TIN DEPOSITS OF THE BLUE TIER DISTRICT

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The investigation into the possibilities of the BlueTier, as a tin-producer, has necessitated the preparation of several plans, incorporating the work of previous workers as well as any additional surveys that were considered necessary. As far as possible, most of the available information has been placed on the plans, which are listed below:-

1. Sketch - Geological, of the Blue Tier (Scale 1 mile to 1 inch)

This is based on the mineral charts, and on earlier geological plans, as well as on several reconnaissance pace and compass surveys. All heights are approximate only, being based on aneroid readings, which are sometimes rather widely spaced. This sketch plan shows, however, the general distribution of the tin-granite, the relative position of the different mines, as well as the physiography and the main geological features.

2. Value - Contour Plan:

This is based chiefly on the prospecting work of the Mount Lyell Mining and Railway Company, and although this work does not cover all the Blue Tier Tin Field, it expresses the value distribution, and shows the nature of the tin-ore shoots, in a much clearer manner than merely listing these results.

The plan covers only the central areas, and the chief areas not included are the Cream Creek and Kent Workings to the west, and the Anchor Mine to the south east.

All individual workings were not resurveyed. This was done only when previous plans were considered inadequate or there had been further work since the previous plans had been prepared. The undergrowth and collapse of some of the workings, prevented this examination from being, in several cases, as exhaustive as would have been desired. The following is a list of the workings that were surveyed but several others were examined in detail:-

1. Anchor Mine
2. Australia
3. "Chapman's North Cambria"
4. Don
5. F-B Lode
6. Kent Workings
7. Liberator
8. Lottah Tunnels
9. Michael
10. Moon (Full Moon, New Moon, Michael Moon

PREVIOUS LITERATURE:

In writing this report, the work of previous authors has been studied and the following is a list of the authors who have been consulted:-

1. G. Thureau, 1886 - Report on Blue Tier Mining District and its Tin Deposits (Plan and sections of part of Lottah Tunnel, Wellington, Anchor, Cream Creek, Haley's lease and Geological plan - 20 chains : 1 inch)

He divided the occurrences into :-

1. Lodes of which the Lottah Mine is typical
2. Dykes
   (a) indurated
   (b) soft
3. Soft formation or Great Fault
4. Basaltic Dykes.

2. A. Montgomery, 1889 - "Report on the Blue Tier Field" (Plan and section of Lottah Mine, 2 chains : 1 inch Sketch Geological plan - 10 chains : 1 inch.)

He states that there are three distinct occurrences of tin ore :-

(a) Alluvial Tin Ore
(b) Lodes (e.g. Lottah)
(c) Dykes (i.e. what is now called the Tin Granite)

The basalt dykes are not included with the tin occurrences

He lists the various mines and work they are doing and discusses the possible dam site locations of the Tier.

3. A. Montgomery, 1893 - Report on the Tin Mines at the Blue Tier, Country of Dorset.

He describes the Tin Granite as Quartz Porphyry Dykes running through the Porphyritic Granite. His plan shows the distribution of this granite (Scale 80 chains: 1 inch. After commenting on each of the mining properties of the district, he discusses the problem of the profitable mining and treatment of large masses of low grade ore.

4. W.H. Twelvetrees, 1901 - The Mines of the Blue Tier, Country of Dorset.
The object of Twelvetree's report was to supply information as to the extent of the deposits of tin ore in connection with the hydraulic scheme propounded by Rahbeck.

5. Malcolm S. Moore - Report on the Tin Field of the Blue Tier District, Tasmania. Aust. Inst. Min. Eng. December, 1912.
(Plan 40 chains to 1 inch, and section; 9 drawings of rock sections as well as sections of quarry faces)

He regards the deposition as part of the final stage of magmatic differentiation and cooling, some features of which were the intrusion of pegmatite into nearly horizontal "skrinkage" flows and the subsequent formation of vertical cracks and joints.

5a. (Some criticism of the views of the above paper was given by J.B. Lewis who quotes K.B. Lewis v. Aust. Inst. Min. Eng. 1913 No. 10)
In this paper the view is expressed that the tin granite is intrusive into the porphyritic granite, and the deposits may be due to pneumatolysis of the margin of the second granite intrusion coming up through the first formed granite of the district.

6. H. Herman, Australian Tin Lodes and Tin Mills Proc. Aust. Inst. Min. Eng. No. 14, 1914. H. Herman merely reviews the literature, and on p. 349 gives details of the plant (a previous account of this mill was given in 1904 "Aust. Mining and Metallurgy" p. 214)

7. J.B. Lewis, vol. 16, 1924. Chem. Eng. and Min. Review. The Blue Tier Tin Field of N.E. Tasmania, (Plan on scale 18 chains : 1 inch - shows position of aerial tramways) In this he gives his returns as 3.5 lbs per ton SnO_2 (or 1/5%), and describes his plans for bringing ore to a central milling plant by means of the aerial tramways. Over most of these working areas, he prospected on chessboard pattern, 12 feet square, and at each intersection bored a hole 12 feet deep. The details of these, however, are not given and are not available. He states that the value of the stone as crushed turned out to be only one half that obtained by sampling.

   Ore was brought from both Australian and Summit faces, and treated at the Anchor Mine.

   When work ceased before the 1914 War, the work was just paying and had not recouped the outlay for the aerial tramways.

8. J.B. Lewis - September 5th, 1924, Chem. Eng. and Mining Review "Exploitation of a Large Low Grade Tin Deposit."

   In this the author gives a plan of the Anchor Mine, in which are given the names of the faces, the position of the shafts and adits, the position of the diamond drill bores, (no details of the latter are available, however), and the layout of the tramways, &c. He gives further details of his plant and method of work, including his costing for one year, which was the most favourable for the supply of water for crushing (1906-1907) and had the greatest number of heads crushing. His production costs must normally have been higher than shown.

9. 1904 - The Mount Lyell Mining and Railway Company- bored 7200 feet of diamond drill holes and cut 49,000 feet of trenches.

   Faces of old workings and fixed lengths of the trenches and bores were sampled. In the northern part of the area, lines of jumper holes were sunk.

   These results were placed on plans generally 30 feet to 1 inch - and a smaller scale of 200 feet in 1 inch was used for showing the relative position of the workings.

   This is by far the most thorough and scientific testing of the Blue Tier that has yet been attempted.

   The results appear to be negative as far as a large open cut is concerned, but the information obtained is invaluable, and shows the nature of the ore shoots.

10. 1928 - Geological Survey Bulletin No. 38 - "Blue Tier Tin Field" by A. McIntosh Reid and Q.J. Henderson.

This is the most complete and exhaustive account of the Blue Tier that has appeared to date. It is illustrated by a contoured Geological map, and what is termed a Structure map, which apparently contains more geological information than the abovementioned plan. Not only is the history of the field exhaustively treated, but also such subjects as the geography, physiography, stratigraphy, and petrology. Many analyses of the rocks are given. Mining economics are dealt with at length and then the mining properties themselves are dealt with.

The arguments for an Anchor-type of ore body are not very conclusive and are an extension of the ideas of M.S. Moore on this subject. Diagrams of the building of a dam at Sun Flat are reproduced. The plan of the southern and northern group ore bodies are a reduction of the plans of the Mount Lyell's prospecting work without the detailed assay results. The position of the departmental bores and trenches are shwon.

The Bulletin is a very important source of information concerning the Tier.

11. Report of the Blue Tier Tin Committee, 1927 (C.G. Ryan, L.C. Clark, H.A. Curtis, A. McInstosh Reid, G.L. Clark)

This Committee was appointed by the Tasmanian Governemtn on the suggestion of the Development and Migration Committee to advise and report on the economic possibilities of the Blue Tier Tin Field. They selected the southern area first of all and arranged for an amalagamation of interest of the existing leases and the reservation of the Crown Land around and about the leased ground.

It was the considered opinion of this Committee that the deposits are of such magnitude and value as to warrant the expenditure of at least £10,000 in their exploration by drilling.

The scheme was based on the excavation and treatment of 1,500,000 tons per annum; power requirements 4,000 h.p. to be supplied by the Tasmanian Government's Hydro-Electric scheme, at £5/10/- per horse power per year.

The scheme presumed on the average recorded yields, a recovery of 0.20% tin oxide assaying 72% metallic tin.

It was recommended that bores should be placed on corners of squares of sides of 400 feet - followed by check boring at the centres of these squares (i.e. corners of squares 288 feet.)

Appendix No. 1 deals with Working Results of the Anchor Mine.
Appendix No. 2 Estimated working costs of the Scheme.
Appendix No. 3 Method of prospecting.
Appendix No. 4 Assaying methods.

Notes on Speicmens of Tin Bearing Ore by Dr. Frank Stillwell are also appended.

Vanning tests on tailings were also carried out and showed that tailings on 120 mesh contained only trace; through 120 mesh (-34% of whole) gave 2-3 Lbs. SnO_2 per ton.

Unfortunately the drilling programme was not carried out, and the additional data as to whether the ore reserves justified this programme were never obtained.

12. Through the courtesy of Mr. L.C. Clark , the plans and report of 1935 on the Anchor Mine were made available. This work is a welcome addition to our knowledge of the area, as it deals with that portion of the field, recommended by the Tin Committee as suitable for production. This report is illustrated by the following plans :-

Plan 1 - Scale 4 chains : 1 inch - shows area prospected.
Plan 2 - Anchor faces 1" : 1 chain.
Plan 3 - Anchor lease and surroundings - 1" = 100 ft.
Plan 4 - Assay plan 1" - 100 feet.

