

Larger agglutinated foraminifera from the Faeroe Channel and Rockall Trough collected by W. B. Carpenter

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ABSTRACT—The Carpenter collection contains numerous slides of larger agglutinated foraminifera from the Faeroe Channel area. These have been re-identified during the preparation of a catalogue. The Faeroe Channel has a cold bottom water mass to the north (temperature $\sim 0^{\circ}\text{C}$) overlying sandy sediment with few larger agglutinated foraminifera, and a somewhat warmer water mass to the south (temperature $> 2^{\circ}\text{C}$) overlying carbonate ooze with a diverse fauna of larger agglutinated foraminifera.

INTRODUCTION

In 1844 Edward Forbes had put forward the view that life would not be found below 300 fathoms ($\sim 550\text{ m}$) in the oceans. However, not all the marine scientists of the time believed this to be correct and sampling was extended into deeper water to test the hypothesis. In 1868, the Swedish Government Inspector of Fisheries, Mr. M. Sars, dredged to a depth of 300 fms off the Lofoten Islands and recovered abundant animal life. This was shown to Prof. Wyville Thomson of Belfast during a visit to Norway. On May 30th 1868 he wrote to Dr. W. B. Carpenter suggesting a programme of research into deep sea life.

“I have little doubt that it is quite practicable, with a small heavy dredge, and a couple of miles of stout Manilla rope, to dredge to a depth of 1000 fathoms.” (Carpenter, 1869, p. 199). Carpenter wrote to the President of the Royal Society on June 18th 1868 to seek help from the Admiralty and on July 14th he received a letter from the Admiralty telling him that the steam-vessel ‘*Lightning*’ was being prepared immediately for their use and the cruise took place during August and September of that year.

The area selected for study was the Faeroe Channel. Surface and bottom water temperature readings were made at 16 stations, the depth ranging from 60 to 650 fms (110 to 1189 m). Dredging was also carried out and that at 650 fms was the deepest ever taken. In their preliminary results Carpenter (1869) reported the presence of life to 650 fms, the existence of cold bottom water to the north of the Faeroe Ridge (now the Wyville-Thomson Ridge) and warm bottom water to the south, and he suggested that the distribution of life was controlled more

by water temperature than by depth or substrate. He also drew comparisons between deep sea ooze and Cretaceous chalk. The geological consequences of these observations were regarded with some excitement, and a programme of further research formed the concluding remarks in the Preliminary Report. Carpenter also wrote “I shall myself lose no time in preparing an account of the *Rhizopods* we have collected . . .”

In the summer of 1869, the Admiralty made available H.M. Surveying-Vessel ‘*Porcupine*’ to continue the research. The area examined was extended to include Rockall Bank, Rockall Trough, and the west margin of the British Isles. (Carpenter *et al.*, 1870). Bottom, surface, and serial water temperature measurements were made together with chemical analyses and samples of sediment were dredged from 90 stations. Much of the report is by Carpenter on the physics and chemistry of the water. The presence of a cold bottom water mass to the north of the Wyville Thomson Ridge was confirmed as was the warm water mass to the south. It was recognised that “. . . a general interchange of Equatorial and Polar waters is continually taking place in the great Oceanic Basins.” (*ibid.*, p. 454). This was further elaborated (*ibid.*, p. 472):

1) The movement of a vast body of *warm* water, extending to a depth of several hundred fathoms, in a northeast direction, which moderates the cold of the Boreal area by bringing into it the warmth of that vast expanse of the North Atlantic Ocean which is heated beneath the Tropical sun.

2) The existence of a flow of *ice-cold* water, at depths greater than 300 fathoms, in a southwest direction along the floor of the channel between the North of Scotland

and the Faeroe Islands, which contributes, with other frigid streams from the Arctic basin, to diffuse over the North Atlantic sea-bed, at depths greater than 1000 fathoms, a temperature below 39°, ranging downwards with increase of depth to about 35°. (i.e., 4° to 2.7° C). Thus, an important contribution was made to understanding the complexities of oceanic circulation.

