

is made to the presence of gold in veins among these schists near Sherbrooke, as well as in Leeds, where "masses of native gold of several pennyweights are found with copper glance and specular iron in a vein of bitter spar." Recent discoveries of native gold have also been made in a small vein of quartz, which cuts the schists in Westbury, south of Dudswell. All these widely separated finds show that the hypothesis put forward so many years ago as to the source of the gold is true, to a certain extent at least, and the metal is clearly visible in certain veins found in connection with the pre-Cambrian rocks of the central anticlinal.

Reports of gold also from the mountain ridge of schists on the west side of Massawippi Lake, in a brook which flows over similar rocks to those found in the ridges farther north, furnish further confirmatory evidence in this direction; while the recurrence of alluvial deposits on the west side of the Belvidere road, which keeps along the west flank of the Sherbrooke and Lake Memphremagog ridge of similar schists would show that probably the gold there found was derived from quartz veins which cut these rocks. So also in the township of Halifax, where crystalline rocks occur, gold has been found in the gravel.

The age of the crystalline schists has now been definitely recognized as Huronian. To the rocks of this system, presumably also belong the gold-bearing rocks of the Lake of the Woods and Sudbury districts, the resemblance in character between the rocks of all these localities being marked. It is also highly possible that the gold-bearing schists of the Marmora and Madoc district are not very different in age from these, though this point has not yet been definitely settled. The evidence therefore that the Huronian crystalline schists and associated rocks carry auriferous quartz veins is very conclusive.

On the other hand it is very well established that the auriferous quartz veins in Nova Scotia occur in slates and other strata which are called Cambrian, and which, geologically speaking, succeed the crystalline schists and other associated rocks of the Huronian just described. This gold-bearing belt in Nova Scotia has been carefully studied by the Geological Survey staff, as well as by others, over many miles, and the peculiarities of its structures, and the conditions under which profitable gold-bearing veins occur, have been carefully noted. This work in Nova Scotia is of interest as bearing upon the question of the Quebec gold deposit; since we have now ascertained, quite conclusively, that much of the slates and quartzites which underlie the most productive alluvions in Quebec are precisely similar in character to the gold-bearing slates of Nova Scotia and are their probable equivalents in age. The fact that the richest pay streaks in Quebec, or those yielding the largest nuggets and the coarsest gold, have been uniformly found overlying or near quartz veins, which traverse these Cambrian rocks, is an important one, and should be kept in mind in future investigations.

In view of this important determination we may consider, first of all, if there are any peculiar conditions existing in the Cambrian slates to warrant the hypothesis that the gold may be derived from quartz veins in this series; secondly, whether any similar conditions occur in the pre-Cambrian slates, and thirdly, what conditions existed which could afford the present alluvial distribution of the gold itself as we now see it.

On the two eastern map sheets of the Townships series published by the Geological Survey of Canada, the distribution of the rocks assigned to the pre-Cambrian, Cambrian and Cambro-Silurian systems has been delineated as well as could be done in a series of highly disturbed strata, for the most part destitute of organic remains by which exact horizons might be defined. The mapping of the crystalline schists of pre-Cambrian age was rendered comparatively easy from their lithological character, as contrasted with the slaty and sandy strata of the overlying formations, while the older aspect of certain slates and quartzites which flank the crystalline rocks at many points, and which are intermediate between these and the overlying series of slates and limestones which contain fossils of Chazy-Trenton age, enables us to define, with a fair degree of accuracy, the outlines of the Cambrian series, the rocks of which are, as already stated, probably the equivalent of the Nova Scotia gold series. Quartz veins are found in the rocks of all the systems, and it is scarcely necessary to say these have been produced in the containing strata at some date subsequent to their deposition, and are presumably due to some disturbing cause, either of folding, cracking or metamorphism which has affected large areas of all these rocks.

