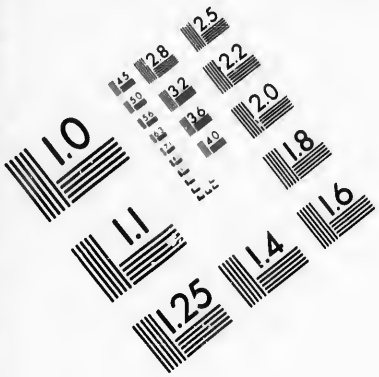

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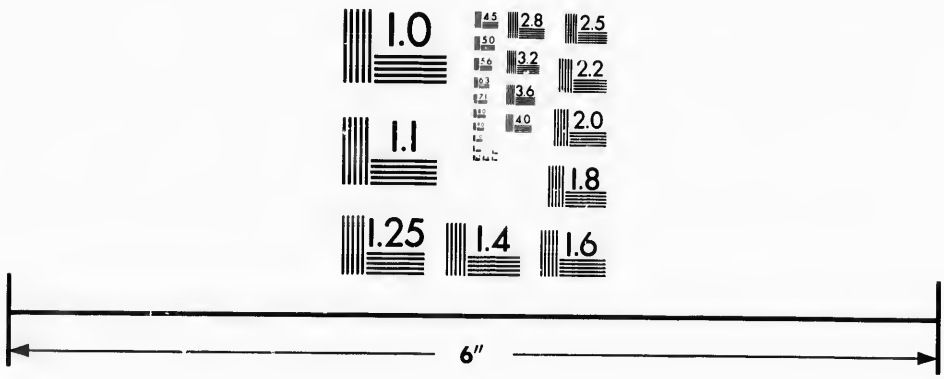

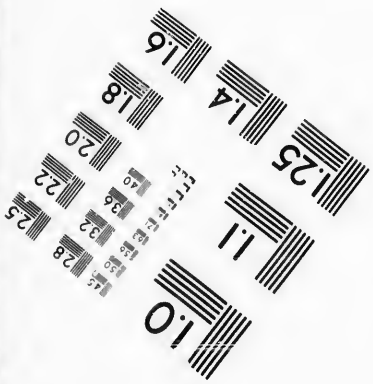

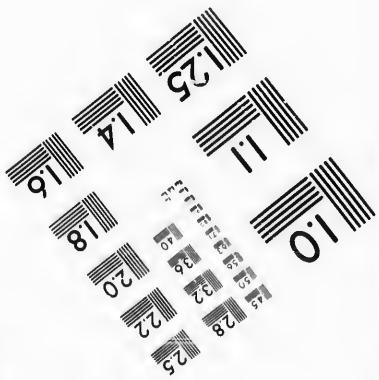

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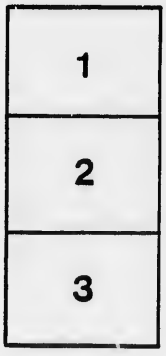

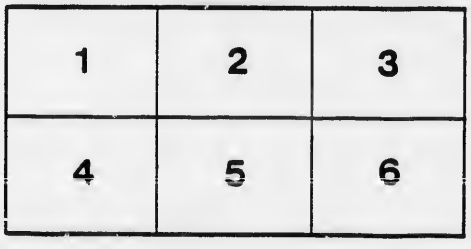

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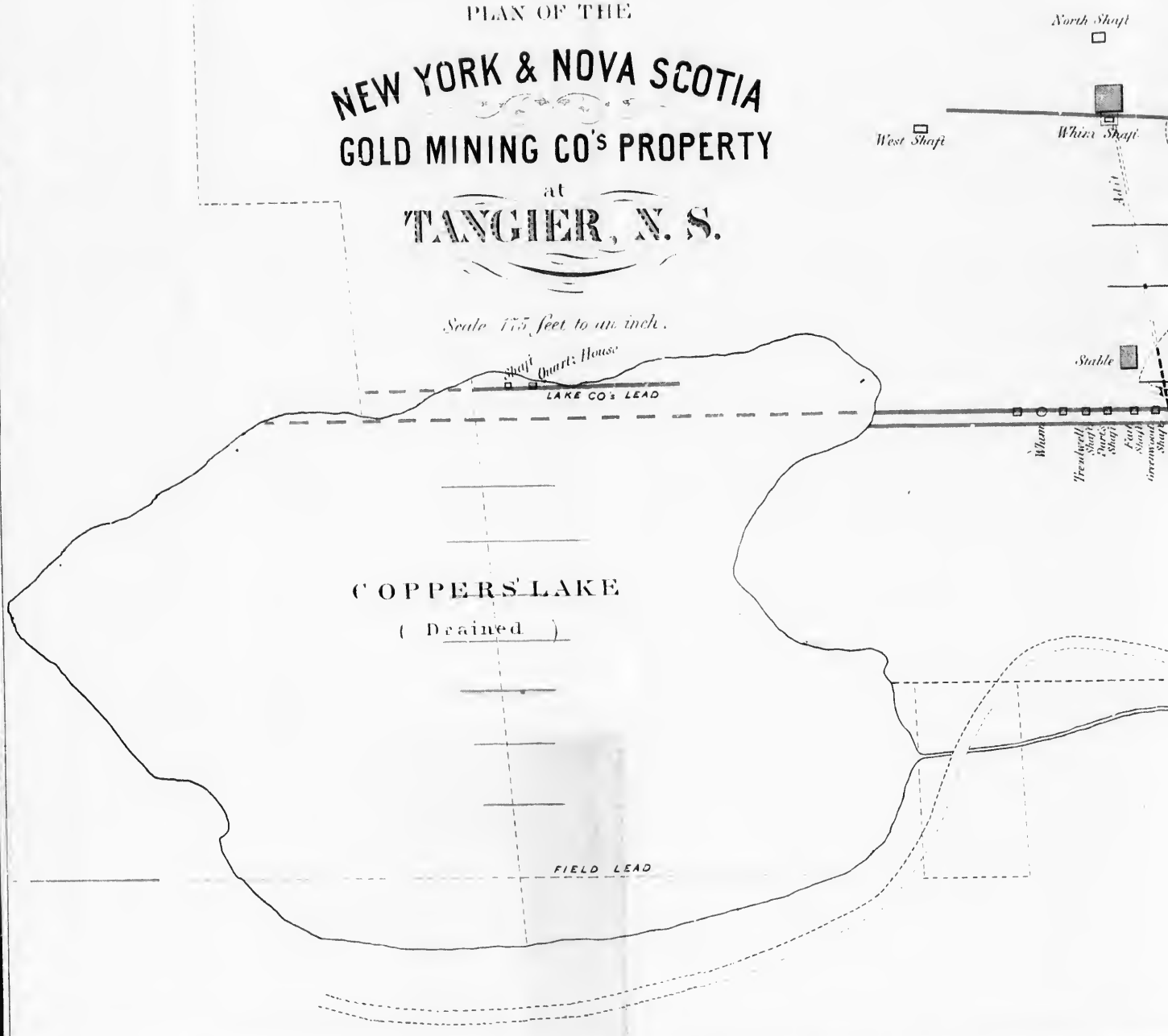
PLAN OF THE

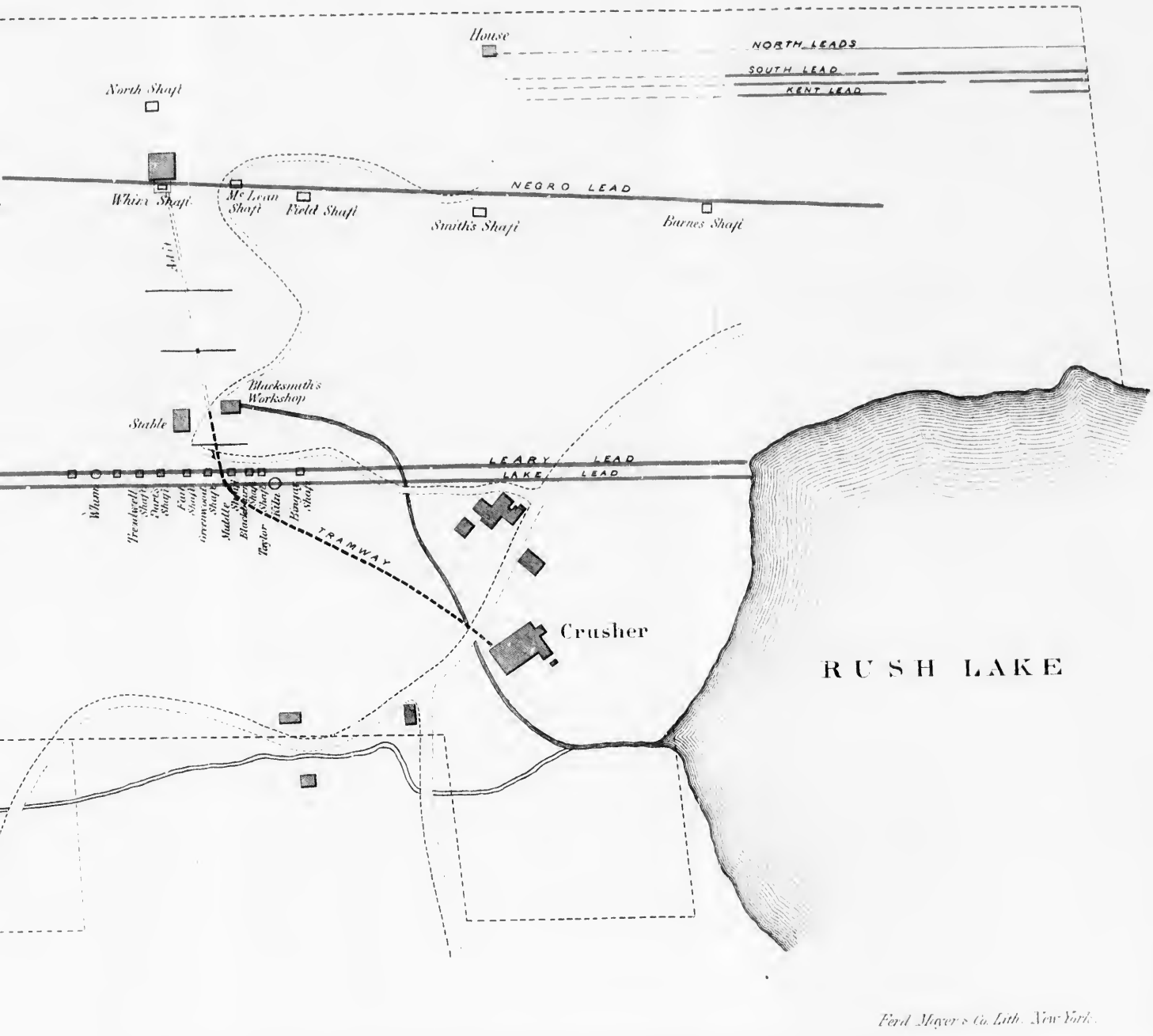
NEW YORK & NOVA SCOTIA GOLD MINING CO's PROPERTY

at

TANGIER, N. S.