The narrative of the *Porcupine* cruises includes many references to the occurrence of Foraminifera. Agglutinated forms were abundant together with miliolids and large and diverse 'Cristellariae', i.e. Nodosariaceans. All these characterised the Globigerina ooze of the warm area; the sandy bottom of cold area yielded few larger Foraminifera. In the area intermediate between the two (*Porcupine* sta. 51 (Fig. 1)) there were large numbers of the tubes of *Botellina* (*ibid.*, 1870, p. 444).

Although Carpenter published a succession of papers on Foraminifera throughout the period 1870 to 1885, he never gave any detailed results from either the *Lightning* or *Porcupine* cruises to the Faeroe area. However, his collection of agglutinated Foraminifera was made available to H. B. Brady who used it in the preparation of the "Report on the Foraminifera dredged by H.M.S. Challenger, during the years 1873–1876" (Brady, 1884). In addition, Brady received unwashed samples of dried sediment from the *Porcupine* cruise from the Rev. A. Norman. Nuttall (1927, 1931) compiled a list of localities for material illustrated by Brady (1884) from an examination of the Brady collection of slides. It must be assumed that in the cases where *Lightning* or *Porcupine* material was preserved in the Brady collection, Brady had mounted his own specimens. However, a number of illustrated specimens are not represented by slides in the Brady collection and in some cases this was because Carpenter's slides were used (see Murray & Taplin, 1984).

The Carpenter Collection of Foraminifera is housed in the Royal Albert Memorial Museum, Exeter (Murray, 1971). A catalogue has been compiled and copies have been deposited in the British Museum (Natural History) and the Linnean Society (Murray & Taplin, 1984). The *Lightning* and *Porcupine* material has been revised taxonomically mainly with reference to Barker (1960) and Loeblich & Tappan (1964). Carpenter worked only with larger material and few of the specimens are smaller than 1 mm but because he processed a large volume of sediment there are many specimens of large, rare Foraminifera. This gives the collection particular interest and makes further study worthwhile.

RE-EXAMINATION OF THE CARPENTER MATERIAL

The *Porcupine* slides are labelled 263/1903, 1–156 and the *Lightning* slides 252–287. It is not known whether the number of specimens mounted reflects their true

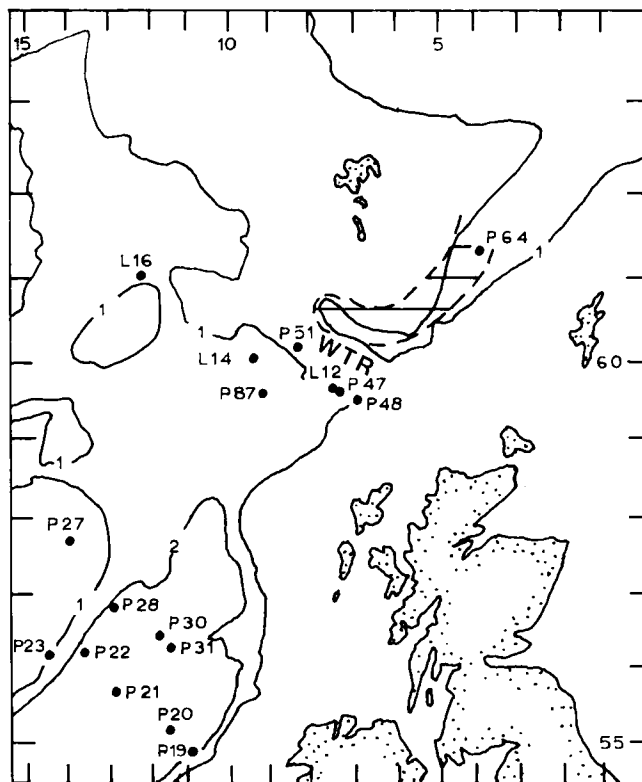


Fig. 1. Position of the *Lightning* and *Porcupine* sampling stations and the extent of cold and warm water (based on Lee & Ramster, 1981, pl. 2.05).

abundance in the dredge samples. Only *Porcupine* sta. 64 is in the cold area. In Table 1 the records are based on the presence or absence of the taxa. Additional data from Brady (1882) and Pearcey (1890) have been included for the cold area. Pearcey clearly looked at a smaller size fraction than that used by Carpenter and he records the following additional species in the cold area: *Saccammina socialis*, *Hyperammina elongata*, *Reophax fusiformis*, *R. scorpiurus*, *R. dentaliniformis*, *R. guttifera*, *Haplophragmoides canariensis*, *H. latidorsatum*, *H. mananum*, *Placopsilina vesicularis*, *Webbina hemispherica*, *Textularia sagittula*, *Gaudryina pupoides* and *G. rugosa*.

