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REPORT ON THE

FEDERATION AREA

E.L. 11/76

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May 1976

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- Appendix 2 Extraction from Geol. Surv. Bull 21 - Federation Tin Mine by L.L. Waterhouse 1916.
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SUMMARY

The Federation area, E.L. 11/76 is considered to have the potential for the development of a viable large tonnage, + 40 million tonnes/low grade, 0.2% Sn deposit, centres on the Federation and Sweeney's Mine areas.

The numerous Federation workings cover an area approximately 1 km x 1.5 km and have intersected several cassiterite bearing quartz tourmaline and greisen zones, with tin grades between 0.2% Sn and 19.5% Sn. Work to be undertaken during 1976-77 will involve the detailed mapping and sampling of lodes, altered zones and mine workings.

A total of \$12120 has been budgetted for this purpose. Should the results of this work be considered sufficiently encouraging, diamond drilling and bulk sampling programmes are envisaged for 1977-78 and 1978-79.

FEDERATION AREA E.L. 11/761. INTRODUCTION

E.L. 11/76 of twenty six square kilometres was granted to Renison Ltd. on the 22nd April, 1976. The area is considered to have potential for the development of a large tonnage, low grade tin deposit centred on the Federation mine area, where numerous old workings have been developed in altered and mineralised granite over an area approximately 1 km by 1.5 km.

This report outlines the history and development of the area, the mine workings and geology and includes recommendations for future work.

2. LOCATION AND ACCESS (Map 1)

E.L. 11/76 is situated, on the coast immediately North of Trial Harbour, approximately 12 km West of Zeehan. Access is via the unsealed Zeehan - Trial Harbour - Granville Harbour road. Access to the immediate area of the Federation mine is limited to two four-wheel drive tracks: one to the foot of the old Federation Haulage and a second track, passable only in good weather, to Lake Cumberland and Heywood and Coleman's workings.

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3. HISTORY

The history of the South Heemskirk Tinfield and the development of the various prospects is well documented, particularly by Waterhouse 1916 and Keid 1943a, to which the reader is referred, and only a brief outline will be given here.

Mining of the field originated with the discovery of alluvial tin near Mt. Heemskirk in 1876. Development quickly followed and by 1884 there had been erected several stamp batteries, and in addition several companies were sluicing alluvial ground. The boom collapsed as quickly as it had begun and by 1890 the field was practically deserted. A number of factors contributed to its failure: it is likely that rich patches of detrital cassiterite led prospectors to believe that they had found large ore bodies comparable to Mt. Bischoff, then being opened up. Exaggerated reports and speculation encouraged the pegging of a large area, part of which was under the sea and at least fifteen companies installed batteries and plant at great expense before proving up workable ore reserves. Some of the ore is pyritic and the plant was not equipped to treat it, also in some cases black tourmaline and hematite appear to have been mistaken for cassiterite. Many of the ore shoots although rich seem to be irregular and little capital remained to finance systematic development and exploration.

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Production to date: 1924-1959.

<u>Mine</u>	<u>Concentrate (tons)</u>	<u>Tin Content (tons)</u>
S. Heemskirk to 1916	200	Est. 120
Federation Mine	322.13	193.86
Maynes Mine	200	Est. 140
Miscellaneous	44.71	23.86
	<u>766.84</u>	<u>477.74</u>

Several attempts have been made to re-open some of the mines, particularly the Federation Mine, which was the biggest producer on the field: but again capital was spent on buildings and treatment plants (Scott 1928 - Appendix 5) and little on the development of ore reserves and the attempts failed. In recent years several companies have looked at the area or prospects in the area.

In 1945 the Mt. Lyell Co. held an option over Heywood and Coleman's workings and sampled the main adit (Hudspeth 1945). The Mt. Lyell Co. had a further look at the Federation Mine in 1964 (Brook 1964) and had a second look at Heywood and Coleman's workings in 1973, prior to the pegging of S.P.L. 129 (Wells 1973). In 1965 the E.Z. Co. executed three diamond drill holes at Heywood and Coleman's workings with poor results, also Pacific Copper Explorations Pty.Ltd. drilled two short holes, near the workings, in 1968, again with poor results. In 1971 the Australian and New Zealand Exploration Co. briefly looked at the area for tungsten mineralisation, and part of the area was held by Texins Development Pty. from 1968 to 1974, during their exploration of the Tenth Legion area.

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4. GEOLOGY AND MINERALISATION (Map 2)

The exploration licence is contained entirely within the outcrop of the Heemskirk Granite which was intruded into Precambrian and Cambrian sediments during the Middle Devonian. The granite is an adamellite consisting of : orthoclase, albite, quartz, biotite and tourmaline, accessory minerals include: apatite, zircon and magnetite. The granite which varies from a coarse red to a coarse white variety is also fine grained in places and has many scattered dykes of: tourmaline microgranite, porphyritic microgranite and aplite. Thin veins of pegmatite occur consisting of coarse orthoclase and quartz with some black tourmaline. Quartz-tourmaline veins and dykes are common but veins of greisen are less abundant. A striking feature is the numerous nodules of quartz and black tourmaline scattered irregularly throughout the white granite and tourmaline microgranite.

Cassiterite is present in quartz-tourmaline or greisen fissure veins, also in pipes or masses of soft greisenised granite. The veins trend generally between N.W. and N.E. ranging in thickness generally, up to 2 m. wide. They consist of central veins of green or black tourmaline and quartz with disseminated cassiterite crystals which locally may be concentrated to form layers. An irregular greisened pipe at Federation carried values ranging from 6% to 23% cassiterite (4.5% Sn to 19.5% Sn).

Other minerals recorded at South Heemskirk are: pyrite, chalcopyrite and arsenopyrite. Bismuthinite occurs at the Federation Mine also wolfram and molybdenite have been recorded. Galena, tetrahedrite, chalcopyrite, sphalerite and

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pyrite as well as cassiterite occur at the Globe mine and stibnite has been recorded from Sweeney's Mine.

5. MINE WORKINGS

5.1. Federation Mine Area (Maps 3 and 4)

The Federation Mine was the biggest mine in the area and in fact consists of several groups of workings. The workings have been described in detail particularly by Waterhouse 1916 and Keid 1943a also Loftus-Hills 1920 and Blissett 1962 (Appendices 1, 2 and 3).

5.1.1. Mine Workings

The workings can be divided, geographically, into four main groups:

- (a) Western Workings
- (b) Central Workings
- (c) Eastern Workings
- (d) Southern Workings.

(a) The Western Workings: include the Tributors No.1 and No. 2 levels, Fowler and Dunn's workings, Yates adit, J.B. Geasons workings, Bismuth shaft and numerous smaller adits and trenches, including Riley and Grey's workings to the N.W.

These workings were developed largely along the line of the Cross Lode, which strikes roughly S.E., approximately at

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right angles to the majority of the Heemskirk Lodes, which strike at either 20° or 70° . Several other smaller lodes, including the Whip Shaft lode were also developed and tin grades appear to have varied from as high as 19.5% in a greisenised pipe in the Tributors workings to grades of less than 1.0% in some of the smaller quartz tourmaline lodes.

(b) The Central Workings: include the Long Adit, Munroe's Shaft, Inclined (or Underlay) Shaft, together with numerous smaller trenches and adits, which were all developed on or adjacent to the Black Face Lode. Several smaller lodes were developed particularly in the Long Adit, which may not have reached the Black Face, and these include: the Cumberland Lode and the Air Shaft lode. The smaller lodes appear to have been largely quartz tourmaline veins, up to 6 m. wide, although usually less than 2 m. wide, with grades of 0.4% Sn to 0-8% Sn. The Black Face Lode is thought to occur where two sets of the 20° and 70° fractures converge (Loftus-Hills 1920) and consists of a mass of dark green tourmaline and quartz with an average grade of 1.0% Sn. Tungsten, bismuth and molybdenum also have been reported with both the Western and Central Workings.

(c) The Eastern Workings: near Lake Cumberland are comparatively minor and consist of a shaft and a small adit developed on a cassiterite bearing quartz-tourmaline vein. Waterhouse (1916) stated that 14 tons of concentrates were produced but Keid (1943a) considered this estimate excessive.

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Included with this Eastern group of workings is Waxman and Weston's workings. A large trench and shaft were developed on a micaceous hematite formation within decomposed granite, which included a band of euhedral pyrite crystals up to 10 mm. across. High grade tin has been reported from the hematitic formation but no figures are available to the writer.

(d) The Southern Workings: include Heywood and Coleman's workings and the Phar Lap workings.

Heywood and Coleman's workings consist of several trenches and two adits developed on a number of quartz tourmaline veins and Keid (1943a) reported an irregular greisen lode. Tourmaline nodules within decomposed granite carry up to 17.0% Sn (nodules in the Heemskirk area, while often associated with tin bearing zones, usually carry little or no tin) and channel sampling of the adits revealed values of 0.2% Sn to 0.5% Sn (Appendix 4).

The Phar Lap workings consist of a small open cut and a shaft developed in a much decomposed white granite, with bands of limonite and quartz tourmaline veins. High grade cassiterite was intersected, associated with coarse stanniferous pyrite cubes up to 15 mm. across. No figures for grades or tonnages are available to the writer.

5.1.2 Ore Reserves (Appendix 3)

In 1920 Loftus-Hills calculated ore reserves for the more developed lodes in the Federation Mine area. He calculated that within the : Pipe, Black Face, Whip Shaft, Cumberland and Big Trench Lodes there existed:

60,000 tons of Proved Ore at 1.0% Sn and
400,000 " " Probable Ore at 1.0% Sn.

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However, Keid (1943a) considered that : "There are, on present development, no ore reserves either positive or probable".

Recent calculations based on the dimensions of proved (?) ore within these lodes and the Air Shaft lode, given by Loftus-Hills indicate a figure of 165,000 tons at 0.86% Sn.

5.1.3. Metallurgy

Investigations into the grain size and metallurgical characteristics of Federation Mine ore were undertaken by the Tasmanian Mines Department in 1931 (Clark 1931). This report is included as Appendix 6. The gangue at Black Face appears to be of two types: quartz or decomposed feldspar with tourmaline. The cassiterite was considered to be fine being mainly less than 400 microns.(40 mesh). However, the majority of the cassiterite appears to be in the 150-200 micron (100 mesh) range, which is approximately two to three times coarser than the cassiterite being currently produced at Renison.

5.2. Other Workings (Map 2)

Numerous small workings occur throughout the South Heemskirk area. The majority produced only small amounts of tin.

Cornwall Mine: consisted of several trenches and small adits developed on narrow pyritic quartz tourmaline veins.

Cliff Mine (S.P.L. 129) : A small shaft and open cut on quartz tourmaline veins up to 0.7 m. in width.

Empress Victoria (S.P.L. 129) : A shaft sunk on a cassiterite bearing quartz tourmaline lode ; the cassiterite giving way to : arsenopyrite, pyrite and chalcopyrite with depth. Some greisen developed.

Prince George : consists of a shaft on a 0.7m. wide quartz tourmaline vein.

Montagu and Montagu Extended : several shafts, adits and winzes developed on quartz tourmaline and greisen veins. Approximately 6 tons of cassiterite were produced.

Wakefield Mine : an adit developed on a quartz tourmaline cassiterite vein within a greisenised and tourmalinised granite. Only minor tin production.

Sweeney's (or Birthday) Mine : an adit and shafts on a lode of black sphalerite with pyrite and small amounts of stibnite and chalcopyrite in a gangue of : quartz, fluorite and tourmaline. The main adit intersected at least 38 m. of altered and kaolinised granite carrying fine disseminated cassiterite. Samples taken from the area assayed up to 2.83% Sn; adit sampling gave values from nil to 1.05% Sn, three samples from the crosscut assaying 1.05% Sn, 0.97% Sn, and 0.51% Sn. (Blissett 1962).

Globe (Mt. Agnew) Mine : consists of an adit driven on a lode carrying galena and tetrahedrite rich in silver, and chalcopyrite. Some sphalerite and pyrite is also present in a gangue of quartz, tourmaline, fluorite and siderite. A grab sample from the dump is reported as assaying 0.37% Sn and 887 grams per tonne Ag.

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6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

The table on the following page compares the known characteristics of the Federation Mine area with the general characteristics of the few, known, large, low grade, tin deposits.

The size and grade of a viable low grade deposit have been studied by Taylor (1976) : "The break even or cut off point for 10,000 tonnes per day is around \$4.00A/tonne which on a 60% recovery would require primary ore worth about \$6.70A. Thus at £2,500/tonne(\$4252A) a grade of 0.16% Sn is required to break even and at £3,500/tonne (\$5952A) 0.11% Sn. Given that a profit of 15-20% is also required..... in round terms it is concluded that at £3000 (\$5103A)/tonne at 60% recovery, the target would be + 40 million tonnes at around 0.2% Sn." Earlier studies by Dowie (1970) on a 5000 tonne per day operation, with a similar recovery, also indicated a grade of around 0.2% Sn. Obviously smaller tonnages at a higher grade would also be acceptable.

The Federation Mine area is considered to have the potential for both this tonnage and grade. The majority of other workings in the area are considered to be of little importance, although areas where greisenisation has been reported are possibly worth examining in the future. The only exception is Sweeney's Mine where extensive greisenisation with disseminated cassiterite has been reported.

6.2. RECOMMENDATIONS

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CHARACTERISTICS OF LARGE TONNAGE/LOW GRADE TIN DEPOSITS (BASED ON TAYLOR 1976).

1. Tin bearing granites showing extensive zones of alteration (greisen etc.) appear to be intruded at a late stage into a larger granite massif, which consists of multiple intrusions of different types of granite.
2. The greisen environment appears to offer the most potential for the development of sufficient tonnage.
3. Greisenisation develops along joint and fracture planes and large masses ("pipes") often develop at the intersection of major planes.
4. Successful exploration for bulk/low grade deposits are enhanced by:-
 - a) Association with valuable elements, some of which are recoverable, eg. W, F., Bi, Mo, Be.
 - b) Association with high grade ores (vein systems) which can be mined in conjunction with the low grade regions.
 - c) Intense alteration allowing low cost extraction techniques.

KNOWN CHARACTERISTICS OF THE FEDERATION MINE AREA.

1. The Heemskirk Granite consists of multiple granite intrusions. The tin bearing and altered (greisen) zones, eg. Federation, appear to be related to a late stage tourmaline micro-granite.
2. The Federation area shows strong similarities to the generalised picture of greisen systems (Scherba 1970 - Taylor 1976). Greisen is developed throughout the area at Tributors Workings (Pipe), Black Face lode, Phar Lap etc.
3. Black Face lode developed at the intersection of two sets of the 20° and 70° "joints". Greisenisation at Federation appears to develop towards the area where the Cross Lode and the "Normal" lodes would intersect. This area would appear to have had little work undertaken on it.
- 4a. W, Mo and Bi occur with the tin in both the Central and Western workings.
 - b. High grade ore in veins occurs at Fowler and Dunn's Workings (+6.0% Sn), at the Cumberland Air Shaft and Coleman's Lodes etc. (+ 1.0% Sn).
 - c. The granite in places is very soft eg. Tributors Workings, Phar Lap workings etc.

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A five step exploration programme is recommended for the Federation and Sweeney's Mine areas:

- (1) All the present data requires plotting clearly, particularly the position, dip and strike of lodes and alteration.
- (2) A detailed geological map is required, again, in particular: the different types of granite, the position, dip and strike of lodes and zones of alteration. This will have to be related to the data obtained in step 1.
- (3) All lodes, altered zones and accessible workings will require careful sampling and analyzing for : Sn, Bi, W, Mo, Be, As and Cu. However, great care will be required in the interpretation of this data, particularly from surface samples, as values are likely to be erratic and in greisen outcrops, the "cassiterite is frequently concentrated in the non outcropping selvages and not in the outcropping silica" (Taylor 1976). Probably many of the results will have to be regarded as indications rather than facts.

Excavation of costeans will probably be useful for both mapping and sampling purposes, at a later date.

