14. 1890.

TASMANIAN BISMUTH AND GOLD MINING COMPANY, MOUNT RAMSAY.

REPORT OF INSPECTION.

In the following I beg to submit for the consideration of yourself and partners in the above mine the result of the inspection I recently made of it in your company:—

The deposit containing the bismuth crops out on the steep south-western slope of and about 600ft below one of the highest peaks of Mount Ramsay, a granitic mountain mass, rising steeply from hilly basalt-covered country about 14 miles S.S.W. of Mount Bischoff. According to representative specimens, collected from the different places opened, the deposit is composed of a coarsely and finely crystalline-granular amphibolite or hornblende-rock, more or less densely impregnated with larger and smaller crystalline particles and roundish pellets of native bismuth, grains, crystals, and small irregular patches of arsenical pyrites (closely intermixed with some iron pyrites), further of copper pyrites, magnetic pyrites, ilmenite (hexagonal titaniferous iron), scheelite (tungstate of lime), fluorspar, garnet, and rarely axinite. This impregnation is porphyritic throughout—of vein or band-like segregation, there being at present no sign—but regarding the mode of distribution of the native bismuth and the different species of pyrites severally in quantitative respect, it varies considerably through the small extent of ground prospected, as will be seen from the description of the various workings. These consist of an irregular vertical shaft, about 15 feet deep, sunk at the south-east corner of the outcrop; several larger and smaller shallow excavations, distributed over a distance of about three chains in a north-west direction from the shaft along the upper boundary of the outcrop; and of a large opening down hill about 1½ chains south-west below the shaft. In the bottom and all down the walls of the latter, larger and smaller specks of bismuth can be seen in abundance, whilst arsenical and iron pyrites are rather plentifully, copper and magnetic pyrites more sparingly, distributed. The heap of picked ore stone—some 10 to 15 tons—obtained from the shaft, contains, perhaps, from 7 per cent. to 10 per cent. of the metal, and I have no doubt there are several per cent. contained in the stuff thrown out as waste. As a feature of importance exposed by this shaft has to be noticed that the metalliferous hornblende rock dips north-east and south-east, and at a rather flat angle into the mountain beneath an envelope or shell, as it were, of a dense, hard quartzite or horn stone, which appears to be interposed between it and granite along its upper (north-east) boundary, and a highly micacious gneissose rock, cropping out a short distance south-east of the lower large opening, down its lateral (south-east) termination. This hornstone is rather densely impregnated with very small particles of magnetic pyrites, and encloses also patches or lumps of this ore, thickly filled with small crystals of brown garnet; some of these enclosures in fact represent a rather loose aggregation of considerably more garnet than pyrites. Of the several excavations along the upper boundary of the deposit, the one nearest the shaft, about 55 feet from it, is the largest, and the walls of the hornblende rock, as well as the ore masses excavated show specks of native bismuth; in fact, I found here the largest piece of the latter, weighing nearly half an ounce; still in the aggregate the metal is here not as abundant as in the shaft, and the same is the case with iron and arsenical pyrites, whilst magnetic and copper pyrites, especially the former, are more frequent. Touching the other excavations along the boundary, which are very small, I was not successful in finding any bismuth in the exposed rock, but Mr Heazlewood, who made the openings, assured me that the metal occurred in each though sparingly. The impregnation of the different kinds of pyrites appears similar in quantity as in the larger excavation first noticed. Owing to the dense scrub ahead of the last of these openings any close examination of the surface was impossible, but from what could be seen there is no evidence of a sudden termination of the deposit, at least for a chain further north-west, whilst occasional outcrops along the line from the shaft indicate that the dense hornstone, before mentioned, continues to accompany the hornblende rock. Proceeding to the large excavation below the shaft, the appearance it presents is certainly very striking. All the faces of the hornblende rock, as well as the rock masses worked out, glisten with thickly impregnated particles, and sometimes patches exceeding a square inch in size, of magnetic and copper pyrites—the impregnation amounting at a rough estimate to perhaps 20 per cent. of the former and 5 per of the latter—whilst iron and arsenical pyrites are but sparingly represented. Native bismuth in pretty large pieces has here also been found by Mr Heazlewood during working, and though my search for it was not rewarded, its occurrence at this place has been verified by Mr Crosby, late manager of the Mount Bischoff Tin Mining Company, who recently reported that he found some himself. The boundary of the metalliferous hornblende rock below this excavation is not clearly defined, but it seems to lie probably a chain further down hill, where in the bed of a little watercourse (the one which afforded by particles of bismuth and scheelite washed from the drift the first clue to the discovery of the deposit) a fine-grained diorite greenstone, very rich in magnetite, makes its appearance.

