立子山
院内銀山
探測報告書

益田孝

Honorable Ennoye Kaori

Sir;

In obedience to your instructions, the first report which I submit to your inspection is that on the Silver Mine of Innai. This will be followed by reports on the Copper mines of Aracawa Ani and Osaruzawa; on the Smelting works of Kagoyama, and on the Iron mines of Kambu, as soon as the translations of answers to my questions have been made, and I have had time to examine them thoroughly.

In studying the data on which I base my opinion, I have found ample reason to regret that the very short space of time I devoted to the mines of Innai did not enable me to obtain fuller information, or to make a more extended personal examination.

You will therefore please consider this report as one which embodies my views from a hasty inspection only. I cannot say in what respect I might change my views after a more thorough acquaintance with the works, but I would certainly be able to speak more positively than I now do. Nevertheless I have mastered the details of the property to a greater extent than I anticipated. For this I must thank your kindness in having ordered all facilities to be given to me; and I am also greatly indebted to the kind assistance of Messrs Tominaga & Ennoye Masaru, and to the willing cooperation of the students. Mr Mori, my interpreter, has been of great service to me, and he deserves credit for the pains he has taken in translating the documents given me. This was no easy undertaking as many of the words used were purely technical, and the subjects were not at all familiar to him. The knowledge that all of these gentlemen have acquired of the mines will render their services of great value to you in the management of the properties.

One of the great drawbacks in mining is, that the owners are generally ignorant of the business and must intrust their fortunes to the management of others. That your officers should be familiar with their duties, is a matter of prime importance. Honesty and integrity, without knowledge, will not insure good management.

As it will be my duty to submit reports to you on a number of mines it may be well to indicate some of my guiding principles in order that, if the method I adopt is not satisfactory, there will be ample time to effect any required change.

In the first place, I intend to make my reports as concise as is consistent with a clear exposition of my views and of the bases upon which they are founded. I shall give all facts which were of sufficient importance to influence my judgment, in order that you may check any impression formed upon erroneous information. I shall omit all discussions which are purely scientific or which do not bear directly upon the main object of my reports, notwithstanding their intrinsic interest. I also omit such details of engineering which must be left to the officers in Charge. Several matters which are of equal importance to all of your mines I shall embody in separate reports.

Finally, I shall bear constantly in mind that this report is addressed to persons whose object is to work the mines in the way which will bring the best returns - will make the most profit - whether that way be Japanese or foreign, nor shall I forget that the peculiarities and prejudices of the workmen must be considered, that they know nothing of foreign improvements, or of machinery, and that the introduction of any thing new is attended with difficulty and expense.

Innai Silver Mines

Among the many questions of interest which arise in discussing the merits of a mineral property, its geographical position is by no means the least important, and it becomes of especial interest when the introduction of machinery requiring facilities for transportation is under consideration. In this respect, although it is not entirely satisfactory, the situation of the Innai Mines is more favorable than any of the other mining properties under your charge - The main road which connects it with Kobuta, the sea port of Akita, is probably the best in northern Japan. For the greater part of the distance the road is in excellent condition but it is rendered almost useless for heavy transportation by the innumerable small crossings over irrigating ditches, which are too narrow even for a Jinricksha to pass, and over which a horse must walk with care, and besides these, there are a number of streams which are crossed in ferry boats. Now, although in the present condition of the road there would be great difficulty in transporting machinery over the whole distance, nevertheless, all these difficulties can be easily overcome, and that too, at an expense to the Government which is trifling compared to the great benefit that the country would derive therefrom. The internal development of a country necessitates the early introduction of good roads; and even if Railroads are to be built, it is first necessary to establish good waggon roads that the machinery and supplies may be easily transported.

It is understood that the Japanese Government is paying particular attention to these matters, but there is danger that, as the desire to have good roads is still only a general undefined wish, there will be no haste in having the wish gratified. When it becomes the interest of a particular body of men, it will not be difficult to hasten the action of the Government in this respect. Now the establishment of easy communication will be of such a benefit to your Company that my first recommendation must be, not to lose sight of this fact, and to take such a personal interest in the matter as will insure a speedy accomplishment of your desires -

The Mines of Imai have been worked for upwards of 260 years. No records of the past have been preserved at the Mines, but, doubtless, they have shared the common fate of all old works, and have had their seasons of depression and of prosperity. At times the Ore was found in abundance and of good quality, and at others, there was little to be had and that only at great expense. as it was in the past, so it may be in the future, and it is well to have a thorough knowledge of the works that all contingencies may be provided for before hand.

