Nova Scotia Gold Fields.

BY

PROF. B. SILLIMAN, JR.

MONTAGUE—WAVERLEY.
The EDITH and LORNE PIERCE COLLECTION of CANADIANA

Queen's University at Kingston
INTRODUCTION.

REMARKS ON THE GOLD REGION OF NOVA SCOTIA. — ITS GEOGRAPHICAL EXTENT AND POSITION.

The entire Atlantic coast of Nova Scotia, from Cape Sable on the west to Cape Canseau on the east, a distance of about two hundred and fifty miles, is bordered by a fringe of hard, slaty rocks, sometimes micaceous schists, more usually argillaceous, and occasionally granitic. These rocks, when stratified, are always found standing at a high angle, sometimes almost vertical, with a course, in the main, east and west. They seldom rise to any great elevation, the promontory of Aspatogon, about five hundred feet high, being the highest land on the Atlantic coast of the province. The general aspect of the shore is low, rocky, and desolate, strewn often with huge boulders of granite or quartzite, and when not bleak and rocky, is covered with forests of spruce and white birch.

This zone of metamorphic rocks varies in width from six or eight miles, at its eastern extremity, to forty or fifty miles at its widest points, preserving in its northern boundary only a rude parallelism with its southern margin.

This district comprises about six thousand square miles of surface, and may, geologically speaking, be called the Gold region of Nova Scotia. Not that gold is to be found in all parts of it, but it is not unreasonable to search for the precious metal anywhere within this region, where the occurrence of quartz veins — the almost sole matrix of the gold — is shown by boulders on the surface.
It is true that gold has been found outside of the limits here assigned, as at the head of St. Mary’s Bay in Digby County, and on Breton Island in Inverness County, and it is by no means improbable that these discoveries may extend to the newer metamorphic rocks in other parts of the province, the analogy of other gold regions leading decidedly to that belief.

A large part of the district named is little better than an unexplored wilderness; and the fact that the discoveries which have been made are, in a majority of cases, on the sea-shore, where the country is open and the search is easy, by no means diminishes the probabilities that continued search in the less frequented portions of the region will be rewarded with new discoveries as important as any which are now known.

GEOLOGICAL AND PHYSICAL CHARACTER OF THE GOLD REGION.

There is no positive evidence of the geological age of the auriferous rocks of the Atlantic border. No trace of a fossil has yet been found in any of the slates or associated rocks. Opinion seems to favor the belief that they belong to the Silurian age; but as yet no place has been found where the rocks next higher in the geological column may be seen resting upon these. Dr. Dawson, in his "Acadian Geology" (p. 347), evidently favors the belief that they are probably metamorphic Silurian rocks. That the rocks are highly altered (metamorphosed) is very evident to the most careless observer, as well as that they have been greatly changed from their original position of horizontality, as sedimentary rocks, by upheavals, which have tilted them up to a position almost vertical. The same causes have also resulted in the segregation or infiltration of the sheets or layers of white and mottled quartz, which are now the gold lodes, and charged the slates with arsenical and cubical pyrites in all the mineralized bands.

The most striking physical feature of this whole region to
the eye of a geologist, next, perhaps, to the uptilted state of the slaty rocks, is the universal evidence of a high degree of glacial action, which has so worn down and polished the rocks that their edges everywhere resemble the leaves of a book which has been cut with a dull knife in the binder's press, in a direction at right angles to that of the leaves.

Over very considerable areas, the glacial scouring has been so thorough that nothing whatever is left on the rocks but the groves and striae which accompany their polish. In other cases, the glacial drift is seen, composed of angular, rarely-rounded fragments of quartzite and clay slate, imbedded in a tough clay resting on the surface of the polished rocks. This detrital matter is auriferous, but a large amount of coarse angular fragments of rocks would render it very difficult to wash, even where it occurs in situations where water could be conveniently obtained for sluicing. The gold which it contains is coarse and angular, often still attached to the quartz, and showing but little evidence of long transportation. The "Boulder Lot" at Sherbrook has yielded a considerable amount of gold from this glacial drift, and is rewarding its owners handsomely. Probably too little attention has been given in the province to this source of gold, the quartz veins alone having been the chief object of attention.

Everywhere over this whole district, the eye of the observer is constantly arrested by the long lines of granitic and quartzite boulders which have been left in trains by the glaciers upon the surface of the polished rocks. These at times recall strongly the moraines of the Swiss glaciers, and rival them in the magnitude of the transported blocks. Some of the most striking cases of this sort which I saw were in the vicinity of Musquodobit Harbor, also on the flanks of the Musquodobit Mountains, and on the elevated plateau between Jeddore Bay and Ship Harbor known as the "Barrens." Here the boulders of white quartz are also very conspicuous. Some very striking examples of a like character occur also on the hills north of Oldham, in the vicinity of Gay's River.

The general course of the strike of the rocks is east and
west. Between Hammond Plains and Tangier, for a distance of nearly one hundred miles, this east and west course is so marked that it may be considered universal. This course is not usually over 5° or 6° away from the magnetic meridian, and is usually south by that quantity. But to the east and west of the points named, the strata bend round to the sea, so that the whole system assumes very much the form of a bow, whose arc or string is the coast line, the strata at each end losing themselves in the ocean.

Consequently, for a great part of the whole coast the glacial scratches, or course of the glacial drift, has been almost at right angles to the strike of the rocks. A most conspicuous example of this may be seen at the Round Tower near Halifax, where a large surface of the harder slates is completely denuded, and shows splendidly the whole phenomena of glacial action. These facts bear in a most important manner, it will be seen, upon the occurrence of the gold. They account, in fact, for

THE GENERAL ABSENCE OF ALLUVIAL GOLD.

If we consider for a moment the physical and geological features just described, it at once becomes evident that the great mass of loose materials which came from the scouring off the country by glacial action has gone into the Atlantic Ocean, where the gold is safely deposited. Sable Island, which by Mackinlay's map is distant about one hundred miles from the shore, is a sand-spit thirty miles long by about half a mile wide, shaped like a bow, and consists entirely of an accumulation of loose white sands. Mr. Campbell, the Provincial geologist, informs me that he washed gold from these sands in 1857, and that it was in very small, highly-polished scales, like the fine gold of California; that it came with the sands which it accompanied from the scouring off of Nova Scotia, no geologist can doubt for a moment. It follows from this view of the case that the occurrence of extensive diggings in Nova Scotia is a thing not to be expected. No long Sacra-
mento valley has retained here the spoils of the glacial epoch, and the fact appears to have been practically recognized from the outset, as comparatively few efforts have been made to obtain gold from any source but from the quartz vein.

The success following the washings of the sands near Lunenburg was, however, encouraging; and there are, doubtless, places of considerable extent in the numerous harbors and bays of the coast, where auriferous sands exist in remunerative abundance. The bottoms of some lakes, which can be drained, furnish considerable deposits of alluvial gold, and the same is true, no doubt, of certain river estuaries and marsh lands, which have hitherto attracted too little attention. Such, probably, are the flats bordering on Chedabucto Bay.

CHARACTERISTIC ROCKS OF THE GOLD REGION.

Quartzite.—The most noticeable rock in the gold regions of Nova Scotia is a dark gray, almost black, rock, which is called by the miners "Winn," or "Whin," a Scotch term for an igneous rock resembling trap or diorite. The rock to which this name is applied in Nova Scotia is in reality a granular quartz rock called quartzite. It is a very hard, compact rock, consisting of grains of quartz or sand consolidated into an extremely fine mass. Its lines of bedding are quite distinct, and it has three very well-defined planes of cleavage (one of which is the bedding), by which it breaks out into very regular shaped masses, so regular often as to simulate artificial surfaces. It is usually dark gray, often almost black, in color, but on exposure, weathers very nearly white, so that on the surface it presents often an almost glaring appearance in the sunshine. It shows frequently abundant stains of iron, from the decomposition of arsenical pyrites (mispickel) and yellow iron pyrites, with which it is always highly charged in the metalliferous districts. The fresh cleavage surfaces of the rock often glisten, as if with scales of mica, but in reality with the brilliant cleavage planes of pyrites.

This rock attains an enormous thickness, and is undoubtedly
the fundamental or basement rock of the region. Mr. Campbell, in his Report on the Gold Fields, made by authority of the Provincial Legislature, estimates it as over a mile in thickness; and he informs me that in the section of the railroad at Schubenacadie, he has measured it of that thickness. It frequently forms the foot-wall of the gold-bearing veins.

