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THE MONTANA SILVER - LEAD MINE - ZEEHAN

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DEPARTMENT OF MINES - TASMANIA

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Introduction:

The properties at present held by the Montana Silver-Lead Mining Company N.L. comprise three 40 acre leases Nos. 11789M, 11790M, and 11791M (Zeehan Mineral Chart). The leases are located in a north-south line on either side of the Zeehan - Corinna Road about three miles from Zeehan Post Office. The present underground workings are located near the south-west corner of lease No. 11789M and the present report is concerned with the workings occurring on that lease only. Some trenching and exploratory work by bulldozer has been undertaken on the two northern leases but the results obtained have been inconclusive.

The present investigation was authorised by the Director of Mines in October 1950 and its purposes were :-

(1) To carry out a routine survey of all workings.
(2) To make a study of the lode system exposed and to report on Ore types
  Structure of the system
  Relationship of structure to ore deposition
  Location and valuation of ore shoots
  Any other features of economic or scientific interest.
(3) To apply the results of the investigation to other known lode systems occurring in the vicinity.
  The search for other possible lode systems in the vicinity

The report is based on field work carried out between May and July 1951 and is accompanied by the following plans.

General plan of lease No. 11789M	(1" - 50')
Plan of adit level	(1" - 20')
Plan of 100' level	(1" - 20')
Plan of 150' level	(1" - 20')
Long and cross sections	(1" - 20')

All survey work was carried out by B.L. Taylor while D. Burger was responsible for the greater part of the detailed mapping. Assays of samples were carried out by the Mines Department Laboratory at Launceston while microscopic investigation of ore samples was undertaken in the Hobart office. The report is the result of collaboration between Messrs. Taylor and Burger. General responsibility for all statements is assumed by the senior author.

Some confusion may arise in regard to the naming of the mine. In the early days of the Zeehan field an English Company operated two mines at the north end of the town known respectively as the Zeehan-Montana No. 1 and the Zeehan-Montana No. 2. It is stressed that the present mine, the Montana Silver-Lead Mine has no connection with these older mines nor is the present company related in any way to the Zeehan-Montana Company.

TOPOGRAPHY:

The above sections are located in the buttongrass region to the west of Zeehan township. A marshy flat striking northwest bisects No. 11789M diagonally. A low range rising fifty feet above the level of the flat occurs to the south west while somewhat higher ground occurs to the northeast. The drainage from the flat finds its way into Little Pine Creek and thus into the Pieman River just east of the junction of that river with the Heemskirk River. The course of Little Pine Creek is marked by a broad flat marshy zone to the west of the lease. The Big Ben mine occurs west of the present mine on the west side of Little Pine Creek. The area is almost devoid of timber except for a few scattered patches of stunted gums.

MINE SURVEY:

An underground survey of the mine was carried out by Mr. O. Douglas between 1937 and 1938 and subsequently additional survey was carried out by a Mr. Doran. The plan of the original survey was available to the present writer but details of the later work could not be located. Since :-

(1) None of Douglas' stations could be located beyond doubt
(2) The whole of the data was not available
(3) Douglas' plan does not show the widths of the drives
(4) Much additional underground work has been carried out since this survey was done

it was decided to initiate a complete re-survey of the workings. This was carried out by theodolite and steel tape the instrument used being a Watts No. 1 Microptic theodolite.

Lease No. 11789M has been gridded, the origin of co-ordinates being the southwest corner peg of the lease. All plotting of points has been by co-ordinates with the exception of some stadia shots taken to costeans and cuts.

The shaft plumbing was undertaken with the aid of two wires suspended at the surface. The instrument was set up at the surface and at each level so as to make almost an equilateral triangle in each case. Sixteen observations of the angle between wires were taken at each level and also sixteen readings between the reference wire and the reference point in each case. A close was made by taking high angle shots with the aid of a diagonal eyepiece through the internal winze from the adit to the 100' level. Two main closes were effected as follows :-

(1) A/12-A/11-A/10-A/8-A/7-A/5-A/3-A/2-A/1-S/3-S/4-S/5-S/7(=A/12)
Closing error = 1 in 4327.

(2) A/9 - A/7 - A/5 - A/3 - A/2 - A/1 - S/3 - S/4 - S/5 - S/8 - shaft reference wire - B/1 - B/2 - B/6 - B/7 - B/9 - B/10 - B/11 - B/12 - B/14 - B/15 - B/16 - B/17 - B/30 - B/31 - B/33 - A/9
Closing error = 1 in 8472.

Levels were run with a quickset level along the main drives, and a closed level survey taken from the bench mark at the top of the shaft over the hill to the mouth of the adit and return via the access road to the bench mark at the shaft. The closing error in this circuit was 00.20'. An assumed R.L. of 900.00' has been assigned to the bench mark at 100' level and all levels are related to this assumed datum.

The bench marks used during the survey are located as follows :-

(1)	Top of Shaft.	On collar set - north west corner of centre compartment
(2)	100' level	On plat set - northwest corner of centre compartment
(3)	150' level	On plat set - Northeast corner of centre compartment
(4)	Adit level	Staple in cap of first set at mouth of adit.

Appended hereto is a table showing the co-ordinates and reduced levels of stations used during the survey.

TABLE OF CO-ORDINATES AND REDUCED LEVELS OF SURVEY STATIONS

STATION	LATITUDE	DEPARTURE	R.L.
S/2	247.14	38.69	
S/3	497.68	45.32	992.27
S/4	425.77	259.83	1056.96
S/5	498.06	289.70	1045.05
S/6	282.51	257.29	1046.30
S/7	451.54	347.52	1039.00
S/8	660.05	496.78	
S/9	711.88	597.70	
S/10	569.02	374.13	1012.07
S/11	00.00	1320.00	
S/12	570.20	144.90	
S/13	713.03	183.71	
S/14	831.31	195.27	
S/15	883.95	418.80	989.47
S/16	678.09	505.83	
S/17	1010.61	450.47	994.45
S/18	1060.73	605.47	1008.11
S/19	992.66	851.55	1017.81
S/20	837.27	984.42	1026.13
S/21	729.32	1137.26	1034.08
S/22	593.67	1248.28	1039.47
S/23	404.21	1323.16	1046.11
S/24	52.70	1539.98	
B.M. Collar of shaft			997.51
A/1	458.71	100.87	996.77
A/2	403.35	166.77	997.44
A/3	353.63	231.06	998.12
A/4	377.05	247.13	
A/5	303.32	293.12	999.94
A/6	284.03	277.63	1000.61
A/7	332.55	315.40	1000.11
A/8	346.13	322.46	1001.02
A/9	352.44	326.73	1005.27
A/10	387.83	327.91	1002.65
A/11	428.33	319.74	997.25
A/12 (=S/7)	451.53	347.72	997.16
A/13	252.31	258.08	1000.13
A/14	280.86	287.00	
A/15	547.01	409.11	
A/16	547.04	373.13	
A/17	567.87	301.06	
A/18	571.06	285.36	
B.M. 100' Level			900.00 (Assumed)
B/1	659.70	495.23	906.15
B/2	627.26	477.21	906.87
B/3	663.33	544.39	
B/4	695.89	503.91	
B/5	648.42	432.44	
B/6	591.59	492.35	907.61
B/7	574.81	489.65	907.29
B/8	553.07	466.42	
B/9	524.65	487.80	907.89
B/10	496.14	462.58	908.24
B/11	474.01	433.40	907.28
B/12	435.05	414.58	907.76
B/13	445.21	374.23	

STATION	LATITUDE	DEPARTURE	R.L.
B/14	416.89	402.70	907.10
B/15	368.66	358.71	907.99
B/16	352.48	353.90	908.04
B/17	325.10	338.57	909.04
B/18	343.40	309.39	
B/19	300.64	323.62	908.67
B/20	268.35	320.26	910.38
B/21	259.86	348.94	
B/22	613.76	357.02	
B/23	599.24	476.15	
B/24	525.83	449.42	
B/25	507.55	451.69	
B/26	460.95	382.71	
B/27	454.08	346.39	
B/28	479.13	393.38	
B/29	520.89	432.01	
B/30	344.41	348.84	907.14
B/31	342.49	340.87	937.09
B/32	364.26	354.43	
B/33	346.22	343.20	
B/34	321.59	325.61	935.57
B/35	312.46	315.98	935.78
B/36	281.56	300.63	
B/37	251.23	316.08	912.70
B/38	252.92	296.58	
B/39	272.64	281.39	
B/40	282.78	285.23	
B/41	492.74	405.52	
B/42	503.33	432.07	
B/43	460.39	325.58	
B/44	666.46	563.36	
B/45	684.65	667.03	
B.M. 150' Level			846.38
C/1	668.20	541.89	852.11
C/2	652.50	537.57	845.59
C/3	738.51	561.00	853.12
C/4	751.81	529.05	
C/5	777.51	573.63	
C/6	745.38	588.81	
C/7	799.77	598.82	852.79
C/8	614.12	540.35	853.14
C/9	592.08	519.85	846.62
C/10	602.43	486.23	
C/11	578.64	505.58	
C/12	586.25	504.47	
C/13	541.42	487.04	847.57
C/14	581.14	491.76	
C/15	598.19	476.08	

HISTORY OF THE MINE:

Prospecting in the area now held by the Montana Silver-Lead Company N.L. apparently commenced on 8.1.94 on which date a 40 acre lease No. 2116/91M was marked out in the name of the May Queen Prospecting Association N.L. A lease was issued dated 1.4.94, voided on 10.2.95, re-instated on 20.12.95 and finally voided on 18.8.96. During this period, a small underlay shaft was sunk to a depth of fifteen feet some distance south of the southern boundary of present lease No. 11789M i.e. not on the present property. This shaft is said to have intersected metal but details are not available. In addition a pit was sunk to nine feet on the site of the present main shaft and a small costean cut in the vicinity of this pit. The costean has since been covered by later developments.

On 18.8.96 an area No. 1453/93M was marked out on the site of former section 2116/91M in the name of William Jenkyn. A lease was issued dated 1.11.96 and the following transfers were effected.

(a) To Western Extended North Silver Mining Company N.L. 14.12.96
(b) To H.S.M. Evans 2.8.98
(c) To Western Extended Silver Mining Company N.L. 4.11.98
(d) To Western Consolidated Silver Mining Company N.L. 12.10.00

The lease was voided on 16.12.02.

Again on 17.1.07 the same area was marked out as No. 2889M by R. Clabburn. A lease dated 1.5.07 was voided on 15.12.08. There is no record of any exploratory or developmental work having been carried out during the period 18.8.96 to 15.12.08.

Sometime during the period 1908 to 1922, a prospecting campaign was initiated under the supervision of Hartwell Condor, State Mining Engineer. During this campaign a series of cuts were made in known mineral areas in the Zeehan field. One of these costeans (No. 1 on the accompanying plan) was cut on the site of present lease No. 11789M by Mr. J. Dhue.

On 24.1.23 an area of 40 acres, No. 8948M was marked out for Richard Clark, a lease dated 1.4.23 was issued and voided on 26.2.24. This lease covered mostly the area of the previous leases but was located several chains further east. It still included what is now known to be the area of the lode system. Again on 11.3.26 the same area was marked out for Richard Clark as No. 9652M and was cancelled on 1.3.27. During these periods, G.W.S. Clark carried out the following prospecting work on the area :-

(a) Widening and deepening of the May Queen prospecting pit.
(b) The cutting of a costean west from this pit. This costean has now been filled in.
(d) The cutting of No. 2 costean south of what is now No. 1 prospecting shaft.

During the period 1935-37 a prospecting party led by G.W.S. Clark was established with government assistance. This party carried out the following work :-

(a) Sinking of No. 1 prospecting shaft on an underlay of 60°E for a depth of 42'
(b) The driving of an adit from the bottom of this shaft in an easterly direction for approximately 60 feet.
(c) The extension of No. 2 costean
(d) All cuts on the top of the hill
(e) The driving of the adit crosscut as far as the tillite lode
(f) The driving of the eastern adit and associated drives as mapped.

On 12.2.37 the area of former lease No. 9652M was marked out in the name of A.A. Summerhays as No. 11789M. Two futther leases Nos. 11790M and No. 11791M were marked out simultaneously in the same name the latter two being north and adjoining 11789M. These areas were transferred to Montana Western Extended Silver-Lead Company N.L. on 29.4.37, and leases issued dated 1.5.37. Subsequently the leases were transferred on 11.8.39 to Montana Silver-Lead Company N.L. who are the present holders. Under these two companies work at the mine proceeded continuously until early in 1941 when operations were suspended owing to the low price of lead. During this period almost all the underground workings were opened up as follows :-

(a) The enlargement of the old May Queen shaft to 12' x 4' and the deepening of it to 297' by the end of 1939 when work on the shaft was stopped owing to the inflow of water.

(b) The driving of 100' level to approximately 510 feet from the shaft together with.

