

INTRODUCTION

It has been shown in the accompanying report on the general geology of the Mt. Lyell that the district is occupied by the following rocks:-

- (1) A north-south tract of Silurian conglomerates etc., capping the mountains of the West Coast Range.
- (2) A zone of schists along the western side of the above tract - the Mt. Lyell schists.
- (3) A parallel zone of felspar porphyries to the west of the schists, the boundary being an indefinite one - the Queen River porphyries.
- (4) Another zone to the west comprising Silurian slates, sandstones and limestones - the Queen River slates and sandstones.

The Mt. Lyell schists are regarded as altered portions of the Queen River porphyries. The Queen River porphyries and the schists are considered to be intrusive into the Silurian rocks (both the Queen River slates and sandstones and the West Coast Range conglomerates, series) and to be of Devonian age, representing dyke-like injections from the main granite intrusion.

The mineralised zones and the ore-bodies are restricted to the Mt. Lyell schists and further descriptions will be given below.

The Mount Lyell Schists.

These rocks extend in a general southerly direction from the Comstock mine to a point 100 chains south of the Queenstown-Gormanston road, the belt having a total length of 340 chains. The width of the belt of schist ranges from 15 chains to 80 chains, and has an average width of 40 chains. Along this belt the schists are most prominent, and also maintain a more regular width (40 to 50 chains) between the western end of Mt. Lyell and the Queenstown-Gormanston road (a length of 180 chains). To the north and south of this area the schists extend as narrower tongues in the porphyries.

The planes of schistosity have a very uniform strike within the main area of  $310^{\circ}$  to  $320^{\circ}$  and a high dip to the south-west. North-easterly dips exist at a few localities but only over small areas. Contortion is rare and is restricted to the vicinity of some reefs of quartz. To the north of the main area the strike tends to parallel the line of the conglomerate contact of the western end of Mt. Lyell and becomes almost north and south opposite the western end and  $45^{\circ}$  towards the Comstock mine. These figures apply to localities close to the contact while further west the schists and schistose porphyries maintain their normal strike of  $300^{\circ}$  to  $320^{\circ}$ .

The schists include a number of different types, and it is difficult to select any particular one as being a typical representative. It would be expected that, as the schists are derived from the porphyries, which are fairly constant in character, along the East Queen River (felspar porphyries), they should be constant in type. However, practically the whole of the schist belt has been affected by the mineralising solutions, with the results that a number of types have been formed.

The schistose porphyries differ only from the porphyries in that the ground mass is schistose and the feldspars are slightly deformed. There is a gradual transition from these types into those with no visible feldspars. Among the schists proper, a type is sometimes found consisting of a grey-green schist (probably sericite - chlorite) with numerous thin white spots, probably representing the relics of former feldspar crystals. The completely deformed porphyry, not affected by mineralising solutions is a greyish green somewhat massive type. It weathers readily to a soft compact rock of which fresh specimens cannot be obtained, as mine workings are not carried out in it. Among the schists proper, this type is probably represented by a similar greyish green rock weathering to a white product with a chalk like texture and appearance. It is composed of fine grained sericite, chlorite, quartz etc.

The greater proportion of the schists are in the mineralised zones and can be divided generally into chlorite and sericite types. The chloritic type is dark grey-green in colour, the schistosity not being markedly developed. Quartz is sometimes visible, particularly in the chalco-pyrite ore-bodies, but the microscope reveals that quartz and sericite are always present.

The sericitic type includes sericite and sericite-quartz schists. These types are generally associated with the pyrite mineralisation. The sericite schist is a white typical-looking sericite schist though probably never devoid of quartz. With increase of quartz the sericite-quartz and quartz-sericite types are developed. As the latter type is approached the quartz becomes present as irregular nodules and veins and the outcrop resembles an irregularly nodular rock.

Gregory made a microscopic examination of a few schists and found that they consisted essentially of sericite, quartz, chlorite, with a cryptocrystalline base. The latter is sometimes resolvable into a mass of small brightly-polarising scales which he termed margarodite and considered to be a fine-grained intermixture of white potash and soda micas. As the schists consist essentially of silica alumina, oxide of iron, potash and soda, such a mineral composition is required.

Only a few microscopic sections were examined during the present survey, but they confirm Gregory's determinations. The terms used in the above descriptions are more general than specific, the term sericite being used to embrace all the mica minerals.

#### Types of Mineral Deposits.

Though the Mount Lyell field is important because of its copper deposits, other deposits also

exist in and adjacent to it. The various types of ore-bodies include.

- (1) The copper deposits of the Mt. Lyell field and the Jukes-Darwin to the south thereof.
- (2) The lead-zinc-silver deposits of the Tasman and Crown Lyell extended mine.
- (3) The barite deposits of Howard's Plains and Intercolonial Spur.
- (4) The auriferous quartz-reefs of Lynchford, Woody Hills, Madam Howard's Plains etc.

Of the above, the copper deposits will be described in this report. The lead-zinc-silver deposit is in the copper belt and quite close to the Comstock ore-bodies. A vein of galena also occurs in the footwall country of the Comstock ore-bodies, while small quantities are present in other ore-bodies. It is evident therefore, that the copper and lead-zinc ore-bodies are closely related and deposited under somewhat similar conditions.

The more or less pure deposits of barite, occur partly (Howard's Plains) outside the copper belt, but also (Intercolonial Spur) in the copper belt. Further, the abundant barite in the North Lyell and Mt. Lyell mines and in other ore-bodies in lesser amounts prove a relationship between the copper and barite ore-bodies.

The auriferous quartz reefs occur generally to the west of the copper belt, although at Howard's Plains the barite deposits were probably formed under somewhat different conditions to those of copper etc.

However, the whole of the deposits are more or less related and the result of the one period of mineralization, though representing different phases.

Further descriptions will be restricted to the copper deposits of the Mount Lyell field.

#### Age of the Mineralization.

It will be realised from the present descriptions that the copper deposits are restricted to the Lyell schists which represent altered porphyries. The latter intrude silurian sedimentary rocks and are considered to be of Devonian age. The barite deposits occur in both the schists and silurian sedimentary rocks. The auriferous quartz reefs occur in the porphyries and silurian rocks. It is evident therefore, that the mineralization was later than silurian and also than the porphyries of Devonian age. As with one exception, at Cygnet, there is no mineralization in Permo-Carboniferous or younger rock systems, the mineralization is considered to be associated with the intrusions of the Devonian porphyries which form part of the suite of Devonian igneous rocks including granite, porphyries, dolerite (not to be confused with Mesozoic dolerite or diabase), gabbro, serpentine etc. It is most probable that the mineralization followed closely upon, or was even contemporaneous with the alteration of the porphyries into the Lyell schists.