If the results of the above programme are considered sufficiently encouraging:

- (4) Diamond drilling should be undertaken, again, to further outline the position, continuity, size, structure and general mineralogy of mineralised zones and as an indication of grade. Cassiterite distribution can be very erratic and "care should be taken in the interpretation

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of both very high and very low results" (Taylor 1976).
The clearing of previously inaccessible adits in appropriate areas for sampling (grade) and mapping purposes would also be useful.

(5) If the diamond drilling programme is considered encouraging, particularly in terms of size and tonnage: A bulk sample should be obtained by either extending an old or driving a new adit(s) to enable a more accurate estimate of grade as well as for metallurgical tests.

6.3. BUDGET 1976-77

A budget of \$12120 has been recommended for 1976-77 to enable steps 1 to 3 to be undertaken. The budget has been made up as follows :

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BUDGET 1976-77, FEDERATION AREA E.L. 11/76

ITEM	P.1	P.2	P.3	P.4	P.5	P.6	P.7	P.8	P.9	P.10	P.11	P.12	TOTAL
SALARIES	500	1000	1000	1000	1000				1000	1000	1000	500	8000
CONSUMABLES	50	200	200	100	100				100	100	100	50	1000
ASSAYING	200	200	200	200	200				400	400	400	300	2500
VEHICLES	50	100	100	100	50				60	60	50	50	620
PERIOD TOTALS	800	1500	1500	1400	1350				1560	1560	1550	900	12120

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Ltd.

? 1914-15 Mine Sampling of S. Heemskirk
held by A.S. Morton under
direction of State Mining Engineer
Tas. Dept. of Mines.

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APPENDIX 1 :

REPORT ON SOUTH HEEMSKIRK TINFIELD

H.G.W. KEID

1943a

REPORT DEPARTMENT OF MINES, TASMANIA

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REPORT ON SOUTH HEEMSKIRK TIN FIELD

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INTRODUCTION:

In a previous publication of the Geological Survey of Tasmania, Bulletin 24, p. 225, a comprehensive and detailed account is given of the history of the Heemskirk Tin Field. In that account various stages of the fields history, prospecting, boom, collapse, neglect, and recovery, are outlined.

It is shown that mining on the field originated in the year 1876 with the discovery of alluvial tin by surveyor Mr. C.P. Sprent. As early as the year 1881 there had been erected on the field nine treatment plants, comprising a total of 80 heads of stamps, of which the first commenced operations in the year 1884. This would suggest that little in the way of prospecting or mining development had taken place up to that time. This opinion is confirmed by the knowledge that despite the fact that the Orient Mine had ceased operations at that date, high grade detrital ore was discovered, in the year 1902, by Mr. J. Mayne, at a point not 8 chains distant from the site of the Orient battery and within 15 chains of the place of residence which he (Mayne) had occupied for a number of years.

In recent years a number of attempts have been made to revive the industry but, whilst in a few instances some success has been achieved, in general, the earlier errors have been repeated. Expensive dwellings and machinery have been erected without definite knowledge of ore reserves sufficiently large to warrant the expenditure incurred and with no certainty that the plant erected was suitable for the treatment of the grade of ore to be won.

During the years of the Heemskirk boom, practically the whole of the field was held as mining leases, some of which extended beyond the coast. The decline of the field is indicated by the fact that the present holdings cover an area of only 165 acres.

POSITION AND ACCESS:

The area reviewed by this report is portion only of the South Heemskirk Tin Field. It has an area of approximately ten square miles and extends from the foreshores in the vicinity of Trial Harbour in an easterly direction for a distance of five miles. In a northerly direction, it extends for a distance of two miles and embraces all mining tenements at present in force. The Zeehan to Trial Harbour road crosses the south eastern corner of the area about eight miles from Zeehan, whilst the old road from Trial Harbour to Corinna and the new road to the Federation Tin Mine give access to the western and north western portions of the area, respectively. Within the limits of the area and easterly to Zeehan, the roads are in reasonably good condition and are serviceable for motor traffic. A fortnightly service from Zeehan, by motor truck, is at present maintained.

GEOLOGY:General Geology:

Except for a comparatively small area of slates and quartzites in the south-eastern portion, the area under review consists of a series of granitic rocks consisting

of granites, aplites, pegmatites, and granite porphyries. Of this series, the granites are the most important, the remaining members occurring as comparatively narrow dykes occupying a relatively small proportion of the area. These rocks have been assigned to the Devonian age.

The Granites: The granites vary in grain size from fine to coarse grained, but are in general medium to coarse grained rocks with occasional development of porphyritic structure. They consist essentially of orthoclase feldspar, plagioclase feldspar, and quartz with varying but lesser amounts of biotite mica, muscovite mica, and tourmaline.

The color of the granites is governed to a great extent by their mineral constituents and to some extent enable subdivision of the granites into pink and white varieties.

The pink granites owe their color to a preponderance, in their make up, of pink orthoclase feldspar which shows marked variation in amount in granites from different localities.

In the white granites, the pink orthoclase is almost absent, but otherwise their composition is similar to that of the pink varieties.

Tourmaline segregations are fairly common in all the granites, but are more prominent in the white varieties and in places become extensively developed.

Quartz-tourmaline nodules: A special type of quartz-tourmaline segregation is represented by the occurrence of more or less spherical nodules consisting of quartz and tourmaline in almost equal proportions. The nodules vary considerably in size, ranging up to six inches in diameter, and occur irregularly through the granites, in places being so plentiful as to form the greater portion of the rock mass. Usually, however, they are irregularly distributed through the granite and are not confined to any particular horizon occurring at altitudes varying from sea level to the top of Federation Hill, a height of 1,500 feet. The nodules are, in general, more resistant to weathering than the parent rock, and accumulations of freed nodules are common. They are usually barren of tin, although occasionally the normal nodules have been shown to contain up to 0.5% Sn.

A special occurrence, much more limited in extent of tin-bearing nodules, ranging in grade to 17.0% Sn, has been recorded in Heywood and Coleman's lease. These nodules differ from the normal variety in being generally smaller in size, less regular in shape, and lighter in color. They differ also in that whereas the normal nodule is invariably solid, the tin-bearing nodules occasionally are hollow. Like the normal nodule, they are more resistant to weathering than is the parent rock.

No attempt has been made to define the limits of the various types of granite for variations in color and composition are sufficiently great to suggest the mergence of one type to the other without definite boundaries.

Pegmatites: Small pegmatites veins, inches only in width, occur throughout the granite area.

Many of the prominent features of the area, locally referred to as quartz blows, are, on examination, found to be coarsely crystalline bodies composed essentially of quartz and felspar. They would be more correctly described as pegmatite dykes. They vary in width to upwards of twenty feet and persist for comparatively long distances. Though they do not all conform to a general direction of strike, the greater proportion have a north-easterly strike to conform with the general direction of the principal veins.

Irregularly along their length tourmaline occurs, in varying amounts, as radiating crystals or as segregations varying in size and extent but always of a minor nature.

ApXlites: ApXlites occur as fine grained light colored rocks consisting of equal parts of quartz and felspar. They are widely distributed throughout the area as minor intrusions in the granite, the dykes seldom exceeding a few inches in width but occasionally reaching a width of from four to five feet. Individual dykes are not persistent in length and generally extend for a few feet only, but occasionally may be a few chains in length. They do not conform to any directional regularity and, weathering with the granites, are not prominent features.

Granite Porphyries: The granite porphyries occur as fine grained dykes showing phenocrysts of both quartz and felspar in a fine grained ground mass of quartz and felspar with a little biotite mica and some tourmaline. They occur as narrow dykes, of short length, in the granite area.

ECONOMIC GEOLOGY:

Throughout the history of the South Heemskirk area, the mineral of greatest economic importance has been cassiterite (tin ore). The discovery of alluvial tin in the year 1876 led to extensive search for that product, and resulted in the discovery of the primary product in veins and lodes.

Perhaps of equal economic importance, and worthy of further consideration and development, are the ores, of Bismuth which, although their occurrence was recorded as early as the year 1902 (report of G.A. Waller, p.25) are still in an undeveloped state. Most of the Bismuth occurrences are in association with known occurrences of tin. They have been described in a separate paragraph.

To a lesser extent, wolfram occurs but, although records of production are far from complete, they suggest that profitable exploitation is improbable.

In isolated cases, veins of high grade sphalerite (zinc ore) occur, but they are in general too small to be profitably mined. At Sweeneys mine, the sphalerite veins show a development of fluorite and in places pyrite.

The economic minerals of tin and bismuth generally occur in association with veins which traverse both the granites and the sedimentary rocks. The strike of the veins shows great variation, but usually conforms with the direction of the main joint planes in the granite to strike on bearings of 20 degrees and 70 degrees with a marked preference for the more northerly direction. Occasionally, as in the cross lode of the Federation Mine, the strike varies from the main direction to trend in a south-easterly direction.

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The veins may be classified according to their more prominent constituents, and the manner in which those constituents occur, into quartz-tourmaline veins, pinitoid formations, and pipe formations. The two latter types may be regarded as being similar in character, as the pipe formations of the area have resulted from the pinitoid alteration of granite.

The veins have been described in detail by Waterhouse in Bulletin 21 and the full classification of that and previous writers is there set out.

Quartz-tourmaline veins show considerable variation both in size and in mineral character. In every instance, however, the two minerals together form the greater part of the vein, although either mineral may be the preponderant one. Tourmaline may occur as the marginal phase of a vein which otherwise is essentially quartz, but it may also occur as a soft central core in a similar vein. Development of pyrite has been regarded as evidence of a distinctive type as also have those veins which show evidence of greisenisation.

In the more massive lode formations, and in some of the normal vein formations, the quartz and tourmaline may be evenly distributed to give a more or less granitic appearance to the lode material, whilst in the Black Face lode, wide sections of tourmaline may occur, banded with similar sections of quartz.

In all types of veins, lesser amounts of arsenopyrite, chalcopyrite or sphalerite may occur, and vein types merge from one to the other.

The pinitoid formations are of much less frequent occurrence and are not so well defined as the quartz-tourmaline varieties. They are micaceous in character, waxy in appearance and are considered to result from the alteration of the feldspathic constituent of the granite. The pipe formation (Trubuters workings) of the Federation Tin Mine was the first discovered of these formations. Other similar formations occur at Sweeney's Mine and probably at Geason's and the Phar Lap workings.

Higgins Workings (Maynes Mine):

The leases held in the name of W.E. Higgins cover an area of 45 acres held as two leases, No. 16M/42 of 5 acres and No. 32M/42 of 40 acres, and include the area locally known as Mayne's Mine, together with the greater portion of the area originally held by the old Kelvin Company and a portion of the area held by the old West Orient Company.

Recently, options were held over the properties by a Melbourne company, the Golden Sovereign No Liability whose operations were directed chiefly towards reconditioning the battery and treatment of the spoil dumps left from earlier operations at Mayne's Mine.

The workings are little more extensive than was the case when the Lyle Syndicate ceases operations, and except for the work done by that Syndicate, are much the same as when the original companies ceased operations.

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The tin ore which constituted the original discovery, was of a detrital nature, and was won by sluicing. The removal of the detrital matter exposed the underlying tin bearing veins which were then exploited. That most of the veins were narrow ones is apparent from the comparatively large quantity of spoil stacked near the workings. The irregular nature of the mine workings suggests that individual veins persisted for only a few feet laterally where often intersection with other similar veins occurred. A large number of the veins which have been worked were horizontal or nearly so, and have varied in thickness to perhaps four feet. Remnants of the flat veins are now visible in the sides of the open cuts from which the higher grade ore has been won.

The country rocks of the area consist of a series of slates and quartzites, highly silicified and tourmalinised as the result of metamorphic action of the granite, the boundary of which occurs to the north of and within six chains of the workings.

The ore bodies are composed essentially of quartz and tourmaline with, in parts, occurrences of pyrite and to a lesser extent galena and sphalerite. Both black and green varieties of tourmaline were noted with the tin ore showing a greater affinity for the green variety.

A tunnel driven through the hill was primarily intended to divert the water from Pykes Creek to enable the alluvial deposits in the creek bed to be won. At the same time it served to prospect the hill at depth. It is significant that of nine veins cut by the tunnel, only one was developed. This was a flat tourmaline vein on which a level was driven for approximately 20 feet. That no stoping has taken place suggests that the ore was low in grade if, at all, tin bearing. From the end of the level, connection has been established with the surface by a rise which made connection with a shaft sunk from one of the open cut workings.

Situated about half way between Maynes workings and the granite boundary are the workings of the old Kelvin Tin Mining Company. The old adits have collapsed in part, and are inaccessible. Recently, an attempt was made to reclaim one of the adits. The work involved the removal of a considerable quantity of spoil, the result of a landslide in the old open cut. The position of the adit was not definitely known, and the work was abandoned without having achieved anything.

To the south east of Mayne's workings, immediately across Pykes Creek, two small veins have been exposed by short adits. It is reported that these veins carry a proportion of high grade tin ore. The greater of these veins is 12 inches in width but may yield a small quantity of ore on development.

The known occurrence of high grade ore have in all cases been in the nature of short lenses which were treated mostly by sluicing. The loss by this method of treatment must have been considerable, but operations were, no doubt, profitable, as the result of cheap mining methods. The known ore has now been exhausted. Future development must, therefore, be directed towards the discovery on the surface, of fresh veins or the development of known veins from the existing adits. The latter offers few prospects as the known veins are small and low in grade and worked shoots of ore have in all cases been short. Surface trenches may reveal additional veins which would lend themselves readily to treatment.

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Other Workings: To the north and north-east of Maynes Workings across the granite-slate contact, some old adits have been examined. It is suggested that at least one of these adits represents workings of the old Orient Company. Waller in the year 1902 under the heading of "The Old Orient Company" states - "The underground workings disclose the presence of parallel veins of quartz and greisen striking 50° to 70° W. of N. some of which carry visible tin. Most of the veins are too small to pay for mining, but some of them go up to 3 feet in thickness, and should be payable provided they carry a fair percentage of tin."

A plan has been prepared of workings to which the above description is applicable. Evidently Waller's description covers only the shaft and levels from that shaft. A drainage adit has since been driven to connect with the northern level from the shaft. Detailed information is provided on the plan.

The pyritic formation at the end of the northern level has been sampled but was shown to be barren of tin.

Other workings, in the granitic country, which are still accessible, have been examined and are shown on the general plan covering this section of the area. Most of these workings were intended for prospecting purposes. Evidently the grade of ore revealed was too low to warrant further development despite the fact that in one instance 320 feet had been driven to cut the vein.

The Birthday Mine (Sweeneys):

This property originally comprised four leases of a total area of 80 acres on the west bank of Pykes Creek, situated about half a mile north of the main road from Zeehan to Trial Harbour and about the same distance south from the Cumberland Dam. A small battery of 5 heads, since removed, was erected in the bed of the Creek but there is little evidence that any ore was treated. The greater proportion of tin produced was alluvial in character and was won from the creek bed by sluicing.

The area is still in a comparatively undeveloped state, but surface trenches and adits within the limits of an area of 20 acres suggest the necessity for further development and sampling of the known exposures.

Reports on these holdings have previously been written by L.L. Waterhouse (Bulletin 21), and by A.M. Reid in the year 1927.

Little development has taken place since these reports were written except to extend the main adit to a total distance of 245 feet from the portal.

Reid in his report shows that his sampling of the workings yielded assay values ranging up to 2.83% Sn, and quotes further assay returns by J. Levings as yielding 1.9% Sn.

In the year 1940 samples taken in 20 feet sections along the adit on behalf of W.E. Higgins varied in value from nil to 1.05% tin. The three samples taken in the vicinity of the cross cut yielded 1.05%, 0.97% and 0.51%. The two former samples suggest an average assay value of 1% tin.

The accompanying plan shows the present state of development and suggests the possibility of the occurrence of at least three, more or less parallel, veins which strike north-westerly and dip to the south-west at comparatively high angles. Of the three veins, two at least each approximately 3 feet in width at the surface contain an appreciable amount of sphalerite and of which the more northern probably corresponds with that which occurs in the face of the main adit. The third vein, situated a little further north, has a greater total width than the two former and is composed of a hard quartzose band lying to the east of a softer kaolin like band (pinite) containing abundant pyrite. This vein has not with certainty been exposed in the main adit, but the pinite section of the vein may correspond with the pinite vein on which the cross cut has been driven from the main adit towards the east. It may, however, correspond with the 3-inch pug vein exposed by the main adit at a point 20 feet south of the cross cut.

