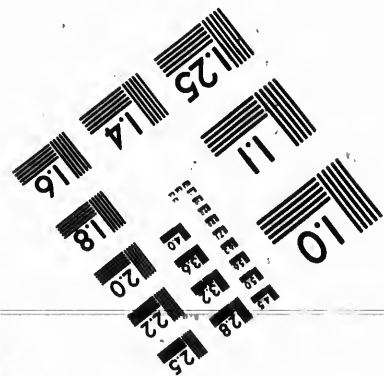
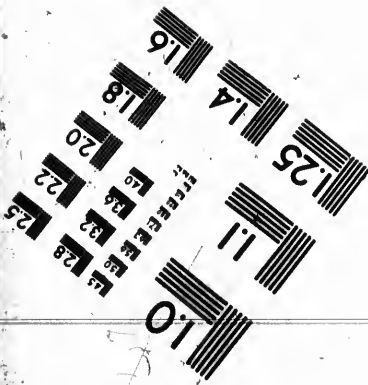
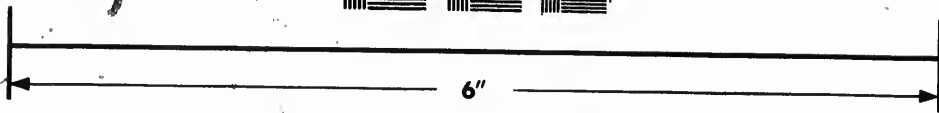
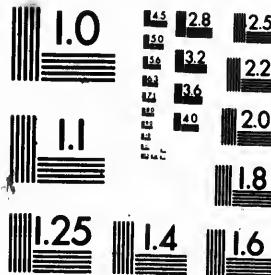


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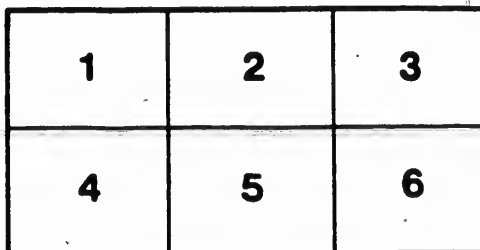
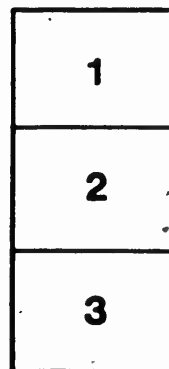
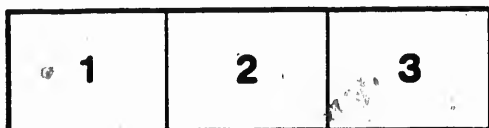
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Orford Nickel Co.

REPORTS

ON

THE CROWN

Copper and Sulphur Mine,

OWNED BY THE

ORFORD NICKEL & COPPER CO.



BOSTON:

