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REPORT ON  
TASMAN AND CROWN LYELL EXTENDED MINE

Leases

The workings of this mine are situated upon leases 8891/M of 40 acres, and 8904/M of 20 acres.

These leases are held in the name of J. A. Cornish, G. Heywood, and J. Reynolds, and a Syndicate entitled the Horseshoe Prospecting Syndicate has been formed to work the Mine.

Location and Access

The mine is situated in the Sedgwick Gap between Mt. Lyell on the south and Mt. Sedgwick on the north, about 4 miles north-east from the township of Queenstown. It adjoins the Lyell Comstock Mine, owned by the Mt. Lyell Mining and Railway Company, whose two-foot tramway connects this mine with the terminus of their railway at Queenstown. This tramway follows the bed of the Queen River and the eastern branch thereof and has a length of 5 miles.

Queenstown is connected with the port of Strahan on Macquarie Harbour by the Mt. Lyell Company's railway of 3' 6" gauge and 22 miles in length.

Strahan is connected by Government railway with Zeehan, which is, in turn, connected by the Emu Bay Company's railway with the port of Burnie on the north-west coast of Tasmania and thence with the railway system of the State.

Topography

The mine is situated on the eastern side of the Sedgwick Gap between Mt. Lyell on the south and Mt. Sedgwick on the north, these mountains being two of the highest peaks of the West Coast Range. The Gap is 1,300 feet above the sea-level, whilst Mts. Lyell and Sedgwick rise to heights of 2,750 feet and 4,000 feet respectively above the sea.

From the Sedgwick Gap, the eastern branch of the Queen River rises and flows westerly and later southerly. The Gap or Comstock Creek also rises in the Sedgwick Gap and flows easterly into the Ring River.

Geology

Nearly the whole of the surface in the valley of the Comstock Creek is covered by glacial deposits, so that the elucidation of the geology is rendered difficult. This applies to the greater part of the leases, but the underground workings have exposed the rocks below the covering of this drift. The hills are practically devoid of trees and also, in places, of soil, so that good exposures are available.

### Cambro-Ordovician Series

The oldest rocks are a series of sedimentary ones occurring to the west and north-west of lease 8891/M. They are well exposed in the Sedgwick Gap and on the foothills of the mountains to the north and south thereof. They can be traced as far to the east as the lowest workings of the Lyell Comstock Mine, but no further. To the west they extend down the valley of the Queen River and are probably conformable with the non-schistose and igneous rocks of this locality, but this area was not examined in detail.

The series consists of conglomerate, slates and fine-grained argillaceous sandstones. The pebbles in the conglomerates are chiefly those of soft rock types (decomposed igneous rocks, slates, etc.), very few pebbles of quartz, chert, etc. being present. These conglomerates present a striking contrast to the hard siliceous variety capping the mountains. The slates are light buff coloured types. The sandstones are fine-grained, white, argillaceous types.

The strata have a strike varying from  $285^{\circ}$  to  $330^{\circ}$  and dip either vertically or at high angles to the south-west or north-east.

The eastern boundary of this series is formed by the quartzitic outcrops of the Lyell Comstock lode and apparently by the schists of this mine and the Tasman and Crown Lyell Extended.

As already stated above, the series is probably conformable with the partially schistose and non-schistose rocks and other igneous rocks along the valley of the Queen River. These rocks undoubtedly comprise the suite of igneous rocks (plutonic, intrusive, volcanic and pyroclastic) known in Tasmania as the Porphyroid series and referred to the Cambro-Ordovician period.

### The Mount Lyell Schists

In the workings of the Tasman and Crown Extended and the Lyell Comstock Mines, a series of schists is exposed. In the former they are much decomposed by superficial weathering and their nature is uncertain. When fresh samples are available, they are seen to be dark green types, to which the field name of chlorite schists would be applied. Other types are very similar to typical talc schists. Professor Gregory has proved these schists in the vicinity of the Mt. Lyell and North Lyell mines to be altered igneous rocks and that they consist essentially of an aluminous silicate with small amounts of potash and soda. To this mineral he applied the name of margarodite.

These schists have a general strike from  $45^{\circ}$  to  $90^{\circ}$  and dip either vertically or at high angles, chiefly to the southeast or east. ?

To the west or north-west these schists should junction with the porphyroid series described above. To the east they are in contact with the West Coast Range Conglomerate series to be described below. They form a

narrow belt not exceeding 10 chains in width and extending in a north-easterly direction parallel to their junction with the Conglomerate series. To the south and south-west the same belt continues through the North Lyell and Mount Lyell mines.

