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THE GEOLOGY OF THE ROUND HILL SILVER-LEAD DEPOSITS

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(I) INTRODUCTION

The survey upon which this report is based was carried out following a request by the West Mt. Claude Prospecting Syndicate to the Director of Mines.

Since no important ore bodies are exposed and all the important workings are inaccessible the report is not based upon the examination of any existing large ore bodies. The survey is, therefore, an attempt to predict further large deposits by means of a close study of the structural geology of the area and a critical review of the available literature. It has been found necessary to study a large area in a general fashion before proceeding to a detailed examination of the leases. By this method it is hoped that the various structures have been relegated to their correct degree of significance.

The survey was carried out during the period March to June, 1955.

(II) LOCATION

Round Hill is a distinctive, steep-sided hill situated approximately one mile south of Cethana and about 12 miles south-west of Sheffield, the nearest large town. The Round Hill Mine is located on the south bank of Claude Creek very close to its junction with Redwater Creek and the main workings of the mine have been driven south-east under Round Hill itself. The co-ordinates of Round Hill on the Military Grid of the State 4 inch map are N891.1. E.415.9.

(III) ACCESS AND FACILITIES

The mine is freely accessible by road, the main Roland-Lorinna road passes within a few yards of the main workings. This is a narrow metalled road having a fairly good grade but with poor

sight distance in places. The nearest railway is at Roland, lying some 11 miles by road to the north-east.

A fair supply of timber, mainly eucalypt regrowth, is available in the immediate vicinity and large supplies could be obtained from saw mills in the Lorinna area, about 7 miles distant by road. An adequate water supply for milling purposes is available for at least 8 months of the year from Claude Creek. For the remainder of the year enough water could be stored in the No. 3 adit to carry the mill through the summer period.

Apart from one small hut near the present mill site no accommodation is available in the immediate vicinity. The nearest supply of electric power is at Staverton approximately 3 miles north of the mine. No extension of the power beyond this point is contemplated in the immediate future. The telephone line from Cethana to Lorinna passes through the West Mt. Claude Mining Syndicate's leases.

The syndicate has erected a small treatment plant near the No. 1 adit. However, this has not been in use since 1951 and is suitable for small scale operations only. Air and water lines have been laid to most of the workings.

(IV) PREVIOUS LITERATURE

This mine has been examined previously by several geologists. The first reports are those of Thureau in 1881 and 1885. However, little development had taken place at that time and these reports are therefore of limited value. Montgomery next examined the mine in 1893 but at that time the developments were centred

around the No. 3 adit and his report is not optimistic.

The first important description of the mine is contained in Geological Survey Bulletin No. 14 written by Twelvetrees in 1919. He gives a brief description of the geology and structure and a detailed account on the mine workings at that date. By this time the No. 3 adit had been abandoned, the Western workings had reached their maximum development, No. 1 adit had been driven 190 feet and No. 2 about 75 feet. Twelvetrees pointed out the anticlinal control of the ore bodies and made the following points:-

1. "The characters of an ordinary lode are missing, the ore bodies are contained in a compound lode."
However, he expected the vertical component of the lode system to descend in the manner of ordinary veins.
2. "The ore bodies are contained in a series of small, parallel, vertical fissures intersecting the beds mainly at the crests of the anticlines. Some ore is present as irregular bunches extending down the limbs of the folds."
3. In view of these conclusions he pointed out that exploration in this area would make heavy demands on the judgment and skill of the manager and recommended a policy of driving on the anticlinal axis and sinking on any ore bodies thus located.

The next report is that by Mckintosh Reid contained in Geological Survey Bulletin No. 29 published 1919. This report is important as the Eastern workings were then in an advanced stage of development and several ore bodies were exposed. The writer gives a good account of the mineralogy and structure of these ore bodies which must necessarily be drawn on by any later writers as it contains the only real description of the lodes. Mckintosh Reid also describes the other workings in the area but this is simply a reiteration of Twelvetrees earlier work. No further work had been done on the No. 3 adit or the Western workings between Twelvetrees visit and the time of Mckintosh Reid's report. Important points made by Mckintosh Reid are as follows:-

1. Again the anticlinal control was noted.
2. He observed that the ore bodies are related to the softer bands interbedded in the quartzite.
3. Introduced the idea of the ore bodies pitching conformably with the fold.
4. Described the folds as of the "parallel" type and states that there is evidence of both "flowage" and "fracture" folding. He noted that the axial planes of the folds were vertical.
5. He gave a fairly accurate account of the ore bodies, noted some evidence of replacement, but observed that the ore is mainly along ore channels, bedding planes and joints and to a small extent only in the country rock.

Neither Twelvetrees nor Reid attempted any structural mapping in the area.

In 1948 Hughes studied the general area surrounding the mine and made the first attempt at mapping the folds in which the ore bodies are contained. At this time the mine workings were inaccessible and he pictured the ore bodies as being contained in vertical, fractured zones in the axial planes of the anticlines. He also mapped the Claude Creek fault over some distance. Some conclusions contained in this report are as follows:-

1. The axial planes of the folds are vertical and the folds have no appreciable plunge.
2. The folding is of the "parallel" type.
3. The chronological order of events leading to the present structure is
(a) thrust faulting, (b) folding,
(c) ore deposition.

The report gives an account of the development of the mine from Twelvetrees visit until it closed in 1927 together with production figures. The report recommends that the search for further ore bodies should be concentrated on the anticline nearest the Claude Creek fault. He recommended a drilling programme part of which was carried out by the present lessees.

(V) SURVEY AND RELIABILITY

The regional geological plan and the accompanying sections are intended to indicate the broad structural environment of the Round Hill area. This is important as there has been a tendency in the past to confuse the minor

and major structures. The advent of air-photos, not available to previous workers is of great assistance in this regard. Many of the minor structures which do not affect the overall picture have not been indicated on this plan. The regional plan has been prepared from stadia traverses and chain and compass traverses, and should not be regarded as a detailed working plan. The accuracy varies considerably depending on the distance from the control traverses. It is, however, considered to be sufficiently reliable for the purpose outlined above.

The detailed plans are based on a series of stadia traverses carried out with a Watts No. 1 microptic theodolite for the most part and chain and compass traverses elsewhere. These plans can therefore be regarded as being sufficiently accurate for all general purposes. Where boundaries and geological structures have been extrapolated due to lack of exposures this has been indicated on the geological plan. The sections incorporate all the data available but as mentioned later in the report rely heavily on the writer's interpretation of the structure. Due to the complicated structure some extrapolation is unavoidable and this should be borne in mind when referring to the sections. All bearings in this report are magnetic.

(VI) PHYSIOGRAPHY AND VEGETATION

(1) Relation to Structure

The physiography of this area is closely controlled by the geological structure. With only minor exceptions the anticlines form the hills and the valleys are occupied by synclines

or faults. This relationship is fairly common throughout Tasmania in rocks of this age and is due largely to the resistant character of the Ordovician quartzites and conglomerates. This kind of topography is relatively uncommon elsewhere and there is a suggestion from evidence outside this area that at an earlier stage of erosion the more typical synclinal ridge type of topography existed. It is tentatively postulated therefore that the present topography is of the "resequent" type.

The topography is modified somewhat by the various fault systems, e.g., Redwater Creek has cut down through an anticline in the very resistant Round Hill Conglomerate. However, its course has been largely determined by a series of fractures along the Creek bed. The series of waterfalls occurring at intervals along Claude Creek are all related to soft bands interbedded in the quartzites and conglomerates.

(2) Drainage

The main stream in this area is the Forth River which is joined by a series of young active streams running approximately northwest. These streams in general parallel the geological structure, they have very steep irregular profiles indicating recent rejuvenation. This probably occurred following the Pleistocene glaciation, evidence of which is widespread in the form of glacial tills in this area. Characteristic U-shaped valleys typical of glacial erosion are not well defined, however Hughes states that the valley of Claude Creek is U-shaped down to the 1130 contour. Since only a small portion of the Forth River is covered by this area its physiographic relations are not clearly

defined. From the little evidence available it would appear that ~~its~~ course has been inherited from an earlier cycle of erosion. The main streams joining the Forth in this area are Tin Spur Creek and Claude Creek with its tributaries Redwater Creek and Carlsons Creek.

Tin Spur Creek drops very rapidly in a series of falls and rapids exhibiting a state of extreme youth. Its course is controlled by Tertiary faulting and does not appear to have been modified in any way by glaciation.

The development of Claude Creek has been influenced by the geological structure and probably later by the glaciation. Originally the creek must have flowed along the Claude Creek fault some distance south of its present course. The creek has cut down along the fault plane undercutting the resistant Round Hill Conglomerate, which, being left unsupported, has broken off along joint and bedding planes. Eventually the creek encountered the soft beds in the centre of the Claude Creek synclitorium and became entrenched there following a course shown today by Claude Creek down to the Upper falls near the mine and thence continuing along the synclinal axis on the course now occupied by Carlsons Creek. Later, a creek parallel to it now occupied by the lower part of the present Claude Creek and by Redwater Creek was established. First this creek cut down along a series of fractures until it encountered the Claude Creek fault in its lower reaches. This stream has eventually captured the head of the original Claude Creek thus producing the present drainage system. The river capture probably took place during or immediately after the Pleistocene glaciation and the process

has been sketched in Fig. 1.

(3) Vegetation

The vegetation throughout the area varies considerably and is controlled largely by aspect but also indirectly by the lithology of the underlying rocks. The following associations are present :-

1. Eucalypt vegetation - this may be open or accompanied by dense secondary growth. It occurs widespread throughout the area and is the typical vegetative type.
2. Buttongrass Moors - occur in undrained or poorly drained areas.
3. Dense ti-tree - occupies the steep hillsides and more exposed localities. It may be sufficiently thick to impede progress where well established.
4. Baura - occurs locally in the more elevated areas.

(4) Relation of Topography to Mining

The strong relief favours the exploration and development of the various lodes by means of adits and, as indicated by the detailed plan, this has been a favourite method of mining. Adits provide quick and cheap access to the ore bodies, and where the structure of the lodes is suitable, have been used quite successfully. However, it seems that some of the exploration could have been carried out much more cheaply by test pits. The shallow workings above the No. 3 adit and the No. 2 adit (Round Hill Extended) are clear examples of wasted effort in this respect. Probably this has been due to the fact that mining exploration in the past has been based on the misconception that the ore bodies were fissure fillings, having pronounced vertical components.

