

banks, with water of low salinity (under 33° 00) and very low temperature (down to 1-5° C.) except at the surface in summer; (2) a Northern Oceanic zone (boreal) along the southern side of the Grand Banks, with water of moderately high salinity (33-35° 00) and moderately low temperature (3°-8° C.), which connects with the bottom water of the Atlantic; and (3) a Southern Oceanic zone (tropical) farther to the south in the Gulf Stream, with water of high salinity (over 35° 00) and high temperature (10°-25° C.).

The northern coastal water owes its low salinity to the fresh water poured in by the rivers and to the melting of the icebergs from the north, and its low temperature to the cooling effect of the rigorous winters and to floating ice.

The southern oceanic water is brought up from the tropics by the Gulf Stream. This accounts for its high temperature and salinity.

The northern oceanic water may be derived in part from a mixture of the two preceding kinds. It is essentially an intermediate water, and in its circulation will, on the one hand, have its temperature and salinity reduced by mixture with the coast water and, on the other hand, have its temperature and salinity increased by mixture with the Gulf Stream water. As it is heavier than they, it will be found beneath them and, particularly toward the south, where it is less extensive, it will permit of their mixing together above it. It is continuous around the south side of the Grand Banks with the open water of the northwestern Atlantic, where is found the Labrador current. The latter doubtless contributes along this course (around the Banks) to our northern oceanic water, but for the most part only at some depth and not on the surface.

To these may be added a fourth, the Southern Coastal zone existing in the Magdalen bay, to which certain southern coastal forms, e.g., the oyster, are restricted. It is characterized by water of very low salinity and very high summer temperature, and is therefore similar to the upper layers of the northern coastal water. Its low salinity is due to the large amount of fresh water poured into it by the St. Lawrence and other rivers. Its high summer temperature is due to the same cause and to the shallowness of this part of the gulf. In a negative way the absence of heavy tides contributes to both the low salinity and the high temperature.

In the Southern Oceanic zone we have at the surface *Sagitta enflata*, *S. binneculata*, small *S. serratodentata*, and *Pterosagitta draco*. In the depths there are *S. hexaptera*, *S. lyra*, and *Khronilla subtilis*. The extent of this zone in July-August is shown in fig. 1. Surface species are indicated by horizontal lines, deep-water species by vertical lines. The further extension landwards of the surface forms in the southwest part of the region and of the deep-water forms in the northern part is noteworthy. This is corroborated by the distribution of small *S. serratodentata* as shown in fig. 6. The nearness of the zone to the continental shelf on the south as compared with the north is also important, indicating a turning of the Gulf Stream to the east.

On the May-June cruise only the northern part of the area was investigated. Only deep-water species were obtained. The records show that the surface Gulf Stream forms, which were not found, must have been farther out than the deep-water forms, and that both were at that time farther from the continental shelf than in July-August.

There is the question as to what part the Gulf Stream plays in mixing with either the coastal or the boreal oceanic waters. The sharp inner margins of the areas of distribution of most of the Gulf Stream species is against the view that the Gulf Stream by any back eddies remains as a distinguishable part of our waters. In the upper layers the most abundant species (*S. enflata*) decreases in abundance toward the inner side of the stream, and may even be lacking, showing that this inner margin is mixed water going with the stream. A solitary individual was found inside the stream, far in on the Scotian bank off Halifax. Its ability to survive in the water of intermediate salinity and temperature indicates that there can be little water of Gulf Stream origin in the intermediate boreal oceanic zone, otherwise individuals of this species would have been obtained at some of the nine intervening stations. *S. serratodentata*