The country rock is a fairly coarse grained pink granite in which radiating crystals of black tourmaline occur.

In the main adit the granite is, in general, hard and fresh, but as the cross cut is approached, increasing mineralisation by pyrite is evident. In the cross cut, a vein of pinite has been followed, whilst in the face of the adit, a quartz tourmaline vein is exposed with sphalerite, pyrite and fluorspar abundant.

As some of the samples from the veins have yielded high grade ore, it is to be regretted that additional surface trenching has not been carried out to determine the lateral extent of such ore in the veins, which at surface, are of sufficient width to warrant development, should the grade of ore persist. Samples from positions near the cross cut in the main adit have yielded approximately one per cent of tin and further testing in that position is desirable.

The Federation Tin Mine:

Portion of the area now referred to as the Federation Tin Mine was applied for by W. Montgomerie as a mining lease of 80 acres in the year 1879. In the same year, the West Cumberland Tin Mining Company Registered was formed, and mining operations were commenced. Since that date the holdings have been gradually extended, until at the termination of operations in 1938, the total holdings covered an area of 574 acres.

During the period since the year 1878, various companies and individuals have operated on the whole or portion of the holdings. The original Federation Company was a local one, and was formed in the year 1900 under the name of the Federation Tin Mining Company No Liability. In the year 1905 an English company, The Federation Tin Mining Company Limited, administered the property. A further change in administration took place in the year 1920 when a Melbourne company, Federation Tin No Liability, became the holders. The last change of proprietors took place in the year 1926 with the formation of an English Company, Federation Tin Mines Limited. This company or its agents held the leases until September, 1938, when the company went into liquidation and its assets were sold. Since the year 1938, the greater portion of the leases have been forfeited, only one lease of 80 acres being held in the name of J.B. Geason.

The earlier mining operations on the Federation leases were confined to the western slopes of the hill where development consisted of driving of adits and sinking of shafts on comparatively narrow veins. A little development, the Eastern workings, was carried out in the hills situated to the east of the main hill. The later operations were directed towards the exploitation of the Black Face Lode situated near the summit of the main hill. In almost every instance, the operations were financially a failure.

The Western Workings:

Of the leases originally held by the Federation Company only one, of 80 acres, is in force. At the time of this inspection, the lease was held in the name of J.B. Geason, and on it were situated all the workings of the company generally referred to as the Western workings.

Among the Western workings, there are only minor open cuts, the greater proportion of development having been carried out by means of adits and shafts. The work has been primarily directed towards the testing and development of the cross lode and, although some of the veins which strike in a northerly direction have been followed in driving the adits, none have penetrated further than the supposed position of that lode.

Some of the adits are cross cut adits which have terminated at the cross lode.

The Tributary Workings:

The Tributary workings have been the most important of the western workings. They are situated on the north-eastern end of the line of workings, but are at present mostly inaccessible. It has been reported that approximately 80 tons of concentrates have been won by the limited operations carried out there.

The original workings were open cut workings on what has been described by Waterhouse (Bulletin 21, p.262) as an irregular pipe formation of which the gangue material is pinitoid in character. Waterhouse also states "Associated with the tin, are abundant crystals of pyrite, crystals being of all sizes, from one thirty-second to over 1 inch across.... Many examples were noticed of crystals of pyrite and cassiterite intergrown, sometimes also with tourmaline and quartz." Similar formations occur and have been described elsewhere.

At the time of the 1915 inspection, only one adit had been driven below the open cut. Since that date, two other adits have been driven to cut the formation at depth and stoping from those levels has been carried out. The stopes are at present inaccessible.

No. 2 Tributary Adit:

This adit has been driven on a small quartz-tourmaline vein which strikes at about 80 degrees, for a total distance of 360 feet. At a distance of 290 feet from the portal, a level has been driven towards the north for a distance of 25 feet on a quartz-tourmaline vein, 8 inches wide, which dips steeply to the east. This vein has not been further developed. At 335 feet from the portal, a vein of quartz-tourmaline, two feet wide, has been cut and levels driven to the north and to the south for short distances. There has been no development of this vein, but from the northern end of the level, connection has been established with the pipe formation by a rise.

No. 1 Tributary Level:

This is a cross cut adit driven to cut the pipe formation. At a distance of 100 feet from the portal a short level has been driven to the north on a narrow vein. At 130 feet from the portal a vein, striking south, has been cut and some stoping has been done.

The remaining workings from this level have been designed to facilitate the working of the pipe formation.

Waterhouse reported that in the open cut, a vein occurred up to 5 feet in width. Mining operations have since removed the ore from this vein and its extension is represented only by narrow veins in the face of the open cut.

Fowler and Dunn's Workings:

Under this heading are included not only the workings originally opened by Fowler and Dunn, but also those workings since done by the Company in the vicinity of those workings.

From past records, Fowler and Dunn's workings are covered by what is now an open cut at the entrance to No. 1 level. A winze has been sunk from the floor of this cut on an eight inch vein of quartz-tourmaline. There is nothing now visible to indicate the nature of the ore treated by Fowler and Dunn, but it is reported that 60 tons of concentrates were won.

The Company's workings consist of a number of adits known as Nos. 1, 2, 3, 4 levels, together with Yate's adit situated a little to the east.

The relative positions of the adits shown on the general plan, and plans, on a larger scale, of each of the adits, are shown to record observed details. Reference to these plans shows that Nos. 3 and 4 levels have been driven on the same vein, and although only a limited amount of stoping has taken place in No. 4 level, the fact that an open cut has been made above No. 3 level indicates that at least some profitable ore was won. In this open cut, however, a considerable amount of country rock has been mined with a comparatively narrow vein to the detriment of the grade of ore finally treated.

The relative positions of the open cut at No. 3 level and the stoping at No. 4 level suggest that the pitch of the ore shoot is towards the south-west and the length of the shoot in each adit is of the order of 40 feet.

No. 2 level has been driven on the southern extension of the vein opened by Fowler and Dunn in their open cut.

No. 1 level has been driven from the face of the open cut, and on the course of the vein worked therein. At 66 feet from the portal, the vein worked in the lower levels has been met and the level continues in this formation to a point 105 feet from the portal. From this point however, the level follows only a narrow vein until the cross lode is cut.

The vein traversed by Nos. 3 and 4 levels is exposed both in a cross cut from No. 1 level and in the level itself. Its continuation should junction with the cross lode in the vicinity of the winze sunk from the western level near the face of Yates adit. The fact that development has been neglected on this vein suggests low grade ore, but exploitation from either Yates adit or No. 1 level is desirable.

It has been reported (Bulletin 21, p. 256) that Bismuth occurs in the workings near the face of Yates adit where some stoping has taken place.

There is little doubt that both No. 1 level and Yates adit have penetrated to the cross lode but exploitation has not been extended north of that vein.

The remainder of the work done by the Company has been directed towards the testing of the cross lode. A series of trenches, two shafts, and two adits, have been made to test its possibilities.

The trenches have revealed widths of vein formation varying to 6 feet, and over a section of its length have shown the vein to have split into two sections.

Of the adits, one has collapsed, and is inaccessible. The second adit has been driven to cut the vein to reveal a width of 5 feet 3 inches of tin bearing quartz-tourmaline formation. Development of this vein is advisable.

Of the two shafts, one is 30 feet in depth but has neither ladders nor windlass, whilst the section shaft is filled to within 15 feet of the surface. This latter shaft is referred to as the Bismuth shaft.

Geason's Workings:

Since the liquidation of the Federation Company in the year 1938, the lease covering the Western workings has been held in the name of J.B. Geason, since deceased. This proprietor has produced approximately six tons of tin concentrates equivalent to a production of 3.426 tons of metallic tin, to a total value of £876. The records are not in sufficient detail to indicate that the whole of this output has been won from this lease, and it is known that other holdings have been exploited by him.

The records also show that one parcel of each wolfram and bismuth concentrates have been despatched by the same proprietor.

Several positions on the lease have been tested by Geason. These have been indicated on the general plan of the workings. Three positions at least have shown reasonably high grade ore.

(1) Marked "J.B.G. Shaft." This shaft was sunk to a depth of approximately 20 feet from a position near the northern end of the existing tramline. A quartzose vein, with some tourmaline, striking south from the cross lode, with which it junctions, has been tested to yield high grade ore. At the junction with the cross lode, this vein is only two inches wide and is composed of quartz only. It develops in a southerly direction and has a width of two feet in the shaft. The formation at the shaft is irregular in character. It is vertical for about 5 feet in the shaft whence it dips flatly to the north east and becomes narrow. Levels have been driven short distances from the bottom of the

shaft towards the north-west and south-east to test the formation.

(2) Marked "J.B.G. old workings." Yielded a fair prospect by vanning; an irregular shaft has been sunk to a depth of 10 feet on the line of the cross lode. A quartzose formation, with irregular veins of tourmaline on the joint planes, was revealed. The tourmaline rich material yielded a fair prospect for tin with a trace of Bismuth.

(3) "Geason's Tin Workings." These have been the main source of production. A trench approximately 75 feet in length has been cut across the formation. The trench varies in depth to 20 feet, in width to 15 feet, and has a bearing of 116 degrees.

In the vicinity of the trench a quartz-tourmaline formation outcrops. It strikes in a south-westerly direction and extends for some distance on either side of the trench. In a south-westerly direction, the outcrop can be traced to a point above that represented by the face of the underground workings of Yates' adit and may be the continuation of the formation exposed in levels 3 and 4.

The trench exposes an irregular pinitoid formation dipping at 20 degrees in a south-easterly direction. This formation occurs between two hard quartzose bands. A similar occurrence is met in a trench about one chain distant in a northerly direction and again in a shallow shaft a further one chain to the north.

Recent production from the Federation area, by J.B. Geason, is shown in the accompanying table (p.12). Of 32 recorded sales, it is noteworthy that in only one instance has the grade of concentrate reached 70% tin, whilst the average grade for the whole of the returns is 47.4%. These results are suggestive of tin of fine grain size and are confirmatory of sizing tests carried out in 1931 by Mr. Lindsay Clark who showed that 38% of the recoverable tin was of such grain size as to pass through 150 mesh screens.

BISMUTH OCCURRENCES:

In connection with the Western Workings of the Federation Mine, it is appropriate to discuss occurrences of bismuth ore, for, on that area, are most of the known occurrences. That bismuth ores occur on the area has been known for a period of years. G.A. Waller in his report of 1902 (p.25) mentions the occurrence of bismuth ores in the western workings of the Federation Tin Mine. In Bulletin 21 of the Geological Survey of Tasmania (p. 256) in the description of Yates' adit, it is reported that at a distance of 237 feet from the portal, bismuth was recorded. It is asserted that "assays have shown as much as 8 per cent. over the old winze, but a sample broken over a width of 3 feet from the eastern side of the drive, returned tin 0.46%, Bismuth 3.76%.

There is, however, no record that bismuth was ever produced in quantity from these workings. Failure to develop these resources has been due, evidently to the belief that the grade of ore was too low, or the quantity of available ore too little for profitable treatment, for, during the period 1930-1932, the average price of bismuth was £533.3 per ton, and during the period 1937-1940, the average price was £440.

The only recorded production from the area is of comparatively recent date. A return in favour of J.B. Geason, dated 5th December, 1940, reveals that a dry weight of 84 lbs. of concentrates of an assay value of 42.1% bismuth, equal to a yield of 35.36lbs. of metallic bismuth, gave nett monetary return of £8/16/10 after charges, &c., were made, Bismuth being valued at 5/- per lb. or £460 per ton. For this return, it was reported that one ton of ore from the spoil dump of the bismuth shaft was treated by sluicing. The percentage recovery was, therefore, 1.57% bismuth, and is much in excess of assay values of two samples each taken over a width of two feet from the shaft. These samples yielded 0.25% and 0.43% bismuth, respectively. They were taken from each end of the shaft and on its southern side.

A further occurrence of bismuth ore was noted in a trench about 2 chains south west of Munro's shaft near the Black Face Lode. Two samples from this trench yielded 1.31% and 0.14% bismuth, respectively, over sections each 3 feet in length along the trench. Bismuth appears to occur at this position in a narrow vein striking with the trench.

Bismuth ore is also recorded from a trench, shown on the plan, a few feet to the north of Fowler and Dunn's open cut. A sample from this position yielded on assay 2.57% Bismuth.

Apart from these localities, which are reasonably close to each other, a fair prospect for bismuth was obtained by vanning from the face of Riley and Grey's workings situated about one mile to the north-west of the Federation Mine. Bismuth has also been reported from Sweeneys (Birthday Mine), and from positions previously recorded by Waterhouse in Bulletin 21, near Maynes workings.

Throughout this inspection, only occasionally were minerals of bismuth recognised in the hand specimen, and then only in insignificant quantity. Bismuth concentrates were obtained in the prospect dish when vanning tin samples, and when "probable" bismuth sites were tested. Bismuth concentrates have a specific gravity approximately equal to that of tin concentrates, and are white or pale yellow in color. They cannot easily be separated from tin concentrates. In this locality, Bismuth ore, is in general, a yellow clay like material resulting from the decomposition of the vein material. Bismuth ores have in each case been disclosed during operations directed primarily towards the discovery of tin ores, and in most instances, the bismuth deposits are found in association with the veins which have been developed for that purpose, or in trenches which have been cut to expose the continuation of veins known to carry tin ores.

WOLFRAM:

The official records show that only minor quantities of wolfram ore have been won from the South Heemskirk district. In the year 1940, the total yield recorded was 0.09 tons of wolfram ore. Earlier reports, Bulletin 21, p. 213, reveal that "At one locality (on the Federation Mine near the old inclined tramway), a deposit of alluvial of limited extent was worked and several bags of wolfram ore won."

Local reports state occasional bags of wolfram ore have been despatched, but these reports could not be confirmed.

Sales returns for the year 1940 show that Geason in July of that year forwarded for sale a quantity of mixed tin-wolfram ore. Of 195 lbs. weight of mixed concentrates despatched, 100 lbs. of wolfram concentrate and 95 lbs. of tin concentrate were paid for. The wolfram concentrate yielded on assay 44.2% WO₃, and was valued at £8/10/0, whilst the tin concentrate yielded on assay 26.5% Sn and was valued at £1/19/4. Expenses and penalties absorbed practically the whole of the tin value, and the nett return for the entire product was £8/10/11.

Primary wolfram occurs, only at one or two points, in association with quartz or quartz-tourmaline formations. These positions have been indicated on the general plan. They are, however, of no economic importance.

Central Workings - (Black Face Lode):

In a description of the Cumberland Company's Mine, G. Thureau, in the year 1881, makes reference to some of the workings now included in the Central Workings or those on the Black Face Lode. In his report, reference is made to a high level tunnel giving 60 feet of backs (the 85 ft. level). He refers also to a vertical shaft 50 feet deep (Munro's Shaft), and also to a main tunnel from Packers Creek to provide about 200 feet of ground to work beneath the mouth of the shaft (220 feet level.) This tunnel had then been driven 170 feet.

In the year 1884, the same writer refers to the workings as follows :- "The mines have been opened by means of a commodius main adit, over 1,000 feet in length... formation 6 feet 6 inches in width was intersected..... In an air shaft the same formation - there 14 feet wide - was again intersected.....At between 900 and 1,000 feet in from the mouth of the adit, another very hard lode formation, bearing north-west by south-west, was intersected." This description applies to what is now known as the long tunnel driven in a northerly direction from the southern face of the hill. It has since been extended to a position approximately below the most southern of the open cuts in the main lode.

Mr. G.A. Waller in the year 1902 refers in his report to these workings, and mentions the 85 feet level and the 115 feet level, but fails to mention the 220 feet level. He mentions two small open cuts in the lode and refers to tin. Production figures are quoted - "From this face 720 tons of stone have been treated in the mill yielding 12 tons 18 cwt. 22 lbs. metallic tin. This is equivalent to about 1 per cent. of metallic tin in the crude stone."

