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PRELIMINARY REPORT NO. 2 ON THE KING ISLAND SCHEELITE MINE

by

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DEPARTMENT OF SUPPLY & SHIPPING.

MINERAL RESOURCES SURVEY BRANCH.

PRELIMINARY REPORT NO. 8. ON THE KING ISLAND SCHEELITE MINE.

(REPORT NO.1943/8 - PLANS NOS. 718.798.799.)

I. INTRODUCTION.

In view of the shortage of tungsten supplies in the allied countries, efforts are being made in Australia to increase the production with a view to not only satisfying domestic requirements, but also exporting to Great Britain and the United States of America. The King Island Scheelite mine is at present the largest producer of tungsten ore in Australia, and the possibilities of increased production from it were, therefore, among the first to be considered.

Geological and geophysical surveys were made in June and July, 1942. A preliminary report was prepared in September and a drilling campaign drawn up to test the deposits with the object of proving sufficient ore-reserves to justify increased production for war purposes. Further geological surveys were made in October and November and the drilling campaign began at the end of October. Up till the present, fifteen drill holes have been completed and under a modified programme four remain to be drilled (two of these are in progress). This second preliminary report is based on the drilling and assaying results to date. (details of thirteen holes are available).

II. LOCATION, ACCESS, ETC.

King Island is situated at the western end of Bass Strait and forms part of the State of Tasmania. The King Island Scheelite mine is situated at Grassy on the south-eastern coast of the island.

Access to the mine is gained by road (14 miles in length) from Currie, a township and port on the western side of the island. There is a shipping service between Currie, Melbourne and Tasmanian ports, but only small vessels can enter the port. Owing to the unsheltered nature of the port, the regularity of the service is greatly affected by adverse weather conditions. Currie is also connected with Melbourne and Tasmania by an air service with, in normal times, three trips per week each way.

The mine and Currie are connected by road with Naracoopa, a port on the eastern coast. This port is exposed, but only affected by easterly weather. The depth of water is greater and larger vessels can berth at the pier.

There are no loading and unloading facilities on the piers at Currie and Naracoopa and the ship's gear has to be used. The small vessels at Currie can only handle loads up to 5 or 6 tons, but the larger vessels which can enter Naracoopa are capable of handling loads up to 10 or 11 tons.

The mine is worked by the King Island Scheelite N.L. This Company holds mineral leases 220P/M of 218 acres, 219P/M of 53 acres, 11988/M of 10 acres, and 10W/41 of 1 acre and a water right 2933/W on the Grassy River.

III. HISTORY AND WORKINGS.

Scheelite was discovered at Grassy by Mr. T. Farrell about 1913. The deposits were prospected and developed by the King Island Prospecting Association until 1916, and, in February, 1917, King Island Scheelite N.L.

was formed to work them. This company conducted active mining and treatment operations from the middle of 1917 to July, 1920, when, due to the great decrease in the price of tungsten, operations became unprofitable and the Company decided to cease working.

In the middle of 1934, Mr. W.E. Hitchcock became interested in the deposits and the King Island Scheelite Development Company was formed. Seven drill holes were put down by this Company during the latter half of 1934. No further work was conducted until 1938, when the present company (King Island Scheelite N.L.) was formed. Mining and treatment operations commenced in 1938 and have continued without interruption until the present and are still proceeding.

The discovery by Mr. Farrell is reported to have been situated on the beach and to be visible only when the tide is extremely low. It is also reported that a small amount of work was done near high-water level, but the site is at present covered by beach sand, and the working is not visible. A shaft was then sunk at a place about 80 feet inland and is said to have cut the same formation. The formation had a strike of about 300° and further prospecting by adits and shafts was conducted farther inland and along the possible line of extension of the formation. During the course of such work, some of the lodes (garnet) that have been worked in the open cut, were discovered. The formation on the beach was a vertical one and quite distinct from the garnet lodes, and it is interesting to note that the prospecting along its possible extension led to the discovery of the larger and more important bodies.

