

Sudbury Nickel Deposits.

Report by Experts to the United States Government.

BUREAU OF ORDNANCE,

NAVY DEPARTMENT,

OCTOBER 14th, 1890.

Hon. B. F. Tracy,

Secretary of the Navy, Washington, D. C.

SIR,—In obedience to the Department's order of the 28th ultimo, we proceeded to Cleveland, Ohio, and on the afternoon of the 1st inst. were received by the Board of Directors of the Canadian Copper Company. These gentlemen informed us that every facility would be afforded us to see their property in Canada, and the plant, progress and processes at their mines.

Mr. S. J. Ritchie, one of the directors, was selected by the Board to accompany us, and he subsequently instructed the manager of the works to freely answer all our questions concerning the mines, and the operations of the company, at the various points under his management, and during our visit we found every indication of the desire on the part of the management and its employés to show us the exact state of affairs.

Wednesday night we left Cleveland; arrived at Sudbury Friday afternoon in time to examine the mining operations at the Copper Cliff Mine. Saturday we visited the roasting beds, and the smelting works at Copper Cliff, and were shown the indications of the line of ore deposits extending from the Evans to the McConnell mines.

The same evening we went to White Fish station, on the Algoma branch of the Canadian Pacific Railway, and the next day visited the deposits of the Crean Hill range and the Vermillion mine, returning to Copper Cliff to spend the night.

Monday we went to the Naughton station on the same line, and from there rode to and saw the Company's property in Creighton Township. Tuesday we visited the Stobie mine, and the works of the Dominion Co., at the quarter section marked Du Charme on the map (enclosure No. 1), Sir Hussey Vivian's works at the Murray mine, and the Worthington mine, belonging to the Dominion Company, at the point called Crean mine on the map above referred to.

The next morning we started on our return, via Sault Ste. Marie, visiting on the 10th inst. the shops of the Gates Iron Works and Fraser & Chalmers, manufacturers of mining machinery at Chicago, thence to Cleveland, Ohio, where we were again present at a meeting of the Board of Directors of the Canadian Copper Company, and on the 12th inst. returned to our regular stations.

Having thus briefly summarized our itinerary, we have the honor to submit the following general observations upon the mining district of Sudbury, and a more detailed description of the special points we visited:

THE SUDBURY MINING DISTRICT.

The presence of extensive and promising tracts of mineral deposits in what is now called the Province of Ontario has long been known, and as early as 1846 a report was made to the Canadian Government stating this fact, but saying that owing to the difficulties of access and the cost of transportation, working these deposits must be delayed until railways were constructed, and freightage to markets thereby reduced.

Enclosure No. 2.—A map published by the Canadian Pacific Railway Company shows the situation of this district and the lines of railways now finished; and it was not until the construction of this railroad that the great value of these deposits were even moderately estimated. Mr. S. J. Ritchie took out applications covering a territory of about 100,000 acres, extending in a north-easterly direction from Crean mine to Stobie, and embracing a belt of territory about 25 miles long and from three to seven miles broad, within which the mineral deposits were reported to lie. Upon a more careful examination of this district he selected the territory shaded red from the Evans to the Stobie mine, suffering the remainder which he had pre-empted to revert to the State. The Canadian Copper Company, which had been chartered January 6th, 1886 (capital \$2,000,000, afterwards, August 8th, 1889, increased to \$2,500,000) under the laws of the State of Ohio, and granted by special act of the Canadian Government, all the rights that it would have acquired under a Canadian charter, subsequently purchased the tract of land colored red in Creighton. All of the beds of ore seem to lie between strata of granite on one side, and diorite on the other, and as those formations generally plainly appear on the surface, they have guided the company in its selection of territory. We were fully convinced from the surface indications and the borings and shafts already sunk, that the company have an amount of mineral which cannot be exhausted by this generation. The surface indications are found in the belt previously mentioned, and although they seem in each case bounded by the walls of granite and diorite, more careful examination of the country when it is opened out may discover other valuable deposits, connecting those owned by this company.

The general character of this country and the neighborhood for hundreds of miles is broken by rocky ranges, from 100 to 600 feet high, the bare rocks cropping out in many places and the rest covered by a thin soil, upon which were pine forests. Between the hills are marshy valleys, and numerous lakes and streams, capable of

furnishing abundant water power. As yet there are no roads, excepting in the immediate vicinity of the railways, and the country is accessible only on foot, except where trails have been cut to several points.

