CORRESPONDENCE.
(1)

May 26th, 1954.

Mr. M.R. Keys,
Creston, B.C.

**014757**

Dear Merv:

I have been digesting your report, which arrived on the 21st.

I find myself a bit confused by your reference to A. veins at Island Mountain. We have always considered that there are no A. veins in Island Mountain, probably none in the Rainbow Member, unless some of the shapeless masses of quartz we sometimes find might be considered to be incipient A veins. On page 14 you state that many of them have a fairly regular tabular form and some have been found to have a length of over 300 feet. If you have your copies of the maps handy, would you please cite a few examples?

It occurs to me that you may be talking about a different type of vein than we are when we talk about A veins. We use the classification set forth in the C.G.S. reports of Hanson and of Uglow and Johnston. This classification is as follows:

A Veins

Quartz veins whose strikes are in the southeast and northwest quadrants. Unfortunately the C.G.S. writers include the so called bedded veins in this classification. (They really are not bedded veins, since they conform to the schistosity and therefore cross the bedding at angles from very acute to, in folded areas, very obtuse). I think it unfortunate that they did not reserve the A classification for those veins that stike from S30E to S60E (Conforming closely to the strike of the schistosity) and dip deeply N or S. The best known examples of these are the B.C. vein, Canusa Vein, Black Bull Vein, Stedman Ledge. We have also seen dozens in our work on Richfield Mountain. I have seen many out towards the Cariboo Hudson and as far afield as likely and Kiethley, on the Cariboo and Quesnel Lakes. They appear to be very widespread throughout all the Cariboo series of sediments except the Rainbow member, where they are either very scarce of non-existent, unless the shapeless massesreferred to might be called A veins.

B. Veins.

Quartz veins whose strikes are in the northeast and southwest quadrants, crossing the schistosity, striking N30E to N65E and dipping steeply either N.W. or S.E. These are known to exist in quantity only in the Rainbow Member and to a far lesser extent in the Baker and Lowhee Members. They are very scarce, if they exist at all, in the other sediments of the series.

These of course,are then sub-divided, as described by you, into diagonal and transverse veins.

Reading your report, I can not help feeling that since you did not have an opportunity to observe any of the veins I mention under "A" veins, you have called our barren bull quartz diagonals (such as 3500-8 and 11) A veins. I agree that they are probably veins which did not get refractured to allow entry of auriferous solutions, but they certainly would not fit with our former classification of A veins.

All the best,

Sincerely,

(Sgd.) G.G. Sullivan.

~~(2)~~

~~Beaton, B.C.~~

~~June 12th, 1954.~~

~~Dear Sully~~

(2)

Beaton, B.C.

June 12th, 1954.

Mr. G.G. Sullivan,
Island Mountain Mines Co. Ltd.,
Wells, B.C.

Dear Sully,

John Drybrough has raised the same point as you regarding my classification of A veins at Island Mountain, so I have written a little squib which I am sending to all who received my report. I believe that some other terminology would have been better, but I thought that some distinction should be made between veins like 3500 - 8 and the usual diagonal ore type veins. At the same time I did not realize fully the confusion likely to arise from the classification I adopted.

Best Regards,

Yours sincerely,

(Sgd.) M.R. Keys.

(3)

Beaton, B.C.
June 12th, 1954.

Mr. J.A. Pike,
717-744 West Hastings Street,
Vancouver, B.C.

Dear Jim,

Some confusion has rewulted from my reference to A veins in my Island Mountain report. Some further discussion may clarify my reasoning.

In the past, those veins that strike northwesterly, and dip steeply north or south have been known as A veins. Since no veins of this attitude are exposed in Island Mountain, I have not had the opportunity of examining veins of this type. According to description they are generally poorly mineralized and extremely low grade or barren, but occasional pockets of high grade havé been found. The B.C. vein of Cariboo Godl Quartz is one example of this type of vein. This vein occurs in a strong shear zone, and I believe that other veins of a similar nature have been found in shear zones in Cariboo Gold Quartz. I have discussed x these shear zones briefly under the heading of strike faults. I cannot say whether all the conventional A veins found in the area occupy syc shear zones, but at least they have the same attitude as the shear zones.

I have called the barren or very low grade veins of Island Mountain A veins also. In a general way these take two forms. Many are extremely irregular, but others are fairly regular and x tabular. Examples of these latter veins are 3500-8 and the drifted veins at the west end of the 3000 level. Like the conventional A veins, the low grade veins of Island Mountain are composed of coarse unfractured quartz and minor pyrite which is generally in the form of patches in the veins. At Island Mountain these veins are obviously the fillings of tension fractures. As pointed out, I Believe these fractures were formed partly due to movement on the strike faults and partly due to initial movement on the Aurum type faults which probably had their origin as shears complementary to the strike faults. Thus the conventional A veins could have formed in or parallel to the strike faults at the same time as the"Island Mountain" A veins formed in the subsidiary tension fractures. Mineralogically the two types are apparently similar. For these reasons I think it is reasonable to class the barren veins of Island Mountain with the convéntional A veins of the area. The distribution of the two types may well have been determined by the relative competency of the rocks.

Cont.....

According to my classification some confusion may arise as to whether a vein, such as 3500 - 8, should be classed as a diagonal or an A vein. Since probably the majority of the diagonals are simply A veins that have been refractured and remineralized, the two types differ in their structure, texture and amount of mineralization. The diagonal veins, therefore, have associated horsetail stringers, a more fractured quartz and more and agreater variety of pyrite. On the whole the distinction should not be difficult. Although my classification may not be the best, it has one advantage in that it classifies the veins according to the time they reached their final development.

Not much success has attended the exploration of A Veins at Island Mountain, but in Cariboo Gold Quartz productive transverse veins are occasionally found cutting barren A type veins.

Yours sincerely,

(Sigd) M.R. Keys.

c.c. Mr. Drybrough.
Mr. Kraft
Mr. Sullivan.

ABSTRACT

The rocks found in the Island Mountain mine are mainly dark and light coloured quartzites and argillites and smaller amounts of limestone of various degrees of purity. They strike northwesterly and dip at moderate angles to the northeast. They lie on the southwest limb of an anticline which has been overturned to the southwest.

Faults which strike about N25W and dip at about 40 degrees to the northeast have localized quartz vein and pyrite replacement ore near them. The quartz vein ore is most commonly found in the dark Rainbow quartzite. It grades about 0.32 ozs. per ton. Replacement ore is found in limestone horizons and grades about 0.65 ozs. per tone. Mill heads are currently about 0.40 ozs. per ton.

A strong fault, the J.C., occurs near the boundary with the Cariboo Gold Quartz mine to the southeast. It strikes N.25E and dips at 50 degrees to the northwest. It is believed to be a post-ore normal fault. As a result of movement on this fault it is believed that the ore zone of the Cariboo Gold Quartz mine should lie below the present Island Mountain workings on the west side of the fault.

## INTRODUCTION

The Island Mountain Mine is situated at Wells, B.C. in the Cariboo District of British Columbia. It is about 4 miles northwesterly of Barkerville and some 50 miles easterly of Quesnel. The Cariboo Gold Quartz mine adjoins the Island Mountain mine on the southeast.

This report is based on a study of the Island Mountain mine carried out during ten days in December 1953 and during the period January 11th to April 29th, 1954. I should like to record my appreciation of the help and co-operation given me by the Island Mountain staff and in particular by G.G. Sullivan, General Superintendent. The management and staff of the Cariboo Gold Quartz mine kindly provided trips underground and information on the geology of the mine. During the investigation I have drawn extensively on information already recorded by numerous previous workers, and my appreciation thereof is hereby recorded.

