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*NORWEGIAN MARINE INVESTIGATIONS.*

*Bergens Museum. Report on Norwegian Marine Investigations, 1895-97.* By Dr. Johan Hjort, O. Nordgaard and H. H. Gran. (Bergen: John Grieg, 1899.)

THIS Report contains two papers, the first, on the "Currents and Pelagic Life in the Northern Ocean," by Drs. Hjort and Gran, and the second, "A Contribution to the Study of Hydrography and Biology on the Coast of Norway," by O. Nordgaard.

In the first paper, the authors give the general results of their observations on the hydrography and pelagic life of the Northern Ocean obtained during recent years. More detailed results of their observations in Norwegian waters, with especial reference to the herring fishery, are reserved for future publication.

It may at once be said that this work, though only an instalment, is a very important contribution to oceanographical knowledge, and well sustains the character of Scandinavian research.

The first chapter deals with the hydrographical condition of the Northern Ocean, and the second chapter contains plankton studies in the same region. Then follow voluminous and detailed tables of the actual observations. These tables are illustrated by a series of seven plates, which show easily and very clearly the peculiarities of the region under description.

The Northern Ocean, as a deep-water basin, lies on the polar side of a curved line passing through Iceland, the Farö Islands, and reaching the Norwegian coast at the point where its trend changes from north to north-east. The shallow water portion includes all the Norwegian littoral waters and the portion of the North Sea between Norway and Scotland lying north of latitude 57° or 58° N. The Wyville Thomson ridge connecting Iceland with the Farös and the Orkney Islands is debatable ground separating the Atlantic from the Arctic areas. The position and the bathymetric characteristics of the different regions are very well shown in Plate I, taken from Mohn's "Northern Ocean."

Along the entire Norwegian seaboard there are three deep regions of well-marked hydrographic characters: (1) The region of periodical changes to a depth of 200 or 250 metres; (2) the Atlantic region to a depth of 500 metres; and (3) the Arctic region. Referring to this classification, the authors say:

"Of these regions it is chiefly the uppermost that is of interest to us, as it is our main purpose to unravel all the conditions which may influence the migration of fishes; and it may well be presumed that the great changes produced by currents, by summer warmth and winter cold, and the variations from year to year of the different factors, may be of the greatest importance to the periodical fisheries."

In pursuing the investigations of these conditions, five sections of the sea off the coast between Stavanger and Lofoten were made in 1895 by Hjort, and the same ground was gone over by Nordgaard in the winter of 1896. The

results of these investigations are shown graphically in Plates VI. and VII. The figures in these plates take the form of sections running out from the Norwegian coast to a depth not exceeding 400 metres, and showing the distribution of depth, temperature and salinity. Of these, the most interesting are those made in the same locality in summer and in winter. The difference of season affects principally the water at and near the surface, and is dependent on the rainfall in Norway. If the west coast of Norway were a perpendicular cliff, and the whole of the rain which falls on it ran eastwards, the fluctuation of conditions with which this paper deals would be either non-existent or insignificant. The physical observations of the papers are mainly directed to chronicling the variations in the salinity of the coast waters, and especially in the quantity of water of low salinity, which has a tendency to cover the surface and monopolise the summer heat received from the sun, of which it contributes next to none to the layers immediately below it. This view, that the freshening of the coastal waters, with all its consequences, is due to the mixture of Atlantic water with fresh water from the continent, and not to the addition of water from the Arctic ocean, is developed in considerable detail in the paper. In so far the paper is of a polemical and, indeed, of a more or less national character, because the opposing view is especially identified with Sweden, and the one supported by the authors with Norway. It is, however, a form of polemic from which nothing but profit is likely to result to science. With regard to the evidence afforded by plankton studies, which have been held to favour the Arctic theory, the authors say in their *résumé*:—

"As all inflowing bodies of oceanic water are of an Atlantic kind, the Arctic organisms, which may be met with at certain times, must in any case pass through Atlantic water if they really are derived from the Arctic currents, but their subsequent appearance in the colder and fresher waters on the coast is no proof of the coastal water's Arctic origin."

The concluding paper by Nordgaard, dealing mainly with the food of the cod, is very interesting, but not of a kind to be easily abstracted. In presenting the results of his investigations, he makes some important remarks. He admits that the fluctuations of the herring fishery are largely, though not exclusively, due to changes in the physical conditions of the sea in the spawning regions.

Referring to the cod, he says:—

"We are thus led to the conclusion that a principal factor in the produce of the Lofoten fisheries is the number of the fish that migrate inwards, and as the migration from the ocean, according to the observations hitherto made goes on in such a great depth that the annual variations in the physical conditions are very insignificant, we are obliged to look for another explanation of the change, in the numbers of the immigrations. I am apt to think that much can be derived from changes in the numbers of the fish staying on the outer banks. In the same way in which we speak, for instance, of a bad grouse season, by which we mean that the number of grouse is small, we may certainly also speak of a bad cod season."

It will be seen that this, as well as the preceding papers, are of a very detailed character, and they will repay careful study.

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