

BALFOUR MINING FIELD1. INTRODUCTION :

The Balfour Mining Field was visited during the latter part of June and the beginning of July to determine whether any prospects justified the expenditure of a grant of £1,000 as requested by the Circular Head Municipal Council. Over three weeks were spent on this investigation.

2. LOCATION AND ACCESS :

At the present day the only possible route is by the old Coast road from Marrawah. A road, which can be used by motor cars connects Marrawah with the ferry service near the mouth of the Arthur River. From the Arthur River to Temma, about 16 miles apart, the track although of reasonable grades, is unformed. The first part, towards the Sundown Creek is along the coastal sand dunes, which are avoided by travelling along the Sundown Beach whenever conditions are favourable. Beyond the Sundown Creek, the track is generally over peat-covered, gently undulating country which would soon become impassable with heavy traffic. From Temma which was the port for the district, a graded but, at present, very rough road runs to Balfour. Part of the road is corduroy and where the peat has been stripped, depressions on the peneplain have become water channels causing either deep scouring of the wheel tracks or the formation of long pools of appreciable depth. Some of the bridges and culverts are in urgent need of repairs. The Temma pier can no longer be used, so that the only means of transport is by road.

The back track from Roger River to Balfour is impassable as, apart from fallen timber and overgrowth, the Arthur River and Frankland River bridges have been destroyed by fire or flood.

Under winter conditions, the vehicular trip from Marrawah to Balfour takes at least three days. As this distance is approximately 42 miles, some idea of the difficulties of transport on this track can be realised.

3. PREVIOUS LITERATURE :

Reports on the Balfour Mining Field by L.K. Ward (Geo. Surv. Report No. 1, 1910 and Geo. Surv. Bull. No. 10, 1911). The above reports were written while active mining operations and prospecting were being undertaken in this area. As most of the workings at the present day are inaccessible, Ward had better facilities for assessing the potentialities of most of the mining properties than later investigators.

The only other investigation has been by Q.J. Henderson Jnr. (Typewritten Report 19/2/35 - Report on the Balfour and Interview River Tin Field), who described the mining operations and prospects of the tin deposits as existing then.

4. PHYSIOGRAPHY :

Three major divisions are noticeable : -

1. The coastal plain;
2. The uplifted peneplain;
3. The dissected plateau.

These are observed successively going eastwards.

1. The Coastal Plain -

This extends southward from the Arthur River. It is characterised by the fringing belt of dunes along the coast and inland by a sudden rise to the uplifted peneplain. This rise is also marked by a number of tree-covered basalt residuals. The present coastline has a succession of rocky capes separated from each other by dune-flanked sandy beaches.

The coastal plain is covered by fine, white, sand. Here and there protruding through this sand are isolated rocky masses which suggest the rocky capes and islands of former shore lines.

2. The Uplifted Peneplain -

This peneplain is marked on the west by the line of basalt residuals and on the east side by the northerly extension of the Norfolk Range. Mount Balfour, probably the northern end of this range, rises as a monadnock above this uplifted peneplain. A similar monadnock but on a much smaller scale is the Little Frenchman lying between the headwaters of the Nelson River and the Little Eel Creek.

The characteristic features of this physiographic unit are : -

- (1) Its flat nature;
- (2) Its gentle slope seawards;
- (3) Its parallel west-flowing consequent streams, which are, at present, entrenching themselves.

Apart from some stunted trees growing along the water courses this peneplain is covered by low heath and button grass.

In a few cases, the streams rise beyond the limits of this peneplain, e.g. Nelson River, Daisy Creek and the Lagoon River to the south of this District. In these three cases, they probably captured the headwater of other streams rising in the eastern slopes of the Norfolk Range.

3. The Area East of Balfour -

A succession of roughly parallel ridges trending north-north-west with each succeeding ridge increasing in elevation to the east, characterise the area east of Balfour. Our knowledge of this country is so scant that we have nothing further to add beyond suggesting that it may be a dissected plateau. The mining field of Balfour is located along the junction of the last two physiographic units. This junction is probably along the line of dislocations which gave rise to the Balfour lodes at an earlier period. Continued movements along the same lines of weakness have left their imprint on the present physiography.

The lower part of the Frankland River is partly along this line and the tributaries of this river extend into both of the physiographic units, so that the line of demarcation between these two units is not sharply defined one.