No. 1 West Crosscut
No. 2 West "
No. 3 West "
Bypass drive
No. 2 West Crosscut North Drive
No. 1 East Crosscut
No. 2 East "
Rise connection to adit level
Rise connection to adit level from No. 2 W. Crosscut
Rise to surface from Bypass Drive.

(c) Sinking of No. 2 prospecting shaft to 41 feet and a drive south therefrom.
(d) Continuation of adit crosscut to main lode and drives north and south.
(e) A leading stope on this level.
(f) Rise from adit drive to No. 1 prospecting shaft.
(g) The driving of an intermediate level between 100' and adit levels.
(h) The driving of 150' level and associated crosscuts commenced later in 1939 and continued till work ceased in 1941.
(i) The cutting of a rise from 150' to 100' level.
(j) The partial cutting of a plat at 200' level.

Sometime in 1947 a tribute was let to Mr. R.E. Clarke and Mr. T. Brampton for part of the mine. These men worked continuously till 31.8.50. During this period a connection was made between adit north drive and the short drive from the floor of No. 2 Prospecting shaft and stoping was carried out above the adit drive and between the intermediate and adit levels. No work was done in the 100' and 150' levels. The main shaft was not in use and all access was by the adit crosscut.

As from 1.9.50 active operations by the Montana Silver-Lead Company N.L. were resumed under the managership of Mr. R.E. Clarke. The lower levels have been unwatered, the mainshaft brought into operation and development work is in progress on 100' and 150' levels concurrently with mining operations in the adit level. Milling plant is beihg installed and should be in operation shortly. All ore from the shaft is at present being stacked in anticipation of the completion of the mill. Ore obtained from the adit is being jigged and represents the sole saleable product of the mine at present.

Most of the information regarding dates of leases above has been obtained from old Mines Department registers held at Zeehan. For descriptions of the works carried out in the past the author is indebted to descriptions contained in past Annual Reports of the Director of Mines and to information given by Messrs. J. Bell, G.W.S.Clark, R.E. Clarke, and T. Brampton, residents of Zeehan.

MINE PRODUCTION:

The following table shows the quantities and values of silver and lead produced from the mine since 1937. The information relating to the years 1937 to 1949 have been taken from past Annual Reports of the Director of Mines and the figures for 1950 and 1951 have been supplied by the Inspector of Mines, Queenstown.

TABLE SHOWING QUANTITIES AND VALUE OF SILVER AND LEAD PRODUCED FROM 1937 to 1951

Year	Tons ore treated	Tons concentrate produced	Total lead Tons	Total Silver Ounces	Estimated value.
1937	N.R.	101.90	59.14	8813	£A2120
1938	81.0	N.R.	16.30	1921.6	£A410
1939		Not Recorded			
1940	852.0	123.60	79.868	9488	£A2986.6
1941	919.0	96.70	65.9	6916	£A2373.68
1948	N.R.	85.344	54.855	8473.575	£S7188.0
1949	N.R.	228.783	142.548	22863.399	£S18504.557
1950	N.R.	172.777	97.348	15117.605	£S14402.706
1951	N.R.	84.138	49.295	75[illegible]8.876	£S9853.373

Notes (1) N.R. = Not Recorded.
(2) Figures for 1951 to June 30th.

MINING DEVELOPMENT:

As at July, 1951, the following developmental work has been carried out on or in the vicinity of the lode system on Lease 11789M.

Surface:

(1) Five cuts on western flank of the hill near S.W. corner of lease.
(2) Two cuts on eastern flank of the hill.
(3) Two E.W. costeans and several small pits in the vicinity of these cuts.

Underground:

(1) Southern adit crosscut driven on a tortuous course for a total of 76 ft.
(2) Eastern adit crosscut driven southwest for 52 ft. from a point 100 ft. southwest of main shaft. At this point the lode was met and a south drive put along the lode for 17 ft. The main crosscut was continued east for 88 ft. and a southeast crosscut driven for 40 ft. from the point at which the lode was intersected.
(3) Two prospecting shafts sunk from the crest of the hill in the vicinity of the cuts and costeans. No. 1 prospecting shaft (co-ordinate position 282N, 257E) sunk on an underlay of 60° to east for a vertical depth of 51 ft. No. 2 prospecting shaft (co-ordinate position 451N, 347E) sunk vertically for a depth of 42 ft. From this shaft a southwest drive continued partly in lode matter for 42'. A small cuddy was cut in the northwest corner of the bottom of the shaft also in lode matter. From No. 1 shaft an easterly crosscut was driven about 60 ft. without intersecting lode.
(4) An adit crosscut driven from co-ordinate position 459N, 101E in a south-Southeast direction for 243 ft. At 168 ft. from the portal a lode was met and driven on 26 ft. north-east and a small cuddy cut on the south wall of the adit. At 243 ft. the crosscut intersected a main lode system which was driven on northeast and southwest. The south drive continued to 63 ft. in lode matter and a connection was made to No. 1 prospecting shaft at 26 ft. from the end of the adit. The north drive followed lode channel for 95 ft. then veered into the footwall for a further 40 ft. where it connected with the drive from the floor of No. 2 prospecting shaft. In this drive at a point 25 ft. from the end of the adit a winze has been sunk from the floor of the south drive along the hanging wall of the lode to a vertical depth of 29 ft. A short prospect drive from near the bottom of the winze goes south west for fifteen feet.
(5) A main three-compartment shaft has been sunk from co-ordinate position 660N, 514E for a depth of 297 ft. From this shaft levels have been put off at 97.7 ft. and 151.3 ft. The plat has been partially cut at the 220 ft. level.

(6) 100 ft. level. A crosscut west from the shaft intersected the lode formation at 18 ft. and drives have been put north and south.

(a) North Drive proceeds 40 ft. without crosscuts.

(b) No. 1 West Crosscut. The crosscut from the shaft was continued for a further 150 ft. westerly.

(c) No. 1 East Crosscut. This has been put out in a direction slightly north of east for 163 ft. from the shaft. At 60 ft. from the shaft, two short drives go north and south respectively. At 150 ft. from the shaft another short northerly drive has been put out.

(d) South drive. This is the main development at this level. According to Blake (4) this has reached a distance of 510 ft. from No. 1 West crosscut as at May 1939. The end of the drive is now fallen at approximately 450 ft. from No. 1 West crosscut and it is not known just what distance was ultimately reached.

(e) No. 2 West Crosscut commences at 246 ft. from No. 1 West crosscut and according to Blake (4) extends 114 ft. west with a northwesterly deviation of 35 ft. from the 80 ft. mark. This crosscut is now fallen at 92 ft. from south drive and the end cannot be inspected. At 65 ft. from south drive a vertical rise has been put up connecting with No. 2 Prospecting Shaft.

(f) No. 2 West Crosscut North Drive. This commences 41 ft. from south drive and proceeds northerly and northeast for 97 ft.

(g) No. 3 West Crosscut commences at 359 ft. from No. 1 West crosscut. According to Blake (4) this attained a length of 43 ft. from south drive at which point a southwest drive was put out for 21 ft. and at 10 ft. from the end of this drive a further 10 ft. of northwest drive was cut. The crosscut is now fallen at 34 ft. from south drive.

(h) Bypass Drive. This commences from south drive at a point 93 ft. from No. 1 West crosscut. The drive commences south west and veers south and south east to meet south drive again at 182 ft. from No. 1 West crosscut. From this bypass a north drive proceeds 35 ft. from a point 20 ft. from south drive. Again from the bypass drive at 70 ft. from south drive a connection has recently been driven to No. 2 West Crosscut North Drive meeting this latter at 50 ft. from No. 2 West crosscut.

(i) No. 2 East Crosscut. This has been driven 30 ft. E.S.E. from south drive commencing at a point 420 ft. from No. 1 west crosscut. A small cuddy occurs midway between this crosscut and No. 3 West Crosscut.

(j) At 338 ft. from No. 1 West crosscut a rise has been put through from south drive and connects to adit level north drive 55 ft. from the end of the adit crosscut.

(k) From the bypass drive a somewhat tortuous rise has been driven to the surface. The top of this rise is located just west of the compressor shed.

(l) At 437 ft. from No. 1 West crosscut a rise has recently been put west for 24 vertical feet at an elevation of 37°. From the top of this rise 35 ft. of northwest and northerly drive has been cut in an attempt to link up with the intermediate drive.

(7) Intermediate Level: At a height of 28 ft. above south drive an intermediate level has been cut from the rise connection. The south drive of this level proceeds 68 ft. and the north drive ft. No crosscutting has been done at this level.

(8) 150 ft. Level. From the plat an east crosscut meets the lode at 25 ft. from the shaft and north and south drives have been put out.

(a) North Drive. This extends 155 ft. from the crosscut.

(b) South Drive. As at July, 1951 this extends 145 ft. southwest and is being actively extended.

(c) No. 4 West Crosscut goes off north drive 75 ft. from the shaft and extends 37 ft. W.N.W.

(d) No. 5 West Crosscut. This leaves south drive 80 ft. from the shaft crosscut and extends for 43 ft..10 ft. from the end a short south drive extends 22 ft.

(e) No. 3 East Crosscut. This leaves north drive opposite entrance to No. 4 West crosscut and extends for 25 ft.

(f) A small cuddy 10 ft. square occurs in the main drive opposite the shaft crosscut.

(g) A rise has been put through from a point just south of the entrance to No. 5 West Crosscut meeting 100 ft. level 75 ft. south of No. 1 West Crosscut.

(9) Stoping. The following stoping work has been carried out.

(a) 150 ft. level. A leading stope occurs at the south end of south drive. This has recently been timbered, and normal stoping operations are at present in progress here.

(b) 100 ft. level. Little stoping appears to have been done in the past. In a few places leading stopes have been commenced but have not been proceeded with. In the bypass drive some stoping has recently been in progress but has been stopped temporarily.

(c) Adit Level. Two leading stopes were taken out by the operating company prior to 1941. The greater part of the stoping in the mine occurs in this area and was undertaken by the tributing party between 1947 and 1950. The greater part of the length of the adit drives has been stoped out in a rather irregular manner good patches of ore only having been taken out. In three places breakthroughs to the surface have been made. These stopes are in a rather dangerous condition at present and it was not considered wise to undertake detailed surveys through them. The accompanying long section of stopes has therefore been merely sketched with references to such fixed points as could be located on the surface and in the adit level.

Additional stoping has been undertaken by the tributing party at various points between the intermediate and the adit levels as shown on the long section.

At present an underhand stope is being cut below adit level from the winze in south adit level drive. This stope commences at a point 18 ft. below adit level and extends 40 ft. to the northeast.

PREVIOUS LITERATURE:

There appear to be no published official reports on the area. Three typed reports of the Department of Mines are available and reference has been made to them in the compilation of this report:-

"Geological Report on the May Queen Area " F. Blake June, 1936
"Montana Western Extended Mine" F. Blake Oct. 1938
"Montana Western Extended Mine" F. Blake May 1939

The first of these reports was concerned with work which had been performed by the government - assisted party under G.W.S. Clark. The latter two were reports on underground workings by the operating company.

GENERAL GEOLOGY:

In the investigation of the general geology of the lease, it has been necessary to carry out a brief inspection of the outcrops on the Corinna Road from the Zeehan-Montana No. 1 to a point half a mile beyond the present mine. This work has been facilitated by the use of aerial photographs. A plan is attached as an inset to the General Plan showing the general geology and structure of the area. The plan is a direct tracing from the relative photographs, is of an approximate scale of 20 chains to an inch, and is not completely accurate owing to the normal distortion of photographs.

It is convenient to discuss the general geology under the following headings (a) Rock Groups (b) Structural Relations and (c) Age of the Rock Groups.

(a) Rock Groups

These are three in number.

(1) Group A - Rocks west of the Corinna Road and in the mine area

These consist mostly of shales and quartzites. The shales are generally light to dark grey in colour. They are thinly bedded and become paler on weathering. The quartzites are pale grey to brownish, coarse to medium grained and rather impure. In places they grade to compacted sandstones. In many places they are distinctly micaceous. The mica, a white type, varies in grain size from very fine to quite coarse, and the plates lie parallel to the bedding of the quartzite. The quartzite sometimes forms massive bands but in general it occurs in bands 1" to 2" in width interbedded with shale. Quartz veins are of fairly general occurrence in the shales and sometimes penetrate into the quartzite.

(2) Group B - Rocks occurring east of the Corinna Road

On the eastern margin of the road where it cuts through lease No. 11789M, another group of quartzites and shales is encountered. In a general way they are similar to those of Group A. The shales are a somewhat darker grey, fine grained, and thickly bedded. The quartzite varies from pale pinkish white to dark grey, is fairly impure and of rather coarse grain size. It does not appear to be micaceous. In the few outcrops available, the quartzite shows as bands up to one foot in thickness interbedded with shales. The rocks of this group do not show development of cleavage where inspected.

