer whorl, apertural face of the last-formed chamber broad, slightly convex; sutures distinct, more or less depressed; surface smooth; aperture in the form of a narrow arched slit at the basal margin of the apertural face.

Length, about 0.45 mm.

Localities.—All stations, 4–33 fathoms.

Remarks.—This species is common in Mutsu Bay. CUSHMAN (1914) recorded it from four Albatross stations, ranging in depth from 84 to 622 fathoms, off Japan. My previous report (1929) was based on the specimens taken from three localities off Hokkaido.

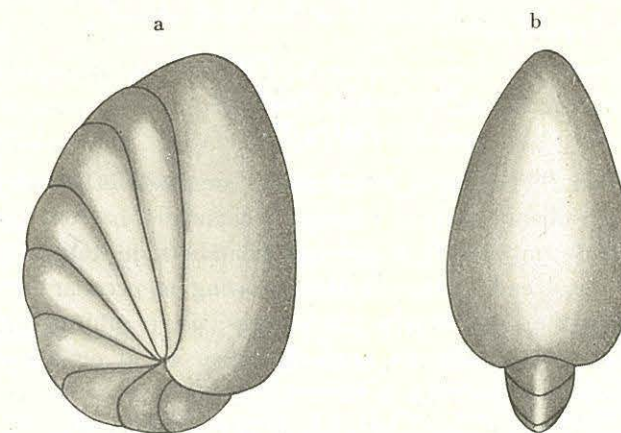
79. *Nonion turgida* (WILLIAMSON).

(Text-fig. 78)

Rotalina turgida, WILLIAMSON, 1858, p. 50, pl. 4, figs. 95–97.

Nonionina turgida, H. B. BRADY, 1870, p. 306; 1881 (b), p. 17; 1884, p. 731, pl. 109, figs. 17–19; EGGER, 1893, p. 233, pl. 19, figs. 45, 46; GOËS, 1894, p. 105, pl. 17, fig. 832; KIAER, 1900, p. 50; MILLETT, 1904, p. 602; SIDEBOTTOM, 1909, p. 13; CUSHMAN, 1914, p. 29, pl. 15, fig. 3.

Description.—Test equilateral, compressed, composed of about ten visible chambers in the outer convolution; chambers elongate, narrow,



Text-fig. 78. *Nonion turgida* (WILLIAMSON). ×80.
a, side view. b, peripheral view.

curved, each becoming longer than its preceding one, last-formed chamber strongly enlarged and widened, often occupying nearly one-half of the whole test, broadest at its base, tapering towards the subacute peripheral margin; sutures distinct, but slightly depressed; wall smooth, thin and somewhat translucent, finely perforate; aperture forming a narrow arched slit, invisible externally.

Length, up to 0.68 mm.

Localities.—It is obtained at all stations, 4–33 fathoms, where the collection were made.

Remarks.—The species is very abundant in the bottom material from Mutsu Bay. Of this species only one previous record in Japanese waters was made by H. B. BRADY (1884) in the Challenger Report, the specimens being secured from *Hyalonema*-ground in 345 fathoms, off the coast of Japan.

Genus NONIONELLA CUSHMAN, 1926.

Test subtrochoid, the dorsal side only partially involute, ventral side completely so, close coiled; chambers especially in the adult inequilateral, the ventral side developing a distinct elongate lobe at the umbilical end, which covers the umbilicus itself; wall calcareous, finely perforate; aperture at the base of the apertural face of the chamber, low and elongate, extending from the peripheral border toward the ventral side.

80. *Nonionella pulchella*, n. sp.

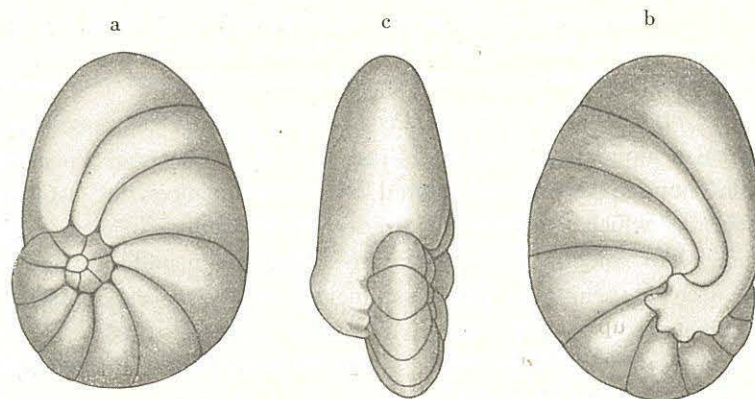
(Text-fig. 79)

Description.—Test oval, compressed, composed of about two convolutions, peripheral margin rounded; chambers narrow, curved, increasing rapidly in size as added, all chambers in the outer whorl visible, umbilical end of the chamber growing in peculiar manner and covering over the umbilicus in the ventral side; sutures distinct, depressed slightly; wall smooth, somewhat translucent or opaque, finely perforate; aperture forming a narrow, arched slit.

Length, about 0.45 mm; breadth, 0.30 mm; thickness, 0.18 mm.

Localities.—All stations, 4–33 fathoms.

Remarks.—This species is found abundantly in the collections



Text-fig. 79. *Nonionella pulchella*, n. sp. $\times 100$.

a, dorsal view. b, ventral view. c, peripheral view.

from Mutsu Bay. It differs from *Nonionella miocenica* in the crenate margin of the umbilical lobe of the chamber, this margin having five distinct lobelet or crenations, and also in the dorso-ventral diameter of the test which is less in this species than in CUSHMAN's (1926, pl. 13, fig. 4 c) *N. miocenica*. In this species occurrences of the different directions of the convolutions building up the test are nearly equal in Mutsu Bay.

Genus ELIPHIDIUM MONTFORT, 1808.

Test typically planispiral, bilaterally symmetrical, mostly involute; chambers numerous with distinct sutures either depressed or raised and limbate, with septal bridge and depressions; wall calcareous, perforate; apertures one or more at the base of the apertural face.

81. *Eliphidium striato-punctatum* (FICHTEL and MOLL).

(Text-fig. 80)

Polystomella striato-punctata, H. B. BRADY, 1870, p. 305; 1881 (b), p. 18; 1884, p. 733, pl. 109, figs. 22, 23; EGGER, 1893, p. 241, pl. 19, figs. 49, 50; GOËS, 1894, p. 101, pl. 17, figs. 815c, f, k, l, 822; 1896, p. 78; FLINT, 1897, p. 337, pl. 80, fig. 2; KIAER, p. 51; MILLETT, 1904, p. 602; RHUMBLER, 1907, p. 73, pl. 5, figs. 61, 62; CUSHMAN, 1908, p. 31, pl. 5, fig. 4; HERON-ALLEN and EARLAND, 1909, p. 695; SIDEBOTTOM, 1909, p. 14, fig. 10, pl. 5, figs. 1, 2; CUSHMAN, 1914, p. 31, pl. 18, fig. 2; HERON-ALLEN

and EARLAND, 1915, p. 732; HOFKER, 1927, p. 54, pl. 26, figs. 3, 4, 7, pl. 27, figs. 9, 10, pl. 28, fig. 9; HADA, p. 14.

