Nubeena Mine.

The workings of the Nubeena Mine are located on Nubeena Hill a little less than ¼-mile east-north-east from Grubb's Mine, and are reached by a branch line from the Grubb's tram.

According to Blissett (1962) the host rocks are "folded and disturbed shale, slate and pale grey saccharoidal quartzite which are part of the Oonah Quartzite and Slate".

Descriptions of the workings have been included in Montgomery (1893), Waller (1904) and Twelvetrees and Ward (1910). A total of five lodes were recognized, viz. No 1, Nubeena, Jaeger's, Barnett's, and Llewellin's, but Jaeger's Lode and No. 1 Lode were apparently of little importance. The Nubeena Lode was, according to Twelvetrees and Ward, small but high in silver content. The mineralization was reported to consist of clean galena assaying 78% lead and 95ozs. of silver per ton. Barnett's Lode was described by Twelvetrees and Ward as a pyritic galena lode, and the following assays were reported to be indicative of the average value of the ore sold.

	Pb(%)	Ag (ozs. per ton)
1.	59.00	38.00
2.	60.00	40.00
3.	61.50	42.85
4.	56.50	37.30

Llewellin's Lode was described by Waller as " a very large loose fissure-formation" with up to four feet of solid galena. The width of the lode apparently varied considerably. No assay figures are available for ore from Llewellin's lode.

Mineralized material is not abundant in the dumps around the workings of the Nubeena Mine, but the samples collected are generally in keeping with the descriptions of Waller(1904) and Twelvetrees and Ward (1910). The main metallic constituent of the samples is galena, which occurs in a gangue of siderite, quartz and shale. Small patches of pyrite are also visible in hand specimen, while boulangerite, bournonite, tetrahedrite, sphalerite, arsenopyrite, marcasite, pyrargyrite and gold were observed in polished sections.

The samples examined show a close resemblance to the galena-rich material from Grubb's Mine.

The galena contains abundant inclusions of boulangerite, which vary considerably in shape and size. The most common form is a blade-like shape ranging from 0.002mm. up to 0.05mm in length, but other shapes observed are round, ovate and irregular. The total size range of the boulangerite bodies is from 0.001mm., for the small round sections, up to 0.03mm. for the largest of the irregularly shaped bodies. Some of the elongate bodies show an alignment along crystallographic planes in the galena.

Bournonite occurs as occasional small (0.02mm.) round inclusions within the galena, but is more common as areas up to 1mm. in overall width (P.341). These areas occur within the massive galena and the bournonite is frequently, but not always, separated from the galena by a narrow (0.005mm to 0.01mm) rim of boulangerite which surrounds the bournonite. Inclusions of galena, boulangerite, and tetrahedrite are present within these bournonite areas.

Tetrahedrite also occurs as occasional inclusions within the galena, but the distribution is rather sporadic, These inclusions are more common in P.339 than in other sections, the maximum size observed being 0.3mm x 0.1mm. The majority of the tetrahedrite bodies are within the size range 0.02mm to 0.06mm., and the shape is generally irregular. Occasional composite boulangerite - tetrahedrite inclusions are also present within the galena. Pyrargyrite occurs in the galena as rare small inclusions (0.01mm to 0.035mm.), approximately ovate in shape (P.339, 340). Composite boulangerite - pyrargyrite inclusions within the galena were also noted.

Pyrite is disseminated throughout the gangue as fine idiomorphic and subidiomorphic crystals, but shows as variable distribution in the galena. Pyrite is common within the galena in P.338 and 341 but is not common in the other sections. In P.338 and 341 the pyrite forms patches up to several millimetres in overall width, and shows evidence of partial replacement by galena. Pyrite occurs in P.339 and 340 as only small inclusions in the galena and has apparently been extensively replaced by the galena.

Arsenopyrite forms clusters of small idiomorphic crystals, 0.02mm. to 0.05mm, within the galena and the quartz. Marcasite is not common but occasional inclusions up to 0.01mm. were noted within galena in P.338 and 340. Both the arsenopyrite and the marcasite appear to have undergone partial replacement by the galena.

