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A
GEOLOGICAL EVALUATION
OF
THE REX TIN MINE
TASMANIA

By
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THE REX MINEIntroduction

The Rex Mine, which is located in north-eastern Tasmania, was initially worked for silver-lead in about 1890 but was found to contain more tin than silver-lead at depth. By 1902 government geologist G. Waller reported that the "...large mass or chimney of tinstone, from 60 to 80 feet in diameter.." which was yielding 7% of tin concentrates gave him "...every reason to believe that the Mt. Rex deposit will live down to very great depths, though its size and contents may vary at different depths; at any rate, we can reasonably hope that the mine will become one of the permanent metal-producers of the State". By the year 1909, the Mt. Rex Tin Mining Co. had ceased operations and had let the mine to tributers. These men worked the mine in a small way until 1913 when they lost use of the crushing and concentrating plant; the Mt. Rex Tin Mining Co. had sold it out from under them to the owners of the Royal George Mine. The only other attempt at active mining of this deposit was in 1966 when Mr. Brinckman and Mr. Dicker removed a few tons of stone from the main lode in the open cut. This ore averaged 4.8% metallic tin.

The main cause of the 1909 cessation in operations was a rather dramatic change in the character of the main lode between the 200 ft. level and the 300 ft. level. It ceased to exist.

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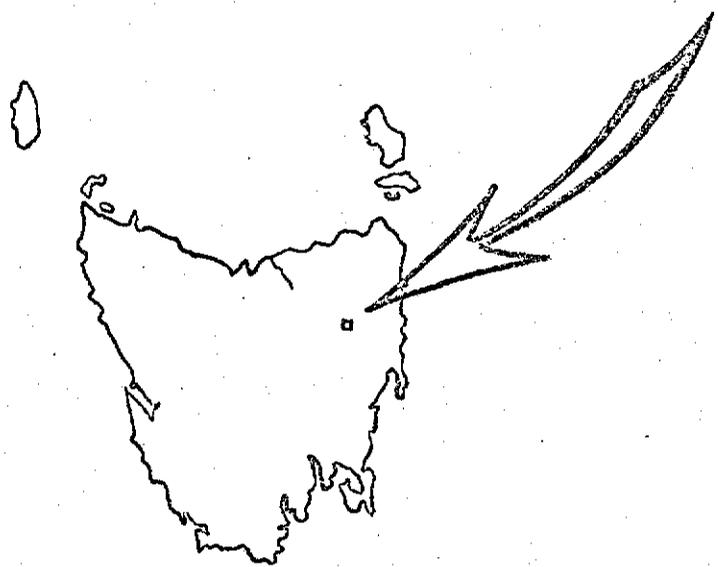
In November 1977, I carried out an intensive literature survey, geologic mapping in the vicinity of the Rex Mine and a regional photo-geologic interpretation. All the evidence gathered to date shows that the upper 250 ft. (75 m) of the Rex Lode was sheared off by low-angle, drag faults and displaced 260 ft. (80 m) down-dip. There is every indication that Mr. Waller's reasons for this lode "living" at depth are valid. As well, there is no indication whatsoever from the mining effort by the Mt. Rex Tin Mining Co. or from the various reports by geologists that they recognised the extreme significance these low-angle faults have for the Rex Lode.

Location

The Rex Mine (also known as the Mt. Rex Mine or the Rex Hill Mine) is located in the north-eastern part of Tasmania some 9 km NNW of the town of Avoca (See Fig 1). It is on the western slopes of the 800m high Mt. Rex. Access is year round via paved road from Launceston to Avoca and good quality, graded, gravel road from Avoca to within 1.5 km of the mine itself. This last 1.5 km requires a vehicle with reasonable road clearance; a four wheel drive vehicle would be unnecessary except in extremely wet weather.

A major electric power line was put through the area within the last few years and passes within 600m of the mine.

FIGURE 1



TASMANIA

Lease Situation

The old mine and its environs are presently held under mineral lease nos. 11/10S.S. and 12/18S.S. by Mr. R. Brinckman (See Fig 2). Each mineral lease covers a 10 acre area. The mine has been held under various titles since about 1885; during that 90 year period only short periods of 1 to 2 year duration have passed when no one held title on the area.

Topography, Vegetation and Climate

The difference in elevation between the town of Avoca (elevation 200m) and Stacks Bluff, which is some 15 km to the north and is also the southern boundary of the Ben Lomond National Park, is 1330m (See Fig 3). The Bluff itself rises up over 600m in a distance of only 2 km. Mt. Rex is not only physically situated half way between these two places it is also topographically between them. Avoca is on a river flat. The relief around Mt. Rex is on the order of 300m in a distance of 2 km. The area is highly incised by many creeks and rivers, some of which run year round. The crests of most of the hills and mountains consist of outcropping rock, while the slopes have a thin soil cover with abundant boulders, cobbles and pebbles.

In early November 1977, extensive bush fires passed through the area so little or no undergrowth remains; this does little for an aesthetic appreciation but it certainly makes on foot access easier. The trees, in

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general, were unaffected and the area can be considered to be an open woodland; the most common tree is the eucalypt known as the peppermint. Except for an occasional, isolated stand of taller and older trees, most are 15 to 20 m high; they undoubtedly represent a second growth since most of the original stand was cut to feed the two steam engines at the Rex Mine.

The climate is described as mild and temperate with an annual rainfall of 90 cm. The rain is distributed quite evenly over the year but the wettest month, on the average, is August and the driest month is February. Snow can fall in the Ben Lomond Mountains to the north.

