Old Mines on Zeehan Lodes.

The Florence Hill.

(1) Location and Access.

(2) History.

(3) Output and Profit.

(4) Geologic Enrironment.
- (a) Keratophyric Tuffs and Black Slates.
- (b) Ordorician-Silurian Sandstones and Shales.
- (c) The Brickfields Fault
- (d) The Oonah-Montana Tear Faults.
- (e) The Minor Tear Faults.
- (f) Tension Cracks.

(5) The Ore-bodies.
- (a) The 'Pug'
- (b) Lodes in Tuffs and Slates.
- (c) Lodes on the 'Contact'
- (d) Lodes in Sandstones and Shales.

(6) The Ore.
- (a) Constituent Minerals
- (b) The Concentrations.

(7) Mine Workings.
- (a) New Mount Zeehan
- (b) Florence
- (c) No 6 Argent
- (d) No 5 Argent
- (e) No 1 Argent
- (f) Water and Pumping.

(8) Discussion of Possibilities.

(9) Recommendations.

The Florence Hill

I Location and Access.

The group of old mines embraced within this unit is located immediately adjacent to Main Street, a few chains west of the Post Office. It occupies the eastern portion of the Argent Flat and the higher ground rising between the eastern edge of that Flat and Solly Street. Its northern limit is in the vicinity of the old New Mount Zeetan main shaft whence it extends in a general southerly direction to the vicinity of the Florence Dam.

The total length thus embraced is 4000 feet in north-south direction and 2500 feet is the extent of the east-west dimension. These limits are in some degree arbitrary, having been determined by the standard-sized drawing, but they very closely cover what must be regarded as one economic mining unit. Nevertheless it must be pointed out that there is a continuance southwards of similar geologic structure beyond the southern limit dealt with in this report.

Access is easy. An old tramline, now in the form of a road, runs from Main Street to within 1500 feet of the southern boundary but could be extended to that point very easily. ~~In the western portion Fowler Street runs~~

II History

The old mines included within this unit are:- New Mount Zeetan, Florence, Last Hope, Worry-me-to-death, No 1 Argent, No 3 Argent, No 6 Argent, No 5 Argent (later renamed State Argent Mine) and Keatle's.

Section 559 which formed part of the New Mount Zeetan holdings, and section 943 originally known as Smith's and later as the Florence, were among the first six areas pegged at the time of the original discovery of Zeetan in 1882.

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southwards from Main Street and becomes a road which coincides with the old British Zeehan tram and continues to the No 2 Argent and the Comstock Trams.

Launceston in 1898. The initial mining operations did not produce solid galena similar to that which the Western Company thrived on, and financial reconstruction became necessary. The New Mount Zeehan Company emerged about 1896 with a little fresh capital. Continued failure to locate runs of solid galena precluded financial success and the Company ceased operations in 1900. The mine has not been reopened since.

Smith's section (943-M) had a quite different history. It was neglected by Smith the lessee until a miner named McKay secured a tribute from him. This was in the early 1890's. Work on McKay's lode continued intermittently until in 1896 Hortin, Currie Flaherty and others secured tributes on small areas east of McKays workings on the rising ground of Florence Hill. All of these parties uncovered ore previously not suspected. Currie and Hortin particularly were very successful and made a lot of money. By 1900 something like 6,000 tons of galena had been obtained from the shallow workings. It was because of these successes that R. Quiggan secured ownership of the lease and floated the Florence Company.

The Florence Silver-Lead Mining Co under the management of H. Astles sank the Main Shaft to 214 feet and opened up levels at 128 ft and 200 ft. In the middle of 1903 a heavy burst of water flooded the mine. This was the 'first flooding'. Unwatering was successfully accomplished, mining was resumed and in August 1904 the concentrating plant started operating. By May 1906 the Company had produced 2000 tons of galena but were in financial difficulties. The mine closed down.

However, in April 1907 a syndicate of tributors undertook to unwater and work the mine. From then until August 1908 a total of 3800 tons of galena was produced. At that juncture the 'second flooding' occurred and unwatering proving beyond the

resources of the syndicate), the mine was abandoned.

In March 1909 the Tasmanian Smelting Company secured a tribute from the Florence Company and undertook to unwater and work the mine. No difficulty was encountered in the unwatering, but mining operations were on an indefinite and insecure basis. The mine manager became ill and a metallurgist (M.M. Marks) with no mining experience was put in charge. John Craze was asked to run the mine for a month as a test of what could be done. Marks did his best with mechanical troubles and bad ground unnerving him, until in November 1910 a series of bursts of water became too much for the mechanically unreliable pumps. H Harris the Tasmanian Smelting Co's general manager, ill in hospital in Hobart, gave instructions to cease pumping. This was the 'third flooding'. The mine has been under water ever since. A total of 1000 tons of galena had been raised and Marks admits that ore in chutes at the bottom level was left as the water quickly rose.

No 6 Argent has had a history embracing company operations and concerted tributors' efforts. In the early nineties spasmodic shallow workings on lode outcrops by prospecting parties was the type of operating attempted. At a later stage the area became part of the large consolidated lease of the Mount Zeehan (Tasmania) Silver-Lead Mines Ltd, a London company with British capital. That company sank the external shaft to a depth of 122 feet and crosscutting east discovered the No 3 lode which did not outcrop at the surface. That lode proved quite productive but its further development was prevented by the overshadowing effect of the spectacular results from the Spray No 1 lode from 1897 onwards. Nevertheless a total of about 4000 tons of galena was produced.

In August 1922 the mine was reopened by a small

group of Zeehan residents under the title of No 6 Argent Company. A new shaft was sunk from the eastern end of an adit to a depth of 170 feet, the power transmission to the internal shaft being by means of a weird variation of the Cornish lift, the remains of which are still standing as an interesting exhibit of past mining methods. Crosscutting at the 170 ft level disclosed the No 3 lode and another (No 4 lode) to the east of it. Up to December 1923 this group produced 1300 tons of galena. At that stage they ran out of money, could not buy firewood for power, were refused help by the Government and closed down. It is still closed down.

No 5 Argent is of special interest as having been operated by the Government as a State Mine. It was first worked by the Mount Zeehan (Tas) Coy who sank the shaft and from early in 1909, when they closed down the Spray, made it their chief activity for about 12 months. The results were disappointing. In 1914, after much disputation between John Craye and the Labour Government as to testing the Zeehan field in depths, the No 5 Argent was selected by the Government, apparently on the advice of Gerald Aherne, as the locale of depth testing. The State Mine was launched with clearly expressed intentions of proving that deep-sinking at Zeehan would disclose values at depth. At the time the State took over in 1914, the shaft was down 150 feet; when it finally closed down in 1917, the shaft was then only down 314 feet. It has since remained untouched.

No 1 Argent was originally worked by the Silver Queen P.A. during the 1890's. Workings from No 1 Shaft at the 190 feet level were abandoned about 1896 and have remained untouched since then except when they were exposed for a few weeks at the 150 ft level during the operating of the State Mine by the drive northwards along Flaherty's lode.

The locality referred to as Keatles adjoins No 6 Argent on the south. It is a relic of the earlier prospecting phase of Zeehan and is confined to shallow workings the records of which have been lost.

The 'Last Hope' was the site of tributing work during the 1907-1908 period of the Florence. It is near the southern boundary of Smiths section. The 'Worry-me-to-death' is a more recent enterprise, being to the east of the 'Last Hope' in the Silurian rocks. It dates from about the Smelting Co's regime at the Florence. It found ore but did not develop further than small-scale prospecting.

(3) Output and Profit. chequered ??

The checkered, halting and haphazard career just described cannot be expected to provide anything approaching comprehensive figures of production and profit.

The succession of the Mount Zeehan and New Mount Zeehan Companies of Launceston got output but made no profit. The operations of the Mount Zeehan (Tasmania) Company of London were a part of the work extending far beyond the confines of this area and nothing can be said as to profit or loss although they certainly obtained appreciable output.

The tributing progenitors of the Florence Company made good profits but their banking accounts were private. R. Quiggan, the father of the Florence Company made a handsome competence and the Company paid dividends although it ended without funds. The estate of R. Quiggan in subsequent years drew royalties from the tributors concerted effort of 1907-1908. The Tasmanian Smelting Company's affairs were very secretive but the indications are that they barely covered expenses at the Florence.

The No 6 Argent operations of 1922-1923 made profits which were taken as made with the result that when

difficulties were encountered there were no financial resources available.

The same incompleteness exists in regard to details of output. However, sufficient is known to indicate its general order of magnitude. But in view of certain conclusions to be drawn in a later portion of this report as to genetic significance and relative economic importance of two different types of lodes occurring within the area under review, it will be advantageous to present separately the production from each type of lode occurrence. This differentiation of lode type is based on the rock ~~system~~ group in which they occur. Their designation will therefore be;- ① Lodes in Cambrian Complex; ② Lodes in Silurian Sediments.

Mine	Output of Galena	
	Lodes in Cambrian Complex Tons	Lodes in Silurian Sediments Tons
Florence	11,000	3,000
New Mount Zeehan	2,000	
No 6 Argent	300	5,000
No 5 Argent (State)	3,000	
No 1 Argent	2,000	
Keeble's	300	
Totals	18,600	8,000
Grand Total	26,600	

④ Geologic Environment.

ⓐ Keratophyric Tuffs and Black Slates.

The whole of the Argent Flat consists of this rock series, the dominant constituents of which are beds of tuff. This has been confirmed by Dr Prider's field work which showed that the black slates are not only subordinate in amount but are prone to consist partly of tuffaceous material. Dr Prider also confirmed the conception of a higher degree of metamorphism within these rocks than any disclosed in the younger rocks within the Florence Hill.

ⓑ Ordovician-Silurian Sandstones and Shales.

These are the younger rocks constituting the

Florence Hill from its northern end southwards. Dr Prider's detailed field mapping and interpretation dimonstrates a faulted relationship between these rocks and the keratophyric tuffs and slates. There is thus firmly established the original conception of 1946 regarding the major meridional fault.

But there is not a corresponding certainty in regard to the exact horizon of the Ordovician-Silurian beds occurring on the western slope of the Florence Hill. That is why the Ordovician-Silurian qualification is used. In 1946 the horizon was deduced as being the Smeltes sandstone formation, but Dr Prider's mapping combined with Professor Carey's photo-geological interpretation throws doubt upon this. It would appear at the moment that the beds at the Florence to as far south as No 6 Argent are higher than the Smeltes sandstone, but this is by no means certain. Dr Prider states quite frankly that he was unable to detect any key bed or horizon. Therefore it is clear that detailed surface mapping with exact palaeontological observations in the existing unmapped area between the Florence Dam and the Bell area must be carried out to finally determine this important problem.

(c) The Brickfields Fault.

The fault mapped by Dr Prider separating the older keratophyric tuffs and slates from the younger sandstones and shales shows the same general pattern as that depicted in 1946. The actual variation will be dealt with when dealing with the transverse faults. Attention at this stage will be confined to the significance of the relationship between fault plane and the strike of the Ordovician-Silurian beds as mapped in detail by Dr Prider.

Except in close proximity to the meridional fault the strike of those beds is at an appreciable angle to that of the fault. This applies to the belt extending southwards from the junction of Wilson and Solly Streets to about

200 feet south of No 6 Argent shaft. Although there are small variations in strike of the fault plane within the respective off-set blocks, this non-parallel relationship persists.