At the time of the visit of Mr. L.L. Waterhouse in 1916, the mine workings consisted of five adits (two of which had already collapsed), the approach to an adit and three shafts. During the operations of the King Island Scheelite Co. in 1916-1920, one of the earlier adits (Waterhouse's No. 2) was extended and four other adits driven (one at No. 2 level, two at No. 3 level and one at beach level), at least twelve prospecting shafts were sunk and an open cut with two branches (North and West open cuts) was excavated. Ore-breaking was conducted in the open cuts and ore trucked from two adits (No. 3 North and No. 3 West).

The present company extended the No. 3 North adit, drove an adit at each of the 45 feet and 170 feet levels, and is driving one at the 90 feet level. In addition it sank four prospecting shafts and had 21 vertical percussion drill holes put down to a maximum depth of 100 feet. The Company has extended the open cut and has benches at the 90, 120, 140 and 170 feet levels (the former 155 feet level is not being retained). In the open cut, mechanical shovels are used to load the ore and overburden into motor trucks which transport the material to ore bin and mullock dump respectively.

Because the numbering of the adits by Waterhouse and Venn Brown was different and because of the additional adits and the several levels opened by the present company in the open cut, it is deemed advisable to draw up the following suggested scheme for numbering the workings and levels. The table includes the numberings by previous investigators, so that ready reference can be made to previous reports and plans. For the remainder of this report, the suggested numbers, etc. will be used. Some of the older adits have been removed in the course of mining, while others have collapsed, and some are covered by dumps.

SUGGESTED SCHEME.			FORMER SCHEMES.	
Reduced Level Feet.	Level Number.	Adit Numbers	Waterhouse	Venn Brown
170	1	No.1. Completely removed by mining	- No.3 adit	- No.1 adit
140	2	No. 2. (partly removed by mining)	No.2 adit	No.2 adit
		Completely removed by mining	---	Adit above West open cut.
120	2A			
90	3	No. 3 North	---	No. 3 Level N.
		- Centre	---	---
		- West	---	No. 3 Level W.
		Partly removed and remainder collapsed.	---	No. 3 adit.
45	4	No. 4	---	---
0	5	No. 5	---	Beach adit.

Note: The two adits already collapsed at the time of Waterhouse's visit are not included. The Upper one is completely collapsed and is at a level of approximately 230 feet. The Lower adit (Venn Brown shows two) is collapsed and covered by dumps and is at a level of approximately 60 feet.

IV. PRODUCTION.

The production during the two periods of working has been as follows:-

Year	Ore Treated	Concentrate Produced	Yield of Concentrate	Approx.value of Concentrate	Dividends
	tons	tons	per cent	£	£
1917	4937	69	1.40	12130	5000
1918	21088	216	1.02	39352	10000
1919	21832	199	0.71	43181	5000
1920	13853	105	0.76	17903	5000
TOTAL	67710	589	AV.0.87	112566	25000

Year Ended	Ore Treated	Concentrate Produced.	Yield of Concentrate	Approx.Value of Concentrate	Nett Profit (without depreciation and Income Tax charges)
31/10/38	5845	27	0.46	6092	1065
31/10/39	27670	168	0.61	38330	14680
31/10/40	35600	228	0.64	55484	24970
31/10/41	29190	204	0.70	44295	11191
31/10/42	32200	243	0.75		
TOTAL :	130505	870	Av.0.67		

In addition a tailings re-treatment mill recovered:

Ended	Tailings Re-treated.	Concentrate Produced.	Yield of Concentrate	Approx.Value of Concentrate	Nett Profit (without depreciation and Income Tax charges)
31/10/40	22390	35	0.16	7944	5724
31/10/41	18870	17	0.09	3741	1996
TOTAL :	41260	52	Av.0.12	11685	7720

The total amount of ore treated to 31/10/42 has therefore been 198,215 tons and from it has been obtained 1511 tons of scheelite concentrates.

V. GENERAL GEOLOGY.

(1) Introduction. The determination of the geological structure was rendered difficult by a general scarcity of outcrops and exposures.

The drill holes of the present campaign are, however, yielding a high percentage of core and will enable the structure to be satisfactorily determined.

(2) General. The rocks in the mine workings and the adjacent country consist mainly of a series of hornfels of several types representing altered sedimentary rocks. The hornfels series is intruded by granite rocks (granite, porphyry and aplite). The above are overlain by a thin but extensive cover of Recent deposits (mainly wind-blown sand).

