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SIMSBURY COPPER MINE.

A REPORT

ON THE MINES OF THE

CONNECTICUT COPPER COMPANY,

IN GRANBY,

HARTFORD COUNTY, CONNECTICUT.

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MIDDLETOWN, January 1, 1857.

HON. EZRA CLARK, JR.,

President Conn. Copper Co.

DEAR SIR:—Having made a careful examination of the Mineral property in the town of Granby, Conn., owned by your Company, I now take pleasure in giving you, at your request, the result of my observations, with my views as regards the working of the mines.

The deposits of copper ore in Granby, were among the very first discoveries of mineral wealth made in New England. This becomes evident, from the perusal of a pamphlet published in New York in 1831, when it was proposed to form a large company to work your mines. The "*extracts from the earliest printed laws of the Colony of Conn.*," contained in this publication, show that as far back as the year 1709, under the reign of Queen Anne, an act existed in which the Copper Mine at Simsbury, (near Granby,) is spoken of as "*having been so improved as to give a good satisfaction.*" This act was passed *for the better encouraging, directing and enabling the proprietors and undertakers, or others that are or may be concerned therein, to manage, carry on and improve said mines to*

the best advantage." Another act, appointing commissioners, "*for the directing and regulating the management of said Mines, and the Mills and works belonging to some of the undertakers of said Mines,*" was passed in 1721, in the seventh year of the reign of King George, and in 1723, 1730, 1732, and '38, various other laws were created for the especial regulation "of the Mines." It is therefore certain, from these laws, that during a period of thirty years at least, they were in active operation, and, indeed, even if no records existed, the magnitude of the old excavations would authorize the conclusion, that a large number of men must have been employed in making them during a period of many years. Nor are the shafts and levels in which you have commenced your operations, the only old mining explorations existing on your property. There is plainly visible the margin of another shaft entirely filled up and overgrown with grass, sunk near the junction of the sandstone and the trap rock, to which I shall refer hereafter—and other excavations, of unknown extent, on your property, are only to be distinguished by "burrows and attle," and various depressions in the ground. Actual mining operations, however, ceased, probably, in 1745, when the French war was commenced, by which the Colonies were much affected. In after years we find the principal shaft and levels, the work of the old miners, used by the State of Connecticut as a prison, for which purpose they were occupied during nearly sixty years, under the name of "New Gate Prison." It seems to have been the intention of the State to employ the prisoners as miners, but this project failed, as was to be expected, and until the whole property passed into the

hands of your company, no active mining operations were carried on here.

Before speaking of the mine itself, it will be necessary to say a few words regarding the geology of the immediate region in which the metalliferous belt containing the copper ore occurs. Geological observations are particularly valuable for mining enterprise in developing analogies with other well-known and explored fields where mines have been worked successfully—thus presenting certain rules for the guidance of the new undertaking. Many examples of this kind could be mentioned. In Cornwall, for instance, copper lodes occurring in Killas (clay slate) traversed by channels of Elvan (Porphyry,) and in the immediate vicinity of Granite, have been found, generally, more productive than those not similarly situated. In the great mining district of Saxony (the Erzgebirge) the lodes of argentiferous ores, which have been worked for many centuries, are rich when veins of porphyry are found in their immediate vicinity. The explorations of the native copper lodes of the Lake Superior region, have proved that those in the Trap and Amygdaloid rock are vastly richer than the veins found in the Greenstone, while the most productive are those occurring between the Trap and the Conglomerate rock. Breithaupt, Cotta, and others, have, from such facts, deduced laws, the observance of which, takes from mining operations that peculiar illegitimate appearance of a mere lottery, which they generally have to the mind of persons not acquainted with them, furnishing to the educated practical miner a safe compass by which he shapes his course.

One of the laws developed through the observation of

analogies is, that lodes and metalliferous deposit in general, are richer when found in the immediate vicinity of true igneous rocks. In the Atlantic States, in particular, trap dykes seem to have had an enriching influence upon the mineral deposits in the metamorphic rocks; and wherever these dykes traverse or cut through the old or new red Sandstone, they have apparently produced an action through which native copper, or ores of copper were deposited in these rocks. Many examples of this kind might be adduced. The whole of the Lake Superior region, the cupriferous sandstones of New Jersey, the lodes near Phœnixville, Pa., the numerous as yet unexplored deposits of copper ore in Connecticut, as for example, near Meriden, Berlin, New Britain, Cheshire, &c., &c., and many similar localities in other States, could be mentioned in this connection. Your mine is only an additional proof of the above stated fact.

