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ZEEHAN EXPLORATIONS N.L.

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MINES IN

ZEEHAN DISTRICT

M. D. GARRETT

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LOTUS-HILLS

1947

537001



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Zeehan 1-7

Introduction

AMG REFERENCE POINTS ADDED

537002

REPORT

ON

CURRENT ACTIVITY AT ZEEHAN

.. by ..

M. D. CASRETTY

March 4, 1947

C O N T E N T S

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Geophysical Work

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The North Spray Mine
The Bell Mine
The Ring Mine
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Unworked and partly worked Sidrite Lodes
The Silver Duke

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The time has arrived when several decisions have to be made concerning the Zeehan property. Accordingly, this Report has been prepared to give a conspectus of the present state of affairs in the field and to make specific recommendations concerning future operations.

RECOMMENDATIONS

In the text of the Report the following important recommendations are made :-

- (1) That the present Concession be converted to 35 leases and two further Special Prospectors' Licences acquired. Total cost will be approximately £540 for each of the two Companies.
- (2) That four mines be unwatered and examined, with a view to early production.
- (3) That several other mines be cleared out and sampled (no unwatering problem exists).
- (4) That several of the old mines of the field be diamond drilled.
- (5) That in view of the difficulties attending satisfactory drilling of the limestone blocks, the drilling programme in this portion of the field should be modified to take advantage of -
 - (a) any disclosures obtainable by sinking trenches or pits
 - (b) a geophysical survey.
- (6) That the sampling of the more important dumps continue, without prejudice to other operations.

would also suitably sites from which direct drill-holes could be drilled horizontally...ooooo...at the limestone at the Zeehan drilling programme was aimed at testing the same strata, since there is no known control of each

THE LIMESTONE PROBLEMDiamond Drilling Programme:

The difficulties being encountered in diamond drilling progress have been reported in earlier statements. The present position is that two diamond drill-holes - No. 9 and No. 10 - are being drilled as "test cases" to determine whether drilling in the limestone areas should be continued. The two drill-holes mentioned have been sited in the most favourable positions and are being drilled at the most favourable angle to overcome the difficulty of bad ground. If these drill-holes are successful, it is likely that drilling can be continued. If they are both failures, it is likely that further diamond drilling in the limestone would be ineffective.

While it is as yet too early to say that we must abandon diamond drilling in the limestone, it would be well to consider at this stage the possible alternatives. The digging of trenches and pits is to some extent a substitute method for exploring the limestone, but it has serious disabilities. In the first place, it is limited to limestone which actually extends near to the surface, and, in the second place, it can give little information as to the conditions in the more solid ground at depth. However, if trenches be dug at random through the limestone in the nature of exploratory cuts and also in particular on the known occurrences of mineralisation, it would be possible to delineate areas of the limestone which were sufficiently mineralised to warrant sinking exploratory shafts. With this warranty for their construction, the shafts would eventually reach solid ground below the oxidised zone or weathered zone. Once in this solid ground, they would afford suitable sites from which diamond drill-holes could be radiated horizontally to test the limestone at large. The diamond drilling programme was aimed at testing the limestone at random, since there is no known control or easily

obtainable control, for the occurrence of ore in the limestone. The proposed substitute method would mean that the existing mineralised patches in the limestone would be utilised as stepping stones to enable the exploration of the limestone to be more easily carried out.

Geophysical Work:

A more important aid to the testing of the limestone might possibly lie in the application of geophysics. The data obtained from the diamond drilling work already done - especially in the Oceana Lease - now provide a scale upon which any geophysical instruments may be calibrated. I have placed all the data available before the Commonwealth Chief Geophysicist, Mr. J. M. Rayner, and have discussed the problem with him. He has indicated that there is a very good chance that both the gravity meter and the electrical method might solve our problem, inasmuch as they would indicate the existence of ore at or near the surface. There is little hope that either method would be able to find ore at a greater depth than about 100 feet. However, that would not be vital, since our immediate problem in the limestone areas is to determine whether or not they contain bodies of ore at all. Accordingly, application has been made to the Department of Supply & Shipping for geophysical work to be carried out at Zeehan. Representations have also been made to the Premier of Tasmania (Mr. Cosgrove) suggesting that he should use his influence with the Commonwealth Government to have the work expedited, since there is a long programme of field work ahead of the Geophysical Survey officers. Mr. Cosgrove has taken the matter up with the Prime Minister. I have the impression that if the efforts to facilitate the work are successful there is a possibility that geophysical work may start at Zeehan at or about the end of April. Apart from incidental expenses, the work would be free of charge to the Companies.

Should the geophysical work succeed in indicating the presence of ore, this ore may be developed rapidly and some idea of the value of the limestone obtained thereby.

RE-OPENING OLD MINES

Much work has been done in the study of the old mines of the Zeehan field. The assembly of data from varied sources has been carried out chiefly by Dr. Loftus Hills working under my direction. The data have been carefully studied by us and have been assembled into a number of factual reports by Dr. Hills. These reports follow the text of this Report as an appendix. Although the reports are over Dr. Hills' signature, they have been written in detail with my approval and in any case consist chiefly of quotations and statements of fact assembled in chronological order. The conclusions and recommendations are logical deductions from the facts.

I do not propose to discuss each of the mines in this portion of my statement. It will be sufficient to call attention to the Spray Mine, which, perhaps, offers the most attractive features. This mine contains large ore shoots developed but incompletely mined on the one hand, and extending strongly below the bottom levels on the other hand. The reasons for the closing down of the mine in the past consisted chiefly of:-

- (a) The low price of metal
- (b) The fact that galena gave place to jamesonite - an antimony-rich lead sulphide - which could not be recovered in the gravity concentration mills.
- (c) The fact that antimony was heavily penalised by the smelters at that time, whereas today it would be the subject of a premium as it is present in considerable amount.

The Spray Mine offers an exceptionally strong case for re-opening, sampling and commencement of mining operations.

In all, four mines warrant unwatering and examination. They are -

The Oceana Mine - already diamond drilled in part

The Spray Mine

The King Mine

The Bell Mine.

The South Spray Mine should be cleaned out and sampled, but no appreciable unwatering problem exists. The North Spray Mine and the Nike Mine are primarily a diamond drilling proposition; there will be some unwatering but not very much. The King Mine, the Bell, the South Spray, and the North Spray all offer splendid scope for quick results from surface diamond drilling. The Spray Mine itself is scarcely suited to diamond drilling at this stage because of the depth of the workings and the disadvantageous situation in regard to topography. In passing, it may be noted that diamond drilling in these localities is not expected to encounter the same difficulties as those hindering operations on the limestone belt.

The unwatering and testing of the mines mentioned above should be commenced at once. I recommend that a first-class engineer be lent from the Broken Hill staff of one of the Companies to the Zeehan organisation for a short time to report in detail on the requirements. His report should consist of a statement of the machinery required for the operation, and estimates of cost for unwatering and examining each of the mines. The obvious advantage of considering unwatering and examining the mines as a group has led me to postpone recommending that the Oceana Mine should be developed until this report was being prepared.

Detailed study of the other mines of the field is in progress, but naturally the more attractive mines - as seen in the light of our present knowledge - were selected for the first study, and from these the mines mentioned above have been selected as worthy of being opened up.

From the above to a central mill and the cost of milling will be easily be less than 10/- per ton, including transportation of

D U M P T R E A T M E N T

While the treatment of existing dumps will necessarily be a small part of the ultimate Zeehan programme, it may at the same time occupy an important place in the early stages of that programme.

The work of sampling and estimating the tonnage of the dumps is, therefore, proceeding as an adjunct to, but without interfering with, the main programme at Zeehan.

So far 19 mullock dumps and 3 tailings dumps have been surveyed and sampled. The tonnage represented is 54,200. It may be assumed that the total number of dumps, which are believed to contain an appreciable quantity of lead, will amount to at least 100,000 tons. So far, samples have been assayed for only about 32,440 tons of the mullock or tailings dumps material. Lead assays in the mullock (excluding oxidized lead) range from 1.0% to 3.8% and in the tailings from 2.5% to 3.6%. The weighted average for the 32,400 tons is 2.0% lead, 2.25 oz. of silver per ton, and a small amount (about 1%) of zinc. Taking the price of lead at £60 Australian per ton and a mill recovery of 85%, the recoverable value of the lead and silver in the dumps would thus be of the order of 30/- per ton. That is, this is the net amount receivable after paying all smelting charges, freight, and the inevitable losses in milling. Naturally, this can be taken as only a round figure at this stage as the assay value of the remainder of the dumps is unknown. From the recoverable value, quoted above, must be deducted the cost of transport and milling of the dumped material and also an appropriate charge for the cost of erection of a mill to treat it. No estimates have been made, but it would appear that the cost of transporting the material from the dumps to a central mill and the cost of milling might easily be less than 10/- per ton, excluding amortisation of

of a low market price for lead. In calculating the recoverable

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As a preliminary speculation to serve for the time being until accurate estimates are available, it may, therefore, be supposed that profit of the order of £100,000 may be made from treating the dumps. From this profit must be deducted the cost of a suitable mill. It may be assumed that a mill to treat 500-1000 tons per week of this easily treated material might be built by the Companies for a sum in the neighbourhood of £10,000 to £15,000. Thus, even if the mill were of no use at the end of the dump treatment period, it could still have been completely written off from the profits made.

On the other hand, there is every reason to believe that the mill would serve for other purposes as well. Within the period during which the dumps were being treated it would be a useful medium for treating development ore from the old mines which are being opened up, and also for obtaining pilot plant tests on the metallurgical peculiarities of the ores being developed. If it should happen that the old mines of Zeehan which it is proposed to open up must supply most of the output of the field in the near future, then the mill which was put up to treat the dumps could probably handle quite well the output from those old mines. If large ore bodies are opened up in the limestone deposits, it will surely be necessary to have a mill with a larger capacity and this will have to be built; nevertheless, the experience gained in the smaller mill from the treatment of representative ores from the whole of the field will be invaluable in designing the later and larger mill.

The treatment of 100,000 tons, or thereabouts, of dump material over the next two years would result in an acceptable increase in the Australian production of lead - probably about 1,000 tons of lead per annum. It is also reasonable to assume that the venture would be quite free of danger of a low market price for lead. In calculating the recoverable

values mentioned earlier, the price of £60 Australian per ton was assumed. If the dumps were treated within the next two years it would appear likely that a higher, rather than a lower, price would apply. The lead produced is clearly an addition to Australian production and must be rated at the overseas price.

If assay results expected within the next few weeks should confirm the position outlined in this section, I shall recommend metallurgical investigation of the ore, with a view to the immediate design and construction of a suitable mill to treat the material. One result would be that from that point onwards the Zeehan enterprise would be self supporting.

LAND ACQUISITION

One of the terms in the option agreement between the two Companies and the Vendor provides that at the end of March the Companies shall supply the vendor with sufficient money to apply for leases which may be required by the Companies. In submitting his terms, the Vendor had in mind that the only leases required by the Companies would be those sufficient to cover the limestone area. It is now clear, however, that in addition to that area, the Companies will require rights over a much larger area embracing the older mines which have been shown to be interesting.

The area which has been studied and shown to be of direct interest to the Companies for detailed work, or for opening up mines, should be acquired under lease, and an accompanying diagram shows that the area required under lease will consist of thirty-three 80-acre leases, one 50-acre lease and one 40-acre lease. The approximate cost of these leases will be £1069, or £535 for each of the Companies, as against the originally expected £240.

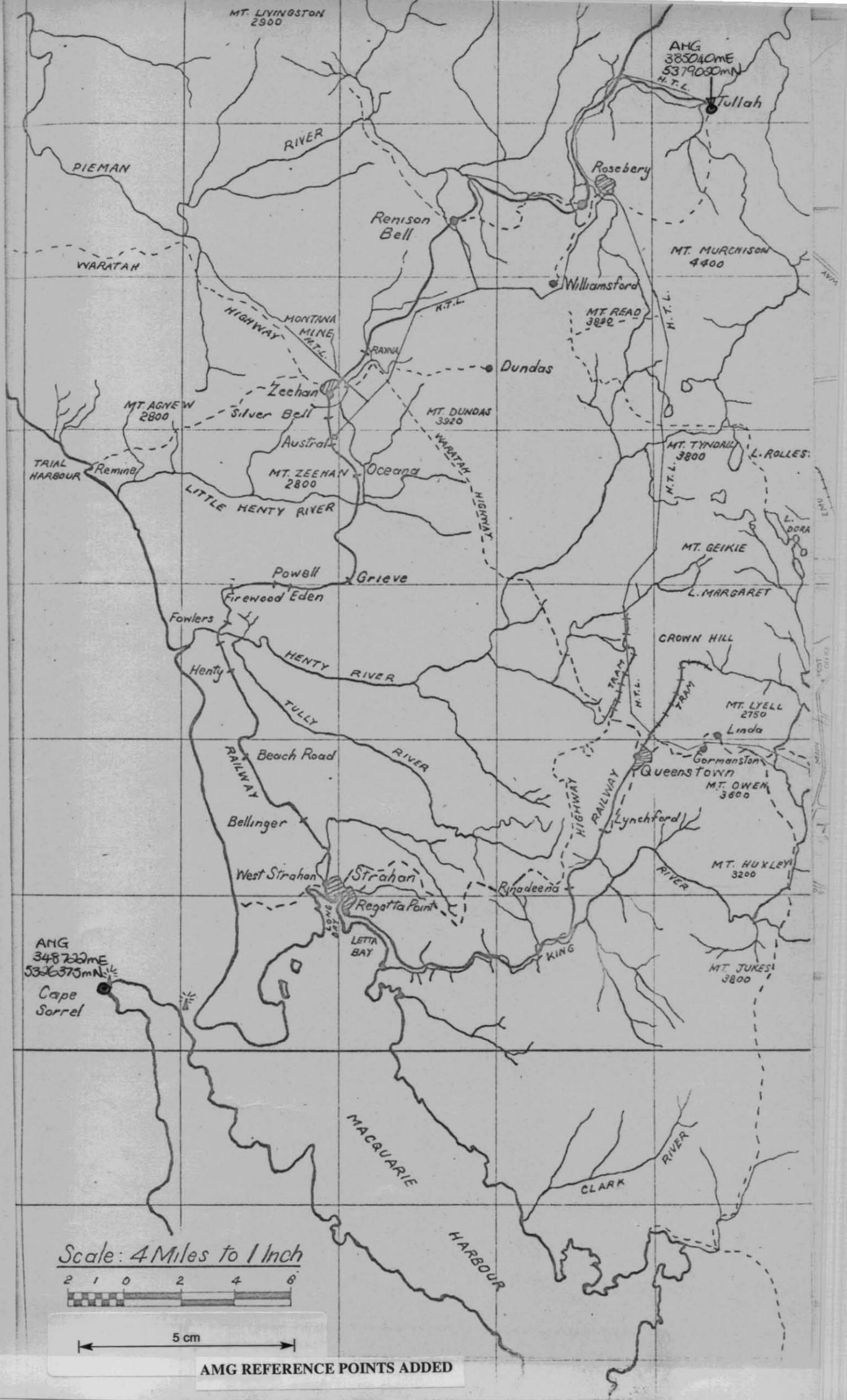
In addition to the leases, it is recommended that the Companies apply through officers on their staff for two

Special Prospector's Licences. The two areas required under Special Prospecting Licence are also shown on the diagram. The western area would consist of about 4,000 acres and the northern area of 2,400 acres. Sufficient is not known of this country to warrant taking it up under lease; on the other hand, and for the same reason, it is most undesirable to throw this land open for general public pegging. This is particularly so in the case of the western area, because the Electrolytic Zinc Company is showing an increasing interest in that area. In the northern section there are a number of ore occurrences which have not yet been examined but which may prove to be of considerable importance to this enterprise in the future.

In the case of both of the Special Prospector's Licence areas there is some work required in them near the boundary of the lease areas. In this way the Companies will be able to fulfil the expenditure conditions of the Concessions without undue difficulty. Any area held under Special Prospector's Licence is subject to rigorous conditions of expenditure and employment of labour. It is suggested that the areas be applied for by Mr. Klug and Mr. Liebelt, who are on the Companies' staff at Zeehan. The cost of the Concessions will be £1 each.

It would not be practicable to take up the whole of the area required in the field by means of Special Prospector's Licences. The area recommended for pegging as applications for leases should be claimed under Lease rather than by Special Prospector's Licence for the following reasons:-

- (a) The area has already been held under Special Prospector's Licence by the Vendor for the full legal time with all extensions. It is very doubtful whether an application for a Concession, even by the Companies, would be successful.
- (b) Land applied for under Lease is practically certain to be granted. Land applied for as a Concession under Special Prospector's Licence need not be granted if objections are lodged by other parties.

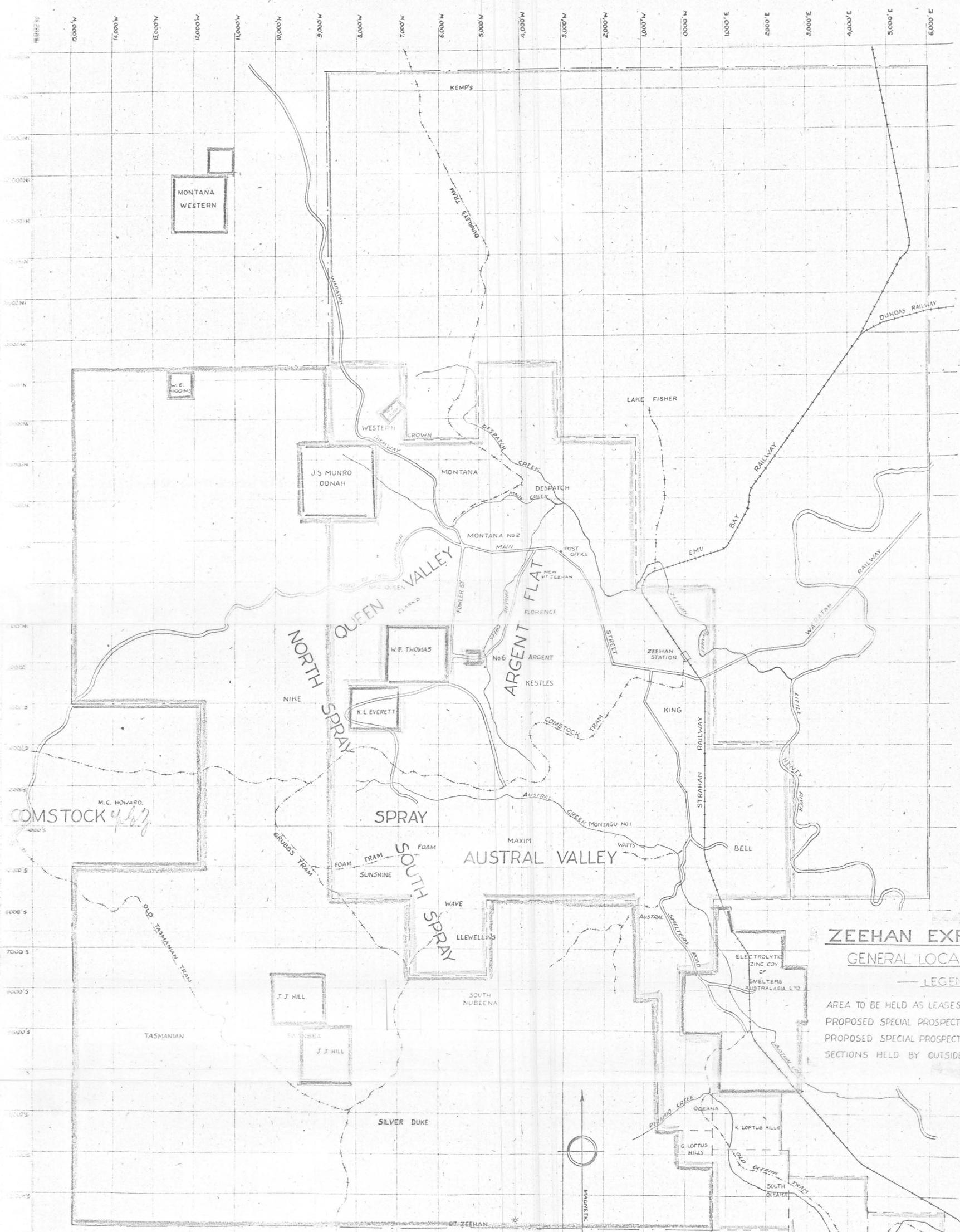


Scale: 4 Miles to 1 Inch



5 cm

AMG REFERENCE POINTS ADDED



ZEEHAN EXPLORATIONS
GENERAL LOCALITY PLAN
 — LEGEND —
 AREA TO BE HELD AS LEASES
 PROPOSED SPECIAL PROSPECTOR'S LICENCE N°1
 PROPOSED SPECIAL PROSPECTOR'S LICENCE N°2
 SECTIONS HELD BY OUTSIDE INTERESTS

5 cm

(d) South Spray:

This is a description of the occurrences southwards from the Spray along the continuation of the Spray Shear Zone. Gives an outline of the workings which have located the lode and shear over a length of some thousands of feet.

(e) The Western:

Making no attempt at anything approaching a complete description of this mine, this report sets out to draw attention to the character of the lodes in the deeper levels. It is emphasised that they were not barren siderite lodes but carried tetrahedrite and chalcopyrite in an amount which may constitute the basis of future mining operations.

(f) North Spray:

Under this title the group of lodes in the Nike and vicinity is dealt with and the possibility suggested that a large low-grade proposition may exist here. It is pointed out that galena occurs between the lodes in the network as fillings of cleavages and joints in the slate.

(g) Florence Hill - Argent Flat:

The scope of this report is greater than any of the others as it covers all the Mines along the Florence Hill and, excepting Nos. 2 and 4 Argent, all those on the Argent Flat.

Mine plans of Florence, New Mount Zeehan, State and No. 6 Argent are presented. In addition a Composite Plan of the whole area on a scale of 100 feet to 1 inch is included. This shows the geology and structure, together with the mine workings nearest to 500 feet above sea-level. Incidental to this, the scheme has been adopted of making this 500 feet above sea-level the basis of presenting mine workings in all such composite plans.

(h) Manganese Hill:

This report incorporates all available information on the workings and problem of this locality. The composite plan illustrates the conclusions as to geology and structure arrived at in the context. Such interpretations as are there given are not regarded as the last word on this, as yet, in-

possibilities which compel future close attention.

The composite plan is an extension southwards of the Florence Hill - Argent Flat plan.

(i) Montana No. 2:

This report extends the Florence Hill - Argent Flat composite plan northwards and north-westwards. It presents the whole story of the Montana No. 2 and surroundings and includes a complete mine plan. The composite plan embraces the old workings of the Queen No. 5 to the westwards, thus linking up with the Zeehan - Queen area.

(j) Zeehan - Queen:

This embraces the original Silver Queen workings, including the Clarke's composite galena-stannite lode. Disconnected mine plans have been correlated and joined into one plan. The additional composite plan shows geology and geologic structure.