(3) Group C - Tillite

This occupies the valley along which the road is cut commencing 30 chains southeast of the mine and continuing in a narrow strip for at least a mile past the mine entrance. Along this flat area, the tillite is mostly obscured by a thick growth of buttongrass and by swamps. It is only exposed in road cuttings, drains and on small mounds. Detailed description of the tillite is given in the section on underground geology.

(b) Structural Relations of the Groups

The rocks of Group B strike northwest and dip at angles between 40° and 60° to the northeast. The strike is very constant and a strike ridge can be traced on the photographs from opposite the mine entrance back almost as far as the Zeehan - Montana No. 1 showing little deviation. The rocks of Group A, on the other hand, show over a wide area west of the road as an extremely contorted group. The general strike is approximately east-west with dips to the north but wide variations from this occur. Several strong folds occur over the area.

The tillite has been observed to dip under Group B rocks along the road northeast of the mine. In fact, the road has been cut almost along the contact. In general the contact is a conformable one but in places slight unconformity was noted between the tillite and the overlying sediments. The evidence that rocks of Group B overlie the tillite is conclusive, and the tillite is probably to be considered as part of that group. The contact between tillite and Group A rocks on the southwest side of the valley cannot be observed as no outcrops occur. Odd outcrops along the valley are all tillite, however, and it is deduced that tillite covers the whole of the valley floor.

A major fault has been observed to separate rocks of Group A from the tillite and Group B. This fault strikes northwest and the raod from the Zeehan-Montana No. 1 to 30 chains southeast of the present mine is along two valleys which are located on the fault line. At two places on the road, in the deep cutting just north of the Zeehan-Western and 40 chains southeast of the Montana, the fault line is crossed by the road. In each case, a wide zone of intense crushing and contortion marks the fault line. Beyond the latter point, the fault line is not observable in outcrops but the line is marked by the northeast margin of the low ridge cutting through lease No. 11789M. It is considered that the fault continues northwest and crosses the main mine access road 150 ft. northeast of the mill building. Beyond this point it cannot be traced on the surface. This major fault marked by crush zones has been identified as the No. 1 slide of the Zeehan - Montana No. 1 Mine which has been discussed in detail by Twelvetrees and Ward (1). Its importance in location of ore will be discussed in the section on Structural Features of the Lodes. There is reason to believe, as discussed in the section mentioned, that another crush zone or slide striking approximately east-west occurs as a split from the main slide, the junction of the two occurring a little east of the main shaft.

This major fault zone is considered to be the chief structural feature of the district. The rocks of Group A on the west are considered to be older than those of Group B and the fault has brought them into juxtaposition. The tillite is regarded as lying normally below Group B and structurally behaves as part of the group.

Crossing the major fault zone occur two parallel faults striking east of north and dipping steeply to the southeast. One of these is the main lode fissure and is discussed in detail elsewhere. Some 100 feet west of this fault another parallel fault occurs and has brought the tillite into contact with Group A rocks. The contact is observable in the cuts Nos. 1 to 5, No. 2 costean, the southern adit and the drive on the tillite lode from adit level crosscut. This fault dips to the east at about 40° where observed. Movement along the fault is indicated by the drag of the sedimentaries in the underground exposures and the western side has moved south relative to the eastern side.

(c) <u>Age of the Rock Groups</u>:

At the present time, no opinion as to the exact age of the rock groups can be offered. To date, no fossils have been found in the area, and, owing to the recurrance of several groups of shales and quartzites in the Zeehan district and to the distance from the nearest group of rocks of this type of which the age has been determined (at Dundas) no correlations can be made. All that can be said is that the rocks of groups A and B as defined above are older than the West Coast Range Conglomerate and are therefore older than the top of the Upper Cambrian.

Group A rocks show a somewhat higher grade of metamorphism than those of group B, their quartzites are micaceous and, in general, the rocks are highly contorted. On this evidence it is deduced that group A rocks are the older. They are probably of Early Cambrian age or possibly even late Pre-Cambrian. Group B rocks are certainly Cambrian, probably about the middle of the period and the tillite, being interbedded in this group would be of approximately the same age. Exact age determination must await the discovery of fossils in the area.

Summarising, then, it may be stated that there are present an older and a younger group of shales and quartzites the latter group having a tillite member. A period of fracturing has brought the younger group adjacent to the older and the contact is marked by a wide crush zone. At a somewhat later period, fracturing in a direction at right angles to the earlier fractures opened up the present main lode channel and also brought the tillite into contact with the older group of sediments. Subsequently, both of these later fractures were mineralised.

UNDERGROUND GEOLOGY:

The geology of each level will be described separately.

EASTERN ADIT LEVEL:

The entrance to these workings consists of a crosscut 52 ft. in length of which 45 ft. is driven through shale with a general northeast strike and dip of 38° to the south east. The shale is thinly bedded and is in general of a lighter grey colour than those encountered in the lower levels. At 7 ft. from station S/10, a mineralised shearing zone occurs with an average horizontal width of 3 ft. More or less parallel to this zone, and 4 ft. east of it runs a minor fault. The mineralised zone is exposed by a southerly drive over a total length of 27 ft. Hanging and footwalls are fairly well defined, while country rock on either side consists of shale. The hanging wall dips 40° to the east. The lode material consists of partly decomposed soft shale and carried some metal, the northern part being richer than the southern.

The southeast crosscut, entering into the hanging wall country, penetrates first 17 ft. of soft shale, which cuts out against a fault striking east with southerly dip of 60°. South of this fault is a bed of probable volcanic rock dipping under shale, about 2 ft. in thickness. This rock has a general greenish-grey colour. Coarse fragments of a grey green rock are embedded in a dark ground mass. Traces of pyrite occur and a colourless unidentified mineral. Some of the fragments have a porous texture. On the exposed surface, the rock is covered by a thin crust of a colourless unidentified mineral occurring in extremely fine needles.

Continuing past the lode, the adit crosscut penetrates first shale over a distance of 15 ft. from station S/10, where it is overlying quartzite. At 6 ft. west of S/10 a fault occurs, striking north with dip of 44° to the east. At the shale-quartzite contact, the strike is slightly west of north and the dip 78° to the east. The quartzite is exposed over a length of 23 ft. while the strike is N.N.W. with dip of 60° to 65° to the east. At 31 ft. west of S/10, the quartzite is overlying shale, which continues to the end of the crosscut. The area in the western part of the crosscut appears to have been disturbed by two sets of faults, nearly perpendicular to each other. One set strikes E.N.E., with dips to S.E. and N.W. while the other set strikes N.W. with easterly dips of from 45° to 90°. In addition, a third fault in the north wall of the crosscut, can be traced for 40 ft. It runs practically east with dips of 46° to 51° to the north. Near the western face a group of quartz stringers occurs striking northeast with vertical dip. At 60 ft. from S/10, a wedge of fractured material occurs resembling closely the material in the main zone of faulting. However, no mineralisation occurs here. The shale in the western part of this crosscut is much shattered.

ADIT LEVEL:

In the crosscut the following features occur. West of the tillite lode, the country consists of tillite. It is a soft rock containing small pebbles of decomposed grey quartzite and coarse angular quartz grains. Just inside the entrance, the tillite has a clayey appearance but further in it becomes quite firm. Structural features occurring in the tillite are (1) a group of parallel joints at 70 ft. from the entrance dipping steeply to the northeast (2) a contact between two types of tillite the contact striking easterly and dipping 36° to the south. The underlying tillite is relatively poor in pebbles while the overlying tillite contains abundant pebbles. Along the road cuttings near the entrance to the adit the weathered tillite shows also yellowish to brown colours. At 167 ft. from the entrance the tillite is cut off by a fault zone nearly 2 ft. wide in which the tillite lode is located. This fault contact is marked by slickensides, crushed and shattered shale and drag of shale beds close to the zone. The shale extends 55 ft. from the tillite lode and is dark grey in colour. It is much shattered by a number of small faults (1) at 10 ft. from the tillite lode striking northeast and dipping 62° to the southeast (2) two nearly parallel faults striking northwest and dipping northeast (3) at 57 ft. from the tillite lode a fault striking northeast and dipping southeast.

The fault forms the contact between shale and quartzite. Where the shale is clearly bedded it has a northwestern strike and dips to the northeast at 61°. The next part of the crosscut, about 13 ft. long, is driven through quartzite, which in places is much shattered; it has an E.N.E. strike and dips to the northwest. The quartzite is grey and medium grained. The crosscut has now reached the main shearing zone. At this point the footwall of the zone is a prominent fault striking E.N.E. with a steep southerly dip.

The tillite lode has been exposed over a length of 33 ft. but it was found that mineralisation was limited to the southern part of the exposure. This part has clearly defined walls, enclosing a zone

1½ ft. wide of soft shattered shale and galena. The lode has a dip of 54° to the southeast. It widens to the north, and metal content decreases. In the northern part of the short drive the walls are not clearly defined and no mineralisation occurs. At this point the shearing zone is at least 10 ft. wide while the country rock is a much shattered soft dark shale.

The adit level drive is situated almost wholly in the major zone of shearing, which contains the principal ore bodies of the mine. The zone consists of brecciated and shattered fragments of shale and quartzite. Large portions of the zone show silification. In general, the mineralisation is limited to the hanging wall side. This wall is a well defined fault plane. The footwall, at least on this level, is not generally clearly defined. As exposed, the zone of brecciated and shattered material is at least five feet wide at the southern end, while in the northern part the width appears to be about 16 ft. Part of the drive, between the southern end and No. 1 Prospect Shaft, a length of about 36 ft, is characterised by low metal content. The actual lode has petered out to a mere one or two inches of galena along the hanging wall; consequently no stoping has been done in this part of the mine. The hanging wall shows a dip of 61° to the southeast. A second fault plane, nearly parallel to the hanging wall, can be followed for nearly 30 ft. It is, however, not the footwall of the shearing zone as shattered material occurs above as well as below this plane. The material is relatively soft and shows signs of weathering. At the foot of No. 1 Prospect Shaft, there occurs a barren quartz lense six inches wide. The hanging wall country consists of shale, very much shattered and dark in colour. From the prospect shaft northwards the drive follows closely the hanging wall of the shearing zone. A local structure of thinly bedded shale can be traced for about 20 ft. south of station A/7. Over this distance, the shale beds are running parallel to the drive but, turn sharply at the end of the structure and cross the major fault plane almost at right angles. The dip of this structure is almost vertical. The chamber cut out around the top of the rise from 100 ft. level shows that the zone of crushed material is at least 15 ft. wide. Mineralisation, except for a small patch near the northwest corner of the chamber, is limited to a width of 4 ft. on the hanging wall side. North of A/10 the drive deviates considerably from the strike of the main fault, but turns at A/11 towards No. 2 Prospect Shaft. It is quite probable that the well pronounced fault which, south of the shaft, turns into the east wall of the drive, is the same as that which forms the hanging wall of the mineralised zone. At A/11, a small exposure of shale occurs showing N.W. strike and N.E. dip of 40°. It is likely that this is the footwall of the main shearing zone although it is not marked by a fault plane. Eight feet south of No. 2 Prospect Shaft, a small vertical fault branches in a westerly direction. The drive has been extended for six feet past the prospect shaft; at the face mineralisation occurs over a width of 3.25 ft. The hanging wall country is dark shale striking northeast and dipping 55° to the northwest. Near the face, a small fault branches off in a southerly direction with a dip of 41° to the east. The south easterly dip of the main fault plane, forming the hanging wall is quite regular where exposed along the whole length of the drive, varying only between 58° and 68°.

THE HUNDRED FOOT LEVEL:

In the main drive, the main zone of faulting as exposed in the northern extension of the drive, has well pronounced walls. At the north face the horizontal width is 5 ft., gradually increasing to 10 ft. at station B/1. Dips observed on the hanging wall vary between 42° and 60° to southeast. From exposures at the entrance of No. 1 West crosscut and the 100-ft. level plat it appears that the hanging wall consists of quartzite and the footwall of shale. From station B/1 to B/6 the drive has been closely timbered. Consequently a great part of the exposures are not visible. However, the footwall seems to become less clear. Near station B/2 a fracturing suggests a link-up with the lode exposed in the by-pass northdrive. The hanging wall is clearly defined and cuts the floor level several feet east of the drive. Dips on this part of the drive vary from 58° to 70° to east. The part of the drive from station B/6 to station B/12 is characterised by two important features (1) the presence of additional fault planes branching off from the major fault plane forming the hanging wall. Some of them rejoin the hanging wall farther south, while others turn more and more westward. (2) the presents of a well mineralised area. Indication of a first split in the hanging wall occurs near station B/7. Along this plane, which is vertical, the by-pass drive has been driven, exposing a well mineralised area.

