ART. XVII.—NOTES UPON THE COUNTRY IN THE VICINITY OF QUEBEC, BY HENRY D. SEWELL, ESQ. M. A.

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The geological position of Quebec and its vicinity cannot fail of being an interesting object of investigation to the members of this Society. United for the purpose of carryiug our researches as well into the natural as into the political history of the country we inhabit; of looking forward to the future resources of a growing province, as well as, of tracing backward the causes of advancement or failure, which we have to admire or lament; an inquiry into the nature and structure of the soil beneath our feet, its external capabilities for the purposes of agriculture and its internal treasures as applicable to the arts and manufactures, must prove alike interesting and advantageous to each of us. It is not however my intention, on the present occasion, to enter, at any length, into so prolific a subject of enquiry; I shall content myself with throwing together a few scattered observations, which, meagre as they are, may, I trust, hereafter prove of some use to the geological historian of Canada. The field of observation is however wide and almost untrodden, and the facts as yet collected necessarily few; it must not therefore be made a subject of reproach or astonishment if, hereafter, as the country around us becomes more open to research, some of the observations which I am about to make should prove incorrect: where data are few and obscure, it cannot be expected that the conclusions drawn from them can be of a different type; all that is now pretended, is, to draw from the facts we have, such deductions as the nature of the case admits of.

The position of the City of Quebec is well known to all present: its Gibraltar-like character, its picturesque site, its capabilities as a port of trade, its great resources and advantages as the only natural outlet for the rich produce of the western Province, have all been frequently described. Our present business lies with none of these; the object now in view being, simply, an examination of the strata and substrata of this vici-

nity; the probable manner of their formation;—their position, nature and uses.

The promontory of Quebec, extending from the mouth of the St. Charles to the outlet of the river Carouge, a distance of nine miles, consists, mainly, of Clay-Slate (so called) black at Quebec—red at Carouge, whence the name Cap-rouge, and blue in the intermediate space; passing near the old French works beyond the St. Louis-gate, into a carboniferous rock—and alternating with a coarse-grained limestone conglomerate along the ridge extending from Palace-gate westward. At Sillery and thence to Carouge, a highly inclined stratum of Greywacke crops out, forming the north bank of the River St. Lawrence, hard, durable and easily quarried, and consequently held in high estimation as a building material. This formation appears to be of great extent—stretching along both sides of the river, and in many places extending far back into the country on the south side. It forms the bed of the Chaudière above and below the falls—sweeping round towards Pointe-Lévi, and probably passing there below the St. Lawrence as it appears again on the Island of Orleans in large masses, as well as forming the rocky islets in its neighbourhood. It again appears in large quantity on the north shore at Ange Gardien, alternating with sandstone—below which at St. Joachim it passes into a coarse conglomerate.

The mineral contents of these strata are, as follows: In the Clay Slate at Quebec—a species of petroleum which exudes from the rock, in dark thick drops, in the operation of mining, called by the workmen "*Gum*," and used by them as an application to flesh wounds;—seams of a shining, black, anthracitic coal;—quartz crystals, vulgarly called "Cape Diamond";—iron pyrites; cale spar; and indurated nodules of green jasper, capable of a high polish and sufficiently compact to bear the engraver's tool without chipping. The earthy oxide of Manganese and massive pearl spar are also found near Sillery.

At Carouge, associated with the Greywacke beds, are found pearl spar and carbonate of iron; rounded and hollow nodules of embedded Greywacke;—and occasional indications of coal in thin seams.

The only mineral spring yet discovered in either the Clay Slate or Greywacke is one highly impregnated with sulphuretted hydrogen, in the Clay Slate of St. John Suburbs, at one time a fashionable place of resort, but held in less repute of late years.

As a building stone, the Clay Slate is of very little use, being rendered friable by exposure to the action of the atmosphere and

splitting along the lines of its cleavage. Of late a very strong water cement has been produced from it by Captain Baddeley, R. E. which, it would appear from experiments that have been made both in this country and in England, is, in some respects, superior either to those of Hull, U. C. or Harwich, being more tenacious and not more subject to disintegration than either of them. This cement is also capable of being run into moulds, of which it takes a good impression and is consequently applicable to all the purposes of ornamental architecture. It is of a light buff colour, and rings with a metallic sound, when struck with a hard body.

The surface of the ridge we have been considering is in some parts thickly dotted with boulders—consisting of almost every variety of primitive rocks: of these I shall have occasion to speak more fully hereafter.