Scale 175 feet to an inch.





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REPORT

ON THE

GOLD PROPERTY

OF THE

New York and Nova Scotia

GOLD MINING COMPANY,

WITH AN INTRODUCTION ON THE

GENERAL STRUCTURE AND GEOLOGY OF THE

NOVA SCOTIA GOLD FIELDS.

BY

B. SILLIMAN, JR., M. A., M. D.,

PROFESSOR OF GENERAL AND APPLIED CHEMISTRY, IN YALE COLLEGE, &C., &C.

NEW-YORK:
GEORGE F. NESBITT & CO., PRINTERS AND STATIONERS,
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1864.

To Ben

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New

To Benjamin C. Buzby, Esq.

President of the New York and Nova Scotia Gold Mining Company.

Dear Sir:

Having at your request visited and examined the property of your Company at Tangier Harbor, in Nova Scotia, and since my return having worked up my notes and the chemical analyses, I am now prepared to submit for your consideration the following report, to which I have prefixed a general account of the Nova Scotia Gold Region. Supposing that the information contained in this Introduction, not being generally accessible, may be of interest to those who give attention to this new field of enterprise,

I remain, with respect,

Your obedient servant,

B. SILLIMAN, Jr.

New Haven, *February 1st*, 1864.

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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 Aspatogoen, about 500 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 6,000 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 not be rewarded with new discoveries as important as any which are now known. Such, indeed, was the discovery of the Oldham District, made by two hunters, who had heard of the association of quartz with gold, and remembered in their hunting excursions to have seen a large boulder of this mineral in a densely wooded tract, now the centre of one of the most valuable gold districts in the Province.

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" (page 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 positions 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 grooves and striæ, which accompany their polish. In other cases, the glacial drift is seen composed of angular, rarely rounded, fragments of quartzite and clay slate, embedded in a tough clay, resting on the surface of the polished rocks. This detrital matter is auriferous, but the large amount of coarse, angular fragments of rocks would render it very difficult to wash, even when 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 Sherbrooke, 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 quartzitic boulders which have been left in trains by the ancient glaciers upon the surface of the polished rocks. These at times recall strongly the moranies of the Swiss glaciers, and rival them in the magnitude of the travelled 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 abundant. Some very conspicuous blocks 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 100 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 long 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 of the country by glacial action, has gone into the Atlantic Ocean, where the gold is safely deposited. Sable Island, which, by McKinley's map, is distant about 100 miles from the shore—is a sand spit, 30 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 Sacramento Valley has retained here the spoils of the glacial epoch; and this 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 veins.

The success following the washing 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, will probably 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 "Whin," or "Whinn," 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, properly called quartzite. It is a very hard, compact rock, consisting of grains of quartz or sand, consolidated into an extremely firm 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 rhombic-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 Shubenacadie, he has measured it of that thickness. It frequently forms one 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 average distances, 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 their generalization, which, if true, is of the highest economic 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 green magnesian rock, closely resembling serpentine or indurated talc.

Chloitic 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 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 in the mines to require other aid in its removal than a few buckets daily. In one case, in Waverly, the levels are extended at the depth of 110 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 Capt. 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 for the hardness of the rocks, and the consequent cost of mining; and the same quality has compensation also in the diminished cost of timbering underground. 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 the stratified rocks at various angles.

(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 very 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 Sett.

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 8 feet, and the middle lode 6½ feet.

As a rule, the quartz veins in Nova Scotia are not large, being more usually from 4 to 8 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 of crystalline quartz, often quite white, sometimes mottled, having the gold usually in coarse visible particles, and showing a decided tendency to crystallization, both in the quartz itself, and in the associated minerals. Such are the "Negro Lode" at Tangier, 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 lamellar 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 "Leary Lode," "Field Lode," "Lake Lode" and "Copper's 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 the 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 of the vein. 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, where 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, embedded 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 portion 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 detached bits of the pyrites are not unfrequently held together by gold thread, 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 over the intervening valleys, to re-appear on the opposite hillside. 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 50 feet or more, (this is common also to all the smaller veins of the sett,) but the vein, as a whole, has been opened more than half a mile—and the more powerful veins at Hammond Plain extend probably over a mile, and those at Tangier about 1,500 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 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; and then 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, where a mass of the quartz vein, of perhaps two cubic feet capacity, yielded, as I was informed by an eye-witness, $4,500 in gold, and the price of the stock went up, in a few hours, from $5 to $40; 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. P. 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 1st, 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 10,565 tons, and on the yield of gold of 6,870 oz. over the same period of the pevious year.

"It will be perceived that the yield of gold, per ton, had experienced a variation of 22 grs., equal to $5\frac{3}{4}$ per cent.

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

"The profit on the quartz crushing, for the year ending September 30th, was £22,958 16s. 5d."

It appears from the report of Messrs. Garnett & Wakelle, of San Francisco, (June 15, 1863,) on the Mariposa Estate that the Princeton Mine, (the best mine on that vast estate,) during three years last past furnished 62,000 tons of quartz, yielding $1,250,000, or about $20 per ton. While in the present year 160 stamps, (in 4 mills,) in 540 days' aggregate work, crushed 24,013 tons of quartz, yielding $385,000, or almost exactly $16 per ton. The best mill average 27 working days to the month; $1\frac{87}{100}$ ton of ore daily, equal to 744 per stamp.

The *present* averages from the principal mines on this estate are stated as follows: Princeton ores nearly thirty dollars per ton, Green Gulch, $14, and Mount Ophir, $16 per ton.

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 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, informed me that he had crushed a slate from that region which yielded him over an ounce to the ton. Caution 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 a 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 thirty feet, became two feet, and in four hundred and two days work, they obtained two hundred and forty-six 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 eight and a half ounces of gold per ton for all the quartz raised.

The "Triad Co.," for July, from twenty-two tons, obtained one hundred and forty-five ounces, or over six and a half ounces to the ton; and the same company in August obtained, from twenty-six tons nine hundred pounds, eighty-three ounces of gold; for October, from thirty-five tons, one hundred and forty ounces.

The Hattie Lode, at Wine Harbor, has yielded sixty ounces to the ton, and sixty-six ounces from one and a quarter tons of quartz.

Butler & Co., at Wine Harbor, for September, from 29 tons took 69 ounces, and for October, from 30 tons 800 lbs. 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 four to six ounces to the ton.

A lot of 2,500 lbs. of selected quartz, from the South Taylor Lode, in Waverly, crushed by Huff, yielded 22 oz. of gold, while a lot of the same lode, unselected, yielded $2\frac{3}{4}$ oz. 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 60 oz. to the ton of quartz from it.

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

4	tons	yielded	16	oz.	5 dwt.
1	"	"	20	"	3 "
6	"	"	21	"	17 "
2	"	"	5	"	12 "
14	"	"	65	"	6 "
$1\frac{1}{2}$	"	"	65	"	10 "
13	"	"	59	"	10 "
2	"	"	9	"	12 "
1	"	"	3	"	8 "
$12\frac{1}{2}$	"	"	78	"	— "
2	"	"	33	"	5 "
$17\frac{1}{2}$	"	"	57	"	— "

Or, in round numbers, an average of five ounces to the ton, on about 100 tons of quartz crushed. While, on the other hand, 442 tons yielded an aggregate of only 821 ounces, or not quite two 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 five ounces 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 as 800 lbs., yielded, on dry crushing in a hand-mortar, 21½ ounces of gold, leaving still all the small gold in the tailings, 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 own 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 a Gold District within assigned limits. 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 "claims" or "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 "claim" or "area;" but he may elect on which of any number of contiguous claims on a given vein he will work, and may expend all the labor required for the whole upon that one, as in sinking a shaft, &c. 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 render 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," an example of which will be found in the Appendix, marked "A." 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, Samuel Creelman, Esq., gives a large, interesting and important amount of 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 experiences 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 has been, 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 small and 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 burthen of keeping the vein free of water, on pain of forfeiture for neglect, after twenty 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, will apply.

METHODS OF DRESSING AND AMALGAMATING GOLD ORES IN NOVA SCOTIA.

The quartz is generally reduced by stamping mills—sometimes by Chilian mills—and is first 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, 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, by boxes of mercury set before the stamps, by riffles, shaking tables and blankets; and a few use the round iron pan, with mercury, somewhat similar to the California plan, but managed very differently. Such is essentially the case in the English mills, and in these alone and the New York and Nova Scotia Co's. mill did I observe a Hundt's buddle at the end of the system to concentrate and save the pyrites.