West Coast Range Conglomerate Series

This series, as its name indicates, is prominent on the West Coast Range. It forms the major part of and caps Mts. Lyell and Sedgwick. The rocks comprising this series are conglomerates, quartzites and sandstones. The pebbles in the conglomerates are all hard types, such as quartz, quartzites, and quartz schists, and they are cemented by a quartzite matrix. The pebbles of quartz schist are lithologically identical with the Pre-Cambrian quartz schists, and have undoubtedly been derived from such rocks. The quartzites are generally pinkish in colour, but white types are also present.

These rocks cross the south-eastern part of lease 8904/M, where they junction with the Mt. Lyell schists, in a general north-easterly direction. Near the junction the conglomerates have a strike of 30° and dip high to the east, but right at the junction, they appear to dip to the west.

Further east along the north flank of Mt. Lyell, the rocks have a general east-north-easterly strike and dip to the north. On the southern flank of Mt. Sedgwick the strata appear to be folded into a large anticline.

In other parts of Tasmania this series unconformably overlies the Cambro-Ordovician rocks and underlies conformably the Middle Silurian limestone series. It is therefore referred to the Lower Silurian system, and is regarded as the base of the Silurian system in Tasmania.

Tertiary

The tram cuttings and other excavations on the northern part of lease 8891/M, and to the north thereof expose, a horizontally bedded series of clays and sandy clays containing pebbles sparsely distributed through them. The same strata are also exposed for the first 200 feet from the entrance of No. 3 tunnel. Here, however, they are well-bedded and more compacted and are more of the nature of mudstones. These strata underlie the glacial deposits but their exact age is uncertain. They may represent Permo-Carboniferous rocks such as occur in the Linda Valley to the south, but they are not so consolidated as the typical rocks of this age and no fossils were found in them.

It is more likely that they are of Tertiary age, and may even form a more or less continuous series right up to the Pleistocene glacial deposits.

Pleistocene Glacial Deposits

The whole of the valley of the Comstock Creek was filled with deposits formed by glaciers and their retreat during Pleistocene times.

These glaciers formed on the summits and flanks of Mts. Lyell and Sedgwick and moved down the Comstock Valley in an easterly direction. No trace of glaciation is present in the valley of the eastern branch of the Queen River, which flows to the west and south.

The glacial deposits contain huge boulders of the West Coast Range Conglomerate series - conglomerates, quartzites and sandstones. More sparsely distributed throughout them are blocks of fossiliferous friable white sandstones, containing typical Silurian brachiopods.

### Structural Geology

In the above discussion it has been seen that to the west of the area, there is a series of Cambro-Ordovician strata with a strike of  $315^{\circ}$  and a vertical dip. These are bound on the east by a narrow belt of Mt. Lyell schists, which in turn junction with the West Coast Range Conglomerates of Silurian age. The latter junction has been traced for a considerable distance to the south and has been proved to be a faulted one, the Silurian series to the east being faulted down against the Mt. Lyell schists. This fault has a general north and south direction with a dip to the west, and has been heaved laterally by transverse faults.

In the north this fault continues a short distance across the Comstock Valley in a north-easterly direction. On the foothills of Mt. Sedgwick it has been disturbed by a large transverse fault similar to that on the south of Mt. Lyell and heaved a considerable distance to the west.

Thus on the southern foothills of Mt. Sedgwick the Silurian rocks on the north abut against the porphyroid series to the south.

### Origin and Age of the Mt. Lyell Schists

It has been seen above that the Mt. Lyell schists form a narrow track of country parallel to the main Lyell fault and to the west thereof. Further, it has been shown by previous investigators that practically all the ore-bodies of the field e.g. the Lyell Comstock, North Lyell, Mt. Lyell, etc. occur in the schists in close proximity to the main Lyell fault. It is evident from the field relations that they do not form an independent series, but are intimately related to the faulting and the ore-deposition. The relation, which is at once suggested, is that the schists have been formed in some way from one of the adjacent rock series by the movements and conditions connected with the faulting and ore-deposition. They could not have been formed from the highly siliceous Silurian rocks, and it is apparent that they have been formed from the Porphyroid series. It has been shown by Prof. Gregory by petrological and analytical means that at Mt. Lyell the schists represent metamorphic types which have undoubtedly been formed from the porphyroid series.

It is evident therefore that the origin of these schist as pictured above is the correct one that they have been formed from the Porphyroid series during the faulting of the Silurian rocks along the main Lyell fault and the simultaneous or subsequent ore-deposition.

### Economic Geology

#### Geology and Origin of the Ore

As already referred to above, the ore-bodies of the Mt. Lyell field, such

as the Mt. Lyell and North Lyell, occur in the Mt. Lyell schists adjacent to the main Lyell fault.