This precludes the conception of the fault as due to an anticline breaking parallel to its axis. Rather is there indicated a fault sub-parallel to the axis and converging to the northwards. Dr Prider's recordings of strikes and Professor Carey's structural map shows a major fault extending from the vicinity of Howards Mill in a north-easterly direction towards Leslie Junction. For identification purposes this fault will be termed Brickfields Fault.

When cognisance is taken of the existence of the major tear fault so clearly indicated in the Rotunda Hill and to be described below, the conception emerges of the faulting of the Brickfields Fault by the tear fault. This makes the fault across the northern end of the Florence Hill the faulted continuation of the Brickfields Fault, the portion north of the tear fault having moved 1700 feet east-south-eastwards.

(d) The Oonah-Montana Tear Faults.

In the Montana, Western and Oonah mines there occurs a series of north-dipping 'slides' striking varying degrees north of west. They are shown by Waller and Twelvetrees & Ward as sub-parallel in the mine plans. Waller joins as one the main slide of the Montana and the Western No 4 lode and this is accepted by Ward. Carey's structural map shows a major tear-fault in this vicinity which must correspond to this structure.

Dr Prider's map is clearly incomplete in its extreme north-eastern portion i.e. the portion in the vicinity of Rotunda Hill. Firstly, it does not show limestone on Main St and east thereof. Secondly, the acceptance of the structural block extending from the Wilson-Solly Sts intersection to Rotunda Hill as there depicted necessitates placing the limestone as overlying all that thickness of Ordovician-Silurian sediments. But we know beyond any shadow of doubt that such is not the stratigraphical sequence. However, if the

dips do not bring out on this map the structure described by Waller:-

"This contact is, I think, clearly a fault fissure. To the southeast of this line the strata are evenly bedded, striking from 35° to 40° west of north. As the contact is approached the strata bend round to the north, and at the contact a complete change of country takes place. ..... The faulting movement has had a lateral as well as a vertical component. From the way in which the strata bend on approaching the contact it is evident that the western country has been heaved to the north or the eastern country to the south." (1)

It must be realised that Waller had the advantage of underground observations which are denied us to-day. However, Dr Prider's work demonstrates that the strike of Waller's fault is meridional and not north-east as hypothecated by the latter. The angle between the Waller Upthrust and the synclinal axis is therefore 40°-50°

(1) S.A. Waller 1904 p 34.

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tear fault be placed on Dr Prider's map where it is visible on and near Rotunda Hill, the structure forms a pattern in concordance with the stratigraphy.

There still remains, of course, the task of correctly joining up the fault line thus delineated with the 'slide' system of the Montana-Western-Oonah mines. The far from straight line of fault joining the south end of King Extended Hill – Rotunda – Druids Hall exposures when connected with Professor Carey's delineation for the Western – Montana area presents a realistic picture. That is as far as we can go at present and it is probably quite correct.

(c) The Minor Tear Faults.

An outstanding feature of Dr Prider's map is the absence of transverse faults crossing the Queen Hill. The presence of a key quartzite bed on that hill within the Nubeena Quartzites & Slates enabled almost continuous mapping of it to be achieved. That mapping shows definite folding but very little if any faulting! Certainly there are breaks in exposures of the quartzite and it must be made a temporary reservation that faults may occur at these breaks, for there are faults in the curved line of the Nubeena Quartzites – Keratophyric Tuffs demarcation. But as the map stands it would appear that between the Corinna Rd – Trial Harbour Rd bifurcation and the Nike there occurs no persistent tear-fault of the type so clearly discernable both to the north and to the south. Incidental to this it must be accepted that the Oonah 'slide' crosses the Nubeena Quartzite formation at the road bifurcation where B. Webb reports pronounced crumpling and brecciation and it most probably joins the Montana Tear Fault somewhere east of this.

There is, however, on the opposite Florence Hill an equally outstanding congregation of transverse faults. As deciphered by Dr Prider these are approximately in the same positions as depicted in 1946, but their orientation is north of east in marked contrast to the south of east orientation of the 1946 picture. The effect on the

Keratophyric Tuffs – Ordovician Sandstones faulted contact, is to stagger it in a series of off-sets. Although Dr Prider had some difficulty in fixing the contact in certain of the adits, because of complete surface decomposition, there seems to be little doubt that except at the Florence the fault-lines, both meridional and transverse, are mapped as closely as is possible without some extensive surface trenching and underground mapping.

It must be pointed out at this stage that the first edition of Professor Carey's structural map showed no transverse fault on Florence Hill. His second edition shows one. This is located in the vicinity of the Florence shaft. It is just here that Dr Prider has mapped three closely spaced transverse faults. It would seem, therefore, that the aerial photographs show this emphasised structure but that the others are masked. It is important in this connection to note that Professor Carey's lone fault passes through Florence Hill but not the Queen Hill. There is thus that much confirmation of Dr Prider's restriction of the transverse faults to the Florence Hill.

What is the nature of these transverse faults? What is their relationship to the outstanding Tear Faults? The study of this problem is essentially that of an overall conception of the regional structural picture and especially the fracture pattern. Without going far from the Florence Hill it becomes quickly obvious that the tear-fault pattern is a composite of lengthy (several miles) master tears such as the Balstrup and quite short ($\frac{1}{4}$ to $\frac{1}{2}$ mile) minor breaks such as those in the vicinity of the Tasmanian Crown. Viewing Dr Prider's transverse faults from this angle it is clear that they could fit into the picture both as to orientation and length. They can therefore be regarded possibly as part of the tear fault system. But are they all of such an origin?

We must now realize that there is another possible interpretation. The movement on the Brickfields Fault was up on the north side and down on the south side within the Teetan Syncline.

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The 'shoulders' at each end of the fault as it passed from the older rocks into the Ordovician-Silurian and vice-versa must adapt themselves by bending or breaking. At the north-eastern emergence the adjustment has been by bending. This is shown in Professor Carey's structural map and can be traced on the ground at the 4-Mile on the Emu Bay Railway. The south-western emergence, if it coincides with the most northerly of Dr Prider's transverse faults which runs from the western end of Tridrick St slightly south of west, shows no such pronounced and steady bending. Instead, there is only localised bending adjacent to the Waller Upthrust. It is not impossible, therefore, that some at least of the transverse faults are the breaks by which adjustment has been brought about.

Now we have to determine which is which. The following is a classification of Dr Prider's faults, which have been numbered for identification purposes from north to south, based on the general trend of all-round evidence:-

Nos 1 is the Brickfields Fault which has been the site of a second movement of the nature of dragging on the south side of the Montana-Oonah Tear Fault. xxx

⊕ Nos 2, 3, 4 & 5 are 'shoulder breaks' probably somewhat accentuated by similar dragging.

Nos 6 and 7 probably substitute Carey's Tear fault. There seems to be some discrepancy between these (Prider's) faults as placed on the map and Waller's references (certainly rather recent) photo-geological interpretation combined with field study at South Oceana and Mt Misery which show folds broken by faults parallel to sub-parallel to the axes. There is of course a variation in the fault-erosion relationships, the erosion having reached a deeper structure exposure at Mt Florence than at Mt South Oceana.

⊕ Tension Cracks.

These are numerous and typically erratic in both orientation and distribution. Flaherty's lode driven on in the State Mine shows the meandering course so common in the Zeehan siderite lodes. McKay's lode at

to Prider's mapping results in Currie's, Astle's and South lodes being shown as within the Ordovician–Silurian. This is not in concordance with Waller who states:-

"This is confirmed by observations on one lode at least on the west side of the contact. Currie's lode as it approaches the plane of contact bends round to the west" (2)

Waller's 'contact' must be the Waller Fault. And we are thus compelled to visualise not only Currie's but also Astle's and South lodes as occurring in the Keratophyric Tuffs. This is confirmed by the character of the material in the mullock dump which is dominantly tuff and slate and not sandstone or slate. However, in order to reconcile surface exposures to the southwards we must bring the Ordovician–Silurian westwards at about the southern end of Currie's lode. This can only be factually achieved by a Tear Fault striking north of west. The composite plan shows this interpretation. It conforms to the general experience at Zeehan in the rich 8 feet of solid galena in Currie's lode as it bends approaching the 'slide' and the high yields from Hartin's workings which were just on the north side of the Tear fault.

xxxxxx rogue) to the location of the Waller Fault. In the 1910 plan of the Florence appear two pencilled lines marked 'Slide No 2' + 'Slide No 3' which correspond neither in position nor orientation to either Tear fault or Prider's transverse faults, but until we can get underground it is as well to ignore them.

Nos 8 + 9 are probably orientated wrongly (they are interpolated only by Dr Prider) and are most likely to be Tear faults related to the slides or cross courses recorded by Waller in the No 2 Argent which have the characteristic north of west strike. They are shown thus in the composite plan.

The Waller Upthrust continues southwards of Dr Prider's mapping and we do not know to what extent it is cut by Tear-faults until we reach the Balstrup Tear Fault which cuts and offsets it on a large scale. Recent doubt thrown on the Waller Upthrust conception is unwarranted in view of the above interpretation of the Florence Hill structure and

(2) S.A. Waller 1904 p35

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Mount Pectan's No 2 Lode W turns abruptly to a little south of west for a distance of 90 feet. This is parallel to and actually coincident with the western extension of this Brickfields Fault ⊕

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It is significant and probably confirmative that Dr Pride's western extension of this fault into the Ruffo of the Argent Flat traverses an area marked by him as "very disturbed gone" and "schisted gone". It is important to [illegible] that the south drive on #

the Florence shows similar characteristics as does the lode driven on southwards from the New Mount Teetan shaft.

By contrast, Moyle's lode at the Florence and No 3 lode at No 6 Argent seem to run a more even course. A consideration of these contrasts will be covered in the next chapter.

(5) The Ore-bodies

(a) The 'Pug'.

The occurrence of this still problematical material within the Florence Hill is both a challenge and an inducement. Its first appearance in the mining scene was in Hortins adit driven in 1897 into the Florence Hill from just north of the present Main Shaft. Waller refers to this in his 1904 report and mentions a crosscut showing a 40 ft width of 'black pug' carrying galena which was treated in a sluice box with good results.[3]

Twelvetrees in his 1900 report describes the two adits driven eastwards into the Florence Hill by the New Mount Teetan Company. In both of them he records 'black pug', but only mentions galena therein quite casually. But the "Teetan + Dundas Herald" of that period mentions galena in 'black pug' as being extracted by the New Mount Teetan Coy. This seems to be confirmed by the plan of the New Mount Teetan workings signed by R.B. Montgomery and dated 4th August 1901, which shows appreciable workings where Twelvetrees recorded the 'black pug'.

Dr Prider during his field work was only able to penetrate a short distance into these tunnels but nevertheless got some evidence of the 'black pug'. He was able to see no bed or continuity of this material, but did recognise a few isolated occurrences with dimensions up to a few feet. These were located close to the faulted contact of the older and younger rocks. He took samples and his subsequent laboratory tests showed the black colour to be due to carbonaceous material with no reaction for calcite.

(3) G.A. Waller 1904 p 69.