**W. L. BROWN, BOOK AND NEWSPAPER PRINTER, 20 BROADWAY STREET,
1878.**



REPORTS

ON

THE CROWN

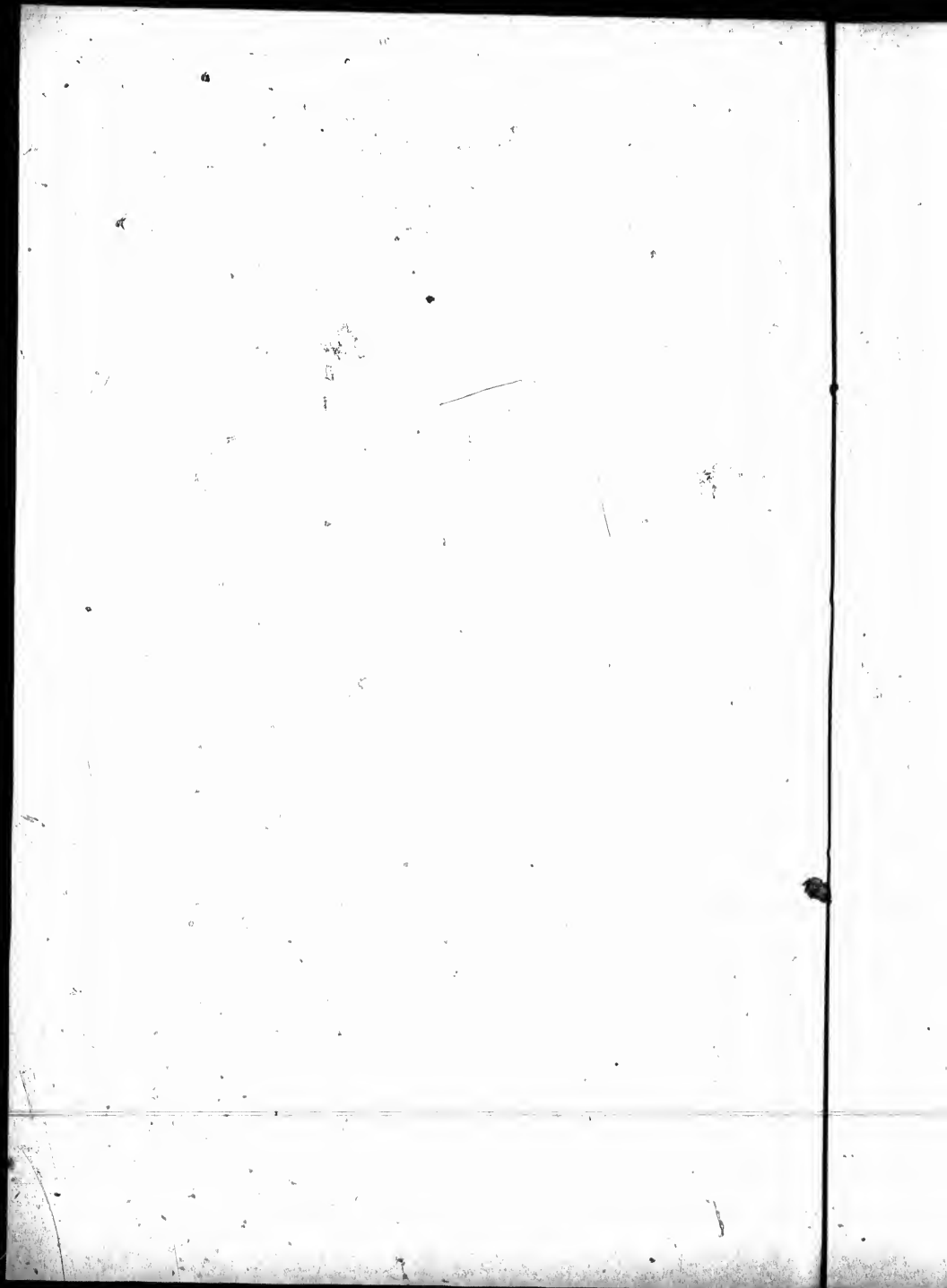
Copper and Sulphur Mine,

OWNED BY THE

ORFORD NICKLE & COPPER CO.

BOSTON:

W. K. MOODY, BOOK AND NEWSPAPER PRINTER, 50 BROMFIELD STREET.
1879.



CROWN COPPER AND SULPHUR MINE.

DEAR SIR:

I beg leave to call your attention to the following reports and estimates relating to the Crown Copper and Sulphur Mine, which show that ingot copper can be produced, transported and sold for ten and one-third cents a pound, in quantities that will pay a net annual profit of.....\$95,000 00

And that sulphur can be produced and marketed at a cost of six dollars a ton, and showing an annual profit of..... 66,000 00

Making a total of.....\$161,000 00

If you will take the trouble to read the following pages you will be prepared to consider the value of the mine as an investment, on the terms set out at the close of this letter. The reports are:

1. Descriptive, by R. G. Leckie, with confirmatory letter from Dr. T. Sterry Hunt.
2. Geological, by Prof. J. D. Whitney.
3. On developing the mine, by Richard Bray, Mining Superintendent of the "Hariford Mine," of which mine the Crown is a continuation.
4. On the "Plant," required for the mine and extraction works, by W. E. C. Eustis and H. M. Howe, Mining and Metallurgical Engineers.
5. Description of the Leckie Sulphur Process, taken from the United States Patent.
6. Estimates of the cost of producing ingot copper, by Messrs. George and John Thomson.

DESCRIPTION OF THE CROWN MINE BY

R. G. LECKIE.

The Crown Copper Mine is situated in the township of Ascot, province of Quebec, and is distant from Sherbrooke about eight miles. The Passumpsic River Railroad skirts the property, Capelton station being less than a mile distant, thus furnishing direct connection with the whole railroad system of the Northern States. The Grand Trunk Railroad passes within a mile and a-half of the mine, furnishing means of transport to Portland Quebec, Montreal and the Western States.

The veins or beds of copper ore, upon which the mine is located, have been opened on at various points over a distance of two miles. The Hartford Mine, adjoining this property, has been worked by the Canada Sulphur and Copper Company (limited), of Glasgow, and yielded a monthly product of from 1,500 to 2,000 tons ore, averaging nearly five per cent.* copper and thirty per cent. sulphur. This ore was treated without further sorting by the Henderson Process, which extracted the copper in the humid way.

No. 5 shaft on the Hartford Mine, from which the whole supply of ore was drawn, was started on the surface four hundred and seventeen feet from the line. It follows the dip of

*The Laboratory Book of the Canada Copper and Sulphur Company shows the average percentage of the ore, exclusive of the rich ores picked out and shipped to England, during the last six months the Hartford Mine was worked, to be:

	Per cent.
Green ore.....	4.87
Burnt ".....	4.83
Fines.....	4.68
Sulphur in burnt ore.....	7.23

And it must be noted that a part of the ore came from the Crown Mine.

R. M. T.

the ore-bed (from twenty-five to forty degrees (25° to 40°), and has been sunk to a depth of five hundred and thirty feet, which carries it fifty feet beyond the dividing line between the Crown and Hartford Mines. The present stopes at the line of the Crown Mine are 225 feet in length, and average from six to thirty feet in width, of solid ore, with a very decided improvement of quality in the lowest levels.

The ore is a sulphuret of copper and iron (copper and iron pyrites), and averages five per cent copper; but at several points the copper contents rise to ten and even twenty-four per cent.

All of the ore contains a notable amount of silver, the distribution of which, in the lode, is irregular, running from three ounces to thirty ounces per ton. Dr. Harrington, Chemist of the Geological Survey of Canada, reports that he has found over seventy ounces in the gray arsenical ore. A parcel of forty per cent. matte, shipped to England, contained two hundred and twenty ounces silver per ton, by assay made there.

If this ore should be smelted, all the silver would be concentrated in the matte, and could be saved.

Several trial shafts have been sunk upon the Crown Mine, and considerable surface explorations made, proving even a larger developement of ore-bearing ground than on the Hartford.

The ore from the Hartford Mine is being raised and delivered at the Works at an average cost of sixty-three and six-hundredths cents per unit, equal to two and three-quarter cents per pound of fine copper contents. The cost of extracting the copper from the ore by the Hunt & Douglas process, and running the precipitate into ingot copper, is estimated by Mr. Douglas

not to exceed five and one-quarter cents per pound; and in treating the ore by the Hunt & Douglas process, the whole of the silver is saved, and this will be found sufficient to pay the cost of mining the ore, so that the actual cost of the copper will be only the metallurgical treatment, amounting, as already stated by Mr. Douglas' estimate, to five and one-quarter cents per pound. In addition to this, the sulphur can be made a source of profit by its conversion into flour sulphur or sulphuric acid.

