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DEEP MINING OF GOLD-BEARING QUARTZ LODES AT LEFROY:

REPORT ON FUTURE PROSPECTS, BY MR. G. THUREAU, F.G.S.

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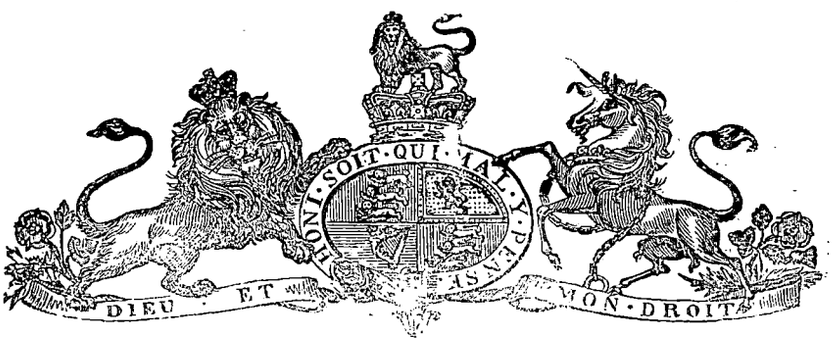

REPORT ON THE FUTURE PROSPECTS OF DEEP MINING OF GOLD-BEARING QUARTZ LODES AT LEFROY.

Launceston, September, 1883.

In accordance with the instructions given by the Hon. Minister of Lands and Works, the Lefroy quartz mines were visited, and the lowest levels yet attained were carefully examined for any gold-bearing formations occurring at those depths.

It is deemed necessary, before dealing with the important question of "deep mining," to give a few particulars as to the present state of mining at Lefroy, in order to elucidate matters; after that to refer to the experience had elsewhere, so that some conclusion may be arrived at as to the probable future of this branch of mining, which governs the future prosperity of all our efforts in that direction.

There are three principal lines of reefs of depth at Lefroy; viz.—the Native Youth, the New Chum, and the Star: these are placed in the order of the depths to which the shafts and workings have been carried.

The New Native Youth Gold Mining Company's main shaft has been sunk to a total depth of 812 feet, or about 560 feet "below sea level," and at 800 feet their present prospecting operations are being carried on. The strata—Silurian—as already described in my Report, No. 118, maintain, at this considerable depth, their peculiar foliated form, and they are still almost horizontally bedded, with a dip of from six to eight degrees to the east. It may be stated that this level is 200 feet below the workings where the last gold-bearing quartz has been worked, and that in sinking the main shaft to its present depth a large flat body of mineralised quartz, 14 feet in thickness, was passed through at 724 feet from the surface, which, however, has been left almost untried for the present. The workings at the 800 feet level comprise a chamber 10 feet long by 12 feet wide, a crosscut north, 53 feet long, and a main level east, on the course of a metalliferous formation 60 feet in length; and these are the deepest mining excavations yet made in Tasmania.

At and above the 600 feet level, which leaves from the end of the crosscut but 450 feet to be driven or bored east to the Star line of reef, the gold-bearing quartz or "shoot of gold" dips in the strike of the lode to the west, or in the direction of the Excelsior Company's shaft; at the 800 feet level, however, the dip is reversed to the opposite, and the continuation of the fault or cross-course dips consequently east, so that in the 200 feet intervening between these two levels it—the cross-course,—would be found located about 70 feet east of the shaft.

When this mine was being examined for the purposes of this Report there were indications in the end of the eastern bottom level of a more defined and of a cleaner and more mineralised quartz forming behind the cross-course alluded to, at about 20 feet north of the shaft, slightly improving as the workings are being extended. The vein-matter was at the end of the drive about four feet wide, consisting principally of a sandstone-like quartz much mineralised by iron and some arsenical pyrites, bounded at each wall by a soft black vein of "selvage" or "flucan;" this vein-stuff contains traces of gold as obtained by "panning." *

The country immediately north of this formation has been tested latterly for a distance of 30 feet, including a horizontal bore-hole of 15 feet in depth, without, however, disclosing any change.