Experience has shown in California that the old system of amalgamation by riffles, and the system of copper plates covered with mercury, is very imperfect and unsatisfactory, and in its best state, with amalgamation in battery, can save not over 65 to 75 per centum of the gold which the fire assay shows to be present. Hence the almost universal adoption, in California and Nevada, of the system of concentration by the iron pan in 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. These pans when properly managed save, it is said, on the authority of "Küstel," a mining engineer and metallurgist of great experience, not less than 95 per cent. of all the gold shown to be present by the fire assay.

NOTE.—See his "Processes of Silver and Gold Extraction." San Francisco, Cal., 1863. 8vo.

COMPARATIVE ADVANTAGES OF GOLD MINING IN NOVA SCOTIA AND ELSEWHERE.

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 proportionately 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 uses, 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."

This emphatic testimony from so competent a witness as Prof. Phillips, who is familiar with the gold fields of the world, as few others have had an opportunity of becoming, leaves nothing more to be desired on this head.

It will be useful to compare the average product of a man's labor in the Nova Scotia Gold Mines with the similar product elsewhere. The Gold Commissioners' returns enable us to do this with an approach to accuracy. From this source I have prepared the following abstract of the labor and products for six months, ending December 31, 1863:

In July,	994	men	earned	$35 85 each.
" August,	1,156	"	"	28 30 "
" September,	750	"	"	33 42 "
" October,	719	"	"	42 14 "
" November,	715	"	"	40 86 "
" December,	747	"	"	32 20 "
Average per man				$35 46

Assuming 27 days' labor in a month, the daily produce of the labor of one man is $1.31, not deducting the cost of crushing. The produce of one man's labor in Victoria, in 1860, where 18,296 men produced a gold value of $1,813,989, was 31 cents per day, not deducting the cost of crushing.

It is to be remembered, that systematic mining by well-organized companies is quite in its infancy in Nova Scotia, such organizations being all quite recent, and none of them as yet making returns. The returns published are almost entirely from individual efforts on a small scale.

THE GOLD DISTRICT AT TANGIER.

As the Tangier district was the gold field earliest brought to public notice in the Province of Nova Scotia, so does it still remain one of the most interesting in the promise of good results to systematic and economical mining. The crowd of adventurers who peopled the hills of Tangier in 1861 and 1862, on the course of the "old South Leads," has indeed disappeared, and the evidence of their unsystematic and ill-applied labor, now scars the hills with numerous grave-like pits, filled with water, and perilous from imperfect covering. If many, in their *auri sacra fames*, found here only a place to bury their hopes, others, more fortunate, were rewarded with splendid wages for their personal labor. The ill-considered system of allotting claims, at first adopted by the Colonial Government, in a manner compelled the early adventures to abandon their labors, as soon as the surface water accumulated in the open pits or shallow levels, beyond the control of a single bucket or other primitive contrivance. Even the most fortunate adventurers were soon drowned out by the accumulated waters from adjacent claims, abandoned by less successful neighbors. Nearly all of these early efforts at individual mining are now abandoned, and the claims have since been consolidated in large companies.

The value of the Tangier District, in the opinion of Mr. John Arthur Phillips, of London, is thus expressed in his Report to the Nova Scotia Land and Gold Crushing and Amalgamating Company, in London, 1862:

"This is, at present, one of the most important mining localities in the Colony. The workings, which I inspected here, are on a hill, a short distance from the Harbor of Tangier, extending over an area of about three-quarters of a mile in length, by about two hundred yards in width. There are at least five distinct lodes at work within this band of mineralized ground, varying in thickness from five to fifteen inches. The quartz, extracted from many of these claims, presents large quantities of visible gold, and some tons weight have been crushed and amalgamated by means of two

Chilian mills, which have been erected on the spot, and have yielded from three to nine ounces of gold to the ton. There can be no doubt that the gold deposits of Tangier will prove largely and permanently valuable, provided a sufficiently large area can be secured to enable a company to work the mines in a scientific and systematic manner."

SITUATION AND NUMBER OF VEINS IN THE TANGIER SETT.

The auriferous veins at Tangier occupy a neck of land facing the sea, in Tangier Harbor, and reaching from near the bridge, over the Tangier River, east, as far as the middle of Rush Lake. The distance, on the north line, is over half a mile, and including the eastern openings, on the land of the English Company, on Strawberry Hill, must be about a mile. Within this area, there are at present explored, not less than thirty veins of gold-bearing quartz, large and small, varying from two feet to one inch, and continued search is constantly adding to the number. Many of the smaller veins, which are grouped together at the surface, will doubtless unite in no great depth, offering important advantages for mining. At present, attention has been bestowed chiefly on those veins which have shown a good thickness at surface, and have proved themselves most productive in gold.

GEOLOGICAL AND MINERALOGICAL CHARACTER OF THE VEINS AT TANGIER.

The rocks, at Tangier, strike almost due east and west, not varying, by the compass, over 5° or 6° S. of E. They stand at a high angle, dipping uniformly south, from 10° to 30° departure from the verticle. These rocks comprise, 1st. the quartzite beds, often highly charged with arsenical pyrites, breaking in rhombic forms, and of an almost basaltic blackness of color, though weathering nearly white. 2nd. The hard blue slates, sometimes also metalliferous, especially near the quartz veins. Sometimes this slate is highly metamorphosed and contorted: again, quite soft, fissile, and regularly divided by joints, into rhombic forms. Its color is generally dark blue, stained at surface by iron rust,

in the metalliferous zones. Sometimes it is olive colored and gray, and rarely chloritic. It is very rarely micaceous or hornblendic, and contains few crystalized minerals besides pyrites; minute crystals of staurotide and epidote occur rarely, but I saw no tourmaline or garnets, although garnets occur in the sands of Copper's Lake. The sands on the sea shore, as well as in the lake, indicate the existence of ilmenite and chromic iron, or magnetic iron. 3d. The quartz veins are of two descriptions; those which occur parallel to the bedding of the rocks, and which are the gold-bearing veins; and cross veins, intersecting the strata at an angle, and generally barren of gold. The latter form, in the districts which I have examined, an insignificant feature in the geology, compared with the auriferous veins.

Associated with the quartz, the principal minerals are yellow and white pyrites, mispickel, copper pyrites, galena, zinc blende, and more rarely carbonate of lime, metallic copper, or carbonate of lime and iron, green carbonate of copper, specular iron, iron sinter, and arseniosiderite, are also seen, but less frequently. I sought in vain for bismuth or antimony, although small crystals believed to be sulphuret of silver, have been detected in the pyrites. The gold seems to be most intimately associated with the arsenical pyrites, or mispickel, and the zinc blende often enclosing or penetrating these minerals. More rarely the gold is associated with galena, most of the specimens shown me of this sort, proving on examination to be zinc blende or mispickel. The mispickel and the iron pyrites are both auriferous, and when these minerals occur in sufficient abundance, they should be reserved for separate treatment, the amalgamating process not securing the gold they contain. The largest masses of arsenical pyrites are found in the blue slate, forming bunches, often highly crystalized and of considerable weight. This slate, with the mispickel, is usually the foot wall. The gold occurs often in little nuggets and pipettes in the pure white quartz, sometimes, but rarely, beautifully crystalized, often showing a strong tendency to crystallization, of a splendid lustre and high color. It also occurs in scales and plates in the adjacent slate, near the line of contact of the quartz, and,

as already mentioned, implanted in masses of arsenical pyrites, zinc blende, and more rarely with yellow iron pyrites and galena.

Its disposition to occur at or near the line of contact between different minerals, or wherever there is a shut or change in the vein, is very manifest. It also occurs, of course, in particles too small to be seen in the solid quatz, as is constantly shown by the results of dressing. The quartz veins often preserve a striking similarity to the harder slaty bands as if they were metamorphic of the slates. Generally they are compact and less cellular than the gold quartz of the Appalachians, often oily looking, blue and gray in color, though frequently quite white in some parts of the vein. The walls are polished in contact with the slates, and rarely separated from them by any lining of "flucan" or decomposed rock. Sometimes near the surface the decomposition of the pyrites on one wall has left an open space, partly filled by iron rust from the pyrites, and in such cases this material is apt to be rich in gold, though in an invisible form.

There is the same structure also in the Tangier veins, noticed elsewhere in the Province, as respects the occurrence in them of swells and rolls, alternating with plain spaces; where these rolls occur the quartz is usually more auriferous, and the spaces between them are proportionately poorer in gold.

These rolls preserve an essential parallelism with each other, and have a dip obliquely to the west or east according to the pitch of the associated rocks, and parallel to what has been called the "grain" of these rocks, that is to say, parallel with the direction of the axis of elevation. As the shafts and drifts cut these swells at an oblique angle, it happens, that the progress of exploration carries the work alternately through pieces of ground where the veins swell or contract, and where there are corresponding differences in the gold product. At times the contraction of the vein shuts it off for a short distance, producing the impression that it is about to come to an end, when, from a narrow thread, it enlarges again gradually or rapidly to its full size.

These rolls or swells in the quartz appear to me to have had their origin in the upheaval which has given the easterly and westerly

pitch to the axis of elevation of the rocks, on the line of strike, the corrugations, or rolls occurring as a consequence of this mechanical disturbance.

The distribution of the gold in the quartz is sometimes such as to excite surprise at its abundance. Mr. Campbell, who was employed by the Provincial Legislature to prepare the geological section, and notice of the Nova Scotia gold fields, addressed to the Hon. Jos. Howe, Provincial Secretary, [dated Halifax, 25th of July, 1863—legislative document, p. 12, 4to,] informs me that while he was, in 1861, engaged on this survey, he saw, at the Lake Company's Lead, on the borders of Copper's Lake (now on lands of the New York and Nova Scotia Gold Company), a mass of quartz of about a cubic foot in volume, which was entirely plated over with gold, on the plane of contact, on the south or foot wall of the vein. During the working on the "South Leads" in 1861-62, numerous very showy specimens of gold were taken out, particularly from the Negro Lead, worth in gold value from $100 to $325. During the past summer three men, who were repairing the road in Tangier, near Archibald's, in digging earth from the road-side to mend the way, took out in three days coarse gold to the value of $950, from a spot not over three or four yards square. This gold was in the form of nuggets and coarse grains, not at all worn. One nugget weighed sixteen ounces, others eight, six, three and two ounces, and smaller. This spot was no more promising for such a discovery, than any other one in the region, and although the surface is covered with large masses of quartz, and it is plain from which direction they must have come, no efficient search has been made for the vein which yielded this gold, which had obviously not been moved far from its original source.