This rock, according to the section which Mr. Campbell has prepared, comes to the surface six times between the Atlantic coast and the northern boundary of the gold district, say thirty or forty miles. As in each case the associated rocks accompany it, and with them the auriferous quartz, it is plain that if this structure is clearly established as that of the district, there must be not less than twelve parallel zones, at an average distance of not more than three miles from each other, in which the explorer may reasonably look for the occurrence of gold-bearing quartz. My own explorations were not sufficiently extended to enable me to satisfy myself of the accuracy of this generalization, which, if true, is of the highest importance.

Slates.—Of the accompanying slates in which the gold-bearing quartz appears, and of the quartz itself, I shall speak in sufficient detail under other heads. Nor is it needful to dwell in this connection on the granites of the Musquodobit range or of the Eastern district.

The middle districts are remarkable for the absence of micaceous schists, and of magnesian rocks. Not an example of talcose slate occurs, so far as I have observed, between Hammond Plains and the Tangier River; but to the east of that point, magnesian rocks make their appearance; and at Wine Harbor, the gold occurs in a greenish magnesian rock, closely resembling serpentine or indurated talc.

Chloritic rocks appear in the Tangier district, but they are rare compared with the argillites, which form, next to the quartzite, the predominant feature in the geology of the Middle districts.
MINING AND DRAINAGE OF MINES.

One peculiar physical feature of this region, which strikes the observer at once, and which is also connected with its geological structure, is the remarkable number of small lakes. They seem to be as numerous as the little islands which dot the shores, or the countless harbors which everywhere indent them on the Atlantic border. It appears that these lakes exist in consequence, primarily, of the extreme compactness and tightness of the rock-strata, which, although turned up on edge, are so tight bound as to shut out almost completely the percolation of surface-water. This fact has an unexpected relation to mining, in the remarkable absence of water, which is a consequence of it. In no place which I visited had the water proved, thus far, a matter of sufficient moment to require other aid in its removal than a few buckets daily would supply. In one case, in Waverly, the levels are extended at the depth of one hundred and ten feet below the water in Lake Thomas, which is distant but a few paces, and still the water accumulating in these mines was only one bucketful in twenty-four hours.

I conversed with Captain Opie, an intelligent Cornish-man, in charge of the mines and mills of the English Company, and he assured me that nowhere in the Province was there a wet mine, or likely to be. There is a large element of compensation in this fact in the hardness of the rocks, and the consequent cost of mining. And the same quality has compensation also in the diminished cost of timbering under-ground,—almost all the levels I have seen being strong enough to stand without timber.

The drainage of some of the lakes, which are favorably situated for sluicing, will, also, beyond doubt, furnish an available source of alluvial gold, as already proved at least in one case.

ON THE GOLD-BEARING QUARTZ.

There are two classes of quartz veins in Nova Scotia: — 1. Those which cut across, or intersect at various angles the stratified rocks. 2. Those which occur parallel to the rocks, or are, in geological phrase, conformable to the strata.
The first are usually more or less irregular in their course, and are seldom or never auriferous, or if so, only to a limited degree. Such veins are known in Nova Scotia by the local name of "Bull Veins." They consist, as far as I have seen them, of compact white quartz, sometimes ferruginous, but not metalliferous, and what a Cornish miner would call "unkindly for ore;" a well-known example is the cross vein in the Tangier set.

The second class of quartz veins is the one which furnishes a matrix for the gold. They are always parallel to the associated slaty rocks, and partake of the foldings and irregularities to which these are subject. They are of all dimensions as respects thickness, from a mere line or fraction of an inch up to eight or nine feet or more; the largest, which I have myself measured, being at Hammond Plains, where the Mitchell Lode measures over eight feet, and the Middle Lode six and one-half feet.

As a rule, the quartz veins in Nova Scotia are not large, being more usually from four to fifteen inches; and the largest veins in thickness are not usually the richest in gold.

There are two very distinct classes of quartz veins among the auriferous lodes. The first are composed of crystalline quartz, often quite white, sometimes mottled, having the gold usually in coarse, visible particles, and showing a decided tendency to crystallization, also, in the associated minerals. Such are the "Negro" Lode, at Tangier, the Montague Lode, Taylor's South Lode, at Waverly, and some of the lodes at Hammond Plains.

The second class I should designate as veins of a slaty structure; the quartz being lamellar or fissile in planes parallel to the bedding; the faces of the laminae being striated like the surface of the slates; the color being usually dark, sometimes blue or blackish, sometimes ferruginous, and of an oily lustre. The gold is usually disseminated more finely in these veins, or lies in plates on their borders, and sometimes is quite invisible. Of this class are the Field Lode Copper's Lake, the Leary Lode, and Lake Lode, at Tangier, the
Blue Lode at Oldham, the smaller veins at Wine Harbor, and many others. It is impossible to say to which class the preference should be given, although undoubtedly the first is the one which conforms most closely to the character of mineral veins in general; but on the other hand, some of the most productive veins in the province belong to the latter class.

As regards the wall-rocks, between which the quartz lodes are confined, in a majority of cases, which I have myself seen, the upper or hanging wall is quartzite, and the lower or foot-wall is blue slate; sometimes both walls are slate, but I do not find in my notes an example in which both walls were quartzite.

The associated sulphurets as a rule show a tendency in some cases — perhaps in a majority of instances — to segregate on the lower or foot-wall side. In other cases, they seem to be pretty evenly disseminated through the body of the quartz. But the gold is almost invariably associated with the sulphurets when it is visible, and most frequently of all with the mispickel or arsenical pyrites, although I often saw it with zinc blende, and more rarely with galena.

The mispickel or arsenical pyrites, is frequently found in considerable masses on the foot-wall, occurring as bunches, oftentimes of many pounds weight, imbedded in blue slate, and, as far as I have observed, always auriferous. This is especially the case in the Montague vein at Lake Loon, in the Leary and Negro Lodes, at Tangier, and at the "White Head," at Oldham. Sufficient attention has not been paid to this feature of the Nova Scotia veins, and there is good reason to believe that in many cases the miners have failed to take down the foot-wall slate when it was pyritous, not being aware of its value, since, by the process of crushing and amalgamating alone, but a small part of the gold contained in the matrix can be saved. It demands an entirely different treatment, which will be mentioned in its proper place. At Montague, indeed, it is evident to the most uninstructed person that the Mispickel is auriferous, as hardly a lump of it can be broken without exposing scales of the precious metal; and the de-
tached bits of the pyrites are not unfrequently held together by gold-threads, or little veins, which are occasionally strong enough to require to be cut apart by a chisel.

As regards the extent of the quartz-lodes and their depth, as well as the uniformity of diffusion of the gold in them, it may be said that the smaller veins are rarely, if ever, continuous for any great distance, or more than a few hundred feet. Probably they never run across the intervening valleys to reappear in the opposite hill-side; but, on the other hand, they are not unfrequently succeeded by another series; or, perhaps, the same vein is now shut off, the slate-walls dividing it entirely; and then, after an interval, opening again with its former appearance and thickness. The larger veins are, as a rule, continuous for much longer distances,—not always without faults, as at "Montague," where there is an offset of thirty-five feet or more (but this is common, also, to all the smaller veins of the set), but the vein as a whole has been opened more than half a mile; and the more powerful veins at Hammond Plains extend, probably, over a mile, and those at Tangier about fifteen hundred feet.

In depth there is no doubt they also extend as far as it is probable they will ever be explored. As regards improvement in depth, it may be said there are numerous examples of several small parallel veins separated at the surface by thin partings of slate, which, at a moderate depth, have been found united into one powerful lode. No doubt the same fluctuations will be found in depth which are noticed in width, along the surface line, and the same changes in productiveness. There is a tendency in particular veins to the accumulation of gold along certain lines of structure in the vein, where the yield is much above the average; but in such cases the adjacent parts are comparatively poor. It has been observed that, wherever a remarkable nugget was found in a vein, the adjacent portions were well-nigh sterile at a short distance from the rich deposit. A remarkable example of this occurred in the Barrel quartz of Laidlaw's Hill two years ago, when a mass of the quartz vein of perhaps two cubic feet capacity yielded, as I
was informed, forty-five hundred dollars in gold, and the price of stock went up in a few hours from five dollars to forty dollars; but the adjacent portions of the quartz for a considerable distance proved to be quite barren. Other things being equal, those are undoubtedly the most desirable lodes in which there is a moderate amount of gold evenly diffused in a powerful body of quartz, which can be taken out at a small cost of mining, and supplied in large and steady quantities to the stamps.

In illustration of this point I will here quote a passage from a paper on gold mining, by John Arthur Phillips, Esq., of London, well known on both sides of the water for his skill as a mining engineer. This paper was read, May 16, 1860, before the Society of Arts, in London. Mr. Phillips says (p. 424, Vol. 10 of the Society's Journal),—

"As an instance of the small yield of gold, which even in Australia, is at the present time remunerative, I quote the following results of the Colonial and Port Philip Company. It must, however, be observed that, to obtain a satisfactory profit from ores of this class, it is necessary not only that large quantities should be treated, but also that the greatest economy should be observed in every department of the manipulation.