The same conditions hold at the Lyell Comstock mine to the north of the above and also in the Tasman and Crown Lyell Extended. The Mt. Lyell ore-body is one of massive pyrite containing copper, gold and silver. The North Lyell, Lyell Comstock and others consist of bornite, chalcopyrite and cupriferous pyrite. The Tasman and Crown Lyell Extended ore-body is, however, a lead-zinc-silver one, and is in this respect exceptional in this field.

It occurs in the same geological position as the copper deposits viz., in the Mt. Lyell schists adjacent to the Lyell fault and the West Coast Range Conglomerate series, and is probably of the same period of ore-formation. This period is either contemporaneous with or slightly subsequent to the period of faulting. As Silurian rocks were involved in the latter the period of mineralisation must be post-Silurian. It is, therefore, probably contemporaneous with the Devonian period which resulted in the formation of the majority of the ore-bodies in Tasmania.

#### Mineralogy of the Ore

The ore is a dense mass of sulphides with little or no gangue showing in hand specimens. The sulphides present are galena, sphalerite (zinc blende) and pyrite. Generally these form a fairly intimate mixture, but occasionally pyrite forms a small portion of the ore without an admixture of the other minerals. This pyrite is dense, fine-grained and massive. The galena and blende each predominates in certain portions of the ore, but not to the total exclusion of other minerals. The galena is the typical cubicle form, ranging up to 1/8 inch in grain size where it predominates.

The sphalerite is generally fine-grained and intimately mixed with the other minerals, but occasionally it occurs in larger areas. In these, it occurs as the coarsely crystalline resin blende. The general colour of the fine-grained ore indicates that this is the form in which it occurs throughout the ore.

The only gangue mineral visible in hand specimens is an occasional piece of quartz. The ore contains up to 9% insoluble matter and so it is probable that gangue minerals occur to a limited extent in the sulphide ore but are not visible to the eye.

The silver in the ore is associated chiefly with the galena, though small amounts are also associated with the blende and the silver content generally shows a direct relation with the lead content, but not always so. In the lead ore sold, however, this relation is very definite and the silver content is equal to 0.55 to 0.6 ozs. per unit of lead. Sample No. 8 shows the iron pyrite to contain 6 ozs. of silver per ton, but it is stated that higher assays have been recorded.

#### Composition of the Ore

It is important to obtain as closely as possible the average composition of the ore, and this will be dealt with below, all the available information being considered.

Winze from No. Tunnel to 68 foot Level:

The Mine Manager (1912) reported that the winze was sunk 24 ft. in ore, and 300 tons of ore assayed 30% lead, 14 zinc and 19 ozs. silver per ton.

The 68 Foot Level

The Manager (1912) reported that 600 tons were stoped from this level with an average value of 28% lead and 13 ozs. silver per ton.

Samples Nos. 6 and 7 were taken from the western end of this level, but not right across the lode. They show 22.5% and 18.6% lead, 25.6% and 27.3% zinc and 8.55 and 8.9 ozs. of silver per ton respectively.

A sampling campaign was carried out over a length of approximately 100 feet towards the west end of this level and the assay plan shows results from 12.9% to 51.9%, 13.5% to 25% zinc and 9.2 to 23 ozs. silver per ton, the average being 28.7% lead, 18.4% zinc and 15.8 ozs. silver per ton.

The 98 Foot Level

The Mine Manager reported the ore from this level as assaying 28% lead, 10% zinc and 16 ozs. of silver per ton.

The 134 Foot Level

The Mine Manager reported the first 60 feet of driving on the lode assayed 27% lead, 21% zinc and 20 ozs. of silver per ton. In the No. 1 stope opened from this level, the ore - 9 feet wide - is stated to have assayed 32% lead, 16% zinc and 15.4 ozs. of silver per ton.

In the accompanying Table, samples Nos. 1 to 5 were taken across 25 feet of ore from south to north, each sample representing approximately 5 feet. The average across the ore is 33.5% lead, 25.76% zinc and 7 ozs. silver per ton.

TASMAN AND CROWN LYELL EXTENDED by P.B. NYE, GOVERNMENT GEOLOGIST.

TABLE OF ASSAYS.

Sample	Gold	Silver	Lead	Zinc	Copper	Iron	Sulphur	Insoluble
	<u>Per Ton</u>		%	%	%	%	%	%
	Dwts.	Ozs.						
1.	Trace	6.05	40.10	22.21	Trace	7.01	25.09	4.56
2.	2.8	2.90	14.40	34.81	Trace	8.98	29.46	11.00
3.	Trace	8.55	30.10	28.60	Trace	4.98	24.58	10.28
4.	3.4	14.05	29.80	19.06	Trace	9.49	25.48	15.66
5.	Trace	10.50	42.00	24.21	Trace	5.71	25.67	2.22
6.	Trace	8.55	22.50	25.61	0.28	12.53	29.70	9.00
7.	Trace	8.90	18.62	27.35	1.10	9.94	27.00	15.48
8.	Trace	6.07			Trace	44.0		
9.	Trace	6.70			14.46	20.2		
10.	Trace	8.05	15.86	31.08	2.90	9.39	28.09	11.50
11.	Trace	1.30			2.40	37.4		

Nos. 1 to 5 - Each 5 feet wide approximately across lode at 134 foot level.