At 23 ft. south from station B/7 a second fault plane branches off to disappear in the west wall of the main drive. This fault plane is locally of special importance as it is the hanging wall of the lode. Galena occurs along this wall forming a massive vein 2 inches to 4 inches thick, and as irregular blobs father from the wall. At 35 ft. south from B/7 the major fault plane is cut by the drive. The zone between the two faults, although consisting of highly shattered material, is barren. At station B/9 the drive is well inside the hanging wall country which appears to be shale.

The part of the drive, between stations B/9 and B/10 is again below the hanging wall, but no metal occurs. The material consists of highly shattered shale, while on the west wall of the drive bedded shale occurs, striking northeast and dipping northwest at 54° to 60°. The area between stations B/10 and B/11 is characterised by several faults which join the major fault plane. The one immediately west of station B/10 may link up with the fault plane, previously mentioned as the hanging wall of the lode. Another one emerges from the by-pass drive and runs over a distance of 20 ft. parallel to the major fault plane but then becomes ill defined.

Between stations B/11 and B/12 the major fault plane is well exposed. At 12 ft. north of station B/12 a fault branches off in a westerly direction along which No. 2 west crosscut has been driven. Continuing southward along the main drive small amounts of metal occur along the hanging wall, but the first mineralised area of appreciable size is at 20 ft. south from station B/14. This area is probably 25 ft. long and at least 4.5 ft. wide. The next mineralised area is found at the entrance of the southern rise, where galena occurs as a small lens 2 ft. wide and extending to 10 ft. along the rise.

Between these two mineral occurrences the drive follows the major fault closely. The hanging wall country is shale in this part of the drive. The shattered material in the roof of the drive is in general softer and less silicified than in the northern part of the drive. The dips of the major fault plane vary from 42° to 72°. The steepest dips were observed near station B/2, and between stations B/7, and B/9, B/14 and B/30. This latter part shows over a length of 90 ft. a remarkably constant dip of 71° to 72°.

The by-pass drive and by-pass north drive are both situated in mineralised country. At the north end of the by-pass north drive a lode has developed 3.75 ft. wide, with pronounced walls; its material is similar to that of the other mineralised areas along the main drive. Following this lode southward its walls become ill defined.

The west wall of the by-pass drive is a nearly vertical plane between stations B/8 and B/24. South of the last station a split occurs, and two fault planes with steep easterly dips develop. The mineralisation is regular along these two drives and results in an ore of fair grade. There are no actual veins, but the galena occurs as coarse irregular blobs in the gangue. The latter is in places highly silicified and mainly consists of large fragments of broken shale.

No. 2 west crosscut north drive - The north face of this drive shows feeble mineralisation only, but farther southward an important mineralised area is intersected over a length of about 40 ft, extending roughly 20 ft. north and 20 ft. south from station B/41. Structural features in this part of the drive are (1) a well pronounced fault plane extending along the west wall of the drive over a length of 52 ft. to disappear in a southwesterly direction near station B/28. (2) two other fault planes, branching off north of station B/28, joining the under (1) mentioned fault again farther north in the drive. A remarkable fact is that these faults all dip to northwest at angles between 62° and 70°. Exposures in the west wall of the drive show that the country is for the greater part shale, but a quartzite bank of 6 ft. wide occurs north of station B/28. The southern part of the drive, south of station B/28 consists of barren, crushed and silicified material. In the recess south of station B/13 a little metal has been found. Structures in the southern part of this drive include bedded shale at the western corner of the entrance, striking west north west with dip of 78° to north and a vertical fault running around the eastern corner. This fault however does not continue northward.

No. 1 west crosscut has exposed 138 ft. of the footwall country. The rock types are mainly shale and quartzite; the distances at which they are encountered relative to the stations are as follows: from 7 ft. to 20 ft. west from station B/1 shale. It forms the immediate footwall of the major zone of faulting. The strike is north east and dip 53° to 77° to southeast. A definite drag of the beds can be observed, suggesting that the footwall country has been moved in a southerly direction relative to the hanging wall country. From 20 ft. west of B/1 to 35 ft. west of B/5 is quartzite, except for an isolated bed of shale 1 ft. thick which crosses the cross-cut at 28 ft. east of B/5. East of the shale bed there occur a series of large vugs in the roof - probably part of a fracture. The quartzite is light to dark grey, medium grained and in places rich in free quartz occurring in irregular stringers. For nearly 50 ft. the cross cut runs parallel to the strike of the quartzite. Over this distance dips vary from 69° to 90° south. At 20 ft. west of B/5 the beds start to turn to the south. Strikes and dips suggest that the crosscut has cut through the central part of a fold. Although 75 ft. of quartzite have been exposed, the horizontal width is probably not more than 20 ft. From 47 ft. to 42 ft. east of B/2 - shale striking north and dipping 77° to east. From 42 ft. to 29 ft. east of B/22 - quartzite striking south east and dipping vertically. From 29 ft. to 27 ft. east of B/22 - shale cut off by a fault striking south east and dipping 63° to north east. From 27 ft. to 13 ft. east of B/22 quartzite which, on the west, is separated from shale by a fault striking south southeast and dipping 57° to east. The quartzite is part of a fold with northerly pitch of 15°. The last 15 ft. of the crosscut has exposed shale, including an isolated bed of quartzite 1 ft. thick. The shale strikes north and dips 78° to east.

The 100 ft. level plat has been cut in quartzite which continues eastward into No. 1 east crosscut to 55 ft. east of B/1. The quartzite is fine grained and light grey in colour. Just east of the hanging wall of the major fault zone, the quartzite shows a definite drag in the bedding suggesting a movement of the hanging wall country relative to the foot wall country. West of the shaft the quartzite strikes east and dips 7° south. East of the shaft the strike turns southeast to form a small anticline pitching 20° to southeast. The contact with the shale is normal, strikes north and dips 53° to east. Immediately east of the quartzite-shale contact, there occurs a fault striking north northeast and dipping 60° to southeast, while the shale beds show a drag. The dip of the shale now becomes nearly vertical and the strike north northwest. 4 ft. east of B/44 there occurs an important fault striking north northwest. This structure has been exposed over a length of 22 ft. by two short drives north and south of the crosscut. That this fault is an important disturbance is shown by the following facts -

(1) west of the fault the shale dips nearly vertically and strikes slightly west of north, while east of the fault the strike is northeast and dips are variable to the southeast.

(2) the dip of the fault is extremely variable. North of the crosscut the dip is 64° to the east while to the south it is only 30° to the east. This indicates a strongly twisted fault plane.

Twenty eight ft. east of B/44 there occurs another fault striking northeast and dipping 70° to the east. Faultpug occurs, but no metal. The country penetrated by the crosscut is shale, the beds of which enter the crosscut at a very sharp angle. The strike is slightly south of east of the last 75 ft. while dips vary from 40° to 60° with flatter dips towards the end of the crosscut. Near the face, there is a small fold pitching 30° to east southeast.

In No. 2 West crosscut the main feature is an important fault branching off from the major fault plane and continuing as far as the bottom of the rise to No. 2 prospect shaft where it becomes indistinct. This fault has produced a zone of fractured material from the main drive to B/13. At the entrance of the crosscut, the southern wall consists of quartzite striking west southwest and dipping 45° to southeast. Quartzite beds soon become indistinct. At 20 ft. and 27 ft. respectively west of B/12 other fault planes branch off to the southwest and northwest. The first dips southeast at 60° to 70°. Where it disappears into the south wall, 8 ft. from B/13, a small patch of metal occurs. A third fault branches off at B/13 in a south westerly direction. West of B/13 the bedding of the rocks is clearly visible. Their general strike is northwest with north east dip of 53° to 58°. A certain amount of drag occurs as they approach the fault planes which form the southern wall of the crosscut. The rock is shale except for an isolated bed of quartzite 1 ft. thick. Close to the northwest corner of the rise a small barren quartz vein occurs.

The part of the crosscut west of the rise has been driven in quartzite. Structural features are (1) a prominent joint-plane forming the northwall, with dip of 65° to southeast. (2) gently folded quartzite at the end of the crosscut, with northern strike and eastern dip of 40°.

No. 3 west crosscut has been driven over its entire length in shattered and broken dark shale, which no doubt is a part of the major shearing zone. Numerous, small, irregular, stringers of milky quartz occur. On the south wall three nearly parallel fault planes have developed. Their mean strike is west, while their southerly dips vary from 42° to 75°.

In No. 2 east crosscut shale occurs over its entire length. The shale is broken into blocks by a series of small faults and in addition has been much contorted. The faults are running in east south eastern and north western directions. Dips are all nearly vertical. A group of parallel thin milky quartz veins dipping vertically, occurs along the south wall of the crosscut. No metal occurs in these quartz veins.

The drive of the Intermediate Level penetrates shattered and broken shale; no silicification occurs in this zone. The hanging wall is less clearly defined than the foot wall. Gently folded shale occurs north of the rise beyond a fault striking north north-west and dipping at 74° to northeast. South of the rise the hanging wall country shows varying strikes and dips. A number of faults have disturbed the area at the south end of the drive. These faults have varying strikes but all have vertical dips. A wedge of bedded shale occurs in the zone of shattered material. Galena occurs on the footwall of the rise and the drive, but only in widths of ½ inches to 1 inch. In the stope immediately above the drive galena occurs in a vein of 4 inches thick.

The rise from the 100 ft. level to the Adit Level shows the following features: at the top the lode is 4 ft. wide but is soon weging out downward. Over a length of 35 ft. there are clearly defined hanging and foot walls, between which the fractured material is well mineralised. At the 6 ft. from the top the actual lode is wedging out and bends towards the footwall of the rise. At 35 ft. from the top, the hanging wall becomes very indistinct, while the now 1 ft. wide lode continues along the footwall. The lode is gradually petering out to a width of one inch at 59 ft. from the top and consequently stoping was not continued below this level. Between the Intermediate level and the 100 ft. level only thin scattered patches of metal occur on the footwall of the rise.

The rise which connects the 100 ft. level with No. 2 Prospect shaft on the Adit Level penetrates shale over the first 57 feet. The shale strikes southeast to south southeast and dips at 60° to 70° to east. At 17 ft. a 1 ft. thick quartzite bed is intersected which is probable the same occuring at the bottom of the rise. At 42 ft. above the 100 ft. level numerous irregular quartz veins occur in the shale. At 57 ft. the shattered and silicified material, characteristic of the major shearing zone, has been intersected. A drive of 8 ft. long has been cut at this level, following a well pronounced fault plane, which strikes south southeast and dips at 50° to east. No metal occurs in the face. From 57 ft. up to 77 ft. the rise penetrates shattered and silicified material in which at 71 ft. some small patches of metal occur. At 77 ft. the hanging wall of the main shearing zone appears to turn in a northwesterly direction around the northern face of the rise. The hanging wall country consists of shale. The last 20 ft. of the rise have not been closely investigated as ladders were missing, but the west wall of the rise is inside the main shearing zone.

The rise to the Intermediate Level has been driven along the hanging wall of the main shearing zone. A small lens of galena along the northern wall is petering out at 10 ft. above the 100 ft. level. Higher up in the rise only small isolated patches of metal occur along the hanging wall. The penetrated material is soft dark shale, much shattered, and although small irregular veins of milky quartz occur, there is no general silicification. The dip of the hanging wall at the bottom of the rise is only 46°, which is relatively flat compared with dips in other parts of the mine.

From the top of this rise a crosscut has been driven towards the drive of the Intermediate Level. At the time of the investigation 35 ft. have been driven through soft, dark, shattered shale with stringers of milky quartz.

<u>150-FT. LEVEL:</u>

The northern part of the drive, following the major shearing zone, has exposed quartzite on either side over a distance of 120 ft. In general the quartzite is of the grey, medium grained type. Close to the shearing zone the quartzite is much shattered. Near the northern face the quartzite strikes east and dips at 80° to south. The major zone of shearing in this part of the drive is characterised by well pronounced hanging and foot walls. Its material consists of quartzite fragments and is in places highly silicified. The dip is fairly constant and varies between 58° and 67° to east between the stations C/7 and C/1. No metal occurs between the stations C/7 and C/3. The width of the shearing zone varies considerably. From the north face of the drive where the width is 3.5 ft, it decreases gradually to a width of 1 ft, at a point 7 ft. south of C/3. South from this point a shearing zone of considerable magnitude is developing, branching off in a south easterly direction. Remarkable is the fact that there is no sharp intersection, but a gradual bending off from the main shearing zone. This branch is not less than 14 ft. wide at the point where it disapperars in the east wall of the drive. Its material consists of soft dark, shattered shale; a sample taken from this material did not show any appreciable metal contents. The foot wall of this branch zone dips to northeast at 47°. At the southern corner of No. 4 west crosscut mineralisation occurs along the footwall, associated with faultpug. Opposite this point a small isolated patch of metal occurs in the roof of the drive. South of the branch zone the major shearing zone increases in width from 1.5 ft. to 3.5ft. at C/1. Footwall country is quartzite, its bedding is indistinct. The hanging wall country consists of quartzite as far south as 20 ft. from C/1. At that point a wedge of shale occurs between two fault planes in the east wall of the drive. The part of the drive between the 150ft. level plat and No.5 west crosscut, shows a considerable increase in width of the major zone of shearing. Both foot - and hanging walls are less clearly defined; the material is heavily silicified. Mineralisation occurs (1) as a seam of galena 1 inch thick in the footwall of the shearing zone near C/2; it cen be traced for 10ft. until it disappears into the west wall of the drive. (2) an important lens of good grade ore extending 10ft. north and south of C/8, while the width is at least 5.5ft. Between C/8 and C/9 the hanging wall becomes again well defined; the dip is 72° to southeast. The hanging wall country in this part of the drive consists of shale striking north north-west and dipping at 56° to west. Six ft. south of C/9 the hanging wall is joined by a fault plane which runs almost parallel to the footwall of the shearing zone, but it is likely that it joins the latter somewhere west of the drive. In that case the total width of the shearing zone is about 20ft. Dips of the hanging wall vary between 52° and 77°. At the entrance of the No. 5 west crosscut the shearing zone is only 5ft. wide.