(VII) GEOLOGY

(1) STRATIGRAPHY

The following table indicates the various rock units present, their ages and equivalent units elsewhere in Tasmania:

| Age | Unit | Approx. thickness | Correlation |
|----------------|--|-------------------|--|
| Recent | (Residual soil) (Talus and Alluvium) | | |
| Pleistocene | Glacial Till | | |
| | UNCONFORMITY | | |
| Lower Devonian | Dalcoath Granite | | |
| Ordovician | Lorinna Limestone | 200 ft.+ | Gordon Limestone |
| | Carlsons Creek | | (Caroline Creek beds |
| | Quartzite | 800 ft.+ | (Tubicolor Series |
| | Round Hill | | |
| | Conglomerate | 1,200-100 ft. | (Owen Conglomerate (West Coast Range (Conglomerate |
| | JUKESIAN UNCONFORMITY | | |
| Cambrian | Cethana Group | 1,000 ft.+ | Dundas Group |

(A) Sedimentary Rocks

(1) Cethana Group

This group comprises a suite of altered pyroclastics, greywackes, shales and lavas. They are now altered to argillites, slates, phyllites, schists and porphyries. The rocks outcrop at various places along the Lorinna Road showing an unconformable relationship with the overlying Round Hill Conglomerate wherever this contact is exposed. The best exposure of this unconformity is in the road cutting about 1 mile north of the Round Hill Mine. Very close to the contact a small thrust fault displaces the beds but this does not in any way affect the clearly unconformable relationships between the two groups. A similar exposure can be seen in the road cutting near Tin Spur but here the rocks have been more profoundly altered by the nearby Dalcoath Granite. At three points between these two unconformities small outcrops of Cethana Group rocks occur. These are under Brazen Nose, along the Cockatoo Road and just upstream of the bridge over Tin Spur Creek. In these localities the rocks consist of sheared grey-purple quartz feldspar porphyries and at each point underly a conglomerate similar to the Round Hill Conglomerate.

Considering the Cethana Group rocks as a whole there is a marked change in lithology and metamorphic grade across the area. In the north-east corner furthest from the Dalcoath granite these rocks consist of slates, argillites and schists with some porphyries. They are, for the most part, clearly recognisable as of sedimentary origin and the bedding and structure can be mapped. In the

vicinity of the Cockatoo Ridge and Tin Spur Creek they comprise sheared porphyries in which no relict elastic structures can be observed. Near the Dalcoath granite in the south-west of the area the rocks are entirely massive quartz and quartz feldspar porphyries in which no definite bedding can be recognised. This change in metamorphic grade is related in part to the proximity of the granite. However, the rocks underlying the Round Hill Conglomerate at Tin Spur were probably derived from vastly different parent types than those near Cethana. It is suggested that these rocks were originally basic lavas and tuffs which have subsequently been altered.

There is no fossil evidence in this area to determine the age of this group but evidence from Dundas and other areas place them as being of Middle to Upper Cambrian age. This correlation is based on their stratigraphic position in the field and on lithological similarity, together with the grade of metamorphism.

The outcrop of porphyry along the Cockatoo Road described earlier has been interpreted by Hughes as a dyke of Lower Devonian age and he places the overlying conglomerate as a member of the Tubicolar series (Carlsons Creek quartzites). The contact here is not exposed and no direct evidence is available as to its structural position. The opposing interpretations by the writer as an unconformity alters the regional structure slightly but does not affect the structure in the vicinity of the mine to any extent. The writer has based his interpretations of this outcrop on the regional structure and stratigraphy and can find no evidence for the conglomerate member in the Carlsons Creek quartzites. However, due to the lack of clear

exposures Hughes' interpretation cannot be disproved.

The thickness of the Cethana group is probably several thousand feet but not more than one thousand feet has been indicated on the plans. Little is known of the structure of these rocks as the main outcrops lie outside the area mapped.

(11) Round Hill Conglomerate

This formation overlies the Cethana group rocks unconformably and is overlain conformably by the Carlsons Creek quartzites. The formation name "Round Hill Conglomerate" has been adopted for these rocks in this area as no physical connection between here and a type area can be demonstrated. The formation is equivalent to the Owen Conglomerate of Bradley (Papers & Proc. Roy. Soc. 1954), now regarded as strictly the correct name for the formation and also to the West Coast Range Conglomerate of Hughes and earlier writers. The correlation is based solely on lithological similarity but in this case the lithology is highly distinctive and a correlation is offered with confidence. The age of this formation has been found on fossil evidence in other areas to be Tremadocian (basal Ordovician), however, no fossils have been found in this area to date.

Typically, the rock is an exceedingly dense, pink conglomerate, however, all variations from quartzites through pebbly quartzites to conglomerates are present. The colour varies also from white through pink to purple and is due to silicification and haematite staining. The pebbles are usually

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of quartz or quartzite but schist pebbles are present. All pebbles are rounded to some extent and vary in size between the various beds and sometimes within a single bed. The material is typical of a shoreline deposit and has been subjected to much reworking, occasionally imbricate structure can be recognised. Actually the conglomerate shows a high degree of sorting due to this re-working process and usually the pebbles are in contact with one another.

A characteristic of this formation is the rapid lensing of beds and the formation thins out rapidly over very short distances. In this area it thins from approximately 1200 feet thick on Mts. Claude and Roland about one mile to the north-east to approximately 800 ft. thick at Round Hill, and to less than 100 ft. thick in the vicinity of Tin Spur. The change in thickness across the section is accompanied by some change in the lithology. On Mt. Claude the pink conglomerate predominates with only occasional quartzite bands and this is also found on Round Hill although here the conglomerate is intensely sheared and the detailed lithology indistinct. On the Cockatoo Ridge the conglomerate is approximately 100 ft. thick, contains more sandy bands and is lighter in colour. Further south-west on Tin Spur the conglomerate is white due to intense silicification, this latter effect has masked the outlines of the pebbles and on cursory examination the rock appears to be a dense white quartzite. Closer inspection reveals the shadowy outlines of the original pebbles and the old name for this rock at Tin Spur "the Ghost Conglomerate" is an adequate description. The change in colour and the intense silicification

of the conglomerate here is due to the proximity of the Dalcoath granite and is of course exhibited to some extent by the underlying Cethana Group rocks as described earlier.

Along the strike at this point the conglomerate lenses out completely, the Carlsons Creek quartzites then overly the Cethana Group rocks directly. This systematic thinning out of the conglomerate is also a very common feature elsewhere in Tasmania. The formation occurs as a belt fringing round the old pre-Cambrian nucleus of Tasmania and always shelves out rapidly on this core.

The Round Hill Conglomerate behaves as a very competent formation during folding. The distribution of the conglomerate and the line along which it thins out have profound effects on the primary structure of this area. Usually the conglomerate is folded into broad open folds, it is exceedingly hard, massive and strongly jointed. Usually it is difficult to determine the attitude of the bedding due to this strong jointing and massive character. Quartzite bands within the formation and imbricate structure where present are useful for this purpose. Where the conglomerate has been faulted and overturned near the Claude Creek fault and along the north boundary of the Round Hill synclinerium it is intensely sheared. The shearing extends through both matrix and pebbles alike but the matrix suffers most and is frequently quite sandy. However, such extreme effects are local and away from the fault the conglomerate retains much of its massive character even though sheared.

(iii) Carlson's Creek Quartzite

This name has been adopted for the formation conformably overlying the Round Hill conglomerate and underlying the Lorinna limestone. It is equivalent to the Tubicular Series of earlier workers. This latter name should be discarded under the recently adopted code of stratigraphic nomenclature on the following grounds:-

- (a) Tubicular casts on which the old name is based also occur in rocks of different age, e.g. Eldon Group
- (b) Formation names should be based on geographic occurrences.

The formation may later be found to be equivalent also to the Caroline Creek beds as it occupies a similar stratigraphic position. The age of the formation is probably lower Ordovician as it overlies the Round Hill conglomerate conformably which is of Tremadocian Age and is overlain in turn by the Lorinna Limestone of (presumed) Lower Ordovician Age. Since the exact age of the base of the Lorinna Limestone has not been determined in this area the Carlsons Creek quartzites could extend up to Middle Ordovician.

This formation is the host rock for the ore deposits at Round Hill and is therefore important from an economic view point. The formation is tightly folded and broken by numerous faults. For this reason it has not been possible to measure a complete stratigraphic sequence sufficiently reliable to be used with confidence. However, the general lithology of the formation is known.

The Carlsons Creek quartzites consists of interbedded quartzites, grits, sandstones and shales with at least one thin conglomeratic band.

The dominant colour of all these rocks is grey when fresh but they are locally coloured brown, cream, green or pink by various iron compounds in weathered outcrops. The dominant rock type is a dense, massive, strongly-jointed quartzite, occasionally containing tubicolar casts. Usually the jointing masks the bedding but occasionally the quartzite is thinly bedded or flaggy and the more massive beds separated by thin slate bands up to 6 inches thick. Such quartzites occur throughout the formation but are better developed towards the top. The Round Hill Extended workings (adit No. 1) and the upper portion of the formation in the No. 3 adit (Round Hill workings) are typical of this facies. Gritty beds are common, the grit particles being distributed in a fine-grained groundmass and the whole resilicified, occasionally these grade up to fine conglomerates.

Near the portal of No. 1 Adit a thin conglomerate band is interbedded with the grits together with shales and fossiliferous sandstone. This facies is more characteristic of the lower portion of the formation. Grits also occur near the base of the formation in the vicinity of Tin Spur. However, grits occur also close to the top of the formation in the bed of Claude Creek near the Round Hill Extended workings.

At least two oolitic sandstone bands occur, the oolites being composed of (or replaced by) pyrite. These bands also yield poorly preserved fossils and may become important marker horizons in this formation. The two bands are seldom more than 6 inches thick and are separated by a dense quartzite member usually about 30 inches

thick which is typically stained green by the oxidation products of the pyrite. The upper colite is overlain by a quartzite carrying abundant tubicolar casts. This sequence is exposed at many points but can be seen best in the road cutting through the Fall's anticline.

The basal beds of the formation show some transition from the underlying conglomerate, the general sequence being from conglomerate through grits and sandstones to quartzite. The top of the formation also shows some transition from quartzite through calcareous grit to limestone. However, within the formation the sediments change from fine to coarse grain with no transition, indicating rapid fluctuations of sea level.

The junction between the overlying limestone and the Carlsons Creek quartzites is exposed in the No. 3 adit at Round Hill. This contact has been described by earlier workers as a fault and by Hughes and Elliston as a normal sedimentary boundary. The writer has accepted the latter view but with some reservation as the contact is far from clear due to the poor condition of this adit.