## SCOPE OF WORK

It became apparent early in the investigation that detailed re-mapping of the mine would serve no useful purpose, and that no significant changes would be made in the mapping already recorded by Benedict and others. The problem then became one of interpretation. In the course of the work I have visited all the accessible workings, some of them several times. The objective has been to fit the various features observed into the larger geological picture in an attempt to arrive at a reasonable explanation of the controls which have affected ore deposition. I believe that some progress has been made, but several problems await further information for their final solution.

## GENERAL

Throughout this report, unless otherwise designated, figures relating to widths etc. will refer to horizontal measurements.

## GENERAL GEOLOGY

The rocks of the mine area belong to the Richfield formation of the Cariboo Series, believed to be Precambrian in age. The mine lies on the northeast limb of a northwesterly trending anticlinorium which has an extent of some fifty miles.

The Richfield formation has been subdivided into the following members:

Baker

Rainbow

B.C.

Lowhee

Basal

In the mine only the Baker and Rainbow have been exposed by the workings; the B.C. has been cout by a few drill holes and is exposed on surface in one locality at least.

Benedict has shown, on the basis of the folding, that the rocks of the mine lie on the southwest limb of an anticline which is overturned to the southwest. I have seen no evidence that would alter this conclusion. On this basis the Baker is the lowest member of the formation.

GENERAL STATEMENT OF THE EFFECT OF THE J.G. FAULT SYSTEM

It will facilitate later discussion if a general statement is made at the beginning concerning the J.C. fault system and its effect. The J.G. fault system lies under Jack of Clubs Lake at the eastern end of the mine. It is comprised of two main faults, about 100 ft. apart, which strike about N25E and dip from 50 to 75 degrees northwest. In future, unless otherwise noted, the system will be called simply the J.C. fault.

Many geologic features are strikingly different on opposite sides of the fault. These will be discussed throughout the report. Unless otherwise noted, the discussion will refer to those conditions found west of the fault, i.e., in the area in which almost all the work in Island Mountain has been concentrated to date.

BAKER MEMBER

The predominant rocks of the Baker are light coloured argillite, quartzite and sericite schist. Some of these are calcareous. Light coloured talcose rocks probably owe their origin to silicification of dolomitic horizons. Metacrysts of ankerite generally about 1/16 inch in diameter, are common. Dark coloured quartzites, in many places indistinguishable from the Rainbow quartzite, are of local occurrence and probably do not comprise more than ten percent of the member.

I have seen no truly representative exposure of the Johns limestone. Records indicate that it is mainly a dark grey impure limestone with local bands of white limestone. Apparently it is discontinuous horizon and varies greatly in thickness. Locally, at least, there are other bands of impure limestone with local bands of white limestone. Apparently it is a discontinuous horizon and varies greatly in thickness. Locally,at least, there are other bands of impure limestone in the footwall of the Johns. It may be one of these that was the host for the replacement ore mined on the 4430 and 4480 levels.

The footwall 100 ft or so of the Baker contains various amounts of limestone; in some places there is nonem, in others there are widths of close to 100 ft. of quite pure limestone. White, dark, bluish grey and greyish white varieties are found. It is apparent that some at least of the white crystalline material originated by recystallization of the dark bluish grey limestone. In the past it has been customary in the mapping to distinguish between the purer white limestone and the limestone with which there is internedded a certain amount of argillaceious material. On the maps accompanying this report only the purer white limestone has been shown. From the economic viewpoint, for reasons discussed later, it is doubtful if it is possible to make a useful differentiation of the various types of limestone.

East of the J.C. fault there is relatively little pure white limestone in the footwall section of the Baker. The predominant type is a d ark grey impure liestone or calaareous argillite. It is probably even more lenticular in habit than inthe area west of the fault. These conditions are al so fpund in the Cariboo Gold Quartz mine.

## RAINBOW MEMBER

The Rainbow has been subdivided into five bands which from hangingwall to footwall, as as follows: No. 1 band, 301 band, No. 3 band, 309 limestone and No. 4 band.

### No. 1 Band

No. 1 Band is compresed predominantly of dark grey to black competent fissile quarzite. It increases in width from an average of about 250 ft. on the upper levels to about

400 ft. on the lower levels. Black argillite, generally in minor amounts, is interbedded with the quartzite. Lenticular beds of black argillite are of local occurrence. The black colour of the wuartzite and argillite is due to the inclusion of finely divided carbonaceious material. This has produced graphitic material where the rocks have been strongly sheared, as along faults. Local areas of No. 1 band are calcareous to various degrees, and a few small occurrences of impure limestone are known. Local bleaching of the argillites has provided minor amounts of light coloured sericite schist.

East of the J.C. fault No. 1 band is on the whole more argillaceous. In the limited workings in this area the band is about half relatively pure 'normal' Rainbow quartzite and half argillaceous rock containing elongated 'pebbles' and lenses of quartzite. The quartzite of these 'pebbles' is generally a little lighter in colour than the usual Rainbow quartzite. In places the argillaceous rock has the appearance of a conglomerate but it is not believed to be one, nor is it likely the result of shearing. It occurs in well-defined bands, several tens of feet in width, interbedded with bands of normal Rainbow quartzite. It has been observed in the Cariboo Gold Quartz where I am told it is common, but lenticular in habit. It is believed to owe its nature to conditions of sedimentation. ??

301 Band

This band varies in width from a few feet on the upper levels to about 150 ft. on the lower levels. It is composed of dark grey calcareous argillite, dark grey impure limestone, light coloured argillite and subordinate amounts of dark argillite. Some light coloured quartzite has been included in this band. All types are lenticular in nature, and in places the entire band pinches out. Where the rocks are not calcareous the band has been classified by the presence of light coloured rocks. Ankerite matacrysts up to 1/4 inch in diameter are common in the argillites. The greater width of the band at depth is due to the greater width of light coloured rock. Since there are no really distinctive rocks bounding the band, and since the light colourad of the rocks is a product of alteration, the greater width and continuity of the band at depth are more a measure of the intensity of alteration than of stratigraphic thickness. In other words it is probable that rock which is dark coloured at shallow horizons and not included in the band has at depth been included by reason of its alteration.

East of the J.C. fault 301 band is generally similar lithologically to that west of the fault. It is characteristically light coloured and contains calcareous sections. In the Cariboo Gold Quartz, where it is called No. 2 band it has been essentially continuous throughout a good part of the mine. In Island Mountain in the area explored east of the J.C. fault it lies 150 - 250 ft. from the Baker, whereas on the same levels west of the fault it is 300 - 450 ft. from the Baker. This suggests that the band is possibly not the same horizon on opposite sides of the fault. It is conceivable that the discontinuous calcareous and argillaceous horizons lying approximately in the middle of No. 1 band west of the fault have become consolidated into a wider and more persistent horizon in th block of ground east of the fault. In this case 301 band west of the fault would be synonymous with No. 4 band to the east. Unfortunately there is nothing sufficiently characteristic about any of the bands tp allow a reliable correlation.

No. 3 Band

The rocks of this band are essentially the same as those of No. 1 band and could not be distinguished from them were it not for their stratigraphic position.

309 Limestone

This is an impure dark grey limestone about 50 ft. in width. Exposures and drill hole intersections of this horizon are limited and confined to the levels above 3,500 ft. In this block it appears to be persistent and of fairly constant thickness. It is strange therfore, that it has not been found in drilling to the southwest on the 3000 and 2550 levels. It has not been recognized east of the J.C. Fault.

No. 4 Band

This is mainly light coloured argillite and quartzite. The only accessible exposures of this band are on the 2550 levels.

## B.C. ARGILLITE

There are no underground exposures of this rock and only a couple of drill intersections on the 4230 level. It is described as a black slaty argillite containing some thin quartzitic bands.