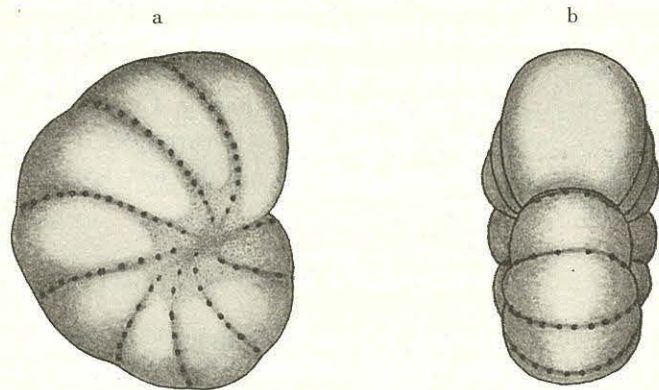
Eliphidium striato-punctatum, CUSHMAN and LEAVITT, 1929, p. 19, pl. 4, figs. 5, 6.

Description.—Test discoidal, equilateral, slightly depressed at the umbilical region often filled with the fine shell material; peripheral margin rounded; about ten inflated chambers forming the last-formed convolution which encloses all predecessors; septal bridges regular, distinct; wall smooth, finely perforate; aperture usually in the form of an arched opening at the basal margin of the apertural face.

Diameter, up to 0.82 mm.

Localities.—Off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms; near Ōshima, 23 fathoms.

Remarks.—This species is fairly common in Mutsu Bay. From many previous records it may be assumed that several variable forms



Text-fig. 80. *Eliphidium striato-punctatum* (FICHEL and MOLL). ×60.

a, side view. b, peripheral view.

are included under this name. Among the species obtained from Mutsu Bay there may be distinguished at least two forms. The first is comparatively large and broad with septal depressions clearly visible, while the second is small with a thin and translucent wall with narrow septal bridges. In the material from the littoral area off Hokkaido I (1929) have obtained specimens equally in size those found in Mutsu Bay.

82. *Eliphidium crispum* (LINNÉ).

Polymorphina crista, WILLIAMSON, 1858, p. 40, pl. 3, figs. 78, 79; CARPENTER, PARKER and JONES, 1862, p. 278, pl. 16, figs. 4–6; H. B. BRADY, 1884, p. 736, pl. 110, figs. 6, 7; EGGER, 1893, p. 240, pl. 20, figs. 20, 21; GOËS, 1894, p. 102, pl. 17, figs. 820, 821; CHAPMAN, 1895, p. 45; FLINT, 1897, p. 338, pl. 80, fig. 3; KIAER, 1900, p. 51; MILLETT, 1904, p. 603, pl. 11, fig. 2; CUSHMAN, 1908, p. 32; SIDEBOTTOM, 1909, p. 15; CUSHMAN, 1914, p. 32, pl. 18, fig. 1; 1921, p. 368; HERON-ALLEN and EARLAND, 1924, p. 640; CUSHMAN, 1925 (a), p. 136; IKARI, 1927, p. 15, pl. 2, figs. 16a, b; HOFKER, 1927, p. 55, pl. 26, fig. 8, pl. 27, figs. 5, 6, 11, 12, pl. 28, 3, 5–7; HADA, 1929, p. 14.

Eliphidium crispum, CUSHMAN and LEAVITT, 1929, p. 20, pl. 4, figs. 3, 4.

Description.—Test thick, lenticular, both faces convex, peripheral margin keeled with the sharp edge, composed of numerous, long, narrow, curved chambers with the final visible convolution enclosing all the predecessors; umbilical portion umbonate, convex, filled with a mass of clear shell substance and provided with a few small depressions; septal depressions large; aperture consisting usually of pores arranged in a V-shaped line at the basal margin of the apertural face.

Diameter, about 0.95 mm.

Localities.—Off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms.

Remarks.—I have found a few specimens in the collections from Mutsu Bay. Previous records of this species from Japanese waters are three; the first of CUSHMAN (1914) from the “Nero” material in 613 fathoms off Japan, the second of IKARI (1927) from Misaki and the third of mine (1929) from the littoral area off Hokkaido.

83. *Eliphidium subnodosum* (MÜNSTER).

(Text-fig. 81)

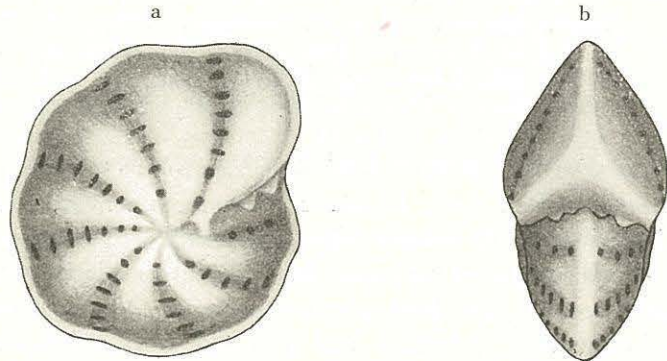
Polystomella subnodosa, H. B. BRADY, 1844, p. 734, pl. 110, fig. 1a, b; GOËS, 1894, p. 102, pl. 17, figs. 817–819; KIAER, 1900, p. 51; MILLETT, 1904, p. 604; BAGG, 1908, p. 165; SIDEBOTTOM, 1909, p. 16, pl. 5, fig. 6; CUSHMAN, 1914, p. 32, pl. 14, fig. 8; 1921, p. 367.

Description.—Test lenticular, symmetrical, both sides convex, peripheral margin subacute, carinate; umbilical area usually umbonate; ten or more chambers forming the outer visible convolution enclosing all others; septal lines curved, scarcely depressed, with distinct septal

depressions; surface smooth, polished; aperture an arched slit at the basal margin of the apertural face.

Diameter, about 0.60 mm.

Localities.—At all stations, in 4–33 fathoms, where collections were made.



Text-fig. 81. *Eliphidium subnodosum* (MÜNSTER). ×70.

a, side view. b, peripheral view.

Remarks.—The species is not very common in Mutsu Bay, but was secured in every collection examined. CUSHMAN (1914) obtained the specimens from the Inland Sea of Japan and from the eastern channel of the Korea Strait.

84. *Eliphidium macellum* (FICHTEL and MOLL).

