II.—*Report by RALPH RICHARDSON, F.R.S.E., Vice-President, Delegate of the Edinburgh Geological Society to the Meeting of the British Association at Montreal, August-September 1884.*

(Read 6th November 1884.)

NEW YORK, 17th September 1884.—In giving in my Report as the Delegate of the Edinburgh Geological Society to the Meeting of the British Association, which was held at Montreal from 26th August to 3rd September 1884, I shall confine myself only to a few leading topics of interest. I may premise that the visit of the Association for the first time to a city out of Britain, proved most successful, and will doubtless lead to other excursions, tending to knit together the vast cosmopolitan world of science.

The Canadians warmly welcomed the members of the British Association, and the *Canadian Mining Review*, published at Ottawa during this month, alluded to the Montreal Meeting as “the great event of the year 1884 in the Dominion of Canada.” That journal likewise pointed out the practical advantage of such meetings, by their bringing scientific criticism to bear on the countries visited. Thus it proceeds:—“At the meeting in Montreal, in the course of a review of our numerous rich mineral indications, a serious defect was brought to light by one of the leading geologists and mining authorities in England”—Dr Le Neve Foster—“namely, that Canada, of all the colonies, is the most destitute of information concerning mineral reports and statistics available for reference.” I may add that it has no lack of admirable geological museums,—the beautiful Peter Redpath Museum at Montreal, the Geological Survey’s Museum at Ottawa, and the University Museum at Toronto, being particularly rich and well arranged.

In the Geological Section at the Montreal Meeting some very interesting discussions occurred, especially those in which the geologists of North America took part. I do not mean to affirm that they settled the “glacial question.” Whilst some American geologists held advanced glacial views, our Honorary Fellow, Principal Dawson (who became at this meeting Sir William Dawson, amid a chorus of applause) adhered as staunchly as ever to his opinion that a vast ice-sheet did not, as Agassiz first alleged, cover either Europe or North America. Some of the American geologists furnished interesting details regarding the physical features of their great continent. Professor Claypole said that a river once issued from Lake Michigan near Chicago and flowed into the Mississippi, the water-shed between that lake and river being now only 10 feet higher than the lake. The water that once found an outlet by the Mississippi, now

flows over Niagara Falls, which gradually cut through the rocky barrier, and where also the land probably subsided. Lakes Michigan, Huron, and Erie have much the same level. Another American geologist said that a river once left Lake Ontario near Oswego, and flowed into the Hudson River. These remarks show what great physical changes the American continent has undergone within comparatively recent times.

One of the most interesting of all the meetings was that in the Geographical Section, when Lieutenant Greely, the gallant leader of the American Arctic Expedition, appeared (still suffering from the terrible hardships he had endured), and gave a brief account of his recent expedition, when he placed the American flag nearer the North Pole than any flag has yet been planted. He told us distinctly that he had observed two great ice-caps in Grinnell Land with glaciers descending from both to the sea. Thus, on his authority, we must conclude that ice-caps with glaciers descending from them, form the surface-covering of some of the most northern land in the world. One of these ice-caps was, he said, on an average 150 feet thick, and extended for some 70 miles. Another ice-cap covered an area of 6000 square miles,—an area greater than that of all the Scottish lowlands, from Forth to Cheviots. Lieut. Greely's observations thus confirm the ice-sheet theory of Agassiz, although they suggest that the ice-sheet may not have been so thick as often stated. The line of perpetual snow in Grinnell Land was 3500 feet. Then, as to the new land, still further north, discovered by Lieut. Greely, it consisted (to use his own words) of "confused masses of mountains, either eternally snow-clad or covered with ice-caps." Now, may this not be a picture of Scotland during the glacial epoch? The ice-caps in Scotland may not have been so thick, as some geologists contend; and keeping in view that the line of perpetual snow would, in an intensely arctic climate, begin at a comparatively small elevation, a very thick ice-sheet may not be necessary to account for all the phenomena of glaciation which are observed in countries now far removed from extreme glacial influences.

Agassiz said that, judging from ice marks he detected on Mount Washington, New Hampshire, which rises to an elevation of 6293 feet, he considered that the ice-sheet which had once covered North America had attained a thickness of 6000 feet. This is also the minimum thickness of the ice-sheet believed by Dr Archibald Geikie to have once covered Norway, as stated in his recent "Text Book." Nordenskiöld found the ice-sheet covering the interior of North-East Land, Spitzbergen, to be between 2000 and 3000 feet thick. I ascended Mount Washington, and traversed generally the White Mountains, and I considered that the summit of Mount Willard (3000 feet high) showed marks of glaciation, whilst in the valleys (as near

Glen House) *roches moutonnées* seemed to me to be very evident. The valleys in many localities, as at Crawford House, which is 1920 feet above the sea, are deeply covered with a deposit of unstratified gravel and sand, in which travelled rocks occur, and which bears a certain resemblance to the Boulder clay with which we are so familiar. At the same time, I found no ice-marked or striated stones in these gravel beds; and, as to the glaciation of Mount Willard, the snow and ice which every winter cap its summit would necessarily tend to polish it. In the valley beneath, at the Willey House, an avalanche descended in August 1826, and destroyed the entire Willey family, nine in number; showing that even at that period of the year the White Mountains have known extraordinary violence on the part of glacial agents. I think that if we look at the action of these ordinary agents, and keeping in view Lieut. Greely's observations as to the thickness of existing ice-caps in the Arctic regions, we may perhaps be able to restrict the dimensions of the ice-sheet claimed by Agassiz so far as its *thickness* is concerned.

Before the meeting of the British Association concluded, a Conference was held of the delegates of the various scientific societies, which was largely attended, and at which I was present. Mr Whitaker, of the Geological Survey of England, was appointed chairman, and a discussion took place regarding the best method of stimulating scientific work by means of these Societies. Some suggested a closer union among local Societies, and Professor Trail, of Aberdeen, explained the mode of co-operation adopted by the scientific Societies of the North-East of Scotland. No definite resolution was adopted, but Mr Whitaker mentioned that at the meeting of the Association, to be held next year at Aberdeen, more matured plans would be laid before the delegates of the various Societies. He assured the meeting that the authorities of the British Association were most anxious to do all in their power to unite and strengthen the local scientific Societies of the United Kingdom; and he confidently expected that at the Aberdeen meeting some definite plan would be adopted whereby these Societies would be united in a manner never hitherto realised.

In concluding, therefore, this Report, I would just say that it would be highly desirable if every scientific Society in Britain, and at all events in Scotland, were represented at the Aberdeen meeting next year, so that the important conference of Delegates which will then take place may result in lasting good to the cause of Science, as represented by the local Societies of the United Kingdom. With greater co-operation better work would be done, kindly relations would be established, labour would be concentrated and economised, and new life would be infused into every Society forming the confederation.