The formation is sparsely fossiliferous, the tubicolar casts characteristic of the formation occurring in sandstone and quartzite beds throughout. This fossil has been described by Opik as *Diplocraterion*, a dwelling pocket of an unknown animal. This fossil is useless as an age indicator as it occurs in rocks ranging in age from Lower Cambrian up to the Triassic.

The casts are said to be useful in determining the attitude of the bedding as they are described as occupying a position normal to the bedding planes. However, similar structures lying parallel to the bedding can be found in a sandstone bed just inside the entrance of No. 1 adit and also in No. 7 adit drive. These appear to be structurally similar to the Diplocraterion but with a tendency to branching which is rarely observed in the former genus.

A quartzite band from Claude Creek near the Falls anticline has yielded a few indistinct brachiopods. So far no useful zone fossils have been recognised in the formation. The lavas described by Hughes from this formation appear to be attenuated drag folds containing the oolite bands described previously and the writer has found no evidence for any igneous rocks in this formation.

The Carlsons Creek quartzite formation occurs widely throughout the area mapped and its distribution is indicated on the geological plan. In contrast to the extremely competent underlying Round Hill conglomerate which behaves as a massive unit this formation is closely folded and cut by a great number of small thrust faults. At first the close folding appears surprising due to the apparent competence of the formation but close study indicates that the shale members greatly facilitate this folding although occupying a very small proportion of the stratigraphic sequence.

The thickness of the formation in this area is at least 800 ft.

(iv) Lorinna Limestone

Limestone occurs in two localities in Claude Creek overlying the Carlsons Creek quartzite formation. It has also been encountered in the No. 3 adit, again overlying the quartzites. In the Lorinna area, some 8 miles to the south-west, similar limestones occur in the same stratigraphic position. Here the exposures are somewhat better and a greater thickness is exposed. Previous workers in the Round Hill area have tended to be somewhat cautious in correlating these limestone with the Gordon limestone formation. However, when the structure of the area is studied it becomes obvious that the limestone is occupying its normal stratigraphic position and there is no valid reason for assigning any other age to it. Since no physical connection with established outcrops of Gordon limestone can be demonstrated and the beds overlying the limestone have been removed it has been given the above local name and correlated with the Gordon limestone formation.

The outcrops in Claude Creek consist of small residuals of limestone in the centre of the Claude Creek synclitorium. Here the limestone contains numerous shaley bands in which limonite has been deposited giving the outcrops a roughly banded appearance. No fossils have been identified but a close search would reveal many identifiable types. In the No. 3 adit the limestone is a dense blue rock containing numerous veins and knots of calcite. It is crushed and highly disturbed by the close folding and at the contact of the underlying quartzites locally overturned. A close examination of the surface above the

No. 3 adit has failed to reveal any limestone outcrops, the area being covered by glacial debris. However, some small road cuttings expose a grey/buff residual clay which could well be the decomposition product of limestone. Such lack of outcrop in limestone areas subjected to heavy erosion is very common in Tasmania.

The maximum thickness of limestone exposed in this area is of the order of 200 ft. but here the top of the formation is missing. Elsewhere the thickness may be as much as 2,000 ft. The age of the formation ranges from Lower to Upper Ordovician.

(v) Glacial Till

Evidence of the Pleistocene glaciation occurs at several points in the area. One occurrence of glacial till is exposed on the top of the hill above the No. 3 adit and comprises large blocks of quartzite, Round Hill conglomerate and basalt in an indeterminable matrix. The size of the boulders, its composition and position in relation to the topography plainly point to a glacial origin. This deposit has apparently been subjected to extensive erosion and most of the matrix has been carried off leaving only the boulders. Near the junction of the Cockatoo Road with the Lorinna Road a further deposit of till is exposed in a gravel pit. Here the fines have not been leached out and the till retains its original structure. It consists of boulders of all sizes showing little or no rounding and no sorting whatsoever, set in a silicious matrix of sand-grade fine materials.

Approximately a quarter of a mile along the Cockatoo Road and just below the road a rather remarkable outcrop of till occurs. Here the till

has apparently been silicified and outcrops over some distance as cliffs 20 ft. high. At first sight this appears to be an outcrop of Round Hill conglomerate but closer inspection reveals quartzite blocks containing tubicolar casts within the "conglomerate." It must, therefore, be later than the Carlsons Creek quartzites and since it has all the characteristics of tillite and is surrounded by glacial debris of Pleistocene age (indicated by the presence of Tertiary basalt boulders) it has been mapped as Tertiary tillite. The high degree of lithification is surprising and it may well be that this is a relict of an earlier tillite possibly of Permian age. However, no evidence of Permian till occurs elsewhere in the area. Similar silicification has been observed in river gravels underlying the Tertiary basalts in the Ouse district of Tasmania. However, there is no conclusive evidence yet for post-Pleistocene basalts which could have effected the silicification of the Pleistocene tills.

(vi) Residual Soils, Talus and Alluvium

Clay soils, possibly derived from the Lorinna limestone, have been mentioned previously. Elsewhere the soil cover is thin, sandy and of the skeletal type. Talus accumulations occur locally under favourable conditions such as the south-west facing slopes of Mt. Claude, Round Hill and Brazen Nose and also in the vicinity of the Round Hill Extended workings. In these localities the talus obscures almost all outcrops and renders detailed geology difficult and often unreliable. Since no useful purpose could be served in mapping these areas no detailed mapping has been attempted in areas thickly covered by talus. River deposits consist largely of boulders of conglomerate and

quartzites and judging from the size of these boulders much of the bed load of the streams is derived from the dissection of Pleistocene till rather than normal stream erosion.

(B) Igneous Rocks

(1) Dalcoath Granite

This rock occurs in the extreme south-west of the area as a stock having the approximate dimensions of $1\frac{1}{2}$ miles by 1 mile. Only portion of this mass has been included in the area mapped. Typically, the granite is cream to pink in colour and is composed of plagioclase and orthoclase feldspars, quartz and biotite mica. Twelvetrees and Mckintosh Reid state that the plagioclase "belongs to the oligoclase-andesine series" and that the plagioclase and orthoclase are present in roughly equal proportions.

Narrow aplite veins and dykes are common within the granite itself and a few have intruded the surrounding rocks. The granite contact where exposed further south-west of this area is strongly greisenized and carries topaz, fluorite, wolframite and molybdenite as accessory minerals. The aplite dykes also commonly carry wolframite and molybdenite and have been actively prospected in the past.

The zonation of economic minerals around this granite has been commented upon by various writers. As mentioned above the parent granite carries tungsten and molybdenum. Just outside the granite at Tin Spur small cassiterite and arsenopyrite deposits have been worked and further out again at Round Hill we have lead, silver, gold, zinc, bismuth and copper.

The metamorphism of the Cethana

Group rocks near the granite has been commented upon earlier. In the younger rocks the main effect has been silicification. The Round Hill conglomerate and Claude Creek quartzites have been converted to extremely dense and highly silicious rocks over a very wide area. Also gash veins of quartz and sheets of quartz along the bedding planes are very common in these rocks. The bedding plane quartz usually shows strong striations due to bedding plane slippage.

The granite is definitely of post-Ordovician age as it has intruded or altered all the sediments up to and including the Lorinna limestone. No definite Silurian or Devonian sediments are known from this area. The granite is therefore taken to be of Lower Devonian age in common with many other granites in Tasmania.

(2) STRUCTURAL GEOLOGY

The general plan of the area surrounding Round Hill shows a marked orientation of the structures which trend in an approximate north-west direction. All the major fold axis, the faults and most of the minor folds have this orientation. A set of smaller faults cuts across this major structure approximately at right angles. Taking the whole area in the general plan as a unit it can be seen that it forms a major complex synclinorium. The smaller folds within this belt are also synclinoria and anticlinoria within which in turn are smaller, often asymmetrical, dragfolds.

There are, therefore, four orders of folds in this area, having the following dimensions:-

| | | Order of Width |
|-----|---|--------------------|
| 1st | Round Hill Synclinatorium | Approx. 20,000 ft. |
| 2nd | (Claude Creek Synclinatorium) (Cockatoo Ridge Anticlinorium) " etc. | 2,000 ft. |
| 3rd | (Main Anticline) (Sales Anticline) (Falls Anticline) etc. | " 200 ft. |
| 4th | Small Drag Folds on limbs of 3rd Order Folds | " 20 ft. |

The majority of the 3rd and 4th order folds lie outside the area mapped in detail but many are known to exist and a few of them have been indicated on the general plan where they cross the Lorinna Road.

1st Order Structures

The Round Hill synclinatorium is the name chosen to conveniently describe the 1st order structure lying between Mt. Claude to the north-east and the Dalcoath granite in the south-west. This structure is complicated by faulting but is clearly strongly asymmetrical in section. The north-east limb is overturned and is the seat of strong thrust faulting. The Claude Creek fault is the most profound over-thrust in this area but others also run along this limb more or less parallel to it and have been indicated on the plan. In front of the Claude Creek fault, that is south-west of it, a 3rd order syncline has been strongly compressed and attenuated, probably passing into a thrust fault further to the north-west. Small 4th order folds on the limbs of this fold have in places been completely

attenuated, overthrust and overturned. The derivation of this structure has been indicated in Fig. 2.

In contrast to the above, the southwest limb of the Round Hill synclorium has fairly symmetrical folding with no overturning so far as is known. The strong fault running approximately parallel to Tin Spur Creek is considered to be a normal fault of Tertiary age. However, comparatively little is known of this fault at the present stage but there is no doubt as to its presence and the position indicated on the plan is substantially correct. If it were a thrust fault it would be expected to swing away to the west north-west of the Lorinna Road due to the dip of its fault plane. The trace of this fault on the plan indicates that it must be nearly vertical and this suggests a normal fault rather than an overthrust, there is no evidence of trans-current movement in that area.

The asymmetry of the Round Hill synclorium is also evidenced by the outcrops of limestone along the axis of the Claude Creek synclorium close to the north-east limb of the main structure and by the overturning in the centre of this synclorium in the No. 3 adit. Of the faults cutting the major structure at right angles and therefore trending north-east some are clearly transcurrent, representing portions of the overthrust blocks of the Claude Creek fault which have moved forward more than others. These faults are therefore cognate with the major structure. Others of these faults may be of Lower Tertiary age. The structural

relations of these small cross faults is discussed more fully later together with the derivation of the Claude Creek fault.

2nd Order Structures

The asymmetry of the major fold belt is reflected to some extent in the 2nd order folds. The Claude Creek synclinorium being closest to the north-east limb of the major structure is also asymmetrical in the same sense. That is, the north-east limb tends to be steeper and is overturned locally. However, this synclinorium is cut by a great number of small thrust faults and it is difficult to assess the throw on these faults individually. This renders the precise structure difficult to interpret. At its north-west end this synclinorium appears to pass into a north-east dipping overthrust fault.