Having herewith given a description of the workings and the metalliferous character of the deposit disclosed by them, the first question arising is, to what class of mineral deposits in a geological point of view does the one under notice belong? i.e., is it a lode, layer, stock, or other kind? On this point, the small extent of ground explored—dense scrub and detritus preventing examination of the rock surrounding—did not, unfortunately, afford me sufficient satisfactory data to form a decided opinion. Still, what is disclosed of the deposit down and along the slope of the mountain, its mineral character, structural features, and more especially its connection with, and the nature of, the surrounding rocks, render it extremely probable that it is neither a lode nor a layer, but represents a massive contact deposit, most resembling a "stock," though also in some respects allied to the zones of impregnation, the so-called "Fallbands" of Scandinavia—both kinds of mineral occurrences of which many were opened centuries ago, and are still being successfully worked at the present day. According to this view, the metalliferous hornblende rock under notice, whilst being no doubt of greater surface extent along the slope of the mountain than at present proved, might, and its dip from the upper and lateral boundaries into the mountain is a favorable indication—considerably increase in thickness in depth, showing perhaps irregular outlines, though on the whole a lenticular shape. It might also be considered as not unlikely that, through accession of quartz, mica, and feldspar, the rock gradually underwent a change in depth, rendering it similar to the bounding rocks—granite or greenstone as the case might be—and that thereby its metalliferous character would be unfavorably affected. However, of such a contingency there is at present not the slightest sign, and I am of opinion that even the extent of the deposit at present proved, in view of the valuable metals contained therein, invites mining operations on an extensive scale. With regard to these metals the native bismuth is, from its abundance, in connection with its high price in the market—ranging from £1000 to £1200 per ton—the one in which the value of the deposit at present centres. Although the workings have, so far, not shown it to be distributed in uniform richness throughout the hornblende rock, yet there is certainly satisfactory evidence of the existence of a rich shoot or zone of impregnation extending from the shaft along the upper boundary of the deposit. On estimating this shoot to be only 10 feet wide, and to extend from the shaft about 60 feet along the boundary, i.e., to the end of the first excavation, working it out 15 feet deep (a depth to which the shaft has proved it) would produce 9000 cubic feet of metalliferous hornblende rock, if the surface were level; but taking one-third off on account of the slope of the mountain, there would remain 6000 cubic feet, equal to 666 tons in round numbers, on reckoning 9 cubic feet per ton. If we now take this stone to contain only 3 per cent of bismuth, the contents of the metal of the 666 tons would be close upon 20 tons, worth £20,000, at the rate of £1000 per ton. Further, supposing that only 80 per cent., or £16,000 worth of this could be extracted, and the working expenses amounted to £8000, there would still remain a profit of £8000. This result roughly calculated as obtainable from a comparatively small piece of ground, and which I believe to be considerably under the mark, will give an idea of the value of the deposit in bismuth alone. For uncertain and patchy, as according to general mining experience the occurrence of this metal has hitherto proved, its general distribution in small specks through the rock in this case allays apprehension of its sudden decrease or disappearance, and warrants the belief in its departure from the old rule. In the walls and bottom of the shaft, the prospects of the metal, as before described, are certainly excellent. The other metals, the occurrence of which in the deposit in some measure enhances its value, are copper and gold. The first is represented in the copper pyrites, which, as mentioned, occurs impregnated throughout the rock, though in appreciable quantity only, i.e., to about 5 per cent. in the lower part of the deposit, where opened by the large excavation. Considering that perfectly pure copper pyrites only contains 34 per cent., or about one-third of copper, the above 5 per cent. would represent 1⅔ per cent.; i.e., 100 tons of the hornblende rock would only hold 1⅔ tons of the metal—an amount evidently too small to pay for extraction in this locality, irrespective of other unfavorable circumstances, which will be adverted to in the sequel. Judging from analogous cases, and certain indications, I think it likely, however, that the ore will increase in quantity in depth, so as to render its saving and metallurgical treatment profitable.