Polystomella macella, H. B. BRADY, 1884, p. 737, pl. 110, figs. 8, 9, 11; EGGER, 1893, p. 240, pl. 20, figs. 22, 23; BAGG, 1908, p. 165; SIDEBOTTOM, 1909, p. 15, pl. 5, fig. 4; CUSHMAN, 1914, p. 33, pl. 18, fig. 3; 1920 (b), p. 633; 1922 (b), p. 56, pl. 10, figs. 1, 2; HERON-ALLEN and EARLAND, 1924, p. 640; HADA, 1929, p. 14.

Polystomella crista, HOFKER, 1927, p. 55, pl. 26, figs. 5, 6, 9, pl. 27, figs. 7, 8, pl. 28, figs. 1, 2.

Eliphidium macellum, CUSHMAN and LEAVITT, 1929, p. 18, pl. 4, figs. 1, 2.

Description.—Test discoidal, compressed, bilaterally symmetrical, composed of numerous, long, curved chambers in the visible, last-formed convolution; periphery keeled sharply; umbilical region slightly depressed, usually porous, occasionally filled with clear shell material; surface marked with the well-defined reticular work; aperture formed

of small openings arranged in a curved row at the basal margin of the apertural face.

Diameter, about 0.75 mm.

Localities.—Off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms.

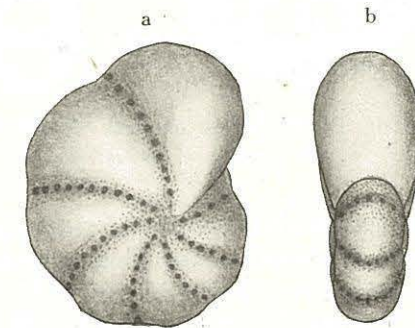
Remarks.—This species is commonly found in the collections from Mutsu Bay, being represented by specimens of two types which are more or less different from each other as in H. B. BRADY (1884, pl. 110, figs. 8, 9). CUSHMAN (1914) recorded this species from the Gulf of Tokyo, in 9 fathoms and from the Albatross stations, in 120 fathoms and in 500 fathoms off Japan. I (1929) have previously found it in the shallow water off Oshoro and Nemuro in Hokkaido.

85. *Eliphidium fabum* (FICHTEL and MOLL).

(Text-fig. 82)

Polystomella faba, HERON-ALLEN and EARLAND, 1916 (a), p. 281, pl. 43, figs. 11–19; HADA, 1929, p. 14.

Description.—Test compressed, bilaterally symmetrical, composed of about eight visible chambers in the outer convolution embracing other predecessors; chambers rather broad, somewhat inflated; peripheral margin rounded; umbilical region slightly depressed, covered with fine granular shell material; septal depressions and septal bridges marked rather indistinctly due to sutural depressions filled with the fine granular material; wall finely perforate; aperture in the form of an arched slit at the basal margin of the apertural face.



Text-fig. 82. *Eliphidium fabum* (FICHTEL and MOLL). ×80.

a, side view. b, peripheral view.

Diameter, about 0.48 mm.

Localities.—Off Yunoshima, 18 fathoms; between Ōshima and Bentenjima, 33 fathoms.

Remarks.—This is a comparatively rare species in Mutsu Bay.

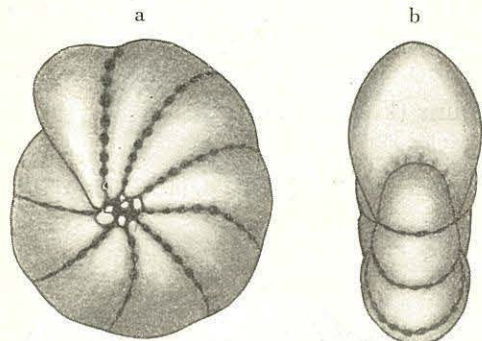
Previously I (1929) have secured the species from shallow water off Hokkaido.

86. *Eliphidium decipiens* (COSTA).

(Text-fig. 83)

Polystomella decipiens, HERON-ALLEN and EARLAND, 1916 (a), p. 282, pl. 43, figs. 20-22; HADA, 1929, p. 14.

Description. — Test discoidal, bilaterally symmetrical, compressed, outer whorl composed of about ten somewhat inflated, visible chambers,



Text-fig. 83. *Eliphidium decipiens* (COSTA). × 80.
a, side view. b, peripheral view.

enclosing entirely all preceding ones; peripheral margin rounded, umbilical region roughly granulated, depressed slightly; septal depressions distinct in the later sutures, while indistinct and forming long irregular grooves in the earlier visible sutures; wall more or less translucent, finely perforate; basal margin of the apertural face of the last-formed

chamber slightly crenulate externally, with a narrow, curved, slit-like aperture; color usually white, sometimes yellowish brown.

Diameter, about 0.54 mm.

Localities. — Off Yunoshima, 10-18 fathoms; off Futagojima, 17-25 fathoms; between Ōshima and Bentenjima, 33 fathoms.

Remarks. — Judging from the examination of the specimens obtained in Mutsu Bay and in shallow water off Hokkaido (1929), this species seems to be widely distributed in the shallow water surrounding the northern part of Japan.

Family **Buliminidae**.

Test typically an elongate spiral, divided into chambers, in the specialized genera biserial, or uniserial, or even monothalamous; wall

calcareous, perforate; aperture loop-like or rounded and terminal, usually with some sort of apertural tooth or spiral connected with the interior tubular siphons connecting the apertures.

Subfamily **BULIMININAE**.

Test spiral, usually triserial, becoming involute and finally in *Entosolenia* monothalamous; aperture loop-shaped, the larger end away from the inner margin, (or in *Entosolenia* rounded) usually with a distinct tooth and internal tube connecting the chambers, (or in *Entosolenia* free at the inner end).

Genus **BULIMINA** D'ORBIGNY, 1826.

Test, an elongate spiral, generally triserial; chambers inflated, spiral suture more or less obsolete; wall calcareous, perforate; aperture loop-shaped with a tooth or plate at one side and an internal spiral tube connecting through the chambers between the apertures.

87. *Bulimina aculeata* D'ORBIGNY.

(Text-fig. 84)

Bulimina pupoides, var. *spinulosa*, WILLIAMSON, 1858, p. 62, pl. 5, fig. 128.