No. 6 - 5 foot sample-Stope 68 foot level.

No. 7 - Face - West drive

No. 8 - Iron pyrite - West Drive

No. 9 Grab sample: black oxidised ore; Face, West Drive, 68 foot level.

No. 10 Borings - near Face, West Drive, 68 foot level.

No. 11 Pyrite - Concentrates from copper ore.

### Recent Production

Since beginning operations, the Syndicate has disposed of ore in the following ways. The ore as mined was picked at the surface in order to produce a marketable lead ore, the residue being kept for sale as a zinc ore, except that all clean pyrite was discarded.

Altogether 263 tons of lead ore were obtained, with lead ranging from 34.1 to 43.1% and silver from 18 to 27.6 ozs. per ton (zinc values, unfortunately, were not given).

The average content of this ore was 38.5% lead and 24.3 ozs. of silver per ton.

At the same time quantity of zinc was produced of which 45 tons with an average composition of 21% zinc and 25% lead and 14.5 ozs. silver per ton, were sold.

The average of all this ore is 36% lead and 24 ozs. silver per ton. Allowing for an additional amount of zinc ore which was produced but not sold, this average would be probably, 33% lead and 21 ozs. silver per ton.

In one sample of lead ore (39% lead and 22.4 ozs. silver) the zinc content was 16.05% and it is probable that the zinc content of the 33% lead and 21 ozs. silver ore would be approximately 18%.

Taking all the above figures into consideration, the composition of the ore appears to be:-

	<u>Lead</u> Per Cent	<u>Zinc</u> Per Cent	<u>Silver</u> Ozs. per ton
68 foot level	28 to 33	14 to 18	16
98 foot level	28	10	16
134 foot level	27 to 33	16 to 25	10 to 20

### The Ore-body

The ore-body was first discovered at the end of the No. 2 tunnel. A winze was sunk vertically on it and continued in ore for 2½ feet, at which depth the ore passed to the north of the winze, so that the lode was dipping to the north. This winze was later connected with a rise from the 134 ft. level and the 68 ft. level was opened up and later connected with the main shaft. From the cross-cut from the shaft, ore has been exposed for a distance of 180 feet to the west and is still showing in the face. The lode varied from 5 to 15 feet in width and had a dip to the north of from 70° to 80°. At the western end, near the present stopes, several large flat makes of ore project from the hanging wall in an irregular manner.

These add considerably to the tonnage of ore and should all be closely followed.

The eastern face of the 68 ft. level was still in ore but the glacial drifts came right down to the level.

At a point 120 feet south-east from the shaft at the 134 ft. level, a rise was put up to the level of the 68 ft. level and a cross-cut was driven northerly across the lode. This rise could not be entered, but the information was obtained from a report on the mine by Mr. King. The lode at the 68 ft. level is therefore at least 300 feet long with ore still exposed at both ends.

At the west end of this level it was stated that a copper lode containing up to 21.5% copper occurred. Copper ore does undoubtedly occur, but it exists only at the cap of the lode under the glacial drift. It is present in the form of a black coating on the lead-zinc ore or as small lumps in the gossan and glacial drifts. The copper is present in this black ore as the black oxide of copper (melanconite, the earthy form of tenorite). It has been derived by oxidation and concentration from the small amount of copper in the lead-zinc ore, or may have been deposited from copper-bearing solutions dissolving copper from an adjacent copper lode.

Between the 68 ft. and 134 ft. levels

The present owners carried out some underhand stopes to a depth of 20 feet below the 68 ft. level immediately to the east of the crosscut from the shaft. The lode was from 4 to 6 feet wide. It first dipped to the north, then vertically, and finally showed a tendency to dip to the south, thus undergoing a reversal in dip.

A winze immediately below that from the No. 2 tunnel to the 68 ft. level connects the latter with the 134 level. It cannot be traversed at present, but an extract from the former mine Manager's reports (1912) is as follows:-

"No. 3 rise connecting with winze at end of No. 2 tunnel, cut a body of zinc ore 3 feet thick about 20 feet up from the level (134 feet), assaying 48.25% zinc and 18.2% lead. This lode has not had anything further done on it ....."