The Cockatoo Ridge anticlinorium is a somewhat more symmetrical structure and is again broken extensively by faulting. The syncline at Tin Spur is probably also a 2nd order fold but is a fairly regular open fold with only relatively minor flexures on the limbs. Also it is somewhat smaller than the other 2nd order folds.

Of the above 2nd order folds only the Claude Creek synclinorium has been studied in any detail. The 3rd order folds on the north-east limb of this structure are the locus of the ore deposits at Round Hill and on the south-west limb those at the Round Hill Extended. The synclinorium is a fairly tight structure and it may be more extensively faulted than is indicated on the plan, particularly along its axis. However, it is difficult to obtain

proof of faulting along the axis due to lack of exposures. The structure is tight enough to have infolded the Lorinna limestone which does not appear in any of the other folds.

The synclorium plunges north-west from Round Hill itself to a point near the No. 3 adit where the plunge reverses thus forming a basin-like structure. The change in plunge is certainly due in part to the cross faults indicated on either side of the No. 3 adit but is also a feature of the main structure.

3rd Order Structures

These are the drag folds and associated faults on the limbs of the 2nd order folds. The axis of adjacent 3rd order anticlines are about 200 ft. apart but they vary somewhat from place to place. The axis are frequently offset by the small thrust faults. Folds of this order are exposed at many places throughout the area covered by the general plan, but of these only the 3 anticlines likely to contain ore bodies near Round Hill have been mapped in detail. A limited amount of work has been done on the folds near the Round Hill Extended workings but here the exposures are rather poor.

The anticlines near the Round Hill Mine have all been mineralised to some extent and may thus be the focus for further exploration in this area. The folds mapped here have been termed:-

1. Main anticline - This is the anticline extensively mined in the past. Nos. 1 and 2 adits at the Round Hill Mine have been driven along its axis for about 1,200 ft.

2. Sales anticline - Lies approximately 200 ft. south-west of (1) and has been worked at Sales Quarry and the Western workings.
3. Falls anticline - Adjacent to and approximately 200 ft. south-west of Sales. Has been worked to some extent near Claude Creek and in the No. 1a and No. 8 adits.

These folds exhibit several puzzling features which have led to their being described by various authors as both "parallel" and "similar" folds. In parallel folds the individual beds all lie on arcs of concentric circles. The folds are characteristic of shallow depths and/or competent beds. Such folds can be constructed geometrically. In similar folding the beds are all the same shape and are characterised by a thickening of the beds at the apices of the folds. A property of parallel folds is that if the fold is asymmetrical the axial plane dips away from the steeper limb. In similar folds the axial planes are vertical.

The three folds mapped in detail have the following characteristics:-

1. Vertical axial planes indicated by the cleavage and by the superposition of the levels in the old mine workings.
2. In the case of the Main anticline particularly they are asymmetrical.
3. They appear to be of the parallel type without pronounced thickening of the beds at the apex of each fold.

In drawing the geological sections of this area it is found to be impossible to develop the folds accurately by either the geometrical methods for similar or parallel folds.

Actually the folds are neither strictly parallel or similar in type but lie somewhere between these two. The reason for this is the extreme difference in competency between the various members of the Claude Creek quartzites forming the folds. If we have a formation composed of exceedingly massive quartzites interbedded with soft shales and sandstones which is subjected to folding there will be a stress environment in which the quartzites will behave as competent members whilst the shales will be exceedingly incompetent. This stress environment would cover a very wide range in the case of the Carlsons Creek quartzites which contain members differing greatly in lithology.

This explains the apparent anomalies of these folds. In the massive quartzites where the folds are asymmetrical in section the axial planes must dip and these folds tend to be of the parallel type. Close inspection, however, reveals a slight thickening of the beds at the apex of the folds so that strictly parallel types are never developed. However, the softer beds behave in a most incompetent manner and flow into the axial crests tending to offset the dip of the axial planes. This kind of behaviour is well exposed in the Main anticline on the north-west bank of Claude Creek opposite No. 1 adit portal. A diagrammatic sketch of this kind of behaviour

is illustrated in Fig. 3. Since the Carlsons Creek quartzites are dominantly competent beds it seems that a relatively small thickness of incompetent material is sufficient to offset the axis enough to give the appearance of competent folding. A further factor in the process is the offsetting effects of the numerous small thrust faults and also the slight flowage in the quartzite members themselves. The kind of folding described above has been recognised by continental geologists and has been termed "Flexural Slip Folding."

The folds are cut by a number of small overthrust faults which strike roughly parallel to the folds and dip at various angles to the north-east and south-west. All such faults which are exposed in the area mapped in detail have been indicated on the plan. However, it is difficult to trace some of the faults over any distance due to lack of exposures and their continuation beyond the limits shown on the plan is therefore doubtful. The trace of these faults on the plan is exceedingly complicated in some cases due to the low angle of dip of the thrust planes and to the violent topography. The small thrust which is exposed in the road cutting opposite the No. 1 adit in particular, has a complicated trace on the ground. The fault dips north-east at approximately 35 degrees and therefore where it crosses the valley cut by Claude Creek it swings north rapidly to the bed of the creek and then runs south again as it cuts back up the other bank. This fault offsets the axis of the Main anticline above No. 7 adit by some 20 feet. The total offset in this region

is approximately 40 feet but part of this is due to the fault and part to the incompetent behaviour of the bed exposed near the creek level in this anticline. From this point the fault runs approximately south-west and cuts off Sales anticline. The low-angle thrust shown in the section through No. 3 adit is probably this fault also.

Other such faults are shown on the plan and in most cases they offset the anticlinal axis to some extent, often the intervening synclines are thrust right out. More thrusts similar to those indicated may be concealed beneath the glacial till above No. 3 adit and the talus accumulations on the slopes of Mt. Claude, Round Hill and other places. In general these faults tend to be parallel to the dip of the rocks and it is only in good exposures that they can be separated from bedding plane slippage. Indeed some of the exposures considered to be bedding plane slippage could possibly be thrust faults but lack of exposure frequently prevents tracing these over any distance.

4th Order Structures

A few small drag folds occur locally on the limbs of the 3rd order folds. A few of these have been indicated on the plans. They are of the order of 20 ft. in width but vary considerably in size depending upon the lithology of the rocks at that point.

Sequence of Events Producing Present Structure

A study of the regional structure of this area reveals the sequence of events leading up to the present structure. However, one or two further observations in this area provide

further light on this subject. These are:-

1. In the vicinity of the old mill site two sets of slickensides are exposed. One set is normal to the fold axis and due to bedding plane slippage and the other set at an angle to these and normal to the Claude Creek fault. In this exposure the slickensides due/^{to}the folding have been dragged around by the later movement normal to the Claude Creek fault, thus the Claude Creek fault post-dates the 3rd order folding
2. The 2nd order cross faulting offsets the 3rd order fold axis. Since these faults spring from the Claude Creek fault it further supports the above.
3. The Round Hill conglomerate encountered in the rises from No. 2 adit is reported to be mineralised at the contact. This conglomerate lies on the upthrown side of the Claude Creek fault. Hence the mineralisation post-dates the Claude Creek fault.
4. The 3rd order thrust faults are mineralised in some places and hence pre-date the mineralisation.

The present structure has been produced by compression acting in a north-east south-west direction. First the rocks folded into a major synclinalorium which with continual compression developed into something like the present complex structure. The asymmetrical shape is due to the rapid thinning out of the Round Hill conglomerate near the north-east limb and to the shallowing of the basement

to the south-west. The basement rocks resisted the folding due to their higher degree of lithification at the time of the folding. Once the Round Hill synclorium had assumed something like its present shape continued compression was more easily relieved by faulting. This is probably due to an intensification of the compressive forces, the rocks being unable to deform rapidly enough yielded first through a large number of conjugate shears running roughly parallel to the fold belts and tending to dip north-east and south-west at 45 degrees. However, this ideal state is lost to some extent by the influence of the bedding on the dips. Where the beds dipped at angles close to 45 degrees the small over-thrust faults tended to form parallel to the beds and run up the limbs of the anticlines. They then cut across the beds on the other side of the anticline at an angle of more nearly 45 degrees to the next anticline. Thus a very complicated pattern of small over-thrust faults was formed. Most of these have only relatively little displacement along them (20 - 30 feet and less). The faults appear to die out fairly quickly along the strike and be replaced by further thrust faults in echelon fashion.

Finally, as the compression intensified still further the rocks yielded by outright fracture and movement along the Claude Creek fault. Opposite the Round Hill Extended workings this fault formed first where the Round Hill Conglomerate thins out rapidly from about 1,200 ft. to less than 200 ft. in thickness. The highly competent conglomerate block to the north-

east over-rode the younger rocks south-west of it. Since the line along which this conglomerate thins out is slightly oblique to the components normal to the thrust movements the Claude Creek fault also tended to form in echelon pattern. Opposite No. 3 adit (Round Hill workings) some of the movement is taken up in an attenuated syncline which forms an incipient thrust fault in front of the Claude Creek fault at this point. Further to the north-west this attenuated fold passes into a true thrust fault. Where this fault begins to take over part of the throw along the Claude Creek fault a few small cross structures have been formed adjusting the throw between the two blocks. (See Fig. 4).

Up to this stage fluids from the uprising Dalcoath granite had produced widespread silicification throughout the area. Following the movement along the Claude Creek fault the mineralisation forming the ore deposits at Round Hill occurred. The most favourable horizon for deposition was in the 3rd order anticlinal axis where a small thrust fault intersects a soft bed. Later the structure has been modified somewhat by normal faulting. This probably occurred during the Lower Tertiary. The sequence of events is illustrated by Fig. 5.

It is emphasised that the stages of development outlined above are not clearly defined steps but merge into one another as a continuous process.

(3) ECONOMIC GEOLOGY

Mining Properties.

(A) West Mt. Claude Mining Syndicate

The leases held by this syndicate, numbers 111M/47, 40 acres and 4M/49, 40 acres, cover the areas held by the various companies working the silver lead deposits near Round Hill in the past.