The natural productions are oak, ash, elm, pine (red and white,) spruce, balsam fir, or sapin and a vast variety of smaller shrubs, plants and grasses, the description of which come rather within the province of the botanist, than of the geologist. In addition to these the agriculturist produces wheat, barley, oats, Indian corn, buckwheat, and the usual root crops, in sufficient abundance. The soil is however gravelly and poor, requiring very frequent enriching.

Leaving the Clay Slate ridge we find ourselves to the north of the City, on an extensive alluvial plain or rather valley extending in breadth, from Quebec to the little village of Auvergne below Charlesbourg, a distance of about three miles, but varying in extent at different points—and in length from Quebec to Ancienne Lorette, a distance of about nine miles. The soil of this valley is very deep and consists generally of a surface of Clay loam lying upon a substratum of stiff clay, used in brickmaking, containing a large quantity of small spicula of talc of great depth and alternating with sand. In this substratum are found fragments of wood far below the surface. Last summer I discovered a very large tree apparently a Hemlock (abies canadensis) to judge from the appearance of the bark which still remains perfect, lying in a horizontal position full twenty feet below the surface. I have since discovered another at a still greater depth, and indeed the land shifts caused by the undermining of springs, and the disintegration of the stratum by the action of frost, are continually opening out these wrecks of former times. These have in all probability been deposited at a period when the waters of the St. Lawrence, by their expansion in this locality, have formed an extensive lake. The surface

of the valley is overspread with large boulders of granitic rocks, evidently deposited in their present situation subsequently to the formation of alluvial matter on which they repose.

The plain, throughout its whole extent, is rent by many deep ravines which act as outlets for the accumulated waters of the mountain range lying to the north of the City. These afford great facilities to the industrious farmer for draining the lands in their vicinity, and as they occur very frequently and the land itself lies on a gentle slope towards the south, it might naturally be supposed that advantage would have been taken of them for that purpose. But, notwithstanding the natural facilities thus offered, and the immense advantages derivable in an agricultural point of view from a careful system of drainage, large tracts in the immediate vicinity of the City, remain to this day overspread with stagnating waters, the abode of noxious reptiles, useless to their owners, and injurious, by their putrid exhalations, to the health and comfort of the inhabitants.

The whole plain abounds in a variety of botanical plants. The soil is rich, generally speaking, and well suited to the production of grain, hemp, flax and the esculent roots.

At the village of Auvergne we ascend a sloping bank of Clay Slate dipping to the south-east. This rock contains some few organic remains, but they are small and rare and generally imperfect. The most common is a very small trilobite—but from its minuteness and mutilated state, it is very difficult to identify the species. The upper part of the stratum is occasionally broken by jointed veins of indurated limestone, containing between the joints small portions of coal or jet—while in the lower part thick veins of a soft sectile sandstone, or rather Grey-wacke Slate, are found alternating with Clay Slate and containing organic remains similar to those above mentioned. The mineral contents are chert—whetstone—a rich umber and yellow ochre.

This bank may be traced from Cap Tourment thirty miles below Quebec to Three Rivers, about ninety miles above it, and I believe much higher, with every appearance of having at some distant period formed the northern bank of the St. Lawrence. It is in this bank at Beauport that the tertiary formation of marine shells is found, remarkable for the perfect state in which they still exist—the colours even in many instances remaining nearly as vivid as in the recent specimen. They lie imbedded in a close and heavy blue clay mixed with sand and overlying the Clay Slate. They are in large quantities, the stratum in many places for several feet in depth consisting of little else. These shells are found in several other places over-

lying the carboniferous limestone of which I shall have occasion to speak hereafter, but nowhere present themselves in such masses as in the locality just described. This formation seems to be the Pleiocene of Professor Lyell.

The Clay Slate formation of this vicinity is seen in great perfection in the gorge formed by the falls of Montmorency, and may be traced, at intervals, to a considerable distance west of Charlesbourg, until it dips under a loose bed consisting of rolled stones, sand and shells. In this formation has lately been discovered immediately above the Falls, a coarse rock—marle of a reddish grey colour, which has been applied as a mineral manure with eminent success to the lands in that neighbourhood—the produce from those fields to which it has been applied being at least equal, if not greater, than that of those enriched in the usual manner. The whole formation seems to be identical with that of the Clay Slate at Carouge, and is probably continuous below the alluvial deposit of the plain. In this latter a calcareous sand has also lately been discovered.