It is not stated which way the lode was striking or dipping. As the top of the rise is to the south of the ore at the 68 ft. level, if this lode represents or is connected with the lode at the 68 ft. level, it would have to dip from the latter to the south. It is probable that this is the same lode, and the reversal in dip corresponds with that noted above, and also below, in the case of the 98 ft. level.

The 98 ft. level.

This level was opened up from the top of a rise in a branch drive off the 134 foot level. It could not be entered, but the Mine Manager's report (1912) stated:-

"About 40 feet along the level from the rise galena ore was cut and was driven along the course for a distance of 70 feet. The width is not known as the drive was driven along the footwall, the lode assaying 28% lead, 10% zinc, and 16 ozs. silver".

The present manager, who entered the level from a short crosscut from the shaft, states that the drive was along the northern or north-eastern side of the lode. If this is the footwall, the lode apparently dipping to

the south or south-west.

The 134 ft. level

The south crosscut from the shaft did not intersect ore until 50 feet from the latter. No ore can be seen at this point, although a drive to the east soon broke into the ore on the south side. In a closely timbered rise past this drive, ore is, however, exposed a short distance above this level. The manager's report (1912) however, states:-

"About 50 feet south of shaft, a galena lode was cut running N and S being the same lode as in the 98 ft. level. It is a small lode but opens out to 7 feet wide in places. It junctions with the "big" lode, and stoping of it carried to the east where it was on the footwall of the big lode. About 47 feet south from the shaft a drive was put 40 feet cutting the big galena lode".

This small lode referred to is undoubtedly that exposed at the 98 ft. level. It is either a branch off the main lode or what is more probable, a narrow part of this lode with an unusual strike. This lode has not been followed to the west or north-west apparently. It was not seen in the most western southerly crosscut on the 134 ft. level although cut in the No. 3 rise. This would indicate that the western end of the lode had been reached and that it has a flat pitch to the east.

The drive east from the southerly crosscut from the shaft has ore on the south side at 20 feet and at 40 feet was driven into the lode. The lode was then followed for a distance of 190 feet to the east. For a distance of 70 feet or more after being cut it was exceedingly wide, being 30 feet in places. The drive is blocked at present and the last feet of lode cannot be seen, but according to old plans and reports it decreased in width eventually and petered out. In a "jump up" near the widest part of the ore, a crosscut north and south exposed 27 feet 6 inches of ore. The southern wall was not clearly exposed and seemed to be rather irregular and indefinite. The northern wall had a strike of 310° and a dip to the south.

If the dip between the 68 ft. and 134 ft. levels underwent a reversal as indicated above, the lode should at this level dip to the south. This is supported by the southerly dip of the northern wall at the exposure in the jump-up.

Below the 134 ft. Level

A winze sunk from a point 400 feet east of the crosscut must have commenced in ore and probably passed out of it as there are no records of any ore at the 191 ft. level. The winze cannot be entered, and the dip of the lode in the winze has not been recorded.

The 191 ft. and 253 ft. Levels

These could not be entered owing to falls of rock in them, but there are no records of the lead-zinc lode being cut in them. In plan they are situated to the north of the 134 ft. level. If the lode continues on a southerly dip as is indicated between the 68 ft. and 134 ft. levels and at the latter, it would naturally

pass to the south of the two lower levels.

Search should be made at these levels by sinking a winze or winzes from the 134 ft. level to determine the dip of the lode below, and then cross-cutting either north or south from the lower levels. This latter might be done without sinking the winzes, but is not recommended. The best point to sink a winze would be about 200 feet east of the shaft, where the lode is narrow and more likely to be well defined in dip.

### History

A great boom in copper mining took place on the Mt. Lyell field after the initiation of operations by the Mt. Lyell Mining and Railway Company in 1896. Mineral leases were taken up in the whole of the surrounding area and companies were floated to prospect for copper deposits and develop the same.

For this purpose the Tasman Crown Lyell Extended Mining Company, No Liability, was formed in 1899 and after several reconstructions became the Tasman & Crown Lyell Extended Mines in 1907.

Underground work was begun to the north-east of the Lyell Comstock ore-body, in an apparent search for the continuation of this body. The No. 1 tunnel intersected a low grade pyritic deposit, which was later also exposed at greater depths in the Nos. 2 and 3 tunnels and numerous intermediate levels. This deposit was, however, eventually found to be too low grade to exploit commercially and work on it was discontinued.

In driving the No. 2 tunnel south-east through the copper ore-body, the cap of a zinc lead sulphide lode was encountered. After the copper boom subsided, and the copper ore-body referred to above was found unpayable, attention was then devoted to the zinc-lead lode. The tunnels were extended towards it, intermediate levels were opened on it, and finally a main shaft was sunk and connected with the lowest level (253 ft. or No. 3 tunnel). Small treatment plants were erected and a small amount of stoping performed, but the results were not successful.