The estimated number of veins at Imai is 21, of which but 2 are now being worked, and by some it is supposed that these two may unite in depth. All of the veins have a general Easterly and Westerly course, and are inclosed in the same country rock — a feldspathic greenstone. The two (2) veins to which work is now confined, are a considerable distance apart from the others, which form a group of their own, and many of which may unite in depth. These latter veins have not been worked for a very long time, and I could find no one to give me any estimate of their condition. Because they has been worked, and apparently, for no other reason, in later years a tunnel was started to develop them. This tunnel, I understand, was to have been some 1800 feet long, but was abandoned when it had been driven 600 feet. In all probability the good ore in the upper part of the veins have been exhausted, and new bodies can only be found by undertaking works of considerable magnitude. It is possible, however, that a considerable quantity of low grade ore may be found which can be profitably worked by some new process. It is for this reason that I call attention to the fact and advise an examination to be made into their condition.

For the last 30 years and upwards, the work has been chiefly confined to the one large vein which forms the main reliance of the property. The works are of great magnitude, and would be recognised as such in any part of the world. Whether the 2nd vein of which I have spoken should unite with the large vein or not, is a matter of little practical

importance, for they can be developed and prospected by the same system of works and therefore, need be considered as one alone. It is from the study of this vein that I draw my conclusion regarding the whole property, and I therefore think it well to describe it in some detail.

The first question which I attempted to solve at each of the Mines of your Company was the nature of the veins, their characteristics and their permanency in depth. I do not know that I have met any one connected with Mining in Japan who seems to have even considered the possibility of veins being only superficial deposits, and not likely to contain ore in depth; yet, all veins are not alike, and it becomes of vital importance to establish the nature of the vein before works of any magnitude are entered upon. In respect to your Mines, there has been no injury done from a positive belief in their continuance in depth, for they are all true fissure veins and therefore belong to the most regular and permanent of all deposits. The deposit at Sunai is no exception to this rule. The nature of the inclosing rock, the width of the vein, its contents, in fact all its characteristics tend to prove that its origin is due to some deep seated cause. The formation of the fissure was probably contemporaneous with, or caused by, one of the many violent convulsions of nature which have occurred in this Island; and its continuance in depth beyond the limits of remunerative Mining, may be taken for granted. The actual depth of the veins therefore need not engage our attention, it is the cost of extracting the ore which assigns to them their practical limit.

The length of the fissure can only be determined by actual development. The extent of the Sunai vein in this respect, at least is more than sufficient to outlast the present generation.

The process by which the fissure has been filled is of no considerable importance as a guide to future exploration. That which constitutes the ore and accompanying gangue was probably deposited from a thermal-aqueous solution of the contents, or, in part, from the condensation of mineral vapors. But the manner in which the deposition has taken place, the richness of the ore deposited, the relative amount of ore to

waste rock, and of paying ore to that which is worthless, all these are matters of exceeding importance, and can only be ascertained (and even then approximately only) from extensive development. The greater the extent of work done on a vein, the greater is our surety in future exploration.

In the hasty examination which I made of the Lunar deposit, it was impossible for me to inform myself thoroughly on all the features of interest, but, aided by the answers given me by the Engineers, the Agent, and a number of the leading workmen, I submit here the conclusions I arrived at.

The vein is of varying width, but its average is quite large. The mean of more than thirty (30) different measurements made on the vein at different places in the mine, gives the average at seven (7) feet. The greatest width was upwards of eighteen (18) feet and the lowest was about one foot (1). There are many places where the vein is from five (5) to twelve (12) feet in width. At times however the vein "pinches" or becomes exceedingly narrow, but this "pinch" soon widens out again.

The gangue of the vein is Carbonate of Lime and Quartz. Sometimes the two become intermixed, but, as a rule, the one predominates over the other in different places. The limestone is sometimes intermixed with Carbonate and silicate of Manganese which gives a pink color to the mass.

The minerals are varied in Character, but the occurrence of all but the Silver minerals is so slight that there is no hesitation in classifying this as a true Silver vein It carries enough gold, however, to make the latter an object for metallurgical treatment, and to influence the choice of a new process for working the ore.

The Silver minerals are the simple and complex sulphurets, with some antimoniates and arseniates of silver and, perhaps, a little Zahlore. Accompanying minerals are the sulphurets of lead iron, Copper and zinc. The Gold occurs in a metallic state, but not in sufficient quantities to induce a separate metallurgical treatment independently of its silver contents.

To sum up its mineral and lithological Characteristics,

there is nothing in the vein which would render the metallurgical treatment of the ore a matter of difficulty, and there is much in its favor which renders it one of the most favorable veins to work that I am aware of.

The vein is not uniformly rich in ore. In some places large quantities are found, while in other places the bodies of ore are small and of a low average; but, I believe, the vein is nowhere entirely without ore. Sometimes the ore is found in rich streaks and branches running through the gangue; at others, it is found interwined throughout the gangue, and must then be closely assorted to make it fit for the present metallurgical treatment.