The workings are again mentioned by Waterhouse p. 270 of Bulletin 21 of the Geological Survey of Tasmania, which published in 1916 shows the state of development at that time.

In the year 1927 the company was re-organised and mining operations were commenced in the year 1928. The Black Face Lode was the immediate objective, and was the source from which ore supplies were to be won. An expenditure of approximately £80,000 was made on reconditioning and modernising the treatment plant and in the erection of buildings, power house and generating machinery, and an aerial ropeway, &c. Assay results obtained by the company during an extensive sampling campaign extending from 1927 to 1929, indicate that from none of the then existing workings was profitable grade of ore to be expected. At no time during its history did the mine return a profit, and the Company's liquidation in the year 1938 was to be expected.

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The Black Face Lode is of an irregular nature. It strikes generally on a bearing of 20 degrees in an area of granite which has been subjected to considerable fracturing, the fracture planes being more or less parallel with the general strike of the lode. Towards the northern end of the lode a more easterly trend is apparent. A branch formation, also with an easterly trend, occurs about one chain south from the portal of the 85 feet level, and it is this formation on which the eastern levels from the 220 feet and the 115 feet adits have been driven.

The Lode is a quartz-tourmaline formation with both green and black tourmaline in abundance. In parts pyrite occurs. What tin is present exhibits a greater affinity for the green tourmaline than for the black variety. Local reports assert that in part the tin occurred as narrow veins of almost pure cassiterite. The lode formation exhibits a decided banded structure and bands of tourmaline-rich rock occur in juxtaposition with much harder bands composed essentially of quartz with a lesser amount of tourmaline. The country rock adjoining the formation shows similar banding. In the immediate vicinity of the portal of the 115 ft. level the rock is essentially a quartz formation with numerous narrow tourmaline veins. With increasing distance from the lode formation the granitic structure increases but some tourmaline veins occur until finally at the extreme position the formation merges into normal granite.

A repetition of this banding occurs on the eastern and north-eastern sides of the lode formation which has all the characteristics of a replacement ore-body where, in this instance, the granite has been replaced by mineralisers rising along fracture planes. The general line of fracturing has a bearing of 20 degrees. Subsidiary minor fractures trend easterly and have rise to the branch formations mentioned above. The main ore-body terminates about 100 feet to the east of the adit positions, by merging gradually into normal granite.

The branch formation occurring one chain south from the portal of the 115 ft. level has been proved by cross cuts from that and the 220 feet levels for distances of 120 and 200 feet, respectively, in an easterly direction. In the latter case the cross cut extends for a distance of 110 feet from the main adit, and from that point a horizontal bore, 110 feet in depth, was in the lode formation for a distance of 90 feet before it passed into granite.

An inclined bore, on an angle of depression of 60 degrees, driven from a position 55 feet from the face of the level to a depth of 120 feet in the direction of the level was in lode formation for 110 feet before it also passed into granite.

There are no records available to show that sampling of the bore cores was carried out.

Sampling of the level from the 220 feet adit showed the formation to be barren of tin. At the 115 feet level a short section of the lode formation was of a grade of approximately 0.05% tin.

Records of production by the Federation Tin Company are incomplete. What reference are available refer only to low grade ore.

In a report dated June, 1929, mention is made of 1,953 tons of ore yielding 7.7 tons of tin oxide valued at £750. A further mention is made that the average percentage of tin in the stone according to daily tests of bulk samples is not greater than 0.3% tin oxide.

In the year 1935 the position had not improved for a further report states that from 5,582 tons of ore, a return of 8 tons 11 cwt. 3 qrs. 7 lbs. of concentrate, equivalent to 5.16 tons of metallic tin were recovered and were valued at £1,124, or a recovery of 4/- per ton of ore treated. The average grade of ore was, therefore, 0.09% Sn.

Eastern Workings:

The Eastern workings of the Federation area are of little importance. They were referred to as early as the year 1902 by G.A. Waller in his report on the field. The workings then consisted only of a prospecting shaft.

In the year 1916, L.L. Waterhouse, in Bulletin 21, refers to the workings. At that time, an adit had been driven to connect with the shaft and some stoping had been done.

The present state of the workings is essentially as described by Waterhouse. They have been idle for a considerable period of time. The workings reveal a narrow quartz-tourmaline vein in which the tourmaline is of the green variety. There is no official record of production, but Waterhouse mentions the recovery of 14 tons of concentrates. This would appear, from the condition and extent of the workings, to be an excessive estimate.

Heywood & Coleman's Workings:

Heywood and Coleman's workings are situated on lease No. 20M/41, a 40-acre lease, coincident with old Lease No. 8614, and previously the property of Federation Tin Mines.

Prior to its selection by the present proprietors, several trenches and two adits had been made to prospect the area.

Of the trenches, only one was productive. This was known as the Long or Rich trench and some ore was taken from shallow depths in a flatly dipping quartz-tourmaline formation, high grade in tin. There is no record of the amount of tin won, but the workings at this point are not sufficiently extensive to have yielded significant quantities.

Of the two adits driven on the property, the lower one is inaccessible throughout the entire length, and the approach has been dammed to conserve water for sluicing purposes.

The upper adit is accessible for part only of its length. A rise from the lower adit made connection between the two at a point about midway along the upper adit. This rise has now collapsed to cause a blockage in the upper adit, but the fall of earth has extended to the surface and access is possible to the inner part of the upper adit.

At the position of collapse, an extensive tourmaline formation is visible in the upper adit. It occurs on the eastern side of the adit, dips westerly at 60 degrees

and strikes at 20 degrees to pass out of the adit. At a point 25 feet from the fall of earth the adit turns to follow approximately the line of strike of the veins. There are, however, no persistent veins showing, but two minor veins $1\frac{1}{2}$ inches and 6 inches in width have been recorded. The adit maintains this bearing for a distance of 85 feet to the face where a quartz-tourmaline vein, with some limonite, 5 inches wide, occurs. From a point 28 feet from the face, a cross cut has been driven in a westerly direction for a distance of 48 feet. This cross cut reveals several narrow veins, striking 20 degrees, from one of which it is reported three bags of tin concentrates were recently won. The assay results of sampling by the company in the year 1927 were, however, discouraging.

Recent workings have exposed an irregular body of ore, parts of which have yielded high grade prospects. The main workings are situated about 200 feet north-east from the rich trench. A long shallow trench extends from a point 120 feet from the rich trench on a bearing of 41 degrees for a distance of 87 feet to connect with the main openings. In this trench a pinitoid formation occurs carrying a little tin. Overlying this formation and extending into the main workings on the western side is a flat dipping green tourmaline formation, barren in part. On the south-western corner of the main workings a hole, 8 feet deep, has been sunk on a small vein in granite to expose an occurrence of tin-bearing quartz-tourmaline nodules. These nodules range in size to 2 inches in diameter and vary in grade to 17% tin. They occur as irregular clusters in the granite which weathers readily to free them.

Development has been of such a haphazard nature that it is difficult to form an opinion of the occurrence but it is probably a continuation of the formation already exploited in the rich trench although no surface connection between the two can be established. The pinitoid material appears to be dipping flatly to the east under the irregular tourmaline formation and to be striking in a general north-easterly direction with the nodular formation in the granite occurring immediately to its west.

The whole formation is covered by a thickness of two feet of peat and detrital. The detrital is in part tin bearing.

The area affords an opportunity for systematic prospecting. At present ore of an estimated grade of two percent, tin is considered by the proprietors to be too low in grade for profitable exploitation.

Phar Lap Workings

The Phar Lap workings are situated on the southern portion of old lease No. 5765/M about 300 feet to the north-east of the north-east corner of old lease No. 5401/M and about 1,200 feet south-west from the portal of the Long Tunnel of the Federation workings. The workings were commenced by J.B. Geason and were later taken over by Waxman and Weston and finally again by J.B. Geason.

They consist of an irregular open cut from which a shaft has been sunk to a depth of 35 feet. At the time of this inspection the deeper workings were inaccessible, the shaft being full of water.

The country rock is a much decomposed white granite. In the open cut workings bands of limonite together with narrow quartz-tourmaline veins are exposed.

The ore taken from the shaft was treated by sluicing. It was soft and clay-like in character, and represented a pinitoid alteration of the granite. Near the bottom of the shaft, cubic crystals of pyrite were plentiful in association with high grade cassiterite ore. More than one ton of these crystals are lying on the ground at the point where sluicing operations were carried out. The crystals varied in size up to one inch cubes, but all the larger crystals have since been removed. The remaining crystals range to $\frac{3}{8}$ " cubes and are high grade in tin, for in many instances the pyrite is partly replaced by crystalline cassiterite. An attempt at calcining the crystals, without prior crushing, proved uneconomical and the untreated crystals, probably of a grade of 2 percent. tin remain on the site.

The opinion formed, based on data supplied by local reports, is that further testing and exploration of these workings is warranted. The workings are situated on comparatively flat country with the collar of the shaft only a few feet above creek level. Factors contributing towards cessation of work were the necessity for more or less continuous baling operations and the inability to recover the tin by roasting of the pyrite with which high grade tin was associated.

Waxman and Weston's Workings:

These workings are situated on flat swampy country near the north-western end of the Cumberland Dam, between the Dam and eastern slopes of Federation Hill. The work was done, during the life of the Federation Company, in the belief that the site was outside the limit of the Company's holdings. This, however, was not the case, and operations were terminated with the discovery that the land was held by the company.

The workings are not extensive. They consist of a trench, 140 feet in length, varying in depth to 9 feet at its southern end. For 110 feet the trench has a southerly trend at which point it turns S.W. for 30 feet. At this point a shaft, 14 feet in depth, has been sunk in ore reported as being high grade in tin.

The approach of the trench is in swampy ground. In a southerly direction it then reveals fine-grained granite, much decomposed. At about 60 feet south in the trench a band of cubic pyrite, showing crystals of $\frac{1}{4}$ " cubes was out. South of the pyrite band fine-grained granite recurs. No tin was visible in association with the pyrite.

The south-westerly section of the trench has been driven along an ironstone formation revealed first as a limonitic formation which gradually gives place to specular iron (micaceous haematite) which is more or less massive at the collar of the shaft. The high grade ore is reported as being associated with the ironstone formation.

The workings are situated little above the level of the Cumberland Dam, and future operations will be handicapped by the influx of excessive water.

The Cornwall Mine:

These old mine workings are situated within a few chains of the sea shore, on the eastern slopes of a ridge trending parallel with the coast and on the west bank of Packers Creek in the elbow formed by that creek where it turns easterly to enter the sea.

There has been only spasmodic development at this site since the original company, as reported by G. Thureau, closed down in 1884. Some of the workings are now in a collapsed and overgrown condition and those which are open for inspection show little to warrant the expenditure incurred in performing the work necessary for their completion.

A cross section of the country is provided by a tunnel driven through the hill. The tunnel was driven originally for transport of ore to the battery situated on the foreshore, but was later used to divert the water from Packers creek to enable the creek bed to be worked for the recovery of alluvial tin. The tunnel, driven on a bearing of 230 degrees through granite shows a series of parallel quartz-tourmaline veins striking on a bearing of 290 degrees, ranging in width from 1 to 18 inches. None of these veins has been developed from the tunnel, but from a few yards north from the eastern approach of the tunnel three short adits have been driven to develop the largest of the more eastern veins. A little stoping has been done to yield only a few tons of ore.

The Cliff Mine:

Although this area has been occupied in comparatively recent years (1927) the state of development is much the same as when the original Cliff Mining Company ceased operations. The mine is situated on the cliffs facing the sea shore about half a mile south from the old Cornwall Mine.

The workings consist of two adits driven in an easterly direction along a narrow quartz-tourmaline vein, six inches in width. In the upper adit a rise to surface has exposed widths of only a few inches, of the vein.

The lower adit is inaccessible due to falls of earth.

Several mineralised veins have been referred to in earlier reports on this area. Of these veins, the following are the chief ones :-

(1) The narrow vein exposed in the adit workings.

(2) Near the creek, trending west, a quartzose reef 4 feet in width occurs associated with an aplite dyke of similar width. This vein strikes at 120 degrees and has been developed, over a length of 150 feet, by a narrow open cut ranging in depth to 12 feet.

In this open cut a flat vein of quartz-tourmaline 14 inches thick is exposed.

(3) A micaceous quartz-tourmaline vein up to 4 feet in width striking northerly and apparently crossing the strike of the former veins.

It would appear that the object of driving the adits was to expose the intersection of the two veins striking at right angles to each other. This has not been accomplished.

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The country rock is nodular white granite in which the quartz-tourmaline nodules range up to 5 inches in diameter.

Although a battery of 10 heads of stamps had been erected, there is no evidence that the mine ever passed the prospecting stage of development, and future prospects are not encouraging.

Donaghue's Workings:

The Montagu Mining Company were not original holders of the old lease No. 6660. Portion of this area is now held by Mr. M. Donaghue under prospecting licence. The workings of the old company, with the exception of the main shaft, are now collapsed. The main shaft is in a poor state of repair and is inaccessible.

Donaghue's workings are situated within a few chains of the main shaft. They consist of a short adit on the eastern side of Montagu creek and a wide approach preparatory to the driving of an adit on the west side of the creek. The creek in the vicinity of the workings has been worked, by the company, for the recovery of alluvial tin, and for this purpose a water race has been cut for some distance on the western side of the creek.

Donaghue's adit has been driven in a general easterly direction. An approach of 40 feet has been driven on a bearing of 70 degrees to the portal of the adit which has then been driven on a bearing of 77 degrees for a distance of 27 feet. At the portal, on its northern side, a quartz-tourmaline vein, striking at 60 degrees, high grade in tin, is exposed. Cassiterite is visible in hard specimens. At about 15 feet from the portal, a vein 8 inches wide, striking south, has been cut by the adit. The upper portion of this vein has been displaced about two feet in a westerly direction by a flat fault which is visible in the adit to the face. This fault dips in a south-easterly direction. In the face of the adit a second quartz-tourmaline vein, parallel to that at the portal, is exposed above the flat fault. This adit is well timbered. It is proposed to continue the adit for a further two sets, 10 feet, then to drive in a northerly direction to cut the continuation of the vein exposed at the portal.

Westerly from this adit and across Montagu creek, an approach for a second adit has been made. In these workings, three separate veins have been exposed. The face in the approach shows 18 inches granite, 6 inches quartz-tourmaline vein, 36 inches granite, 3 inches quartz-tourmaline vein, 12 inches granite and 11 inches quartz-tourmaline vein, made up of $1\frac{1}{2}$ inches tourmaline, 8 inches quartz and $1\frac{1}{2}$ inches tourmaline to the edge of the face. No development has taken place at this position. Between these two workings, in the water race, a quartz-tourmaline vein is exposed. It is probable that these exposures are on the same vein or on a series of veins occurring on eschelon.

In an easterly direction towards the Wakefield Mine, for a distance of perhaps a quarter of a mile, similar occurrences are visible. It is claimed that these exposures are of the continuation of the same vein, but it is more probable that a series of parallel or sub parallel veins occur.

There are no records of production available for this area. The old Montagu Company developed their workings to a depth of more than 150 feet.

In the creek, near the main shaft, it is evident that under hand stoping, on a crescent shaped formation, has taken place. Locally it is claimed that this work has been carried out on a formation previously mined by the old company, but no outcrop is visible due to overburden. Thureau in 1884 suggests the presence of a second vein, striking northerly, in this locality. It is probable that the stoping has occurred at the junction of these two veins.

Future development will depend on the results of development from Donaghue's main adit and may yield minor quantities of high grade ore.

Humphries Workings

Mr. M. Humphries was holding, under Miner's Right, portion of old lease No. 1158 adjacent and to the west of the old Montagu lease No. 6660M. The workings consist of three adits, driven in a north-easterly direction, of which the longest is 170 feet. Several proprietors have previously interested themselves in these workings, and to them is credited the driving of the adits. The present proprietor has sunk two winzes, 12 feet and 35 feet deep, respectively, from the floor of the longest adit and has produced meagre tonnages of high grade tin ore from short shoots occurring in irregular quartz-tourmaline veins. It was found that the tin ore was associated with both the quartz and the tourmaline for free tin was recovered from the ore by sluicing and the tourmaline content of the material reduced. The remaining hard quartzose portion of the vein was crushed, the grade being such that from three tons of ore, 3 cwt. 10 lbs. of concentrates of an assay value of 60% metallic tin was won.