It is unfortunate that there is available no description or plan of the underground geology of the Florence workings. Waller's description is obscure and the very opposite of precise. His sequence to the 'rough' is vague; he gives its approximate dimensions but says nothing as to the nature of the wall-rock. This is aggravating, as verbal statements by several men who worked in the Florence Mine indicate that 'pug' occurs in the underground workings. Questioning of Mr M.M Marks who was last in charge of the Florence unfortunately has been unproductive of helpful information — he was a metallurgist and frankly admits lack of knowledge regarding rocks, lodes and structure. The only thing he could say as possibly bearing on this problem was that there was some 'bad ground' which was worrying him, but he had no idea as to what was the nature thereof.

Apart from the indefiniteness as to the exact location of the 'pug' underground in the Florence main workings, correlation of surface geology and mine workings shows that the 'pug' is intimately related to the Ordovician - Silurian formations.

(b) Lodes in Tuffs and Slates.

Within the confines of the area being dealt with herein no lode in these older rocks has been particularly productive. Two mining propositions which were economic failures illustrate this. They are the New Mount Zeehan and State Argent mines. It is not that the lodes were barren, but that as far as they were explored they did not yield enough of those concentrations of solid galena which were a sine-qua-non to past mining operations at Zeehan. Longitudinal exploration was appreciable on several of the lodes but vertical range did not exceed 300 feet. Very little information is available as to the distribution of galena in these lodes wholly within the tuffs + slates, and we have to depend on examination of the material on the dumps. One outcome of such an approach is the paucity of galena in the siderite of the State dump as compared

with that in any of the other dumps such as New Mount Zeehan, Florence, No 1 Argent or Keatle's.

The respective lodes with what is known of them will now be enumerated and described:-

(i) Mount Zeehan No 1 lode W.- This lode was cut in the West Crosscut from the Mount Zeehan main shaft at the 124 ft level at 150 feet from the shaft. It was driven on for 180 feet north with a branch striking off to the north-east at 150 feet which was driven on 120 feet. A continuation of this north-east drive would connect in 90 feet with the short south-west drive from the Northern Crosscut. This presents a picture typical of the 'branching and anastomosing' character of the majority of the Zeehan siderite lodes.

(ii) Mount Zeehan No 2 lode W.- Cut at 220 feet in the West Crosscut, this lode has been driven on for upwards of 1000 feet - 600 feet north and 400 feet south. The general direction of the north drive is 15° while that of the south drive is 8°. The deviations from these general orientations are not pronounced and the general aspect less 'wobbly' than is usual in these old Zeehan lodes. Montgomery in 1893 had this to say:- [4] "At the 124 feet level the lode has been followed north and south about 300 feet each way; at the upper level it has been driven for about 200 feet to the south and 400 feet to the north. At the bottom level the lode has been generally very poor, but in several places ore was found in the floor of the drive and rising up into it a foot or two, as if it had been just too shallow to strike new shoots of ore going downwards. The lode is very well defined with smooth walls; it has now been noted, however, in several cases in the Zeehan field that where the walls are smooth and hard the lode is poor in ore. In the upper level the ground was stuck and near the air shaft a good deal of stoping has been done. On the whole, however, the workings have not been profitable, and the mine has lately been shut down."

Montgomery gives the output from this lode as 4800 tons of

[4] A Montgomery: "Report on the Progress of the Mineral Fields of the County of Montagu" May 1893

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John Thurstan a miner with 33 years experience at Zeehan in evidence before the 1922 Enquiry stated on March 6th 1922:-

"My first experience at Zeehan was on the old Mount Zeehan mine. The drive on the main lode continued for 900 feet at the 124 ft level and showed from 4 in to 9 in of galena the whole way and going strong underfoot"

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of milling ore and 70 tons of hand-picked galena. The milling ore assayed Pb 12·4% Ag 13·4ozs; the hand-picked ore Pb 59% Ag 76ozs. This was the position as at May 1893. Except for a little stoping near the Air Shaft at the 60 ft level this ore came from driving along the lode. It was a reconstructed company entitled "New Mount Zeehan" that continued driving on this lode an additional 300 feet north and 100 feet south. That company also extended the main crosscut both west and east and disclosed the following lodes:-

(iii) Mount Zeehan No 3 Lode W.:- Located 180 feet west of No 2 Lode W., and driven on only 60 feet, this lode was clearly not regarded as important.

(iv) Mount Zeehan No 4 Lode W.:- At 80 feet further west another lode was encountered. This was driven on 40 feet north and 75 feet south. Beyond the evidence of the mine plan that the strike is 340° no information as to this lode is available.

(v) Mount Zeehan No 5 Lode W.:- At the extreme western end of the crosscut a lode was cut and driven on for 150 feet south-eastwards. It shows the irregular orientation pattern.

(vi) Mount Zeehan No 1 Lode E.:- At 200 feet east of the Main Shaft a lode was cut and driven on which the mine plan shows sub-paralleling No 2 Lode W and having divers ~~digress~~ wobbly ~~characteristics~~ course. The north drive is 200 feet and the south drive also 200 feet. The whole 400 feet is unusually straight and bears 30°. No information is available as to what it contained. A fair assumption would be milling ore with very little massive galena available for selective mining or hand-picking.

(vii) Mount Zeehan No 2 Lode E.:- A parallel lode 120 feet east of this latter lode has been driven on for 60 feet south-westwards. It would seem to have been regarded as unimportant.

(viii) McKay's Lode.:- This was the first lode worked on the Florence. It was driven on 350 feet at the 100 ft level and 300 feet at the 200 ft level. The strike is 15° and the dip 80° eastwards. It is 170 feet west of the Main

Shaft at the 128 ft level. It was McKay's success on this lode which induced Currie and Hortin to start work in the neighbourhood. It was the irony of fate that the lodes they found in the Ordovician – Silurian rocks proved so much more productive that in the later history of the Florence, McKay's lode was a minor factor in the background. It was from 1 to 6 feet wide.

(ix) Last Hope lode.– This lode was worked wholly on tribute. It was worked from a shaft on the flat at the 75 ft and 105 ft levels. Very little information is available but it is clear that the lode was only small — 6 inches to 2 feet of formation with however high grade galena in a 3 inch to 8 inch seam. The length driven on was 80 feet at the 75 ft level, but for the 105 ft level it is unknown.

(x) Flaherty's lode.— Described by Waller in 1904 as an important occurrence this lode has been driven on at the 150 feet level of the State mine for a length of 1350 feet. The orientation, of this somewhat unusual length among the Zeehan lodes, is 30°. This orientation is only slightly departed from except towards the north-eastern end. It therefore approaches the character of 'straight' but does not come within the same category as the No 1 Spray lode in this respect. Waller in referring to the southern portion of this lode indicates appreciable productivity. Gerald Thorn at the 1915 enquiry stated that this lode had been stoped for a length of 100 feet at the No 5 Shaft but that the values ceased at 23 feet above the 150 feet level. This was confirmed by T. H. Vincent. The north drive at the 150 ft level was unprofitable and the 360 feet driven at the 300 ft level was disappointing.

(xi) No 16 Lode.— This lode is marked on the State mine plan as No 1 but is Waller's No 16 lode cut in the early westerly directed adit. No 5 Argent Shaft was sunk on it. It was driven on at the 150 ft level for 60 feet north and 370 feet southwards. At the Adit level it was driven on for about 100 feet, but was not opened up at all

at the 300 ft level.

(xii) Fultons lode.— located 120 feet west of Flaherty's lode this lode is parallel thereto. It was productive at the surface, quite promising at the 150 ft level where it was driven on for 240 feet, but disappointing at the 300 ft level. It was driven on at the latter level for 100 feet as one of the final efforts of the State mine.

(xiii) No 5 Argent No 1 lode.— Driven on for only 80 feet at the 300 ft level but neither at the 150 ft or 1 adit levels, this lode is simply recorded with no indication of its value. Its strike is a few degrees east of north.

(xiv) No 5 Argent No 2 lode.— With a strike of 50 degrees west of north but with no further information about it this lode is recorded as cut in the east crosscut at the 150 ft level and driven on for about 80 feet.

(xv) No 5 Argent No 3 lode.— This is the lode which was the basis of No 3 Argent operations in the early days. No 3 Argent Shaft was sunk to a depth of 160 feet and the lode was driven on for 200 feet on it. This shaft became dry in 1916 and some ore was extracted by State Mine tributors, but it was only driven on for 50 feet at the 150 ft level and 40 feet at the 300 ft level. Its strike is 330° and it is nearly vertical. The ore is described by Waller as being second-class.

(xvi) No 5 Argent No 4 lode.— Surface workings on this lode are 200 feet in length. It was driven on for 200 feet at the 150 ft level but the east crosscut at the 300 ft level did not reach it. Its strike is 320° and it has been regarded as a good lode at the 150 ft level. It is possible that this is Kestle's lode as listed by Waller who names it as the most westerly of a group of west-of-north striking lodes and then mentions No 3 as the next lode westwards. But Kestle's shaft as plotted by Waller is 200 feet south-eastwards along the strike. The siderite on the dump of Kestle's shaft carries disseminations and veins of galena.

(xvii) Cockran's and Quinlevan's lodes.— These do not appear on any mine plans but are listed by Waller as being between Inglis' and Kestle's lodes. He says this of this group of lodes:—

"All of these lodes have been worked by tributors and between them have produced a large quantity of ore. The first four in this list (Brampton's, Lambert's, Astle's and Inglis') were all very payable lodes in the upper levels. In Astle's and Inglis' lodes the principal ore mined was kaolin and gossan, much of which was exceedingly rich"

We are thus left in the dark about Cockran's and Quinlevan's lodes. They would seem to have been productive in shallow workings but have not been reached in the deeper workings of either the No 5 or No 6 Argent.

(xviii) Mainwaring's lode.— Situated just east of No 6 Argent shaft this lode strikes 330°. It has been driven on at the 122 ft level for 360 feet. There is no more information about it except that Waller says Mainwaring took 16 tons of galena from surface workings.

(xix) Lambert's lode.— This lode was originally explored by a shaft sunk by Lambert to about 50 feet. It was driven on at the 122 ft level of No 6 Argent for 120 feet. There are no details but it is included in the group described by Waller as very productive. Strike is 340°

(xx) Astle's lode.— This lode was cut in the east crosscut at the 122 ft level No 6 Argent. Its strike is 340° and it was driven on in this direction for 80 feet.

(xxi) Inglis' Lode.— The adit a few feet south of No 6 Argent shaft was driven by Inglis to cut this lode. It was worked by Inglis at that level and it was cut and driven on at the 122 ft level for about 90 feet. Its strike is 10° and the dip is eastwards.

(xxii) No 1 Argent Nos 4 & 6 lodes.— This is one of a group of lodes within the confines of the old No 1 Argent. In 1893 Montgomery reported on this property as follows:—

"The Argent main shaft is 140 ft deep, and levels have been opened from it at 72 feet and 132 feet. There are five known lodes in the section, four running

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north-easterly and one north-westerly, but only two, known as Nos 4 and 6, are being worked from the main shaft as yet. Both of these lodes were looking very well at the time of my visit, being strong bodies 4 to 8 feet in width, with well-defined walls, and in both payable ground was being stoped out, much of the galena being very pure. The value of the galena in silver is very much the same as in the adjoining Mount Zeehan claim, rarely less than 65 ozs silver per ton.