Mount Frankland is a monadnock, similar in type to Mount Balfour, and is separated from the latter by Tin Creek, a tributary of the Frankland River.

5. GEOLOGY:

Geological Succession

Tertiary	Pleistocene and Recent	Sand Dunes and river alluvium
	Pliocene) Coastal sands '''
	Miocene) Newer Basalts ''' Sub basaltic limestones and gravels
		(Hiatus)
	Epi-Devonian	Intrusive Dykes and Metallogenic Epoch Unconformity
	? Upper Silurian	West Coast Range Conglomerate Series Unconformity
	Cambro-Ordovician	Balfour Series

(1) Balfour Series. (Balfour Shales and Sandstones of L.K. Ward)

This series forms the fundamental basement of the whole district, and consists mainly of interbedded slates, mudstones, grits and sandstones which are generally thinly-bedded and are normally referred to as of Cambro-Ordovician age. It is folded with the main axial lines trending north-westerly. In places, the folds are fairly flat and pitches on the rolls of these are undulating and often in opposite directions. Areas of flat folds rapidly alternate with areas of sharp folding, which are accompanied very often by minor crumpling. Although there may be some over-folding, this is purely local in character.

The general sequence from the coast towards Balfour is a regionally ascending one. The anticlinorium is probably in the vicinity of Temma, while the synclinorium lies to the east of Balfour.

Faulting, on a small scale, is very prevalent, and faulted belts very often have the quartz veins associated with minor overfolds. This is generally true of the area which is ore-bearing and where the dips are consistently steeper than is normally the case, e.g. the area around Specimen Hill and around Balfour itself. Incogruent cross folds are a marked structural feature of the Balfour synclinorium.

(2) West Coast Range Conglomerates -

Isolated patches of conglomerates which are tentatively referred to the above, occur in the Tin Creek Valley. They are flat bedded and rest unconformably on the upturned edges of the Balfour Series.

Lithologically similar conglomerates form the back-bone of Mount Frankland. These beds dip to the west at high angles but toward the northern slopes of the mountain, there is a sudden change of direction of strike from north to west. Faulting is evident on the western sides of Frankland, and, as traverses both north and south of the mountain failed to reveal any trace of the conglomerates, these must, in our opinion, which differs from that expressed by L.K. Ward, be regarded as forming faulted blocks of West Coast Range conglomerates. In this district, apart from an occasional basic dyke referred to the Epi-Devonian igneous activity, there is a hiatus in the geological sequence following the above rocks. The next youngest rocks in the district are of Tertiary and Quarternary age.

(3) The sub-basaltic limestones and gravels -

Underlying the basalts at Kaywood, L.K. Ward records Polyzoal limestone of Miocene age near the headwaters of Little Eel Creek. A mile farther north, towards the Rebecca Creek, another outcrop was located. It is thus likely that the limestones underlie the basalts in this area.

At Balfour, gravels which are lightly stanniferous underlie the basalt.

(4) Basalts -

The basalts now form isolated outcrops. Two belts can be recognised. The first is on the edge of the coastal plain and extends south from the Rebecca Creek to the Dawson River; the second consists of the two outcrops near Balfour township and the isolated outcrop between the Nelson and Frankland Rivers.

(5) Sands and Alluvials -

The sands of the coastal plain are younger than the basalts and are probably contemporaneous with the few alluvial flats developed along the rivers.

5. GEOLOGICAL HISTORY :

(1) Deposition of the sediments which formed the slates and sandstones of the Balfour Series. Then deformation and uplift followed by erosion.

(2) Deposition of the West Coast Range conglomerates followed by their deformation which is accompanied by various igneous intrusions and the accompanying mineralization.

(3) Long hiatus of which no record is preserved in this area.

(4) Events associated with Tertiary times.

(a) Formation of polyzoal limestones, with stanniferous gravels inland, if conditions are favourable.

(b) Uplift of approximately 200 feet and accompanied by extravasion of basalt.

- (c) Erosion reducing the basalt to isolated remnants concomitantly with the formation of sands along the coast and of alluvium along parts of the drainage system and the establishment of isostatic equilibrium.

6. ECONOMIC GEOLOGY :

There are two types of ore occurrences : -

- (1) Veins
- (2) Alluvial and detrital deposits.