* The Government Analyst has also found traces of gold by assay: he ascribes same to the presence of pyrites.

The " flat reef," at 724 feet from the surface, it is suggested, should be thoroughly tested by means of bore-holes made by means of the No. 2 Diamond Drill, in the direction of its dip south-west, in order to ascertain its real value, which cannot be accepted as correct with the crude tests made of the quartz hitherto.

In the bottom of the main shaft the country appears to be more favourable to other developments than probably in the 200 feet above same, excepting the flat body of quartz referred to; a softer strata has been penetrated, and indications of a metalliferous deposit have been met with, apparently following a pretty well defined north and south wall, carrying mineralised matter, principally consisting of various kinds of sulphurets.* Altogether the features at this great depth (812′) are of such a character as should encourage energetic and systematic prospecting *from beneath* the present bottom of that company's main shaft, assisted by the best and most effective rock-boring machinery that can be obtained, for the purpose of ensuring the much speedier progress of mining operations than is possible by means of manual labour alone.

The New Chum line of reef, situate north north-west of the Native Youth line, has been wrought to a depth of 425 feet in the shaft of the West New Chum G. M. Co., Registered. This line of reef occurs in exactly similarly formed strata, and has been proved far more regular in its mode of occurrence than the one first reported on, and a much greater length has been worked by the several companies along its strike of a little south of west. At the fourth level of that company it was found, however, that the solid body of reef had split into two parts, divided by a " horse " of schist. Other indications were not wanting at the same time of still further divisions taking place of the reef in question. At their lowest level the cross-cut intersected a body of mineralised quartz, nearly three feet thick, held to be the northern branch of the main reef, which latter has not so far been found. Altogether the strata and the quartz enclosed present favourable appearances for other formations being found to exist at still deeper levels, provided these deeper mining operations are not made, as now, unreasonably expensive by employing for that very necessary work any but manual labour.

The great drawback in all these deep mines consists in the longer time occupied in mining by hand exclusively, whereas proper rock-boring machinery should instead be employed, thereby opening these mines at a much increased speed, whereby the number of miners actually employed would, as in other mining districts, be very materially increased, and the crushing machines would be furnished with a continuous supply of quartz to be crushed.

The Morning Star line of reef occupies a central position between the Native Youth and New Chum lines, but the records of what has been done previous to the present company's resuming active operations could not be obtained.

The Morning Star G. M. Co., N.L., have sunk their shaft to a depth of 410 feet from the surface. In this instance, at least, it is curious that the theory so far held by some, that gold decreases at increased depths, does not appear to hold good, because above their 340 feet level the quartz yielded but twelve pennyweights of gold per ton on average, whereas *below* that level over two ounces of gold per ton have been obtained. The strata in this mine also is similarly bedded, dipping at low angles from the horizon, and this lode fissures, so to speak, likewise more or less vertically through that country rock.

Having now described the character and general features as observed at each of the mines on the principal lines of reef at Lefroy, it would be judicious, it is submitted, at this stage to draw attention generally to the subject or question of gold occurring in lodes, vein-stuffs, and in other formations in remunerative percentages, and continuing so to do at considerable depths.

This very important question has engaged the serious attention for years of both scientists and practical men, with a but varying result so far. Those holding opinions contrary to remunerative gold continuing to great depths claim, perhaps in specific instances where gold ceased to exist or could be profitably worked, to have their theory proved as correct. On the other hand, similar success has been claimed for those contending that gold would be found to continue to considerable depths on just as similar grounds. Then, again, the experience had in Victorian quartz mines has been referred to as an example for the former party, which experience, doubtless, should have considerable weight here, but not so as to exclude *all* other evidence, because, after all, good payable or remunerative gold has recently been found in the deepest quartz mine at Sandhurst—or the deepest on this side of the Equator. Great improvement has also been shown at Stawell. In the deepest levels, at 1680 feet in Mr. Lansell's No. 180, and both the Unity and Carlisle at 1308 feet (Bendigo) from the surface, good payable quartz is being got after a long search in barren ground above the present site of these discoveries.