Lines and areas were scrubbed and burned and several shallow holes sunk to determine the boundaries of the two granites. The assay plan shows the position of the chases and bore holes, together with assay values. Apart from the location of these bores and chases, it brings to light the fact that the rich shoots of ore are very narrow, are not extensive in length or persistent in depth. Thus in any estimation of the potentialities of this area, very detailed exploratory work is necessary.

Further tests were instituted into the fineness of the tin (See Appendix 4). The information in this report is invaluable and Mr. L.C. Clark is to be commended for placing this information at our disposal.

PHYSIOGRAPHY.

Physiographically the Blue Tier is a plateau dissected by the tributaries of the Ringarooma River to the west and north, by the Anson and Mussel Roe Rivers to the eastern and north eastern side, and by the George River and its tributaries to the south. The Tier is,however, a stripped peneplain - a "fossil peneplain" - as is shown by the remnant of Carboniferous rock on Mount Littlechild. There is thus on the Blue Tier a large area of gently undulating land about 2,500 feet high, with monadnocks, e.g. Mt. Michael, Mt. Littlechild, standing a few hundred feet higher.

The rivers flow in broad, flat valleys, before plunging down in steep sided valleys on all sides of the Tier. This knick point is sharply defined. There appears to be a second knick point, e.g. near the Frome Dam Site, and on the Wyniford River, below its junction with Sir Garnet Creek. Probably corresponding with this are the lower spurs near the Liberator and Crystal Hill spurs. The river systems then normally join the coastal plains.

One other feature of the river system should be mentioned, namely, the possibility of river capture of the upper water of the Frome by the Wyniford. The great width of the Frome Valley around Emu Flat near where the valley of the Wyniford seems to be perched above the head of Kent Creek - the wind gap between the two valleys at this

point, and the change of direction of the Wyniford, are very pronounced. It seems extremely likely that the branch of Cottons Creek cut back, beheaded and shortened the line of flow of the Wyniford River.

The physiography helps us to understand the river system; the flat upper portions where unfortunately the amount of catchment is insufficient to fill any large reservoir; then the rapid fall of the streams and their youthful topography with the absence of any suitable sites for dam construction; the probability of river capture so that the water of the Wyniford could be diverted into the Frome by means of a very short race, the possibility of increased water power made available by the sharp drop in elevation at this point, and, lastly, the suggestion of the second knick point which in the case of the Frome led to the construction of the Frome Dam above this point, and of the hydro-electric scheme below.

GENERAL GEOLOGY

As previous investigators have dealt with the geology in detail, it is here summarised :-

AGE	TYPE OF DEPOSIT	GENERAL REMARKS
Recent	Alluvial and detrital deposits.	Rich in tin, but worked out where water is available.
Tertiary	1. Basalt	Lava poured out from many points of eruption - of no economic importance for tin producing; occur also as dykes.
	2. Sub-Basaltic Wash	Very poorly developed in this district, but contain a little tin, and rich in pebbles, &c., derived from the Carboniferous rocks.
? Jurassic	Dykes of Diabase	Intrude the older rocks; no influence on tin.
Carboniferous	Sandstones mainly	Form flat beds, and outcrop only in one small area at Mt. Littlechild.
Epi-Devonian	Granites and associated minor intrusions	1. Porphyritic Granite 2. Tin Granite, intruding the Porphyritic Granite; the tin deposits are closely related to the final phases of the intrusion of this magma.

The alluvial and detrital deposits have been in the main exhausted, but the original source of the tin, namely, the enrichments associated with the intrusion of the tin-granite, form a vast reservoir for tin. Any information regarding the tin granite is thus of great importance.

The field evidence is convincing as to the presence of two granites :-

1. The Porphyritic Granite:

This in itself is not stanniferous, but veins of quartz, greisen, aplite or any minor intrusions of later granite may carry tin. Many attempts have been made to work these occurrences where they are of sufficient size, or sufficiantly close together to make their extraction payable.

2. Tin Granite:

This intrudes the earlier granite in an irregular manner. The introduction of tin is associated with a late phase in the cooling of this magma as well as the final phase, which is generally associated with the formation of the minor intrusions, e.g. pegmatites, greisen veins and aplites.

The contact between the two granites can be studied in detail at several places, e.g. the Anchor faces, Moon Workings, Marie Workings, F-B Lode, and Cream Creek.

Of particluar interest are the fairly flat contacts at the Anchor faces, Cream Creek, F-B Lode, and Don Workings. The angle of contact can alter very rapidly, e.g. at the Anchor Mine the contact on the eastern and western sides dips to the south at 8° - 10°, but the southern boundary has a very steep dip to the south, as in the Tributors adit, it dips 42° to the south, and further east this has increased to 70°.

Although not universally developed, pegmatites are characteristic of the junction of the two granites. The pegmatites form lens-shaped bodies and where they are missing the contact of the two granites is a very sharp one, marked by a darker band a few inches thick, due to the concentration of mica. In other parts there is a whitish kaolinised layer with blades of mica, 2" - 3" long. While the above are characteristic of the flatter contact, the pegmatites may be developed on very steep contacts, e.g. in the cut for the tramway on the west side of the Don Workings.

In the valley of the Wyniford, just below the junction of Cotton's Creek, a relatively fine grained rock with occasional large phenocrysts of felspar and quartz, is intruded into the porphyritic granite. This may be a marginal phase of the tin granite, or a separate intrusion. The other boundaries were not found, and detailed mapping and petrological work are necessary before a complete picture of the various igneous rocks can be obtained.

The granitic rocks of Epi-Devonian age are the source of the tin, and the matter of deciphering the sequence of events and the relationship of the granites to each other is thus important.

ECONOMIC GEOLOGY

There are two granites present on the Blue Tier, and each has its characteristic type of ore deposit:-

1. Porphyritic Granite - and associated aplites and pegmatites, &c.

   These are not tin bearing, but are intruded by quartz, greisen, aplite and pegmatite veins of a later intrusion which may be tin bearing.

2. Tin Granite - which is much finer grained, and in places more altered than the Porphyritic granite . This granite intrudes the Porphyritic Granite, and truncates the older aplite veins, and rarely contains inclusions of the Porphyritic Granite.

   In this granite, the tin occurs as seams sometimes very thin and nearly vertical, as disseminations in the rock, very often in flat floors. Greisen-quartz veins which are tin bearing out indiscriminately through the two granites.

The sequence of events as far as these rocks are concerned, can be stated as follows :-

1. Intrusion of Porphyritic Granite (not tin bearing) 1a. with final, pegmatite, aplite phase (also not tin bearing)

2. Intrusion of Tin Granite into the Porphyritic Granite, with pneumatolitic phase associated with the introduction of cassiterite.

   2a. Final phase of aplite, pegmatite which may be tin bearing, and of greisen and quartz veins which cut through both granites.

From an economic point of view there are thus important distinctions between the granites and the type of tin deposits associated with them.

1. The Porphyritic Granite:

Quartz and quartz-greisen lodes intruding this granite have been mined for tin. As a rule, these are thin, but sometimes several occur together and can be worked, provided the alteration of the granite is sufficiently advanced to soften it so that it can be sluiced. The types of deposits of this nature that have been worked can be broadly considered under the following headings :-

(a) A series of parallel veins, e.g. Cambria Mine,
(b) Intersecting system of veins, e.g. Chapmanls "North Cambria",
(c) "Bulges" on Greisen Veins, e.g. Chintock's Prospect,
(d) Quartz Veins, e.g. Lottah Tunnels, Full Moon.

In some cases the greiser veins themselves are soft, but as a rule they are much harder than the enclosing granite. The tin bearing ore can thus be concentrated by sluicing away the barren porphyritic granite and this ore is then crushed on stamper batteries. Several plants only used boxes to recover the tin, but most of the plants now use concentrating tables. Unless the granite can

be sluiced away, no financial success can be expected from mining operations, owing to the small thickness of the veins. The factors governing the softness of the granite depend on weathering or on chemical changes in the granite. The presence of the veins makes the granite softer due to partial kaolinisation, or hydrothermal alteration, but this has not proceeded very far, and it is depth of weathering that is, as a rule, the factor governing the degree of softness of the granite. Residual surface concentration from the greisen veins is by no means uncommon, but none of the deposits are extensive.

2. Tin Granite:

The tin granite is stanniferous in certain parts, and in these, richer patches are to be found. Generally, the tin bearing portions, owing to pneumatolytic and hydrothermal re-actions associated with the introduction of tin in the granite, are much softer than the barren portions, and are thus more susceptible to weathering. As a result, most of the richer patches have been discovered during sluicing operations on these detrital deposits. When the true nature of the deposits was discovered, mining methods were adopted when convenient.

Normally the tin granite is fairly coarse and even grained. The alteration of this granite is of the type known as greisenisation. During this change, the dark mica is changed into a white mica, the felspar is destroyed, to be re-placed by topaz and quartz, and sometimes fluorite. This change is accompanied by the introduction of cassiterite. According to Dr. Stillwell (Report to the Blue Tier Tin Committee) the above process is probably followed by a hydrothermal alteration, which is indicated by the presence of prosopite, as an alteration product of the topaz. In certain parts, there is also silicification of the tin granite. These changes have advanced to different degrees in various parts of the field, and account for the varying aspects of tin granite. As the introduction of the cassiterite is intimately associated with these changes, it follows that the <u>normal tin granite does not contain tin - the search for tin has thus to be confined to the areas where altered tin-granite outcrops</u>.