(3) Hornfels Series. The different hornfels are almost certainly part of one series, but will be described in five divisions or groups corresponding to different parts of the area, the rock types in each area being more or less distinct. The areas are the country north, east and south-east of the mine; that west from Burn Creek; the ore-bearing zone; the north-western portion of the open cut and the immediate vicinity; and that immediately south of the ore-bearing zone.

(a) North, East and South-East of the Mine. In this area the most common type is a greyish, fine-grained rock resembling a soft quartzite, but which under the microscope has been determined as a biotite-hornfels.

A lighter coloured type resembles a white quartzite and under the microscope has been determined to be a muscovite-quartz-hornfels or muscovite-quartzite. Associated with the above two types there is a spotted type of hornfels which microscopic examination shows to be similar to the above two types, the spotted appearance being due to aggregates of coarser flakes of white and greenish mica.

Hornfels of the above types are exposed along the coast to the south of the tailings re-treatment mill, near the stables, in the cliffs to the north-east of the open cut, in shaft B, in the northern-most adit and on the steep slopes on the north-eastern side of the gully immediately to the north-east of the latter adit.

Few strikes and dips are observable. Those dips measured are similar in amount to those of other areas, viz. at 30° to 40°. The strikes are not regular, but are generally north-north-east to north-east, the dips being to the east.

This group is in some places separated from the ore-bearing zone by the No. 3 fault. In other places, the group is separated by the No. 3 fault from the footwall rocks of the ore-bearing zone.

(b) West from Burn Creek. The rocks to the west and north-west of the mine workings are generally of a similar type to those described above, but in hand specimens appear to be quartzites and to have much lower contents of mica than the above hornfels. No strikes or dips were observable.

(c) Ore-Bearing Zone. The rocks in the mine workings and the immediate vicinity consist of hornfels, the types being generally different from the above. Dr. Stillwell described the following types:-

Biotite-hornfels, garnet-diopside-hornfels, garnet-hornfels, calcite-hornfels (marbles), and hornblende-actinolite-epidote hornfels.

For purposes of description and to distinguish the rock from similar types outside the ore-bearing zone, the biotite-hornfels in this group will be referred to as biotite-quartzite. Of the above types, the only one similar to the hornfels farther from the mine workings is the biotite-quartzite. The rocks in the mine workings are, of course, closely associated with scheelite-bearing ore and have apparently undergone much more intense alteration.

The garnet, garnet-diopside, biotite and calcite hornfels are found interbedded in the mine workings. They represent intensive alteration of a series of sedimentary rocks (probably shales and limestones).

In the western portion of the open cut, the strike is 280° and the dip to the south at approximately 40°. In the eastern part of the mine workings, the strike is approximately 45° and the dip at 40° to the south-east.

The relations of the rocks of the ore-bearing zone to all other groups excepting those west from Burn Creek are observable in the mine workings. The relations to the rocks in the north-western part, and on the southern side, of the open cut will be discussed when describing the latter groups. The rocks to the north and east of the open cut are similar to those below (in the footwall of) the ore-bearing zone. As already stated, the former are separated from the ore-bearing zone and the rocks in the footwall by the No. 3 fault. The rocks of the ore-bearing zone are, therefore,

regarded as being stratigraphical above those to the north and east of the mine.

(d) North-Western Portion of Open Cut. The rocks consist of biotite and biotite-actinolite hornfels. In hand specimens the rocks appear to be much weathered and the biotite-hornfels to be somewhat different from that in the ore-bearing zone. The rocks appear massive and show little or no bedding at the western end of the open cut, but towards the eastern margin they contain what appears to be interbedded quartzites. These quartzites have not been microscopically examined, but in hand specimens are harder and appear to contain much less biotite (possible none) than the biotite quartzites. This group of rocks occurs in association with those of the ore-bearing zone. The relationships are confusing, four different relations being observed. On the 155 and 170 feet benches the rocks are separated from those of the ore-bearing zone by the steeply dipping No. 2 fault. Immediately below the northern part of the 140 feet bench, the rocks overlie those of the ore-bearing zone with an uncomformable junction probably representing an almost horizontal fault. Immediately north-east of the latter place, the rocks appear to be conformable with those of the ore-bearing zone. In the north-eastern part of the 140 and 155 feet benches, the rocks appear to be conformably above those of the ore-bearing zone and the latter appear to have been formed by alteration of the former.