And it has been estimated that the ore can be smelted at the mine and refined for about five cents per pound.

R. G. LECKIE.*

* LETTER FROM DR. T. STERRY HUNT TO ROBERT
G. LECKIE, Esq.

R G. LECKIE,

MY DEAR SIR:

I have for many years been familiar with the deposit of copper ore to which the Crown and Hartford Mines at Capelton belong, and have followed with interest the progress of mining at the latter; The ore here forms an inter-bedded mass, conforming to the strike and dip of the Country Rock, and very persistent. I have had an opportunity, in the course of the present month, of examining it at a depth of eighty-five fathoms on the slope, being the lowest point reached in the workings of the Hartford, on the Crown Mine, and can fully confirm your statements in the accompanying description as to the quantity and quality of the ore now being raised from that depth, while I have good reason to believe that the figures given by you as to cost of production, are correct.

I think that there is every prospect that the plan of operations proposed by you will develop on the Crown property a mine of great value, the successful

working of which, on a legitimate basis, should do much to remove the discredit which injudicious speculation has thrown upon the copper mines of the Province of Quebec.

I am, my dear sir, faithfully yours,

T. STERRY MUNT.

REPORT OF PROF. J. D. WHITNEY.

To R. M. THOMPSON, Esq., }
BOSTON, MASS. }

MY DEAR SIR:

I have made a hasty inspection of the "Hartford Mine," near Sherbrook, Canada, and beg leave, herewith, to present my report of the same:—

The lode is contained in a glossy, pure-grained slate, belonging to the "Quebec Group" of the Canadian Geological Survey. Portions of this rock disintegrate with rapidity when exposed to the air; other portions remain firm and solid. Specimens of the slate have been found, on examination, to contain great numbers of small crystals of pyrites disseminated through the mass. This rock has a variable strike, being much twisted in its stratification. At the mine it runs nearly east and west and dips at a moderate but varying angle to the south. It is intersected by vertical dykes of eruptive material (metaphyr), which run east and west, and intersect both country rock and lode without much disturbing either, so far as I had opportunity to observe. When the dykes have branched so as to include a portion of the lode, this retains its natural appearance.

The lode appears to be what is called, in this country, a "Segregated Vein" or mass; that is to say, a deposit of metalliferous

rous material lying pretty nearly in the plane of the stratification or lamination of the enclosing country rock, and not separated by well-defined flucan selvages or other ordinarily observed indications of a preexisting fissure. In some places, however, a tolerably smooth wall does extend for some distance separating, or indicating a separation between the lode and the country. In general, the outline of the mass of ore, in a direction at right angles to the run of the lode, or in a transverse section on the dip, is very irregular. The general character of the ore body, however, is that of a flattened mass, dipping with the formation, having a length along the strike of the county rock of from one hundred to two hundred feet, and a thickness of from six or eight to thirty, or even more, feet. This mass has been followed down in Shaft No. 5 as far as the eighty-five-fathom level, and the character of the lode has been found to be essentially the same from top to bottom. The dip averages about thirty degrees, and is in a southerly direction, the shaft carried down on the dip of the lode having almost exactly a southerly direction, (magnetic, the variation being sixteen degrees west).

Shaft No. 5 appears to be on the western edge of the ore body; at all events, the workings have been entirely confined to the region east of No. 5. It would look as if the ore had been cut off on this side by a "fault" or heave; but I was unable to assure myself that such had been the case.

From the best information I could obtain, about seventy-five thousand tons of ore have been taken from this mine, which would indicate, as the average dimensions of the shoot of ore worked, about one hundred feet in length by ten in thickness.

The character of the ore is extremely uniform as exposed in the mine. It is a vast body of iron pyrites, with a small percentage of copper contained in it, and almost, or quite entirely free from any admixture of gangue or vein-stone.

It is a metalliferous mass of very remarkable dimensions and freedom from mineral matter. Unfortunately its tenor in copper is not high, as is evident from inspection. Its actual yield could, of course, only be told after assay, as low grade copper ore cannot be estimated with any approach to accuracy by the eye alone. It is said to have yielded by the "Henderson Process," in the wet way, four-and-a-half per cent. of metallic copper, on the average. Specimens of a higher grade ore were shown me as having come from the part of the mine now under water, and you have the authority of Capt. Bray as establishing the fact.

The inference to be drawn from the facts observed, and the information gathered from reliable persons, seem to be that there is here a very large body of low-grade copper ore which has been already worked to a considerable depth, and which is likely to hold for a considerable distance downwards. Several considerations support this view. In the first place, the ore-body is so large that it would seem to be highly improbable that it should come to a sudden termination. In the next place it would appear from the facts gathered that where the line of the "Crown" properly crosses the lode (which in the shaft is a little below the seventy-three-fathom level), there is no falling off in the dimensions of the mass; but, if anything, an increase, the workings being fully two hundred feet long on the line of the "Crown" property.

Had not the weather and an accident prevented my making an examination on the line of outcrop of the lode, I should have got additional, and, I presume, valuable testimony as to its character for permanence. The lode is said to have an extensive linear development, and that I should regard as an important element in judging of its holding in depth. It has also become a question whether there are not other chimnies or shoots of ore on the lode, of extent and value enough to be worked, and which may be richer in copper.

The question seems to be narrowed to a metallurgical one; namely, whether a low grade copper ore occurring in large quantities, and under very favorable conditions for being cheaply mined, can be worked with profit. It is also fairly to be considered, in this connection, that the ore *may* increase in richness as indicated by the occurrence of a better grade near the bottom of the mine than any which had been previously found.