(1) The Veins.

Two distinct types of veins are distinguishable by their mineral content.

- (i) The copper veins;
- (ii) The tin-wolfram veins.

(1) The Copper Veins

No information additional to that available in Geo. Surv. Bull. No. 10 can be given, as all mine openings are now inaccessible. Plans of work since the above Bulletin was published could not be obtained from official sources. Although some drilling has been undertaken by private enterprises since then, details are not available.

There are numerous exploratory workings scattered over a wide area, along certain defined lines. The exploratory work has been extensive rather than intensive and forces one to the conclusion that the shoots of ore must be short and not as continuous as indicated on L.K. Ward's map.

The Copper Reward Mine was the only one that produced any quantity of ore, the Balfour Central Mine producing a few hundred tons of ore. Although the former had every facility for mining and treating the ore, its life was limited.

Since the closing of the mine, some copper has been produced by F.W. Emmerton, by precipitation, from the mine water of one of the adits.

Since Ward's report, mining operations were continued by R.C. Sticht with, Luke Williams as manager.

MURRAY'S REWARD.	<u>BALFOUR COPPER</u>		
	YEAR	QUANTITY TONS ORE	VALUE
			£
1907	Nil	-	
1908	Nil	-	
1909	1207.25	14,793	
1910	487.00	6,450	
1911	2083.00	21,367	
1912	1214.00	8,008	
1913	947.00	4,557	
1914	44.00	178	
1915	25.00	200	
1916	76.00	1,726	
1917	93.75	980	
	<u>6177.00</u>	<u>£58,259</u>	

CENTRAL BALFOUR

1911	197 tons Ore	£1,473
1912	6 " "	5
	<u>203</u>	<u>£1,478</u>
The only other records are : -		
1929	2.06 tons metallic	£156
1937	1.19 " "	66
1941	0.562 " "	34
	<u>3.812</u> " "	<u>£256</u>

Total production of copper has been 6,380 tons ore valued at £59,737, and 3.812 tons metallic copper valued at £256, that is, copper production has been worth £59,993.

(Figures indicate that the mine ceased production in 1917 although reports stated that preparations were being made for the erecting of a concentrating mill.)

(ii) Tin Wolfram Veins.

While the copper veins are confined to long narrow belts and individual veins are slightly oblique to the general strike of the enclosing rocks, the tin wolfram veins are restricted to the one area which has Specimen Hill as the locus, and have no definite parallelism of strike or dip. They are of insufficient concentration to be regarded as a stock-work.

The dimensions of any one vein are too small to be mined individually and the degree of concentration of the veins is insufficient to warrant mining as a whole. Furthermore, in the few attempts that have been made to mine the veins, operations have ceased when the pyritic zone was reached at shallow depths (Less than 20 feet.)

The size of the veins can be gauged from the following facts. We did not observe and can find no record of any veins which reached a width of twelve inches, while the vast majority are but a few inches wide. The strikes of the veins are not constant and although in some cases we observed veinlets developed from minor fractures, the total amount of quartz along these veins is so small that they cannot be mined profitably. The percentage of tin and wolfram in the veins is not great, and no attempt was made to determine the actual amount, owing to the extremely erratic distribution of the tin and wolfram content and the limited exposures. During our visit, no vein was available for examination down to the sulphide zone. It is recorded in Henderson's Typewritten Report 1934 that the tin content of a sample of the pyritic ore was 1.45 per cent. Operations always ceased when this pyritic zone was encountered, and there is no record of anyone attempting to calcine the pyritic ore.

The existence of sufficient pyritic ore, to maintain even a small calciner, has not been proved.

While parts of some of the veins contain an admixture of tin and wolfram, in the majority of cases one or the other predominates. In the oxide zone, the veins are essentially quartz with minor amounts of tin and wolfram and insignificant amounts of pyrite, chalcopyrite and arsenopyrite.

Even the widest veins, up to ten and twelve inches, show a marked thinning out laterally, and it is reasonable to assume that similar conditions will be met with in depth.

The presence of the sulphide zone at such shallow depth, together with the impersistence and narrowness of the veins are the factors inhibiting the mining and systematic development of the tin and wolfram veins.

