

THE SHEPHERD AND MURPHY MINE - MOINA

Situation and Access

The mine is now operated by Moina Tungsten Tin Mining Company No Liability, and is situated south-east and adjoining the former township of Moina.

The greater part of the mine is located on two adjoining mineral leases Nos. 10795/M and 53M/51, each of 20 acres in extent. Other adjoining mining tenements held by the company total 197 acres and water rights are attached to Bismuth and Brampton Creeks. A portion of the workings extends into unleased Crown land to the south-east of Section No. 10795/M.

Only one residence, including the Post Office and store, now remains on the old Moina Town Reserve and the existing settlement is clustered in vicinity of the mine.

Access to the mine is gained by motor road from Sheffield via Wilmot in a distance of 24 miles. At 11 miles south of Wilmot, on the Cradle Mt. road, a branch road reaches the mine in  $1\frac{1}{2}$  miles.

Previous References

The following list includes all previous departmental publications, and an unpublished report, containing references to the Shepherd and Murphy Mine:-

Publications:

- 1893 - Montgomery, A.: Report on the Mineral Discoveries in the Neighbourhood of Bell Mount.
- 1897 - Smith, J. Harcourt: Report on the Shepherd and Murphy Tin Mine, Bell Mount.
- 1898 - Smith, J. Harcourt: Report on the Bell Mount and Middlesex Mineral Fields.
- 1901 - Waller, G.A.: Report on the Mineral Districts of Bell Mount, Dove River, Five-mile Rise, &c.
- 1913 - Twelvetrees, W.H.: The Middlesex and Mt. Claude Mining Field (Tasmanian Geological Survey Bulletin No. 14).
- 1916 - Hills, Loftus: Middlesex and Mt. Claude Districts (Tasmanian Geological Survey, Mineral Resources No. 1, Part II).
- 1919 - Reid, A.M: The Mining Fields of Moina, Mt. Claude and Lorinna (Tasmanian Geological Survey Bulletin No. 29)
- 1938 - Nye, P.B. and Blake, F.: The Geology and Mineral Resources of Tasmania (Geological Survey Bulletin No. 44).

Unpublished Report:

1943 - Keid, H.G.W.: Report on the Moina Mineral District.

Plans

A surface map showing the general geology, together with the vein system, and a mine detail plan with longitudinal sections accompany this report.

History

The ore deposits of the Shepherd and Murphy Mine were discovered in 1893 by Thomas Shepherd and Thomas Murphy. During the early stages of prospecting and mine development production was intermittent, but from 1907 to 1918 regular production of tin, wolfram and bismuth was maintained. Prior to 1914 mining was confined to the lodes above No. 3 Adit, but by 1915 the main shaft had been sunk below that level to a depth of 171 feet. From this period up to 1919 Nos. 4 and 6 Lodes, together with the North-West Branch of the latter, were developed from the shaft levels, the greater part of the stoping being carried out on No. 6 Lode. In 1919 a bushfire destroyed the milling plant and the mine closed down.

The erection of a new mill, commenced in 1921 by the Shepherd and Murphy Syndicate Limited, was completed in the following year by the New Shepherd and Murphy Mining Company. The latter company milled some 2000 tons of ore, principally from broken material in stopes above No. 3 Adit and from surface dumps, for a return of approximately 22 tons of "Firsts" and a quantity of "Seconds" concentrate. The shaft levels were not unwatered and operations ceased in 1924.

In the years between 1933 and 1950 J.P. Godwin carried out intermittent sluicing operations on alluvial and detrital deposits, together with the treatment of limited quantities of ore by hand jigging methods.

The present holders of the mining tenements, Moina Tungsten Tin Mining Co. N.L., completed the unwatering of the mine by September, 1953, and the new mill and concentrating plant was still in course of erection at that stage. Records show that by the end of 1954 the company had treated 2500 tons of ore.

Physiography

The Mine occupies high ground rising southerly from Iris River valley at an altitude of about 2000 feet above sea level. The area is dissected by Bismuth Creek on the east and Brampton Creek to the west, both flowing north-easterly to join Iris River in a distance of one mile. Bismuth Creek has cut a deep channel through basalt flows to expose underlying sedimentary rocks on the denuded sides of the valley. The ore bodies are contained in the

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sedimentary rocks and the rugged topography has thus assisted in the prospecting and mining of the lodes to depths of several hundred feet by means of adits. The lowest adit occurs at an altitude of 2160 feet above sea level and the hill surface rises 340 feet in a distance of 1500 feet to the highest outcrop of the veins worked in the mine.