Like all true fissure veins, or rather, like the majority of all veins, the one under question is more or less irregular in size, in richness of its contents, and in the number and position of its bodies of ore. A study of its past history often reveals what its prospects in the future may be, and for this study nothing is of greater importance than reliable plans of the works old and new. The plans that were given me were excellent in certain respects, but were not enough in detail to be of much value. From them, however, I infer the following.

In the beginning, the vein was worked downward from the croppings, and small tunnels were run to lessen the cost of extraction and to drain the deposit of water. As time advanced, the ore was found to be of excellent quality and to be in sufficient abundance to warrant extensive and costly exploration. It was therefore decided to run a deep drain tunnel, and this was accordingly started about 167 years ago, or nearly 3/5 twenty years after the mines were first worked. The length of this tunnel, say 11400 kens (8400 feet) its dimension, and the difficulty of accomplishing such a piece of work before the use of powder was known, are all proofs of the great reliance the owners had in the property, and proved, too, that there were bold miners in those days.

But a season of depression came upon the property, the bodies of ore were exhausted, the vein grew small in places, and where it was wide enough, the ore that was extracted did not pay the expense of working. Miners doubtless abandoned the

place in search of more certain pay; while the few who remain continued the work with but little hope, and at a dead loss to the owners. Fortunately their efforts were ultimately crowned with success. The present body of ore was found, and since that time all work seems to have been confined to this. But this body has not been found of equal value throughout. Many parts within the present limits are said to be left untouched because too poor to work by the present system. The quantities of good ore extracted during some years exceeded the production of others. While the present yield is only about 400 Kwamme of Gold and Silver per annum, it is not long since that the yield was nearer 1000 Kwamme; and it may not be long (under the present system) before the yield decreases to less than 400 Kwamme, while the ever increasing expenses may soon swallow up all possible profits.

What has happened in the past may happen again in the future. To know this, is the first step towards its prevention. We cannot make ore when there is none, but we can find out where new bodies exist before the old ones are exhausted, and while some of the present profits may be applied to such exploratory works.

The system of work which I shall hereafter submit is based upon these views, as well as upon all others that I entertain regarding this Mine.

It is necessary to have a thorough knowledge of the present working system, its defects and its merits, before one can form a decided opinion as to all the Changes which should be introduced and to what extent these Changes would prove of value. I now undertake to present the salient features only and leave all details to a more thorough examination.

The first thing that strikes one's attention is the fact that the work, both of extracting the ore and of reducing the metal, is left, under certain restrictions, to the workmen. The owners, through a corps of officers, exercise a general supervision, and advance money to enable the miners to carry out their work, and find their profit in buying the produced metal of the miners at a fixed rate which is below the market value. This system is

doubtless the result of experience, and is so guided and controlled by custom that its demerits are not so great as one at first might imagine; that it is a wrong system, I shall have occasion to show. The advantage consists in this: The owners proceed on a basis of certainty; if no metal is produced, then the Company has nothing to pay except the wages of the officers and the exploratory work that is now undertaken at their expense. It is not likely that either of these amounts would prove excessive if the mine produced little or nothing. Besides, this system furnishes an incentive to the miners to be as diligent as possible. The more ore he extracts, the more he is paid. The most diligent and efficient miner, receives the most wages. In fact, the system is, on a large scale, what the contract system is in foreign mines, and is an excellent one when the work is crystallized into a certain routine, and when the owners are contented with a small present profit, at little risk, leaving the future to take care of itself. This, however, is contrary to the spirit of modern mining enterprises, and is contrary to the teachings of experience. In the present age, mining is known to be uncertain and works are conducted on that basis. The study of veins have developed certain characteristics which are now treated as fixed facts. It is no matter how slowly and cautiously a body of ore is worked; it is sure to become exhausted sooner or later, and then the mines must either be abandoned (if exploratory works have not previously been carried out) or the further search for metal must be conducted under the most depressing and expensive conditions. There is nothing that gives value to a mining property except the amount of ore in the vein. If this fails, all the works on the surface, the houses, the smelting furnaces, - every thing in fact, have only a nominal value. There in lies one of the demerits of the system in vogue. You are not providing for the future. Although the cost of the plant is so small that no heavy loss would be sustained in this respect from a failure in the supply of ore, yet the greater injury of an utter ruin of the property may be the result.

Nevertheless, a change from this to another system would have to be so radical, and would be attended with so much

difficulty unless properly managed that you must give the subject earnest consideration before deciding.

The chief demerit of the present system is that the Company has no control over the method of mining, of the waste that might take place in concentration or of imperfect reduction. The Officers being without authority or responsibility have no incentive or right to interfere with the workmen, and these in turn, know of nothing better than their present system and, like all men of that class, are disposed to be careless. I must say however that the workmen at Iwami seem to be aware that they are now losing considerable silver and gold and are desirous of learning some more profitable method of working their ore - But it is of themselves that they are thinking, not of the Company.