Brief reference will be made to the various metallic and non-metallic minerals associated with the mineralized zones and the ore-bodies. The secondary minerals derived from the oxidation of the ore-bodies are present in only small amounts and quite unimportant from the economic aspect and will not be described. No descriptions of the rock-forming minerals in the porphyries and the Mt. Lyell schists will be given.

Quartz is present as a common constituent of the schist. In the sericite-quartz and quartz-sericite schists it became greater in amount and forms larger nodules and irregular veins. It is also present as irregular quartz reefs in the schists and as irregular veins in the conglomerates at the schist contact.

Pyrite is plentifully distributed throughout the schists being particularly prominent in the mineralized zones and the ore-bodies. It occurs as narrow veins of more or less solid pyrite, but mainly as small crystals throughout the schists, particularly the sericitic types. It is fairly common in the schists outside the mineralized zones. It also occurs in the ore-bodies and in the quartz reefs. The largest and most massive bodies were those of the Mount Lyell and South Lyell mines, the ore from which were smeltered for their contents of copper etc.

Chalcopyrite is probably the most abundant copper bearing mineral in the field. It occurs in all the ore bodies including the North Lyell. Its usual mode is in the form of disseminated blebs etc., patches in the schists, veins up to two inches in width being sometimes present but comparatively rare. In the irregular quartz veins, it occurs in lumps up to 5 inches in size.

Bornite occurs chiefly in the North Lyell ore-bodies being particularly developed in the sericitic schists, the chalcopyrite in the same ore-bodies being associated with zones of silicified or quartzitic schist. Bornite also occurred in part of the Lyell Tharsis, and to a less extent in the Comstock ore-body. Small amounts were present in the North Crown Lyell and the Mount Lyell mine.

Tetrahedrite was present to a small extent in the Mount Lyell and North Lyell and Mount Lyell Reserve ore-bodies.

Tennantite was present in the bonanza in the Mount Lyell <sup>ore</sup> body.

Chalcocite has only been found in small quantities in a number of the ore-bodies and is probably of secondary origin e.g. South Lyell Tharsis. It may occur as a primary mineral to a slight extent in the North Lyell ore-body.

Galena is most plentiful in the lead-zinc silver ore-body of the Tasman and Crown Lyell extended mine. It also occurs to a small extent in most of the copper ore-bodies.

Sphalerite occurs similarly to galena. From specimens on the dumps it appears to have been present in somewhat larger quantities in the Lyell Tharsis ore-body. It occurs in chloritic schist to the north-east of the Razorback.

Molybdenite is present to only a small extent

being most common in the pyritic ore-body at the mouth of the adit into the South Lyell open cut. It also occurs in the schists near the new ore-body between the Royal Tharsis and West Lyell ore-bodies, and in some of the other ore-bodies, and in the North Crown Lyell.

Hematite is plentiful around the North Lyell mine and to a less extent around the Mount Lyell. It is particularly developed along the schist conglomerate contact to the south of the North Lyell mine in a dense massive form. At the ~~Mount~~ Lyell mine and in the bottom levels of the North Lyell it is associated with barite. The hard dense hematite possibly represents replacements of conglomerates and quartzites in some cases, and the softer hematite schists represent replaced schists and slates.

The specular or micaceous variety occurs in quartz veins around the contact and in the conglomerates, especially of the Tharsis conglomerate.

Barite. As stated above this occurs largely in association with hematite in the Mount Lyell and North Lyell mines. It is also present in veins one to two feet wide in and near the North Lyell mine and the Glen Lyell mine. In other ore-bodies and mineralized zones it is present as small irregular veins often with a flesh-coloured tint. It also occurs in a few coarse-grained veins with quartz in the Western Tharsis and with quartz and specular hematite on the eastern side of the Tharsis conglomerate.

In adjacent districts Barite occurs in veins and reefs of good quality which have been mined for the barite.

Carbonate minerals. Calcite, siderite etc. are not prominent, but small quantities occur in some of the ore-bodies such as South Lyell Tharsis, Lyell Tharsis, Comstock etc.

Tourmaline occurs to a very small extent in a silicified zone to the west of the Royal Tharsis - Western Tharsis zone.

Fluorite is present in small quantities in the Comstock mine.

Chlorite is a common constituent of most of the Lyell schists. It occurs in many of the irregular quartz veins as fine-grained aggregates, and also in rosette-shaped clusters of crystals of a bright green colour in the vicinity of the North Mount Lyell Consols and elsewhere.

#### Nature and Effect of Mineralising Solution

The formation of the mineralized schists and the ore-bodies was due to the action of mineralizing solutions containing mainly silica, sulphur, iron, copper and barium. The solutions attacked the schists and deposited quartz, pyrite, chalcopyrite, bornite, barite and hematite as well as smaller amounts of other minerals.

The siliceous part of the solutions played a

large part in altering the schistose porphyries and converting them to the chloritic and sericitic schists. In addition it was responsible for the deposition of the quartz present in these schists (chlorite-quartz, sericite-quartz, and quartz-sericite) and also the innumerable small and irregular quartz reefs and veins in the schists and mineralized zones. In addition it probably supplied most of the quartz in the veins in the conglomerates near the schist contact.

The sulphur in the solutions gave rise to the pyrite, chalcopyrite, bornite etc. in the mineralized zones and also to the barite associated therewith.

The iron was used largely in the formation of the pyrite, chalcopyrite and bornite. It assisted in the formation of the hematite around the North Lyell mine and at the contact near that mine and elsewhere, and also of the micaceous hematite in the small quartz veins in the mineralized schists and the conglomerates near the contact. The iron may also have helped in the formation of the chlorite in the schists, although the iron in the mineral was derived largely if not wholly from the iron and magnesium originally present in the porphyries.

The copper entered into the formation of the chalcopyrite, bornite, tetrahedrite, tennantite and chalcocite.

The barium was used wholly in the formation of barite.

#### The Mineralized Zones.

As stated above the belt of schists is almost entirely mineralized, but it is possible to recognise in the schist belt a number of more or less definite zones of mineralization. At the same time the schists between the zones may not be entirely devoid of mineralization, though it is much smaller in extent and degree than in the zones.

The zones agree in strike with the schists. As the schist belt has a general north and south trend, the zones cut across it at an acute angle. The south-eastern end of a zone is situated at or near a conglomerate contact, while the north-western end is near the indefinite boundary between the schists and the porphyries. These features apply to the central or main part of the field between Mt. Lyell and Moore Creek. Opposite the east end of Mt. Lyell and to the north, the zones are parallel and adjacent to the conglomerate contact. South of Moore Creek the zones are smaller and controlled by the conglomerate contacts.

Duke Lyell Zone. This zone is situated south of Conglomerate Creek and has a trend of  $315^{\circ}$ . It occupies a position on the south-western side of a large body of conglomerates etc. projecting into the Lyell schists. It has been developed by the adits of the Duke Lyell Co. and the adits and shafts of the Great Mount Lyell Copper Company. As exposed by these workings the ore consists of chalcopyrite and pyrite in a chloritic schist. The grade of the ore on the dump is fair, and further testing of this zone is warranted.