Not being an authority in metallurgy, and having only a superficial knowledge of that subject, I do not feel competent to give any opinion on the possibility of working an ore which has yielded four and a-half per cent. by the Henderson Process, nor do I know how much has been lost in this process; that is, how much the real percentage of the ore is.

As ore not averaging over one and a-half per cent. of copper is successfully treated in Europe, it would seem that the ore of the Hartford Mine ought to pay a respectable profit when treated by an economical process. The facilities for opening and working the mine so as to produce a large quantity of ore at a low cost, are certainly very great.

Very respectfully yours,

Cambridge, Mass., }
April 29, 1878. }

J. D. WHITNEY.

REPORT OF CAPT. BRAY.

ROBERT M. THOMPSON, ESQ.
Sec., Orford Nickel and Copper Co., }
 BOSTON, MASS

DEAR SIR:

I am in due receipt of your favor of the 16th inst., requesting me to answer certain queries on the subject of the mining property in this neighborhood known as the Crown Mine.

Query First.—The probable cost of opening and working the said mine through the present shaft known as Shaft No. 5 of the Hartford Mine.

Answered.—This operation would be simply a continuation of the works at this shaft in the same style, or nearly so, as they were conducted when that shaft was sunk to its present depth by the C. C. and S. C. L. of Glasgow.

It would be necessary to sink this shaft to a depth of—say thirteen fathoms, and to extend a drift eastward from the bottom so attained for a distance of about twenty fathoms, or so far as would be permitted by the state of ventilation in the mine; and to this end it would be necessary to arrange with the above-mentioned Co. to be enabled to sink a winze from the eighty-five-fathom level at a point where this is intersected by the boundary line between the two properties; this last would be sunk to the same level as would be attained by Shaft No. 5, and the two being connected by the above-mentioned drift would open up a block of ore-ground *twelve* fathoms deep by *twenty* fathoms in length, which, if it should prove to be as productive as a like block in the mine of

Hartford in the level above, would turn out about twelve thousand (12,000) tons of copper pyrites, assaying five per cent. for copper by humid assay.

The working cost of sinking this shaft, which is fourteen feet by seven feet, containing an area of ninety-eight square feet would average one hundred and thirty dollars per fathom lineal measurement.

The cost of sinking the winze, with an area of fifty-four feet, would be seventy-five dollars per fathom, lineal measurement.

And the cost of driving the drift containing an area of forty-two feet, would be from sixty-five to seventy dollars, lineal measurement.

SUMMARY.

13 fathoms at \$130.....	\$1,690 00	
18 " " 75.....	975 00	
20 " " 68.....	1,360 00	
	<hr/>	\$4,025 00
4 tram men at \$30 per month, 8 months.....	960 00	
1 engineer at \$50 per month, 8 months.....	400 00	
1 foreman at \$52 per month, 8 months.....	416 00	
1 blacksmith at \$48 per month, 8 months.....	368 00	
2 loaders at \$30 each 8 months.....	480 00	
1 carpenter at \$40 per month, 8 months.....	320 00	
3 or more laborers at \$36 each.....	624 00	
Laying tram road, &c.....	500 00	
	<hr/>	\$8,093 00
Superintendence to be added.....		920 00
		<hr/>
		\$9,013 00

This work would occupy, under favorable circumstances, about eight months to complete; but, as an offset to this, within two months or less after starting the drift eastward, the sinking of the shaft would be resumed, so that almost as soon as the first block of ore would be opened, the shaft would be again deep enough to repeat the operation as above described, and the ground

east of the wings would also be opened up so soon as this should have acquired the requisite depth; in fact, after opening up the first block of ore, the general operations of the mine would come into full play, and would be increased or diminished as might be required by the then existing circumstances.

Query Second.—The probable cost, &c., if a new shaft is sunk vertically upon the middle of the shoot of ore at *about the level of the present bottom.*

<i>Answered.</i> —Say fifty-four fathoms vertical shaft, at \$130 per fathom....	\$7,020 00
Dividing, timbering and laying skip-road in shaft, from.....	1,000 00 to \$1,500 00
Machinery, cars, ropes, &c.....	4,000 00

Day and skilled labor, as in the case of No. 5 shaft, Hartford.

I may be permitted to remark that if this operation be confined to striking the ore at the level of the bottom of Hartford Mine, no ore ground would be laid open for stoping; the operation of opening ground for ore would have to be commenced from the point of intersection, as described in the case of "Sink- ing No. 5 Shaft," and, therefore, need not be repeated here.

Time required for this operation about fifteen to eighteen months.*

Query Third.—Give in each case the time necessary to open the mine, and the amount of ore that can be delivered per month after the mine is opened.

Answered.—The time has already been mentioned, the calculations being based on the work being performed by hand, without any assistance from drills worked by steam or compressed air.

*Responsible contractors, working with power-drills, offer to complete this work within eight months.

In opening through No. 5 Shaft and winze from the eighty-five-fathom level, moderate returns would be immediately made, as there is a small block of ore already opened at the angle the Shaft No. 5 makes with the eighty-five-fathom level, which lies within the Crown Mine limits, and is ready for stoping; this would produce *altogether*, about eight hundred tons of ore. (800), the shaft is fast leaving the dip of the ore body, and probably will soon be altogether out of it. After sinking about six fathoms deeper than the present bottom, unless a change should take place, no returns can be counted on from this point.

The winze would go down in a strong body of ore, and ought to produce from seventy to eighty tons of good ore from each month's sinking of three and a-half or four fathoms.

After the first block of ore is opened out, there would be nothing to prevent the monthly output commencing at four hundred tons (400), in a few months reaching one thousand (1,000), by which time the second block would begin to make returns, in fact, after two years' work, during which time there would be a gradually increasing scale of returns. I see no reason to doubt that the mine could be put into a condition to return, if required, two thousand (2,000) tons of ore per month without overstraining its capacity.