It would appear that the rocks of this group are in general stratigraphically above those of the ore-bearing zone, and have been brought into juxtaposition with the latter by faulting (No. 2 and possibly others) and that the faulting may have occurred before the mineralisation.

(e) South of the Ore-Bearing Zone. It is only recently that exposures have been made in this vicinity. Previously the only evidence of the rocks present consisted of one small exposure, and specimens from the test shaft near No.11P shaft. The rocks are much weathered. The types determined are biotite-actinolite and actinolite hornfels. While the types are similar to those in the group in the north-western part of the open cut, the two groups weather differently, but this may be due to causes other than those of difference in rock type. These rocks conformably overlie the rocks of the ore-bearing zone (as exposed on the 140 feet bench) ~~xxxxxxxxxx~~ although there may be faulting at the contact.

(4) Granite. Granitic rocks occur on the shore to the south-east of the mine and at intervals to the south as far at least as the jetty point about 30 chains distant. The granite around the jetty point forms the northern margin of a much larger body of granite. This body appears to connect with the granite in the south-western corner of the company's lease (220 P/M), but most of the intervening country is covered with sand. The bearing of the northern boundary of the main granite body would, therefore, be about 330°.

Immediately south-east of the mine, the granitic rock appears as a dyke in the hornfels and with a general strike of 50°. Along the shore, south of this dyke, innumerable narrow veins and dykes traverse the hornfels between this dyke and the main body of granite.

The granitic rocks include granite, porphyry and aplitic types. At one place the granite is banded and in several places contain xenoliths of dark hornfels.

In the mine workings, there are numerous narrow and irregular dykes and sills of an acid rock ranging in type from an aplite to a medium-grained porphyry. These dykes intrude all the rocks of the ore-bearing series, including the garnet hornfels. The widest and longest dyke occurs on the 90 feet bench.

At the western end of lease 220 P/M, a dyke of quartz-felspar porphyry can be traced for nearly 20 chains. It has a general east-west strike and is situated several chains north from the boundary of the granite and the hornfels. It is possible that the boulders of aplite near the manager's house may be shed from an eastern extension of this dyke.

It is obvious from the above that the granitic rocks intrude the hornfels series.

(3) Recent. The surface of much of the country is covered by sand probably largely wind-borne from the adjacent coast. The sand extends to heights of at least 260 feet above present sea level. It is deepest immediately to the west of the western part of the open cut where it attains a thickness of 50 to 60 feet. To the north, the thickness decreases and is usually between 5 and 10 feet.

In the southern part of the open cut, conglomerates, grits and clays occur as in-fillings of a former gully. These are probably of marine origin and were deposited when the sea covered this portion of the island. The deposits in the gully extended to a height of 140 feet above the present sea level and had a maximum thickness of about 50 feet.

VI. STRUCTURAL GEOLOGY.

1. Folding. Except in the extreme eastern portion of the workings the rocks of the ore-bearing zone have strikes of 280° and dips to the south at angles ranging from 35° to 40°. In the eastern portion of the workings the strikes are at 45° and the dips are to the south-east at angles of 35° to 40°.

On the northern side of the workings this change in strike appears to be due to minor folding in the strata, but there are several east-west faults in the vicinity of the apparent bend and this east-west faulting may account partly for the change in strike. Towards the southern side of the workings the change in strike appears to be due to a fault (No. 1) with a general north-south strike. The only indication of this fault in an outcrop is on the northern side of the roadway between the 90 and 120 feet levels.

In the extreme north-eastern portion of the open cut, the strike ranges from 270° to 300°. This portion is adjacent to the No. 3 fault and probably represents a block between that fault and a parallel one (No. 4) to the south.

In the western faces of the 120 and 140 feet levels, drag folding by the No. 2 fault has produced a small anticline.