Copper Estates Zone is situated along Moore Creek immediately below the waterfall, and also along the next tributary to the south where the schists as a narrow

tongue into the conglomerates etc. In the latter portion the schists are sericitic and the mineralization pyritic. Along Moore Creek, the Copper Estates Company drove a number of adits which are now inaccessible. Copper is reported to have been obtained in one adit, and this portion appears to be the only one worthy of further testing.

Mount Lyell Reserve Zones. The western zone crosses the Gormanston-Queenstown road and Conglomerate Creek, and consists of pyrite in sericite schists. A few adits have been put into test the pyrite, but the zone is not an important one and is included to show the presence of mineralization some distance from the conglomerate contact. It is generally on the line of the Duke Lyell zone and may represent a discontinuation of same.

The eastern zone is larger and more important than the western one. It includes the Mt. Lyell Reserve workings south of the haulage in which tetrahedrite was found. Where the zone crosses the Queenstown-Gormanston road it is represented by sericitic schists containing abundant pyrite, chalcopyrite being present in some of the quartz veins in the schists. This zone is situated in the schists some 40 chains from a conglomerate contact. Any association with a contact would be through any south-eastern extension which would arise from the contact east or north-east of the Duke Lyell zone.

Glen Lyell Zone is situated to the west of the South Lyell mine and between it and the Mt. Lyell Reserve western zone. It is a fairly large zone and extends between the Mt. Lyell haulage and the old North Lyell road. Portions of this zone have been developed by numerous adits etc. of the old Glen Lyell Co. At the south-eastern end the mineralization is largely baritic. Generally the mineralization consists of pyrite in sericite and sericite-quartz schists. Chalcopyrite occurs in a number of the old workings (trenches etc.) and on the dumps of adits, and can be seen at places in the untested portion towards the haulage.

South Lyell Zone includes the South Lyell ore-body to be described below. It is close and parallel to the Mt. Lyell zone and somewhat to the west thereof. It is a short distance off the conglomerate contact, being west of and opposite the abrupt change in direction of the latter where it trends easterly towards Gormanston. The Prince Lyell zone is on the line of continuation of this zone to the northwest and the two may be one and the same although there is little mineralization between them.

Mount Lyell Zone includes the Mount Lyell ore-body to be described below. It is situated against the conglomerate contact and in a slight elbow in the contact just north of its easterly trend towards Gormanston. The West Lyell zone is generally on the line of the Mount Lyell one if continued to the north-west, and may represent the continuation of the latter, although there is little mineralization between them.

The West Lyell Zone lies to the north-west of the Mt. Lyell mine. It consists of sericite schists and chlorite-quartz schists, the mineralization being pyrite, with chalcopyrite also present. It contains two ore-bodies viz. the West Lyell and Blazey, while others may exist as the recent geophysical survey has shown

a number of conductive zones in it.

The zone is west of the conglomerate contact but approaches it at the northern end of the Razorback spur. This point is probably the south eastern end of the zone as there is a distinct bend in the contact, or it may continue south-easterly along the contact towards the Mt. Lyell ore-body which is generally on the same line. To the north-west the zone ends generally along Glover Creek.

This zone is an important one as it contains two ore-bodies and a number of other possible ones. It requires further testing based upon the results of the geophysical survey.

The Prince Lyell Zone is adjacent to and west of the West Lyell zone. It contains sericite-quartz and chloritic schists with very extensive pyrite mineralization, while chalcopyrite is also present. The large low grade Prince Lyell ore-body occurs in this zone and has been tested in recent years by the Mount Lyell Company. The zone has been geophysically surveyed and a number of conductive zones proved in it. It is separated from the contact by the West Lyell zone. Its continuation to the south-east would embrace the South Lyell although only a small amount of mineralization occurs between the two. To the north-west it ends generally along Glover Creek.

The North Prince Zone adjoins the Prince Lyell and is west of the latter. It is shown as a separate zone but could possibly be considered as part of the Prince Lyell. Very little development has been carried out in this zone apart from the North Prince adit. Sericite and sericite-quartz schists occupy the zone with pyrite mineralization fairly abundant. Chalcopyrite is present at the surface at several places along a line which lies to west of the North Prince adit and which would not have been cut by the latter. The geophysical survey gave indications of several small conductive zones.

The Royal Tharsis Zone lies to the west of the Tharsis conglomerate and north of Glover Creek. Its south eastern end is adjacent to the south-western end of the Tharsis conglomerate, and is to the east of the north-western end of the West Lyell Zone. It trends north-westerly across the schist belt and includes sericite-quartz, quartz-sericite and some chlorite-quartz schists. Pyrite mineralization is everywhere in evidence, while chalcopyrite is present at a number of places. The western side has a parallel zone of quartz mineralization with small amounts of tourmaline.

The zone includes one ore-body (Royal Tharsis) at present being worked. The remainder of the zone has been tested by the workings of the Royal Tharsis, North Mt. Lyell Consols, Tharsis Consols, and Western Tharsis. Chalcopyrite is visible on the dumps of most of these adits, while barite is also present in small quantities.

The north-western end of this zone is shown merging into the Anaconda and North Lyell zones.

This zone is one of extensive mineralization and worthy of testing by geophysical surveys prior to any boring, underground work etc.

The North Lyell Zone is probably the most important one in the field. Its south-eastern end is

located in the narrow belt of schists between the "main" conglomerate contact and the Tharsis conglomerate contact and the Tharsis conglomerate. Its north-eastern boundary is the Mountain conglomerate, and it extends to the north-west parallel to the latter. Mineralization is most intense in the area between the three bodies of conglomerate. To the north-west the zone merges into those of the Royal Tharsis and Eastern ore-bodies. It includes sericite, sericite-quartz and chlorite quartz schist, but in the North Lyell and Eastern ore-bodies silicification was intense and produced the "quartzitic ores". Bornite occurs in the North Lyell and Lyell Tharsis ore-bodies, and chalcopyrite and pyrite in these and the other bodies. Hematite is developed along the contact with the "main" conglomerate, while hematite and barite intermixed are developed extensively in the North Lyell mine.

The north-eastern extension should be tested by geophysical surveys, as should also the southern extension, if any, from the Lyell Tharsis.

The Anaconda Zone is intended to include the extensions of the North Lyell and Royal Tharsis zones, as these zones merge near the western end of Mt. Lyell. It forms a zone with a general east and west trend against the conglomerate of Mt. Lyell. It is occupied by sericite-quartz and chloritic schists with abundant pyrite. Some intensive silicification is evident at the surface, but is probably in part a surface feature. Numerous adits, trenches etc. were put in by the North Mount Lyell and Anaconda companies. Chalcopyrite occurs on some of the dumps.