(2) Alluvial and Detrital Deposits :

Alluvial Deposits -

The very limited area containing tin and wolfram veins extending in the south from the Tinville area west across Specimen Hill to Cigar Hill, Skinner's Flat in the west and a short distance north of the Temma-Balfour road, has a most important corollary. Not only is the alluvial tin confined to those streams which traverse this area, but to that length of these streams in this area and for a short distance below.

The youthfulness of the topography militates against the accumulation of large alluvial deposits.

The alluvial deposits are practically confined to the valley of Tin Creek and some of its tributaries. The maximum depth of wash is nine to ten feet and it is reported that only the bottom two feet six inches is tin bearing. Furthermore payable tin wash is confined to narrow gutters in these flats.

The runs of payable tin-bearing wash were easily located by pot-holing. The shallow depths of much of the alluvial, the general flatness of these areas causing great difficulty in tailing disposal and the seasonal inadequacy of the water supply, have all contributed to prevent any attempt to sluice these alluvial deposits.

The total yardage of tin-bearing wash available for sluicing is not sufficient to warrant any scheme which involves even the additional cost of restoration of the existing dams and water races.

Detrital Deposits -

The factors that delimit the area of alluvium are also effective in the control of the distribution of the detrital material.

The total depth of these deposits is very small and generally does not exceed two feet in thickness. Even below the existing races, only isolated areas have been ground-sluiced, thus conclusively proving that only portions of these deposits could be profitably mined. Above these races, small areas have been worked by sledging or barrowing to the races below. These richer patches mark the outcrops of the rich veins.

In 1916, an attempt was made to mine the detrital deposits in bulk. Altogether, seven acres were ploughed, worked up and scooped into the sluicing-races and then puddled. The following year owing to the dry season a programme of dam construction for water conservation was undertaken. In 1918, a ten-head stamper battery was in course of erection, for the purpose of treating specimen tin obtained during sluicing operations, but this work was never completed.

The low average tin content of the detrital deposits and their shallowness, offer no inducement to formulate a scheme for large scale sluicing operations, particularly as water cannot be brought to Specimen Hill at an effective elevation by gravitation.

SUMMARY :

Although the presence of alluvial tin at Balfour had been known since at least 1884, the copper lodes were not discovered until 1901. For some years after, little progress was made in prospecting the district, but from about 1906, there was a marked increase in activity, reaching its maximum about 1909 and at that time practically the whole area had been taken up under mineral leases.

Maximum production of copper was reached in 1911 when 2280 tons of copper ore were sold for £22,840. Of this, 2,083 tons valued at £21,367 was produced by Murray's Reward.

After 1913, production declined rapidly.

In 1916-1917 there was a slight increase due to the installation of a concentrating plant. Since then the records show that less than four tons of metallic copper produced by precipitation have been sold.

The graphs express very clearly the chief facts concerning this mineral field. Foremost among these is the close relationship between the production of tin and copper. Thus the production of tin reached its peak in 1907 (when 45 tons of tin concentrates valued at £5,094 were produced) just before the commencement of copper production. The remarkable peak in copper production in 1911, succeeding the apparent decline in 1910, is due to the building of a tramline from Balfour to Temma, and of the construction of a jetty at Temma. In 1911, the ore was first sent by the new route and included some accumulated stocks of ore. During the years when copper was receiving most attention, very little or none was given to tin. As the production of copper was waning, that of tin increased for a few years with a maximum production of 20 tons for one year. Since 1918 the yearly production of tin has been very low, while to all intents and purposes the mining of copper ceased in 1917. The slight increase in production before cessation of operations was due to the installation of the treatment plant. Reserves were insufficient to keep this plant in operation. The graphs express in no uncertain manner the rapid rise and fall of this mining field.

The alluvial and detrital tin deposits are of such limited extent and low average content that they do not justify any scheme which involves the additional cost of restoration of even the existing water races and dams.

The tin-wolfram veins have never lent themselves to systematic mining, and are such that render difficult the formulation of any scheme of testing at depth.

The field is thus essentially one for small operators.

The Circular Head Municipal Council, the applicants for a grant of £1,000 for assistance to mining from Federal funds, have no concrete proposal to offer as to how money should be spent, and we are unable to suggest any definite scheme of prospecting or development that would justify the expenditure of that amount of money with any hope of reasonable return.

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