About eighteen years ago forest fires swept the whole neighborhood, and the standing trunks of immense pines are surrounded by a second growth, which in the valleys is so dense as to be scarcely passable, and, with the fallen trees, slippery rocks and marshy lands, renders even a prospector's task difficult.

The Canadian Copper Company claim to have spent thousands of dollars in surveying and prospecting, and as they had the right of selection, it is reasonable to suppose that, with the great capital at their disposal, they did not leave much to others. The properties of the other companies mentioned are at the extremities of the belt, and may be only the fringe of the main body of deposits. From our examination they appeared to be in extent and capability hardly one per cent. of that owned by the Canadian Copper Company.

The Crean mine, at the south-west extremity, has been worked out and abandoned, and the Worthington mine, near the same, seems to be only a pocket.

The Dominion Company's mine, at the other extremity, seems to be nearly worked out, and the Murray mine but comparatively small; should other deposits be not found outside the belt mentioned, the Canadian Copper Company have practically everything. The others claim, however, to own large tracts of land in the north and north-west, but the existence of ores therein is disputed, and seems to be doubtful. Neither company claims to be doing any work beyond prospecting, at any points we did not visit.

The character of the ores in this district is technically described in a paper written by Dr. E. D. Peters, who was for a time manager of the Canadian Copper Company.

It is important to notice from an economic point of view, that these ores can be smelted in their natural state, that is, they do not require the admixture of fluxing substances. The dead pine timber found in great abundance in the neighborhood, and which can be delivered at the furnaces at \$1.80 per cord, is a good fuel for roasting, though hard wood would be better, but owing to the fusible qualities of the ores, and intermixed rock, it answers the purpose. Coke is hence the only material that has to be brought from abroad. This is procured from Pittsburgh, and can be delivered at the works at \$7 per ton.

The general processes are:

- 1st, Mining.
- 2nd, Roasting.
- 3rd, Smelting.

The points selected for mining are determined from surface indications, and by examination of the substrata by a diamond drill. This drill cuts a core from the rock through which it passes, thus furnishing material for analyses of the substrata. The convenience of working and transportation are of course considered. Should the deposits of ore be in large quantities on a hillside, it is simply blasted off, but as they more frequently dip under the surface, mining by a series of levels is less expensive. A shaft is run at an angle determined by boring a convenient depth, and then the ore blasted out of a large chamber, the miners working around the walls and ceilings, standing on the mass already thrown down, until work on this level is exhausted. The shaft in the meantime is continued to another level, and another chamber worked as before. Shaft mining is also much better adapted to the severe winter climate than surface work, and is alone sufficient reason for its adoption here.

The mass of rock and ore thrown down in the chambers is broken into handling sizes by the miners, the good ore separated from the rock and low grades, loaded into trucks and hoisted to the crusher at the top of the shaft. Passing through this, it is divided by sieves into three sizes, and falls into bins respectively. Before and after crushing, the "gangue" (non-ore bearing rock) is picked out as much as possible.

The rock from the chambers and low grade ore are dumped into a heap at one side.

2nd, Roasting.—Roast beds are prepared by levelling a surface on the ground, which should be well drained and hard. Upon this a thin layer of the "fines" is laid, then a layer of pine wood from one and one-half to two feet in thickness, according to the fusibility of the ores; then "coarse" and "ragging" is laid on to a depth of about seven feet, and the whole covered over with "fines" to confine the heat. Fires are started, and the mass burns from 40 to 70 days. It is then broken up and transported into bins near the smelting furnaces.

3rd, Smelting.—The furnaces are, speaking generally, vertical receptacles, into which combustion, started at the bottom, is continued through successive layers of coke and ore, the minerals fusing and running off as matte at the bottom, and the feeding continuing at the top as the mass smelts down.

Various qualities of ores are in bins at the level of the charge door of the furnace, and the successive charges of ores and coke are weighed and shovelled into the same. A cold blast at the bottom stimulates the combustion, and as the mass is fused it runs into a forehearth, from which the slag is drawn off at short intervals through a taphole near the top, and the matte at longer intervals from the bottom.

Upon the disposition of the means of handling the material through its various stages, avoiding handling to the greatest possible extent, depends to a considerable degree economic production.

Having thus generally noticed the characteristics of the district, and the processes employed, we beg leave to give a detailed description of the mines and ore deposits, as follows:

THE CANADIAN COPPER COMPANY.

