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XL.—*On some Arctic Foraminifera from Soundings obtained on the Austro-Hungarian North-Polar Expedition of 1872-1874.* By HENRY B. BRADY, F.R.S.*

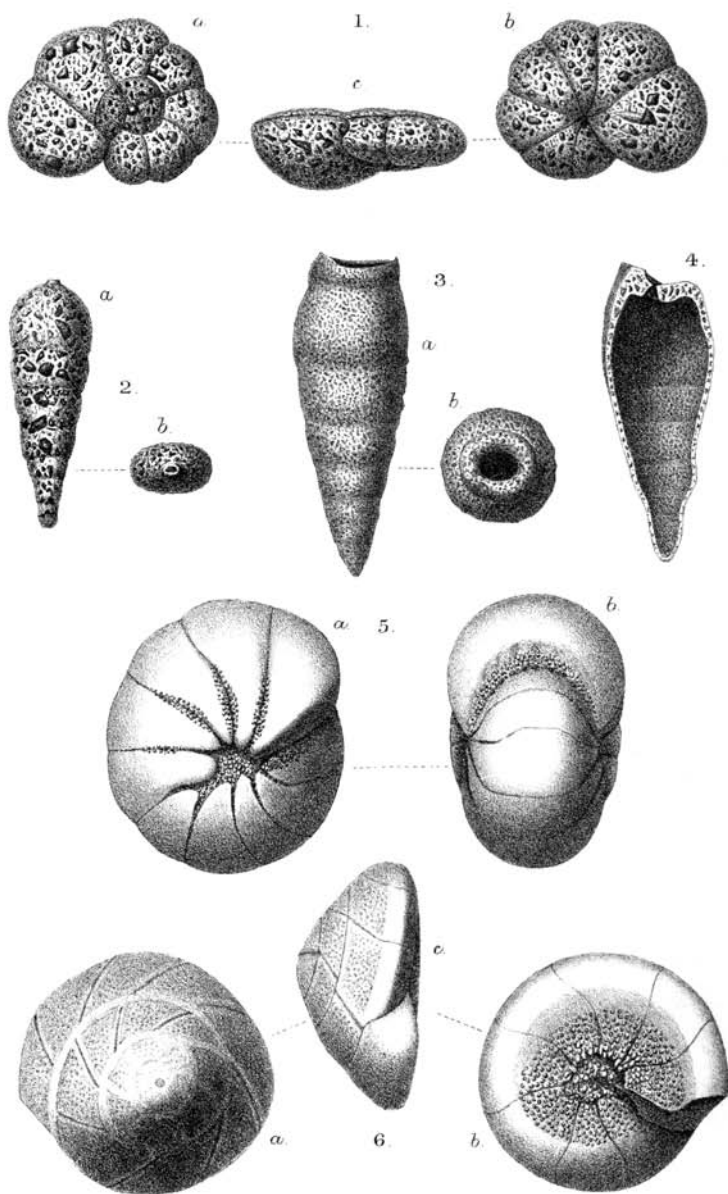
[Plate XXI.]

TOWARDS the end of last December I received from my friend Dr. F. Karrer, of Vienna, a parcel of soundings from Franz-Josef Land and the Novaya-Zemlya sea, obtained during the Austro-Hungarian North-Polar Expedition, with the intimation that he had been authorized by the Imperial Academy of Sciences to place them in my hands for investigation, and the suggestion that I should draw up a report upon the Microzoa contained in them for presentation to the Academy.

My first duty under these circumstances is to express my thanks to the Academy for the courtesy which has afforded me the opportunity of reverting to a subject to which I have before given some attention, namely the distribution of minute forms of animal life in the seas of high latitudes.

Before enlarging upon the results of the examination of the

* Report presented to the Imperial Academy of Sciences of Vienna—*“Ueber einige arktische Tiefsee-Foraminiferen, gesammelt während der österreichisch-ungarischen Nordpol-Expedition in den Jahren 1872-1874,”* Denkschriften d. math.-naturw. Cl. d. k. Akad. d. Wissensch. vol. xliii. p. 91, map and plate.



A. J. Hollick, a. d. nat. del. et lith.

Min. tern. Bros. imp.

material, it may be interesting to recapitulate briefly the successive steps that have heretofore been made towards a knowledge of the Rhizopod-fauna of the polar seas, that we may be in a position to determine the precise value to science of the instalment now furnished by the explorations of Lieuts. Weyprecht and Payer.

The first record of any importance concerning the Rhizopoda living at the sea-bottom within the Arctic Circle is contained in a short paper by Profs. W. K. Parker and T. Rupert Jones, published in 1857, entitled "Description of some Foraminifera from the Coast of Norway"*. The specimens therein described were chiefly found in dredgings made by the late Mr. M'Andrew at points not far from land, between lat. 65° N. and 71° N., in depths of from 30 to 200 fathoms (55 to 366 metres). The total amount of material, however, appears to have been small; and the number of species described and figured is only twenty-six.

In 1864 the same authors presented to the Royal Society their well-known memoir "On some Foraminifera from the North Atlantic and Arctic Oceans, including Davis Straits and Baffin's Bay"†, a work which has, since that time, been generally accepted as the text-book of the subject. It contains the results of the examination of soundings taken by Sir E. Parry in Baffin's Bay, between latitudes 74° 45' and 76° 30' N., and of those made by Dr. Sutherland off the Hunde Islands in lat. 68° 50' N., together with a revised and extended list from Mr. M'Andrew's Norwegian dredgings in the latitudes already named. One of the distribution-tables which accompany the memoir is devoted to the Arctic fauna. It comprises twenty localities, of which seven belong to the group of soundings from Baffin's Bay, five to the Hunde Islands, and eight to the coast of Norway. In all seventy-five species of Foraminifera are included; and of these twenty appear only in the Norwegian list.

On the departure of the last British North-Polar expedition in 1875, the steam-ship 'Valorous' accompanied the exploring vessels as far as Davis Straits, with Dr. J. Gwyn Jeffreys as naturalist; and on the return voyage some dredging was accomplished. A preliminary report on the Foraminifera obtained on this cruise was drawn up by the Rev. A. M. Norman‡; and a brief notice of some of the larger species was supplied by Dr. Carpenter. The record of Mr. Norman's

* Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 273, pls. xi., xii.

† 'Philosophical Transactions,' vol. clv. p. 325, pls. xii.-xix.

‡ Proc. Royal Soc. vol. xxv. p. 202.

observations on the Rhizopoda, which, as far as they affect the Arctic area, were confined to four stations, is unfortunately incomplete, as no detailed report on the subject has as yet appeared; and this is the more to be regretted as the preliminary notice gave promise of valuable additions to our knowledge of the distribution of the northern types.