The part of the drive south of this cross-cut is the most important at this level as a well mineralised zone has been exposed at least 50ft. long and from 3.5ft. to 7.5 ft. wide. The greatest width of the ore body occurs at 10ft. south from C/11 where the shearing zone is heavily mineralised over its entire width. Farther south the shearing zone becomes gradually wider but mineralisation is limited to the hanging wall side where good milling ore occurs in a width of 3.5 ft. The hanging wall is a very smooth fault plane dipping at 68° to east; galena occurs on this wall as a massive vein from 1 to 4 inches thick while farther from the hanging wall it occurs as large irregular blobs. Small amounts of sphalerite are associated with the galena. The orebody has no pronounced foot wall and its width should be determined by sampling. Mineralisation also occurs beyond the hanging wall in the form of widely spaced narrow galena stringers. This zone is about 1.5ft wide but sampling proved that it could not be considered as commercial ore.

A number of well developed slicken sides occur on the hanging wall. They dip at 38° to north.

NO. 4 west crosscut has been driven over its entire length through quartzite striking northeast and dipping almost vertically. A fault occurs at 12ft. west of C/3, striking north north-east a dipping 67° to east. At the end of the crosscut two faults occur joining each other at a sharp angle; they strike east and dip steeply to north.

No. 3 east crosscut is also entirely driven in quartzite. From exposures in the roof and southwall it appears that the general strike of the quartzite is east north-east, while the dip is 41° to south. A small fold occurs pitching at 42° to southeast. The quartzite contains an isolated bed of shale 1ft. thick. Near the face of the crosscut the quartzite is cut by two faults joining each other at a sharp angle. They strike north-west and dip at 54° and 80° to north-east. The quartzite beds show some drag in the proximity of these faults.

The 150ft. level Plat has been cut out in quartzite striking north-east and dipping at 53° to the south-east. A small fault runs parallel to the footwall of the main shearing zone; its dip is 52° to the south-east. The 10ft. long crosscut east of the drive penetrates shale, over 9ft. and quartzite over 1ft. The shale strike north north-east and dips to the east at 48°. At 5ft. from the eastern face a minor fault occurs parallel to the main faults and dipping at 48° to the east.

No. 5 west crosscut has been driven in an area which is much disturbed by a series of minor faults From the entrance shale is exposed over a distance of 12ft. after which a fault contact with quartzite follows This fault strikes north north-west and dips at 50° to the east. The quartzite is exposed over 7ft. and is followed by shale. The contact is normal; the shale continues towards the west face of the crosscut where again the shale is followed by quartzite. Strikes and dips vary; the quartzite-shale contact at 9ft. east of C/10 strikes north north-east and dips at 54° to the east. The shale-quartzite contact at the west face strikes north and dips at 64° to east. Near C/10 the strike is north west and the dip vertical.

The crosscut driven from C/10 in a south south-eastern direction penetrates shale disturbed by 3 faults (1)a fault striking south-east and dipping vertically (2) a fault striking south and dipping at 70° to east. (3) a fault with vertical dip and striking west northwest. The shale in this area is in general dark, fairly soft and much shattered.

STRUCTURAL FEATURES OF THE LODES:

There appear to be two distinct lode systems developed in the workings viz. Main Lode System; Tillite Lode. The structural features of each will be discussed separately.

A. Main Lode system: The four main drives are all located in one lode channel ("Clark Lode" of Blake (3) P.3. have been intersected in crosscuts as follows:
(a) No.1 West crosscut near end.
(b) No.2 west crosscut - two lode channels now inaccessible but mentioned by Blake (4) P.2.
(c) No.3 west crosscut - one lode channel now inaccessible but mentioned by Blake (4) P.2
(d) No. 1 east crosscut - a small lode channel 160ft. from the shaft.
(e) On surface - Blake (2) states in his conclusions "It is shown that up to six lode channels are located on the surface...." One of these included the tillite lode.
At no point have these subsidiary lode channels been intersected in the main drives but, owing to the general parallelism exhibited as far as the present openings permit, these channels may be considered as behaving in much the same way as the main lode i.e. they are all considered here as part of the one system.

Referring to the structutal features of the main lode, Blake (3) P.2 - 3 states: - "The lodes represent infilling and replacement of crushed zones in slates and quartzites on either side of irregular northeast trending lines of pre-mineral faulting. The fault planes are evidently the main channels along which the mineral solutions passed before spreading into the crushed zones and depositing their mineral content. The are generally well-defined and occur as smooth planes with erratic strike and varying angles of dip to the east. The lateral boundaries of the lode occuring in the crushed zones are ill-defined, there being no well-determined walls except that the main fault planes commonly coincide with hanging walls of lodes. The latter is not general, however, since lode matter and or are found in places on hanging wall side of fault planes Outside the ore shoots, the lodes generally consist of veinlets, bunches and blebs of quartz, with small amounts of carbonate of iron and splashes of galena, sphalerite and pyrite."

The above statement is an accurate description of the lodes as opened up at that time. However, subsequent developmental work has revealed a clearer picture of the structure. The occurrence of relatively unusual features is repeated at three sections of the lode.(1) In No.2 prospecting shaft in the vicinity of adit level and for a short distance south along the level.

(2) On 100ft. level in the area from just north of the by-pass drive to just south of No.2 west crosscut and including that crosscut. No.2 crosscut north drive, the by-pass drive and the main drive.

(3) The whole of the south drive on 150ft. level. The structural features occurring in these areas may be summarised as follows: -
(a) Each of the three areas shows the effects of intense shattering. In places slaty shales and quartzites are inextricably mixed. The chief rock type present, howeve is shale and, throughout, the openings, the shales appea

to be crossed by a large number of irregular fractures. The fracture planes are very distinct and each one shows the effects of slickensiding. These planes are extremely irregular surfaces and mutual intersections are common. They appear to have no systematic orientation. Some planes are very distinct and can be traced for many feet while others are of quite small extent. The longer one spends in examination the more fracture planes can one observe. A study of the slickensiding reveals that movement has taken place in many different directions. Particularly at the intersection of planes, it is seen that movement in each plane has taken place in a different direction. The shattering effects are naturally best shown on the 100ft. level where most opening occurs. They are, however, being well exposed on 150ft. level as driving and stoping proceeds.

(b) In No.5 West Crosscut and associated drive on 150ft. level, the rocks consist of bedded shales. The contortion of these shales over a comparatively short distance is most marked. The beds have been crushed and crumpled and several movement planes as described in (a) above can be recognised.

(c) On the northern side of the shattered zone on 100ft. level, both hanging and foot walls of the lode are well defined. On the southern side of the zone the hanging wall is commonly well-defined while the footwall varies from vaguely to reasonably well defined. Within the shattered zone, however, both walls of the lode are ill defined and in places cannot be determined. Also, whereas the lode outside the shattered zone is confined to one channel of approximately constant width, within the shattered zone, it appears to split into a number of smaller veins varying in width from a fraction of an inch to several inches. These smaller veins spread out from the main lode in the general form of a fan although the general course of each vein may be extremely irregular. An extreme case of this irregularity is provided by a vein which courses along No.2 west crosscut from the main drive to the cuddy in the south wall i.e. its direction is almost at right angles to that of the main lode. This feature of lode branching was mentioned by Blake (3) P.4-5 "Abranch lode exposed along 15ft. in a short drive deviates from Clark Lode on a bearing of 225° 91ft. from No. 1 West crosscut in south drive." Subsequent workings have revealed at least three main splits on 100ft. level, two on 150ft. level and numerous smaller ones on both levels. Each of these splits usually carries solid galene ore of very fine grain size. It has been noted that these ore splits are usually located either along or parallel to the irregular fracture planes mentioned in (a) above although by no means all the fracture planes carry ore. It appears that only the larger, more persistent, planes have been favoured with ore deposition. In addition to the deposition of ore in splits, it is found that the whole of the crushed zone country between splits is impregnated with ore which occurs in irregular stringers and blebs the latter ranging in size up to lenses a foot or more across. The orientation of these blebs and stringers is very irregular and they are obviously due to infiltration of ore-breaking solutions along small cracks and planes of weakness. The occurrence of ore in relation to fracture planes as detailed above has occassioned some confusion in the minds of those working in the mine.

Depending on where the veins of ore occur, the fracture planes have been regarded as haning or foot walls of lodes but when further work has disclosed blebs or ore on the far side of the "wall" the miners have been at a loss for an explanation.

(d) The plan of the 100ft. level shows clearly that there is a bend or "drag" of the main lode channel as the crushed zone is approached. The lode channel which trends west of south turns south into the crush zone and swings back again to west of south on the southern side of the zone. On the 150ft. level, the south drive shows the characteristic swing to the south as the crush zone is approached. This level does not so far penetrate through the crush zone and the complimentary swing has not been revealed. Again, the adit drives are almost wholly on the south side of the crush zone and show only the swing from south back to west of south.

(e) The main series of ore shoots so far revealed consists of a group of patches of ore which have been removed by the tributing party between the intermediate level and the surface. The zone in which these ore shoots occur is located south of the main crush zone. This fact is considered to be of considerable importance as will be detailed below.

The structural features of the Montana Silver Lead Mine show a close parallelism to those which were observed and studied in theZeehan - Montana No. 1, the Zeehan - Western and the Oonah. The structure in these three mines was studied by Twelvetrees and Ward and a critical discussion is found in Bulletin No.8 P.79-88 while general descriptions of the individual mines are found on pages 101-109 and 127-132. In the Zeehan - Montana, the controlling structural feature was a series of three roughly parallel fractures striking a little west of north. These fractures were known locally as "slides". The several lode fractures crossed these slides at approximately right angles and various typical features in the vicinity of the intersections were noted. Twelvetrees and Ward draw attention to the identity between the slides and the "ruscheln" of the German miners. Regarding the nature of the slides Twelvetrees and Ward (1) state inter alia: -
"In some cases it was observed that the slides were fault planes showing a width of 1½ to 2ft. of broken rock...... but in the case of that the displacement of the country has resulted in the production of a broad zone of broken rock. It is now known that the slide extends at No. 3 level for a width of over 150ft.....Where slate occurs on both sides the exact boundary of the broken zone is hardly recognisable...Within the boundary of this fault zone there are very numerous subsidiary fractures and the slate betwee them is much crushed and crumpled. Slickensides caused during this crushing are very numerous. The subsidiary fractures and slickensided surfaces exhibit only a general tendency to follow the dip and strike of the fault zone as a whole. The ruscheln have been found to continue down without interruption to the lowest depths reached and....it would appear certain that the influence of the faulting must extend downwards for a great distance - beyond the limit of profitable working."

Twelvetrees and Ward adduce evidence that the ruscheln are of somewhat earlier age than the lode fissures and that the period of ore deposition post-dated both series of fractures.

With regard to the modification of the later fissures by the presence of the pre-existing fractures they state that three important effects have been noted (p. 83-85).

(1) The Bending or "Drag": The most noticeable of the phenomena is the turn of the course (strike) of the lode fissure as it approached the slide. This bending is at first gradual and increases with proximity to the slide until, in many cases, the lode fissures become parallel to the boundary of the slide. Nevertheless this ..... is absent at some points.....

(2) The Splintering: Frequently it is found that the lode, as it approached the ruschel splits up into a number of stringers which diverge as they approach the slide so that the lode as seen in plan spreads out like a fan with narrow wedges of country rock between the stringers of lode matter. Each of the stringers usually shows to some extent the "drag".....

(3) Dying-Out: In many cases it is apparent that the lod fissure on reaching a slide "dies out" or teminates abruptly....In other cases there has not been sifficient prospecting to warrant any definite statement concerning the termination of the lode fissures....it is possible that the same forces which have produced several fissures on one side of a ruschel may cause the formation of a single fissure on the other side."