"The quantity of quartz crushed by this Company between October 1, 1860, and September 30, 1861, was 32,258 tons, from which the produce was 24,336 oz. 6 dwts., being an average of 15-2 dwts. per ton. The quantity crushed during the preceding year was 21,693 tons, and the produce 17,466 oz., being an average of 16 dwts. per ton, showing an increase in crushing of 10,563 tons, and on the yield of gold of 6,870 oz. over the same period of the previous year.

"It will be perceived that the yield of gold per ton had experienced a variation of 22 grs., equal to 5½ per cent.

"The total expenditure per ton has been 12s.; in the preceding year it was 16s.

"The profits on the quartz-crushing for the year ending September 30, were £22,958, 16s. 5d."
IS THE GOLD CONFINED TO THE QUARTZ?

While beyond doubt the quartz-veins are the chief gold-bearing rocks, it yet remains to be proved that they are the only ones. It is common to see the gold in the blue slate adjacent to the quartz, and I have seen a zone of quartzite in the Montague district, mixed with slate, which showed "sights" of gold in the quartzite, and gave over an ounce to the ton on some tons which were tried as a sample. A talcose slate at Wine Harbor, which I have seen, is beautifully plated with gold; and McDonald Sutherland, of Oldham, owner of a quartz mill, informed me that he had crushed a slate from that region which yielded him over an ounce to the ton. Investigation is certainly required to ascertain the truth in this matter; but, from analogies of other gold districts, we are authorized in expecting that the associated rocks will sometimes be auriferous.

REMARKABLE INSTANCES OF PRODUCTIVENESS IN THE NOVA SCOTIA VEINS.

While the prudent adventurer will regard with superior interest the reliable average yield of auriferous veins as the only safe basis of expectation, it is always pleasant to see the prizes which the lottery offers,—not forgetting the blanks. I took pains to collect such authentic examples as fell in my way while in Nova Scotia, the official character which is given by law to the mining records rendering it easy to do so.

Two poor men at Isaac's Harbor, almost without capital, commenced work on a quartz lode of six inches, which, at a depth of 30 feet became two feet, and in 402 days' work they obtained 246 ounces of gold, and had each a profit of over $2,000 for their labor. This was claim No. 12, on the lode, and No. 13, the next one adjoining, is turning out even better, the month of November giving 8½ ounces of gold for all the quartz raised.

"The Triad Company," for July, from 22 tons obtained
145 ounces, or over $6\frac{1}{2}$ ounces to the ton; and the same company, in August, obtained from 26 tons 900 pounds, 83 ounces of gold; for October, from 35 tons, 140 ounces.

The Hattie Lode, at Wine Harbor, has yielded 60 ounces to the ton, and 66 ounces from 1\frac{1}{4} tons of quartz.

Butler & Co., at Wine Harbor, for September, from 29 tons took 69 ounces, and for October, from 30 tons 800 pounds, took 95 ounces.

At Lake Loon (the Montague property), Robinson & Co. took a nugget of gold, found in the mispickel, which weighed 22 ounces; and the stuff from the vein has yielded from 4 to 6 ounces to the ton.

A lot of 2,500 pounds of selected quartz, from the South Taylor Lode, in Waverly, crushed by Huff, yielded 22 ounces of gold, and a lot of the same lode, unselected, yielded 2\frac{1}{3} ounces to the ton.

At Oldham, is a small vein of about an inch or two in thickness, which is owned by four workmen, who have taken from it 60 ounces to the ton of quartz.

Mr. Frankfort Davis, owner of a crushing-mill at Oldham, gave me the following statement of remarkable products, from his official returns, on the quartz from various lodes in Oldham:

<table>
<thead>
<tr>
<th>Tons</th>
<th>Yielded</th>
<th>Ounces</th>
<th>DWT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>21</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>65</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1\frac{1}{2}</td>
<td>65</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>59</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>12\frac{1}{2}</td>
<td>78</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>33</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>17\frac{1}{2}</td>
<td>57</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

Or in round numbers an average of 5 ounces to the ton, on about 100 tons of quartz crushed. While on the other hand,
442 tons from the same district yielded an aggregate of 821 ounces, or not quite 2 ounces to the ton.

At Wine Harbor a group of veins, on the Middle Lode, has yielded, to the present depth of 40 feet, over 5 oz. of gold to the ton of quartz.

Mr. O’Conner, one of the four owners of a claim on the Montague vein, informed me that a lot of the quartz from that vein, estimated at 800 lbs., yielded, on dry crushing, in a hand-mortar, 21½ ounces of gold, leaving, still, all the small gold, in the tailing, which would probably swell the whole yield to 24 ounces for 800 lbs., or 60 ounces to the ton of 2,000 lbs.

These examples might be multiplied,—as every district has its remarkable stories,—but I have confined myself to a portion of the examples which came to my knowledge.

THE GOLD COMMISSION. — TENURE OF GOLD LANDS.

By the law of the Provincial Legislature, the conditions of mining are substantially as follows: The fee of the mineral lands is in the Crown, and all mines are worked on a royalty, amounting, in the case of gold, to three per centum of the gross returns. A district having been determined to contain gold, it is declared by the Gold Commissioner to be within assigned limits a Gold District. It is then surveyed, and laid off into "areas;" which, as the law now stands, are three-fourths of an acre each, or 150 feet on the supposed course of a vein, and 250 feet in the other direction. Any individual who has discovered a new locality of gold, becomes, in virtue of the right of discovery, entitled to one "free claim" or "area," which he is at liberty to select where he pleases. If the owner of the land, on notice being given, declines or neglects to exercise his prior right of occupancy (he paying the same royalty, however, but a less sum down), then the Gold Commissioner may sell, to the first applicant, as many "areas" as are called for; the applicant paying down, for each "area," the sum of ten dollars, which is an advance on royalty. The purchaser then becomes obligated
to work the "areas" he has purchased, to the extent of one hundred days in each year, for each lease of not over five "areas;" but he may elect on which of any number of such contiguous areas he will work, and may expend all the labor required for the whole upon that one, as in sinking a shaft, etc. He is also required to make to the Gold Commissioner a quarterly return of the amount of labor expended, and the quantity of gold obtained; neglecting to do which, he forfeits his claim, and the Gold Commissioner then has the right to sell it to another purchaser. All owners of quartz mills are also required to send official returns, under oath, in a form prescribed by law, of all quartz crushed, stating from what mine, and for whose account, and the quantity obtained. This is designed as a check on the miner, as the two statements must, if correct, balance each other.

The Chief Gold Commissioner resides in Halifax, but has his deputies in each gold district, whose duty it is to see that the provisions of the law are carried out, and returns duly made each month, accompanied by a report on the condition of the industry in the district represented. From these returns the Gold Commissioner prepares a Quarterly Exhibit, which he issues in a "Royal Gazette." The Gold Commissioner also makes an Annual Report to the Provincial Secretary, giving an account of the mining operations in the several gold districts of the Province during the previous year. This Report, for the year 1862, is a valuable document, in which the then Chief Commissioner, Mr. Creelman, gives a large amount of interesting and important information.

The Provincial Law, respecting the gold fields, was plainly conceived, in its first draft, in the natural idea that there was to be a repetition in Nova Scotia of the experience of California and Australia, and that thousands of adventurers would flock to the "diggings," with the expectation of washing gold from auriferous sands. How completely different from this the actual experience in Nova Scotia is has already been explained. I have given good physical and geological reasons why it should be so. It is plain that gold
mining in Nova Scotia, as in California, can, as a rule, be carried on only by well-organized companies, with sufficient capital to make systematic and long-sustained explorations. For this purpose the small "areas" (20 by 50 feet), at first laid off, were found totally inadequate, and those now made, of three-quarters of an acre, are much too small, taken singly.

It is only where many such "areas" are taken consecutively, that a sufficient stretch on a vein is obtained to authorize regular mining.

Such, it will be seen, has been the course adopted by all companies from the United States. The law has lately received important modifications with a view to compel negligent occupants of adjoining claims to bear their part of the burden of keeping the vein free of water, on pain of forfeiture for neglect, after 20 days' notice. Suitable provisions are also needed to authorize the extension of levels through the claims of intervening proprietors in depth, on equitable terms, and here, no doubt, the principle of the common law, by which an owner has right of access to his land over the land of another, in certain cases, will apply.

METHODS OF DRESSING AND AMALGAMATING GOLD ORES, IN NOVA SCOTIA.