An underlay shaft has been sunk on the north-westerly lode to the south-east from the main shaft, and shows it to be a strong vein carrying a good deal of ore. This (lode) should join or intersect Nos 4 and 6 lodes to the south of the main shaft, and may thus be worked from the latter."

In 1904 Waller gives the following information;–

"No 6 and No 4 were worked by the company from their No 1 Shaft. There are here three levels – at 72 feet, 132 feet and 190 feet respectively. No 4 lode contained one rich shoot of ore 75 feet long, which was good down to No 2 level but did not live down to No 3. The lode was driven on for a considerable distance without cutting anything further. No 6 is described as having been a really good lode, and still contains ore which will pay to take out." (5)

John Hornby, miner, giving evidence at the 1915 enquiry stated that Nos. 4 + 6 Lodes had been productively worked south of the shaft at the Nos 1 + 2 Levels, but not much had been done north of the shaft. He further stated that No 6 Lode had been cut at the No 3 Level but was poor where cut and work was not persisted in.

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(5) G A Waller 1904 p 73.

→ Details of what was encountered during development are contained in the 'No 1 Argent File' of extracts from weekly reports in the Z + D Herald of 1891–1896. On June 2nd 1893 the following summary appears:–

" This mine is looking very healthy right through, and the stopes present a good show of concentrating ore. In some parts of No 6 lode, the only lode from which ore is being broken, is up to 8 ft wide and carrying 40 per cent of ore. One place shows the formation 10 ft in width. All the ore going to the concentrators is coming from between the surface and No 1 level and from No 1 to No 2 levels. There is therefore no stoping being done below 130 ft level. The work done at the bottom level is showing very satisfactory results. A crosscut has been put in east for 28 ft and at 9 ft from shaft the footwall of lode was met with carrying 2 ft of ore which assays Pb 80%, Ag 83 ozs. ...... Besides the ore vein of 2 ft wide, several feet of formation carries small strings of galena which appear to be running across to the hanging wall. ..... The crude ore averages about one in six of concentrates which assay Pb 80%, Ag 80–90 ozs."

← Typical of weekly reports is the following, dated May 6th 1893;–

" North drive on 72 ft level — The stope in back of this level has been worked by 6 men, and produced 79 tons 19 cwt good seconds and 2 tons 8 cwt of firsts. Lode in north end of stope 20 in. wide carrying splendid ore, and in south end 7 ft 6 in wide carrying fair quality milling ore. ...... 132 ft level No 4 Lode — Work carried on as usual with six men producing 92 tons 19 cwt of good milling ore. For the month's work the lode has averaged 6 ft wide, producing 248 tons high grade second class ore."

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S A Waller 1904 p

(xxiii) Currie's lode. — There is no record of the surface manifestation of this lode. Currie worked it from a shaft and it was subsequently worked from the Main Shaft (Florence) at the 128 ft and 200 ft levels. The present state of the surface indicates that the outcrop was not at all prominent or important.

There is no plan available of Currie's workings but occasional references in the Z + D Herald indicate that between the surface and 100 feet he had 3 levels, No 3 Level being at 100 ft. It would appear that his levels were at 30 ft, 70 ft and 100 ft. When the water burst occurred at the 128 ft level in 1903, it was thought that it came from Currie's

workings 28 feet above. But this was found not to be so as all Cudries workings were intact.

Waller in 1904 refers to Currie's lode as having been a productive one. Since then it has been worked at the 128 ft and 200 ft levels. From the plans of those levels it can be seen that the strike is meridional and the dip eastwards at a high angle. The width is not indicated specifically but may be taken as from 3 - 5 ft. Except in the southerly portion the lode is shown by the workings to be free from marked 'wobbles' or deviations. The southern end, however, shows a marked swing to the westwards and assumes a strike of 230°. This is emphasised by Waller but without any indication of the structural control responsible for it. As previously pointed out, Waller's attempt to correlate this lead with Moyle's lode was astray because of his assumption of an incorrect strike for the latter lode. The proved length of Currie's lode is 300 feet.

(xx iv) Astle's Lode. — This lode was unexpectedly encountered in crosscutting from the Florence Main Shaft at the 200 ft level to cut Currie's lode. It was first met at 30 feet east of the shaft as a 10 inch vein of siderite splashed with galena. This widened out, and continued driving on it proved a continuous lode until Currie's lode was cut. It was subsequently opened up at the 128 ft level and, as it was going strongly underfoot at the 200 ft level, at the 238 ft level by a winze equipped with a Tangye pump. The W D Herald of 12th April 1906 gives this description:-

> "Astle's lode is striking north-west and dips to the north-east. It was first cut about 50 ft from the shaft at the No 2 (200 ft) level. A shoot of ore was stoped out above this level for a distance of 200 ft in length by 35 feet in height. More recently a winze has been sunk on this lode to a depth of 38 feet below the No 2 level. The lode has been driven on at the winze level for a distance of 150 feet up to

the present time, and almost throughout the whole length driven and stoped shows a fine body of carbonate of iron and galena ranging from 2 ft to 6 ft in width. There is still 30 ft to stope out in the north drive from the winze, the lode carrying excellent milling ore with some good veins of first-class throughout. In the third stope north from the winze there is at present a fine show of ore. The lode at this point is fully 6 ft wide, and on the hanging-wall there is a splendid make of clean galena, ranging from 12 to 18 in. wide, the remainder of the lode being good milling with veins of clean ore."

Although there is a later mention of an intention to continue the winze to a deeper level, there is no indication that this was done. Moreover, the mine plan of 1910 shows only one level below the 200 ft level.

It is interesting to note that when Astle's lode was first struck, the comment was made that no ore was expected in that locality until the downward extension of Hortin's lode was met. Actually it appears that the main part of Astle's lode is under Hortin's old workings, which it is significant to remember were in 'pug'.

When first encountered, the dip of Astle's lode was taken to be easterly, but the mine plan shows a relationship between the 200 ft & winze levels which indicates verticality below the 200 ft level.

(XXV) South lode. — Not much information is available concerning this lode. Work on it seems to have been confined to the 128 ft and 200 ft levels. There is no doubt that considerable work was done at both these levels, the drives along the lode measuring 300 feet and 400 feet respectively. The orientation shows a pronounced bend which is emphasised at the 200 ft level. This bend divides the lode into a 320° strike and a 350° strike. The north-westerly striking portion is practically vertical while the nearly meridional portion trends steeply eastwards.

(c) Lodes on the 'Contact'.

Emphasis was laid by Waller on the existence of the 'contact' between the older and younger rocks running along the western slope of the Florence Hill. He recognised that contact as being a major fault and drew the inference that it could constitute the 'mise-en-place' of ore deposition. He then picked on Moyle's lode[6] of the Florence as having this structural environment. He further indicated that No 3 lode of No 6 Argent was of similar structural character and went as far as suggesting that these two occurrences were part of a large 'mother lode'. However, this latter inference is bound up with his mapping (admittedly sketched) of the contact line as a nicely gently curved line from No 6 Argent - to the Florence. But we now know that this contact is a staggered one with pronounced almost right-angled zig-zags. Waller's inference as to the 'mother-lode' is ruled out, but there still remains the necessity to critically examine the 'contact' in relation to those lodes claimed by Waller to be on that 'contact'.

It must be pointed out at this stage that Waller is rather indefinite in his description of the actual position of both Moyle's and No 6 Argent's No 3 lode in relation to the contact plane. This is what he says:-

> "From the north-eastern portion of section 120 9M (No 5 Argent) the contact takes a course of 30° east of north through sections 192-87M and 193-87M (No 6 Argent), section 943M (Florence) and section 559 M (New Mount Zeehan). This contact is, I think, clearly a fault fissure. To the south-east of this line the strata are evenly bedded, striking from 35° to 40° west of north. As the contact is approached the strata bend round to the north, and at the contact a complete change of country takes place. To the east we have slates and sandstones, to the west melaphyre tuffs and interbedded slates. The faulting movement has had

(6) Waller calls this lode 'Flaherty's lode', but on the 1910 mine plans it is termed 'Moyle's lode'. In future the latter name will be used in order to avoid confusion with 'Flaherty's lode' of the State mine.

a lateral as well as a vertical component.... ....". We have then the strongest circumstantial evidence of the presence of a great fault fissure running along the eastern margin of the Argent flat. There are also good reasons for believing that this is also a lode-formation. In Flaherty's shaft [Marsh's shaft in mine plans] on Smith's Section a very large lode-formation was cut in the east crosscut. It was a loose open formation, and when first struck there was a burst of water, carrying with it quantities of slurry, broken slate, carbonate of iron, and slugs of galena. This formation was striking 30° east of north and is marked on the geological plan as Flaherty's lode. ..... This lode of Flaherty's looks to me to be very much like what we are looking for. It is in the right position, its strike is right, and it is just the kind of formation which we would expect to find. I think also that the great rough which was struck in the Florence workings, and which resulted in the loss of a man's life, was connected with the same fissure. ..... I think it is also possible that this same formation has been lately cut in the east crosscut from the No 6 shaft of the Argent Mine. I have not been able to inspect this lode but Mr Vincent describes it to me as a large loose formation containing a large quantity of water, and, what is of more interest from a commercial point of view, payable quantities of high-grade galena. This lode strikes 30° east of north and is almost directly in line with Flaherty's lode. It is just about where the contact is to be expected, and I have great hopes that it will turn out to be the main or 'mother' lode of this portion of the field." (7)

Correlation of Dr Price's mapping of the contact

(7) G A Waller "Report on Zeehan Silver-lead Mining Field" 1904 pp

and the position of the lodes as shown by the mine plans throws doubt on Waller's conception. Admittedly the adit workings on Moyle's lode show the latter to be acceptably coincident with one of the broken sections of the Waller Fault both along the strike and down the dip to the 200 ft level on the assumption of an easterly dip of the fault plane (which however is rather doubtful). But the No 3 lode at the No 6 Argent (which incidentally did not reach the surface) and the southern portion of the Florence (South lode) come well within the Ordovician–Silurian formation, being definitely east of the contact line as now delineated.

If, therefore, we accept the present structural interpretation as correct, there is only one lode definitely known to coincide with the actual contact plane. This is Moyle's lode and it is now due for description. However, incomplete data necessitate only partial description.

Moyle's lode has been worked at the Adit, 70 ft, 130 ft, 160 ft, 200 ft and 220 feet levels. The lengths at those respective levels were 130 feet, 200 feet and 220 feet. There is no precise information as to width. Waller refers to it as "a very large lode formation"; the Zeehan & Dundas Herald reports widths of 5 to 6 ft at the north end 128 ft level and 5 ft 6 inches at the south end 200 ft level but it is only for the 70 ft level that general averages are supplied by that authority. On 14th Jan 1908 it is stated:–

> "At this level [70 ft] the shoot of ore has been proved for a length of over 100 ft ranging from a few inches to 10 ft and 14 ft in width of practically solid ore, the average being from 3 ft to 4 ft."

M.M. Marks verbally refers to Moyle's lode as of undetermined width at the 200 ft level and explains that parts of it were regarded as 'bad ground' and were not mined.