In dealing with the distribution of ore with regard to the two sets of fractures the authors make the following observations: -
"In reviewing the mode of distribution of the ore in the Zeehan-Montana Mine one is at once impressed with the manner in which the ore continually recurrs at the intersection of the later fissures with the ruscheln.... the shoots of ore are, for the most part, found to occur in the immediate proximity to the ruscheln and on the footwall side of each of these main faults.....The occurrence of ore at the intersection of the lode fissures and ruscheln is marked in two ways (a) THe actual bulk of the lode matter is greater at those points and (b) the proportion of galena in the lode is commonly highest there. The presence of the newly found ore body north of the slide in the Zeehan-Montana Mine is clear proof that the existence of ore is not wholly dependent upon the occurrence of intersections of ruscheln with later fissures....There are known shoots of ore along the course of the fissures further away from the main slide in the Montana Mine but only feature of regularity that has been determined is the fact that the ore makes under the slide."

The authors point out that there is a difference in the ore shoots in depth in the Zeehan - Montana and the Oonah Mines stating that "THis difference lies in the lengthening in depth of the ruscheln in the case of the Oonah while it is found that in the Montana Mine the ore shoots butting against the main slide have always decreased with depth. This difference between the two modes of occurrence serves to prove that the shortening of stope length of the shoot with increasing depth is not a general feature".

There is no record of slides as such in the Montana Silver Lead Mine although Blake(3) (quoted above) mentioned crushed zones in the slates.

As far as the present writer is aware, the fact that a slide occurs has not previously been recognised. It has been considered necessary, therefore, to include in this report the somewhat lengthy quotations from Twelvetrees and Ward above, in order to substantiate the present theories regarding structures. The following features at the Montana Silver Lead Mine have their counterparts in the Zeehan-Montana and the Oonah Mines.

(1) The present of a broad crush zone crossing the main lode fissure at an angle.

(2) The bending or drag of the lode fissure as it crosses the slide.

(3) The splintering of the lode as it passes through the slide.
(4) The presence of an ore shoot on the south side ("Under") of the slide.
(5) The increase in bulk of lode material in the vicinity of the slide.

One feature at the Montana Silver Lead Mine does not parallel some of the older occurrences viz. the "dying-out" of the lode fissure at the slide. In the present case, on the 100ft. level, the lode has been proved on both sides of the slide. A feature in the present case which is so far indeterminate is the question of the lengthening or shortening of the ore shoot with depth in the vicinity of the slide. Not sufficient openings at depth have been made to determine this factor nor can any indication be given in the light of previous experience owing to the conflicting evidence presented by the Oonah and the Zeehan - Montana. With regard to the direction of the slide in the present mine and to the width of the zone, nothing precise can be stated. Since the slide occurs almost entirely in slate country, the boundaries of the zone are exceedingly ill-defined and it is not possible to delimite hanging and foot walls. All that can be said is that approximately 150ft. of the main south drive of 100ft. level are in the crushed zone. Openings on the 150ft. level do not disclose the whole width of the crushed zone and the northern end of the adit level drive has just entered the zone. It appears to the present writer that the zone is about 150ft. wide, has a strike a little north of west, and is probably dipping at a steep angle to the north. More definite information on these points must await the production of more underground openings.

Away from the vicinity of the slide, the main lode behaves in a normal manner. It consists of lode material filling a fissure anc can quite easily be traced through the drives. The width varies from a mere track up to nine feet, but the average would be about three feet. The hanging wall is commonly well-defined, and there is usually a thin band of pug developed along this wall. The footwall is poorly defined except in the north drive of 100ft. level. Along the course of the lode there is usually a development of solid ore mostly on the hanging wall but occasionally on the footwall. The presence of this solid ore is an almost constant feature and its width varies from a fraction of an inch to about two feet. This is considered to be a perfectly normal feature.

The thickening of the lode occurs in places along the original channel which offered lower resistance to the movement of mineralising solutions - most probably cavities - the solutions became concentrated in these areas of least resistance and consequently thicker "makes" of ore were produced. It is considered that these conditions recurred at intervals along the line of the lode fracture which now consists of a series of comparatively small lenses of ore up to two feet in thickness connected by "trails" of very thin ore. These conditions have clearly obtained in the upper portion of the lode above the intermediatel level. In this section, the patches of good ore have been removed and the trails remain in pillars between the stoped portions. There is no reason why these conditions should not have recurred at intervals along the length and depth of the lode where it behaves in a "normal" manner (i.e. away from the influence of the slide). There are at present, however, no criteria for determining in advance the distribution and frequency of such patches of ore. It can only be recommended that exploratory driving be continued concurrently with normal mining operations in order to locate the patches of ore which are undoubtedly there to be found.

There is some evidence that another slide appears in the south end of 100ft. level south drive. In the area between No.2 east crosscut and the end of the main drive the country rock is shale which shows signs of being fractured and is much contorted. Similar conditions appear in the new rise to the intermediate level and the associated northerly drive. The ground is rather loose and characterised as "bad" by the miners. As this is the only opening into this disturbed area, it is too early yet to state whether it is a slide or not. However, the indications are that a slide may exist in this section and the possibility should be borne in mind while future work is proceeding there. If it is a slide, it is probable that a make or ore will be found to the south.

As detailed at the beginning of this section there are signs of several smaller mineralised fractures paralleling the main lode and appearing in the crosscuts This is hardly surprising as it is unlikely that a major fault should occur without associated fracturing in a roughly parallel direction. Most of these small fractures appear to be mineralised but where opened up they are much too small to be of economic value. However, it is always possible that a lode may be thin where cut but may thicken elsewhere, particularly in the vicinity of slides. At present these small channels have been cut in a few places only and little driving along them has been done. Future prospecting along them may be warranted. It is considered unlikely, however, that any of these smaller channels will prove to contain any appreciable width of clean metal, although they may contain milling ore which may be mixed with richer material from the main lode. There is a possibility that these subsidiary channels are actually splits off the main lode. However, no junctions have so far been found and the writer is of the opinion that they are parallel fractures.

B. THE TILLITE LODE:

The existence of this lode appears first to have been noted during the cutting of the south adit by the May Queen prospecting Association. It was subsequently revealed in No.2 costean by G.W.Clark during the period 1922-23 and in the costeans and the adit level crosscut by the government prospecting party in 1935-37. Apart from the short drive on adit crosscut no driving along the lode has been done.

The contact between the tillite and sedimentaries strikes a little east of north and dips east at about 40°. Beyond the contact in the adit crosscut the sedimentaries are seen to strike south of east and to dip steeply to the north. In the drive on the tillite lode and in the south adit there is a marked bending of the sedimentaries along the course of the contact. On this evidence, it is asserted that the tillite/ sedimentary contact in this area is a fault contact.

In the south adit exposure, the contact is marked by a six inch band of siderite which carries sphalerite and traces of galena. The surface exposures of the contact show merely a thin band of puggy material not carrying sulphides although it is possible that these latter have been leached out by surface waters. In the adit crosscut exposure, the zone is two feet wide on the south wall and appears to be widening along the driv The zone is marked by pug in which are found patches and veins of quartz associated with finely-divided galena.

As these are the only exposures, it is difficult to predict the behaviour of the lode in general. However , since the lode fissure parallels the main lode fissure, it is reasonable to assume that the two fractures are of the same period and behave in much the same manner. On this basis, therefore, it can be stated that the tillite lode is likely to persist horizontally and vertically. The width of the lode where exposed is shown to be variable and this variation may be expected to be a feature of the lode. It is not considered that this lode will show the same regularity of structure nor relatively high values of sulphide content as are shown by the main lode. The slide discussed above may be expected to cross the tillite lode a little north of the drive on the adit level and it is likely that a make of ore on the tillite lode will occur at this intersection.

MINERALOGY OF THE MAIN LODE:

The main lode consists of a gangue of quartz, calcite, siderite and pyrite in which occur galena, sphalerite, silver and copper.

Quartz: This is the chief gangue mineral. It is usually the milky variety occurring as intergrowths of fine to medium grained crystals with random orientation. Vughs are rare but when they occur lined with quartz, the quartz is commonly almost colourless and is developed as single-ended prisms up to half an inch in length normal to the wall of the cavity. The quartz appears to be in two generations as detailed below.

Calcite: This is a much rarer gangue. It usually occurs in very narrow veins in country rock. Some composite veins of both quartz and calcite occur.

Siderite: Whereas calcite is rather rare, siderite is common as a gangue but does not attain the same bulk as the quartz. Calcite and siderite appear to form an isomorphous series and all variations have been noted from pure white calcite, "cream calcite", light brown siderite to dark brown siderite. Often times a banded structure can be noted in veins, the deeper brown (more iron-rich) material occurring next to the vein walls with progressively lighter bands towards the centre. The junction between bans is usually sharp. Sometimes, but not always, the central band is pure calcite. This indicated that iron-rich carbonate was first precipitated and that the composition of the residual liquid trended progressively towards the composition $CaCO_3$.

Pyrite: Owing to the small amounts of this material it is here regarded as a gangue mineral. Its usual occurrence is in very fine grains commonly with idiomorphic crystal boundaries which are occasionally corroded. It does not form large masses in the lode but rather is limited to blebs up to an inch or two in diameter. It is more common in the small veins penetrating country rock in which case it tends to form narrow bands close to the vein walls.

Galena: This is the chief economic mineral of the lode. It assumes a variety of physical forms varying from coarse "cubical lead" in which the cubes may be up to half an inch in length, down to extremely fine grain sizewhen the crystals cannot be distinguished by the naked eye. In the massive shoots of galena, a peculiar streaky appearance can sometimes be noted. The explanation of this feature is not known. Again, some patches of galena are quite soft, and can easily be broken with a pick. This type is usually but not always "cubical lead". The bulk of the galena, how ever, is fairly compact and breaks with a hackly featur In general, the colour is silver-white and has a brilliant metallic lustre. In this respect it is different from gale occurring in limestone deposits such as the Oceana and from the Broken Hill lode. In the cases of the latter two occurrences the galena has a steelgrey, somewhat bluish colour. The somewhat unusual colour of the Montana ore is due to its high silver content. The distinction is so apparent and so definite that the colour may be used as a guide to silver content.

Sphalerite: This is a constant associate of galena in the lode, albeit in small amount. Two distinct varieties occur which may often be observed in the one sample although never physically intermingled.
(a) Ordinary Sphalerite: This type is light reddish-brown with a resinous lustre. It is the type commonly found in the Zeehan and Dundas Districts.

(b) Marmatite: The iron-rich variety of sphalerite. IT is dark brown to black in colour with a resinous lustre but the lustre is not as pronounced as in the ordinary variety. This mineral is not common in the Zeehan and Dundas fields although it is elsewhere e.g. at BRoken Hill. Some of the dark coloured mineral called marmatite at the Montana shows a fine fibrous structure and may actually be wurtzite, the high temperature form of sphalerite. This point has not been determined.

Silver: The assay show that silver is present in considerable abundance in the lode. Silver minerals cannot however, be determined in the hand specimens nor, as indicated below, have they been indentified in polished section under the microscope. It is probable that the silver is present in solid solution in the galena either in the form of silver sulphide or native silver. As indicated above, the colour of the galena is a good guide to silver content.

Copper: This is of sporadic distribution. In some specimens chalcopyrite has been determined and bornite occurs in one specimen examined. Of twelve ore samples, all of which were examined for copper, four showed small amounts apparently less than 0.2 per cent. The chalcopyrite is probably associated with the pyrite. It cannot be considered as of economic importance.

FOR the purpose of enquiring into the physical relationships between the various minerals present, a series of twelve representative ore specimens was taken throughout the mine. Field descriptions of the samples were made and each was then divided into three parts. One series was sent for assay, one sent to Hobart for microscope investigation and one filed for reference. The following results were obtained.

Field Descriptions:

MM 1 150ft. level, 6ft. north of station C/13. On hanging wall. Medium grained galena intergrown with quartz. The latter occurs in two parallel zones adjacent to the hanging wall at a distance of one inch. Further from the wall silicification is irregular.

MM 2 150ft. level, 6ft. north of station C/13. Two feet from wall. Mostly gangue and a bleb of medium graine galena. GAngue is broken black shale. Space between fragments is filled with quartz and yellow siderite. Traces of pyrite, sphalerite and bornite.

MM 3 150ft. level. Stope 39ft. north of C/13. Highly silicified well mineralised specimen. Galena medium grained. Fair amount of sphalerite. A bleb of pale yellow siderite.

MM 4 100ft. level. A four inch vein 31ft. south of station B/7. Highly silicified with fine grained galena and sphalerite. Quartz relatively coarse. Gangue is silicified fragments of black shale.

MM 5 100ft. level. 16ft. south of B/24. Specimen less silicified than previous ones. Galena fairly coarse. Small amounts pyrite and sphalerite and traces of chalcopyrite. Quartz occurs in small irregular blebs between fragments of dark shale.