The adits are little above creek level and difficulty is experienced in keeping the winzes free from water by baling.

Both the winzes contained water at the time of the inspection, but it was claimed that from the deeper winze, more than one ton of tin concentrates of a grade of 68% metallic tin was won.

A plan recording details of the veins is attached.

CONCLUSIONS:

The Heemskirk tin field has been known since the year 1876. Since that date reports have been written, either on the field as a whole or on individual mines, by the following writers :-

G. Thureau in 1881, 1882, and 1884 reported on portions of the field and made suggestions for its development.

A. Montgomery in 1893 and 1895 reported on individual mines.

W.H. Twelvetrees in 1900 reported on the field.

G.A. Waller in 1902 wrote a concise report on the field.

L.L. Waterhouse in 1916 wrote a comprehensive report, on the field, which was published as Geological Survey Bulletin No. 21.

Unpublished reports by P.B. Nye and A.M. Reid on individual mines have since been written.

The earliest operations on the field were directed towards the recovery of alluvial tin from creek beds, some of which have been worked throughout their entire length. Shortly after the discovery of the field lode-tin mining was commenced at several positions and have since been carried on intermittently. Despite the long life of the field, comparatively little surface development has been carried out. The greater proportion of the expenditure on mining operations, a relatively small proportion of the total expenditure, has been used on underground development. In almost every instance the greater proportion of the total expenditure has been devoted to the purchase and erection of dwellings and mining and milling equipment, &c., to the final detriment of the field. There are, on present development, no ore reserves either positive or probable.

In general, the average grade of the ore won from the field has been low, although narrow veins and small deposits of high grade ore have occurred. These may have been profitably exploited by small syndicates or individuals, but in no case were the proven ore reserves sufficient to warrant expenditure of the large capital supplied by the companies promoted for their exploitation.

The future of the field will depend on the development of known, and further search for similar, high grade deposits. Of the several known deposits which may yield profitable returns, the following are worthy of mention:

Geason's present workings: Where high grade ore has been proved, but its full extent is still unknown. The work to date has been directed towards production of concentrates sufficient only to meet living expenses and little has been done to delimit the occurrence.

Heywood and Coleman's workings: Ordered prospecting is necessary to enable estimates to be made of their value.

Sweeney's Mine: At this mine sampling suggests that further development is desirable.

Donaghue's workings: These may be productive of small quantities of high grade ore.

Phar Lap: Further development and prospecting is desirable at this position. High grade pyritic ore has been won and failure to treat this ore by calcining together with the occurrence of heavy water in the workings, contributed to the cessation of operations.

Bismuth ores are widely distributed through the Heemskirk field and although generally in minor quantity those occurring in the Federation area are worthy of further consideration. Although their occurrence was noted in the year 1902, no attempt has been made to develop them. The present price of Bismuth (£700 stg. per ton) should tend to encourage development of comparatively narrow veins of moderate grade ore.

H.G.W. Reid,
FIELD GEOLOGIST

Department of Mines,
Hobart.

25th June, 1943.

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RENISON LIMITED

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APPENDIX 2

EXTRACT (FEDERATION TIN MINE) FROM

SOUTH HEEMSKIRK TINFIELD

L.L. WATERHOUSE

1916

Bull. Geol. Surv. Tas. 21

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EXTRACTS FROM,
GEOLOGICAL SURVEY BULLETIN NO. 21
1916

THE SOUTH HEMISKIRK TIN FIELD, By
L. LAWRY WATERHOUSE, B.E., Assistant
Government Geologist

THE MINING PROPERTIES - THE FEDERATION TIN MINE

Page 309 - Black Face Line of Lode -

"This large and important body of ore has been described with the work done upon it in the past, and as it promises to be the biggest ore-producer on the property in the near future its development and future working need consideration.

It must be recognised at once that little is known of this ore-body at the present time, and that further prospecting is necessary to learn something of its structure at a greater depth. But surface prospects are so encouraging that further work is certainly justified, and should be carried on as soon as possible. Whether this huge mass of ore is a purely local development at the intersection of a favourable set of fissures, or whether it will maintain its size and value as a greater depth is attained, the future alone can decide, but progressive work should be carried out without delay, in order to provide reliable data for the planning of future work. The writer is of opinion, after studying the formation, that a strong and well-defined lode will be encountered, and that it will be permanent to a very considerable depth.

Even in its present state, a large body of ore is available for economic mining by open-cut methods. But it is advisable, in order that it should not be a burden, that developmental work should be carried out while the quarrying of the ore at the surface is in progress."

Page 314 - The Lode -

"(a) Value - The tin content of the lodes, considered apart from the actual market value of tin, is of little real use as a criterion; the latter will be considered under a separate heading. In estimating the tin content, two methods are useful, and one should always, where possible, supplement the other. These are the actual battery returns of ore treated, and assay values of samples taken systematically as work progresses. The battery returns from bulk parcels treated in the past have, I understand, been quite satisfactory. Actual return from the operations of the old Cumberland Company are not available, but it is known that rich ore was treated. From the No. 2 adit and Messrs. Fowler and Dunn's workings actual returns were between 5 and 6 per cent tin oxide. The Whip Shaft workings produced about 350 tons of stone, from which the battery return was 1.1 per cent. From the Black Face workings over 700 tons of ore yielded about 1 per cent metallic tin. It must be clearly borne in mind that these figures represent actual battery returns, and that in all cases owing to the unsuitable plant, losses in concentration were much heavier than would be the case with a modern plant under efficient management. The small amount of work done on the property has been noted, yet as a result of this work, over 200 tons of tin oxide have been produced since the commencement of operations. The writer did not systematically sample the mine. He did, however, take occasional samples at doubtful points, and at others had prospects washed to satisfy himself as to the actual tin content. As a result of this,

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with a study of results obtained during previous official examinations, the writer satisfied himself that, so far as tin values are concerned the property is thoroughly genuine. Viewed as a whole, it is unlikely that the mine will maintain a continuous output of rich ore, but that rather it will prove (if worked on proper lines) a big low grade proposition, keeping up for a long period an output which, if the market price of tin be not too low, should yield a satisfactory margin of profit over working expenses. Rich shoots of ore have been found in the past, and it is certain that prospecting will reveal others but these will not prove the mainstay of the mine.

(b) Size - This feature of the lode-formation is important, as rich tin veins might exist, which are not payable because of the narrow width. But on this property, the size of the lodes must be considered as very satisfactory, and values quoted are certainly over payable widths. It seems superfluous to again quote the actual sizes of the various formations which have already been described in detail, but there is no question as to the size of the lodes.

(c) Permanency - This aspect is of the utmost importance in considering the probable future of the property. As has been indicated in the course of this report, most of the work carried out up to the present has been surface work. The deepest level driven (the Long Tunnel) has not been continued far enough to cut the lodes exposed on the hill over 300 feet above, although shoots of rich tin ore have been cut in this tunnel and are undoubtedly continuing strongly underfoot. The veins cut in this tunnel are in no respect different from those exposed on the surface on other parts of the property. The 57 feet level also exposes a lode which can be traced on the surface for a considerable distance, and the tin contents at the greater depth have suffered no appreciable diminution. Although mining has not given much positive information as to the behaviour of the lodes at a depth below the present surface, indications are all favourable to the permanency of the lodes and of their contained tin values to considerable depths. The main branch of Packer's Creek, which traverses the south-western portion of the property, has cut through a quartz-tourmaline lode which outcrops for a considerable distance on the surface. In the creek it is between 600 and 700 feet vertically below the highest point on the outcrop. The nature of the stone exposed here is exactly similar to that higher up; samples do not appear to have been assayed, but the tin value does not appear to be high, a fact which is no argument against the permanence of tin values to depth, as the tin is known to occur in shoots, and the point in question may be beyond the limits of a definite shoot. In the branch of Packer's Creek to the north of the property, too, a lode-formation is shown to be continuous for between 400 and 500 feet vertically."

Conclusion - Although the Federation Mine at the present time can scarcely be called a well developed and thoroughly equipped mine, it is one which offers some distant inducements to the investor. For the small amount of development work done about 200 tons of tin oxide have been sent away. Several distinct tin-bearing lodes have been partially opened up. A large tonnage of ore is available for immediate extraction by open-cut methods. A large amount of backs can be rendered available for extraction by stoping, by adits of moderate length. There is a considerable quantity of detrital material lying about the surface, which is estimated to carry highly payable values. The writer considers that the tin values are likely to be permanent in depth, that there is no reason for believing that the ore will become more complex at depth (exceeding that pyrite will be present in at least some of the lodes), and that structural features are not likely to hinder economic working.

There are exceptionally fine facilities for economically mining and treating the ore.

Although rich ore has been won in the past, it appears more likely that the mine will become, on further development, a big low grade proposition, rather than a small producer of rich ore.

Progress has been hampered in the past, and the mine is at a standstill at the present time, largely for lack of capital to carry out the necessary developmental work. One of the chief reasons why the necessary capital has not been forthcoming appears to have been that the property happens to be situated in a mining field which was boomed some years ago. In the boom time large amounts of money were subscribed, and wasted mainly in unwarranted and unsuitable surface works. Very little genuine mining work was carried out and the inevitable crash came. Public confidence was severely shaken and the few genuine properties have felt the effects ever since.

The time is not far distant when confidence in the Heemskirk tinfield will be restored, and the Federation Mine is one of the properties which certainly deserves further development. If developments continue to be satisfactory and the writer believes they will- the necessary remodelling of surface plant can be confidently undertaken and the future of the property should be assured."

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APPENDIX 3

FEDERATION TIN MINE, HEEMSKIRK

LOFTUS-HILLS 1920

REPORT DEPARTMENT OF MINES, TASMANIA

INCLUDES ORE RESERVE CALCULATIONS

FEDERATION TIN MINE, HEEMSKIRK.
- - - - -1 - PREVIOUS EXAMINATIONS & REPORTS

During the last 20 years there have been four official examinations of the area which now constitutes the Federation Tin Mine. The present report brings the total up to five.

In the year 1900, the late W.H. Twelvetrees made an examination.

G.A. Waller, than Assistant Government Geologist made a thorough examination of the Heemskirk Field in 1902, and his report deals in detail with the Federation Mine, as well as the neighbouring properties.

In the summer of 1913-14, L.L. Waterhouse, B.E., then Assistant Government Geologist, made a complete geological survey of the Heemskirk Field, and his report, dated 15th October, 1915, contains a meticulous description of the Federation Mine.

Mr. A.S. Morton of Zeehan was employed under the direction of the State Mining Engineer in 1914, to carry out a thorough and systematic sampling of the tin deposits of the Heemskirk Field. This work occupied most of the summer of 1914-15. The results of this sampling are in the possession of the Mines Department. The Federation Mine was included in this sampling and the whole of the workings accessible at that time were systematically sampled. The results of this sampling have been largely made use of in the present examination and in the compilation of this report.

2 - OBJECT OF THE PRESENT EXAMINATION

The present examination was undertaken for the purpose of determining the value and permanency of the lodes on this mining property in the light of recent developmental work carried out thereon. Particularly was it desired to ascertain whether the "Black Face lode" persists in depth. In addition, it was desired to know whether the other lodes on which work has been done are sufficiently large and possess sufficient tin contents to warrant the expectation that they will constitute a source of payable tin ore in appreciable quantities.

3 - SCOPE OF THE EXAMINATION

The meticulous description of the geology of the area presented by L.L. Waterhouse in Geological Survey Bulletin No. 21 obviated the necessity of repeating such work.

Accordingly the information contained in that Bulletin was made use of in this examination, which was confined to the immediate proximity of the lodes themselves. The structure of the lodes and of the granite in their vicinity was closely studied to enable conclusions to be drawn in regard to the probable persistence of the lodes in depth and the distribution of the tin contents.

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In connection with the determination of the actual tin content of the lodes, the existence of the results of the systematic sampling by Mr. A.S. Morton and the numerous samples taken by previous investigators, made it unnecessary to resample the old workings. However, measures were taken to ascertain the thoroughness of Mr. Morton's sampling and the conclusion was arrived at, after an examination of the sampling channels made by him, that the work of sampling had been conscientiously carried out. To bring this information up to date, the recently exposed faces were sampled, and the assays made in the Geological Survey Laboratory, Launceston.

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4 - THE MORE IMPORTANT TIN-BEARING LODES

There exist a very large number of lodes on the leases held by the Federation Company. A great number of these, however, have had little or no work done on them, and consequently their influence on the value of the Federation property can only be stated in terms of general possibilities.

In arriving at conclusions, therefore, in regard to the permanency and value of the mine, attention should be confined to those lodes which have had sufficient work done on them to disclose a definite body of ore. The more important of such lodes are enumerated below:-

- | | |
|----------------------|----------------------------|
| (a) Black Face Lode. | (g) Hadley's Lode. |
| (b) Whip Shaft Lode. | (h) Fowler & Dunn's Lodes. |
| (c) Cumberland Lode. | (i) Grey's Lode. |
| (d) Air Shaft Lode. | (j) Montague Lodes. |
| (e) The Pipe | (k) Wakefield Lode. |
| (f) Big Trench Lode. | (l) Eastern Lode. |

5 - THE PROVED DIMENSIONS AND VALUE OF THE LODES

- (a) Black Face Lode.

The total proved length of this lode is 500 feet. The average width over which payable tin values have been demonstrated to occur is 28 feet. The vertical dimensions have been shown to be at least 60 feet. The lode has not yet been penetrated at a lower level than this, but has undiminished values at a depth of 60 feet. The average of all samples taken of this lode is 1 per cent metallic tin.

- (b) Whip Shaft Lode.

The length of this lode at the top of the Whip Shaft is 60 feet; at the 500 ft. tunnel (80 feet below collar of shaft), the length is 180 feet; at the 570 ft. tunnel (150 feet below collar of shaft), the lode is 350 feet in length. The vertical range thus proved by the Whip Shaft is 150 feet.

The average width is 5 feet. The average content of metallic tin is .75 per cent.

- (c) Cumberland Lode.

The length of lode exposed in the Long Tunnel workings is 200 feet. The average width is 5.6 feet. The average tin content is .61 per cent. This latter figure has been obtained by sampling the exposed back of the drive along the lode, but the average is probably higher than this, as rich patches occur in the lode. The acceptance of .61 per cent as the

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average tin content is therefore on the conservative side.

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The vertical dimension from the surface to the bottom of the 80 ft. winze sunk from the Long Tunnel level is 400 feet.

(d) Air Shaft Lode.

The average width of this lode at the surface is 24 feet, and where out by the Long Tunnel it is 20 feet in width. The length has not been definitely disclosed, but appears to be about 300 or 400 feet; the proved length, however, cannot be taken as more than 50 feet. The proved vertical range is 270 feet. Bulk samples at the surface show an average

(e) The Pipe

This ore-body is of a totally different type from that of the usual quartz-tourmaline lodes of the district, being richer in tin contents but less regular in structure. The greater part of the richer portion of this pipe has been worked out down to the Tributor's Tunnel level, but there is a definite portion of it on which a winze has been sunk which has dimensions of:

Length: 30 feet, width: 8 feet, depth: 30 feet.

The average value of this block is 3 per cent metallic tin. An adit is being driven to cut the downward continuation of this pipe at a depth of 60 feet, but is at present 180 feet from this objective.

(f) Big Trench Lode

This lode has only recently been developed and has a somewhat similar mineralogical composition to the Pipe. It has been proved on the surface over a total length of 100 feet, with an average width of 10 feet. It has been driven on for 40 feet and proved to a maximum of 30 feet below the surface. At this level the average width so far proved is 4 feet, with an average tin content of 3 per cent metallic tin. Work is proceeding on this lode.

(g) Hadley's Lode

This lode has not had much work done on it, but outcrops at the surface over a length of at least 700 feet. The width averages about 5 feet. Assays of from .5 to .75 per cent metallic tin have been obtained from bulk samples.