In regard to the nature of this 'bad ground', significant light is thrown by repeated references in the Z & D Herald during 1908 to 'pug'. The extreme northern end of the lode at 128 ft level is described as consisting of 'pug carrying galena'. The following extracts indicate the prevalence of 'pug':–

> "The east crosscut from the north drive

(128ft level) has passed through a big pug formation, and it is now in hard carbonate of iron; considerable trouble has been experienced for some distance in this crosscut owing to the soft nature of the ground, which necessitated face boards being used" (8)

"Owing to the puggy nature of the country about the lode at Moyle's tribute, some difficulty was experienced in connecting between rise and the winze, and the output of ore from these workings has accordingly been considerably reduced during the last few weeks. The connection has not been established, and driving is being carried out south on the lode from the east crosscut 128ft level. The formation is mainly composed of pug at present, but is carrying a 4 to 5 inch vein of galena" (9)

There is no specific reference to pug at the 200 ft level. The report of the burst of water at the 200 ft level when the southern end of Moyle's lode was penetrated in August 1908 refers to a large volume of water which burst from behind the solid end of the crosscut and speculates as to whether it was from a vaught. When the Tasmanian Smelting Coy reopened the mine in 1909, the approach to Moyle's lode was via a deviated crosscut but no information is available as to the character of the lode or its environment.

Reference to pug to the north of the Moyle's lode, as delimited in the description so far presented, occurs on 14th January 1908 as follows:-

"Whelan and party are sinking on the extension of Flaherty's lode north of Moyle's tribute. Buttons of galena are at present being obtained in a pug formation which may yet lead to another shoot of good ore at a greater depth."

On the basis of Dr Prider's map the total length could be 425 feet.

(8) Z & D Herald 14th Jan 1908

(9) Z & D Herald 14th March 1908

Moyle's Lode has been markedly productive. On 14th January 1908 the Z + D Herald has this to say:—

"At Moyle's tribute a splendid output has been maintained during the last four or five months, ranging from 400 tons to 600 tons of firsts and seconds per month, worth an average of from £7 to £9 per ton".

(d) Lodes in Sandstones and Shales.

Since Waller's investigations, the penetration of the mine workings has been extended eastwards into the Ordovician – Silurian strata. Wherever this has happened additional lodes have been found. For example there is the lode east of Moyle's mentioned in the Z + D Herald 9th December 1907:—

"At Horton and Mahoney's tribute south and adjoining Moyle's tribute a nice improvement occurred on Saturday. A crosscut east from Flaherty's shaft has been extended for a distance of 95 ft, and cut a large lode formation, consisting of carbonate of iron and galena, and the hanging wall of which has not yet been reached. The ore has, however, considerably improved in quality during the last two shifts, and on Saturday carried a large percentage of clean galena. The lode is east of and parallel to Flaherty's."

It must be noted, however, that the mine plan of 1910 does not show this extended crosscut, although there is an east crosscut at the 128 ft level from towards the southern end of Moyle's lode workings at that level. A south drive from the eastern end of that crosscut is suggestive of a parallel lode on which a little work has been done. There is certainly no outcrop of such a lode at the surface. This, however, is in conformity with the conditions at the No 6 Argent where the No 3 Lode was encountered at the 122 ft level with — as

The orientation of Moyle's Lode is north-south. It is essentially 'straight'. The dip down to the 200 ft level is 60° eastwards. It was regarded during the period 1907-1910 as the most productive and significant lode of the Teetan Field.

It is advisable to mention at this juncture that apparently Currie's Lode touches the Waller Fault where the vugh was encountered. It is just southwards of this that Currie's Lode starts to bend westwards as it approaches the Florence Tear Fault.

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emphasised by Waller – no surface outcrop. This 'no outcrop' characteristic of some lodes in the Ordovician–Silurian environment is ~~drawn~~ further illustrated ~~attention to~~ in the workings at the No 4 (170 ft) level of No 6 Argent where a short east crosscut from No 3 lode encountered a new lode (No 4) unknown on the levels above and certainly not seen on the surface.

It is pertinent at this juncture to draw attention to the number of adits driven into the Florence Hill from the Argent Flat level or slightly above it. Quite a number of these did not disclose ore, but in view of the occurrences just mentioned, it cannot be accepted that the testing of the Ordovician–Silurian belt adjacent to the 'contact' has been adequate. This will be further dealt with when discussing future possibilities towards the end of this report.

Before proceeding to deal seriatim with the lodes located inside the Ordovician–Silurian it must be pointed out that correlation between Dr Prider's map and the plan of the Florence shows Curries, Astles and South lodes as in the Ordovician–Silurian, but by taking cognisance of Waller's statements and the nature of the mullock dump, they must be in the keratophyre tuffs except the southern half of South lode.

shifts, and on Saturday carried a large percentage of clean galena. The lode is east of and parallel to Flaherty's."

It must be noted, however, that the mine plan of 1910 does not show this extended crosscut, although there is an east crosscut at the 125 ft level from towards the southern end of Moyles lode workings at that level. A south drive from the eastern end of that crosscut is suggestive of a parallel lode on which a little work has been done. There is certainly no outcrop of such a lode at the surface. This, however, is in conformity with the conditions at the No 6 Argent where the No 3 lode was encountered at the 122 ft level with — as

(i) Florence South lode. It is only the southern portion of this lode which is here included. The actual portion is that which has a meridional strike, i.e. south of the Florence Tea Fault. Information as to width is meagre. The Z+D Herald of 7th August 1907 states:-

> "Green & party are continuing operations on the south lode from the No 2 level [128 ft], where there is a strong carbonate of iron formation, about 4 ft wide carrying bunches of galena, which is being hand-picked in the stopes."

It must suffice to add that at the 200 ft level the South lode was being driven on southwards when the final water-burst occurred, as the face on the 1910 plan is dated 18/10/10. It will be remembered that the final flooding occurred 10/11/10.

There remains to mention that Quigleys workings to the south at a depth of 75 feet explored east and west for southern continuations of lodes in the main workings. On 11th July 1908 the Z+D Herald reports:-

> "Quigley and party, after about 10 months work, have struck ore in their workings, which are situated on the hillside some 408 feet south of the main shaft. A winze is now being sunk on the lode, which is about 12 inches wide, carrying good bunches of galena. This development is probably on the southern extension of the south lode."

The particular significance attachable to this is that on locating ore at 75 feet below the surface they sank on it rather than rose on it. This could be indicative of the existence of another lode which does not reach the surface.

(ii) No 6 Argent No 3 lode. — Here is a lode about which we have some specific data. This is due to the fact that in 1924 a Zeehan syndicate which had been working the No 6 Argent mine asked for Government assistance. The Mines Department sent W.R Williams, Inspector of Mines, at Queenstown, to sample and report. His assay plan and report are available. Before presenting the information contained therein it is as well to mention that on that report financial aid was refused.

Sampling at the 170 ft level was apparently on the floor of the drive. The results are thus summarised:-

Distance from Crosscut	Width Sampled	Assay	
		Pb %	Ag. ozs
25' north	4'6"	8.6	12.1
50' north	5'5"	12.1	15.4
80' north	6'0"	19.0	12.4
115' north	6'0"	21.0	26.8
15' south	0'6"	25.4	38.4
25' south	1'2"	27.5	4.5
25' south	1'6"	24.1	62.2
37' south	2'9"	37.3	78.0
53' south	4'7"	26.2	34.1
72' south	0'6"	61.4	60.0
72' south	0'8"	19.1	20.0
102' south	2'0"	21.8	48.0

The total length driven on this lode at the 170 ft level is 300 feet. At the 122 ft level the length is the same but the north drive goes further to the north and the south drive less to the south. And we know quite definitely that the values are continuing underfoot. But what we do not know are the width and values at the 122 ft level. Waller in 1904 describes it at this level as "containing payable quantities of high-grade galena in a large loose formation".

The strike is 30° and the dip undulatory vertical. As previously pointed out, this lode has no surface outcrop. It was found by exploratory easterly crosscutting at the 122 ft level by the Mount Zeehan (Tasmania) Spray Coy. It has supplied by far the greater part of the total output from No 6 Argent.

(iii) No 6 Argent No 4 Lode:- A short exploratory easterly cross cut at the 170 ft level during 1923 disclosed the No 4 lode which was and is still unknown at any higher level. It is parallel to No 3 Lode. W.R. Williams in January 1924 reported as follows:-

"This lode was driven on 80 feet northerly

and 53 feet southerly from the south crosscut and is reported to have varied up to 5 feet in width with an inclusive width of up to 2 feet of ore.

Three samples of drill ore from this lode assayed 33-35% Pb, 26-29 ozs Ag. Seven parcels of ore, together with a small quantity from No 3 lode approximated 44.2% Pb and 38 ozs Ag.

The south end of drive and a short rise therefrom were discontinued in channel filling carrying a seam of galena about 2 inches in width. In end of north drive the lode channel was interrupted. In an easterly crosscut therefrom a seam of antical galena occurs about 3 inches in width. A sample said to have been taken from this seam assayed 78·8% Pb and 73 ozs Ag."

(iv) Worry-me-to-death lode. — At 275 feet south-east of the East Hope shaft is a shaft put down by Brampton about 30 years ago. It is within the Ordovician-Silurian belt. There is no doubt that a lode was encountered and driven on at a depth of about 70 feet. No details are available but the lode material on the dump shows a similarity to that of Moyle's lode and No 3 lode of the No 6 Argent. Its location could permit it to be the northern continuation of the latter lode.

(6) The Ore.

(a) Constituent Minerals.

Galena is the economic component. The oxidised zone was never of great significance and is certainly not at this stage. Sphalerite must be recorded as present, but is a decidedly subordinate part of the economic picture. All that can be said in regard to pyrite is that it can be found when looked for. Chalcopyrite is a rare curiosity.

The Ag:Pb ratio is high and variable. It is given by Waller as 1 to 1·5. This is confirmed by the assays

reported since Waller wrote, whether the ore is from the Florence, the No 6 Argent, New Mount Lechan or No 5 Argent. There is no reference anywhere to tetrahedrite or jamesonite and no visible occurrence in any specimens examined recently. But no mineragraphic study has been made. It is quite possible and in fact most probable that tetrahedrite is intimately associated with the galena. The ore as milled shows the relative loss of silver which characterised all Lechan milling — sliming of the tetrahedrite and perhaps also argentite.

The dominant gangue is siderite which takes the form of the manganese-carrying variety mangano-siderite. It invariably weathers black. The galena is intimately associated with this mangano-siderite. Except in the case of the State Mine, mangano-siderite in the dumps shows seams or disseminations of galena in a majority of the lumps.

Quartz becomes an appreciable component only in the lodes associated with the Ordovician-Silurian, but apparently does not even here constitute the dominant gangue.

Any consideration of the constituent minerals of the lodes must include a mention at least of 'pug'. Veins and disseminations in pug are frequently mentioned in the old reports. Such pug functions as the gangue. What is the pug? Is it the replica of the Rotunda and Austral occurrences? Does it represent detached masses and slices of the 1000 ft limestone formation associated with the fault drag?

(b) The Concentrations.

