Director of the Geological Survey of New Zealand ; John Holbrook, Esq. ; George Payne, Esq., jun. ; John Saul, Esq. ; and Edward Lionel Scott, Esq.

The following Paper was read :—

ON THE GEOLOGY OF NEW ZEALAND WITH SPECIAL REFERENCE
TO THE DRIFT OF THAT COUNTRY.

By Dr. HECTOR, C.M.G., F.R.S., Director of the Geological
Survey of New Zealand.

(*Abstract*).

The author first drew attention to the geographical position of the islands, indicating on the South Polar chart their situation relative to known lands of the Antarctic area. Great ice-packs encumber the intervening ocean, circulating around the pole ; travelling in a spiral, and thus increasing their distance from the centre. On the meridian of South Shetland, as low as 40° S. latitude, the seas are at all seasons crowded with icebergs, but there is an indentation of the ice-pack opposite Australia and New Zealand, though erratic masses escape sometimes. There are, however, five degrees of latitude off the extreme south of New Zealand, clear of the limit where icebergs are ever found. As regards latitude the islands occupy a position equivalent, in the Northern Hemisphere, to a line between Paris and Algiers. They lie parallel to Australia, 1,200 miles E. by S., and repose on a sub-marine plateau, which, along the west shores of the islands, is submerged to a depth of from 1,200 to 1,300 feet, but further westward terminates in water 6,600 feet deep. The edge of this plateau comes close in shore on the S.W. extremity of the Southern (middle) island. Thus New Zealand is a remnant of a once far more extensive land, whose eastern boundaries are not as yet clearly defined, but the author was disposed to include the Chatham Islands as a portion of it. *North Island*.—The eastern shore is the boldest ; foul weather, and consequently denudation, coming from the N.E. The west side is more shelving ; but the great volcanic boss of Mount Egmont, which rises at a gentle angle to a conical summit, protrudes its protecting buttresses of lava far into the western sea, and has thus been the means of preserving a great tract of Miocene Tertiaries behind it ; these constitute some of the best land in the

country. *South Island*.—The denudation comes from the west : its western shores also approach nearer to the edge of the plateau, and the mountains of the south-west angle rise from a profound abyss to a height of from 4,000 to 5,000 feet. In the North Island a belt of hard rocks, consisting of the Upper Palæozoics, and the older Mesozoics, constitutes a sort of back-bone, occupying the east-central portions, against which the softer beds of more recent age recline. In the South Island this belt of Upper Palæozoic rocks, constituting the high mountain chain known as the Southern Alps, sweeps down through the centre with an incline towards the west, and then curves round towards the east again quite to the sea on that side. Against these also the Upper Mesozoics and Tertiaries recline. On the west and south of this easterly bend of the belt of the newer Palæozoics a great mass of foliated rocks occur in the province of Otago, constituting the well-known gold-field. In the far south-west we have only crystalline rocks, and these belong to a series which seems to reappear in much of the detached lands of the Southern Ocean, such as Kerguelen's Land, Auckland Islands, &c., where Miocene volcanic rocks also occur. The meteorology of the country, as having an important bearing on the denudation of the surface, was next considered. Referring principally to the Southern Island, we have here the mixing point of the N.E. and S.W. currents. On the west Oside, at kitika, the annual range of temperature is 50° ; on the east side, at Christchurch, 65° ; moisture, west side, 90° ; east side, 75° ; rainfall, west side, 120 inches; east side, 25 inches; number of rainy days, west side, 202; east side, 91. Much of this enormous precipitation is deposited as snow in the Southern Alps, which comb out the moisture from the westerly winds; hence the extensive glaciers of the mountain region and the comparative dryness of the Canterbury Plains. Mount Cook has an elevation of 14,000 feet; this is the principal snow area of the Southern Alps, and here the island is narrowest. In shape this snow-field is less compact than that of the Bernese Oberland and of the Mont Blanc region; their respective areas are: snow-field of Mount Cook, 160 square miles; Bernese Oberland, 140 square miles; Mont Blanc, 75 square miles. The crystalline mountains of the south-west do not contain nearly so much snow. The Tasman glacier is 18 miles long, and 2 miles wide at its terminal face; the terminal face of the Godley glacier

is three miles across. The author then gave a description of the leading features of the glacier scenery, illustrated by very effective pictures; one of Milford Haven, with the half-snowed peaks of Mount Pembroke and its neighbours rising to a height of more than 5,000 feet, was very striking; he also demonstrated the erosive action of glaciers in cutting back cols—an action more energetic formerly, some of the cols having been worn down as low as 1,800 feet. The author pointed out on a map, specially constructed for the purpose, the immense extent of the snow area in former times as contrasted with that now existing. This is proved by the abundance of moraine matter. At present the glaciers on the west side of the Southern Alps are remarkably clean (as was well shown by a splendid series of sketches in colour by the Hon. Mr. Fox and lent for exhibition to the meeting), whilst those on the east side are largely charged with detritus. Following a given section in this direction away from the central ridges we find generally a rock basin, and still lower immense moraines extending to the Canterbury Plains, till they pass under the deposits of these plains, which are referred to Pliocene and Post-Tertiary age. In further illustration of the former extent of the snow-fields, the author indicated old centres of glaciers in the north of the island. The reason for this contraction of the ice area is the great question for determination. Was it due to difference of climate, the result of a great Glacial period? The remains of the past fauna afford no evidence of this. We may, indeed, suppose that the whole fauna migrated to the north, but we must in that case invent the land and bring into play oscillations more extensive than those required for another alternative, viz., the alteration of level within the area itself. We might suppose a general alteration of level, even to the extent of 4,000 feet higher than at present, but the evidence afforded by the shore line is unfavourable to this view. There remains then the theory of unequal elevation, which, combined with a most enormous destruction of surface, the result of ages of glacier action, best explains the phenomenon. There can be no doubt that at present the south-west portion of the island, where the crystalline rocks prevail, is very much depressed in comparison with its position at some former period; the extraordinary depth of the sub-marine valleys proves this. The author was inclined to believe in a period of irregular elevation, the south-west

portion having been elevated first, though possibly the Nelson region at a still earlier date. In conclusion, the author stated his belief that there had been no general change of climate, but many changes of relative level, resulting in a great destruction of surface, which had taken place in groups of peaks at different times; the areas of the crystalline rocks have been least affected in their relative changes of level, the oscillation having been greater in other masses, which have been crumpled up against these.

ANNUAL GENERAL MEETING.

FEBRUARY 4th, 1876.

WILLIAM CARRUTHERS, Esq., F.R.S., F.G.S., &c., President, in the Chair.

The following Report was read by the Honorary Secretary:—

REPORT OF THE GENERAL COMMITTEE FOR THE YEAR 1875.

The General Committee, in presenting their Report, have every reason to congratulate the Members upon the results of the past year.

A large number of new Members have been elected, and the interest evoked in several localities by the Excursions of the Association, have attracted the attention of local geologists to a considerable extent.

The losses by death and withdrawals have not been very great, but your Committee have thought it necessary to exclude from the Association several Members whose contributions to the Treasury had been in arrear for a considerable time. Your Committee regret to say that in this way some of the founders of the Association have, in consequence, ceased to be Members.

Members elected during 1875	...	...	48
Deaths	...	...	6
Withdrawals and exclusions	30—	...	36
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Increase	...	...	12
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