(h) Fowler & Dunn's Lodes

A very rich ore-body was worked by Messrs. Fowler and Dunn, from which they took 1,000 tons of 6 per cent ore by open-cut workings. No work has since been carried out at this point and no defined ore-body of similar character is now visible. There are, however, a number of intersecting veins which carry from .2 to .32 per cent tin. There is certainly a locus of strong tin deposition here and further work will doubtless result in disclosing other rich concentrations similar to that already excavated.

(i) Grey's Lode

Several trenches have been cut on this lode,

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the width of which is about 25 feet. Bulk samples in these trenches assay .5 per cent metallic tin. Although the lode is visible on the surface for a considerable length, the trenches are limited to a length of about 50 feet.

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This is a very promising lode on which very little work has been done.

(j) Montague Lodes

These lodes were worked by the old Montague Company, but the lease has recently been acquired by the Federation Company. They have been proved to outcrop on a length of about 250 feet and the width varies from 1 foot to 15 feet. At the point of intersection of these two lodes, the tin values have been proved to persist to a depth of at least 100 feet. Some high grade tin ore was obtained, but the workings are not accessible for sampling. The old reports, however, state that both lodes carry tin values and they are very promising formations.

(k) Wakefield Lode.

The lease on which this lode occurs has recently been acquired by the Federation Company. The lode is well defined and of the quartz-tourmaline type. The old workings are inaccessible for sampling. Good tin values can be seen at the surface above the old adit. The width here is 15 feet.

6 - ORE RESERVES

In relation to the number of lodes definitely known to carry tin values, the amount of ore which can be indicated as ore-reserves in terms of tonnage, is small. This is due to the fact that the work so far accomplished has been distributed over such a large number of lodes. In the past no systematic scheme of development work has been carried out, and much of the work has been confined to the extraction of certain rich shoots of ore. The figures presented below, therefore, must serve as an indicator to the general potentialities of the property, and should serve as a nucleus around which future development work will accumulate a tonnage of ore more nearly commensurate with the general possibilities indicated by the geological features of the lodes already known.

1. Proved Ore.

Certain portions of the ore-bodies exposed in the workings in the following lodes may be regarded as "proved ore":

Black Face
Whip Shaft

Cumberland
Big Trench

The Pipe

Including 2,000 tons of ore assaying 1.2 per cent tin, already mined and stacked, this "proved ore" constitutes a reserve of approximately 60,000 tons, the assay of which is 1.0 per cent metallic tin.

2. Probable Ore

In addition to the portion of the abovementioned ore-bodies which is exposed on three or four sides and which constitutes "proved ore", there exist blocks of ore which are definable as "probable ore".

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The total tonnage of this probable ore may be put down in round figures as 400,000 tons, the assay value of which, judging from the sampling of the exposed faces, should approximate that of the "proved ore".

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3. Prospective Ore

This property possesses potentialities in addition to those indicated above in the form of tonnage figures which are only possible of indication in a general way. In addition to those portions of the Black Face, Whip Shaft, Cumberland, and Big Trench Lodes, and the Pipe, taken into consideration in arriving at the above estimate of "proved and probable ore", there are the following which indicate general possibilities or "prospective ore", which are quite justifiable on the geological evidence:-

- (1) The Whip Shaft lode below the 570 ft. Level.
- (2) The downward continuation of the Black Face lode below the 85 ft. level.
- (3) The downward continuation of the Cumberland lode below the Long Tunnel level.
- (4) The downward continuation of the Big Trench lode below the present tunnel
- (5) The continuation of the Pipe below the bottom of the winze at the Tributor's Tunnel.

In addition there exist the undoubted possibilities of developing considerable ore-reserves in the following lodes, which, as indicated earlier in this report, are tin-bearing, and of considerable dimensions but which have not been taken into consideration in estimating "proved and probable ore":-

Air Shaft	Hadley's
Fowler & Dunn's	Montague
Grey's	Wakefield
Eastern	

In addition to these tin-bearing lodes, there are the bismuth lodes disclosed in the workings near Fowler & Dunn's lodes, which have very promising features.

7 - PERSISTENCE OF THE LODES IN DEPTH

In considering the question of the influence of depth on the size and value of the tin lodes, cognisance must be taken of the proved vertical range of the lodes and the structural features disclosed by geological examination.

The geological survey made by L.L. Waterhouse has shown that the tin has been deposited in the Heemskirk field over a vertical range of at least 1500 feet. On the Federation Mine the greatest proved vertical extent is clearly greater than this as the lode is continuing strongly underfoot.

An important, although not vital, consideration in regard to the future prospects of the mine is the downward continuation of the Black Face Lode. The recent examination of the structural features of this lode has revealed the fact that it is located at the locus of convergence of two series of parallel fractures in the granite which have been simultaneously developed. One series of parallel fractures has a strike of 14 degrees and consists of a large number of closely spaced fractures having a slight inclination towards the east. The other set has a strike of 70 degrees, and the fractures are not so closely spaced and are more nearly vertical. The line

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of intersection of these two series strikes 40 degrees, which is the strike of the Black Face Lode.

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The seams in the ore body which have a strike of 14 degrees are due to the solutions, which rose through the 70 degree fractures, having spread along the 14 degree fractures and replaced the granite outwards from these. The ore-body is thus of irregular width along a main axis striking 40 degrees, the banding being parallel to the 14 degree fractures, but the walls of the ore-body having no exact relationship to either set of fractures, the limit of the ore being regulated by the distance the ore-bearing solutions travelled from the 70 degree fractures along the 14-degree fractures.

Any conclusion as to the dip of the ore-body as a whole must therefore, be drawn from a consideration of the angle of dip of the plane of intersection of the two series of fractures, and from neither the apparent dip of the walls of the ore-body observable at the surface, nor from the dip of the bands within the ore-body. This plane of intersection will not depart more than a few degrees from the vertical and therefore the ore-body may be expected to be practically vertical. It is significant in this connection that all of the quartz-tourmaline tin-bearing lodes on this property, which have been exploited to any depth, have been found to be approximately vertical.

The Long Tunnel is being driven to intersect the Black Face lode at a depth of 320 feet below the highest point of the outcrop. It is at the present time 50 feet from a point vertically below the nearest portion of the outcrop on the hill. The fact that this tunnel has not yet cut the lode cannot be taken as evidence that the lode does not persist to this level.

The whole of the geological evidence and the work already carried out on the lodes of the property, justify the conclusion that both the lodes and their tin content will continue to considerable depths.

8 - CONCLUSION

The Black Face lode is the largest ore-body on the Federation property. Development work up to date has not proceeded far enough to definitely establish its existence 320 feet below the surface, but there is every reason to anticipate on the geological evidence that the lode will be encountered at the Long Tunnel level.

Besides this ore-body there exist four lodes on which sufficient work has been done to allow of the calculation of approximate ore-reserves. The amount of ore available in these and the Black Face lode may be stated as:-

Proved ore: 60,000 tons assaying 1 per cent tin
Probable ore: 400,000 tons probably of similar grade.

This estimate does not exhaust the possibilities of these five ore-bodies, and the additional prospective ore contained therein must be added to that in seven other lodes, which have been proved to contain payable tin values and to be of appreciable dimensions, as indicated in this report.

With such a large number of tin-bearing lodes available for operating upon, the Federation Mine should, with efficient management, become a stable producer of tin.

(Signed) LOFTUS-HILLS, M.B.E., M.Sc.
GOVERNMENT GEOLOGIST.

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RENISON LIMITED

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CALCULATIONS UTILISING L.HILLS LODE DIMENSIONS

BLACK FACE LODE

500' x 28' x 60'

(160 x 9 x 20) m³

~ 86,400 tonnes x 1.0% Sn

WHIP SHAFT LODE

150' x 5' x 180'

(50 x 1.5 x 60) m³

~ 13,500 tonnes x 0.75% Sn

CUMBERLAND LODE

200' x 5.6' x 400'

(60 x 2 x 130) m³

~ 46,800 tonnes x 0.61% Sn

AIR SHAFT LODE

22' x 50' x 270'

(6 x 16 x 90) m³

~ 25,920 tonnes x 0.4% Sn

THE PIPE

(cont.)

RENISON LIMITED

THE PIPE

30' x 8' x 30'
(10 x 2 x 10) m³
~ 600 tonnes x 3.0% Sn

BIG TRENCH

30' x 7' x 75'
(10 x 2 x 25) m³
~ 1500 tonnes x 3.0% Sn

TOTAL 164,720 tonnes x 0.86% Sn

RENISON LIMITEDAPPENDIX 4EXTRACT (COLEMAN'S WORKINGS)FROM REPORT ON SOUTH HEEMSKIRKK. WELLS 1973CONSOLIDATED SYNDICATE REPORT

Cliff Mine

In this area the granite is white medium-coarse grained with numerous well developed tourmaline nodules. The granite appears to be kaolinised in places and a small aplite dyke was also noticed. A sample of soft kaolinised granite gave the following results :

<u>% Sn</u>	<u>% As</u>	<u>Cu ppm</u>	<u>Pb ppm</u>	<u>Zn ppm</u>
0.038	0.015	20	15	20

The workings are no longer accessible but a small shaft, two adits and a narrow open cut were developed on some small tin bearing veins which parallel the N.W. and N.E. striking joints. Scott (1928) reports assays of 3.18% Sn over 2' at the bottom of the shaft and 5.5% Sn over 10' at the surface, 50' S.E. of the shaft. Tin is also reported as being found within some of the tourmaline nodules.

Prospect N.E. of the Cliff Mine

This consists of a trench approximately 15' long, 3' wide and varying from 2' to 6' deep and striking at 190° m. The granite is white, massive with nodules of tourmaline and displays veins of quartz and tourmaline. Cassiterite occurs also arsenopyrite. Four samples collected gave the following results :

	<u>% Sn</u>	<u>% As</u>	<u>Cu ppm</u>	<u>Pb ppm</u>	<u>Zn ppm</u>
Granite	13.20	13.40	100	240	25
Granite	0.048	0.047	85	30	20
Granite with visible arsenopyrite	3.92	11.00	480	665	520
" " " cassiterite	12.80	12.40	270	315	45

Numerous alluvial workings, where sluicing has been undertaken, occur in the same area.

Coleman's Workings

Coleman's workings are situated on a 40 acre mine lease, No. 20M/41, which was originally the property of Federation Tin Mines who had developed several trenches and two adits.

The Mt. Lyell Company examined the property in January, 1945 and took several samples from the top adit (bottom edit collapsed) and the trenches with the following results (Hudspeth, Jan. 1945).

<u>Sample No.</u>	<u>% Sn</u>	<u>Remarks</u>
<u>Top Adit</u>		
13	0.72	Over 3' width. Sample 10' from portal.
4	0.22	Over 5' width. Next to rise.
3	0.11	End of No. 2 cross-cut.
<u>No. 1 Winze</u>		
2	8.96	Bottom of winze.
14	0.78	Over 5' width. Footwall of winze, 16' below ground level.
15	2.63	Over 5' width. Hangingwall of winze, 16' below ground level.
16	2.63	Over 5' width. Hangingwall of winze, 16' below ground level.
<u>No. 2 Winze</u>		
1	4.37	Over 4' width. Bottom of winze.
<u>Federation Trench</u>		
18	0.44	Over 4' width. 40' E. of No. 1 winze.
<u>Eastern Trench</u>		
9	0.22	Trench bottom.
11	0.67	Trench bottom.
7	5.60	Over 3' width from trench wall.
12	39.70	½ lb. nugget of cassiterite. Top of winze.
8	0.56	Over 2' width. End of trench.
17	24.30	Over 3' width. N.E. corner of trench.
<u>No. 3 Winze</u>		
5	1.23	Decomposed granite at top of winze.
6	0.90	From spoil heap.
<u>Eastern Outcrop</u>		
10	0.22	250' S.E. of No. 3 winze.

These results were considered encouraging and a six month option was taken on the property on 28th March, 1945. At the same time a Special Prospector's Licence was taken over an area of 855 acres surrounding the lease. The work undertaken consisted essentially of repairing and extending the main adit and sampling of the workings (Hudspeth, September, 1945).

1. Main Adit

Cleared out and repaired from 0' - 145' end (102' timbered).

10'	0.39% Sn
40'	0.22% Sn
48' - 55'	0.56% Sn
115' - 145'	0.31% Sn

2. No. 1 Cross-cut
Cleared out from 0' - 18' (end)
0' - 18' 0.02% Sn
3. No. 2 Cross-cut
Cleared out from 0' - 45' (end)
- | | | |
|-----------|----------|------------|
| 0' - 5' | 0.14% Sn | } 0.45% Sn |
| 5' - 10' | 0.95% Sn | |
| 10' - 15' | 0.03% Sn | |
| 15' - 20' | 0.50% Sn | |
| 20' - 25' | 0.95% Sn | |
| 25' - 45' | 0.30% Sn | |
4. No. 3 Cross-cut
Driven 50' in an Easterly direction from 105' mark in main adit.
- | | | |
|-----------|----------|------------|
| 0' - 40' | 0.12% Sn | } 0.16% Sn |
| 40' - 45' | 0.36% Sn | |
| 45' - 50' | 0.14% Sn | |
5. No. 1 Rise
Extended 27' from 8' mark in No. 3 Cross-cut to meet a winze sunk 10' from the surface.
- | | | |
|-----------|----------|------------|
| 0' - 20' | 0.18% Sn | } 0.28% Sn |
| 20' - 27' | 0.56% Sn | |
6. No. 4 Cross-cut
Driven 9' in an Easterly direction from 53' mark in main adit.
- | | | |
|---------|----------|------------|
| 0' - 5' | 0.84% Sn | } 0.53% Sn |
| 5' - 9' | 0.11% Sn | |
7. Main Adit
Extended 97' from 145' to 242'.
- | | |
|-------------|----------|
| 150' | 0.49% Sn |
| 155' - 205' | 0.08% Sn |
| 205' - 215' | Nil |
| 220' | 0.06% Sn |
| 225' | 0.26% Sn |
| 230' - 242' | 0.05% Sn |

The results of the sampling were thought to be poor and in view of this no work was undertaken on the S.P.L. and the area was relinquished in September, 1945.

In 1965 the E.Z. Company executed three diamond drill holes. The highest assay from the core was 0.11% Sn and the prospect was abandoned. Later work suggests that these holes were in fact drilled parallel to the strike of the mineralisation.

In 1968 an option was taken on the property by Pacific Copper Explorations Pty. Ltd. and two short holes were drilled in November, 1970. The highest tin value recorded was 0.15% over 10' and the prospect was abandoned. Again there is some doubt as to whether these holes in fact intersected the target area.

The prospect was visited by Messrs. Reid and Wells of the Mt. Lyell Company on the afternoon of August 10th, 1973. The area consists of white granite with veins of quartz/tourmaline. The numerous tourmaline nodules are again a striking feature and some appear to carry cassiterite. Samples were taken from both the alluvial workings and the underlying rock.

	<u>% Sn</u>	<u>% As</u>	<u>Cu ppm</u>	<u>Pb ppm</u>	<u>Zn ppm</u>
Small O/C veined face	0.73	0.006	115	55	15
Top of No. 1 Rise	15.00	0.004	90	45	10
Blue Tourmaline near No. 1 Winze	1.28	Nil	20	-	-
Rubble in trench	8.55	8.27	175	320	240
Nodule hole	8.62	Nil	100	-	-
Nodule hole	0.59	Nil	60	-	-

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APPENDIX 5

REPORT ON FEDERATION TIN MINES LTD.,

SOUTH HEEMSKIRK

J. SCOTT (STATE MINING ENGINEER) 1928a

REPORT DEPARTMENT OF MINES, TASMANIA

REPORT ON FEDERATION TIN MINES LIMITED
SOUTH HEEMSKIRK.

INTRODUCTION.