## OTHER ROCK TYPES

### Diorite

This is a soft schistose greenish rock which occurs in discontinuous still-like bodies, mainly in the footwall portion of the Baker. Its origin is obscure. In many places it has been highly carbonatized by an iron-bearing carbonate, presumably ankerite. In such areas it is sometimes difficult to distinguish diorite from ankeritized sediments, and there have probably been some inconsistencies in classification, mainly in core logging, for this reason. Where not ankeritized the diorite appears to consist mainly of calcite and a greenish micaceous mineral which is probably chlorite. In the Cariboo Gold Quartz it is called altered tuff. The only evidence I have seen that the diorite may be of volcanic or sedimentary origin is the common occurrenece along its margins of a soft thin-bedded greyish green shaly rock which varies from a few inches to a couple of feet in thickness. This type of material is not found elsewhere in the sedimentary series.

A sill-like rock, generally similar to the diorite, is found in No. 1 band above the 3875 level. For lack of a better classification I have also considered this to be diorite.

## ALTERATION

### ~~ankeritization~~ Ankeritization.

Several areas of highly carbonatized rusty weathering rocks, the result of ankeritization of sediments, are found at several stratigraphic horizons. They have a maximum width of about 50 ft. and individually appear to be of limkited extent. As noted above , this alteration is especially prominent in the vicinity of diorite, whereit has affected both the diorite and adjoining sediments.

Silicification

Silicification is widespread but is most prominent in the light coloured rocks. It is not commonly found close to productive quartz vein areas, and to my knowledge none has been found associated with a productive vein. It therefore has had no close connection with the with the ore mineralization.

Bleaching

In the foregoing discussion such mention has been made of the light coloured rocks. These are clearly the result of alteration of the dark varieties. Skerl believes that the bleaching has come about by oxidation of the carbonaceous material of the dark rocks. This seems to be a plausible explanation. I understand that he produced a bleached rock merely by heating a dark argillite in a furnace. This clearly indicates that the bleaching is the result of the thermal metamorphism.

On the whole the bleaching has followed certain stratigraphic horizons so that mapping of the light coloured rocks gives a generally accurate picture of the disposition of the original rocks. This is best illustrated by the case of the Baker-/Rainbow contact, where the contact of the light coloured Baker with the dark Rainbow has been proved to be an accurate stratigraphic contact by reason of its being comformable with the limestone beds, some of which lie within a few inches of it. However, at some other horizons there is reason to believe that the bleaching has locally crosscut the bedding. Thus it would be unsafe to base a structural interpretation on the disposition of the bleached rocks without confirmation from better marker beds.

FOLDING

Benedict has demonstrated that the mine lies on the southwest limb of an anticline overturned to the southwest. The rocks strike bout N70W and dip between 30 and 60 degrees northeast. He identified two periods of folding, an older period which produced tight attenuated folds with much slicing of the beds, and a younger period which resulted in gentle open folds. The older folding is much more prominent.

In the mine the older folding produced one large fold, which has offset the Baker - Rainbow contact 300 - 450 feet, and a multitude of smaller folds. A small but persistent warp in the Baker - Rainbow contact, which swings through the contact through an arc of about 20 degrees, is also related to the older folding. The axes of the folds strike about east-west, and the axial planes dip at 35 degrees or less to the north. The predominant plunge of the folds is at an angle of 22 degrees in a direction abput N45W. Local variations of this attitude are fairly common, especially near the s tronger faults. Compression associated withthe folding produced cleavage which strikes within a few degreds of east-west and dips north at 40 degrees or less. Many jointsare present. These strike northeast and dip 60 - 70 degrees southeast. They are most likely related to the folding, and therefore their attitude indicates that the folding was caused by a skhx couple acting in a plane inclined at 20-30 degrees to the north-west.

The younger open folding is not prominently evident in the mine. However, the variation in dip of the axial planes of the early folds, from horizontal to 35 degrees north, is no doubt due, at least partly, to a later open flexing along north-westerly trending axes. Crumpled eleavage, discussed bdlow, is believed to be due to a still later period of minor foldings.

CRUMPLED CLEAVAGE

Crumpled cleavage has resulted from minor folding after the development of the cleavage and is widespread in the mine. The folding is open, and individual crumples are no more than a foot or so in width. Two types are found. In both, the folding has taken place along axes striking N45E, and the axial planes dip 60-70 degress southeast. The folds plunge from a few degrees to 25 degrees northeast. In one t ype the overlying layers have moved down the regional plunge relative to the underlying layers. Transvdrse veins commonly occupy axial plane breaks in these folds. In the ot h r type of crumple the reverse movement has taken place. Few of these contain veins. Apparently both types of crumple have been produced by compression actin in a northwestsx - southeast direction.

FAULTING.

?A multitude of faults occurs in the mine and bhe area. Many of these are post-ore, whose only effect has been a relatively minor disruption of mining operations. Others are believed to have formed concurrently with the ore and to have had an important effect in localising it. Still others are believed to be pre-ore but to have played a part in the formatibn of the early vein structures. All known present displacements are normal, although some of the movement along some of the faults during the earlier stages of their development may havebeen reverse.

Strike Faults.

Faults of this tupe are probably the oldest in the area. This is the type of fault occupied by the B.C. vein. No major faults of this type are known in the mine, but the workings do not extend sufficiently far southwest to reach the area where these faults have been found on Cariboo Gold Quartz ground. They strike about N45W and dip 55 - 70 degrees northeast. The Aurum type faults probably originated as shears compleentary to the strike faults, and the many bull quartz veins found throughout the area probably filled tension fractures formed between strike faults and Aurum type faults.

Aurum Type Faults.

Four of these are either exposed in the workings or have been indicated by drilling. These are the Mosquito, Aurum, Lake and East. The Mosquito is the only one not exposed in the workings. Movement on the faults is normal with a right hand offset.

The Aurum has been the most important ore maker. It strikes about N.23W and dips 40 - 45 NE. It is fairly regular in strike and dip. Branches are known, but it has not been proved that these have a great deal of persistence, or that much of the movement has been dissipated along them. At the only point where a positive determination of the displacement on the Aurum could be determined it was fo nd to be 240 ft. vertically and 475 feet horizontally. On the basis of experience to date the maximum extent of its ore making influence for quartz veins, measured horizontally normal to the fault, is 1,000 ft. from the footwall and 500 feet from the hangingwall.

The Mosquito fault has been cut by drill holes on the 3000 and 2550 levels where its indicated strike is N30W and dip 39 degrees NE. The veins found in the relatively unfavourable No. 4 band on the 2550 level are probably related to the Mosquito fault. These are good grade but proved too narrow to be profitable. From Map 1 it may be seen that the favourable zone of the Aurum varied greatly at different levels, so that the limited information on the Mosquito on two levels is not sufficient to assess its importance. The occurrence of the ore grade veins on the 2550 level would tend to indicate that favourable conditions extend up to 700 ft. fromthe hangingwall of the fault. Contradicting this, however is the lack of ore in the more favourable No. 1 band rocks along the projection of this 700 ft.

zone. There is, therefore, some reason to believe that the Mosquito may have ore making characteristics more of the scale of the Aurum type faults east of the J.C. fault. In the Cariboo Gold Quartz this has been found to be about 250 ft. on either side of the faults.

The East fault is found east of the J.C. fault. Information on it is meagre as yet. It strikes N37W and dips 35 - 50 degrees NE. It is not as strong as the Aurum. On the basis of experience with similar faults in the Cariboo Gold Quartz, its favourable zone of influence might be expected to extend about 250 ft. horizontally from it.

The Lake fault has only been exposed on the 4000 and 4230 levels near the eastern boundary of the property. It appears to be a weak structure. Some ore was mined from its vicinity on the 4000 and 4230 levels, but it is difficult to be sure that some of this ore was not related to the Aurum. On levels above 4230 the fault has been eroded, and at shallow depth below the 4000 level it would be cut off by the J.C. fault.