On the return of this expedition in the following year, the soundings and other similar material which had been collected by Capt. H. W. Feilden, R.A., the naturalist in charge, were placed in my hands for examination; and a report upon the Rhizopoda contained in them was published soon afterwards*. This material comprised gatherings made in twenty-four localities, between latitudes $71^{\circ} 15' N.$ and $83^{\circ} 19' N.$, and yielded altogether fifty-three species of Foraminifera besides a considerable list of Radiolaria. From a geographical point of view it represented a district considerably further north than any previously investigated, the most northerly, indeed, that has yet been attained; and it furnished conclusive evidence that there was no diminution in the lower types of animal life inhabiting the sea-bottom, at any rate to a point within seven degrees of the North Pole. A tabular summary of the Foraminifera of the polar seas accompanied this memoir.

A brief but interesting paper "On Foraminifera from the Gulf and River St. Lawrence"†, was contributed to the pages of the 'Canadian Naturalist' in 1870 by Dr. G. M. Dawson. Though pertaining to an area far to the south of those which have been already mentioned, namely to about lat. 49° or $50^{\circ} N.$, the Rhizopod-fauna therein described, owing probably to the influence of a cold polar current, presents a remarkable analogy to that existing at many points within the Arctic Circle.

The various memoirs that have been enumerated all refer to those portions of the Arctic sea which lie to the west of the European coast-line (that is to say, from the Norwegian coast westward to the shores of Greenland, Davis Straits, and the adjacent regions); and until a year ago, when some soundings made by Capt. Markham during a holiday voyage in the Novaya-Zemlya Sea, were brought home for examination, little or nothing was known of the Microzoa of the sea-bottom north of the European continent. A brief report upon Capt. Markham's soundings has recently been published‡; and

* Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 425, pls. xx., xxi.

† 'Canadian Naturalist,' ser. 2, vol. v. p. 172, woodcuts.

‡ "Notes on Rhizopoda obtained from Capt. Markham's Soundings on the Shores of Novaya Zemlya, by Henry B. Brady," in 'A Polar Reconnaissance,' by Capt. A. H. Markham, R.N., p. 346 (London, 1881).

though the quantity of the material was too small to yield results of any great value taken alone, the information it affords is of considerable interest in connexion with the still more northerly fauna brought to light by the enterprise and perseverance of Lieuts. Weyprecht and Payer. A summary of the report, with some slight corrections, is therefore presented herewith as a supplementary note, and will be found on a later page.

We may now turn to what is more particularly the subject of the present paper—the material procured on the Austro-Hungarian expedition.

The parcel of soundings contained in all sixteen samples of the sea-bottom, varying in quantity from 0·15 to 12·0 grammes, but, for the most part, between one and two grammes in weight. Their physical characters and contents are described in general terms in the following summary. The letters A to P correspond to the headings of the columns of the Distribution Table. The depths are given approximately in fathoms as well as in metres, for more ready comparison with the Tables contained in the memoirs which have been referred to.

A. No. 500. 29th July, 1872. Lat. $74^{\circ} 46'$ N., Long. $53^{\circ} 36'$ E. Depth 400 metres (219 fathoms).

Fine grey siliceous sand with fragments of slate and occasional grains of magnetite. In this as well as in some other of the soundings there occur little masses of red earth, probably the result of the decomposition of some volcanic mineral. In sounding 522 (N) the shells of many of the calcareous Foraminifera are more or less stained brown by it.

This sounding is the richest of the whole series in the variety of the Foraminifera it contains, thirty-two species in all having been found. Of Ostracoda* only a single species was noticed, *Krithe glacialis*, Brady, Crosskey, and Robertson. There were also a number of sponge-spicula and fragments of Polyzoa.

B. No. 501. Lat. $74^{\circ} 48'$ N., Long. $54^{\circ} 53'$ E. Depth 130 metres (70 fathoms), mud.

Siliceous sand, with fragments of black shale and of hypersthene or some similar mineral. The total amount of material

* The Ostracoda were in all cases reserved when picking out the Foraminifera; but the number of specimens obtained was too small for separate treatment. My brother, Dr. G. S. Brady, has been kind enough to examine them; and the results are embodied in the present report.

is too small (less than 0·2 gramme) to be considered in any respect representative.

C. No. 502. 12th August, 1872. Lat. $76^{\circ} 14' N.$, Long. $58^{\circ} 54' E.$ Depth 100 metres (55 fathoms).

Siliceous sand, with a large proportion of dark-coloured grains of slate, trap, hypersthene, &c.

Only a small sounding, but tolerably rich in Foraminifera. It also contained specimens of one species of Ostracoda, *Cytheridea Sorbyana*, Jones.

D. No. 503. 30th August, 1872. Lat. $76^{\circ} 25' N.$, Long. $62^{\circ} 43' E.$ Depth 130 metres (70 fathoms).

Grey siliceous sand, with fragments of a dark-coloured porous rock, probably volcanic, and occasional grains of magnetite. Rich in Foraminifera, twenty-seven species in all, of which *Nonionina scapha* is especially remarkable for size and abundance.

E. No. 504. 16th September, 1872. Lat. $76^{\circ} 36' N.$, Long. $61^{\circ} 7' E.$ Depth 100 metres (55 fathoms), mud.

Grey siliceous sand, with fragments of slate and particles of the red earth before mentioned.

Contained thirty species of Foraminifera, as well as the following Ostracoda :—

Cythere leioderma, Norman.
Cytheridea Sorbyana, Jones.

Cytheridea punctillata, Brady.
Cytheropteron angulatum, Brady.

F. No. 506. 2nd October, 1872. Lat. $76^{\circ} 59' N.$, Long. $65^{\circ} 49' E.$ Depth 170 metres (93 fathoms), mud.

Siliceous sand, with particles of slate and schist, and fragments of trap, possibly basalt.

Moderately rich in Foraminifera, especially the smaller arenaceous forms. Contained also broken bits of an Ophiurid and some small Echinus-spines, together with the following species of Ostracoda :—

Cythere leioderma, Norman.
 — *dunelmensis*, Norman.

Cytheridea punctillata, Brady.
Eucythere argus, G. O. Sars.

G. No. 514 a. 17th May, 1873. Franz Josef Land. Depth 230 metres (125 fathoms), mud.

Consists almost entirely of the tests of *Saccamina spherica*, either entire or broken. These are constructed of siliceous sand. There are also a few fragments of slate present.

Tolerably rich in Foraminifera; the only sounding in which *Haplophragmium subglobosum* (one of the most important

constituents in the "*Biloculina*-ooze" of the cold area of the North Atlantic) was found, if we except a chance specimen or two in No. 518.

Two species of Ostracoda were noticed, namely:—

Krithe glacialis, B. C. & R. *Cytheropteron arcuatum*, B. C. & R.

H. No. 515. 23rd May, 1873. Franz-Josef Land. Depth 163 metres (89 fathoms), mud.

Chiefly reddish siliceous sand, with fragments of *Saccamina*-tests. The quantity was too small to yield an extensive list of Foraminifera.

Two species of Ostracoda were found:—

Cythere mirabilis, Jones. *Krithe glacialis*, B. C. & R.

I. No. 515 a. 23rd May, 1873. Franz-Josef Land. Depth 163 metres (89 fathoms), light-coloured mud.

Very similar to the foregoing, but somewhat richer in the smaller Rhizopoda.

J. No. 516. 1st June, 1873. Franz-Josef Land. Depth 238 metres (130 fathoms), light-coloured mud.

Siliceous sand, with fragments of soft brown rock and red earth.