(k) Unworked and Partly Worked Siderite Lodes:

This report was written to draw attention to the existence of siderite lodes which for various reasons were either not worked or only worked to a few feet. They are therefore available for exploitation and could repeat the productive but depth-limited history of the old Zeehan siderite lodes. They are divided into two groups - the Town Group and the Austral Valley Group.

(l) Silver Duke:

In view of information in Waller's Report this old prospect was found and examined and the report covers the reasons for doing nothing further.

(m) Sunshine:

Located in the western portion of the area, just west of the Spray, this occurrence is yet to be investigated and all data assembled in standard form.

(n) The Austral Valley:

In preparation.

(o) Montana No. 1:

In preparation.

(p) The Oonah:

In preparation.

3. OLD MINES IN LIMESTONE.(a) Oceana:

This is a comprehensive presentation of all available information on this mine with plan and longitudinal section.

(b) South Oceana:

Being nothing more than a preliminary statement this report was prepared in order to place on record and draw attention to an ore occurrence which is recorded in no literature or official record and not even in the Z. & D. Herald.

(c) Pyramid:

A preliminary statement on an ore occurrence as replacement of limestone which was only pin-pricked to 40 feet depth, but which has definite promise. A later short note, accompanied by a sketch plan, proposes an exploratory diamond-drill hole.

(d) Rotunda:

Under this title is presented a compilation of all the information available as to ore-occurrences in the vicinity of the main business centre of Zeehan. There is a large number of these and they are all recorded and plotted. The mine workings of the old King Extended mine and the easterly workings of the old Mount Zeehan are included. The composite plan embraces them all.

(e) Despatch:

The area dealt with in this report is the northward extension of the Rotunda area. It embraces the old Despatch mine, the workings of which are shown in the composite plan illustrating the report. The report incorporates all ascertainable facts concerning this long-abandoned area.

(f) Tasmania Crown:

There are two reports on this proposition. The first is no more than a preliminary note drawing attention to the occurrences and their possible importance.

from old records and plans. The composite plan covers the area northwards from that included in the Despatch report. It shows geology and structure and the mine workings. The latter are shown at various levels in separate colours, being thus a departure from the standard practice of showing the 500 ft. contour workings in black.

(g) Austral:

The dual problem existing in this area is presented with all available data culled from all sources. The two types of ore occurrence - galena and sphalerite in limestone and black pug, and the limonite-haematite-psilomilane bodies carrying lead and silver - are dealt with and their relationship to the structure indicated. The composite plan includes the underground workings of the old Austral mine reconstructed from old reports.

(h) Montagu No. 1:

This old mine worked for lodes in the Keratophyric Tuffs encountered replacement deposits in limestone. This limestone is about 150 feet below the surface. All ascertainable data are presented including a plan of the old underground workings.

(i) Kemps:

This is another preliminary statement on ore in limestone on which very little work has been done.

4. SPECIAL REPORTS.

(a) Old Zeehan Mines:

This report is of the nature of a general review of all Zeehan Mines regarded as providing opportunity or justification for working under present economic conditions. The mines are classified in the following categories -

- Mines Warranting Re-opening.
- Mines to be held Provisionally.
- Mines with No Immediate Attraction.

(b) Glossary of Terms Used in Old Zeehan:

As the study of Zeehan progressed it became apparent that quite a number of terms were used in the active mining days of Zeehan which could not be interpreted correctly by

applying meanings of the present day or of other fields.

(b) It was accordingly thought desirable to record these and give the exact meanings they used to have.

This glossary is essential to anybody starting to read the old records and literature of Zeehan.

(c) Zeehan Propositions Awaiting Attack:

This is a review on similar lines to (a) above, but prepared towards the close of 1949. It brings consideration up to date and incorporates the results of the investigations completed up to the date of writing. Each proposition is presented on a standardised basis designed to indicate the factors bearing on any decision as to their relative desirability of attack.

(d) General Review of the Behaviour of Zeehan Lodes:

In preparation.

5. SPECIAL MAPS

(a) The Zeehan Fracture Pattern:

This was compiled quite early in the investigation from available underground plans. Each lode was mapped as at 500 feet above sea-level. While giving a general picture, the present state of our knowledge used in the preparation of a similar map would involve some modifications.

(b) Production Map:

The distribution of the past production of lead at Zeehan is depicted by red circles in units of 1,000, 100 and 10 tons of lead placed along the respective lodes. These are plotted on a map on a scale of 400 feet to 1 inch, produced by enlarging Professor Carey's first photogeological map.

(c) Lode - Structure Relationship:

Similarly plotted on the 400 feet to 1 inch map are the lodes, ore-bodies and mineralised zones. Also shown are the faults as deciphered by Professor Carey in his first edition of the photogeological map.

This was a step forward in our understanding of this

this nor a similar map if produced now shows the story in full.

(d) Geological Map:

Again using 400 feet to 1 inch map, advantage was taken of Professor Carey's geological boundaries. The first attempt was made to subdivide the Cambrian sequence. While in general this was correct, further study shows many modifications as necessary. Some of these have been incorporated in the more recent composite maps of areas such as Florence Hill - Argent, Lechan - Queen, etc.

5. REPORTS ON MINE DUMPS

There are five of these reports. They are intended to indicate those dumps which, after a close examination of the exposed contents, seemed to contain enough galena to warrant sampling. Both mullock dumps and tailings dumps are included. The former are numbered in numerical sequence with the prefix M, while the tailings dumps have their own sequence with prefix T.

Since those reports were prepared, evidence has been obtained that the big Montana No. 1 Dump is worth sampling. The exterior of this dump is misleadingly barren rock representing the sinking and driving from the 400 feet level to the 800 feet level.

6. INDEX MAP.

As an index to all these reports a map is to be prepared showing the locations and areas covered. This is in preparation.

C. LOFTUS HILLS.

4th January, 1950.

OLD ZEEHAN MINES.

PRESENT RELATIVE IMPORTANCE.

1. HISTORIC BACKGROUND.

In the OLD ZEEHAN MINES, 19 mine after mine as Zeehan closed down. By 1913 the Zeehan was complete, and with the exception of the mine (1913-1923) and the Sunshine 1923 and 1931, no mines have operated since.

1. HISTORIC BACKGROUND. loss of a depth of anything up to

500 feet in these mines and to any appreciable depth gave rise

2. GEOLOGIC BACKGROUND.

to the fact that the probability that the Zeehan lodes

(a) Structure.

changed at a certain point to a site without any value.

(b) Lode Composition.

Twelve years ago it was attempted to change such a

gene 3. MINES WARRANTING REOPENING. recurring ore-shoots, but

signally failed to re-open the mining community.

4. MINES TO BE HELD PROVISIONALLY.

Recent work on the Zeehan, however, have produced evidence

that 5. MINES WITH NO IMMEDIATE ATTRACTION. as possess characteristics

and possibilities pointing to an economic importance not previously realized.

2. GEOLOGIC BACKGROUND.

(a) Structure. A study of the fracture pattern has disclosed criteria for selecting those lodes possessing characteristics favourable to persistence.

There have also been striking indications of the existence of unutilised shatter zones which are potential mining propositions larger than those so far worked in the past.

(b) Lode Composition. From a study of the lode material throughout the Zeehan field there has emerged the classification of the Zeehan lodes into two distinct types. The more important of these is characterised by a siliceous gangue. The other type is that which in the past has been regarded as the typical Zeehan lode - possessing a siderite gangue. Examples of the two types are Spray (siliceous) and Montanz (siderite).

There has also emerged a realization of a vertical change in the nature of the metallic constituents of the lodes. Such a change is clear-cut and impressive. In the spray it takes the form

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OLD ZEEHAN MINES.

PRESENT RELATIVE IMPORTANCE.

1. HISTORIC BACKGROUND.

In the few years preceding 1913 mine after mine at Zeehan closed down. By 1913 the debacle was complete, and with the exception of the Nike (1915-1926) and the Sunshine 1923 and 1931, no mines have operated since.

The disappearance of galena at a depth of anything up to 300 feet in those mines worked to any appreciable depth gave rise to the fixation in the mining community that the Zeehan lodes changed at a shallow depth to siderite without any galena.

Twelvetees and Ward in 1910 attempted to change such a generalisation into a broader view of recurring ore-shoots, but signally failed to convince the mining community.

Recent studies at Zeehan, however, have produced evidence that certain of the lode groups and lode-types possess characteristics and possibilities pointing to an economic importance not previously realised.

2. GEOLOGIC BACKGROUND.

(a) Structure. A study of the fracture pattern has disclosed criteria for selecting those lodes possessing characteristics favourable to persistence.

There have also been observed striking indications of the existence of mineralised shatter zones which are potential mining propositions larger than those on the lodes worked in the past.

(b) Lode Composition. From a study of the lode material throughout the Zeehan Field there has emerged the classification of the Zeehan lodes into two distinct types. The more important of these is characterised by a siliceous gangue. The other type is that which in the past has been regarded as the typical Zeehan lode - possessing a siderite gangue. Examples of the two types are Spray (siliceous) and Montana (siderite).

There has also emerged a realisation of a vertical change in the nature of the metallic constituents of the lodes. Such change is clear-cut and impressive. In the Spray it takes the form of a

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change from galena to a mixture of jamesonite and tetrahedrite immediately below the No. 4. Level (R.L. 500 ft.) In the Western Mine it is a mixture of chalcopyrite and tetrahedrite which takes the place of galena from just below the No. 5. Level (R.L. 425 ft.)

It was the refractory nature of such ore opened up in the lower levels which was the deciding factor in determining the abandonment of the Spray and Western mines (both closed down in 1908)

3. MINES WARRANTING REOPENING.

In regard to certain of the old mines at Zeehan the stage has been reached of deciding that the reopening of them is justified. This applies to the following mines. The nature of the initial operations is indicated in each case:-

SPRAY: Clean out "A" and "E" Adits.
Unwater from No. 1. and Internal Shafts.
Systematic sampling.

KING: Unwater.
Systematic sampling.
Geological Survey.
Diamond-drilling from surface.

BELL: Unwater.
Systematic sampling.
Geological Survey.
Diamond-drilling from surface.

SOUTH SPRAY:
Clean out and open up all adits.
Systematic sampling.
Detailed geological survey.
Diamond-drilling from surface.

NORTH SPRAY:
Clean out Quigleys and Low-level adit.
Unwater.
Systematic sampling.
Crosscutting, Diamond-drilling.

4. MINES TO BE HELD PROVISIONALLY.

There are several other old mines which, while disclosing interesting possibilities, do not come within the category of mines for definite immediate action. They require further study before a precise method of attack can be designed or even a decision made as to whether or when they should be dealt with. Pending such decisions, however, it is desirable to hold them.

They can be specified thus:-

WESTERN: Possibility of working from the No.6. Level downwards as a copper-silver proposition.

TOWN LODES: Five lodes in Main Street with galena at surface awaiting freeing from the town

FOWLER STREET LODE: Ready to open up under 'Authority to Enter'.

LOCATION OF LODES

AUSTRAL VALLEY: At least 11 lodes partially worked by hand picking.

5. MINES WITH NO IMMEDIATE ATTRACTION.

A general study of the remaining old mines of Zeehan has disclosed no outstanding attraction. It cannot be accepted, however, that more detailed study or future developments and disclosures at Zeehan may not indicate possibilities. Nevertheless that eventuality at present appears too remote to justify holding the ground at this juncture.

But it is important to have the full stories of them complete with plans available for future eventualities. It is intended that Dr. Loftus Hills should carry this work to its final conclusion.

- (i) General Characteristics.
- (ii) Geology Sheets.
- (iii) Jamesonite Sheets.
- (iv) Grade of Ore Mined.

7. MINE WORKING

- (a) Adits.
- (b) Shafts.
- (c) Drifts.
- (i) No. 1. Lode.
- (ii) No. 2. Lode.
- (d) Crosscuts.
- (i) No. 1. Lode.
- (ii) No. 2. Lode.

8. DISCUSSION OF FERTILITIES.

- (a) Available Ore.
- (i) China.
- (ii) Antimonial-lead-silver.
- (b) Diamond Drilling.
- (i) Surface Contours relative to Objectives.
- (ii) Character of Objectives.

RECOMMENDATIONS

THE SPRAY.1. LOCATION AND ACCESS.2. HISTORY.3. OUTPUT AND PROFIT.4. GEOLOGIC ENVIRONMENT.

- (a) Country Rock.
- (b) Position Relative to Regional Structural Pattern.
- (c) The Shears.

5. THE LODES.

- (a) Number and Spacing.
- (b) Proved Length and Width.
- (c) Orientation.

6. THE ORE.

- (a) Character of Lode Material.
- (b) Constituent Minerals.
- (c) Ore Shoots.

- (i) General Characteristics.
- (ii) Galena Shoots.
- (iii) Jamesonite Shoots.
- (iv) Grade of Ore Mined.

7. MINE WORKINGS.

- (a) Adits.
- (b) Shafts.
- (c) Drives.
 - (i) No. 1. Lode.
 - (ii) No. 3. Lode.
- (d) Crosscuts.
 - (i) No. 1. Lode.
 - (ii) No. 3. Lode.

8. DISCUSSION OF POSSIBILITIES.

- (a) Available Ore.
 - (i) Galena.
 - (ii) Antimonial-lead-silver.
- (b) Diamond Drilling.
 - (i) Surface Contours relative to Objectives.
 - (ii) Character of Objectives.

9. RECOMMENDATIONS.

OLD MINES ON ZEEHAN LODES.

and the crude ore was milled to a profit and was placed down in February 1903, and has never been reopened.

THE SPRAY.1. LOCATION AND ACCESS.

This mine is situated 110 chains S.S.W. of the Zeehan Post Office. The No.1. Shaft and the adits are located at the head of the Austral Valley. The lodes are within the high hill to the south of the valley-head. The summit of that hill is at the 1,200 ft. contour while the collar of No.1. Shaft is at the 810 ft. contour.

Access to "A" Adit and No.1. Shaft is by means of a tramway formation from Main Street at the Argent Flat. The tramway passes under the ridge on the north side of the valley along which the Comstock Tram runs by means of a tunnel 300 ft. in length.

2. HISTORY.

The success of the Spray Mine starts from the discovery in early 1898 of the No.1. Lode by Messrs. McDermott and Page. At that time the area was included in the Consolidated Lease of the Mount Zeehan (Tas.) Silver-Lead Mines Ltd. A tribute was let to McDermott and Page whose work demonstrated the value of the lode. The company then proceeded to develop both No.1. Lode and No.3. Lode which was also found by tributors.

In the period 1898-1908 the Spray was the most productive and profitable mine at Zeehan. During that period the lodes were explored over a total length of 1,400 feet and down to a depth of 450 ft. below the collar of the Internal Shaft. The Spray's record is the best of all the mines so far worked at Zeehan.

Towards the end of 1908, with the exhaustion of the rich galena shoots above No.4. Level, the position was reached wherein the future operations must depend upon the antimonial-lead ore (jamesonite-tetrahedrite mixture) disclosed as taking the place of the galena just below No.4. Level and extending downwards to Nos. 5 and 6 Levels. As this ore could not be successfully milled

and the crude ore was unsaleable at a profit the mine was closed down in February 1909, and has never been reopened.

3. OUTPUT AND PROFIT.

The total output has been:-

Lead 45,000 tons.
Silver 4,000,000 ozs.

The total profit made was £320,000. Of this sum £170,000 was paid in dividends and £150,000 was spent on exploring other properties.

4. GEOLOGIC ENVIRONMENT.

(a) Country Rocks. The lodes occur in the Ordovician rock series. Except in the extreme northern end the rock types are quartzites and slates. To the east of No.1. Lode slates predominate but westwards towards No.3. Lode quartzite is the dominant rock-type.

"The west wall of No.1. Lode is hard quartzite and the eastern country is slate". (1)

"The ore always makes on the west wall. There is only one wall to the lode all through". (2)

"The lode only makes one wall. No wall on other side. The west wall is the only one and on the opposite side there is no clear division between lode and country". (3)

In the northern end of the workings at Nos. 2, 3, 4, & 5, Levels the interbedded old lava flow (melaphyre, spilite, or "bile-bean rock") was encountered.

(b) Position Relative to Regional Structural Pattern. The rock series shows the folding and contortion characteristic of the Ordovician. For example, the exposures in "A" Tunnel are described by Twelvetrees (4) :-

"The dip of country is first to East, then to West, and the beds are often contorted. The general dip however, is to East. Further in it changes and flat bedding is often prevalent". and

"Just before reaching No.4. Lode the strata strike West and stand on end".

(5) At the surface, bedding planes in the slates can be found at any angle to the cleavage.

- (1) W. H. Twelvetrees "Field Notes" 1909 P.3.
(2) " " " " " P.8.
(3) " " " " " P.7.
(4) " " " " " P.5. & 6.

An outstanding feature demanding explanation is the fact stated by Twelvetrees⁽⁵⁾ and confirmed by McDermott:-

"No alteration in the country rock in the No.2. Shaft right down. Quartzite on West side and slate on the East".

The vertical distance involved is 450 feet.

The Spray mine locality lies between the Balstrup and Nubeena Tear Faults as depicted in the Zeehan Geologic Structure Map.⁽⁶⁾ These two tear faults are shown as converging from the westwards. The country between them must have been subjected to pressure in a general north-south direction, and could be expected to show evidence of shearing. In actual fact Nos. 1 and 3 Lodes are definite shears. Waller⁽⁷⁾ describes them thus:-

"The walls are usually grooved or striated in a nearly horizontal direction, but inclined slightly to the north".

(c) The Shears. Too little is known of Nos. 2 and 4 Lodes to justify any opinion as to whether they are shears or the more common tension cracks. But there is no doubt that Nos. 1 and 3 Lodes have been deposited along shears or shear zones.

The general strike is 332° and the mine plans show very little deviation from that bearing. Both shears are nearly vertical, the upper portions as disclosed in the mine workings having a small inclination eastwards, but the lower portions showing a somewhat more definite tendency westwards.

Horizontally the greatest proved extension of the shears is 1440 feet at the A and E Tunnel Levels. At the No. 4. Level No. 1. Shear has been followed for 1200 feet without finding the northern or southern limits. No. 3. Shear has been followed for 720 feet at the A and E Tunnel Levels; it shows bifurcation at the southern end but still persists at the northern end.

(5) W. H. Twelvetrees "Field Notes" 1909 P.4.

(6) C. Loftus Hills "Submission of Zeehan Project to North Broken Hill Ltd." 1946. Drawing No.2.

(7) G. A. Waller "Report on Zeehan Field" 1904 P.79.

"the No. 3. lode was 30 feet wide."

"At least one lode is 4 feet wide with 2 feet of high-class ore, and it is 10 feet wide down to 3 inches of ore. It is a splendid continuous lode."

5. THE LODES.

(a) Number and Spacing. There are four (4) lodes within a width of 590 feet. No. 1. Lode is the most easterly. No. 2. Lode is 195 feet west of No. 1. No. 4. Lode is 450 feet west of No. 1. No. 3. Lode is 590 feet west of No. 1.

(b) Proved Length and Width.

(i) No. 1. Lode

(a) Orientation. Nos. 1. and 3. Lodes follow the shears.

Length:-

At Adit Level:	1440 feet.
" No. 1. " "	1510 "
" " 2. " "	1140 "
" " 3. " "	1320 "
" " 4. " "	1200 "
" " 5. " "	1215 "
" " 6. " "	690 "

(both N. & S. faces showing strong Lode.)

In addition to Width:-

"The lode in the lower levels maintains an average width of about 10 feet. The full width is not taken in driving but it does not vary much wherever they have proved it." (8)

(ii) No. 2. Lode. At all levels, the lode being about 8 to 10 feet wide.

Length:- At adit level: 70 feet.

Width:- (quoting internal report, manager, Spray Mine):-

"First came on small split in No. 1. and in the adit. Split dipping to E. split in W. direction. Have picked (iii) No. 3. Lode all the levels. A very rich bunch at the junction of the side. Three years ago got a rich bunch at the split of the lode. Stopped out the ore across the wires."

At G. Tunnel Level: 780 feet.

If twelve feet "Adit" level: 720 feet.

" No. 3. " " 645 "

Width:-

"It is 28 feet wide". (9)

Twelvetrees "Field Notes" 1909 P.4.

" " P.6.

" " P.7.

Waller "Report on Zeehan Mining Field" 1904 P.82.

"The average width of the ore carrying part of the lode is 2 feet. It may be said to consist of a series of bunches or pockets of lenticular form, and disappearing and making alternately". (10)

W. Walford an old Zeehan resident who worked in the Spray Mine states that

"the No. 3. Lode was 30 feet wide."

"At best the lode is 4 feet wide with 2 feet of first-class ore, and from this it tapers down to 6 inches of second-class ore."

(iv) No. 4. Lode. (14)

Length:-

At Adit Level: 50 feet.

Width:-

Apparently small.

"This is a well-defined formation, consisting of mullocky lode-matter, with strings of iron carbonate and antimonial galena". (12)

(c) Orientation. Nos. 1. and 3. Lodes follow the shears.

Their general orientation is therefore 332° . The only marked variation from this orientation is at 120 feet north of No. 2. Shaft where No. 1. Lode deviates 12° - 15° from the general bearing for a distance of about 250 feet, beyond which it resumes its normal course.

In addition there is the rather obscure reference to "the split" in Twelvetrees "Field Notes". Waller does not mention it and McDermott has never heard of it. Walford states that at anything from 30 to 100 feet north of the Internal Shaft they met a break or split in the No. 1. Lode at all levels, the lode being offset 3 to 10 feet. This may or may not be "the split" referred to by Twelvetrees. This is what Twelvetrees says (quoting information from Mr. T. Vincent, Manager, Spray Mine):- (13)

"First came on the Split in No. 1. and in the adit. Split dipping to S. Split in N.W. direction. Have picked the split up in all the levels. A very rich bunch at the junction 11 ft. wide. Three years ago got a rich bunch of ore at the split of the lodes. Stopped out the ore between two winzes."

If Twelvetrees "split" corresponds to Walford's "break" there is some confirmation of it in the mine plan at Nos. 1, 3, 5, and 6 Levels where offsets or bulges in the drives show a south-dipping effect. This south dip actually brings the effect south of the Internal Shaft at 5 and 6 Levels.

Another local and limited departure from the regular orientation is mentioned by Twelvetrees. He states:-

"Crosscourses is Nos. 5. and 6. These carried a very little galena. The branch was never seen above No. 4. Strike about $W.50^{\circ}N$. Nothing payable found in it. The lode has a

(12) G. A. Waller "Report on Zeehan Mining Field" 1904 P.81.