Sphalerite is present in these samples as only a minor constituent, and occurs as small inclusions within, and apparently extensively replaced by, galena. Some of these sphalerite bodies contain minute exsolution blebs of chalcopyrite, and a noticeable feature of these is the zonal relationship with respect to the shape of the sphalerite body. These sphalerite bodies within the galena are often roughly ovate and rarely have a maximum dimension greater than 0.1mm.

Rare fine (0.01mm) particles of gold were noted within the siliceous gangue, the shape being irregular (P.338,340).

Assemblages of ore minerals.

Common:	Boulangerite - galena Galena - pyrite Bournonite - galena
Infrequent:	Arsenopyrite - boulangerite - galena Arsenopyrite - galena Boulangerite - bournonite Boulangerite - bournonite - galena Boulangerite - galena - tetrahedrite Boulangerite - pyrite Bournonite - pyrite Bournonite - tetrahedrite Chalcopyrite - sphalerite Galena - marcasite Galena - sphalerite Galena - sphalerite - tetrahedrite Galena - tetrahedrite Pyrite - sphalerite
Rare:	Boulangerite - galena - pyrargyrite Galena - pyrargyrite.

South Nubeena Prospect.

The workings known as the South Nubeena Prospect are situated approximately ¼-mile south of the Nubeena Mine workings.

A siderite-quartz lode, thought to be a continuation of Llewellin's Lode, was discovered in workings known as Butler's Tunnel (Waller, 1904; Twelvetrees and Ward, 1910). The lode contained a seam of galena from one to two inches in thickness, according to Waller, and assays of the galena gave values of 70% lead and 100ozs. silver per ton.

No mineralized material is now present in the dumps near the workings.

Colonel North Mines.

The area between the Spray Mine and the Nubeena Mine includes numerous small workings which were on leases held, at various times, by the Colonel North Mines and Railway Co. N.L., and are normally referred to as the Colonel North Mines. These workings include the Colonel North shaft, the Victoria - Zeehan shaft, the Silver Foam adit, the Silver Beach adit, and the Silver Wave workings. The Grubb's Mine, further south was also operated by this Company, and was referred to in some reports as the Colonel North Mine.

Blissett (1962) has described the country rocks in the Colonel North area as "folded and disturbed shale, slate and pale quartzite or sandstone whichare part of the Oonah Quartzite and Slate".

The mineralogy of the ore found in the various workings appears to have been essentially uniform. Descriptions by Twelvetrees and Ward (1910) indicate that galena was the main metallic mineral, with small amounts of pyrite, sphalerite and an antimony-bearing mineral (probably boulangerite) in a gangue of quartz and siderite. The mineralization was patchy and of low grade overall.

The Chloride Lode in the north-east part of the Colonel North area was described by Twelvetrees and Ward as carrying bands and nodules of hematite and mamillary limonite, the nodules containing silver chloride and native silver. Some high grade patches assayed as high as 1,000 ozs. silver per ton, but the average silver content of the material extracted was 40 ozs. silver per ton.

Dumps in the vicinity of the various workings have been examined for samples of ore but most contain only traces of galena in shale, quartz and siderite. The only useful material for mineralogical examination was found in the dumps of some small workings in what Twelvetrees and Ward (1910, p.118) described as the "Tramway Formation". These workings are in the southern part of the Colonel North area and are situated close to the Grubb's tram. Twelvetrees and Ward stated that the vein of ore was about 18 inches in width, and that sphalerite was dominant mineral with galena occurring only in spots. This description is in accordance with the samples collected. In addition to sphalerite and galena, minor amounts of boulangerite, tetrahedrite, bournonite, pyrite and chalcopyrite were observed in polished sections of the specimens.

The galena "spots" (P. 342, 343) are patches of galena, from 1mm. up to 2.5cm in overall width, in massive white quartz. Some specimens of quartz are the "hacked" or "chopped" form referred to by Petterd (1910, p.149) from the north-east of Tasmania. Petterd attributed the sharp angular impressions in the quartz to feldspar crystals but it appears likely that the impressions in this material from the Colonel North area have been caused by a crystalline carbonate, probably siderite, which has since been leached out.