Dr. Stillwell also gives the measurements of the grains of tin oxide in the slides he examined. These give some idea of the size of the cassiterite, but as the number of slides that he examined was small, the measurements need not be representative. The largest he found measured .8mms. x 4 mms., and the smallest .02 mms. x .02 mms.

Veins of greisen similar to those that cut through the porphyritic granite can sometimes be seen cutting through the tin granite. The formation of the tin deposits can thus be associated with the final phases of the intrusion of the tin granite, and the tin bearing greisen, aplite and quartz veins, as the last incident associated with this intrusion.

DISTRIBUTION OF THE TIN GRANITE

The main bodies of tin granite are shown on the sketch plan. To delimit the boundaries accurately, would necessitate detailed surveys which would take some time. The boundaries which have been sketched are shown as such, and the only areas where there may be a big development, not shown on the plan, is around the Wyniford River, from the junction of Cotton's Creek to the marked change in the course of the river, north of the Kent Creek.

The distribution can be conveniently described as a southern belt and a northern belt, joined dyke-like bodies forming the central belt.

Southern Area:

The tin granite outcrops on the south flanks of the Tier to the West of Lottah. This body terminates rather abruptly on the top of the Tier, and to the south somewhere near the Broom River, so that while the junction with the porphyritic granite is generally flat, e.g. the Ethel Prospect, the east and west edges must be steep. The small extension northward on the Don Workings also shows a very flat junction, and the same applies to the eastern extension around the Anchor workings. Another smaller patch extends eastwards along the ridge between Lottah and Gould's Country. The boundaries of this are not known in detail, but do not reach as far north as the Ramsom River. One contact is to be seen at the Victory Mine.

The distribution of the mines seems closely related to some of the contacts of the granites, as shown on the plan, or where they could reasonably be projected, e.g. Anchor, Don, Duce, Australia, Summit, Ethel and ? Victory Mine. The one exception is apparently the Liberator Mine.

Northern Area:

Two large areas extend from the Wyniford northward. The first embraces that part in which the Perennial and Michael Mines are located. Apart from one small tongue this does not reach Cotton Creek.

The second body is separated from the first by a narrow strip of Porphyritic granite, but the boundary on the western side is very imperfectly known, as the small north trending parallel strip near Masher Creek may be more extensive than shown. If the Granite Porphyry just below the mouth of Cotton Creek is a contact phase of the Tin Granite, ther may be a much bigger area of tin granite than is shown on the plan. Apart from Masher Hill, there is no mine opened in this area of tin granite.

Smaller isolated areas occur further west, as that in part of the Kent, Wickborg Valleys and extending down to the Emu Flat, but only one enrichment is known, namely, that at the Kent Workings.

Around the F-B Lode, there is also a small patch of Tin Granite, which has been sluiced. Irregular boundaries in thickly forested area, makes the delineation of the boundary vary difficult on the Cream Creek and Spink's Workings.

The Central Dyke-like Bodies:

While the large masses of tin granite show their nature clearly, the large narrow connections between the northern and southern bodies are essentially dykes. Their connection with the larger masses makes it clear that they are merely projecting portions of the tin granite. There are three of these dykes which should be mentioned.

There are no mines in the western-most. This has been prospected near the Wyniford, where it is known as Griffins Dyke.

The central one, just to the west of Poimena, is known in great detail, as the boundaries have been delineated by the prospecting work of the Mount Lyell Mining andRailway Company. There are also a number of shafts, cuts and tunnels, while the bores give information as to the behaviour of the dyke at depth. It varies in width from 30-120 feet, and has a slightly sinuous course, while it has a defined but irregular dip to the west of between 40°-50°.

The eastern and shorter body is that near the Moon Workings, where a plug-like intrusion fingers out rapidly both to the north and to the south. The boring and trenching programme gives a very accurate picture of this deposit.

VALUE - CONTOUR PLAN: Drafting Room No. 853/33

This is based mainly on the prospecting work of the Mount Lyell Mining Company's work.

This work emphasises a few important things:

(1) The low tin values over most of the tin granite and indeed their absence over large areas;

(2) The richer patches are limited in extent, and do not form continuous bodies. The sporadic nature of the rich shoots is very proncunced.

(3) The meridional trend of the shoots is at once evident;

(4) Richer values have a tendency to occur where the junction of the two granites is fairly horizontal and at right angles to the meridional trends of the ore shoots. e.g. (a) Don, Duco, Crystal Hill in southern part of the plan; (b) Summit and Ethel Prospects in central portion.

This is due to the tendency of the richer values to be along "floors", which correspond to the "bedding" planes of the granite massif.

The Australia Mine probably represents a "floor" beneath that of the Summit and Ethel "floor".

In the central dyke-like body, the values have a decided meridional trend. Areas of richer values are apparently not continuous, and the claim of McIntosh Reid that there is a central rich portion cannot be substantiated. Still further north, the programme of prospecting work gave very little information. As far as can be gathered, lines of jumper holes were used, and if the richer values are in narrow meridional bands, then many could easily be missed.

The area around the Michael Mine is marked as a belt of high values, because detailed records are not available, and it seems extremely likely that the plan should show higher values in certain spots rather than the average value as shown on the plan. The values as shown on the plan are rather lower than figures supplied by Bulletin 38.

iii MINING PROPERTIES:

(a) Southern Area:

THE ANCHOR MINE

Of all the mining at the Blue Tier, only that at the Anchor Mine, situated on the extreme south of the field, has been of sufficient dimensions to give information of values as to mining of the tin granite on a large scale.

For details as to the history of the mine, reference should be made to Mines Department Bulletin No. 38. At the time this was written in 1928, a party of tributors were producing on a small scale.

Between 1925-1933, no official records of production are available. The Annual Report for the year 1928, however, states that tributors from the Anchor Mine recovered 4.25 tons metallic tin valued at £1489,34.

In 1934, the Anchor Tin Syndicate commenced operations, drove a low level adit, and installed an ore breaker, 10 head stamper battery, classifiers and tabling units. Additional milling and concentrating units were installed in the following year.

In 1936, Tasman Tin No Liability after careful investigation took over the mine, and installed new classification and tabling units and machines were used instead of hand drilling.

Since early in 1938, the mine has been worked by tributors.

The official returns are as follows :-

YEAR	ORE TONS	TIN OXIDE TONS	METALLIC TIN TONS	VALUE £	RECOVERY %	REMARKS
1934	1956	10.125	7.100	1,628	0.36	Anchor Tin Syndicate
1935	18121	100.700	71.428	16,294	0.39	do.
1936	17084	30.500	21.718	4,520	0.13	Tasman Tin N.L
1937	24982	45.150	31.230	7,633	0.125	do.
1938	24528	46.625	33.322	6,377	0.13	do(Tributors
1939	26204	34.123	24.317	5,581	0.09	do.
1940	20652	33.900	24.230	6,211	0.117	do.
1941	10942	35.405	26.110	6,823	0.24	do.
1942		20.210	14.480	3,758		do.

Most of the ore obtained from the Tunnel face, but when the tunnel collapsed, work was tranferred to the most southerly of the Pentridge faces (the Lower Haulage face).

From the inception in 1890 to the end of 1942, the official returns show 2322.109 tons metallic tin valued at £347,453, have been produced.

GENERAL GEOLOGY

The plan which was prepared from a tacheometer survey agrees very closely with that prepared for the Tasman Tin No Liability. The workings are on a sufficiently large scale to trace accurately the junction of the tin granite and the porphyritic granite. Several dykes of basaltic or doleritic composition trending NE are present, but obviously have no influence on the tin bearing ore.

The southern boundary of the tin granite has a very steep dip (in the tunnel of 42° south and in the face further east of 72° south) and thus limits the extension of the open cuts in this direction.

The boundary between the granites then flattens, and has a very gentle dip to the south, as can be seen from the sections. The porphyritic granite extends over the hills to the east and west of the workings, and although attempts have been made to strip this overburden mainly on the east side, the expense has proved too great. Most of this work was done before 1914, but the thickness of the overlying barren granite is too great, and the depth to which weathering has proceeded is not sufficient to permit of sluicing this away.

The northern boundary can be seen just above Gaunts and Breadmore's Faces, but owing to the covering of scrub could not be traced as accurately as in the open cuts. The Tasman Tin N.L. however, sank many holes and defined the boundary between the two granites in this part of the lease. A narrow tongue of tin granite extends up Ariel Gully, and opens out into the large area around Crystal Hill. North of the main eastern (Pentridge) faces, the tin granite extends to the Lottah Road. East of the Pentridge faces, the tin granite outcrops on a sharp knob west of the main road. This was prospected by an adit, which, however, did not disclose ore that could be profitably mined.

The Contact of the Two Granites:

The junction of the two granites is very sharply defined and is usually marked by a development of various types of coarse pegmatite.

Tin Granite: The tin granite shows variation from place to place and over most of the open cuts it is greisenised. In the Haulage Face (southern part of the Pentridge Faces) it is whiter, due to the hydrothermal alteration of topaz to (?) prosopite.