Another striking feature at the Iwami mines (in fact at all of your mines) is the entire absence of machinery. This, of course, is not to be wondered at considering the past isolation of Japan; but the disadvantages that are apparent from the want of machinery must be discussed. At present, every thing is done by manual labor, and therefore, unless the works are very extensive, it is impossible to put enough men into a mine to insure a large production. The present depth of the mine is wonderful when it is remembered that all the ore, waste and water, must be raised by manual labor alone. The labor, to be sure, may be considered as cheap; but if it could be had for nothing it still could not compete with the many advantages that accrue from using machinery; for instance, the rapidity with which a mine can be developed; the concentrating into one year the work of many; larger drifts; better ventilation; saving of the strength of the workmen by providing easy means of ascent and descent; and by introducing a system of management which involves responsibility on the officers in charge and enforces a more active supervision.

The system of reducing the ores is another prominent feature in the working of this mine, It is partially the result of, and partially the cause of the system of mining and concentrating the ores - In every well organized enterprise all the parts are mutually dependent upon one another; and if one of the parts suffers a

change, all the others will be affected to a greater or less extent.

In the metallurgical system adopted it seems to be necessary that the ore must be closely concentrated; that the amount of ore which is smelted should be about 1/6th only of its weight as taken out of the mine; and yet, as it comes from the mine, it is richer than the ore from the generality of silver veins. As it is prepared for smelting, the ore assays from $400 to $1000 per ton, and to get it to this grade, a large quantity of gold and silver must be lost in the 5/6th of the total weight which is thrown away. Besides, as the ore must be of a high grade to be smelted, the miners are unable to extract any but the best of the ore in the mine, and, in all probability, there is, in the aggregate, as much silver and gold left unworked in the explorations as is taken out. Necessarily this must be considered a bad system when it requires a sacrifice of so much of the precious metals.

It may be taken as an axiom that those mines are the richest which produce low grade ores in large quantities; and further that every mine has many tons of low grade ore to one ton of high grade. It therefore follows that any metallurgical system which permits of low grade ores being worked to an advantage is greatly preferable to one which requires a high grade of ore with all the attendant losses in Concentration.

Further along I shall examine into the costs of the present system, and hope to be able to point out the great advantages to be derived from a Change.

Another item worthy of note is the great size that the present body of ore has had, and the fact that nearly all exploration is confined to its outer edges. There are some 212 working places from which ore, as I am told, is being or will be extracted; and, furthermore, there are 29 drifts of which 28 are being run by the Company alone, and 1 by the united action of the Miners. Why this one drift should be run by the miners I do not remember, unless it was that the Company would not take the risk. As a rule, all the prospecting work is done at the Companys expense, and when ore is found, the miners extract and smelt it. Thus they, as a rule, incur no risk; and the price which they

finally receive is supposed to cover only the cost they are put to, - leaving them fair wages only for their work.

The drifts are run from different levels of the mine and, generally, in a soft part of the country rock-a "gouge", as it is called by miners - which lies at varying distances back of the vein. The drifting can be done more quickly in this gouge than in the vein itself, but it necessitates the raising of a large quantity of waste rock. I think, however, that the system pursued is the correct one.

From the drift, cross cuts are made at intervals to test the vein. Where ore is found, miners are allowed to work in a manner prescribed by Custom.

Now, if the system was changed, much of the details of this work could be retained, but instead of driving 28 drifts, in all probability only 4 would be required, each of which would be much larger than any of the present ones. Instead of working out the rich parts of the vein only, the whole of the vein would be extracted, and the waste rock from the drifts in the gouge could be used to fill up the vein as it was worked out, and thus the cost of raising it can be saved.

Carrying the waste rock and ore out of the mine is performed by men and women, partially at the expense of the miners, but chiefly at the expense of the Company.

Raising the water from the lower levels is also performed by manual labor and at the Company's expense. That such labor is at all adequate to perform such work is a fair proof that the quantity of water in the mine is small.

Putting timbers into the drifts to support the walls, as well as many other items of repairs is done at the expense of the Company.

Thus, it will be seen, the Company has to pay all cost of administration, and all such costs of mining and smelting which involve any contingency, leaving to the miners the cost of extracting the ore, when it is found, and of smelting it. Both of these items call for very little change in the system or cost throughout the year. Therefore if we know what the miners receive and the quantity of

ore that they attract we can make a comparative estimate of the cost with that in other Countries

Another question to which my attention was directed, was the objection that the workmen might feel to the introduction of any new System. This of course is a question of importance and I shall have occasion to speak more fully thereon in some future report. On the willingness and on the ability of the workmen, much depends; but the Mines must not be mismanaged because of their prejudices. The old routine must give way to any new system which can be advantageously adopted. But these men are depended on the Mines for their means of living, and they are unable to look elsewhere for work. Again no man can work willingly at any task which he believes will result to his disadvantage. Therefore, their welfare must be duly considered, and they must be made to see that any proposed Change is to their benefit. In this respect there need be no trouble at Sinai, and as I have said, they already call for some Change. A foreign System contemplates the improvement of the Condition of the workmen, and by paying better wages, demands a closer attention and more responsibility from them.

