occurring in northern Europe and Asia, and also in North America from British Columbia to California, and on the east from eastern Canada to Pennsylvania. These facts prove land communication. Dry land at Bering Straits would have sufficed, and required an elevation of but 200 feet. But there was probably connection also across from Europe to Arctic America. The connection was prolonged for the polar part into the Champlain period.

The accompanying bathymetric map will aid in appreciating the effects of a change of land in the Arctic regions.<sup>1</sup> An elevation now of but 1000 feet would add certainly 700 to 1000 miles to the width in a northward direction of Europe and Asia, putting Franz Joseph Land along the northern margin, and, perhaps, much of the unsounded region farther north. Only about 650 miles intervene between northern Spitsbergen and Greenland. The map shows further that an elevation of 3000 feet would make a dry land passage from Norway by Britain to Greenland, drying up the German Sea, and probably nearly the whole of the Arctic Ocean. The waters north of Melville and Bathurst lands may be as shallow as those north of Lapland.

Apparent upward change due to change in water level. — Part of the apparent upward change of level may have been only a downward change in the water level of the ocean. Agassiz, holding that ice covered nearly the whole continental area of the globe, argued that the abstracting of water from the ocean to make ice would have occasioned a large continental emergence. But the proportion that was actually covered was so small relatively to the whole surface of the globe that the consequent emergence could not have exceeded 60 feet. South America has but a narrow strip in glacial latitudes, and the ice areas of Australia and New Zealand were very small.

Another cause affecting the water level was the attraction of the mass of the high ice-plateau. It acted on the ocean's waters like that of any other elevated land-mass, by drawing the water up over the land, and thus occasional actual submergence. The effect was, therefore, opposite to that from the loss of water for making ice.

## Height, Thickness, and Flow of the Ice.

Evidence from glacial scratches and transported bowlders. — On the map, Fig. 1548, the mean directions of glacial scratches are marked by arrows, and these directions are taken in all cases, as far as could be ascertained, from the results of observations over the *higher land* of a region, away from the influence of valleys or depressions.

Positive facts as to the height of the ice in particular localities are few. Scratches observed by E. Hitchcock on Mount Washington, in 1841, put the limit, in that part of New England, above 5500 feet; and the more recent discovery by C. H. Hitchcock (1875) of transported bowlders, some of them 90 pounds in weight, near the summit of the mountain (6293 feet above the sea level), proves that the mountain was completely covered, and that the

<sup>1</sup> The depths, on the map, are given in 100 fathoms, 5 signifying 500 fathoms or 3000 feet, and .5, 50 fathoms. The arrows show courses of marine currents.