

Report on the Distribution of the Microplankton. By L. R. Crawshay. (*Report on the work carried out by the ss. "Scotia," 1913. (Pages 68-126, Plates 23-35.) H.M. Stationery Office, London. 1914.*)

THE purpose of the *Scotia* Expedition to the North Atlantic in 1913 having been to study the movement and distribution of the ice in the region of the Labrador Current, the subject of the Report on the plankton investigations concerns the distribution of the microplankton, especially the Diatoms, as regulated by the Labrador Current on the one hand, and by the warm Atlantic water on the other.

The area of investigation extended roughly between 44° and 55° N., and between about 44° W. and the coastal water to the westward.

The species dealt with are very largely neritic forms, characteristic of the polar water, and the distribution of these as contrasted with that of certain oceanic species, especially *Rhizosolenia styliformis*, was found to conform very closely with the distribution of the Labrador water as ascertained by the hydrographic observations. Among the species considered, a third class is distinguished as "intermediate" species, as including those which possess a wider hydrographic range, and of which the hydrographic relations are of chief importance in their bearing on secondary details. Such importance have the distribution of the Peridinidæ in the month of July, after the decline of the neritic Diatoms, and the distribution of *Ceratium arcticum* as compared with that of *C. longipes*.

The report is divided into two sections, dealing with the surface and vertical distribution respectively of the species considered.

The first section is illustrated by a series of charts showing the distribution, as observed over four periods between April and July, of certain of the more important species. These four periods correspond with those observed by Mr. Matthews in the construction of his charts of the physical conditions, with which the plankton charts may therefore be directly compared.

Up till the end of June, the seaward boundary of the neritic species was found to follow, north of the Grand Banks, approximately the 34.50 isohaline and an isotherm somewhat above 4°. Outside the 34.70 isohaline and the 5° isotherm they were only recorded in a single instance, in an isolated patch of 34.50 water, and the whole of this region was tenanted by an abundance of *Rhizosolenia styliformis*, in company with

other oceanic species. In the region of the Flemish Cap the neritic species were found spreading out more irregularly to the eastward, to a considerable distance outside the Cap, their distribution between the latter point and the eastern edge of the Banks being much confused with that of the oceanic species. Here also the hydrographic limits of the neritic species were about 34.50 and 5°, though the isohalines and isotherms were very irregular in this region. The southern boundary of the neritic species referable to the Labrador water could not be definitely ascertained, but so far as the investigations extended they were found to be confused with oceanic species along a line between Cape Race and the south-eastern border of the Banks from April onwards.

In the beginning of July, the seaward boundary of the neritic species, north of about 50° N., showed only a slightly more westerly position than was observed in the middle and latter part of June. The most important change during this month concerned the entire disappearance of the neritic Diatoms from the surface water of the northern half of the Banks, and for some distance outside their northern edge, the species being nowhere abundant south of 50° N. The Diatoms were found to be superseded by an abundance of Peridinidæ and other forms, notably Tintinnidæ, the species, however, including also *Ceratium arcticum*, which is generally characteristic of the true Labrador water though not confined to it. These changes occurred concurrently with a general rise in the surface temperatures in this region to 6° and over, and a fall in the salinities, at most points, below 33.00. From several vertical series of water samples which Mr. Matthews kindly obtained for me with the water bottles during the working of his stations it was found, at all points investigated on the Banks and a short way to the northward, that the Diatoms were present in an underlying body of cold water, the upper limit of their vertical range varying from 17 to 40 fathoms or more below the surface. At a station off the southern end of the Flemish Cap these conditions did not occur, and the dominating oceanic species *Rhizosolenia styliformis* ranged from 0 to 50 fathoms.

A second point of importance observed in July concerned the zone of transition between the two forms *Ceratium arcticum* on the north, and *C. longipes* on the south. This was found occurring in the latitude of Cape Race, and southwards to near the south-eastern border of the Banks, in a region where in April, as has previously been stated, the neritic Diatoms of the Labrador water were found confused with *Rhizosolenia styliformis* and other oceanic species. *C. longipes* was in fact once recorded in April in the same region, in about 45° N. and 51° W.,

and it is probable that the zone of transition between the two *Ceratium* forms was fairly constant in position on the southern half of the Banks from April onwards. There is little to suggest that the transition represents a gradual change in process between two nearly related forms of possibly the same species, prompted by changes in the physical conditions. The observations lead to the view that the origin of each is entirely distinct, that of *C. arcticum* being in the Labrador water on the north, and that of *C. longipes* being in the south and west, a southerly origin being also ascribed to the oceanic Diatoms that were found present here as early as April.

As has been stated, the limitations of the neritic Diatoms as a whole were found to conform closely with the hydrographic boundaries along the outskirts of the Labrador Current, and only at those points where the salinities and isotherms became irregular, as, especially, in the region of the Flemish Cap, did the former become confused. This point is brought out in the very low average temperatures which species show, as compared with those obtained by the International Investigations in the North European waters. For a large number of "abundant" records, *Thalassiosira Nordenskiöldii*, for example, shows an average temperature of 0.9° , as against an International Investigations average of 5.3° ; in *T. gravida* the average is 1.4° , as against 6.3° ; in *C. sociale* it is 0.9° , against 3.9° . The sharpness of the limitations in distribution usually occurring in this region seems to be due to the suddenness and extent of the change which at most points occurs between the polar and the Atlantic water. At the surface, wave movement was probably accountable for the fact that frequently, when intersecting the boundary of the polar water, a narrow intervening belt was traversed in which both polar and oceanic Diatoms became almost or entirely absent, the conditions being apparently intolerable to both. In the vertical direction, at positions where different layers of water were superimposed, and where little or no such mixing occurred, the vertical range of species was found so sharply defined that it was measurable within a metre or less.

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L. R. C.