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REPORT

on

AVOCA TIN MINE

TASMANIA

by

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23rd November, 1934.

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THE AVOCA TIN MINE.

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INTRODUCTION.

The lodes of this mine were discovered and inspected as far back as the early eighties. During the following two decades small mining syndicates opened them to shallow depths, and in the process obtained a considerable amount of tin ore. Not until 1911, however, when a company, organised in Launceston, took up the work, was any considerable progress made in developing the bodies. It may be said that the history of its development is written in the records of that Company, which, after a number of set-backs came to an end in 1922. The result of the work performed by the Company enables us today to form an idea of the value of the lodes. This report therefore will deal largely with its work.

PRODUCTION.

The complete records of production of tin ore from this mine are not available. Local authorities estimate the total at not less than 900 tons of 65 to 70 per cent quality, of which the late Company contributed the greater portion.

Official statistics of production of the Company are given in the table hereunder:-

Year	Crude Ore Mined tons	Tin Ore Obtained tons	Value.
1913	.....	122.30	.....
1914	.....	81.50	.....
1915	.....	97.55	.....
1916	.....	137.662	.....
1917	19,823	112.35	£14,481
1918	20,264	109.25	£21,421
1919	3,223	34.50	£4,726
1920	18,667	89.00	£14,808

On the assumption that the figures given in the table of statistics are correct the run-of-mine ore contains recoverable tin oxide in the proportion of 0.555 per cent, and tin in the proportion of 0.3905 per cent. On the same basis the value of the crude ore then was 17/10 per ton, and today the value of that ore would be 19/8 per ton.

#### SITUATION AND ACCESS.

The mine lies 10 miles east of Avooa, a mining and pastoral settlement on the Fingal Railway, 49 miles from the port of Launceston. The road connecting Avooa and Swansea passes through the property, and it joins with the main road system.

#### GEOLOGIC RELATIONS.

The rock of greatest interest, having the greatest economic bearing upon the deposition of tin ore, is of granitic nature but of many varieties. The parent stock from which the many varieties have sprung is a very coarse grained rock containing much biotite and large porphyritic feldspars. Dykes of granitic granite, representative of the later phases of differentiation, intrude the normal type, and they in turn have been subjected to the effects of the last phases of the action, that is, they have been affected by the tin-bearing mineralising solutions. The result is a series of closely-spaced greisen veins encased in hard barren alaskite granite.

The ore-bodies have been little affected by agents of erosion for rocks of the Permo-Carboniferous system have only of recent time been removed from them. We have, therefore, a lode formation today in almost its original condition.

#### THE NATURE OF THE LODDES.

The ore-bodies consist of numerous veins of tin-bearing quartz, mica-quartz and quartz-tourmaline greisen from a few inches to many feet thick. As regards the various kinds of greisen it is noteworthy that the older bluish quartz-tourmaline

bodies are not as rich as the younger white quartz-mica-tourmaline ones, and that the latter are less rich in tin ore than the mica greisen and pinite rich ore-bodies.

Pyrite and chalcopyrite (and its oxidation product malachite) are very common accessory components of the tin-rich vein material. Their presence therefore should be regarded with favour.

#### THE STRUCTURE OF THE LODES.

The ore channel is 80 feet wide, and courses north 40 degrees west to north 45 degrees west, and dips westward at 72 degrees. The many greisen veins are so closely spaced in the lode part of the ore channel that even the intervening graphitic granite is mineralised. Most of the greisen veins course acutely across the ore channel and end at the channel walls. Half-way along the channel two groups of gradually converging veins meet and coalesce and form a massive body 34 feet wide.

In the open-cut and the Sixty-Foot Level the ore-body is opened 850 feet in length. At the south end it tapers out; at the north end a strong body continues, but there it is not of average quality.