As for the Officers of the Mine, men who are directly in the employ of the Company, they must do all they can to further the Company's interest. If they object, they must be removed. Their Condition, also, would be benefitted by a Change, but they might object because it would involve more responsibility and work than is now required of them.

Concerning the employment of foreigners I shall have more to say hereafter. In this report I need only say that no professional foreigner of reputation would be willing to work for pay alone if he did not think he could render his services of value to the Company; and, although there may be exceptions to the rule, you can fully rely upon their doing their utmost to further your interests. Necessarily their services cost money or they would not be of much value; therefore employ them to the best advantage and let them do as much good as is possible during their stay. The Amount they receive must have due weight in

considering the cost of any Change. For instance, take Lunar. The amount of ore reduced very year is only about 120 tons. A change of the system would require the employment of a number of foreigners, and their united wages would, in all probability, amount to $6000 per annum without considering other items of expense. Now this sum amounts to $50 per ton, an amount which it is impossible to save out of the present cost of working the ore (which is about $45 per ton). It therefore follows that, if foreigners are engaged it can not be with the sole view of bettering the present metallurgical system. And yet, at times, this might be done with advantage, for the foreigner is engaged for a short time only, while the benefit of the Changes he may introduce will last for ages.

In the preceding, I have glanced hastily at the leading features presented by the property in question, avoiding such details as might fatigue the attention. I must now pass to a consideration of the receipts and expenses, and show in what manner the mine can be worked to better advantage. I shall here refer only to the Chief items contained in the accounts (in order not to fatigue the attention) and shall give more detailed Statements in an appendix.

The accounts I have under examination are for the year October 1st 1871 to September 31st 1872. These are more complete than later accounts. In fact, I base my entire arguments, on facts which are no longer recorded, and without which my report would be little more than a mass of conjectures.

Other items of importance were furnished by the officers and their workmen. I must, in my examination, assume them to be correct; but I would certainly not advise any large expenditure until these items could be verified. They will be pointed out in the proper place.

General Statement Receipts and Expenditures for One Year, October 1st 1871 to September 30th 1872.

Receipts

Sale of 383 9/11 Kine Silver bullion @ $ 136 per 10 Ronme		$ 52.746.1858
Sale of Gold bullion 3.96 53 Kine		8.592.5666
N.B. The above bullion was reduced from 417 56/1 Kine mixed bullion bought of miners.		
Profits from reworking Slags		195.0960
Total mining Receipts		$ 61.533.8484
Total mining Expences		51.964.5361
Total mining Profits		$ 9.569.3123

From Sale of Goods

Rice	$ 4473.5422	
Lead	933.028	
Saki	3.987.1852	
Sundries	396.8038	9.790.5592
Total profit of the Company		$ 19.359.8715

The above statement differs from another which I have received, but the discrepancies do not affect the conclusions I have formed, and therefore it is not necessary to try and reconcile the differencies.

In the preceding pages I have not referred to the profits arising from the sale of goods although the revenue therefrom equals the revenue from the mine. In many Countries it is customary for a mining Company to supply goods to their Workmen, and the profits enable them to carry on the mining on a larger scale. In the present report I look upon the property as belonging to a mining Company who own a store, rather than as a Company of Merchants who own a mine, and therefore I confine my attention to the mining features only.

The expenses for the year may be summed up as follows.

Purchase of Silver Cakes from the Miners

417$\frac{572}{2000}$ Kwanme @ £ 86$\frac{00}{00}$ £ 35.909.4118

Mine Expenses	Pumping	£ 2522.712	
Labor	Drifting	3.683.00	
"	Carrying out waste	2.247,4646	
"	Framing & timbering	325.7515	8.778.9281
General Management &c:			
	Salaries to Officers	1637.2710	
	Sundry items paid at Mine	373.3684	
	" " " Smelting works	391.9276	
	Materials, Timbers &c	872.7151	
	Various expenses of Management	2514.7441	
	Parting Gold from Silver	1268.17	7.276.1962
	Total		£ 51.964.5361

The following table shows the quantity of material raised from the Mine during the year, and the per centage of each kind to the total.

	Quantity in Kwanmes	Quantity in Tons	Per centage
Waste Rock	863.727	3598.8	83$\frac{16}{100}$ %
Vein Matter 1st Class Ore	12.900	53.7	1$\frac{28}{100}$ %
Vein Matter 2nd " "	16.100	67.1	1$\frac{47}{100}$ %
Vein Matter Rejected as poor	146.200	609.2.	14$\frac{09}{100}$ %
Total	1038.927	4328.8	100.00

From the above it is seen that the waste material from drifts &c. was 83$\frac{16}{100}$ % of the total mass; while the vein matter was 16$\frac{84}{100}$ % only. Hence if a new System of Mining could stop the raising of this large quantity of waste, it would effect considerable economy.