The geophysical survey of the Royal Tharsis zone should be extended into this one.

The North Crown Zone includes any mineralized zone extending north from the Anaconda zone along the western foothills of Mt. Lyell. This part of the district has its surface covered with detritus from Mt. Lyell and little or nothing can be seen of the bedrock. A number of adits have been put in by the Anaconda and North Crown Companies. Mineralization is in evidence around the North Crown workings where the chloritic schists contain pyrite and chalcopyrite. Bornite is reported to have been cut in some of the workings.

This zone is a narrow one paralleling the conglomerate contact of Mt. Lyell. It is continuous with that of the Comstock zone to the north-east, and the Anaconda to the south.

The Comstock Zone has a general north-easterly trend from the North Crown to the Comstock mine. It is adjacent and parallel to the conglomerate contact of this part of Mt. Lyell. It contains sericite and chlorite schists with abundant pyrite in places. The Comstock group of ore-bodies occur in this zone and consist of sericitic quartz schists with chalcopyrite, pyrite and a little bornite. Silicification is evident at numerous places at the north-eastern end of the zone and particularly to the west of the Comstock mine and is probably, in part, a surface feature. This zone also includes the galena-sphalerite-pyrite ore-body of the Tasman and Crown Lyell Extended.

In addition to the Comstock mine workings it has been tested by the adits of the Queen Lyell Company.

To the north-east of the Comstock mine the zone is covered by glacial material and cannot be examined. Testing in this direction would be warranted, but is rendered nearly impossible owing to the deep cover of glacial deposits. A geo-physical survey south-west of the Comstock is recommended.

### The Ore-bodies.

The ore-bodies which have been or are being mined are seven in number and are described below. In addition the West Lyell, Prince Lyell, and Blazey ore-bodies are described as a considerable amount of testing has been carried out on them, and two at least (West Lyell and Blazey) will probably be worked in the future.

Ore has been found at many other places and been tested by underground workings by various companies in the past. Such ore-bodies probably did not have a grade of ore suitable for working at those particular periods, while some may have had only a small extent. These bodies will not be described but mention of the workings have been made in describing the mineralised zones.

The Mount Lyell Ore-Body. As the greater part of this ore-body has been mined and active mining ceased some 8 years ago, and the workings being mainly inaccessible. The following information is based largely upon previous reports, mine plans etc.

The greater part of this ore-body consisted of almost pure iron pyrite, the ore extracted containing about 87% of this mineral, and containing copper, gold and silver values. The most important copper mineral is chalcopyrite, others being enargite, tetrahedrite, bornite and chalcocite, while probably some copper is contained in the pyrite. Galena and sphalerite are present in small quantities. The only gangue minerals are quartz and barite, while a small amount of unreplaced schist is probably also present.

The copper values were not uniform, being higher on the footwall side of the body. They ranged from 0.5% up to 6% copper and ore of an average grade of 2.35% was extracted for some time, but this did not include the lower grade (0.6%) ore from the hanging wall portion. The small and richer shoots ranged in value up to 5 to 11% copper. The most important shoot was the Mount Lyell Bonanza which contained high copper, gold and silver values, the silver averaging 1011 ozs. per ton and the 850 tons yielded £105,000.

The ore-body occurred in the schists at and near the conglomerate contact. It was roughly elliptical in section, the dimensions at some of the levels being:-

Level	Length	Width	Strike of major axis
No. 3			310°
4	660 feet	270 feet	317°
5	510 "	210 "	315°
6	510 "	270 "	296°
8	280 "		272°

The general strike is given in the above table, but actually it has two components. The southern

part has a general N & S strike, as it conforms to the conglomerate contact. The northern part is not along the contact but wholly in the schists and conforming in strike with the planes of schistosity ( $310^{\circ}$  to  $320^{\circ}$ ). In the upper levels the southern part was the most prominent and in the lower levels, the northern part, and the ore-body thus had a different strike as depth was attained. 175

The ore-body was worked from the surface down to No. 9 level, a depth of approximately 700 feet. It dips to the south-west at  $65^{\circ}$  to  $70^{\circ}$ . At depth the dip of the footwall decreased while that of the hanging-wall remained more constant, and the body decreased in thickness. The dip of the footwall conformed to that of the conglomerate contact: It was found that the dip of the latter became very flat below the No. 9 level and that the ore-body petered out just above the conglomerate. This flattening has been described as being due to a horizontal thrust plane, but may be nothing more than a change in the dip of the conglomerate contact. The same thrust plane was assumed to fault the Mount Lyell ore-body, the downward continuation of the latter being considered to be represented by the South Lyell ore-body. The officials of the Mount Lyell Company do not consider that such a fault exists. Further, the mine plans show that the South Lyell ore-body was worked between Nos. 6 and 10 levels and the Mount Lyell ore-body down to No. 9 level, so that the former extends well above the latter and any fault would have to dip at a moderate angle to the east or north-east, and there would have been ample opportunities of detecting same at all levels between No. 6 and No. 10. It would appear therefore, that the Mount Lyell ore-body is not faulted at depth but has a natural ending. This is supported by the decreasing width with depth, and the bottoming of the ore-body is probably associated with the flattening of the dip of the conglomerate contact.

Although there is not much evidence of mineralization between the Mount Lyell and the West Lyell ore-bodies, the former is situated where the West Lyell mineralized zone would intersect the conglomerate contact and may represent the commencing (or finishing) point of that zone.

The ore-body was first discovered at the surface as an outcrop of hematite which afterwards became known as "The Blow". This when developed proved to be on the footwall of the pyrite body. It was described as consisting of hematite and specimens found on the dump proved that it was a mixture of hematite and barite, similar to the material in the North Lyell mine. It is evidently therefore, of primary and secondary origin. The material was rich in gold and led to the opening of the mine as a gold one. It cannot now be stated whether the gold was primary or secondary, owing to complete removal of the deposit and absence of gold bearing specimens.

The South Lyell Ore-body. This ore-body is generally similar in nature to the Mount Lyell and consists of massive pyrite.

It is generally parallel to the Mount Lyell body, and is situated 600' to 800' to the south west of the latter. The strike is  $315^{\circ}$  and the dip to the south-west at angle of  $65^{\circ}$  to  $70^{\circ}$ .

This ore-body did not extend to the surface and was discovered at a depth of approximately 520 feet below the surface during the sinking of the South Lyell shaft. It was worked down this shaft and later from the Mount Lyell underground workings from No. 6 down to the No. 10 level.

It was of greatest dimensions at the No. 8 level, being 540 ft. in length and up to 90 ft. in width. The mine plans show that it consisted of wide portions at each end with a narrower or unpayable portion between the wider ones. The south-eastern end was worked in the Main stopes and was 270 feet by 105 feet at the No. 8 level. The Main stopes were continued down from the No. 6 to the No. 10 level, the south-easterly end pitching to the north-west. The north-western part of the ore-body was worked in the North stope from the No. 7 level to the No. 10 level, being 240 feet in length and 50 feet in width at the No. 8 level.