Regional Geology

The sedimentary rocks in the area were formed in two distinct periods of time. The oldest (Silurian 395-430 my) were folded, intruded by granite (Devonian 345-395 my) and peneplaned before the second period (Permian 225-280 my to Jurassic 136-190 my) of sedimentation. The Silurian rocks (quartzites, siltstones, slates and tuffs) crop out along the northern and eastern boundary of the Devonian Ben Lomond Pluton. The Permian rocks (sandstones, conglomerates, limestones and mudstones) form a very thin cover over much of the granite pluton. The Jurassic and Triassic rocks (dolerite and coal bearing sandstones and shale respectively) crop out along the southern and western boundary of the pluton; the only observable contact they have with the granite is a major fault known as the Castle Carey Fault.

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The many tin lodes in the district occur near the edge of the pluton, either within the granite itself or in the older, Silurian, sediments. I know of no tin occurrences in the younger, Permian to Triassic aged, rocks. All of the lodes have two features in common - they all dip or rather plunge toward the center of the pluton and they all are situated within what I have called the concentric fracture pattern observable in the pluton. The fractures can be placed in one of two general types - concentric and radial. Figure 4 shows this fracture pattern. The information for this figure was taken from the Geological Sketch Map of the Rossarden and Story Creek Area (Fig 5) as presented in the report by A.H. Blissett (1959). This report is included in the appendices. The concentric fractures all dip at 60° to 80° toward the center of the pluton. Therefore they form, in the third dimension, a series of cones of diminishing diameter which would be seated one inside the other. The radial fractures all appear to be very steeply dipping if not vertical. I know of no tin lode in this district which is situated along or within these radial fractures.

A very good, detailed description of the general geology of this district can be read on pages 21 through 49 in the above mentioned report.

Rex Mine Geology

The Rex Mine is situated in granite on the south-western margin of the Ben Lomond Pluton; it is only 150m from a faulted contact with dolerite. This fault is the Castle Carey Fault which is a major structural feature at least 9 km long. Vertical as well as lateral movement has taken place along this fault, the significance of these movements on the Rex Lode will be discussed later in more detail.

The main, cylindrical orebody (See Figs. 6 & 7) is surrounded by unaltered, coarse grained granite which has exceptionally large (up to 25mm) phenocrysts of orthoclase and beta (high temperature) quartz (Rock Sample R9). The 18m diameter core of this cylindrical, pipelike body is a crystal quartz-greisen rock (Rock Sample R17) which is surrounded by a 6m wide aureole of greisenised and silicified, coarse grained granite. Cassiterite occurs both in the core and the aureole. G. Urquhart (1967) states that "The transition from altered aureole rock to coarse-grained granite is irregular but sharp". This evidence along with the cylindrical shape, and the concentric fracture pattern centered on the core led Mr. Urquhart to the conclusion that the body is of diatreme origin. This high quality report is included in the appendices.

The quartz-greisen core was emplaced along the intersection of two major fractures. One trends in a northerly direction, dips steeply to the east (towards the center of the pluton)

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and is part of the plutons concentric fracture pattern described earlier. The other trends in a north easterly direction, is near vertical and is part of the pluton's radial fracture pattern. Costeans have been put down on the many greisen leaders (Rock Samples R3 & R4) which occur around the Rex Mine; these leaders appear to occur primarily if not exclusively in the concentric fractures.

The cassiterite and various sulphides (Rock Sample R5) in the Rex Lode are present either as a fissure filling or as a replacement. Both fissure filling and the emplacement of a diatreme would require that the fractures be under tension. The replacement type mineralisation is restricted to the aureoles which surround the filled fissures. The sulphides were found to decrease in quantity with increased depth. The tributers reported that at the 300 ft level on the "new make" the ore consisted of cassiterite only, while at the surface the ore consisted of the following primary sulphides and oxides (in order of abundance): sphalerite, galena, pyrite, chalcopyrite, cassiterite, arsenopyrite, fluorite, wolframite, marcasite, pyrrhotite, and others (D.I. Groves 1968). The first six minerals listed are by far the most abundant.

It is interesting to note that Mr. Groves concludes from his mineragraphic study that at least two and possibly three generations of cassiterite are present. The first generation is found in relatively wide spaced quartz-healed fractures which contain no sulphides; this cassiterite occurs as small granular aggregates of subhedral to euhedral crystals. The second generation occurs as

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clusters of subhedral, zoned or twinned crystals in closely spaced fracture foliations which cut the earlier quartz-cassiterite veins. The third generation forms a drusy coating on the surface of sulphide minerals. The individual cassiterite crystals rarely exceed 3mm in diameter but clusters up to 15mm are common. Mr. Groves states that the lack of cracking in the cassiterite crystals "...may be related to the lack of reaction between sulphides and cassiterite.". The relatively large size and the lack of cracks in the crystals will facilitate the extraction process.

The importance of the proximity of the Rex Lode with a major structural feature like the Castle Carey Fault seems to have gone unnoticed by previous geologists who have carried out surveys on this area. All of them have assumed that the Castle Carey Fault is a steeply dipping if not vertical fault; I have evidence that this assumption is invalid. In reality, it is a low-angle (20° to 30° dip) fault dipping off to the southwest; movement along this fault has had a profound impact on the Rex Lode.

