extended much farther west, perhaps with a greater proportionate depression in going westward, and on which heavy ice from the Laurentian districts on the east was wafted southwestward by the arctic currents, while lighter ice from the Rocky Mountains was being borne eastward from these mountains by the prevailing westerly winds. We thus have in the west on a very wide scale the same phenomena of varying submergence, cold currents, great ice floes and local glaciers producing icebergs, to which I have attributed the boulder clay and upper boulder drift of eastern Canada.

A few subsidiary points I may be pardoned for mentioning here. The rival theories of the glacial period are often characterized as those of land glaciation and sea-borne icebergs. But it must be remembered that those who reject the idea of a continental glacier hold to the existence of local glaciers on the high lands, more or less extensive during different portions of the great Pleistocene submergence. They also believe in the extension of these glaciers seawards, and partly water-borne in the manner so well explained by Mattieu Williams, in the existence of those vast floes and fields of current- and tide-borne ice whose powers of transport and erosion we now know to be so great, and in a great submergence and reëlevation of the land bringing all parts of it and all elevations up to 5,000 feet successively under the influence of these various agencies, along with those of the ocean currents. They also hold that at the beginning of the glacial submergence, the land was deeply covered by decomposed rock, similar to that which still exists on the hills of the southern states, and which as Dr. Hunt has shown would afford not only earthy debris but large quantities of boulders ready for transportation by ice.

I would also remark that there has been the greatest possible exaggeration as to the erosive action of land ice. In 1865, after a visit to the Alpine glaciers, I maintained that in these mountains glaciers are relatively protective rather than erosive agencies, and that the detritus which the glacier streams deliver is derived mostly from the atmospherically wasted peaks and cliffs that project above them. Since that time many other observers have maintained like views, and very recently Mr. Davis of Cambridge and Mr. A. Irving have ably treated this subject.[13]

[13]Proceedings Boston Soc. Nat. Hist., XXII. Journal of Geological Society, February, 1883.