On the shore to the south-east of the mine workings the strikes are generally similar to those in the eastern portion of the workings and are north to north-east, the dips being to the east.

On the 140 and 155 feet faces in the north-western part of the open cut, the biotite and biotite-actinolite-hornfels appear to have general east-west strikes and high dips (in agreement with the No. 2 fault). To the east and on the 140, 155 and 170 feet levels, the apparent strikes and dips agree with those of the ore-bearing zone, but these determinations depend upon the quartzites being interbedded.

2. Faulting. Several major faults and many minor faults are present in the mine workings.

One of the most important faults is that (No. 1) already referred to above and which, on the southern side of the open cut at least, is responsible for the different strikes of the ore-bearing rocks in the eastern and western parts of the workings. At the place already

referred to in which this fault was indicated, a north-striking quartz vein appears to coincide with the fault. Similar quartz veins are reported to occur in the No. 3 Centre adit (the place is closely timbered and cannot be examined) and on the surface immediately to the north of that adit (the exposure is covered by detritus), and is visible in the western drive from the No. 3 North adit. These quartz veins, together with an aplite dyke in the northern crosscut from the No. 3 North adit occur generally along a more or less straight line and suggest the extension of the No. 1 fault to the north. Any southern extension is covered by Recent deposits.

Another important fault (No. 2) appears in the western face of the 120 feet level and has a quartz vein associated with it. A body of garnet ore is terminated near the floor of this level by this fault which here has an east-west strike and a dip of about 50° to the north. The mud covering of the bench of the 120 feet level prevents any attempt to trace this fault to the east. At the western end of the 90 feet level, however, there is a plane with a high dip to the north and with some quartz associated with it. The plane has garnet rocks on both sides of it and there is no folding and no evidence of displacement other than the Mine Foreman's statement that in the working the garnet rock on the two sides appeared to be different. It is tentatively assumed that this plane represents the eastern extension of the No. 2 fault which would, therefore, have a strike of 100°. If this plane does not represent the No. 2 fault, the latter must be covered by the Recent deposits of the in-filled gully to the south. In the No. 4 adit and in the north crosscut therefrom, two probable fault planes occur on the general line of extension of the above fault to the east. In the adit, the plane was revealed by a recent fall and there appears to be a displacement associated with it, the rocks on the southern side being displaced eastwards. Any extension further easterly would intersect the No. 3 fault near the treatment plant.

To the west the No. 2 fault is represented by a narrow fault zone striking east and west and which is exposed in the faces of the 140 and 155 feet levels. In the 140 feet face the zone is bounded by two faults, the southern one dipping to the north at an angle of 60° to 70° and the northern one dipping to the south at an angle of 25°. The southern one of these two faults represents the westerly continuation of the No. 2 fault. In the face of the 155 feet level, the zone was 5 feet wide, the faults more vertical, jointing occurs parallel to the faults and there is slight silicification. The fault zone does not appear on the 170 feet level because the face, as so far developed, has exposed only sand in the anticipated position of the fault. Between the 140 and 155 feet faces, the fault has a strike of 280°. The strike between the 120 and 140 feet faces and the smaller dip in the former face, appear to be local irregularities.

Another important fault (No. 3) occurs in the north-eastern part of the workings. It has a general north-westerly strike and its dip is probably at a high angle to the south-west. This fault appears to limit the ore-bearing zone in the north-eastern part of the workings. To the north-east of the fault hornfels with little or no sign of mineralisation occur.

The presence of the fault is indicated in the face of the 170 feet level, immediately to the north of the No. 1 adit. It should be present in the adit and not far from the mouth, but the adit is closely timbered in that place. The fault reported by L.L.Waterhouse in his Nos. 1 and 3 adits represents the south-eastern extension of this fault. Its north-western extension is visible in the west drive from the No. 1 adit and has a northerly dip at 50°. It should cross the north crosscut from the No. 3 North adit, but there are several fault planes in that crosscut, and it is not possible to determine which one represents the No. 3 fault. The continuation farther to the north-west would separate those vertical drill holes which intersected ore from

those which did not intersect ore -- the former are on the southern side of the fault and the latter are on the northern side of the fault.