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* The Government Analyst has also found traces of gold by assay : he ascribes same to the presence of pyrites.

Having studied this momentous question for some years, and having had many opportunities for carefully examining gold quartz mines, not only in the Australias but also in America, I would in this connection offer the following as the result of those extensive and practical researches.

Gold occurs in quartzose matrices, forming veins and lodes primarily; also more widely diffused in the following rocks; viz.—Protogine, beresite, granite, trachytes, serpentines, greenstones, and porphyries; and late discoveries prove its existence as impregnating gneissic strata,* differing imperceptibly from the bounding rocks, into which they pass insensibly, without any siliceous or other vein or gangue matter accompanying or confining same to quartzose rocks or lodes and veins.

However, as gold occurring in quartz lodes or veins claim first attention at present, it may be observed that the form or method of such occurrence varies nearly in every locality where auriferous quartz lodes have been found to exist, rendering it difficult in the first instance to observe their peculiarities everywhere, and, secondly, forming obstacles in the way of formulating a "hard and fast" rule governing the continuance of gold to great depths or otherwise. The very form of those richer portions of an auriferous vein deposit vary greatly in every district, and more so in all gold-producing countries. For instance, at Sandhurst the "shots of gold" dip (anticlinally) both north and south from a common centre in their reefs, forming "saddles," and frequently when one "leg" is rich in gold the one opposite on the other "leg" descending from the "saddle" common to both legs is poor, or *vice versâ*. It has likewise been observed, for example, on the famed Garden Gulley line of reef, that those saddle formations, so peculiar to the Bendigo district, are of different values at various depths so far as their gold contents are concerned. At the Pandora Gold Mining Company's mine four or more saddles were proved to be of medium or worthless quality beneath an extraordinary rich one at or near the surface; below the last of these valueless formations of quartz, the so very characteristic veinstone on the line disappeared altogether, and over three hundred and thirty feet had to be sunk through very dense and hard rock, and very expensive to work, before the next saddle—an exceptionally rich one—was found at a much greater depth.

In the Mount Alexander district (Castlemaine, Fryerstown, &c.), the quartz is more massive, and the "shots" of gold occur nearly vertical, but they are displaced frequently so as to lead to periodical abandonment until the continuation of the gold-bearing quartz has again been discovered, the period thus non-productive sometimes extending over several years.

Similar features have also been observed at Dunolly, St. Arnaud, Blackwood, and probably with modifications at Ballarat, Clunes, and Egerton, in the colony of Victoria. It will thus be seen that no general rule can be laid down or made to apply in that by far the most prominent quartz mining colony in the world, by means of which the gold could be limited to certain depths only, and no further, because late discoveries in many places have shown that after years of ill-directed, and therefore fruitless search, gold may occur almost at any depth. It is at the same time an unfortunate fact that the causes or the law of this unequal distribution of gold and its combinations have not yet been discovered, and that much, if not everything, depends on practical experience.

In America, *i.e.*, the States of California and Nevada, I have observed similar instances, and the occurrence of "pay-rock," "chutes," "bonanzas," "streaks," or "pay chimneys," also vary in every district visited; but, on the whole, their "ledges" or reefs are generally larger, more extensive, and regular, with greater richness in gold. The celebrated Eureka Quartz Ledge, Amador County, California, 1300 feet deep in 1877, was six feet thick at the surface, has regularly increased in thickness and value with the sinking. The Idaho Ledge, near Grass Valley City, was found to have become poor at about 900 feet from the surface, the ledge being a block 12 feet wide and 900 feet in length, but it has since resumed its average, viz., 60 dollars per ton.

In 1877, at the 2500 feet level of the Comstock Ledge, which is 600 feet wide at the surface from wall to wall, the "bonanzas," *i.e.* shot of gold and silver ore, were very rich, assaying as high as 11,000 dollars to the ton; "ore," as the quartz is termed there, broken out by myself at the 2650 feet level, was also nearly as rich, but since then the bonanzas became impoverished, and, owing to the enormous current working expenses at those depths, almost unremunerative; it is now reported that a new formation of another bonanzas has been found below the 3000 feet level which improves as the preliminary workings progress.