I have already, under a former head, given the reasons which, in my view, account sufficiently for the general absence of alluvial gold in the Nova Scotia gold region, and discoveries like this only confirm the views before expressed.

REPORT

ON THE

New York and Nova Scotia

GOLD COMPANY'S PROPERTY.

SITUATION AND EXTENT OF THE PROPERTY.

The estate of the New York and Nova Scotia Gold Mining Company is situated in the Tangier Gold District, about 60 miles east of Halifax, at the head of Tangier Harbor. It comprises about 75 acres of land, in an area measuring nearly half a mile from east to west, and about half that distance from north to south. Its form and boundaries will be understood from an inspection of the accompanying map. It adjoins the estate of the Atlantic Mining Company on the west, and the two form together the most important part of the Tangier Gold District already described.

Facing the harbor on the south, it is accessible for vessels of sufficient draft for transportation of coal, lumber and heavy machinery, while by land it is connected by the mail route with Halifax.

Rush Lake forms its south-eastern boundary, and offers a convenient receptacle for the waste of the dressing works, situated on its margin. The dry bed of Copper's Lake forms its south-western boundary, being connected by a canal and small stream with Rush Lake, which is somewhat lower, and into which sluicing can be carried, if it is decided to wash the detritus on the bottom of Copper's Lake in that manner.

The buildings on this estate are numerous, and the property is in the midst of the most considerable settlement on this part of the coast, an industrious and thriving village, having sprung up with the development of the Company's mines, and those of the neighboring Companies.

CHARACTER AND DEVELOPMENT OF THE PROPERTY.

This is undoubtedly, at the present time, the best developed gold property in the Province of Nova Scotia. It was to this spot that the great crowd of gold hunters rushed in 1861–62; vainly hoping to enrich themselves by unorganized and unsystematic labor. While a few were fortunate, the chief benefit of their ill-directed labor was the discovery and exposure of a large number of gold-bearing veins, now consolidated in the organization of this Company. Since its organization it has been the policy of this Company to push its explorations upon the most promising veins, and especially upon two of them—known as the Leary Lode and the Negro Lode, by sinking shafts, driving levels and raising ore, so as to place themselves in a position to keep up a regular system of crushing and amalgamating. To this end they have built a substantial crushing mill with twenty-four head of stamps, a powerful steam engine and boilers, two Chilian mills, and round buddles to concentrate and save the gold-bearing pyrites—which have generally been rejected. An adit level has been driven from near the level of Rush Lake, which will cut all the lodes in the sett when extended, but at present has reached only to its intersection with the Negro Lode. By this adit the ore stuff will be delivered by trams, already constructed, to the kilns and crushing mill. In short, the whole property has been laid out with evident engineering skill, and with a view to economy of labor, doing credit to the well-known abilities of Capt. M. D. Field, who was the engineer. A large amount of ground is open, and the stopes are in progress from the adit to surface. The number of lodes already opened on the property is eleven, to which may be added twenty-one smaller ones, cut in the exploration of Copper's Lake, and the probable extension of some of the veins of the Atlantic Company into this property. All these items will be considered in detail in their proper place, being alluded to in this connection merely to justify the statement before made of the forward state of exploration and development of this property. Of its gold product, suffice it to say, that it will compare favorably with that in any district in Nova Scotia.

DESCRIPTION OF THE GOLD-BEARING LODES.

The general geological structure of this district has already been sufficiently considered; we will now enumerate and, as far as necessary, describe the gold-bearing veins at present known to exist upon the Company's property.

Commencing at the north, we find firs a group of seven veins, on which, at present, but little exploration is being made, but which demand specific notice. We will name them in the order of their position:

1. *The Four North Lodes.*—These veins vary from 2 to 12 inches in thickness. They have been traced in all about 1,200 feet in length. It is interesting to remember that it was one of this group which, in the month of October, 1860, furnished the earliest knowledge of the existence of gold in this part of Nova Scotia. Peter Mason, a fisherman, and a resident land owner near the head of the Tangier Harbor, was passing through the woods, about half a mile from his residence, upon his own land, when he stooped down to drink at a small stream which passes over the North Lodes. He observed, while in that position, a shining yellow substance in a piece of white quatz which abounds thereabouts. Securing the specimen he satisfied himself that he too had discovered gold, which had not long before been detected on the headwaters of the Tangier River.

The advanced state of the season prevented much exploration that fall, and, in the Spring, the Government took possession of the district through their agent, and laid it off in small lots upon the supposed course of the veins.

The deepest shaft which has been sunk upon the North Lodes is 40 feet. The vein was found at that depth very nearly perpendicular. The gold in this group of lodes is associated largely with metallic sulphurets and arsenical pyrites. It is finely divided, but with an occasional occurrence of coarse gold.

No data remain from which to determine the gold value of this quartz to the ton. The gold was extracted by breaking up the quartz with hammers and by rudely constructed arrastras—

methods by which, without doubt, much of the gold was lost, and nearly all that associated with the sulphurets and arseniurets.

The excessively bad system of small areas of 20 by 50 feet led to the excavation of so many shallow surface pits, that the accumulating surface water soon drove out the adventurers, who abandoned their claims, and the ground has remained since quite neglected. The mineralogical character of the North Lodes is such as to refer them to the group of crystalline veins. The quartz is crystalline and highly mineralized, the abundance of sulphurets being a striking peculiarity. The color of the quartz is bluish and without an oily lustre or slaty structure. I am informed that copper ore and antimony glance have been found in this group of veins, but have not seen specimens of those minerals from it.

When the leisure of the Superintendent permits, I should advise the exploration of this ground, as it is not unlikely to yield favorable results.

2. *The Middle Lode.*—This vein has not been worked, although it was among the earliest discovered. It is associated with what is locally called a "Bull Load," or cross course, two to three feet thick, intersecting the plane of statification, and therefore a true vein. Lodes of this description in Nova Scotia are usually barren of gold. Hence a prejudice arose against this middle lode, which shows but little sulphurets, and the quartz of which is of a compact, somewhat oily character. It deserves, a trial, however, as soon as other and more important explorations permit.

3. *The Two South Lodes.*—These were so named because they were found about the time when the north lodes were being opened, and it was supposed that they were the southernmost of all the veins in the Tangier District. They are situated about 50 feet south of the group of north lodes, and are separated from each other at surface by about 15 feet of interposed rock; but at a depth of 81 feet from surface they are only 4 feet apart, owing to the fact that the underlie of the larger vein is more rapid than that of its neighbor; and it is plain they must intersect or unite

in one larger vein at a depth of 110 feet, if the same uniform dip is maintained. The larger of this pair is from 4 to 6 inches thick; the smaller, or "little south lode," is from 2 to 3 inches only They have been traced upwards of 1500 feet in length. Numerous shafts have been sunk on them by the early explorers, and to this day several of these have continued to be worked upon adjacent properties. They vary in depth from 60 to 100 feet, but, owing to the want of organized and systematic labor, many of them have been abandoned.

I learn from the local Gold Commissioner that the yield of gold from these lodes was, in most instances, highly remunerative—from half an ounce to six ounces, to the ton of quartz. The average was estimated at three ounces to the ton, and in some of the shafts there was a marked improvement in depth, owing, no doubt, to the mode of distribution already described in the Introduction.

The mineralogical character of the quartz in these leads is quite favorable; coarse gold is visible in it, especially near the slate wall, and the associated minerals are such as accompany the most productive lodes. The south wall is a soft pyritous slate, fissile, and easily removed—conditions highly favorable to mining. The north or hanging wall is quartzite with some pyrites. The iron pyrites in both the slate and quartz is abundant, and is accompanied in the quartz with arsenical pyrites and metallic copper. These veins belong to the group of crystalline lodes.

At present nothing is being done on these lodes upon the property of the New York and Nova Scotia Company, but it is highly desirable to make a thorough exploration of them on this property as soon as practicable. It will be seen, by reference to the returns from White & Esty's Mill, quoted in the introduction, that the yield from the south leads was over 4½ ounces of gold to the ton. A result so highly encouraging as to leave no room to doubt the propriety of resuming explorations upon them.

4. *The Kent Lode.*—This is a strong quartz vein, from one to two feet in thickness, highly pyritous, and referable to the

class of slaty veins, with oily quartz. But little has been done in its exploration—being nearly vertical, it was believed by those working the south lodes, (distant fifty-four feet on the surface,) that they, with a more rapid dip, would intersect it at a depth of about 150 feet—a point which yet remains to be proved. It has yielded, at surface, small quantities of gold.

The foregoing veins, it will be seen by the map, occupy the north-eastern portion of the property of the Company, and have received almost no attention since they came under the present organization. They may be regarded as a kind of reserve fund for future use, when the time arrives, which will permit the proper research to be made on them.

We come now to consider the two most important lodes on the property—certainly those on which the greatest amount of labor has been expended—and which are of more immediate interest as giving present returns.

5. *The Negro Lode.*—The "Nigger Lead," as it is familiarly called, (because it was discovered by two of the innocent causes of the present war,) is a large vein of crystalline quartz, about one hundred feet south of the last-named. Its size is from 10 inches to 2 feet, and it has been opened over a distance of 2,500 feet. If the Dana Lode on the Atlantic property is the same vein, as there is good reason to believe, then it is known to extend over half a mile. It dips 60 degrees to the south, resting on a dark blue soft slate for its under wall. The hanging wall is a heavy bedded quartzite, filled with mispickel and yellow iron pyrites.