The South Lyell ore-body is not situated against the conglomerate contact as is the Mount Lyell, but a short distance to the south-west thereof. At the No. 8 level, the Main stope (the south-eastern end of the body is closest to the contact) is approximately 60 feet from the contact.

In describing the Mount Lyell ore-body, it was suggested that the South Lyell ore-body is not the faulted downward continuation of the former. Its upper limit was about the No. 6 level and extended down to the No. 10 level at least.

The South Lyell ore-body is in line with the Prince Lyell zone and may represent the starting (or ending) point of it.

West Lyell Ore-body. This body was developed by the old company known as Copper Mines of Mount Lyell West, but not mined. It was developed mainly by means of the Russell tunnel workings, but two other short adits and two surface shafts were also put into test portions of it. The Russell tunnel was recently sampled by the Mount Lyell Company and 100 foot level of the Royal Tharsis mine has recently been extended southwards to further test it, and has been connected with the Russell tunnel.

Very little can be seen at the surface where this body should outcrop. The ore-body as shown on the plan is copied from the Mt. Lyell Company's plans and based on the Russell tunnel exposures. The recent geophysical survey has outlined the body or bodies in a slightly different way, and the shape and dimensions will be proved by the development work now proceeding. The recent geological survey revealed chalcopryrite at a number of points along what is probably the western side of the ore-body. The chalcopryrite was found in a sericitic schist together with pyrite. The eastern part may be more siliceous and associated with the crag existing on the surface. The dump of Russell shaft contains much pyrite, while chalcopryrite in vein quartz and pinkish barite are also found. Hematite occurs around and to the north of the Curtain shaft. Massive pyrite is abundant to the east and north of the above two shafts.

This ore-body is situated in the West Lyell zone, about 12 chains west of the main conglomerate contact.

Prince Lyell Ore-body. This ore-body was prospected and partly developed by the old Prince Lyell

Company. The workings consist of numerous trenches and two adits, but no stoping was carried out. In recent years the Mt. Lyell Company investigated the body by sampling the workings and putting in a number of diamond drill holes. The ore-body as shown on the plans accompanying this report conforms to the outline as deduced by the Company. The recent geophysical survey showed a number of conductive zones different somewhat from the ore-body as outlined.

The orebody is exposed at the surface and consists of chloritic schist with impregnations and veins of pyrite. Fine grained quartz is associated with the veins of pyrite. Chalcopyrite was confined to irregular quartz veins, but probably occurs as disseminations in the schists.

It is shown as being 1300 feet in length and ranging up to 400 feet in width, and occupies a considerable portion of the Prince Lyell zone. It is rather low in copper values and the company's reserves show it as containing 1% copper.

The general strike is  $320^{\circ}$  in conformity with the strike of the planes of schistosity. The ore-body is situated in the schist belt zone 14 chains from the main conglomerate contact.

Blazey Ore-body. This ore-body was discovered during the recent geophysical survey. It is situated in the West Lyell zone some 20 chains west of the conglomerate contact, and north of, but slightly east of the continuation of the West Lyell ore-body. It has been tested by a number of surface test holes and a deep hole put in from the drive south from the Royal Tharsis to the West Lyell.

The surface outcrop is represented by a brownish silicified crag. Small veins and pockets of limonite occur in the crag and the rock is traversed by innumerable narrow veins of quartz. The unweathered rock is a quartz-chlorite schist. No copper minerals were visible at the surface, but are present in broken rock six inches below the surface and consist of chalcopyrite in small patches throughout the quartz-chlorite schist. While the crag corresponds to the main part of the ore body (about 90 feet wide), the sericite schists on both the east and west sides contain pyrites and chalcopyrite.

The strike as so far determined agrees with that of the schists and the dip is to the south-west at  $60^{\circ}$  to  $70^{\circ}$ .

Royal Tharsis Ore-Body. This body was developed by two companies viz the Royal Tharsis and the South Lyell Tharsis, the former having the north-western portion on their leases, and the latter having the south-eastern portion. It was opened up by both companies by adits, trenches etc. The South Lyell Tharsis Company mined the ore by an open cut, and concentrated it in a plant situated on Glovers Creek. The Mt. Lyell Company subsequently acquired the leases of both companies. Recently the company tested the ore-body by drill holes, sampling etc. A shaft was risen from the North Lyell tunnel and active mining is proceeding at a number of levels.

At the surface the ore consists partly of chloritic schist and partly of sericitic-quartz (with some chlorite) with disseminated chalcopyrite. At

depth it is sericite-quartz schist with blebs and stringers of chalcopyrite. In the Royal Tharsis open cut narrow veins of chalcopyrite with pyrite occur, and the quartz is often flesh-coloured. In the South Tharsis open cut, a system of quartz veins contain small amounts of secondary copper minerals.

The ore-body has a general strike of  $315^{\circ}$  and a dip of  $63^{\circ}$  to the south-west. It has a general lenticular shape, but the north-west end consists of two legs with a barren or low grade tongue of schists between. At the surface it is 600 feet in length and 110 feet in width, while at the mine levels the lengths and widths are respectfully No. 1, 270 and 110 feet; No. 3, 220 and 90 feet; No. 5, 465 and 100 feet; and No. 7 390 and 95 feet. Both ends appear to pitch to the north-west at angles between  $70^{\circ}$  and  $80^{\circ}$ , the north-western end having the greater pitch.

The ore-body at the surface is situated a short distance south-west (nearest point being 50 feet) from the south-western extremity of the Tharsis conglomerate body. The same conditions persist in depth, as shown by the proximity of the conglomerate in the magazine drive at the No. 7 (North Lyell tunnel) level. It is situated at the south-eastern end of the Royal Tharsis mineralised zone.

Lyell Tharsis Ore-body. This ore-body consists of adjacent bodies of different types. The eastern part was situated close to the North Lyell boundary and was worked by the Lyell Tharsis Company, by open cut, adits and shaft workings down to the 100-foot level. Later it was worked by the Mount Lyell Company at the 200 foot level. It has a strike ranging from  $317^{\circ}$  to  $340^{\circ}$  and a dip either vertical or high to the east. At the 50 and 100 foot levels it was 240 feet in length and had a maximum width of 40 to 60 feet; at the 200 foot level its length was 140 feet and width 25 feet; at the 300 foot level there was only a 3 foot seam of high grade ore; and at the 400 foot level it had petered out. This portion resembles the North Lyell ore-bodies in that the copper mineral was bornite, and it occurs against and on the west side of the main conglomerate contact, while hematite and hematitic schists occur on its eastern wall.