At various periods during the past thirty years examinations by officers of the Mines Department have been made and reports furnished on this property. These include:-

1. Examination and report by the late W. H. Twelvetees, 1900
2. Examination and report by the late G. A. Waller, 1902
3. Examination and report by Lawry Waterhouse, B. E., 1913-1914
4. Systematic sampling of the mine by A. G. S. Moreton under direction of the Hartwell Conder A.R.S.M., M.A. then State Mining Engineer, 1914.
5. Examination and report by Loftus Hills, M.B.E., D.Sc., 1920.

The information and data supplied respectively by these officers embraces all matters pertaining to the geographical position, physiography, geology, estimated quantity of ore, tin content of the ore bodies, water supply and general prospects of the property.

During the long period covering the time of discovery of the field to the present day considerable quantities of Tin Oxide have been won from the Mine both in the form of alluvial tin and from the result of crushing lode material.

All efforts to carry on productive work in the past have been under very disadvantageous circumstances, and, in consequence, a continuity of operations on a satisfactory basis was impracticable.

In past years a considerable amount of capital has been spent in various directions on the property in the way of developing the ore bodies and in providing plant for power and ore treatment. All such efforts have been unsuccessful.

Some few years ago a Company was formed in Australia for the purpose of providing capital to work the mine on a large scale basis. The amount of money raised proved to be insufficient to carry the work through and in consequence operations were abandoned.

About 2½ years ago further capital was raised in England and a new Company formed to take over the assets of the former Company. Active work was commenced in March of last year under the supervision of Mr. J. H. Jeffers, the Company's Engineer, who came from England for that purpose.

During July, 1927 a commencement was made with the construction of a Hydro-Electric Power Scheme which has since been completed at a cost of £20,000. The erection of concentrating plant and aerial ropeway for ore transport purposes was then proceeded with and completed about a month ago.

The total expenditure of the present Company, according to official figures supplied, is Fifty five thousand five hundred and sixty seven pounds (£55,567).

The Mine, concentrating plant and power plant have now been brought to a stage to enable productive work to be proceeded with without further expenditure in constructional work.

The writer witnessed trial runs with various units of the crushing and concentrating plant, also the aerial ropeway.

TRANSPORT

On commencing operations, the first obstacle confronting the Company's Engineer was the question of transport of heavy machinery from the terminus of the Government narrow gauge railway at Comstock to the Mine, a distance of 11 miles. The route had formerly been used as a road and had been converted into a wooden tramway, which proved to be inadequate. The wooden rails were removed by the Company, the road gravelled, repaired generally and made suitable for transport of heavy material by motor lorries.

The reconstruction of the road was completed in June last year, the total cost to the Company being £3,000. The Public Works Department assisted to the extent of £600. That section of the road between Zeehan and the terminus of the Comstock Railway was also reconditioned and rendered suitable for heavy motor traffic.

PLANT AND MACHINERY

The following includes a list of the various essential works carried out by the Company in the way of mine equipment preparatory to productive operations:-

Hydro-Electric Power Scheme - Water for this is obtained from the Cumberland Dam situated on the Mine leases. Catchment Area 3 square miles. Average depth of water 8 feet approximately Depth at outlet 19 feet.

Outlet through 22 in. diameter mild steel rivetted pipe line controlled by sluice valve.

Head race to pipe line 59½ chains in length including 15 chains of wooden flume, remainder rock cutting and earth excavation.

Pipe-line - Forebay of reinforced concrete. Intake is provided with silt discharge, grizzly and screens.

Total length of columns 1960 feet. Vertical Head 760 feet. The pipes which are flanged are constructed of mild steel welded plate. Bottom section 14 in. diameter ½" plate and graded up to 18" diameter of 3/16" plate. The column is held in position by 9 reinforced concrete anchors, with expansion joints (8) behind each. Any section of column can be removed if desired. Column is supported on concrete blocks and substantial wooden trestling.

Power Station - This consists of one 700 Brake Horse Power latest type Boving Pelton Turbine. Speed 1,000 R.P.M. Governed by Boving patent oil pressure Governor.

The Pelton Wheel is direct coupled to 563 K.V.A. British, Thompson Houston Alternator generating 6,600 volts, 3 phase, 50 cycles. Complete Switch Board, high tension and low tension controlling outgoing mains, one to mine workings and one to concentrating plant. The reticulation of the low tension is to convenient points for use. The foundations for power plant consist of reinforced concrete, housing of wood frame building covered with G.C. iron. Building is provided with I section girders for overhead crawl and hoisting appliances.

Incline steel tramway runs parallel with pipe column and is indispensable for transport purposes, it is provided with an electrically driven winch and connects with steel tramway extending for half a mile in the direction of the mine workings. A small auxiliary power plant consisting of 1 Petters Crude Oil Engine connected with 25 K.W. Generator serves as a stand by. It was used for power during constructional operations and is separately housed. All transmission lines and transformed stations are complete. Voltages for power 415 for lighting 230. Transmission lines are designed for double the present station capacity. Pipe column is of sufficient diameter for duplication of present generating set. Provision for a second take off has been made. The Power plant is automatically controlled.

Crushing and Concentrating Plant. - This consists of 1 Jacques No. 5 Gyratory Crusher capacity 40 tons per hour reduced to pass through 2" ring. Stone from crusher delivered to mill hopper by conveyor belt. Crusher is driven by 50 H.P. Electric Motor.

1 No. 54 Warcy Ball Mill of latest type mechanically fed from mill hopper, rated capacity 200 tons per day. This mill is operated by a 50 H.P. G.E. Motor through Morse chain drive. It is fitted with patent centre feed and scoop feed combination.

This is the first instance in Tasmania where the stamp battery has been discarded in tin dressing plants for the modern and efficient Ball Mill.

Mill discharges to 1-6' x 3' Leahy vibrating screen which controls crushing, oversize from screen returned to mill by bucket elevator. Concentrating plant is equipped with the latest type griding pans, sand pumps, classifiers, concentrating tables, etc. Flooring of mill building is constructed of concrete, all foundations for heavy machinery are of substantially reinforced concrete. The mill building is provided with a substation control room in mill. Adjacent to mill building is one 250 K.V.A. Transformer station.

Separate electrical motors are provided for the various crushing and concentrating sections of the plant.

The Mill building is constructed of heavy wooden framing covered with G.C. Iron.

ORE TRANSPORTATION

An aerial ropeway of the mono-cable system has been constructed to connect what is known as the "Black Face" at the Mine Workings with the milling plant.

The distance between Terminals is 3800 feet. It is of the latest design made in Australia by Ropeways Ltd., having a rated capacity of 25 tons

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With additional skips deliveries could be increased to 30 tons per hour.

The steep mountain side over which the Ropeway has been constructed is extremely rough. The Rope bearers are supported on steel towers resting on concrete foundations. A very effective design of tension gear is constructed at the lower terminal at the unloading station at the Mill end. The ore is delivered to a bin of 200 tons capacity which is provided with loading chutes for convenience of trucking to Crusher.

The Ropeway owing to steep inclination is self-acting, but for convenience of control is geared by spur and pinions and belting to one 15 H.P. Electric Motor. The loading station is situated in a position that will command deliveries of ore from the Lower Level tunnel at the "Black Face" mine workings. At this station a storage hopper of 200 tons capacity is constructed. Present deliveries of ore will be obtained from the 85 ft. level at the Black Face. Ore from this level to loading station hopper is delivered by means of a self-acting double track tramway.

MINE WORKINGS

The Mine workings are situated at various points somewhat remote from each other. There are twelve known lodes on the leases in a more or less developed state and they carry varying quantities of tin ore. Particulars of the estimated quantity of ore in these lodes and the tin ore contents have been supplied by officers referred to and need not be repeated here.

Since the date of Dr. Loftus Hill's report very little developmental work has been carried out excepting at the Black Face.

The Aerial ropeway has been placed for the specific purpose of obtaining supplies from this face. The immediate future of the Mine will depend upon the results obtained from mining operations on this particular lode. On the commencement of productive work preparations can be made to provide transport facilities from other known sources of payable stone.

The former incline haulage track which runs roughly parallel with the aerial ropeway could with small expense be re-laid with steel rails and provided with necessary equipment to deliver stone to the unloading station of the Mine ropeway hopper.

The lode formations which the ground tramway was designed to connect with could not be conveniently served by the Aerial ropeway, hence the advantage of having a means to augment ore supplies obtained from other sources.

ORE BODIES

Black Face Lode - In the foregoing it is stated that the immediate future of the Mine will depend upon the results obtained from the treatment of stone mined from the Black Face lode, that is without incurring further expenditure other than on productive operations. Under the circumstances it is unnecessary to here refer in detail to other sources of ore on the Mine seeing that the Black Face lode is the only one at which deliveries

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for milling can be obtained without additional
constructional work.

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Subsequent to the last official report on this ore body, by Loftus Hills, D.Sc., a considerable amount of developmental work has been carried out by the Company.

Taking the surface at Munro shaft as a datum level, the level from the top of the ore bin at the Aerial ropeway loading station is 220ft. below the former. At this point a tunnel has been driven in the direction of the Black Face lode but is not sufficiently advanced to reach it.

The next level is driven at a point on the lode 115 feet below datum, the vertical dimensions being proved to be nearly double it was at the time Dr. Hills made his report.

At a vertical depth 85 feet below datum, a tunnel driven under the floor of No. 1 open face on the Black Face lode is connected with the latter by a rise. No. 1 open cut level is 50 feet below datum.

In early days of the field it is authentically recorded that 720 tons of stone treated in the old stamp battery from No. 1. open cut of the Black Face yielded 12 tons 18 cwt. 22 lbs. of high grade tin concentrates, which is equivalent to an average of 1 per cent. of metallic tin in the crude ore. This face at present shows a width of over 20 feet of ore of similar grade to that removed.

No. 2 open cut is situated at the entrance of the 85 ft. tunnel level, a massive face of ore is exposed here, the outcrop of the lode rising 30 to 40 feet above. This face is within a few yards of the loading hopper of the self-acting tramway.

ORE RESERVES

The estimation of ore reserves made by Dr. Loftus Hills in 1920 have not been materially altered excepting in respect to the Black Face lode to which a considerable accession of what may be termed proved ore has been made. The writer in making the examination to which this report refers confined attention to the Black Face only.

To systematically sample this ore body would occupy more time than the object of the present examination demands.

There is sufficient ore in sight which can be mined by open face methods to keep the plant crushing to full capacity for at least a year providing the ore body maintains its width to the 115 ft. level. From indications showing there is not reason to doubt that it will persist below the 220 ft. tunnel level.

From a number of crushing and vanning tests made by the writer from samples of ore taken from points where exposed in the workings well payable prospects of tin were obtained. The estimated tin content of 0.7 per cent. made by officers of the Company should be exceeded in actual treatment.

The Marcy Ball Mill installed at the plant is designed to treat 200 tons of ore per day. To commence with half that quantity would be a fair amount to handle until the various concentrating units are adjusted to full working capacity.

The ore of the Black Face Lode consists of quartz tourmaline the latter is to great extent softened, which obscuring the quartz gives the stone a dark appearance. Tourmaline in that form is readily carried off in concentration, the quartz matrix also being of low specific gravity which with the absence of any heavy constituent in the ore, renders it an ideal class of stone for the separation of the relatively heavy particles of tin oxide it contains.

The tin ore in the Black Face lode is well distributed through the stone although enrichments in the softer portions of the ore body are not uncommon. The tin oxide occurs in fine-crystal form and in colour resembles chocolate.

Assuming that the plant treats on an average 100 tons of ore per day, basing the recoverable tin content at 0.7 per cent. metallic tin, the daily yield would be 18 cwt. of tin oxide of an approximate net value of £100. The total cost of mining, transportation and treatment should not exceed 10/- per ton, with open face methods of mining which it is possible to adopt to the greatest advantage on the Black Face lode to a considerable depth below the outcrop.

WATER SUPPLY

Particulars of the capacity of the Cumberland Dam have been referred to in the foregoing. So far as power is concerned the Company is fortunately situated. The storage capacity of the dam is sufficient to ensure a full supply for all purposes throughout the year. For dressing purposes at the mill site, present requirements can be obtained from streams flowing from the higher ground nearby. For the dry season provision has been made by the construction of a water race from Packers Creek to a point below the mill site from which it will then be raised to tank at mill by an electrically driven centrifugal pump.

PRODUCTIVE OPERATIONS

The Company recently reached a stage in which productive work could be commenced, but owing to exhaustion of funds with which to carry on, suspended all work pending arrangements being made for further capital.

Every reasonable facility has been provided by the Company for convenience of the employees. Camp accommodation is arranged for 120 men. The camps are substantially built wooden structures with G.C. iron roofing and are situated at various points on the mine to suit the convenience of the workmen.

There are two residences for officials, also a boarding house conducted under the supervision of the Company.

MINE EQUIPMENT

The mine is provided with two stores which are well stocked with necessary mining tools, etc.

Fitters, blacksmiths and carpenters shops have been built and are provided with latest equipment in the way of mechanical and hand tools and appliances.

For transportation the Company possesses one 6 wheel Carrier Lorry, 2 one ton Ford trucks, one private motor car, 4 horses and harness.

FINANCIAL POSITION OF COMPANY

The appended schedule of costs of the various works and amount paid in wages was supplied by officers of the Company.

The Company some months ago exhausted its funds and a sum of £22,000 was raised by the issue of debentures for that amount in addition a further sum of £3,000 is owing to sundry local creditors.

The Company in addition to the expenditure on the Federation Mine, purchased an adjacent property for the sum of £3,000. On this a 5 head stamp battery was erected and a limited tonnage of ore treated with satisfactory results. Unfortunately the quantity of payable ore was very limited and following a brief period of activity operations ceased. If the Company had not been compelled to incur the heavy expenditure on the Trial Harbour road from Zeehan and confined its operations solely to the Federation Mine, the amount of capital expended in the district would have been sufficient to carry through to the productive stage.

CONCLUSION

The Company holds eleven mineral leases totalling 548 acres and eight water rights totalling 74 sluiceways.

The temporary cessation of operations following the completion of constructional work at the Mine with the consequent addition of a large number of men to the ranks of the unemployed is a severe blow to the district. It will be noted that during the brief period the Company has been carrying on operations in the district the sum of £26,225. 7.10d. has been distributed in wages.

In addition to the disbursement of such a large amount of money in wages in a brief period, the advent of the Company has been the direct means of affording the residents of Zeehan district an outlet by road to the seaside, a much needed utility which is availed of to the fullest extent during the summer and autumn months of the year. There is every probability of this road being used in the future as a connecting link from Corinna and Waratah to the Main Road system of the State.

The future success of tin lode mining in Tasmania will depend to a great extent on the result of the operations of the Federation Company. In addition to the more modern crushing appliances new and improved ore dressing appliances have been installed.

The Power Scheme completed by the Company is certainly a great asset to the district and should eventually prove the means whereby other mines will become established in the neighbourhood. The want of cheap and continuous power has been a factor which has

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greatly retarded progress in this part of the western mining fields.

A number of men are remaining in the vicinity of the field awaiting a resumption of work.

The Company will no doubt by some means raise sufficient capital to enable productive work to be commenced. To carry this into effect would cause considerable delay and expense in keeping the plant from deteriorating through idleness.

The present situation of the Company is somewhat unusual. It possesses a complete modern plant, including power, crushing and concentrating units and transport facilities. It has used all present available capital in constructional work, all preparations are complete to start productive operations without delay, but it has not sufficient money in hand to carry on until returns on ore production can be realised on, to continue work.

All that now remains to be done is to employ the necessary labour to supervise and conduct the various operations when money to pay wages, etc. is forthcoming.

The prospects at the Mine are sufficiently encouraging to venture the opinion that with the commencement of operations a good margin of profit over and above working expenses will result.

Taking all circumstances into consideration, the writer is of the opinion that this is an instance where the Government would be justified in extending assistance to the Company to enable it to commence productive operations without further delay.

I wish to record my appreciation and thanks to the Company's engineer, Mr. J. H. Jeffers for information placed at my disposal and assistance rendered, also to other officers of the Company.

J. G. Scott
STATE MINING ENGINEER.

Mines Department,
Hobart.

23th September, 1928.