This vein is, in many respects, the most remarkable one in this district. It is highly crystalline, being the type of the first class of auriferous veins, and carries with it a large number of well crystallized minerals. It has always yielded the showiest specimens of crystallized gold which have been obtained, some of which have had a gold value of $100 and upwards. Its associated minerals are calc-spar—rarely found elsewhere in these veins. Carbonate of iron, yellow and white iron pyrites, sometimes very beautifully crystallized, mispickel and yellow copper; it has, in fact, more the

aspect of a metalliferous vein than any other I examined in this district.

The gold it contains appears to be generally coarse—or visible gold, which, it would seem, has been separated at the expense of the mass of the quartz, since the returns from stamping are not as large as the showy character of the specimens would lead us to expect.

A reference to the accompanying plan will show that six shafts have been sunk on the course of this lode, to various depths, from 25 to 60 feet. From three of these—the Main shaft, Smith's shaft, and Barnes's shaft—drifts have been commenced, and are being extended east and west, to open the mines for stoping. The west shaft, at the time of my visit, was not yet quite down to the ten fathom level. The location of some of these shafts illustrates the evil consequences of the bad system of small allotments, leading to a great waste of capital and labor by compelling adjacent owners to sink on their own land, in place of adopting a system of consolidation, with a view to extended and deep explorations. This remark applies with even more force to the Leary vein in which shafts were, by this system, crowded together in the most absurd manner.

But little stoping has yet been done in the Negro vein, the ten fathom level not being yet driven through. In the whim shaft I witnessed the commencement of stoping (overhand) early in December, and measured a piece of ground 12 by 8 feet, which four men had broken down in three and a half days' time, at a total cost of $12.60. The ground broken was four feet wide, of which the vein measured not quite one foot; at twelve cubic feet to the ton, the amount of product was not far from 8 tons—call it 6 tons, and the ore would cost $2 per ton for mining. It could be contracted for at that price beyond doubt. This level, on the 6th of December, was driven 93½ feet east and 90 feet west. At the west end the lode was split by a mass of slate, and at the east end it was evidently pinched by one of those rolls or folds already described. The evidence of this folded structure was plainly visible in the lode at other points. I advised the mining captain to send

up the adjacent slate wherever it was seen to carry arsenical or other pyrites, or to be cut by thread veins of quartz; since then it is almost certain to carry coarse gold at the lines of contact, or fine gold in the pyrites.

When the 10-fathom level is extended from "Barnes'" to the "West" shaft, the ground opened by it for stoping will be about 1,000 feet long, and will average 40 feet high. This will yield by measure—calling the average size of the lode, with the accompanying thin shale, one foot—3,500 tons of ore stuff, or about one year's supply for a mill averaging 10 tons daily. Assuming the cost of mining and crushing as $4 the ton, which is probably about the fact, all contingencies considered, on a vein of this size, it will be seen that if the gold yield is only one ounce, or $20 per ton, the returns will be satisfactory.

As, however, it is always a time-consuming operation to sink shafts and drive drifts, it is equally evident that the active prosecution of these preparatory labors is essential to continued success that the new ground may be well in hand before the old is completely exhausted. The sinking of new shafts at proper distances upon the supposed western extension of the vein is also called for to open up the ground in that direction. The whim shaft should therefore be sunk without delay to the 30-fathom level and downward.

6. *The Leary Lode.*—This beautiful vein is situated nearly 400 feet south of the "Negro," and appears to be not entirely parallel with it or with the Lake Lode which is next south of it, as may be seen by glancing at the map. It has been very much cut open by the surface pits of early explorers. On the east it is lost in Rush Lake, at least it has not been discovered in that direction, nor has it been identified beyond the margin of Copper's Lake on the west. Although it is believed by some that it has at this point suffered a heave to the north, in which case the openings on the margin of the lake, known as the "Lake Company's Shaft," may be upon the Leary. This cannot, however, be assumed, although the mineralogical character of the quartz in the two is not very un-

like. Both veins belong to the 2d class or group of oily quartz, with a more or less slaty structure, and mottled with dark blue or gray patches, with a white semi-transparent paste.

The Company now own the entire length of this lode, from the middle of Rush Lake westward, as far as it is at present known to extend, (perhaps 1,500 feet,) having consolidated the numerous small claims into which it was t first broken up. One ill effect of this former divided ownership, before alluded to, may be seen in the numerous shafts crowded within a small space, there being no less than three shafts in the space of 100 feet, and six in a space of 450 feet. This is, however, a thing of the past; and as this Company has not been put to the expense of their construction, they have derived some profit from the needless labors of their predecessors.

This vein is characterized by its mottled aspect, due to a mixture of dark blue and gray quartz, with a semi-transparent colorless quartz. A laminated or slaty structure is also visible in it, the surfaces of lamination being often striated, and not unfrequently coated with a film or plating of iron pyrites and scales of gold. On calcining, the blue and gray quartz becomes milk white, and patches of slate imbedded in the vein become very conspicuous.

The gold appears in crystalline particles, set like gems in the white quartz, in threads and veins penetrating the quartz, and binding it together and in thin scales, between the sheets or folds of the slate and quartz, and occasionally in the blue slate itself. Besides the visible gold, it is well known that both the quartz and the pyrites contain invisible gold. Associated with the gold are mispickel, zinc blende, yellow pyrites and galena. The gold is often embedded in one or more of these minerals, and there is good reason to believe that they are never entirely free of gold, even where no particles of the precious metal are visible.

The foot-wall or north side of this lode is a soft, fine-grained fissile, dark blue slate, easily mined and carrying in it frequently considerable masses of arsenical pyrites or mispickel, although it is not, as a general rule, so highly charged with disseminated pyrites as the foot-wall of these veins often is. I have advised that, so far as

it is seen to carry mispickel or to be penetrated with thread-veins of quartz, it be removed and reserved for dressing for gold. Masses of spathic iron and dolomite not unfrequently occur in this slate surrounding the lumps or bunches of mispickel; native copper and yellow copper also occur in the vein.

The hanging-wall is quartzite, charged with sulphurets and mispickel.

The gold product of this vein has varied from $25 to $80 or more per ton. One lot of 30 tons yielded $26; 39 tons in several lots gave $25; another lot of 6 tons gave $84 to the ton, and a lot of 16¼ tons, crushed in the Chilian mills, when I was at the mine, yielded 2 oz. 5 dwt. to the ton. Two ounces of gold to the ton of quartz I consider a fair statement of the vein.

An assay at the U. S. Assay Office, by Mr. Kent, gave the following interesting results, showing the distribution of the gold in the several members of the vein.

1	Mixed ore containing visible gold (in the ton of 2,000 lbs.)	$1892.17
2	Pyritous ore containing no visible gold " "	93.05
3	Black ore containing no visible " " "	15.57
4	Brown ore (ferruginous) " " "	7.75
5	White ore " " " "	11.63
6	Mixed ore, finest portion sifted " "	62.03

Excluding 1 as no guide, 6 as comprising the others, and No. 4 as forming no important part of the contents of the vein, the average is $40, or almost exactly two ounces to the ton, the same as deduced from actual trial on the large scale. — (See Appendix B.)

The gold of this vein assayed at the U. S. Assay Office, yielded $19.97 the ounce.

Of the value of the pyrites I shall speak further on.

The ground open upon the Leary Vein is all above the 10-fathom level, the ore still standing there in December, being about 600 tons. This estimate includes all the unbroken ground from the west shaft, the eastern limits of the present workings, and above the 10-fathom level, and assumes an average of 6 inches for the

vein. This was being taken down by contract, and about 100 tons were at surface at that time.

The shaft Nos. 1 and 3 were sinking by contract to open the 20-fathom level. These works of exploration cannot be pushed forward too rapidly, as it is evident that all the new ground will be wanted as fast as it can be made ready. To sink these shafts, at least two months will be required before they can reach the 20-fathom level, and to drive the levels to a point, where stopes can be advantageously commenced, will probably require as much more time. A section of this vein, 60 by 100 feet, will contain, assuming 8 inches as the width of the vein raised, about 4,000 tons of ore.* As the Company expect to crush 20 tons of stuff daily, and have the power to crush 40, it is easy to see how long such a section would last. It is to be presumed, however, that they will raise at least half the stuff required by the stamps from the Negro Lode.

7. *The Lake Lode.*—About twenty feet south of the Leary is a lode of the same general appearance and thickness as the last named. The quartz is laminated and its surface striated, its color mottled, and lustre oily. Of its value nothing is known at present. No deep shafts have been sunk upon it.

8. About twenty-five feet south of the last named is a large untried vein, measuring from two to three feet in thickness, and resembling, it is said, the "barrel quartz" of Waverly. This also is quite unexplored.

9. *The Ferguson Lode*, of the Atlantic Company, is believed to intersect the property of this Company not far south of the last, named vein. But this supposition remains to be established. If it should prove true, as from its strength is quite probable, it will be a valuable addition to the Company's property.

10. *Copper's Lake Co. Lode.*—On the border of Copper's Lake a shaft, forty-two feet deep, was sunk upon a vein nearly a foot

* In this estimate I call the vein 8 inches, because some of the foot-wall is broken with it.

thick, of blue and white quartz, very pyritous, and carrying about $21 of gold to the ton of quartz. The pyrites have been estimated, from a trial by Mr. Wm. Barnes, Mining Supt. of the Atlantic Company, as nine per cent. of the mass of the vein. The mean of two assays of the pyrites, made, under my directions, in the Sheffield Laboratory, gave a value in gold of $187.04 to the ton, or $16.83 to the ton of ore, giving a value of $37.83 per ton to the quartz. This, then, is one of your most valuable lodes, and demands immediate attention. As yet this Company has done nothing with it. It has a soft black slate as its foot-wall on the north side, and quartzite for its hanging wall.

11. *Other Veins*—Not included in the foregoing enumeration are several veins, occupying the ground between the Negro and the Leary, the position of some of which is indicated on the map, but of which nothing is known at present.