The main point to be emphasised is that larger agglutinated foraminifera are rare in the cold area (Carpenter *et al.*, 1870; Brady, 1881; Pearcey, 1890).

There is some confusion surrounding the distribution of *Reophax sabulosa*. This was said by Brady (1882, p. 710) to be present at *Knight Errant* sta. 8 (cold area, "... only previously known by specimens from one of the '*Porcupine*' stations." However, in the Carpenter collection, the four slides of this species are labelled *Lightning*. No station number is given but the depths and bottom temperatures are given for three. In each case the depth is 530 fm. In one case the temperature is given

Table 1. Occurrence of agglutinated foraminifera in the Faeroe Channel in the Carpenter collection

Name	cold	warm	Name	cold	warm
AMMODISCACEA			LITUOLACEA		
<i>Ammolagena clavata</i>		X	<i>Alveolophragmium subglobosum</i>	X	X
<i>Astrorhiza arenaria</i>	X	X	<i>Ammobaculites agglutinans</i>		X
<i>Bathysiphon crassatina</i>	X		<i>Aschemonella ramuliformis</i>		X
<i>Bathysiphon discreta</i>		X	<i>Aschemonella scabra</i>		X
<i>Bathysiphon filiformis</i>		X	<i>Cyclammina cancellata</i>		X
<i>Botellina labyrinthica</i>	P	X	<i>Discammina compressa</i>		X
<i>Crithionina pisum</i> v. <i>hispida</i>		X	<i>Hormosina carpenteri</i>		X
<i>Hyperammina cylindrica</i>		X	<i>Hormosina globulifera</i>		X
<i>Hyperammina friabilis</i>		X	<i>Hormosina normani</i>		X
<i>Marsipella cylindrica</i>	P?	X	<i>Karrieriella novangliae</i>		X
<i>Marsipella elongata</i>		X	<i>Martinottiella communis</i>		X
<i>Pelosina rotundata</i>		X	<i>Reophax agglutinatus</i>		X
<i>Psammosphaera fusca</i>		X	<i>Reophax distans</i>	P	X
<i>Rhabdammina abyssorum</i>		X	<i>Reophax pilulifer</i>		X
<i>Rhabdammina linearis</i>		X	<i>Reophax sabulosus</i>	B	X
<i>Rhizammina algaeformis</i>		X	<i>Textularia agglutinans</i>		X
<i>Rhizammina indivisa</i>		X	<i>Tritaxilina caperata</i>		X
<i>Saccammina sphaerica</i>	P	X	<i>Trochammina globigeriniformis</i>	P	X
<i>Saccorhiza ramosa</i>	P, B	X	<i>Trochammina squamata</i>		X
<i>Storthosphaera albida</i>		X	<i>Vulvulina pennatula</i>		X
<i>Tholosina vesicularis</i>		X			
<i>Thurammina papillata</i>	P, B	X			
<i>Tolypammina vagans</i>		X			

(P = Pearcey, 1890; B = Brady, 1882)

as 32°, in another 32° has been crossed out and 47° added, and in the third the temperature is given as 47°. The depth suggests *Lightning* sta. 12 (warm area) and the 32° temperature suggests sta. 8 (cold area). However, from the narrative (Carpenter, 1870, p. 172) it is clear that bad weather prevented sampling at sta. 8. So the *Lightning*. No station number is given but the depths and warm area, perhaps sta. 12. There are no records from the *Porcupine* samples. In the 'Challenger' Report, Brady (1884) states that the species is known only from the cold area of the Faeroe Channel and that the illustrated specimens are from the *Lightning* cruise. Furthermore, he notes that the *Knight Errant* material came from "near the same spot". But the position of *Knight Errant* sta. 8 is close to *Lightning* sta. 8 from which no sample was obtained! Perhaps the species occurs in both cold and warm areas.