At some places greisenization has produced a tin-bearing stone consisting almost wholly of secondary quartz; at others pinite and muscovite alterations of original feldspars are notable features; again, other changes, such as that of quartz-mica greisen, are not uncommon, and, especially in the lower level, pyrite, chalcopyrite and tourmaline are abundant accessory components. Near the middle the containing rock is a quartz porphyry with its group of narrow veins of quartz and quartz-mica greisen so closely spaced as to lend the appearance of ribbon structure. The veins are only 2 to 6 inches wide, spaced 2 to 6 inches apart, and are, in the aggregate, about 20 feet in width. Not only are the veins above average grade, but the slightly altered intervein material contains tin from 0.15 to 0.32 per cent. The whole body is broken as ore and sent unsorted to the mill.

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In the open-cut part of the workings the richest ore has been removed, yet may be seen occasional veins entering the sides of the cut and large masses of poorer material which, under better operating conditions, may be broken and treated. At the northern end the orebody the tin-bearing stone pitches into Roy Hill property, into which it has been traced 300 feet from the boundary.

#### UNDERGROUND WORKINGS.

The underground workings consist of a shallow adit 30 feet below the surface, and the shaft level 60 feet below the adit. No. 2 or Shaft Level is opened by way of an underlay shaft inclined at an angle of 60 degrees north-westerly or in the direction of the strike of the orebody. In consequence of this extraordinary design the shaft, if extended, would not prove of much use.

A short cross-cut from the footwall side of the main vein connects with Main Drive, 621 feet in length. Main vein from the cross-cut to 408 feet is of average width 8 feet, at which point another body, containing 9 feet of massive veinstone joins it, and the two, widening, form a body 34 feet across. Between points 480 and 530 feet the ore has been blocked out on ground floor over the full width (34 feet), and between 530 and 621 feet it has been removed in part.

It is proposed that a drive along the course of the extension of the orebody southward from Roy Hill property be undertaken, and that the treatment plant to be erected should be placed there. This adit would cut the orebody in its northern extension, and, following it, would reach the main section about 40 feet below No. 2 Level. Thus a large body of ore would be made available during the period of shaft sinking.

#### ORE RESERVE.

The ore reserve of bodies such as these, with all the required data at hand, would be difficult of close estimation;

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with incomplete data no attempt can be made. No doubt the reserve of probable ore of 0.4 per cent tin grade is high, but that reserve cannot be expressed in figures.

#### AVERAGE VALUE.

The only reliable means of ascertaining the actual value of the crude ore is to accept the late company's records as a basis of calculation. The average proportion of tin (metallic) saved by the company was 0.3905, and the lowest value of the tailing was 0.15 per cent, therefore, the average proportion of tin in the crude ore was 0.5405 per cent, and the highest extraction was 72 per cent of the whole.

Those results receive confirmation from analyses of bulk samples of the lode material taken from the bins at the mine. The average of five samples was 0.57 per cent tin.

#### MILLING AND CONCENTRATING.

The only metallic mineral associates of the tin ore are pyrite and chalcopyrite, which, if saved with the tin ore, can be separated from the concentrate without serious difficulty. But, those sulphidic minerals contain some very fine tin oxide, enough, perhaps, to warrant an auxiliary plant for its extraction. The separation may be brought about by very fine grinding and treatment by oil flotation, or by calcining, regrinding and separation on tables. The first mentioned is the better process, for by that means the concentrated copper ore is saved. This method has been well demonstrated by the writer.

Not much improvement has been made of late in the water concentration processes of treatment, therefore, no suggestion will be made in this report on that subject. In the treatment of tin ores the milling cost is the heavy one, this, therefore, will receive attention. The writer would suggest a large rock-breaker of modern type, to reduce to 3-inch size, then pass that broken material into drum crushers set to crush to 3/4-inch, then into a rod mill of Rexman type, with screens suitable to the fineness of the tin ore particles in the stone.

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## POWER.

Electric power would be supplied by the Hydro-Electric Department at about £12 per horse-power year.

## WATER SUPPLY.

At the time of the inspection (November, 1934) one small stream passing through Roy Hill Estate near the proposed Mill Site contained 4 sluice-heads ( 1 sluice-head amounts to 24 cubic feet per minute) and another contains 2 sluice-heads. On Foster Freehold on the other side of the mine is another small stream of 3 sluice-heads. These streams would be almost dry during summer.