If now we examine the structure of the schists we find them not only highly inclined, contorted, and, in places overturned, but intersected also by numerous intrusive masses or dykes of granite, diabase or some other form of igneous rock; and it is near these intrusive masses that the metalliferous lodes, such as the copper and iron are found; similar conditions prevailed in the still older Laurentian rocks in connection with the deposits of mica, apatite, etc., and also in the mining area of Sudbury with the deposits of nickeliferous pyrites. It may therefore be inferred that the presence of intrusive dykes, both in the schists and the overlying slates, has exercised a marked influence for good in the production of the gold there found. These intrusive masses, it may be said, occur at all the places where gold has been noted in the quartz veins, at Leeds, Dudswell, Westbury, the Sherbrooke anticlinal, etc., in all which places, and in many others, dykes of diorite are clearly defined, but in none of these has the quantity of gold yet discovered been sufficient to warrant the expenditure of much capital in its extraction.

In the Chaudiere section, the Cambrian slates and sandstones are well developed along that stream for some miles. They are well exposed along the line of the Quebec Central Railway from Theford north, and the contact with the underlying schists is apparently about midway between Beauce Junction and the Village of St. Joseph. Thence they extend upward along the stream to the Famine river, near the village of St. George, Beauce, and in this part of the section we have the rich alluvions of the Des Plantes, the Gilbert and the Famine on the north, and of the Millstream and the Bras on the south, as well as of the bed of the Chaudiere itself. Many quartz veins occur in this area, some of which are of large size, but in which visible gold has been rarely found. In the Geology of Canada, 1863, however, we find free gold reported from a quartz vein which crosses the Chaudiere at the Devil's Rapid, between St. Francis and the Gilbert, and on Bras, as well, in a garnet rock in which small grains have been found.

The presence of gold in pieces of quartz near the Devil's Rapid vein, recorded in the Geology of Canada, leads to the remark then made, that "it was derived, in part at least, from beds or veins of this mineral which are common among the talcose slates of the region."

An examination of the rock along this portion of the Chaudiere shows the presence of intrusive masses at many points. In the vicinity of St. Francis, and between that village and the Gilbert, these intrusions are specially conspicuous in the form of masses and dykes of dioritic diabase, which cut the Cambrian slates and alter them along the contact. West of St. Francis village, towards the Bras stream, intrusions are also seen in the hillsides and along the roads, as well as on the Bras itself; while on the north side of the Chaudiere about the Rochers station, and in the Des Plantes River, the intrusive rocks are frequent and include both granites and diorites, the latter being altered in places to serpentine and carrying small veins of chrysotile. While there is no evidence to show the precise date of these intrusions, they are certainly newer than the slate which they penetrate; but as very considerable

disturbances of the strata occurred in this area subsequent to the Silurian time, as seen by the altered condition of the Devonian rocks near St. George, it is probable that some of the intrusions at least belong to a comparatively recent period, and are presumably about the time of those found to the south and south-east as at Montreal and the other dioritic mountains of the Eastern Townships.

That the greater increase in the yield of gold from these portions of the slate formations affected by these dyke masses is due to this agency is supported by the evidence from other localities. Thus at Marmora and Madoc in Ontario, the gold-bearing belt is in close proximity to a mass of granitic rock which has penetrated the strata at that locality, while at the Risborough and Marlow silver mines the dioritic dykes are closely associated with the metalliferous lodes.

The same beneficial action upon, or at least intimate association of intrusive rocks with the strata containing our economic minerals, has been pointed out at many other places.

Bearing this in mind we would naturally suppose that the most favorable place for profitable gold mining in the Beauce district would be found where these intrusions are the most marked; and the past history of the industry clearly supports this aspect of the case.

The consideration of the alluvions presents somewhat different features, though as a whole it is closely allied to the question just discussed. The work of the last fifty years along the Chaudiere shows that by far the richest deposits have been found in the streams between St. George and St. Joseph, notably on the Des Plantes, the Millstream and the Gilbert; much of the gold obtained in these streams being coarse; while large nuggets are not infrequent in these localities, as well as the channel of the Chaudiere itself. Further to the south and to the south-east but little attempt has yet been made to find the ancient channels of the many streams which are tributary to the Chaudiere. The gold is found at many places, in fact there is scarcely a stream anywhere throughout this great synclinal valley, between the boundary of Maine and New Hampshire on the east, and the Sherbrooke and St. Francis ridge on the west, in which gold cannot be obtained. Much of this, however, is very fine, and appears to have been carried a long distance; while the coarse gold is invariably found in close proximity to quartz veins in the Cambrian slates, both in the Chaudiere and the Ditton areas.