To the east of the mouth of the No. 3 North adit there is a fault (No. 4) with which is associated a change of strike of the rocks on either side and also termination of a body of garnet rock. It has a general north-westerly strike and a high dip to the north-east. It has not been noted to the west of the aplite dyke near No. 3 North adit, but if it continues it will be represented by one of the fault planes (probably that at the bend 130 feet from the face) in the north crosscut from the No. 3 North adit.

On the northern side of the eastern part of the 90 feet level there is an east-west fault (No. 5) which cuts off the north-eastern extension of the garnet lode worked at that level. To the north of the fault, garnet-diopside rocks occur in juxtaposition with the lode (on the southern side). The amount of displacement is not known, but it would probably be some 10 to 40 feet, the downthrow being on the northern side. It has a strike of 290° and a vertical dip. The No. 5 fault is one of a number which occur on the 90 feet level near, and to the north of, the No. 3 Centre adit. They also occur on the adjacent portion of the 120 feet level, and thus exist on both sides of the aplite dyke. These faults have strikes of 280°, but their displacements are probably small, excepting for No. 5 fault. The fault on the 120 feet level having the greatest displacement (it apparently faults the garnet lode exposed in the mouth of the No. 2 adit) is probably the continuation of the No. 5 fault - the downthrow appears to be to the north in both cases.

3. Igneous Intrusions. Little can be said as to the form of the intrusions of the granitic rocks which occur on the shore south-east and south of the mine because of the general lack of outcrops between the shore and the mine. The main body of granite will, of course, form a portion of a larger intrusion now occurring mainly beneath the waters of Bass Strait. Between the mine and the main body of granite, there is one large dyke and innumerable veins and small dykes.

As already stated, aplite and porphyry dykes occur in many places in the workings. These dykes are usually of narrow width (up to 2 feet) but in one case the width ranges up to 20 feet. The latter dyke occurs on the eastern portions of 90,120, and 135 feet levels. In the eastern portion of the face of the 170 feet level, at least two sill-like intrusions of aplite occur. The dykes and sills are irregular in strike and width and do not persist for any great length.

Decomposed granite was reported in the lower 53 feet of drill hole No. 20. An inspection of the cuttings revealed one piece of porphyry and much grit which might represent granitic quartz. Any granitic rock present is probably part of the dyke which may exist near, and west of, the Manager's residence. It is difficult to understand the reported softness of the formation.

The point near the old jetty and to the south of the mine was not visited, but Waterhouse reports that narrow and irregular dykes of basalt and lamprophyre occur there.

VII ECONOMIC GEOLOGY.

The King Island mine is being worked for the recovery of the scheelite content of its ores. The scheelite occurs mainly in beds of garnet rocks, but is also present in other rocks such as garnet-pyroxene, pyroxene-garnet, etc. The garnet rocks consist of coarse-grained dark garnet with interstitial quartz. The garnet-pyroxene and pyroxene-garnet rocks consist of a light brown garnet and pyroxene (diopside) with irregular areas of each of these minerals. In some places the latter two rocks are banded, the garnet and the pyroxene being in separate bands.

The scheelite-bearing rocks form a zone with a maximum width of approximately 180 feet. This zone represents the alteration of limestones and probably interbedded shales and their replacement by the garnet and pyroxene-bearing rocks. On the southern side of the No. 2 fault, the original beds have been more or less completely replaced and the mineralised zone is wide and it contains considerable thicknesses of ore.

On the northern side of the No. 2 fault, the geological conditions are different from those on the southern side. In most places the limestones appear to be absent and in other places, where they are present, replacement by ore has not been extensive. The result is that the bodies of ore are narrower.

The mineralised zone is conformable with the bedding of the rocks of the area. In the western part of the workings, the general strike is 280° and the dip is to the south at 40°. In the vicinity of faults, for example the No. 2 fault, the dip changes in amount and direction, but there is little or no change in the strike. In the eastern portion of the workings, the general strike is 45° and the dip is to the south-east at 40°. In the extreme north-eastern portion of the workings, the strike and dip are similar to those in the western portion of the working.

