

INTRODUCTION

## Preliminary Statement

Tin ore, it is reported, was found in the valley of Main Creek by James Cowie (the original owner of the property) in 1828, and samples of the material were sent to England by Surveyor Wedge. (If the report be true this is the first authentic record of the occurrence of tin ore in Australasia). The importance of the Brookstead area as a potential source of tin, however, did not become known until 1890. In the following year the Brookstead Proprietary Tin Mining Company, No Liability, was formed for the purpose of testing the extent and value of the grounds of veins traversing Mt. Montgomery. After careful investigation it was considered that the valley of Main Creek provided the most convenient point of attack accordingly, mining operations were commenced there on Main and Christoe Veins, and a milling and concentrating plant was erected nearby to treat the excavated material. Details of the operations are not available; but it is stated that from 1300 tons of material treated in this plant 32.5 tons of concentrated tin ore was obtained. A recovery of tin ore in the proportion of 2.5 per cent, would be considered satisfactory at the existing market rate for tin. The reasons for the cessation of operations by this Company are not apparent. The veins continue unbroken and their tin content, although variable, appears to be of average grade, yet the Company failed in its operations. That has been the only serious attempt to test the ore-bodies on a commercial scale. During the following period options of purchase were obtained successively by H.R. Hancock of Adelaide, Bowes Kelly of Melbourne, Fairthorn of Launceston and the Badak Tin Mining Company of Melbourne. Hancock tested the more important veins by means of trenches and adits, and by means of shafts and bore-holes ascertained the extent and value of the alluvial deposits. His work may be characterised as thorough but only part of the property was investigated. Bowes Kelly concentrated his attention on the alluvial deposits, especially those of Bailey Marsh and Main Creek. The operations of Fairthorne were confined to Bailey Marsh from which he obtained over eight tons of tin ore by sluicing the alluvial ground. The Badak Company although giving more attention to the alluvial deposits sampled the outcrops of the important veins and exposed them to better advantage by trenching. The result of all this work was inconclusive, even with regard to the alluvial ground.

## General Statement

Owing to the short space of time that could be allotted to the work a reconnaissance survey only was made. In consequence of this the report lacks the finish and definiteness so requisite in order to arrive at a true conception of the actual value of the property as a source of tin; but, nevertheless, the information obtained and given herein, it is considered, should prove sufficient for the purpose in view. The object aimed at is to present a clear interpretation of the nature of the ore-bodies, their extent at surface and their persistency in depth, and an account of the methods most suitable for their development and exploitation.

The first official record of the occurrence of tin ore in this area is contained in a report written in 1882 by G. Thureau, Government Geologist, to the Secretary for Mines. In the year 1892 A. Montgomery paid a hurried visit to the mine and in the following year a more extended examination

was made by him of the several ore-bodies exposed at that time. The results of the investigations are contained in the annual reports of the Secretary for Mines for the years 1893 and 1894. Since that time very little development work of any considerable importance has been performed on the mine, therefore the descriptions given in those reports are, in the main, applicable today.

#### LOCATION AND AREA

The area to which this report relates is in the county of Cornwall, in the north-eastern part of Tasmania. It is bounded on the south by St. Paul River and extends northward to St. Paul Dome and Fingal Range. The main centre of population is Avoca, 10 miles by road to the west. Avoca is connected with the seaport of Launceston by a railway of standard gauge. The property is easily accessible by road from Avoca, the only obstacle being St. Paul River which in flood is impassable for vehicles.

The area described is 5470 acres in extent.