(13) W. H. Twelvetrees "Field Notes" 1909 P.2. "Report on"

tendency to branch again further on in the same level and in same direction." (14)

"In Nos. 4. and 5. Levels north the lode turns W. This is rather a poor branch. They then picked up the east wall of the lode with ore going 60 oz. and 7%. No sign of it (the ore C.L.H.) in No. 4. The main channel continued towards the No. 1. Spray shaft". (15)

"Never saw galena in No. 5. drive. The W. branch of No. 5. carried lead ore 3 or 4 stopes up. The E. branch never carried lead ore. It is 4 ft. wide antimonial ore and siderite - the first place where there was any distinction between antimonial ore and lead ore". (16)

It would thus appear that Twelvetrees' reference to "Crosscourses in Nos. 5. and 6." should read "Crosscourses in Nos. 4. and 5." It seems scarcely likely that they are "cross-courses" similar to those in the Montana etc. On the evidence it would at present be preferable to regard them as "caunters" associated with the shears at Kalgoorlie for example.

In regard to No. 3. Lode the only recorded deviation from the regular direction is the split at the extreme southern end at Adit Level. This is shown in mine plans.

This marked regularity in orientation of the Spray Nos. 1. and 3. Lodes differentiates them from the majority of the Zeehan lodes. Twelvetrees describes the general run of Zeehan lodes thus (17):-

"The sets of lodes at Zeehan form a complex series branching and anastomosing in a network fashion, so that any particular lode cannot be followed far along a course the having any definite bearing".

Four years later Waller, after a study of the Spray lodes (which Twelvetrees had not seen in 1900), recognised their contrast to certain of the Zeehan lodes by describing them thus (18)

"The lodes of the Spray Mine present a remarkable contrast to those on the adjoining sections to the north. In the latter the lodes are very numerous, but they are for the most part small, irregular, ill-defined and patchy. The good lodes on the Spray section are, on the other hand, fine, well-defined fissure-formations, running parallel with one another, and maintaining a true course throughout".

This contrast is illustrated in the accompanying drawing which depicts on the same scale the No. 4. Level on No. 1. Spray Lode alongside a typical lode in the Montana mine, viz. the No. 2. Lode at the No. 5. Level.

(14) W. H. Twelvetrees "Field Notes" 1909 P.4. (18) G.A. Waller
(15) " " " " " " P.3. "Report on Zeehan
(16) " " " " " " P.8. "Silver-Lead Field"

6. THE ORE.

(a) Character of Lode Material. Neither Waller in 1904 nor Twelvetrees and Ward in 1910 described the nature of the lode material. The mine being now under water the only source of specimens of lode-matter is the mullock dump.

Based on this limited scope the impression evolves that the ore is dominantly of replacement origin. This would seem to be confirmed by previous quotations from Twelvetrees' "Field Notes" to the effect the West Wall is the only true wall there being no defined eastern limit to the ore. (1) (2) (3)

The lode material seems to be fundamentally siliceous, the constituent minerals being distributed in this groundmass.

(b) Constituent Minerals. Galena, jamesonite, and tetrahedrite are the important metallic minerals of the primary ore, with pyrite and sphalerite as accessories, and argentite as a much rarer accessory. (19) Quartz is the principal gangue mineral, with siderite as a variable accessory. Chalcopryite occurs occasionally being mostly in siderite.

"Never had any tin in their ore. Had copper pyrites. One piece = 12% Cu. Never got copper in the clean ore; only in the siderite. Once a little copper was got in the galena. It rarely occurs in the lead ore. It went 12% Cu. and 80 oz. Ag." (20)

(c) Ore Shoots.

(1) General Characteristics. A study of the longitudinal section on the No. 1 Lode workings shows that there were two outstanding shoots of ore - the North and South Shoots - with an indication of a Centre Shoot making its appearance at the northern end of No. 6 (the deepest) Level.

At its maximum the South Shoot was 720 feet in length and at the No. 6 Level it is known to be 450 feet in length. The North Shoot had a maximum length of 300 feet, the length at No. 6 Level being about 150 feet.

The interpretation of the ore shoot or shoots in No. 3 Lode is not so clear. At the Upper Levels a length of 700 feet was mined. At the Adit Level it was mined over a length of 500 feet. The position at No. 3 Level (lowest level on No. 3

(19) W.F.Petters "Catalogue of Minerals of Tas." 1910 p.12.

(20) W.A.Twelvetrees "Field Notes" 1909 p.2.

Lode) is obscure. Waller never saw this level. Neither did Twelvetrees see it (it was under water) in 1909, but he quotes Mr. T. Vincent as follows :- (21)

"The lode in the north end (Adit Level C.L.H.) is soft, between slate and hard quartzite. The quartzite is traversed by irregular gashes of quartz It goes down for some depth and then in the bottom level there is nothing."

In regard to the South portion at Adit Level Twelvetrees has this to say :- (22)

"There are stopes below this level. Very fair lode 8' or 9' with solid galena at a branch."

Information from Walford is to the effect that stoping was carried out for a considerable length at No. 3 Level. It seems reasonable therefore to make the shoot 160 feet in length south of the Crosscut. But the general purport of statements made by Walford and others who worked in the Spray is that the 400 feet north of the crosscut carried values although apparently it did not come up to Vincent's standard of pay-ore.

It would thus appear that the shoot of pay-ore (1908 standard) in No. 3 Lode is in the shape of a right-angled triangle with base 700 feet in length at surface and the apex somewhere below No. 3 Level in untested ground.

Such being the general shape and occurrence of the ore-shoots, the next step must be a consideration of the type of ore within them. The outstanding fact in this connection is the change in the shoots in No. 1 Lode from galena with some jamesonite and tetrahedrite to jamesonite and tetrahedrite with no galena just below No. 4 Level in the South Shoot and just above No. 4 Level in the North Shoot. The galena shoots have been stoped but the jamesonite shoots have not.

No such change is recorded in regard to No. 3 Lode but this could simply be due to the fact that the workings on this lode only go downwards to the No. 3 Level.

(ii) Galena Shoots. Waller thus describes the galena shoot in the South Shoot between the Adit and No. 3 Levels :- (23)

"The 'A' Adit and the top of one of the richest shoots of ore which has been mined in the Zeehan Field. The ore for most of the distance hardly lived up

to the roof of the drive. It was sunk on and widened out very rapidly to from 4 to 8 feet of solid metal. This shoot of ore is now known to be nearly 400 feet in length of which about 200 feet is exceptionally rich. At its best the lode carried 16 feet of ore, about two-thirds of which was galena, while for long distances from 3 to 5 feet of solid ore was present in the lode".

Waller's reference to the "ore" osculating the Adit Level must be interpreted as meaning "high grade ore" as the lode undoubtedly carried values above the level near the Internal Shaft, thus making the shoot really continuous with the rich ore mined by McDermott and Page at and above the "E" Adit.

The galena was in due course followed downwards from the lowest level (No. 4. Level) seen by Waller. He reports the face at about 60 feet north of the Internal Shaft as assaying in bulk sample Pb. 13.1%, Ag. 35.6 ozs. However, subsequent work showed that the galena continued for only a small depth below No. 4. Level. There the galena entirely disappeared, its place being taken by jamesonite and tetrahedrite.

The northern galena shoot started at about 40 feet above No. 2. Level and continued to the back of No. 4. Level where again jamesonite and tetrahedrite took its place.

The galena shoot in No. 3. Lode was still a galena shoot at No. 3. Level. Waller never saw it at No. 3. Level but has this to say of the upper levels:- (24)

"The grade of the galena in this lode is not quite so good as in No. 1. Lode, a bulk sample of the ore yielding 82 ozs. of silver per ton with 68 per cent of lead. Still it is good metal".

The longitudinal section shows the pay-shoot at No. 3. Level starting at the crosscut and running south for 150 feet. This was 8 to 10 feet wide with a foot or more of solid galena on each wall with "good seconds" in between. Northwards from the crosscut the lode was 3 to 4 feet wide bulging in places to 10 to 12 feet and also narrowing to 6 inches. The lode along the whole 400 feet of the north drive carried values but was only stoped at the bulges. (25)

(24) G. A. Waller "Report on Zeehan Silver-Lead Field" 1904 P.82.

(25) W. Walford. Personal communication.

(iii) Jamesonite Shoots. These start at or just below the No. 4. level in the case of the North and South Shoots, and just above the No. 6. Level in the case of the Centre Shoot. As far as is at present known they are confined to No. 1. Lode.

The North Shoot is 200 feet long at No. 4. Level but the length at No. 5. Level is undetermined. The width is 10 feet. (26)

The South Shoot is 520 feet long at No. 5. Level and 420 feet at No. 6. Level although in neither case has the southern limit been definitely established. The width according to Twelvetrees (quoting T. Vincent) averages 6 feet. (27)

"The average width of the lode in No. 6. Level for a length of 200 feet is 6 feet and with Pb. 5% and Ag. 30 ozs. This is the lowest level in the mine and the ore is there yet. They had a trial treatment of the ore by the Elmore process at Broken Hill."

The Centre Shoot was seen only at the north end of No. 6. Level. It was driven in for 60 feet with the north face still in ore. Twelvetrees quotes the following assays from here :- (28)

Pb. %	Ag. OZS.	Pb. %	Ag. OZS.	Pb. %	Ag. OZS.
3.0	42	3.2	24	2.5	11
1.0	12	4.5	255	1.2	30
28.0	65	0.5	32	14.3	23
31.0	11	5.5	43	0.5	19

Bulk Assay	Pb. %	Ag. OZS.
average	14.3	23

Incidentally it is by no means certain that the lode in No. 5 Level between the northern and southern shoots contains no ore and it seems probable that there is jamesonite-tetrahedrite ore in No. 6 Level between the Southern and Central Shoots.

There is another ore occurrence which, although not justifying the status of an ore-shoot, might have future possibilities. This is at the extreme northern end of No. 3 Level north of No. 1 Shaft. It is referred to by T. Vincent as follows :- (29)

- (26) W.H.Twelvetrees "Field Notes" P:4.
- (27) W.H.Twelvetrees "Field Notes" p.3.
- (28) do. do. p.8.
- (29) T.Vincent "Letter Book" 1909-12 p.60. Date 24/1/1909. The letter press states No. 1 level, but this is because Vincent was referring to No. 1 shaft only where there are only two levels.

"as yet I have nothing encouraging to report in Spray No. 1 Shaft. The lode has been cut (at No. 5 Level C.L.H.) and driven on for 50 feet but, so far is valueless. A vein of ore stuff in the South face, when sampled gave on assay the very poor result of 7.5% Lead and 0.5 ounces Silver per ton. The North face has a promising appearance, and if the hunch of ore we had in No. 3 Level North lives down, I hope to have better news to report in this mine."

The mine closed down a few days later. This therefore is the very last work done at the Spray Mine below the Adit Level.

(iv) Grade of Ore Mined. The only accurate figures available as to the grade of ore actually mined are contained in a letter written by T. Vincent to H. Simpson, Hobart, the Legal Manager in Tasmania for the Mount Zeehan Silver-Lead Mines Ltd. He states :- (30)

"I beg to append the following figures for the Financial Year ending 30th June, 1908

Ore Raised	12,885 tons
Ore Produced	5,007 "
Containing -	
Lead	2,106 tons
Silver	315,944 ounces "

The concentrate as actually sold thus assayed :-

Pb. %	Ag. Ozs.
42	63

Calculating back to the ore as raised from the mine this means that the recoverable values were :-

The tailings average -	Pb. %	Ag. Ozs.
	4.5	10

Therefore the crude ore as extracted from the mine must have assayed in round figures :-

Pb. %	Ag. Ozs.
20	34

It thus seems clear that the standard for pay-ore was high. It must inevitably be asked - what did they leave behind?

Mr. T. Vincent's remuneration as General Manager was based on a commission on profits. Although this was common knowledge at Zeehan it is interesting to have it confirmed in the following letter from T. Vincent to the Commissioner of Taxes, Hobart. (32)

(30)	T. Vincent	"Letter Book" 1909-12	p.152.
(31)	do.	do.	p.115.
(32)	do.	do.	p.93.

"In reply to yours of 21st inst. My Assistant is my son T.H.Vincent who during the year ending 31st December, 1908, filled the position of Underground Manager on the above Company's Mines, and during my absence at any time, was in sole charge. The salary I pay him is earned, and has no bearing on the relation between us; but, unfortunately, owing to the depressed values of metals and other causes, my own emoluments from a Commission on Profits was practically nothing. As this state of things still continues, it is my intention to make other arrangements for the year 1909."

The general opinion at Zeehan was that Vincent only took the richer ore out in order to ensure his income being adequate. At one period (in 1906) the Zeehan & Dundas Herald took the question up and considerable enmity developed. This is referred to by T. H. Vincent in 1911. (33)

"Had I thought the report in the "Rag" would have been noticed I would have written requesting them to correct it; but at the time the matter appeared to me to be too trivial to bother, and is just in keeping with their usual treatment of my father and self. Their antagonism dates from about five (5) years ago, when their Mining Reporter - Sligo - was not allowed to go through the Company's Mines."

What was it that they did not want Sligo to see? In a chamber excavated at Adit Level. A ventilation rise was put up to "C" Level. It is 400 feet deep to bottom of ramp.

During the latter part of 1908 and early 1909, while the No. 1 Shaft was still being operated, a tribute was let to Welford & Fordy to extract the ore left near the shaft between Nos. 3 and 5 Levels. Welford maintains that they worked properly and feels sure that except for muck on the plat the shaft is clear. He admits, however, that they dumped some muck down the shaft but contends that it would only be enough to fill the wall.

The No. 1 Shaft was sunk from the surface. The collar is 18 feet above "A" Adit Level. It is 400 feet to bottom of the wall. The collar is open. Dimensions are 18' x 7'. (33) T.Vincent "Letter Book" 1909-1912 p.245. No Internal but only Nos. (2) - Nos. 3 and 5 - from No. 1 Shaft. No. 1 Level is complete from Internal to No. 1 Shaft but at No. 5 Level there remains 70 feet to No. 1 Shaft to connect.

The water in the Spray Mine was never heavy. This is

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7. MINE WORKINGS.

(a) Adits. Tunnels B, C, D, F and G are at the upper levels and have no special significance at the present juncture.

"A" Tunnel runs straight from portal to No. 3 Lode - a distance of 1071 feet. The entrance is open but needs draining. The general opinion of those who worked in the mine is that it ought to be in good condition.

"E" Tunnel which is about 10 feet higher than "A" runs straight to the end at 360 feet having cut No. 1 Lode at 330 feet. The entrance is blocked by an accumulation of ferric hydroxide but can be easily drained. It should be in good condition.

"H" Tunnel is about 20 feet above the collar of No. 1 Shaft. It has been driven a distance of 50 feet to cut the northern continuation of the No. 1 Lode. It is open.

(b) Shafts. The Internal Shaft was originally a winze on the No. 1 Lode from the "A" Adit Level. It was later enlarged to a working shaft, winding engine etc. being installed in a chamber excavated at Adit Level. A ventilation rise was put up to "C" Level. It is 460 feet deep to bottom of sump.

During the latter part of 1908 and early 1909, while the No. 1 Shaft was still being operated, a tribute was let to Walford & Party to extract the ore left near the shaft between No. 3 and Adit Levels. Walford maintains that they timbered properly and feels sure that except for mullock on the plat the shaft is clear. He admits, however, that they dumped some mullock down the shaft but contends that it would only be enough to fill the well.

The No. 1 Shaft was sunk from the surface. The collar is 18 feet above "A" Adit Level. It is 400 feet to bottom of the well. The collar is open. Dimensions are 18' X 7'.

Six (6) levels have been opened from the Internal Shaft but only two (2) - Nos. 3 and 5 - from No. 1 Shaft. No. 3 Level is complete from Internal to No. 1 Shaft but at No. 5 Level there remains 70 feet to be driven to connect.

The water in the Spray Mine was never heavy. This is

definitely stated by McDermott quoting conversations he had with T. Vincent. The latter writing to his Directors on 10th January, 1909, in connection with work at No. 1 Shaft says :-

"At present there are 10,000 gallons per hour making from No. 5 Shaft, in addition to what we were already pumping from No. 3 Level".

It would thus appear that the water may be gauged as not exceeding 24,000 gals. per hour.

(c) Drives.

(i) No. 1 Lode. Extensive driving on the lode has been accomplished. From the Adit Level downwards the following are the lengths :-

Adit Level	:	1470 feet
No. 1 "	:	510 "
No. 2 "	:	1140 "
No. 3 "	:	1320 "
No. 4 "	:	1200 "
No. 5 "	:	1140 "
No. 6 "	:	690 "

Add for Drives on Counters at 4 & 5 Levels : 230 feet
Add for Drive at "H" Level : 420 feet

Total Driving : 8120 feet

(ii) No. 3 Lode.

Adit Level	:	740 feet
No. 3 "	:	640 "

Total Driving : 1380 feet

Aggregate Driving on 4 Lodes : 9620 feet

(d) Crosscuts.

(i) No. 1 Lode. Comparatively little cross-cutting has been done. The crosscut at No. 3 Level from No. 1 to No. 3 Lode is 600 feet in length.

The mine plan shows small crosscuts as follow :-

At Adit Level	:	7 crosscuts from 10 to 20 feet
At No. 1 "	:	none
At No. 2 "	:	1 crosscut of 30 feet
At No. 3 "	:	none
At No. 4 "	:	3 crosscuts from 10 to 30 feet
At No. 5 "	:	3 crosscuts from 10 to 20 feet
At No. 6 "	:	3 crosscuts from 10 to 15 feet

(ii) No. 3 Lode.

At Adit Level	:	2 crosscuts of 10 feet
At No. 3 "	:	3 crosscuts from 10 to 25 feet

8. DISCUSSION OF POSSIBILITIES.

(a) Available Ore.

(i) Galena. It must be assumed that the galena shoots above No. 4 Level have been stoped out. At the

same time it must be remembered that this refers to Vincent's pay-ore only. What does the lode carry outside the shoots which have been defined by actual stoping?

Walford is definite that galena occurs throughout the whole of No. 3 as driven on. But what are the values?

McDermott states that the No. 1 Lode as driven on by him at "E" Level never was barren of galena. His milling ore had to give in the mill a minimum recovery of 12.5% Pb. or the Company would not take it. Since the mill tailings average 4.5% Pb. McDermott's milling ore would have to assay 17% Pb. When the Smelters agreed to take "two twenties ore", i.e. 20% Pb., 20 ozs. Ag., McDermott preferred to select the ore by knapping and picking, only sending the rejects to the mill. McDermott insists that the whole of the unstoped portion at all levels carried metal - there was no really barren lode.

The evidence therefore points to the possibility that present-day pay-ore exists between the stoped out pay-shoots and beyond them. The only way to find out is by sampling the unstoped sections.

In No. 3 Lode the Vincent pay-ore is going under foot on a length of 150 feet. To make this available a crosscut at No. 4 Level will be necessary. We do not know at what depth, if any, the galena will change to Jamesonite-tetrahedrite.

Another possibility of pay-ore lies in the filled stopes. No mullock for filling was passed underground. Lode material was used as filling. What is its value?

In addition there is the galena ore at the extreme north end of No. 3 Level, north of No. 1 Shaft. This is untested both north of that point and below the level.

(ii) Antimonial-lead-silver. Between Nos. 4 and 6 Levels there are two more or less defined shoots almost wholly unstoped with a third just projecting above No. 6 Level.

This ore containing Jamesonite and tetrahedrite could not be effectively treated by the gravity-concentration mill.

could not be sold to the Smelters because of the penalties for antimony. If high-grade enough it showed a profit. Twelvetrees illustrates this :- (34)

"They broke out a parcel just to show that they had clean ore. It assayed 425 oz. silver and 16.3% lead. This was last year and fetched £44/-/8 per ton."

No. No assays for antimony are given in any records but the above parcel must be assumed as assaying at least 12% antimony because the ore is jamesonite. Twelvetrees emphasises the crippling effect of the antimony :- (35)

"The mine depends upon the Smelters. The ore would not pay cartage to Strahan on account of its antimonial contents."

It was this impasse which closed the mine down.

A trial treatment of the ore was carried out at Broken Hill by the Elmore Process. No details are available as to recoveries but they were apparently not very encouraging.

T. Vincent has this to say :- (36)

"In reference to the Minerals Separation Concentration Process and enclosure with your letter of 23rd September, and the question of other experiments being conducted with the Elmore process as suggested by Mr. White, I would like to say that, at present, there is not an Experimental Plant in Australia, the one at Broken Hill having been taken over by the Zinc Corporation Ltd. Besides, the freight costs of sending other large parcels for experimental treatment puts this quite out of the question, and as, on Appeal, the Courts have decided that "Minerals Separation" is an infringement of the Elmore process, and have granted an injunction against further infringement, there is hardly need to further discuss their relative merits."

And so the Spray Mine died.

The metal contents of this ore are unknown. An indication is given by two bulk assays quoted by Twelvetrees. (37) How the samples were taken and what bulk they represent is uncertain. The assays only show Pb. and Ag., but to draw attention to the character of the ore the Sb. has been interpolated, but these figures must be regarded as no more than an intelligent guess.

	Pb. %	Ag. ozs.	Sb. (interpolated) %
19200' on South Shoot at No. 6 Level	5	30	4(?)
60' on Centre Shoot at No. 6 Level	14	23	10(?)

(34) W.H.Twelvetrees "Field Notes" 1909 p.1.

(35) do. do. p.2.

(36) T.Vincent "Letter Book" 1908-19 p.93. 29/12/08.

(37) W.H.Twelvetrees "Field Notes" 1909 p.1 & p.2.

The Pb., Ag., Sb. contents of the lode along the whole of the Nos. 5 and 6 Levels are unknown and can only be obtained by sampling.

The above discussion deals only with the ore above No. 6 Level. Although there exist therein quite valuable possibilities for the immediate future, the ultimate future of the mine must depend on what exists below No. 3 Level on No. 3 Lode and below No. 6 Level on No. 1 Lode. There is here a great attraction. The lodes being replacements along shears can be expected to carry values down much more definitely than the tension cracks - the shears getting their ore-bearing solutions in depth directly from the original source.

It is interesting to note at this stage that at the north end of No. 1 Lode (i.e. nearing the Montana Tear Fault) at the 600 ft. Level of the Western Mine the lode carried tetrahedrite and copper pyrites. Of this Waller says :- (38)

"The former (tetrahedrite) is rich in silver assaying 270 ozs. to the ton, but it is present in such small quantities that the ore will bulk only 20 ounces (i.e. 7.4% Tetrahedrite C.L.H.) (39). It has been found impossible to concentrate the ore in the ordinary way

The alteration in the character of the Western Lode in depth is a very curious thing. I would suggest that some of the ore might be sent to London to be tested by the Elmore oil process."

(Both Nos. 1 and 3 Lodes of the Spray must be tested below their present lowest levels. This calls for diamond-drilling.

(b) Diamond Drilling.
(1) Surface Contours Relative to Objectives.

