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REPORT ON SOUTH HEEMSKIRK TIN FIELD

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INTRODUCTION:

In a previous publication of the Geological Survey of Tasmania, Bulletin 21, p. 225, a comprehensive and detailed account is given of the history of the Heemskirk Tin Field. In that account various stages of the fields history, prospecting, boom, collapse, neglect, and recovery, are outlined.

It is shown that mining on the field originated in the year 1876 with the discovery of alluvial tin by surveyor Mr. C.P. Sprent. As early as the year 1881 there had been erected on the field nine treatment plants, comprising a total of 80 heads of stamps, of which the first commenced operations in the year 1884. This would suggest that little in the way of prospecting or mining development had taken place up to that time. This opinion is confirmed by the knowledge that despite the fact that the Orient Mine had ceased operations at that date, high grade detrital ore was discovered, in the year 1902, by Mr. J. Mayne, at a point not 8 chains distant from the site of the Orient battery and within 15 chains of the place of residence which he (Mayne) had occupied for a number of years.

In recent years a number of attempts have been made to revive the industry but, whilst in a few instances some success has been achieved, in general, the earlier errors have been repeated. Expensive dwellings and machinery have been erected without definite knowledge of ore reserves sufficiently large to warrant the expenditure incurred and with no certainty that the plant erected was suitable for the treatment of the grade of ore to be won.

During the years of the Heemskirk boom, practically the whole of the field was held as mining leases, some of which extended beyond the coast. The decline of the field is indicated by the fact that the present holdings cover an area of only 165 acres.

POSITION AND ACCESS:

The area reviewed by this report is portion only of the South Heemskirk Tin Field. It has an area of approximately ten square miles and extends from the foreshores in the vicinity of Trial Harbour in an easterly direction for a distance of five miles. In a northerly direction, it extends for a distance of two miles and embraces all mining tenements at present in force. The Zeehan to Trial Harbour road crosses the south eastern corner of the area about eight miles from Zeehan, whilst the old road from Trial Harbour to Corinna and the new road to the Federation Tin Mine give access to the western and north western portions of the area, respectively. Within the limits of the area and easterly to Zeehan, the roads are in reasonably good condition and are serviceable for motor traffic. A fortnightly service from Zeehan, by motor truck, is at present maintained.

GEOLOGY:

General Geology:

Except for a comparatively small area of slates and quartzites in the south-eastern portion, the area under review consists of a series of granitic rocks consisting

of granites, aplites, pegmatites, and granite porphyries. Of this series, the granites are the most important, the remaining members occurring as comparatively narrow dykes occupying a relatively small proportion of the area. These rocks have been assigned to the Devonian age.

The Granites: The granites vary in grain size from fine to coarse grained, but are in general medium to coarse grained rocks with occasional development of porphyritic structure. They consist essentially of orthoclase felspar, plagioclase felspar, and quartz with varying but lesser amounts of biotite mica, muscovite mica, and tourmaline.

The color of the granites is governed to a great extent by their mineral constituents and to some extent enable subdivision of the granites into pink and white varieties.

The pink granites owe their color to a preponderance, in their make up, of pink orthoclase felspar which shows marked variation in amount in granites from different localities.

In the white granites, the pink orthoclase is almost absent, but otherwise their composition is similar to that of the pink varieties.

Tourmaline segregations are fairly common in all the granites, but are more prominent in the white varieties and in places become extensively developed.

Quartz-tourmaline nodules: A special type of quartz-tourmaline segregation is represented by the occurrence of more or less spherical nodules consisting of quartz and tourmaline in almost equal proportions. The nodules vary considerably in size, ranging up to six inches in diameter, and occur irregularly through the granites, in places being so plentiful as to form the greater portion of the rock mass. Usually, however, they are irregularly distributed through the granite and are not confined to any particular horizon occurring at altitudes varying from sea level to the top of Federation Hill, a height of 1,500 feet. The nodules are, in general, more resistant to weathering than the parent rock, and accummulations of freed nodules are common. They are usually barren of tin, although occasionally the normal nodules have been shown to contain up to 0.5% Sn.

A special occurrence, much more limited in extent of tin-bearing nodules, ranging in grade to 17.0% Sn, has been recorded in Heywood and Coleman's lease. These nodules differ from the normal variety in being generally smaller in size, less regular in shape, and lighter in color. They differ also in that whereas the normal nodule is invariably solid, the tin-bearing nodules occasionally are hollow. Like the normal nodule, they are more resistant to weathering than is the parent rock.

No attempt has been made to define the limits of the various types of granite for variations in color and composition are sufficiently great to suggest the mergence of one type to the other without definite boundaries.

Pegmatites: Small pegmatites veins, inches only in width, occur throughout the granite area.

Many of the prominent features of the area, locally referred to as quartz blows, are, on examination, found to be coarsely crystalline bodies composed essentially of quartz and felspar. They would be more correctly described as pegmatite dykes. They vary in width to upwards of twenty feet and persist for comparatively long distances. Though they do not all conform to a general direction of strike, the greater proportion have a north-easterly strike to conform with the general direction of the principal veins.

Irregularly along their length tourmaline occurs, in varying amounts, as radiating crystals or as segregations varying in size and extent but always of a minor nature.

Aplites. Aplites occur as fine grained light colored rocks consisting of equal parts of quartz and felspar. They are widely distributed throughout the area as minor intrusions in the granite, the dykes seldom exceeding a few inches in width but occasionally reaching a width of from four to five feet. Individual dykes are not persistent in length and generally extend for a few feet only, but occasionally may be a few chains in length. They do not conform to any directional regularity and, weathering with the granites, are not prominent features.

Granite Porphyries: The granite porphyries occur as fine grained dykes showing phenocrysts of both quartz and felspar in a fine grained ground mass of quartz and felspar with a little biotite mica and some tourmaline. They occur as narrow dykes, of short length, in the granite area.

ECONOMIC GEOLOGY:

Throughout the history of the South Heemskirk area, the mineral of greatest economic importance has been cassiterite (tin ore). The discovery of alluvial tin in the year 1876 led to extensive search for that product, and resulted in the discovery of the primary product in veins and lodes.

Perhaps of equal economic importance, and worthy of further consideration and development, are the ores, of Bismuth which, although their occurrence was recorded as early as the year 1902 (report of G.A. Waller, p.25) are still in an undeveloped state. Most of the Bismuth occurrences are in association with known occurrences of tin. They have been described in a separate paragraph.

To a lesser extent, wolfram occurs but, although records of production are far from complete, they suggest that profitable exploitation is improbable.

In isolated cases, veins of high grade sphalerite (zinc ore) occur, but they are in general too small to be profitably mined. At Sweeneys mine, the sphalerite veins show a development of fluorite and in places pyrite.