A few veins of scheelite and of quartz veins with scheelite occur in the workings and in a few places, it is also possible to see some coarse scheelite in the garnet and other ores. In general, however, the grain size of the scheelite is too small for detection by eye. In the past, the presence of scheelite has been detected by sampling and by assaying or panning in a dish. Recently use has been made of a Mineralight ultra-violet outfit loaned by the Mineral Resources Survey Branch. The latter outfit shows that the scheelite is in general uniformly distributed throughout the ore, but that in detail the distribution is somewhat irregular. There is also a considerable range in the grain size of scheelite.

The scheelite fluoresces with the yellow colour indicating an appreciable content of molybdenum. This is confirmed by the fact that it is impossible to obtain scheelite concentrates free from molybdenum.

Molybdenite is present in a few places in the workings. It is most plentiful in, and near, the wide aplite dyke in the eastern portion of the workings and appears to be particularly associated with the pyrite occurring alongside that dyke.

Very small amount of pyrrhotite occur in the rocks and a small amount of fine-grained pyrite appears to occur chiefly in the footwall rocks of the mineralised zone.

Scheelite ore has been proved by the workings, drill holes, etc. to extend over a length of 1400 feet in a general east-west direction. Ore is being worked along a length of 700 feet.

The drilling campaign in progress is designed to test a length of 500 feet, occupying the western portion of the present open cut workings.

In the open cut workings, the width of the ore-bearing zone approaches a maximum of 500 feet in a north-south direction. The geological surveys have shown, however, that there are several faults (with approximately east-west directions and with downthrows to the north) which have faulted the mineralised zone and given it a considerable apparent width. The stratagraphic width of the mineralised zone ranges from 160 to 180 feet and corresponds to a horizontal width of 210 to 240 feet.

The full width of the mineralised zone does not represent ore of profitable grade. The higher grade ore occurs in bands (mainly of garnet rock) corresponding to original beds, the differences being due to the different alteration and mineralisation of individual beds. In general, the uppermost part of the zone contains the highest grades (over 1 per cent WO_3) and corresponds to a band of coarse garnet rock 20 to 40 feet in thickness. The underlying part is usually low grade for a width ranging up to 50 feet. Underneath this barren layer, there is another ore-bearing layer ranging from 0.4 to 1.0 per cent in grade and a thickness up to about 75 feet. Underneath this lower ore-bearing layer there is usually a thin low grade layer before the footwall rocks are reached.

The thickness and grade of the ore-bearing layers are being determined in the present drilling campaign. The results of the drilling and assaying to date have given the following information regarding these factors. In this table only material with a grade greater than 0.2% WO_3 has been included. It may be desirable at a later date to use a higher figure than 0.2 to determine what will be regarded as ore and what will be regarded as waste material. The effect of such a change would not be great and would reduce the quantity of ore slightly and at the same time raise the grade.

Drill Hole	Ore above 0.2% WO_3			Remarks.
22	1.12%	across 8.2'	(14.9)	Portion of uppermost lode not present.
	0.43%	" 72.6'	(77.3)	
23	1.52%	" 20.0'	(25.3)	Small portion of uppermost lode not present.
	0.48%	" 63.0'	(68.2)	
24	0.44%	" 18.9'	(19.3)	North of No. 2 fault.
25	0.80%	" 23.7'	(40.7)	North of No. 2 fault.
	1.21%	" 30.7'	(34.3)	
26	0.95%	" 19.2'	(20.7)	North of No. 2 fault.
27	0.45%	" 8.8'	(9.0)	Upper portion of mineralised zone not included and to be re-drilled North of No. 2 fault.
	0.52%	" 19.8'	(20.0)	
28	1.79%	" 36.7'	(40.8)	Small portion of uppermost lode not included.
	0.6%	" 13.1'	(13.3)	
	0.49%	" 15.6'	(17.0)	
29	0.81%	" 50.6'	(67.4)	Uppermost portion of zone removed by erosion.
30	-	-		Less than 0.04% - North of No. 2 fault.
31	1.15%	" 22.5'	(24.2)	Whole zone probably represented.
	0.58%	" 52.2'	(66.9)	
	0.4%	" 6.4'	(6.5)	
32	4.1%	" 3.7'	(10.5)	North of No. 2 fault.
33	-	-		No assaying results available - North of No. 2 fault.
34	1.54%	" 25.2'	(25.3)	Whole zone probably represented.
	1.01%	73.6'	(87.0)	
35	-	-		No assay results available. Uppermost portion of zone not represented. 100' of garnet possibly of good grade is present

Drill hole	Ore above 0.2% WO_3	Remarks.
36	-	No assay results available Uppermost 20' will probabl; average over 1%. The lower portion of zone is probably of average grade.