Water may be pumped direct from St. Paul River or may be gravitated by way of a water-race from a point 10 miles higher upstream. It is possible also to divert the upper waters of Swan River into Snow Creek, which passes close to the mine.

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## WORKING COSTS.

The estimates given hereunder are based on the following premises:-

1. Annual throughput, 75,000 tons.
2. Working time per annum, 50 weeks, 6 days, 16 hours per day.
3. Basic rate 13/4 per day, plus 10% for possible variations, and usual margins for skill are allowed.
4. Power delivered at the mine at £12 per horse-power year of maximum demand (500 H.-P.)
5. Price of tin as at present (November, 1934).
6. Average grade of ore 0.50% tin.

The ore weighs approximately two tons per cubic yard in place. It is an altered granite, much softer than the normal granite of the district. It breaks up readily, and only in the final reduction does the cost of comminution mount up seriously.

A 10% allowance for major breakdowns is provided, and should prove sufficient, in view of the fact that standby units are provided for in the capital estimates for all the large units of plant except the large crusher.

1. Power -

The power requirements are estimated at 500 horse-power maximum demand. On a throughput of 75,000 tons of crude ore per annum, and power cost at £12 per horse-power year, this item of cost works out at 9.60d. per ton.

2. Breaking Ground -

Using jackhammer drills, an average rate of 25 feet per machine-shift is allowed, and allowing for drillers working six shifts per week, day and afternoon shift, they will have to break 125 tons per shift. Allowing for 0.5 foot of drill-hole per ton of ore broken the footage to be drilled will be 62.5 feet per shift, the work of  $2\frac{1}{2}$  drillers or 5 drillers in all. Then the costs work out

Five drillers at 17/6 per day	4.20 d. per ton
Explosives, fuse, detonators	3.50 d. " "
Steel and steel sharpening	2.50 d. " "
Pipes, fittings, drill repairs	2.00 d. " "
	12.20 d. per ton.

3. Development Work -

Provision is made for the employment of three drillers for this work, the cost of which, therefore will amount to 9.26d. per ton of crude ore.

4. Loading and Underground Transport - This item by man labour at 13/4 per man per shift would amount to

	3.95 d. per ton
Two plate layers at 14/-	1.34 d. " "
Greaser and grease	0.64 d. " "
Renewals and repairs to trucks	0.30 d. " "
Track maintenance	0.55 d. " "

6.78 d. per ton.

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5. Haulage -

Electric power .....	1.92 d. per ton
Two engine drivers at 20/- £2-0-0	
Two braccemen at 15/- £1-10-0	
Two Platmen at 15/- £1-10-0	
.....	4.80 d. " "
Annual cost of plant 20% of cost of equipment or 20% of £2,750 - £550 .....	1.76 d. " "
Oil and grease .....	0.18 d. " "
Winding rope, skips, etc. 25% of cost (£2,250) or £562.5 .....	1.80 d. " "
Track maintenance - 20% of cost or 25% of £1,280 - £340 .....	1.10 d. " "
Four truckers at 15/- .....	2.88 d. " "
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Cost	14.44 d. per ton.

6. Milling and Concentrating -

Two shift engineers at 20/-	£2- 0- 0
Two engine drivers at 17/6	£1-15- 0
Four men at crushers 15/-	£3- 0- 0
Two men at Classifiers 15/-	£1-10- 0
Two men at jigs 15/-	£1-10- 0
Two leading hands at tables 15/-	£1-10- 0
Four men at tables 13/4	£2-13- 4
Two men at slimes at 13/4	£1- 6- 8
Two pump attendants at 13/4	£1- 6- 8
Two plant attendants at 15/-	£1-10- 0
Two tailing attendants at 13/4	£1- 6- 8
One tin dresser at 16/-	£0-16- 0
One tin collector at 13/4	£0-13- 4
Two tin baggers and handlers	£1-10- 0
One electrician at 16/8	£0-16- 8
One " labourer	£0-14- 0
One fitter at 16/8, labourer 14/-	£1-10- 8
One carpenter 18/-, labourer 14/-	£1-12- 0
One blacksmith 18/-, labourer 14/-	£1-12- 0
Cost per ton labour .....	27.50 d.
Maintenance -	
crushing section .....	4.52 d.
concentrating .....	2.00 d.
Miscellaneous, add 25% .....	1.63 d.
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Cost per ton milling and concentrating .....	35.65 d.