The economic minerals of tin and bismuth generally occur in association with veins which traverse both the granites and the sedimentary rocks. The strike of the veins shows great variation, but usually conforms with the direction of the main joint planes in the granite to strike on bearings of 20 degrees and 70 degrees with a marked preference for the more northerly direction. Occasionally, as in the cross lode of the Federation Mine, the strike varies from the main direction to trend in a south-easterly direction.

The veins may be classified according to their more prominent constituents, and the manner in which those constituents occur, into quartz-tourmaline veins, pinitoid formations, and pipe formations. The two latter types may be regarded as being similar in character, as the pipe formations of the area have resulted from the pinitoid alteration of granite.

The veins have been described in detail by Waterhouse in Bulletin 21 and the full classification of that and previous writers is there set out.

Quartz-tourmaline veins show considerable variation both in size and in mineral character. In every instance, however, the two minerals together form the greater part of the vein, although either mineral may be the prepond-erant one. Tourmaline may occur as the marginal phase of a vein which otherwise is essentially quartz, but it may also occur as a soft central core in a similar vein. Development of pyrite has been regarded as evidence of a distinctive type as also have those veins which show evidence of greisen-isation.

In the more massive lode formations, and in some of the normal vein formations, the quartz and tourmaline may be evenly distributed to give a more or less granitic appearance to the lode material, whilst in the Black Face lode, wide sections of tourmaline may occur, banded with similar sections of quartz.

In all types of veins, lesser amounts of arsenopyrite, chalcopyrite or sphalerite may occur, and vein types merge from one to the other.

The pinitoid formations are of much less frequent occurrence and are not so well defined as the quartz-tourmaline varieties. They are micaceous in character, waxy in appearance and are considered to result from the alter-ation of the felspathic constituent of the granite. The pipe formation (Trubuters workings) of the Federation Tin Mine was the first discovered of these formation. Other similar for-mations occur at Sweeney's Mine and probably at Geason's and the Phar Lap workings.

Higgins Workings (Maynes Mine):

The leases held in the name of W.E. Higgins cover an area of 45 acres held as two leases, No. 16M/42 of 5 acres and No. 32M/42 of 40 acres, and include the area locally known as Mayne's Mine, together with the greater portion of the area originally held by the old Kelvin Company and a portion of the area held by the old West Orient Company.

Recently, options were held over the proper-ties by a Melbourne company, the Golden Sovereign No Liability whose operations were directed chiefly towards reconditioning the battery and treatment of the spoil dumps left from earlier operations at Mayne's Mine.

The workings are little more extensive than was the case when the Lyle Syndicate ceases operations, and except for the work done by that Syndicate, are much the same as when the original companies ceased operations.

The tin ore which constituted the original discovery, was of a detrital nature, and was won by sluicing. The removal of the detrital matter exposed the underlying tin bearing veins which were then exploited. That most of the veins were narrow ones is apparent from the comparatively large quantity of spoil stacked near the workings. The irregular nature of the mine workings suggests that individual veins persisted for only a few feet laternally where often intersection with other similar veins occurred. A large number of the veins which have been worked were horizontal or nearly so, and have varied in thickness to perhaps four feet. Remnants of the flat veins are now visible in the sides of the open cuts from which the higher grade ore has been won.

The country rocks of the area consist of a series of slates and quartzites, highly silicified and tourmalinised as the result of metamorphic action of the granite, the boundary of which occurs to the north of and within six chains of the workings.

The ore bodies are composed essentially of quartz and tourmaline with, in parts, occurrences of pyrite and to a lesser extent galena and sphalerite. Both black and green varieties of tourmaline were noted with the tin ore showing a greater affinity for the green variety.

A tunnel driven through the hill was primarily intended to divert the water from Pykes Creek to enable the alluvial deposits in the creek bed to be won. At the same time it served to prospect the hill at depth. It is significant that of nine veins cut by the tunnel, only one was developed. This was a flat tourmaline vein on which a level was driven for approximately 20 feet. That no stoping has taken place suggests that the ore was low in grade if, at all, tin bearing. From the end of the level, connection has been established with the surface by a rise which made connection with a shaft sunk from one of the open cut workings.

Situated about half way between Maynes workings and the granite boundary are the workings of the old Kelvin Tin Mining Company. The old adits have collapsed in part, and are inaccessible. Recently, an attempt was made to reclaim one of the adits. The work involved the removal of a considerable quantity of spoil, the result of a landslide in the old open cut. The position of the adit was not definitely known, and the work was abandoned without having achieved anything.

To the south east of Mayne's workings, immediately across Pykes Creek, two small veins have been exposed by short adits. It is reported that these veins carry a proportion of high grade tin ore. The greater of these veins is 12 inches in width but may yield a small quantity of ore on development.

The known occurrence of high grade ore have in all cases been in the nature of short lenses which were treated mostly by sluicing. The loss by this method of treatment must have been considerable, but operations were, no doubt, profitable, as the result of cheap mining methods. The known ore has now been exhausted. Future development must, therefore, be directed towards the discovery on the surface, of fresh veins or the development of known veins from the existing adits. The latter offers few prospects as the known veins are small and low in grade and worked shoots of ore have in all cases been short. Surface trenches may reveal additional veins which would lend themselves readily to treatment.

Other Workings: To the north and north-east of Maynes Workings across the granite-slate contact, some old adits have been examined. It is suggested that at least one of these adits represents workings of the old Orient Company. Waller in the year 1902 under the heading of "The Old Orient Company" states - "The underground workings disclose the presence of parallel veins of quartz and greisen striking 50° to 70° W. of N. some of which carry visible tin. Most of the veins are too small to pay for mining, but some of them go up to 3 feet in thickness, and should be payable provided they carry a fair percentage of tin."

A plan has been prepared of workings to which the above description is applicable. Evidently Waller's description covers only the shaft and levels from that shaft. A drainage adit has since been driven to connect with the northern level from the shaft. Detailed information is provided on the plan.

The pyritic formation at the end of the northern level has been sampled but was shown to be barren of tin.

Other workings, in the granitic country, which are still accessible, have been examined and are shown on the general plan covering this section of the area. Most of these workings were intended for prospecting purposes. Evidently the grade of ore revealed was too low to warrant further development despite the fact that in one instance 320 feet had been driven to cut the vein.

The Birthday Mine (Sweeneys):

This property originally comprised four leases of a total area of 80 acres on the west bank of Fykes Creek, situated about half a mile north of the main road from Zeehan to Trial Harbour and about the same distance south from the Cumberland Dam. A small battery of 5 heads, since removed, was erected in the bed of the Creek but there is little evidence that any ore was treated. The greater proportion of tin produced was alluvial in character and was won from the creek bed by sluicing.

The area is still in a comparatively undeveloped state, but surface trenches and adits within the limits of an area of 20 acres suggest the necessity for further development and sampling of the known exposures.

Reports on these holdings have previously been written by L.L. Waterhouse (Bulletin 21), and by A.M. Reid in the year 1927.

Little development has taken place since these reports were written except to extend the main adit to a total distance of 245 feet from the portal.