#### TOPOGRAPHY

Brookstead in the broad valley of St. Paul River which is confined between two mountain ranges composed largely of diabase. The topography of the surrounding country is one of high relief, the most prominent features being due to the occurrence of erosion-resisting diabase and granite and to the bold configuration resulting from the corroding effect of St. Paul River. The mountain ranges rise 1000 feet above river level, and are clothed with heavy forests. St. Paul River is the major affluent of the South Esk and joins it at Avoca. It was even in Tertiary time a river of considerable magnitude and had then carved its channel deep into the granite bedrock. Periodic changes have brought about alternate stages of alluviation and degradation as exhibited in the successive variations in the composition of the fluvial terraces observed on the valley sides far above the present bed of the river, and also as shown in the nature of the Tertiary strata into which the river is now carving its channel. The nature of the terraces and other fluvial deposits affords some evidence of the successive minor movements operating to produce the existing topographic features. West of the homestead near the present channel shafts and bore holes have revealed beds of Tertiary shale rich in plant remains. These beds were penetrated at 45 feet, and were intersected to a depth of 80 feet, not reaching bottom. Underneath these shales it is possible that a deep lead of tin-bearing gravel occurs. The river bed at this depth is narrow, indicating a rapid erosion of the granite floor. This action was suddenly arrested by the subsidence of the land surface and a long period of alluviation supervened resulting in the deposition of the shales and the gravels immediately over-lying them. During the subsequent period of stability the gravels and the diabase shingle were laid down up to the level of Dunn Terrace as the Tertiary river extended its borders and formed the very broad valley it meanders through today. The several terraces indicate successive uplifts each giving renewed power to the river, which soon carved its course through the loose shingle and is now entrenched within its former channel. The river has nearly reached the limit of its erosive power and is formidable only in heavy flood. At the western end of the property vesicular basalt overlies soft Tertiary sandstone with concretionary ironstone and on Benham Plain cellular basalt covers a large area formerly occupied by river drift. Numerous fast-following creeks, having their sources in Fingal Range and St. Paul Dome, flow south-ward through Brookstead into St. Paul River. These streams bringing the waste of

Trias-Jura and Permo-Carboniferous sediments and of Devonian granite form deposits of recent gravels on the plain in the bottom of the valley. Some of these deposits contain tin ore in profitable proportion.

### GENERAL GEOLOGY

The oldest rock formation in the district consists of Cambro-Ordovician quartzites and slates. These rocks were intruded in Devonian time by a great dyke-like body of granite which probably is connected with the subjacent batholithic mass protruding here and there in many parts of Tasmania. This granite rock is the source of the tin ore deposits, consequently lodes or veins are not found in any formations of later age. At the time of intrusion the granite magma did not reach the surface, but cooled under cover of the Cambro-Ordovician sediments into which the ore-bearing solutions penetrated. The accompanying uplift was the prelude of the first cycle of erosion which extended to the Carboniferous Period and resulted in the denudation of the granite rock. There followed a depression of the land and the gradual deposition of the Permo-Carboniferous sediments on a gradually subsiding ocean floor. The beds of water-worn boulders and gravels of granite at the base of the Permo-Carboniferous formation, as illustrated near Panel Marsh, represent the first shore-line of the sea at that time. Succeeding this the Terrestrial Trias-Jura sediments of any disconformity between them and the preceding formation. The Permo-Carboniferous and Trias-Jura completely covered the granite and other older rocks effectively protecting them from the agents of decomposition and erosion.

Following this came the great eruption of diabase in Cretaceous time or at the close of the Mesozoic. Dykes and sills, the off-shoots of a larger subjacent laccolithic body, were intruded at various horizons in the Permo-Carboniferous and Trias-Jura formations completely disrupting and dislocating them. Following this upheaval the second cycle of erosion came into being and continued to Tertiary time without interruption removing the softer sedimentary rocks and re-exhuming in some places the tin-bearing granite. During part of the Tertiary, sediments were laid down on the valley floors and these were in turn covered with sheets of basaltic lava which was erupted toward the close of the period. The third cycle of erosion continues to the present day and is responsible for the alluvial deposits of tin ore of Quaternary and Recent formation.

### THE ORE DEPOSITS

#### Kinds of Deposits

The ore-bodies, aside from placers or alluvial deposits consist of lode fissures and veins, the walls of which have been altered to greisen. At Mt. Montgomery the closely spaced fissures have been formed into a solid ore-body by the greisenising action of fluorine-rich solutions. As a rule the tin ore accompanies green tourmaline, gilbertite, vein quartz and some sulphidic minerals filling fissures in granite whereas the intervening greisenised wall-rock is almost barren. Impregnation of the wall-rock varies from a few inches to two feet in the case of individual widely spaced fissures, to ten feet and more where they are closely grouped. The wall rock is a porphyritic granite consisting of large phenocrysts of idiomorphic soda orthoclase, corroded phenocrystic quartz, and a little biotite, the whole set in a younger generation of the same minerals. Orthoclase in crystals sometimes two inches

long predominates over all other components.. Near the veins muscovite is more abundant than biotite and nodules and veinlets of black and green tourmaline become prominent. The porphyritic variety gives place to coarse-grained equi-dimensional granite, and again to aplite which appears intrusive into the normal rock. Consisting largely of orthoclase and other minerals easily susceptible to alteration the normal granite in which the ore-bodies are contained has been almost completely transformed into a quartz-tourmaline rock near the fissures.