7. Administration -

Mine administration .....	£3,000 per annum
Insurance, rates, rents, workers compensation, travelling expenses .....	£1,000 " "
Head Office .....	£1,200 " "
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	£5,200 " "

Cost per ton of crude ore 16.65 d.

8. Redemption of capital -

If the total capital of the company is assumed to be £120,000, and the life of the mine 15 years, an annual charge of £6,500 paid into a sinking fund and invested would

suffice to redeem the capital on exhaustion of the mine.

Cost per ton 13.00 d.

Obsolescence of Plant -

The maintenance charges allowed in the working costs are sufficient to keep the plant in first-class running order, and, in view of its first cost having been redeemed as above, any further charges on account of depreciation would be for obsolescence only. An annual charge of £5,000 is allowed for this item, which, in ten years, would suffice for the renewal of the plant.

Cost per ton 10.00 d.

SUMMARY OF COSTS.

Power .....	9.60 d. per ton
Breaking Ground .....	12.20 d. " "
Developing .....	9.26 d. " "
Loading and Transport .....	6.78 d. " "
Haulage .....	14.44 d. " "
Milling and Concentrating .....	35.65 d. " "
Stope filling and Timbering .....	4.54 d. " "
Freight on ore and bags .....	1.12 d. " "
Administration .....	16.65 d. " "
Redemption of Capital .....	13.00 d. " "
Obsolescence of Plant .....	10.00 d. " "
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	133.24 d. per ton.
Add 10% for contingencies .....	13.32 d. " "
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Total	146.56 d. per ton.
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(Note - Some of the estimates of cost may seem very high, and all a little higher than rates today, but provision is made for extraordinary conditions that may arise during the next decade.)

Now, the average value of the crude material mined and treated at the mine during the period 1913 - 1920 was 214.0 d. per ton (see record of company's operations) and today the value (as given by purchasers) is 236.0 d. per ton of crude ore, therefore, taking the lower figure we have

Value of crude ore .....	214.00 d. per ton
Cost of mining and treating .....	146.56 d. per ton
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Estimated profit per ton .....	67.44 d.
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Annual Profit based on a throughput of 75,000 tons per annum

works out at

£21,250.

or at the rate of

17.7 per cent.

#### WORKING CAPITAL.

Working capital is required for equipping and developing the mine. Capital provided for £60,000, to be used for

1. erection power line from Avoca (10 miles);
2. milling and concentrating plants;
3. Power plants;
4. Water-races and pumping plants;
5. Adit and Shaft;
6. Mine equipment and mine buildings;
7. Winding plant and gear.

#### RECOMMENDATIONS.

The whole of the foregoing plan of operations depends upon the provision of a large reserve of ore of 0.50 per cent tin grade, and the average price of tin remaining at the 1913-1920 level or rising higher.

It is suggested that the ore-body be closely drilled to 500 feet depth or 500 feet below the level of the shaft. The holes should be drilled from the west side obliquely to the dip. The cost of such work would amount to £3,000, but if the first three holes did not reveal ore of the quality stated (0.50% tin) then further exploration by drilling should be abandoned.

The records of the operations of the late company gives a warrant for such work.

If the drilling tests prove satisfactory the large ore-body exposed in the flat country to the west may be tested. No account has been taken of that body in the foregoing estimates, and no account has been taken of the lodes opened up south of the main workings.

The mine is one of considerable promise.

(Signed)- Alex. Mackintosh Reid.

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23rd November, 1934.