The relative success of the old mining units is a measure of the frequency and abundance of the occurrences of solid galena. An essential prerequisite for successful mining enterprises in old Lechan was the availability of seams, bands or bunches of galena which could be selectively mined or hand-picked as an immediately saleable product. This is well illustrated by mines within the ambit of this report. For example the New Mount

Zeehan mine produced only 70 tons of hand-picked galena while it milled 4800 tons of 'milling ore' and was a financial failure; the Florence mine up to August 1904 had produced 6,000 tons of hand-picked galena and 4,500 tons of 'milling ore' with satisfactory financial results. It is significant in this connection that the Mount Zeehan mill started in 1892, while the Florence mine, operated by tributors, thrived without one until August 1904.

It can be stated in general that galena concentrations within the lodes as far explored are small and infrequent in the Mount Zeehan and No 5 Argent (State) mines, but are appreciable and frequent in the Florence and No 6 Argent. In the old reports there are frequent references to 10 inches to 20 inches of solid galena in the lodes of the latter mines. On 29th November 1907 the Z. & D. Herald reports on Moyle's lode at the 70 ft level:-

> "It ranges in width from 18 inches to 4 feet and 5 feet of practically solid ore."

The only lode of which we have an assay plan — the No 3 lode of No 6 Argent — shows no major concentration. At 72 feet in the south drive 170 ft level a seam of galena 6 inches wide assays 61·47% Pb and 60 ozs Ag. It was apparently because the concentration is of this very minor order of magnitude that Government assistance was refused in 1924. By contrast is the reference to the character of the Florence lode in Z. & D. Herald 24th January 1904:-

> "Between these lodes the mill should have fair work to do. It might have more to do if the ore now being driven on and stoped from the winze level below the 900 ft level did not carry so much first."

(6) Mine Workings.

(a) New Mount Zeehan.

The underground workings of this early Zeehan mine had reached their existing extent by 1899. In

actual feet the main shaft had been sunk and the greater part of the driving and crosscutting at the 124 ft level accomplished by 1892. The mine has been full of water for 50 years.

(i) Shafts.— The Main Shaft is reported to in all old references as 124 ft deep, the well being 8 ft making the total 132 feet.
The timber of the collar is gone but the excavation stands so that picking up presents no insuperable difficulties.

Another shaft down to the 124 ft level is the Air Shaft. This is 250 feet west of the Main Shaft. It was sunk as an incline shaft on No 2 lode W. down to the 124 ft level which it contacts in the north drive a few feet north of the west crosscut. Its surface identity has been lost, but a 'pothole' plotted by Dr Prider seems to indicate it.

At the extreme western limit of the workings is an incline shaft down to the 124 ft level on No 5 lode W. This has completely lost its identity at the surface.

There are a number of other shafts shown on the 1900 mine plan but none of these reach the 124 ft level. They are shallow prospect shafts and are of no more importance than the 'potholes' of later date which dot the surface of the Argent Flat.

There remain of course the No 2 and No 3 Shafts. But these are outside the area embraced in this report and have been dealt with in the report on the 'Rotunda' area. Neither of them reaches the 124 ft level although No 2 only needed a rise of 50 ft from that level to connect.

(ii) Crosscuts.— There are two crosscuts — Main Crosscut and North Crosscut. The former is east and west from the Main Shaft; the latter is eastwards from towards the northern end of the north drive on No 2 lode W. The Main Crosscut has a total length of 1100 feet; the North Crosscut 650 feet.

(iii) Drives.— The outstanding achievement on these lines is the drive on No 2 lode W at the 124 ft level. Its length is 1050 feet. At the 60 ft level the drive along the same lode is 630 feet.

The drive on No 1 lode E at the 124 ft level is 420 feet in length. No 1 lode W. has been driven on north of the crosscut a distance of 250 feet, while that on No 5 lode W is 150 feet South of the crosscut.

There are four other drives but they are only from 50 to 100 feet in length. But at adit level a drive under the Florence Hill is 200 feet in length.

Four adits have been driven eastwards into the Florence Hill within the confines of the Mount Zeehan old leases. They are only partially accessible. Twelvetrees in 1900 described two of them as follows:— (10)

"No 2 Tunnel was 123 feet in, and the end 70 or 80 feet from the surface. A wide formation of black pyritic pug had been met with but no galena, except a little near the entrance, and 18 inches of ore which came up in the sole. In the end is a white lumpy crystalline sandstone. There is every sign of the pug being the upper part of a lode"

"No 1 tunnel near Smith's section is 200 feet from the boundary, and passes through the same black pug formation as in No 2. A lode 2 feet wide has been cut in it..... The black pug probably represents Currie's lode in Smith's section. The length of the tunnel is 206 feet and the end is 180 feet below surface."

(b) Florence.

The mine workings of the Florence are in marked contrast from those of Mount Zeehan just described. They are bunched into a relatively small area — 750'x 750' as compared with 1250'x1250'. In addition there are 4 levels and adit level.

(i) Shafts.— The Main Shaft is 214 feet deep. Its dimensions are 13ft by 6 ft in the clear. There are levels at 128ft and 200 ft. The collar is standing and the water stands at 4 feet below the surface. A dilapidated cage is

(10) "Report on the Mineral Districts of Zeehan and Neighbourhood" 1900 p. 26.

spreadeagled at the collar. The collar is at same level as New Mount Flaherty's Shaft is located up the slope of Florence Hill 320 feet east of the Main Shaft. It is 100 feet deep. The collar is intact and the timber still standing. It is shown on the 1910 mine plan as Marsh's Shaft.

Currie's Shaft is 175 feet east-north-east of the Main Shaft. It is still identifiable and is shown on Dr Prider's map, but is now only a depression in the surface. It was an important shaft in the early history of Smith's Section. It was used as an auxilliary pumping compartment during the water crisis of July 1903. It was 6'x4' and apparently was about 80 feet deep.

McKay's Shaft preceded Currie's and was about the same depth, but has been completely obliterated by subsequent dumps. It was north-west of the Main Shaft.

Last Hope Shaft is located 570 feet south-west of the Main Shaft. It is 115 feet deep. It was plotted by Dr Prider but is only just recognisable as an old shaft. It was a small tributor's effort.

Quigley's Shaft is mentioned in the Z+D Herald in August 1907 as being sunk about 400 feet south of the Main Shaft on the hillside. In July 1908 it is stated that a lode had been cut in these workings. Dr Prider's map shows two shafts in this locality 80 ft and 60 ft deep respectively. No plan exists of the underground workings, but in view of the fact that the objective of the prospecting was to find the southern continuation of the Moyle's - South lode group, east-west crosscutting is sketched in the composite plan.

Worry-me-to-death Shaft is 275 feet east-south-east of Last Hope shaft. It was sunk by Brampton in the Ordovician - Silurian to a depth of about 60 feet. This shaft is open.

There are many other shallow shafts or potholes in the vicinity of the shafts thus specified. They are plotted on Dr Prider's map but are not of sufficient importance to deal with separately. The important shaft of course is the Main Shaft which is sunk in the Keratophyre Tuffs and Slates.

(ii) Crosscuts.— A glance at the Florence mine plan indicates a lack of anything approaching systematic attack in development. The mine 'grew like Topsy' and the complexity of the lode system inevitably shows itself in meandering workings. Waller in 1904, describing the exploration from the Main Shaft, refers to the crosscutting eastwards at the 200 ft level. He records encountering a short distance east of the shaft an unexpected lode (christened Astle's after the mine manager) and then goes on to say:-

"The crosscut was continued as a drive along Astle's lode to cut Currie's lode" (11)

There would seem, therefore, to be little point in listing crosscuts. With the availability of the mine plan showing Adit, 128 ft and 200 ft levels, it will suffice to indicate that at both the 128 ft & 200 ft levels irregular easterly crosscuts reach Astle's, Currie's, South, Moyle's, and East lodes and similar crosscuts westwards to McKay's Lode. Nevertheless it is appropriate to mention the arcuate crosscut at the 128 ft level which curves in a general north-easterly direction from the vicinity of Currie's Shaft. It is symbolic of the 'patchwork' effect of spasmodic mining under the tributing system.

(iii) Drives.— These may best be indicated by enumerating the lengths of the drives on each lode at each level.

Name of Lode	Length of Drive in feet 128 ft level	200 ft level	238 ft level
McKay's	325	250	
South	350	475	
Astles	225	300	150
Currie's	375	300	
Moyle's	250	225	
Thorne's	70		
Brampton's	60	25	
No 1		120	
No 6		100	
East	50		

(11) S.A. Waller 1904. p. 69.

It must be realised of course that between the 128 ft level and the surface is a maze of workings of which there is no complete plan. Some of them e.g. Hoskins workings are shown on the 1910 mine plan, but as they are all apparently worked out, it is unlikely that they will ever enter the economic picture, which is essentially one of depth development.

(c) No 6 Argent.

(i) Shafts.— The original shaft was sunk by the British Zeehan (Spray) Co. from the surface at the western foot of the Florence Hill. It is 13' x 5' and is 122 ft deep plus the well. The shaft is open with water standing 5 feet below the surface. The collar is 10 ft above Florence Shaft.

The Internal Shaft was sunk from the eastern end of the adit driven from opposite the collar of the external shaft at about 240 feet from the portal. It is 14' x 5' and is 170 feet plus a well below adit level. The longitudinal section accompanying Williams 1924 report shows this shaft continued upwards to the surface. Dr Prider's map shows a 'Rise' from the adit at 30 feet in. The mullock dump on the hillslope indicates that haulage was to the surface and not via the adit.

Kestle's Shaft is 500 feet south of the Main Shaft. It is of minor size and importance and represents a comparatively early phase of exploration. Its depth is about 70 ft.

(ii) Adits.— There are two adits in the vicinity of the Main Shafts. They are within 30 ft of each other and are parallel. The Main Adit has the Internal Shaft at the end of it. The other is Inglis' Adit and was in existence when Waller wrote in 1904, having been driven to cut Inglis' lode. Main Adit is 250 feet and Inglis' Adit 210 feet in length.

About 300 feet east of Kestle's shaft is an adit driven in a general easterly direction for 200 feet. It was clearly designed to search for any southerly continuation of No 3 + 4 lodes which, however, the main No 6 workings above did not extend up to this horizon.

There are several other adits, now inaccessible, driven into the Ordovician-Silurian.

(iii) Crosscuts.— The main crosscut is that driven eastwards from the Main Shaft at the 122 ft level for 300 feet. Apart from this there are only the two short eastern crosscuts at the 170 ft level. These are the Main Crosscut from Internal Shaft to No 3 lode and the South Crosscut from south drive on No 3 lode to No 4 lode, each 20 feet in length.

(iv) Drives.— At the 122 ft level, 30 feet east of the shaft a drive springs from the crosscut northwards and then north-eastwards for a distance of 210 feet. It cuts No 1 lode and Lambert's lode. Apart from this the drives are along lodes. They can be tabulated thus:—

Name of lode	Length of Drive in feet.			
	Adit level	70 ft level	122 ft level	170 ft level
Inglis'	80		105	
No 1			360	
Lambert's			180	
No 3			400	290
No 4				140
Kestle's		150?		

(d) No 5 Argent (State).

When Waller wrote in 1904, the No 5 Argent shaft was down to 85 ft. In 1909 the British Zeetan (Spray) Coy closed down the Spray and concentrated on No 5, which they sank to 150 feet. In 1914 the State Government took over the mine and carried out exploration at the 150 ft level, and sank the shaft to 300 feet with limited exploration at that level, as compared with the 150 ft level.