In the early literature on this area the various workings have been given different numbers by the companies engaged in the area. Also, the recent workings put in by the West Mt. Claude Mining Syndicate are difficult to refer to by their locations. The writer has therefore allotted the following numbers to the more important workings, keeping as near as possible to the numbers used by earlier workers. The various workings are all indicated on the detailed plan :-

- No. 1 adit - Main drive under Round Hill from the bank of Claude Creek.
- No. 1a workings - Shallow workings on the hill above No. 3 adit.
- No. 2 adit - Upper level of main Round Hill workings driven from the road immediately above No. 1 adit.
- No. 3 adit - (water-tunnel) - the long cross-cut adit driven from the tramway between the main workings and the original mill site.
- No. 4 adit - Small adit 45 ft. long lying approximately 130 ft. east of the western workings.

- No. 6 adit - Lower level of the western workings.
- No. 7 adit - (magazine drive) - On the opposite bank of Claude Creek from No. 1 adit.
- No. 8 adit - Approximately 60 ft. west of No. 1a workings.
- No. 9 adit - Intermediate level of western workings.
- No. 10 adit - Small adit close to western workings lying between No. 6 and 4.
- No. 11 adit - Upper level of West Mt. Claude Mining Syndicate workings driven from Lorinna Road, approximately 250 ft. north of original mill site.
- No. 12 adit - (Maori Queen) - Intermediate level of West Mt. Claude Mining Syndicate, bottom side of road below No. 11.
- No. 13 adit - Lower level of West Mt. Claude Mining Syndicate workings driven from near the bank of Claude Creek directly below Nos. 11 and 12 adits.

These workings can be conveniently divided into 4 groups:-

- A. Main or eastern workings - comprising
Nos. 1, 2 and 7
adits from which
the great bulk
of production has
come.

B. Central workings - Nos. 1a, 3 and 8 adits.

Little or no ore has been produced from these workings.

C. Western Workings - Nos. 4, 6, 9 and 10

adits from which a small quantity of ore was obtained in the early days.

D. West Mt. Claude Mining Syndicate workings -

Nos. 11, 12 and 13 adits, approximately 20 tons of ore have been produced from these adits.

(1) History

The original discovery in this area was made by Weekes and Shepherd about 1878. In 1880 the Mt. Claude Silver Lead Mining Co. was formed and commenced driving the No. 3 adit, reaching 593 ft. They also commenced working in the vicinity of the main workings before closing down in 1884. In 1890 B.L. Thomas and Thos. Terry continued this work until the Southern Cross Proprietary Silver Mining Co. took over. They continued the No. 3 adit to 650 ft. and carried out other small exploratory works at No. 12 adit and on the main workings. In 1893 the Kentish Proprietary Silver Mining Co. N.L. carried the driving of the No. 3 adit to its present face and operations were again suspended in 1907. In this year the Round Hill Silver and Lead Mining Co. N.L. commenced operations. This company opened up the property and prospected extensively until 1912 when the

mine was let on tribute. During this period the western workings reached their present stage of development, producing 67 tons of ore in the period 1907-8. The tributors continued driving No. 1 adit and had reached 190 ft. in 1913 when Twelvetrees visited the mine. At that time they had encountered a further ore body and were producing high grade ore. In 1915 the Round Hill Silver Lead Mining Co. N.L. recommenced work and by 1918 when Mckintosh Reid examined the area mining operations were in a flourishing condition. Hughes report gives the following description of the developments from 1918 - 1927. I quote him:-

"The main workings, in 1918, consisted of two levels 70 feet apart, both adits, but connected with each other and the surface by a series of rises. The lower or main tunnel was driven for 545 feet on a lode formation containing a series of ore shoots which pitched to the north-west and had been stoped up from this level. At 545 ft. the adit branched, one drive following to the south-east a formation carrying much quartz but little galena, and the other an indicator vein to the east. At 144 ft. in this latter drive, a cross cut was put into the north-east and at 30 ft. cut a strong lode. At the end of the year this lode had been driven 51 feet north-west and 57 feet south-east from the cross cut and showed an average width of 12 feet of ore, concentrates from which gave a bulk assay of 3 dwt. gold, 85 ozs. silver, and 42% lead per ton.

Meanwhile the No. 2, or Upper adit, which at the time of Reid's visit was in 500 feet, had been further advanced and found to contain a fair quantity of ore in a crushed formation as far as the conglomerate wall which was encountered in rises. 1919 saw the first development of the new formation. It was driven on a further 286 feet south-east and 21 feet north-west over an average width of 16 feet of ore, and five stopes were opened up. Development continued over the next few years and by 1921 the adit was in 1,420 feet including 700 feet on the new development. In this year a commencement was made to test this lode at a lower level, and at about 700 feet from the entrance an internal shaft was commenced. The next year, 1922, saw a level 80 feet below the main adit opened out and the lode was driven on 137 feet to the south-east vertically below the main adit.

From 1922 to 1927 when the mine closed, most development was undertaken from this shaft level. From the shaft, drives had been extended 600 feet to the south-east and 700 feet to the north-west. More stoping was done south-east of the shaft where the lode averaged 4 feet in width."

In 1948 the present syndicate was registered and commenced operations. The No. 7 adit was developed further for a

41.

few feet and the No. 12 adit cleaned out and extended. An upper and lower level Nos. 11 and 13 were opened up above and below the No. 12 adit. This work was abandoned by 1950 and a programme of diamond drilling carried out in search of further ore. Following the survey of the leases in 1954 the Company recommenced operations by continuing the No. 7 adit drive for about 18 feet. At the present date work has been suspended pending this report on the area.

(11) Developments

Main Workings.

The No. 1 adit is blocked by a fall approximately 100 ft. from the entrance. To this point the drive is roughly along the axis of the Main anticline. The anticline is rather broad and has a small drag fold along the apex. The exposures in this adit are poor as a good deal of the ground surrounding the adit has been stoped out. A few small galena veins are showing on the north wall of the drive 20 to 30 ft. from the entrance. They are only an inch or two wide. At 60 feet a cross-cut 15 ft. long has been put into the south-west with the intention of intersecting the small galena lode which crosses Claude Creek just above the small falls. However, nothing is showing in the face and the cross-cut should have been continued a further 15 ft. to cut this lode. At 55 ft. a cut in the north side of the drive leads into an old stope above the drive.

The stope is now partially collapsed. However, it does show that the ore body mined was more or less parallel to the bedding planes and plunged north-west at about 15 degrees. An ore pass leads from this stope to the entrance of No. 2 adit on the edge of the road above. No. 2 adit is completely collapsed at the entrance and as far as is known is inaccessible. The writer has examined the No. 1 rise but this simply leads into an old stope and does not give access to the workings beneath. The No. 2 rise could be accessible but this is 150 ft. deep and no equipment was available to explore this.

No. 7 (magazine adit) has been driven for 57 ft. along a bearing of 208 degrees. The adit commences on the north limb of the Main anticline and passes through the axis of this fold at 20 ft. At 39 ft. some galena veins have been driven on for 73 ft. These veins are confined to the bedding planes on the south limb of the anticline. The veins pinch and make along the drive but average about 6 inches in width. The present lessees have recovered about 4 tons of ore from the last 18 ft. of this drive. Samples of selected ore from this drive assayed:-

| Sample No. | Lead % | Zinc % | Gold per ton Oz. dwts. grs. | | | Silver per ton Oz. dwts. grs. | | |
|------------|--------|--------|--------------------------------|----|----|----------------------------------|-----|----|
| 171 | 54.3 | - | trace | | | 3.8 | - | - |
| 486 | 10.2 | 1.5 | 0. | 0. | 18 | 2. | 15. | 16 |
| 487 | 61.2 | - | | | | 6. | 14. | 0 |
| 488 | 59.8 | - | | | | 4. | - | - |

The galena veins just above the small falls referred to earlier have been driven on for a few feet at the end of No. 7 adit and also on the south-east bank of Claude Creek for about 30 feet. Selected material from this vein assayed:-

Lead 57.1% Gold .04 ozs. per ton Silver 11.9 ozs.
per ton.

Copper and zinc are also present.

These veins are essentially similar to those in No. 7 adit drive, being confined to the bedding plane on the south limb of the Main anticline.

Central Workings

No. 3 adit (water-tunnel). As described earlier this adit was one of the earliest workings in the area. It was driven with the intention of cross-cutting all the lodes in the area and was carried out courageously but with only the slightest encouragement. Had the lodes in this area been normal fissure fillings this adit would have served its purpose admirably. However, it provides some useful geological information and was for many years boarded up and provided a source of water for the mill during dry periods. The walls of the adit are now covered by limonite deposits which obscure a good deal of the geology.

The detailed plan and sections indicate the essential points of the geology along the tunnel. Briefly, the adit starts on the northwest limb of the Main anticline and the axis of this fold is intersected at 84 ft. Twelvrees reports that some galena was encountered at this point, but the writer found no signs of this due to the poor condition of the wall. At 180 feet a galena vein a few inches wide has been driven on over a total distance of 35 ft. No metal is showing in the face either side of the cross-cut but a little material was obtained from the back assaying:-

Lead 21.6% Silver 12 ozs. 5 dwts. 15 grs. Gold 12 grs.

This drive is on the north-west limb of the syncline between Main and Sales anticlines and about 6 ft. from the axis of it. Sales anticline is intersected at 280 ft. and Falls at 470 ft. The adit passes into limestone at 520 ft. the sediments being locally overturned at this point and the contact dips north at 70 degrees. From here to the face at 820 ft. the tunnel is in limestone. The underground water issuing into the tunnel at 650 ft. from two joints is probably connected with an over deepened glacial valley above.

No. 1a Workings:- These consist of a trench 50 ft. long cut along a bearing of 182 degrees, passing into a short adit from 50 to 59 ft. The trench and adit are in overburden and decomposed quartzite, the latter showing very strong iron staining and close jointing. At 45 ft. drives have been run east and west from the trench along a crushed zone near or on the axis of a syncline. This may be a fault zone along which a little movement has taken place. The drive is an astonishing accomplishment, being driven for 45 ft. along a bearing of 095° with only approximately 4 ft. of backs. At 41 feet a "rise" has been put into the surface 4 ft. above. The drive to the west proceeds 13 ft. on a bearing of 290° and then swings south parallel to the main cross-cut.

Some gossanous material can be found on the surface above the adit and apparently these workings were designed to explore any ore body beneath this. No ore is exposed in the workings but some encrustations of cerussite have formed in the workings since work was suspended indicating the presence of lead ores in the

vicinity. The gossan is apparently the remnants of an ore body which has been removed by denudation.