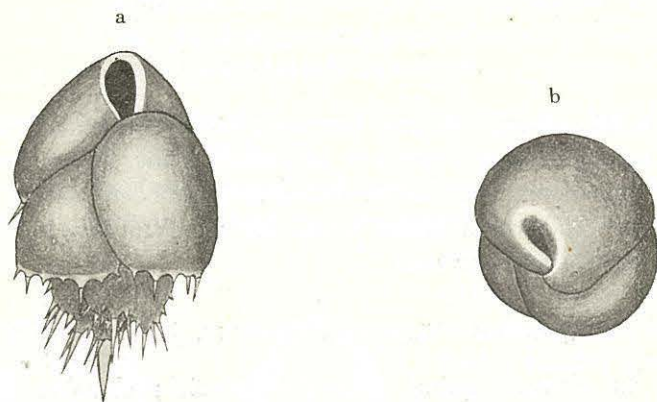
Bulimina aculeata, H. B. BRADY, 1884, p. 406, pl. 51, figs. 7-9; EGGER, 1893, p. 95, pl. 8, figs. 72, 78; CHAPMAN, 1895, p. 22; GOËS, 1896, p. 45; FLINT, 1897, p. 291, pl. 37, fig. 4; MILLETT, 1900, p. 278; SIDEBOTTOM, 1905, p. 12; BAGG, 1908, p. 134; HERON-ALLEN and EARLAND, 1908, p. 332; CUSHMAN, 1911, p. 86, text-fig. 139a, b; HERON-ALLEN and EARLAND, 1913 (c), p. 63; PEARCEY, 1914, p. 1014; HERON-ALLEN and EARLAND, 1916 (a), p. 236; 1916 (b), p. 42; CUSHMAN, 1921, p. 161, pl. 31, fig. 5; 1922 (a), p. 96, pl. 22, figs. 1, 2.

Description. — Test ovate, composed of inflated chambers arranged triserially and more or less overlapping the predecessors, early portion provided with many long spines, later portion smooth, but lower margin of the later chambers crenulate or with short spines; sutures distinct, much depressed; wall in the adult opaque; aperture fairly broad, loop-shaped.

Length, about 0.38 mm.

Localities. — Off Yunoshima, 18 fathoms; off Futagojima, 17-25 fathoms; between Ōshima and Bentenjima, 30-33 fathoms.

Remarks.—This species is comparatively rare in Mutsu Bay, and in the material obtained from this bay I have found a number of



Text-fig. 84. *Bulimina aculeata* D'ORBIGNY. ×120.
a, side view. b, apertural view.

specimens with comparatively short spines. H. B. BRADY (1884) reported this species from a single Challenger station, 345 fathoms deep, on the *Hyalonema*-ground south of Japan and CUSHMAN (1911) obtained it also from a great number of stations in the Western Pacific about Japan, ranging in depth from 76 to 1299 fathoms.

Genus ENTOSOLENIA EHRENBERG, 1848.

Test monothalamous, the single chamber with an internal tube free at the inner end; wall usually thin, finely perforate; aperture elliptical or circular.

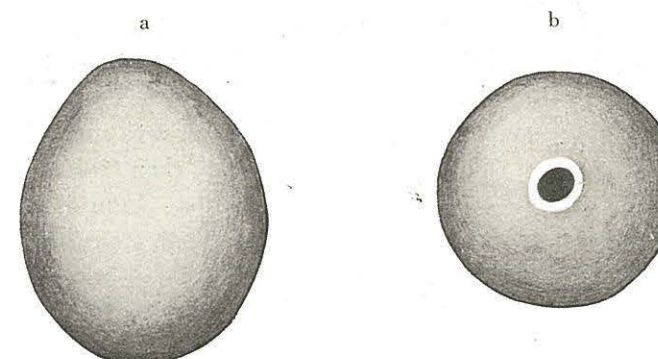
88. *Entosolenia globosa* (MONTAGU).
(Text-fig. 85)

Entosolenia globosa, WILLIAMSON, 1848, p. 16, pl. 2, figs. 13, 14; 1858, p. 8, pl. 1, figs. 15, 16.

Lagena globosa, H. B. BRADY, 1870, p. 293; BUTSCHLI, 1880-1882, p. 197, pl. 7, fig. 2; H. B. BRADY, 1881 (b), p. 13; 1884, p. 452, pl. 56, figs. 1-3; EGGER, 1893, p. 131, pl. 10, fig. 69; CHAPMAN, 1895, p. 27; FLINT, 1897, p. 306, pl. 53, fig. 4; KIAER, 1900, p. 39; MILLETT, 1901, p. 3; SIDEBOTTOM, 1906, p. 1; RHUMBLER, 1907, p. 63; BAGG, 1908, p. 141; HERON-ALLEN

and EARLAND, 1909, p. 422; 1913 (c), p. 72; CUSHMAN, 1914, p. 3, pl. 4, fig. 2; HERON-ALLEN and EARLAND, 1915, p. 654; 1916 (a), p. 242; 1916 (b), p. 44; CUSHMAN, 1920 (b), p. 607; 1921, p. 173; 1923, p. 20, pl. 4, figs. 1, 2; HADA, 1929, p. 12.

Description.—Test globular, smooth, circular in transverse section, slightly drawn out at the apertural end; wall usually translucent, some-



Text-fig. 85. *Entosolenia globosa* (MONTAGU). ×140.
a, front view. b, apertural view.

times opaque; aperture opening at the central portion of the apertural end, connecting with an internal tube.

Length, about 0.30 mm.

Locality.—Off Yunoshima, 18 fathoms.

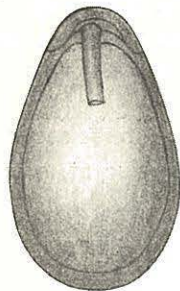
Remarks.—This species is very rare in Mutsu Bay, and I have found only one small specimen in the collections obtained from that bay. I (1929) have secured a few specimens of this species from Oshoro Inlet, Hokkaido.

89. *Entosolenia lucida* WILLIAMSON.
(Text-fig. 86)

Entosolenia marginata, var. *lucida*, WILLIAMSON, 1848, p. 17, pl. 2, fig. 17.

Lagena lucida, KIAER, 1900, p. 40; MILLETT, 1901, p. 494; SIDEBOTTOM, 1906, p. 6, pl. 1, figs. 9-12; HERON-ALLEN and EARLAND, 1909, p. 425; CUSHMAN, 1913, p. 36; 1913 (c), p. 87; 1916 (a), p. 249; 1916 (b), p. 46; CUSHMAN, 1923, p. 33, pl. 6, figs. 1, 2; HADA, 1929, p. 12.

Description.—Test elongate, elliptical in side view, slightly compressed, surrounded by faint marginal carina becoming more distinct



Text-fig. 86. *Entosolenia lucida* (WILLIAMSON). $\times 150$.

at both ends; apertural end somewhat produced, basal end usually rounded, occasionally tapering into the apiculate end; wall smooth, translucent; aperture usually slit-like, connecting with an internal tube.

Length, about 0.25 mm.

Localities. — Off Yunoshima, 18 fathoms; between Ōshima and Bentenjima, 30–33 fathoms.

Remarks. — This species is somewhat common at depths greater than 18 fathoms in Mutsu Bay. The apiculate form is very rare as compared with typical form; only one apiculate form being found among about ten specimens. In the neighbouring seas about Japan CUSHMAN (1913) reported the species from two stations and I (1929) have seen this form in the material from shallow water off Hokkaido.