The galena is rich in inclusions of boulangerite, and inclusions of tetrahedrite and bournonite are also common. The boulangerite occurs as fine needle-like bodies ranging in length from 0.002mm up to 0.08mm. These show an even distribution through most of the galena but are occasionally concentrated into small patches (up to 0.3mm in width) consisting of clusters of these fine needles. Tetrahedrite is less evenly distributed and occurs as irregularly shaped bodies ranging in overall width from 0.01mm to 0.075mm. These tetrahedrite bodies always occur in the galena but are frequently observed on the borders of sphalerite inclusions in the galena. Bournonite is present in the galena as very fine bodies, common and evenly distributed in P.342 but less common in P.343. These bodies are generally rod-like or round in shape, although it is quite likely that many of the round bodies are merely cross-sections of rod-like bodies. The lengths of the "rods" vary from 0.002mm to 0.015mm., and the diameters of the round bodies range from 0.001mm to 0.005mm. In P.342 some of the bournonite inclusions show alignment in crystallographic directions in the galena.

Pyrite is not common in the coarse galena, where it occurs only as very small (o.01mm) idiomorphic crystals which appear to have been extensively replaced by the galena. Pyrite is a little more common in the sphalerite-rich ore, where it occurs in the massive sphalerite as idiomorphic crystals (0.01mm to 0.05mm) apparently partially replaced by the sphalerite.

Sphalerite occurs in the coarse galena as small areas which appear to have been extensively replaced. The size of these inclusions rarely exceeds 0.1mm. The specimens of massive sphalerite (P.344-346) consist almost entirely of sphalerite with small amounts of quartz gangue. The sphalerite is moderately dark in hand specimen.

Minor amounts of galena occur throughout the sphalerite as small irregularly shaped patches, rarely greater than 0.25mm in overall width. This galena appears to represent incipient replacement of the sphalerite.

Chalcopyrite is also present in some areas of the sphalerite as extremely minute blebs, most of which are less than 0.0005mm. in size and show random orientation. Some minute blebs in these areas may be pyrrhotite but the fine nature prevents precise identification.

<u>Assemblages of ore minerals.</u>

Common:	Boulangerite - galena Galena - sphalerite Galena - tetrahedrite Bournonite - galena Pyrite - sphalerite.
Infrequent:	Boulangerite - bournonite - galena Boulangerite - galena - sphalerite Boulangerite - galena - tetrahedrite Chalcopyrite - sphalerite Galena - pyrite Galena - pyrite - sphalerite Galena - sphalerite - tetrahedrite
Rare:	Bournonite - galena - sphalerite Galena - pyrite - sphalerite - tetrahedrite

Spray Mine.

The main workings of the Spray Mine are located on the northern slopes of Spray Hill, south of Manganese Hill and on the southern side of the Comstock tram formation.

The host rocks of the ore-bodies are quartzites and slates of the Oonah Quartzite and Slate (Blissett, 1962). According to Waller (1904) the Main Lode continued north and entered rocks which Blissett (1962) considers to be probably part of the Cambrian Crimson Creek Formation. Waller observed that the lode was productive only in the Precambrian quartzite and slate, as the workings in the Cambrian rocks were shallow and the ore completely oxidized.

Detailed descriptions of the workings were given by Waller (1904) and Twelvetrees and Ward (1910). A total of four ore-bodies were reported, all of which were parallel, striking NNW and steeply dipping. The most important lodes were No. 1 (Main) and No. 3 (Gurnie's); Nos. 2 and 4 were of little economic importance. Waller described the lodes as "well defined fissure formations".

The ore was reported to consist of galena and a lead-antimony sulphide (referred to as jamesonite), with pyrite in a gangue of siderite and quartz. According to Waller, one of the richest ore shoots discovered in the Zeehan district occurred in the Main Lode, in Page and McDermott's workings. The ore in this shoot reached a maximum width of 16 feet, and the length of the shoot was reported to be 400 feet. Waller estimated approximately two-thirds of the ore to be galena.