Query Fourth.—Give in each case the expense of opening the mine ready for work, specifying, &c.

Answered.—The particular operations for opening the mine to a certain extent, and the expense attending them, have been already detailed.

The cost of mining the ore, after the mine is opened, by either of the above-mentioned methods, would not vary materi-

ally, and may be set down in round numbers, for all mining expenses, at three dollars per ton, and the loss in materials will throughout the year be about ten per cent. on the total outlay. In the case of working by contract, the contractors repay the value of nearly all the materials they use, with which they are supplied by the Company at a fixed price.

Query Fifth.—State from your past experience, &c., what percentage, &c.

Answered.—For the last three years the Hartford Mine was worked, about sixteen per cent. of the total output was eliminated to bring the ore to the percentage required at the Extracting Works; this rejected portion consisting of two-thirds of poor rock and the remaining one-third of ore rich in sulphur, but containing only from one to two per cent. of copper; this last product was sold under contract at three dollars per ton delivered at the station on the cars.

As the deposit of ore has steadily though slowly improved in quality between the fifty and eighty-five-fathom levels in the Hartford Mine, and as it now contains little or no unproductive rock mixed with it, the quantity to be rejected would be rather less than above stated, to bring the ore to an average of five per cent. of copper by wet assay, and this, by careful manipulation, ought to produce in actual fine copper four per cent., or, say, one ton of fine copper to every twenty-five tons of ore delivered at the Works.

The average of sulphur in the rejected ore was from thirty-eight to forty per cent., and on this basis it was sold.

I do not think the better class of ore was, as a general rule, assayed for sulphur; if it was, it never came to my knowledge.

I think, though, that at least thirty per cent. may be counted upon, and this is a very important item.

Query Sixth.—Give the cost of breaking the ore by hand and by machinery and of delivering it at the kilns for burning, &c.

Answered.—All the ore burnt at the *Hartford Mine* was spalled by hand, and burnt in piles in the open air at an average cost of about forty cents per ton, all cost included (except superintendence); what the cost of breaking by machinery would be I cannot say, but should suppose that about sixteen cents per ton, or even less, would cover it. The amount of forty cents per ton included spalling, removing to piles, piling, screening, wood and attendance during the operation.

In conclusion, I beg to say that in the case of a new shaft being sunk vertically, I think it should be so placed as to strike the vein at a point that would give a vertical depth of at least one hundred feet below the present bottom of *Hartford Mine*; the piece of ore included in that distance could be attacked by means of cross-cuts from the shaft to the vein.

You are, I believe, already aware that the deposit of ore as presented in the eighty-five-fathom level of *Hartford Mine*, one quarter part of the length of which is already within the limits of the *Crown Mine* property, consists of a solid mass of copper pyrites of almost uniform quality, and with little admixture of unproductive rock, extending from No. 5 shaft eastwards, to a distance on the level of two hundred and twenty-five feet, and I may here remark that present indications favor the presumption that this enormous shoot of ore will continue in depth as far as any such have ever yet been followed.

It will appear clear to you that this property of the Crown Mine is altogether removed from the common run of mining speculations, considered as such. Here the ore body is known to exist, its bulk known to a certain extent, and its economical value acknowledged, only requiring skillful management in the reduction as well as in the mining department, to make it such a success as shall redeem the hitherto rather unfavorable character of Canadian copper mines.

Should you require any further information on this subject that I can furnish, I shall be much pleased to do so.

I am, my dear sir, very truly yours,

RICHARD BRAY.

Sherbrooke, P. Q., }
Nov. 20, 1878. }

ADDENDA.

I should hope that arrangements can be made to work this property through No. 5 shaft, for a few years at least, and can see no valid *reason* why such may not be made. R. B.

REPORT OF COST OF PLANT.

ROBERT M. THOMPSON, ESQ., }
Treas. of the Orford Nickel and Copper Co. }

DEAR SIR:

We submit herewith, in Schedule I., our estimates of the cost of Sinelting Works and Mine Plant, necessary in our opinion for working the Crown Mine, at the rate of 2,000 tons of ore per month. Also, in Schedule II., an estimate of the expendi-

tures necessary for carrying on the work during the first year,
and while the mine is being opened up.

Yours very truly,

W. E. C. EUSTIS, } *Engineers.*
H. M. HOWE, }

January 11, 1879.

SCHEDULE I.

COST OF PERMANENT PLANT.

SMELTING DEPARTMENT.		
420 burners at \$62.50,.....	\$28,250 00	
16 cupolas at \$500,.....	8,000 00	
Flues and stack,.....	3,470 00	
2 reverberatories at \$1,500,.....	3,000 00	
12 matte stalls at \$350,.....	4,200 00	
Blower to furnish 6000 cubic feet of air,.....	250 00	
Countershafting, hangers, pulleys, belts, &c.,.....	100 00	
65 4-inch gate valves,.....	96 00	
Piping,.....	400 00	
Duty, freight, setting up, &c.,.....	254 00	
		\$46,020 00
HOISTING, PUMPING AND MINING.		
A. Engine to run the whole establishm't, from \$1,300 00 to.....	\$1,800 00	
Freight,.....	48 00	
Duty,.....	306 00	
Foundations, setting up, &c.,.....	100 00	
B. Hoisting rig—Drum, frictions, gears, shafting, &c., for hoisting from mine shaft; and drum, frictions, &c., for hoisting coke cars,.....	\$1,484 47	
Freight,.....	52 53	
Duty,.....	249 00	
Foundations, setting up, &c.,.....	200 00	
C. 4 3 1/4 inch Burleigh drills,.....	\$1,000 00	
Tripods, columns, clamps, hose, &c.,.....	500 00	
No. 3 Burleigh air-compressor, without engine,.....	1,500 00	
Air pipe,.....	400 00	
Foundations, handling, &c.,.....	50 00	
Duty and freight,.....	550 00	
D. Two heavy pumps, each throwing 500 feet,.....	\$1,200 00	
Pump pipe, 2000 feet of 4-inch pipe,.....	600 00	
1 light sinking pump,.....	450 00	
Amount carried forward.....	\$10,450 00	\$46,020 00