Significance of the Low-Angle Faulting

During the third day of my geological reconnaissance in the Mt. Rex area I walked up Buffalo Brook which is 1.5 km north of the Rex Mine. I was especially impressed by the predominance of the low-angle faulting dipping to the southwest (See Photo A). I didn't, at this time, appreciate their real importance. In the

other areas which I had visited in this district, I recognised similar low-angle fractures but the big difference was that on Buffalo Brook they were no longer mere fractures, they were faults with shear zones at least 1m thick (See Photo B). In fact, as I walked farther up the Brook I found a whole series of imbricated plates bound by low-angle faults. With what I had observed here, the sinuous nature of the Castle Carey Fault, as seen on the Photogeologic Interpretation, (See Fig 8) became more significant. If this fault had a near vertical dip as previous geologists had assumed, it would be a straight, linear feature when observed in plan. This it is not.

The dominant joint attitude, as measured by G. Urquhart, at the Rex Mine (See Fig 9) strikes in a north westerly direction and dips to the southwest (away from the center of the pluton). The dips vary between 35° and 80° ; the most common dip being 60° to 70° . This is appreciably steeper than the 20° dip seen in the granites along Buffalo Brook. This may be explained by the fact that the rocks in and around the Rex Mine are highly silicified and therefore very competent rocks; they would be more competent than the granites on Buffalo Brook. It seems logical that a more competent rock would fracture at a steeper angle - it would be analagous to a light wave passing from air (less dense) into a glass (more dense) lens. The light wave is bent toward the line normal to the lens surface at the point of entry, hence it steepens.

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I noticed on the Geological Map of the Rossarden-Story Creek Area (Fig 5) that the predominant fractures for all the other lodes which have been mined in and around the Ben Lomond Pluton dip toward the center of the pluton. I assumed the Rex Lode would be the exception and dip toward the edge since the predominant fractures dipped in that direction. This assumption proved untrue. Even though the two reported attitudes (P.B. Nye, 1954 and G. Urquhart, 1967) for the Rex Lode are at variance with one another they at least agree that the Lode dips toward the center of the pluton (to the east). The biggest and most significant difference, then, between the Rex and the other mines is that even though the Rex Lode was deposited in a fracture dipping toward the center of the pluton (east) the fractures and faults which predominate now all dip toward the edge of the pluton (west). Looking at Fig. 4 will help to understand the reason for this. The concentric and radial fracture pattern present in the Ben Lomond Pluton can be used to determine the original, physical center of this circular (in plan view) body of rock. By circumscribing the pluton using this center we can show that the southwestern quarter of this body is beneath Permian-Jurassic-Triassic rocks. The original Devonian-Silurian lithologic contact, that is, the contact of the granites with the sediments into which they intruded, is at least 4.3 km southwest of the presently observable fault (Castle Carey Fault) contact.

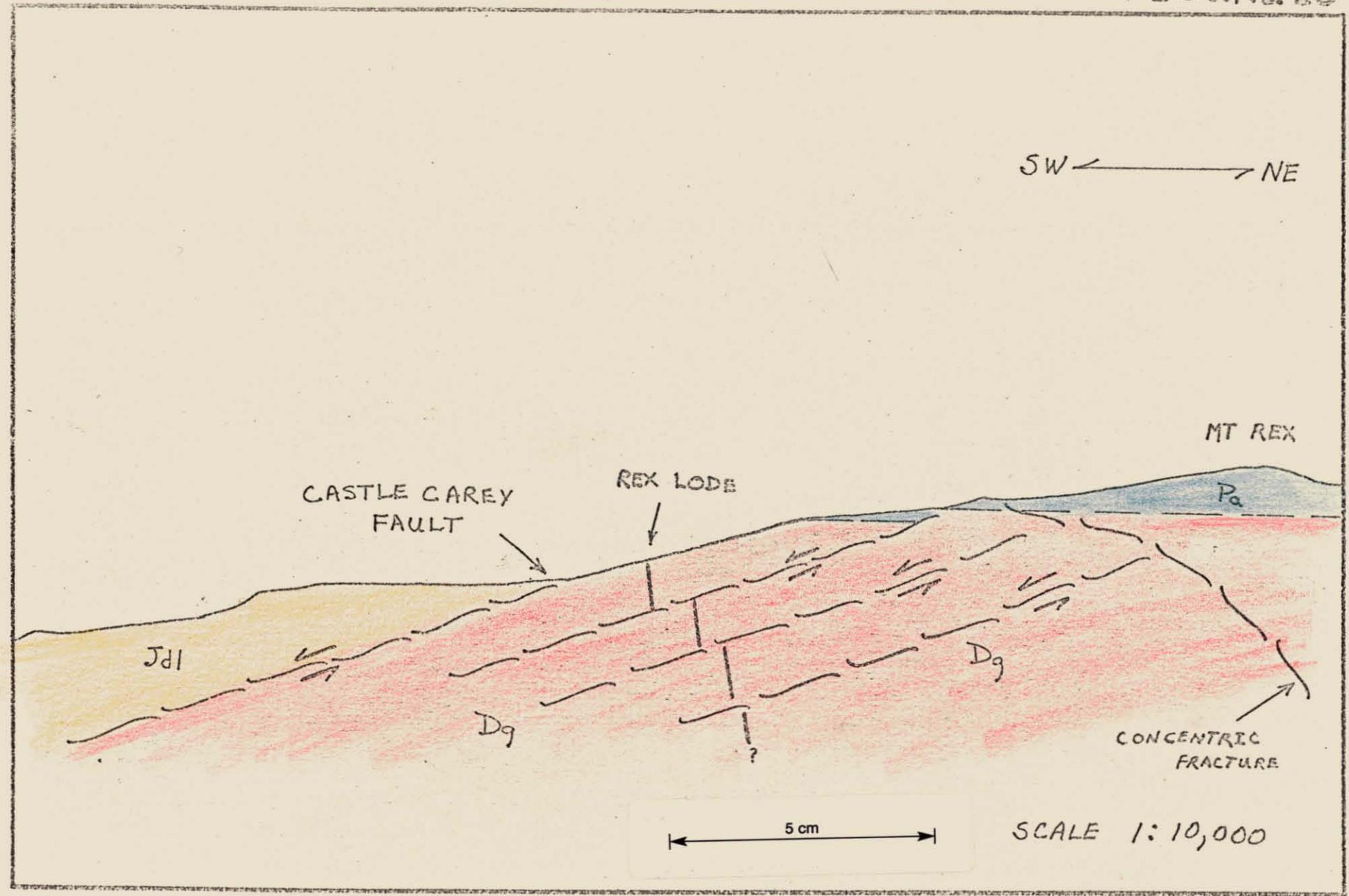
The Ben Lomond Pluton has moved up through these overlying rocks; as this took place the thousand metre thick pile of Permian to Triassic rocks slid off to the southwest dragging plates of granite off with it. The dip of these