No. 8 adit:- This lies 60 ft. east of and 30 ft. lower than the No. 1a workings. The adit was apparently designed to test the gossanous formation at a lower level again than the No. 1a workings. The adit is driven approximately south (bearing 186 degrees) for 150 feet. At 34 feet drives have been put in east and west along some thin galena veins which seldom reach 2 inches in width. The east drive is 33 ft. long on a bearing of 095 degrees. The west drive commences on a bearing of 285 degrees but swings north-west at 40 feet for 20 ft. and then back on to a bearing of 290 for a few feet. At 50 feet along this drive a strong fault is encountered which cuts off the galena veins. The main cross-cut intersects a synclinal axis at 70 feet and the fault encountered in the west drive at 100 feet. At 105 ft. the axis of Falls anticline is cut.

The workings are driven in hard, grey, blocky quartzite containing a few sandy and shaley bands. The fault zones are filled with a grey, clay gouge. The rocks in these workings are quite highly disturbed by the various faults. No records are available of production from either this or the 1a workings but it is doubtful if any significant production was achieved.

Western Workings

These workings consist of 3 open cuts one above the other from the lower two levels of which drives have been put in along a strong fault dipping north at 63 degrees and striking

295 degrees. Other small faults dipping south at 60 degrees and 35 degrees are cut by the main fault which exhibits strong brecciation. These workings are reported to have produced 67 tons of ore and at one time an aerial ropeway was put in to carry the ore to the mill site.

The lower adit, No. 6, is 86 feet long and driven along the north dipping fault which forms the hanging wall of the drive. At 34 feet a cross-cut has been put in to the south but this is now inaccessible, it is reported to be 40 feet long. At 54 feet the ground on the south wall of the drive has been stoped out for about 20 feet above the drive and at 75 feet a further small cut has been made in the south wall of the drive.

The upper adit, No. 9, has been driven 44 feet along the same fault as No. 6 adit. This drive is in flaggy quartzites with a shale band forming the back. No stoping has been done from this drive and apparently the production has been small.

The highest level of the western workings consists of a small open cut about 20 feet high from which only a little ore has been obtained. This ore contains arsenopyrite and sphalerite. The arsenopyrite is in silvery crystals giving good tests for iron, arsenic and sulphur. This was previously reported as Jamesonite by Hughes but no positive tests for Antimony or lead could be obtained.

The ore at the western workings, generally, consists of fine veins of galena and sphalerite and pyrite in the country rock. The main ore body was apparently on the hanging wall of the north dipping fault, possibly in the shale band, but some veins penetrated into the country rock along bedding and joint planes with replacement of the rock in some instances. The workings are situated on the south limb of Sales anticline close to the axis of this fold. However, the faults offset the axis of this fold somewhat so that it is difficult to fix the axis precisely in the immediate vicinity of the workings. Ore from the western workings yield the following assays :-

Sample 1 (15 ft. along south wall of No. 9 adit):

Lead 31.6% Gold .04 ozs. Silver 10 ozs.
plus zinc

Sample 2 (from dump outside No. 9 adit):

Lead 28.5% Gold trace, Silver 5.1 ozs.
plus zinc and molybdenum.

100 feet east of the western workings two further adits Nos. 4 and 10 have been put in in an endeavour to cross-cut to the axis of the anticline in search of further ore bodies. However, a south-westerly dipping thrust fault which is exposed in the Western workings has offset the axis of this fold here. Although the anticline is clearly exposed on the hillside above these adits they lie beneath the fault plane and have either not been driven far enough or else the fault at this point has thrust out the anticline. The adits commence in flaggy quartzites and run into sheared, grey shales with thin quartzite bands. No ore is exposed in these workings.

West Mt. Claude Mining Syndicate Workings.

No. 11 Adit:- This adit is driven on some small galena veins exposed in the road cutting. It is an extremely irregular drive along a general bearing of 125 degrees and 64 feet long. The drive is parallel to the bedding which here dips vertically or is slightly overturned and consists of massive, jointed quartzites containing a few thin, slaty bands. Several thin veins have been cut in the drive and driven on for a few feet. In the face four such veins are exposed. They vary in thickness along the drive but total about 6 inches average width. The ore consists of coarsely crystallised galena with some chalcopyrite, sphalerite and pyrite contained in thin partings along the bedding planes. Several other such veins are exposed at various points along the drive but all are thin and patchy.

At 47 feet along the drive a cross-cut has been put in along a bearing of 027° for 69 feet. This cross-cut quickly crosses the anticlinal axis and enters thinly bedded sandstones and shales dipping north-west. At 38 feet a small thrust fault, also exposed in the road cutting outside, is crossed. Against this fault the beds are highly contorted and dragged. At 48 feet the cross-cut intersects a synclinal axis and from here to the face it is in broken quartzite carrying strong quartz veins.

According to Mr. A.G. Rowe in charge of operations for the syndicate about 5 tons of ore were obtained from these workings. Hughes report quotes an assay cut across 6 feet of the mineralised zone. This contained:-

Lead 5.4%, zinc 2.7%, silver 4.6 ozs. per ton, gold 4.5 dwts.

A selected sample of vein material collected by the writer assayed lead 42.5%, silver 33.5 ozs. per ton, gold trace, plus copper and zinc.

No. 12 adit (Maori Queen):- This is an old adit on the bottom side of the Lorinna road about 25 feet below No. 11 adit. The present syndicate cleaned out these old workings and extended it for a few feet. Although some galena veins were encountered no production resulted as the grade was too low. The adit commences as a cross-cut driven for 61 feet along a set of strong joints in hard blocky quartzite, over-turned and dipping steeply north to 50 feet. From here to the face it is in thinly bedded quartzites and slates and then broken quartzites. At 53 feet some galena veins have been driven on 71 feet along a bearing of 119 degrees, that is, parallel to the bedding. The drive is along a zone of steep overturning with strong bedding plane slippage. This zone has been weathered somewhat and forms a hanging wall of the drive. The foot wall is in blocky quartzites and at 62 feet along the drive a galena vein is exposed selected samples of which assay:- lead 52.3%, silver 37 ozs. per ton, gold .12 ozs. per ton, plus copper and zinc.

No. 13 adit:- These workings are situated just above the bank of Claude Creek directly below No. 12 adit. From the portal a drive has been put in along a bearing of 119 degrees for 67 feet and from the same portal a cross-cut has been sent in for 150 feet along an

approximate bearing of 060 degrees. The cross-cut was apparently designed to cut the veins worked in Nos. 11 and 12 adits at a lower level. Unless the over-turning on the north limb of this syncline is greater at depth than indicated by the workings above the veins in Nos. 11 and 12 adits should have been met in this cross-cut. However, no metal was encountered but a few more feet of cross-cutting would be necessary to prove that the veins do not persist to this depth. The lower values of these veins in No. 12 adit probably discouraged further work here. The cross-cut is in hard, blocky quartzite which dips vertically or is slightly overturned.

The drive has been made on some galena veins exposed at the portal, like the workings above these veins are narrow (total 4 inches and less) and confined to the bedding planes. The drive is thus along the bedding which here dips south at 70 to 75 degrees, in a thinly bedded sheared quartzite between two more massive beds. Along the drive the veins are very irregular and where thickest have been stoped up for 10 feet above the drive. A production of about 5 tons of ore is said to have been made from this drive, and haulage gear has been erected to carry the ore to the road above. A galena vein $1\frac{1}{2}$ inches wide is exposed in the face, picked samples from which assay:- lead 76.1%. silver 44.8 ozs. per ton, gold trace, plus copper and zinc.

Smaller Workings

On the West Bank of Claude Creek just below the water-fall a short adit has been put in close to the axis of Falls anticline. The

adit is in closely jointed quartzite showing pronounced bedding plane slippage. No ore is exposed in these workings at present but a small lode is reported to be visible in the bed of Claude Creek at this point during periods of low flows.

Sales workings are located on the top of the hill above Claude Creek 180 feet south of No. 7 adit. The workings consist of some trenches and a small quarry near the axis of Sales anticline. Some ore is reported by Twelvetrees to have been obtained from here in the early days. The ore is described as being in small veins generally parallel to the bedding but branching somewhat.

Several other small adits and numerous trenches in the area have been mapped and are indicated on the detailed plan. No ore is visible in any of these workings.

(iii) Structure of the Various Ore Bodies

The study of this area and of the various literature reveals that there are two distinct types of ore bodies present. First the thin galena veins lying parallel to the bedding and secondly the large deposits mined in Nos. 1 and 2 adits. Examples of the first type are exposed in many of the workings e.g. adits Nos. 3, 7, 11, 12 and 13. Characteristically these veins are thin and irregular and usually contain clean ore which may be hand picked. Where such veins are sufficiently wide they can be profitably worked but their irregularity renders any operations based on such veins alone a doubtful venture.

Examples of the second and more important ore bodies are no longer exposed since the main workings have collapsed. The writer is therefore forced to turn to the old literature for descriptions of these ore bodies. Mckintosh Reid visited the area while such lodes were being worked and his description of them (in part) is as follows:-

"The ore bodies follow the pitch of the fold and as they are brought down they are carried north-west. The principal mineralisation has taken place at the apices of the anticline but solutions have migrated also along the bedding planes. Deposition has taken place in the weaker beds ----- As these layers are rarely more than 20 feet thick the depth of the ore shoot is limited to this extent.

The ore bodies are thus contained in shoots about 25 feet wide and 20 feet deep (measured at right-angles to the pitch) and of (as yet) indeterminate length along the pitch.

Mineralisation has also taken place to a minor extent along cleavage and bedding planes ----- but the main channel of access was along the flowage planes of the crushed beds."

All writers agree on the localisation of these bodies in the axis of the Main anticline and that mineralisation if it occurs in the intervening syncline is slight and unimportant. Two of the old stopes of the main workings are still accessible, the first from No. 1 adit and the other from the No. 1 rise of No. 2 adit. Both these stopes bear out Mckintosh Reid's description of the ore bodies. They indicate that the ore bodies were roughly

conformable to the bedding and pitched north-west along the axis of the fold. This explains the failure of the No. 3 adit as an exploratory measure. The soft beds in which the ore is likely to be contained would be carried at least 150 feet beneath this adit from the known pitch of the fold. McKintosh Reid gives the dimensions of the ore body as 20 feet deep at right angles to the pitch. He also states that the first ore shoot came in at 57 feet along the drive and continued for 75 feet. From these dimensions the ore shoot must pitch north-west at 16 degrees. Measurements of the pitch of the Main anticline in this locality indicate a pitch of 15 degrees.