Reid in his report shows that his sampling of the workings yielded assay values ranging up to 2.83% Sn, and quotes further assay returns by J. Levings as yielding 1.9% Sn.

In the year 1940 samples taken in 20 feet sections along the adit on behalf of W.E. Higgins varied in value from nil to 1.05% tin. The three samples taken in the vicinity of the cross cut yielded 1.05%, 0.97% and 0.51%. The two former samples suggest an average assay value of 1% tin.

The accompanying plan shows the present state of development and suggests the possibility of the occurrence of at least three, more or less parallel, veins which strike north-westerly and dip to the south-west at comparatively high angles. Of the three veins, two at least each approximately 3 feet in width at the surface contain an appreciable amount of sphalerite and of which the more northern probably corresponds with that which occurs in the face of the main adit. The third vein, situated a little further north, has a greater total width than the two former and is composed of a hard quartzoze band lying to the east of a softer kaolin like band (pinite) containing abundant pyrite. This vein has not with certainty been exposed in the main adit, but the pinite section of the vein may correspond with the pinite vein on which the cross cut has been driven from the main adit towards the east. It may, however, correspond with the 3-inch pug vein exposed by the main adit at a point 20 feet south of the cross cut.

The country rock is a fairly coarse grained pink granite in which radiating crystals of black tourmaline occur.

In the main adit the granite is, in general, hard and fresh, but as the cross cut is approached, increasing mineralisation by pyrite is evident. In the cross cut, a vein of pinite has been followed, whilst in the face of the adit, a quartz tourmaline vein is exposed with sphalerite, pyrite and fluorspar abundant.

As some of the samples from the veins have yielded high grade ore, it is to be regretted that additional surface trenching has not been carried out to determine the lateral extent of such ore in the veins, which at surface, are of sufficient width to warrant development, should the grade of ore persist. Samples from positions near the cross cut in the main adit have yielded approximately one per cent of tin and further testing in that position is desirable.

The Federation Tin Mine:

Portion of the area now referred to as the Federation Tin Mine was applied for by W. Montgomerie as a mining lease of 80 acres in the year 1879. In the same year, the West Cumberland Tin Mining Company Registered was formed, and mining operations were commenced. Since that date the holdings have been gradually extended, until at the termination of operations in 1938, the total holdings covered an area of 574 acres.

During the period since the year 1878, various companies and individuals have operated on the whole or portion of the holdings. The original Federation Company was a local one, and was formed in the year 1900 under the name of the Federation Tin Mining Company No Liability. In the year 1905 an English company, The Federation Tin Mining Company Limited, administered the property. A further change in administration took place in the year 1920 when a Melbourne company, Federation Tin No Liability, became the holders. The last change of proprietors took place in the year 1926 with the formation of an English Company, Federation Tin Mines Limited. This company or its agents held the leases until September, 1938, when the company went into liquidation and its assets were sold. Since the year 1938, the greater portion of the leases have been forteited, only one lease of 80 acres being held in the name of J.B. Geason.

The earlier mining operations on the Federation leases were confined to the western slopes of the hill where development consisted of driving of adits and sinking of shafts on comparatively narrow veins. A little development, the Eastern workings, was carried out in the hills situated to the east of the main hill. The later operations were directed towards the exploitation of the Black Face Lode situated near the summit of the main hill. In almost every instance, the operations were financially a failure.

The Western Workings:

Of the leases originally held by the Federation Company only one, of 80 acres, is in force. At the time of this inspection, the lease was held in the name of J.B. Geason, and on it were situated all the workings of the company generally referred to as the Western workings.

Among the Western workings, there are only minor open cuts, the greater proportion of development having been carried out by means of adits and shafts. The work has been primarily directed towards the testing and development of the cross lode and, although some of the veins which strike in a northerly direction have been followed in driving the adits, none have penetrated further than the supposed position of that lode.

Some of the adits are cross cut adits which have terminated at the cross lode.

The Tributers Workings:

The Tributers workings have been the most important of the western workings. They are situated on the north-eastern end of the line of workings, but are at present mostly inaccessible. It has been reported that approximately 80 tons of concentrates have been won by the limited operations carried out there.

The original workings were open cut workings on what has been described by Waterhouse (Bulletin 21, p.262) as an irregular pipe formation of which the gangue material is pinitoid in character. Waterhouse also states "Associated with the tin, are abundant crystals of pyrite, crystals being of all sizes, from one thirty-second to over 1 inch across.... Many examples were noticed of crystals of pyrite and cassiterite intergrown, sometimes also with tourmaline and quartz." Similar formations occur and have been described elsewhere.

At the time of the 1915 inspection, only one adit had been driven below the open cut. Since that date, two other adits have been driven to cut the formation at depth and stoping from those levels has been carried out. The stopes are at present inaccessible.

No. 2 Tributers Adit:

This adit has been driven on a small quartz-tourmaline vein which strikes at about 80 degrees, for a total distance of 360 feet. At a distance of 290 feet from the portal, a level has been driven towards the north for a distance of 25 feet on a quartz-tourmaline vein, 8 inches wide, which dips steeply to the east. This vein has not been further developed. At 335 feet from the portal, a vein of quartz-tourmaline, two feet wide, has been cut and levels driven to the north and to the south for short distances. There has been no development of this vein, but from the northern end of the level, connection has been established with the pipe formation by a rise.

No. 1 Tributers Level:

This is a cross cut adit driven to cut the pipe formation. At a distance of 100 feet from the portal a short level has been driven to the north on a narrow vein. At 130 feet from the portal a vein, striking south, has been cut and some stoping has been done.

The remaining workings from this level have been designed to facilitate the working of the pipe formation.

Waterhouse reported that in the open cut, a vein occurred up to 5 feet in width. Mining operations have since removed the ore from this vein and its extension is represented only by narrow veins in the face of the open cut.

Fowler and Dunn's Workings:

Under this heading are included not only the workings originally opened by Fowler and Dunn, but also those workings since done by the Company in the vicinity of those workings.

From past records, Fowler and Dunn's workings are covered by what is now an open cut at the entrance to No. 1 level. A winze has been sunk from the floor of this cut on an eight inch vein of quartz-tourmaline. These is nothing now visible to indicate the nature of the ore treated by Fowler and Dunn, but it is reported that 60 tons of concentrates were won.

The Company's workings consist of a number of adits known as Nos. 1,2,3,4 levels, together with Yate's adit situated a little to the east.

The relative positions of the adits shown on the general plan, and plans, on a larger scale, of each of the adits, are shown to record observed details. Reference to these plans shows that Nos. 3 and 4 levels have been driven on the same vein, and although only a limited amount of stoping has taken place in No. 4 level, the fact that an open cut has been made above No. 3 level indicates that at least some profitable ore was won. In this open cut, however, a considerable amount of country rock has been mined with a comparatively narrow vein to the detriment of the grade of ore finally treated.