Subfamily VIRGULININAE.

Test usually showing traces of its spiral origin in the twisted young, later biserial, and in the end forms uniserial.

Genus VIRGULINA D'ORBIGNY, 1826.

Test elongate, more or less compressed fusiform, the early chambers spiral about the elongate axis, triserial, later ones becoming irregularly biserial, whole test usually twisted; wall calcareous, finely perforate; aperture elongate, loop-shaped, usually with an apertural tooth or plate and internal tube.

90. *Virgulina schreibersiana* CZJZEK.

(Text-fig. 87)

Virgulina schreibersiana, H. B. BRADY, 1881 (b), p. 13; 1884, p. 414, pl. 52, figs. 1–3; EGGER, 1893, p. 98, pl. 8, figs. 93, 95; GOËS, 1894, p. 48, pl. 9, figs. 459, 461–472; CHAPMAN, 1895, p. 23; FLINT, 1897, p. 291, pl. 37, fig. 6; KIAER, 1900, p. 34; SIDEBOTTOM, 1905, p. 13, pl. 3, fig. 4; CUSHMAN, 1911, p. 94, text-fig. 148a, b; 1921, p. 169; 1922 (a), p. 117, pl. 26, fig. 6; 1927 (a), p. 153, pl. 3, fig. 3; CUSHMAN and WICKENDEN, 1929, p. 9, pl. 4, fig. 2a, b.

Description. — Test elongate, conical, somewhat compressed, slightly curved, tapering gradually to the apical end with a spine; chambers more less long, inflated, generally arranged biserially; sutures distinct, depressed; wall somewhat translucent; surface smooth, polished; aperture elongate, oval, loop-shaped.

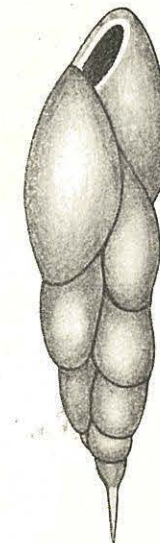
Length, about 0.45 mm.

Locality. — Off Futagojima, 25 fathoms.

Remarks. — Rare, only two specimens found in the collections from Mutsu Bay.

Genus BOLIVINA D'ORBIGNY, 1839.

Test elongate, usually somewhat compressed, tapering from the subacute or rounded initial end, which is often twisted; chambers typically biserial; wall calcareous, perforate; aperture elongate, usually oblique to the median plane, elongate, reaching to the base of the chamber, often with a plate-like tooth connecting with an internal tube.



Text-fig. 87. *Virgulina schreibersiana* CZJZEK. $\times 150$.

91. *Bolivina robusta* H. B. BRADY.

(Text-fig. 88)

Bolivina robusta, H. B. BRADY, 1881 (a), p. 57; 1884, p. 421, pl. 53, figs. 7–9; EGGER, 1893, p. 102, pl. 8, figs. 31, 32; CHAPMAN, 1895, p. 24; CUSHMAN, 1911, p. 36, text-figs. 59, 60; 1921, p. 129; HADA, 1929, p. 11.

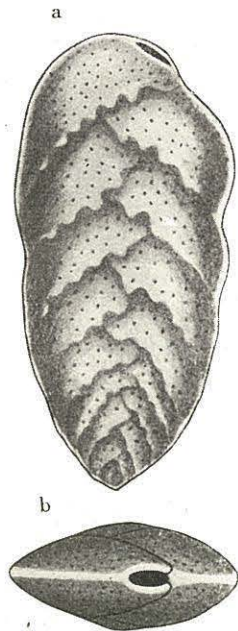
Description. — Test elongate, compressed, tapering gradually and slightly to the initial end, at which sometimes apiculate, thickest on the long median line of the test, slightly thinning out to the lateral subacute edges somewhat carinate; chambers long, narrow, curved slightly, arranged biserially, eight to ten in each row, crenulate on the lower margin of each chamber; sutures distinct, somewhat limbate; wall rather coarsely perforate; aperture elongate, situated obliquely.

Length, about 0.50 mm.

Locality. — Off Yunoshima, 18 fathoms.

Remarks. — The species is rare in Mutsu Bay, and no apiculate

form was in the material. CUSHMAN (1911) has detected this species in the collections obtained at many Nero and Albatross stations off the southern coast of Japan, and I (1929) have collected the specimens from Oshoro Inlet and Akkeshi Bay in Hokkaido.



Text-fig. 88. *Bolivina robusta* H. B. BRADY.
×120.
a, side view.
b, apertural view.

92. *Bolivina seminuda* CUSHMAN.

(Text-fig. 89)

Bolivina seminuda, CUSHMAN, 1911, p. 34, text-fig. 55; 1927 (a), p. 157, pl. 3, fig. 6; HADA, 1929, p. 11.

Description.—Test elongate, somewhat compressed, tapering slightly towards the aboral end bluntly pointed, obliquely truncate at the oral region; peripheral margin rounded; chambers arranged biserially, more or less inflated; sutures distinct; wall thin and hyaline, the proximal area of each chamber rather coarsely perforate, the distal area smooth,



Text-fig. 89. *Bolivina seminuda* CUSHMAN. ×85.
a, side view.
b, apertural view.

without perforation; aperture elongate, loop-like, placed obliquely on the apertural face; color white or yellowish white.

Length, about 0.60 mm.

Localities.—Off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms.

Remarks.—In the collections taken from Mutsu Bay the species is frequently found. It was rather rare in the collection from Oshoro Inlet.

Subfamily REUSSINAE.

Test distinctly triserial, at least in the young of most forms, in specialized forms becoming uniserial; aperture in the simpler forms and in the young, elongate, in the uniserial forms and some of the triserial ones, cribrate.

Genus REUSSIA SCHWAGER, 1877.

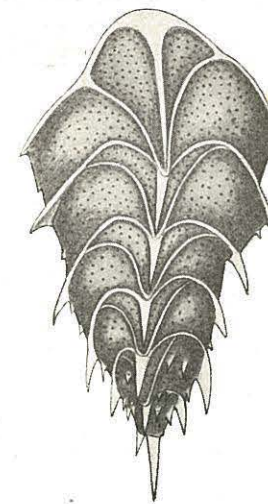
Test distinctly triserial, triangular in transverse section, broadest at the apertural end; wall calcareous, perforate; aperture elongate, oblique, in the triangular apertural face.

93. *Reussia spinulosa* (REUSS).