All the fissures strike in a general north-westerly direction and dip at high angles to the south-west. Many of them persist unbroken over a mile in length keeping their relative positions with remarkable regularity. They vary in width from one to four feet. Some occur in groups whereas others are widely separated. All are tin-bearing; some are richer than others, and in these the richest concentrations of ore are found in shoots varying from 100 to 400 feet in length. Rich and poor shoots alternate and pitch toward the north-west.

Alluvial or placer deposits are of three ages, namely:

Tertiary  
Quaternary  
Recent

The littoral deposit of early Permo-Carboniferous age forming the base of that formation as exposed in Panel Marsh valley has not been included because it is not a true placer deposit and because it is of no commercial importance.

Tertiary deposits represent the waste of Trias-Jura and Permo-Carboniferous rocks, diabase and granite that has been accumulated in the bottom of St. Paul River valley. The base of the Tertiary has not been reached either by drilling or by shaft-sinking. Probably underneath the shales and clays beyond which exploration works have not been carried, beds of tin-bearing gravels will be found of commercial importance. The uppermost bed consists largely of diabase shingle with interstitial tin-bearing granite drift. The large proportion of diabase reduces the value of this material much below the point of profitable operation.

Quaternary and Recent deposits may be grouped for convenience of description under one heading. They represent later accumulations derived largely from the disintegration of the ore-bodies and granites, and in the main have been formed by tributary streams of St. Paul River. In places Quaternary and Recent gravels have been laid down on alluvial deposits of Tertiary age, and it is found that they are much richer than the uppermost bed of the Tertiary. The failure of operators to recognise this fact led to the abandonment of Main Creek section, because the almost barren Tertiary beds reduced the average grade of the two formations below the point of profitable production whereas the Quaternary alone proved of fair value.

#### GENESIS OF THE ORE-DEPOSITS

In order to arrive at a clear conception of the deposits a short outline of the mode of formation is necessary. The granite magma may be considered as a solution containing besides the granite portion a certain amount of water vapour and other chemically active compounds and elements such as

fluorine, boron, and chlorine, known as "mineralisers". As the magma cools the relative solubility of its components will decrease and it will split into two parts, one of which will have the composition of the final granite, whereas the other will contain the water vapour and mineralisers and the excess of silica. As the granite was intruded under a heavy cover of old sedimentary rock now represented by quartzite the gases it contains cannot escape and they re-act on the granite forming topaz tourmaline, etc. When the granite shrinks (form) on cooling cracks are formed and these become filled with the minerals brought up in solution or produced by chemical reaction of the gases on the susceptible components of the wall-rock. Among the minerals deposited under these conditions are quartz and cassiterite. Fluorine is one of the most active of these agents. The fluorine solutions attack the orthoclase and mica components of the granite solution depositing their burden of tin ore and forming tourmaline or topaz or both. That is why cassiterite (tin ore) is usually found in association with tourmaline or topaz.

#### NATURE OF THE ORE-DEPOSITS

All the ore-bodies in this area consist of greisen veins of one type or another. Greisen is an alteration product of granite and represents one of the last phases of the action of the acid extract of the magma. It consists essentially of quartz, mica and the fluorine and boron minerals tourmaline and topaz with also, in some cases, lithia micas. It occurs in large bodies of irregular outline as in the case of Blue Lode, and also as a local alteration product of the wall-rock of fissures as in the many veins traversing the areas. On Mt. Montgomery where the fissures are numerous and closely spaced the intervening rock is wholly converted into greisen. Thus are found there alternate bands of tin-bearing green tourmaline, black tourmaline, hard mottled quartz-tourmaline containing little cassiterite, and occasional bands of quartz-mica. In places where the fissures are most widely spaced greisenisation extends only a foot or two into the wall-rock. As a rule the fissure fillings, especially where the material consists largely of green tourmaline, are much richer in cassiterite than is the greisen of the walls. Cassiterite and tourmaline (both green and black) replace the orthoclase felspar, and the biotite component is also converted into black tourmaline. As a fissure filling the gilbertite variety of mica is prominent in some parts whereas in others the massive sericite variety is more abundant. Both appear to be indicative of the presence of cassiterite. It is possible that the massive sericite represents altered topaz, but fresh topaz has not been detected. These are not the only alterations that have taken place. In some sections of the ore-bodies quartz wholly replaces the felspar component of the granite resulting in the formation of a hard dense, pellucid quartz rock in which the original phenocrystic quartz is discernible with difficulty. Where the veins extend from the granite to the overlying invaded rock, as in the cases of the quartzites of the Blue Lode, a metasomatic alteration product essentially similar to greisen is formed in the quartzite.