Bedded Faults

These faults have only been prominent in Island Mountain below the 3250 level. They strike and dip about parrabel to the cleavage. They are weaker than the Aurum type, although some have had considerable movement judging by the amount of gouge. The displacement has been normal with the horizontal component being roughly twice the vertical. Offsets of veins are rarely more than 25 ft. horizontally. The movement is left hand.

Although there is not a great deal of information on the extent of individual faults, there is reason to believe that most of them do not persist for more than 100 ft. laterally and along the dip. One, however, is indicated to have a strike length of over 300 ft. on the 3250 level. As information is gained it may be found that they are more persistent than thought at present. Some, at least, show a tendency to branch or curve along strike and dip, and this adds to the difficulty of projecting them.

Examples have been noted where transverse stringers, an inch or so in width, start from a bedded fault but pinch out within a few feet above and below it. In other places, where bedded faults cut diagonal veins, the ore is wider and/or richer on opposite sides of the faults. The ore making influence of individual faults appears to be only a few tens of feet at most. This is amplified where several faults occur reasonably closely spaced. Experience has shown that the veins are generally higher grade on the hangingwall sides of the faults. Clearly, movement along the faults opened the fissures for the introduction of some of the transverse veins and reopened some of the existing diagonal veins, and probably some of the transverse ones too, for the introduction of additional ore mineralization. A Good example of the localization of gold by a bedded fault, well outside the zone of ore making influence of an Aurum type fault, is found in 3000 - 1 W crosscut about 100 ft. south of 12 drift. Here, two 8 inch transverse veins occur on the hanging wall side of a strong bedded fault. Chip samples of these assayed 0.46 ozs. and 5.46 ozs. These veins are in country which is characterized by barren bull quartz veins and are 900 ft. from the nearest known ore veins to the southeast.

The bedded faults were no doubt formed during one of the periods of movement along the Aurum type faults and represent a complementary set of shears. Since they are not as well defined or as persistent as the Aurum type it is not possible to use them as guides for general exploration. However, in a smaller scale way it might be profitable to direct some exploration to areas where some of the stronger bedded faults would intersect known low grade veins. This work should be directed to cut the veins on the hangingwall sides of the faults.

Bedded faults are common in the Cariboo Gold Quartz where they are considered to be important ore makers.

## VEINS

Veins found in the mine are essentially quartz with varying amounts of pyrite. The common occurrence of vugs lined with quartz crystals indicates that they are the fillings of open spaces. There is no evidence of wallrock replacement, and there is no wallrock alteration. Some veins are devoid of any obvious mineral except quartz but these are very low grade or barren. The commercial veins contain from a few percent up to probably 30 percent of pyrite, but the average content is ten to fifteen percent. At least two, and probably more, kinds of pyrite are present. One is a very fine grained dense type which is invariably high grade. The much more common type is moderately coarse-grained. It occurs as masses scattered haphazardly through the veins and as cubes and grains scattered throughout the veins or in streaks paralled with the walls. The coarse-grained pyrite sometimes forms a coating on small masses of the fine-grained dense variety and therefore appears to be the younger of the two. There is likely more than one age of coarse pyrite. This is suggested by differences of colour and texture. The low grade early bull quartz veins generally contain some pyrite, characteristically as masses of the coarse variety scattered through the vein, whereas most of the later ore veins, as well as containing more purite, also contain some in the form of well formed cubes. This suggests that at least some of the coarse massive pyrite since veinlets of quartz cut it. However, since there appears to be different ages of quartz as well as of purite, all the relations are difficult to determine

Small amounts of sericite, ankerite, scheelite, galena, sphalerite, arsenopyrite and cosalite are present. Sericite and ankerite are characteristic of low grade veins. Galena, sphalerite and cosalite are probably quite late in the sequence. Most of the gold is associated with pyrite, apparently quite loosely as a good recovery is made with moderate grinding. Most of the gold is therefore likely later than the pyrite. Free gold is rare and is most commonly found with cosalite. It is likely quite late.

As a general rule the grade of the veins varies with the amount of pyrite present. This is not always true, however, as some veins with a high pyrite content are very low grade. In such cases the pyrite is generally the coarse type in masses through the vein. Scattered grains and cubes and streaks of cubes are generally indicative of higher values.

There are three main types of veins in the mine. These are the relatively barren bull quartz veins, henceforth called A veins, diagonal veins and transverse veins. In addition to thesethere are zones of quartz stringers paralled to the cleavage. These appear to have formed partly by replacement. They contain no pyrite or gold. They antedate and have no apparent relation to the mineralization. Quartz veins are more abundant in the dark purer quartzites, and for this reason the Rainbow No. 1 band contains most of them.

A Veins

The A veins are characterized by their coarse-grained unfractured quartz and generally irregular outline. They are invariably below ore grade. They are the most widespread of all the veins. Many of the occurrences are so lacking in any definite shape or pattern that they may best be described as a boxwork of interlacing stringers and veins. Many of them, however, have a fairly regular tabular form, and some of these have been found to have a length of over 300 ft. They are nearly vertical and strike from N60E to E-W. They vary in width from a few inches to several feet, buy most of the ones exposed by drifting are from 2 to 6 ft. wide. Many are arranged in en eshelon fashion with left hand offsets in plan and in section looking northeasterly. Overlap of the lenses is probably less than 10 percent of their lateral or dip extent.

The A veins were formed early in the mineralization seqyence and are the fillings of tension cracks. I belidve they are tension veins related to the shearing that formed the strikd faults. The B.C. vein of Cariboo Gold Quartz occurs in one of these faults. From descriptions, this vein too is an irregular bull quartz type which has locally been mineralized with cosalite and free gold. The fact that A. veins are sometimes more abundant near the Aurum type faults indicates that movement took place along these at the same time as along the strike faults.

Diagonal Veins

These veins have provided most of the production of quartz ore. They strike N55 - 80E and dip steeply south. An ore shoot generally comprises 75 percent or more of the vein. Most ore sections are about 125 ft. long, 3 to 4 ft. wide and 100 ft. on the dip. The greatest stoped length is 300 ft. , and the greatest width of ore is 10 ft. The greatest dip dimension is a little over 200 ft.

Diagonal veins are charactgerized by the occurrence of horsetail stringers along their walls (Figs 1 and 2). These horsetails curve away from the main veins. Less than a foot from the main vein they staighten out into the attitude of a transverse vein, which is 20-30 degrees more mortherly in strike and 10-20 degrees flatter to the southeast than the diagonal. They are widest at the junction with the main vein and generally pinch out a couple of feet from it. Their mineralization is the same as that of the main vein.. They have been formed by the filling of tension cracks caused by movement in the plane of the main vein. This movement has always been such that the southeast wall moved northeast and upwards along a line inclined to the southwest at about 15 degrees. The diagonal ore veins therefore are weak shear zone structures.

Diagonal veins commonly pinch out laterally and vertically into a series of transverse stringers (Fig 3). In doing so, as they become weaker, they commonly swing into an attitude which is more nearly that of the transverse veins, and finally they actually turn into the transverse attitude. Diagonal vein ore shoots also sometimes die out laterally and vertically into irregular veins and stringers of bull quartz similar to those already described. As this takes place the transverse horsetail stringers disappear.

There is good reason to believe that many, if not the majority, of the diagonal ore veins are simply earlier A veins which have been subjected to later movements which fractured them, produced the horsetail fractures, and allowed the introduction of later mineralization, including quartz. Evidence of this is the fact that diagonal ore sections commonly die out in bull quartz, and many diagonal ore veins have the same en echelon arrangement, in plan and in section, as the A. veins. Sometimes a diagonal ore shoot is composed of several closely spaced en-echelon lenses. (Fig 1), sometimes individual larger ore lenses are several feet apart and constitute separate ore bodies.

Since there is no bull quartz in evidence in the vicinity of some diagonal ore veins, it seems likely that these were formed in their entirety during the period of fracturing that reopened some of the v eins.