By this time £90,000 had been spent in developing the mine, and as the Company would not raise any more capital, operations ceased.

The present holders acquired the property in 1922, and have carried out operations on a small scale since that date.

### The Mine Workings

The mine workings consist of a main shaft, three tunnels five levels connected with the shaft, and numerous short intermediate levels, together with the attendant winzes, rises, passes, etc. Altogether, the total length of tunnels and levels is 7,000 feet. The main shaft is 253 feet deep, being a three compartment shaft to the 191 ft. level, and then a two compartment from there to the 253 ft. level.

The Nos. 1 and 2 tunnels are not connected

with the shaft although the latter is connected by a winze with workings from the shafts. Levels are connected with the shaft at depths of 68, 134, 191 and 253 feet. An intermediate level at 98 feet is connected by a rise from the 134 ft. level, but not directly with the shaft.

All the workings on the copper lode, with the exception of the No. 1 tunnel, are connected by winzes right from the surface down to the No. 3 tunnel or 253 ft. level.

The main shaft is equipped with a geared winch with hand brake. Motive power is supplied from a small Pelton Wheel driven by water under a head of 200 feet. An internal combustion engine is also installed for emergency power purposes.

### Ore Reserves

The lode has been proved for a length of 180 feet west of the shaft, and it still extends in that direction. It has also been proved at a point 120 feet east of the shaft. At the 134 ft. level it has been proved for a length of 190 feet.

The width at the 68 ft. level varies from 5 feet upwards, not counting the flat makes at the west end. The width at the 134 ft. level varies up to 30 feet. The quantities of ore in the different sections are:-

#### Above 68 ft level

There is a block of ore, 180 feet long, 30 feet high in the centre and nothing at the east and west ends (owing to the glacial drift coming down to the 68 ft. level) and 5 feet wide.

$$\text{Volume} = \frac{1}{2} \times 180 \times 30 \times 5 = 13,500 \text{ cubic feet.}$$

In addition there is a probable reserve west of the present face of the 68 ft. level.

#### Between the 68 ft. and 134 ft. level

At the 68 ft. level, the lode is 300 feet long, and of an average width of at least 5 feet.

At the 134 ft. level, the lode is 190 feet long and an average width of 15 feet. The depth of ore is 60 feet.

$$\begin{aligned} \text{Volume of ore} &= \frac{1}{2} \times (300 \times 190) \times 60 \times 10 \\ &= 147,000 \text{ cubic feet.} \end{aligned}$$

### Total

The total volume is therefore 160,500 cubic feet, or allowing 8 cubic feet to the ton, 20,000 tons. A few hundred tons have been stoped from this.

No account has been taken of the irregular flat makes occurring at the western end of the 68 ft. level

which would make an appreciable addition to the reserves.

In addition to these proved reserves, there are probable reserves west of the west end of the 68 ft. level, and also below the 134 ft. level.

No account is taken of the galena ore in the main copper lode between the 134 ft. level and No. 3 tunnel.

Production

The old Company produced only a small quantity of lead ore. At least 600 tons of crude ore were stoped and treated from which 77.7 tons of first grade, and 44.875 tons of second grade concentrates were produced.

The present Syndicate have sold 263 tons of lead ore and 45 tons of zinc lead ore.

Marketing of the Ore

There are three main methods which might be adopted in the marketing of the ore:-

a) Disposal as Lead ore - This would mean selling the ore as it is mined, without any hand-picking or treatment. Such ore would probably average 30 to 33 per cent Lead; 18 to 25 per cent zinc; and 7 to 20 ounces of silver per ton. Ore such as this might be accepted for lead smelting purposes, but the zinc content is rather high. As a result, it might not be acceptable, or alternately a penalty for zinc be imposed, which would reduce the net value of the ore below profitable dimensions. Even if accepted with or without a penalty, the zinc content of the ore would be lost.

b) It has been shown above that by hand-picking the ore, a lead ore can be obtained averaging 38.5 per cent. lead, 24.3 ozs. silver per ton and probably 16 per cent zinc. At the same time, a zinc ore averaging 21 per cent. zinc, 25 per cent lead and 14.5 ozs. silver per ton can be obtained.

This lead ore is readily accepted for smelting, although under some tariffs a penalty is imposed for the zinc content. A difficulty is experienced at present in finding a ready market for the zinc ore. With markets for both products, this method is undoubtedly an improvement on the first one. The zinc contained in the lead ore is, however, lost.

c) The ideal method would be, of course, to separate the galena and blende from each other and the other portions of the ore and market a comparatively pure galena and a comparatively pure blende product.