#### EROSION OF THE ORE BODIES

Wherever tin deposits are associated with a batholithic intrusion of granite it is found that the deposits occur at or near the summit of the batholithic body. Hence on the amount of erosion that has been taken place depends the extent

of the tin deposits in depth. Where denudation has exposed only the upper portion of the granite the ore-bodies have not been greatly reduced. If, on the other hands, erosion has been extensive very little of the original bodies remains. Formed in the early Devonian and subjected to heavy erosion during that period the granite even at that time and has been denuded of its sedimentary (quartzite) cover near time the centre of Brookstead area, though the quartzite still remains in the western part. However, erosion ceased then and through the succeeding Permo-Carboniferous and Trias-Jura periods continuous sedimentation formed a cover upwards of 1000 feet over the ore-bodies. Although erosion commenced again in Cretaceous time and has been active to the present day the cover of sedimentary rocks effectively protected the lodes until late Tertiary and remnants of these formations may still be seen overlying the granite rock on the sides of St. Paul River valley. Tertiary and post Tertiary erosion have formed deep incisions in the granite, but where the lodes are exposed on Mt. Montgomery the Permo-Carboniferous cover has only recently been removed. From the fore going it will be seen that the greater part of the area of granite has been subjected to Devonian erosion only, and that has not been very extensive. Taking into consideration the area of the exposed granite, its width over a large part of it, the quantity of material removed cannot have been very great. From this it follows that the tin contents of the ore-bodies may be expected to continue in undiminished proportions to depths of several hundred feet below the out-crops.

#### DEVELOPMENT

##### Mt. Montgomery

Probably the most important ore-bodies are those outcropping on MT. Montgomery. These have been exposed to advantage in deep trenches and open-cuts. At the north-east end of Mt. Montgomery an open-cut 30 feet long, 15 feet wide and 6 feet deep exposes two fissures and intervening greisenised granite. The normal granite here is a medium-grained, equi-dimensional rock consisting of quartz orthoclase and muscovite with massive secondary mica and crystalline gilbertite. The quartz is phenocrystic, orthoclase is interstitial, and the mica is secondary. It contains nodules of black tourmaline. The greisen consists of waxy pinite and gilbertite, quartz and black, green and blue tourmaline. Black tourmaline in large columnar crystals constitutes the bulk of the fissure filling. Cassiterite in coarse crystalline form is prominent filling interstices in the gangue and in the greisen of the walls. It is reported that tin occurs here in the proportion of 1.4 per cent. Each of these fissures is eight feet wide and, assuming that the reported tin content is correct, should prove highly profitable. The tin occurs in clear gem-like crystals of amber, ruby, resin, and grey colours. Because of its large proportion of crystallised black tourmaline this is known as the No. 1 Black Lode.

No. 2 Black Lode lies 120 feet to the south of No. 1 and like it consists largely of black tourmaline. The fissures are 6 and 10 feet wide separated by an eight-foot band of greisen. Cassiterite is not discernible by eye, but it is present, though not in profitable proportion. Northward at the summit of the Mount the greisen appears in a large body composed almost wholly of quartz. Black tourmaline

in blotches shows out prominently from the white quartz setting and occasional blebs of green tourmaline are noticeable. Cassiterite appears more abundant as facings in joints, but is not prominent in any association.

Three chains southward from No. 2 is a deep cutting across another group of fissures. One section 10 feet wide consists almost wholly of black tourmaline with cassiterite sporadically distributed through it. Another consists of tourmaline and gilbertite and a little quartz, and a third fissure is filled with green tourmaline quartz and cassiterite. The last referred to is unusually rich at this point. Clean veinlets of cassiterite are found in joints in the quartz gangue and also in blebs and bunches associated with green tourmaline. Its constant association with the green variety of tourmaline is pronounced. The rich ore-body is exposed to better advantage in a trench further westward. The blue mottled quartz-tourmaline represents the greisenised wall-rock of granite. In this case black tourmaline replaced felspar only, and the quartz with rounded outlines represents the original phenocrysts. These two trenches constitute all the development work performed on this No. 3 ore-body. Without access to analyses it is impossible to form a true conception of its value, but it certainly appears to be rich and is probably the most important body yet opened up.