The lode orientation-contour relationship presents difficulties in drilling from the surface. This is illustrated by the accompanying map of the Spray area and a cross-section thereon. It was experienced by the State Mines Dept. when they attempted to test No. 1 Lode at 250 ft. below No. 6 Level in 1931. They chose the northern slope of the Spray Hill rather than the southern. They aimed at the South Shoot. They assumed a slight westerly dip of the lode and calculated to hit it at

044

months, reached 930 feet and stopped. At 911-917 they passed through 5 feet of lode formation containing iron pyrites and siderite with traces of antimonial ore. (40) Was this the No. 1 Lode? Although short of the calculated objective the explanation could lie in upward deflection of the bore. But there is a discrepancy in wall-rock details. Down to No. 6 Level the west wall is quartzite with the lode right on it. In the bore there occurred 3 feet of slate between the lode formation and the quartzite. In addition, it is contended by McDermott that at the upper levels the west wall of quartzite is the eastern face of about 200 feet of quartzite without slate bands. This point could of course be settled by an examination of "A" Tunnel after it is cleaned out.

The problem of drilling from the western slope is exemplified by laying out bores on the cross-section. An example could be a drill-hole at the 890 ft. contour aimed to hit No. 3 Lode at 100 feet below No. 3 Level and No. 1 Lode at 200 feet below No. 6 Level. Such a drill-hole would be 1560 feet long depressed 27° .

The conditions are much better for testing the northern end of No. 1 Lode below No. 3 Level i.e. north of No. 1 Shaft. Holes not far from vertical could be designed from about the 850 ft. contour.

(11) Character of Objectives. It must be realised that the objectives of diamond-drilling at the Spray are lodes in which values are irregularly distributed. One drill-hole could penetrate either a rich or poor section. Reliability of results will be directly proportional to the number of holes. Multiplicity of holes is possible from underground but impracticable from the surface.

9. RECOMMENDATIONS.

- (a) Drain and clean out "A" and "E" Tunnels.
- (b) Unwater the mine from either or both Internal and No. 1 Shafts.
- (c) Sample all faces and backs and filled stopes.
- (d) Diamond-drill from levels and crosscuts.

(40) Annual Report Department for Mines, Tas., 1932 and
"Mines Dept."

(e) Diamond-drill from surface.

An incidental but essential phase of such operations will be the provision of at least a temporary power line from the nearest sub-station. The distance will be 110 chains over cleared and easy country.

C. Loftus Hills,

Zeehan.

24th January, 1947.



ZEEHAN EXPLORATIONS

PLAN OF SPRING MINE, ZEEHAN

1947

RECENTLY EXPOSED QUARTZITE & SLATES
QUARTZITES AND SLATES

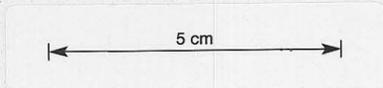
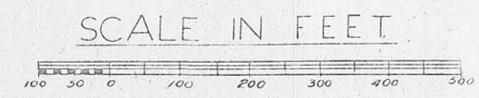
SCALE IN FEET

100 200 300 400 500 600 700 800 900 1000



ZEEHAN EXPLORATIONS
PLAN OF SPRAY MINE LOCALITY

— LEGEND —
 KERATOPHYRE-METAPHYRE TUFFS & BRECCIAS 
 QUARTZITES AND SLATES 

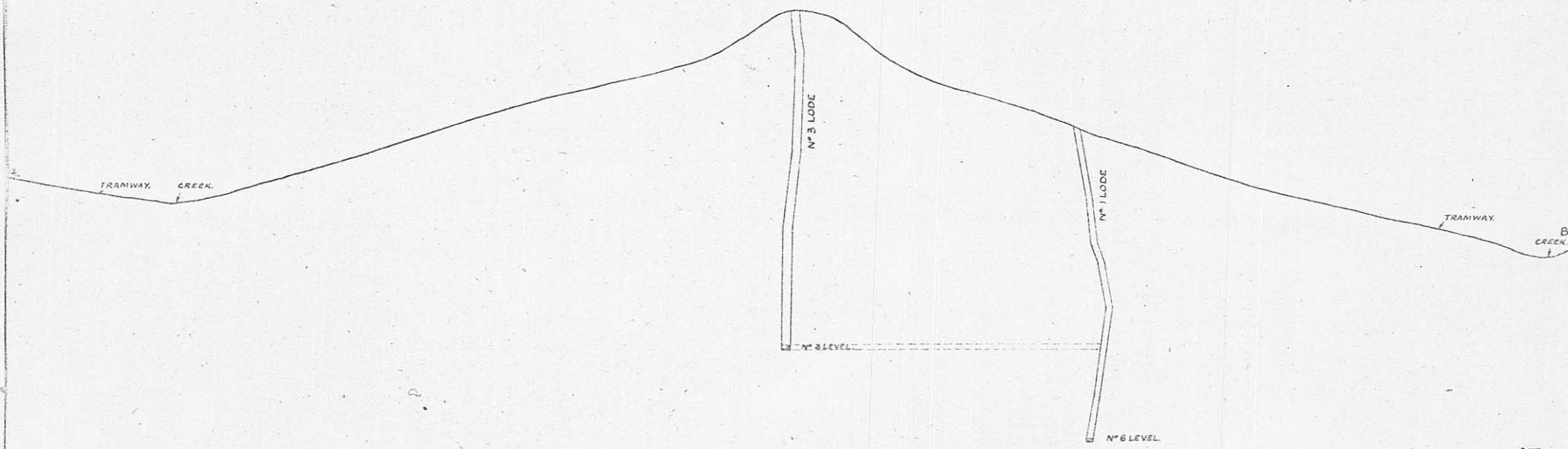
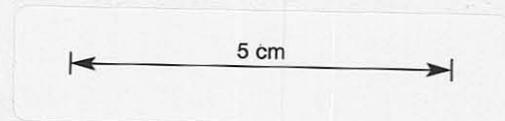


ZEEHAN EXPLORATIONS.

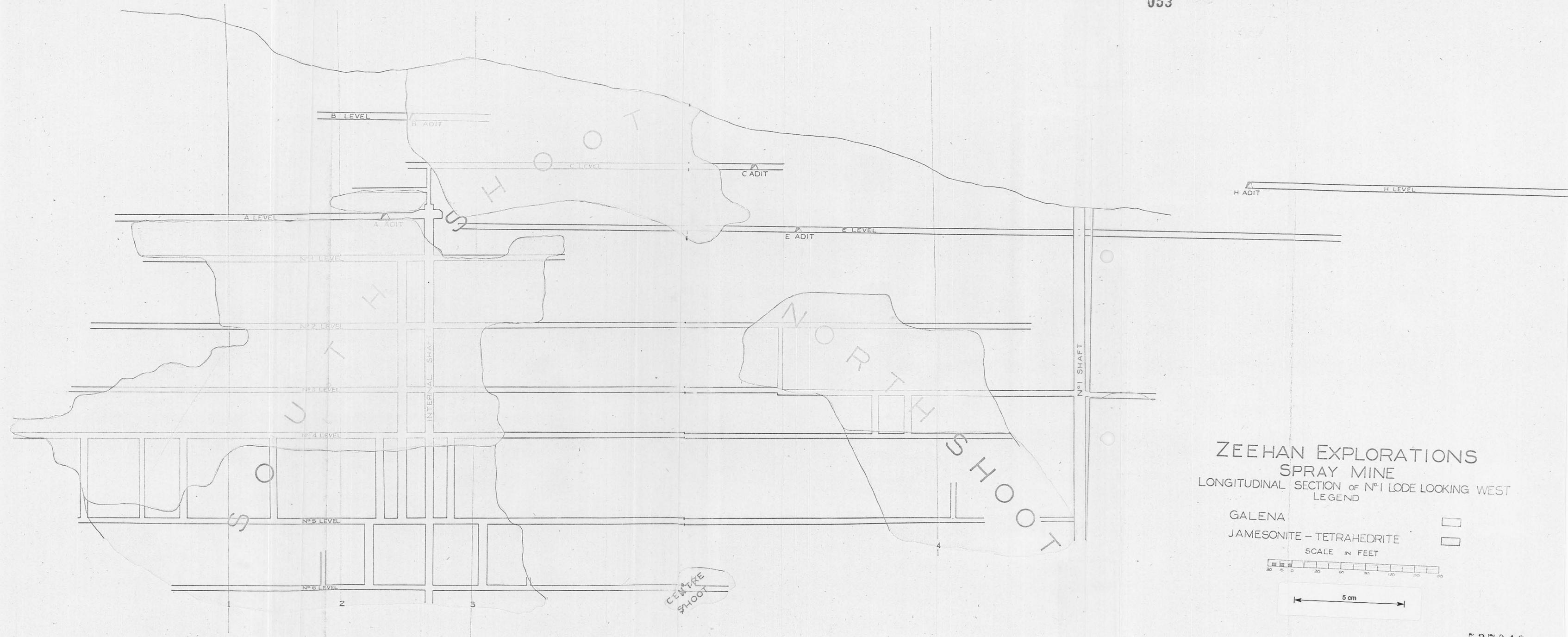
SPRAY MINE.

CROSS-SECTION ON LINE AB.

SCALE IN FEET.

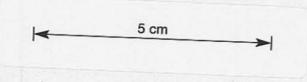


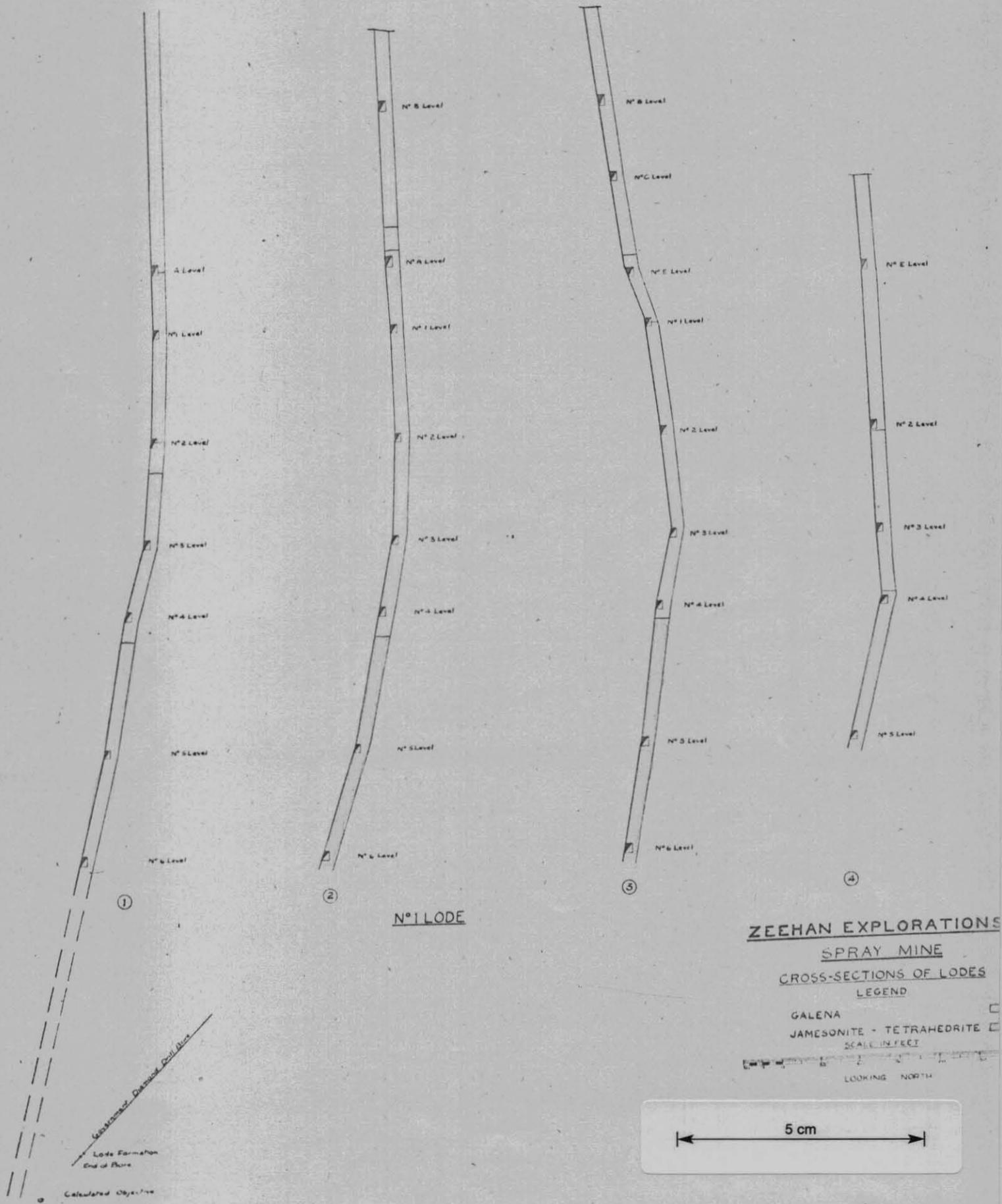
DATUM: SEA LEVEL.



ZEEHAN EXPLORATIONS
 SPRAY MINE
 LONGITUDINAL SECTION OF N°1 LODGE LOOKING WEST
 LEGEND

GALENA
 JAMESONITE - TETRAHEDRITE





N° 1 LODE

ZEEHAN EXPLORATIONS

SPRAY MINE

CROSS-SECTIONS OF LODES

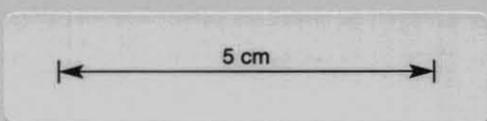
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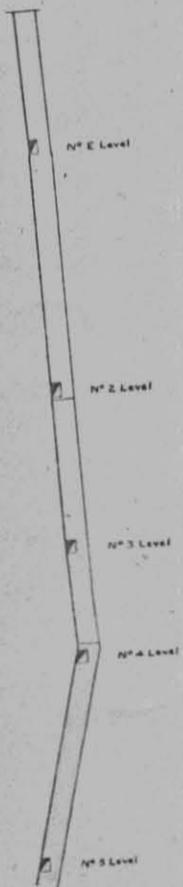
GALENA

JAMESONITE - TETRAHEDRITE

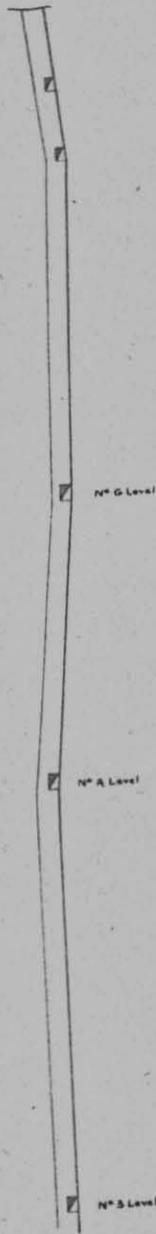
SCALE IN FEET

LOOKING NORTH

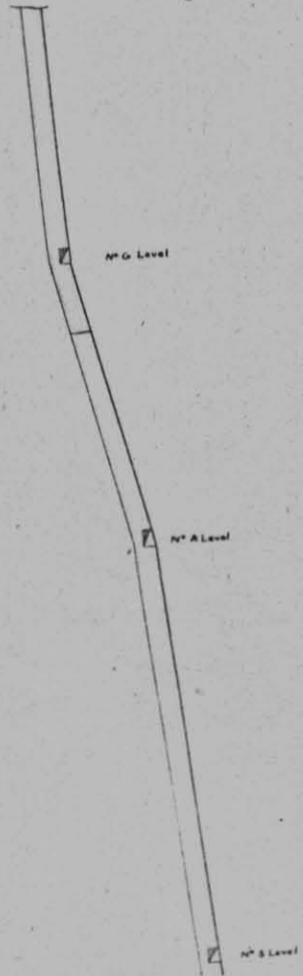




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⑥

N° 3 LODE

ZEEHAN EXPLORATIONS

SPRAY MINE

CROSS-SECTIONS OF LODES

LEGEND

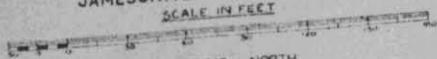
GALENA



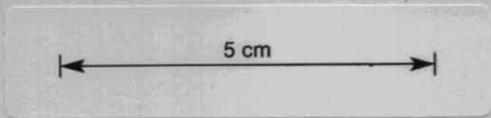
JAMESONITE - TETRAHEDRITE



SCALE IN FEET



LOOKING NORTH



OLD MINES ON ZEEHAN LODES.

SOUTH SPRAY.

The nature of this area is 170 acres

1. LOCATION AND ACCESS.
2. HISTORY.
3. OUTPUT AND PROFIT.
4. GEOLOGIC ENVIRONMENT.
 - (a) Country Rocks.
 - (b) Position Relative to Regional Structural Pattern.
 - (c) The Shear Zone.
5. THE LODES.
 - (a) Number and Spacing.
 - (b) Proved Length and Width.
 - (c) Orientation.
6. THE ORE.
 - (a) Character of Lode Material.
 - (b) Constituent Minerals.
 - (c) Ore Shoots.
7. MINE WORKINGS.
 - (a) Adits.
 - (b) Shafts.
 - (c) Drives.
 - (d) Crosscuts.
8. DISCUSSION OF POSSIBILITIES.
 - (a) Available Ore.
 - (b) Diamond Drilling.
9. RECOMMENDATIONS.

HISTORY. Silver-Springs Railway was constructed in 1890. The discoveries along this belt which gave a present-day significance were made until 1905, following on the spectacular development in the spray. Nevertheless some work was done on the Old Zeehan Lode in 1892, including a branch tramway from Cradock which was later (1901) extended to the Silver Mine. Also in 1896 the Colonial North Co. sank a shaft to 200 feet on the Brunstone outcrop of what is now the Main Mine, but later transferred its activities to the old Cradock Mine.

The discoveries which now assume importance were made by prospectors. The Silver Mine and Silver were tributary to the

Colonel North OLD MINES ON ZEEHAN LODES. but branch tramways

to their workings in SOUTH SPRAY. Llewellyn's lode was

discovered in 1903 on the Nubeena lode, but was never connected

1. LOCATION AND ACCESS. The centre of this area is 170 chains S.S.W. of the Zeehan Post Office.

It is accessible via the Cornstock and Grubbs Tramway formations, the distance along this route being about $3\frac{1}{2}$ miles from the Zeehan Station. From Grubbs Tramway three old branch tramway formations lead to the Sunshine, Silver Foam and Silver Wave workings respectively. The latter are situated at about the centre of the north-south dimension of the area. The southern portion can best be reached from the Smelters Road via the Austral Valley. An old tramline formation runs from just north of the Austral Flux Quarry to within 20 chains of the South Nubeena workings.

Such are the main points of entry to the area, but detailed access within the area will not be so easy as in other parts of Zeehan. An indicator of this is the fact that the height above sea-level of the various workings are as follow :-

Foam	:	900 ft. contour
Wave	:	950 ft. contour
Llewellyn	:	980 ft. contour
South Nubeena	:	850 ft. contour

The country is quite rugged but access to workings located for depth continuation will not be difficult.

2. HISTORY. Although Grubbs Tramway was constructed in 1890 the discoveries along this belt which have a present-day significance were not made until 1901, following on the spectacular development in the Spray. Nevertheless some work was done on the Old Nubeena Lode in 1892, including a branch tramway from Grubbs which was later (1901) extended to the Silver Wave. Also in 1896 the Colonel North Co. sank a shaft to 200 feet on the ironstone outcrop of what is now the Sunshine, but later transferred its activities to the old Grubbs Mine.

The discoveries which now assume importance were made by tributaries. The Silver Foam and Silver Wave Tributary Companies were formed in 1901 to develop two such discoveries within the

Colonel North Company's lease. They both put branch tramways to their workings from Grubbs Tramway. Llewelin's lode was discovered in 1903 on the Nubeena lease, but was never connected by tram or road to Grubbs Tramway. The South Nubeena lode was discovered shortly afterwards.

The whole of the work on this belt has been halting, indefinite, long drawn-out and unappreciated. The successive attempts have been by various companies, syndicates and tributors at different times at the same locality under different names. The reading of published reports is hopelessly confusing unless the following history at each locality is realised :-

Foam locality - Originally known as Colonel North. The eastern portion later became the Silver Foam. Still later (1909) it became the Victoria - Zeehan. The western portion ceased to be the Colonel North (this title being transferred to Grubbs), then became in turn Silver Beach, Victoria,-Zeehan, and finally the Sunshine (1923).

Wave locality - Originally known as the Nubeena. Then became the Silver Wave and later the Victoria - Zeehan.

Llewelin's locality - Originally the Nubeena. Then became the Old Nubeena, later Llewelin's and ended up as the Venezia.

South Nubeena - Originally known as South Nubeena it ended up as Butler's.

3. OUTPUT AND PROFIT. The output has been negligible. The total ore sold would not exceed 1,000 tons. This was all obtained by knapping and hand-picking, there being no mill on any of the various shows. Second-class ore where mined is still at the surface, there being very little of this except at Llewelin's where there is a heap of about 500 tons of good milling ore.

In no case did the work done exceed exploratory shaft-sinking, cross-cutting and driving. The little production has been incidental to this work, plus very limited sporadic stoping.

4. GEOLOGIC ENVIRONMENT.

(a) Country Rocks. The country rocks belong to the Ordovician system but are a facies differing from the dark-coloured slates and sandstones of the central portion of the Zeehan field. The Nubeena Hills stand out in bold relief. The rock outcrops on them stand out as a distinct white colour.

This is due largely to the way the rock weathers but is also caused by numerous irregular gash veins of white quartz which characterise the belt carrying the lode formations of the South Spray System. A certain amount of silicification of the rock has also occurred which shows up white as the partially silicified rock weathers.

Waller describes these rocks as follows⁽¹⁾ :-

"White sandstones or quartzites appear from a superficial examination of the country, to be the prevailing rock in this area, as it outcrops largely on most of the spurs; but work underground has shown that this is not the case. The white sandstones and quartzites which are found so abundantly on the surface do not occur underground. They alter in depth to a siliceous slate, or a dark argillaceous sandstone or quartzite. Bands of this siliceous rock are interbedded with the softer slates, sometimes one predominating and sometimes the other. Speaking generally, the rocks are more siliceous in the eastern portion of the belt than in the western, where slates appear to dominate."

It is in the eastern portion that the South Spray Shear Zone is situated :-

(b) Position Relative to Regional Structural Pattern.

The outstanding feature of the Spray Mine is the occurrence of two pronounced shears (Nos. 1 and 3 Lodes). A possible explanation is the horizontal compression in a general north-south direction between the converging Balstrup and Nubeena Tear Faults. A similar explanation can be applied to the Foam and Wave lodes which occupy undoubted shears with approximately horizontal movement.

In the case of Llewellyn's, however, the altogether similar shear lies between the Nubeena and Bell Tear Faults.⁽²⁾ And the South Nubeena shear lies between the Austral and South Austral Tear Faults. The Nubeena and Bell Tear Faults are parallel to each other and so are the Austral and South Austral. Explanation by convergence in the easterly movement of the blocks therefore seems improbable.

Nevertheless the undoubted existence of the shears cannot be denied. The significant fact also exists that Spray No. 1, Foam, Wave, Llewellyn's and South Nubeena are in alignment although not necessarily representing complete continuity. This could be

(1) R.A. Waller "Report on Beehan Silver-Lead Field" 1904 P. 6.