Reports indicate that the silver content of the ore varied considerably throughout the mine, but it would appear, from the available figures that the average silver content of the ore was of the order of 100 ozs. per ton. Twelvetrees and Ward noted a correlation between high silver and antimony contents in the ore, and Twelvetrees (1901a) reported that some rich antimonial-lead ore assayed over 2,000 ozs. of silver per ton. Waller (op. cit.) stated that the antimony content of the ore was higher in upper levels, and that pyrite increased in abundance at lower levels.

The presence of small quantities of argentite associated with siderite was reported by Petterd (1910), and a specimen (X.235/P.52) in the Tasmanian Museum collection confirms this report. This specimen, which was originally in the W. F. Petterd collection, contains patches of argentite, up to 3cm. x 2cm., occurring as thin films on siderite. Traces of galena, covellite and pyrite within the argentite were noted in polished section.

Petterd (op. cit. p. 9) also recorded the presence of native antimony, as "thin radiating patches, about an inch in diameter, implanted on a siliceous matrix". This identification may be unreliable as a specimen from Petterd's collection (now specimen no. X47 in the Tasmanian Museum Collection), labelled as "Native Antimony, Zeehan" has been identified as stibnite. In the absence of any reports of native antimony from other localities in the Zeehan area, it is likely that this specimen is from the Spray Mine.

Petterd (op.cit) also listed small amounts of the secondary minerals kermesite and stibiconite in the Spray workings.

The gossan outcrop of Gurnie's Lode at the top of the Spray Hill was reported by Twelvetrees and Ward (1910) to be rich in native silver and silver chloride.

Specimens of ore in the Tasmanian Museum collection and material collected from the surface dumps near the workings were found to contain boulangerite, galena, pyrite and sphalerite as the major metallic constituents in a gangue of siderite and quartz. Minor constituents identified in polished sections were arsenopyrite, tetrahedrite, bournonite, chalcopyrite and pyrrhotite. The proportions of the various constituents show a considerable variation between specimens.

Stillwell (1947) described some specimens from the Spray Mine and there is good agreement between Stillwell's descriptions and the specimens examined in this investigation. All of the minerals and features described by Stillwell have been observed and some additional minerals (bournonite and pyrrhotite) have been noted. Sphalerite is considerably more abundant in some of these specimens than in those described by Stillwell.

Boulangerite, which is the most abundant ore mineral in the suite of specimens examined, represents the mineral referred to as jamesonite in many earlier accounts of the geology of the Zeehan area. The properties and identification of the boulangerite are described elsewhere (p.194). Some specimens of ore (eg. P.202) consist essentially of massive boulangerite with minor amounts of tetrahedrite, galena, bournonite, pyrite and arsenopyrite present as inclusions within the boulangerite. Tetrahedrite is a common associate of the boulangerite in these specimens, and in one sample (P.50) constitutes approximately 10% of the ore. The size of the individual areas of tetrahedrite within the boulangerite range from very fine up to 0.25mm., and the textural relationship suggests that tetrahedrite has undergone partial replacement by boulangerite. The frequency of the assemblage boulangerite-tetrahedrite is in keeping with the observation of Twelvetrees and Ward (1910) that high silver values were often related to high antimony content in ore from the Spray Mine.

Boulangerite also occurs throughout much of the siderite gangue as fine rod-like and needle-like crystals (eg.P.187), with the lengths of the individual crystals rarely exceeding 0.05mm. These fine crystals are common in small clusters and veinlets, and occasionally merge to form areas consisting of masses of these fine "rods" and "needles" (Plate 5, No. 1). The width of the individual massive areas reaches a maximum of several centimetres (eg. P. 200).

Galena is less abundant than boulangerite in these specimens, and is rarely observed without some associated boulangerite. The larger areas of galena (eg. P.195) are up to several centimetres in overall width and are surrounded by gangue, and contain fine inclusions of boulangerite, tetrahedrite, sphalerite, pyrite and arsenopyrite. Galena also occurs as frequent fine (0.01-0.075mm.) inclusions, of irregular outline, within the massive boulangerite.