The quartz is best reduced by stamping mills, and is cracked by a machine which resembles Blake's stone breaker, preparatory to stamping. The use of fire to calcine the quartz is frequent although not universal, and opinion is divided upon the desirableness of this treatment; not that there is any doubt of the saving of labor and time in crushing, but whether the additional cost is not more than a balance for its advantages. The best stamps are those which have an iron rod, and revolve with the lifter, falling from 50 to 120 blows per minute in batteries of four or six. The English Mills, erected under the direction of Messrs. Phillips and Darlington, of London, are excellent examples of the best kind of non-revolving stamps. They strike in iron mortars, with movable linings
and soles. The shoes which wear longest and most evenly are cast from the well-known Franklinite iron, a variety remarkable for hardness and great strength combined; the screens vary in fineness from 40 to 80 holes to the linear inch. Where the use of mercury in the battery is adopted, the mortar bed is heated by steam or hot water.

The old Chilian mill, an edge-wheel, is still in use, and it is said that upon the barrel quartz of Laidlaw Hill it has made better returns than the stamps, which may be very true without commending either system very highly,* as it is certainly true, that very few of the mills have done as well as they should do in saving gold.

The usual amalgamation process in the Nova Scotia mills is by amalgamated plates of copper, boxes of mercury set before the stamps, rifles, shaking tables and blankets. A few use the round iron pan, with mercury, somewhat similar to the California pan. Such is essentially the case in the English mills, and in these alone did I observe a Haudts buddle at the end of the system, to concentrate and save the pyrites.

Experience has shown in California that the old plan of amalgamation, by rifles and the system of copper plates covered with mercury, is very imperfect and unsatisfactory, and in its best state can save not over 60 to 75 per centum of the gold which the fire assay shows to be present. Hence the almost universal adoption of the system of concentration by the iron pan with mercury, which is only a very highly improved and methodized "arrastra" mill. The one most usually adopted is Wheeler's pan and agitator, or Hepburn and Peterson's pan, which is a somewhat more complicated system than Wheeler's. Those pans, when properly conducted, save, it is said, on the authority of Küstel, a mining engineer of experience, not less than 95 per cent. of all the gold shown to be present by the fire assay.†

* Assays made under my directions on the waste or tailings from "barrel quartz," run through a stamping mill at Waverley, showed the presence of nearly fifteen pennyweights of gold to the ton of tailings, not over eight pennyweights having been saved in the original working.
In the same paper, already quoted, Prof. Phillips speaks as follows of the gold bearing veins of Nova Scotia:

"The thickness of its auriferous veins is perhaps less than those of California and some other countries, but they are generally speaking richer, in visible gold, than the average of those I have seen in any other part of the world. It must also be taken into consideration, that Nova Scotia possesses many decided advantages over both California and Australia. Each of these countries is situated at a great distance from Europe, and can only be reached after a long and expensive passage, and, as a natural consequence, wages were for a long time exceedingly high, and provisions proportionally dear. Nova Scotia, on the contrary, is within an easy distance both from Europe and the United States of America, and possesses a considerable settled population, of intelligent, industrious, and sober people, eminently adapted, after a little experience, to become steady and efficient miners. The whole of the gold-bearing portion of the province, also, lies within a convenient distance from the coast, which abounds with magnificent harbors, affording ample security to shipping, whilst wood, in large quantities, is to be everywhere procured for all descriptions of mining purposes, and an abundant supply of water is generally to be met with for the purposes of washing and amalgamation.

"From these circumstances it is impossible that wages can ever reach the extravagant rates that mainly led to the failure of nearly all the gold mining enterprises of 1852. Since which period many of the mines have been advantageously worked, which were then abandoned on account of the enormous expenditure necessary to carry on the operations."
MONTAGUE GOLD FIELD.

SITUATION.

This gold field is situated on the borders of Lake Loon, a small lake some four or five miles distant, to the northeast, from the town of Halifax. Although but little work has as yet been done here, compared with what has been done in some other districts,—the place having been opened only about a year,—the gold returns, in proportion to the quartz and rock broken, are among the most flattering in the province. This appears, from what has already been stated in the former part of this Report, under the head of Remarkable Examples of Productiveness, and more fully in the sequel.

The district is well wooded with hard wood and spruce, and an abundant water-power is furnished by the lake, for mining purposes and for crushing; it is easy of access, and conveniently near to all sources of supply.

THE VEINS IN THIS DISTRICT.

The existence of eight lodes has been thus far determined upon that portion of this district known as the Belt property, and now included in the Montague Gold Mining Company. But a systematic and thorough search will undoubtedly develop others. As yet the attention of explorers has been directed almost exclusively to that very remarkable lode, called by distinction, the Montague Lode, which is, in many respects, the most interesting mineral vein I have seen in the province. As it is both the best characterized, the most fully exposed, and, at present, the most promising mineral vein of this district, I propose to describe it as minutely as the data at my command permit.
DESCRIPTION OF THE MONTAGUE LODE.

This lode is often called the “Belt Lode,” or the “O’Conner, McQuarry, and Robertson,” from the names of owners upon it.

Its course is east, ten degrees west, that being the strike of the rock, by the compass, in this district. The annexed plan will serve to show its relation to Lake Loon, and its outlet stream, which, it will be observed, is entirely included in the estate of the Montague Company. It has been traced by surface-digging a long distance,—not less, probably, than half a mile. At a point not far west of the claim of O’Conner & Co., there is a shift or fault, which has heaved the most productive portion of the vein about thirty-five feet to the north; but to the east of that, as far as yet opened, the vein remains undisturbed.

Its dip is with the rocks, almost vertical, say from 80° to 85° south. The vein is contained between walls of slate, on both sides, and is a double or composite vein, being formed of, first, the main leader; second, of a smaller vein, on the foot-wall side, with a thin slate parting between the two, and, third, of a strongly-mineralized foot-wall slate, which, it will be seen, is really a most valuable portion of the ore channel.

The quartz is very highly mineralized, and crystalline, belonging to the first class of auriferous quartz lodes recognized in the general description of the region in the first part of this Report. The associated minerals in the quartz are cuprite or yellow copper, green malachite or carbonate of copper, mispickel or arsenical pyrites, zinc blende, iron pyrites, sesquioxide of iron rich in gold, and frequent “sights” of gold. Gold is also visible often to the naked eye, in all the associated minerals, and particularly in the mispickel and blende.

In thickness, the main quartz vein varies from three to eight or ten inches, at the surface; but it is reported at the bottom of a shaft of 40 feet, as 20 inches thick; but the shaft being filled with water, at the time of my visit, I could not verify this statement. That it varies considerably in thickness was very evident, owing to the folds or plications, of which I will speak more particularly presently.
The associated minerals, especially the cuprite and mispickel, are found most abundantly upon the foot-wall side of the quartz.

The smaller quartz vein appears to be but a repetition of the larger in all its essential characters, and is believed to be fully as productive in gold.

The underlying slate is filled with bunches of mispickel,—not distributed in a sheet or in any particular order, so far as yet observed, but enveloped by the slate and varying in size, from that of small nuts to many pounds' weight,—masses of over 50 pounds having been taken out. This mineral is always auriferous at this locality. A careful search will rarely fail to detect "sights" of the precious metal imbedded in its folds or between its crystalline plates. The slate itself is also very probably auriferous, scales of gold being seen between its laminae. This slate is not very hard, and will easily permit the miner, in his progress, to bear in upon it without drilling the quartz. The entire thickness of ground which is auriferous, and which should be reserved for dressing, cannot be less than 12 or 15 inches, and may, in depth, be much more. Altogether, this is one of the most interesting and promising lodes in the province. It is very highly mineralized, and all its minerals are auriferous. Nowhere else have I seen so powerful a display of auriferous mispickel.

OTHER LODES ON THE PROPERTY.

There are several parallel lodes north of the Montague, which are as yet but imperfectly known; these I saw in the road, near McQuarry's house. One of these lodes is a quartz vein of great strength, opened by a trench 200 feet long, and confined between walls of slate. But I could obtain no authentic information respecting it. It is certainly well worthy of exploration.

I also saw here what fell under my observation nowhere else in the province, namely, a group of small veins with quartzite, and in the quartzite visible particles of gold. Mr.
Murray, who was opening this place, assured me that he had obtained very encouraging returns from a sample of a few tons which had been crushed at Waverley. I have elsewhere pointed out the desirableness of proving the quartzite, when it is observed to be well charged with mispickel in the vicinity of auriferous lodes. The mispickel appears to me to be the most uniform associate of the gold in Nova Scotia, and while it is highly probable that it is often without gold, it is equally true that the gold is seldom or never found unless in company with the mispickel.

GOLD PRODUCT OF THE MONTAGUE VEIN.