(2) Lortus Hills "Geological Survey of the ..."

explained by visualising a block squeezed between the Balstrup and South Austral Tear Faults. These two faults undoubtedly converge eastwards, but what about the Nubeena, Bell, Spion Kop, North Austral and Austral Tear Faults? These faults explain the present positions of the Waller Upthrust and the position and orientation of the limestone blocks. But it must be admitted that the evidence for their present positions and orientation as shown in the Structural Map with the possible exception of the Austral is not as complete as for the nine (9) Tear Faults to the north or the Oceana, Smelters and South Austral to the south.

It is clear therefore that the investigation of the South Spray shear zone must be concurrent with the more detailed mapping and study of the Nubeena, Bell, Spion Kop, North Austral and Austral Tear Faults. This will be done in association with the fixing of the detailed positions of the Waller Upthrust at the eastern end of the Austral Valley and with due regard to the "Slide" at the Sunshine and other evidence of transverse faulting.

(c) The Shear Zone. However, whatever may ultimately be disclosed as to the exact relationship to the regional structural pattern, definite shears have been observed and described at intervals for 4500 feet southwards from the southern end of the workings on No. 1 Lode (Shear) in the Spray.

We are indebted to Waller for the observations and descriptions. It will be necessary to reopen the various workings to see and study them. In the meantime this is what Waller says :-

Llewellyn's :- "Llewellyn's lode is a very large loose fissure formation striking about 28° west of north, and dipping almost vertically, or perhaps a little to the east. I take it to be a continuation of the main Spray lode. It is the same character of lode and the walls are grooved in a nearly horizontal direction, pitching slightly north, just as in the case of the Spray lode". (3)

South Nubeena :- "There was a good vertical wall on the east side containing horizontal grooves, just like those of Llewellyn's and the Spray lodes". (4)

(3) G.A. Waller "Report on Enehan Silver-lead Field" 1904 p. 21.
 (4) do. do. p. 22.

062

Waller's description of the Foam and Wave lodes does not deal with the shear as such but this is what he says :-

"I am strongly of the opinion that this is the main Spray lode. It is a fine big formation The good shoot in the Spray Mine is situated along the main fissure, as represented by a seam of dig or rubble from 6 to 12 inches thick. This seam is also present at the Foam, but it was passed through without notice in the crosscut from the shaft." (5)

"The workings of the old Silver Wave are also on the line of the Spray lode, and if I am not mistaken the lode has been cut and driven on for a considerable distance. The lode which I take to be the Spray lode is known as the "pug" lode; the strike is 30° west of north and the dip is 80° to the east." (6)

Twelvetrees in 1910 thus describes the Foam :-

"At 184 feet the lode formation was cut, averaging 6 feet in width. A pug seam existed on each wall and the intermediate portion was principally quartz, decomposed slate and carbonate of iron gangue containing a little lead ore There is no good reason for doubting that the No. 1 Spray lode was struck in the Foam adit, and the lode driven on from the shaft crosscut must be the same." (7)

Of the Wave Twelvetrees states :-

"There is more than one lode here, but the vein-system appears to be on the No. 1 Spray lode-line. The line here strikes N 30° W and the lodes dip to the north-east The veins have the appearance of spurs running off from the pug lode, which lies east of and parallel with the lode seen in the adit. The fractures between the lodes seem to carry the ore". (8)

Twelvetrees refers to Llewelin's thus :-

"In the northern part of the section there is a group of lodes observing a more or less parallel course in a north-westerly direction. These are Llewelin's, Barnetts, Jaeger's and Wylies. They are virtually on the same line as the Spray lodes, Foam and Silver Wave further north, and the position and general character of Llewelin's lode harmonise with those of the main Spray lode, which supports the contention that the lodes are identical. The continuation of this lode is seen in the south-east angle of the property, where it crosses into the South Nubeena section". (9)

In regard to the Spray No. 3 lode, the only attempt to correlate actual lode occurrences is by Twelvetrees :-

"The Chloride Lode is in the northern part of the section and has been worked at intervals up to the northern boundary about 20 feet below the crown of the hill (Spray Hill C.L.H.) It passes into the Mt. Zeehan (Tas.) Silver-lead Mines property (Spray C.L.H.) It seems to be a continuation of the No. 3 Spray lode, although that lode has been supposed to trend about 40 feet east of it." (10)

- (5) G.A. Waller "Report on Zeehan Silver-lead Field" 1904 P.85.
 (6) do. do. P.86
 (7) Geol. Survey Tas. Bull. 8 P.116.
 (8) do. P.117.
 (9) do. P.118.
 (10) do. P.119.

The various lodes in this South Spray area are confined to a zone about 1000 feet wide and upwards of 4500 feet in length. Twelvetrees recognised this and states :-

"Several silver-lead lode systems intersect the Victoria-Zeehan property in a general south-easterly direction. These are continuation of known lodes on the Spray section to the north, and some of them evidently pass through the entire property, and across the Nubeena and South Nubeena sections further south. The Spray lode system is perhaps the longest on the whole Zeehan field, being traceable for about $1\frac{1}{2}$ miles at intervals through these sections." (11)

There seems to be a well-defined eastern boundary to this Shear Zone. This is formed by the line of the No. 1 Spray Shear. The plan shows a striking persistence in direction of this line of shear. Nevertheless attention must be drawn to the prevalent quartz gash veins in a belt to the east of this line especially just east of Llewelin's. It is significant in connection with this defined eastern boundary to remember that the country east of No. 1 Lode in the Spray Mine has been well crosscutted by both "A" and "E" Adits and no lode has been found in that locality in any way resembling those to the west of No. 1 Lode.

The western limit is not so well-defined but the zonal width of 1,000 feet covers the western Sunshine and Old Nubeena lodes.

Persistence along the line of the Spray No. 3 Lode is not indicated in anything approaching the significance of the recurrences along the line of No. 1 Lode. In fact, a change in the character of the faulting in the central and western portion of the Shear zone occurs southwards both in the Wave and Llewelin's. It takes the form of a shatter zone. This is referred to by Twelvetrees :-

"The veins of galena (in the Wave Top Adit C.L.H.) have the appearance of spurs running off from the pug lode which lies east of and parallel with the lode seen in the adit. The fractures between the lodes seem to carry the ore At 50 feet from the entrance (of the Waves Lower Adit C.L.H.) a little galena was met with, facing the stone Further in the lode was intersected, veins of ore occurring between the two lodes as above". (12)

"The ground was loose (Jaeger's lode in Venezia Adit C.L.H.) and flat seams run off east in cross-fractures in the lode-channel. In the end of the drive is black slate with a little galena and banded quartz." (13)

(11) Geol. Survey Was. Bull. 6 p. 114.

(12) do. do. p. 117.

(13) do. do. p. 121.

Waller mentions the same characteristic at the Wave :- (14)

"The lode is not a big fissure - it is rather a zone of fractured rock which has been impregnated with galena."

Visual evidence of this Shatter zone is supplied in dumps from the Wave Lower Adit and the Venezia Adit. Slate with veins of galena up to $\frac{1}{2}$ " width is prominent. The galena does not occur on the slaty cleavage but in fractures irregularly orientated. They seem to be sufficiently closely spaced as to assume a possible economic importance.

(5) THE LODES.

(a) Number and Spacing. A specific statement as to the number of lodes within the Shear Zone is impossible. Development is meagre and exploration is incomplete.

Only in two localities - Foam and Llewelin's - can a number be indicated and it is uncertain whether that number is complete. In the Foam locality four have been identified. At Llewelin's there are five formations named as lodes.

The spacing of the Llewelin's group shows the five lodes to be confined within a width of 750 feet. Llewelin's, Barnett's and Jaeger's lodes occur within a width of 400 feet. The economic aspect of such spacing is modified by the occurrence of the mineralised shatter zone between them.

It remains for future exploration to determine just what are the distribution and spacing of the mineralisation over the whole 1,000 feet width of the Shear Zone.

(b) Proved Length and Width. In relation to the total length (4,500 feet) of the Shear Zone the proved length of the lodes is small. The following are the extent and range of penetration on the various ore occurrences along the Shear Zone :-

(i) Foam Lode.

Length : 150 feet approx.
Depth : 300 feet
Width : 6 feet + "bunches of galena beyond East Wall." (15)

(ii) Pug Lode (Wave)

Length : 150 feet approx.
Depth : 40 feet
Width : Unknown "The most ore fills the small fractures between the lodes". (16)

(14) G.A.Waller "Report on Zeehan Silver-lead Field 1904 P.87.

(15) do. do. P.85

(iii) Llewelin's.

(iii) Length : 150 feet (approx.)
 Depth : 40 feet
 Width : 15 feet

(iv) South Nubeena.

Length : 120 feet
 Depth : 50 feet
 Width : Unknown

"Sheared and broken country of undetermined width. There is metal through the formation. The formation is a very large one, and it is difficult to know what to follow." (17)

The above occurrences are strung out along the general line of southward extension of the Spray No. 1 Lode.

(v) Cross Chloride Lode.

Length : 100 feet
 Depth : 50 feet
 Width : 2 feet

(vi) Wave Lodes.

West of the Pug Lode there is a complex of lodes within the mineralised shatter zone.

Length : 200 feet
 Depth : 75 feet
 Width : 100 feet (approx.)

(vii) Barnett's - Jaeger's Lodes.

West of Llewelin's Lode there is a similar complex of lodes within the mineralised shatter zone.

Length : 200 feet
 Depth : 100 feet
 Width : 200 feet

(viii) Butler's Lodes.

West of the South Nubeena is again a similar complex of lodes located before the eastern South Nubeena was discovered. Very little work has been done on them.

The above occurrences are strung out along the general line of southward extension of the belt between Nos. 1 and 4 lodes in the Spray. They clearly represent a change in the fracture system southwards.

(ix) Chloride Lode.

This lode is immediately to the south of the southern end of the workings on Spray No. 3 Lode.

Length : 400 feet
 Depth : 150 feet
 Width : 5 feet

(x) Sunshine Lode.

Length : 100 feet
 Depth : 50 feet
 Width : 20 feet

(xi) Old Nubeena Lode.

(a) Discovery This is the original discovery in the South Spray Shear Zone (1892)

such as thrust, the Length: 100 feet
Depth : 40 feet
Width : 5 feet

(c) Orientation. The bearing of the Shear Zone as a whole is 330° . The bearings of the individual lodes which constitute the possible southern extensions of the Spray No. 1 Lode are :-

Foam : 340°
Pug (Wave) : 330°
Llewellyn's : 330°
South Nubeena : 330°

The other lodes within the Shear Zone vary in bearing between 322° and 335° with the exception of the Cross Chloride Lode (35°), Old Nubeena (17°) and Jaeger's No. 1 (8°) which probably belong to the "Caunter" series.

The dip of all the lodes is eastwards at a very steep angle.

6. THE ORE.

(a) Character of Lode Material. The ore as so far exposed consists essentially of galena and quartz. The lode material varies from silicified slate or sandstone to quartz filling of irregular intersecting fractures. The galena occurs in bands, bunches or disseminations in the silicified groundmass and as filling the intersecting fractures either alone or with accompanying quartz.

A characteristic of the more defined formations is the occurrence of pug on one or both walls. The Foam lode at the 300 ft. level has a pug seam on each wall 6 feet apart. The Pug Lode at the Wave receives its name from the pronounced pug on the walls.

The Sunshine lode consists of vertical bands of galena upwards of 8 inches wide standing in reddish-yellow pug. It cannot be said at present whether this pug is a primary lode characteristic or a surface decomposition effect.

(b) Constituent Minerals. Galena is dominant. Sphalerite is apparently only an accessory. Jamesonite is in definite evidence in the Foam lode.

Quartz is the prevalent gangue. Siderite is accessory.

(c) Ore Shoots.

(1) General Considerations. With ore occurrences such as these, the exploration and development of which are on such a meagre scale, delineation of ore-shoots is out of the question. It is only possible to indicate the general distribution of values disclosed by the limited workings.

In this connection it must be realised that the objective of all past exploration at Zeehan was solid galena. If a lode disclosed none of this, it was regarded as 'no good'. Even 'good milling ore' was by itself (i.e. unaccompanied by at least 6 inches of solid galena) quite unattractive.

The following information as to the distribution of values disclosed, by exploratory work is taken from old reports. It is best presented under the headings of the respective lode formations.

(ii) Foam. Where cut in the adit the lode was barren. A drive 30 feet north at this level continued in barren lode.

At 60 feet below adit level antimonial lead ore with some galena began to make in the lode channel. East of the east wall there were "fair bunches of galena for a width of 3 feet". (18)

At 100 feet below adit level the Jamesonite occurs in the hanging (east) wall. Twelvrees says :- (19)

"Found a small vein 3 or 4 inches wide carrying some nice antimonial lead ore. This was in the hanging wall country. It was driven on about 25 feet south, and swells into a bunch 7 or 8 inches wide just behind the end. There is pug on the west wall with some ore in it."

At 300 feet below adit level i.e. in the crosscut from bottom of the Main Shaft, Twelvrees/describes what was disclosed :- (20)

"At 184 feet the lode formation was cut, averaging 6 feet in width. A pug seam existed on each wall, and the intermediate portion was principally quartz, decomposed slate and carbonate of iron gangue containing a little lead ore. The only place where some clean ore was met with was where the lode took a sharp bend."

(iii) Wave. Work on this complex of lodes has been very sporadic. Stoping has been carried out for short lengths on several of the formations. The type of ore shoot mined is illustrated

(18) G.A. Waller "Report on Zeehan Silver-lead Field" 1904 p.115.

(19) Geol. Surv. Tas. Bull. 8 p.115.

(20) G.A. Waller "Report on Zeehan Silver-lead Field" 1904 p.116.

by the following quotation from Waller :- (21)

"Messrs. Featherstone have obtained 15 tons of ore from this lode, carrying a little over 1 ounce of silver to the unit of lead. The lode is not a big fissure - it is rather a zone of fractured rock which has been impregnated with galena. There were 6 feet wide of seconds showing at the time of my visit. I am told that the lode contained up to 2 feet of clean metal for a short distance The pug lode, though it apparently contains less metal is, in my opinion, the most likely formation if it were tested in depth".

(iv) Jaeger's. "The lode channel has been fairly wide all through (130 feet in length C.L.H.) 4 or 5 feet with splashes of ore continuously". (22)

(v) Barnett's. "About 170 feet have been driven on the lode. The channel has an average width of 4 to 5 feet with splashes of ore right through. The clean ore has a width of 1 inch up to half a foot, and generally keeps to the footwall side, with an occasional bunch in the centre..... The length of the ore-shoots stopped above the level for 100 feet in height aggregates 150 feet." (23)

(vi) Llewellyn's. The whole of the 150 feet opened up on this lode must be classed as ore-shoot.

The height between the two adits is 40 feet. The values were higher in the northern portion. Solid galena 18 inches wide at the upper level widened to 4 feet downwards but decreased to 8 inches at the lower level. A crosscut at the lower level showed 15 feet of 'splendid jigging ore'. (24)

(vii) South Nubeena. The only information available is from Waller :- (25)

"When I saw the lode it had been driven on for about 20 feet On the wall there was a seam of metal 1 to 2 inches in thickness. To the west of this was a seam of dig and rubble, 12 inches wide, and then sheared and broken country of undetermined width. This lode has now been driven on for about 120 feet. The formation is a very large one and it is difficult to know what to follow. There is metal right through the formation, but up to the present no payable ore has been cut."

(viii) Sunshine. For the whole length of 100 feet mined this lode was persistent in value, the pug between the galena bands carrying galena which was obtained by sluicing.

(ix) Grade of Ore. The galena from all of these lodes varies from slightly under to slightly above 1 oz. silver per unit of lead.

- (21) G.A.Waller "Report on Zeehan Silver-lead Field" 1904 p.87.
 (22) Geol.Surv. Tas. Bull.8 p.121.
 (23) do. do. p.121.
 (24) G.A.Waller "Report on Zeehan Silver-lead Field" 1904 p.91.
 (25) do. do.

The clean galena was obtained by selective mining where it occurred in wider seams, and by knapping and hand-picking elsewhere.

There is a heap of rejects at Llewelin's which by appearance would assay 10 - 15% Pb. There is a mullock dump at the lower Wave adit which carries an appreciable amount of ore from the shatter zone. Again estimating by appearance such ore would assay 8 - 12% Pb.

The oxidised ore from Chloride Lode averaged 40 oz. Ag. per ton.

Twelvetrees quotes a statement that a bulk sample of the lodestuff from the Foam Lode at the 100 feet level yielded :-

Pb. %	Ag. ozs.	Sb. %
20	19	?

7. MINE WORKINGS.

(a) Adits. : The area being one of high relief adits prevail. The following are the principal adits. The exact length of some of them is at present unknown. The need is obvious for reopening and examination.

Foam Adit:

(a) Elevation : 900 ft. contour
 Direction : 40°
 Length : 500 ft.

Upper Wave Adit:

Elevation : 1000 ft. contour
 Direction : 170°
 Length : 100 ft. (?)

Lower Wave Adit:

(a) Elevation : 950 ft. contour
 Direction : 100°
 Length : 400 ft.

Barnett's Adit:

Elevation : 950 ft. contour
 Direction : 90°
 Length : 250 ft.

Llewelin's Upper Adit:

Elevation : 1020 ft. contour
 Direction : 330°
 Length : 90 ft.

Llewelin's Lower Adit:

Elevation : 980 ft. contour
 Direction : 330°
 Length : 150 ft. (?)

Upper South Nubeena Adit:

Elevation : 900 ft. contour
 Direction : 150°
 Length : 120 ft.

Lower South Nubeena Adit:

Elevation : 850 ft. contour

Direction : 220°

Length : 150 ft. (?)

(b) Shafts.

Colonel North Shaft:

Location : On W. side of Shear Zone west of Foam.

Date : 1896

Depth : 200 feet

Condition : Collapsed

Foam Adit Shaft:

Location : From Foam Adit

Date : 1902

Depth : 100 feet

Condition : Unknown

Foam Surface Shaft:

Location : 100 ft. S. Foam Adit portal

Date : 1908

Depth : 310 ft.

Condition : Collapsed

Sunshine Shaft:

Location : On W. side Shear Zone west of Wave

Date : 1931

Depth : 50 ft.

Condition : Unknown

Wave Shaft:

Location : At entrance Upper Wave Adit

Date : 1902

Depth : 40 ft.

Condition : Open

(c) Drives.

Very little driving has been done. The greatest length in any location is 150 feet. Detailed information is not at present available but a general review of the position indicates that the aggregate of driving does not exceed 2,000 feet.

(d) Crosscuts.

Apart from the adit crosscuts the only crosscutting on significant scale is 450 feet north-eastwards at 200 feet level of the old Colonel North Shaft, and 185 feet in a similar direction at the 300 feet level of the Foam Surface Shaft.

There are occasional short crosscuts in the various adit workings to test parallel lodes where closely spaced.

8. DISCUSSION OF POSSIBILITIES.(a) Available Ore.

At Llewellyn's there are upwards of 500 tons of good ore at the surface. The mullock dump at the Wave lower adit contains an appreciable amount of ore from the shatter zone. Similar ore but apparently with less

metal contents is prominent in the dumps of Barnett's Adit.

Apart from such ore already mined there must be milling ore available in the adit workings, but the amount and value cannot even be guessed at. It must remain for examination when the old workings are opened up for examination.

It is quite clear, however, that in the absence of anything more than very limited workings any such immediately available ore will be limited in amount. But, on the other hand, the possibilities associated with future development work are attractive.

Future possibilities centre around the following :-

- (i) The combined aspects of similarity and line continuation with the Spray No. 1 Lode which carries pay-ore down to R.L. 340.
- (ii) The geologic structural pattern plus the character of mineralisation which both favour continuance in depth.
- (iii) The length (4500 feet) and width (1000 feet) of the Shear Zone.
- (iv) Llewelin's 15 feet wide of good milling ore plus bands up to 4 feet wide of solid galena.
- (v) Repeated lode widths of 4 to 5 feet with values around 20% Pb. 19 ozs. Ag.
- (vi) Undetermined but undoubtedly good widths of shatter zones carrying lead and silver values warranting systematic sampling and development.
- (b) Diamond Drilling.
 - (1) Surface Contours relative to Objectives.

It would be accepted that the high relief must present opportunities to penetrate the Shear Zone at appreciable depths below its surface or near-surface manifestation. Diamond Drill sites down to the 700 ft. contour could be selected within drillable distance of the Shear Zone.

Good strategic points based on the contour factor are :

South-west of Foam Shaft.
 West of Wave.
 West of Barnett's-Llewelin's.
 East of South Nubeena.

(ii) Character of Objectives. The objectives of any diamond-drilling campaign would be twofold.

In the first place traverses across the Shear Zone are required to determine the distribution within it of ore

occurrences. Horizontal or slightly depressed holes could be used for this purpose.

In the second place steeper holes would be required to search for ore-shoots below known ore occurrences or lode formations known at shallow levels.