The Mt. Montgomery bodies apparently cut out a few hundred feet farther westward but they reappear in Main Creek valley and have been opened up there in trenches and adits.

On the south-western end of Mt. Montgomery a trench has been cut in a soft, aplitic granite coursing in a north-westerly direction. This aplite contains a fair proportion of tin ore and is worthy of careful attention.

#### MAIN CREEK WORKINGS

In 1891 the Brookstead Proprietary Tin Mining Company commenced operations on Main and Christoe Lodes in the valley of Main Creek. Their operations consisted of the driving of an adit on Main Lode 271 feet, the erection of a milling and concentrating plant, and the construction of a tramway and a water-race. At this stage in the development of the mine the capital at the disposal of the Company had been spent, and having failed to comply with the terms of the agreement their leases were forfeited and their assets were sold. Another Company acquired the leases and stock and continued the work of development and exploitation. According to reports a recovery of 2.5 per cent tin was obtained from 1300 tons of material treated. The adit has since been continued by the several optionees to a point nearly 400 feet from the entrance. Over this distance the vein varies in width from one to three feet. The lode consists of greisen enclosing a central vein or fissure filling richer in tin ore. The greisenised wallrock of the fissure is composed of pellucid quartz, black and green tourmaline, pinite mica (massive) and a little cassiterite; and the veinstone consists of quartz, cassiterite, green tourmaline, fluorspar, much gilbertite, with also a considerable amount of chalcopyrite, sphalerite, arsenopyrite, and a little galena. As a rule the cassiterite is coarsely crystallised and disseminated through the body of the gangue. The associated sulphides excepting chalcopyrite, are nowhere prominent and are not likely to prove troublesome. A striking feature is the sharp line of demarcation between

the greisen and unaltered granite, and between the venstone and greisen. This lode has been opened up at surface by numerous open-cuts for six hundred feet on the hill-slope showing no appreciable variation in size and value.

Christoe Vein lies 94 feet to the north-east of Main Vein and is parallel to it. Where first opened up on the level of Main adit this vein was exceptionally rich in tin ore. The vein materials are similar to those of Main Vein but it contains a large proportion of chalcopyrite and it is of equal size. Christoe adit exposes ore of average grade a distance of 100 feet and numerous cuts into the lode on the hillside show tin-bearing veinstone over 500 feet in length.

Between Main and Christoe veins another but smaller-body has been opened up. It is essentially similar to them, and is worthy of further attention.

West of Christoe Vein about 200 feet, is another parallel vein two feet wide composed of similar materials and apparently of equal quality. Trenches expose it to advantage on the side of the hill.

Hancock Vein outcrops fifteen chains to the north and has been driven on 60 feet in a south-easterly direction from the bank of Main Creek. This vein is one to two feet wide with a well-defined wall on the south side and an irregular footwall. It lies in a nearly vertical plane with a slight inclination to the south-west. A veinlet of clean cassiterite up to half an inch thick occupies the centre of the vein, which consists largely of green tourmaline, quartz, and gilbertite with cassiterite in fine grains and minute veinlets sporadically distributed throughout its mass. Greisenisation has been very irregular here, unaltered blocks of granite occurring in the fissure whereas at other points the greisen juts out far into the footwall rock.

Ruby Vein, so called because of the quantity of ruby cassiterite found in it, is situated 15 chains to south-west of Main Vein and Shamrock Vein lies 10 chains farther on. These veins are of average width and quality and are essentially similar to those already described.

Reference to the map will clearly indicate the positions of the veins described, and will convey an idea of the large number exposed in other parts of the property. They are all similar, and, although varying in their content of tin from point to point, it is difficult to determine which are the richer without recourse in mining works. (In order to avoid repetition a description will not be given of the undeveloped veins of this type.)

On the ridge separating Williams Creek and Long Marsh three large elliptical-shaped bodies of greisen stand out prominently from unaltered quartzite and normal granite. These bodies are entirely different from the veins in the eastern part of the property, and although very little cassiterite is discernible at the outcrop, it is considered that mining works will reveal profitable ore at a depth of fifty feet. One of the reasons for this assumption is that altered quartzite still forms a cover over the granite and this rock is not susceptible to replacement by tin-bearing solutions. It is evident therefore, that mine openings should reveal richer deposits in the greisenised granite. The southernmost is remarkably similar to ordinary greisen. The

rock has a bluish hue, and consists of very hard quartz flecked with black tourmaline. In the fissured part of the ore-body greenish black tourmaline, and a little cassiterite are present. A trench across this body reveals a small body of unaltered, medium-grained granite.