It occurs in a bed of white Sandstone, interstratified between beds of a red rock of the same age and nature. To what exact geological age these strata are to be assigned, I have not been able to determine—but they are evidently not coeval with the new red Sandstone of the Connecticut valley. A range of massive Trap, or rather a series of dykes, cuts through these beds, which have a regular easterly dip of nearly 25 degrees. The locality has, therefore, those characteristics which would lead us to expect the presence of copper ores in the vicinity, even had they not been discovered in your mine.

The manner in which your ores occur, is that of a bed, and not as a lode. As before stated, the Sandstone containing them, is interstratified, and although of a different

color, is exactly of the same nature as the beds surrounding it. There are no walls present, properly speaking, as what has been termed walls in this mine, is nothing but the stratification of the beds themselves. The deposit shows, also, nothing of the crystaline nature which regular injective or fissure veins generally have. There are no vaughs or open spaces filled with crystalized minerals found in it, which, in true lodes, are nearly always met with. It would be wrong, however, to suppose that your mine is any the less valuable for being a bed instead of partaking of the nature of a lode. Numerous examples of highly productive mines worked upon metalliferous beds could be mentioned. The Mannsfeld Copper Mines of Germany, which have been worked profitably for their copper ores during more than one hundred years, are beds in the so called Kupferschiefer (Copper Slate.) Nor is the Fluckan (a decomposed Mica slate) of the Bristol Copper Mine, in Connecticut, which is very rich in purple copper ore, (Erubescite,) anything but a bed, and most of the copper deposits of Scandinavia, Tuscany and Africa, are of the same nature. There is every reason to believe that the bed in which your mine is wrought, descends to an unknown depth, and will always yield an abundant supply of ore, remaining as rich, at least, as it is at present.

The average width of the stratum in which the ore is found, may be set down as three feet, although it is in some places much wider. That, from such a deposit, an immense quantity of orey material can be obtained is very evident, and I can state to you, without hesitation, that *I believe the supply of copper carrying rock from your mine*

to be inexhaustible. There is, therefore, no speculation or risk incurred in working the mine, as regards the supply from it. Through the ancient excavations, you have large backs laid open from which any quantity of copper rock may be stoped away, and the only questions bearing decisively upon the importance of the mine are the nature of the ore, its mode of occurrence, and the means by which it can be made marketable. An investigation of these matters will give reliable data from which the great pecuniary value of the mine will be seen.

1. *The Ore itself.*—The copper contained in the bed exists in it as Vitreous copper, Malachite (Carbonate of copper,) and Chrysocolla, (Silicate of copper.) I did not see any Copper Pyrites (yellow ore) or Purple ore, as what appears to be the latter is merely tarnished Vitreous ore. The Vitreous copper contains in its pure state, (after being liberated from the surrounding rock,) about 78 per cent. of metallic copper, the Carbonate from 50 to 60 per cent., and the Chrysocolla about 30 per cent. of the metal. These ores are therefore of the very richest kind and there is in fact, no ore of copper of commercial value richer than the Vitreous ore known. This is the most abundant in the mine. I am however, well convinced that the high percentage of the rock in copper, as raised from your mine, is not only to be attributed to the presence of a great deal of finely disseminated Vitreous ore, which is almost invisible, but also to that of the Malachite and Chrysocolla with which nearly all the bed is saturated, and which gives it a peculiar green appearance in some places. This occurrence of Malachite, reminds me much of a deposit which I examined some years ago, and which is

worked near the great St. George Copper Mine, Perranzabulo, in Cornwall. Here the waters coming from different adits, and holding sulphate of copper in solution, have for many years flowed over beds of sand near the sea-shore, which contain carbonate of lime in the shape of fragments of shells, the chemical action thereby generated, producing a regular Malachite, which has cemented the sand together. To indulge in theoretical speculations as to the origin of the carbonate and silicate in your mine, may not be within the range of this report; still, I would here say that I have little doubt of their not being, as is usually the case in other places, the products of the decomposition of the sulphuret which is contained in the bed itself, but rather that they are the results of an action similar to that which has produced the "Greens," as they are termed in Perranzabulo. From chemical examination of the Sandstone composing the bed in your mine, I can state that it contains a great deal of carbonate of lime, and seams of Calcite are abundant everywhere in the rock. I am led from this and from what I shall say hereafter, of the very curious manner in which in your mine, the Vitreous ore occurs, (which seems to have escaped observation, although it is a most vital point in relation to the mode of making the ore marketable,) to believe that a solution of sulphate of copper passed through this bed, coming from some as yet not discovered body of ore in the vicinity of your mine, the copper which it contained remaining in the state of carbonate or silicate, while the iron which gives the red color to the sandstone surrounding the cupriferous belt, passed off with the liberated sulphuric acid as sulphate of iron. This would