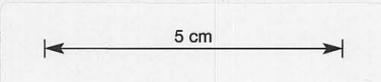
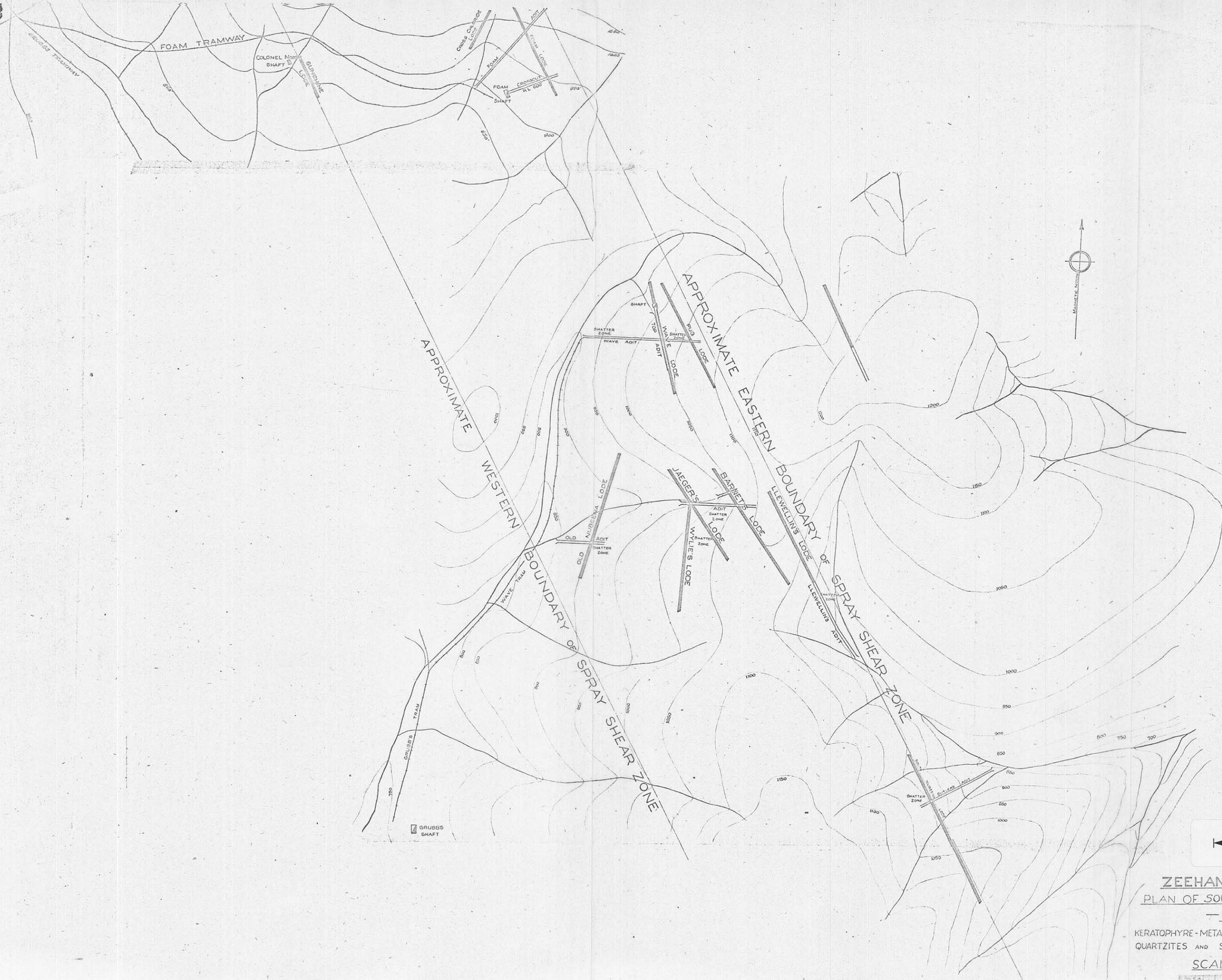
In both cases, however, it would be advisable to postpone the laying-out of any diamond-drill hole until the topographic and geologic survey is completed. Particularly is it desirable to determine the position and orientation of the Tear Faults. At present the line of lode occurrences along the general southerly extension of Spray No. 1 Lode is discontinuous as far as actual disclosures are concerned. Whether real continuity exists has yet to be proved. In addition, there is the problem of pay-shoots. Into both of these problems the Tear Fault Effect inevitably enters. It is already known, for example, that the good ore in the Sunshine Lode ends southwards against a 'slide' which is probably a tear fault. It is thus desirable to avoid drilling in unfavourable relation to the tear faults.

9. RECOMMENDATIONS.

- (a) Open up and clean out all adits not hopelessly collapsed. Systematically sample all ore occurrences.
- (b) Sample all ore-types in the dumps.
- (c) Complete topographic survey of the area shown in Plate of this report. This survey will include location of all mine workings including underground surveys.
- (d) Detailed geological mapping with special emphasis on location of tear faults. The geological work to include close examination of underground workings.
- (e) The design of a diamond-drilling campaign based on the results of the above work.

C. Loftus Hills

12/2/1947.



ZEEHAN EXPLORATIONS
PLAN OF SOUTH SPRAY LOCALITY
 — LEGEND —
 KERATOPHYRE-METAPHYRE TUFFS & BRECCIAS
 QUARTZITES AND SLATES
 SCALE IN FEET

OLD MINES ON ZEEHAN LODES.NORTH SPRAY.1. LOCATION AND ACCESS.2. HISTORY.3. OUTPUT AND PROFIT.4. GEOLOGIC ENVIRONMENT.

(a) Country Rocks.

(b) Position Relative to Regional Structural Pattern.

(c) The Shatter Zone.

5. THE LODES.

(a) Number, Spacing and Dimensions.

(i) Shatter Zone.

(ii) Shear Zone.

(b) Orientation.

6. THE ORE.

(a) Character of Lode Material.

(b) Constituent Minerals.

(c) Ore Shoots.

(i) General Characteristics.

(ii) Grade of Ore Mined.

7. MINE WORKINGS.

(a) Adits.

(b) Shafts.

(c) Drives.

(d) Crosscuts.

8. DISCUSSION OF POSSIBILITIES.9. RECOMMENDATIONS.

OLD MINES ON ZEEHAN LODES.

The northernmost workings of the Spray mine have entered the eastern NORTH SPRAY.

1. LOCATION AND ACCESS. The centre of this area is 100 chains from the Zeehan Post Office in a S.W. direction. It is in the south-western end of the Argent Flat.

It is accessible by road from the Zeehan Station, the distance by this route being 2½ miles. The Spray tramway formation is also available.

2. HISTORY. The numbers of the old mining leases involved - 187-87M, 188-87M, 189-87M - indicate discovery very early in Zeehan's history. The portion of present significance was portion of the Silver Queen Extended Prospecting Association's ground.

Work has been desultory by tributors and small syndicates. Up to 1915 the only work had been sporadic and restricted gauging by tributors of whom Marsh, Featherstone and Quigley have been recorded. In 1915 The Nike Company was formed in Zeehan and somewhat more pretentious mining was undertaken under T.C.Goodall. Good profits were being made when the latter met with accidental death. Operations immediately ceased and have not been resumed. This was in 1926.

3. OUTPUT AND PROFIT. It is impossible to isolate from production records the output which has come from the workings within the northern extension of the Spray Shear Zone. The following figures therefore are approximate only :-

	<u>Pb. (Tons)</u>	<u>Ag. (Ozs)</u>
Tributors (1899 - 1913)	900	90,000
Nike Co. (1915 - 1926)	2100	220,000
Total	<u>3000</u>	<u>310,000</u>

4. GEOLOGIC ENVIRONMENT.
 (a) Country Rocks. Consideration of the northern extension of the Spray Shear Zone from the northernmost Spray workings brings two distinct rock series into the petrologic picture. Both of these series belong to the Ordovician system but each of them possesses characteristics of apparently divergent economic significance.

(1) C.A. Miller "Report on Zeehan Silver-lead Field" Geol. Surv. Tas. Bull. 3
 (2) C.A. Miller "Paper on Zeehan Silver-lead Field" 1904 p. 8
 (3) Geol. Surv. Tas. Bull. 3 p. 37
 (4) C. Loftus Hill "Concise Statement on Lead-lead-lead"

The northernmost workings of the Spray mine have entered the western limb of the keratophytic tuffs and breccias "tripod".⁽¹⁾ The width of this limb in the direction of the Shear Zone is 1800 feet.

After traversing this 1800 feet width of keratophytic tuffs and breccias with its associated slates and sandstones, the Shear Zone enters the quartzites and slates of the Queen Hill which are similar to the quartzites and slates of the Spray and South Spray portions of the Shear Zone.⁽²⁾

Referring to the Queen Hill and Nubeena Hill rock-types Twelvetrees & Ward state :-⁽³⁾

"Apparently these two developments are of like age, for they seem to be lithologically similar to one another, and at the same time dissimilar to the other formations of the field. They consist mainly of white sandstones and pale-coloured slates, with occasional layers of dark slate."

(b) Position Relative to Regional Structural Pattern. The ore occurrences dealt with in this report are confined within a width of 1000 feet. This belt is a continuation of the South Spray - Spray Shear Zone along its general strike of 330 - 332°.

As far as observed up to the present, however, the pronounced shear planes of the Spray and South Spray do not occur. Instead there seems to be a notable development of shatter.

This shatter zone seems to be confined to the Queen Hill rock series and apparently has not been developed in the keratophytic tuffs and breccia series. It is quite striking how the shattering begins immediately the shear zone passes over into the sandstones and slates.

In the Structural Geological Map⁽⁴⁾ the Balstrup Tear Fault is shown as being on this line of transition. As explained in the 'South Spray' report further investigation and study is necessary to elucidate the relationship between the Shear Zone and the Tear Faults. It would appear on present evidence that the portion of the North Spray Shear Zone to which attention is now being directed lies between the Balstrup and State Tear

Faults: (1) G.A.Waller "Report on Zeehan Silver-lead Field" 1904 p.8.
(2) G.A.Waller "Report on Zeehan Silver-lead Field" 1904 p.6 &
(3) Geol.Surv. Tas. Bull. 8 p.37. G.S.Tas.Bull.8 p.37.
(4) C.Loftus Hills "Concise Statement on Lead-Zinc-Silver Ore-

(c) The Shatter Zone. In various parts of Zeehan, irregular and anastomosing lodes occur whose spacing is not wide. But the outstanding occurrence with close spacing is in the vicinity of the Nike workings. Here there is something approaching a stockwork. Waller refers to it as "a regular network of lodes". (5)

There appear to be two groups - one embracing Featherstone's Lode and the other around No. 1 Lode - but it is by no means certain that the intervening space of only about 300 feet does not also contain the network. Waller says of the Featherstone group :-

"The other lodes are all small branches, often containing nice bunches of metal, but too small and irregular to yield large profits."

Of the No. 1 Lode group he says :-

"There are a number of other lodes on this section west of No. 1 Lode".

The Nike workings are in the Featherstone group. One of the most significant pieces of evidence as to the stockwork character of this network is the belt of shattered slate carrying veins and veinlets of galena encountered in the east crosscut in the Nike workings. This is reported to be upwards of 50 feet in width. Evidence of it is seen in the mullock dumps wherein slates with seams and veins of galena are prominent.

Just what happens to the Shear Zone within the 1800 feet width of Keratophytic tuffs and breccias is uncertain. The Northernmost workings of the Spray show that the shears are continuing northwards. There are ironstone outcrops as yet untested. Moyle's Lode which is on the line of Spray No. 3 Lode seems to be at the intersection of an east-west vein of serpentine with a 330° shear plane.

5. THE LODES.

(a) Number, Spacing and Dimensions.

(1) Shatter Zone.

Length : 500 feet (N & S limits not determined)

Width : 400 feet approx.

No. of Lodes : 8 + vein network.

The above figures are for the Nike locality. Future investigation must be awaited before the

(5) G.A. Waller Report on Carbon Silver-lead Deposits

Gossanite is accompanied by arsenite in the gossan of Moyle's

lode.

No. 1 Lode group can be definitely included in the true shatter zone.

(11) Shear Zone. On the eastern side of the 1000 feet wide Shear Zone, within the keratophytic tuffs and breccias, there occur two prominent outcrops of gossan 400 feet apart along the line of Spray No. 1 Lode. They have had no work done on them.

On the western side i.e. on the northerly extension of Spray No. 3 Lode is Moyle's lode on which a little work has been done. Waller describes this as "a big formation" (6)

The chief lode so far worked south-east of the Nike workings has been referred to above as No. 1 Lode. Its strike is 345° with steep easterly dip. It has been driven on for 275 feet. It may represent the northernmost recrudescence of Spray No. 1 Lode. If this is so the length of the Shear Zone in North Spray is 2300 feet.

(b) Orientation. It is the location of this belt on the northern extension of the general orientation of the Spray Shear Zone which primarily draws attention to it. The evidence within it supplied by recorded characteristics of lodes and lode walls, with the exception of the Shatter Zone, is admittedly meagre. However, the type of mineralisation, including the occurrence of Jamesonite, is of special significance in correlation.

6. THE ORE.

(a) Character of Lode Material. The lodes of the Nike Network are essentially siliceous. Vein quartz is not prevalent, the silica being in the form of silicified rock carrying disseminated minerals. Solid galena up to 2 feet wide is frequent.

The veins in the Shatter Zone consist wholly of galena in criss-crossing veins in the slate.

Moyle's Lode shows dolomite and serpentine with splashes of galena. It is a replacement of dolomite derived from following small lodes of the Network. It may have been leached serpentine.

(b) Constituent Minerals. Galena is dominant. Jamesonite is subordinate but characteristic. Sphalerite is accessory.

(6) G.A.Waller "Report on Zeehan Silver-lead Field" 1904 p.82.

Cerussite is accompanied by crocoite in the gossan of Moyle's Lode. (b) Shooting. An incline shaft has been sunk in the Nike network. Quartz is dominant in the Nike Network. Siderite is with accessory.

Dolomite is dominant as the gangue in Moyle's Lode.

(c) Ore Shoots.

(1) General Characteristics. It is really inappropriate to talk of ore-shoots in such restricted workings. It must suffice to mention the runs of solid galena mined by Featherstone in 1899 and by the Nike Company in 1915-1926. Apparently most of the constituent lodes of the Nike Network carry continuous values with solid galena shoots. That is as far as present knowledge goes.

(ii) Grade of Ore Mined. Milling ore has not been mined. Ore sold was obtained by selective mining plus knapping and hand-picking. Indications of the value of the milling ore are obtained from the mullock dumps which contain the milling ore which was unavoidably mined in taking out the solid galena. The large boulders of quartzose material carrying about 25% Pb. came mainly from the 170 ft. level.

Information as to the value of the shatter zone in the slate will only be available when the workings are opened and sampling is possible.

The Pb: Ag ratio is high, being of the order of magnitude of 1 : 1.

7. MINE WORKINGS.

(a) Adits. In the Nike Network there are 3 adits. The 2 Upper Adits driven from the same approach are of unknown length. They are driven in directions 360° and 330° .

Quigleys or Main Adit is 76 feet below the Upper Adits.

It is shown in the only plan of the Nike workings available (1916) as 460 feet long with many changes in direction - obviously following small lodes of the Network. It may have been lengthened since that date.

About 200 feet below Quigley's Adit is another adit 275 feet in length which was driven on No. 1 Lode in the 1890's.

(b) Shafts. An Incline Shaft has been sunk in the Nike workings from the approach to the Upper Adits. It connects with the Quigley Adit and descends from there down to 150 feet below. This shaft is open.

A small shaft has been sunk on the flat in front of the Low Level Adit. Its depth is not more than 50 feet.

(c) Drives. There is a drive at the 90 ft. level below the Quigley Adit and another at the 150 ft. level. Their length is unknown but probably neither exceeds 400 feet.

(d) Crosscuts. Apparently there are only two crosscuts at the Nike. These were driven eastwards from the 90' and 150' levels. The length of each is upwards of 300 feet.

8. DISCUSSION OF POSSIBILITIES. It is therefore clear that the scale of operations has been very limited. There would be very little attraction in any proposal to resume operations where the Nike left off and on a similar scale on lodes 2 - 3 ft. wide with bulges up to 5 ft. wide. However, there is an attractive possibility which results from a consideration of the significance of the 'network' grouping of the lodes taken in conjunction with the occurrence of the mineralised shatter zone.

That possibility revolves around the feasibility of mining the network plus shatter zone in bulk. As already indicated the dimensions involved are of the order of magnitude of 500 feet by 400 feet. Vertical extension has been proved to 226 feet below the Upper Adits.

The economic factor is the rate of recurrence of galena-bearing lodes, veins and bands. Waller plotted 8. To this must be added an undetermined number of veins and small lodes referred to by Waller and indicated by the only plan of mine workings available. In addition there is the stockwork in the slate at least in the eastern part of the zone. Do these constitute an open-cut proposition? The topography lends itself to the development of an open-cut. Certainly some of the ore has been taken but this is confined to the wider lodes and only portion of such width has been taken.

It is clear that cross sections are called for. This can be achieved either by crosscutting or diamond-drilling.

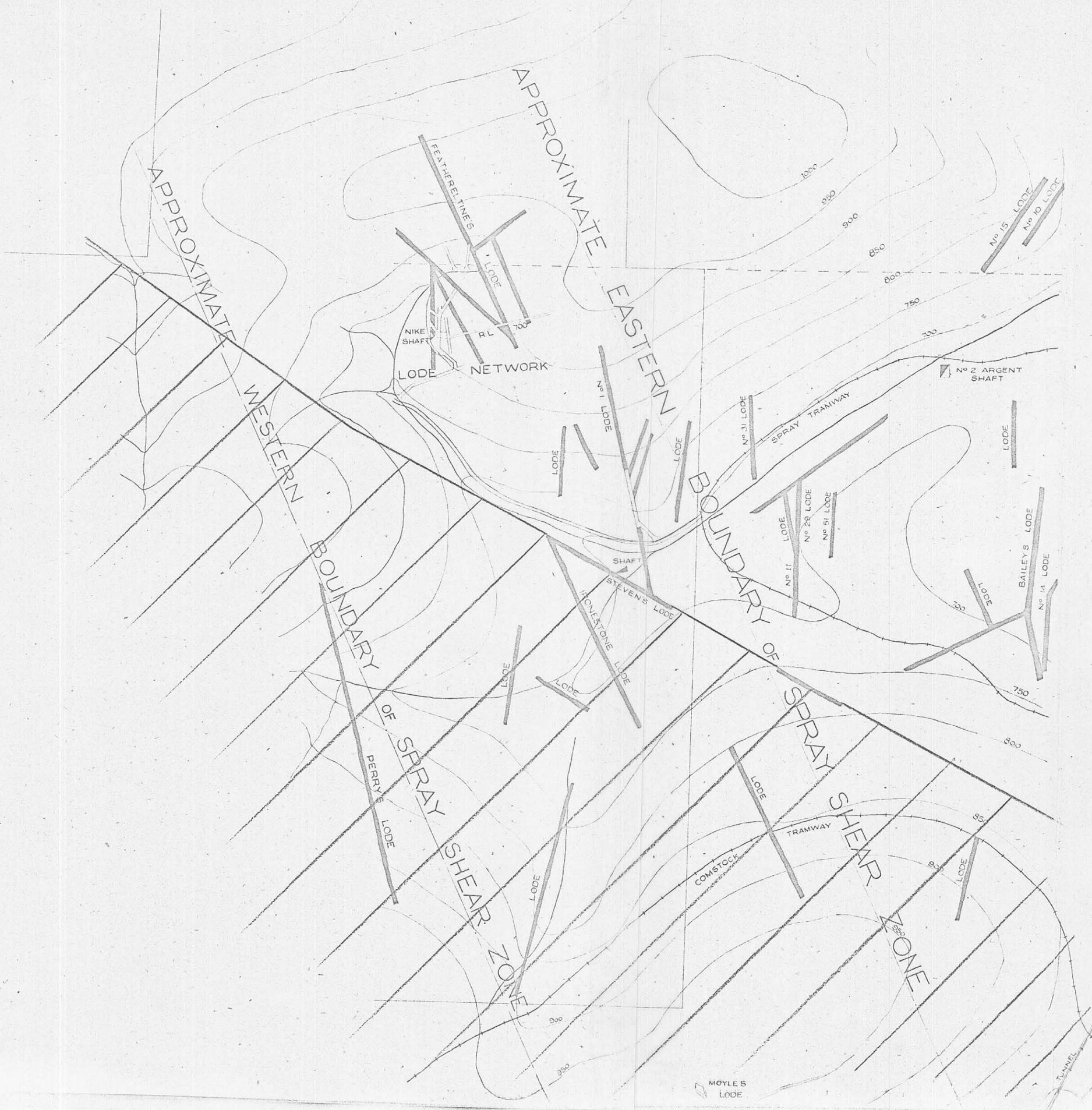
The other possibility in this North Spray Shear Zone is in the unexplored portion of the zone as it crosses the 1800 feet of keratophyric tuffs and breccias. It is a striking fact that there are no workings therein except the pot-hole in the galena-dolomite outcrop on the line of Spray No. 3 Lode. Systematic diamond-drill traverses are called for. Attack from either the eastern or western sides of the rounded spur sloping northwards towards the Argent Flat, will facilitate such drilling.

9. RECOMMENDATIONS.

- (a) Open up Quigley Adit and the Upper Adits. Study the lode-vein system exposed therein and sample ore exposures.
- (b) Unwater the Shaft and carry study and sampling downwards.
- (c) Lay-out of systematic driving-cross-cutting and/or diamond-drilling, based on the result of such work.
- (d) Design of a series of diamond-drill bores to systematically traverse the 1000 ft. wide Shear Zone in the keratophyric tuffs and breccias.

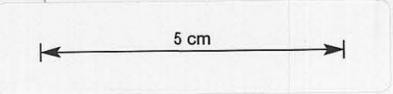
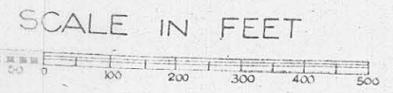
C. Loftus Hills.

15th February, 1947.



ZEEHAN EXPLORATIONS
PLAN OF NORTH SPRAY LOCALITY

- LEGEND**
- KERATOPHYRE METAPHYRE TUFFS & BRECCIAS
 - QUARTZITES AND SLATES



OLD MINES ON ZEEHAN LODES.THE WESTERN.

1. LOCATION AND ACCESS. The Western shaft is 37 chains N. of the Post Office. It is accessible by road from the Post Office being distant therefrom 2 miles.
2. HISTORY. In 1888 this mine had a prosperous history but closed down for lack of capital for further development.
3. OUTPUT AND PROFIT. In 1888 this mine had a London in 1888.
4. GEOLOGIC ENVIRONMENT.
 - (a) Country Rocks.
 - (b) Position Relative to Regional Structural Pattern.
 - (c) The Fractures.
5. THE LODES.
 - (a) Number and Spacing.
 - (b) Proved Length and Width.
 - (c) Orientation.
6. THE ORE.
 - (a) Character of Lode Material.
 - (b) Constituent Minerals.
 - (c) Ore Shoots.
7. MINE WORKINGS.
 - (a) Shaft.
 - (b) Levels.
 - (c) Drives and Crosscuts.
8. DISCUSSION OF POSSIBILITIES.
9. RECOMMENDATIONS.
 - (a) The Fractures.
5. THE LODES.
 - (a) Number and Spacing. Eleven (11) lodes with a width of 1500 feet.
 - (b) Proved Length and Width. The Main (No. 1) Lode :-
Length = 700 feet
Width = 2 to 12 feet
 - (c) Orientation.
Dipping from 30° to 50° in strikes.
All lodes dip to eastwards.

OLD MINES ON ZEEHAN LODES.THE WESTERN.

1. LOCATION AND ACCESS. The Western Shaft is 87 chains north-west of Zeehan Post Office. It is accessible by road from the Zeehan Station being distant therefrom 2 miles.

2. HISTORY. Started in 1888 this mine had a prosperous career until 1901 when it closed down for lack of capital for sinking below the 600 ft. level. Refloated in London in 1903 it sank its shaft to 800 feet but again was in financial difficulties. With Government aid, however, it went deeper by another 200 feet to a total depth of 1000 feet. The mine finally closed down in 1908.

3. OUTPUT AND PROFIT. In round figures the total output was :-

<u>Lead (Tons)</u>	<u>Silver (Ounces)</u>
37,000	5,000,000

Dividends paid :- £102,000

4. GEOLOGIC ENVIRONMENT.

(a) Country Rocks. The Western mine workings are confined to the melaphyre - melaphyre tuffs - slates and sandstones phase of the Ordovician system.

(b) Position Relative to Regional Structural Pattern. Ore deposition was wholly under the influence of the Montana Tear Fault.

(c) The Fractures. Apart from the Tear Faults within the Montana Tear Fault system, the fractures are Tension Cracks.

5. THE LODES.
(a) Number and Spacing. Eleven (11) lodes within a width of 1300 feet.

(b) Proved Length and Width. The Main (No. 1) Lode :-

Length : 700 feet
Width : 2 to 12 feet

(c) Orientation.

