

One of the points to which it is my wish to draw attention is the age of the copper-bearing rocks of Lakes Superior and Huron, as determined by the evidences collected on the Canadian survey; and another, the differences that exist in the structural condition of the western and eastern parts of the Province.

The rocks on the north shore of Lake Superior consist of reddish granite and syenite, which in ascending order pass into micaceous and hornblendic gneiss and allied forms. These are succeeded by chloritic and partially talcose slates, which become interstratified with obscure conglomerates, with a slaty base; and upon them rest unconformably bluish slates, with intermingled bands of chert and limestone towards the bottom, and a thick and extensive overflow of greenstone trap at the top. Reposing on these are white sandstones, which pass by an alternation of colours into red sandstones and conglomerates, often with jasper pebbles, and these are repeated after the occurrence of an uncertain amount of reddish limestone of an argillaceous quality. The sandstones and conglomerates become interstratified with amygdaloidal trap layers, and an enormous amount of volcanic overthrow divided into beds crowns the summit. The sandstones are often argillaceous, and display ripple-mark and crack casts on their surfaces, while the concentric curves of flow sometimes characterize those of the trap. Innumerable dykes cut up the sedimentary and volcanic beds; and both the dykes and the overflows are almost universally marked by a transverse columnar structure. The thickness of the whole from the base of the blue slates cannot be less than 12,000 feet; and the whole formation is intersected by copper lodes of different characters in different places, which run in directions both with and transverse to the strike.

On the north shore of Lake Huron the granite is succeeded by a formation consisting of white, often vitreous sandstone or quartz rock of great thickness, sometimes passing into a beautiful jasper conglomerate, and alternating with great beds of slate and bands of conglomerate with a slaty base, both being interstratified with thick masses of greenstone. A persistent band of limestone of about 150 feet in thickness, and interstratified with thin cherty layers, occupies a place in the series, probably somewhere about the middle. The surfaces of the sandstone often exhibit ripple-mark; and the total thickness of all the members of the formation may be about 10,000 feet. Different intrusive rocks intersect those of stratification; and, as related to one another, they display a succession of events in the history of the formation. There is of course a set of dykes,—greenstone, no doubt,—cutting the sedimentary rocks, and giving origin to the greenstone overflows. It is difficult, however, to identify these; but another set of greenstone dykes are seen cutting both the sedimentary and igneous strata; intrusive granite, sometimes occupying considerable areas, thrusts these antecedents aside, sending forth dykes of its own order, intersecting all, and reaching to considerable distances from the nuclei; and then another set of greenstone dykes, and all that previous causes had placed. Evidences of disturbances and dislocations accompany all these successive intrusions,—those connected with the granite being the most violent. But there is, in addition, another set of disturbances of still posterior date, and it is to these that is due the presence of those metalliferous veins which give the country its value as a mineral region.

In respect to the age of the Huron cupriferous formation, the evidence afforded by the facts collected by my friend and associate, Mr. Murray, (published in our Report of Progress for 1847-48,) on the Grand Manitoulin, La Cloche, Snake, Thessalon, Sulphur, and other Islands, points ranging along a line ninety miles out in front of the coast, is clear, satisfactory, and indisputably conclusive. On these Islands, the Potsdam sandstone, the Trenton limestone, the Utica slates, and the Loraine shales,—successive formations in the lowest fossiliferous group of North America, were each, in one place or another, found in exposures

denuded of all vegetation, resting in uncomformable repose, in a nearly horizontal position, upon the tilted beds and undulating surface of the quartz rock and its strata: filling up valleys; overtopping mountains; and concealing every vestige of dykes and copper veins; and it would appear that some of these mountains have required the accumulation of the whole thickness of the lowest three and part of the fourth fossiliferous deposit, equal to about 700 feet, to bury their summits.

The chief difference in the copper-bearing rocks of Lakes Huron and Superior seems to be the great amount of amygdaloidal trap present among the latter, and of white quartz sandstone among the former. But on the Canadian side of Lake Superior there are considerable areas without amygdaloid, while white sandstone are present in others, as on the south side of Thunder Bay, though not in the same vast amount or the same state of vitrification as those of Huron. But, notwithstanding these differences, there are strong points of resemblance in the interstratification of igneous rocks, and the general mineralized condition of the whole, as to render their proximate equivalence highly probable; and the conclusive evidence given of the age of the Huron would thus appear to settle that of the Lake Superior rocks in the position given to them by Dr. Houghton, the late State Geologist of Michigan, as beneath the lowest known American fossiliferous deposits; and in this sequence those of Lake Huron, if not those of Superior, would appear to be contemporaneous with the Cambrian series of the British Isles.

The eastern limit of this formation on Lake Huron is in the vicinity of Colling's Inlet, opposite the eastern extremity of the Great Manitoulin Island, whence it gradually recedes inland, taking a north-eastern course; and farther down the St. Lawrence and its lakes the Lower Silurian appear to rest upon gneissoid rocks, without the intervention of the Cambrian.

If a line be drawn on the map in continuation of the Hudson River and Lake Champlain valleys to the vicinity of Portneuf, about thirty miles above Quebec, and thence in a north-eastward direction, it will divide the country into two areas; which, though nearly resembling one another in the general formations of which they are composed, yet present important differences in their structural condition. Each area belongs to a great trough of fossiliferous strata resting in Canada, with the exception of the supporting Cambrian formation of Lakes Huron and Superior, on gneissoid rocks, and containing coal measures in the centre; and the conditions, in which the two areas differ, are the general quiescence and conformable sequence of the formations from the base of the Lower Silurian upwards in the western, and the violent contortions and unconformable relations of those of the eastern. The coal measures of the eastern area are those of Rhode Island, and in a metamorphic state of Massachusetts, and those of Nova Scotia and New Brunswick. None of the productive part of the New Brunswick coal measures reaches Canada; but there comes out from beneath it, on the Canada side of the Bay Chaleur, 3000 feet of carboniferous red sandstones and conglomerates. These are succeeded by 7000 feet of Devonian sandstones, which rest upon 2000 feet of Upper Silurian rocks, consisting of limestones and slates. The base of the Upper Silurian group has been traced a distance of about 700 miles from Gaspé on the Gulf of St. Lawrence, first to Memphramagog Lake in Canada, thence to Halifax on the southern limit of Vermont, and further into Massachusetts, keeping in its outcrop at a variable distance from the coast. In the interval, between the Upper Silurian and the carboniferous formations, there can be little doubt the Devonian sandstones will display a conspicuous figure in the eastern area, as they are known to be still 2500 feet thick in the eastern portion of the western area, in which they do not die away until reaching the banks of the Mississippi. In the eastern area the Lower Silurian strata sweep round the Upper, occupying a zone of between 40 and 50