The portions of the drill holes represented by the above results are shown in position on the cross sections of Plate 2. The percentages given are for WO_3 content. The first width given is that represented by the core recovered and the second (in brackets) is that representing the full width (or length of hole) from which the recovered core was obtained. The lodes or ore-bearing zones have been assumed to be at right angles to the drill holes and the widths intersected taken as the true widths. In some drill holes the dip may depart slightly from the above, but the reduction from the apparent to true width would be small.

VIII. ORE RESERVES AND OVERBURDEN.

Taking into consideration the following factors:-

(i) The information on the cross sections along lines 1 to 4 regarding the distribution, thickness, extent and grade of the scheelite-bearing formations.

(ii) A length of 500 feet along the mineralised zone.

(iii) A depth extending to sea level,

the amounts of ore and overburden have been calculated to be 1,129,000 tons and 1,182,000 tons respectively.

The ore has been calculated on the basis of 12 cubic feet per ton and the overburden at 14 cubic feet per ton. A batter of 40° has been assumed in determining the sides of the open cut and the amount of overburden to be removed. The overburden will consist partly of sand, partly of weathered rocks, and partly of unweathered rocks. In the former two types, a batter of 40° will probably be found to be necessary, but in the unweathered rocks it may be possible to use higher batters with a consequent reduction in the amount of overburden removal.

The grade of the ore in this block is estimated to be 0.7 per cent WO_3. The estimated 1,129,000 tons contains some material with grades lower than 0.2 per cent WO_3 (the average grade of such material is about 0.1 per cent WO_3). It would be possible to reject much of this low grade material, and such rejection would reduce the tonnage of ore to be treated, but would increase the grade of the ore. For the past two years the operating company has rejected an amount approximately equal to one quarter of the ore treated. General calculations show that the above 1,129,000 tons of ore would contain low-grade material in similar proportion. In the actual mining operations the amount of low-grade material which would be rejected and sent to the dump would depend largely on the method and equipment being used, but cannot be accutately determined at present. It would, therefore, be preferable to regard the grade of ore to be milled as 0.7 per cent WO_3 subject to the proviso that the selective mining would tend to increase the grade.

In addition to that in the above block, ore exists both to the east and west of it. To the west the presence of the ore is proved by the 1941-42 vertical drill holes; but it is completely covered by sand and it not visible for inspection and sampling. To the east, ore has been worked in the past and is visible in open cut and adits and was intersected by the 1934 drill holes. In this eastern block the amount of possible ore down to sea-level is

estimated to be approximately 200,000 tons. Its grade has not been determined as accurately as that in the 500 ft. block, but it is probably a reasonable assumption that it would be similar, viz. 0.7 per cent WO_3. Sampling of the adits in this section is in progress and the samples will shortly be sent for assay.

The overburden in the eastern block is estimated at approximately 300,000 tons.

There is, therefore, approximately 1,329,000 tons of ore in the 500 feet block and the eastern block. The total amount of overburden on the two blocks is 1,482,000 tons (equivalent to about 768,000 cubic yards). For each ton of ore mined, it will, therefore, be necessary to remove 1.11 tons or 0.58 cubic yards of overburden.

In addition to the drill holes on which the above figures are based, other drill holes are being put down. These holes are intermediate ones between some of the existing holes, and intended to give further information as to the grades and thicknesses of ore. Examinations of the cores from the recently drilled holes (including one of the intermediate ones) by Mr. C. L. Knight, Geologis with the Mineralight ultra-violet light equipment suggest that the grades are generally similar to those in previous holes.

CANBERRA, A.C.T.
2nd February, 1943.

P. B. NYE,
Assistant Director.