The entire quantity of material was less than a gramme; it yielded nevertheless seventeen species of Foraminifera.

K. No. 518. 4th June, 1873. Franz-Josef Land. Depth 207 metres (113 fathoms), light-coloured mud.

Fine clean siliceous sand. One of the richest samples in the variety of its Rhizopod-fauna.

Contained also specimens of a single species of Ostracoda, namely *Krithe glacialis*, B. C. & R.

L. No. 519 b. 5th June, 1873. Franz-Josef Land. Depth 198 metres (108 fathoms), dark-coloured mud.

Siliceous sand, with some brown clay.

Contained very few species, and nothing of much interest.

M. No 519, a. 6th June, 1873. Franz-Josef Land. Depth 198 metres (108 fathoms), dark-coloured mud.

Siliceous sand, with fragments of a brown variety of quartz and a good deal of red earth.

Like the foregoing, contained only a small number of Foraminifera. Of Ostracoda, *Krithe glacialis*, B. C. & R., was the only species observed.

N. No. 522. 17th June, 1873. Franz-Josef Land. Depth 222 metres (121 fathoms), mud.

Fine, white, siliceous sand, with numerous grains of magnetite and a little red earth. Many of the calcareous Foraminifera are stained brown by this or some similar colouring-matter.

Not very rich in organisms; the Foraminifera belong chiefly to the smaller species.

O. No. 523. 20th June, 1873. Franz-Josef Land. Depth 220 metres (120 fathoms), dark-coloured mud.

Siliceous sand with red earth; quantity of material very small. List of organisms manifestly imperfect.

P. No. 525. 12th July, 1873. Franz-Josef Land. Depth 265 metres (145 fathoms), light-coloured mud.

Siliceous sand, with fragments of soft brown rock and some red earth, also bits of hypersthene or epidote.

Affords a good representative list of Foraminifera. Some valves of *Cythere mirabilis*, Jones, were also found.

On reference to the map it will be seen that these soundings refer to two tolerably distinct areas. The more southern area, represented by Nos. 500-506 (A-F), embraces the western shores of Novaya Zemlya between latitudes 74° and 77° N.; whilst the more northern, represented by Nos. 514-525 (G-P), lies in the latitude of Franz-Josef Land—that is to say, at about 79° or 80° N.

There is not much that is new to be said respecting the general aspect of the Rhizopod-fauna brought into view by the careful investigation to which the material has been subjected. The total number of species obtained from it is seventy-one, which suggests a somewhat greater variety in the Rhizopod life of the eastern arctic area than exists in the western region explored by the British North-Polar expedition of 1875-76. The soundings obtained on the latter occasion yielded on examination fifty-three species of Foraminifera. Too much reliance must not be placed upon these figures in either case, inasmuch as the total amount of material that has as yet been secured is insufficient to furnish what can be regarded as even approximately exhaustive lists.

The Distribution Table, which will be found facing page 418, indicates the prevalence over the whole area of certain species which previous researches had shown to be common denizens of polar seas—namely *Globigerina bulloides* and its arctic variety, *Pulvinulina Karsteni*, *Truncatulina lobatula*, *Cassidulina levigata*, *Cassidulina crassa*, and *Polystomella striatopunctata*; but over this eastern ground there appear in

addition three arenaceous species with the same very general distribution—*Reophax difflugiformis*, *Reophax scorpiurus*, and *Haplophragmium nanum*. These forms, so far as is known, are very rare or entirely absent in corresponding latitudes on the western or American side of the Arctic Ocean.

Comparing the set of soundings in the Novaya-Zemlya sea (A–F) with those from Franz-Josef Land (G–P) it may be noticed that one or two species, such as *Nonionina scapha*, which are abundant in the former, are absent, or nearly so, from the latter series; and the genus *Lagena*, though still represented by a few specimens, diminishes in frequency as we proceed northwards. On the other hand, *Saccamina spherica*, which is the most prominent Foraminifer on the shores of Franz-Josef Land, has not been found in any of the southern group of soundings; and the other arenaceous species are also conspicuous by their size and abundance in the more northern region.

The influence of climate and other external conditions in modifying morphological characters is a subject full of interest, though it is much more easy to observe the changes that take place than to account satisfactorily for them. Some of the coarse arenaceous types, such as *Saccamina spherica* and, in deeper water, *Rhabdammina abyssorum*, attain their maximum size and importance in the polar seas; whilst upon other sandy forms the more northerly conditions appear to have a starving or depauperating effect. For example, *Haplophragmium globigeriniforme*, which in the North Atlantic is often 1·6 millim. in diameter, is represented in the soundings from Franz-Josef Land by specimens not much more than one tenth of that size (0·18 millim.). *Globigerina bulloides*, of which the North-Atlantic specimens are often 0·6 millim. or more in diameter, and have the typical subglobular segments, is represented in the arctic area by a thick-shelled variety, with a diameter of about 0·3 millim. and much more compactly built.

There is another peculiarity, common amongst northern specimens of certain clear-shelled perforate species, that I do not think has been previously noticed, namely the habit of covering the shell with a coat of very fine loose sand. This may be seen in the genera *Nonionina* and *Polystomella*, and in adherent specimens of *Truncatulina lobatula*. The latter species, in its young parasitic condition, frequently constructs a perfect *nidus*, in the form of a convex tent-like covering of light-coloured sand, that may easily be mistaken for the test of some Lituoline organism, like *Webbina hemispherica* or *Placostilina vesicularis*. Many of the specimens of *Polysto-*

mella striatopunctata contained in these soundings had originally a thin coating of adherent sand. In all cases this sandy investment is easily removed, without mechanical interference beyond washing in warm water. Amongst the adherent arenaceous types a similar tendency may be observed. *Valvulina conica* is commonly surrounded at its base by an accumulation of fine sand, easily distinguished from the test itself by its colour; and the same is the case with certain true *Textulariæ*, of rough arenaceous texture, when found growing attached to other bodies. If the shell of any of these be detached, the sandy environment remains behind, showing that it has no real connexion with the proper test.

The following is a list of the species found, with notes on some of the more interesting and important forms. The numbers prefixed correspond with those in the Distribution Table.

CORNUSPIRA, Schultze.

1. *Cornuspira involvens*, Reuss.

Operculina involvens, Reuss, 1849, Denkschr. k. Akad. Wien, vol. i. p. 370, pl. xlv. fig. 20.

Cornuspira involvens, Reuss, 1863, Sitzungsb. k. Akad. Wien, vol. xlviii. p. 39, pl. i. fig. 2.

Very rare; represented by a few broken specimens.

BILOCULINA, D'Orbigny.

2. *Biloculina ringens*, Lamarck, sp.

Miliolites ringens, Lamarck, 1804, Ann. Mus. vol. v. p. 351, vol. ix. pl. xvii. fig. 1.

Very rare; the specimens are of long, oval form, scarcely typical.

3. *Biloculina bulloides*, D'Orbigny.

Biloculina bulloides, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 297, pl. xvi. figs. 1-4; Modèles, no. 90.