Small veins of greisen can be traced in some of the faces, particularly the western ones. These have a general northerly trend and, as a rule, are nearly vertical. Their course is often marked by thin, soft partings, which carry rich patches of tin ore. They apparently form the channels of mineralisation.

The deeper faces do not show the "floors" as plainly as the shallower ones, but in all cases joint faces dipping steeply to the east or west are much more pronounced than the horizontal jointing. Joint measurements show that the major joints run chiefly within 10°-15° of N and S, and that the system running approximately at right angles is about equally well developed. Many of these joints are coated with fluorite.

Nature of the Ore Shoots: The tin is not evenly disseminated through the tin granite. All previous investigators are unanimous in their opinion that a flat rich "floor" was present. Evidence of this can still be seen in the eastern faces, particularly where an attempt was made at mining by chambering beneath the porphyritic granite.

There is also strong evidence of other enrichments as in the Syndicate Face which had the character of a pipe-like mass gradually decreasing in size downwards.

The tin oxide also occurs in steeply dipping seams, striking a little east of north, separated from each other by bands of barren and frequently harder stone. This latter observation applies with equal force to the horizontal seams, which form the "floor" deposits so characteristic of this tin field.

Prospecting: The Tasman Tin N.L. carried out a programme of sampling by cutting chases at right angles to the greisen veins, and vertical jumper holes were sunk to a depth of about 25 feet. These holes as they cut the ore veins at an unfavourable angle, did not afford much information. Details of these chases can be seen from the plans of the above company, which clearly show the occurrence of the richer ore in shoots. (see also appendix)

In addition to the above 9 holes were sunk by a churn drill. The available details are listed below :-

No. 1 Bore 155' deep 0.032% Sn.

Two highest 5 ft. sections yielded just over 1 lb. tin oxide per ton.

No. 2 Bore 200' deep

0' - 5'	0.03% Sn
5' - 10'	0.22%
10' - 15'	0.19%
20' - 25'	0.08%

The other results were all below .03% Sn.

No. 2A Bore (check on first 25 ft. of No. 2)

4' - 10'	0.54% Sn
10' - 25'	0.06%

90' deep

No. 3 Bore

0' - 5'	0.25% Sn
5' - 10'	0.13%

The rest only a trace.

150' deep

No. 4 Bore

Trace except for the section 60' - 65' which gave 0.61% Sn.

No. 5 Bore 180' deep

0' - 5'	0.21% Sn
5' - 10'	0.22%
10' - 15'	0.06%
15' - 20'	0.12%
20' - 25'	0.03%
25' - 30'	0.09%
30' - 35'	0.17%
35' - 40'	0.19%
40' - 45'	0.31%
50' - 55'	0.17%
55' - 60'	0.06%
60' - 65'	0.03%
65' - 70'	0.03%
70' - 75'	0.04%

The rest were below .03% Sn

No. 6 Bore 175' deep

Only one section gave more than .07% Sn.

No. 7 Bore 84' deep

Poor to 65 feet, then 10 feet only of payable ground.

No. 8 Bore 87' deep

Average over 87 feet about 0.15%

No. 9 Bore Average is in porphyritic granite and did not penetrate the tin granite.

The result of this drilling campaign show that, taken as a whole, the ore is low grade, but that there are enrichments in certain places. Unfortunately, no attempt was made to delimit the lateral extent of these enrichments by a closer boring programme.

The returns of the Tasman Tin N.L. bear out the testimony of the bore holes as to the low grade of the ore, particularly when it is borne in mind that the mining is selective.

Conclusions:

Although the ore is low grade as a whole, attempts could be made to prove the extent of the enrichments, disclosed by the bore holes. The problem of the extension of the mine workings is governed to a large extent by the question of overburden. The workings cannot be extended further south as the boundary between the two granites has a steep dip to the south, while both to the east and the west, the cover of porphyritic granite is too tick for economical removal. There is room for expansion northwards, however, up the two gullies that have been cut through the barren cover rock, and on the ridge between these two gullies.

This ridge should be prospected, as two shallow faces, Breadmore's and Goughs have proved the presence of stanniferous granite.

Before formulating any scheme of working this part, prospecting work should be carried out by costeaning or boring, to determine the amount and grade of the ore that is available.

DON WORKINGS:

The workings are situated near the foot of the spur between Crystal Creek and its tributary, Tin Dish Creek. The main cut is just north of Crystal Creek, but a smaller one with a short adit is on Tin Dish Creek.

The cut is 360 feet long and is up to 120 feet wide, with two well marked floors. The upper floor is on the level of a rich make of stone which has been followed into the hill by a number of chambers.

The boundary between the two granites has the usual pegmatite contact in the cuttings for the tram line to the battery, which was further upstream. The dip here is steep, 70° to the west, but this flattens out as the contact changes its direction and turns to the east on the spur just north of the open cut. The porphyritic granite does not outcrop in the faces, as claimed by Bulletin 38, and this is substantiated by the boring by the Mount Lyell Company.

The workings were thoroughly tested by the above company, and disclosed a very rich floor in the eastern half, and the extension of this, as a "flat floor" was indicated by the bores. This rich floor has since been extracted, as is shown by the plan, but even then only selected material was sent to the battery. The following list indicates the results of the bores :-

Bore No. 45 - Inclined 45° N.E. - 100 feet - Average 97.6' x .03% Sn

Only first 30 feet of this bore yielded any tin values:-

0' - 10'	gave	.02%
10' - 20'	"	.10%
20' - 30'	"	.13%

Bore No. 47 - Inclined 45° E.N.E. - 100 feet

This gave only a trace

The other bores were at varying distances up the hill side, and are fairly close to the face (20 feet).

Bore No. 43 - Inclined 70° to S.E. - 100 feet - 89.8' 0.11% Sn

Approximately the first 30 feet gave a trace, but the next 10 feet gave very high values of 0.91%. The values dropped to .06% for the next 20 feet, and then diminished further, so that only a trace was obtained over the last 30 feet.

Bore No. 44 - 80° for 100' - 65' from face
Grade 75.6' x .038% Sn (and not .02% as in Mount Lyell plan)

In this bore, as in No. 43, the tin values are very low except between 30' and 40' where a grade of 0.21% was obtained, and the next 10 feet which yielded 0.08%.

The other three bores, further up the hill side, all started in the overburden granite and passed into tin granite at about a depth of 10 feet. The contact between the granites is fairly level, with a slight dip to the south.

Bore No. 49 - vertical - 79.5' deep - Average less than .01% Sn

Between 50 feet and 60 feet the richest part yielded only .05% Sn.

Bore No. 46 - 60° to S.S.W. for 100 feet. Averaged .02% for 80.7'

At first only trace, then between 50' and 80' successive 10 feet lots gave .05%, .06% and .04% Sn.

Bore No. 48 - 60° for 72.5' - Average 58.2 feet for .003%

Only the last 10 feet of bore gave any values and they were exceedingly low, viz. .01% Sn.

CRYSTAL HILL AND DUCO WORKINGS:

These workings are situated south of the Weldborough-Lottah road, and the tin granite on these spurs is connected by a thin neck of tin granite with the Anchor area.

Several patches of tin bearing ore have been located here, but they are apparently very limited in extent. It should be noted that the present plan differs from older ones, in showing a large bulge of porphyritic granite south west of the Don Mine, so that the exploratory work of the Mount Lyell Company is broadly arranged around this bulge.

1. Eastern Trench -

This exposes a aplite dyke 8' wide running East and West. North of the dyke a floor gave 0.65% Sn for 35 feet, but the rest gave 0.04% and 0.05%.

Bore No. 38 dipping 45° to north for 100 feet gave only trace of tin. The bore is to the west of the cut, and the assay value to the east of the rich floor was very poor. The shoot is thus very narrow in an E-W direction, but its extension to the North and South has not been proved.

2. "Apatite" Trench -

This gave very poor results, and Bore No. 36 directed to Eat at 45° for 100 feet gave either nil or a trace of tin.

3. Gaunts Shaft -

This shaft is under water, but is 20 feet deep. Mount Lyell Company's assays of samples around shaft and 3 feet above floor of cut, gave 0.24% Sn, and 24 feet around shafts yielded 0.16%. In shaft 18' below floor of cut, a result of 0.10% Sn was obtained.

A bore hole 154 feet to the south west on dip 45°, passed beneath the shaft, but results were disappointing, being merely a trace.

4. The West Cut -

This is on the small creek to the west of Crystal Hill and is of small size. A bore hole to test this at depth at 45° for 100 feet to the west did not disc lose values worth noting.

5. The Duco Workings -

This lies further to the north west and near the main road. They consist of an open cut about 60' in diameter with an approach 150' long, bearing S.30°E. At the end is a shaft (fallen in at time of inspection) and a very short drive. At the mouth of the approach is a winze connecting with the adit, that runs underneath the main road.

The granite was sluiced, and when it got too hard was blasted. Even then it proved too hard to be disintegrated by water power.

Bore hole No. 42, dipping west at 45°, gave good values, confirming the values obtained by the surface sampling, as

0' - 10' gave 0.08% Sn
10' - 20' " 0.08% Sn
20' - 30' no core, and then values were poor.

Although the Crystal Hill Company erected a 10-head battery, very little crushing had been done when the battery was destroyed by a bush fire.

Of 6,058 feet trenching by the Mount Lyell Company, only about 2,500 feet was tin bearing, and the average value over this length was 0.012%. 30 feet of rich stone averaged 0.57%.