In deference to the opinion of those Geologists who have preceded me in the examination of our strata, I have called the rock we have been considering, Clay Slate—but I think there is more reason for considering it the Greywacke Slate of Jameson—and my reasons for this opinion are these, viz: 1st The Clay Slate of Jameson is a primitive rock. The Greywacke and the Slate of the same name a transition rock. Now it follows from hence, that if the rock in question be indeed the Clay Slate, we ought *always* to find it *inferior* in position to the Greywacke—but such is not the case; wherever I have found the two rocks in actual contact I have uniformly found the rock which has received the name of Clay Slate *superior* in position to the Greywacke. 2dly. The Clay Slate contains no organic remains, the Greywacke Slate does contain them,* and we have already seen that our rock contains them. 3dly. The Clay Slate is not very subject to contortions, the Greywacke Slate is more so, indeed "greatly subject" to them.† Of the contortions of our rock, very numerous instances present themselves near the Inclined Plane, where the strata have been distorted into the most grotesque forms. Again "Greywacke" says Phillips in his geology,‡ "is associated and often interstratified with slate, (Greywacke Slate) which it is impossible to distinguish sometimes from Clay Slate. This in its more simple

* Phillips, p. 154.
† Phillips, p. 148.
‡ p. 148.

state appears to consist of indurated clay frequently of a greenish colour, and which being laminated splits pretty readily, or the lamina sometimes separate by exposure." The most casual observer of the Slates of Carouge and Auvergne cannot fail to remark how completely those formations coincide with the description just given. But further he states that Greywacke mostly occurs in thin beds lying in the slates belonging to it. This is also the case with our rock. It also bears a strong resemblance to Greywacke Slate in its mineral contents. But to proceed.

Having ascended the bank we have above described, at Auvergne, we find ourselves on a terrace sloping to the S. E. and consisting of almost every variety of soil, from stiff heavy clay to peat earth and vegetable loam. This terrace is from its position easily drained, and from the great variety of soils as easily manured. Boulders are occasionally found upon its surface, much resembling those below. Its natural productions are elms, butternuts, birch, beech, maple and basswood. The soil near the church of Charlesbourg, is a rich vegetable loam, well suited to the production of garden stuff.

At the church of Charlesbourg we ascend another bank composed of horizontal beds of carboniferous or mountain limestone, rich in organic remains, among which we may enumerate—trilobites—terebratulœ—orthoceratites—nautili — ammonites — producti—belemnites and madrepores—but all of a very small size. Sulphuretted hydrogen springs are occasionally found—and the rock itself has a fetid odour. The stratum is continuous from Ange Gardien where it meets the Greywacke which it immediately overlies, to the river Jacques Cartier, which has in many places forced its way through it and excavated it into narrow and deep channels. At Beauport it immediately abuts upon the slate in unconformable beds, and its perpendicular wall-like elevation is very visible from the high road. It forms, when burnt, an excellent lime, with which the market of Quebec is supplied. From Beauport it is easily traced, bending along the foot of the mountains in a semicircular form as far as Indian Lorette, where the same wall-like elevation presents itself near the seigniorial mill below the falls of the St. Charles at that village ; lime is also made from it here for the supply of the neighbourhood. A few loads are occasionally brought to market, but though equal in quality to the Beauport lime it cannot, compete with it in price, owing to the greater expense of transport, the distance being nearly double. At Charlesbourg, the rock from some cause or other has become silicified, and though consequently of more value as a building material—the lime produced from its calcination is inferior.

Wherever this rock presents itself at Indian Lorette and in that vicinity, it is found to rest on the sienite which forms the mountain chain north of Quebec. At the opposite extremity, viz., at the river Montmorenci, the bed of the river is also sienitic upon which the horizontal beds of limestone elevate themselves to form its banks. This is very conspicuous at the "natural steps," where the torrent has made a breach completely through the limestone and worn its way to the substratum of sienite. The debris formed by this denudation of the substratum is visible in the rolled pebbles of limestone which are found below the falls. At both these points, viz : at Indian Lorette and at Montmorenci above the falls, the slate formation is wanting, but at Beauport its position is very distinct, resting upon the sienite and inferior to the limestone beds. From the position of these beds, though perhaps not very probable, it is not wholly impossible that a coal basin may at some future period be discovered, not perhaps in the immediate vicinity of Quebec, yet at no very great distance from it. I believe it is no longer doubted that the beds we have described are analogous in character aud composition to the carboniferous limestone of England. Now in England as far as we know, the carboniferous limestone always forms the bed and sides of the great coal basins. The subsidence of the rock in many parts having formed bowl-like cavities in which the coal measures are deposited. Such basins may exist in our carboniferous limestone, though not yet discovered. It does not indeed follow that every carboniferous limestone contains the coal measures, but this much we know, that although the coal measures are occasionally found even in the Greywacke series and other rocks, yet they are of most frequent occurrence in the carboniferous group.