(Text-fig. 90)

Verneuilina spinulosa, H. B. BRADY, 1884, p. 384, pl. 47, figs. 1–3; EGGER, 1893, p. 89, pl. 7, figs. 11, 14–16; MILLETT, 1900, p. 11; SIDEBOTTOM, 1905, p. 10, pl. 2, fig. 5; RHUMBLER, 1907, p. 61, pl. 5, fig. 53; BAGG, 1908, p. 132; HERON-ALLEN and EARLAND, 1908, p. 327; CUSHMAN, 1911, p. 55, text-fig. 88a, b; PEARCEY, 1914, p. 1039; CUSHMAN, 1921, p. 141, pl. 27, fig. 5; 1922 (a), p. 60, pl. 19, fig. 5; 1922 (b), p. 28, pl. 3, fig. 11; 1922 (c), p. 51; 1925 (a), p. 125; 1926 (a), p. 76; IKARI, 1927, p. 11, pl. 1, fig. 8; HADA, 1929, p. 11.

Description.—Test tricarinate, triangular in transverse section, tapering towards the initial end with a tapering



Text-fig. 90. *Reussia spinulosa* (REUSS). ×110.

terminal spine; chambers numerous, arranged triserially, each terminating in an angle with a spine and with edges thickened; wall smooth, translucent, often provided with a number of short spines distributed irregularly; aperture elongate at the triangular apertural face.

Length without the spine, about 0.50 mm.

Localities.—Off Yunoshima, 10–18 fathoms; off Futagojima, 23 fathoms; near Ōshima, 23 fathoms.

Remarks.—This species is not very common in Mutsu Bay. According to the records previously published this species seems to be widely distributed especially in comparatively shallow waters CUSHMAN (1911) detected the specimens in the material from many stations distributed among the waters off Japan. IKARI (1927) found it in the bottom sand from Misaki, and I (1929) have secured the specimens from Oshoro Inlet, Hokkaido.

Subfamily UVIGERININAE.

Test generally triserial, at least in the early stages, later in some forms uniserial or irregular; aperture typically terminal with a neck and hyaline lip, and in some genera a spiral tooth and an internal twisted tube connecting the chambers.

Genus SIPHOGENERINA SCHLUMBERGER, 1883.

Test elongate, cylindrical, with the early stages typically triserial, rounded in section, later uniserial; wall calcareous, perforate; aperture in the adult terminal, with a distinct neck, hyaline lip and internal tube.

94. *Siphogenerina raphanus* (PARKER and JONES).

(Text-fig. 91)

Sagrina raphanus, H. B. BRADY, 1884, p. 585, pl. 75, figs. 21–24; MILLETT, 1903, p. 272; HERON-ALLEN and EARLAND, 1915, p. 677.

Siphogenerina raphanus, EGGER, 1893, p. 125, pl. 9, fig. 36; CUSHMAN, 1913, p. 108, pl. 46, figs. 1–5; 1921, p. 280, pl. 56, fig. 7; 1922 (b), p. 35, pl. 5, fig. 5; 1923, p. 175, pl. 42, fig. 14; 1924 (b), p. 28, pl. 8, figs. 1, 2; 1925 (a), p. 128; 1926 (b), p. 4, pl. 1, figs. 1–4, pl. 2, figs. 1–3, 10, pl. 5, figs. 1, 2; IKARI, 1927, p. 13, pl. 2, fig. 5a, b; HADA, 1929, p. 13.

Description.—Test either cylindrical or somewhat tapering; chambers broader than long in the straight uniserial portion; sutures somewhat depressed; surface marked with raised ridges running along nearly entire length of the test; aperture comparatively large, circular, opening at the end of a short neck, with a well-developed lip.

Length, up to 1.70 mm.

Localities.—Off Yunoshima, 18 fathoms; off Futagojima, 17–25 fathoms; near Ōshima, 23 fathoms.

Remarks.—This species occurs frequently in Mutsu Bay. The records given by CUSHMAN (1913), IKARI (1927) and myself (1929) tell us that this species is widely distributed in the waters off Japan. The megalospheric and microspheric forms of this species may be distinguished by the external shape of the test. In the megalospheric form the test is usually rounded at the initial end, while in the microspheric one it is bluntly pointed at that end.



Text-fig. 91. *Siphogenerina raphanus* (PARKER and JONES). $\times 40$.
a, side view.
b, apertural view.

Family Rotaliidae.

Test generally trochoid except in *Spirillina*, all the chambers visible from the dorsal side except in a very few genera which become partially involute, only those of the last-formed whorl usually visible from the ventral side; wall calcareous, usually rather coarsely perforate; aperture typically on the ventral side of the test.

Subfamily ROTALIINAE.

Test trochoid, umbilical region typically closed, sometimes with a definite conical plug of clear shell material; wall of the test often double and a tubular canal system developed; apertural ventral, along the margin of the chamber between the periphery and the umbilical area.

Genus *ROTALIA* LAMARCK, 1804.

Test trochoid, usually biconvex, the umbilical area closed, usually having a conical plug of clear shell material; sutures on the ventral side usually deeply depressed and often ornamented along the sides, dorsal side usually limbate; wall calcareous, perforate, often double; aperture, an arched opening at the border of the ventral face midway between the periphery and the umbilical area, interseptal canal sometimes present.

95. *Rotalia papillosa* H. B. BRADY.

Rotalia papillosa, H. B. BRADY, 1884, p. 708, pl. 106, fig. 9a-c; FLINT, 1897, p. 332, pl. 76, fig. 2; MILLETT, 1904, p. 505; CUSHMAN, 1915, p. 70, pl. 31, fig. 1; 1921, p. 347, pl. 72, fig. 3a, b; IKARI, 1927, p. 14, pl. 2, fig. 3a-c.

Description.—Test subglobular, highly convex on both sides, peripheral margin rounded, composed of three or more convolutions with the last-formed whorl consisting of ten to thirteen chambers; sutures externally variable in shape and character, irregularly limbate on the dorsal side; umbilical region covered with granular shell material as well as sutures on the ventral side; aperture, an arched fissure at the inner margin of the apertural face on the ventral side.

Diameter, up to 1.80 mm.

Localities.—Near the Marine Biological Station, 4–10 fathoms; off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms; near Ōshima, 23 fathoms.

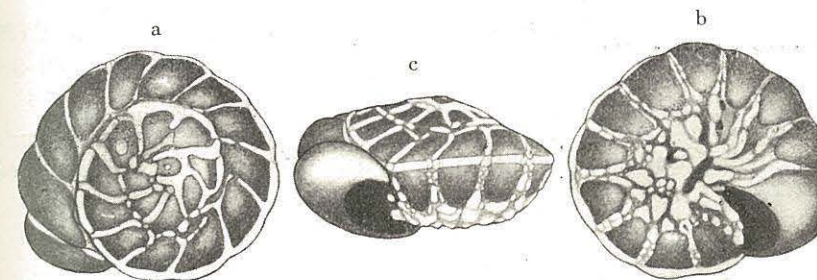
Remarks.—This species occurs very frequently in the comparatively shallow area of Mutsu Bay. CUSHMAN (1915) previously reported it from the eastern channel of the Korea Strait, and IKARI (1927) recorded it from Misaki.