In open cuts, 342 feet gave 0.12% and 56 feet gave 0.44%.

AUSTRALIA MINE:

This mine is situated on the steep southern flank of the Tier, and north of the Crystal Hill. At present, there are two open cuts, one on either side of the self-acting tramway, but at the time of the Mount Lyell Company's exploratory work, only the eastern open cut was worked, and was known as the Puzzle Face.

Exact details of production are not known - but the Australian Tin Mining Company which had a battery of 30 stamps at this time, crushed between this face and the Don selected stone which is said to have averaged 0.66%.

The Puzzle faces were sampled in detail, e.g. an aggregate width yielded an average of 0.495%, and here again values appear to indicate the presence of a rich floor. Greisen veins dipping steeply to the north and striking a little to the north of east gave very rich returns.

The trenching of the Mount Lyell Company disclosed enrichments west of the Puzzle Face, and the work was carried on in this part by the Anchor Company, under J.B. Lewis, and the ore transported by aerial tramway to the Anchor battery. There are two floors in this western cut, the most westerly one being 30 feet lower than the other. The eastern floor has a shaft, connected to the adit from the tramway from the western most face.

The eastern open cut (Puzzle face) was tested by two bores.

Bore No. 37 dips 20° to North for 150 feet, and disclosed very low tin values, the highest being 0.03% Sn. The bore as a whole averaged 0.004% Sn.

Bore No. 39 is also inclined at 20° N. for 150 feet. The richest values in 10 feet lengths of this bore were between 30' - 60' and these assayed, respectively, .04%, .08% and .05%, Sn.

The average for the bore is .035% Sn.

Both these bores were below the rich floor and apparently did not cut the rich greisen seams.

Bore No. 41 is approximately 160 feet south of Bore No. 37 which dips 45°W for 100 feet. This bore yielded only a trace. This bore also did not reach the east striking greisen veins.

Bore No. 35 lies to the north of the faces and dips west according to the plan the section, however, shows dip to E and again disclosed only traces of tin.

SUMMIT MINE:

This lies on the edge of the Tier, and the open cut was opened by the Anchor Company, the better grade ore being sent to an ore bin at the Australia Mine, by a self-acting tramway, and then by aerial tramway to the Battery at the Anchor Mine.

The open cut is over 40 feet deep, just over 70 feet long, and about 30 feet wide, and the approach is about 140 feet long.

The side of the quarry is where an enrichment was shown to be present by the Mount Lyell Mining Company.

Three bores by that Company give information about the deposits. Bores 30 and 28 dip 45° towards each other in an E-W line.

The westerly bore (No. 30) proved very low values, but in No. 28 Bore (148') there is an enrichment at about 45-50 feet (vertically), as can be seen from the following figures :-

Depth (along Bore)		
49' - 52'	-	0.06% Sn
62' - 68'	-	0.52% Sn
68' - 78'	-	0.09% Sn

Values are poor below this except 120 - 140 feet which gave 0.13%. The average over the entire length is 0.07% Sn. Bore

No. 32 is like Bore No. 30, in the open cut, but is directed vertically. Very poor values were cut, except for the first 20 feet which gave 0.54%, Sn. This ore is that on which the quarry was opened.

It should be noted that as in the case of the Australia and Don Mines, it is only selected stone that was sent to the Battery.

Between the Summit and the Australia Mine is a bore dipping N. at 45° for 100 feet testing the area around a small and shallow cut. Richest portion was between 10 and 20 feet which assayed 0.10% Sn.

LIBERATOR MINE:

Position:

These workings are situated to the west of the Crystal Hill, on the southern end of a flat spur running south from the Lottah-Weldborough road.

The records of work done are very meagre, and are listed below :-

1891 An up to date milling and concentrating plant was erected;

1896 The lease was worked by the Anchor Company;

The records of production are still more meagre:

1899 About 3,00 tons of selected ore averaged 0.75% SnO_2;

1900 3,100 " " " " " 0.63% SnO_2.

There is then no record until 1927, when it is stated (Bulletin 38) "a small plant at present in operation. the yield is at the rate of 0.4%.....Selected ore only is treated, and the average is not more than 0.2% grade."

Judging from the extent of the cuts, very little work was done after that date.

WORKINGS:

The main workings are of two quarries by a narrow shelf. The eastern one is 150 feet long and the maximum width of 80 feet and depth of 25 feet.

The western quarry has maximum dimensions of 100 feet x 90 feet and depth of 27 feet. The bottom is an enclosed floor, from which a tunnel yields to an inclined tramway.

A third face which was opened on the hill side, about 100 feet to the S.W. is 80 feet x 40 feet.

The workings are all in tin-granite, which contains more fluroite.than usual. The occurrence is outside the area prospected by the Mount Lyell Mining and Railway Company, so that detailed results of prospecting are not available.

The meagre and incomplete records of production show that rich shoots were present and that later operations, even with selected ore, show a marked and persistent falling off of values. The small extent of the workings prove conclusively that the ore shoots are of very limited extent.

The following portions of the main quarry were sampled :-

1. The top bench of the western cut;
2. The Main West face;
3. The bottom bench;
4. Material stacked in the main quarry.

None of these samples yielded more than a trace of tin.

The deposit is ideally situated for working by open cut and for testing by trenches, or by drilling.

THE CENTRAL DYKE-LIKE BODIES OR PLATEAU WORKINGS:

Geology:

The larger outcrops of tin granite to the south and the north are connected by a long thin dyke-like belt of stanniferous tin granite. This varies in width from 30 - 120 feet, and has a general north and south sinuous trend. The configuration of the country is fairly flat, that the adit method of attack is limited to shallow levels. The open cutting is shallower than usual because of the narrowness of the dyke, and because of its dip generally about 40° - 50° to the west.

Previous Work:

No work on any scale has been done since Bulletin 38 was published, and the additional bores sunk in 1928 along the Marie Sections "are confirmatory of those obtained by the Mount Lyell Mining Railway Company in its investigations some years ago". In the previous paragraph (Bulletin 38, p. 102), it is stated "that the tin ore occurs in shoots, and that it is confined to a narrow strip near the middle of the dyke." The results of the Mount Lyell Company's sampling and those published in Bulletin 38 certainly show that the ore shoots are patchy in nature, but do not substantiate the idea that there is a rich central portion in the dyke.

(N.B. the numbering of the bores on Pages 101-102, does not correspond with those given on the plans, or with the assay numbers. An attempt is being made to clear up this matter).

Mining:

Details of the workings are best seen from the plans of the Mount Lyell Company on which are also placed the position of the trenches and bores, together with results of the sampling.

Since that time, very little work has been done. The results of the departmental boring and sampling of the Marie Workings is listed on Pages 101-102 of Bulletin 38.

There are three groups of workings on this central dyke-like formation - the Plant Workings on the south, then the Southern Cross (sometimes also known as Haley's Lease), and the Marie sections to the north. The trenching programme has been such that the boundaries of the ore formation have been accurately determined, and the bores reveal that the irregular shape of the outcrops also applies in depth.

A battery (now dismantled) was erected on the Marie Workings by A.C. Gardiner since Bulletin 38 was written, but the workings are very shallow and disclosed nothing of note. In some of the cuts, some enrichments of tin ore can be seen, but they are not of any extent. One of these was also worked with a small battery further north than Gardiner's faces.

The prospecting work that has been done shows that the enrichments, which are short as a rule, are separated by longer stretches of almost barren material. A more exhaustive investigation is necessary before sufficient data can be obtained to be used as a basis of calculation for determination of the available ore.

MOUNT MICHAEL MINE:

Situated on flat ground between Mt. Michael and Little Mt. Michael, the workings consist of one open cut, roughly rectangular in shape with a length of about 300 feet and a maximum depth of 20 feet. This cut has a long narrow approach.

Operations commenced in 1924, and the following are the official returns :-

	Tons Metallic Tin	Value £
1925	11.77	3,080
1926	15.60	4,536
1927	19.81	5,730
Total . .	47.18	£13,346

According to A. McIntosh Reid (Bulletin 38, p. 117), the mine treated ore of an average grade of 0.4%, worth £17,000. (According to Major T.H. Vincent in a report to the Michael Tin Mining Syndicate in 1933, approximately 70 tons conc. (70% grade) were recovered, from approximately 39,000 tons, and valued at £13,169).

Taking the output of ore at 39,000 tons, the grade of ore is much less than that indicated in Bulletin 39, and works out at 0.18% Sn.

As the plant had no classifying units, the recovery could have been improved. This plant was later shifted to the Moon Mine.

In 1933, the Michael Tin Mining Syndicate carried on a drilling campaign, and according to their reports, good results were obtained, particularly from the bores in the open cut. A check bore was also put down in the open cut by Major Vincent, who reported on the property for the Syndicate.

This check bore was 14 feet deep, and according to this report averaged 4.3 lbs. tin oxide, which is the lowest value disclosed in any of the bores in the quarry itself. (Taking oxide as 70% grade, this gives 0.13% Sn)

In 1935, the Mines Department bored 7 holes on this property. The positions of these are marked on the plan, and it is unfortunate that no bores were placed in the open cut itself. The results of these are as follows:-

	Depth in feet	Result
No. 1 Bore	45	Trace
2	40	Nil
3	77.5	0.15% Sn
4	66	0.12% Sn
5	36	0.02% Sn
6	57	Nil
7	27	Nil

These results are lower than in the corresponding bores of the Syndicate.