It appears from a variety of testimony that the average yield of the Montague Lode is not less than 4 ounces to the ton. Mr. O’Conner assured me it was on their claim from 4 to 4½ ounces. Mr. Huff, a very reliable and cautious mill-owner, in Waverley, showed me from his books the results of crushing three tons of Montague quartz from the Belt Lode, which produced 6½ ounces to the ton, the quartz being unassorted. The same gentleman assured me that a nugget of 22 ounces of gold was extracted from a lump of mispickel at Lake Loon (McQuarry’s claim). The mispickel which was brought to him to crush was often interpenetrated by threads and plates of gold, requiring a chisel to cut the masses asunder.

A lot of quartz from the McQuarry claim, estimated as 800 lbs., and selected as showing “sights” of gold, yielded, when crushed by hand in a mortar, dry, 21½ ounces of gold; only the coarse gold, which could be picked out, being removed. There was left three barrels full of “tailings,” still rich in gold, which, it was estimated, would easily carry the product up to 24 ounces per 800 lbs., or, at the rate of 60 ounces of gold to the ton.

In two other cases, lots of 2½ tons each of unselected quartz from the McQuarry claim, yielded each 11½ ounces of gold.

Another lot of five tons (31 barrels) of the unassorted quartz of the same lode, yielded 27½ ounces of gold.
These results fully sustain, it will be seen, the average yield stated at the commencement of this paragraph.

As showing the rewards of personal labor, I would quote here the statement I obtained direct from the parties who own the McQuarry claim (which, it will be remembered, immediately adjoins the Nova Scotia Mining Company, and now purchased by the Montague Company), all of whom are practical miners, working their own claims; that in the five weeks ending December 1st, they divided, above all expenses, $1,200 between the four. Miners' wages are about $40 a month in Nova Scotia. This result was obtained without any investment in machinery, and with simple pick and drill, working an underhand stope in an open cut, with all the disadvantages of bad weather and no drainage,—neither of the men being experienced miners.

In all these results it is to be remembered that the gold obtained is probably far short of the actual gold contents of the lode. The pyrites is rich of gold, but the process of dressing and amalgamating adopted does not save it. The mispickel cannot be treated with any success by amalgamation; thus a large part of the gold associated with the pyrites is not saved at all, while probably not over seventy per cent. of the gold in the quartz is obtained. Experience in California has shown that amalgamation by the modes now chiefly practised in Nova Scotia, fails to save more than that amount; while by improved methods, which are not more expensive or difficult, ninety-five per cent. of all the gold may be saved.

VALUE OF THE MISPICKEL.

From what has been said already it is evident that an important source of gold exists in the pyrites of this lode, and especially in the mispickel and blende. As far as I can ascertain no really systematic exploration has been made on the foot-wall slate, and there is reason to believe that a large part of this gold-bearing ore is still standing even in that part of the lode which has been worked, which is a very small part.
With a view to determine its actual value, I have caused a sample of several pounds of the mispickel which I brought with me to be analyzed in the Sheffield Laboratory, here. The results are as follows:

**GOLD VALUE OF THE MISPICKEL.**

The ore was pulverized and sifted through a fine sieve to separate the coarse gold for the purpose of determining the proportion of coarse and fine gold in the ore. The fine portion after roasting was fused with litharge, and cupelled. The coarse gold was fused with borax to separate all adhering particles of ore, and weighed. The results are as follows, calculated for the net ton of 2000 lbs.

\[
\begin{array}{c}
2000 \text{ lbs. gave } 0.5679 \text{ lb. coarse gold,} \\
\quad \text{"} \quad \text{"} \quad 0.2740 \text{ " fine gold.}
\end{array}
\]

\[
\frac{0.5679 + 0.2740}{2} = 0.9419
\]

Reduced to Troy weight this amounts 13 oz. 12 dwt. 22 grs. per ton of 2000 lbs.

Analysis gave the following percentage composition for the gold:

\[
\begin{array}{c}
\text{Gold, . . . . . . . . . . . . 96.66} \\
\text{Silver, . . . . . . . . . . . . 3.34}
\end{array}
\]

\[
\frac{96.66 + 3.34}{100} = 100.00
\]

Gold of this fineness is worth . . $19.97 per oz.
The silver it contains is worth . . . . .43 "

Value of the precious metals, . . . . $20.30 "

This gives $276.49 as the value per ton of the sample of mispickel assayed.

The samples from which this assay was made I selected from average specimens; they showed only one or two pyrites of gold, and are probably as fair an average as can be obtained in the small way.

The relation of the fine to the coarse gold in this assay is
interesting. I infer from it that very little if any of the gold in this ore is chemically combined with the arsenic.

**TREATMENT OF THE ARSENICAL PYRITES.**

This ore must be reserved for a different treatment from the quartz. If brought in contact with mercury, a loss of both gold and mercury is unavoidable. The best way, for the present, will probably be to accumulate a stock of it until a sufficient quantity is shown to exist, to authorize the erection of works for roasting it. The arsenic it contains is worth saving and may probably pay the expense of roasting the ore. The demand for white arsenic is chiefly in producing the paint known as "Paris Green," and other green paints, for paper-stainers’ use and for oil-paintings.

Its present value in London is about £8 pr. ton, but has been as high as £14 within the past year. Each ton of the crude mispickel will probably produce half a ton of white arsenic.

The roasted ore may be treated either by litharge and cupellation, or by Plattner’s chlorine process. The latter is the least expensive, and yields equally good results. The details of this process can be given whenever they are desired. From the foregoing assay it appears that a mechanical process of dry crushing and sifting will secure three-fifths of the gold in this ore, and that portion it would appear best to save by such means before the chemical methods were used.

The ore of your property belongs, it is evident, therefore, to two entirely unlike classes, and these demand equally unlike treatment.

The quartz, as has been seen from the foregoing descriptions, is uncommonly pyritous. After crushing and amalgamation, the tailings must be taken to some simple and rapid sort of concentration apparatus, where the pyrites can be obtained measurably free from sand, preparatory to roasting.

The mispickel is an ore containing, in round numbers, arsenic 42 to 43 parts; sulphur 21 parts; iron 34 to 36 parts. The gold is probably associated with it chiefly, if not entirely,
in the metallic state, and much of it in a state of very fine division. The arsenic completely forbids the attempt to amalgamate it. The only resort is to roast it with a free access of air. The expense of this treatment with poor sulphurets is an effectual bar to its adoption, but with the mispickel the expense is met, as already suggested, by the value of the arsenic.

I had no exact means of determining the percentage of pyrites in a fair sample of the quartz; but it is, I think, from ten to fifteen per cent. of the whole mass.

STRUCTURE OF THE VEINS AND DISTRIBUTION OF GOLD IN THEM.

The open cut by which this vein has been exposed—absurd and culpable as it is as a mode of mining—has yet served a good purpose in showing, in a very distinct manner, the structure of the veins which is, so far as I have seen, general in the province. The quartz is not, as might naturally be supposed, in an even, plane sheet of equal thickness; on the contrary, it is seen to be marked by folds or plications occurring at pretty regular intervals, and crossing the vein at an angle of forty or forty-five degrees to the west. Similar folds may be produced in a sheet which is hung on a line, and drawn at one of the lower corners. The cross-section of the vein is thus made to resemble somewhat the appearance of a chain of long links; the rolls or swells alternating with plan-spaces. A better comparison is that of ripples or gentle waves, as seen following each other on the ebb in a still time.

The distribution of the gold appears to be influenced by this structure. All the miners agreed that the gold abounded most at the swells, and that the mispickel followed the same law. The spaces between are not found to be so rich.

This structure explains the signal contrasts in thickness and productiveness of the vein, seen in sinking a shaft. As the shaft passes through one of these diagonal swells, the thickness of the vein increases, and again diminishes as the work proceeds below this point; again to go through similar alternations.
There is no fear that there will be any failure in depth on these veins, either in gold product or in strength. The formation of the country is on too grand a scale, geologically, to admit of a doubt on this point, so vital to mining success. Vigorous and unremitting exploration by sinking shafts and driving-levels is the one thing wanted to insure success.

EXPLORATIONS ON THE MONTAGUE VEINS.

Within the limits of the property three shafts have been commenced on the course of the vein. One of them is down, I am informed, 40 feet, but, as already stated, it was full of water when I was there, and I could not inspect its bottom. The two others are not so deep; one of them was said to be 39 feet deep. The line of the vein has been opened on the surface to a depth of from 12 to 15 feet by open cut. By this extraordinary proceeding — the most costly and the worst mode of mining — the whole vein is laid open to the surface-water, and has, of course, become a wet ditch. Fortunately, the vein is very close, so that this water can hardly find its way to any depth; and it can easily be cut off from the shafts by dams. Beyond this open cut, the property can hardly be said to be explored at all.