12. *The Copper's Lake Alluvial Gold.*—The drainage of Copper's Lake was expected, by the adventurers who undertook it, to expose to view an exciting accumulation of nuggets. Disappointed in this, and finding only a mass of vegetable matter and mud, covering a stratum of glacial drift and tough clay, after some unsuccessful search for the expected wealth, the Company abandoned their enterprise, and one-half of Copper's Lake now forms part of the property of this Company. Its total area was only fourteen acres. That its bottom contains gold is certain; but to what extent remains to be proved. On sinking pits anywhere on its surface to the under-clay, and washing the dirt, gold is found in small unrounded nuggets, just such as are seen in the quartz, quite rough and free from any signs of mechanical action. Accompanying it is the *black sand*, so characteristic of gold-washings. The magnet picks up more than half of the sand accompanying the gold, and the remainder (after the magnetic sand is removed) consists of ilmenite or titanic iron, epidote, garnets, &c. As the waters of Tangier River are at a sufficient elevation, within a mile of this lake, to flow to the spot by a flume, it is probable that the joint owners of this lake-bottom may find it advantageous

to adopt the Californian method of sluicing this spot, running the waste into Rush Lake, if, as is probable, the fall is sufficient to give a proper slope to the sluice. As the course of the glacial current has been such as to deposit a part of its burthen in the bed of this lake, and several auriferous veins are known to exist to the north of it, there is certainly good reason to suppose that alluvial gold may be found there in remunerative quantity. The general absence of this source of gold in Nova Scotia, and its reason, has already been considered in a former part of this report.

The remarkable discovery of nuggets, by the roadside, in this neighborhood, last summer, already described, should be a warning not to overlook this source of gold, mined to hand by nature's forces during the glacial period, whose traces are so evidently now on the surface of all the rocks of this region.

The Adit.—An adit has been driven from a point indicated on the map, near the Leary Lode, to intersect the Negro, near the whim shaft. This important piece of work was, on the 1st of December, within 29 feet of the Negro Lode, making it about 280 feet in length. It is proposed to put a tram-way in this adit, and deliver the stuff at the kilns and stamping mill without animal power. The ore from the Leary Load will take the same course. By extending this adit about 200 feet further north, it will intersect the group of veins before mentioned, and at the same time explore a belt of unknown ground. But, perhaps, the most important service this adit can perform will be the drainage of the mines. It has been already remarked that the strata of this region are so close that, when the surface water is disposed of, there proves to be so little water in depth, it is doubtful if there will be need of pumping machinery for its removal. The adit provides a drain for the surface water, all of which, by simple contrivances, well known to miners, can be discharged from this exit, thus relieving the lower levels completely of this great source of annoyance.

SUMMARY OF UNDERGROUND EXPLORATION.

I find from my notes that, on the first of December, the following work had been done, *underground*, in developing the property of this Company, chiefly upon the Negro and Leary Lodes:

Aggregate depth of shafts, sunk on the		Negro Lode,	292 ft. 3 in.
" " " " "		Leary Lode,	199 ft. 3 in.
" length of levels driven "		Negro Lode,	375 ft. 4 in.
" " " " "		Leary Lode,	not measu'd.
Length of adit.....			239 ft.

Shafts 1 and 3, (Munn and Whim,) on the Leary, are to be sunk immediately to the twenty-fathom level, and united by driving at that depth. It appears, from this statement, that the quantity of ground open for stoping in the Negro Vein was, on the 1st of December, much greater than that in the Leary Lode; much more ground having been removed from the Leary above the ten-fathom level than from the Negro, as may be seen by a glance at the plan.

To this summary should be added numerous surface pits, mostly the work of the early adventurers, by means of which much knowledge has been obtained of the position and character of the several veins.

SURFACE IMPROVEMENTS.

1. *Tram Roads.*—A well-considered system of tram-roads has been constructed to communicate from the adit and the shafts, on the Leary Vein, with the kilns for calcining the ore. By this means much manual labor and animal power is saved, and the expense of handling the stuff reduced to a minimum. The wisdom of such dispositions is evident when we remember how large an item labor is in the cost of mining and dressing ores. The grade of the tram-road is such as to deliver the ore at the head of the kilns which are thus filled by gravity.

2. *The Kilns.*—There are two kilns constructed of quartzite, and calculated to hold 25 or 30 tons each. It requires three days to fill, fire and discharge a kiln of 25 tons capacity. If, therefore,

20 tons of stuff per day is to be stamped and dressed, four kilns of 30 tons each will be required to maintain a constant operation. It remains, however, to be determined by experiment whether it is best to calcine all the ore taken to the crushers. Undoubtedly the hard white quartz destitute of pyrites and of visible gold, should be calcined; and so far as the facility of crushing is concerned, there can be no question but that it is greatly promoted by calcination. But the expense of fuel and of labor, in the process, can hardly be less than $1 per ton, where the price of wood is $4 the cord. It is also the opinion of experienced persons, that the saving of time, and of wear and tear in crushing, is not sufficient to pay the additional cost, unless when arrastras or Chilian Mills are used in place of stamps. The calcination is rarely, if ever, carried to a sufficient extent to expel the sulphur from the sulphurets, unless on the outside of the lumps. But usage is divided on this subject in well-ordered mills, and probably experience must decide in your case how far it is to your advantage to push the process. If kilns are used, it is plain they should be laid up in fire-mortar, and not with lime, as is the usual way in the Nova Scotian Gold Fields.

The process of calcining will be found much more effectual in disintegrating the quartz, if the ore can be quenched with water as soon as the fuel is exhausted. Experiment has shown that quartz, so treated, becomes extremely friable; and the stamps would, undoubtedly, pass nearly, or quite double the quantity of quartz which had been quenched as of the uncalcined ore. It might seem, from this statement, that there could be no question of the propriety of adopting a system capable of such results. Every practical ore-dresser knows, however, that there are many other important matters, needful for successful amalgamation, besides rapid crushing.

It will be observed that a very important part of the gold value of the Tangier ores is connected with the pyrites, and the concentration and saving of this portion of the ore is rendered more difficult by calcination, while the apparatus used for the purpose of concentration, must bear a just proportion to the amount of stuff worked,

and the latter cannot be increased beyond a certain point without disturbing the proper working of the apparatus.

Dressing-Works and Machinery.—The steam crushing and amalgamating mill of the Company, is a substantial frame building, 40 by 50 feet, of two stories, with a boiler house annexed.

The Steam Engine is the best one I saw in the Nova Scotia Gold Region. It is estimated at fifty-horse power, has a cylinder of fourteen inches diameter and three feet stroke, with a fly wheel of fifteen feet diameter. It is supplied with steam from two cylinder boilers, forty-two inches diameter, and twenty-eight feet long. Two small donkey engines and pumps supply water, for the boilers and dressing machinery, from a well, communicating with Rush Lake, which is immediately adjoining. This portion of the machinery was supplied by C. H. Richards, of Brooklyn, N. Y., and does much credit to the builders.

The Stamps are arranged in four batteries of six each—twenty-four heads—with wooden lifters, raised by cams, making three blows to each revolution of the cam shaft, which is designed for twenty revolutions per minute, giving sixty blows each minute of a hammer weighing in all 800 lbs. The mill has power for forty head of stamps. As originally built, the stamps had wooden boxes. These have been, in part, changed for cast-iron boxes with four-inch buttoms and six-inch arms, calculated to crush in six inches of water, using mercury in the boxes. The system adopted also includes—

Two Chilian Mills, or edge-stones, running on cast-iron tracks or pans, $6\frac{1}{2}$ feet in diameter, weighing 31 cwt. The stones are of granite, 4′ 2″ diameter by 18″ face, and weighing about two tons each. They make ten revolutions each per minute, at an estimated cost of four-horse power. These mills are fed directly from the stamps, or they may be run separately, as when I saw them, being then fed by hand. They discharge upon

Riffle Tables, covered with amalgamated copper plates, designed to retain the fine gold which escapes from the mills. The sluice

boxes, from the stamps to the mills, are also lined with amalgamated copper. Beyond the riffle-boards the tailings pass by launders to

Round Buddles in an adjacent building, 24 by 45 feet, at a lower level. The form of this apparatus here adopted is that devised by Hundt, and introduced first in England and this country by Messrs. Phillips and Darlington, the well-known mining and consulting engineers, of London. A description of this buddle may be found in the *Mining and Smelting Magazine*, Vol. I. The object of this apparatus is to concentrate the pyrites by washing it free of the lighter waste with which it is associated. A circular, funnel-shaped floor, eighteen feet in diameter, is prepared with a fall to the centre of about 5°, (5½ inches in 8 feet.) The ore-stuff is distributed upon the outer edge by four arms, having spouts at their extremities for the discharge of the stream of ore and water, which enters at the center in a circular launder surrounding the shaft, and of which the four arms are but extensions; canvas wipers are hung from the arms to aid in the even distribution of the stuff; and when the due proportions of water, ore-stuff and velocity of rotation are observed, it is said this apparatus effects a sufficiently close separation of the heavy sulphurets from the quartz waste. The valuable portion, of course, remains near the head or outer edge of the buddle, while the waste is distributed lower down the slope, and the excess of water escapes at the open center. The English Company at Strawberry Hill in Tangier, have erected one of these buddles, and there I saw the result of an experiment of two or three days' running of the apparatus, which could hardly be esteemed a fair trial, as the mill had but just commenced operations. Such as it was, however, the result disappointed me. The concentration was very imperfect, and the separation of the pyrites quite unsatisfactory. I see, however, no reason why the apparatus should not do as good work as can be obtained in ore-dressing on this system, which, however, I do not think well adapted to this purpose.

The house has capacity for two such buddles; one only has,

however, as yet, been constructed. The waste, after passing the buddle, is discharged into Rush Lake.

Taken as a whole, the crushing and amalgamating mill of the Company is a well-considered establishment, capable now of doing good work, and easily modified to meet the results of a more mature experience, without interruption of regular work.