The relative positions of the open cut at No. 3 level and the stoping at No. 4 level suggest that the pitch of the ore shoot is towards the south-west and the length of the shoot in each adit is of the order of 40 feet.

No. 2 level has been driven on the southern extension of the vein opened by Fowler and Dunn in their open cut.

No. 1 level has been driven from the face of the open cut, and on the course of the vein worked therein. At 66 feet from the portal, the vein worked in the lower levels has been met and the level continues in this formation to a point 105 feet from the portal. From this point however, the level follows only a narrow vein until the cross lode is cut.

The vein traversed by Nos. 3 and 4 levels is exposed both in a cross cut from No. 1 level and in the level itself. Its continuation should junction with the cross lode in the vicinity of the winze sunk from the western level near the face of Yates adit. The fact that development has been neglected on this vein suggests low grade ore, but exploitation from either Yates adit or No. 1 level is desirable.

It has been reported (Bulletin 21, p. 256) that Bismuth occurs in the workings near the face of Yates adit where some stoping has taken place.

There is little doubt that both No. 1 level and Yates adit have penetrated to the cross lode but exploitation has not been extended north of that vein.

The remainder of the work done by the Company has been directed towards the testing of the cross lode. A series of trenches, two shafts, and two adits, have been made to test its possibilities.

The trenches have revealed widths of vein formation varying to 6 feet, and over a section of its length have shown the vein to have split into two sections.

Of the adits, one has collapsed, and is inaccessible. The second adit has been driven to cut the vein to reveal a width of 5 feet 3 inches of tin bearing quartz-tourmaline formation. Development of this vein is advisable.

Of the two shafts, one is 30 feet in depth but has neither ladders nor windlass, whilst the section shaft is filled to within 15 feet of the surface. This latter shaft is referred to as the Bismuth shaft.

Geason's Workings:

Since the liquidation of the Federation Company in the year 1938, the lease covering the Western workings has been held in the name of J.B. Geason, since deceased. This proprietor has produced approximately six tons of tin concentrates equivalent to a production of 3.426 tons of metallic tin, to a total value of £876. The records are not in sufficient detail to indicate that the whole of this output has been won from this lease, and it is known that other holdings have been exploited by him.

The records also show that one parcel of each wolfram and bismuth concentrates have been despatched by the same proprietor.

Several positions on the lease have been tested by Geason. These have been indicated on the general plan of the workings. Three positions at least have shown reasonably high grade ore.

(1) Marked "J.B.G. Shaft." This shaft was sunk to a depth of approximately 20 feet from a position near the northern end of the existing tramline. A quartzoze vein, with some tourmaline, striking south from the cross lode, with which it junctions, has been tested to yield high grade ore. At the junction with the cross lode, this vein is only two inches wide and is composed of quartz only. It developes in a southerly direction and has a width of two feet in the shaft. The formation at the shaft is irregular in character. It is vertical for about 5 feet in the shaft whence it dips flatly to the north east and becomes narrow. Levels have been driven short distances from the bottom of the

shaft towards the north-west and south-east to test the formation.

(2) Marked "J.B.G. old workings." Yielded a fair prospect by vanning; an irregular shaft has been sunk to a depth of 10 feet on the line of the cross lode. A quartzose formation, with irregular veins of tourmaline on the joint planes, was revealed. The tourmaline rich material yielded a fair prospect for tin with a trace of Bismuth.

(3) "Geason's Tin Workings." These have been the main source of production. A trench approximately 75 feet in length has been cut across the formation. The trench varies in depth to 20 feet, in width to 15 feet, and has a bearing of 116 degrees.

In the vicinity of the trench a quartz-tourmaline formation outcrops. It strikes in a south-westerly direction and extends for some distance on either side of the trench. In a south-westerly direction, the outcrop can be traced to a point above that represented by the face of the underground workings of Yates' adit and may be the continuation of the formation exposed in levels 3 and 4.

The trench exposes an irregular pinitoid formation dipping at 20 degrees in a south-easterly direction. This formation occurs between two hard quartzoze bands. A similar occurrence is met in a trench about one chain distant in a northerly direction and again in a shallow shaft a further one chain to the north.

Recent production from the Federation area, by J.B. Geason, is shown in the accompanying table (p.12). Of 32 recorded sales, it is noteworthy that in only one instance has the grade of concentrate reached 70% tin, whilst the average grade for the whole of the returns is 47.4%. These results are suggestive of tin of fine grain size and are confirmatory of sizing tests carried out in 1931 by Mr. Lindsay Clark who showed that 38% of the recoverable tin was of such grain size as to pass through 150 mesh screens.

BISMUTH OCCURRENCES:

In connection with the Western Workings of the Federation Mine, it is appropriate to discuss occurrences of bismuth ore, for, on that area, are most of the known occurrences. That bismuth ores occur on the area has been known for a period of years. G.A. Waller in his report of 1902 (p.25) mentions the occurrence of bismuth ores in the western workings of the Federation Tin Mine. In Bulletin 21 of the Geological Survey of Tasmania (p. 256) in the description of Yates' adit, it is reported that at a distance of 237 feet from the portal, bismuth was recorded. It is asserted that "assays have shown as much as 8 per cent. over the old winze, but a sample broken over a width of 3 feet from the eastern side of the drive, returned tin 0.46%, Bismuth 3.76%.

There is, however, no record that bismuth was ever produced in quantity from these workings. Failure to develop these resources has been due, evidently to the belief that the grade of ore was too low, or the quantity of available ore too little for profitable treatment, for, during the period 1930-1932, the average price of bismuth was £533.3 per ton, and during the period 1937-1940, the average price was £440.

The only recorded production from the area is of comparatively recent date. A return in favour of J.B. Geason, dated 5th December, 1940, reveals that a dry weight of 84 lbs. of concentrates of an assay value of 42.1% bismuth, equal to a yield of 35.36lbs. of metallic bismuth, gave nett monetary return of £8/16/10 after charges, &c., were made, Bismuth being valued at 5/- per lb. or £460 per ton. For this return, it was reported that one ton of ore from the spoil dump of the bismuth shaft was treated by sluicing. The percentage recovery was, therefore, 1.57% bismuth, and is much in excess of assay values of two samples each taken over a width of two feet from the shaft. These samples yielded 0.25% and 0.43% bismuth, respectively. They were taken from each end of the shaft and on its southern side.

A further occurrence of bismuth ore was noted in a trench about 2 chains south west of Munro's shaft near the Black Face Lode. Two samples from this trench yielded 1.31% and 0.14% bismuth, respectively, over sections each 3 feet in length along the trench. Bismuth appears to occur at this position in a narrow vein striking with the trench.

Bismuth ore is also recorded from a trench, shown on the plan, a few feet to the north of Fowler and Dunn's open cut. A sample from this position yielded on assay 2.57% Bismuth.

Apart from these localities, which are reasonably close to each other, a fair prospect for bismuth was obtained by vanning from the face of Riley and Grey's workings situated about one mile to the north-west of the Federation Mine. Bismuth has also been reported from Sweeneys (Birthday Mine), and from positions previously recorded by Waterhouse in Bulletin 21, near Maynes workings.