Later on, a shaft was sunk in the floor of the quarry. This was under water at the time of the inspection and so could not be sampled. The dump was carefully sampled, and yielded 0.2% Sn.

In 1937, an attempt was made to rehabilitate productive measures. Ore was quarried from island ground and from the base of the old quarry, and treated at the plant at the Moon Workings. 610 tons were treated for 1.75 tons tin oxide (or 1.2 tons metallic tin) valued at £274. This gives a grade of ore of just under 0.2% Sn. At the same time 2,750 cubic yards of alluvial ground was sluiced for 1.8 tons tin oxide (1.2 tons metallic tin) valued at £311, but after this, operations were once more suspended.

As on most other mines on the Blue Tier, a body of tin bearing granite has been worked, but the information available is not sufficiently detailed to form an accurate estimate, of the probable ore. A series of shallow bores in the cut, and around the cut, would give the required information.

THE MOON WORKINGS (New Moon, Michael Moon):

This mine is situated on the Blue Tier Plateau near the junction of the Moon and Hope Creek, in a roughly rectangular area of tin granite, with a length of about 350 feet.

The western boundary dips steeply to the west, but on the eastern boundary, the contact between the two granites dips about 12° east.

The rock is typical altered tin granite, but the central portion is greisenised.

Production, &c:

The records of production are meagre :-

1890 The manager reports that during the period February to July 1890, the company crushed 2,088 tons which gave 62 tons of tin ore (62% Sn) i.e. 0.79% Sn.

The workings of this company are shown by the plans prepared by the Mount Lyell Mining and Railway Company - the old open cut with a maximum depth of 14 feet, 120 feet long and 80 feet wide with three smaller cuts to the south and south east, the largest of these being 10 feet deep, 50 feet long, and 30 feet wide. Tunnels were driven connecting these enclosed floors, in order to drain them and to carry the waters of the Moon Creek. A shaft 40 feet deep was sunk 40 feet to the N.E. of the main open cut.

1906 - 1907 - the workings were thoroughly tested and explored by the Mount Lyell Mining and Railway Company by trenching and diamond drilling. Altogether, nine holes were drilled, generally to a depth of 150 feet, but the vertical hole is 500 feet deep. These bores and trenches disclosed a rich shoot at the surface near the centre of the body, and the patchy nature of the ore shoots, e.g.

Bore 14 (inclined 60° to N.E.) gave between 84' and 94' - 0.19% Sn; and between 98' and 104' - 0.44% Sn;

Bore 22 (dip S.W. at 60°) between 70' - 80' - 0.11% Sn;

Bore 23 (dip 60° to N.E.) disclosed highest values of 0.04% Sn, between 120' - 130';

Bore 25 (vertical) - first 10 feet gave o.23% Sn;

Bore 18 (60° to S.W.) gave very high values 0.51% Sn, between 20' - 32'. This enrichment appears to be of the type that generally occurs when the junction between the two granites is a fairly flat one.

Since Bulletin 38 (Blue Tier) was published, a syndicate worked the rich patch patch proved to be present by the above prospecting. They worked an open cut 80 feet x 50 feet on the eastern side of the old shaft. This was under water at the time of the survey, but the maximum depth would not be more than 10 feet.

1931 - The plant which was on the Michael was transferred to this mine. Most of the material crushed was from an inclined cut in the greisenised tin granite along a prospected trench running up the Hope River. This cut is narrow, about 110 feet in length, and with an opening 50 feet wide at the southern end. The only record of production is as follows :-

1932 - 913 tons milled - 4.448 tons tin conc. - 3.03 tons Sn, valued at £455 (i.e. a grade of 0.33% Sn)

The plant is still on this mine. The ore was hauled by winch to the plant to a 16" x 10" Jacques Crusher, and then elevated to a bin, and automatically fed to the 10-stamps, and then concentrated on a Phoenix Weir Table. The power was supplied by a suction gas plant driving a Hornsby Rushton Engine.

When the ore from the Michael Moon proved unremunerative, some ore was carted from the Michael and crushed at this plant.

MINES ON THE WESTERN PART OF THE BLUE TIER:

Several attempts at mining have been made on the western side of the Tier, both on the greisen veins, e.g. Chintock's Prospect, F.B. Lode, and Doyle's Mine; and on the westerly extensions of the tin granite, e.g. Kent Workings, and Cream Creek.

Kent Workings: (see plan)

These workings are situated near the head of Kent Creek and on the track from Weldborough to Poimena.

No information is available as to returns, and the amount of mining that has been done is small, amounting at most to shallow prospecting along the eastern junction of the two granites.

A long prospecting trench is situated on the ridge, but is too far west to test the richer portions of the ore body. A bore was drilled to a depth of 100 feet by the Mount Lyell Mining & Railway Company, but yielded only a trace over the whole length. Unfortunately the exact location of this drill hole is not known.

The boundary of the two granites on the eastern side is fairly flat, and it is along this part that enrichment of the tin values can be seen. The evidence available is not sufficient to determine the quantity and value of the available ore.

Chintock's Prospect:

A little to the south east is Chintock's Prospect, a bulge on a greisen vein. A shallow open cut shows the nature of the occurrence very clearly. A shaft in the cut, is about 20 feet deep and drives north have prospected this occurrence. The ore was crushed in the 10-head stamp which was driven by a water wheel.

Although the reef continues underfoot, it is insufficient in amount to warrant mining at deeper levels. Little evidence is available as to the amount of ore crushed, or the quantity of cassiterite that was recovered. In 1933, a 12-head stamper battery was installed together with boxes and an overshot water wheel. 0.738 tons metallic tin was recovered valued at £166.8

F.B. Lode :

The F.B. Workings are on a greisen lode striking approximately N.W. - S.E., and with a very steep south-westerly dip. The lode cuts through an area of tin granite, which has been sluiced. Around this area, the contact of the two granites can besseen very clearly. The contact is fairly flat, is a sharp one, and here and there occur small lenses of pegmatite. Thin nearly vertical seams of cassiterite point to the method by which the tin was introduced into this formation.

The F.B. Lode is a typical fissure lode, narrowing gradually to the south, where it is 6 feet wide. Over most of its course it is 10-12 feet wide. It has been stoped for the full length (over 7 chains), to a maximum depth of 40 feet. The lode is a cassiterite-chalcopyrite association, and is thus different from the mormal ore occurrence of the Blue Tier.

The workings are now under water.

Some indication that the reef continued at depth is to be found in the bores of the Mount Lyell Mining and Railway Company - No. 51 Bore gave an assay of 0.57% Sn over 12 feet; and No. 56 Bore 0.44% Sn over 10 feet. The amount of copper present, however, was not determined.

According to Nye (P.B. Nye - Mr. A.C. Nichol's Mine, Frome River. Typewritten report, 1927), the mine was later worked by A.C. Nichols. Ore was transported up an inclined tramway to the treatment plant by a winch driven a Pelton Wheel, under a head of 150 feet. The 5-head battery crushed 60 tons of ore per week. Between 1924 and 1927, 30-35 tons of tin ore were produced, and the ore gave 0.35%-0.45% SnO_2. At the time of his visit, the ore was recovered in a sluice box.

Later a Diesel engine was installed, and jigs and a table erected.

The ore was treated for the recovery of tin only, no attempt being made to recover the copper.

In 1937, operations were in that portion which lies north of the Frome River, and 1,348 tons of ore were crushed, which gave 6.56 tons concentrates (4.5 tons metallic tin) valued at £1,134.

As can be seen from the plan, attempts were made to work the continuation of the lode on Hibernus Creek to the north. The open cut is apparently just to the east of the line of the reef which was driven on by an adit to about 300 feet. As the mouth of this had collapsed, no information corroborating this statement could be obtained, but a careful examination of the open cut failed to reveal the presence of any mineralisation in the greisen veins.

The lode is now being systematically drilled by the Mines Department to prove the copper-tin values as well as their extension in length and depth. There is a considerable extent of ground between the F.B. Workings and those in Hibernus Creek, where no outcrops afford any information as to the extension of the lode in this direction.

Cream Creek:

No work has been done at this property since Nye (Typewritten report) reported on it in 1929, and he stated that, apart from a little stoping between 1917 and 1924, practically all the excavating was done by the Cream Creek Company, in the late eighties.

Taking the upper workings which are connected by stopes as one, there are four open cuts arranged N.E. to S.W. over a length of 1,400 feet. The value of the ore has been determined by past working and by the prospecting programme of the Mount Lyell Mining & Railway Company.

Montgomery in 1893 stated that the mining was selective, about 10 tons being discarded for every ton treated. This selected ore averaged 0.48% tin oxide. Most of this was crushed at the plant below the lower workings, near the Frome river, where the ore was delivered by a number of ways, two tramways discharging into bins, and self-acting tramway to the mill. The returns for the later work (1917-1924) from a small plant near the upper workings, is not available.

The Mount Lyell Mining Company's prospecting work consisted of sinking three bore holes, the cutting of four trenches, and the sampling of the open cuts.

The lower quarry gave very poor results except for the north west side where one length of 46 feet assayed 0.27% Sn, and 50 feet which gave 0.19% Sn.

Bore 50 inclined at 45° westerly, disclosed no values except for the first 10 feet which yielded 0.10% Sn. The surface trench in which the bore is situated showed the presence of tin, and the first 25 feet North West of the bore hole assayed 0.34% Sn, but the second trench 136 feet long, failed to disclose even the presence of tin.