Anything from 305° to 60° in strike.

All lodes dip to eastwards.

6. THE ORE.

(a) Character of Lode Material. Fundamentally siderite lodes.

(b) Constituent Minerals. Galena with accessory sphalerite down to 300 ft. level (R.L. 425 feet). Tetrahedrite with chalcopyrite from 360 ft. level (R.L. 365 feet) downwards. Gangue is siderite.

(c) Ore Shoots.

(1) General Characteristics. In general the galena shoots were typical of the dictum "ore makes under the slide". The parallel slides within the Montana Tear Fault zone combined in the case of the Main (No. 1) Lode in producing an ore-shoot 700 feet in length.

From now on in this report attention will be confined to the Main (No. 1) Lode.

Galena ceased in the Main Lode at 300 feet below collar of shaft (R.L. 425 feet). Tetrahedrite and chalcopyrite began to appear at the No. 6 or 360 ft. level (R.L. 365 feet).

(ii) Tetrahedrite - Chalcopyrite Shoots. It is the possible economic importance of this depth development that has given rise to the preparation of this report.

It is a remarkable thing that Twelvetrees and Ward in their report on the Zeehan Field in 1910 ignore this development except for recording the finding of $1\frac{1}{2}$ cwt. of solid tetrahedrite at the 800 ft. level (R.L. - 75 feet)⁽¹⁾

However, six years before, Waller although clearly mystified as to its genetic significance was definitely aware of its possible economic importance. Reporting on the early results obtained by the new London Company at the 500 ft. level (R.L. 275 feet) on the Main Lode he says :-⁽²⁾

"In the end of the drive north, when the old Western Company left it, the face was showing about 5 feet of good seconds. This proved to be only a patch. It cut out going north to fahl ore and copper pyrites. The former is rich in silver, assaying 270 ounces to the ton, but it is present in such small quantities that the ore will only bulk 20 ounces. It has been found impossible to concentrate the ore in the ordinary way."

"The alteration in the character of the Western lode in depth is a very curious thing, and one on which it is impossible to venture an opinion at the present time."

(1) Geol. Surv. Tas. Bull. 8. p.109.

I would suggest that some of the ore might be sent to London to be tested by the Elmore oil process. This is the class of ore which would be eminently suited to this method of treatment. Twenty ounces of silver to the ton with a little copper would be a payable proposition if a process could be found for treating it, and if there were sufficient ore to make it worth while putting up a plant."

Waller in 1904 was just beginning to realize the possible importance of this development which he had seen two years before in its earliest manifestation which he thus described :-(3)

"The Main Lode at 500 ft. level was then driven on north, and very soon it widened out to a good-sized carbonate of iron lode, containing a little rich antimonial silver-copper ore, probably freibergite. Galena then came in, and the lode gradually improved, and became a good lode of second-class ore, with bunches of firsts. This drive was continued for about 120 feet north of the crosscut before the mine closed down. In the face of the drive the lode is 6 feet wide, with from 3 to 5 feet of good seconds and nearly 6 inches of firsts."

This is the sum total of any written records so far located. Although forgotten or not even ever recognised in the technical world, it is still remembered by old miners still living. For additional information we depend upon these old miners, but the statements they make have to be carefully reviewed.

Mr. William Payne is a good type of miner with a good memory. He was placed in charge of the Sunshine by the Mining Warden consequent upon quarrels between the brother owners in 1923. He worked in the Western under the London Company, taking a tribute on the silver-copper ore in 1908.

Payne in his descriptions puts emphasis on the copper. He states that in mining it they judged its value by observing the amount of 'yellow copper ore' (chalcopyrite). He further states that a number of tributes were let, each party being given 100 feet length along the lode. The ore was sold to the Zeehan Smelters as 'flux'. They were paid for the silver contents with (as usual) deductions. These operations came to a sudden end with the decision to close down the mine.

Payne gives the width as varying from 4 to 5 feet up to 12 feet in places. He describes the Main Lode as being copper-

(3) G.A.Waller "Report on Western Silver Mine, Zeehan" 1902 p.6

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silver from the 360 ft. level downwards to the 1000 ft. level. Incidentally Twelvetrees and Ward give the width of the Main Lode as averaging 4 feet for 1000 feet in length at the 800 ft. level, casually mentioning the tetrahedrite. (4)

Payne's information as to values is confined to the simple statement that the Smelter's returns on consignments varied from 18 to 30 ounces silver per ton.

It is possible to venture a tentative estimate of the value of the ore under present-day metallurgical efficiency, using as a basis :-

(1) Average Ag. content 20 ozs; tetrahedrite carrying 270 ozs. Ag. per ton.

(ii) Payne's estimating of ore value by observing the chalcopyrite, which will thus be assumed to at least equal the tetrahedrite in amount.

This gives the mineralogic composition :-

Tetrahedrite : 7.4 per cent
Chalcopyrite : 7.4 per cent

The tetrahedrite will contribute : Cu. 3.0% Sb. 1.6%

The chalcopyrite will contribute : Cu. 2.5%

The metal contents of the ore would thus be :-

Cu.	Sb.	Ag.
%	%	Ozs.
5.5	1.6	20

7. MINE WORKINGS.

(a) Shaft.

Depth : 1000 feet (collar at 725 ft. contour)
Dimensions : 16' X 5'
Water : 27,000 gals. per hour.

(b) Levels.

No. 1 Level : 45 feet
No. 2 Level : 110 feet
No. 3 Level : 170 feet
No. 4 Level : 230 feet
No. 5 Level : 290 feet
No. 6 Level : 360 feet
No. 7 Level : 430 feet
No. 8 Level : 500 feet
No. 9 Level : 600 feet
No. 10 Level : 700 feet
No. 11 Level : 800 feet
No. 12 Level : 900 feet
No. 13 Level : 1000 feet (R.L. - 275 feet)

(4) Geol. Surv. Tas. Bull. 8. p. 109.

(c) Drives and Crosscuts. Total : 12 miles.

8. DISCUSSION OF POSSIBILITIES. Ore assaying Cu. 5.5%, Sb. 1.6%, Ag. 20 ozs. in a lode 4 to 12 feet wide is attractive. But precise information is lacking as to the actual average assay value, and in addition as to the following points :-

Length of ore-shoots at all levels from No. 6 to No.13.

Width of lode at all levels from No. 6 to No. 13.

It is known that at No. 11 (800 ft.) level the average width is 4 feet over a length of 1000 feet. How much of this is ore-shoot? What of the other levels? According to Payne the ore-shoots extend over some hundreds of feet.

9. RECOMMENDATIONS.

(a) Peg the Western Mine area, as it is outside the Special Prospector's Licence. It is desirable to hold it pending further investigation.

(b) Search the "Zeehan & Dundas Herald" for the period 1903-1908 for information for progress developments.

(c) Search of records in Mines Department, Hobart, for any information in reports by Inspectors of Mines and State Mining Engineers.

(d) Contact any old miners who worked in the Western mine during the period 1903 - 1908.

(e) All this must precede any attempt to unwater. Such a step would be justified by positive and favourable information from the above investigation.

(f) Valuable information as to the metal contents of the copper-silver ore from the Western Mine Tributors must be contained in the records in possession of the Electrolytic Zinc Co. at the Zeehan Smelters. It is suggested that arrangements be made to have access to these old records of the Tasmanian Smelting Co.

C. Loftus Hills

15th February, 1947.

OLD MINES ON ZEEHAN LODES

MANGANESE HILL

1. LOCATION and ACCESS

2. HISTORY

3. CONTENT and PROFIT

4. GEOLOGIC OLD MINES ON ZEEHAN LODES

- (a) Karstophytic Tuffs and Black Slates
- (b) Ordovician - Silurian Sandstones and Shales
- (c) The Waller Fault
- (d) MANGANESE HILL
- (e) Major Faults
- (f) Minor Faults
- (g) Tension Cracks
- (h) The Probable Geologic Structure

5. THE LODES

- (a) The Iron-Manganese Occurrences
 - (1) Distribution
 - (ii) Structure
 - (iii) Extent by Depth Testing
- (b) **C. LOFTUS, HILLS, M.B.E., D.Sc.**
- (c) The "Pug"

6. THE ORE

- (a) The Iron-Manganese Material
 - (1) General Character
 - (ii) Constituent Minerals
- (b) The Sider.....
 - (1) Character of Lode Material
 - (ii) Constituent Minerals
- (c) The "Pug" Material

7. MINE WORKING

- (a) Shafts
- (b) Adits
- (c) Open-Cuts

8. DISCUSSION of POSSIBILITIES

9. RECOMMENDATIONS

OLD MINES ON ZEEHAN LODESOLD MINES ON ZEEHAN LODESMANGANESE HILL

1. LOCATION and ACCESS Manganese Hill is situated at the centre of the Broken Silver-Lead Field. It is a

1. LOCATION and ACCESS

physical feature of the district, being truncated

2. HISTORY

considered in outline, the peak being 1,400 feet above sea-level.

3. OUTPUT and PROFIT

The top of the hill can be approached from all sides.

4. GEOLOGIC ENVIRONMENT

The hill is reached from Forster Street via the old

(a) Keratophyric Tuffs and Black Slates

area, the hills being covered westwards on the Spray

(b) Ordovician - Silurian Sandstones and Shales

area, now reached by the road round the eastern slope

(c) The Waller Fault

of the hill, the fault being near the old Central Eastrop

(d) Major Tear Faults

Shaft. The southern flank is entirely controlled by the

(e) Minor Tear Faults

consolidated, now converted to a road.

(f) Tension Cracks

The Manganese Hill is entirely clear of timber.

(g) The Probable Geologic Structure5. THE LODES

The original discovery on Manganese Hill was

made by (a) The Iron-Manganese Occurrences of the West Adit.

Rich silver (i) Distribution of the outcrop focussed attention

(ii) Structure

on the iron-(iii) Extent of Depth Testing at Manganese Hill and

on parts (b) The Siderite Lodes of Broken Hill was claimed and

and (c) The "Pug" Material at Manganese Hill Silver Mining

6. THE MINE located in Manganese. Capitalisation was 100,000

shares (a) The Iron-Manganese Material; 50,000 issued to the

public; (i) General Character of the Company. This was

(ii) Constituent Minerals

in 1890.

(b) The Siderite Ore

The West (i) Character of Lode Material undertaken with

(ii) Constituent Minerals

confidence that under the iron-manganese outcrop of the great

(c) The "Pug" Material

there must be something similar to Broken Hill. After about 2,000

7. MINE WORKINGS

feet of adit driving with disappointing results the Main Shaft

(a) Shafts

was sunk in an endeavour to get below the "oxidation" which was so

(b) Adits

evident in the adit. The descent to the lode from the bottom

(c) Open-Cuts

of the shaft showing no improvement, operations ceased and the

8. DISCUSSION of POSSIBILITIES

mine was closed in November, 1892. Nothing has been done since

9. RECOMMENDATIONS

About the same time in 1890 the eastern portion of

OLD MINES ON ZEEHAN LODES

Manganese Hill was discovered in 1890 by Peter M. Balstrup

MANGANESE HILL, a deepening shaft to

1. LOCATION and ACCESS. Manganese Hill is situated at about the centre of the Zeehan Silver-Lead Field. It is a prominent physical feature of the district, being truncated conical in outline, the peak being 1,100 feet above sea-level.

The flanks of the hill can be approached from all sides. The northern flank is reached from Fowler Street via the old Spray Tram to the State Mine and thence westwards on the Spray Tram, now a road, eastwards by the road round the eastern slope of the hill to the Comstock Tram near the old Central Balstrup Shaft. The southern flank is entirely controlled by the Comstock Tram, now converted to a road.

The Manganese Hill is entirely clear of timber.

2. HISTORY. The original discovery on Manganese Hill was made by Peter M. Balstrup near the entrance of the West Adit. Rich silver assays in the ferruginous outcrop focussed attention on the iron-manganese outcrops at the crest of Manganese Hill and on parts of the slopes. Analogy to Broken Hill was claimed and amid very great optimism Balstrup's Manganese Hill Silver Mining Company was floated in Melbourne. Capitalisation was 100,000 shares of 10/-; 50,000 issued to owners; 50,000 issued to the public; £7,500 placed to the credit of the Company. This was in 1890.

The West Adit and the Eastern Adit were undertaken with confidence that under the iron-manganese outcrop of the crest there must be something similar to Broken Hill. After about 2,000 feet of adit driving with disappointing results the Main Shaft was sunk in an endeavour to get below the "oxidation" which was so evident in the adits. The crosscut to the lode from the bottom of the shaft showing no improvement, operations ceased and the mine closed down in November, 1892. Nothing has been done since.

About the same time in 1890 the eastern portion of Manganese Hill was floated as the Balstrup's Central Silver Mining Company. A Main Shaft to 99 feet, a prospecting shaft to 30 feet and four adits from the south-eastern slopes of Manganese Hill were achieved by 1892. Results were somewhat better than those of the larger company, but not sufficient to pay for further development, and the mine closed down. Nothing has been done on it since.

In subsequent years after the establishment of the Zeehan Smelters the iron-manganese oxides on the south side of Manganese Hill were quarried for flux. This continued with interruptions until the final closing down of the Smelters in 1913.

During the 1930's the area was taken up as a source of iron and manganese, but no work was done.

3. OUTPUT and PROFIT. Neither Company obtained much output. About 200 tons of hand-picked galena was obtained from the West Adit and some cwts. of Silver Chloride; there was nothing from East Adit.

About 100 tons of galena were obtained from the workings of the Central Balstrup on Johnson's Flat, and a similar amount from the No. 4 Tunnel at Brown's Creek.

The total output of galena may thus be said not to have exceeded 400 tons.

Many thousands of tons of iron-manganese flux were quarried and sent to both Zeehan Smelters and the North Lyell Smelters at Crotty.

No profit was made by the two Companies but subsequent leaseholders made profits supplying flux to the Smelters. There is no information as to what amount was made, but it would not be great.

4. GEOLOGIC ENVIRONMENT.

(a) Keratophyric Tuffs and Black Slates. This rock formation constitutes the greater part of Manganese Hill. The only portion of the Hill itself above the 600 ft. contour which does not consist of this rock assemblage is the south-eastern portion. As will be seen later this portion of the Hill most probably contains the limestone and some of the overlying Crotty sandstones.

The East Adit was driven in the Keratophyric Tuffs and Slates for 1,100 feet. Excellent exposures of the weathered facies occur along the Comstock Tram from the South Adit westwards towards the Spray turn-off. Splendid fresh specimens of the various rock-types can be gathered from the dump of East Adit.

(b) Ordovician-Silurian. It is in connection with these rock formations that an exasperating but important problem exists. Although the problem cannot be said to have been solved, a series of observations over the last eighteen months has thrown considerable light on it. One of these discoveries, namely that by Mr. M.L. Yaxley of Ordovician fossils in the iron-manganese of the flux quarries on the south side of the Hill, compelled a drastic readjustment of existing ideas as to the distribution of the Ordovician rocks in this vicinity.

In addition to the indisputable occurrence of Ordovician fossils in the ironstone, there is the observation originally made by Dr. Prider and recently confirmed by Mr. Webb and myself, of a gritty and even pebbly facies in the decomposed material in the upper portion of the road running from the State Mine to the Central Balstrup shaft. This had been assumed to be decomposed tuff because of its colour, but nowhere do any beds of undoubted keratophyric tuffs show other than a very fine grain-size. In view of the fact that the whole of this eastern side of Manganese Hill shows essentially ditrital accumulations, it seems a fair assumption that this pebbly facies indicates Crotty sandstones higher up the slope, i.e., west of the road.

We seem therefore compelled to visualise the extension of the Ordovician in this south-eastern portion of Manganese Hill to as far west as the westernside of No. 3 Flux Quarry. The structural picture which is responsible for this will be suggested in the final section of this chapter.

There is no doubt concerning the occurrences on Johnson's Flat, Goode's Hill (the southern extension of Florence Hill) and the Comstock Tram at the sand quarries. They are clearly Ordovician-Silurian, but are confused by structural displacement. The Black Shales of Johnson's Flat simulate the shale beds of the limestone formation, and their fossil content could possibly be used to confirm or reject this. The sandstones and grits of the sand-quarries on existing evidence would seem to be Crotty. This is the interpretation in Professor Carey's photo-geological map which incidentally puts the sandstones of Goode's Hill as Crotty. This latter interpretation makes Johnson's Flat look very like the limestone formation. The interpolated position

(c) The Waller Fault. This major fault continues from the Florence Hill - Argent Flat area. It runs in an approximately meridional direction just east of the entrance to East Adit. Southwards from this it is obscured by the talus accumulations of the eastern slope of Manganese Hill. The suggestion indicated above that the limestone extends to the western edge of No. 3 Flux Quarry entails the conclusion that the Waller Fault has been displaced by the Manganese Fault. This, however, is in strict concordance with what has happened northwards as fully described in the Florence Hill - Argent Flat report. It is probable that the meridional line of iron-manganese outcrop in situ below the Comstock Tram south of the Flux Quarries represents the Waller Fault just before it suffers its greatest displacement, namely that brought about by the Balstrup Tear Fault.

The latter occurrence is of interest. The Waller is 1906 thus
The conception, which obtruded into the Zeehan structural picture, that the Waller Fault was rather an unconformity must uncomprehendingly be ruled out and relegated to the long list

misconceptions originating in only partial knowledge of West Coast geology. Waller with his intimate acquaintance with the rock systems of Zeehan recognised it, and the writer after years of study of the West Coast confirmed it as a major structure.

(d) Major Tear Faults. The Balstrup Tear Fault runs east-west on the southern boundary of the area embraced by this report. Its position on the map produced herewith is that determined by Professor Carey in his photo-geological map, but it seems probable that it should be slightly to the northwards of the position shown.

The Manganese Tear Fault comes into the structural picture as a major factor. Proof of its existence starts at the Keratophytic Tuffs - Nubeena Quartzites contact at the No. 2 Argent in the big bend of the old Spray Tram. This is certainly a faulted contact. It again manifests itself on the south end of Johnson's Flat where the black shales are in faulted contact with Crotty Sandstones of the sand-quarries. The interpolated position between these two manifestations takes into consideration the orientation of structure shadows in the iron-manganese outcrops at the crest of Manganese Hill and the change from gritty talus to clay talus along the State Mine - Central Balstrup road.

Another major tear fault now comes into the structural picture. Nowhere can it be seen as displacing rock formations, but there are pointers which force hypothecation of its existence. These pointers are: the orientation and character of the iron-manganese formation outcropping and penetrated by the Central Balstrup workings; the apparent orientation of the line of the three Flux Quarries; the structure-shadow in the South-West Outcrop; and the dolomite-galena occurrence between the Comstock Tram and the north end of No. 3 Spray Lode.

The latter occurrence is of interest. Waller in 1906 thus describes it on page 82: p. 78.

(2) Waller, 1906, p. 78.

"In the north-eastern portion of this section Mr. W. Moyle has been working on a curious formation on the line of No. 3 Spray lode. It is a big formation, and the workings are not yet sufficiently extensive to enable one to form an opinion as to the strike of the lode. The iron outcrop at the surface strikes a little north of east, but this seems to have been cut by another lode formation striking west of north. From the shaft which he has sunk a good deal of dolomite and serpentine has been obtained carrying splashes of galena."

In the plan accompanying this report this tear fault has been shown by a broken purple line and named the Central Tear Fault. It is shown not offsetting the Waller Fault where it crosses, but in actual fact it will probably be found to do so if and when exploration underground proceeds.

(e) Minor Tear Faults. It appears probable that the West Adit was driven on a fracture which may belong to this group. Balstrup's original discovery was where the adit portal now stands. Waller's description of the Manganese Hill operations is sketchy as it was ancient history by his time. Nevertheless he throws some light on the problem:-

"The upper level (West Adit) was started on the lode, but soon lost it, and was continued in footwall country. A crosscut was put out east and cut the lode." (1)

"The main outcrop of ironstone is believed to be the capping of what is known as Balstrup's lode. The strike of this lode is 45° west of north, dipping to the north-east at a high angle." (2)

This is the lode driven on at the levels of West Adit and Low Adit. It is described as having had well defined walls. Its direction suggests that it is in a minor tear-fault. It certainly does not correspond to the Manganese Tear Fault, being well to the north thereof. The question then arises as to what they followed in the Main Drive of the West Adit. There is

(1) G.A. Waller, 1904. P. 78.

(2) G.A. Waller, 1904. P. 78.

no information available as to whether they were following a fracture or were just blind stabbing.

The structure shadow in the iron outcrop south of the West Adit portal is probably the Manganese Tear Fault, but that in the next outcrop southwards must be one of the minor tear faults.

(f) Tension Cracks. Within the area embraced by this report there is, by Zeehan standards, a paucity of the tension type of ore repository fractures. This may be because exploration has been limited. Waller says of the East Adit:-

"Another long adit was driven from the north-eastern portion of the section, and for over a thousand feet, and though a number of gossan formations were cut, none of these has been definitely recognised as Balstrup's lode. There is a formation at about the spot where the lode should pass, but it was of no value where cut, and was not driven on. All the formations cut in this adit are completely oxidised." (3)

Do these "formations" represent tension cracks?

(g) The Probable Geologic Structure. The map accompanying this report must be regarded as a sketch map only. It has been prepared with full realisation that data are incomplete and fixation of certain positions yet to be finalised, but its purpose is to illustrate the present conception of the fundamental structure at Manganese Hill.

The dominant structures are the Balstrup and Manganese Tear Faults and the Waller Fault. The latter has brought the Crotty sandstones in the northern portion, and limestone in the southern portion, in faulted contact with the Keratophyric Tuffs and slates. The effect of the Manganese Tear Fault is to place the Waller Fault about 450 feet further east than its position between the Manganese Fault and the Balstrup Tear Fault. The effect of the Balstrup Tear Fault is to bring Keratophyric Tuffs

(3) G.A. Waller, 1904. p. 78.

QUARRY OUTCROP. This seems to be the largest individual outcrop. It has been penetrated by three open-cuts and

its dimensions would seem to be 500 ft. by 500 ft.

abutting on the Ordovician on the latter's south side. Such an interpretation would result in there being at least portion of the limestone bed under the south-eastern slope of Manganese Hill. It would have a steep easterly dip. Incidental to this, traces of original bedding are clearly visible in the Flux Quarries dipping steeply eastwards. More will be said of this in the later portion of this report. But all this presupposes that the limestone is hidden either by replacement by the iron-manganese or by being covered with hill talus. However, it is perhaps significant that within the limestone area thus conceived the decomposed material constituting the subsoil has a distinctly sandy facies. Most of Johnson's Flat is covered with silt.

5. THE LODES.

(a) The Iron-Manganese Occurrences.

(1) Distribution. - A close examination of the surface occurrences of this iron-manganese material indicates that an appreciable amount consists of boulders which are not in situ but are "floaters". Waller's map shows a distinct "line" through the crest of the Hill and indicates that this is "the line of the Balstrup Lode." But it is at least doubtful whether there is such a continuous "line" from the Flux Quarries to the crest of the Hill. Rather is there indicated a distinct break about half-way up the slope.