THE CRUSHING-MILL.

On the small stream supplied by the lake, a mill has been erected, and needful appliances for crushing and amalgamating (in the mode most in use in Nova Scotia) have been provided. The mill is 30 × 45. A good frame building, conveniently arranged, containing boilers, steam-engine of 50 horse-power, and twelve stamps of 500 pounds each, and all the necessary machinery, which is entirely new, and can be set in motion in two weeks. Besides this, there is quite an assortment of tools, drills, powder-fuse, quicksilver, etc., etc.; in short, everything required to commence successful operations at once.
I have observed a disposition throughout the Province to construct mills and machinery for dressing gold in advance of the wants of the miners. It is so plain as to commend itself to the most uninstructed person in mining, that this is a mistake, that it is hardly needful to insist on it. A very moderate quartz mill will dress ten tons of quartz daily. This is 3000 tons per annum. On an average, the quartz raised in the Province costs three days' labor to each ton,* or at least 9000 days' labor would be required to raise the quartz which a ten-ton mill would dress, or the constant labor of 30 men. This is not a very formidable force for a profitable mine, it is true, but it will require a considerable amount of labor before the levels of a new mine can be opened in which this number of men can be advantageously employed. It would be my advice therefore that before any expense is incurred in remodeling the existing mill, that the work of exploration in the mine should be well advanced. Meantime, the company can institute inquiries, and satisfy themselves of the best system to be adopted to meet the peculiar conditions of their own property, which are different in some important particulars from any now existing in Nova Scotia. Under another head I shall offer a few suggestions on the development of the mine.

THE PROPERTY OF THE NOVA SCOTIA GOLD MINING COMPANY AT MONTAGUE.

The land and mineral property of this company is part and parcel of the district which has been already described, and comprises sixty-five areas of three-fourths of an acre each, located as shown on the accompanying plan. The total length on the Montague vein is about 2250 feet. The map will show the exact position and extent of the areas held by this company.

The following condensed account of the property of the

* Commissioner Creelman's Report, Nov., 1862.
Company is taken from the Report of Mr. Young, the agent in Nova Scotia: —

The Montague Gold Field is about six and a half miles from Dartmouth. The most direct road to the digging turns off from the Old Truro Road at a distance of five miles from Dartmouth. This, though a rough road in summer, can be used with great facility in winter. The Nova Scotia Gold Company purchased a number of mining areas in the field, but the whole of the mining operations were confined to five areas (Class No. 1), "150 feet on the lead by 250 feet across" N. 1142, 1143, 1144, 1145, 1146. Through the centre of these areas runs a five-inch quartz lead, and this has been uncovered by a trench or open cutting for upwards of 700 feet. From this a large quantity of quartz has been raised and crushed, giving a yield of, per ton, from 5 oz. to 1 oz. 13 dwts.

The object of working the vein in this manner has evidently been to raise the quartz as quickly as possible in order to obtain returns, and although this method is very expensive,—the works being liable to be stopped by the surface-water after every rain-storm, and it also requiring the entire removal of a large quantity of gravel and debris, which need not be disturbed,—yet the yield of gold has been so good that the works have paid. The Montague gold field was justly regarded as the most valuable mining site in the possession of the Nova Scotia Gold Company. There are four shafts on the lead. Two of these are main shafts, one 40, and the other 30 feet deep; the remaining two were merely sunk close to the 40-feet shaft, one on each side in order to raise quartz from the open cutting, and they were evidently used also to lift water from the works. One of the shafts is situated in a claim formerly belonging to Messrs. Blair & Wier, but purchased from them by J. W. Belt, the agent of the Nova Scotia Gold Company. About 10 tons of quartz were raised from this, after the claims were purchased; but no separate return of the gold taken from this quantity has been kept. In the main shaft, at a depth of 40 feet, the quartz was found to improve very much in richness compared with the returns nearer the surface. It must be remembered, however, that quartz leads
are in most instances very variable in their returns; but the experience of the Nova Scotia Gold Company proves that this vein, though generally giving a good return, sometimes is very rich. From the quarterly returns made to the government Gold Office, which are sworn to by Belt, the total yield is as follows:

120 tons. 15 cwt., gave 295 oz. 11 dwts. 8 grs.
4 " " " 8 " 11 " 0 "

No regular system of prospecting the ground has been carried out, the whole amount of money expended in this way being not more than $50.

The buildings belonging to the Company are in number three, and one carpenter's shed. Two are in good order, namely, the office and blacksmith's shop. The building intended for a crusher has the roof boarded and shingled, — the north and west sides are boarded, — the S. and E. are open. Inside the building, which is 50×25, a stamper-bed, and frames for the stampers and boxes are laid. This portion of the machinery is made of good hard wood, and formerly belonged to the Lawrenceton Crusher. It was constructed under my own personal inspection, and erected at Lawrenceton by me. A large frame is erected outside this building for the wheel, and through this frame a heavy stream of water is at the present time running. The boards for finishing the mills are, I am informed, at Porto Bello, about 4½ miles from the works. A large quantity of lumber lies on the ground, consisting of spruce and pine, and there is also some good hard-wood plank. There are a number of mining tools locked up in the office.

I propose to sink two or more shafts on the lead, to a sufficient depth, connect them by driftways, and then proceed to take out the quartz as economically as possible. The 40-foot shaft has hitherto cost $19 per foot. The driftways will cost from $5 to $6 per foot, at least. The cost per ton of raising the quartz will depend on the size of the vein; it will of course diminish as the lead increases in thickness, and increase as it diminishes.

It would be advisable to let as much of the work as possible; but there is a difficulty here in obtaining men to undertake and
finish small contracts. With respect to proceeding with the crusher at present, I think the Company had better send the quartz raised from the shafts to the Waverly Crusher, in order to determine, from the returns, whether it will be advisable to conduct the works on a large or moderate scale. A fund ought to be set apart for a regular system of prospecting the remaining claims.

In conclusion, I can state, that from conversations with Mr.-Belt, and information derived from other sources, I consider the Montague Gold Field one of the most promising in this province.

To the Directors of the Montague Gold Mining Company, Boston.

Signed J. B. YOUNG.

HALIFAX, N. S., Feb. 1, 1864.

PROBABLE YIELD OF THE MINE.

Assuming the average of 4 ounces to the ton,—which takes no account of the gold in the pyrites and mispickel, and supposes no more economical process for saving the gold than the very imperfect methods hitherto applied to it,—and taking as a basis of daily work ten tons of quartz crushed, only a very simple calculation is required to show a gross annual product of 12,000 ounces of gold. If the quartz costs $20 a ton, all expenses included, there would be a deduction of one-fourth from the gross gold product. The gold is about 960 thousandths fine, and is worth, as already shown, over $20 per ounce.

But the cost of the quartz cannot be so much by one-half as that named above; and the additional value of gold from the pyrites and mispickel, as well as probably 15 per cent. saving on the total amount of gold produced by improved methods of working, places this adventure on a basis of probability for remunerative returns sufficiently flattering to meet the most sanguine views. But on the other hand, the product of the vein may not reach so high an average in deep working, and
a liberal discount must be made for unforeseen accidents and the ultimate exhaustion of the mine.

That no uncertainty may exist as to the actual loss in the tailings from dressing the Montague quartz, I here present the results of two assays made under my instructions of carefully prepared samples. Of the tailings from a mill in Waverly, where this ore was crushed, the mean yield of gold in the tailings was 16 pennyweights 13 grains. A loss of $16.75 per ton, or the over-cost of mining.

SUGGESTIONS FOR THE DEVELOPMENT OF THE PROPERTY.

Assuming the length of the veins on your property to be — which I suppose they are — 2250 ft., it will probably be best to lay off the ground with a view to sinking two or more shafts. Probably one and perhaps both the extreme shafts already commenced may be in the proper place, but if they are not,— for the decision of which point a careful inspection of the sett by a good mining engineer will be required, — then the new shafts must beset without reference to the present shallow ones. These shafts must be laid off of such ample dimensions as will accommodate all the future wants of the mine when it is down one or two hundred fathoms in depth, giving space for hoisting, for a ladder way, and for pumps and ventilation. Most of the shafts I have seen in Nova Scotia have been laid out on too limited a plan for a successful business, and at too short distances from each other. One good sized shaft is better than two small ones. As the ground does not appear favorable for an adit at a level sufficiently low to give good backs, the only object for driving one will be to take off the surface-water to the brook, and for this purpose it may be specially important, as the open cut before mentioned will ensure a needless quantity of superficial water, which in depth would become a great annoyance. Probably here, as elsewhere in the Gold Region, the quantity of water below the adit will be small. If the adit is to be driven it should be commenced at once on the course of the vein, and after a time when, it is
sufficiently advanced, the veins may, if deemed expedient, be stoped up from the adit, for an early supply of quartz. At a depth of ten fathoms below the adit a drift or gallery should be started from the main shaft both ways, which can of course be driven at the same time the shaft is being sunk, an operation which is on no account to be suspended for an instant, day or night, after it is once commenced. The importance of this policy cannot be overestimated. If a mine is worth working at all it can be kept so only by pushing these fundamental works of exploration. Meantime, if an early supply of quartz is needed to satisfy the reasonable curiosity of stockholders, it may be obtained partly from the sinking of the shafts and more from driving shallow levels from the bottom of the existing shafts, so as to obtain an overhand stope.