Of the total vein matter raised, say 730 tons (175.200 Kwe) there was 609$\frac{2}{10}$ Tons rejected as too poor to work leaving only 120$\frac{8}{10}$ Tons (say 29.000 Kwe) which was finally smelted down and from which 417$\frac{551}{1000}$ Kwe of bullion was produced and for which the

Miners received £35.909 4113/... This therefore represents the entire payment to the miners for all costs of mining and smelting that they incurred and out of which they make their profit. The amount they receive is 86 cents for every 10 Kwanne of bullion produced.

There are no accounts to show the actual cost of mining, but the Superintendent has made an estimate of the cost of smelting. Accepting this estimate as correct, we can ascertain the amount paid for mining alone.

It places the cost of smelting £0.1775 per Kine = £42.60 per Ton
Cupelling 0.0125 " £2.40 "
Total £0.1900 £45.00 "
Cost of Concentrating 0.03 £7.20 "

Summing up various foregoing figures we find:

Total Amount of Ore smelted 29.000 Kine
bullion produced 417 512/... "
" received by Miners £35.909 4113/...
" " from sale of bullion & from Slags £61.533 8448/...
" Cost of Smelting £5.510
Concentrating £870
Mining £29.529 4113/...

From the above we find that 1 Kine of ore yielded 14.39 Kwanne
The Miners received for each Kine £1.23.754
Of which the cost of concentrating & smelting was 0.22.
Leaving for cost of Mining alone £1.01.754

To make the foregoing more apparent I reduce the accounts to Tons of ore, and this weight I shall hereafter retain. The ton contains 240 Kwannes. We have then

Total number of tons smelted 120.8
Cost per ton, (34538 Kines @ £0.086) £29 7/... 00
Of which, the cost of smelting was £4.5
Concentrating £7.20
Mining 244.80

The above represents merely the cost to the Miners. To ascertain the cost to the Company we must add the cost of drifting, pumping, &c., say £8778.9281. And the cost of administration &c. £7276.1962 making a total further cost of £16.055.1243.

Therefore the cost of drifting, pumping &c
per ton of ore is say $ 72.673
And cost of administration, per ton, 60.23
Making total cost per ton including price
paid to miners, say $ 430.00
And total value to be " 509.40
Which gives a profit per ton, of, say $ 79.40

It certainly is a striking fact that out of such very rich ore, yielding upwards of $ 500 per ton, only $ 79.40 is netted by the Company. An increase of a few thousand dollars in the expenses or a slight decrease in the yield of the ore would deprive the Company of all profits; and when it is remembered that the mine will be worked with greater expense as a greater depth is attained; and, furthermore, that the value of the ore has fallen to less than one half of what it was in the past, and that it may fall off still more, the necessity of improving the system in very way possible becomes apparent.

I shall show later that it is possible to increase the profits by altering the metallurgical system without much interference with the present mining system; but the above shows the uselessness of attempting to alter the system to reduce the expenses on 120.8 Tons only. As I have said, a foreign metallurgist would have to be employed, and his salary and a few attending expenses, would certainly amount to $ 6000.00 per annum, and this represents a cost of $ 50.00 per ton. But the present cost is only $ 15.00 per ton, and the loss in smelting is not excessive.

Let us now examine the accounts in regard to the quantity of ore extracted and to the possibility of bettering the system of reduction with but a slight change in the routine of work.

I will first recall to your attention the fact that the miners extract the vein matter (that is, the ore, poor and good) take it to the small concentrating works at their houses and there reduce the quantity by rejecting all which is too poor to cover the expenses, and then take the good ore to be reduced at the smelting works.

The total quantity of vein matter that was extracted

(see table) was 730 tons
The amount that was retained as good 120.8 "
Therefore the rejected amount was 609.2 "
or, say, $83\frac{43}{100}$ % of the total.

This is a fearful loss of weight to result from concentrating silver ore, in which, almost invariably, the precious metal is intermixed throughout the gangue (or vein matter) and, as a necessary consequence, the miners are right in ascertaining that they do meet with a heavy loss. The extent of the loss is unknown; but, as this forms an important item in my conclusions, I make the following statements of my attempt to discover the amount.

1st — In the yard of one of the mines, I examined a heap of ore which had already been twice picked over and which was to be re-examined with the hope of utilizing one third of it.

An Assay of this pile showed $ 173.07 per ton of ore.

2nd — One of my companions examined and took a sample from some ore which had been thrown aside - An Assay of this gave per ton of ore $ 206.63.

3rd — Although much of the waste ore is thrown into the creek, there were a few piles scattered about - all of which I examined - In every pile I saw some good ore, and estimated in my mind that an assay would show from $ 50 to $ 100 per ton.