The Copper Cliff mine and vicinity.
The Evans mine and vicinity.
The Stobie mine and vicinity.
The deposits in Creighton Township.

THE DOMINION MINERAL COMPANY.

The Bleazard mine.
The Worthington mine.
The Crean mine.
The Murray mine.

The Copper Cliff mine is situated on a branch road, about a mile from Copper Cliff Station, about four miles from Sudbury, on the Algoma branch of the Canadian Pacific Railroad, and was opened in the summer of 1886. The face of the hill, about 60 feet high, was blasted off, and a shaft sunk at 45° into the earth. The mining is now on the fifth level, and the sixth about to be opened, the length of the shaft being about 600 feet. 56,534 tons of ore have been taken to the roast yard from this mine from the opening up to the 1st of October, 1890. At present about 180 tons of ore are crushed daily. There are no indications of decrease in the extent or richness of the ore. It does not appear in veins, but the entire mass seems ore of varying grades, with small quantities of rock intermixed. There is irregularity in the ore as to the proportions of the above named minerals, one or the other predominating in spots in a way not to be predicted or accounted for.

The average amount of copper and nickel combined is about eight per cent., five of copper and three of nickel. Specimens, however, have been picked with copper running as high as 30, and nickel 15 per cent., but the presence of small deposits of abnormal richness cannot be considered as indicative of the richness of the mine, as regularity promises greater extent of the deposit.

The plant consists of a hoisting engine, with two drums and cables, one No. 5 Blake crusher, 15" x 9" aperture, with sieves for sorting ore, capable of crushing about 400 tons of the kind of ore taken from this mine in 24 hours, a steam pump and reservoir for compressing air for the rock drills, a small machine shop for making repairs, two boilers, furnishing about 80 H.P., which suffices to run all of the machinery, one steam pump used at the lower level of the mine, which condenses into the tank it pumps from, one small pump run by compressed air for filling this tank, and four rock drills, also run by air. In addition are the ore trucks and utensils for blasting, breaking and handling the ore.

Near this mine are the offices of the company, and about 40 log houses for the employés and their families.

The ore from the bins under the crusher drops into dumping cars upon the railroad track, which connects with the roast yard. This track runs up grade on to a trestlework about a mile long, leading towards the smelting furnaces. On one side of this trestle, the level of which is about 15 feet higher, the ground is levelled off for the roast beds, about 2,000 feet along the track, and from 150 to 75 feet wide. The ore from the cars falls through a chute in hand barrows, by which it is distributed over the beds. After roasting, the ore is carried in hand barrows to a track running parallel to the other, on the opposite side of the trestle, and on the level of the roast beds. This track leads to the smelting furnaces, and the roasted ore is dumped into the bins thereat. The present capacity of the roast yards is about 60,000 tons. This can be easily increased to 90,000 by preparing the ground near it at small expense, and indefinitely by lengthening the trestle, and cutting into the hillsides at no great expense.

At the time of our visit about 35,000 tons of raw ore were in the roast yards. The work in the yards is done by contract, and at present about 75 men are employed. The company provides fuel, plant and tools, and the contract price is 20c. per ton from bins and off cars on to the beds; and 30c. per ton off beds into cars, and into bins at smelting furnace. Total from bins at the mine to bins at the furnace, 50c. per ton.

Working full power, the beds can be used about four times a year; that is, counting the time occupied in bedding, roasting, and clearing the beds, it can hardly average less than three months; the full yearly capacity of the present yards is 240,000 tons. By additions that could be made in one month, the yearly capacity could be increased to 360,000 tons.

All the roasting of the Canadian Copper Company will be done at this point.

In connection with the line of tracks from the main line and roast yards are the smelting furnaces. The plant here consists of two Herreshoff water jacketed furnaces, with two complete sets of blowers, either of which has sufficient power to supply the blast for both furnaces.

The two levels of track are conveniently disposed for economical handling, the upper level dumping into the bins, on the level of the feeding platform, the roasted ores, raw, "fines," and coke, and the lower taking away the "matte," loaded from where it lies level with the platform of the cars.

The Herreshoff furnaces are an American patent, and said to be the best used. One has reduced 187 tons of the ore from these mines in one day, and the manager and furnace man said that, running without forcing, 135 tons could easily be reduced. English furnaces of the same size do not reduce more than 50 tons per diem.