### Geology

The oldest rocks in the mine area are those in which the ore bodies are contained. They are of Ordovician age and comprise sedimentary beds of quartzites conformably succeeded by altered limestones. These rocks are largely covered by Tertiary basalt. In places the basalt flows conceal alluvial deposits of a former stream system. Devonian granite outcrops outside the area to the east of the mine.

Ordovician - Stratigraphically these rocks belong to the Juneau Group the sequence of which is as follows:-

Gordon River Limestones  
Caroline Creek Sandstones and Shales  
West Coast Range Conglomerate (sandstones  
and conglomerates)  
Jukes Breccias and Conglomerate.

Two formations of the group have been recognized in this district, they are the Gordon River Limestones principally comprising limestones, and the West Coast Range Conglomerate consisting of conglomerates and sandstones. As a result of contact and metamorphism of the surrounding rocks intruded by the granite mass, sandstones in the vicinity of the mine were transformed into quartzites and the limestones converted to garnet-pyroxene rocks or skarn. The latter is principally composed of garnet, epidote, pyroxene and magnetite, with vesuvianite, fluorite and other subordinate compounds. Unaltered limestones are exposed, below basalt covering, in the bottom of Bismuth Creek valley at 50 chains downstream from Moira road crossing.

In the mine locality, to the west of Bismuth Creek fault, garnet rocks conformably overlie quartzites. They strike generally north and south and dip to the west, at angles from 30° to 50°. Owing to the restricted outcrops, due largely to the basalt cover and combined with the influence of faulting, the rock structure could not be satisfactorily determined. However the strike and dip measurements suggest the presence of a west dipping limb of a meridional trending drag fold.

On the east side of the main fault quartzites predominate and occur opposite both quartzites and garnet rocks. However, towards the south-east a small area of garnet rock again appears and is here in contact with quartzites, occurring on the opposite side of the fault line. Quartzite beds are repeated on the hillside to the north-east of this exposure of garnet rocks, where they strike NW - SE and dip to the south-west in the correct sequence below the altered limestones.

Devonian - The June Group of rocks was intruded in Devonian times by a granite which now outcrops some  $3\frac{1}{2}$  miles to the east of the mine. From the affect of contact metamorphism on the local sedimentary rocks, it appears likely that granite extends below the area at no great depth.

Tertiary - Basalt flows extruded during the Tertiary period covered a large portion of the former land surface. These rocks have been greatly denuded and now occur over the northern and western parts of the area. The basalt covers the western extension of the ore-bodies at the surface.

The basalt has filled the former valleys and covered early Tertiary alluvial deposits formed along the course of the previous stream system. Remnants of the alluvial deposits, in the form of a sub-basaltic lead, are revealed at several places in the underground workings and to a greater extent in a surface cut.

Tectonics - Tangential compression forces during the Tabberabbean orogeny of the Devonian period brought about extensive folding of the Ordovician strata. The axes of the principal folds developed generally along N.W. - S.E. Lines. Between these main folds minor drag folding occurred with axes trending from N.E. to N. Tension in the rocks caused by the folding movements was relieved by fracturing in the form of tension fractures.

Contemporaneous with the folding a period of granite activity occurred accompanied by metallogenesis. Mineralising gases and solutions, emanating from the granite intrusion were deposited in the tension gashes to form the quartz veins of the area.

Faulting - A steeply dipping thrust fault traverses the valley of Bismuth Creek. Its course can be distinguished on the air photographs and it is also indicated by the mapping where younger altered limestones have been displaced, as a result of movement along the fault, and occur opposite older quartzite beds. The fault strikes on a general bearing of  $315^{\circ}$  and the displacement of the strata indicates a heave of at least 1200 feet.

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The best exposure of the fault is seen in cuttings along Cradle Mt. road, half a mile to the south-east of the mine and north of the crossing of Bismuth Creek. Here it dips at a high angle to the north-east along a wide brecciated zone. Beds on the footwall side show upward drag as opposed to downward drag on the hanging wall side.

Wolfram bearing veins formed at the same period as those at the Shepherd and Murphy Mine are dislocated by the fault movement. The fault is therefore shown to be of post mineralisation age.

A series of small faults have been revealed in the mine workings. The veins are dislocated by the faults to only a minor degree, with displacements from 3 feet to a maximum of 10 feet. The dip of the fault planes vary from vertical to  $45^{\circ}$  to the north. These faults occur more frequently about the junction of the quartzites with the overlying garnet rocks. Little difficulty has been experienced in locating the continuation of the veins in the vicinity of the faults during mining operations.