(i) Shafts.— The Main Shaft is 13' x 6' and is open with collar in good condition. (The collar is 50 ft above Flowers Shaft). There are two levels — 150 ft and 300 ft. Several other shafts are dotted over the area, but these are potholes. They are indicated on Dr Prider's map.

(ii) Adits.— An adit 560 feet in length was driven in the early days directed west-south-west. Its depth below the surface at its western end is about 50 feet, but its entrance has been entirely obscured. It disclosed a lode

at 500 feet which is indicated by Waller as No 16 lode. The No 5 Shaft was originally sunk to develop this lode. Dr Prider has mapped several other shallow adits, but these are of no significance.

(iii) Crosscuts.— The general picture of the State Mine workings is similar to that of the New Mount Zeehan. The area covered is 1500 ft by 1300 ft.

At the 150 ft level the West Crosscut is 800 feet and the East Crosscut also 800 feet. At the 300 ft level the West Crosscut is 440 feet and the East Crosscut 720 feet.

There are minor crosscuts at the 150 ft level from the north drive on Flaherty's lode — one of 120 feet to cut Fulton's lode and one of 120 feet to cut No 3 lode of No 1 Argent. There are also several short crosscuts along Flaherty's lode.

(iv) Drives.— The drive on Flaherty's lode at the 150 ft level is among the longest on any lode at Zeehan. Its relative unproductiveness must have some significance in the metallogenic picture. The drives are tabulated:—

Name of lode	Length of Drive in feet.		
	Adit level	150 ft level	300 ft level.
Flaherty's		1320	360
No 16	90	440	
Fulton's		240	110
No 1 Argent No 3		100	
No 5 Argent No 1			60
No 5 Argent No 2		60	
No 5 Argent No 3		50	30
No 5 Argent No 4		200	

(e) No 1 Argent.

This mine had been closed down for eight years when Waller wrote in 1904. It has not been opened since. During the operation of the State Mine the north drive along Flaherty's lode at the 150 ft level penetrated the old workings of No 1 Argent but got no further than that. Montgomery in 1893 reports the shaft as down to 132 ft. It was deepened to 190 ft.

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(i) Shafts. — Main Shaft to 200 feet with levels at 72 ft, 132 ft and 190 ft. The old Incline Shaft on the south east lode is now covered by the old Spray mill dump.

The collar is 10 feet above Florence Shaft. It has partly collapsed.

(ii) Crosscuts. — West crosscuts at the three levels about 150 feet.

(iii) Drives. — These can be tabulated thus :—

Name of lode	Length of Drive in feet. 72 ft level	132 ft level	190 ft level
No 4	500	500	250
No 6	300	300	20

Name of lode	A
Flaherty's	
No 16	
Fulton's	
No 1 Argent No 3	
No 5 Argent No 1	
No 5 Argent No 2	
No 5 Argent No 3	
No 5 Argent No 4	

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Water and Pumping.

Water and pumping have in the past been a bugbear to mining on the Argent Flat. In the case of the Florence this took the form of heavy sudden bursts, but in all the other workings the water was the normal sub-surface infiltration showing sympathetic variation with the rainfall. Over a number of years a drainage scheme for the Argent Flat was talked of as the basis for the revival of Zeehan. This was a four mile tunnel from McLean's Creek which would have been about 300 feet below the Argent Flat. It was contended that this would free a great number of bodies for profitable working.

But the weakness of that scheme lay in the fact that the Argent Flat is not a water-logged field. Unwatering of one part does not unwater the whole. Thus the unwatering of the Florence had no effect on the New Mount Zeehan and, rather surprisingly, very little and rather slow effect on No 6 Argent. Nevertheless pumping at No 5 Argent had no effect on either No 1 or No 2 Argent until in the former case connection was made by the north drive on Flaherty's lode.

The Z & D Herald of 25th July 1918 gives the "volumes of water pumped by the various mines in the winter season". It is further stated that "the volume given is the theoretical quantity delivered by the pump. In practice it was 10 to 20 per cent less."

No 5 Argent (State)	21,360 gals per hr
New Mount Zeehan	13,200 " " "
No 6 Argent	20,000 " " "
Florence (12)	90,000 " " "

It is the Florence which calls for special consideration. On 21st January 1908 the Z & D Herald refers to pumping:-

> "All work connected with the new 15 inch plunger was completed on Wednesday and a start was made pumping yesterday. A very great difference was noticeable in the volume of water raised from the shaft by the plunger

(12) This is the maximum; normal pumping gave 36,000 gals per hr.

In this connection Gerald Ahern in giving evidence before the 1922 Public Works Committee erglin made this statement reported in Z+D Herald April 5th 1922:-

"If the Florence mine were unwatered it would probably mean a difference of 7000 gals per hr to No6 Argent. This was proved by the fact that when they were pumping at No6 Argent the water was lowered 30 ft in the Florence; and furthermore when the Florence was pumping and the No6 was idle, the water in the latter was lowered 40 ft."

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working from 4 to 5 strokes per minute, compared with from 12 to 14 strokes previously required when running the drawlift".

On the 27th August 1908 the following occurs:-

"At 11 o'clock yesterday morning a heavy burst of water occurred at the Florence. . . . . An idea of the volume of water that entered the workings can be gathered from the fact that within an hour from the time the inrush occurred, 5000 feet of drives etc had been filled and the water was within 85 feet of the collar of the shaft, although the pump was throwing 42,000 gals per hour, while up to 5 o'clock last night it was still gaining at the rate of 6ft per hour."

And again on 31st August:-

"It has been decided to start baling with tanks to-day in addition to keeping the pumping plant in operation. The pump has been kept running at from 13 to 15 strokes per minute and is forcing from 40,000 to 42,000 gallons per hour to the surface. The level of the water is now at a point over 10 ft below where it rose to in the shaft after the big burst occurred".

On 5th September the position was:-

"Since Monday last the water has been gradually lowered in the main shaft of the Florence mine, and is now down close to the 128 ft level, where the greatest extent of drives crosscuts etc have been opened up about the various lodes. Both the pumping plant and the turbines are being kept going, raising from 50,000 to 60,000 gallons per hour

The position on 15th September is thus described:-

"Pumping is being continued at the main shaft,

but notwithstanding that close on 60,000 gallons of water are being raised per hour by the plunger and tanks, only a slight impression has been made on the volume during the last few days. The water was lowered last week to a point about 4 feet above the bottom of the 12 ft level, but owing to another burst it rose again to the back of the chamber"

Two days later, on 17th September they gave up:-

"Regret will be generally expressed that the Florence tribute party have been compelled to abandon pumping operations for the present, all work having been stopped yesterday afternoon at 4 o'clock. Every endeavour has been made since the burst of water occurred three weeks back to overcome the difficulty, but as the boiler power at the mine was not sufficient to cope with the requirements it was decided that no good could be attained by continuing further at present"

The Tasmanian Smelting Coy. started arrangements for reopening the Florence in March 1909. They installed 2 large boilers and added the pumping plant of the Austral Valley mine (capacity 13,200 gals per hr). How long it took them to unwater is obscure. It seems certain that the mine was still underwater during the period August – October 1909 or Twelvetrees and Ward who were at Zeehan during that period would surely have examined it and included it in their report, whereas actually the Florence is only casually mentioned. Yet it was being operated early in 1910. M.M. Marks in a recent personal communication describes with chagrin the continuous trouble with the pumps and maintains that if these had been in good order the water would not have beaten them.

On 16th November 1910 the T + D Herald states:-

"On Thursday last a further quantity of

water came in at the Florence mine, and notwithstanding that the pumps and buckets were throwing fully 80,000 gallons per hour, it gradually gained, till for the 24 hrs ending Monday morning the united efforts of the lift, Cameron pump, and buckets had been beaten to the extent of 15 feet. The general manager of the Tasmanian Smelting Coy (Mr H H Harris) who is at present in Hobart, was advised of the trouble, and he wired reply to draw the lifts etc"

On the 18th November appears the following:-

"An assay of the new shoot of ore met with in the Florence mine prior to the extra quantity of water beating the pumps assayed 100 ozs silver and 75 per cent lead. During the last day or so an effort has been made to hold the water with the tanks, but as this was found impossible the mine was virtually closed down yesterday."

The first burst came from a bough near Currie's lode at the 125 ft level. The second flooding came from the south end of Moyle's lode at the 200 ft level. The final water inrush was at the 200 ft level but there is no information as to just where it emerged but the following is an extract from T + D Herald of June 1910:-

"The recent heavy rains have caused such an increase in the inflow of water at this mine that for the last few days the boilers - fired with wet wood - have been unable to keep the bottom level clear. Yesterday, however, another tank was put on and to-day the manager intends putting down a big Cameron pump as a further auxiliary and with these additions it is considered that the water will be easily held. As soon as the inflow has eased sufficiently the 20 inch lift will be placed in position in

the shaft. Most of the water entering the mine is coming from an easterly direction, and it is believed to be percolating through in large quantities from the neighbourhood of Silly street. It might be possible to conduct the greater part of this storm water by drains to Pea Soup Creek, and thus relieve the Florence mine of much of its trouble".

The only really reliable conclusion to be drawn from all this is that the water comes either from the Ordovician–Silurian or the fault which separates these formations from the keratophyric tuffs and slates. The sudden bursts are suggestive of water-filled cavities and we know definitely that the 1903 flooding came from a rough measuring as stated by Walled "30 feet wide, 40 feet high and of unknown length". What is the origin of these roughs? Limestone?

(8) Discussion of Possibilities

In so far as past achievements may constitute a guide as to future possibilities, the position has to be faced that of the five old-time mining units embraced within the present 'Florence Hill' unit, two — New Mount Zeehan and No 5 Argent — were never successful. Two others — No 1 Argent and No 6 Argent — achieved limited success. Only one — Florence — can claim aggregate success. It so happens that the Florence has not even the deepest workings. But this has no real significance when it is realised that the depth penetration is trifling. Depths of 300, 200, 190, 170, 150 and 124 feet justify neither absolute nor comparative conclusions. Neither is there indicated by such restricted vertical penetration anything of the nature of consistent downward decrease of galena contents of the lodes. Thus although, as reported by Waller, No 1 Argent No 4 lode was rich at the 72 ft and 132 ft levels but poor at the 190 ft level, Astle's lode in the Florence was richest in the winze sub-level of 238 ft — the deepest point reached in this 'Florence Hill' unit other than the State Mine. In 1893 Montgomery, describing the Mount Zeehan No 2 lode W. at the 124 ft level, refers to 'ore in the foot of the drive rising up into it a foot or two, as if it has been just too shallow to strike new shoots of ore going downwards'. On the face of it such a description recalls the experience in the south drive on No 1 lode in the Spray 'A' adit level, but no downward testing has been done.

A comparison of production based on the yield of galena per vertical foot has a limited significance, but for what it is worth here it is:-

Mine	Galena per Vertical Foot
Florence	70 tons
No 6 Argent	33 tons
Mount Zeehan	16 tons
No 5 Argent	10 tons
No 1 Argent	10 tons

Even the Florence with its 70 tons suffers by comparison with the Spray with its 250 tons but taking £60 as the value

of galena it represents a gross value of £4200 per vertical foot.