From the limestone ridge to the mountains another terrace very much resembling the last described extends itself—the soil consisting chiefly of peat and sand with occasional boulders interspersed.—I ought perhaps rather to call it a valley than a terrace, as the limestone above described forms a ridge separating the one valley or terrace from the other. Small streams traverse this valley, bounding the foot of the mountains and emptying themselves into the river Jacques Cartier. The peaty nature of the soil through which they run has given them a deep black colour and a soft mawkish taste—marsh plants are found abundantly along their banks, which are low, and in spring and autumn usually overflowed. The forests of this locality contain most of the shrubs, and trees common in the vicinity of Quebec, and already enumerated, except the oak,

which I have only found in the woods of Sillery and on the Island of Orleans. The valley is difficult of drainage from its low position, and its soil not among the most fertile.

We have now reached the mountains, and as we ascend we find ourselves on a ridge of sienite which every where presents its smooth rounded surface. This rock is remarkably hard and crops out so frequently as to render the cultivation of these hills absolutely impossible. Very large trees however find support for themselves by forcing their roots into the interstices of the rock and apparently deriving nourishment from the rock itself. Trees of all kinds have thus spread themselves over these otherwise barren mountains, forming a natural screen which protects the valleys beneath from the piercing winds that blow during winter from the north and north east. It is much to be regretted that so little judgment is shown in stripping these mountains of the clothing which nature has given them. Deprived of their shelter the valleys cannot fail to suffer, and the owners will find when it is too late to remedy the evil, the effects of their indiscretion, by the partial or even total failure of their crops.

Embosomed in these mountains are found frequent lakes abounding in trout, round which numerous emigrants have located themselves. The soil however is not such as will reward their labours, being chiefly siliceous with numerous boulders interspersed so thickly as in many places to prevent the operation of the plough. The lapse of centuries has deposited on these sterile sands, a thin vegetable surface arising from the accumulation from age to age of the leafy spoils of the forest—but a few years will exhaust the scanty nourishment thus afforded; the crops will deteriorate, and the settler, at so great a distance from town, unable to procure sufficient animal or vegetable manure for his crops and without a prospect, embosomed as he find himself among granitic hills, of obtaining a cheap succedaneum from the mineral world, will be unable to compete with his neighbour of the plain and still more with the graziers of the eastern townships, who may reasonably be expected in a few years to be the sole suppliers of the live stock required for the use of this city and its shipping.

But though, in a manner, useless in an agricultural point of view, we may yet look for many useful products to be hereafter derived from these mountains. For instance, they might be quarried to any extent for building materials, which they would afford at least as good as that of the Quincy granite of the neighbouring State of Massachusset s,now exported in very large quantities to every part of the Union. Many of the sienites

which lie in this range of hills are very compact, and well calculated to stand the ravages of time and exposure to the great changes of temperature to which we are liable. Indeed, from the small quantity of felspar which they contain, they might almost be considered as indestructible. We may also anticipate the discovery of the best Millstones;—Statuary Marble; Iron and other ores, such as Galena and Tin,—Blende,—Native Copper and its ores,—and, possibly, even Mercury. Graphite, better known under the name of "Black Lead," and some other minerals, have already been discovered. The precious metals are not usually found in granite, though frequently met with in Gneiss and Mica slate, and in Talcose Chlorite, which all are among the primitive formations, and usually accompany each other. A large mass of native gold has recently been discovered in a small stream not thirty miles from Quebec on the opposite side, of the river probably washed from its position in the Talcose Chlorite of that neighborhood. The discovery of Anthracite, or even bituminous coal, in one or other of the strata by which we are surrounded, is neither impossible nor wholly improbable. In the neighbouring States the great coal field of Pennsylvania is said to occur in the higher beds of Greywacke. The next great deposite of Anthracite occurs still lower in the series of rocks, and the Anthracite of Worcester is said to occur in an imperfect Mica slate associated with Gneiss. At the Boccage in Calvados, Lower Normandy, *coal measures* with their usual plants have been recently discovered; and they occur in the same relative position at Magdeburg; while in England they are also occasionally found in sand-stone beds that alternate with mountain lime-stone.* All these rocks exist either in our mountains or at their base. Mr. De la Beche, in his Geological Manual,† states of the carboniferous deposites of the Netherlands, that they would appear to be continued into Germany to those deposites which repose on the Greywacke rocks in that part of Europe. At Saarbruck and the neighboring country the coal measures he says are abundant, and rest, where trappean rocks are not interposed, upon part of the Greywacke mass.