The western portion was not worked previously but has been tested recently by the Mt. Lyell Company and developmental work is now proceeding on it preparatory to active mining. It is situated immediately to the west of the other portion and is similar to the other ore-bodies of the field, excepting the Mt. Lyell and North Lyell ones. It has a strike of  $310^{\circ}$  but the dip has not been definitely determined. It is most prominent at the surface and has a length of 300 feet and a maximum width of 130 feet. It is also prominent at the No. 1 level, but it is stated that it is much smaller at the No. 2 level (North Lyell and Crown levels). The ore is a quartz-chlorite schist which resembles that of the Blazey ore-body, with blebs and irregular stringers of chalco-pyrite.

The Lyell Tharsis ore-body occurs in a narrow belt of schists, four chains wide, between the main conglomerate contact on the east and Tharsis conglomerate body on the west. It is nearer to and parallel with the main contact, with which the Tharsis contact is also parallel. This ore-body occupies the greater part of a small mineralized zone limited on its north-western end by the Tharsis conglomerate. The apparent non-persistence

in depth may be due to the easterly dip of the Tharsis conglomerate contact.

Crown Lyell Ore-body. This ore-body is situated to the north of the Lyell Tharsis, and west of the North Lyell ore-body. It was opened up by the Crown Lyell Company from the Crown shaft, but only a small amount of ore was mined. It was later acquired by the Mt. Lyell Company which is now working the body.

The ore-body does not outcrop at the surface and it is probable that this is due to leaching to shallow depths and not to the fact that the summit of the ore-body did not reach the present surface.

At the No. 1 level, the body is L-shaped, the southern part trending east and west and the northern part trending north and south. From the No. 2 to No. 6 levels the strike is north and south, and the dip at  $63\frac{1}{2}^{\circ}$  to the west. The southern end pitches at a somewhat greater angle, these angles referring to the ore-body below No. 2 level.

The lengths and widths are as follows:-

Level	Length	Width
No. 1	144 feet	40 feet
" 2	216 "	30 to 60 "
" 3	270 "	40 to 70 "
" 4	285 "	45 to 65 "
" 5	215 "	35 to 60 "
" 6	180 "	45 to 50 "

The ore-body has been proved to extend to a depth of at least 600 feet. The ore is a sericitic or sericite-chlorite schist, but it becomes quartzitic at a few places. Chalco-pyrite is the copper-bearing mineral, while pyrite is also present as well as barite and siderite in small quantities. The ore is relatively low grade and contains 2% copper, the chalcopryrite being present as blebs and small irregular veins in the schist.

The ore-body is in the North Lyell zone and is situated immediately to the east of the north-eastern end of the Tharsis conglomerate.

Eastern Ore-body. This ore-body is one of the North Lyell group of ore-bodies. It is situated some 200 feet to the north-east of the North Lyell ore-body. It appears to be located in the schists near the contact with the "main" conglomerate and not far from the Mountain conglomerate.

It was worked by the North Lyell Company by means of open cuts, and also underground to shallow levels. Very little of it can now be seen, except in parts of the open cuts and the more recent Crown mullock quarry. It was reported to consist of quartzitic boulders and decomposed material carrying chalcopryrite and a small amount of bornite. Small portions of it were mined and yielded high-grade ore. As now exposed it appears to consist of pyrite in a quartzitic gangue, but chalcopryrite is also visible at numerous places. Sericite schists with pyrite are also present adjacent to the ore-body. The body has a strike of  $310^{\circ}$  and a dip either vertical or high to the east. A few smaller bodies appear to branch off on the western side.

It has a length of at least 800 feet and

a width ranging up to 100 feet. It is difficult to determine its extent in depth, but an examination of the Mount Lyell Company's geological plans suggests that it extends down to the No. 3 level at least. Schists occur below it but are possibly not mineralized. For a number of levels below No. 4 however, this part of the property has not been prospected.

The south-eastern end of the ore-body probably occurs in a tongue of schists projecting into the main conglomerate. It passes through the old open cuts and the Crown mullock quarry in a north-westerly direction, and cannot be traced further owing to the fallen detritus at the surface. Exposures of pyrite further north-west are generally on the strike of the ore-body.

North Lyell Ore-body. The North Lyell group of ore-bodies are situated between the Tharsis conglomerate, "main" conglomerate and Mountain conglomerate, and are confined apparently entirely to the schists in this region.

At the surface a number of ore-bodies were located in bays and elbows in the "main" conglomerate contact. These apparently consisted of bornite in a sericite schist, and generally, excepting the Main and "D" stope ore-bodies did not extend to any depth.

The main ore-body extended vertically down as two more or less irregular pipes between the Main shaft and the Engine winze. It was apparently located at the northern extremity of a body of conglomerate etc. projecting into the schists, and tended to develop on the eastern side of the conglomerate. These conditions held down to the No. 7 level where the ore-body assumed an easterly dip in conformity with that of the Tharsis conglomerate contact. Near the surface, the latter was 400 feet west of the ore-body, but at No. 7 level it was only 100 feet distant. Actually the ore-body seems to bottom on the Tharsis conglomerate at the Nos. 9 & 10 levels. A mineralized zone of schists extends down along the Tharsis contact and part of the ore-body begins to peter out.

The portion going down near the engine winze gives out near the No. 11 level. Between the Nos. 4 & 5 levels a branch pipe starts to make on the south-west side, gradually increasing in length and continuing down to the No. 12 level with a north-easterly dip.

Between the Nos. 2 and 3 levels another pipe starts to make north-west of the Main shaft and extends down to No. 5 level, whence it extends to the north-west as depth is attained and forms a long and wide ore-body. At the No. 8 level there were continuous stopes for 1560 feet in length with widths ranging up to 140 feet. This body had a strike of  $340^{\circ}$ , but actually consists of three portions arranged en echelon each with a strike of  $315^{\circ}$ . From the No. 5 level down the dip changed from vertical to  $45^{\circ}$  to the north-east which dip it maintained from the No. 7 level down. This large ore-body continued in depth to No. 11 level, but became small at No. 12 level and only two small root-like ore-bodies occur at No. 13 level.