Below the 3375 level many of the diagonal ore veins strike more northernly than on higher levels, i.e., their strike is more nearly that of the transverse veins. At about the same horizon the transverse veins become more prominent. This indicates a weakening of the shear structures and a strengthening of the tension structures at depth. This may seem to be the reverse of what would be expected, but a similar condition has been noted elsewhere. A notable example is the Hollinger mine, where the vein structures are similar in many basic respects to those at Island Mountain. At the Hollinger, however, the change is much more gradual than at Island Mountain and became noticeable at about 3,5000 ft. below surface.

Transverse Veins

Relatively little production has come from these veins at Island Mountain. None has been mined on the 3500 level and above. They strike N30 - 60 E (mostly N.40E) and dip 50 - 70 southeast. They are much more numerous than the diagonal veins. On the whole their grade is probably higher than that of the diagonals, and individually a greater proportion of the v ein carries ore grade values. Most of them, however, are too narrow (less than 6 inches) and too widely spaced to make ore. The average length of sections mined is 65 ft. wx and width from 1 to 2 ft. They ar shorter than the diagonal ore veins, vertically as well as laterally

The transverse veins are the fillings of tension fissures that that formed almost parallel to the jointings The joints no doubt helped to localize them, but most of the veins have greater lateral and vertical dimensions than the joints. They are therefore not simply the fillings of joints, but owe their origin to tension fracturing which was later and stronger than the jointing. There is no evidence of movement in the planes of the veins, and there are no horsetail stringers associated with them.

The 3375 level is the highest horizon on which the transverse veins have been large enough to mine, and below this level transverse veins of all sizes are much more abundant than on higher levels. Below the 3375 level productive transverse veins are about as numerous as productive diagonals. Some veins in this section of the mine tend to be part diagonal and part transverse, and therefore it is difficult to make an accurate classification into two types.

As noted above, many transverse veins occupy breaks which have occurred along the axial planes of cleavage crumples. All transverse veins do not occupy such breaks, but most of the stronger ones do. Since the axes of these crumples plunge NE at angles up to 25 degrees, it is likely that veins associated with them do the same. This feature may be useful in mining these veins.

Sets of transverse veins show both right and left hand offsets in plan and in section so it is not possible to offer any rule in this respect at present. In the Cariboo Gold Quartz mine I am told that both types are found, but ones in which the offsets are left hand in plan and in section looking NE. are most common.

Throughout the Cariboo Gold Quartz mine transverse veins have been much more prominent than in Island Mountain west of the J.C. fault. They are probably no more numerous t an in Island Mountain below the 3375 level, but more of them are longer and wider an more are more closely spaced with the result that there has been substantial production from them. The same condition is being found in Island Mountain east of the J.C. fault.

REPLACEMENT ORE

Replacement ore occurs mainly in the form of pipes which have the attitude of the regional structure. They therefore plunge about N45W at an angle of 22 degrees. The ore consists essentially of fine-grained massive pyrite. The host rock is limestone which in the orebodies has been completely replaced. Most of the ore has been mined from the footwall part of the Baker within 50 ft. horizontally of its contact with the Rainbow. A good deal of this ore has been found only a few feet from the contact. The limestone nearest the Rainbow was generally the one replaced. Small amounts of ore have also been mined from the Johns Limestone and the 309 limestone. East of the J.C. fault replacement ore has been found mainly in a dark calcareous argillite or impure limestone. Therefore it cannot be said that any one limestone is favourable to the exclusion of others.

In detail it is impossible to put forth any rules that would be an infallible guide to the location of ore. In a more general way certain conditions may be said to be especially favourable. The main one of these is the occurrence of an intricately folded structure within the ore making range of an aurum type fault. Thus the most productive area in the mine has been the major fold where it was within the ore making influence of the Aurum fault (Map 2). The anticlinal portion of the fold, and in particular its southwest limb, has been much more productive than the syncline. On the southwest limb of the anticline on the footwall side of the Aurum there has been a productive block whose maximum dimensions are 1,250 ft. along the plunge by 380 ft. in a vertical plane measured normal to the crest of the anticline. The dimensions of the corr-esponding block on the hangingwall side of the Aurum are 800 ft. along the plunge by 260 ft. vertically. It is interesting to note that both dimensions on the footwall of the Aurum are very nearly 1.5 times those on the hangingwall. Although the ore within the fold has not proved as continuous as that on the southwest limb of the anticline, it is likely that there would be the same favourable plunge length. Thus ore might be expected within the fold to about the 3125 level. Recently a minor warp in the Baker - Rainbow contact has been recognized on the 3000 level. It persists to the 2700 level, the deepest workings in this area. Most of the ore on these levels is related to this warp, and this productive zone bears the same relation to the axis of the warp as the zone on the southwest limb of the major anticline bears to the anticlinal axis. It is fair to assume that this lower zone would also have a plunge length of 1,250 ft. from the Aurum, which would extend it approximately to the 2550 level.

Many transverse veins and some stringers off the ends of diagonal veins extend short distances into the Baker (Fig 3), and sometimes replacement ore has been found where this occurs. Transverse stringers are fairly common in replacement ore, and small amounts of replacement have frequently spread out a few feet from a transverse stringer where it cuts a limestone band. It is likely that the replacement ore was fed at least partly by transverse veins and probably to a lesser degree by the diagonals, but it hs not been possible to develop a practical guide for exploration on the basis of this hypothesis. Fill drifts, run into the Baker from/ends of stopes, sometimes locate replacement ore however.

SUMMARY COMPARISON OF CONDITIONS EAST AND WEST OF THE J.C. FAULT

AS noted above, there is less pure white limestone in the foot -wall section of the Baker east of the fault. East of the fault the No. 1 band contains beds of 'quartzite conglomerate'. The 309 limestone has not been found to the east. These features indicate that the sedimants east of the fault were deposited closer to shore than those to the west. If so, the dividing line between the two types may have been such that the eastern type of rocks were never extensive in the western area. It is most unlikely, however, that the dividing line was exactly parallel with the J.C. fault.

Aurum tupe faults occur at small intervals east of the J.C. fault. In Cariboo Gold Quartz this interval has been 600 ft. or less. West of the fault the Aurum and Mosquito faults are about 1,900 ft. apart.

Transverse veins are more prominent east of the fault. Although curving horsetails are reported to occur along some of the diagonal veins in Cariboo Gold Quartz, the more common type of transverse vein either cuts straight through the diagonal veins or extends straight out from either wall. So far in Island Mountain east of the fault no curving horsetails have been found along diagonal veins. All the transverse veins are essentially straight, and either branch off diagonal veins or go straight through them. East of the fault the diagonal veins and the paralled striking but more flatly dipping 'bedded veins' are believed to have originally been entirely A type veins which were fractured and mineralized by the transverse veins. Since the curving horsetails are the result of shearing movement along the diagonal veins, it follows that there has not been any significant movement along the diagonals during the formation of the transverse. veins in the area east of the fault. However, the fact that the weaker transverse stringers usually terminate against diagonal veins and are spatially related to them indicates that there has been some slight adjustment along the walls of the diagonals at the time the transverse veins were formed. Thus I believe it will be found in developing the area east of the fault that the diagonal and bedded veins are the focal points of the ore areas, although most of the ore will be likely comprised of transverse stringers and veins spatially realted to them (fig 4).

East of the fault substantial amounts of quartz ore have been found in the light coloured rocks, mainly near the footwall of the Baker and in No. 2 band. This condition has hot been fmugddxinxthexkighkxaxxsmxsdxsaskaxxmainkyxnaaxxthexfaatwaik found west of the fault, and there is no reason to believe that this has been due to different methods of exploration.

## J.C. FAULT.

The J.C. fault system is comprised of two faults about 100 ft. apart. They strike about N25E. Most of the movement has taken place on the easterly No. 2 fault which dips west at 50 degrees.