A single specimen in one of the soundings off Franz-Josef Land.

MILIOLINA, Williamson.

4. *Miliolina tricarinata*, D'Orbigny, sp.

Triloculina tricarinata, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 299. no. 7; Modèles, no. 94.

Very rare; occurs in only two of the soundings; specimens small and thin-shelled.

5. *Miliolina seminulum*, Linné, sp.

Serpula seminulum, Linné, 1767, Syst. Nat. 12th ed. p. 1264. no. 791.

Very rare in the more northern soundings, but abundant in the shallow water of the Matyushin Shar.

6. *Miliolina subrotunda*, Montagu, sp.

Vermiculum subrotundum, Montagu, 1803, Test. Brit. pt. 2, p. 521.

In the Matyushin Shar, very rare.

7. *Miliolina agglutinans*, D'Orbigny, sp.

Quinqueloculina agglutinans, D'Orbigny, 1839, Foram. Cuba, p. 168, pl. xii. figs. 11-13.

In shallow water, Matyushin Shar, rare.

SACCAMMINA, M. Sars.

8. *Saccammina sphaerica*, M. Sars.

Saccammina sphaerica, M. Sars, 1868, Vidensk.-Selsk. Forhandl. 1868, p. 248.

Very common in the soundings off Franz-Josef Land.

Saccammina sphaerica, in its typical condition, has a rough arenaceous test, subspherical or somewhat pyriform in contour, with a single orifice situate in a nipple-shaped protuberance; but in localities where the species is abundant the specimens often assume anomalous forms. Sometimes a number of these spherical chambers are adherent to each other, in which case they either have separate orifices and remain, in fact, independent organisms, or, as is more common, they open into each other and constitute a sort of polythalamous test. Occasionally a larger fragment of rock is built into the wall, and the test has the characters of an adherent species. Specimens in all these conditions exist where the individuals are crowded together at the sea-bottom, as, to judge by the samples, they must be in the area represented by the northernmost series of dredgings. Such variations from the typical form are purely the result of accident, and have no zoological significance.

The distinction between *Saccammina* and *Psammosphaera*, which depends upon the presence in the former genus of a general aperture, whilst *Psammosphaera* has none, but protrudes its pseudopodia through interstitial openings between the sand-grains which form the test, is far from satisfactory; for many specimens of undoubted *Saccammina* are found in dredged sands, like some of those from Franz-Josef Land, without any conspicuous general aperture. In polythalamous

specimens of this species the additional chambers are often smaller than the primordial one, and to some extent, therefore, supplementary; in such cases the sandy investment of the terminal sphere is often incomplete, and shows numerous large openings between the sand-grains.

PELOSINA, Brady.

9. *Pelosina variabilis*, Brady.

Pelosina variabilis, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 30, pl. iii. figs. 1-3.

Amongst the numerous chitino-arenaceous and muddy Rhizopod-tests found in No. 514 a (G) are some which are composed of a thickish layer of fine homogeneous mud with a chitinous lining. Unfortunately all the specimens are more or less broken; but the fragments are sufficiently large to leave no doubt that they belong to this species.

RHABDAMMINA, M. Sars.

10. *Rhabdammina abyssorum*, M. Sars.

Rhabdammina abyssorum, M. Sars, 1858, Vidensk.-Selsk. Forhandl. 1868, p. 248.

It is impossible to identify this species with certainty except by the central portion of the test, as the broken arenaceous arms, by themselves, cannot be distinguished from similar portions of several allied organisms. There are, however, two fragments that may be said, without any doubt, to belong to it. *Rhabdammina abyssorum* is very common in some parts of the North Atlantic; and Prof. G. O. Sars's researches suggested the idea that it might be found abundantly in this section of the eastern Polar Sea; its rarity therefore is probably due to insufficient depth of water.

HYPERAMMINA, Brady.

11. *Hyperammina elongata*, Brady.

Hyperammina elongata, Brady, 1878, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 433, pl. xx. fig. 2.

The specimens are small and rough, chiefly in fragments, only a few having the closed broad end entire. They closely resemble the examples obtained in the western Arctic seas. This species, or one nearly allied to it, attains a very large size in more southern latitudes.

12. *Hyperammina ramosa*, Brady.

Hyperammina ramosa, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 33, pl. iii. figs. 14, 15.

Small fragments of the branching variety of *Hyperammina* occur in three of the soundings; but in only one instance is the primordial chamber present. Owing to the thin brittle nature of the shell-wall, the organism is never found entire; but the tubes are usually identified without much difficulty, even in the absence of the primordial chamber.

PSAMMOTODENDRON, Norman (MS.).

13. *Psammotodendron arborescens*, Norman (MS.).

Amongst some Rhizopoda recently dredged by the Rev. A. M. Norman on the coast of Norway is a very remarkable arenaceous form growing like a little tree rooted on a piece of a Polyzoan. The main stem and branches are of nearly even diameter (about 0·07 millim.), cylindrical, compactly cemented, nearly smooth externally, and brown in colour. The ends of the branches are rounded, and have an irregularly shaped orifice with thickened lip. Amongst the arenaceous tubes of various sorts which occur in many of the soundings, a few of the minuter specimens may be recognized as pertaining to this or some very similar species, though they are but small fragments and give but little idea of the general character and appearance of the organism in its living condition*.

REOPHAX, De Montfort.

14. *Reophaax difflugiformis*, Brady.

Reophaax difflugiformis, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 51, pl. iv. fig. 3 a, b.

This is a common species in the far north, and has been found in nearly all the soundings. The specimens are of larger size and much rougher externally than that originally figured *loc. cit.* There appeared at first some question whether *Reophaax difflugiformis* was an independent species or only the first chamber of *R. scorpivorus*. The size of the test and its apparent completeness led to the conclusion that it was specifically distinct; but recently the question has been set at rest in another way. In one of the dredgings made by Sir Wyville Thomson, during the 'Knight-Errant' Expedition, in

* Since the presentation of this report my friend David Robertson, F.G.S., has obtained a beautiful series of specimens of *Psammotodendron arborescens* in dredgings off Cumbrae, on the west coast of Scotland.

the summer of 1880 (lat. 59° 37' N., long. 7° 19' W.), *R. difflugiformis* was found in abundance, whilst *R. scorpionurus* was entirely absent.

15. *Reophax fusiformis*, Williamson, sp.

Protonina fusiformis, Williamson, 1858, Rec. For. Gt. Br. p. 1, pl. i. fig. 1.

A starved variety of *R. scorpionurus*; occurs in the shallow water of the Matyushin Shar.

16. *Reophax scorpionurus*, De Montfort.

Reophax scorpionurus, De Montfort, 1808, Conchyl. Systém. vol. i. p. 330, 83^e genre.

Very common over the whole area.

17. *Reophax nodulosa*, Brady.

Reophax nodulosa, Brady, 1879, Quart. Journ. Micr. Sci. vol. xix. n. s. p. 52, pl. iv. figs. 7, 8.

Small specimens occur in most of the soundings on the shores of Franz-Josef Land; but it is absent from those further south. It is nevertheless a very widely distributed species, and specimens an inch (25 millim.) or more in length have been found in some of the 'Challenger' deep-water dredgings.