ON THE TREATMENT OF THE ORES.

It is obvious, from what has been said, that the treatment of gold-bearing quartz carrying pyrites, in such a manner as to obtain from it the largest possible amount of the gold it contains, is by no means an easy problem. The gold in quartz is often so very fine as to be wholly invisible, even under a powerful microscope; in fact it is *chemically fine*, and may be compared to the condition in which this metal is precipitated from its solution by sulphate of iron. In this condition it will float upon water, and even when much coarser than this, as any one may satisfy himself by the simple experiment of stirring a leaf of gold-beater's gold in a glass of water. To bring gold in this state into contact with quicksilver, without loss of gold, requires peculiar and very nice mechanical arrangements. Then the coarse gold is sometimes "rusty," as the miners express it, that is, covered exteriorly by a film of oxide of iron, or of some other substance which cuts off contact with the mercury, and so the gold escapes, not being amalgamated.

The gold which is associated *with pyrites* is obtained by the usual mechanical means, only very imperfectly; great loss of mercury follows the attempt at amalgamation, when the metal is associated with *arsenical* pyrites, and it is yet an unsettled problem how best to save all the gold in this association.

In California, according to the statement of KÜSTEL, the loss of gold by the amalgamation in battery with a copper-plated platform, with ores containing heavy gold, is from 35 to 40 per centum of the quantity shown to exist by the fire assay; but light gold gives a less favorable result. "A great many fine particles of amalgam adhere together, including also manganese scum,

if present, and form small, spongy, blackish lumps, which are so light as to float, and on account of being coated with foreign matters, will not unite with the accumulated amalgam. Of this amalgam but very little can be saved; it floats over blankets, copper plates or ripples."*

Of amalgamation on copper-plated platforms, troughs and other copper contrivances, this author remarks they are "very imperfect, and mostly abandoned," in California and Nevada.

Certainly the experience of California may be regarded as a safe guide in gold dressing. There every other contrivance for amalgamation has given way to the "iron pans," which is a highly improved arrastra amalgamation, and at present the most perfect gold amalgamation known. The two conditions are friction and contact with quicksilver, at a high temperature. These are met in a highly satisfactory manner by "Wheeler's pans," the gold being extracted by them as close as ninety-five per cent. of the fire assay. The loss of gold in the pans does not result from defective amalgamation, but from improper discharge. This is not the place to describe, in detail, the construction of this apparatus. My duty is discharged by indicating the best methods to be adopted for saving the gold in your veins. That none of the methods now in use in Nova Scotia approach the perfection attainable, is clear to any one at all acquainted with ore dressing. Every process which I witnessed there was faulty in this particular, especially that it provided no means for the *continued and intrimate contact of the gold with quicksilver;* too much water, and too large an amount of quicksilver were also employed for successful and economical amalgamation. The "iron pan" process, as stated, is only a highly improved arrastra amalgamation. The proper use of the "arrastra" (and of the Chilian mill also) requires use of only a limited quantity of water, not more than is needed to convert the ore into a paste, or thick mud, and the quicksilver

* "Nevada and California Processes of Silver and Gold Extraction," &c., by Guido Küstel, Mining-Engineer and Metallurgist. Illustrated by accurate engravings. San Francisco: F. D. Carlton, 1863, 8vo, pp. 327.

is added, after the ore has been brought to this condition, by straining through a dry cloth over the paste, one or two ounces of quicksilver for a charge of six and eight hundred pounds of ore. If free gold is found after the amalgamation has been some time in process, a little more mercury is added. After four or five hours the pulp is diluted with water, and discharged. This process is repeated until one hundred, or one hundred and fifty tons are worked through, the quicksilver always being added in proportion to the gold in the ore from one to one and a half ounces to each ounce of gold in the quartz. It is essential that the amalgam be dry, or else a loss of quicksilver, and an imperfect amalgamation, follows. How unlike this is to the practice in Nova Scotia, any one will see who has witnessed the usual process there.

From what has been said, it will appear that unless ores are very pyritous, and especially unless the quantity of arsenical pyrites is very great, the California method will obviate the use of any process of concentration by buddles or otherwise, and the "tailings" may be safely neglected. Such, I understand, is the latest California experience in quartz mining. The gold in the pyrites is mechanically but very minutely divided, and, unless it is brought into forcible contact with the mercury *by friction*, will not amalgamate.

Even those ores which contain gold in such a condition that it cannot be liberated by grinding, can be treated in the pans after roasting.

The process of separation of gold by chlorine, known as "Plattner's Process," is also very successful upon these sulphurets, and arseniurets which require to be roasted before treatment. It is a process which requires moderate chemical skill, but gives results even closer than those obtained by the pan process, especially if all coarse gold is first removed by mechanical means.

None of your ores appear to me to require this treatment, and it is therefore needless to give its details.

VALUE OF THE PYRITES IN THE TANGIER ORES.

The average quantity of pyrites in your ores is, to a good degree, a matter of conjecture, but it has been variously estimated

from 8 to 12 per cent. The following assays will show the importance of paying attention to its economical working.

No. 1. Assay of a sample of pyrites worked from tailings at the mill of this Company, made at the U. S. Assay Office, Sept. 23, 1863, as reported by Dr. John Torrey, the Chief Assayer. See Appendix C.

Gold per ton (of 2,000 lbs.)	$122 13
Silver " "	2 67
	$124 80

No. 2. Pyrites from Lake Company's Lead, crushed at White & Esty's Mill, on the Tangier River, Nov., 1863. These assays were made Jan. 14, 1854, by O. D. Allen, Chief Assistan in the Sheffield Laboratory of Yale College.

Mean of two assays gave

Gold per ton of (2,000 lbs.)	$187 04

The silver in this assay was not estimated.

No. 3. Assay of pyrites from tailings of the "Leary Lode." This assay was made Dec. 31, 1863, by Edward N. Kent, Chemist and Melter in the U. S. Assay Office in New York, and gave

Gold per ton of (2,000 lbs.)	$93 05

The mean of the three assays gives a value of

Gold per ton of (2,000 lbs.)	$134 99

Assuming an average of 8 per cent. as the amount of the pyrites in the ore, then the gold value in the pyrites will reach $15 20 per ton of ore. That much the greater part of this value has been hitherto completely lost there can be no doubt. The importance of saving so considerable an item is self-evident.

ASSAY OF THE TANGIER GOLD.

As compared with the California gold, the gold of Nova Scotia is very rich, being, indeed, unsurpassed, in fineness, by the gold of any region.

The earliest analysis of the Trangier gold, which I have seen was that made by Mr. O. C. Marsh of the Sheffield Laboratory at Yale College, in October, 1861, and published in *Silliman's Journal*, [2] xxxii, 399. It is as follows:

Specific Gravity	18.95
Gold	98.13
Silver	1.76
Copper	05
Iron	trace
	99.94

Mr. Marsh says the gold he assayed was "from a quartz vein," but does not specify which; but as, at the time of his visit, in 1861, explorations were active in the group of north and south lodes, it was probably from one of those.

The United States Assay Office has lately made an assay of the gold from the "Leary Lode," with the following results:

Before melting, 55.47 ounces; after melting, 5,298 ounces; fineness, $\frac{966}{1000}$; value of the gold, $1,057 96; for parting coinage and fine bars, $5 29; net value $1,052 67.

The declared value of this gold is $19.97 per ounce, troy.

An assay of the gold from the Field Lode, on the Atlantic Company's land, lately made here, gives, as the mean of two assays—

Gold	97.25
Silver	2.75

Equal to 972½ thousandth fine, and, by the California tables, worth $20.10 per ounce, not estimating the silver.

GOLD IN DEPTH.

There has been a notion long entertained, and having its origin in so high an authority as Humboldt, that gold was always confined to comparatively shallow depths: that quartz veins were richest at surface, and would be found comparatively barren in depth. Experience, in both California and Australia, and so far as it has gone in Nova Scotia, also, has set aside this hypothesis as untenable. I have, in the introduction, given the reasons which lead me to the opinion that just the same variations in depth will be found which have been observed in length on the veins and from the same causes. There certainly exists no reason to fear exhaustion in any depth to which the mines are likely to be explored.

FUTURE DEVELOPMENTS OF THE PROPERTY.

The success of the most valuable mining property may be blasted by the adoption of a mistaken principle of management. The desire for early returns to stockholders often leads to a short-sighted system of hand-to-mouth administration, the result of which is uniformly fatal. The mine is robbed to secure a specious show of dividends, and then follows an unproductive period, in which the manager finds an empty treasury and no power of new calls on the owners, or a reluctant response, ending soon in the abandonment of the enterprise. Such is sure to be the case whenever works of exploration are suspended. The process of extraction is easy and rapid. The remorseless jaws of the crusher devour daily, it may be ten, twenty, fifty tons of ore; and, much sooner than he expects, the manager finds himself without stoping ground, and nothing before him but dreary months of sinking shafts and driving levels, in which, but a limited force can be employed. The organization of the mine is demoralized; the expenses of administration and of the plant continues undiminished; the mill rests idle for want of ore, while the labor of exploration is being prosecuted. Every one who has had any familiarity with the history of mining, in America especially, will admit the truth of this picture. The cure is simple and unfailing. *The work of exploration must never stop, and must be always well in advance of the work of extraction.*

Another important consideration besides those already named urges the adoption of this policy. It is unreasonable to expect that any of the veins on your property, will prove equally remunerative in all parts. There will be some places too poor to pay for working, or the veins may be pinched off to a narrow thread, enlarging again to perhaps more than average size at no great distance. These inequalities are of little importance, and by no means causes of discouragement, if they are known to exist in advance. But, suppose the policy of temporizing to prevail, and such a condition as the last named to occur, discouragement would be unavoidable. Moreover, supposing the worst case possible, namely, the actual loss of the vein in depth, either

by a fault or heave, or by actual dwindling to nothing—if the explorations are well in advance of extraction, the manager sees at once the danger before him, and, with prudent energy, commences timely researches on another vein, or in a new part of the old one, and thus disaster is averted.