Throughout this inspection, only occasionally were minerals of bismuth recognised in the hand specimen, and then only in insignificant quantity. Bismuth concentrates were obtained in the prospect dish when vanning tin samples, and when "probable" bismuth sites were tested. Bismuth concentrates have a specific gravity approximately equal to that of tin concentrates, and are white or pale yellow in color. They cannot easily be separated from tin concentrates. In this locality, Bismuth ore, is in general, a yellow clay like material resulting from the decomposition of the vein material. Bismuth ores have in each case been disclosed during operations directed primarily towards the discovery of tin ores, and in most instances, the bismuth deposits are found in association with the veins which have been developed for that purpose, or in trenches which have been cut to expose the continuation of veins known to carry tin ores.

WOLFRAM:

The official records show that only minor quantities of wolfram ore have been won from the South Heemskirk district. In the year 1940, the total yield recorded was 0.09 tons of wolfram ore. Earlier reports, Bulletin 21, p. 213, reveal that "At one locality (on the Federation Mine near the old inclined tramway), a deposit of alluvial of limited extent was worked and several bags of wolfram ore won."

Local reports state occasional bags of wolfram ore have been despatched, but these reports could not be confirmed.

Metal	Ore Moist Weight cwt. qrs. lbs.	Moisture %	Moisture Wt.	Ore Dry Wt. cwt. qrs. lbs	Tin % other metals Bi	Metallic Content cwt. qrs. lbs	Value Unit.	Value £ s d	Impurities
Bi	0 3 2	2.5	2 lbs.	3 0 0	42.1	35.36	5/-lb.	8 16 10	
Sn	3 0 23	8	29	2 3 22	44.5	1 1 6	50/1	16 8 4	s.Tr. WO_3 0.4%
Sn	0 3 21	4.3	5	0 3 16	59.9	2 3.9	52/11	7 0 7	s. 0.08% Zn. Tr. Cu. Tr. Sb0.02
"	0 3 14	4.0	4	0 3 10	58.2	1 26.7	52/9	6 8 10	s. 0.06%;WO_3 0.1%
"	0 3 24	1.5	2	0 3 22	61.0	2 8.7	51/11½	7 8 1	s. 4.0%; Cu. Tr.
"	0 3 25	3.2	3	0 3 22	44.9	1 19.6	48/8	5 3 5	s. 0.15%
"	0 3 21	4.5	5	0 3 16	46.9	1 18.9	53/10	5 4 6	s. tr.
"	0 3 17	7.0	7	0 3 10	36.8	1 6.6	47/1	3 10 2	
"	1 0 15	5.5	7	1 0 8	54.6	2 9.5	54/8	7 18 10	s.tr.; Bi 0.5%
"	1 0 6	3.5	4	1 0 2	57.6	2 9.7	55/2	8 0 9	s.tr.; Bi 0.37%
"	1 0 13	5.5	7	1 0 6	61.0	2 16	55/9½	8 18 3	s.tr.; Bi 0.4;Zn.tr
"	1 0 15	4.5	6	1 0 9	61.3	2 18.1	55/8½	9 3 5	
"	1 0 6	9.5	11	0 3 23	55.3	2 3.1	54/9	7 4 8	s. 0.12%; Bi. Tr.
"	2 2 0	3.0	9	2 1 19	30.2	2 25.8	48/1	8 8 5	s.8.6; Bi.tr.; Zn. 0.14; Cu. 0.04
"	2 0 18	9.5	23	1 3 23	58.3	1 0 15.6	55/7	15 16 10	s. tr.
"	2 1 1	7.0	18	2 0 11	62.0	1 1 5.7	56/6	18 7 6	s. 0.10
"	1 0 3	11.5	13	0 3 18	50.3	1 23.3	54/7	6 5 0	
"	2 0 26	8.5	21	2 0 5	46.0	3 21.3	53/6	12 11 7	s. 0.05%
"	1 0 5	10	12	0 3 21	48.6	1 23	54/-	6 3 0	s. 0.04%
"	3 0 11	7.5	26	2 3 13	48.1	1 1 14.4	55/2	19 0 3	
"	2 0 5	10	23	1 3 10	52.5	3 20.1	56/-	13 0 5	s. 0.06%
"	3 0 11	6.5	22	2 3 17	51.2	1 1 26.4	55/10	20 14 9	s. 0.08%
"	3 0 14	6.8	24	2 3 18	43.8	1 1 2.5	53/11	17 3 8	s. 0.10%
"	2 0 17	6.5	16	2 0 1	56.5	1 0 13	56/8	16 1 7	s. 0.06%
"	3 0 2	10.3	35	2 2 23	42.0	1 0 15.2	53/8	15 4 11	s. 0.06%
"	1 1 2	7.8	11	1 0 19	56.2	2 17.6	56/8	9 6 3	s.tr.; Pb. tr.
"	2 0 17	8.0	19	1 3 26	49.5	3 25.9	55/5	13 11 11	s. 0.05%; Pb Tr.
"	10 2 15	5.0	60	10 0 11	47.5	4 3 5.2	54/2	64 19 1	s. 0.09%
"	3 0 2	9.8	33	2 2 25	47.5	1 1 4.8	54/2	17 10 4	s. 0.10%
"	5 2 17	4.8	30	5 1 15	70.0	4 2 18.1	66/-	62 2 8	s. 0.07%; Cu tr.
"	6 0 3	9.0	61	5 1 26	51.9	2 3 10	63/3	44 19 10	s. 0.05%

One parcel of mixed concentrates containing tin and wolfram weighed 1 cwt. 2 qrs. 27 lbs. dry of which 3 qrs. 16 lbs. was Wolfram concentrate of 44.2% grade which at 58/6 per unit returned £8. 10. 0; and 3 qrs. 11 lbs. was Tin concentrate of 26.5% grade which at 35/- per unit returned £1. 19. 4.

Sales returns for the year 1940 show that Geason in July of that year forwarded for sale a quantity of mixed tin-wolfram ore. Of 195 lbs. weight of mixed concentrates despatched, 100 lbs. of wolfram concentrate and 95 lbs. of tin concentrate were paid for. The wolfram concentrate yielded on assay 44.2% WO_3, and was valued at £8/10/0, whilst the tin concentrate yielded on assay 26.5% Sn and was valued at £1/19/4. Expenses and penalties absorbed practically the whole of the tin value, and the nett return for the entire product was £8/10/11.

Primary wolfram occurs, only at one or two points, in association with quartz or quartz-tourmaline formations. These positions have been indicated on the general plan. They are, however, of no economic importance.