But no temporizing policy of this kind should be permitted to interfere with the works of exploration which must precede those of extraction. It will be no just ground for discouragement in the prosecution of these works of exploration, if, now and then, the vein becomes pinched and seems about to run out, it will enlarge again and resume its former characters in no great distance. To show the importance of the policy here indicated of pushing works of exploration, a few figures will suffice. Ten tons of quartz daily will be esteemed by most persons probably as a very moderate quantity of ore to crush. But assuming that in one foot of ore ground broken for gold (the slate containing mispickel requires to be differently treated, and so is not included in this estimate,) one half goes to stamps, then a year's work will remove 60,000 cubic feet, or a section 1000 feet long by 60 high. This is equal to an entire level of ten fathoms, and it is plain that to prepare so much ground for removal demands that there should be no interruption in the sinking of shafts and driving of levels, as the second year's work cannot be commenced until the shafts are sunk far below the next level and the galleries are driven — a much longer work — to a goodly distance. As the neglect of this very obvious principal has been the ruin of many mining enterprises, I am the more emphatic in urging it upon your attention.
Then it must never be forgotten that a mine is like any other great manufacturing operation. The best prospects will be converted into failures by the want of economy and wisdom in the management. It requires special skill and large experience to manage a large mining and ore dressing establishment with success. A liberal reserve capital is indispensable, and in the event of brilliant success there is not the less necessity for a systematic reserve of a portion of the profits to meet the exigencies which are sure to attend such enterprises. With a due regard to these considerations, it is my opinion you will find the present adventure eminently successful.

B. SILLIMAN, JR.,

Prof. General and Applied Chemistry, Yale College.

YALE COLLEGE LABORATORY,

NEW HAVEN, Dec. 31, 1863.
THE WAVERLEY GOLD DISTRICT.

ITS SITUATION AND EXTENT.

The Waverley Gold District is situated ten miles northeast of Halifax, on the line of lakes which form the Schubenacadie Canal, giving easy access for water transportation from Halifax harbor and from the country to the north, for lumber, coal, and other heavy articles. Lake Thomas and Lake William, two of this chain of lakes, divide the Waverley Gold District into two nearly equal parts,—the village and most of the mills being on the east side at the foot of Laidlaw’s Hill, on which occurs one of the most remarkable deposits of gold quartz yet discovered in Nova Scotia; while on the west side of the lakes is the other part of the district, comprising the well-known Waverley Farm, become famous in the history of gold discovery in the Province.

The surface included within this district, by the survey of the gold commissioner, is rather more than one square mile, of which 480 areas are on the west, and 447 areas are on the east side of the lakes. There is good reason to believe, however, that the gold-bearing veins run beyond the limits included in the survey, especially to the east.

The main post route, from Halifax to Truro, runs through the Waverley District.

The discovery of gold in this district occurred in August and September, 1861, since which date explorations have been continued with zeal up to the present time,—a village of forty or more houses and seven crushing-mills having been erected here since that time.
CHARACTER OF THE ROCKS AND VEINS.

The characteristic rocks, already described as peculiar to the Nova Scotia gold region, recur here; standing at a high angle, and with a strike $12^\circ-15^\circ$ north of east. The general structure is easily made out on the west side of the lakes, while upon the east side, on Laidlaw's Hill, it is less clear at first sight, owing to the existence there of an anticlinal axis or fold, the crest of which has, at this point, escaped denudation, giving a remarkable peculiarity to the quartz found here, of which particular mention will be made further on.

The foot-wall of the veins, in this district, is generally a dark-blue soft slate, the hanging-wall a blue quartzite in most cases which I examined, but not universally so.

The hill on the west side of the lake rises about one hundred feet above the level of the water, giving easy access, by adits on the course of the veins, with "Backs," well situated for easy extraction of the ore by the overhand stope. The quartz-veins on this side are usually crystalline, and well charged with pyrites. The gold is often coarse and crystalline, although I saw no large nuggets. It is often very beautifully set in the clear white quartz, but is more frequently distributed in smaller grains along the lines of split in the veins.

Over twenty gold-bearing veins have been identified in this hill, but active explorations have thus far been confined chiefly to two or three, leaving a large amount of exploration still to be made.

A portion of the ground, along Muddy Pond, seems to offer a good situation for placer-washings.

THE SO-CALLED "BARREL-QUARTZ."

On Laidlaw’s Hill, forming the eastern division of the Waverley Gold District, has been found in great abundance, a peculiar variety of quartz-vein which has acquired a wide reputation under the name of barrel-quartz.
Mr. Phillips, of London, has thus described this variety of quartz:—

"The most remarkable deposit of auriferous quartz hitherto found in Nova Scotia is undoubtedly that at Laidlaw's Farm. The principal workings are here situated near the summit of a hill composed of hard, metamorphic shales, where openings have been made, to the depth of four or five feet, upon a nearly horizontal bed of corrugated quartz of from eight to ten inches in thickness. This auriferous deposit is entirely different from anything I had before seen, and when laid open presents the appearance of trees or logs of wood laid together side by side, after the manner of an American corduroy road.

"From this circumstance the miners have applied the name of 'barrel-quartz' to the formation, which, in many cases, presents an appearance not unlike a series of small casks laid together side by side and end to end.

"The rock covering this remarkable horizontal vein is exceedingly hard, but beneath it, for some little distance, it is softer and more fissile. The quartz is itself foliated parallel to the lines of curvature, and exhibits a tendency to break in accordance with these striae.

"The headings, and particularly the upper surfaces of the corrugations, are generally covered by a thin, bark-like coating of brown oxide of iron, which is seen frequently to enclose numerous particles of coarse gold, and the quartz in the vicinity of this oxide of iron is itself often highly auriferous."
The accompanying section, which I have prepared from a sketch of the place as I saw it in December, will, together with the following perspective view of the opening, convey a clear idea of its peculiar structure.

Only the corrugations in the open part of the cut are visible; the extension of the vein to the right and left is ideal, the superincumbent mass covering it. I measured, however, the quartzite above, dipping to the right and left at a small angle, and I think no geologist would doubt that the crest of an anticlinal axis here comes to the surface and has escaped the denudation which has removed the top of the crest in most places. The corrugations, or folds, appear to be ac-
counted for on the hypothesis of a lateral thrust producing the undulations. The annexed perspective view of this interesting locality is taken from a stereoscopic photograph, showing the appearance of the barrel-quartz after the surface-rock (quartzite) has been removed, and before the miners have broken up the quartz layer for removal.

The value of the barrel-quartz has been not so much from its large average yield as from the comparative cheapness with which it has been mined. Thus it appears from the statements in the Chief Gold Commissioner's Report, dated Jan., 1863, that each miner on Laidlaw's Farm averaged for the last three months of the previous year over nine tons per month, while in other districts the average monthly product per man was from two to three tons. The average yield of gold was small,—about five pennyweights to the ton; the maximum being three ounces, not including remarkable discoveries, like that of the Chebucto Company, of a mass of this quartz, yielding, as already mentioned in the Introduction, for a volume of not over two cubic feet, over $4000 in value, of gold.

It appears that over one ton of quartz has been raised for every three days' labor in this district, for 1862, yielding $1.25 as the product of a day's mining, after paying $4.00 per ton for crushing (more than twice its cost). If this appears a small product, we must remember that the product of gold mining in Victoria for 1860, when 18,296 men were employed in obtaining $1,813,989 in value, was only 31 cents per day, not deducting the cost of crushing; the average product per ton of quartz crushed being about 18 pennyweights.*

* Mr. Creelman's Report, pages 36, 37.
THE WAVERLY GOLD MINING COMPANY.

THE PROPERTY OF THE WAVERLY GOLD MINING COMPANY OF BOSTON.

This Company now own fifty-two acres, of which fifty are between Lake Thomas and Muddy Pond, in the Western district, and two are on Laidlaw's Hill, in the Eastern district. This property lies in a remarkably compact shape, as will be seen by examining the accompanying map. Its contents are not far from seventy-five acres of land, embracing a great deal of ground which has not yet been at all adequately explored.