Unaltered porphyritic granite separates this from the middle body which exhibits similar features. A shaft was sunk 15 feet on this lode by H.R. Hancock and bunches of ore rich in tin were found. No other exploratory works have been performed on these lodes.

These pipe-like ore-bodies are not uncommon. The tin ore in them is not so easy to trace as if it were contained in a channel between properly defined walls because it may not be confined solely to the centre of the body but extend into the true greisen and follow the sinuosities of the enclosing granite. Under these conditions the deposition of ore does not possess the regularity and constancy characteristic of fissure fillings or veins.

#### PLACER OR ALLUVIAL DEPOSITS

Extensive deposits of tin-bearing placers occupy the lower slopes and the bottom of St. Paul River valley. They vary in age from lower Tertiary to Recent, but sedimentation has not been continuous. Alternate stages of alluviation and degradation are exhibited in the several terraces at different elevations by the change in the nature of the materials composing the deposits. These remarks apply particularly to the Tertiary gravels. Tributary streams of St. Paul River running southward from the mountain range have cut through these old terraces and have deposited tin-bearing gravels 8 to 30 feet thick on those beds. These younger deposits have been worked intermittently with fair success by tributors, and by Mining Syndicates holding options of purchase.

It has already been stated in another part of this report that the value of the Tertiary deposits has not been determined. So far as the writer has been able to ascertain not one of the many exploratory bore holes and shafts has penetrated the lowest beds in which tin ore might be found. The gutter of the Tertiary deep lead passes close by the homestead, and, fifty chains westward therefrom, crosses to the south side of the present river channel. Shafts sunk near the river expose 40 feet of diabase shingle overlying 40 feet and more of greyish black shale. Whether the granitic gravels below the shale will prove sufficiently thick and rich to warrant the removal of the almost barren overburden is open to speculation and can be determined only by actual test. The granite rock cuts out two miles to the eastward of the homestead therefore, it may be safely anticipated that diabase pebbles and boulders will constitute the bulk of the material. Holes sunk at Dunn's Terrace which is the northern limit of the Tertiary gravels, reveal materials composed largely of diabase and the waste of Permo-Carboniferous and Trias-Jura strata. Blocks of Trias-Jura coal, evidently derived from the coal seams of this age exposed at Merrywood, are found scattered through the deposit. Apart from the deep lead, the value of which is not known, Tertiary gravels although containing tin ore are of no economic importance.

Recent deposits of alluvial materials are not so extensive but they are much richer and they can be worked to greater advantage. Greater attention has, in consequence, been directed to these more easily accessible beds. The more important are the East Creek, Main Creek, Bailey Creek and Panel Marsh deposits.

From East Creek workings nearly 40 tons of concentrated tin ore has been obtained. The workings are shallow and the gravels are light and easy to sluice. It is estimated by the owners that the tin ore occurs at the rate of 2 pounds per cubic yard of material. Grey, black, amber and ruby cassiterite from fine grains to pea-size showing little evidence of attrition are found in association and without doubt have been derived from the lodge exposed on Mt. Montgomery. The deposit is 50 to 100 feet wide, 6 to 10 feet deep and 60 chains long.

Main Creek deposits are 10 to 20 chains wide and extend from the river to a point within 30 chains of the old Concentrating Plant a distance of 100 chains. The richest section however, is that between a point 20 chains north of the homestead and the upper limit of Dunn Terrace. This section has been closely tested by means of shafts by the several operators and the tin-bearing ground has been proved to a depth of 30 feet in the Creek bed. The tin ore content of the gravel they state varies from half a pound to five pounds to a cubic yard or an average of two and one half pounds. It is an ore of coarse grainsize and can be separated with ease by ordinary methods of sluicing. The old course of Main Creek followed the edge of Dunn Terrace and the flood waters take that channel at the present day. Holes should be sunk along the line of this overflow channel to ascertain the value of the lead. Except on the east side where it is granitic the deposit consists largely of diabase shingle.