Amount brought forward.....	\$10,450 00	\$46,020 00
3 50 H. P. tubular boilers.....	\$1,575 00	
Fittings, gauges, &c.....	60 00	
Settings, chimney, &c.....	400 00	
Duty and freight.....	387 00	
Inspection, handling, and contingencies.....	78 00	
F. Wire rope.....	\$1,200 00	
Sheaves, countershafting, &c.....	250 00	
Holsting buggies, chutes, &c.....	300 00	
Duty and freight.....	200 00	
		\$14,900 00
BUILDINGS.		
Sulphur house, 200 by 40.....	\$1,200 00	
Burner houses, 1200 by 34, at 12 cents per foot.....	4,080 00	
Capola house, 160 by 30.....	800 00	
Rehning house, 30 by 50.....	300 00	
Engine house, shaft house, weigh house and miscellaneous buildings.....	2,000 00	
		\$8,380 00
MISCELLANEOUS ITEMS.		
No. 5 Blake crusher.....	\$1,350 00	
Scales.....	775 00	
Buggies, cars, &c.....	500 00	
Miscellaneous tools.....	500 00	
Laboratory fittings.....	500 00	
Office fittings.....	500 00	
Teams, &c.....	2,000 00	
Tracks.....	4,000 00	
Grading.....	1,025 00	
Trestle work, coke pockets, &c.....	1,500 00	
Exploider.....	180 00	
		\$12,630 00
SUMMARY.		
Smelting department.....	\$46,020 00	
Holsting, pumping and mining department.....	12,900 00	
Buildings.....	8,380 00	
Miscellaneous items.....	14,830 00	
Grand total.....		\$82,130 00

SCHEDULE II.

COST OF INITIAL PLANT.

SMELTING DEPARTMENT.

1 battery of 830 pyrites burners,	\$5,000 00	
5 cupolas, at \$500 each,	2,500 00	
The stack and part of the flues,	1,000 00	
2 matte stalls, at \$350 each,	700 00	
Hoover,	250 00	
Countershaft, hangers, pullers, belting, &c.,	100 00	
Gate valves,	40 00	
Piping,	200 00	
Duty, freight, setting up, &c.,	200 00	
		\$9,990 00

HOISTING, PUMPING AND MINING.

Engine,	\$2,254 00	
Hoisting rig,	1,946 00	
One heavy pump and one light sinking pump,	1,100 00	
Pump pipe,	150 00	
One boiler,	900 00	
Ropes, sheaves, cars, &c.,	1,200 00	
		\$7,550 00

MISCELLANEOUS ITEMS.

Crusher,	\$1,350 00	
Scales,	500 00	
Buggies, cars, &c.,	250 00	
Tools,	250 00	
Laboratory and office fittings,	750 00	
Teams,	1,000 00	
Grading,	1,000 00	
Buildings,	4,000 00	
		\$9,100 00
		\$26,640 00

IMPROVEMENT IN SEPARATING SULPHUR FROM
ITS ORES.

SPECIFICATION FORMING PARTS OF LETTERS PATENT NO.
202,443, DATED APRIL 16, 1878; APPLICATION
FILED NOVEMBER 6, 1877.

To all whom it may concern:

Be it known that I, ROBERT G. LECKIE, of Acton Vale, in
the county of Bagot, Province of Quebec, Dominion of Canada,

I have invented an Improved Process for Separating Sulphur from its Ores, of which the following is a specification:

By this invention, and the manner of working it as herein described, the hydrogen sulphide may be produced in large quantities at the smallest possible cost, and with the minimum of labor. By the intermingling of this gas with the sulphurous acid from the oxidation of the sulphides, the sulphur is effectually precipitated in a condition almost free from impurities.

I am also aware that the sulphurous acid from the roasting of sulphurous ores has been extensively utilized by converting it into sulphuric acid; but this method is not, as a rule, economically available, as mines are frequently situated remote from manufacturing centers, and the transportation of the acid is expensive, both in packages and freight.

Sulphur, on the other hand, is easily handled, requires no expensive packages, and can be transported, without danger, to remote markets.

I shall now proceed to describe the apparatus and method of working it.

a a are kilns or pyrites burners made of any suitable shape, and constructed of refractory material. *b b* are flues for conducting sulphur-gases, and in which the sulphurous gases and sulphureted hydrogen intermingle on their way to the chamber *c*, where the chemical reactions are completed and the sulphur precipitated according to the following chemical reaction: $SO_2 + 2H_2S = 3S + 2H_2O$.

A jet or spray of water is made to play upon the gases and vapors from the top of the chamber *c* through a suitable pipe, to facilitate condensation. The gases are further caught and

condensed, if desired, in the chimney or tower *d*, which is filled with coke or other permeable material, and kept moist by water introduced at top. This water may be used over and over again until it absorbs sufficient acid to be useful in some other process.

A fire having been kindled on the grate-bars *c*, fuel is put on until the kilns are thoroughly heated. The ore is then filled in, and if it contains above sixteen per cent. of sulphur, then the heat generated by the burning of the sulphur will be sufficient to maintain the combustion, and no other fuel will be required. The sulphur, as it is burned, passes into the common flue *b* in the shape of sulphurous acid. When the ore is in a state of combustion—say, at a red heat—the air is shut off and superheated steam is admitted through the pipe *i*, forming sulphureted hydrogen, which, meeting and intermingling with the sulphurous acid from the adjoining kiln, causes the well-known chemical reaction already described to take place, and the sulphur is set free.