Before proceeding to evaluate the future possibilities which emerge from the more modern correlation of geologic structure and metallogenesis, it is interesting and perhaps significant to indicate the viewpoints in 1915 of some of those who by that time had accumulated an acquaintance with Zeehan by many years residence and experience therein. The opinions expressed were elicited by a Parliamentary Public Works Committee enquiring as to the justification or otherwise of spending £3000 on the State Mine. The E + D Herald of 18th August 1915 reports the evidence of John Craze as follows:-

> "The Argent Flat did not appeal to him as being the proper place to prove the Zeehan field by deep sinking, seeing that the lodes had not made good values below 130 feet.
> .....
> In the junction of lodes with faults payable shoots of ore occur. The Western and Montana (especially the latter) is in the midst of a number of faults (perhaps twenty) and it is in the vicinity of these faults where the ore occurred — rarely any ore in the straight line of lode. It seemed that the No 5 shaft is outside the line of known faults. He was of the opinion that the proper place to deep sink was on the Montana mine.
> ..... There were none of these faults at No 5 nearer than 200 feet.

Alfred Thorne a miner with 25 years' experience at Zeehan:-

> "The most likely ground on the Argent Flat to yield payable ore was that from the Florence to No 6 Argent. He regarded that as the richest piece of ground on the field, and knew that it was included in the area which could be worked by the State."

Gerald Aherne manager of the State mine said:-

" Mr Hornby had advised cross cutting east from No 1 workings to intersect from five to six known lodes between the Shaft and the Florence. This had been part of witness' policy since starting operations, and he was only waiting to drain No 1 Argent to put this crosscut out. Regarding his opinion of the future resources of the State mine he would say that he knew practically every property on the West Coast of any note, and if he intended investing in any of these properties — outside of M'Tyell, Mr Farrell or Bischoff — assuming that the State was a private concern and not a Government one, he would sooner put money into the State property than any other he knew."

Joseph Henry Levings mining engineer with 30 years' experience said inter alia :-

" When the scheme of deep sinking was first mooted he gave considerable thought to it. ..... The draining of the Argent Flat would open up many lodes for tributors, even if the State did not work the lodes; therefore his conclusions were that the Argent Flat was the best place to carry on operations. He thought it would be a good policy to sink the No 5 Shaft another 150 feet."

Thomas Henry Vincent said :-

" Regarding No 6 Argent, his opinion was that the shoot of ore in No 3 lode in No 6 mine was the richest on the Argent Flat".

Pogga Giovanni Morri with 50 years' mining experience :-

" He did not think that the Argent Flat had had a fair test at depth. But if he had been on the field when the State Argent

Flat Scheme was under discussion, and his opinion had been asked for, he would have recommended the Government to sink the Montana shaft in preference to the present scheme."

The above extracts and the rest of the evidence given at that enquiry demonstrate the wide divergence of opinion regarding the behaviour of Zeehan lodes. It is a pity that the depth testing was not extended beyond 300 ft. In this year of grace 1949 the Argent Flat is as it was in 1916 except for some additional driving in the State Mine in 1917 and the opening up of No 6 Argent No 3 lode at the 170 ft level in 1923.

Consideration of future possibilities centering round structure in relation to the depth of the concealed limestone bed cannot completely ignore possible yields from the lodes which were the sole mineralisation at the 1905 episode. As an example, due cognisance must be taken of the existence at the 170 ft level on the No 6 Argent No 3 lode of 3 ft 6 inches average width over a length of 220 feet showing 20% Pb and 30 ozs Ag. This is the only lode of which we have specific information as to values. What of the 'unpayable' ore in No 2 lode W of Mount Zeehan mined in 1892 at 12·4% Pb and 13·4 ozs Ag? And what of the good milling ore reported by both Walker and Crane as left in No 6 lode of No 1 Argent? Neither should it be forgotten that Moyle's, Cuprites, Astle's + South lodes were carrying values underfoot at the bottom level of the Florence. And there is the shaft-dotted but unexplored area between Florence + No 1 Argent along the western extension of the Florence Tent fault.

But the whole range of such possibilities, productive as they may ultimately prove, are subordinate to the deposits that could conceivably occur in the concealed limestone beneath Florence Hill. The sum total of geological mapping and investigation to date is to fix quite definitely that there is limestone at some level or levels below the Florence Hill. But we are unable at present to determine the depth. If Professor Carey's photogeological interpretation is accepted as it stands, with the Drumlin formation constituting the northern portion of the Florence Hill

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except the north drive on No 2 lode W.. It is perhaps significant that at both levels the north drives have reached the same point, which coincides with the interpreted position of the Montana–Oonah Tear Fault. And at each level there is a turn of the drive along the tear fault. It is a reasonable assumption that some gold ore was found there at the upper level which justified pushing the 124 ft level that far north.

It is important too to remember that there are no workings reasonably adjacent to the Montana–Oonah Tear Fault northwards of the New Mount Jeckin workings. The lodes in this vicinity are referred to in a previous report on the 'Unworked Siderite Lodes' and are those often referred to as 'nine lodes crossing Main Street'. Recently one of them was exposed while reconstructing the bridge over the creek in Main Street and about 30 cwt of high-grade galena taken from it. Apparently therefore the old dictum that 'ore makes under the slide' is operating and it is just this locality that has not been explored.

Again, what happens to the lodes on the Argent Flat near the Florence Tear Fault between the Florence and No 1 Argent workings? They have never been explored underground. This was pointed out by Hornby in the 1915 enquiry.

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at the Florence and New Mount Zeehan we must visualise the limestone as getting progressively deeper from south to north, with of course the sudden appearance of it at the surface north of the Montana - Oonah Tear Fault.

But we cannot ignore Dr Prider's 75° N trending transverse faults. If we accept the most northerly of these as the south-western part of the Brickfields Fault and Nos 2, 3, 4 and 5 as sympathetic minor breaks, we must expect a progressive uplift of the blocks as we proceed northwards from the No 6 Argent. It is possible of course that such uplift only occurs northwards from the Florence, as discussed in the chapter on structure. Above all there are the occurrences of 'pug' in the adits northwards of the Florence and at the 130 ft level of the Florence workings. These and the Florence vughs suggest the proximity of limestone. The least that can be said, in view of such occurrences, is that the limestone must surely be at a shallower depth than that indicated by Professor Carey's mapping of untroken Drumlin formation.

We are compelled therefore to postpone any attempt at predicting the depth to limestone until more detailed stratigraphical study and extended mapping has been accomplished. But we are able to advance some distance towards confidence in expecting appreciable mineralisation within such limestone. It is surely significant that of all the mining operations so far carried out in the Florence Hill — Argent Flat, the most productive have been above where limestone undoubtedly occurs underneath, viz the Florence and No 6 Argent. And such significance assumes greater force when Professor Carey's recognition of the Tear Fault at the Florence is considered in relation to recorded occurrences of 'slides' in old mine workings of the Argent Flat.

It is certainly a fact that Waller in 1904 only records such 'slides' in the No 2 Argent in his descriptions of mine workings in the Argent Flat, but it must be realised that Waller did not see all of these e.g. No 1 Argent which was closed down in 1896. However, John Craze in 1915,

as quoted above, refers to the absence of faults in the Argent Flat as compared with the Montana. And Gwyne had been underground on all the mines. And on the 1910 mine plan of the Florence 'Slide No 2 + Slide No 3' are shown in pencil. Gwyne certainly says that there is no fault closer than 200 ft to the No 5 Argent, and he may have had the No 2 Argent's 'slides' in mind. In effect, therefore, it would appear that between the Montana-Donah Tear Fault on the north, and within 200 ft on No 5 Argent, there is only the Florence Tear Fault (and its heave in No 1 Argent). Dr Prider's 75° faults seem to assume the character of 'breaks' which on the present evidence do not appear to control ore deposition. The evident recurrence of slides towards the south end of the Argent Flat, taken in conjunction with the 'sympathetic break' conception of Dr Prider's faults, would lead to the suggestion that the offsets in the Waller Upthrust at No 6 Argent are tear faults and not "breaks". The buried limestone at No 6 Argent and southwards thus assumes importance. It is significant in this connection that the best part of Flaherty's lode was near its southern portion.

(9) Recommendations.

In considering the next steps to be taken in regard to this mining unit it must be realised not only that the geological problem is not yet completely solved but also that past mining development has been piecemeal and haphazard. Moreover, the Argent Flat has been the subject of widely divergent opinions since the very early days of Zeehan and it is unfortunate that the 1974 decision to locate State Mining at the No 5 Argent restricted the scope for reconciling such differences.

But at the present juncture we are in a more advantageous position in that the possible replacement deposits in the limestone below the western slopes of Florence Hill are the primary objective and we can regard the known siderite lodes either as a source of revenue pari passu with exploration or as future contributors

But in a weekly report of No 1 Argent in the Z & D Herald dated 6/5/1893 there is a reference to a 'heave'. Although this is an isolated statement it is at least suggestive of what at a later period in Zeehan history were termed 'slides'

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to production when the limestone replacements constitute the mainstay.

We must therefore select the western edge of the Argent Flat as the scene of exploratory operations and study. Incidentally, it is for this reason that the title of this report is 'Florence Hill' and not 'Argent Flat'. We must further face the issue that no matter how far we go or what degree of completeness we achieve in surface mapping we will not have the soundest basis for depth exploration without the detailed underground geology of the Florence. Unwatering of those workings is therefore called for. Admittedly this will be no light task in that it will demand a pumping plant of 100,000 gals per hr capacity or thereabouts. But in this connection there exists a compensating factor in the galena in trucks and chutes abandoned at the last flooding in November 1910. On 16th November 1910 the Z & D Herald states:—

> "At the No 3 level, rails, trucks, Cameron pumpette, had to be left behind, as also a quantity of ore already broken and stacked in other parts of the mine".

This is confirmed by four independant sources in communications by those who worked in the mine at the time, including M.M. Marks, manager and B. Hortin now retired at Devonport. The general indication is that the value of the ore thus left was £3000 at that time. This would be £18,000 now.

Apart altogether from those two factors it would be quite a feasible proposition to unwater the Florence for the sole purpose of sinking the shaft to work the downward continuation of Moylis, Currie's, Astles, South and McKays bodies. After all it has been unwatered twice after flooding. And once down to the horizon of 300 feet diamond-drilling becomes facilitated.

The procedure thus indicated is:—

(1) Continuation of the geological mapping southwards to the Balstrup Tear Fault and eastwards to

tie up with the South King – Smelters mapping.

(2) Special investigation of the palaeontological evidence as an aid to the recognition of key horizons as an additional factor to lithological character.

(3) Check examination of the Queen Hill to see whether the continuously curved quartzite bed has been idealised or whether actually it is anywhere offset by tear faults.

(4) Unwatering of Florence shaft, raising of available ore therefrom and detailed geological mapping of all underground exposures.

(5) After correlation and interpretation of the sum total evidence up to that stage, both:
(a) Diamond drilling underground,
(b) Driving westwards along the Florence Tear Fault

(6) Consideration at that stage of what portions of the Argent Flat to penetrate to, in addition of course to driving inevitably to No 6 Argent.

Perhaps the best fundamental principle to adopt would be to closely determine the tear faults and drive westwards on them. This seems to be definitely called for in the case of the Montana – Dorah Tear Fault which was apparently reached in the northern end of the drive on No 2 Lode W.