It may therefore be stated that, so far as results of deep mining are concerned, quartz reefs carrying gold may become poor or even valueless with greater depths, but that there is no finality of their remaining so for obvious reasons, because at any future time, if no change takes place in their respective wall or country rocks, they may be found to contain at such greater depths as rich gold-bearing quartz in "shots," "bonanzas," "pay-rock," &c. as previously at higher levels. As these peculiar formations are always found in "lenticular" forms, *i.e.* they diminish from their centre in all directions, it follows that yields must also recede when their limits are being approached; but other rich "shots" may appear beneath same, and so on. Another circumstance causes a decrease of the

* North Carolina, U.S.A.

yield of gold at lower levels,—viz., at greater depths, or below the water level, the gold is embedded or occurs associated with sulphurets and other minerals, hindering complete extraction; meanwhile the working expenses increase invariably, and very considerably as the operations, are being carried on at greater depths, thus reducing, in proportion, the profits that were obtainable at the higher levels where the quartz was not so mineralised.

There is yet another drawback which affects Australian and Tasmanian quartz gold mining; viz., too much reliance is being placed upon the very unreliable and misleading results obtained by washing quartz and "panning" until but the "free" gold remains. By those means the auriferous sulphurets are discarded, though they carry most of the gold at the deep levels. Without regular and careful assays by skilful persons the real value of such quartz cannot possibly be ascertained, and hence the loss and disappointment which follows as a matter of course.

The following quotation from the works of the Director of the Geological Survey of Canada (late Director of the Geological Survey of the Colony of Victoria), Mr. Alfred R. C. Selwyn, F.G.S., F.R.S.,* &c., may be of interest and value, as it touches the whole question at issue, and should prove particularly encouraging to investors in mines in regard to permanence in depth; for he says that—

"The depth to which mining can be successfully carried is, under any circumstances, so infinitesimally small when compared with the distances through which the forces supposed to be the cause of the vein fissures must have operated, that there need be no apprehension of the limit of the latter, in depth, being reached at distances less than those which we know them (from surface evidence) to extend horizontally in directions parallel and transverse to the anticlinal axis; and as these distances are reckoned by thousands of feet, it may very safely be conjectured that there is practically no limit to the depth to which the 'leads' ('shots of gold') may be successfully followed. At the same time, the facts observed would suggest the probability that the largest, best, and most permanent veins will, as a rule, be those which are nearest the anticlinal axes; and, likewise, that veins of this character are not likely to occur either in synclinal outcrops, or where there are great thicknesses of *strata nearly horizontal or uniformly inclined in one direction. But in such situations true fissure veins and cross-lodes, either in dislocations or in shrinkage cracks, may be abundant and of such character as to be capable of being mined with profit.* These '*streaks*,' *i.e.* '*shots of gold*,' are always found to have a dip more or less transverse to the dip of the vein. They sometimes vary greatly in width at different depths on the course of the vein, and are, therefore, more or less lenticular or wedge-shaped, not unfrequently dying out altogether before reaching the surface. In some veins they are stated to occur at no great distance apart, while in others they are separated by great thicknesses of comparatively barren quartz. Thus, in following the veins downwards, if the 'streak' (or 'shot') happens to be narrow it it is speedily passed through, and the sudden impoverishment of the quartz causes a mine to be abandoned, when by a little further exploration in the direction of the dip of the 'streak' or 'shot" a very different result might have been obtained."

With our so much smaller lodes, in comparison with those in America especially, it ought to give satisfaction if at deeper levels the former yields of quartz at Lefroy were again obtained. So far, there is nothing against formations of similar veinstone being found to occur beneath the present bottoms of workings on any of the lines of reef referred to.