MM 6 100ft. level. 15ft. south of B/24. Specimen poor in galena. Rich in fine grained pyrite occurring in a narrow quartz vein.

MM 7 100ft. level. No.2 west crosscut north drive east wall. 15ft. north of B/28. Rich in medium grained galena. Some fine pyrite and fragments of dark shale.

MM 8 Same location as MM 7. Highly silicified specimen. Medium grained galena. Tracesof pyrite, chalcopyrite and sphalerite. Gangue contains silicified fragments of shale, fairly coarse quartz and some siderite.

MM 9 Adit level. H.W. side of underhand stope. 5ft. south of A/5. Specimen very rich in fine grained galena associated with relatively coarse quartz. The latter is sometimes porous and contains some pyrite. No siderite.

MM 10 Adit level. H.W. side of underhand stope southern end. 2½ft. from hanging wall. Not as rich as previous sample. Coarse galena with silicified gangue. Quartz fairly coarse. No siderite.

MM 11 Adit level drive. 8ft. north of A/10 on hanging wall. Specimen entirely composed of fine grained galena.

MM 12 Adit level drive. 8ft. north of A/10. 2ft. from hanging wall. Fine grained galena associated with some quartz.

ASSAY RESULTS:

Assays were performed by the Mines Department Laboratory in Launceston with the following results:-

	Silver Oz/Ton	Lead Per cent	Zinc Per cent
MM 1	87.5	48.4	9.1
MM 2	4.1	3.7	4.2
MM 3	25.8	25.0	14.6
MM 4	38.1	17.7	8.3
MM5	11.0	27.4	0.3
MM 6	1.9	0.9	0.2
MM 7	19.5	37.6	3.4
MM 8	41.1	47.5	0.9
MM 9	86.2	62.4	5.3
MM 10	15.3	24.0	1.4
MM 11	111.2	65.4	3.5
MM 12	66.5	60.4	1.8

Samples Nos. 1, 2, 3 and 8 contains small amounts of copper apparently less than 0.2 per cent."

Microscope Investigation:

The polishing of specimens and their examination was undertaken by Mr. G. Everard, B.A., Geologist, in the Hobart office of the Department of Mines. Mr. Everard reports on the samples as follows: -

(1) Medium grained galena and sphalerite in composite vein, showing quartz against wallrock, sphalerite and galena in that order. Sharp contact of quartz and wallrock, and quartz and sphalerite, indicates fissure filling by a later injection of silica. Galena is without preferred orientation and has inclusions of sphalerite showing that sphalerite was deposited somewhat in advance of galena. A few crystals of pyrite were seen in quartz.

(2) Ore bearing siderite vein in contorted slate. Small off-shoots of the siderite vein are cut by quartz stringers. The siderite vein contains fine to medium grained galena and sphalerite and some pyrite.

(3) Quartz vein containing galena and sphalerite with interstitial galena. Some pyrite present, and the minerals seem to have been pretty well contemporaneous with galena a little later than sphalerite. A little siderite occurs at the contact of quartz and slate which has been slickensided.

(4) Galena with included sphalerite and idiomorphic pyrite. The wall rock has been silicified and contains blebs of quartz while the galena has inclusions of silicified rock. At the contact of ore and rock, the rock is eaten into and embayed.

(5) Fractures in silicified slate filled with galena and quartz. Some pale-coloured sphalerite crystals in veins. Euhedral pyrite has collected in small clots in wall rock and quartz.

(6) Pyritised and silicified wall rock. The pyrite has former replacement veinlets along lines of fissility in the slate which have, in places, coalesced to form bodies of pyrite. Subsequently, quartz entered alonglines of fissility and crossfractures cutting veinlets of pyrite.

(7) Medium grained galena with inclusions of quartz and silicified slate. The inclusions have rims of euhedral pyrite derived from slate. The pyrite crystals have congregated ahead of the advancing galena. There is also a little siderite and sphalerite.

(8) Medium and fine grained galena with inclusions of quartz and slate. Fissure filling by quartz followed by replacement with galena. The quartz veins, however, have inclusion of galena.

(9) Medium and fine grained galena with inclusions of quartz Some sphalerite and a minute amount of chalcopyrite.

(10) Medium and fine grained galena and quartz in slate. The slate contains numerous veinlets of quartz and the larger masses of quartz are corroded and embayed by galena. Some small patches of sphalerite.

(11) Medium and fine grained galena with some sphalerite. The slate has been silicified and contains veinlets of quart which are cut by galena. The galena has an embayed irregular outline and contains inclusions of quartz and slate.

(12) Fine grained galena and quartz in slate. The slate contains blebs of quartz and a little disseminated galena.

Considered together, the specimens are examples of fissure filling, and replacement of wall rock, in slate. The first mineralisation was pyritisation, the pyrite being introduced along planes of schistosity. Quartz, carbonates and sulphides followed closely together the order of deposition being quartz, siderite, sphalerite and galena. Finally, there seems to have been a second introduction of quartz along small fractures formed subsequently. There is no evidence of any preferred orientation, the V-shaped pits in the polished galena pointing in all directions. No specific argentiferous minerals were found and all attempts at etching with 20% K.C.N. failed completely. Any silver present must therefore be in a very finely divided state, possibly in solid solution.

Three important conclusions have been reached as a result of this mineralogical investigation and certain deductions may be made from them viz. That pyrite was the first mineral introduced, that sphalerite was the next sulphide and preceded the galena, and that the silver is present in solid solution in the galena.

The sphalerite content of the lode is an aspect which has so far not received much consideration from the miners. Occasionally bunches of the mineral have been met with but much appears to have passed unnoticed. A striking fact which has emerged from the assays is that every sample contains a measurable amount of zinc. It is necessary, therefore, to examine the position and endeavour to discover whether there is any systematic relationship between the quantities of zinc and lead present. The assays of routine samples are given below (pages 31-34). The lead/zinc ratios of all samples from the main lode have been plotted against percentage of lead in GRaph 1 appended. This graph shows that for 0 - 1 per cent lead there is an irregular but consistently high ratio of zinc to lead. From 1 - 24 per cent lead the value of the ratio is low but consistent, the average value being 1 : 0. 15 or approximately 7 : 1.

The deduction to be made is that, in all cases where the lead content rises above 1 - 2 per cent i.e. any material which may be of milling value, the ratio of lead to zinc will tend towards the value 7 : 1. It is for the metallurgist to enquire whether it is practicable and profitable to recover this proportion of zinc.

The explanation of the fact that low values of lead are accompanied by relatively high values of zinc is to be found in the fact that deposition of sphalerite preceded that of galena. The whole of the lode zone was impregnated by the more mobile zinc sulphide which formed a fringe ahead of the advancing less mobile lead sulphide and scattered blebs of sphalerite were formed throughout the zone. It is probable that, at this stage, the content of zinc was low but more or less consistent over the whole of the zone. During the next stage, the main material introduced was lead sulphide with which some zinc sulphide as it is unlikely that there would be a sharp boundary between the two sulphide solutions. Where large concentrations of galena were formed some additional sphalerite was also deposited so that now, in the galena-rich zones there is actually a higher amount of sphalerite present than in the galena-poor zones although in the former case the zinc/lead ratio is lower.

The above deductions apply to the portion of the lode which is at present exposed. On the theory outlined, the zinc sulphide is considered to be more mobile than the lead sulphide and, during impregnation, the former forms a fringe in front of the latter. It follows that, in depth, the composition of the invading solution progressively tended towards the composition of lead sulphide. At depth, therefore, the zinc content of the present lode may be expected to decrease. At what depth the zinc content will disappear cannot be determined at present owing to insufficient data. No significant change can be observed with increasing depth at present.

A similar statistical investigation of the lead/silver ratio of the same group of samples has been undertaken and the results are shown in Graph 2 (Silver in oz/ton). In this case, except for a small rise below 0.5 per cent lead the graph becomes almost a straight line at the value 1:1.20. An average of all samples plotted gives the value 1:1.24 while an average of the higher lead content samples Nos. MM 1 - MM 12 (above) gives the value 1:1.20. Since these figures cover values of lead from less than one per cent up to 65.4 per cent lead, it is safe to say that the ratio 1:1.20 is a fair value to assume for the lead/silver ratio.

The explanation of this constant value is to be found in the fact that the silver is intimately associated with the lead sulphide and was deposited at the same time. The value assessed is that of the original magmatic emanation which consolidated to form the present lode. It follows that there is not likely to be any significant change in this ratio with increasing depth.

Data on the pyrite content is too scanty to permit of reasonable deductions as to its behaviour in depth. In the present mine, the amount is small and gives rise to no mining or metallurgical problems. However, elsewhere along the same line of lode e.g. at Barnett's, solid masses of pyrite appear. In general, pyrite appears to form concentrations along the course of sulphide lodes and it is to be expected that masses will be encountered in the present instance. As to when and where they may occur, no opinion can be offered at present.

Summarising, therefore, it may be stated that:- (1) All ore over 1 - 2 per cent lead content is likely to contain zinc in the proportion one part of zinc to seven parts of lead. The proportion of zinc is likely to decrease with depth but no opinion is offered as to the depth at which significant change will be noted. (2) The lead/silver ratio has been shown to be almost constant at one part of lead to 1.20 parts of silver the silver being expressed as ounces per ton. This ratio is not likely to change at depth. (3) Pyrite content is low but masses of this mineral are likely to be encountered laterally and horizontally.

<u>Sampling</u>:

For the purpose of assessing the value of the lode, a series of fifty chip samples were taken throughout the mine. In all cases the samples were taken at right angles to the strike of the lode usually across the backs but in some cases across the face as, for instance, at the end of a drive. The samples were quartered where necessary and all assays were performed by the Mines Department Laboratory in Launceston, silver, lead and zinc being determined for each sample. Tabulated results of assays are given in the table on pages 39-42 and the location and values are shown on the accompanying plans.

During 1938, Mr. F. Blake took a series of samples in the Intermediate Drive and in the rise connecting adit and 100ft. levels and the following tabulation of results is quoted from his report. Apparently silver and zinc were not determined on these samples.

"""Four horizontal boreholes five feet in length were put out at intervals to test the lode and gave assay results as follows: -

Bore No.	Sample No.	Sample Width	Position of bore from rise	Lead per cent
1	1A	0' - 2'6"	5'	8.5
1	2A	2'6" - 5'	"	5.5
2	1B	0' - 2'6"	21'	15.9
2	2B	2'6" - 5'	"	4.4
3	1C	0' - 2'6"	28'6"	17.5
3	2C	2'6" - 5'	"	5.8
4	1D	0' - 2'6"	38'6"	5.2
4	2D	2'6" - 5'	"	3.0

Three further bores, Nos. 5, 6 and 7 spaced between 38'6" from rise and face of level showed an average of only 0.4% lead.

IN the rise connecting 100ft. level with main adit drive boreholes were drilled at 25ft. and 50ft. respectively below main adit level. Assay results of these holes are as follows: -

Bore No.	Sample No.	Sample Width	Lead per cent
1	1A	0' - 2'6"	53.3
1	2A	2'6" - 5'	15.2
2	1B	0' - 2'6"	15.3
2	2B	2'6" - 5'	6.3""""

TABLE OF SAMPLES AND ASSAY RESULTS

No.	Lab.No.	Level	Position	Horizontal length of channel	Silver Oz.	Lead per ton	Zinc per cent
1	467	100	26' north of station B/1	6.4'	0.5	0.2	0.6
2	468	100	8' south of station B/2	4.5'	0.3	0.2	0.6
3	469	100	29' south of station B/7	3.75'	15.7	7.4	1.2
4	470	100	21' south of station B/9	4.25'	1.4	1.3	0.1
5	471	100	At station B/11	5.0'	1.0	0.4	0.1
6	472	100	15' south of station B/12	6.0'	0.9	0.8	0.2
7	473	100	30' north of station B/15	4.5'	14.6	10.4	1.7
8	474	100	11' south of station B/20	4.0'	0.9	0.4	1.2
9	475	100	9' south of station B/13	4.0'	0.7	0.3	1.5
10	490	100	No.2 W. crosscut N.drive 8' north of station B/26	6.0'	1.1	0.2	0.4
11	491	100	No.2 W. crosscut N.drive 30' south of station B/29	6.75'	5.2	7.6	0.3
12	492	100	No.2 W. crosscut N. drive North face of drive	5.5'	1.5	1.7	0.6
13	493	100	By-pass drive 13' southwest of station B/7	5.0'	9.8	10.2	1.5
14	494	100	By-pass N. drive At station B/23	5.5'	0.8	9.7	2.7