#### The Ore Bodies

The lodes of the Shepherd and Murphy area are essentially quartz fillings of tension fractures.

They consist predominantly of quartz with fluorite, mica, topaz, calcite, beryl and laumontite as accessory gangue minerals. The contained minerals of economic importance comprise cassiterite, wolfram and bismuthenite. Other subordinate metallic minerals include scheelite, pyrite, sphalerite, chalcopyrite, magnetite, molybdenite and galena. Bismuth and bismutite also occur near the surface.

In the mine four parallel E - W lodes have been developed. In order from south to north they are Nos. 2, 4, 5 and 6. Also included is N - W Branch Lode, a vein deviating in a north-westerly direction from No. 6 Lode, towards the western extremity.

The parallel lodes dip steeply at about  $85^{\circ}$  to the south, while the N.W. Branch Lode is nearly vertical, but has a tendency to dip towards the N.E.

The lodes traverse the contained quartzites and garnet rocks at almost right angles to the strike of the strata. They pass from one rock type to another without great change. There is a tendency for the lodes to split into small veins which, with few exceptions, again unite further along the strike. This splitting is more general in the quartzites. The ore occurs sporadically in the lodes in the form of bunches and small blebs. Larger patches containing cassiterite, wolfram and bismuthenite occur infrequently, usually with those minerals independently. Some minor mineralisation of the wall rock for a few feet on either side of the lodes is an occasional feature and often takes the form

of bismuthenite or sphalerite.

The following table details distances between the lodes, average vein width and lengths over which they have been mined :-

Lode	Distance from No.2 Lode	Average Width	Length mined.
No.2	-	10 inches	820 feet
No.4	165 feet	15 "	1300 "
No.5	285 "	8 "	450 "
No.6	755 "	20 "	910 "
N.W. Branch	755 "	15 "	470 "

The lateral extensions of these lodes have not been reached in the mine. They are limited towards the east by the post mineral fault following the course of Bismuth Creek which is expected to have dislocated any veins coming within its influence to a major degree. Further extensions to the west will be determined by driving underground as the covering basalt in that direction largely eliminates prospecting from the surface.

#### The Mine Workings

From the surface down to a depth of 340 feet the lodes have been worked by way of four adits. Below No. 3 Adit, which is the lowest, they have been developed to a further depth of 150 feet in two levels from a main shaft.

Vertical distances between the various levels worked are :-

Surface to No. 1 Adit	100 feet
No. 1 Adit to No. 4 Creek Drive	90 "
No. 4 Creek Drive to No. 3 Adit (No. 1 Shaft Level)	150 "
No. 3 Adit to No. 2 Level, Main Shaft	75 "
No. 2 Level to No. 3 Level, Main Shaft	75 "

Above No. 3 Adit the lodes have been almost completely stoped out to the surface and, with the exception of some small blocks of ore, the reserves in these upper levels are inconsiderable.

Mining and development by the present company is confined to the levels operated from the Main Shaft below No. 1 Level. At No. 3 Level drives have been extended east and west on Nos. 6, 4 and 2 Lodes and westerly on N.W. Branch Lode. Stoping is now principally carried out on these lodes from No. 3 Level.

The reserves of ore developed between Nos. 1 and 3 Levels are not large and at the present rate of extraction will be depleted in a comparatively short time.

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Since the commencement of the present operations the mining and treatment of the ores has indicated that the overall grade of the lodes is tending to decline towards the bottom level and this is reported to be particularly noticeable at the extremities of the drives.

Samples of "run of mine" ore taken between November, 1954 and February, 1955 and assayed at the Mines Department gave the following results:-

No. 6 LODE	Sn %	WO <sub>3</sub> %	MOS <sub>2</sub> %	Bi %
West Drive, No. 3 Level	0.39	0.23	Tr	Tr
" " "	0.33	0.89	0.13	Nil
" " "	0.15	0.39	0.08	Nil
" " "	0.01	0.50	0.13	Nil
" " "	0.22	0.50	-	-
" " "	0.34	0.90	-	-
" " "	0.65	0.65	0.1	Tr
West Drive, No. 2 Level	0.08	0.30	0.08	Nil
East Drive, No. 3 Level	0.21	Nil	0.08	Nil
" " "	0.08	0.18	0.11	Nil
" " "	0.18	0.34	-	-
East Drive, No. 2 Level	0.25	0.15	0.08	Nil
" " "	Nil	0.15	0.07	Nil
" " "	0.08	0.24	0.06	Nil
" " "	2.72	4.39	0.16	Tr