plates and the faults between these plates would parallel the tilted, and now faulted (Castle Carey Fault), contact between the granite and the Permian to Triassic pile. Looking at Fig. 10 we can see the impact these imbricated drag faults have had on the Rex Lode. The first in the series of drag faults within the granite has displaced the upper 75 to 80 m of the Rex Lode at least 80 m down-dip. This 80 m of dip-slip movement can be seen in the topography located some 650m NE of the Rex Mine and is shown in Fig. 10. As I walked up toward Mt. Rex from the Rex Mine (I was essentially walking along the topographic profile shown in this figure), I was impressed and initially a bit puzzled by the distinct steps in the topography, as I recall, there were at least three of these present on the southwestern slopes of Mt. Rex. Only the largest of these steps is shown in Fig. 10. I now know that I was walking up over the ends of fault bound, imbricated plates which dip off to the southwest. As the plates were pulled off toward the southwest (away from the center of the pluton) they broke away, in the northeast, along near vertical planes of weakness which were already present in the granite.

These planes were and are the concentric fractures present in the Pluton. The fracture which is the northeast boundary of the upper most plate can be seen on the Photogeologic Interpretation (See Fig. 8). This fracture curves around the southwest slopes of Mt. Rex and essentially parallels the topographic contour.

FIGURE 10

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This indicates that this fracture in the vicinity of Mt. Rex has a very shallow NE dip. This same fracture several kilometres to the north of Mt. Rex has a near vertical dip. I have concluded that this fracture has been pulled over toward the southwest in the immediate vicinity of Mt. Rex. This is illustrated in Fig. 10.

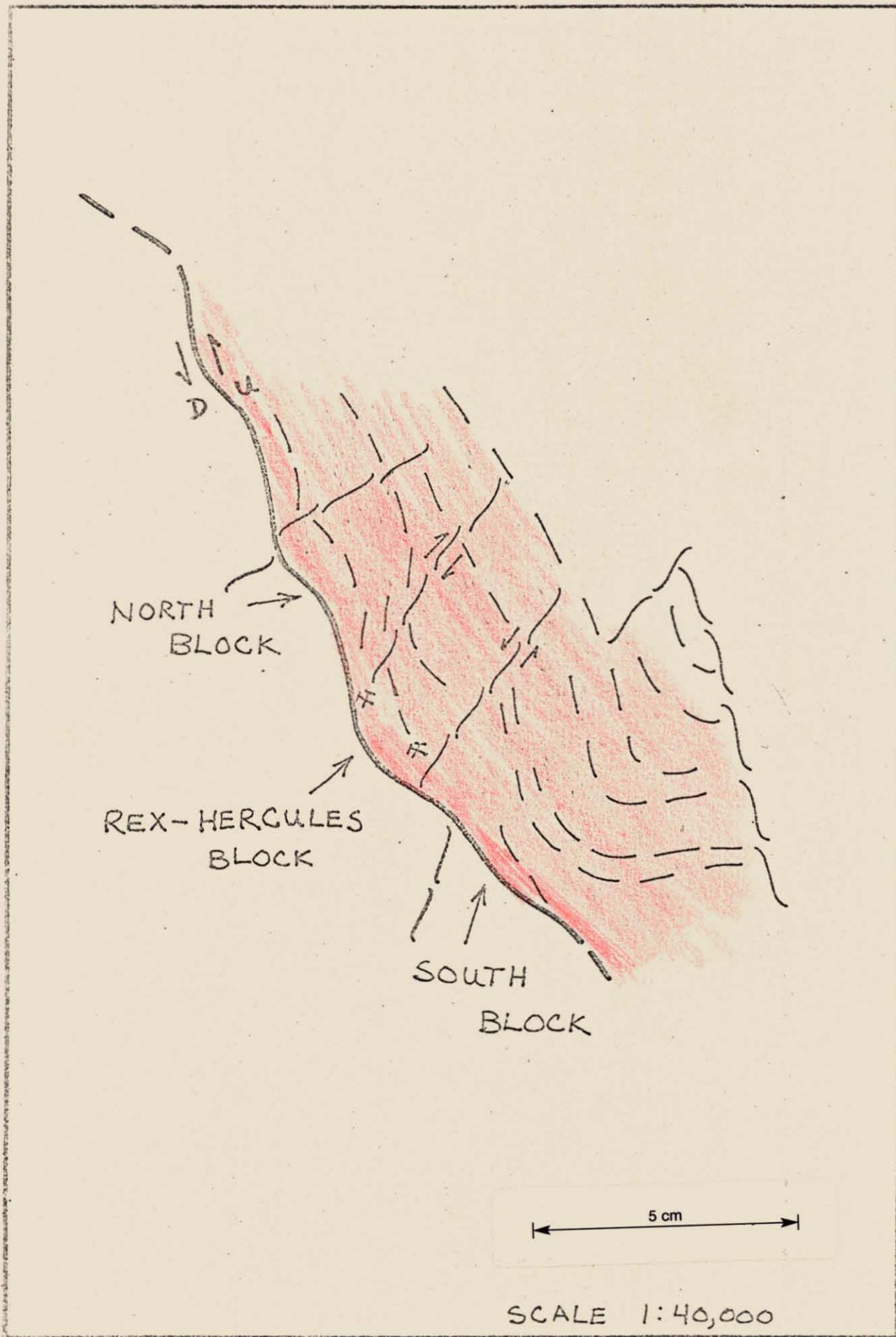
All this means, of course, is that the lower continuation of the Rex Lode will be found some 80 m up-dip (northeast) along the low-angle, drag fault which sheared off the upper 75 to 80 m. Since there is a whole series of these imbricated plates it is very likely that the Rex Lode has been displaced in several places as followed down-plunge.