As regards the existence of gold in the deposit, it was proved by Mr Newbery's assay of sweepings from the shaft; but it remained doubtful whether the metal was originally contained in the associated pyrites—principally arsenical intermixed with some iron pyrites. In order to clear up this and other points of import, I carefully selected samples of all the different species of pyrites occurring in the deposit, and also such containing native bismuth, and gave these, with your sanction, to Mr Cosmo Newbery for assay. The report of this gentleman's investigation, in which he took great interest, is herewith enclosed. It shows the gold prospects generally not to be so favorable as I expected, inasmuch as the magnetic pyrites, which occurs in greatest abundance, more especially in the lower part of the deposit, contains no gold at all; still, as a redeeming feature, the associated copper pyrites is shown to be more valuable by its proved contents of 2oz 12dwt of gold to the ton. A further favorable point, touching expenses of extraction, is that the pyrites proved richest in gold, viz., arsenical and iron pyrites (which could not be separately assayed on account of too close intermixture) are just those principally associated with the native bismuth, or rather where the deposit is richest in this metal there also occurs most of the rich pyrites—their relative quantities standing perhaps in the proportion of 2 to 3. That the bismuth contains as per assay no gold, though closely associated with auriferous ores, is, perhaps, not so surprising as the similar case with the magnetic pyrites, considering that in the Victorian auriferous quartz reefs this mineral is always more or less gold-bearing. Before leaving the subject of the metallic contents of the deposit, I may mention that, judging from the marked resemblance of the latter, regarding the minerals at present observed, to certain of the "fallbands" of Modum, Norway, in which cobalt ores are abundant, there obtains a probability of such ores making their appearance in depth also; the same may be said of "bismuthinite," or sulphide of bismuth.

Considering the most advisable mode of opening the deposit, the position of the latter, high up on the steep slope of a mountain, offers every facility for effecting it by adits—a method which would also obviate the water difficulty. Although I have no doubt that at no distant day it may be found profitable to work the whole width of the deposit, still, considering the circumstances, I think it more advisable for the company to confine their operations for the present to the opening and exploitation of the portion or shoot along the upper boundary, which, as shown, is richest in bismuth and auriferous pyrites. The adit to effect the opening ought, in my opinion, to start at the lower boundary of the hornblende rock, below the large excavation, and be driven in the direction of the 15ft shaft, where it might bring in a depth of above 60ft. As the whole width of the deposit would be traversed by it, the not

unlikely chance is presented of its intersecting ground rich in bismuth on the way, which could, of course, be worked conjointly with the other rich part.