18. *Reophax arctica*, sp. nov. (Pl. XXI. fig. 2 a, b.)

Test elongate, tapering, often more or less irregular, compressed, only slightly constricted at the septal lines. Segments numerous; septation indistinct; aperture simple; walls arenaceous, very thin. Length 0·3 millim.

This is an exceedingly minute and obscure species, which may be regarded as the sandy isomorph of *Lingulina*. With the exception of a single specimen from Station 504, and one which had been previously recorded, without a specific name, from Capt. Markham's soundings, all the specimens are from Station 503; so that the distribution appears confined to the Novaya-Zemlya Sea.

HAPLOPHRAGMIUM, Reuss.

19. *Haplophragmium canariense*, D'Orbigny, sp.

Nonionina canariensis, D'Orbigny, 1839, Foram. Canaries, p. 128, pl. ii. figs. 33, 34.

A very widely distributed species; some of the more northern specimens are rougher and thicker-shelled than usual.

20. *Haplophragmium nanum*, Brady.
(Pl. XXI. fig. 1 *a, b, c.*)

Haplophragmium nanum, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi.
n. s. p. 50.

The commonest of all the smaller arenaceous forms, over the whole area represented by these soundings.

The Arctic specimens are rather smaller than those described from the 'Challenger' dredgings (*loc. cit.*), and seldom exceed 0.25 millim. in diameter; they are generally less convex on the superior surface and altogether somewhat thinner; but these are minor and very variable characters.

21. *Haplophragmium glomeratum*, Brady.

Lituola glomerata, Brady, 1878, Ann. & Mag. Nat. Hist. ser. 5, vol. i.
p. 433, pl. xx. fig. 1 *a, b, c.*

A minute species widely distributed in the North Atlantic and Arctic Oceans, but not common anywhere. It is more frequent in the Novaya-Zemlya Sea than further northwards.

22. *Haplophragmium subglobosum*, M. Sars, sp.

Lituola subglobosa, M. Sars, 1868, Vidensk.-Selsk. Forhandl. 1868,
p. 250.

Common at one station only, 514 *a* (G), where it flourishes in company with *Saccamina sphaerica*, *Reophax scorpiurus*, and other strong arenaceous types.

23. *Haplophragmium globigeriniforme*,
Parker & Jones, sp.

Lituola nautiloidea, var. *globigeriniformis*, Parker & Jones, 1864, Phil.
Trans. vol. clv. p. 407, pl. xv. figs. 46, 47, pl. xvii. figs. 96-98.

This occurs at five of the Franz-Josef Land stations, but in none of the more southern soundings. The specimens are few in number, and all extremely minute and thin-shelled.

AMMODISCUS, Reuss.

24. *Ammodiscus gordialis*, Jones and Parker, sp.

Trochammina squamata, var. *gordialis*, Jones & Parker, 1860, Quart.
Journ. Geol. Soc. Lond. vol. xvi. p. 304.

Represented only by single specimens from four stations.

TROCHAMMINA, Parker and Jones.

25. *Trochammina nitida*, Brady.

Trochammina nitida, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi. n. s. p. 52.

Very rare; only a single specimen from Franz-Josef Land, Station 518 (K), and one from the Matyushin Shar.

HIPPOCREPINA, Parker.

26. *Hippocrepina indivisa*, Parker.
(Pl. XXI. figs. 3 a, b, & 4.)

Hippocrepina indivisa, Parker, 1870, in Dawson's paper, 'Canadian Naturalist,' n. s. vol. v. p. 176, fig. 2.

This is an exceedingly interesting arenaceous type. The test is long, tapering to a point at the inferior extremity, broad and rounded at the superior end. The aperture is at the centre of the broad end, and is irregular in shape, often more or less curved so as to resemble a horseshoe. The shell-wall is thin, finely cemented, and smooth externally; the cavity of the shell is undivided. In colour it is brown at the inferior extremity, lighter near the apex. Length of full-sized specimens about 1.0 millim.; those from the Matyushin Shar are somewhat smaller.

Hippocrepina indivisa was originally found by Dr. G. M. Dawson in Gaspé Bay at a depth of from 16 to 20 fathoms (29 to 36 metres), and has since been dredged by the Rev. A. M. Norman in deeper water off the coast of Norway.

TEXTULARIA, DeFrance.

27. *Textularia agglutinans*, D'Orbigny.

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

Very rare, specimens minute and varying a good deal in contour, possibly belonging to more than one species.

SPIROPLECTA, Ehrenberg.

28. *Spiroplecta biformis*, Parker & Jones, sp.

Textularia agglutinans, var. *biformis*, Parker & Jones, 1864, Phil. Trans. vol. clv. p. 370, pl. xv. figs. 23, 24.

Moderately common and widely distributed.

VERNEUILINA, D'Orbigny.

29. *Verneuilina polystropha*, Reuss.

Verneuilina polystropha, Reuss, 1846, Verstein. böhm. Kreid. vol. ii. p. 109, pl. xxiv. fig. 53.

Common in Capt. Markham's material from the Matyushin Shar, but does not occur in any of the Austrian soundings.

BULIMINA, D'Orbigny.

30. *Bulimina subteres*, Brady.

Bulimina elegantissima, var., Brady, 1878, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 436, pl. xxi. fig. 12.

Bulimina subteres, Brady, 1881, Quart. Journ. Micr. Sci. vol. xxi. n. s. p. 55.

A single specimen of this species was found in the sounding from Station 500 (A). It somewhat resembles the *Robertina arctica* of D'Orbigny, but is stouter and has much fewer segments.

31. *Bulimina elegantissima*, D'Orbigny.

Bulimina elegantissima, D'Orbigny, 1839, Voyage dans l'Amér. Mérid. p. 51, pl. vii. figs. 13, 14.

Only found in one sounding, in which it is moderately common (No. 503, D); the specimens all very minute, thin-shelled, and delicate.

VIRGULINA, D'Orbigny.

32. *Virgulina Schreibersiana*, Czjzek.

Virgulina Schreibersiana, Czjzek, 1847, Haidinger's Naturw. Abhandl. vol. ii. p. 147, pl. xiii. figs. 18-21.

Tolerably common and generally distributed; many of the specimens have a shorter, stouter contour than the typical form.

BOLIVINA, D'Orbigny.

33. *Bolivina punctata*, D'Orbigny.

Bolivina punctata, D'Orbigny, 1839, Voyage dans l'Amér. Mérid. p. 63, pl. viii. figs. 10-12.

In the Novaya-Zemlya Sea; rare and small.

CASSIDULINA, D'Orbigny.

34. *Cassidulina levigata*, D'Orbigny.

Cassidulina levigata, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 282, pl. xv. figs. 4, 5; Modèles, no. 41.

Abundant; generally distributed.

35. *Cassidulina crassa*, D'Orbigny.

Cassidulina crassa, D'Orbigny, 1839, Voyage dans l'Amér. Mérid. p. 56, pl. vii. figs. 18-20.

Common over the whole area.