N.W. BRANCH LODE	Sn %	WO <sub>3</sub> %	MOS <sub>2</sub> %	Bi %
No. 3 Level	0.5	0.56	0.01	Nil
"	0.21	0.97	0.02	0.01
"	0.29	0.64	0.02	Nil
"	0.19	0.43	Tr	Nil
"	0.15	Nil	0.03	Nil
"	Tr	0.11	-	-
"	Tr	Nil	-	-
"	0.12	0.45	-	-
"	Tr	Nil	-	-
"	0.11	Nil	-	-
"	0.69	Nil	-	-
"	0.12	0.20	-	-
"	0.27	Nil	-	-
"	0.12	Nil	-	-
"	0.18	1.55	-	-
No. 2 Level	Tr	0.33	-	-
"	0.11	Nil	Nil	Tr
"	0.19	Tr	Tr	Nil

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No. 4 LODE	Sn %	WO <sub>3</sub> %	MOS <sub>2</sub> %	B1 %
West Drive, No. 3 Level	0.21	0.15	0.03	N11
" " "	0.59	0.09	0.06	N11
" " "	2.63	1.39	0.03	N11
" " "	0.25	0.52	0.03	N11
" " "	0.75	0.19	0.02	N11
" " "	0.18	6.84	Tr	Tr
East Drive, No. 3 Level	0.76	0.11	Tr	Tr
" " "	0.50	0.10	0.02	N11
" " "	0.81	0.52	0.02	N11
" " "	N11	N11	0.02	N11
" " "	0.11	N11	0.07	N11
" " "	0.21	1.23	Tr	Tr
" " "	0.24	0.60	0.11	N11
" " "	0.06	0.35	0.04	0.1
" " "	0.11	N11	-	-
No. 5 LODE	Sn %	WO <sub>3</sub> %	MOS <sub>2</sub> %	B1 %
West Drive, No.3 Level	N11	N11	0.05	0.01
" " "	Tr	N11	Tr	Tr
East Drive No. 3 Level	0.22	N11	-	-
" " "	Tr	N11	Tr	N11

#### Other Prospects

Godwin's Adit - This is situated in the north eastern part of Section 10795/M, about 180 feet north east from the mouth of No. 2 Adit.

An eight inch quartz veins, showing wolfram and molybdenite, has been cut at the entrance with a strike of 263° and steep dip to the south. This is also visible in a small creek bed 25 feet further west.

The adit extends south easterly for 78 feet and has cut five mineralised veins carrying wolfram and traces of tin and molybdenite over widths varying from two to seven inches. The first four veins strike a little south of west while the fifth, towards the end of the opening, is nearly north and south.

In short drives to the east and west, at 48 feet from the portal, one of the veins is exposed over a width of seven inches with a steep dip to the south. It has been stoped nine feet overhead in the east drive and near the face it junctions with the north-south trending veins. The latter is again exposed at 66 feet in the adit where it has been followed for ten feet southerly and stoped overhead to 15 feet.

With the one exception the veins disclosed in Godwins Adit have a general east-west trend in conformity with the principal lodes of the Shepherd and Murphy Mine. They occur north of No. 6 Lode and may possibly extend west and parallel thereto. They represent a promising prospect for further development and this can be undertaken from No. 3 Level in the mine. The level of Godwins adit is 208 feet above the latter and a cross-cut north from the end of east drive on No. 6 Lode, would expect to penetrate the vein system in a distance of 220 feet, providing the veins extend to that depth.

In the north-west corner of Section 10795/M, at 200 feet north-west of the Main Shaft, the top of a wolfram bearing vein has been cut in a surface drain. The vein is partly exposed over a length of 10 feet and appears to trend in a general east-west direction, with a width of about four inches of quartz. It was not found in No. 3 Adit cross-cut, about 20 feet west of the outcrop and 60 feet below the surface.

Nos. 1 and 3 Lodes were located during the early prospecting of the area and are not now open for inspection. They occur along east-west tension fractures located 150 feet south and 60 feet north of No. 2 Lode, near the eastern worked portion of the latter. Old collapsed trenches along the strike serve to indicate the general position and trend of these veins. The deposits evidently proved to be of only minor importance as there is no record of them being worked in the mine.