Reid's description of the ore bodies emphasises the importance of the softer beds in localising the ore shoots. Clearly, from the description above the ore bodies were confined to favourable bands within the quartzite beds. The structure of such soft beds is shown plainly in the sections through both the Main and Falls anticlines along Claude Creek. The soft beds have flowed up into the anticlinal crest forming roughly saddle-like bodies having similar dimensions to the ore bodies described by Reid. It should be noted that the true thickness of such beds would be very much less than 20 feet but they are exaggerated in the anticlinal axis by their incompetent behaviour. Thus we have two clues to the structure of these ore bodies. 1. the anticlinal crest and 2. the behaviour of the incompetent beds. However, obviously there are further controlling factors since the two exposures noted above show soft beds localised in the anticlines

but with no ore of importance contained in them.

A further factor in the formation of these ore bodies lies in the small thrust faults. The Main anticline is cut by at least 3 such faults which run up the north limb of the fold nearly parallel to the bedding and then cut across the crest of the fold. Where these faults encountered the beds on the south limb of the fold the beds are rolled back and overturned. Two exposures of this overturning effect are recorded on the detailed plan. These thrust faults (or some of them) act as the channels for the ore bearing solutions and where they encounter a soft bed at the crest of the anticline an ore body has been formed. As the fault cuts across the beds on the south limb of the fold, these have been opened up slightly and thin veins of ore deposited along the bedding planes.

This interpretation explains several features of the ore bodies at Round Hill :-

1. The ore shoots are confined to the soft beds which pitch north-west at about 15 degrees. However, the mineralisation does not extend indefinitely along the beds as evidenced by the smaller size of the lodes in the shaft level. This is due to the fact that since the folds pitch appreciably the soft beds are only cut for portion of their length. Mineralisation extends out from this zone but becomes weaker and eventually dies out unless the beds are cut by another such mineralising fault.
2. The lack of major ore bodies on Sales and Falls anticlines. As indicated on the sections and shown by the regional structure

- of the area there is a regional dip south from the Main anticline to the centre of the Claude Creek synclinalorium. Therefore the soft beds which may carry the ore bodies are approximately 130 feet beneath Claude Creek at Sales anticline and 200 feet beneath the creek at Falls anticline.
3. The failure of the recent drilling carried out by the West Mt. Claude Mining Syndicate. Since the ore bodies are only approximately 20 feet deep it would be difficult to locate such lodes by horizontal drill holes across the structure however well sited.
 4. The small "bedding plane" veins are usually located on the limb of the anticline cut at a strong angle by the thrust faults. These veins could lie some distance beyond the axis and may be 100 feet or more in depth.
 5. The Western workings are located on one of these mineralising thrusts but the structure there is not favourable to the formation of a large deposit.

It seems that all the three features must be present before an ore body of appreciable size can be expected. There are several instances where two such features are present and no major ore body is present. Doubtless not all such intersections will be productive. There is some evidence to suggest that the ore deposition was a late phase of the structure. In this case it may be that only the later faults are likely to be mineral bearing at such intersections. It is, however, significant that such small thrust faults are present in close relationship to all the known ore occurrences.

Another factor which may be important in this area is the pitch of the folds. However, there is not enough evidence to draw any definite conclusions on this point. It is likely that changes in pitch of the folds would affect concentration of the softer beds and hence be more favourable points for ore deposition. Since this factor may be highly important it should be borne in mind during any further operations in the area. North-west of No. 1 adit the pitch of the Main anticline has been measured at 10 degrees indicating some flattening in this direction. However, at this point the fold has been displaced by a low angle thrust fault which could cause a local variation. Where it has been possible to determine the pitch of the folds this has been indicated on the detailed plan. The formation of the ore bodies as envisaged by the author is sketched in Fig. 6. This shows the relationship of the major deposit to the bedding plane veins. The two types of deposits are thus related to one another and are part of the same stress environment. It is important to visualise the conditions operating during the ore deposition. It has been shown by a great many writers that openings of the size required by these ore deposits could never exist in practice. Some workers have therefore postulated replacement on a large scale to account for such deposits. Whilst there is undoubtedly some replacement in this area it appears to play a minor role.

At the time of the ore deposition the thrust faults were active and where they cut across the anticlinal axis a zone of low pressure formed. The flowage of the soft beds into

the fold axis, purely as a part of the folding process, indicates a pressure gradient acting towards the apices of the folds. This does not imply that actual openings existed but that this area was under rather lower pressure than the surrounding country. Also, as the faults cross the fold axis the beds on the other sides of the folds would tend to be opened up slightly by the fault movement. Again, no actual openings were present. Fluids travelling along the thrust planes would naturally migrate to these areas of lower pressure depositing metal and gangue minerals from solution due to the lower pressures prevailing. Since the fluids themselves were under pressure also there is no reason to postulate that openings ever existed but rather low pressure areas or "potential openings".

(iv) Mineralogy

The mineralogy of the bedding plane lodes is relatively simple. The ore is massive and consists of galena and pyrite with subordinate sphalerite and occasional blebs of chalcopyrite. The gangue, if present, is dominantly quartz, usually milky but sometimes ironstained and rarely crystalline. The galena may be fine-grained or coarsely crystallised.

The mineralogy of the major deposits has been described adequately by Reid. Briefly these ore bodies consist of galena both fine-grained and coarse, with abundant chalcopyrite, a little pyrite, sphalerite and siderite, together with small amounts of bismuthinite, pinite and quartz. The gangue is never abundant and the quartz usually opaque. Pyrite tends to be deposited first but in general the deposition was contemporaneous.

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The silver values are variable being as high as 900 ozs. per ton in some cases. However, generally speaking, they average 1 oz. of silver per unit of lead. Similarly the gold values are erratic but are said to average 2 to 3 dwts. per ton in ore containing 50% lead.

(v) Production

Incomplete figures of production for the period 1908 - 1927 are given by Hughes as:-

| | |
|--------|--------------|
| Lead | 4,700 tons |
| Gold | 1,500 ozs. |
| Silver | 370,000 ozs. |

Since 1948 approximately 20 tons of lead have been produced containing small amounts of gold and silver.

(vi) Diamond Drilling

The following holes have been drilled by the West Mt. Claude Mining Syndicate. No complete logs are available for this drilling and the core has not been preserved in order. In any future drilling programme care should be exercised to preserve the core in order and to prepare accurate detailed logs of the core. Drilling in this area is aided somewhat by the ease of access and the conveniently situated water supply.

The following descriptions of bores are based mainly on the driller's reports:-

Bore No. 11- A horizontal hole along a bearing of 028 degrees drilled from the end of No. 11 adit cross-cut, this hole is 204 feet deep. The bore commenced in quartzites and remained in quartzites with minor slate bands to 164 feet where the Round Hill

Conglomerate was encountered.

Bore No. 2:- Drilled from a cutting on the edge of the Lorinna Road opposite the No. 3 adit, depth 361 feet, bearing 024 degrees approximately horizontal.

This hole was in quartzite with some shaley bands and frequently encountered tubicolar remains. Apart from one thin galena vein in the run between 46 feet and 69 feet no mineralisation was encountered. However, towards the bottom of the hole the quartzites often carried minute flecks of pyrite.

Bore No. 3:- Drilled from near the mouth of No. 1 adit along a bearing of 167 degrees and depressed at 20 degrees. From 52 ft. 6" to 69 ft. 8" a lode was encountered. This is the extension of the first lode which was cut in the No. 1 adit at 57 feet. The hole would intersect this ore body 62 feet from the portal and 20 feet below the adit. Assuming the ore body to be conformable with the surrounding rocks its true width would be between 5 and 9 feet depending upon the assumptions made in reconstructing the fold. Assays of the relevant portions of the core are:-

| Core Lengths | Lead % | Silver Ozs per ton |
|-----------------------------|-----------|-----------------------|
| 52' 6" | | |
| 53' 8 $\frac{1}{2}$ " | 0.4 | 0.2 |
| 54' 9" | Trace | Nil |
| 57' 8" | 0.3 | 0.1 |
| 59' 2" | 15.1 | 2.0 |
| 60' 0" | 11.6 | 3.8 |
| 60' 6" | 0.4 | 0.5 |
| 61' 0" | 28.0 | 8.6 |
| 62' 6" | 3.5 | 2.0 |
| | 0.6 | 0.9 |

| Core Lengths | Lead % | Silver Oss. per ton |
|--------------|-----------|------------------------|
| 63' 5" | | |
| 64' 6"..... | 24.8 | 9.7 |
| 65' 5"..... | 1.2 | 0.7 |
| 66' 7"..... | 15.8 | 6.0 |
| 68' 10"..... | 19.1 | 7.4 |
| 69' 8"..... | 0.1 | 0.3 |

Bore No. 4:- Drilled from the cutting outside the No. 7 adit along a bearing of 200 degrees, depressed 60 degrees. This bore is reported to have encountered mineralised material between 76 feet and 81 feet but no assays or core is available to substantiate this. The hole would probably pass over the lode encountered in No. 3 bore if that lode persists to this point. This drill hole was designed to intersect the lode exposed in the No. 7 adit at depth but was abandoned before achieving its object.

Bore No. 5:- Drilled from inside No. 7 adit drive to test for extensions of the small galena veins there. The hole was 30 feet long and encountered the lode between 2' and 3' which assayed:-

- (1) Silver 42 oz/ton, lead 57.4%
- (2) Silver 4.9 oz/ton, lead 28.3%

Bore No. 6:- Similar to No. 5 to test for extensions of the same lode. Depth 14 feet, lode between 9'3" and 11'3".

Assay:- Silver 1.1 oz/ton, lead 28.2%

(B) Round Hill Extended

This property lies approximately $\frac{1}{2}$ mile south of the main workings of Round Hill and on the south bank of Claude Creek. The original

discovery is said to have been made about 1890. Developments in the area are limited and no work has been done here for at least 30 years. The ore bodies occur on the south limb of the Claude Creek synclinerium and although the lessees at one time considered the property sufficiently attractive to warrant the construction of ore bins no production is recorded from here.

(1) Developments

No. 3 Adit:- This adit was put in by the original syndicate about 60 years ago. It is driven for 81 feet along a bearing of 211 degrees in flatly dipping, grey, blocky quartzites with inter-bedded, puggy shales and sandstones. All these rocks are extensively weathered and closely jointed. At 41 feet from the portal a small drive consisting only of one round from either side of the adit has been put in. The adit is now in very poor condition and no ore can be seen in the drive. Reid, however, reports that a lode striking north-west and dipping flatly south-west composed of galena, sphalerite, pyrite and chalcopyrite was encountered here. A few lumps of ore consisting of small blebs of galena in hard, grey quartzite can be found on the dump and were doubtless derived from the drive. The lode does not appear to have been at all promising judging by the amount of work done on it.