Structural Interpretation

By observing the Photogeologic Structural Trend Map (Fig 8) we get some idea of the structural complexity in a 160 sq km area around the Rex Mine. There are several features which I noticed immediately:

- a) The sinuous nature of the Castle Carey Fault,
- b) The presence of two fracture systems (admittedly highly modified by subsequent faulting) which are concentric with and radial from the center of the Ben Lomond Pluton,
- c) The very distinct geometric shapes of the outcropping Permian sediments,
- d) The fault bound, wedge-shaped blocks in the vicinity of the Rex Mine,
- e) The left lateral (sinistral) movement along the Castle Carey Fault.

FIGURE 11



The first two of these features have already been discussed. In respect to feature c), the most noticeable geometric shape is the arrow head of Permian sediments pointing toward the Rex Mine. I would conclude, from this feature alone, that these rocks have been dragged off to the southwest. Their geometry is similar to what one would expect if one edge of a large lump of clay was pinched between finger and thumb and slowly pulled away.

Feature d) is important to our understanding of the Rex Lode so the structural trends in the immediate vicinity of the Rex Mine have been transferred onto Fig. 11 for ease of evaluation and discussion. In this figure one sees three short (1 to 2 km) NE-SW trending faults which have been truncated on their southwest extremity by the Castle Carey Fault and on their northeast extremity by concentric fractures. With such distinct structural blocks, some of which are capped by Permian sediments, it would appear on first glance that a graben-horst structural situation exists, but when one relates these blocks to topography it is seen that the Permian sediments are present only on topographic highs. It seems more likely that the presence or absence of Permian rocks is more related to the relative competence of the blocks than to their relative vertical movements. The lateral movement between the blocks is easier to interpret - the Rex Hercules Block has moved to the southwest, towards the Castle Carey Fault, relative to the North and South Blocks.

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Feature e) lets us be more accurate in determining the displacement of the upper part of the Rex Lode relative to the lower part. I have presented evidence which shows that the Ben Lomond Pluton has moved up through the overlying Permian-Triassic-Jurassic rocks; this upward movement would be only one of the components. The other would be a left lateral or clockwise movement of the Pluton. Considering both of these components simultaneously the overall, three-dimensional, movement of the Pluton is analagous to a bolt being screwed up through a nut (both the bolt and the nut would need left-hand threads). I stated before that the low-angle, drag faults, which have generated the imbricated plates of granite in the vicinity of the Rex Mine, were responsible for an 80 m down-dip (southwest) displacement of the upper part of the Rex Lode. This is still true but what is now known about the screw like motion of the Pluton we can be more accurate in our description of the displacement. The upper part of the Lode would have moved in an arc which curves off to the south-southeast rather than a straight line, down-dip to the southwest. This means the lower continuation of the Lode would be situated more to the north of the outcropping Rex Lode, where previously when only the dip-slip component was being considered it would have been thought to be simply up-dip to the northeast. The "New Make" discovered by the tributers is almost due north of the outcropping lode.

Comments on Previous Efforts of Mining and Exploration

It is most interesting to note that when the tributers, who worked the mine from 1909 to 1913 after the Mt. Rex Tin Mining Company ceased operations, continued the 300 ft. level drive they reported the existence of a "New Make" located 74m from the main lode in a NNW direction. They removed ore from this part of the lode to the extent that a 16' x 24' (5m x 7m) chamber was discovered when the mine was pumped out in 1934. To quote A. McIntosh Reid (1928), "the late tributers stated that the new "make" of ore at the 300 ft level over a width of 4 ft. yielded tin in the proportion of 4 per cent. Apparently the quality of the stone is above the average of the district. The tributers did not drive far along its course nor rise on the ore-body, but gouged the richest ore where easy of removal. They reported that the last parcel of 4½ tons yielded 8 bags of concentrated tin ore". One bag would weigh 100 lbs, therefore they obtained 800 lbs of concentrate (cassiterite) from 9000 lbs of ore; this was an 8.9% tin ore. This value is quite comparable to the 7% tin ore taken initially, in 1890, from the main lode.

With what is now known about the impact the drag faulting has had on the Rex Lode, it is most likely that the tributers had discovered the displaced downward extension of the Rex Lode; but they had been mining it for only a short time (3 years) when the Mt. Rex Tin Mining Company sold the crushing and concentrating plant out from under them. It was sold to the owners of the Royal George Mine. Of course all mining operations ceased.