account for the white color of the bed itself. During a subsequent action, the sulphurisation, which produced the Vitreous ore from the Malachite and Chrysocolla, may have taken place. I refer to the nineteenth chapter of the first volume of Gustave Bishof's Elements of Chemical and Physical Geology, (Cavendish edition,) for the elucidation of this subject. This theory receives additional support from the singular manner in which the Vitreous ore is found. I have examined the subject very carefully, and I am prepared to say, that as far as the old explorations have gone, there is no *massive* Vitreous ore in branches, strings or spots, anywhere to be found in the bed. A simple microscopic examination of the ore will suffice to prove my assertion correct. Even those pieces which at first sight seem to be solid sulphuret of copper, are nothing but Sandstone thoroughly impregnated with films and coatings of Vitreous ore, the latter surrounding the grains of silica in such a manner as to hide them from the eye. The mottled appearance of the bed is therefore not produced by the dissemination of solid grains in the Sandstone, but by a sort of concentration of the films of vitreous ore around a particular point. I would not speak of this matter at length, were it not of the greatest importance as regards the treatment of the rock for obtaining the large amount of copper which it contains.

You have, therefore, in your mine, a large body of copper-carrying Sandstone, filled with Vitreous ore, Malachite and silicate of copper, in a state of very fine division. But so thorough is the impregnation, that from a number of experiments made, the average of all the rock broken from the bed may be safely said to be three

and a half per cent. of metallic copper, which is a very high yield, as even one per cent. of copper will, when a mine is favorably situated like yours, pay abundantly. There are places in the bed where ore containing from fifteen to twenty-five per cent. of copper can be readily obtained, the saturation of the Sandstone with Vitreous ore being more complete; but as legitimate mining is not conducted upon exceptional specimens, but upon the yield on a large scale, I do not particularly refer to these instances. It may be reasonably asked, considering the extraordinary amount of metallic copper in the bed, why the mining operations carried on by you have heretofore not been as profitable as should be expected, from what I have stated above. The answer is, simply, because the mode adopted for making the ore marketable, is an entirely erroneous one, as I shall try to prove in the following remarks.

2. *The means for cleaning the ore, and bringing it into a state fit for the smelting furnace.* It has been truly said that nearly all necessary for the success of a bona fide mine, which is economically managed, is to understand the treatment which its ores require, in bringing them from the rough state in which they are taken from underground, to a concentration, fit for the market. The idea which some even educated people have of a mine of the valuable metals, viz., that it is a place where one only need to dig down a few feet in order to obtain solid masses of rich ore, is, I need not tell you, ridiculous. Nature has not been so lavish with her treasures, but has left room for the exercise of the mind of man, and in no department of mining operations is ingenuity more called for than in the

cleaning of the ore from the valueless gangue or rock with which it is generally associated. In the great mining fields of Germany and Cornwall, labor is cheap, and many modes of dressing which may be proper there, can not be used in this country, on account of the expense in labor which they require. It is for this reason that the separating table for fine ores, (stamp work,) and the patent Jigg for crushed rock, invented by H. Bradford, Esq., of New York, are of the greatest importance to the mining interest of this country, as they not only produce more ore than any of the old processes of buddling, tyeing, jigging, &c., but effect also a large saving in money, expended formerly in manual labor. From my own experience during one year's working of these machines, I must express myself highly pleased with them, and it is only due to Mr. Bradford to state here that no machine, in my opinion, has ever been invented, which when properly worked and arranged, is superior to his separating table for the dressing of stamp work, or to his patent Jigg, for cleaning the coarse material obtained from a crusher.

At your mill you have put up ten of these tables and one common Jigg. This is a mistake, as neither of these machines is in any way adapted to the purpose for which they were erected by you. You did not succeed in obtaining one-eighth of the copper actually in the material, which you endeavored to dress by these means, as an analysis of the waste heaps around the mill shows. Bradford's machines are no more fit for the profitable working of your ore, than the old processes of buddling, jigging, or tyeing would be, and had you ever investigated the mode

of occurrence of the ore, described by me in the preceding pages, you would have come to the same conclusion.