Open Cut Workings:- The only production of note in this area has come from these workings. They consist of a trench 30 feet long from the end of which a short drive has been put in. The trench is in rather disturbed, fine-grained,

yellow sandstone and grey quartzite all very weathered. The drive is along the same faulted anticline as that in which the ore body at No. 3 adit was contained. The quartzites in the drive have behaved as competent units during the faulting whilst the shaley beds beneath these are crushed, brecciated and mineralised. The puggy, mineralised, fault zone itself forms the main ore body but ore deposition has also extended into the softer beds on either side of the fault. This fault zone has been stoped over-head for a short distance and a winze 25 feet deep has been put in in the centre of the drive. A few tons of ore are stacked outside samples of which assays:-

| | Zinc % | Lead % | Silver Ozs.Dwts.Grns. | | Gold Ozs. Dwts.Grns. | |
|--------------------|-----------|-----------|--------------------------|----|-------------------------|-------|
| Average Ore (1) | 2.2 | 4 | 5. 8. | 10 | 0. | 0. 6 |
| (2) | 2.6 | 3.2 | 3. 19. | 17 | | trace |
| Selected Galena | | | | | | |
| (3) | .5 | 34.8 | 54. 16. | 0 | 0. | 0. 12 |

Samples (2) and (3) contain traces of copper.

No. 2 Adit- This has been put in to explore the ore body encountered in the open cut workings at a greater depth. It commences on the hillside 40 feet vertically beneath these workings and has been driven for 124 feet along a bearing of 229 degrees. At 80 feet the drive has been put in along a bearing of 297° for 40 feet, directly beneath the open cut works. As far as the drive the adit is in grey-green argillites overlain by quartzite and dipping north at about 15 degrees. From here to the face it is in hard, blocky quartzite dipping steeply south. The drive is along the axis of the faulted anticline exposed in the workings

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above No. 3 adit. No ore is exposed in the drive but Reid reported "very little galena between the bedding planes".

No. 1 Adit:- This lies 180 feet vertically beneath the No. 3 adit and has been driven from near the south bank of Claude Creek along a bearing of 220 degrees to intersect the No. 3 adit ore body at depth. The adit is 302 feet long and is in hard, blocky quartzite throughout, except for a few thin slate bands. Near the face the quartzite is somewhat shattered and carries numerous quartz veins. The quartzites are gently undulating to 290 feet where an anticlinal axis is crossed. A few shears cut the adit and have been indicated on the plan. The adit has not been driven far enough to intersect the mineralised fault zone in the open cut workings at No. 3 adit. No other mineralisation has been encountered in this adit which is barren throughout.

Summarizing the important points in this area we have:-

1. All the mineralisation is related to the same faulted anticline which appears to plunge gently north-west (approximately 5 degrees).
2. The deposits worked in the open cut and intersected by the No. 3 adit apparently represent the remnants of more extensive ore bodies which have been largely removed by denudation.
3. The beds beneath the No. 3 adit are dominantly massive quartzites and are not favourable host rocks. Both the

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low level exploratory adits have failed.

4. To prospect beds higher in the formation it would be necessary to explore the anticline further to the north-west.
5. The geological structure in that direction is concealed beneath extensive talus accumulations.

Hence, while the prospect of further ore bodies to the north-west should not be discounted it is considered that the area does not offer sufficient encouragement to warrant exploration as a separate venture.

(4) GEOPHYSICAL PROSPECTING

Modern investigation methods frequently include geophysical prospecting as a tool for explorations. Since the geophysical methods rely upon the interpretation of differences in some accurately measured physical property or properties it is important that any area subject to such surveys should be free from unknown factors as much as possible. These may render the interpretation of geophysical results difficult and sometimes unreliable. In the Round Hill area a number of such factors are present and it is therefore considered that the commonly used geophysical techniques would be unsuitable.

The factors likely to affect geophysical explorations are:-

1. Very strong topography
2. Complex and probably rapid ground water circulation.
3. Complicated folding and numerous

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thrust faults.

4. The presence of the Claude Creek fault.
5. Lack of reliable data on the structure of the basement rocks including the Dalcoath granite.
6. The presence of glacial till over portion of the area.

(VIII) CONCLUSIONS

1. The various small silver-lead veins exposed in the Round Hill area do not constitute a reliable mining proposition.

2. The revival of serious mining operations in this area can only be expected if further large ore bodies of the kind worked in Nos. 1 and 2 adits are located.

3. It is reasonable to expect further such ore bodies along the axis of the Main anticline to the north-west and vigorous prospecting in this area is recommended. The ore bodies in this fold would be located closest to the surface.

4. This prospecting should be carried out by means of vertical diamond drilling along the axis of the fold. The drill core should be carefully logged and faithfully preserved.

5. No explorations have yet been carried out to test the Main anticline beneath the shaft level. At least one deep drill hole to search for the further "ore horizons" at depth is warranted.

6. There are at least 3 factors controlling the ore deposition of the large ore shoots:-
(a) the anticlines, (b) the soft beds and (c) the small thrust faults. Where these 3 factors are localised an ore body may be expected.

Of these factors points can be selected where the soft beds are in the axis of the folds. However, the distribution of the various thrust faults and the character of these faults individually is such that intersections of the faults with the fold axis cannot be predicted reliably. The drilling must therefore explore the axis of the folds at the "ore horizons" thoroughly enough to isolate any such intersections.

7. The discovery of one large ore shoot similar to those worked in the main workings may provide enough ore to pay for an intensive prospecting programme over a wide area. Following a thorough search of the Main anticline several other areas warrant investigation. In order of importance these are:-

- (a) Sales anticline:- The beds likely to contain ore shoots are located at least 130 feet below the bed of Claude Creek where the fold axis crosses it. Below this depth ore bodies may be located. The level of these ore bodies will fall to the north-west to beyond the No. 3 adit and will rise to the south-east with the pitch of the fold.
- (b) Falls anticline:- Similar remarks apply to this as to Sales. However, the first known favourable beds are located at least 200 feet below Claude Creek.

It should be noted that some mineralisation is present on both of these folds at various points. Therefore, if suitable host rocks are cut by a thrust fault in the anticlinal axis further important ore bodies may be found on these folds.

- (c) Further 3rd order folds on the north-east limb of the Claude Creek synclinerium, if they can be located accurately under cover of scree or glacial till.

In this connection it should be noted that the cross-cut from No. 11 adit intersects both an anticlinal axis and a small thrust fault.

This fault would cut the axis of the fold above the adit and the veins worked in this adit may be connected with this since they appear to die out at depth. The rocks here are mainly massive quartzites and therefore unlikely to contain a major ore body, but they may contain some useful ore. Since the area is readily accessible it should be explored by means of a short diamond drill hole from the surface above the adit or by an inclined rise from the adit itself.

- (d) The favourable beds containing the ore bodies at the Round Hill Extended will be localised in the axis of this fold down the pitch to the north-west of No. 3 adit at Round Hill Extended.

8. Geophysical methods of exploration would be unsuitable for this area.

9. The areas in which the best prospects for ore exist are such that developments of any ore bodies located will have to take place from shafts.

10. Although the limestone is the most favourable host rock for major ore deposits in this area there is at present no indication of mineralisation in this formation. Future prospecting should always bear in mind the structural position of this formation in

relation to any ore bodies located.

11. If further ore bodies are located the syndicate should thoroughly explore the Main anticline at depth before capitalising for the erection of plant. The possibility of a change in mineralogy perhaps to tin, bismuth, arsenic and wolfram at depth should always be considered.

12. The relation of the bedding plane lodes to the major ore bodies is worthy of consideration. The veins may contain useful quantities of ore capable of development in conjunction with the larger deposits. Exploration for these smaller lodes could easily take place from workings designed to develop the major ore bodies.

13. Whilst drill holes can be carefully sited on the anticlinal axis at the surface the slight off-setting effects of the soft beds and thrust faults may cause deviations in the axial planes of the folds. These may be sufficient to cause the drill hole to miss ore bodies which are only 25 feet wide in plan. If possible, the holes should be surveyed and failing this a close check should be kept upon the core to determine its relation to the bedding planes. It may be necessary to drill 2 or 3 holes across the axis of the anticlines.

14. Although no major ore bodies are at present exposed in this area the geological structure favours further ore deposits at the points indicated above. A careful and thorough exploration programme to test the Main anticline at depth and to the north-west along its axis is justified. Further explorations to test the

other anticlines should be based upon the results of this initial work. Any company operating in this area will require a thorough knowledge of the structural geology which should always be kept up to date by logging all drill cores and carefully mapping any future workings.

(IX) RECOMMENDATIONS

1. A vertical hole should be drilled on the axis of the Main anticline from either just outside the No. 1 adit or if convenient, in the No. 7 adit. This hole should be carried to 300 feet to test the formation at depth and to locate any extension of the lode encountered in the previous No. 3 bore. The hole will also provide a stratigraphic sequence of the beds in the vicinity of the ore body. If the conglomerate is encountered before this depth is reached the hole should be immediately abandoned. Care should be taken in the drilling to obtain the best possible core recovery and if possible it should be drilled 4x size. The core should be carefully logged and preserved.

2. A vertical drill hole (or series of holes) should be drilled on the axis of the Main anticline south-east of the cross fault near the No. 3 adit. Whilst some footage could be eliminated here by drilling an angle hole from the tramway below this is definitely not recommended as such a hole would only intersect the axial plane over a short distance. This hole will have to be drilled to a level of at least 150 feet beneath the No. 1 adit but the exact depth should be determined by the results of the first drill hole. If further ore shoots or promising horizons are located in the first

hole then this hole should be drilled deep enough to intersect these also.

3. A vertical hole on the axis of the Main anticline from the hill above the old mill site would intersect the axial plane in a favourable area. Here the pitch of the fold changes and a number of small thrust faults are present. The depth of this hole cannot be calculated from the pitch of the fold due to the various cross faults and the change in pitch. The depth must therefore be determined by stratigraphic means using the core from the No. 1 hole above.

4. A hole should be drilled on the axis of the Main anticline near the No. 3 adit (or from inside this adit if a suitable machine is available). Since this is in a downthrown block between two faults the depth of this hole will again be determined by comparing the stratigraphy of the core with that from the No. 1 hole.

5. If any ore bodies are located by the above drilling then intermediate holes as required should be drilled to delineate these ore shoots.

6. Drillings on Sales and Falls anticline should follow the above drilling. Initial drilling on these anticlines should be vertical holes sited on the axis of the folds as near as possible to the bank of Claude Creek.

7. The anticlinal axis above the No. 11 adit should be explored.

Sgd. (I.B. Jennings)
REGIONAL GEOLOGIST

Department of Mines
LORINNA

31st August, 1955.

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