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We can gain some insight into how little was known about the origin of this displaced lower part of the Rex Lode from a report by P.B. Nye (1934). He states that the No.3 (300 ft) level "ore-body has not been cut at a higher level...". An attempt was made by Mr. Gray, who held the lease and had pumped out the mine, in 1935 to do just that. He extended the No.2 (200 ft) level drive another 32 ft, needless to say he found no upward extension. Mr. Gray had sampled the floor of the chamber on the No.3 level (the tributers "New Make"). The eight samples had averaged 1.39% metallic tin, the values ranged from 0.76 to 3.10% and all except two were over 1%. It is obvious now that Mr. Gray was looking up when he should have been looking down. He attempted to find "backs" with the prospect of more immediate remuneration; exploring downward would require a new shaft and new drives, which would have been expensive.

A government geologist by the name of Q.J. Henderson (1935) subsequently carried a survey of the Rex Mine, apparently at the request of Mr. Gray. Mr. Henderson sampled the "New Make" chamber and came up with very low tin values indeed (0.01 to 0.6%). At first I was puzzled by the discrepancy. As I read and reread Mr. Henderson's report, I eventually discovered the cause. To quote Mr. Henderson, "...bulk samples were taken in six foot sections from the corner of the chamber and west wall of drive, around the chamber to its junction with east wall of drive...". Mr. Henderson had sampled the walls of the chamber while Mr. Gray

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had sampled the floor. In fact, of the 34 samples which Mr. Henderson took throughout the mine, 28 of them were from walls. The floor, of course, is the top of the displaced, downward extension of the main ore-body. The walls would be expected to contain low tin values since the ore-body would have been worked laterally until the tin values were so low that it was no longer profitable to do so. The walls of the other chambers in this mine also contain about 0.2% tin. Evidently Mr. Gray did carry out some drilling in this chamber but again he explored in the wrong direction - he drilled for "backs". This is shown by the following quote from Mr. Henderson's report (1935): "Beyond five samples across the floor of the chamber, one on the wall and six drill holes in the "back", no attempt has been made to further develop the ore-body on this level". Even though several people have held a lease on the Rex Mine since 1935, it has not since then been de-watered where this chamber on the No.3 level would be exposed. Mr. Brinckman and Mr. Dicker de-watered the mine down to the No.1 level only in about 1966.

The Permanency of Tin Lodes at Depth

Tin lodes are quite notorious for their lens-like, bulge and pinch nature. Cassiterite is found concentrated in relatively small lenses or bulges, and to quote Mr. Henderson (1935), these bulges are "...along one or more of the joint systems and may be connected only by means of an insignificant fissure filled with fluorite to mark the passage of the mineralisers". In a publication titled, 'The Tin Mining Industry' (1911) Mr. J.E. Carne makes an interesting comment concerning the permanence of tin lodes in depth. In his opinion the limited depth of the tin mines in N.S.W. (80 to 360 ft) may be attributed to the shallowness of mining development rather than the true character of the deposit. "Where a good shoot of ore has been showing on the surface, work has been commenced and the shoot worked out, but seldom have attempts been made to win underlying shoots by continuing the sinking below the impoverished portions of the veins. The existence of such underlying shoots has been proved at the "Gulf" and "Ottley (and Butler) mines". This statement could have been made about the Rex Mine.

There are many old mines around the Ben Lomond Pluton, some of which are still being worked at considerable depths. The Aberfoyle Mine, which has produced tin for about 50 years, is down 1400 ft. The Great Republic Mine was worked to a depth of 600 ft; operations ceased because bad mining technique had made a rich ore shoot unprofitable, not because the shoot had given out. To quote A. Montgomery (1892), "the ore

in the Great Republic shoot has proved very rich, and if obtainable in larger quantity would make the mine a very profitable one. The ore is, however, unfortunately confined to this one shoot, as far as yet ascertained, the lode being outside of this too small and poor to be worked. As the shoot, though a strong and remarkable one, is of very small length horizontally, it has been necessary to do a great deal of dead-work for opening up a comparatively small piece of ground. Every successive level requires the main shaft to be sunk deeper, and crosscuts and drives to be made for a very considerable distance before the ore is reached. This large amount of dead-work is a severe burden on the mine, and unless other shoots are discovered, or the present one enlarges in depth, will probably lead to its eventual abandonment, even though good ore should continue to be found". Subsequent reports show that Mr. Montgomery was right on every count; what is most significant to the present study is that the 0.3m thick vein persisted to a depth of 180m with no decrease in its thickness or in its tin content.

The Ben Lomond Mine is especially significant to and understanding of the Rex Lode. G. Thureau (1881) states that the 0.3m (1 ft) thick vein was "...highly metalliferous, and fully one-third of same is rich cassiterite". The vein was found to disappear at a depth of 10m (30 ft); a low-angle (20°) fault was found to be the cause and "...after some considerable search

the lode was found in the footwall side, but thrown for a distance of twenty feet to the west of the original course of the lode above the slide". By 1892 A. Montgomery reported that this mine had ceased operations, not because of lack of ore but because, "This mine is a standing example of a mistake which is far too common, and which ruins many promising ventures. The capital of the company has been spent on building a battery and doing dead-work of one sort and another before proving the mine itself". Apparently the vein was worked only to a depth of 30m (100 ft).

Ore Production from the Rex Mine

The production figures for this mine can at best be considered incomplete. P.B. Nye (1934) pieced together the sketchy figures; his information came from old annual reports, quarterly statistics and commissioner's reports. His very rough estimate shows that between the years 1899 and 1909, some 1355 tons of cassiterite was produced. I have estimated from information given in old reports concerning the vertical and horizontal extent of the workings that about 40,000 tons of ore was extracted. I based this figure on the calculated volume of ore removed, which is 500,000 cubic feet and the estimate that it would take 13 cubic feet of ore per ton of weight. If as reported, some 1355 tons of cassiterite was produced from 40,000 tons of ore, the average cassiterite content would be 3.4%.