96. *Rotalia papillosa* H. B. BRADY, var. *compressiuscula*
H. B. BRADY.

(Text-fig. 92)

Rotalia papillosa, var. *compressiuscula*, H. B. BRADY, 1884, p. 708, pl. 107, fig. 1a-c, pl. 108, fig. 1a-c; CUSHMAN, 1915, p. 70, pl. 30, fig. 1; 1921, p. 348, pl. 72, fig. 2a-c.

Description.—This variety differs from the typical species in the



Text-fig. 92. *Rotalia papillosa* H. B. BRADY, var. *compressiuscula*
H. B. BRADY. ×20.

a, dorsal view. b, ventral view. c, side view.

compressed form with the subacute peripheral margin.

Localities.—Near the Marine Biological Station, 4–10 fathoms; off Yunoshima, 10–18 fathoms; off Futagojima, 17–25 fathoms.

Remarks.—This variety is usually found in company with the typical form in the material obtained from Mutsu Bay, and the distinctions between them is not very clear. This variety was previously reported by H. B. BRADY (1884) from the Inland Sea of Japan and by CUSHMAN (1915) from the eastern channel of the Korea Strait where the typical form of this species was also secured.

97. *Rotalia japonica*, n. sp.

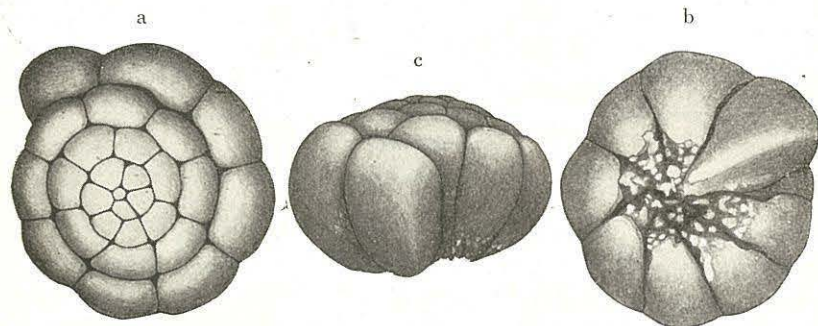
(Text-fig. 93)

Description.—Test subglobular, biconvex, ventral side more convex, composed of about four convolutions, of which the last-formed coil consists of from eight to ten chambers, peripheral margin rounded; sutures on the dorsal side nearly straight, those of the central portion not so deep as in the peripheral part, some of the outer coils depressed, ventral side marked by deep sutural depressions; umbilical area usually slightly depressed, granulated, covered with a plug of clear shell material; wall rather smooth, sometimes polished on the dorsal side; aperture in the form of a narrow slit at the inner margin of the apertural face on the ventral side; color usually yellowish or greyish brown in the central portion of the dorsal surface, fading gradually towards the outer coil.

Diameter, up to 0.90 mm; thickness up to 0.50 mm.

Localities.— Off the Marine Biological Station, 5–18 fathoms; off Futagojima, 17–25 fathoms; between Ōshima and Bentenjima, 30–33 fathoms.

Remarks.— This species is abundant in Mutsu Bay, and occurs also in the shallow water of the Pacific coast of Hokkaido. This



Text-fig. 93. *Rotalia japonica*, n. sp. ×40.
a, dorsal view. b, ventral view. c, side view.

seems to be allied to *Rotalia beccarii*, but it differs from the latter in thickness of the test and in the radiating straight sutural lines on the dorsal side. This species also resembles the specimen figured by H. B. BRADY (1884), pl. 107, fig. 5) as *Rotalia orbicularis* (?) D'ORBIGNY in the Challenger Report.

Subfamily BAGGININAE.

Test generally biconvex, the umbilical area closed, the area adjacent to it on each chamber with a thinner, rounded, clear area, usually without perforations; aperture at the base of the ventral margin of the chamber.

Genus CANCRIS MONTFORT, 1808.

Test trochoid, nearly equally biconvex, compressed; chambers few, rapidly enlarging as added; wall calcareous, perforate; umbilical area with a clear plate of rather large dimensions for the size of the test; aperture narrow, on the inner border of the ventral side of the last-formed chamber.

98. *Cancris auricula* (FICHTEL and MOLL).

(Text-fig. 94)

Pulvinulina auricula, H. B. BRADY, 1884, p. 688, pl. 106, fig. 5a-c; EGGER, 1893, p. 223, pl. 17, figs. 26–28; GOËS, 1894, p. 98, pl. 16, figs. 809, 810; 1896, p. 77; FLINT, 1897, p. 329, pl. 73, fig. 2; KIAER, p. 47; CUSHMAN, 1915, p. 55, pl. 22, fig. 1; 1920 (b), p. 631; 1921, p. 329, pl. 69, figs. 3a-c; 1927 (a), p. 164, pl. 5, fig. 10.

Description.— Test oblong, trochoid, nearly equally biconvex, compressed, peripheral margins acute, somewhat carinate; chambers more or less inflated, increasing rapidly in size as added, six to eight chambers forming the outer convolution, last-formed chamber occupying more than half the ventral surface; sutures distinct, slightly depressed, curved strongly; wall rather thin, somewhat hyaline, finely and distinctly perforate except in the rounded area at the umbilical end of each chamber on the ventral side; aperture in the form of an arched slit on the inner border of the last-formed chamber on the ventral side.

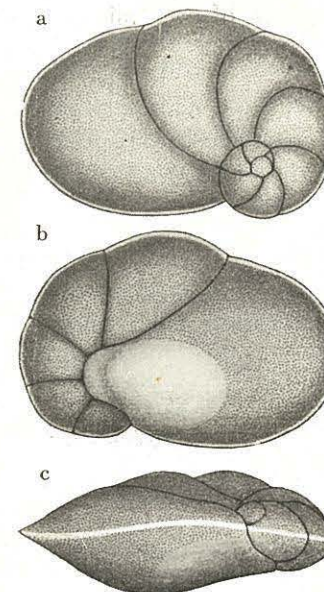
Length, about 0.65 mm.

Localities.— Off Yunoshima, 18 fathoms; off Futagojima, 20–25 fathoms.

Remarks.— This species seems to be rather rare in Mutsu Bay, only several specimens being secured.

Family Globigerinidae.

Test, at least in the early stages, trochoid, umbilicate; wall calcareous, rather coarsely perforate, usually with a cancellated surface, in well preserved specimens of the simpler genera with fine spines; aperture typically large but in the higher genera consisting of numerous small openings variously placed.



