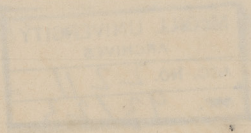


On the Drift of Nova Scotia

The rocky strata of the peninsula of Nova Scotia, belong to the most ancient geological groups. A band of variable width, along the South Eastern coast of the Province, is occupied by quartzite, slate and granite. A narrower and more interrupted band, skirting the first, and several hilly ridges ~~consist~~ not connected with it, consist of strata of the Silurian period, in part metamorphosed, and associated with various igneous rocks. The remainder of the country is occupied by Carboniferous rocks, with the exception of a small part consisting of a newer red sandstone whose age is not yet accurately determined, and of trap contemporaneous with this red sandstone.

The first district above mentioned, presents a rugged and uneven surface, in no part attaining any considerable elevation. The ridges of Silurian and igneous rocks comprise the highest land in the Province; their elevation is not however greater than 1500 feet, in their highest parts. The principal of these ridges are the



Cobeguid hills, extending for miles through a region of Carboniferous strata, and the Antigonish & ~~Merigonish~~ Mountains, also extending through a carboniferous region, though of smaller elevation than the former. The Carboniferous and newer red sandstone districts present an undulating surface, generally little elevated.

The greater part of the surface of the Province, especially the lower parts occupied by Carboniferous strata, is covered by drift, which is of two kinds in most parts of the Province readily distinguishable, and as will afterwards appear differing in age. The first and most extensively distributed variety is a confused accumulation of sand clay and rocky fragments. The second consists of stratified sand and gravel, without clay, angular fragments or large boulders. These two kinds of drift may be considered separately.

1 The Unstratified drift.

This may be viewed as consisting of a base or paste including angular and rounded fragments of rocks. The base varies from a stiff clay to loose sand, and its composition and colour ^{usually} always depend upon those of the underlying and neighbouring rock formations. Over sandstone it is arenaceous, over
shales

Shales argillaceous, over conglomerates and hard slates pebbly and shingly. The greater number of the stones contained in the drift, are, like the base containing them, derived from neighbouring formations. These untravelled fragments are often of large size, and are usually angular, except when they are of very soft material: thus the drift overlying the West Red Sandstones, is often filled with perfectly rounded fragments of these, while the grey peestones furnish a bed of detritus containing masses sometimes eight feet in diameter, and with their angles quite uninjured. Where, as often happens in the Carboniferous system, sandstones are interstratified with shales & clays, the former furnish the angular fragments, the latter the base in which they are included. *but many*

Besides these untravelled fragments, the drift always contains numerous boulders, derived from distant localities, in many cases however not beyond the boundaries of the Province. Over the Carboniferous rocks of Pictou, the drift contains numerous masses of greenstone, gneiss, ~~and~~ ^{and} stony, doloid, hard grit &c, identical with rocks found in situ in the Cobequid range of hills, westward & northward of Pictou

Beside these, there are other boulders whose localities are unknown to me, and some which closely resemble the metamorphic rocks southward of Pictou. In the County of Sydney, where there are numerous boulders as far north as the Cobequid or Antigonish hills, there are granitic masses which appear to have been derived from the metamorphic region to the southward. In the western part of Nova Scotia, the long narrow valley of Cornwallis and Annapolis extending from to , and occupied by soft red sandstones, is bounded on the North by a narrow ridge of happean rocks, and on the south by a broader district, principally occupied by slate & granite. On the southern side of this valley, there are numerous boulders of trap, brought over from the ridge on its northern side, and these are mixed with fragments of slate and large boulders of granite ~~brought~~ carried down from the hilly region to the southward. Such facts as these show that the transport of boulders in Nova Scotia, though it may have been principally from the northward, has by no means been exclusively so; boulders having been carried in various directions from the more elevated and rocky districts and

Scattered over the lower grounds.

The evidence of scratched and polished surfaces, in the few cases where these have ^{been} observed, shows the same irregularity in the direction of the drift-bearing currents. Near Pictou, the outcropping edges of sandstones of the coal formation, covered by clay with stones and boulders, are marked with scratches whose general direction is East and West. Near Gasp River, 80 miles distant from Pictou, are bare hills of hard slate, having their surfaces polished and marked with very distinct scratches, whose direction is North and South. At Halifax, 25 miles distant from Gasp R., similar hard slates have scratches whose direction is N. 30° W.

Very extensive denudation has taken place in Nova Scotia during the boulder period. The present contour of the surface, especially in the Carboniferous districts, is principally due to the depuration of the softer beds, and the projection of those of more resisting materials. It is unnecessary here to refer to any particular instances of this: they are of constant occurrence to a geologist examining the older strata, and often render it im-
possible

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to ascertain the nature of the softer beds, whose outcropping edges are not only deeply cut away, but buried under the debris of the neighbouring higher ground.

The travelled and untravelled blocks are usually intermixed in the drift. In some instances however, the former appear to be more numerous near the surface of the deposit; and their horizontal distribution is also very irregular. In examining coast sections of the drift, we may find for some distance a great abundance of angular blocks, with few travelled boulders, and then we may observe a portion of the section in which both varieties are nearly equally numerous, or in which boulders prevail. On the surface of the country where the woods have been removed, this arrangement is sometimes equally evident: thus hundreds of granitic boulders may be seen scattered over a small patch of ground, while in its neighbourhood they are comparatively rare. This appearance may however in some instances result from denudation, which has occurred subsequently to the deposition of the drift.