No.	Lab.No.	Level	Position	Hotizontal length of channel	Silver Oz.	Lead per ton	Zinc per cent
15A	495	100	By-pass drive West side At stâtion B/25	3.0'	10.3	19.5	1.3
15B	498	100	By-pass Drive east side At station B/25	3.5'	3.5	5.2	0.9
16	497	150	At station C/7	3.5'	0.1	0.1	0.5
17	498	150	28' north of station C/3	5.5'	0.5	0.1	0.9
18	499	150	9' south of station C/3	5.5'	0.1	0.1	0.3
19A	500	150	13' north of station C/1 west side of drive	3.0'	0.2	Trace	0.3
19B	501	150	13' north of station C/1 east side of drive	1.75'	0.6	0.3	0.6
20	502	150	25' south of station C/1	5.0'	1.6	2.4	0.6
21	554	150	2' north of station C/8	5.5'	16.4	17.6	1.2
22A	503	150	31' north of station C/13	7.5'	34.3	24.1	5.1
22B	504	150	East of hanging wall 31' north of station C/13	1.5'	3.9	2.9	1.3
23A	555	150	6' north of station C/13 east side of drive	3.5'	18.6	12.4	2.9
23B	556	150	6' north of station C/13 west side of drive	5.0'	1.7	2.0	1.5

No.	Lab. No.	Level	Position	Horizontal length of channel	Silver Oz.	Lead per ton	Zinc per cent
24	531	Adit	South face of south drive	2.5'	0.6	0.5	0.4
25	532	Adit	21' north of station A/7	3.0'	0.6	0.8	0.7
26	533	Adit	9' north of station A/7	5.0'	1.0	1.6	0.4
27	534	Adit	8' north of station A/10	4.25'	16.2	13.3	2.2
28	535	Adit	24' north of station A/11	4.0'	1.1	2.7	0.6
29	536	Adit	7' north of station A/12	3.25'	4.7	7.4	0.4
30	537	Adit	North end underhand stope Approx. 5' north of station A/5	5.0'	9.5	18.0	1.7
31	538	Adit	At station A/4 (Tillite lode)	5.0'	0.4	0.9	0.4
32	539	Adit	(Tillide Lode) South wall adit crosscut at station A/3	1.75'	20.3	14.1	1.0
33	540	150	At station C/13 footwall side of lode	5.25'	1.6	1.0	0.4
34	541	100	Faultfilling in No. 1 west crosscut 27' east of station B/22	0.1'	trace	0.2	0.8
35	542	100 level rise	54' below adit level	3.0'	9.3	13.5	1.0
36	543	100 level rise	42' below adit level	4.0'	5.0	8.0	1.5

No.	Lab. No.	Level	Position	Horizontal length of channel	Silver Oz.	Lead per ton	Zinc per cent
37	544	100 level rise	4' belowadit level	2.0'	41.4	24.0	3.2
38	545	East adit	Southern drive at station A/16	3.0'	2.0	2.3	1.2
39	546	East adit	North wall of drive opposite station S/10	2.75'	8.9	4.9	0.7
40	557	150	Pug from fault 5' south of station C/3	1.0'	1.8	3.4	1.3
41	558	150	Fault filling 38' south of station C/3	3.5'	0.7	0.1	0.4
42	559	150	9' west of station C/9	4.5'	0.4	0.5	0.4
43	560	150	In rise to 100 level 34' above 150 level	4.5'	1.6	2.3	1.2
44	656	150	3.5ft. north of station C/16	3.5'	9.8	8.0	1.5
45	657	adit	South wall of adit crosscut at station A/3 (Check sample for No.32)	1.75'	20.0	17.6	1.7
46	658	South adit	60ft. east of stations 6/7	0.5'	0.1	Trace	3.7

ORE RESERVES:

Calculations of ore reserves is beset with difficulties and the following figures are to be construed as a guide only to the total quantity of ore which may be available.

A direct average of 45 samples taken throughout the main lode gives the value 6.0 oz. Ag.5.5% Pb. and 1.0% ZN. per ton. These are theoretical only and are indicative of the total grade of material throughout the mine. Selective mining processes should result in an increase of 50 per cent on these figures for material delivered to the mill. The average width of the main lode is 4.5 ft. and on the basis of 11 cubic feet of ore to the ton, there are 30,000 tons of ore available above 150ft. level of average grade as above giving a total quantity of 180,000 ounces of silver, 1,700 tons of lead and 300 tons of zinc. Owing to the irregular nature of ore prices at the present time, it is not considered wise to calculate a value.

An average of 17 samples taken through the "slide" zone gives the values 10.0 oz. Ag. 9.0% and 1.5Zn. On the basis that the slide zone is 100ft. wide and that the ore zone within the slide averages 10ft. in width, there is available to 150ft. level, 15,000 tons of ore of average assay as above giving 150,000 ounces of silver, 1,400 tons of lead and 200 tons of zinc.

No information as to values and width of lode below 150ft. level are available and the reserves below this level cannot be calculated at present. It must be pointed out, however, that ore is going strongly underfoot in the south drive of 150ft. level.

Similarly, information on the tillite lode is too scanty to permit of calculation of reserves. This lode appears to be persistent laterally and there are theoretical reasons for assuming that it will persist in depth. Such assays as are available show a wide variation in values but it is encouraging that at one place the lode has a content of 17.6 per cent lead. As in the main lode, silver and zinc are constant associates of the lead and in this lode it is to be expected that the ratios between the metals will be similar to those of the main lode.

CONCULUSIONS:

(1) The Montana Silver-Lead Mine is, as its name implies, a silver-lead mine. The only other mineral present in possible economic amount is sphalerite.

(2) The mine is situated in buttongrass country and is easily accessible from Zeehan.

(3) The lodes occur in contorted shales and quartzites, rather thinly bedded and of early Cambrian or possibly Pre-Cambrian age.

(4) The chief structural feature of the area is a northwest trending major fault which is marked by a wide crush zone. This fault has been indentified as the No. 1 slide of the Zeehan-Montana No. 1 Mine. This fault has not so far been encountered in the present mine workings.

(5) Crossing this fault are at least two parallel northeast trending simple fractures with which several small subparallel fractures are associated.

(6) Both these main fractures have beensubsequently mineralised, the eastern forming the present main lode and the western forming the Tillite Lode.

(7) Crossing the lode fractures a short distance south of the shaft is an east-west fault which is not a simple fracture but a crush zone similar to that described under (4) above. It is considered to be a split from this major fault and that the two junction some chains east of the main shaft.

(8) The structural pattern deduced has had a strong influence on the location of ore and a parallelism has been drawn between the occurrence here and that observed by previous workers in the Zeehan - Montana No. 1, the Zeehan - Western and the Oonah mines. Minor differences have been noted mostly due to the fact that spilite is not present in the country rock in the present instance.

(9) Structural control of ore deposition is the most important deduction that has been made. The area discussed is only a small portion of a larger area. The same line of lode may be traced southwards through the Saxon, Barnetts, the Doric and possibly to the Comstock. Immediately to the west is the Big Ben and some signs of mineralisation have been noted further west. It is considered that all these occurrences are located along a series of subparallel northeast trending simple fractures. It is not known whether the fracture system continues northwards beyond the Corinna Road although it is considered unlikely that they are cut off by the major shear zone. No ore occurrences north of the road are known as yet.

(10) The chief economic mineral of the lode is galena with which silver is intimately associated the ratio of lead to silver trending towards the figure 1:1.20. Also associated is sphalerite in two distinct forms. The association is not intimate and the ratio of lead to zinc is of the order of 7 : 1.

(11) It is considered that the lead/silver ratio is liable to persist at depth but that the zinc content is liable to decrease with depth. No significant diminution in zinc content has so far been noted.

(12) The value of ore as fed to the mill is likely to trend towards the figure 10 ounces of silver, 9.0 per cent lead and 1.5 per cent zinc. The average grade or ore throughout the mine is lower than this but selective mining methods coupled with blending or ore will tend to maintain the figure above.

(13) The mine is a "dry" one, the country rock in general stands well and there are no difficult mining problems to be solved.

(14) Considerable developmental work has been done by the present and previous companies and the mine is in a condition where it can produce a reasonable quantity of ore for some time. To maintain production, however, additional developmental work must be carried out concurrently with ore extraction.

(15) The milling process has been but recently installed. In any case, discussion of this section is considered to be outside the scope of this report and no opinion on this section is offered.

RECOMMENDATIONS:

These may be considered under the headings
Lateral development;
Development at depth;
Exploration beyond Present Mine Limits;
Mining Procedure.

Lateral Development:

(1) It is a primary principle of mining that developmental work should proceed concurrently with ore extraction. In the present case, it is considered that twelve months supply of ore should be in sight at any stage. This is not the case at the moment so additional developmental work should be undertaken with all speed.

(2) The new rise from the end of 100ft. level to intermediate level should be continued to the floor of the underhand stope below adit level. There appears to be a good block of ore in this area and it is desirable that a change to normal stoping methods be made as soon as possible. This rise connection will block out a considerable quantity of ore.

(3) Both adit and 100ft. levels proceed to within 220ft. of the southern lease boundary. There are signs of good ore in this section and it is desirable that the drives be continued to the lease boundary with two connecting rises to block out ore.

(4) Adit level north drive is just inside the slide zone at No. 2 Prospecting Shaft. Good ore shows here and the drive should be continued to Eastern Adit. It may be possible to take out any ore above this level through the Eastern Adit instead of through the shaft. Ore below the level would, of course, have to go through the shaft.

(5) 150ft. level south drive should be continued with associated rises to 100ft. level. It is likely that it will prove profitable to extend this drive to the southern lease boundary.

(6) Exploratory work on the tillite lode should be instituted.

This should consist first of driving south from the adit crosscut followed by an extension of the north drive on this lode. The metal in this lode is in a finely divided state and the appearance is somewhat deceptive. It is advisable, therefore, that samples for assay be taken at intervals.

Development in Depth:

(1) The 150ft. level is the lowest at present being worked. In other words only the top of the lode has been scratched. It is strongly to be recommended that driving of lower levels be undertaken at an early date. The shaft is down to 300ft. and the plat has been cut at 200ft.

It is recommended that driving of the 200 level be shortly commenced in both directions.

(2) It is deduced that, at 200-250ft. depth, the shaft will be in about the centre of the crushed or "slide" zone. At lower depths, it will tend to be on the south side of the zone. THerefore, levels at 200-250 feet should be driven in both directions while lower levels should first be driven northwards.

(3) Rising at predetermined intervals from the lower levels should be effected. The distance apart will depend on the conditions met with but should be about 100 feet.

(4) Systematic sampling as development proceeds should be instituted to determine trends in the mineral content. No reliance should be placed in "eyeball assay" methods.

(5) If driving on the tillite lode at adit level gives encouraging results, this lode should be investigated at depth. This would most conveniently be accomplished by crosscutting from 100ft. level by continuing either No. 2 west crosscut or No. 3 west crosscut until the tillite lode is intersected and then driving along the lode.

Exploration Beyond Present Mine Limits:

(1) Evidence has been adduced that the No. 1 slide of the Zeehan - Montana No. 1 mine persists northwards from that mine and crosses the access road to the present mine between the shaft and the Corinna Road. From the known behaviour of lodes at the intersections of fractures, it is deduced that a make or ore will be encountered some 300ft. north of the shaft. In this connection, it may be noted that the end of the north drive of 150ft. level shows a swing to the east which may indicate that it is approaching the slide. It is strongly recommended that this drive be continued. The slide if present, will be met with between 100 and 200 feet. The drive should be put right through the slide.

(2) If this exploratory drive does indeed cut a slide, there will be a repitition of conditions obtaining in the vicinity of the present slide. Therefore, in this case all levels should be driven northwards to intersect the slide.

(3) No opinion can be offered as to what conditions may be encountered north of this slide. Further recommendations on this point must await the extension of 150ft. level north drive.

Mining Procedure:

This is somewhat outside the scope of the present report by the following suggestions are offered based on general observation.

(1) Within the slide zone, the lode as such disappears and is represented by small veins with imgregnated country rock between. All this material is of milling grade and the zone varies from 10 to 40 feet in width. Mining operations should be planned so that the whole of this material is removed.

(2) Patches of poor ore should be worked concurrently with rich patches and the material blended to give a reasonably constant mill feed.

(3) Recent internal connections have been made without the aid of survey, the procedure in winzing and rising being to "follow the wall". Particularly within the slide zone, this is liable to result in misconnections as the vein worked on one level may not be the same as that on another. It is recommended that survey be kept fairly close up to developmental work and that connections be made along calculated lines. To this end the table of co-ordinates of the present survey stations is included as a basis for future survey work.

REFERENCES:

(1) "Ore bodies of the Zeehan Field" Twelvetrees and Ward. G.S.Bulletin No. 8 - 1910.

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(3) "Montana Western Extended Mine" F.Blake, Oct. 1938.

(4) "Montana Western Extended Mine" F.Blake, May, 1939.

(5) "Geology and Mineral Industry" Carey & Hills, A.N.Z.A.A.S. Handbook - 1949.

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