Central Workings - (Black Face Lode):

In a description of the Cumberland Company's Mine, G. Thureau, in the year 1881, makes reference to some of the workings now included in the Central Workings or those on the Black Face Lode. In his report, reference is made to a high level tunnel giving 60 feet of backs (the 85 ft. level). He refers also to a vertical shaft 50 feet deep (Munro's Shaft), and also to a main tunnel from Packers Creek to provide about 200 feet of ground to work beneath the mouth of the shaft (220 feet level.) This tunnel had then been drive 170 feet.

In the year 1884, the same writer refers to the workings as follows :- "The mines have been opened by means of a commodius main adit, over 1,000 feet in length... formation 6 feet 6 inches in width was intersected..... In an air shaft the same formation - there 14 feet wide - was again intersected.....At between 900 and 1,000 feet in from the mouth of the adit, another very hard lode formation, bearing north-west by south-west, was intersected." This description applies to what is now known as the long tunnel driven in a northerly direction from the southern face of the hill. It has since been extended to a position approximately below the most southern of the open cuts in the main lode.

Mr. G.A. Waller in the year 1902 refers in his report to these workings, and mentions the 85 feet level and the 115 feet level, but fails to mention the 220 feet level. He mentions two small open cuts in the lode and refers to tin. Production figures are quoted - "From this face 720 tons of stone have been treated in the mill yielding 12 tons 18 cwt. 22 lbs. metallic tin. This is equivalent to about 1 per cent. of metallic tin in the crude stone."

The workings are again mentioned by Waterhouse p. 270 of Bulletin 21 of the Geological Survey of Tasmania, which published in 1916 shows the state of development at that time.

In the year 1927 the company was re-organised and mining operations were commenced in the year 1928. The Black Face Lode was the immediate objective, and was the source from which ore supplies were to be won. An expenditure of approximately £80,000 was made on reconditioning and mddernising the treatment plant and in the erection of buildings, power house and generating machinery, and an aerial ropeway, &c. Assay results obtained by the company during an extensive sampling campaign extending from 1927 to 1929, indicate that from none of the then existing workings was profitable grade of ore to be expected. At no time during its history did the mine return a profit, and the Company's liquidation in the year 1938 was to be expected.

The Black Face Lode is of an irregular nature. It strikes generally on a bearing of 20 degrees in an area of granite which has been subjected to considerable fracturing, the fracture planes being more or less parallel with the general strike of the lode. Towards the northern end of the lode a more easterly trend is apparent. A branch formation, also with an easterly trend, occurs about one chain south from the portal of the 85 feet level, and it is this formation on which the eastern levels from the 220 feet and the 115 feet adits have been driven.

The Lode is a quartz-tourmaline formation with both green and black tourmaline in abundance. In parts pyrite occurs. What tin is present exhibits a greater affinity for the green tourmaline than for the black variety. Local reports assert that in part the tin occurred as narrow veins of almost pure cassiterite. The lode formation exhibits a decided banded struture and bands of tourmaline-rich rock occur in juxtaposition with much harder bands composed essentially of quartz with a lesser amount of tourmaline. The country rock adjoining the formation shows similar banding. In the immediate vicinity of the portal of the 115 ft. level the rock is essentially a quartz formation with numerous narrow tourmaline veins. With increasing distance from the lode formation the granitic structure increases but some tourmaline veins occur until finally at the extreme position the formation merges into normal granite.

A repetition of this banding occurs on the eastern and north-eastern sides of the lode formation which has all the characteristics of a replacement ore-body where, in this instance, the granite has been replaced by mineralisers rising along fracture planes. The general line of fracturing has a bearing of 20 degrees. Subsidiary minor fractures trend easterly and have rise to the branch formations mentioned above. The main ore-body terminates about 100 feet to the east of the adit positions, by merging gradually into normal granite.

The branch formation occurring one chain south from the portal of the 115 ft. level has been proved by cross cuts from that and the 220 feet levels for distances of 120 and 200 feet, respectively, in an easterly direction. In the latter case the cross cut extends for a distance of 110 feet from the main adit, and from that point a horizontal bore, 110 feet in depth, was in the lode formation for a distance of 90 feet before it passed into granite.

An inclined bore, on an angle of depression of 60 degrees, driven from a position 55 feet from the face of the level to a depth of 120 feet in the direction of the level was in lode formation for 110 feet before it also passed into granite.

There are no records available to show that sampling of the bore cores was carried out.

Sampling of the level from the 220 feet adit showed the formation to be barren of tin. At the 115 feet level a short section of the lode formation was of a grade of approximately 0.05% tin.

Records of production by the Federation Tin Company are incomplete. What reference are available refer only to low grade ore.

In a report dated June, 1929, mention is made of 1,953 tons of ore yielding 7.7 tons of tin oxide valued at £750. A further mention is made that the average percentage of tin in the stone according to daily tests of bulk samples is not greater than 0.3% tin oxide.

In the year 1935 the position had not improved for a further report states that from 5,582 tons of ore, a return of 8 tons 11 cwt. 3 qrs. 7 lbs. of concentrate, equivalent to 5.16 tons of metallic tin were recovered and were valued at £1,124, or a recovery of 4/- per ton of ore treated. The average grade of ore was, therefore, 0.09% Sn.

Eastern Workings:

The Eastern workings of the Federation area are of little importance. They were referred to as early as the year 1902 by G.A. Waller in his report on the field. The workings then consisted only of a prospecting shaft.

In the year 1916, L.L. Waterhouse, in Bulletin 21, refers to the workings. At that time, an adit had been driven to connect with the shaft and some stoping had been done.

The present state of the workings is essentially as described by Waterhouse. They have been idle for a considerable period of time. The workings reveal a narrow quartz-tourmaline vein in which the tourmaline is of the green variety. There is no official record of production, but Waterhouse mentions the recovery of 14 tons of concentrates. This would appear, from the condition and extent of the workings, to be an excessive estimate.

Heywood & Coleman's Workings:

Heywood and Coleman's workings are situated on lease No. 20M/41, a 40-acre lease, coincident with old Lease No. 8614, and previously the property of Federation Tin Mines.

Prior to its selection by the present proprietors, several trenches and two adits had been made to prospect the area.

Of the trenches, only one was productive. This was known as the Long or Rich trench and some ore was taken from shallow depths in a flatly dipping quartz-tourmaline formation, high grade in tin. There is no record of the amount of tin won, but the workings at this point are not sufficiently extensive to have yielded significant quantities.

Of the two adits driven on the property, the lower one is inaccessible throughout the entire length, and the approach has been dammed to conserve water for sluicing purposes.

The upper adit is accessible for part only of its length. A rise from the lower adit made connection between the two at a point about midway along the upper adit. This rise has now collapsed to cause a blockage in the upper adit, but the fall of earth has extended to the surface and access is possible to the inner part of the upper adit.