Botellina labyrinthica is known only from *Porcupine* sta. 51, said by Carpenter (1869) to be on the border line between the warm and cold areas. (The records from shallow waters, quoted by Cushman, 1920, are very doubtful).

DISCUSSION

The general absence of larger agglutinated foraminifera from northern polar areas is confirmed by recent results from the Norwegian–Greenland Sea (Belanger & Streeter, 1980) and the Arctic Ocean (Green, 1960; Lagoe, 1977, 1979) although these authors had only small samples to work with. The causes of their absence are not known. Detrital material is readily available so this cannot be a limiting factor. Low water temperature is the obvious explanation but there is no proof that this is correct.

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REFERENCES

- Barker, R.W. 1960. Taxonomic notes on species figured by H.B. Brady in his Report on the Foraminifera dredged by H.M.S. Challenger during the years 1873–1876. *Soc. Econ. Pal. Min., Spec. Publ.*, **9**, 238 pp.
- Belanger, P.E. & Streeter, S.S. 1980. Distribution and ecology of benthic Foraminifera in the Norwegian–Greenland Sea. *Mar. Micropal.*, **5**, 401–428.
- Brady, H.B. 1884. Report on the scientific results of the Voyage of H.M.S. Challenger during the years 1873–1876. *Rept. Voy. Challenger, Zool.*, **9**, 1–814, 115 pls.
- Carpenter, W.B. 1869. Preliminary report of dredging operations in the seas to the north of the British Islands, carried on in Her Majesty's Steam-Vessel 'Lightning' by Dr. Carpenter and Dr. Wyville Thomson, Professor of Natural History in Queen's College, Belfast. *Proc. R. Soc.*, London, **17**, 168–200.
- Carpenter, W.B., Jeffreys, J.G., & Thomson, W. 1870. Preliminary report of the scientific exploration of the deep sea in H.M. Surveying-Vessel 'Porcupine' during the summer of 1869. *Proc. R. Soc.*, London, **18**, 397–492.
- Cushman, J.A. 1920. The Foraminifera of the Atlantic Ocean. Part 2 Lituolidae. *Bull. U.S. nat. Mus.*, **104**, 1–111.
- Green, K.E. 1960. Ecology of some Arctic Foraminifera. *Micropalaeontology*, New York, **6**, 57–78.
- Lagoe, M.B. 1977. Recent benthic foraminifera from the central Arctic Ocean. *J. foramin. Res.*, **7**, 106–129.
- Lagoe, M.B. 1979. Recent benthonic foraminiferal biofacies of the Arctic Ocean. *Micropalaeontology*, New York, **25**, 214–224.
- Lee, A.J. & Ramster, J.W. 1981. *Atlas of the Seas around the British Isles*. Ministry of Agriculture, Fisheries and Food, Lowestoft, England.
- Loeblich, A.R. Jr. & Tappan, H. 1964. In Moore, R.C. (Ed.), *Treatise on Invertebrate Paleontology, Pt. C, Sarcodina chiefly "Thecamoebians" and Foraminiferida*, vol. 1 & 2, 900 pp. Univ. Kansas Press.
- Murray, J.W. 1971. The W.B. Carpenter Collection. *Micropalaeontology*, New York, **17**, 105–106.
- Murray, J.W. & Taplin, C.M. 1984. The W.B. Carpenter Collection of Foraminifera. *J. micropalaeontol.*, London, **3**(1).
- Nuttall, W.L.F. 1927. The localities whence the foraminifera figured in the Report of H.M.S. 'Challenger' by Brady were derived. *Ann. Mag. nat. Hist.*, (9), **19**, 209–241.
- Nuttall, W.L.F. 1931. Additional localities of the 'Challenger' Foraminifera. *Contr. Cushman Lab. foram. Res.*, **7**, 46–47.
- Pearcey, F.G. 1890. Notes on the Foraminifera of the Faeroe Channel and Wyville Thomson Ridge, with a description of a new species of *Hyperammina*. *Trans. nat. Hist. Soc. Glasgow*, **2**, 163–179.