FEDERATION TIN MINES LTD.PARTICULARS OF EXPENDITURE.POWER -

Power station	£5115.	6. 7		
Pipe Line	5252.	9.11		
Haulage	2680.	8. 2		
Diesel set	763.	15. 6		
Cumberland Race	1333.	11. 9		
Transmission Lines	2011.	17. 2		
Battery Sub-station (material only)	496.	10. 0		
Miscellaneous Electrical Plant (A.G. E.)	2346.	16. 9	£20,090.	15.10

AERIAL ROPEWAY -

The amount does not include 10% due on £3760.3.5. or engineers or erectors fees account for which are not to hand

	5290.	9. 0	5,290.	9. 0
<u>MAIN MILLING PLANT -</u>	6577.	2. 4.	6,577.	2. 4

CONSTRUCTIONAL WORK, BLACK FACE (Mine)

	697.	5. 9	697.	5. 9
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MINE DEVELOPMENT -

	3935.	8. 5	3,935.	8. 5
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GENERAL TRANSPORT -

	362.	18.10	362.	18. 10
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SUNDRIES - Including horses, tools, repairs, renewals etc.

	5246.	1.11	5,246.	1.11
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EXPENSES IN CONNECTION PLANT -

	2434.	4. 1	2,434.	4. 1
--	-------	------	--------	------

BUILDING AND CONSTRUCTION -

	2389.	14. 6	2,389.	14. 6
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ROAD CONSTRUCTION - Including Government grant

	3662.	11. 8	3,662.	11. 8
--	-------	-------	--------	-------

MECHANICAL TRANSPORT, LORRIES ETC.

	2500.	7. 8	2,500.	7. 8
--	-------	------	--------	------

WAGES, RILEY & GREY AREA -

	1814.	15. 4	1,814.	15. 4
--	-------	-------	--------	-------

AMOUNT PAID FOR RILEY-GREY LEASE

	3000.	0. 0.	3,000.	0. 0
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TOTAL			£55,567.	11. 3
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Wages paid amount to £26,225. 7. 10.

£81,792. 19. 1

RENISON LIMITED

APPENDIX 6INVESTIGATION OF GRAIN SIZE OF
TIN FROM FEDERATION MINE, ZEEHANL.G. CLARK 1931REPORT DEPARTMENT OF MINES, TASMANIA

INVESTIGATION OF GRAIN SIZE OF TINFROMFEDERATION MINE, ZEEHANL.G. ClarkMethod of Testing

The ore was crushed down in a small jaw-crusher to about $\frac{1}{2}$ " and then to size through a Braun disc-crusher. After crushing to the size required to free the largest tin grains, as determined by preliminary tests which are given below, the ore was sized and each size vanned separately to find the proportion of free tin in each grain size. After the free tin was removed the tailings from each size were recrushed through 150 mesh and vanned again. The object of this was to determine whether any of the coarser sizes could be rejected without further treatment. Considerable difficulty was met in screening the finer sizes as the ore was clayey and for that reason sizing was stopped at 150 mesh on the Reilly Section ore.

The concentrates after vanning were cleaned with a magnet which removed a small proportion of magnetic mineral. They were then digested to endeavour to remove the titaniferous iron. This was in a very resistant form and even after crushing the sample very fine and digesting for four hours very little was dissolved, although the concentrates obviously contained a big proportion of these minerals. Accordingly a number of assays had to be made which it had been hoped to avoid. Owing to the high proportion of heavy mineral it was decided not to attempt to clean the concentrates owing to the chance of losing tin in the vanning. By assaying the concentrates, as was found

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The second parcel was crushed through 30 mesh instead of 40 mesh as before. The crushing to avoid sliming was very carefully done.

Sizing Test

-30 + 40 mesh	33.6%
+ 60 "	12.4%
+ 80 "	9.7%
+100 "	4.0%
+150 "	10.9%
-150 "	29.2%

Free Mineral Test

	% Concentrates	Assay Value Sn.	% Metallic Tin in Size
-30+ 40 mesh	2.18	44.5 %	0.97%
+ 60 "	4.45	-	-
+ 80 "	8.2	13.5%	1.1%
+100 "	11.5	-	-
+150 "	7.35	16.5%	1.21%
-150 "	3.9	22%	0.86%
<u>After regrinding through 150 mesh</u>			
+ 40 "	2.1	6.0%	0.12%
+ 80 "	6.3	1.0%	0.06%
+150 "	14.1	0.5%	0.07%

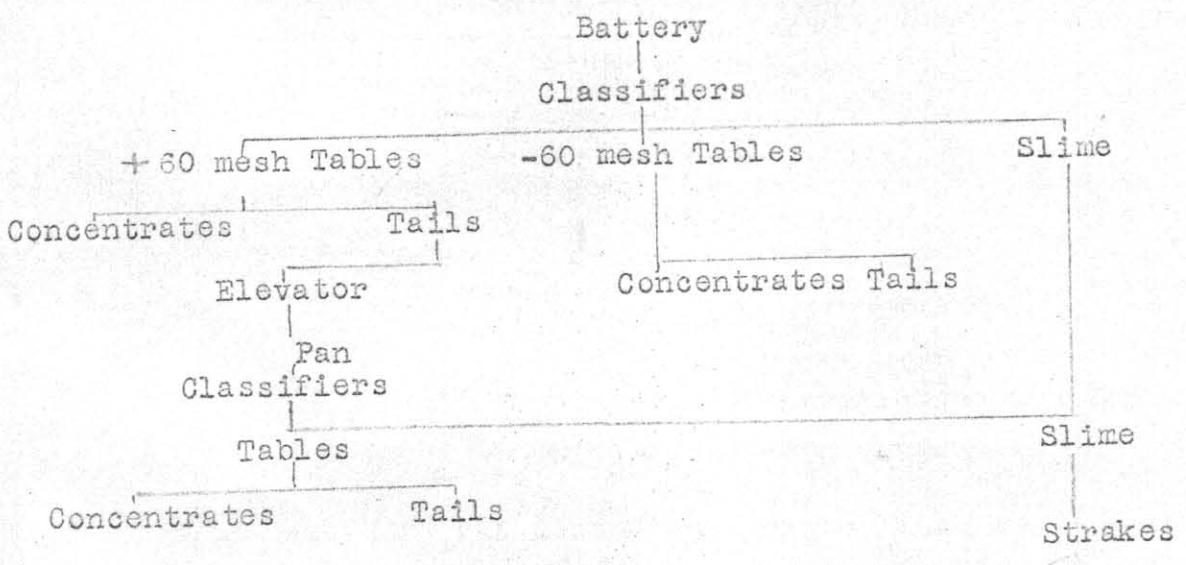
These results show the tin to be well distributed throughout the various sizes but that almost all the tin is freed from gangue by crushing through 40 mesh.

Owing to the above results I would suggest that

consideration be given to slightly modifying the small battery. The principle to be followed in the layout should be to concentrate as soon as the ore is crushed fine enough to free a moderate proportion of tin. The tailings from the tables handling ore down to about 60 mesh should be returned for recrushing in the pan. This will have two effects.

1. It will avoid crushing tin that is freed from gangue and which therefore can be caught on the tables.
2. It will reduce the proportion of ore being recrushed through the pan and so by regulating the size of screen on the battery so as to keep the pan working up to capacity the output of the mill will be increased.

The following flow sheet, shown in outline, would do this.



Changing the flowsheet as suggested would involve putting in a bucket elevator to return material to the pan, or moving pan. It is probable that, as crushed in the battery and pan, a bigger proportion of slimes will be got than by crushing in the . . .

laboratory, which was very , and therefore a relatively big area of strakes would be provided. The details of rearranging the mill will, of course, have to be decided by the staff on the mine. A set of laboratory screens should be obtained and used for controlling the work in the mill.

Black face

The ore from the black face contained two different species of gangue. One was chiefly quartz and moderately hard and the other a rock consisting of decomposed feldspar and tourmaline which was soft. Preliminary tests indicated that no free tin would be obtained on +30 mesh ore. A parcel was then crushed as before and screened, with the following results.

Sizing test

-30 + 40 mesh	21.4%
+ 60 "	20.5%
+ 80 "	7.9%
+100 "	6.7%
+150 "	5.4%
+200 "	5.6%
-200 "	32.4%

The two different gangue materials account for the sizing result.

Each size was vanned and the tailings were recrushed as before through 150 mesh and revanned. The concentrates were treated as before.

ane.

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Free mineral Tests

	% Concentrates	Assay value	% Metallic Tin
+40 mesh	0.47		
+60 "	0.88		
+80 "	1.13		
+100 "	5.1	.36%	
+150 "	6.26		
+200 "	8.29		
-200 "	4.5		

Tails recrushed through 150 mesh

% Concentrates
after recrushing
through 150 mesh

+40 mesh	1.14		
+60 "	0.95		
+80 "	1.42		
+100 "	4.2	...	2.6%
+150 "	0.8		
+200 "	3.8 crushed through 200 mesh		

Done by different vanner.

The concentrates contained a little magnetic mineral.

In the tin is distributed throughout the ore and the coarser sizing need recrushing.

The layout of your new mill should be reconsidered in light of these results. Generally it would appear that the ore should be crushed through -30 mesh in the Marcy Mill followed by classification tabling and recrushing of the coarse tails, preferably in form of tube mill. The same principle as given for the small mill concentrating as soon as tin is freed from gangue, should be followed in the layout. Special thought must be given to the slime department as a large proportion of the softer ore will be slimed.

The following flowsheet shows the proposed mill in outline.

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		% Concentrates	Assay Value	Metallic Tin
-30	+ 40 mesh	X 0.47		0.30
	+ 60 "	X 0.88		
	+ 80 "	X 1.16		0.74
	+100 "	5.1	36%	1.83
	+150 "	6.26	31%	1.94
	+200 "	8.29	26%	2.15
	-200 "	4.5	20%	0.9

Tails recrushed through 150 mesh

% Concentrates, after recrushing through 150 mesh.

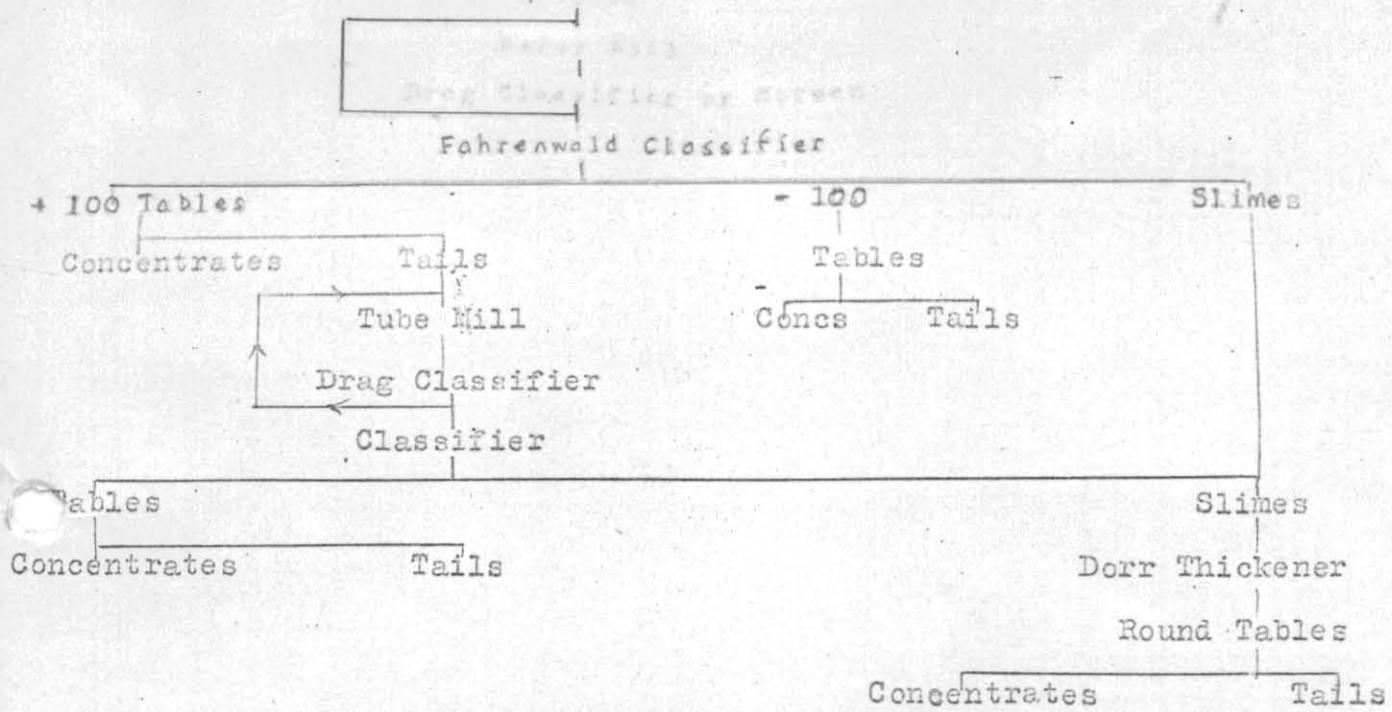
+ 40 mesh	X 1.14	- 51	0.58
+ 60 "	X 0.95		
+ 80 "	X 1.42	60	0.85
+100 "	4.2	2.6%	0.11
+150 "	0.8	2.0	0.02
+200 "	3.8 crushed through 200 mesh	3.0	0.11

X Done by different vanner.

The concentrates contained a little magnetic mineral. Again the tin is distributed throughout the ore and the coarser sizing will need recrushing.

The layout of your new mill should be reconsidered in the light of these results. Generally it would appear that the ore should be crushed through -30 mesh in the Marcy Mill followed by classification tabling and recrushing of the coarse tails, preferably in some form of tube mill. The same principle as given for the small mill of concentrating as soon as tin is freed from gangue, should be followed in the layout. Special thought must be given to the slime department as a large proportion of the softer ore will be slimed.

The following flowsheet shows the proposed mill in outline:-



Both the flow sheets given are only intended to indicate my views generally and do not deal with the details of the layout such as handling of middlings etc.

The results given show that, if regrinding is done on all material + 100 mesh as would appear advisable, regrinding capacity for about 60% of the total feed would have to be provided in the second tube mill. Further, the number of tables needed in different parts of the mill is indicated. Allowing 1 ton per hour for tables treating + 100 mesh material and $\frac{1}{2}$ ton per hour for tables treating - 100 mesh pulp, apart from the slime, the number of tables in each section for any output required can be calculated from the sizing test.

Also it would appear that a slime department handling about 30% of that material handled will be necessary. The replacement of strakes by multiple deck round tables is a possible variation in the slime department.

The flow sheets given above indicate my ideas in outline. I feel that the layout of the new mill requires more consideration than is intended to be given in this report and I should be pleased to discuss this and other matters arising from this report on a visit I am making to Zeehan shortly, the date of which I will



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RENISON LIMITED	
FEDERATION AREA 76-1163	
EL 11/76	
LOCALITY MAP 1553	
GEOLOGIST : K. WELLS	SCALE 1:50000 METRES
DRAUGHTSMAN : J. MATTHEWS	1000 0 1000 2000
DATE : MAY, 1976	
REVISIONS	DRAWING No.

MAP I

36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 42°00'

461083

STRAHAN 15 MI

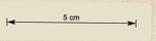
QUEENSTOWN 7 MI



- DEVONIAN GRANITE
HEEMSKIRK
- Dmw** Medium-fine grained white variety
 - Dcw** Coarse grained white variety
 - Dpr** Contaminated Porphyritic red variety
 - Dmr** Medium-fine grained red variety
 - Dcr** Coarse grained red variety
 - Da** Aplites
 - E** Cambrian Sediments and mafic-ultramafic sediments
 - *** Old Mine Workings

SOUTHERN

OCEAN



ZEEHAN A/4	ZEEHAN B/3
ZEEHAN C/2	ZEEHAN D/3
ZEEHAN C/4	

NOTE: Geology after Klaminsky 1969

RENISON LIMITED
461084 75-1163
ZEEHAN C/2
1554

GEOLOGIST	SCALE 1:10,000 METRES
DRAUGHTSMAN	0 200 400 600
DATE	
REVISIONS	

MAP 2
DRAWING No. F.P.1