The final, and not the least important, question remaining for discussion, is that of the treatment of the ore stone for the extraction of the bismuth, combined with that of the gold from the auriferous pyrites. Recollecting the easy fusibility of the bismuth, the method of extracting the metal by liquation direct from the ore, and treating the residue for gold, might at once suggest itself as feasible; however, on looking at the nature of the ore there can be no doubt that this process would lead to a very considerable loss of bismuth, not to speak of its great expense. After well considering all the circumstances, I have come to the conclusion that crushing of the ore, and subsequent concentration of the respective metallic minerals, are absolutely necessary primary operations; and that, if these be carefully and systematically executed, a considerable percentage of the bismuth—a larger one, no doubt, than by direct liquation—might be separated from the other metallic minerals, and these again from the earthy ones. The system I would propose to try is as follows:—Crushing of the ore stone between horizontal cast iron, or, better still, steel rollers, set about one-eighth of an inch apart; classifying the crushed material by means of the sieve-drum or "trommel" into at least three sizes of grain; and finally treating the two coarse sizes separately in improved hydraulic jigging machines, and the fine stuff on the side-throw percussion table. My reasons for proposing to crush so coarse, and substituting rollers for the stamping battery, are that the finer the ore is reduced, especially by stampers, the greater is the danger of loss of bismuth during concentration, on account of the soft and malleable yet brittle nature of this metal, which allows its being easily beaten into minute thin scales floating in water, and thus baffling all attempts to save them. With regard to the results which I expect from the concentration machines, they are based upon the difference of the specific gravities of the minerals principally composing the ore, as shown in the following list: Bismuth spec. grav., 9·7; arsenical pyrites, 6; scheelite, 6; iron pyrites, 5; magnetic pyrites, 4·6; copper pyrites, 4·2; hornblende, fluorspar, and garnet, 3 to 4 (the figures given being averages of the highest and lowest observed). On comparing these several specific gravities, I think it cannot be considered doubtful that, for instance, by careful working of the jigging machine, the native particles of native bismuth in the crushed ore would collect right upon the sieve (finer ones would go through it, and be saved in the box beneath), whilst above would follow a layer of arsenical pyrites and scheelite intermixed; next a layer of mixed iron, magnetic, and copper pyrites, and on the top a stratum of the various earthy minerals. These different layers a skilful ore-dresser would no doubt soon learn from their appearance to distinguish and skim off separately, and thereby accomplish the most important part of the process. Owing to the coarse crushing it must of course be expected that, more especially throughout the two middle or pyrites layers, there are dispersed grains of hornblende rock with more or less of native bismuth attached (the latter occurs but very rarely enclosed within or in contact with any of the other minerals), and it will depend upon the quantity of the metal in this manner contained in the respective ore parcels, which has to be determined by assay, whether it would pay to subject them to a metallurgical process for its extraction. Touching the extraction of gold from these ore parcels, it would best be effected by roasting them in reverberatory furnaces, and subsequent amalgamation in arrastras or Wheeler's pans, as practised in Victoria; but whether it would be advisable to enter upon these processes requires consideration. The contents in gold of both the arsenical and copper pyrites, as proved by Mr Newbery's assays, are quite satisfactory, more especially as regards the former, but then the unfavorable circumstance interferes that both species of pyrites are not obtained in a pure state, but intermixed—the one with scheelite, the other with non-auriferous magnetic pyrites—minerals which, on account of close identity in specific gravity, are not separable from them by any mechanical means. Judging from the frequency of scheelite in the ore stone, and supposing that larger pieces of it were removed before crushing by spalling, its relation in quantity to the arsenical pyrites might be taken as 2 : 1, *i.e.*, one ton of the respective ore mixture would only hold one-third of a ton of arsenical pyrites, containing, as per assay, 1oz 4dwt of gold—an amount which would, I think, with careful management leave a small profit over the expenses of extraction. In the case of the mixture of copper pyrites and magnetic pyrites the relative proportions in which the two ores occur appears to be as about 1 : 4, therefore one ton of this mixture would only enclose one-fifth of a ton of copper pyrites, containing 10½dwt of gold, according to assay, which quantity is certainly too small to meet the expenses of extraction. According to my estimate, if the proportion of the copper pyrites to the magnetic pyrites were as 1 : 2, these expenses might just be met; any change in favor of the former, for instance to 2 : 3, 2 : 2, etc., either by its direct increase, or indirectly by a decrease of the magnetic pyrites, would of course be doubly favorable, inasmuch as it would then not only pay to extract the gold from the ore, but the residue might also be profitably treated for the extraction of the copper. And this consideration has a special bearing upon the lower part of the deposit; for, as I above intimated, there is a likelihood of the copper pyrites increasing in quantity in depth, and, therefore, prospecting might prove this part at a certain depth worth working for gold and copper, irrespective of the chance of any of the native bismuth occurring in the stone being saved by dressing.

With regard to the chief desideratum for the proper execution of the ore-dressing operations, viz., a sufficient supply of water, my examination of the small creek near the workings and of a larger one—Scott's Creek—situated about a quarter of a mile to the west, left me in doubt whether the combined supply of the two creeks would be adequate, and could be depended upon at all seasons. I am therefore glad to hear—and this enhances the value of the mine very considerably—that this important point has been satisfactorily settled by the recent report of so trustworthy an observer as Mr Crosby, viz:—"That about one mile below the workings the Bismuth Creek carries in dry weather about 500 gallons of water per minute, with sufficient fall for driving a turbine; also, that a considerable area of level ground, allowing the construction of a reservoir, exists at a point where Scott's Creek could be turned in. The distance—viz., one mile—from the workings to the water site which Mr Crosby mentions appears rather a large one for the transport of the mineral. However, from what I remember of the fall of the ground in that direction, I believe that a considerable portion of the road would be favorable for the construction of a double self-acting tramway.

There are two other mineral occurrences in the neighborhood of the bismuth deposit, within the area of your mining sections, which judicious prospecting might prove valuable. One is that of tin ore, though in small quantity, in the drift of Scott's Creek, evidently derived, judging from pebbles showing grains of the ore enclosed, from a large dyke of tourmaline rock or tourmaline quartzite, which traverses the granite near the summit of the mountain, and may likely contain rich patches of impregnation, or perhaps veins, of the ore. The other mineral occurrence is represented by a massive dyke of diorite greenstone, crossing the mountain a short distance north of the head of Scott's Creek. This rock, which contains a good deal of pyrites minutely impregnated, closely resembles in mineral character and appearance that of some Victorian greenstone dykes, in which highly auriferous quartz veins occur, and it is therefore, by analogy, not at all improbable that any quartz veins found traversing the dyke under notice may prove auriferous also.