For the better and more regular working of the process, it is found preferable to supply each kiln or pyrites-burner with air and steam alternately, so that while one is producing sulphurous acid another one is producing hydrogen sulphide. At regular intervals the operation is reversed, air being shut off, and superheated steam being then supplied to one, while in the other the steam is shut off and air supplied. Where kilns are constructed in parallel rows, back to back, the superheated steam and air may be controlled by one valve for each row, so that each row of kilns may be producing sulphurous acid and sulphureted hydrogen alternately, and thus yield a steady flow of the desired gases.

When the ore is rich enough in sulphur, and the air and superheated steam are properly controlled, they may be introduced simultaneously and continuously into the kilns or pyrites burner, and the sulphurous acid and sulphureted hydrogen may be produced in such manner as to cause the reaction to take place, as already described. In so doing, it is found preferable to admit the air at the bottom, and the superheated steam nearer or at the top. A stream of moist steam is admitted through pipe *m* into the flue *b*, so that the free sulphur already formed may be protected from burning by any air which may find its way in.

Some of the sulphur will be collected in the flue and chamber, while the remainder will be carried out by the water, and precipitated in tanks or other suitable vessels.

If the ore or sulphur-yielding substances are being roasted or burned in revolving or reverberatory furnaces, worked in pairs, the same method may be employed by alternately introducing air and superheated steam, and mixing the resulting gases in a common flue or chamber, as already described. If working a single furnace, a stream of highly-superheated steam may be continuously admitted, preferably along with heated air, and so regulated that the proper proportion of gases may be produced.

An excess of air is to be avoided.

ROBERT GILMOUR LECKIE.

ESTIMATES OF THE COST OF PRODUCING INGOT
COPPER FROM THE CROWN MINE BY
H. M. HOWE & JOHN THOMSON.

Operation.	Estimate of H. M. Howe.		Estimate of John Thomson.	
	Ton of Ingot. Dollars.	P'nd of Ingot. Cents.	Ton of Ingot. Dollars.	P'nd of Ingot. Cents.
Mining and delivering 27 tons ore, (by contract),.....	81 00	3,62	81 00	3,62
Breaking and burning 27 tons ore,.....	10 80	,48	17 55	,78
Handling from kilns to cupolas,.....	4 05	,18	2 70	,12
Ore smelting, labor, charging, tap- ing, breaking, removing slag,.....	18 09	,80	13 77	,61
Fuel—Geo. Thomson 1 to 5,.....	32 46	1,44	29 45	1,31
Repairs and tools,.....	9 45	,42	9 72	,43
Black, fuel, labor, &c., at engine,.....	8 37	,37	4 18	,19
Breaking and roasting 3 1-3 tone of matte,.....	6 67	,30	8 50	,38
Fusion, 3 1-3 tons of matte,.....	13 01	,58	15 13	,67
Refining, 95 per ct. copper to ingot copper,.....				
Fuel,.....	5 17	,23	4 17	,19
Labor,.....	4 20	,20	3 07	,14
Tools and repairs,.....	5 00	,22	1 00	,05
General expenses,.....	20 00	,90	20 00	,90
Transportation and selling,.....	10 00	,71	16 00	,71
Totals,.....	234 21	10,45	226 24	10,10
Value of copper at 15c. per lb.,.....	336 00	15,00	336 00	15,00
Profit,.....	101 79	4,55	109 76	4,90
Monthly profit on 74 tons of copper,...	\$7,532.46		\$8,122 24	

In addition to the above estimates, we present in detail the monthly expenses of the Company when mining 2,000 tons of ore per month, and producing seventy-four tons of ingot copper:

DATA.

- 7 cupolas working two shifts, and smelting 12 tons per day.
- 3 " " " " to smelt black copper.
- 2 reveratory furnaces working two shifts to refine.
- All tons except copper equal 2,352 pounds.
- 1 ton copper equals 2,240 pounds.
- Coke per ton of 2,352 pounds costs \$6.50 at works.

Mining by contract.....	\$6,000 00
Breaking and burning by contract.....	800 00

ORE SMELTING—LABOR.

14 men at \$31.50 each at cupolas.....	\$441 00
16 " " 37.50 " ".....	600 00
6 " " 25.00 " laborers.....	150 00
8 " " 37.50 breaking and burning matte.....	225 00
8 " " 40.00 black copper cupolas.....	240 00
8 " " 37.50 " ".....	300 00
8 " " 45.00 refining furnaces.....	135 00
2 " " 37.50 " ".....	75 00
2 masons.....	75 00
2 blacksmiths.....	75 00
2 engineers.....	75 00
1 carpenter.....	40 00
1 laboratory man.....	25 00
	<u>\$2,456 00</u>

FUEL.

Ore smelting, 364 tons coke.....	\$2,366 00
Black copper smelting, 70 tons coke.....	450 00
" " refining, 40 tons coal at \$7.00.....	280 00
" " " 160 cords wood at \$2.50.....	400 00
Engine, 100 cords wood at \$2.50.....	250 00
Burling matte, 120 cords wood at \$2.50.....	300 00
General use, 25 cords wood at \$2.50.....	62 50
	<u>\$4,108 50</u>

STONES.

12½ M fire brick, at \$30, ...	\$375 00
Tools.....	200 00
Chemicals.....	50 00
Sundries.....	100 00
	<u>\$725 00</u>
	<u>\$14,069 50</u>

MANAGEMENT—ANNUAL.