LAGENA, Walker & Jacob.

36. *Lagena globosa*, Montagu, sp.

Vermiculum globosum, Montagu, 1803, Testac. Brit. p. 523.

Novaya-Zemlya Sea, very rare.

37. *Lagena lævis*, Montagu, sp.

Vermiculum læve, Montagu, 1803, Testac. Brit. p. 524.

Widely distributed, specimens rare.

38. *Lagena apiculata*, Reuss.

Oolina apiculata, Reuss, 1850, Haidinger's Naturw. Abhandl. vol. iv. p. 22, pl. i. fig. 1.

Lagena apiculata, Reuss, 1862, Sitzungsab. k. Akad. Wien, vol. xlv. p. 319, pl. i. figs. 4-8, 10, 11.

Novaya-Zemlya Sea, very rare.

39. *Lagena gracillima*, Seguenza, sp.

Amphorina gracillima, Seguenza, 1862, Foram. Monotal. Mioc. Mess. p. 51, pl. i. fig. 37.

Novaya-Zemlya Sea, very rare.

40. *Lagena distoma*, Parker & Jones.

Lagena sulcata, var. *distoma*, Parker & Jones, 1865, Phil. Trans. vol. clv. p. 356, pl. xiii. fig. 20.

Novaya-Zemlya Sea, very rare.

41. *Lagena gracilis*, Williamson.

Lagena vulgaris, var. *gracilis*, Williamson, 1853, Rec. For. Gt. Br. p. 7, pl. i. figs. 12, 13.

Novaya-Zemlya Sea, very rare.

42. *Lagena semistriata*, Williamson.

Lagena striata, var. *β. semistriata*, Williamson, 1843, Ann. & Mag. Nat. Hist. ser. 2, vol. i. p. 14, pl. i. figs. 9, 10.

Novaya-Zemlya Sea, very rare.

43. *Lagena sulcata*, Walker & Jacob, sp.

Serpula (Lagena) sulcata, Walker & Jacob, 1798, Adams's Essays on the Microsc. 2nd ed. p. 634, pl. xiv. fig. 5.

Novaya-Zemlya Sea; a small number of specimens, generally distributed.

44. *Lagena striatopunctata*, Parker & Jones.

Lagena sulcata, var. *striatopunctata*, Parker & Jones, 1864, Phil. Trans. vol. civ. p. 350, pl. xiii. figs. 25-27.

Novaya-Zemlya Sea, very rare. This is a widely distributed North Atlantic and Arctic species, though the number of specimens is generally very small.

45. *Lagena squamosa*, Montagu, sp.

Vermiculium squamosum, Montagu, 1803, Testac. Brit. p. 526, pl. xiv. fig. 2.

Novaya-Zemlya Sea and Franz-Josef Land, very rare in both areas.

46. *Lagena lævigata*, Reuss, sp.

Fissurina lævigata, Reuss, 1849, Denkschr. k.-k. Akad. Wien, vol. i. p. 366, pl. xlvi. fig. 1.

Novaya-Zemlya Sea and Franz-Josef Land; very rare in both areas.

47. *Lagena tricincta*, Gumbel*.

Lagena tricincta, Gumbel, 1868, Abh. II. Cl. k. Akad. Wiss. vol. x. p. 606, pl. i. fig. 8, a, b.

Novaya-Zemlya Sea, very rare.

48. *Lagena lagenoides*, Williamson, sp.

Entosolenia marginata, var. *lagenoides*, Williamson, 1858, Rec. For. Gt. Br. p. 11, pl. i. figs. 25, 26.

Novaya-Zemlya Sea and Franz-Josef Land; very rare in both areas.

49. *Nodosaria radricula*, Linné, sp.

Nautilus radricula, Linné, 1767, Syst. Nat. 12th ed. p. 1164, p. 285.

Widely distributed, but the number of specimens very small.

50. *Nodosaria (Dentalina) pauperata*, D'Orbigny.

Dentalina pauperata, D'Orbigny, 1846, For. Foss. Vien. p. 46, pl. i. figs. 57, 58.

One or two fine specimens from Franz-Josef Land.

* I find that Prof. Seguenza has figured this form under the name *Fissurina Orbignyana*, Foram. Monot. Mioc. Mess. 1862, p. 67, pl. ii. figs. 25, 26; his specific term therefore takes precedence.

51. *Nodosaria (Dentalina) mucronata*, Neugeboren.

Dentalina mucronata, Neugeboren, 1856, Denkschr. k. Akad. Wiss. Wien, vol. xii. p. 83, pl. iii. figs. 8-11.

A single broken specimen of this species was found in the sounding No. 514 a, off Franz-Josef Land.

POLYMORPHINA, D'Orbigny.

52. *Polymorphina lactea*, Walker & Jacob, sp.

Serpula lactea, Walker & Jacob, 1798, Adams's Essays, 2nd ed. p. 634, pl. xxiv. fig. 4.

Novaya-Zemlya Sea; very rare, specimens minute.

53. *Polymorphina oblonga*, D'Orbigny.

Polymorphina oblonga, D'Orbigny, 1846, For. Foss. Vien. p. 232, pl. xii. figs. 29-31.

A single characteristic specimen and one or two fragments from the Novaya-Zemlya Sea.

54. *Polymorphina compressa*, D'Orbigny.

Polymorphina compressa, D'Orbigny, 1846, For. Foss. Vien. p. 233, pl. xii. figs. 32-34.

One specimen from the Matyushin Shar.

UVIGERINA, D'Orbigny.

55. *Uvigerina pygmæa*, D'Orbigny (var.).

Uvigerina pygmæa, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 269, pl. xii. figs. 8, 9; Modèles, no. 67.

Sparingly distributed over the whole area; very rare off Franz-Josef Land. All the specimens are of the Arctic variety (*vide* Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 435, pl. xx. fig. 7 a, b), an intermediate form partaking more or less of the characters of *U. angulosa*, Will. They differ from the typical *U. pygmæa* in the partial nature of the surface-ornamentation, and in their tendency to assume a more elongate and subangular shape. These, however, are very variable characters, indicating rather the different life-conditions of a polar climate than any specific distinction; and as we proceed southwards the specimens gradually assume the normal form.

GLOBIGERINA, D'Orbigny.

56. *Globigerina bulloides*, D'Orbigny.

Globigerina bulloides, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 277. no. 1; Modèles, no. 17 & 76.

Minute specimens of the typical *Globigerina bulloides* are found in many of the soundings, especially in those of the more southern series; but the small, compactly built, subspherical variety for which I have proposed the trivial term "*borealis*"* is comparatively common over the whole area. This has been figured as the "Arctic variety of *Globigerina bulloides*," in the Ann. & Mag. Nat. Hist. ser. 5, vol. i. pl. xxi. fig. 10 *a, b, c*; and a further notice of it is now in the press. It prevails, sometimes to the exclusion of the typical form, in the cold area of the North-Atlantic and in some parts of the Arctic Ocean; but there is quite sufficient evidence to show that its morphological peculiarities are merely the result of climatal conditions. Under these circumstances no attempt has been made to separate the *type* from the *variety* in the Distribution Table. In some of the soundings both forms occur, as well as specimens with intermediate characters.