At the position of collapse, an extensive tourmaline formation is visible in the upper adit. It occurs on the eastern side of the adit, dips westerly at 60 degrees

and strikes at 20 degrees to pass out of the adit. At a point 25 feet from the fall of earth the adit turns to follow approximately the line of strike of the veins. There are, however, no persistent veins showing, but two minor veins 1½ minches and 6 inches in width have been recorded. The adit maintains this bearing for a distance of 85 feet to the face where a quartz-tourmaline vein, with some limonite, 5 inches wide, occurs. From a point 28 feet from the face, a cross cut has been driven in a westerly direction for a distance of 48 feet. This cross cut reveals several narrow veins, striking 20 degrees, from one of which it is reported three bags of tin concentrates were recently won. The assay results of sampling by the company in the year 1927 were, however, discouraging.

Recent workings have exposed an irregular body of ore, parts of which have yielded high grade prospects. The main workings are situated about 200 feet north-east from the rich trench. A long shallow trench extends from a point 120 feet from the rich trench on a bearing of 41 degrees for a distance of 87 feet to connect with the main openings. In this trench a pinitoid formation occurs carrying a little tin. Overlying this formation and extending into the main workings on the western side is a flat dipping green tourmaline formation, barren in part. On the south-western corner of the main workings a hole, 8 feet deep, has been sunk on a small vein in granite to expose an occurrence of tin-bearing quartz-tourmaline nodules. These nodules range in size to 2 inches in diameter and vary in grade to 17% tin. They occur as irregular clusters in the granite which weathers readily to free them.

Development has been of such a haphazard nature that it is difficult to form an opnion of the occurrence but it is probably a continuation of the formation already exploited in the rich trench altnough no surface connection between the two can be established. The pinitoid material appears to be dipping flatly to the east under the irregular tourmaline formation and to be striking in a general north-easterly direction with the nodular formation in the granite occurring immediately to its west.

The whole formation is covered by a thickness of two feet of peat and detrital. The detrial is in part tin bearing.

The area affords an opportunity for systematic prospecting. At present ore of an estimated grade of two percent, tin is considered by the proprietors to be too low in grade for profitable exploitation.

Phar Lap Workings:

The Phar Lap workings are situated on the southern portion of old lease No. 5765/M about 300 feet to the north-east of the north-east corner of old lease No. 5401/M and about 1,200 feet south-west from the portal of the Long Tunnel of the Federation workings. The workings were commenced by J.B. Geason and were later taken over by Waxman and Weston and finally again by J.B. Geason.

They consist of an irregular open cut from which a shaft has been sunk to a depth of 35 feet. At the time of this inspection the deeper workings were inaccessible, the shaft being full of water.

The country rock is a much decomposed white granite. In the open cut workings bands of limonite together with narrow quartz-tourmaline veins are exposed.

The ore taken from the shaft was treated by sluicing. It was soft and clay-like in character, and represented a pinitoid alteration of the granite. Near the bottom of the shaft, cubic crystals of pyrite were plentiful in association with high grade cassiterite ore. More than one ton of these crystals are lying on the ground at the point where sluicing operations were carried out. The crystals varied in size up to one inch cubes, but all the larger crystals have since been removed. The remaining crystals range to $\frac{5}{8}$" cubes and are high grade in tin, for in many instances the pyrite is partly replaced by crystalline cassiterite. An attempt at calcining the crystals, without prior crushing, proved uneconomical and the untreated crystals, probably of a grade of 2 percent. tin remain on the site.

The opinion formed, based on data supplied by local reports, is that further testing and exploration of these workings is warranted. The workings are situated on comparatively flat country with the collar of the shaft only a few feet above creek level. Factors contributing towards cessation of work were the necessity for more or less continuous baling operations and the inability to recover the tin by roasting of the pyrite with which high grade tin was associated.

Waxman and Weston's Workings:

These workings are situated on flat swampy country near the north-western end of the Cumberland Dam, between the Dam and eastern slopes of Federation Hill. The work was done, during the life of the Federation Company, in the belief that the site was outside the limit of the Company's holdings. This, however, was not the case, and operations were terminated with the discovery that the land was held by the company.

The workings are not extensive. They consist of a trench, 140 feet in length, varying in depth to 9 feet at its southern end. For 110 feet the trench has a southerly trend at which point it turns S.W. for 30 feet. At this point a shaft, 14 feet in depth, has been sunk in ore reported as being high grade in tin.

The approach of the trench is in swampy ground. In a southerly direction it then reveals fine-grained granite, much decomposed. At about 60 feet south in the trench a band of cubic pyrite, showing crystals of $\frac{1}{4}$" cubes was cut. South of the pyrite band fine-grained granite recurs. No tin was visible in association with the pyrite.

The south-westerly section of the trench has been driven along an ironstone formation revealed first as a limonitic formation which gradually gives place to specular iron (micaceous haematite) which is more or less massive at the collar of the shaft. The high grade ore is reported as being associated with the ironstone formation.

The workings are situated little above the level of the Cumberland Dam, and future operations will be handicapped by the influx of excessive water.

The Cornwall Mine:

These old mine workings are situated within a few chains of the sea shore, on the eastern slopes of a ridge trending parallel with the coast and on the west bank of Packers Creek in the elbow formed by that creek where it turns easterly to enter the sea.

There has been only spasmodic development at this site since the original company, as reported by G. Thureau, closed down in 1884. Some of the workings are now in a collapsed and overgrown condition and those which are open for inspection show little to warrant the expenditure incurred in performing the work necessary for their completion.

A cross section of the country is provided by a tunnel driven through the hill. The tunnel was driven originally for transport of ore to the battery situated on the foreshore, but was later used to divert the water from Packers creek to enable the creek bed to be worked for the recovery of alluvial tin. The tunnel, driven on a bearing of 230 degrees through granite shows a series of parallel quartz-tourmaline veins striking on a bearing of 290 degrees, ranging in width from 1 to 18 inches. None of these veins has been developed from the tunnel, but from a few yards north from the eastern approach of the tunnel three short adits have been driven to develop the largest of the more eastern veins. A little stoping has been done to yield only a few tons of ore.

The Cliff Mine:

Although this area has been occupied in comparatively recent years (1927) the state of development is much the same as when the original Cliff Mining Company ceased operations. The mine is situated on the cliffs facing the sea shore about half a mile south from the old Cornwall Mine.

The workings consist of two adits driven in an easterly direction along a narrow quartz-tourmaline vein, six inches in width. In the upper adit a rise to surface has exposed widths of only a few inches, of the vein.

The lower adit is inaccessible due to falls of earth.

Several mineralised veins have been referred to in earlier reports on this area. Of these veins, the following are the chief ones :-

(1) The narrow vein exposed in the adit workings.

(2) Near the creek, trending west, a quartzoze reef 4 feet in width occurs associated with an aplite dyke of similar width. This vein strikes at 120 degrees and has been developed, over a length of 150 feet, by a narrow open cut ranging in depth to 12 feet.

In this open cut a flat vein of quartz-tourmaline 14 inches thick is exposed.

(3) A micaceous quartz-tourmaline vein up to 4 feet in width striking northerly and apparently crossing the strike of the former veins.