Text-fig. 94. *Cancris auricula* (FICHTEL and MOLL). ×65.
a, dorsal view. b, ventral view.
c, peripheral view.

Subfamily GLOBIGERININAE.

Wall clothed with fine spines, typically trochoid but in some genera becoming planispiral; wall often cancellated, coarsely perforate.

Genus GLOBIGERINA D'ORBIGNY, 1826.

Test trochoid throughout, umbilicate, chambers in the young especially of the microspheric form in a flattened trochoid form like *Discorbis* usually smooth and the wall thin, later chambers globular; wall thick and cancellated, in well preserved, especially in pelagic specimens, clothed with long slender spines coming from the angles of the cancellated surface areas, the base of such areas with the pores of the wall, calcareous; aperture large, opening into the umbilicus.

99. *Globigerina bulloides* D'ORBIGNY.

Globigerina bulloides, PARKER and JONES, 1857, p. 291, pl. 11, figs. 11, 12; WILLIAMSON, 1858, p. 56, pl. 5, figs. 116-118; H. B. BRADY, 1870, p. 298; 1879, p. 28; 1881 (b), p. 15; GOËS, 1882, p. 90, pl. 6, figs. 165-207; H. B. BRADY, 1884, p. 593, pl. 77, pl. 79, figs. 3-7; EGGER, 1893, p. 170, pl. 13, figs. 1-4; GOËS, 1894, p. 83, pl. 44, figs. 754-760; CHAPMAN, 1895, p. 26; GOËS, 1896, p. 65; FLINT, 1897, p. 321, pl. 69, fig. 2; KIAER, 1900, p. 48; RHUMBLER, 1900, p. 21, text-figs. 24-26; MILLETT, 1903, p. 685; BAGG, 1908, p. 153; SIDEBOTTOM, 1908, p. 3; CUSHMAN, 1908, p. 5, pl. 2, figs. 7-9, pl. 9; 1920 (b), p. 621; 1921, p. 285; 1922 (b), p. 35; 1922 (c), p. 54, pl. 12, fig. 5; 1924 (a), p. 7, pl. 2, figs. 1-4; HERON-ALLEN and EARLAND, 1924, p. 624; CUSHMAN, 1925 (a), p. 128; 1927 (a), p. 171; HADA, 1929, p. 13.

Description.—Test subglobular, composed of several globose chambers arranged in a trochoid manner, all chambers visible from above, three or four in the last-formed whorl visible from below; sutures remarkably deep; wall rather coarsely perforate; surface reticulate, provided with numerous long projecting spines; aperture large, opening into the umbilical depression.

Diameter, about 0.40 mm.

Localities.—Off Yunoshima; off Futagojima; between Ōshima and Bentsujima.

Remarks.—This species is the single pelagic species that I have found in the material from the plankton and also in the bottom collections from Mutsu Bay, where it is not so common. This species

is abundant and cosmopolitan in the open seas of the Pacific Ocean, thus H. B. BRADY (1884) and CUSHMAN (1914) have obtained specimens at everywhere in the waters near the coast of Japan. I (1929) have also obtained dead specimens in the bottom material from Akkeshi Bay, and have the living specimens in the plankton from off Oshoro, Hokkaido.

Family Anomaliniidae.

Test free, or attached by the dorsal surface which is typically flattened or concave; chambers arranged in a trochoid manner, at least in the early stages, only those of the last-formed chamber visible from the ventral side; wall calcareous, coarsely perforate; aperture in the adult either at the periphery or with an extension on the dorsal side.

Subfamily CIBICIDINAE.

Test with the dorsal side flattened or concave, the aperture extending over into the dorsal side along the inner margin of the chamber or entirely on the dorsal side, test typically attached by the dorsal side to some substrates.

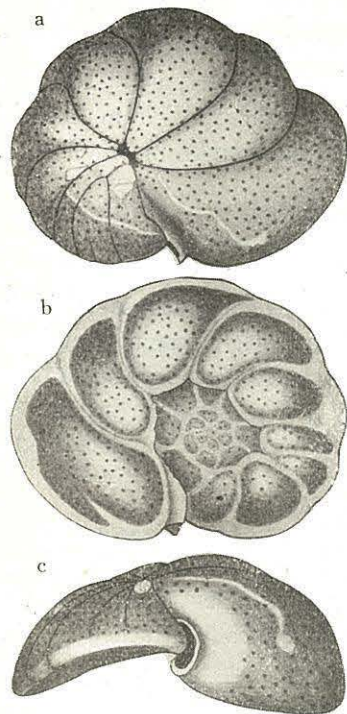
Genus CIBICIDES MONTFORT, 1808.

Test plano-convex, usually attached to various objects by the flattened dorsal side, trochoid; wall calcareous, coarsely perforate; aperture peripheral, at the base of the chamber, sometimes extending ventrally, but typically with a long slit-like extension between the inner margin of the chamber on the dorsal side and the previous whorl nearly or fully the length of the chamber.

100. *Cibicides lobatulus* (WALKER and JACOB).

(Text-fig. 95)

Truncatulina lobatula, WILLIAMSON, 1858, p. 59, pl. 5, figs. 121-123; H. B. BRADY, 1870, p. 303; 1881 (b), p. 17; 1884, p. 660, pl. 92, fig. 10, pl. 93, fig. 1a-c; EGGER, 1893, p. 204, pl. 16, figs. 1-3; CHAPMAN, 1895, p. 4; FLINT, 1897, p. 333, pl. 76, fig. 4; KIAER, 1900, p. 46; CUSHMAN, 1908, p. 30; 1915, p. 31, text-fig. 34, pl. 15, fig. 1; 1920 (b), p. 627; 1921, p. 313, pl. 63, fig. 2a-c; HERON-ALLEN and EARLAND, 1924, p. 635; CUSHMAN, 1925 (a), p. 132; HADA, 1929, p. 13.



Text-fig. 95. *Cibicides lobatulus*
(WALKER and JACOB). ×40.
a, dorsal view. b, ventral view.
c, peripheral view.

Description.—Test typically attached, plano-convex, dorsal side flattened or slightly concave, ventral side convex, all chambers visible on the dorsal side, only those of the last-formed whorl seen on the ventral side; peripheral margin subacute, carinate except a few later chambers with rounded peripheral margin; sutures more or less depressed on the ventral side, thickened on the dorsal side; wall coarsely perforate; aperture forming an arched opening at the periphery, extending along the basal margin of the last-formed chamber.

Diameter, about 0.95 mm.

Localities.—This species was obtained at all stations, 4–33 fathoms deep, where the collections were made.

Remarks.—This species is common in Mutsu Bay as also in Oshoro Inlet, Hokkaido (1929). This species seems to be variable in shape to

the adherent mode of life. CUSHMAN (1915) reported the occurrence of this species from off Japan, but he did not mention the station.

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