The above ore-bodies occur in a zone of mineralized schists situated between portions of the "main" conglomerate, which are probably connected to the south,

the schists forming a projection into the main conglomerate. This zone is fairly vertical down to No. 7 level, at which depth the portion of the "main" conglomerate west of the schists bottoms on the Tharsis conglomerate. The schists then follow down the Tharsis conglomerate contact and the zone dips north-easterly in conformity with the latter, as does also the portion of the "main" conglomerate east of the schists zone. These conditions continue from the No. 7 to the No. 11 level and it is in this part of the mine that the ore-bodies attain their greatest development. Below the No. 11 level the conditions are much different. The Tharsis and Mountain conglomerates are by virtue of their dips rapidly approaching one another and probably come in contact at some points a short distance below No. 14 level (not more than 100 feet). The width of the "main" conglomerate block is becoming narrow and as is also the schists in the latter block. (These descriptions apply to the south-eastern end of the mine, particularly along the line of the North Lyell tunnel) and the schists are probably represented by narrow zones (no more than 100 feet in width) one against the Tharsis conglomerate and one against the Mountain conglomerate with the "main" conglomerate between. At the same time large bodies of hematite with associated barite come in at No. 10 level and extend down to No. 13 level. These are the result of mineralization and represent replacements, but considerable detailed mapping and microscopical work would be necessary to determine the rocks which have been replaced. The hematite sometimes represents replaced schists, other times possibly slates, while much of it may be replaced quartzites and conglomerates. In general the hematite appears to be following the dip of the Mountain conglomerate. At the same time its southern end appears, at the No. 13 level, to be dipping northerly, the latter perhaps being due to a northerly pitch of the junction of the Tharsis and Mountain conglomerates (It is quite possible that the Tharsis conglomerate contact dips very flatly below No. 11 level and occupies much of No. 13 level and junctions with the Mountain conglomerate immediately below the eastern end of that level).

In any case these altered conditions below No. 11 level appear to have cut off the schists and to have affected the nature of the mineralization and the copper ore-bodies die out about the No. 13 level. Going north along the ore-bodies, the conditions would be somewhat more favourable and the schists would extend to somewhat greater depths and while, still further to the north-west, would be more or less free of the restriction of the Tharsis conglomerate.

In addition to the above main ore-body or ore-bodies, the others to the north-east exist but only persist to shallow depths. Thus the "B" stope ore-body persists down to No. 4 level and the adjacent No. 7 stope ore-body only down to No. 2. These occur in a small bay of schists in the contact with the "main" conglomerates.

Both bornite and chalcopyrite occur in the North Lyell ore-bodies. The bornite is partly restricted to sericite schists. In general, however, the ore-bodies are siliceous or quartzitic. Some portions are free from bornite and these are very siliceous as a rule. Pyrite is present in the ore-bodies and in zones of pyritised schists. The hematite and barite have already been referred to in the above descriptions.

are situated in the Sedgwick valley on the north-western foothills of Mt. Lyell. They occur at the north-eastern end of the Comstock zone and in close proximity to the lead-zinc-silver ore-bodies of the Tasman and Crown Lyell Extended mine.

At the surface the conglomerate contact has a remarkably straight course and the ore-bodies are situated some hundred feet to the north-west thereof. On the west or hanging wall side the surface is occupied by a large development of silicified schist (quartzite or chert). The ore-bodies occur in the normal chloritic and sericitic schists derived from felspar porphyries. As will be seen from the geological maps, a dyke of quartz felspar porphyry trends from the north-west to a point just north of the Comstock mine. It can be traced to within several chains of the conglomerate contact, but is hidden by glacial deposits between that point and the contact. Schists with quartz blebs indicate its extension to the foot of the haulage. Underground the quartz felspar porphyry has been picked up at two levels viz Nos. 4 and 7. At No. 4 level a crosscut into the footwall exposes at least 100 feet of somewhat schistose quartz felspar porphyry occurring between the footwall of the ore-body and the conglomerate contact (along which irregular veins of galena are present. At No. 7 level, between the shaft and the old Tasman and Crown Lyell workings, quartz felspar porphyry is exposed almost continuously against the conglomerate contact, several feet against the latter being schistose. As these occurrences are south-west of the dyke as seen on the surface, it appears that the dyke, after nearing the conglomerate contact, turns and runs parallel with it to the south-west and forms portion of the footwall country of the ore-bodies. It can be picked up at the surface some 20 chains south-east of the mine, but does not appear to extend continuously to that place.

The ore-bodies are 290 feet from the conglomerate at the surface and 100 to 150 from it at No. 4 level where the contact is dipping very steeply to the north-west. At No. 7 level the contact is much closer to the ore-bodies and is dipping north-westerly at  $40^{\circ}$  to  $50^{\circ}$ , the flattening of dip being responsible for the shorter distance between the contact and the ore-bodies. It is somewhat problematical as to the behaviour of the ore-bodies below No. 7 level. While it might appear that the conglomerate will intersect the ore-bodies at depth and possibly cut them off, it is just as probable that the ore-bodies will conform to the dip of the contact and follow it down.

The Comstock ore-bodies three in number are situated in close proximity and actually join at a number of places. The No. 1 body is the most northern and has the following dimensions, strikes, etc.

Level	Length	Width	Strike	Dip	Pitch
No. 1	160 feet	10 to 40 ft.		)	)
2	240 "	21 " 35 "	$28\frac{1}{2}^{\circ}$	) $71^{\circ}$	) No.
3	350 "	30 " 42 "	$29^{\circ}$	) to	) pitch
4	300 "	20 " 60 "	$30^{\circ}$	) west	)
5	270 "	20 " 70 "	$15^{\circ}$	)	)
6	270 "	30 " 60 "	$10^{\circ}$	)	)
7					

Below No. 2 level the north-eastern portion has a tendency to strike N.E parallel to No. 3 ore-body.

It also has a tendency to develop south-east trending branches at Nos. 4, 5 and 6 levels.

The No. 3 ore-body is east of the No. 1, but practically joins it at the south western end and diverges from it to the north-east. It has the following dimensions, strikes etc.

Level	Length	Width	Strike	Dip	Pitch
No. 1	160 feet	10 to 40 ft.	N.E.	} 64½° } to north } west }	Below
2	240 "	21 " 35 "	"		No. 2
3	350 "	30 " 42 "	"		high
4	300 "	20 " 60 "	"		to
5	270 "	20 " 70 "	"		S.W.
6	270 "	20 " 60 "	"		
7	225 "	30 " 60 "	"		

At the No. 6 level this ore-body and No. 2 are practically continuous with No. 1 very close to them.

The No. 2 ore-body is situated south of the above two and has the following dimensions, strikes etc.

Level	Length	Width	Strike	Dip	Pitch
No. 1	210 feet	0 to 60 ft.	45°	} 63½° } to the } N.W. }	S.W.
2	230 "	15 " 25 "	45°		end
3	195 "	10 " 20 "	45°		pitch
4	195 "	10 " 25 "	45°		76½°
5	195 "	15 " 30 "	38½°		to S.W.
6	165 "	15 " 30 "	26		N.E.
					end
					has
					greater.

The distance between No. 2 and the other two ore-bodies ranges from 75 to 150 feet, but if the lode in the N.E. drives be considered part of it, the distance is only 75 to 90 feet; while at No. 6 level there are almost continuous stopes.

The Nos. 2 and 3 lodes are parallel and arranged more or less en echelon and have nearly equal dips. Nevertheless due to the slight differences in the dips and pitch, and particularly to the changing strike of No. 2 with depth, they are in line and practically continuous at No. 6 level. No. 1 ore-body is also in contact with them at this level. It therefore appears that they are coming together at depth and forming a more or less continuous Y shaped ore-body. This change may be due to the proximity of the conglomerate contact, but so far no change in dip has become apparent to indicate that the body will follow the contact down, though No. 7 level may give important information in this direction.