The J.C. fa lt displaces the Aurum tupe ore making faults. No ore can be ralated to it. Therefore it is clearly a post-ore fault.

For the following reasons I believe that the J.C. is a normal fault of large displacement:

(1) Transverse veins, which only become pax prominent below the 3375 level in Island Mountain, are a prominent featrue throughout the Cariboo Gold Quartz. There is no evidence that this trend in veins is related to any feature except depth. This is substantiated by similar experiences elsewhere. This indicated normal movement on the fault. A rough approximation of the amount of vertical displacement may be deduced from the fact that transverse veining of the strength found in the Cariboo Gold Quartz has not been found west of the fault in Island Mountain, although there is a suggestion that these conditions are being approached on the 2550 level. If so, the indicated vertical displacement on the J.G. fault is of the order of 2,300 ft. (Fig 6). Since the Baker - Rainbow contact is offset

only a couple of hundred feet, the movement must have been mainly paralled to the dip of the bedding.

(2) The nature of the v eins indicates that conditions of tension were operative during their formation. This tension was in a northwest - southeast direction roughly normal to the J.C. fault. Since vein formation was part of the last structural adjustment before the J.C. fault, it is reasonable to believe that this tension continued until there was failure along the fault. Thus the fault would be a normal gravity fault.

(3) The angle of plunge of the folds is generally steeper than normal near the J.C. fault. If this were due to the Aurum fault (where the two faults are close) it shou ld be flatter than normal.

If the J.C. fault has been classified correctly as a normal post-ore fault, it follows that the Cariboo Gold Quartz ore zone should lie below the present Island Mountain workings west of the fault.

## BOTTOMING OF THE ORE ZONE

On the basis of development results in the Cariboo Gold Quartz, Skerl has postulated a bottom to the ore zone, which plunges northwest at about the angle of regional plunge. I have no knowledge of the areas on which this conclusion was based, so comment on it would be superfluous. If actually the case, I can only offer the following as a possible explanation. We know that the shearing action that produced the diagonal ore veins has become weaker at depth, and that condition of t ension which produced the transverse veins has become dominant. Fundamentally this represents weaker fracturing condition s at depth. Thus it is reasonable to expect that at some horizon the transverse fracturing too will die out.

## SUMMARY OF THE STRUCTURAL HISTORY OF THE MINE AREA

The following events resulted in the geologic structure as we now see it.

(1) Folding that produced overturned folds that plunge northwest at about 22 degrees.

(2) Strike faulting along northwesterly trending zones that produced complementary Aurum type shears and extensive tension fractures which were filled with quartz and minor pyrite (A veins)

(3) Distortion of the areas near the Aurum type faults, during which movement took place along the faults, and complementary shearing plus tension fractured and reopened the earlier A. veins. Introduction of ore mineralization formed the diagonal ore veins. Tension fractures formed at the same time were mineralized to form transverse veins.

(4) Further movement along the Aurum tupe faults and complementary bedded faults resulted in further fracturing of the veins and allowed the introduction of additional ore mineralization.

(5) Development of the J.C. fault, probably as a result of tension acting in a northwest - southeast direction.

## RECOMMENDATIONS

(1) The area east of the J.C. fault on the levels below 3000 is the most promising known at present and should be given priority in development.

(2) If the development of quartz ore continues favourably, consideration should be given to the driving of a crosscut on the 2550 level to the area under the 2700-9-12-14-19 replacement ore country. This structure in the 2700-2850 block has produced 6,500 tons grading 0.64 ozs. with some further tonnage. indicated.

This work would involve 700 ft. of crosscutting, but there are chances for quartz ore in the No. 1 band after the crosscut would have advanced 350 ft.

(3) On the 2850 level further development is indicated to investigate the several drill intersections of replacement ore in the area of the favourable 'warp' These intersections are generally narrow, but since the Baker - Rainbow contact is vertical in this area orebodies such as 2700-14 could easily be missed by drill holes. As a prelude to further development some further drilling might clarify the picture.

(4) On the 2700 level drill short holes to explore the Baker - Rainbow contact for replacement ore where this contact is not adequately exposed for 250 ft. in the region from 90 ft. to 340 ft. east of the west face of 2700 - 2 NW. This area is in the vicinity of the favourable warp.

(5) The control for the vein system in the footwall of the Aurum below 3250 level is not clear. From map 1 the ore appears to trend away from the Aurum towards the Mosquito. Map 3 suggests the possibility of the recurrence of vein clusters at intervals along a zone plunging northwest. Fig 5 suggests the possibility of recurring clusters of ore whose axes strike N37W, and whose lateral extent is 450 ft. from the Baker. I have no solution to this problem. It is interesting to note, hoever, that the possivle favourable area projected to the 2550 level on the basis of map 3 falls along the downward extension of the trend suggested by map 1. To test these various possibilities I recommend the following:

3000 level: A 400-ft drill hole to explore for vein clusters (fig 5) If successful, follow up work could lead to the area believed favourable for replacement (Map 2).

2700 Level: A 400-ft. drill hole to explore for veins which might occur as a result of the trend suggested by Map 1.

2550 Level: A 550-ft drill hole to explore for veins suggested by map 3.

(6) On the 3250 level a 500-ft. hole to explore the Johns limestone for replacement where the limestone should be in the major fold in a favourable position relative to the Aurum. From the scanty information available it appears that the Johns limestone may be getting nearer the footwall of the Baker at depth. There is recorded production of 899 tons grading 0.72 ozs. from the Johns on the 4430 level.

## GENERAL SUGGESTIONS

Development to date indicates that the ore bodies east of the J.C. fault will present problems not hitherto encountered with quartz ore at Island Mountain. As noted above, it appears that diagonal and bedded veins (both originally A veins) form the nucleii of the ore bodies, although transverse veins and stringers associated with these veins actually comprise most of the ore. It is likely therefore that these orebodies will exhibit the same offset pattern that characterizes A veins elsewhere. This is a left hand offset in plan and in section looking NE. It is important to establish whether this pattern or some other one actually does exist, and for this reason I believe that mapping of stopes and raises as well as drifts will be necessary. For this work I recommend 20 - scale maps, as already suggested by G.G. Sullivan.

If deepening of the shaft is ever undertaken I think that new levels should be established at 100-ft intervals. This is indicated by the trend at depth to the occurrence ofveins of less vertical extent and replacement bodies of shorter plunge length.

## CONCLUSION

The immediate future of the Island Mountain mine depends largely on developments east of the J.C. fault. Judging from conditions at Cariboo Gold Quartz less replacement ore may be expected in this area than has been the case west of the fault. On the other hand, the grade of the quartz ore will likely be higher than that experienced at Island Mountain to date. In assessing this area it should be kept in mind that there is always a chance of finding a vein system like the No. 7 at Cariboo Gold Quartz. This produced over 88,000 tons of 0.60 ozs. grade. Even if this grade was obtained by some sorting, it is likely that the grade run of the mine ore in this system would at least equal current mill heads at Island Mountain. The bulk of No. 7 vein ore came from the light coloured rocks of No. 2 (301) band near the Rainbow fault. In the recent development east of the fault at Island Mountain the best ore has also been found in the light coloured rocks of 301 band. Thus the chances of finding quartz ore of sufficient grade to compensate for the probably smaller tonnage of replacement ore would appear to be good.

Respectfully Submitted.

May 11th, 1954. (Sgd.) M.R. Keys.