In this way all the metallic values in the ore would be realised on. In connection with this, there would have to be considered the cost of the metallurgical processes necessary to effect this separation.

Methods of Treatment

The possible methods of treatment depend entirely on the nature of the ore and the contained minerals. The ore is essentially a fine-grained mixture of galena, blende and pyrite, with a small amount of gangue.

The ore in which the galena is most plentiful contains of galena up to probably one-tenth of an inch grainsize. The ore less rich in galena is much finer in grain and it has been stated that crushing to 30 mesh is necessary to free the grains of the various minerals. Certainly crushing to some such size would be necessary to effect this separation.

Coarse jigs would, therefore, be of little use in the concentration of this ore. Fine jigs would probably effect a partial separation of the galena and produce a marketable galena product. The tendency of modern metallurgical practice in treating lead-zinc ores is rather to dispense with fine jigs and to effect the separation on Wilfley Tables.

For Wilfley tables a pulp which would give no more than 10 to 15% on a 40 mesh screen is regarded as suitable. The modern tendency is, however, to grind finer to improve recoveries, as the treatment of slimes does not offer the difficulties that it did in the past.

The crushing to the above size would certainly be sufficient to liberate the minerals in the ore and a marketable galena product might be obtained from the Wilfley Tables.

The tailings and the slimes from the above tabling would have to be further treated to recover the lead values in these, and also the contained blende. This treatment would have to be effected by selective flotation processes.

Instead of the above combined gravity and flotation processes, an alternative method would be to treat the ore solely by selective flotation. The question of the relative advantages and disadvantages of these two methods when treating the class of ore under consideration could only be determined as a result of experiment and experience.

The selective flotation of this class of ore, containing galena, blende, and pyrite, now offers no great difficulties although each class of ore has its own little problems to be solved. The galena is usually floated off first, and then the blende is floated from the residues from the galena flotation the pyrite passing away with the gangue.

At Broken Hill where, however, pyrite is not treated to any large extent, several processes are in use. Eucalyptus oil is the frother used, although other substances may be used in conjunction with it. Sulphuric acid is used as an intensifier and if in a selective flotation of galena, sulphur dioxide is used as a retarding agent on the blende. Copper sulphate is used to partly or wholly replace the acid in the flotation of the blende.

In other places, soda ash is used as an addition reagent in the galena flotation. Copper sulphate and are used in the flotation of the blende, the pyrite being left in the residues.

Similar methods are used at the Consolidated Mining Smelting Company at Trail, Canada. Experiments

by the Mines Department in Canada have shown that lime and sodium sulphate can be used in the galena flotation to keep down the pyrite and blende respectively. After eliminating these by dewatering the residues, soda ash and copper sulphate are used to float the blende and allow the pyrite to pass into the residue. The variety of oil is stated as not being so important as the addition reagents.

The Copper Lodes

The mine was first commenced to search for copper lodes. One copper lode, known as the main lode, was cut in the No. 1 tunnel, No. 2 tunnel, intermediate levels down to the 134 ft. level and the No. 3 tunnel. In the Nos. 1 and 2 tunnels, it consists of schists impregnated with and containing narrow seams of pyrites and a small amount of quartz. Any copper in the lode is contained in the iron pyrite. According to the mine Manager's report (1912) the same formation (about 9 feet wide) was cut in two intermediate levels below No. 2 tunnel, but at the lower intermediate a 12 ft. copper lode was lying on the south side (footwall) of the main lode. It is further stated that 200 tons of this copper lode were taken out and assayed 3.5% copper and 5 ozs. silver per ton.

At the 134 ft. level these lodes, or lode, are represented by an irregular formation. The southern part consists of schists impregnated with pyrite and is succeeded to the north by irregular quartz veins with chalcopryite. The hanging or northern wall of these portions dips to the north, but immediately adjacent to the north there is another formation about 5 feet wide consisting of quartz, chalcopryite, galena and pyrite, dipping northerly. Still further to the north and just south of the winze to No. 3 tunnel, a further irregular formation of quartz with pyrite and chalcopryite occurs. It is 15 feet wide at one place, but does not appear to extend down.

A drive to the west exposes the footwall of this formation and also cuts the hanging wall of the 5 ft. lode containing galena. It is stated that the crosscut was driven on the cap of a shoot of galena, 6 to 8 feet wide, but this probably refers to the whole width of the lode.

This main lode or series of lodes could not be inspected in the No. 3 tunnel owing to a fall. The following extracts are taken from the Mine Manager's report (1912):-

"At 975 feet a galena formation was cut. A drive was driven for 125 feet along channel, cutting a shoot of galena 7 feet wide, and followed for 40 feet, bearing N. 68° E and dipping north west. Bulk assays 17% Pb., 5%Zn., and 3.5 ozs. silver per ton.