ORBULINA, D'Orbigny.

57. *Orbulina universa*, D'Orbigny.

Orbulina universa, D'Orbigny, 1839, Foram. Cuba, p. 35, pl. i. fig. 1. Novaya-Zemlya Sea, rare.

PULLENIA, Parker & Jones.

58. *Pullenia sphaeroides*, D'Orbigny, sp.

Nonionina sphaeroides, D'Orbigny, 1826, Ann. Sci. Nat. vol. vii. p. 293. no. 1; Modèles, no. 43.

In one of the soundings of the Novaya-Zemlya Sea (No. 500, A) this species is not uncommon; but it has not been found in any of the others.

PATELLINA, Williamson.

59. *Patellina corrugata*, Williamson.

Patellina corrugata, Williamson, 1858, Rec. For. Gt. Br. p. 46, pl. iii. figs. 86-89.

Novaya-Zemlya Sea, very rare.

* In a report upon the Foraminifera obtained on the cruise of the 'Knight Errant' in the summer of 1880, not yet published.

DISCORBINA, Parker & Jones.

60. *Discorbina Bertheloti*, D'Orbigny, sp.

Rosalina Bertheloti, D'Orbigny, 1839, Foram. Canaries, p. 135, pl. i. figs. 28-30.

Novaya-Zemlya Sea, Station 500 (A); very rare. The specimens all very small, and similar in character to those found off the Shetland Islands and at some other points to the north of Great Britain.

61. *Discorbina Wrightii*, sp. nov.

(Pl. XXI. fig. 6 a, b, c.)

Discorbina parisiensis, Wright (in part), 1877, Proc. Belfast Nat. Field-Club, 1876-77, App. p. 105, pl. iv. fig. 2 a, b, c.

Test free, trochoid; superior surface subconical; inferior flat; peripheral margin subangular or somewhat rounded, very slightly excavated at the sutural lines. The shell consists of about three convolutions, the whole of which are visible on the superior surface, the final one only on the inferior. Inferior surface ornamented with beaded lines radiating from the umbilicus. Segments numerous, seven or eight in the final convolution; septation of the earlier portion indistinct. Diameter $\frac{1}{50}$ inch (0.5 millim.).

Mr. Wright, in his careful paper on the "Recent Foraminifera of Down and Antrim" (*loc. cit.*), describes and figures certain small *Discorbinae* occurring in shallow water in the north of Ireland under the general name of *D. parisiensis*, D'Orb. The figures represent two varieties, differing considerably in contour and in minor characters, which there was reason to think were only individual modifications of the same species. Of the close affinity of the two there can be no question; and that the thinner specimens have all the essential characters of D'Orbigny's Modèle no. 38 is equally beyond doubt; but further research has led to the conclusion that it will be convenient to recognize the conical form, which is more particularly an inhabitant of northern seas, by a distinctive term; and under these circumstances it is proper to associate Mr. Wright's name with the species.

Discorbina Wrightii is very rare in the Novaya-Zemlya Sea; and a single young specimen has been found in the Matyushin Shar. It is not uncommon on the north-eastern coast of Ireland, and is occasionally met with in deeper water in the North Atlantic.

TRUNCATULINA, D'Orbigny.

62. *Truncatulina lobatula*, Walker & Jacob, sp.

Nautilus lobatulus, Walker & Jacob, 1798, Adams's Essays, 2nd ed. p. 642, pl. xiv. fig. 36.

Common over the whole area.

PULVINULINA, Parker & Jones.

63. *Pulvinulina Karsteni*, Reuss, sp.

Rotalia Karsteni, Reuss, 1855, Zeitschr. deutsch. geol. Gesellsch. vol. vii. p. 273, pl. ix. fig. 6.

Abundant both in the Novaya-Zemlya Sea and off Franz-Josef Land.

NONIONINA, D'Orbigny.

64. *Nonionina depressula*, Walker & Jacob, sp.

Nautilus depressulus, Walker & Jacob, 1798, Adams's Essays, 2nd ed. p. 641, pl. xiv. fig. 33.

Franz-Josef Land, not uncommon; Novaya-Zemlya Sea, rare.

65. *Nonionina umbilicatula*, Montagu, sp.

Nautilus umbilicatulus, Montagu, 1803, Testac. Brit. p. 191, 1808, Suppl. p. 78, pl. xviii. fig. 1.

Distributed over the whole area.

66. *Nonionina turgida*, Williamson, sp.

Rotalina turgida, Williamson, 1858, Rec. For. Gt. Brit. p. 50, pl. iv. figs. 95-97.

Novaya-Zemlya Sea, very rare. Only a single specimen in sounding No. 500 (A).

67. *Nonionina scapha*, Fichtel & Moll, sp.

Nautilus scapha, Fichtel & Moll, 1803, Testac. Micr. p. 105, pl. xix. figs. d-f.

A characteristic form in the Novaya-Zemlya Sea; specimens large and abundant, often with very thick terminal chamber, like *N. labradorica*, Dawson.

68. *Nonionina stelligera*, D'Orbigny.

Nonionina stelligera, D'Orbigny, 1839, Foram. Canaries, p. 128, pl. iii. fig. 12.

Widely distributed, especially in the southern area, but the specimens not numerous.

69. *Nonionina orbicularis*, sp. nov. (Pl. XXI. fig. 5 a, b.)

Test symmetrical, nautiloid, subglobular, somewhat compressed, convex or slightly umbonate at the umbilici; peripheral margin more or less lobulate. Segments numerous, about ten in the final convolution; sutural lines somewhat excavated, especially near the umbilici. Aperture arcuate, either simple or divided by projections from the upper margin. Diameter 0.5 millim.

This species resembles *N. pompilioides* in its subspherical contour, but may be distinguished by its larger number of segments and their less regular disposition, as well as by the thickened umbilici. The aperture is frequently subdivided by cross bars of shell, suggesting its affinity with the weaker forms of *Polystomella*.

Nonionina orbicularis only occurs in one of the soundings, No. 502 (C); but a number of specimens, of somewhat larger size than those now described (0.75 millim.), have been obtained from the 'Porcupine' dredgings in the North Atlantic.

POLYSTOMELLA, Lamarck.

70. *Polystomella arctica*, Parker & Jones.

Polystomella crista, var. *arctica*, Parker & Jones, 1865, Phil. Trans. vol. clv. p. 401, pl. xiv. figs. 25-30.

Widely distributed; the specimens large and abundant in many of the soundings.

71. *Polystomella striatopunctata*, Fichtel & Moll, sp.

Nautilus striatopunctatus, Fichtel & Moll, 1803, Testac. Micr. p. 61, pl. ix. figs. a-c.

Abundant over the whole area.

In addition to the species which have been enumerated, there are a few specimens concerning which it is impossible to speak with certainty. One of these is a minute or young *Cristellaria*; another is probably a worn example of *Lagena hispida*. But in the absence of well-defined examples these and other doubtful forms have been excluded from the list.

Supplementary Note on some Foraminifera from Soundings obtained by Capt. A. H. Markham, R.N., on the Shores of Novaya Zemlya in 1879.