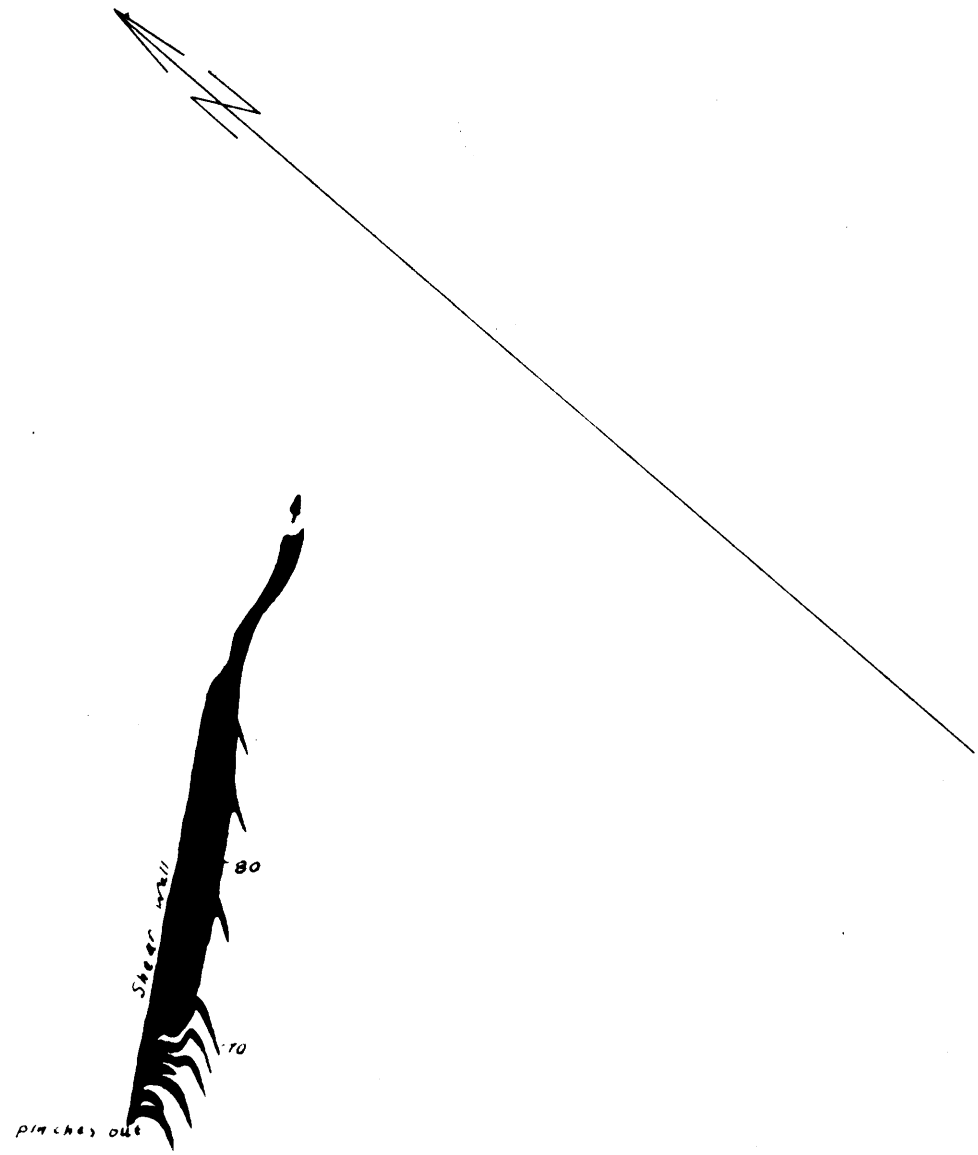

Plan

Part of 4000-384 Stope

Showing diagonal vein comprised of closely spaced en echalon lenses with left hand offsets

1" = 20'