To treat all ores by the same process of dressing is as much impossible as to endeavor to heal all diseases by one medicine, and although Bradford's machines are highly successful in cleaning ore from rock, when the former comes on them in grains of equal size with the latter, they can not work satisfactory in your case, where the ore exists in the ground or stamped material in a state of much finer division than the rock. The natural effect of bringing the copper rock to a powder or flour, fit for the separating tables, whether it is done by stamps, crushers or mill-stones,* is this: the hard grains of silica composing the Sandstone, rubb the softer coatings of vitreous ore which surround them, to a state of such fine division, that when the whole is mixed with water, which it must be, before it is fit for the Separators, the almost impalpable particles of copper ore have no chance to settle, but flow off with the water on account of their lightness, while the heavier particles of silica remain on the table; were the grains of sand and copper ore of the same size, this would not occur, as then the specific gravity of the grains of copper ore being much more than that of the grains of rock, the table would effect a separation. Furthermore: I have above stated that a great deal of copper is contained in the bed as Malachite and Chrysocolla; all this was lost by your way of cleaning the ore, and indeed would be by any mode of dressing in common use for massive ores, as the

* You reduced your ore to flour by mill-stones. I disapprove of this method. They are much inferior to stamps.

specific gravity of these minerals is not high. Nor was the loss occasioned by the washing away of the carbonate and silicate by any means inconsiderable. I have examined specimens of copper rock from your mine in which no Vitreous ore could be seen, nor did they upon analysis, give any trace of sulphur, (showing that the copper contained in the rock was not in the state of sulphuret,) still they yielded two and a quarter per cent. of metallic copper.

Considering these facts, the question naturally arises, *Which is the proper way of treating the ore, and how can all the copper in the rock be saved?*

In answer to this I hereby submit to you a plan which has been for many years practised with success in Germany, upon the Mannsfeld copper-bearing slates and upon a large quantity of the ores of the Rammelsberg. You may rest assured that if the simple apparatus necessary for it is put up properly, you will obtain from it the gratifying result of saving a large amount of copper which by any other mode of treatment must be inevitably lost.

I think you may safely depend upon a supply of 40 *tons of rock per day* for many years to come, from the backs in the levels already opened. A large force of miners would not be required for this purpose. The rock should be thrown upon what in the Cornish miners' language is called a spalling floor, where the richest of it, that is those portions which are most thoroughly penetrated with the Vitreous ore, could be selected, broken up and put into a pile by themselves. This pile (A) would be fit for sale to the smelters without any further manipulation. I

think I may safely say that the average per centage of this picked ore would not be less than 15 per cent. of metallic copper, and that out of 40 tons raised daily, two tons of it could thus be obtained. The remainder you will then assort into two other piles, B and C. Into pile B will be heaped all the material containing visible Vitreous ore, which will be the kind of rock presenting the peculiar mottled appearance. Pile B, will average about $2\frac{1}{2}$ per cent. of metallic copper and comprise say 25 tons out of the remaining thirty-eight. It will be carted or passed over a railway to your mill, where it can be broken up by a large Cornish crusher into pieces of the size of a hazel nut. It should afterwards be roasted for 24 hours in open heaps. The turf, abundant near your mill, can be used as fuel, and then it will be smelted down into what the Germans call Kupferstein (Copperstone) in common smelting furnaces to a matte containing about 15 per cent. of metallic copper. In this way you will save nearly all the finely disseminated Vitreous ore, the carbonate and the silicate, which by any other process would be lost, as I have endeavored to show above. The operation is extremely simple and any laboring man can easily be taught to perform it. In many mines of Germany it has been employed successfully for many years. The flux used is lime, of which the sandstone itself contains a large amount. From pile B you will thus obtain at least 4 tons of a matte or concentrated ore of 15 per cent. which will be ready for sale. Pile C, containing all the rock in which no vitreous ore is visible and in which all the green material full of Malachite and Chrysocolla has been put, will also be taken to your mill, where it must be crushed

and passed through a seive of say 70 holes to the square inch. This flour you will transport to a reverberatory furnace in which with the addition of a sufficient quantity of common salt, it will undergo a roasting—turf being again used as fuel. After having been thus treated for about 12 hours, you will put the whole of this material from the furnace, while yet hot, into large tubs or vats, containing water acidulated by sulphuric acid. In the vats, each of which should be capable of holding two tons, the mixture of rock and water will be kept stirred by machinery for 20 hours, after which time the rock must be permitted to settle. The water is then to be drawn off into tanks into which a quantity of old scrap iron has been put. The fluid thus obtained will hold in solution as sulphate and chloride nearly all the copper which the sandstone contained in the shape of carbonate and invisible Vitreous ore. There will be also a quantity of the sulphate and chloride of iron present; but as neither the ores nor the rock itself contain much of the latter metal, it will be naturally small. The iron in the tanks will precipitate from this solution the copper in the metallic state. This can be taken out carefully and sold to the smelter for refining. The operation which pile C has to undergo, though apparently complicated, is actually very simple and is based upon chemical laws easily understood. It is the only way in which the large amount of copper contained in the carbonate and the invisible vitreous ore can be made useful, and has been practised for years with success in Saalfeld. A process of this nature for ores similar to those of pile C, has been lately patented in England by Messrs. Wagstaffe & Perkins, in London, and its