The middle workings consist of two open cuts. The most westerly with two converging entrances from the south disclosed a floor which assayed 0.53% Sn, for 10 feet, and the sides of the cut gave 0.33% Sn. No prospecting work was done to test the extent of this enrichment. The easterly cut yielded very low results apart from two contig uous 25-feet lengths which yielded 0.24% and 0.30%, respectively.

The two trenches extending to the N.W. one from the end of this cut and the other further up the hill, also are notable for their poor yields. No. 52 bored at 45° to S.E. towards the easterly cut, did not disclose the presence of tin at depth.

The upper workings consist of two open cuts joined by a stoped portion. The tin granite is overlain by the porphyritic granite, and there is a floor carrying an enrichment of tin values just beneath the junction.

The highest values disclosed were 0.36% over 48 feet, and 21 feet for 0.03%.

Bore No. 53 inclined 45° to S.W. for 100 feet beneath the cut, proved negative, except for the upper portion which yielded 0.01% tin.

The Cream Creek workings deomonstrated the patchy and generally low value of the ore. The richer ore shoots are short, and to prove the existence of others, would necessitate a close drilling or shaft sinking campaign.

Spinks' sections further to the north are on a sluiced area of tin granite. Apart from the sluicing, no work has been done. It is worth while recording that two bores (Nos. 55 and 57) were drilled by the Mount Lyell Company on this outcrop.

Both bores dip to the North East. No. 55 disclosed a very rich but narrow seam about 30 feet down where four feet assayed 11.0% Sn. This probably was one of the narrow seams of tin oxide.

Bore No. 57 disclosed no worth while values except for the first 8 feet which yielded 0.26% S.

LOTTAH TUNNELS:

An attempt was made to investigate the Lottah Tunnels, but as these had collapsed, no opinion can be expressed as to the possibilities of this mine. The position

of the various tunnels and the surface features were surveyed, but the only survey of the underground workings is the plan by A. Montgomery in 1889.

The tunnels are now being cleared so that the workings can be critically examined.

The formation is a quartz reef carrying tin, wolfram, molybdenite and chalcopyrite.

It is interesting to note that a similar type of reef occurs on Hope Creek. This may be a continuation of the Lottah Lode.

Several other mines were examined, but surveys were not made in all cases. These are discussed below.

CAMBRIA MINE.

This is a sluicing proposition on a system of thin greisen seams in the porphyritic granite. Blasting is necessary at times, and the tin is recovered in boxes.

"NORTH CAMBRIA":

This is practically on the continuation of the Cambria leaders. It differs, however, in that there is an intersecting system of greisen veins. The general nature of these can be seen from the plan. The mine is equipped with a 10-head stamper battery driven by a Diesel engine. No concentrating tables are in use, but one is to be put in commission. The tin recovery should then be improved.

As in the case of the main Cambria Face, the life of these mines depends on the depth to which the granite has been weathered, as it is this factor which determines how long sluicing rather than mining can be used for ore extraction.

Doyle's Mine, on Wickborg Creek, is a similar proposition to the above. Work has ceased here although the milling plant, including two concentrating tables, has not been dismantled.

The Ransom Mine (or Rio Tinto) is on aplite veins in the porphyritic granite. As all the workings are nnt accessible, nothing can be added to the details given in Bulletin 38. The latter remark also applies to the Victory Mine (West Coast Bischoff). The open cut and the adit to the east are in soft porphyritic granite. The tunnels in the face (now collapsed) probably prospected the junction of the two granites, as the tin granite extends south of the face to the Lottah Road.

No new information can be added to that given in Bulletin 38 regarding several other properties that were examined, e.g. Wolfram Tunnels, Wellington Mine, Perennial Mine etc.

SUMMARY AND CONCLUSIONS

The main features in connection with the economic geology of the Blue Tier Field can be conveniently summarized as follows :-

1. The tin deposits are associated with the final phases of the intrusion of the tin granite into the porphyritic granite. The tin ore is disseminated through portions of the tin granite but occurs only as thin veins in the porphyritic granite.

2. All the tin granite is not stanniferous, but only those portions that show evidence of metasomatic and a slightly later hydrothermal alteration. The evidence shows that enrichments are present :-

   (a) In flat "floors" corresponding to the bedding plans of the granite, particularly in those places where the junction of the granites is a flat one;

   (b) In thin seams which run in the direction of the major jointing planes, and like these, have a steep dip.

   It is also equally evident that the floors are not of great lateral extent, and that a similar lack of continuity applies to the vertical seams. The rich shoots are thus separated by larger, harder and poorer bands. The type of enrichments can be clearly seen from the Value-Contour plan, and the occurrences apparently conform to this general nature even when each of the proved enrichments is considered in detail.

   The Blue Tier Tin Field must thus be considered as a field with localised enrichments, and the problem as far as future developments are concerned resolves itself into the possibility of economically mining these enrichments.

   Several attempts have been made at mining these richer patches, but after a brief period of success, all have failed. The method of mining in several cases was such that this result could be expected. The one serious attempt at large scale mining at the Anchor, and the attempt to augment the ore by drawing on supplies from others by means of aerial tramways, although carried on for a number of years, eventually failed.

   It should be stated that the low prive of tin at that time contributed to this result.

   One of the main causes of failure was the fact that sufficient water power was not available for all power requirements. With more power available, a scheme incorporating mechanical handling of the ore would have been successful. Before any similar scheme can be considered, it is necessary that exploratory work be carried out to determine what ore is available. The evidence to hand is such that no estimate of this is possible - without it, no mining scheme can reasonably be formulated.

Two methods of exploiting the tin granite of the district have been proposed.

(1) The erection of a large central treatment plant at the Anchor Mine, the supply from that place to be augmented by selected ore from outlying mines as proposed by J.B. Lewis.

(2) The development of one or more large open cuts to deal with low grade ore as proposed by the Blue Tier Tin Committee.

The latter proposal is faced with a great difficulty owing to the ore shoots being small and selective mining would be essential to keep to a reasonable grade. The ore is such that only schemes incorporating the handling of large tonnages at a low cost can hope to be successful.

Before any scheme of treatment or mining of these deposits can be considered, it is essential that exploratory work be carried out to locate sufficient ore to justify that scheme. No estimate of the ore reserves of the Blue Tier Tin Field can be formed on the evidence now available. This evidence can be obtained only by a vigorous exploratory programme.

As the field as a whole is a low grade proposition, care would have to be exercised in selecting places for testing, e.g. they should be such that there should be no need ro remove overburden, and that quarrying rather than underground mining methods could be employed. In the second place, the exploratory work should be arranged to suit the particular type of ore-occurrence characteristic of the Blue Tier Tin Field, small enrichments giving "floors" of no great lateral extent developed especially where the contact between the two granites is fairly flat, and with thin vertical feeders forming the means of ingress of these mineralising solutions. Any trenches should thus be cut in a general east and west direction, but vertical bore-holes, although suitable for testing the occurrence of the floor type of deposit, are not effective in testing these rather narrow and nearly vertical veins. Bores inclined to the east or west would best serve the purpose they were intended for.

Although the Tier as a whole has not been methodically tested, the fact that the tin bearing portions of the tin granite are by reason of their chemical alteration peculiarly susceptible to weathering, renders it extremely unlikely that any large areas of tin bearing country yet remain undiscovered. Exploratory work has thus to be confined to those areas already shown to be tin bearing and should be designed to find enrichments in those areas where channels of mineralisation are known to exist, and discover the continuation of these channels.

As the enrichments are known to be of small dimensions, the programme of work would have to be sufficiently close to ensure that no ore is missed.

Deep bore holes would not be necessary, except for an occasional one to test the extension of any enrichments proved by shallower bores.

It is consiered that the following places should be bored, the bores to be spaced at 100 to 50 ft. intervals, inclined at about 45 degrees, and bored in an east and west direction.

1. <u>Anchor Mine</u>:

(a) the area centrally placed immediately north of the workings, Gough's and Breadmore's faces.

The conditions of being near a flat contact of the two granites and which seem to be favourable for a tin enrichment are satisfied. Some tin is known to be present, and if the results are encouraging, the area is

favourably situated as regards location.

(b) Another area which shows promise is along the gully flowing west of the Pentridge Face. No overburden would have to be removed, and it is even easier of access than the previous location.

The above locations form the logical expansions of the Anchor faces.

Most of the faces show low grade ore, but Bore No. 5 in No. 2 west face showed encouraging prospects and these should be further tested.

2. Mines on the Mouthern Fall of the Tier:

These are treated together as they are favourably situated for treatment of the ore from a central treatment plant.

(a) Don: The rich "floor" with its deep chambers, has left a quantity of low grade material that would have to be removed before the continuation of the rich floor can be worked. Whether this is justified depends on the amount of richer ore than yet remains. The Mount Lyell bore holes show that this does not extend beyond the end of the faces of the chambers, but here again the limits of the floor would have to be determined by further boring. In this case, as it is a flat floor that will be prospected, shallow vertical bores would be best.

(b) Australia: The enrichment in the open cuts apparently forms a "floor" deposit, beneath that shown by the Summit Workings. The greisen veins which run nearly east and west give enrichments. The western face disclosed richer values which are not disclosed by the Mount Lyell trenching, while the northerly running shoot of ore to the east of the workings has not been adequately explored.