Treasurer.....	\$5,000 00
Consulting Engineer.....	2,500 00
General Manager.....	2,500 00
Assistant Manager.....	800 00
2 working Superintendents.....	2,000 00
2 Bookkeepers.....	1,500 00
1 Time-keeper.....	460 00
	<u>12) \$14,760 00</u>
Allowance for depreciation, say.....	\$2,500 per year.
Contingencies.....	3,000 "
	<u>12) \$5,500</u>
Transportation at \$12.50 per ton.....	458 33
Selling at 1 per cent. commission.....	925 00
	<u>248 64</u>
Cost of 74 tons—165,760 lbs.....	\$16,951 47
Value of 165,760 lbs. at 15c. per lb.....	<u>24,864 00</u>

Profit monthly.....		\$7,912 53
Profit yearly.....		94,950 36
Cost of copper per pound.....		.10,26 1-4 cts.
Estimate of H. M. Howe.....	.10,45	
" of John Thompson.....	.10,10	
	2) .20,55	
Average.....		.10,27½ cts.

COST OF EXTRACTING SULPHUR.

Premium to men burning ore.....	\$300 00
8 men at \$31.25 per month.....	250 00
Loading on cars at \$1 per ton.....	800 00
Freight to Boston at \$4 per ton.....	1200 00
Cost in Boston of 300 tons of sulphur.....	\$2,050 00
Value.....	7,500 00
Monthly profit.....	\$5,450 00
Yearly profit.....	65,400 00
Profit from copper.....	94,950 36
Total.....	\$160,350 36

PROSPECTUS.

The officers of the Orford Nickel & Copper Company, at present, are:—

President—W. E. C. EUSTIS.

Treasurer—ROBERT M. THOMPSON.

Managing Director—R. G. LECKIE.

Consulting Engineer—H. M. HOWE.

Directors—W. E. C. EUSTIS, R. G. LECKIE, ROBERT M. THOMPSON; and two vacancies, which will be increased to three, by the resignation of one of the present directors.

The property of the Company consists of the Orford Nickel Mine; the Crown Copper and Sulphur Mine; and two patents

for processes for roasting copper ores, and the Leckie Sulphur Patent. The Company is organized under a special charter from the Parliament of Quebec, which exempts stockholders from all liability. Its capital stock is \$300,000, divided into 15,000 shares of the par value of \$20. \$25,000 has already been paid in for the working capital of the Nickel Mine. The Company now desires to raise \$125,000 additional to complete the payments for the Crown Mine, erect extraction works, and for working capital.

To raise this sum, the Company offers its stock at par, preferring this method to putting out a larger number of shares and selling them at a great discount.

In the development of the property, two plans have been considered:

First, to lease from the owners of the Hartford Mine the present shaft; and to put up such part of the smelting works as will be necessary to treat the ore produced. Under this plan the expense for the first year will be:

Payment of balance due on mine.....	\$20,000 00
Sinking shaft and running levels.....	7,500 00
Extraction works and mine plant.....	27,000 00
Salaries and general expenses.....	10,000 00
Working capital for carrying on smelting....	20,000 00
Total.....	\$84,500 00

At least 6,000 tons of ore can be delivered during the first year, and this will yield:

COPPER, 223 tons, or 493,280 pounds. A part of the cost of which is included in the above expenditures, but allowing,

instead of the profit of four and one-half cents per pound shown by the estimates of the Messrs. Howe & Thomson, two and one-half cents as the average profit, the return will then be.....\$12,332 00

SULPHUR, 1200 tons, and allowing on this one-half the rate of profit claimed when the works are at full work. The return will be..... 12,000 00

\$24,332 00

Leaving at the end of the first year, cash assets. . \$84,000 00
To complete the works will require..... 58 000 00

Leaving working capital.....\$26 000 00

Which should be increased from the earnings of the second year to \$100,000, additional stock being issued to represent it, and thus increasing the capital to \$400,000. *The promoters, after careful examination, are convinced that the above plan can be carried out, that is, in substance, that on a cash advance and guaranty of \$125,000, the mine will in two years pay the expenses of its own development and erection of extraction works.*

The second plan, which must be adopted if shaft No. 5 cannot be leased, differs from the first only in the time and cost necessary to sink a vertical shaft, say 400 feet. The time required for this will be about eight months, and the cost \$10,000 to \$12,000. After the shaft is down, there will be some time and money saved in developing the mine, and the work of paying for the mine will take two and one-half instead of two years.

The person who now invests in the stock will, we believe, receive within two years thirty-three per cent. in scrip dividends, and ten per cent. in cash; and thereafter on his stock, dividends

at the rate of thirty per cent., or on the cash invested of forty per cent.

The object of this circular is to provoke investigation. It does not attempt to answer all questions that may be asked, but by calling at our office, 4 Pemberton Square, and talking with one of the undersigned, any further information you may desire, and every opportunity for full investigation will be given.

We understand that in asking Boston investors to take hold of a Canada Copper mine we will be at a great disadvantage on account of the ill success of Boston speculators in Canada, but we do not regard our present offer as a speculation, but as a legitimate business enterprise—an enterprise, to be sure, in which there is risk, but the risk is, we believe, reduced to a minimum, and the enterprise only needs good business management to insure success.

Notice the following points:

- 1.—The subscriptions are not binding until the entire sum of \$125,000 is subscribed.
- 2.—The subscriptions will be payable on easy terms, *viz.*, twenty per cent. down, and ten per cent. a month thereafter as long as money is needed, until one hundred per cent. is paid in.
- 3.—The subscribers for the new stock can elect a majority of the directors, and thus control the business management of the Company.

ROBERT M. THOMPSON,

Treasurer.

We have examined the report and estimates, and the property itself, and believe that the statements made in the foregoing reports and prospectus are true.

W. E. C. EUSTIS, } *Mining and*
H. M. HOWE, } *Metallurgical Engineers.*