working has given ample satisfaction. The produce of the 13 tons treated in this manner will be about 1000 lbs. of precipitated copper, which upon assay will yield say 80 per cent. of fine copper.

The result from the 40 tons of rock raised from the mine daily and treated in the above manner will therefore be:

From pile A—2 tons of 15 per cent. ore, worth at present prices of copper at least 80 dollars per ton, or $160.

From pile B—4 tons of 15 per cent. copperstone, $320.

From pile C—1000 lbs. of 80 per cent. precipitated copper, at least $180.

Making in all a produce per diem equal to 660 *dollars, at least. In this calculation ample allowance has been made for losses unavoidably incurred in the different operations.*

The expenses connected with the whole establishment may be set down as follows:

100 men employed as miners, laborers, smelters, mechanics, &c., whose wages will not exceed on an average $1.25 per day, $125 per diem.

Cartage of 40 tons of rock to your mill at 40 cents, (a contract at 33 cts. per ton has been made,) $16.

Coal, fuel, iron, lumber, carting, powder, &c., $50.

Extraordinary expenses not included in the above, $25.

Making in all a daily expense of say $220, leaving a profit of $440 per diem, or *of one hundred and thirty-seven thousand two hundred and eighty dollars per annum*, counting 26 working days in the month. Deducting from this the large amount of thirty-seven thousand dollars for stoppages, wear and tear of machinery, salaries to managers, &c., and unforeseen expenses of all kinds, the

profit will still be equal to 33 per cent. on the capital stock of the Company, ($300,000.)

I call your attention in particular to the fact that the above calculations are based upon facts already ascertained, and not upon mere suppositions as must be the case in all new mines. Your mine is open, you know exactly what to depend upon, and you are therefore perfectly justified in erecting the machinery necessary to accomplish the above results at once. The Granby mine is not a showy one. Large courses of solid ore are not met with in it,—beautiful crystalizations do not occur, but it is capable of yielding steadily a large supply of cupriferous rock which, if treated as I have recommended, must, for many years to come, yield you the above results. With you mining will be merely a manufacturing business, as you know what to rely upon and you can consequently proceed upon given data.

I can not, however, close this report, without expressing my firm conviction that all the copper in the bed in which your mine is wrought proceeds from either a regular injective vein or a contact deposit of Vitreous ore for which I would look, on your land, in the vicinity of the junction of the Trap and Sandstone. I referred at the beginning to the evident existence of an old shaft situated near that junction, which I believe to have been the last work done on your property before the old mining explorations on it were suspended. This shaft must be cleaned out and examined, and should it be found to have been sunk too far from the junction, then a series of costeaning or trial pits ought to be put down under the direction of an intelligent miner to find it. From analogy I am led to

believe that a large amount of solid vitreous ore in either one or the other of the above mentioned manners exists on your property. Whether this is so could be ascertained in a short time and with little expense. Should such a body be found it will add much to the already great value of your mine, and then all the machinery you now have in your mill could be profitably employed for the dressing of it. My reasons for supposing the existence of this ore near the junction, I have, as you will remember, given when speaking of the mode of occurrence of the copper in your mine.

It may be well to say a few words as regards the buildings, machinery, &c., erected by you and the situation of the same. The old prison stone buildings, owned by you, near the mine are amply large and substantial for the accommodation of from 90 to 100 men, and can be made very comfortable with a small outlay. Your mill building, which is most favorably situated near a station of the New Haven and Northampton railroad and in the immediate vicinity of a never failing stream of water, (one of the greatest desiderata for mining and ore dressing operations,) is well constructed and can be used for the arrangement of the machinery and apparatus proposed by me. The engine now in this building, although not large enough for doing all the work, can be profitably used for accomplishing at least a portion of it, and I see nothing which can prevent you from taking immediate steps for the energetic prosecution of your operations, which, if skillfully and economically conducted, must, in a short time, place your property in the ranks of the most valuable mines known.

E. FRANCFORT.