The ore is a sericitic schist with blebs and stringers of chalcopyrite. Bornite is present in one body to a limited extent. Pyrite is of course present, and small amounts of siderite, fluorite, etc. are sometimes seen. Parts of the bodies are siliceous and of the quartzitic type.

The large silicified zone at the surface is in the hanging wall of the bodies. The No. 2 level passed under part of it but revealed no quartzitic ore. It is probable that this zone is largely a surface feature, but quartzitic-pyrite bodies may be found below it at some places.

FACTORS WHICH INFLUENCED THE LOCATION  
OF THE MINERALIZED ZONES AND THE ORE-BODIES.

- (1) The most important factor in the mineralization is the schist belt. The zones and ore-bodies are restricted to the schists and in fact the schistosity may be due largely to the mineralization.
- (2) The next most important factor is the proximity of a conglomerate contact. This does not refer to the "main" conglomerate contact, but to all of them including those of included blocks of conglomerates e.g. Tharsis, in the schists.

As regards the mineralized zones they usually start or end at the south-east against such a contact, and those so doing include the most important zones. The Duke Lyell, Copper Estates, Mt. Lyell, South Lyell, North Lyell, Anaconda, Crown Lyell and Comstock zones lie against and parallel with the contact. The West Lyell and Royal Tharsis zones depart from the contact and traverse the schists.

Of the ore-bodies worked the Mt. Lyell and North Lyell are against a contact, while the Royal Tharsis, Lyell Tharsis, Crown Lyell and Comstock are quite close to a contact. Of the known ore-bodies not yet worked the Blazey, West Lyell and Prince Lyell are some distance from the contact.

- (3) While the above factors are the two chief ones determining the location of the zones and ore-bodies there are probably other minor factors more or less difficult to determine, that influenced the formation of the zones and bodies in their present position. As far as the detailed work of the recent examination, there are no particular varieties of schists or original porphyries favourable to the formation of the ore-bodies. Any such minor factors therefore, are probably connected with the shape etc. of the conglomerate contact.

It has been reported that the ore-bodies (Mt. Lyell and North Lyell in particular) were determined by the presence of cross faults intersecting the conglomerate contact. There are numerous faults in the conglomerates and many of these intersect the contact, but do not extend into the schists and there is no apparent connection between them and any ore-bodies. Faulting appears to be more or less absent at the Mount Lyell mine. At the North Lyell there is certainly a large fault traversing the south side of Mt. Lyell, and at depth the ore-body approaches close to it, although generally there is little association with it. However, the fault near the mine is also an intrusive contact and this phase may be the important one rather than the faulting. Faulting (large scale) is not known near the Comstock, Royal Tharsis, West Lyell and other bodies.

The configuration of the conglomerate contact probably plays some part in the determination

of the position of the ore-bodies. The North Lyell mine probably provides the best example. At the surface in particular the ore-bodies were associated with a very irregular contact with bays of schists in the conglomerate and vice versa. The North Lyell, Lyell Tharsis, Crown and Eastern ore-bodies are in the area bounded by the Mountain, "main", and Tharsis conglomerates, and apparently it was a very favourable area. The "main" conglomerate contact is regarded as an intrusion with probably blocks of conglomerates etc. included in the schists derived from the intruding porphyries.

The Mt. Lyell body can only be associated with a slight indentation in the contact, while the West Lyell zone starts or ends from a similar indentation at the Razorback. The South Lyell and Royal Tharsis bodies are related to promontaries in the contact due to a sudden change in direction.

No similar feature has been found at the Comstock but may be present at depth. The quartz porphyry dyke at the Comstock has probably some significant association with regard to the ore-body.

Relation of Outcrop to Ore. The Mt. Lyell district has no large oxidised and secondarily enriched zones common to many copper fields. This is due to the fact that the topography is extremely youthful and the rate of erosion is greater than the rate of weathering, oxidation etc.

Although the outcrops of several of the ore-bodies have been removed by mining, it appears from others that oxidised zones are entirely absent. At the Royal Tharsis, Lyell Tharsis and Blazey ore-bodies, the chalcopryite comes to within six inches of the surface, so that the zone of oxidation and leaching is extremely thin. However, even though the zone is thin practically all the chalcopryite has been leached out of the ore.

Under such conditions the problem of correlating leached outcrop with ore would have been an important one. In view however, of the geophysical survey being conducted, the solution of the problem was not investigated in detail.

Conclusions and Recommendations. The present survey was undertaken with the object of locating, if possible, suitable localities for prospecting for ore-bodies, particularly higher grade ones.

This involved a survey of the general geology and economic geology and an investigation of the mode of occurrence of the ore-bodies.

It has to be realized that the Mt. Lyell field has been opened up for over 40 years and that energetic prospecting was carried out for many years. Further the district has been bare of vegetation and even soil for sometime so that conditions were all in favour of the location of all outcropping ore bodies. Nevertheless the location of the Blazey ore-body by geophysical survey showed how an ore-body could be missed.

Although the surveys have not resulted in the discovery of, or suggested localities for prospecting for, high grade ore-bodies, nevertheless, particular zones have been outlined in which further testing by geophysical surveys is warranted.

The general geology structure has been outlined in the above and the attached report. It is considered that the Silurian rocks were heavily faulted and shortly after if not simultaneously intruded by porphyries chiefly in the faulted block of the Queen River series along the western side of the West Coast Range. Further earth movements deformed the porphyries along their eastern margin against the West Coast Range conglomerates. The schistose porphyries were then invaded by mineralizing solutions representing the end phases of the porphyry intrusions, which profoundly altered the schistose porphyries and formed the mineralized zones and the ore-bodies in them.

The various mineralized zones are shown on the geological plan of Mt. Lyell, as are also the ore-bodies. It is recommended that future prospecting consisting in the first place of geophysical surveys, be made of the different zones. While all zones should be tested, some appear to be more important than the others and should be tested first, the relative order of importance being:-

- (1) North Lyell Zone
- (2) Royal Tharsis "
- (3) Anaconda "
- (4) Comstock "
- (5) Duke Lyell "
- (6) Region along contact between the Razor Back and the Lyell Tharsis mine.

While the above represents a suggested order of importance for testing, matters of convenience etc. will probably cause this to be departed from and the surveys carried continuously from one zone to another. Thus (6) above is being tested first as being near the contact higher grade ore may be found. The surveys will then be carried through the North Lyell and Anaconda zones into the Royal Tharsis. The North Crown-Comstock zones could then be investigated, while the isolated Duke Lyell, Mt. Lyell Reserve, and other zones attempted later.

P.B. Nye (Sgd)  
GOVERNMENT GEOLOGIST.

Mines Department,  
 Hobart.

6th September, 1934.