As regards future operations in that deep ground, I would, as a preliminary, strongly recommend the employment of the No. 2 Diamond Drill in those deep mines at Lefroy; the strata can be easily and rapidly bored by that perforator, and all the three lines should participate in that mode of prospecting, under such conditions as may be agreed upon between Government and the parties interested, who should, however, keep their mines clear of water pending further arrangements.

Should, as it is probable it will, the diamond drill intersect any new formations of gold-bearing quartz, it should be sampled carefully and assayed by the Government Analyst, whereupon the question as to a subsidy for sinking shafts, &c. could be submitted to a board appointed by Government for consideration.

G. THUREAU, *F.G.S., Inspector of Mines and Geological Surveyor.*

APPENDIX.

The following returns are submitted for the purpose of elucidating matters, and to show the importance of the matter at issue; they will at the same time, it is submitted, convey an idea to those not acquainted with mining pursuits what large expenditure is necessary to obtain and maintain results. It should be borne in mind that gold so raised has benefited the Colony at large, and caused a large settlement of people upon, generally speaking, sterile land little fitted for cultivation.

NEW NATIVE YOUTH LINE OF REEF.

Total yield	23,350 ozs.		
	£	s.	d.
Dividends	28,437	10	0
Working account	77,917	11	1
Plant and machinery	17,789	3	8

* "Notes and Observations on the Gold Fields of Quebec and Nova Scotia," by A. R. C. Selwyn, &c. London, Trübner and Co., Ludgate Hill, E.C.

The Native Youth Gold Mining Company, Registered, I am informed, had, besides the gold obtained from their mine, other sources of income in order to make up deficiencies,—viz., calls, reserve fund, and crushing for the public,—all of which, however, have now been absorbed and sunk into the concern. The last dividend was paid by this Company on the 5th July, 1877. No dividend tax paid.

DETAILED STATEMENT whilst sinking the last 200 feet, opening and driving lowest levels :—

Workings.	*Measurements.*	*Time occupied.*	*Cost per foot.*	TOTAL.
			£ s. d.	£ s. d.
Main shaft	200 ft. vertical	31 weeks	8 4 9	1647 10 0
Chamber at 800 ft.....	10 ft. × 12 ft.	2 ditto	8 15 0	87 10 0
North crosscut	53 ft. long, ordinary size	5 ditto	7 16 0	413 8 0
			Total Cost	£2148 8 0

THE NEW CHUM LINE OF REEF.

The New Chum G. M. Co., Registered.

Total yields.....	25,675 ozs. 1 dwt. 20 grs.
Dividends	£58,250
Working account	Not stated.
Machinery	Pumping, winding, and crushing.
Dividend Tax paid.....	£1865

The West New Chum G. M. Co., Registered.

Total yield	13,939 ozs. 4 dwts.
Dividends.....	£21,000
Working Account.....	Not stated.
Machinery	Pumping, winding, and crushing.
Dividend Tax paid.....	£787 10*s.*

DETAILED STATEMENT whilst sinking the last 200 feet, opening and driving lowest levels :—

Workings.	*Measurements.*	*Time occupied.*	*Cost per foot.*	TOTAL.
			£ s. d.	£ s. d.
Main shaft	200 ft. vertical	..	7 7 6	1475 0 0
Chamber	15 ft. × 12 ft.	.	6 12 6	99 7 6
Level and crosscut	68 ft.	..	3 9 6	236 6 0
			Total Cost	£1810 13 6

Other Yields on the New Chum Line, viz.—

	ozs.	*dwts.*	*grs.*
United Chum G. M. Co., Registered.....	1342	1	0
East New Chum G. M. Co., Registered.....	331	5	0

THE MORNING STAR LINE OF REEF.

The Morning Star G. M. Co., Limited	502	0	0

	ozs.	*dwts.*	*grs.*
TOTAL GOLD YIELD from the three Lines of Reef	65,139	7	20

	£	*s.*	*d.*
Value, at £4 per oz.	260,557	10	9
Total Dividends.....	107,687	10	0
Total Dividend Tax paid	2652	10	0

G. THUREAU, *F.G.S. Inspector of Mines and Geological Surveyor.*

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