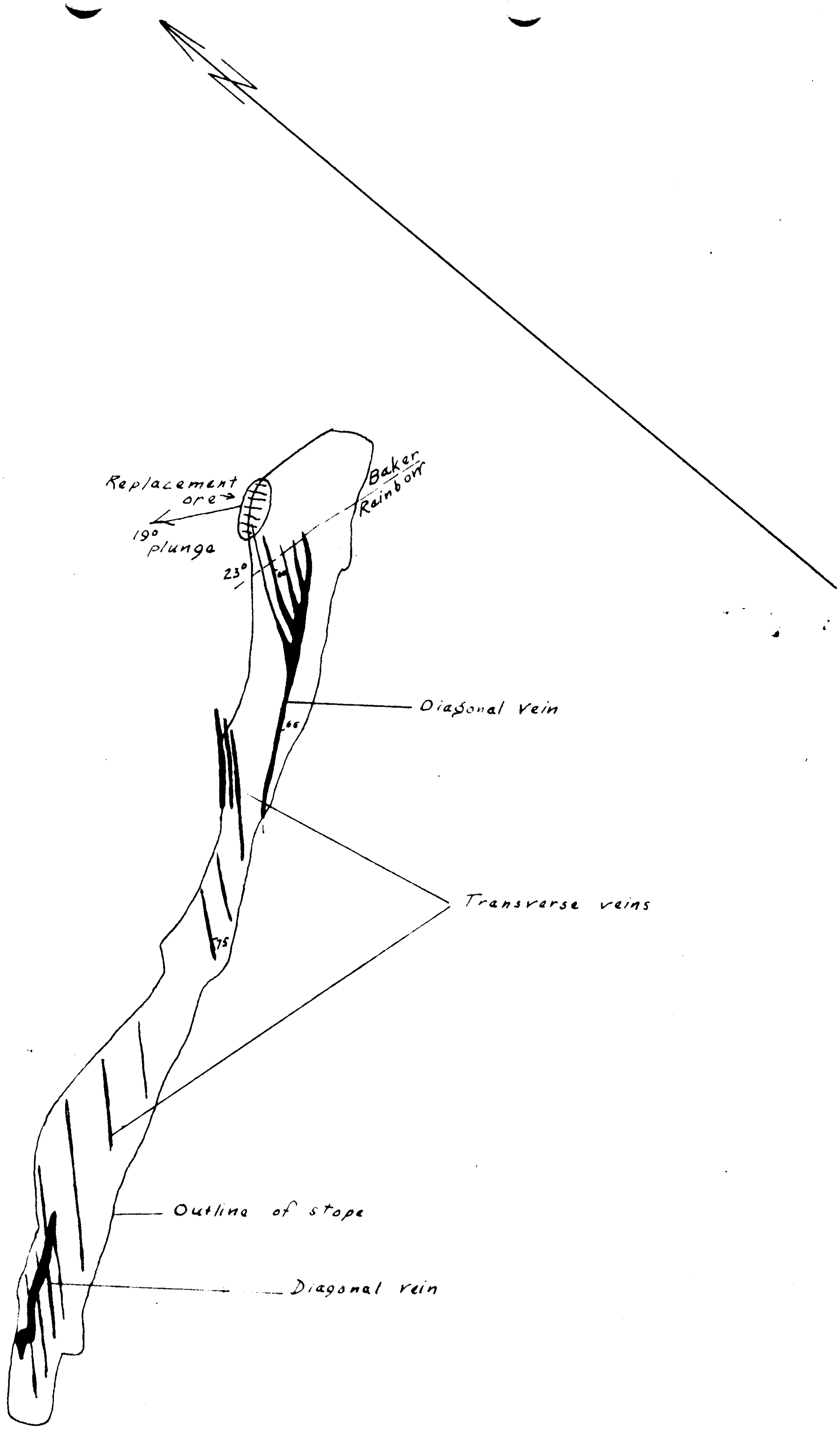
Fig. 1. M.R.K



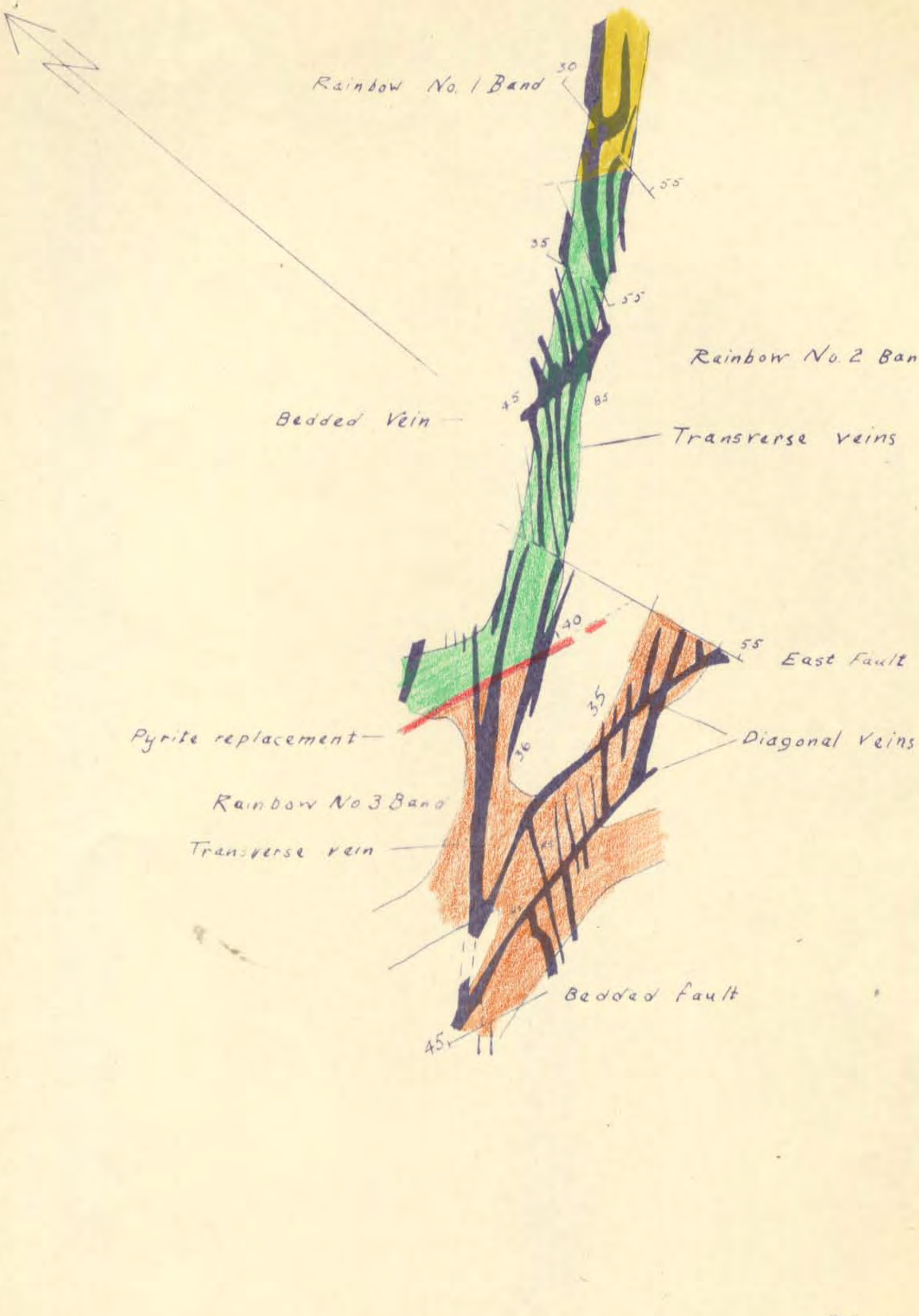

Plan
Part of Vein in 2700-7 Stope
Shows vein structure as diagonal vein pinches out to southwest
1" = 20'

Fig 2

M.R.K



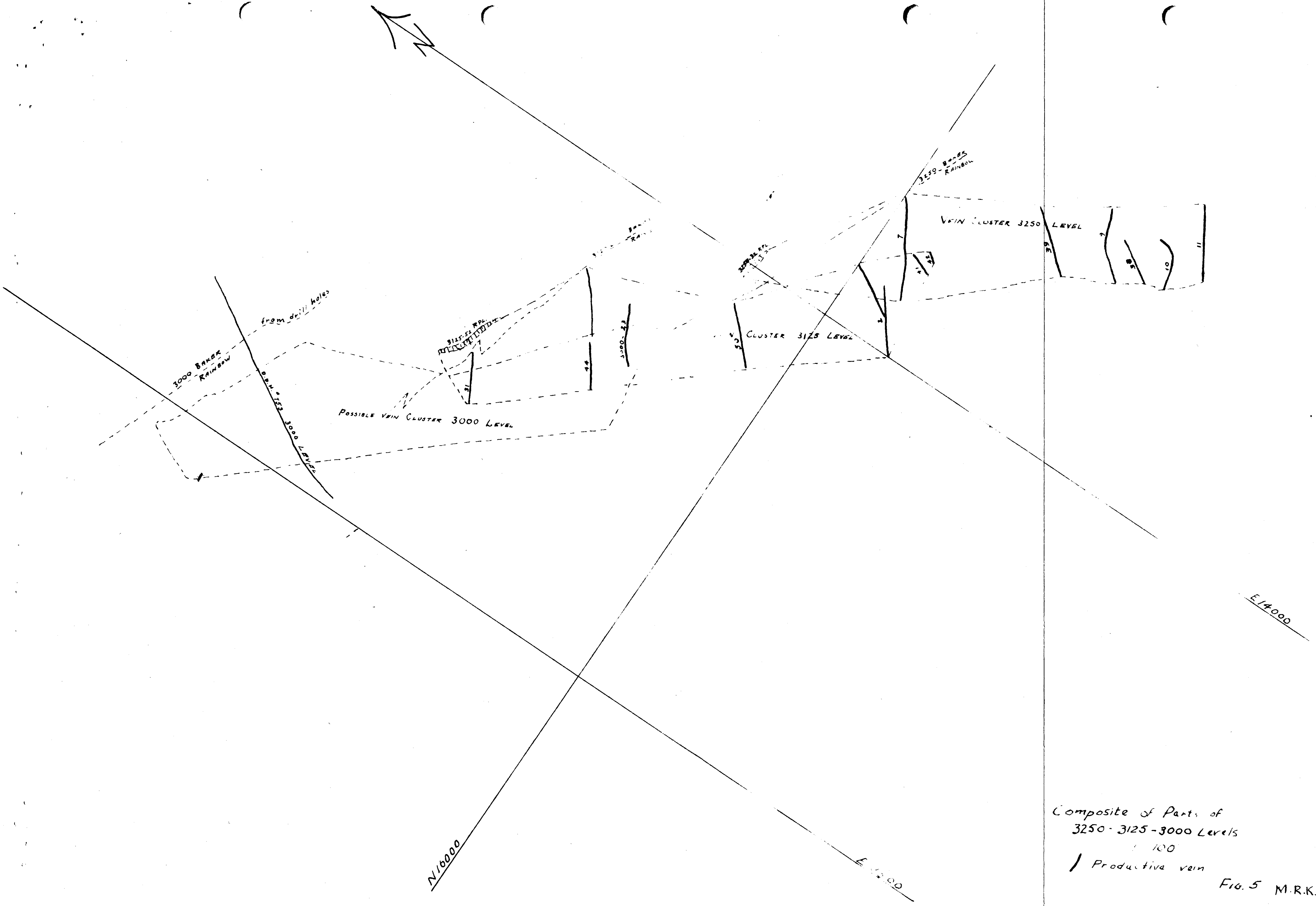

Plan
2700 - 3 Stope
Showing manner in which diagonal vein pinches out at its top into series of transverse stringers
1" = 20' M.R.K FIG. 3




Plan
3000 - 35 and 36 Drifts
Showing typical vein pattern in area east of J.C. Fault
1" = 20'

M.R.K

Fig. 4




Composite of Parts of
3250 - 3125 - 3000 Levels
1" 100
/ Productive vein

FIG. 5 M.R.K.


Generalized Section
Showing possible displacement
(post ore) on the J.C. Fault

1" = 500'

M.R.K. Fig. 6.