In view of these considerations, I trust, I may be pardoned if I seem to assume the direction of the policy of your Company. The principles laid down are of universal application, and if they do not seem to apply to a given case, it must be either that the enterprise alluded to is not worth prosecution, or that those who have it in charge are incompetent to the task in hand.

CONCLUSIONS.

The facts and arguments presented in the foregoing Report appear to warrant the following conclusions:

1st. You have at Tangier a valuable gold property, well developed, as compared with other properties in Nova Scotia, and capable, with good management, of returning satisfactory dividends to your stockholders.

2d. Of about 30 gold-bearing veins known to exist on your property, you at present work only two. Prudence would dictate that you should soon explore some of the others, of which the most promising perhaps are the Lake Company's Lode, and the group of veins north of the Negro, which can be cut in depth by extending the adit until it intersects them.

3d. The main shafts on the Negro and Leary should be sunk uninterruptedly, and of a size adequate to work the mine in depth, providing ladder-ways and space for pumps if they are hereafter required. The levels at the 20–30 &c. fathoms depth to be driven both ways as fast as they are reached.

4th. Your dressing works are capable of disposing of all the ore you are likely to be able to supply, having a capacity for 40 tons daily, and power enough to drive them. The system of amalgamation is perhaps as good as any now in action in the

Province, but falls far short of saving all the gold, especially in the pyrites. It is, however, capable of making immediate returns, and no interruption need be experienced in its modification. The tailings should be so disposed of, that if desirable, they can be worked over again hereafter.

5th. The introduction of the Californian system of amalgamation by the use of Wheeler's or Hepburn's iron pans, heated by steam, is earnestly recommended as likely to add largely to the gold product of the mine.

6th. Your position on the water is highly favorable for cheap freights — coals from Sidney or Pictou being accessible at all seasons.

7th. The labor market in Nova Scotia is far more favorable than that of California or Australia, and constitutes an element of great importance in calculations of profits.

8th. The average productiveness of the quartz veins in Nova Scotia, is believed to be quite as good as that of the quartz mines of California and Australia, while the experience which was so dearly purchased in those countries, is now available, without cost, for your advantage. It is well known that most of the veins which were worked there with loss by the early adventurers, how return satisfactory profits to the present holders with a good system o bor and machinery.

9th. Alluvial deposits are as yet almost unknown in Nova Scotia, nor can they be expected to occur, as a general rule, for reasons stated. But you possess in Copper's Lake a place where alluvial gold occurs, and with the water power at hand to test it.

All which is respectfully submitted by

Your obedient servant,

B. SILLIMAN, Jr.,

Prof. of Chemistry, &c.,

Yale College.

New Haven, Ct., *January* 20, 1864.

APPENDIX A.

Chief Gold Commissioner's Office,

Halifax, November 12th, 1863.

The following Tables show the number of Gold Mining Areas being worked, the number of men engaged in mining, the quantities of Quartz raised and crushed, with the average yield per ton, and the total yield of Gold, &c., &c., in the various Gold Districts, for the months of July, August, and September, as per Monthly Statistical Returns of the Deputy Commissioners.

JULY, 1863.

DISTRICT.	Areas of Class No. 1 being worked.	Smaller Size, Quartz.	Men employed in Mining.	Quartz raised			Quartz Crushed.			Yield per Ton.			Gold from alluvial mines.			Total yield of Gold.			Maximum yield of Gold.			Crushing Mills in District.	Steam Power.	Water Power.
				Tons.	Cwts.	Lbs.	Tons.	Cwts.	Lbs.	Oz.	Dwt.	Gr.	Oz.	Dwt.	Gr.	Oz.	Dwt.	Gr.	Oz.	Dwt.	Gr.			
Stormont (Isaac's Harbor)	8	1	50	80	0	0	81	7	0	3	2	22	....	....	....	256	1	12	6	11	19	1	1	0
Wine Harbor	42	4	170	*292	0	0	*292	0	0	1	18	5	....	....	....	324	15	15	30	0	0	3	2	1
Sherbrooke	15	.....	120	*377	10	0	377	10	0	0	18	3	18	0	0	355	5	18	11	0	0	5	4	1
Tangier	10	22	157	120	0	0	62	10	0	1	0	0	....	....	....	62	3	12	4	0	0	3	1	2
Montague	6	.....	237	34	19	0	37	18	0	2	3	3	....	....	....	81	15	4	3	14	23	.....	.....	.....
Waverly	29	.....	142	888	15	0	888	15	0	0	7	0	....	....	....	343	10	3	17	14	0	6	6	0
Oldham	35	.....	90	100	0	0	154	10	0	1	4	8	....	....	....	182	10	6	29	3	0	5	3	2
Renfrew	10	.....	28	45	0	0	93	5	0	1	2	19	....	....	....	106	8	8	6	6	0	4	2	2
Ovens†	.....	.....	.....	....	....	....	17	10	34	1	1	0	....	....	....	18	8	0	8	13	0	1	1	0
Totals	126	27	994	1938	4	0	2005	5	34	0	17	6	18	0	0	1730	18	6	30	0	0	28	20	8

Average yield of Gold per ton, exclusive of Waverly, 1 oz. 4 dwt. 18 gr.

AUGUST, 1863.

Average yield of Gold per ton, exclusive of Waverly, 1 oz. 4 dwt. 18 gr.

AUGUST, 1863.

Stormont (Isaac's Harbor)	8	1	48	35	0	0	26	9	0	1	11	8	----	----	----	83	0	0	1	11	8	1	1	0
Wine Harbor	12	3	139	196	0	0	196	0	0	1	6	16	----	----	----	253	17	2	56	0	0	4	.	1
Sherbrooke	29	----	90	359	0	0	359	0	0	1	4	15	4	0	0	146	18	13	19	6	16	5	4	1
Tangier	11	16	160	120	0	0	48	17	0	0	11	0	----	----	----	26	1	18	0	17	0	3	1	2
Montague	4	----	374	53	10	0	43	10	0	2	5	5	----	----	----	98	7	0	2	11	1	----	----	----
Waverly	20	----	229	640	0	0	640	0	0	0	7	3	----	----	----	228	10	12	2	0	0	6	6	0
Oldham	40	----	95	100	0	0	135	0	0	1	13	7	----	----	----	224	16	13	43	13	16	5	3	2
Renfrew	12	----	30	59	0	0	106	14	59	2	10	0	----	----	----	254	1	10	6	0	0	4	1	2
Ovensf	----	----	----	----	----	----	21	14	32	0	18	13	----	----	----	20	3	16	9	0	0	1	1	0
Totals	130	20	1156	1553	10	0	1571	4	82	1	0	14	4	0	0	1653	16	19	156	0	0	29	21	8

Average yield per ton, exclusive of Waverly District, 1 oz. 10 dwt. 15 gr.

SEPTEMBER, 1863.

Stormont (Isaac's Harbor) ‡	9	1	51	43	0	0	37	5	0	2	4	0	----	----	----	81	17	0	3	10	0	1	1	0
Wine Harbor	5	2	89	*435	15	0	*435	15	0	1	1	15	----	----	----	473	12	5	66	0	0	4	3	1
Sherbrooke	13	----	85	*259	15	0	*259	15	0	0	14	7	6	0	0	191	6	22	5	0	0	5	4	2
Tangier	12	18	180	230	0	0	100	9	0	0	12	12	----	----	----	63	4	22	0	19	0	3	1	2
Montague	4	----	34	4	0	0	7	15	0	3	1	12	----	----	----	23	16	12	4	2	17	----	----	----
Waverly	20	----	186	563	0	0	563	0	0	0	6	9	----	----	----	180	3	19	1	12	2	6	6	0
Oldham	50	----	100	100	0	0	163	14	33	1	5	17	----	----	----	210	8	8	8	12	0	5	3	2
Renfrew	11	----	34	59	0	0	38	19	0	0	10	0	----	----	----	19	15	16	1	6	16	4	2	2
Ovensf	----	----	----	----	----	----	18	7	7	0	9	21	----	----	----	9	1	17	2	11	22	1	1	0
Totals	125	21	750	1685	10	0	1624	19	40	0	15	9	6	0	0	1253	7	1	166	0	0	29	21	8

Yield per ton, exclusive of Waverly District, 1 oz. 0 dwt. 7 gr.

* Quartz, Mud and Gravel. † Returns not complete. ‡ Wine Harbor.

Total yield of Gold for the Quarter ending September 30th, 1863, 4,620 oz. 2 dwt. 2 gr.

" " Half Year ending June 30th, 1863, as per official returns, 5,193 oz.

P. S. HAMILTON,
Chief Gold Commissioner.

APPENDIX B.

NEW YORK, *January* 23, 1864.

NEW YORK AND NOVA SCOTIA GOLD MINING COMPANY.

Gentlemen :

Agreeable to your request, the samples of gold ore from Tangier, Nova Scotia, sent to me for assay, were carefully sorted, and found to contain gold, per ton, of 2000 lbs. as follows :

1.	Mixed ore containing visible gold.....	$1892 17
2.	Pyritic " " no " "	93 05
3.	Black " " " "	15 51
4.	Brown " " " "	7 75
5.	White " " " "	11 63
6.	Mixed " finest portion sifted	62 03

Yours respectfully,

EDWARD N. KENT.

Chemist.

APPENDIX C.

UNITED STATES ASSAY OFFICE,
NEW YORK, *Sept.* 23, 1863.

NEW YORK AND NOVA SCOTIA GOLD COMPANY.

Gentlemen :

Your sample of ore, left several days ago, yields gold and silver at the following rates :

Gold per ton (2000 lbs.).....	$122 13
Silver " "	2 67
	$124 80

Respectfully, &c..

JOHN TORRY,

Assayer.