

NORTH POLAR PROBLEMS.<sup>1</sup>

THE deep North Polar Basin forms the northern termination of a series of depressions of the earth's crust extending north through the Norwegian Sea from the eastern side of the Atlantic, and dividing between the continental masses of the old and the new world. The eruption of the Jurassic basalt of Franz Josef Land and Spitsbergen may have had some connection with the sinking in of the North Polar Sea bottom, but the basin was probably to a great extent formed before that time. Newer volcanic rocks are not known hitherto from the edges of the North Polar Basin. On Bennett Island, De Long reports lava (or basalt), but we do not know its age.

It is most improbable that any block of land (horst) should have remained isolated in the middle of such a basin, surrounded by deep water on all sides, and without having any connection with the surrounding lands or continental shelves. It is, therefore, of essential importance to determine the edge of the continental shelf off the known coasts. But the edge of the North Polar continental shelf is only known exactly in two places—north-west of the New Siberian Islands and north of Spitsbergen—whilst in the region between these two places we know the deep sea to the north. In the remaining part of the North Polar Sea we know as yet very little about the edge of the continental shelf.

The rule that the continental shelves are generally much narrower outside high and mountainous coast than off flat and low lands holds good only where the mountain formations of the coast are in near relation to the trend of the coast and to the continental slope outside, and also where the mountainous coast is built up by primary rocks. This seems hardly to be the case on the northern coast of the American Arctic Archipelago and Greenland, although there are rather high promontories in some places. It is, therefore, difficult to say much about the extent of the continental shelf there. It is perhaps more the case along the north coast of Alaska, and therefore the continental shelf may possibly be narrower in that region; but even this is uncertain. The deeper soundings taken near the supposed edge of the shelf may simply indicate depths of submarine valleys, which may be numerous in this region, and many more and deeper soundings are required before we can say anything with certainty.

Dr. J. W. Spencer's conclusions as to the width of the continental shelf (*American Journal of Science*, vol. xix., No. 113, May, 1905), drawn from the great depths of the submarine fjords of the American Arctic Archipelago, are hardly well founded. Considerable depths of the submarine valleys and channels (fjords) do not point to a comparatively narrow shelf in regions where there has been glacial erosion. It ought also to be considered that, on the whole, the region of the American Arctic Archipelago exhibits geomorphological features which are exceptional. This region was probably near the heart of the great North American Ice age, and the land has been split up into islands and peninsulas, whatever the original cause of this dissection might have been.

It cannot, therefore, be said that the geomorphologic features of the known part of the Arctic regions exclude the possibility of a wide extension of the continental shelf, possibly with lands on it, into some parts of the Unknown North.

The *Sea Currents and the Drift of the Ice* seem to indicate that there is an extensive area of sea to the north of the *Fram's* track. Peary's experiences during his latest expedition also indicate that there is much sea to the north of Greenland. The ice-drift converges towards the opening between Greenland and Spitsbergen. Peary's observations of a rapid eastward ice-drift also indicate that there cannot have been much land to the east of his northward track; but as we do not know the depths over which Peary travelled, we cannot say much with regard to the possibility of land or continental shelf further north and east.

The drift of the *Jeanette* can hardly be said to indicate

land to the north, as this drift was chiefly influenced by the winds.

My conclusions with regard to an actual current in the surface-layers of the North Polar Basin, pointing towards Franz Josef Land and Spitsbergen ("The Scientific *Fram* Report," vol. iii.), might seem to indicate that there was land to the north, and that the North Polar Basin is a long and narrow depression. For, owing to the earth's rotation, we might expect a surface-current of this kind to be deflected towards the coast on its right-hand side, i.e. towards the Greenland and American side. It is, however, probable that the winds and ice-drift in the unknown parts of the sea might have influenced the direction of our drift, and that therefore the results arrived at as to the direction of the current are not quite correct.

R. A. Harris's contention that the difference in the magnitude of the tides on Bennett Island and the coast of Alaska proves the existence of extensive land to the north is based on a much too scanty material of observations. On the northern coasts of Franz Josef Land I found a smaller tide than the *Jeanette* people on Bennett Island.

The possible differences shown by the ice in the Beaufort Sea, on the coast of Prince Patrick Island, north of Ellesmere Land and Greenland, and in the sea crossed by the *Fram*, cannot be said to point to the existence of land in the Unknown North.

The occurrence of driftwood on the northern coasts, and even on the floe-ice itself (north-west of Greenland), proves that this ice must have drifted across the unknown sea from Siberia or America. The great quantity of "post-Glacial" driftwood, found even at high elevations on the now ice-bound coasts in the north, points to a milder period in post-Glacial times with a more open North Polar Sea.

*Methods of Exploration.*—The drawback with sledge journeys across the Polar ice is that they do not give much opportunity of soundings and oceanographical work; but something could be done by a practical equipment. Determination of the edge of the continental shelf would be most important, but also some observations of the temperature and salinity of the deep-water strata of the deep sea beyond this edge would be of value.

A drift with a ship across the Unknown North from the sea north of Behring Straits or Western Alaska, and towards Greenland, would give important results, and could be done probably in five years, although the drift-cask of Bryant and Melville took nearly six years from Alaska to Iceland (from September 13, 1899, to June 7, 1905).

SEISMOTECTONIC LINES.<sup>2</sup>

IN studying the distribution of the towns and villages damaged by Calabrian earthquakes, Prof. Hobbs finds that they show a noteworthy tendency to grouping along series of essentially parallel straight lines (seismotectonic lines), which he believes are related to coast-lines, borders of mountain-masses, boundaries of geological formations, &c. The places most seriously damaged are generally situated at or near the intersections of indicated seismotectonic lines, while these lines often intersect lines of volcanoes (volcanotectonic lines) at volcanic vents. In the direction perpendicular to seismotectonic lines, he states that the destructive intensity of the waves falls off rapidly, having but little effect upon well-built houses more than a mile distant, except in the case of earthquakes of the first order of intensity. He therefore concludes that "the destructive violence of an earthquake is localised on vertical planes of fracture within the earth's crust; along which cracks the seismic waves are transmitted with the least loss of intensity."

The district chiefly affected by the Calabrian earthquakes is one in which the peculiar earth-sounds, known as brontidi, mistpoeffers, &c., frequently occur. Recent investigations by Cancani, Alippi, and others have shown

<sup>1</sup> Abridged from a paper by H.E. Dr. Fridtjof Nansen, G.C.V.O., read before the Royal Geographical Society on April 29.

<sup>2</sup> (1) "On some Principles of Seismic Geology"; (2) "The Geotectonic and Geodynamic Aspects of Calabria and North-Eastern Sicily, a Study in Orientation." By William Herbert Hobbs. (*Beiträge zur Geophysik*, Bd. viii., pp. 219-362, and plates.)