It would appear that the object of driving the adits was to expose the intersection of the two veins striking at right angles to each other. This has not been accomplished.

The country rock is nodular white granite in which the quartz-tourmaline nodules range up to 5 inches in diameter.

Although a battery of 10 heads of stamps had been erected, there is no evidence that the mine ever passed the prospecting stage of development, and future prospects are not encouraging.

Donaghue's Workings:

The Montagu Mining Company were not original holders of the old lease No. 6660. Portion of this area is now held by Mr. M. Donaghue under prospecting licence. The workings of the old company, with the exception of the main shaft, are now collapsed. The main shaft is in a poor state of repair and is inaccessible.

Donaghue's workings are situated within a few chains of the main shaft. They consist of a short adit on the eastern side of Montagu creek and a wide approach preparatory to the driving of an adit on the west side of the creek. The creek in the vicinity of the workings has been worked, by the company, for the recovery of alluvial tin, and for this purpose a water race has been cut for some distance on the western side of the creek.

Donaghue's adit has been driven in a general easterly direction. An approach of 40 feet has been driven on a bearing of 70 degrees to the portal of the adit which has then been driven on a bearing of 77 degrees for a distance of 27 feet. At the portal, on its northern side, a quartz-tourmaline vein, striking at 60 degrees, high grade in tin, is exposed. Cassiterite is visible in hand specimens. At about 15 feet from the portal, a vein 8 inches wide, striking south, has been cut by the adit. The upper portion of this vein has been displaced about two feet in a westerly direction by a flat fault which is visible in the adit to to the face. This fault dips in a south-easterly direction. In the face of the adit a second quartz-tourmaline vein, parallel to that at the portal, is exposed above the flat fault. This adit is well timbered. It is proposed to continue the adit for a further two sets, 10 feet, then to drive in a northerly direction to cut the continuation of the vein exposed at the portal.

Westerly from this adit and across Montagu creek, an approach for a second adit has been made. In these workings, three separate veins have been exposed. The face in the approach shows 18 inches granite, 6 inches quartz-tourmaline vein, 36 inches granite, 3 inches quartz-tourmaline vein, 12 inches granite and 11 inches quartz-tourmaline vein, made up of 1½ inches tourmaline, 8 inches quartz and 1½ inches tourmaline to the edge of the face. No development has taken place at this position. Between these two workings, in the water race, a quartz-tourmaline vein is exposed. It is probable that these exposures are on the same vein or on a series of veins occurring on eschelon.

In an easterly direction towards the Wakefield Mine, for a distance of perhaps a quarter of a mile, similar occurrences are visible. It is claimed that these exposures are of the continuation of the same vein, but it is more probable that a series of parallel or sub parallel veins occur.

There are no records of production available for this area. The old Montagu Company developed their workings to a depth of more than 150 feet.

In the creek, near the main shaft, it is evident that under hand stoping, on a crescent shaped formation, has taken place. Locally it is claimed that this work has been carried out on a formation previously mined by the old company, but no outcrop is visible due to overburden. Thureau in 1884 suggests the presence of a second vein, striking northerly, in this locality. It is probable that the stoping has occurred at the junction of these two veins.

Future development will depend on the results of development from Donaghue's main adit and may yield minor quantities of high grade ore.

Humphries Workings:

Mr. M. Humphries was holding, under Miner's Right, portion of old lease No. 1158 adjacent and to the west of the old Montagu lease No. 6660M. The workings consist of three adits, driven in a north-easterly direction, of which the longest is 170 feet. Several proprietors have previously interested themselves in these workings, and to them is credited the driving of the adits. The present proprietor has sunk two winzes, 12 feet and 35 feet deep, respectively, from the floor of the longest adit and has produced meagre tonnages of high grade tin ore from short shoots occurring in in irregular quartz-tourmaline veins. It was found that the tin ore was associated with both the quartz and the tourmaline for free tin was recovered from the ore by sluicing and the tourmaline content of the material reduced. The remaining hard quartzoze portion of the vein was crushed, the grade being such that from three tons of ore, 3 cwt. 10 lbs. of concentrates of an assay value of 60% metallic tin was won.

The adits are little above creek level and difficulty is experienced in keeping the winzes free from water by baling.

Both the winzes contained water at the time of the inspection, but it was claimed that from the deeper winze, more than one ton of tin concentrates of a grade of 68% metallic tin was won.

A plan recording details of the veins is attached.

CONCLUSIONS:

The Heemskirk tin field has been known since the year 1876. Since that date reports have been written, either on the field as a whole or on individual mines, by the following writers :-

G. Thureau in 1881, 1882, and 1884 reported on portions of the field and made suggestions for its development.

A. Montgomery in 1893 and 1895 reported on individual mines.

W.H. Twelvetrees in 1900 reported on the field.

G.A. Waller in 1902 wrote a concise report on the field.

L.L. Waterhouse in 1916 wrote a comprehensive report, on the field, which was published as Geological Survey Bulletin No. 21.

Unpublished reports by P.B. Nye and A.M. Reid on individual mines have since been written.

The earliest operations on the field were directed towards the recovery of alluvial tin from creek beds, some of which have been worked throughout their entire length. Shortly after the discovery of the field lode-tin mining was commenced at several positions and have since been carried on intermittently. Despite the long life of the field, comparatively little surface development has been carried out. The greater proportion of the expenditure on mining operations, a relatively small proportion of the total expenditure, has been used on underground development. In almost every instance the greater proportion of the total expenditure has been devoted to the purchase and erection of dwellings and mining and milling equipment, &c., to the final detriment of the field. There are, on present development, no ore reserves either positive or probable.

In general, the average grade of the ore won from the field has been low, although narrow veins and small deposits of high grade ore have occurred. These may have been profitably exploited by small syndicates or individuals, but in no case were the proven ore reserves sufficient to warrant expenditure of the large capital supplied by the companies promoted for their exploitation.

The future of the field will depend on the development of known, and further search for similar, high grade deposits. Of the several known deposits which may yield profitable returns, the following are worthy of mention:-

Geason's present workings: Where high grade ore has been proved, but its full extent is still unknown. The work to date has been directed towards production of concentrates sufficient only to meet living expenses and little has been done to delimit the occurrence.

Heywood and Coleman's workings: Ordered prospecting is necessary to enable estimates to be made of their value.

Sweeney's Mine: At this mine sampling suggests that further development is desirable.

Donaghue's workings: These may be productive of small quantities of high grade ore.

Phar Lap: Further development and prospecting is desirable at this position. High grade pyritic ore has been won and failure to treat this ore by calcining together with the occurrence of heavy water in the workings, contributed to the cessation of operations.

Bismuth ores are widely distributed through the Heemskirk field and although generally in minor quantity those occurring in the Federation area are worthy of further consideration. Although their occurrence was noted in the year 1902, no attempt has been made to develop them. The present price of Bismuth (£700 stg. per ton) should tend to encourage development of comparatively narrow veins of moderate grade ore.

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25th June, 1943.