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This figure sounds a reasonable estimate when one considers that initial production was on the order of 7% and final production from the No. 3 level (that is, final production for the Mt. Rex Tin Mining Company, not for the tributers who worked this level after 1909) was on the order of 1%.

When looking at these production figures, we must keep in mind that the lode was discovered prior to 1890; the Rex Hill Silver Mining Co. was producing ore from a small open-cut by 1890. The first production figures were not available until 1899. Ore was being extracted from the No. 1 level by 1901.

Dewatering the Rex Mine

I have estimated that approximately 500,000 cubic feet of rock has been removed from the Rex Mine. Water weighs 65 lbs per cubic foot, therefore some 16,250 tons or about 3,000,000 gallons (13,700,000 litres) of water now fills the old workings.

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Comments on the Literature Survey

As I read through the literature on the mines in the Ben Lomond District, I was impressed by several things which would make mining in 1890 a very different proposition to mining in 1978. The most important of these are listed below:

- 1) A pervasive pessimistic lethargy especially in the early days (1875 to 1919). The early literature is full of such comments as: "What struck me as very peculiar was that, although there were then some four or five hundred men at work in the district, no attempt had been made to form any township (not from a surveyed point of view). When new fields open, as a rule, buildings soon spring up, and a kind of township is soon formed; but there was no move in that direction here, so I looked around for some reason or reasons. I soon found them. It was considered that the tin mines would last but a short time, that the tin was confined to the watercourses, and that when the beds of the creeks were worked out that would end the field, and that the quantity of tin then being raised, would soon lower the price of the metal".

In contrast with other mining districts we find, "There were not any small parties working ground then (1876). Working men did not seem to have enough confidence in the field as yet. Europeans would not take the risks. Of course, when the Chinese were here, they were compelled to do something, and no other occupation was open for them". Quoted from Mark Ireland's book titled, 'Pioneering on the North-East Coast and West Coast of Tasmania'.

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Government geologist reports contain comments like, "The owners cannot be congratulated on their enterprise in working those promising sections, which have been held for four or five years and practically nothing done on them. It cannot be gainsaid that this field stands very ill in the public estimation at present, but it has been condemned without a fair trial, mainly on account of useless and extravagant expenditure on everything except the lodes themselves". Quoted from a report by A. Montgomery (1892) titled 'Report on the Ben Lomond District'.

- 2) The very difficult and very primitive conditions under which the mines were being worked; and the lack of interest by the government to provide even the basic public facilities. To quote Mr. Ireland again "The so-called cart road was in a frightful state. Broken-down drays were a common thing to see. The tin contents were left there without any watch upon them until a fresh dray was obtained. The road was all a pack-track and this track had to be seen to be believed, for mile on mile it was knee and belly deep for the horses. Another reason was that the government would not give any help in the shape of roads, and the opinion was that freights would keep up".

- 3) The very high transport costs. In about 1880, tin was selling for 75 pounds a ton in London, (all the tin from this district was sent to London) but it was selling for only 47 pounds a ton at the Tasmanian port of George's Bay. To transport the tin to George's Bay cost 13 pounds a ton; this left 33 pounds a ton. To quote Mr. Ireland, "So when freight and cartage were paid there was not much left per bag". A rapid calculation shows that transportation costs consumed 56% of the going price.

- 4) The over-development of the processing plants and the under-development of the ore bodies. To quote A. Montgomery (1892) concerning the Ben Lomond Mine, "This mine is a standing example of a mistake which is far too common, and which ruins many promising ventures. The capital of the company has been spent on building a battery and doing dead-work of one sort and another before proving the mine itself". The same author concerning the Story's Creek Mine, "The same mistake made by the Ben Lomond Company has been repeated here, a battery having been put up before the ore was in sight to keep it going". To quote G. Waller (1901) concerning the Rex Mine, "The company has lately erected a 20-stamp battery, with a complete concentrating and calcining plant, for the treatment of their ore. I am doubtful as to the wisdom of introducing a new machine like this on a mine which is just starting operations". And to quote A. McIntosh Reid (1928) also concerning the Rex Mine, "In the later days of the Company's operations, they were so fully occupied in breaking ore to keep the 20 head mill going that no attention could be given to development, with the inevitable result that no developed ore remained to be broken".

Hearsay

As in any mining district there are stories floating around the pubs about the rich shoot which was discovered and surreptitiously hidden to be rediscovered at a later date or about "the richest show ever, only if...". These stories go on and on and on; I've heard them in the Mother Lode Country in California, the Beryllium Mining Area of Arizona, in the Klondike and in Fairbanks Alaska; I've heard them in Kalgoorlie, on the Mitchell River in Northern Queensland and finally in the Ben Lomond District of Tasmania. Even though the validity of these stories can range from the blatant fabrication (and many times, obviously so) to a factually proven event or situation, I believe they should all be listened to, evaluated, and then accepted or rejected. The following are a few stories I collected about the Rex Mine;

- 1) Mr. R. Brinckman, the present leasee of the Rex Mine, talked with Mr. J. Stevenson in about 1962; Mr. Stevenson was about 95 years old at that time. Mr. Brinckman said he was still mentally alert. Mr. Stevenson was the mill manager for the Mt. Rex Tin Mining Co. prior to 1909; he reported that in 1908 before the mine went on tribute, they crushed 1000 tons of ore from the No. 3 level which averaged 1.4% tin. In 1913 when the leases were dropped by the company, Mr. Stevenson took them up himself and held them until about 1930. The crushing and concentrating plant had been sold off to the owners of the Royal George Mine so Mr. Stevenson attempted to get enough money together to buy a new plant. He never succeeded in doing this.