From a region so difficult of access, and on a subject concerning which so little has hitherto been known, every addi-

tion to the common fund of knowledge is welcome; and each instalment, however small and fragmentary in itself, serves to fill a vacant place. Under these circumstances a few soundings made by Capt. Markham on the shores of Novaya Zemlya possess considerable interest; and as they refer to an area contiguous to that embraced by the southern section of the Austro-Hungarian series, the details of their examination supply a fitting supplement to the present report.

The material consists of eleven samples of the sea-bottom; but the quantity is in every case very small. The lists of species therefore cannot be regarded as even approximately complete, though they serve *collectively* to indicate the general aspect of the Rhizopod fauna.

Four of the soundings contained no Foraminifera; and of these, three showed no evidence of animal or vegetable life of any sort; the remaining seven were labelled as follows:—

1. "Soundings, 10 fathoms, Matyushin Shar, June 21st, 1879."

2. "Soundings, 10 fathoms, Matyushin Shar, June 24th."

3. "Soundings (no depth given), Cairn Bay, Matyushin Shar."

4. "Soundings, 15 fathoms, north side Matyushin Shar, July 28th."

These four samples may be considered collectively as representing the bottom-fauna of the Matyushin Shar at a depth of from 10 to 15 fathoms. The sample without memorandum of depth differs in no particular from the rest. The Matyushin Shar or Matotschkin Schar is the strait dividing the two islands that together form Novaya Zemlya, the latitude being about 73° N.

Mineralogically the soundings were very much alike. They were dark-coloured more or less muddy sands, consisting of flattish felspathic grains, with a small proportion of white angular siliceous particles. Foraminifera were present in all four specimens, but abundant in none; there were also a few Ostracoda and small fragments of Polyzoa, Ophiurids, and Echinoderms.

The following is a revised list of the Foraminifera obtained from them:—

Cornuspira involvens, *Reuss*.

Biloculina ringens, *Lamk*.

Miliolina seminulum, *Linné*.

— *agglutinans*, *D'Orb*.

Hippocrepina indivisa, *Parker*.

Hyperammia elongata, *Brady*.

Reophax nodulosa, *Brady*.

Reophax fusiformis, *Will*.

— *arctica*, *Brady*.

Haplophragmium canariense,
D'Orb.

— *nanum*, *Brady*.

Trochammina nitida, *Brady*.

Verneuilina polystropha, *Reuss*.

Polymorphina compressa, <i>D'Orb.</i>	Pulvinulina Karsteni, <i>Reuss.</i>
Cassidulina lævigata, <i>D'Orb.</i>	Nonionina umbilicatala, <i>Mont.</i>
— crassa, <i>D'Orb.</i>	— stelligera, <i>D'Orb.</i>
Discorbina Wrightii, <i>Brady.</i>	Polystomella striatopunctata, <i>F.</i>
Truncatulina lobatula, <i>W. & J.</i>	& <i>M.</i>

The three remaining soundings are from somewhat greater depths; and their examination has yielded but a poor list of species. Whether this arises from the smaller quantity of material secured, or from the less plentiful distribution of animal life, may be difficult to decide; but the former is the more probable explanation.

5. "Soundings, June 19th, lat. 73° 10' N., long. 50° E. Depth 30 fathoms." Clean siliceous sand with dark felspathic grains; contained but little evidence of animal life. There were a few Rhizopoda, belonging to half a dozen species, namely:—

Miliolina seminulum, <i>Linné.</i>	Nonionina scapha, <i>F. & M.</i>
Verneuilina polystropha, <i>Reuss.</i>	Polystomella striatopunctata, <i>F.</i>
Truncatulina lobatula, <i>W. & J.</i>	& <i>M.</i>
Pulvinulina Karsteni, <i>Reuss.</i>	

6. "Soundings, lat. 70° 45' N., long. 47° E. Depth 80 fathoms." The material in this case consisted only of a pellet of mud weighing about 0·3 gramme, which, after washing, left scarcely any residuum. This, however, yielded specimens of two arenaceous species:—

Haplophragmium glomeratum, <i>Brady.</i>	Haplophragmium nanum, <i>Brady.</i>
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7. "Soundings, lat. 74° 16' N., long. 53° 50' E. Depth 90 fathoms." Quantity of material not much greater than the last, contained the following forms:—

Haplophragmium glomeratum, <i>Brady.</i>	Nonionina stelligera, <i>D'Orb.</i>
Cassidulina crassa, <i>D'Orb.</i>	— scapha, <i>F. & M.</i>

The only species of unusual interest contained in these lists is *Hippocrepina indivisa*, concerning which a note will be found on a previous page (p. 407). The specimens of *Nonionina scapha* often approach in character the variety named by Dawson *N. labradorica*. It is frequently difficult to decide whether some of the flat outspread *Nonioninae* are more correctly placed with *N. asterizans*, *F. & M.*, or *N. stelligera*, *D'Orb.*; but as the distinction between the two depends primarily on the extent to which the stellate sutural limbation is developed (a comparatively trivial character), they have been associated with similar specimens from the more northern stations under the latter species.

These lists collectively furnish the final column (Q) of the Distribution Table.

POLYZOA.

A few of the soundings contained specimens of Polyzoa in more or less fragmentary condition. These have been identified by my good friend the Rev. A. M. Norman as follows:—

- No. 500. *Menipea arctica*, Busk.
Crisia eburneo-denticulata, Busk.

In this sounding, and also in No. 516, there are examples of a very interesting simple form, the type of an undescribed genus.

- No. 514 a. *Idmonea atlantica*, Forbes.
Crisia eburneo-denticulata, Busk.
 No. 515. *Crisia eburneo-denticulata*, Busk.
 No. 525. *Lepralia Jeffreysii*, Norman.
Idmonea atlantica, Forbes.
Hornera lichenoides, Linné.

EXPLANATION OF PLATE XXI.

- Fig. 1.* *Haplophragmium nanum*, Brady, magnified 120 diam.: *a*, superior lateral aspect; *b*, inferior lateral aspect; *c*, periphero-lateral aspect.
Fig. 2. *Reophax arctica*, Brady, magnified 120 diam.: *a*, lateral aspect; *b*, end view, with aperture.
Figs. 3, 4. *Hippocreptina indivisa*, Parker, magnified 60 diam.: *a*, lateral aspect; *b*, end view, with aperture. 4. Section, showing the interior.
Fig. 5. *Nonionina orbicularis*, Brady, magnified 65 diam.: *a*, lateral aspect; *b*, periphero-lateral aspect.
Fig. 6. *Discorbina Wrightii*, Brady, magnified 85 diam.: *a*, superior lateral aspect; *b*, inferior lateral aspect; *c*, periphero-lateral aspect.
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XLI.—On certain Points in the Morphology of the Blastoidea.

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SINCE the appearance of the classical memoir by Römer scarcely any attention has been paid upon this side of the Atlantic to the morphology of the Blastoidea. In America, however, the case has been very different. White, Shumard, Billings, Lyon, Hall, Meek and Worthen, and various other