4th — Speaking on this subject to your Agent at the mines, he told me that a trial he made of some waste ore gave a yield of 2½ Mommes to 1 Kwamme of ore - This would be equal to a yield of 600 Mommes to the ton of ore and represents a value of fully $ 80 per ton.

5th — Many of the engineers and leading miners informed me that this was not a high estimate of the waste rock - Furthermore, that if such ore could be beneficiated there was a great quantity to be had from the old works in the mines - It must be remembered, too, that ore of such a low grade could not be profitably worked; and, too, that, the average yield of the ore worked was 14.39 Mommes per Kwamme; and to get the ore to this grade (considering that $83\frac{43}{100}$ % of its weight is rejected) it is not at all unlikely that much of what remains unworked

contains fully 2½ Rowme of Metal to 1 Kwamme of ore.

I can now think of but one objection to this belief while more proofs might be cited. The objection is this. Since the miners raise only 730 tons per annum, it may be that the ore has to be assorted very closely in the mine, and that they take out all the gangue that appears to carry ore, leaving only very poor vein matter.

It will require a close examination than I could give to determine this point, but I may here state that Eighty different samples taken from 80 different places in the vein show that good ore is to be found throughout.

To examine, now, the cost per ton on the basis of the total amount extracted, its probable value, and other items, we find from the foregoing:

Total amount of ore extracted			730 Tons
Paid to miners, for mining	£ 29.600		
Concentrating	8.870		
Smelting	5.440		£ 35.910.00
Sale of bullion realized			61.534.00
Other items of expense to the Company			16.055.00

(In the above I use whole numbers to avoid fractions)

In the first case we must ascertain the probable value of this ore, and to do this I must assume a certain loss of the metal in smelting (say 10% of the amount extracted) and also must allow for the metal contained in the rejected ore.

We find then

Value of the bullion actually extracted	£ 61.534.00
Less in smelting 10% of the above	6.153.
Value of the Metal in rejected ore, say 2½ Rowme per Kwe = 600 Mes per ton = 365 52/100 Kwammes in the 609 2/10 Tons of rejected ore = @ £ 136 66/100 per Kwamme	49.930.00
Total Assay Contents of the ore	£ 117.617.00
Or per ton of ore	£ 160 57/100

Now, the total amount paid for mining the ore was £ 29.600

Therefore the cost per ton on the present basis of 730 tons is say £ 40 53/100

All other items of expense to the Company amounted to £ 16.100 00/100

Or say per ton £ 22 00/100

In considering whether this ore can be reduced by a new system, I merely state my opinion without giving proofs that it can be. The loss of reduction for the sake of the argument, I will place at 20 %
and the cost of reduction at per ton $20.00

We have then:

Assay value of the ore (per ton)	160.57
Yield, (deducting 20%) "	128.46
Cost of reduction $20 - Mining $40.55 - General expenses $22	82.55
Profit per ton of ore	45.91
Profit on the 730 tons	$ 33.514.30

Now if we compare this supposed profit with that which was realized under the present system we find a difference in favor of the former of $ 23.872.00

And if we suppose, as before, that this change of system owing to the employment of foreigners would be attended with an extra expense of 6.000.00
It still leaves an increase of profit of $ 17.872.00
Or a total profit of $ 27.441.00

I have thus shown:

1st — That no profit could be made by merely attempting to beneficiate the 120.8 tons of ore that are now brought to the smelting works; and

2nd — I have shown that by receiving the ore from the miners, at the mine, and by working it up in a different manner a profit of at least $ 27.441.00 could be made against a present profit of $ 9569.31 only.

It is very true that much of the foregoing is based on conjectures, but these conjectures are based on experience in other countries. And if in some items I have under-estimated the cost, in other it has been over-estimated.

But the above change would almost surely bring about many others of great advantage. The cost of administration and general expenses would be diminished in respect to the amount of bullion produced. The cost of mining would be very greatly reduced, and the amount of ore raised could be greatly increased.

Instead of showing this in detail (the less necessary as I do not know which course you will pursue) let us now consider what would be the ultimate result if a radical change had been gradually brought about, and the property was being developed to its best advantage. If I do not enter into details of the difficulties it is not because I do not see them but because they can all be overcome with a little prudence and determination. Of course it will take time and money; but as the advantages are so very decided, it would be folly to grudge either. Besides, every step you take involving an outlay of money will be thoroughly considered beforehand and you will know the amount of benefit you will derive therefrom.

As the following conclusions form the main feature of my report I will again call to your attention the basis of my deduction.

We have found:

1st — The average width of the vein as shown by 31 measurements in different parts of the mine is 7 feet.

2nd — The present yearly production is about 730 tons. This without assorting represents an Assay value of $160.57 per ton.