Bailey Creek deposits are equally important and have received the most attention. Fairthorne Syndicate working here 9 or 10 years ago found that the proportion of tin ore was 2 lbs. per cubic yard of material. They obtained 8½ tons of tin ore in sluicing an acre of ground ten to twelve feet deep. The material consists of well assorted fine grained, granite waste with occasional boulders of diabase. Fairthorne's party concentrated the ore to 74 per cent, tin, but lost a considerable proportion in effecting this result. The work was performed by means of a hydraulic elevator and nozzles were used in breaking down the alluvium and conveying it to the sump. Between Fairthorne's and the river a block of very rich ground was worked out many years ago. Dish tests of the dumped material from shafts yielded extraordinarily rich prospects. The ground for a mile north of Fairthorne's has been tested by prospect shafts and proved to be of almost equal value. From the bottom of the sluiced ground a shaft 37 feet in Tertiary diabase shingle and at that point the granite content became greater and the tin content higher.

Panel Marsh Creek empties into Bailey Creek near the confluence with St. Paul River. The deposit in this valley is of equal grade and the materials composing them are similar to those of Bailey and Main Creeks. It is 70 to 100 feet wide, 70 chains long and 8 to 10 feet deep. Coarse in grain and angular, the ruby, amber and grey tin ore is confined to the three feet band of coarse gravel resting on the bedrock. The overburden is almost barren and is composed largely of the fine-grained waste of Permo-Carboniferous rocks. There is sufficient fall to admit of ground sluicing methods being employed in the concentration

of the ore. The existing supply of water could easily be augmented by conducting the waters of Salmon Creek into this valley.

In the centre of Dunn's Terrace four feet of granite drift of Recent age rests on Tertiary diabase shingle which has been sunk through to a depth of 40 feet. In places Trias-Jura sandstone constitutes an appreciable proportion of the material and in one hole near the water-race granite drift occurs below the diabase shingle indicating the approach of tin-bearing gravel. Two holes, 47 feet deep, at the north-east end of the Tertiary it is reported passed through material containing tin ore in the proportion of  $1\frac{1}{2}$  lb. per cubic yard.

Before finishing this description reference will be made to the alluvial deposits on G. Blair's section on the south bank of the river. The tin ore has been concentrated at a granite bar and on a very uneven granite bottom. The greater part of it was derived from north-flowing tributaries, but undoubtedly a part was shed from the Mt. Montgomery lodes. The tin ore is of very coarse grain and is contained in ten to twenty feet of diabase and granite shingle. In some places the natural concentration has produced extraordinarily rich deposits, but taken as a whole the material is of average grade only. The tin-bearing gravels deepen to the eastward.

#### WATER SUPPLY

Sufficient water can be conserved on the property for all ordinary requirements without having a draw upon the river supply, but if it is desired to utilise water for the generation of electric power to be used in the driving of plant then other resources are required. The proprietors state that an unfailing supply capable of generating 1200 horse power has been found within a few miles of the estate.

#### EQUIPMENT

The main equipment consists only of the milling and concentrating plant of old design. However, the plant and the building in which it is housed are in good repair and parts of them could be put to use.

#### GENERAL REMARKS

The indications of the potentialities of Brookstead area are fairly encouraging both in regard to the veins and lodes and the placer deposits. Perhaps the most striking features about the veins are their number, their continuity, and their regularity. The persistence of these veins along the strike is indicative of their continuance in depth, as the surface length is generally twice the depth they attain. Wherever exposed by trenching at random tin ore is invariably found; in places not in profitable proportion as might be expected because the rich "makes" occur in shoots, but in other places rich ore has been exposed in them. Under the conditions of this examination an idea of their actual value could not be formed. One of the great advantages in the development of these veins is their favourable position relative to the topographic relief. Development by means

of adits can be performed on each of the many veins to depths varying from 200 to 500 feet. Exploration by the use of the diamond drill, which is especially adapted to the search and development of such continuous ore-bodies, is strongly recommended. As the tin ore is unevenly distributed in the veins selective mining will have to be adopted for successful operation. Developments should be conducted on several veins simultaneously in order to provide as large a reserve of ore as possible and to enable a large quantity to be treated daily.

In regard to the alluvial deposits attention should be directed to those of Recent age. These could be exploited at a very low cost. The surface is clear of scrub, roots and stumps the materials are friable and in small particles; and the tin ore is of coarse grainsize and almost free of heavy minerals.

The time at the writer's disposal was too short to enable him to investigate the ore deposits thoroughly and to prepare estimates of the quantity of ore available and its value.

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