These patches of boulders have some-
times

times linear forms, as if they formed rows or ridges of stones included in the drift. The boulders also in a group, are often of the same or very similar composition, and differ from those of other groups in its vicinity. Thus in examining Coast sections of the drift, which covers the coal formation, we may find one group to consist principally of reddish gneiss, another of greenstone and another of white granite, as if the rocks from different localities, had been sorted and separated from each other.

Connected with the unshaped drift, are loose detached masses occurring on bare granitic hills, without any covering of earthy detritus. For example, on rounded granitic eminences not exceeding 500 feet in height, near the St Marys river, are large perfectly angular blocks of quartzite, which must have been derived from hills of that material not far distant, but separated from the present sites of the fragments by deep valleys.

I have observed no fossils either in the unshaped drift or that which is next to be described.

2 Stratified sand and gravel

This deposit rests upon and is newer than the unstratified drift. Whenever good sections of the two deposits can be obtained, this is sufficiently obvious. In the Eastern part of Merigomish, a coast section of the drift shows, in its lower part, a bed of clay and sand with angular stones principally sandstones. Upon this rests a bed of sand and fine gravel, with layers of coarser pebbles. This sand and gravel are separated from the drift beneath by a layer of large stones, similar to those in the latter, and indicating its partial denudation previous to the deposition of the gravel. (Vide Sect 1). Near Antigonish, a lower carboniferous conglomerate is overlaid by clay with pebbles similar to those of the conglomerate, to which in every respect, except hardness, this bed of drift bears a strong resemblance. Above this clay drift, in many places appears coarse gravel interstratified with sand. (Vide Sect 2). In both of these sections, and in nearly every other which I have examined, the lower part of the gravel contains fewer pebbles, or a larger proportion of sand, than the upper part. The pebbles included in the gravel,
seldom

seldom attain, and rarely exceed diameters of 9 or 10 inches. Boulders are occasionally, though rarely, seen in the stratified gravel.

The stratified gravel does not, like the older drift, assume the form of continuous thick beds; but forms oblong & conical mounds and long ridges, sometimes extending for miles in one direction, and at others shagging, in various directions, over level plains or among the gentler undulations of the older drift. The forms of these accumulations of gravel, are often so regular and sharply defined that they might be mistaken for works of art. They are most numerous in the lower grounds, as the valleys of rivers, plains of small elevation, and the sides of hills thrusting the sea.

The pebbles in the gravel are very various in composition and origin; in many places however, they have been derived from ancient conglomerates. A good instance of this is afforded by a thick bed of coarse conglomerate, belonging to the coal formation, and occurring in the County of Pictou. The outcrop of this bed, rising above the softer sandstones and shales connected with it,

it can be traced for several miles in an East & West direction. ~~Sitting on~~ ~~resting on~~ On the northern side of this bed, there are numerous ridges of gravel, composed of the materials of the conglomerate, and resting on clay drift; on the southern side of the outcrop, no such ridges are seen. In this instance it is evident that the shales and sandstones have been partially removed by denudation, and became covered by clay, leaving the conglomerate exposed. Afterwards, currents transporting materials in a westerly direction, have carried pebbles from the projecting ridge of conglomerate, and deposited them in irregular layers on the lower ground. Similar instances of the connection of beds of gravel with conglomerates, occur near Antigonish and on the North side of the Basin of Mines; but gravels also occur in places where their origin is not thus evident. In some parts of the Province, where the rocks are principally arenaceous, there are mounds and beds of sand, probably similar in age and origin to the stratified gravels.

It appears from the facts above stated, that the drift of Nova Scotia is divisible into two very distinct portions, whose modes of formation must have been very different.

The unstratified or older drift presents two marked peculiarities. First, the mixture of the coarsest and finest detritus, without any indication of its having been sorted by the action of running water; and Secondly, the presence of numerous large travelled masses or boulders. The first of these appearances, viewed in connection with the fact that the materials of the confused mass, have not been transported far from their original sites, and form a continuous sheet extending over large areas, can scarcely be accounted for by the action of violent currents of water, or by that of the sea, extending through long periods and aided by floating ice. These agents are capable of transporting great quantities of detritus, but not of breaking up and heaping in confusion the materials of rocks, without removing them from their original localities. There is however another agent, with whose power we are even now familiar in Nova Scotia, which may have produced these effects. This is intense frost, alternating with thaws. Thus, acting for a long period on the outcropping edges of strata of varying ~~thickness~~ hardness, would produce a mass of detritus precisely similar to our older drift, with the exception of the presence of travelled boulders.

boulders, which may have been subsequently intermixed with it by floating ice. The action of alternate frost and thaw, to produce the effects in question, must have been sub-aerial. It may however have been preceded, and must have been followed by periods of submergence. The frost must also have been of greater intensity than any now occurring in Nova Scotia, or rather ^{the} distance of the extremes of heat and cold must have been greater. The occurrence, in the temperate regions of the northern hemisphere, ~~at~~ at the period of the boulder formation, of a more intense cold than that which now exists in those regions, is however in correspondence with so many geological facts, that, if required by the hypothesis above stated, it could not on general grounds be objected to.

The stratified sands and gravels must be referred to other causes. Owing to the gently undulating character of this country, there are no situations which will allow them to be accounted for by the supposition of the bursting of lakes or of other land floods. Neither can they have been caused by glaciers, unless we suppose there to have
 moved

moved over level or undulating ground, and on
the surface of the older drift. I have not ob-
served them to form regular raised benches.
It is probable that they should be viewed
as banks thrown up by marine currents,
and perhaps as the products of the recession
of the waters, which distributed the boulders
of the older drift.

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