This coarse gold drift is evidently largely local, and occurs for the most part in old river channels, some of which have been recognized for years, but none have been thoroughly explored. Where work has been carried on in the old channels, as in that of the Gilbert, the returns in gold have been very great even with the most ordinary appliances, since no attempt has ever been made apparently to carry out the work in any scientific manner or by the employment of proper engineering skill. The natural inference therefore should be that the coarse gold is derived from the reefs which traverse this area.

The gold found in these old channels should not, however, be confounded with that obtained from the widespread areas of sand and gravel which now in many places border the present channel of the Chaudiere and are found along some of its branches. There is a wide difference in the age of the two deposits. Thus the old channel gravels are clearly proved to be older than the glacial period, since they are covered frequently by a great thickness of other sands and gravels and surmounted by heavy beds of boulder clay. These glacial deposits have effectually closed up the pre-existing channel and forced the streams into new courses. As for the widespread areas of sand and gravel such as are seen about the junction of the Du Loup and Chaudiere, a part are presumably of about the same age, since they are also overlaid by boulder clay, while other portions may be more recent. These have evidently been carried down in the waters of the two streams and deposited here after the manner of other widespread superficial deposits of much more recent date. As a source of gold, however, many of these deposits are destined to be of great importance, and many hundreds of thousands of dollars' worth of the precious metal are there hidden, waiting for the enterprise and engineering skill which, with a proper amount of capital, will certainly make some one wealthy.

The tests made of these gravel deposits by the Geological Survey in 1852 show that the average amount of gold per cubic yard in the area tested was \$1.40. Anyone familiar with hydraulic methods can easily reckon the profit to be derived from the exploitation of a few hundred acres of such a deposit, since with proper appliances the cost of washing and extraction should not exceed four to five cents per yard. In view of the difficulty of locating the old channels of these streams it would almost appear at the present time preferable to turn our attention to these easily reached deposits, especially in view of the fact that a ditch capable of affording a head of water of over 200 feet is already available or can be made so at but small expense. It may be mentioned also in connection with these gravels, that nuggets of good size were obtained at the trial, one of which was valued at \$124. It may, however, be assumed that, with the comparatively crude appliances then used, all of the gold was not collected, so that presumably the real value per cubic yard of gravel is still greater than the figure stated.

It is to be expected that an old channel of the Chaudiere exists near the juncture with the Du Loup, but this will probably be found difficult to work by ordinary methods owing to heavy water. Could it, however, be successfully located and operated, there should be very profitable returns, as the specimens already obtained from the experiments made, show that much coarse gold is there buried.

These extensive deposits of surface gravels and sands of the Du Loup and Chaudiere area have evidently resulted from the destruction of the slates and contained quartz veins which are found along the upper part of these streams and which has been brought down in periods of high water, the gold being as a whole somewhat finer than that found in the old channel of the Gilbert or in the main stream as along the Devil's Rapid vein. The fine gold which occurs over so wide an area of the Eastern Townships, on the other hand, has probably been distributed first of all, through the influence of local glaciers, and secondly by the overlying currents of water that evidently swept over this entire area, subsequent to the retreat of the ice sheet.

It is encouraging to notice the renewed activity which has arisen in connection with the gold deposits of Canada, not only of the east, but of the extreme west. And especially so in connection with the Beauce district, where the subject is now being investigated by proper scientific methods by one of our most able and active members, under whose management we feel sure the enterprise will be thoroughly tested; and we trust his efforts will meet with the financial reward they deserve. In the meantime I do not think that the pursuit of old channels should be allowed to draw off the attention of capitalists from the exploitation of the rich gravels of the Du Loup, which have already been shown by the efforts of the Geological Survey to be so productive of gold when properly worked. I can only reiterate my belief that if the mistakes of the earlier operators are avoided, the scientific testing of these gravels will be productive of very rich returns; and I believe the day is not far distant when the gold fields of Quebec, although they are near home, will be quite an important factor in the output of the precious metal, as many of those areas in the more remote portions of Canada, from which such glowing accounts have lately reached us, but in some of which at least the promised returns are largely swallowed up by the difficulty of access and the greater cost of working.

* Geol. Can. 1863, p. 254.