Two north-west trending veins are located on Section 53M/51. These are situated on either side and in the vicinity of Bismuth Creek fault. The more northerly vein has not been prospected but is exposed in the bed of Bismuth Creek. It is here 10 inches wide and outcrops for a distance of 25 feet along the strike bearing  $302^{\circ}$ . The other occurrence, 70 feet north of Godwins Adit, is indicated by a line of underhand stopes 15 feet in depth and bearing  $305^{\circ}$  over a distance of 40 feet. Further work would be required to establish the value and continuity of this deposit.

On the steep hillside east of Bismuth Creek, opposite the mouth of No. 4 Creek Drive, several quartz veins carrying a little tin and wolfram were cut in a series of trenches during early prospecting operations. The trenches are now largely collapsed and little can be seen at present. The veins are distributed, with general north-westerly trends, on either side of the main fault and are likely to have been largely dislocated by the fault movement. Much more development would be required to prove the value and continuity of these occurrences and it is doubtful whether the expense involved would be warranted.

### Production

Production statistics prior to 1907 are not available and those for 1919 are incomplete.

Mines Department records show the following total production from 1907 to 1918 inclusive :-

ORE MILLED TONS	TIN CONS. TONS	TIN MET TONS	WOLFRAM CONS. TONS.	BISMUTH MET TONS.
72,884	689.645	434.472	276.58	65.941

#### Alluvial Deposits

Alluvial and detrital tin, wolfram and bismuth deposits, formed along the course of Bismuth Creek and the small tributaries, have been worked in the past by ground sluicing methods. These deposits were generally narrow and shallow and are now more or less exhausted.

Under cover of basalt flows, towards the western part of the mine area, the presence of a deep alluvial lead is indicated. In the south-east part of Section 10795/M alluvial tin workings consisting of a large open cut discloses remnants of this lead. The section shows 15 feet of weathered and broken basalt underlain by 25 feet of alluvial drift, dipping to the west and overlying quartzite bedrock. Silicification has taken place in parts of the upper layers of drift near the contact with the overlying basalt. A layer of wash, about one foot in thickness and which is reported to carry the tin values, rests on the bedrock.

At different periods unsuccessful attempts have been made, by means of adits, shafts and open cuts, to penetrate the lead below the basalt along the eastern edge.

In the underground workings of the Shepherd and Murphy Mine sub-basaltic alluvial drifts were encountered at different levels in the following places:-

- No. 4 Creek Drive - West end of drive on No. 4 Lode.  
One foot of tin bearing wash  
below 4 - 5 feet of sandy drift.
- " " " - No. 5 Lode, 90 feet west of  
cross-cut and 40 feet above.  
Also at end of drive.
- No. 3 Adit - 125 feet above west drive on  
No. 4 Lode.
- " " - In rise, 114 feet above east  
drive on No. 5 Lode. 8 inches  
of tin bearing wash.
- " " - West end of drive on N.W. Branch  
Lode.

From the little information available this lead would appear to extend in a general north-westerly direction from the surface exposure in the open cut workings to a position above the underground workings on N.W. Branch Lode. In this locality the basalt cover is probably 100 feet in thickness. Any further extension to the north-west would take the lead below the basalt exposed downstream from the road crossing of Bismuth Creek. The width of the lead has not been established and the thickness of the tin bearing wash, where encountered in the workings, is not more than one foot.

The high costs entailed in attempting to prove substantial quantities of payable material in this lead, coupled with the difficult task of mining below the basalt covering, largely excludes consideration of the working of these alluvial deposits under present economic conditions.

#### Conclusions and Recommendations

Proved ore reserves of an economic grade above the bottom level in the Shepherd and Murphy Mine are comparatively small and are expected to be depleted in a short period at the present rate of extraction. At this level the lodes are contracting in width and the values decreasing laterally in either direction.

Following the recent development and mining of the four lodes and the branch lode at the lower levels of the mine by the present company it has become apparent that to maintain economic production over an extended period development must be undertaken below No. 3 Level on the lodes already worked in the mine and other promising mineralised veins in the area.

To test the economic value of these deposits at greater depth it is recommended that :-

- (1) Winzes be sunk from No. 3 Level on the lodes already worked in the mine, commencing with No. 6 Lode adjacent to the Main Shaft.
- (2) The mineralised veins exposed near the surface at Godwin's Adit be tested at No. 3 Level in the mine by cross-cutting north from end of east drive on No. 6 Lode.

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