"At 1,037 feet, bornite and chalcocite were met. Incline rise was put up for 151 feet and at 100 feet passed through shoot of ore, average width 20 inches. Bulk assays 6.2% Cu., 16.6 ozs. Ag. and 2 dwts per ton of Au.

"Drive 40 feet south west on this lode, cutting through hanging wall and entering main lode, proving main lode to be the hanging wall for copper and footwall for galena lode.

"At 1,220 feet, a rise was put up on main lode 62 feet, showing splashes of bornite and silver glance assaying from 100 to 500 ozs. of Ag. and 5 to 8 ozs. per ton of gold.

"After passing through this lode, another 4 feet wide was cut carrying chalcopyrite and chalcocite. Bulk samples 5% Cu. 9 ozs. silver per ton."

At the upper levels this lode does not appear to be of any commercial value as regards its copper content. At the lower levels, however, it is worth further prospecting on account of the copper and lead contents of various portions of it.

Some of the copper lode was treated in the mill and a quantity of iron pyrite obtained. Grab samples of this pyrite assayed 2.4% copper, 1.3 ozs. of silver and a trace of gold.

At the western end of the 68 ft. level, another copper lode was reported to occur in association with the lead zinc lode. A sample across 5 feet of ore yielded only 1.1% copper and borings from a drill hole 2.9% copper. The summit of the lode at this point contains a black mineral and boulders of the same ore contained in the gossan and glacial drift. A grab sample of this material assayed 14.46% copper, 20% iron and 6.7 ozs. silver. The copper is present as oxide to the extent of 5.52% metallic copper, the remainder occurring as sulphide. This black ore was apparently mistaken for a new copper lode, but only represents concentrations of oxides and sulphides of copper in the oxidised lead zinc ore.

Conclusions & Recommendations

The lode in this mine occurs in the Mt. Lyell schists a short distance north-west of the Lyell fault, of which the West Coast Range Conglomerate series forms the eastern side thereof. All the copper lodes of the Lyell field have been found to occur under the same geological conditions, and the Tasman & Crown Lyell Extended must be said, therefore to occur in a very favourable geological position.

The lode has been exposed in the No. 2 tunnel 68 ft. level, 98 ft. level and the 134 ft. level, but not at the 191 ft. or 253 ft. levels. It has a general east and west strike. Between the No. 2 tunnel and the 68 ft. level, the lode dips to the north, but between the latter and the 134 ft. level, it becomes vertical and then has a southerly dip. If this dip continues, the lode should be found to the south of the levels at 191 feet and 253 feet. In order to locate the lode below the 134 ft. level, it is recommended that a winze be sunk vertically through the lode from a point about 200 feet east of the main shaft. Crosscuts could then be driven, first from the 191 ft. level, and later the 253 ft. level, in the direction in which the lode is proved to exist.

Both the eastern and western faces of the 68 ft. level are in ore and so the true length of the lode has not been found. The eastern end was reported

to have been reached at the 134 ft. level, but it would appear that the western end of the narrow portion at the 134 ft. and 98 ft. levels had not been found.

As so far indicated, the western end has a very flat pitch to the east, while the eastern end has a more or less vertical pitch. Whether these will continue can only be proved as a result of work at greater depth.

The reserve of proved ore is 20,000 tons, with probable reserves west of and below the west end of the 68 ft. level and below the 134 ft. level.

The ore is a zinc-lead-silver one composed of galena, blende and pyrite with 10% of gangue, generally in the form of a fine-grained mixture. The average composition at the 68 ft. level is 28.33% lead, 14.18% zinc, and 16 - 20 ozs. per ton of silver and at the 134 ft. level 27 to 33% lead, 16 to 25% zinc and 10 to 20 ozs. of silver per ton.

The ore is somewhat too high in zinc to be considered as crude lead ore. However, by hand picking, ore containing up to 43% lead and 27.6 ozs. of silver per ton can be obtained, and forms a marketable lead ore. The remainder of this picked ore has been sold as a zinc ore, averaging 21% zinc, and 14.5 ozs. of silver per ton.

To obtain higher grade lead and zinc ores, metallurgical treatment will be necessary. Either selective flotation or treatment on Wilfley tables, followed by selective flotation are the only methods likely to prove successful. Tests would be necessary to determine which would prove the better of these.

An essential preliminary procedure before erecting a treatment plant is to further prospect the lode in order to ascertain whether sufficient reserves exist to warrant this erection. The carrying out of such work and the possible erection of a treatment plant is perhaps an undertaking for a small company rather than a small syndicate operating as at present.

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GOVERNMENT GEOLOGIST.

Hobart,  
18th June, 1925.