Lake Thomas, it will be remembered, is one of the chain of lakes forming the Schubenacadie Canal, giving a direct water communication with Halifax Harbor, distant about ten miles.

The property is naturally divided into two parts, which will be briefly considered separately: 1st, the Mill and its appurtenances, and 2d, the gold-bearing property.

1st. The Crushing Mill. This is situated on the main road and immediately upon the banks of the lake, at a point where a small stream descends from the Laidlaw Hill, affording an ample supply of water for the crushing and dressing works, as well as for the steam-engine. The mill contains 3 batteries of 4 stamps each, say 12 head of stamps, of 350 pounds each head, and 13 inch fall. These work in cast-iron boxes, arranged for heating by steam. The amalgamation is effected in sheet-iron boxes in front of the stamp-screens. The pyrites is saved upon a series of inclined planes divided into six subdivisions and covered by woollen blankets, which are regularly rinsed into
a tank provided for the purpose. These are followed by a series of riffles to save fine gold and mercury.

The power of the mill is 20 tons in 24 hours. The quartz is calcined in brickkilns on the opposite side of the road, where it is delivered from the hill above (Laidlaw Hill), and after calcination is carried on a tram-road to the cracker, immediately behind the stamps, and not more than 75 feet distant from the kilns.

The machinery is driven by an engine of 20-horse power.

Without assays of the "tailings," no just opinion of the working of this mill can be formed. The introduction of some means of trituration of the stamp-stuff, to save the pure gold, will probably be found desirable; and I should advise a careful series of assays, on an adequate scale, to determine the loss of gold experienced in its former workings.

This mill had lain still for some weeks when I saw it, but has since, as I am informed by Mr. Perley, the present manager, been put in running order. I had no opportunity of examining the books of this mill, as at the time of my visit they had been removed from the mill; but I was informed by Mr. Clarke, former manager, that the returns were $160,000 for the twelve months preceding the period when the mill stopped work, in September, I think.

I have given to Mr. Perley my ideas of the changes which are desirable in the present system of amalgamation, and need not repeat them here.

I may add, however, that this mill has been run chiefly on barrel quartz from Laidlaw's Hill. My assay of the waste or "tailings" of this quartz, run through another mill in Waverley, which has the local repute of doing good work, shows that about two-thirds of the total contents of gold in the quartz exists now in the tailings. I very much doubt if this mill has done any better.

2d. The Gold-bearing Property. This embraces two distinct tracts of land. The first includes areas 130 and 172, on Laidlaw's Hill, being about one and a half acres of land on the Barrel Quartz. The other lies between Muddy Pond and Lake Thomas, and measures about 1,800 feet in length by
about 1,200 in breadth, subject to the deduction of several included areas, as may be seen on the map.

The Barrel Quartz has already been sufficiently described in a former part of this Report, and that description need not be now repeated. It will be understood that this description of open-air mining confines active operations to the fine months, and in winter nothing is done on the Barrel Quartz. The two areas owned by this Company have been about one-half worked out; but I should advise that every pound of the old tailings be worked over again, by an improved method, with the expectation that it would be amply remunerative to do so.

The most important gold-bearing veins at present known on the areas between the two lakes, are the so-called "Taylor Leads," or more particularly the "Taylor's South Lode," "Taylor's North Lode," and the "Old North Lode." These veins form a group, not being much over twenty feet distant from each other at the outside. They extend from the western shore of Lake Thomas to the margin of Muddy Point, nearly 800 feet, and quite lately they have been opened on the west side of Muddy Pond. It is highly probable, also, that they extend to the last, beneath Lake Thomas, a point which can be established only by deep exploration.

1. The Taylor South Lode is a vein of quartz varying in thickness from 5" or 6" to 12" or 15". It dips to the north about 80° between slate as the foot-wall, and quartzite above. This vein belongs rather to the second class of auriferous veins. The quartz is somewhat mottled, and splits at times parallel to the walls, revealing a somewhat slaty structure. The surfaces of cleavage carry spangles of mispickel, interspersed often with bright patches of gold. The gold is more usually seen along these lines of cleavage where the quartz is more or less discolored by the slaty structure. Between such structural lines, the quartz is generally more white and crystalline. Sometimes the gold is beautifully set in white quartz, but very rarely without being associated with mispickel, which is the prevailing mineral in this vein, as the associate of the gold.
The gold product of this vein has already been quoted under a former head, and need not be again repeated. Quite lately a lot of 9 tons of the quartz taken from the Henney Claim (No. 177), gave, as crushed by Huff, 21\% ounces of gold or nearly 2\% ounces to the ton. This quartz was not selected, but taken as it came from the vein.

2. *The Old North Lode* is a quartz vein from four to five feet north of the last-named, about 18" thick, and yields, so far as tested, but a moderate quantity of gold. In mining, it is found convenient to take down all the slate between these two adjacent lodes. This slate is sometimes auriferous, and should from time to time be tested, to determine its value. The quartz of the North Lode has been too little examined to authorize a confident opinion of its value. It should be examined at various points on its line of strike, and at various depths.

3. *The Taylor North Lode*. This lode lies about 21 feet to the north of No. 2. It is a quartz vein of about 12" thickness, dipping to the west at a less angle than the last. It has slate for both its walls, and a streak of quartzite about four feet from it, forming a convenient wall. Its gold product is believed to be about the same as the South Taylor; but it has as yet been but little explored. It is known to be better on the eastern end than on the western, and is believed, by those who have known most of it, to be likely to yield as well as the South Taylor. Such was the opinion of Mr. Huff.

4. Other Lodes. The Allen Hill, in which the lodes just named occur, is known to contain numerous other lodes, such as the "Graham," the "Field," the "Parmenter," and others to the supposed number of twenty; but as yet almost nothing has been done for their exploration, so much has attention been directed heretofore to the more accessible Barrel Quartz and to the South Taylor Lode.

The Allen Hill rises to a height of nearly one hundred feet, and thus secures a large amount of ground above water level.

An adit driven in on the course of the Taylor leads will enable you to explore, by a cross-cut, the set of veins on a
north and south course both sides of area 179, where the Company own an unbroken series of nine areas, or 1,800 feet. By pursuing this course of exploration, very valuable discoveries may be brought to light.

Among the undeveloped lodes on this property which I saw is the Graham Lode, which is opened about 200 feet south of the Field leads, and must run through the range of lots commencing with No. 237 on your property. It is about 8' in thickness, and is backed by a lining of white iron pyrites about one inch thick, resembling the similar association at Montague. Specimens which I broke out on the Wolfville claim showed gold. This association is always deemed a desirable one, the richest lodes in the Province having this character.

A shaft is in progress on area 179 which is being actively sunk, and should be continued without interruption, while at the proper interval of ten fathoms, levels should be extended both ways on the course of the vein, and the cross-cut from the adit already alluded to, should be driven with energy. The adit, of course, will serve to drain the whole mine of surface-water, an advantage sufficient of itself to authorize its being driven.

Until these preliminary works of exploration have been carried to a sufficient point, you are not in a situation to return any large quantity of quartz to the mill. The mill was employed heretofore largely in crushing for other parties. A policy not to be advised when owners possess gold resources of their own.

You will permit me to repeat to you, in substance, what I have already said to some other parties engaged in mining gold in Nova Scotia, as the essential conditions of success, granting that you possess, as in this case, a good property, well situated, and of sufficient extent to authorize systematic exploration. Your works of exploration and discovery must always be well in advance of the progress of extraction. Patience, to this end, is a great element of success. It requires time to develop a mine in hard rocks. To sink shafts and drive levels, requires time; and it is only where your
manager is able to lay his tape upon the open ground and compute the number of tons of ore standing in the explored ground and ready for stoping, that he is ready to go on to crush and amalgamate. Economy of administration in each department is essential. Your mining captain must know just what it is worth to drive a given level, sink a certain depth of shaft, or break and deliver at surface a given piece of ore-ground; if he does not, his men will soon discover it, and make you pay for his ignorance in exorbitant wages. It is a manufacturing operation, and the same careful and cautious skill is required at every step as is essential in any other manufacturing process.

Your amalgamating and dressing-works can be remodelled, according to the best skill now attainable, and can be made ready for active work as soon as your mines are in a situation to supply them.

You have a well-chosen, compact, and highly desirable property, already proved to be valuable, and capable, under wise and energetic management, of yielding large returns. Such, if the precautions suggested are observed, will, I am confident, follow at an early day.

I remain, gentlemen,
your obedient servant,

B. SILLIMAN, JR.,
Prof. of General and Applied Chemistry. Yale College.

New Haven, Ct., Feb. 1, 1864.