(c) Summit: The area around this open cut should be tested, as the prospecting work of the Mount Lyell Mining and Railway Company showed that enrichments are present. If these prove to be of the floor type, their extensions can be easily traced.

(d) Liberator Mine: Beyond stating that tin ore has been mined, very little information can be given concerning this mine or about its prospects. The assays of the faces were not encouraging, but should not carry much weight when the nature of the ore shoots is taken into account. In testing this ground, cost-cans as well as bores would be necessary, the former to pick and trace any shoots that outcrop and the latter their extension in depth.

(e) Crystal Hill: The workings are scattered and not localised. Any exploration here would depend on the results of work in the other places.

3. Mines on the Plateau:

The limits of the tin granite have been accurately traced, and the boring has been closer than is usual. No large payable bodies have been disclosed but as usual several small enrichments. The limits of these are not known, and have to be determined.

In the case of the Southern Cross and Marie Workings, the shoots occur in a dyke-like mass underlaying to the west. Owing to this and the flatness of topography, open cut methods would be of limited application.

In the Moon Workings where the tin granite is more of a plug-like intrusion, the boring is sufficiently close to show that the values are low grade. Here it would be necessary to haul the ore from the workings and provide pumping facilities. Because of this added cost, no testing can be recommended until the results from more favourably situated properties are available.

The Michael Workings further north have been partly bored, and it would be necessary to bore the present quarry floors and the immediate vicinity of the faces. There is a reasonable chance of proving a large amount of ore averaging about 0.2% metallic tin. Further north there are patches of soft tin granite, but the extent and value of these is not known.

Further east near the bend of the Wyniford are the Masher Workings, but as these consist of a long trench and a shaft, now under water, no opinion can be expressed as to the prospects here.

In the Kent Workings the richer ore values appear to be on the eastern side of the tin granite, but there has been insufficient prospecting to estimate the quantity or grade of ore that is available.

4. Mine of the Western side of the Tier:

The F.B. Lode is at present being tested. It differs from the usual run of ore occurrences of the Tier in being a tin-copper fissure lode. When boring operations are completed, we shall have more knowledge of the reserves of this lode than of any other ore-body on the Tier.

The Cream Creek workings disclose flat ore shoots and the richer and more readily accessible of these have been worked. The records of the Mount Lyell bores is not encouraging especially as to the repitition of these floors at depth, but the evidence is not sufficiently conclusive to state that no reserves exist here, or to form any opinion as to the extent of any that may be present.

While the Blue Tier Tin Field forms a potential and promising source of tin, it is essentially a low grade proposition which has not been sufficiently prospected to enable computations of ore reserves to be made with any reasonable degree of accuracy. Before any scheme for exploiting this field can be formulated, a close and rigid exploratory boring campaign is necessary. Until this is carried out it is useless, from the evidence that is available, to consider any large scale method of mining. The potentialities of the field are such that it is of national importance that this exploratory work be carried out.

D.E. THOMAS.

21.5.43.

APPENDIX No. 1

LIST OF PLANS

1. Sketch Geological Plan of the Blue Tier: Scale 1 inch: 1 mile. To show distribution of the tin granite, location of mines, and physiography.

2. Value - Contour Plan: Based on prospecting work of the Mount Lyell Mining and Railway Company Limited.

3. Anchor Mine: Scale - 100' : 1 inch: Contoured 10 ft. intervals.

    3a. Tracing of J. B. Lewis' plan to show method of workings before 1914.

    3b. Tracing of plan in L. C. Clark's report of 1935, to show position of chases and jumper holes &c.

    3c. Tracing of plan of L. C. Clark's report of 1935, to show prospecting holes and distribution.

4. Don Workings (contoured)

5. Australia Workings (contoured)

6. Michael (contoured) shows also position of Bore Sites

7. Moon Workings (contoured)

8. Liberator Mine

9. Kent Workings and Chintock's Prospect (contoured)

10. F-B Workings - Main Workings

    10a. do. and with workings further north

11. Lottah Tunnel (surface workings)

    11a. Tracing of underground workings by A. Montgomery, 1889.

12. "North Cambria"

APPENDIX NO. 2

Leases on tin reef-mining propositions that are now in existence in this district are listed below:-

Anchor	Tasman Tin No Liability Consolidated Lease No.	11829/M	252 acres
Australia	M.L. Strugess (Application)	29M/42	20 acres
Summit	J. Cheerioh & A.H. Murtagh	40M/39	25 acres
Southern Cross	B. Griffen	9278/M	20 acres
" "	E.B. Griffen	3920/M	20 acres
Marie	G.D. Gardner	12M/41	58 acres
		10W/41	2 acres
Moon	Michael Moon Tin Mining Company No Liability	81M/38	5 acres
Michael	Blue Tier Development Prospecting Syndicate No Liability	44M/39	20 acres
Kent	G.A. Chintock	54M/38	10 acres

There are several others on lodes, e.g.

Lottah tunnels	by Russel Young	5M/42	15 acres
Chintock Prospect	by G.A. Chintock	55M/38	5 acres
Cambria	C.B. Richardson & G.H. Richardson	11179/M	5 acres
		11037/M	5 acres
		11182/M	5 acres
"North Cambria"	I.B. & B.V. Chapman	11552/M	10 acres
	B.V. Chapman & J.T. Mapley	11033/M	25 acres
	S. Chapman	11585/M	5 acres

Most of the other leases are held in connection with alluvial claims.

About 1935, carefully cut chases, assayed in 10-ft. lengths, augmented by shallow jumper holes assayed in 5 ft. lengths, were part of the investigations by L.C. Clark on the Anchor Mine. The results of these are tabulated below, and are in percentages of metallic tin.

Chase No. 1

1.11% Sn
0.88%
0.62%
0.25%

Average 0.71% Sn.

Chase No. 2	No.1 Jumper Hole	No.2 Jumper Hole.	No.3 Jumper Hole.
0.82% Sn			
0.06			
0.11	0.14%	0.25	
0.22	0.32	0.05	0.01
0.11		0.01	Trace
0.22	Average 0.23%	0.04	
0.29			
0.29		Average 0.09%	
0.25			
0.04			

Average 0.24% Sn

Chase No. 3

	Jumper Holes.		
0.41	No. 4	No. 5	No. 6
0.01			
0.27	0.08	0.18	0.66
0.22	trace	0.20	trace
0.11	0.03	0.03	
0.50	trace		
0.27			
0.14	Average 0.03%	Average 0.14%	
0.09			
0.04			
0.04			
0.01			

Average 0.18% Sn.

Chase No. 4

	Jumper Holes.		
0.14	No. 7	No. 8	No. 9
0.33	0.34		
0.20	0.17	Further east	0.08
0.11	0.17	a trace	0.18
0.14	0.11		
	0.18		
Average 0.18%	Average 0.19% Sn		Average 0.13%

Chase No. 5

0.12
0.29
0.47
0.33
0.13
0.47

Average 0.30%

Chase No. 6 — No. 10 Jumper hole is east of this line

0.26
0.31
0.50
0.20

Average 0.32%

0.05
0.03
0.04

Average 0.12%

Chase No. 7 (In the Heading Face)

0.09
0.06
0.21
0.12
0.21
0.38

Average 0.18%

Chase No. 8

0.06
0.09
0.06
0.14
0.22
0.27
0.24

Average 0.15%

Chase No. 9

0.18 (results not complete)
0.17

Average 0.175%

Chase No. 10

0.26
0.13
0.09
0.01
0.04
0.11
0.47
0.13
0.05
0.25
0.10
0.06

Average 0.13% Sn over 120 feet.

The following jumper holes were also sunk in the Syndicate's face.

No. 12	No. 13	No. 14
0.05	0.65	0.05
0.04	0.05	0.04
0.04	1.02	0.01
0.19		0.04
Average 0.08%	Average 0.57%	Average 0.04%

APPENDIX NO. 4

L.C. Clark made many tests of Battery Pulp and Tailings. One of these is listed below :-

PULP:

	% of Weight	Assay % tin	Content	% Distribution of value
+30 mesh	20.8	0.19	.0399	7.7
-30+100 mesh	41.5	0.43	.1784	34.3
- 100 mesh	37.7	0.80	.3016	58
	100.0		.5199	100.0

TAILINGS:

	% of Weight	Assay % tin	Content	% Distribution of value
+30mesh	27.5	0.09	.025	15.8
-30+100 mesh	41.5	0.06	.025	15.8
-160 mesh	31.0	0.35	.108	68.4
	100.0		.158	100.0

Loss $\frac{.158}{.5199} \times 100 = 31\%$

Recovery thus - 69%

Dr. F.L. Stillwell in Minoragraphic Report No. 214 of the Council for Scientific and Industrial Research describes his investigations into two samples of tailings from the Anchor Mine.

British Standard Screen	Sample No. 1	Sample No. 2
+25	20.0	24.6
+52	17.4	21.3
+72	6.5	7.9
+100	5.9	6.0
+150	5.3	5.1
+200	7.1	6.4
-200	37.8	28.7

It is suggested that the relatively large percentage of the coarse sizings and small percentages of the medium sizings are probably due to the presence of abundant white mica.

Counts were made of the number of cassiterite grains in each section and it is stated that the bulk of the tin in the tailings is due to the presence of free grains of cassiterite, the number of such grains increasing rapidly with decreasing grain size.