The occurrences seem rather to consist of irregularly shaped masses with a tendency in places to assume something in the nature of lineal direction. Detrital boulders in the talus tend to give a false impression of lineal extent. It will be best to list the occurrences which are recognisable as in situ. Their spatial relationships must await further elucidation. The occurrences are:-

Quarry Outcrop.- This seems to be the largest individual occurrence. It has been penetrated by three open-cuts and one adit. Dimensions would seem to be 500 ft. by 300 ft.

Crest Outcrop.- Prominent at the crest of Manganese Hill this mass is roughly circular in shape with a diameter of approximately 300 ft.

West Outcrop.- This is on the lower portion of the western slope of Manganese Hill. An adit has been driven into it. It shows a lineal extent, being traceable at the surface over a length of 300 feet. Its width is about 20 feet.

South-West Outcrop.- This is similar to the last-named. Its length is some hundreds of feet and the width about 20 feet.

Central Balstrap Outcrop.- This is the outcrop cut through by the Comstock Tram. It seems to emerge from No. 1 Flux Quarry, crosses the tramway west of the old Central Balstrap shaft and continues down the hill until it hits the Balstrap Tear Fault where it ends. It has been penetrated by two adits driven by the Central Balstrap Company. Its width is about 10 feet and the lineal extent is about 400 feet.

East Outcrop.- At the extreme eastern foot of Manganese Hill and just above Johnson's Flat is an outcrop which appears to be circular in area. The diameter would be about 50 feet.

South Outcrop.- South of and below the Comstock Tram in vicinity of Flux Quarries. About 20 feet wide with lineal direction roughly meridional of about 100 feet.

(ii) Structure.- Even in the undisturbed outcrop there can be seen in most of the occurrences something in the nature of structure. In the western portion of the Crest Outcrop, the West Outcrop, the South-West Outcrop and the Central Balstrap Outcrop, this takes the form of a pseudo-cleavage. In the three former the direction of this pseudo-cleavage is about 290° . In the Central Balstrap Outcrop it is 315° .

In the Flux Quarry Outcrop the structure is visible in several places as distinct bedding, dipping at a high angle east-

The appearance is that of original beds which have been

replaced by the iron and manganese oxides. It is a very common
 assumption that the "oxidized formation" was the iron-manganese

The outstanding characteristic of the material exposed in
 the open-cuts is the large-scale mammillary forms; botryoidal,
 reniform, and stalactitic forms are present in bewildering
 promiscuity.

1893 sum up the results as follows:-

(iii) Extent of Depth Testing.- Waller was clearly
 puzzled by these iron-manganese outcrops and was well aware of the
 numerous disappointments which followed several attempts to explore
 them in depth. This is his summing up of the problem as he saw it:

"The presence of manganese in these outcrops,
 coupled with their great size, led to the belief
 that the lodes were of the same type as the great
 deposit at Broken Hill, and the highest expectations
 were indulged in as to the future of the mine.
 These expectations have unfortunately not been
 realised. It has been proved, for one thing, that
 the size of the gossan outcrops bears little relation
 to the size of the lodes a short distance below the
 surface. The former appear for the most part to
 be surface deposits of the nature of bog iron, and
 sometimes cut out on a flat floor 30 or 40 feet below
 the surface. In other parts the fissure appears to
 have been enlarged near the surface and filled in
 with gossanous material. This is the more
 conceivable when it is remembered that the whole
 country is in a highly decomposed condition. The
 gossan is very poor, and of no value except as a
 flux." (4)

(5) The Manganese Lodes. The lode driven on at the West end
 Waller, however, was definitely in error in referring to the
 Manganese Hill occurrences as gossan. Whatever it is, it is
 certainly not gossan. But, at the same time, Waller had differ-
 entiated between two types - bog iron and iron-manganese lode
 material.

The deepest depth testing of any outcrop is that which was
 accomplished by the East Adit. The Crest Outcrop at that depth
 was represented by a "formation completely oxidised." Apparently
 it was only a few feet in width. In view of the evidence in the

(4) G.A. Waller, 1904. p. 78.

(5) Gilberton Tilley "The Wild West of Tasmania," 1891, p. 48.

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dump of perfectly fresh undecomposed tuff, it is a reasonable assumption that the "oxidised formation" was the iron-manganese material.

The Central Balstrup's adits penetrated the Central Balstrup Outcrop at 85 ft. and 115 ft. below the outcrop. Montgomery in 1893 sums up the results as follows:- now well-known "black pug".

"A great deal of driving and trenching has been done on this property on the lode, but only to find that it is thoroughly oxidised above the water-level." (5)

But Wilberton Tilley in describing the results in the No. 2 Adit says:-

"This is in over 150 ft., passing through lode matter most of the distance - gossan, ironstone and occasional bands of galena - giving small assays, the highest being 27 oz. Ag and 24 per cent Pb." (6)

In the open-cuts, the vertical exposures reach 30 feet and the same material is seen at the bottom of the cuts as in the upper portion.

(b) The Siderite Lodes. The lode driven on at the West and Low Adit levels was a normal Zeehan siderite lode. It must be termed, following Waller, Balstrup's Lode but at the same time it must be realised that it has a proved length of about 650 feet and not the extended length shown by Waller in his map of Zeehan. Neither are we justified in connecting the lode opened up by the Central Balstrup from the Main Shaft with Balstrup's Lode. This was another error due to the "line of lode" obsession.

The width of Balstrup's Lode was from 6 to 8 feet with a width

(5) A. Montgomery, 1893. p.20.

(6) Wilberton Tilley "The Wild West of Tasmania," 1891, p.48.

The material is similar to that in the Austral Flux Quarries and is probably identical. It is of significance that the latter is demonstrably replacements of limestone.

of 15 feet at 245 feet east of where first cut. The orientation as far as drivin on was 315° .

(c) The "Pug". This heading has been chosen with some hesitation. The occurrences to be described in Johnson's Flat are associated with black material (visible on the dumps) which has the general characteristics of the now well-known "black pug".

The only reference to these occurrences of ore is contained in Wilberton Tilley's "Wild West of Tasmania". Neither Montgomery nor Waller refer to it and there is no official record whatever.

This is what Tilley says:-

"A large and promising show of ironstone and gossan, carrying carbonate of lead, which assayed 48 ozs. Ag and 78 per cent Pb, is situated on the western side of the tramway on what is known as Johnson's Flat. A prospecting shaft was sunk 30 ft. with the object of opening out at this depth, but excess of water put a temporary stop to operations. Trenches were cut near the shaft, and several very rich veins of sulphide ore discovered, having a tendency to make as sinking advanced; bulk assays gave 250 ozs. to 300 ozs. Ag and 56 to 85 per cent Pb. About 25 bags of first class ore are ready for shipment, and about 25 tons could be sent away if necessary." (7)

Subsequently Johnson's Flat was flooded for water storage purposes (The Florence Dam) and it is only recently that on the dam being emptied the old workings have become visible. An examination of the dumps shows slugs of galena exactly the same as in dumps of definitely recognisable pug elsewhere.

6. THE ORE.

(a) The Iron-Manganese Material.

(i) General Character.- The outcrops are black or reddish black in colour. As exposed in the open-cuts the colours range from black to brick-red and even bright red, with variations of brown to yellow.

The material is similar to that in the Austral Flux Quarries and is probably identical. It is of significance that the latter are demonstrably replacements of limestone.

Where cut in the South Adit the material shows a distinct tendency to silicification and is much harder than that in the open-cuts.

(11) Constituent Minerals.- The obvious minerals are limonite, pyrolusite, psilomelane and kaolin. Some of the iron oxide is haematitic rather than limonitic. Quartz crystals occur in vughs in the material from the South Adit.

Waller's remark "the gossan is very poor" gives us ^{no} indication of actual value although implying that it is not barren of lead or silver. The Z. & D. Herald of 9th May, 1892, in a report on the Balstrup's Manganese Hill says:-

"Outcrop of ironstone lode being opened up,
and good ironstone coming to hand.
Assays from outcrops about usual average
2½ oz. Ag per ton."

Nowhere however is there any mention of Pb values in the ironstone from the quarries. This is in contrast to the output from the Austral Flux Quarries which averaged about 1½ oz. Ag and 5 per cent Pb. But Wilberton Tilley in describing the work on Balstrup's Lode in the Balstrup Central states that No. 1 Tunnel driven in the lode gave "assays of small percentages of silver and lead." In the drive on the lode from No. 2 Tunnel he mentions "gossan, ironstone and occasional bands of galena." This probably has significance as the outcrop of the Balstrup Lode is typical iron-manganese material.

Another obscure point is as to whether all the iron-manganese outcrops carry silver values. Apparently no attempt was made in the past to differentiate between the various outcrops it was all "ironstone." Does the outcrop on the top of Manganese Hill carry silver values? Is the silver confined to the "ironstone" which is a replacement of limestone?

Another question naturally follows - in what form does the silver occur? As a matter of fact the same question applies to the ore obtained in No. 1 Bore at the Oceana in regard to lead

zinc and silver. There is no obvious presence of either galena or sphalerite. That question still remains unanswered. Similarly the ore in the Austral Flux Quarries shows no visible galena. How do the lead and silver occur?

There still remains the absence of understanding of the bands of galena encountered in the Central Balstrup workings. Actually these workings are the deepest under any iron-manganese outcrop. Does this mean that at that depth the oxide mineralisation is changing to sulphides?

(b) The Siderite Ore.

(i) Character of Lode Material. - As far as can be seen from an examination of the few specimens in the old dump, the lode material is normal Zeehan siderite-galena. The carbonate is mangano-siderite. On the evidence of these specimens there seems no justification for the oft-repeated statement that all lodes in the Manganese Hill workings are "completely oxidised"; the galena is galena and the siderite still siderite. Have the iron-manganese occurrences confused the judgment of past observers? Apparently they did not recognise the fact that the iron-manganese oxides do not constitute a gossan, for whatever it is, it is certainly not a gossan.

(ii) Constituent Minerals. - Galena and siderite

of course, with most probably subordinate sphalerite. But silver chloride or silver chlorobromide (embolite) is reported as having been obtained in some quantity from the West Adit and Low Adit workings. It is uncertain whether this came from the siderite lode or from the iron-manganese formation. But such silver chloride was not unusual at Zeehan. Thus the Queen, the Sylvester & Junction mines produced it in some quantity. Low Adit produced 300 feet from the portal.

Nevertheless the Balstrup Lode carried high silver values as indicated by the following assays quoted by Wilberton Tilley:-

	<u>Pb.%</u>	<u>Ag.Ozs.</u>
Canary Ore	59	888
Gossan	27	830
Galena	76	190
Ironstone & Galena (Bulk)		119

The Z. & D. Herald of 14th August, 1891, gives the following assays of three piles of ore totalling 80 tons:

	<u>Pb. %</u>	<u>Ag. Ozs.</u>
Carbonate and Galena	40	113
Galena	70	174
Gossan with Canary Ore	20	39

The same source on 9th December, 1891, gives:

	<u>Pb. %</u>	<u>Ag. Ozs.</u>
Galena	77	352-455
Carbonate & Oxide of Lead	72	115
Ironstone	31	78

(c) The "Pug" Material. There is not much of this material exposed on Johnson's Flat, but what there is shows the general characteristics of the black pug occurrences of the Zeehan district. Slugs of galena can be picked up on the dumps.

7. MINE WORKINGS.

(a) Shafts. The Balstrup's Manganese Hill Shaft is down 154 feet, which is 60 feet below the Low Adit. A crosscut was put out westwards to cut the lode. What was encountered there is not recorded, but the Company ceased operations just at that stage. The collar of the shaft is open.

The Balstrup's Central Shaft is 99 feet deep. At 85 ft. it connects with No. 1 Tunnel. The collar has collapsed.

The Air Shaft put up from West Adit seems to have disappeared. The shaft in Johnson's Flat was sunk to only 30 feet.

(b) Adits. Although Manganese Hill lends itself "par excellence" as a proposition for adit exploration, it cannot be said that any approach to thorough testing has been achieved.

East Adit was driven 1,100 feet and got as far as under the crest of the Hill. The West Adit was driven 950 feet. Low Adit reached 850 feet from the portal.

Central Balstrup No. 1 Adit measured 185 feet. The No. 2 Adit was 200 feet in length.

The length of South Adit is unknown. Another adit high up the north-western slope of Manganese Hill is of unknown length, but is apparently quite short.

(c) Open-Cuts. The three open-cuts are on the south side of Manganese Hill. They are quarries approached uphill from the Comstock Tram.

No. 1 Quarry measures about 50 ft. by 20 ft. No. 2

Quarry somewhat higher up the hill is about 30 ft. by 20 ft.

No. 3 Quarry adjoins No. 2 and is a few feet higher. It measures about 40 ft. by 20 ft.

8. DISCUSSION OF POSSIBILITIES.

Montgomery in 1893 expressed the following opinion on the prospects of Manganese Hill:-

"Two long tunnels have been driven on the lode above water-level with the effect of showing that it is a well-defined vein up to 12 feet and more feet in width in parts, but consisting almost entirely of oxidised material. In several places rich oxidised lead ores were found carrying chloride of silver, but always going underfoot and not rising above the tunnels, and it became clear that there was no use expecting any quantity of ore until greater depth was attained and the lode was struck below the zone of oxidation. But by the time this work was done the shareholders had lost faith in the mine and the Company went into liquidation, with the result that the British Zeehan Company bought the lease of this section. I still have much faith in the future of this mine, the work done having proved nothing to its detriment, and given many indications of its probably carrying good ore below the gossan." (8)

When it is pointed out that the British Zeehan Company did absolutely nothing to add to the work of the original Company, it will be realised that Montgomery's opinion still stands untested.

Waller in 1904 states of the Balstrup Lode:-

"Still, the lode can be hardly be said to have had a fair trial below water-level. It is still possible that rich shoots of ore may exist below the gossan."

(8) A. Montgomery. "Report on Minerals Field of Montagu" 1893, p. 19.

But, as previously pointed out, Waller had confused the iron-manganese material with the gossan.

It seems quite clear that a length of siderite lode of from 600 to 800 feet remains untested below Low Level Adit.

The iron-manganese outcrops present a very interesting problem. Along with the similar material at the Austral these occurrences still remain untested and unexplained. I have no doubt at all that the Austral occurrence is replaced limestone, and the small piece of core plus sludge sample results indicate that underneath is silicified limestone carrying galena and sphalerite. The silver assays of the Manganese Hill Flux Quarries are significant and cannot be ignored. What is underneath?

It must be accepted that the East Adit has disposed of persistence in size downwards of the Crest Outcrop. But this immediately raises the question as to whether all the outcrops are genetically similar. The undoubted bedding in evidence in the Flux Quarries, taken in conjunction with the interpretation of geologic structure which brings limestone into that section of Manganese Hill, would place these occurrences in a different category from the Crest, West and South-West Outcrops. These latter lie in fault zones and could possibly be explained by migration of the solutions away from their main locus with either sporadic or zonal deposition. Attention, therefore, becomes concentrated on the Quarry, East, and Central Balstrup Outcrops, accentuated by the occurrence of galena in the lower levels of the latter. There must also be added to such a contemplation the realisation that extensions of the outcrops possibly occur under the talus accumulations.

There is in fact an area in this south-eastern section of Manganese Hill, rhomboidal in shape measuring 800 feet in a 330° direction and 600 feet at right angles thereto, which carries possibilities which cannot be ignored. Replacements in limestone are the objectives to be sought. The area demanding attention is

bounded on the north by the Manganese Tear Fault, on the south by the Balstrup Tear Fault, on the west by the Waller Fault and on the east by the outcrop line of the base of the Crotty Sandstones.

There is in addition the Johnson's Flat area which is awaiting the attention it ceased to receive nearly 60 years ago. Good results were obtained down to 30 feet when water took charge. The occurrences are most probably in the calcareous shales constituting the upper portion of the limestone formation. The area to be explored is triangular in shape, with the base of 800 feet length along the Waller Fault, and height 1,200 feet along the Manganese Tear Fault; the hypotenuse is formed by the western foot of Goode's Hill. It is quite possible that the area is in good condition.

9. RECOMMENDATIONS.

At this stage a reminder is opportune in regard to the sketch character of the plan accompanying this report. It is fundamentally based on Dr. Prider's map which, however, only covers portion of the area. Additions have been based on the 400 ft. to the inch enlargement of Professor Carey's photo-geological map. In the absence of surveys, which have been delayed because of urgent demands elsewhere at Zeehan, many points have been placed in their approximate position. It would be best to regard this plan as a nucleus for a more accurate plan to be prepared when surveys have been made. The following call for accurate fixation:-

1. Positions of Balstrup Central Shaft and Nos. 1 & 2 Adits.
2. Precise mapping of the Balstrup Tear Fault.
3. The position of the Waller Fault south of the Comstock Flux Quarry Tram.
4. The exact positions and outlines of the Flux Quarries.
5. Precise mapping of the Keratophyric Tuffs - Nubeens Quartzites faulted contact on south side of the No. 2 Argent workings.
6. Exact position and orientation of the West and South-West Outcrops.

Further work is also needed to check up on the true geological horizon of the Sand Quarry sandstones and the beds on Goode's Hill and Johnson's Flat. Palaeontological study seems to be the modus operandi.

All these things should be done before attempting to test the possibilities. It is unfortunate that the West and East Adits are so far away from the area to be tested. The ends of these adits are 1,200 to 1,400 feet distant from the Flux Quarries. But the nearest point of the limestone abutting on the Manganese Tear Fault is within 700 feet of the end of East Adit. It may be a possible method of approach to the testing to open-up East Adit. This would involve breaking down the concrete dam at the portal. It is quite possible that the adit is in good condition.

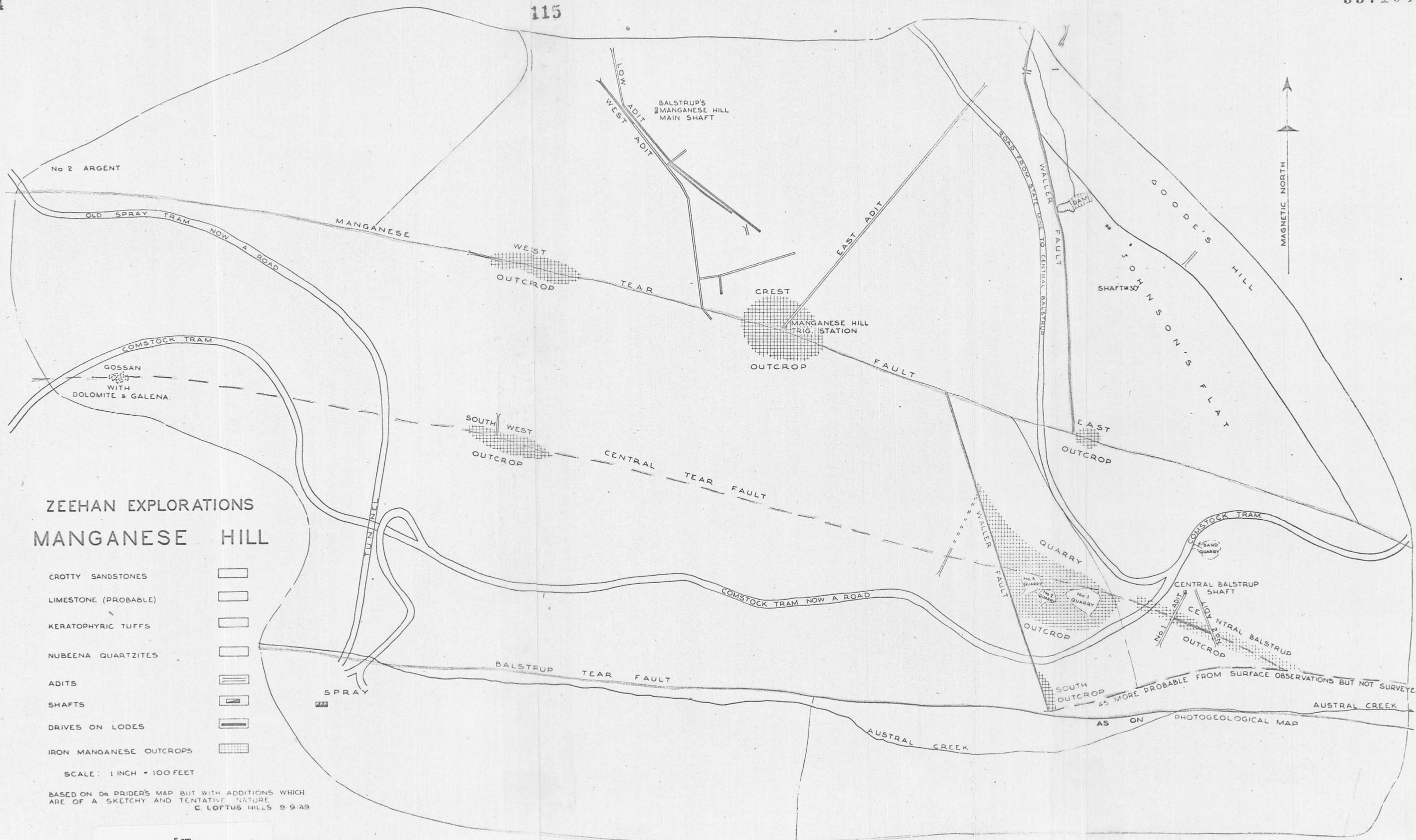
It would be informative and feasible to open up both No. 1 Adit and No. 2 Adit of the Balstrup Central to see just what the lode structure and composition are.

The crux of the testing problem is, of course, depth penetration of the Flux Quarry bodies. Depressed bores directed northwards from below the Comstock Tram seem feasible. It would be as well to make sure that the collars of such holes were north of the Balstrup Fault. Alternatively, vertical holes could be put down from the Quarries.

In the meantime systematic sampling of all the iron-manganese outcrops and the assaying of the samples for Pb & Ag are needed. This should include a similar attack on the Austral Flux Quarries. A mineragraphic study would surely throw some light on this exasperating mystery. This could be handed as a problem to a University student for concentrated study.

C. LOFTUS HILLS,

9th September, 1949.

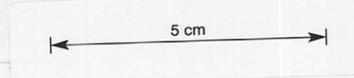


ZEEHAN EXPLORATIONS
MANGANESE HILL

- CROTTY SANDSTONES
- LIMESTONE (PROBABLE)
- KERATOPHYRIC TUFFS
- NUBEENA QUARTZITES
- ADITS
- SHAFTS
- DRIVES ON LODES
- IRON MANGANESE OUTCROPS

SCALE: 1 INCH = 100 FEET

BASED ON DR PRIDER'S MAP BUT WITH ADDITIONS WHICH ARE OF A SKETCHY AND TENTATIVE NATURE
C. LOFTUS HILLS 9 9 23



AS MORE PROBABLE FROM SURFACE OBSERVATIONS BUT NOT SURVEYED
AS ON PHOTOLOGICAL MAP