In Poland M. Pasch describes the more ancient bed of coal as passing into the Greywacke on which they repose. According to M. Sternburg red sand-stone and red porphyry accompany the deposites of coal in Bohemia.

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* Phil. Mag. Vol. 7. No. 38. p. 152.

† Amer. Ed. p. 421.

Mr. De la Beche further informs us* that the coal deposites of Central France rest on Granite, Gneiss, Mica slate &c., without the intervention of any lime-stones, sand-stones, or slates, which can be distincty referred to the carboniferous lime-stone, old red sand-stone, or Greywacke. At St. George, Châtellaison, the coal measures also rest on Gneiss and Mica slate. But enough has been said to show, that the anticipated discovery of coal in some one or other of the strata by which we are surrounded, is no Utopian prospect.

It remains for me, in conclusion, to make a few remarks upon the boulders which are found so frequently in the tract of country we have been describing. As might have been supposed from the nature of the mountain range, they are altogether primitive. They exist in abundance in the plain and upon the terraces, and are also found in vast numbers upon the ridge of Quebec itself. Their position in this last-named locality is not a little extraordinary, and the question naturally suggests itself, how came they in such a position, perched on a long narrow ridge, nearly precipitous on both sides, and yet presenting a rough and, in some instances, angular appearance? I think, from their elevated position and the appearance that they present, the deduction may safely be drawn, that the ridge did not exist at its present elevation at the period when these masses were deposited on its surface,—because, 1st, if such had been the case, we should certainly have found some stray mass or other lodged in cavities or on the ledges that occur in the precipitous sides of the ridge—but we do not find them. 2nd. Because, had the ridge existed it is not probable, calculating the force of water required to raise these huge masses to their present elevation, that they would have been left where they are now found on the very brink of the precipice, the farthest removed from the mountain, from which they probably derive their origin; inasmuch as the wave descending the opposite precipice would naturby its own weight, carry with it the opposing masses. 3rd. Supposing these boulders to come from the northern range of mountains, if they had been quietly deposited at the bottom of a lake, their edges would not be much worn down by the small degree of friction they would meet with in their descent, and we should expect to find them occasionally presenting sharp prominences and a rough angular appearance, and such they do present; on the contrary, if we suppose them to have been raised by the repeated action of the waves, the constant trituration

* Am. Ed. p. 422.

they would meet with against the rocky sides of the ridge, would necessarily remove each angle and leave them like other water-worn masses, smooth and rounded. 4th. We can hardly suppose them to be the produce of diluvial action, for they are not smooth enough to have been carried from any considerable distance, and had they come, as most probably they did, from the mountains of the neighborhood, they are too small to have resisted the diluvial current, and would have been carried much farther to the south. But, supposing the country in which they are found to have at one time formed the bottom of a great lake, we can imagine the waves of such a lake sufficient to have rolled these masses down an inclined plane, such as the appearance of the country now exhibits, but by no means sufficient to have raised them to their present elevation; lastly, there are no existing analogies which will warrant the supposition of their having been so raised.

There remains, then, but one conclusion to be drawn, which is this:—that these boulders were deposited at the bottom of a great lake and that the ridge on which they are now found, originally formed part of the bottom of the lake, from which, subsequently to the deposition of these masses, it was raised to its present height by the subterranean action of fire; I think I am borne out in this opinion by the distorted appearance of the strata of slate rock at Quebec, in some places nearly vertical, in others broken and contorted—here presenting an appearance of liquefaction by heat, there protruding from its pores a species of petroleum and springs of sulphuretted hydrogen, all of which might be expected in a stratum acted upon by volcanic force. I think also that a farther corroboration may be found in the existence of those extremely hard nodules of green jasper, already alluded to, which are found near St. John's Gate.