In conclusion, I have to refer to the facilities of communication regarding transport of machinery, stores, etc., between this mining locality and the seaboard at Emu Bay. The case stands in this respect rather favorable in so far as 42 miles of the road between Mount Bischoff and the bay, as well as the tramway now in course of construction over this distance, run right in the line for Mount Ramsay, and may of course be made use of. Through the remaining 14 miles of country a road requires to be constructed, which will no doubt be very expensive. The first four miles, being across pretty level and hard ground, may not cost much, but the main expense is connected with the next ten miles—nine miles of which are through soft, undulating, chiefly basalt country, traversed by several large creeks, and covered with a dense myrtle forest, while the last mile is over a high saddle of Mount Ramsay. Large as the outlay for this road may be estimated, however, both it and all expenses for machinery and works required for proper mining treatment of the metalliferous hornblende rock described, are specially waranted by the high value of the latter in bismuth—a discovery representing to my knowledge one of, if not the most important and richest made of this rare metal in recent times.

I have the honor to be, Sir,
Your most obedient servant,
GEORGE H. F. ULRICH, F.G.S.
Consulting Mining Geologist and Engineer,
Industrial and Technological Museum,
Melbourne, February 14, 1876.

Industrial and Technological Museum,
Laboratory,
Melbourne,
14th February, 1876.

Report of Assays for Gold of the Metallic Minerals found in the Mount Ramsay Bismuth Ore, received from Mr G. H. F. Ulrich.

The assays were made with 1000 grain samples carefully separated from the gangue.

No. 1. Magnetic pyrites—No gold; trace of silver.

Ditto (repeated)—Ditto.

No. 2. Copper pyrites—Two (2) ounces 12dwt 6 grains of slightly argentiferous gold per ton.

No. 3. Arsenical pyrites, with some iron pyrites, gave three (3) ounces 5dwts 8 grains of gold per ton.

No. 3. (repeated) gave three (3) ounces 18dwts 9 grains of gold per ton. The gold was not so argentiferous as No. 2.

No. 4. Bismuth—No gold; no silver.

Two assays were made of the magnetic pyrites, as the negative result was anomalous.

The difference in the results in two assays of No. 3, arsenical pyrites, is probably due to the presence of more or less iron pyrites so intimately mixed as to defy separation.

J. COSMO NEWBERY, B.Sc.,
Superintendent.

In compliance with your request, I have examined the water facilities for working the bismuth lode at Mount Ramsay, and beg to report as follows:—

The creek, on and near the source of which the lode is situated, is joined 51 chains below the lode by a small creek flowing in from the eastward, and 1 mile 58 chains by Scott's Creek, flowing in from the westward.

The quantity of water running in the creek at one mile below the lode is, by measurement, 510 gallons per minute, and below the junction of Scott's Creek, 1500 gallons per minute. During nine or ten months of the year, the quantity of water would be much greater than at the present time.

The difference of level between the lode and the junction of Scott's Creek is 1322ft, the fall in the first mile being 632ft, with no very great obstacles to overcome in the construction of a tramway; having a fall in the upper portion of 1 in 4, which would be a suitable gradient for a self-acting line, and the lower 1 in 22, where power would be required for taking back the empty trucks. For the next 58 chains the country is much more difficult.

By constructing a dam at the end of the first mile, I think that sufficient water can be obtained both for power and ore-dressing purposes. Above this point the creek runs almost level for several chains, and widens out, forming a flat containing an area of several acres, which is very favorable for the construction of a dam and the storage of water. Scott's Creek could also, I think, be turned in at this point if found requisite. Below this point the creek has a fall 1 in 4, that sufficient elevation could be obtained for hydraulic purposes, and driving a turbine or overshot water-wheel.

The measurements that I have given are all taken on the surface, not the level.

I remain, Dear Sir, Yours faithfully,
W. M. CROSBY.

THUREAU'S DEEP

A meeting of the sha
Thureau's Deep Lead (Haley
Salisbury Prospecting Assoc
held at the Mechanics' Institu
to receive Mr Browne's repo
and appoint trustees to amalg
many, also to conjoin (or
necessary) terms on which th
pany may be formed. There
attendance, and Mr B. P.
voted to the chair.

After the minutes of previ
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Mr A. R. Browne on the wi
was read as follows:—

REPORT.

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