3rd — According to the results of personal examination, of assays, and of information received from various sources, the ore that is rejected, and most of that which remains in the mine as too poor to extract will average to the Assay about $80.00 to the ton (2½ pennies to 1 pennyweight of ore).

4th — The nature of the ore is favorable, and presents no particular difficulty in being reduced by one of various methods.

Therefore, from the foregoing and from my experience in other countries, I have no hesitation in stating:

1st — With the necessary machinery, your mine if properly opened, can easily produce 40 to 50 tons daily at an expense of from $2.00 to $3.00 per ton. I may say that this amount could be produced from a 4 foot vein; and that the expense depends in a measure on the depth from which the ore is raised.

2nd — These 40 to 50 tons daily may very probably contain about $80.00 to the ton per Assay.

3rd — In order however to guard against over-estimates, and possible errors of information, I will suppose that much of this amount

of ore raised will have to be rejected, and that only 20 tons daily can be made available for reduction. The mining and concentrating cost of these 20 tons I will place at $ 10 per ton - These 20 tons, again I will consider as containing only $ 80 per ton.

Making use of these and other figures which have previously been given, we find:

20 Tons daily for 300 days pa annum gives a yearly production of		(Tons) 6000
Assay value of $ 80 per ton		$ 480.000
Loss in reduction (20%)		96.000
	Total Yield	$ 384.000
Cost of mining of $ 10 per ton	$ 60.000	
Cost of reduction of $ 20 " "	120.000	
Cost of Administration	20.000	
Taxes and Sundries	14.000	214.000
	Balance to Profit	$ 170.000

Thus, we see, the anticipated yield is $ 384.000^{00} and the profit is $ 170.000^{00}. The present yield is $ 61.333^{84} and the profit is $ 9.569,31. Decidedly, the prize is worth striving for.

The above shows the advantage to be derived from working low grade ore on a large scale.

If a large quantity of ore is produced, then the cost per ton is lessened & it becomes possible to reduce ores of a low grade.

Again, if ore of a low grade can be worked to advantage, then there is little loss from rejecting much of it as waste, and nearly all the silver and gold in the mine can be made available.

It is also quite probable that some of the other twenty veins of the district may be worked to advantage, if ore assaying $ 80 can be reduced with profit, and these outside mines can employ the labor which is not wanted at the large mine.

After mature consideration I have decided to present no analysis of the cost that would attend a change of the system in use. Such an analysis would be of no value at present, and can best be given when another examination of the mine

has corroborated my estimates of the size of the vein and of the richness of the ore. The best method of reducing the ore must be ascertained by experiments in the assay office and subsequent trials at Sunai.

Conclusions and Recommendations

In the foregoing report I have given you the results of a great deal of consideration on imperfect data. Many points of interest I have left untouched, but I know of nothing which I have not duly investigated.

A subsequent report as to the best manner of bringing about the desired change will be made when necessary examinations have been concluded. At the same time a statement will be given as to the estimate cost of the undertaking.

It will be seen that the conclusions I have arrived at are highly favorable to the property. Although I have shown that the profits will reach £ 150.000 per annum, there is no reason to deny that they may reach to twice that figure. It all depends upon the continuity of the present body of ore or the finding of another.

Under the present circumstances, the course I would advise you to pursue is:

1st Have the necessary experiments made in the assay office as to the proper method of working the ore, the cost there of and the amount of money required to put up the necessary furnaces.

2nd In the meantime send a competent person to Sunai to study up the details of the mine, and to inform himself as to the best method of carrying out the work: and whether a new mine can not be opened on the vein so that there will be no interference with the present system until the new system is proven a success. also, to make an estimate of the first years expenses.

If the report from the assay office and the report from the mine is received in time, it will be a pleasure to me, after consultation with you as to your wishes, to draw up a statement embracing all the facts, and to plan the proper course to pursue. I will then have facts to work upon. Now I have conjectures.

To Conclude. Sufficient time has elapsed since I came to the

opinion I express above regarding the value of your Mine, for me to have duly reconsidered the whole matter. I cannot see that my conclusions are wrong, you have an excellent property in the Iwai Mine, and it now remains with you alone to have the fact demonstrated. If you are successful at Iwai, there will be a revival of Mining for Silver in Japan. The old Mines of Hachimori, for instance, possess a remarkably fine character of ore, but the quantity is too limited to produce the necessary amount of high grade ore for a remunerative undertaking. If low grade ore can be produced in abundance, that place, as well as others unknown to me, may once more attain a prosperous condition.

Finally, I must apologize for the manner in which I have presented this report. I have frequently repeated the same figures and have often given conclusions when they might more logically been presented later.

To have written it differently would have been much easier for me. I adopted the present manner, that I might thereby not fatigue your attention nor make it necessary for you to constantly examine the correctness of my figures.

Hoping that you will be pleased with the results of my examination.

I remain

Yours very Respectfully