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He believed that in the north and south extensions of the ore-body as much tin ore remains as that already removed from the main lode. It appears that the final blow to Mr. Stevenson's attempt to re-open this mine was the washing out of the dam, in about 1930, which had been the primary source of water for the plant.

- 2) In about 1965 Mr. Brinckman was approached by the nephew of a Mr. Duncan, who had recently died. Mr. Duncan was one of the tributers who had worked the mine between 1909 and 1913. The nephew had inherited the Duncan estate and in amongst the papers which Duncan had filed away there was a letter dated 1934 and addressed to Mr. Gray, who was the leasee of the Rex Mine at that time. The letter was never mailed, but evidently it was Mr. Duncan's intention of giving information about the Rex Mine for a price. The letter stated that the "New Make" was rich stone which contained cassiterite only and no sulphides: It went on to say that this ore body was giving two bags of cassiterite to the ton of ore. This would be a 10% ore.
- 3) Mr. Brinckman was introduced to a Mr. Bailey who had worked on the plant of the Rex Mine when he was a boy. Mr. Bailey said he was present in 1935 when Mr. Rubenach, one of the tributers in 1909-1913, came up out of the mine with a sample of very rich tin ore.
- 4) Mr. Rubenach, who knew Mr. Dicker prior to the formation of the Brinckman-Dicker partnership, had told Mr. Dicker that if the opportunity ever arose to take a lease on the Rex Mine that he should do so because of the richness of the "New Make".
- 5) The Hercules Mine, which is quite near the Rex Mine, was reported to have been a "good" tin lode which disappeared completely and suddenly at a depth of 10 to 15 m.

Summary

Following is a list of the features which were used to support the conclusion that the upper 75 to 80 m of the Rex Lode has been sheared off and displaced some 80 m down-dip:

- 1) The radial and concentric fracture pattern within the Ben Lomond Pluton reveals that the southwestern quarter of the Pluton is overlain by Permian to Jurassic rocks.
- 2) The Ben Lomond Pluton has moved up through the overlying rocks to such an extent that only a thin layer of Permian rocks remain. The Triassic and Jurassic rocks have been eroded away.
- 3) The sinuous nature of the Castle Carey Fault, when seen in plan view, indicates that it is a low-angle planar feature, not a vertical fault as concluded by earlier, regional surveys.
- 4) All of the known lode deposits in and around the Ben Lomond Pluton were deposited in fractures which dip toward the center of the Pluton.
- 5) At each of these lodes (except for the Rex Lode) the predominant fractures also dip toward the center of the Pluton.
- 6) The predominance of low-angle faults, which dip away from the center of the Pluton within the granite and the dolerite along Buffalo Brook near the Rex Lode.
- 7) The predominance of fractures at the Rex Mine which dip away from the center of the Pluton.

- 8) In topographic profile, when a 20° dipping fault is inferred as present at the 75 to 80 m level on the Rex Lode (this is the level at which the ore-body disappeared) the fault line is found to intersect a major topographic step on the slopes of Mt. Rex.
- 9) The Permian sediments up on the slopes of Mt. Rex have been displaced 80 m at this topographic step.
- 10) The topographic slope in the vicinity of the Rex Mine parallels this inferred fault indicating that the present land surface near the Rex Mine is the upper surface of a fault bound, imbricate plate.
- 11) If the topographic slope at the Rex Mine is followed down-slope it intersects the Castle Carey Fault.
- 12) The very-distinct, arrow head shaped outcrop of Permian sediments on the top of Mt. Rex indicate that they have been dragged off to the southwest, away from the center of the Pluton.
- 13) The concentric fractures present in the Rex-Hercules Block have been tilted over to the southwest. Indicating that the block has moved to the southwest.
- 14) The diminution of a large diameter (21m) ore-body to extinction in a down-plunge distance of only 75 to 80 m, when other much smaller ore bodies in the district have extended downward at least three times this distance.

Conclusions and Recommendations

I have concluded, using the physical geologic features which I observed in the field; the facts, figures and inferences presented in the literature and the features present in my photogeologic interpretation, that low-angle, drag faults (so prevalent in the Mt. Rex area) have sheared off the upper 75 to 80 m of the Rex Lode and moved it at least 80 m down-dip. The lower continuation of the Lode would therefore be situated 80 m up-dip in a northerly direction from the, now mined out, upper part of the Lode. This lower continuation would be at a depth of 75 to 80 m below the present ground surface.

This location coincides reasonably well with the "New Make" ore-body at the end of the No. 3 Level Drive in the mine. Since this ore-body was not explored at depth, I recommend that it be core drilled; the initial holes should be near vertical, down through the floor of the chamber present at the end of the No. 3 Level Drive. Of course before drilling could be carried out, the 3,000,000 gallons of water now occupying the old workings would have to be pumped out.

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Rock Specimens

<u>Sample No.</u>		<u>Location</u>
R3	Greisen	From a leader located 100 m NE of the Mt. Rex shaft
R4	Greisen	From a leader located 60 m NW of the Mt. Rex shaft
R5	Sulphide Ore	From the old "main lode" ore-body
R9	Coarse Grained Granite	Located 75 m NE of shaft
R17	Quartz-Greisen with Cassiterite	From the core of the "main lode".