Bournonite forms small irregularly-shaped patches within the massive boulangerite, the overall width of these inclusions ranging from 0.025mm up to 0.3mm. A small amount of bournonite was also observed as narrow veinlets (o.005mm. to 0.015mm. in width) in sphalerite and pyrite (P.196). Chalcopyrite, tetrahedrite and galena are present as inclusions within the bournonite in these veinlets.

Pyrite and arsenopyrite are invariably associated, but in various proportions, and occur as idiomorphic and subidiomorphic crystals disseminated through the other sulphides and the gangue. Massive areas up to several centimetres in width are also present (eg. P.189, 192) in some specimens. In these areas pyrite is generally the more abundant of the two minerals but occasionally arsenopyrite is the main constituent. The individual crystals of each mineral range from 0.01mm up to 0.5mm. Both minerals have apparently undergone extensive replacement by boulangerite, galena, tetrahedrite and bournonite, and partial replacement by sphalerite. Boulangerite, tetrahedrite and galena occupy interstitial areas in the massive pyrite and arsenopyrite, and also occur as fine inclusions and veinlets within these minerals.

Sphalerite is abundant in some specimens (eg. P.188,191) but is absent or rare in others. In hand specimen the sphalerite is moderately dark.

Galena and boulangerite occur as common inclusions (0.01mm. to 0.1mm.) within the sphalerite, and appear to have partially replaced the sphalerite. Chalcopyrite is common in the sphalerite as fine exsolution blebs, generally rod-like in shape with a maximum length of 0.01mm. Pyrrhotite is present as occasional exsolution bodies of similar shape and size, but is less common than chalcopyrite. The inclusions of chalcopyrite and pyrrhotite often show alignment along crystallographic planes in the sphalerite.

A little chalcopyrite was also noted as fine inclusions and veinlets within tetrahedrite, and as rare fine inclusions within bournonite.

Assemblages of ore minerals.

Common:

Boulangerite - galena
Galena - sphalerite
Pyrite - sphalerite
Boulangerite - tetrahedrite
Galena - pyrite
Galena - pyrite - sphalerite
Arsenopyrite - pyrite
Chalcopyrite - sphalerite
Boulangerite - pyrite
Arsenopyrite - boulangerite
Galena - tetrahedrite

Infrequent:

Arsenopyrite - boulangerite - galena
Arsenopyrite - boulangerite - galena - pyrite
Arsenopyrite - boulangerite - pyrite
Arsenopyrite - bournonite
Arsenopyrite - galena
Arsenopyrite - galena - tetrahedrite
Arsenopyrite - sphalerite
Arsenopyrite - tetrahedrite
Boulangerite - bournonite
Boulangerite - bournonite - tetrahedrite
Boulangerite - galena - pyrite
Boulangerite - galena - sphalerite
Boulangerite - galena - tetrahedrite
Boulangerite - pyrite - tetrahedrite
Boulangerite - sphalerite
Bournonite - galena
Bournonite - galena - sphalerite
Bournonite - pyrite
Bournonite - pyrite - tetrahedrite
Bournonite - sphalerite
Bournonite - sphalerite - tetrahedrite
Bournonite - tetrahedrite
Galena - sphalerite - tetrahedrite
Pyrite - tetrahedrite
Pyrrhotite - sphalerite

Rare:

Argentite - covellite
Argentite - galena
Argentite - pyrite
Bournonite - chalcopyrite
Bournonite - pyrite - sphalerite
Chalcopyrite - tetrahedrite

Balstrup's Mine.

The workings of Balstrup's Mine, also known as the Manganese Hill Mine, are located on the slopes of Manganese Hill, which rises to an altitude of 1050 feet on the southern side of Argent Flat.

Blissett (1962) has described the country rocks as "fissured and sheared purple, red and green greywacke, siltstone and mudstone or shale assigned to the Cambrian Crimson Creek Formation". A large gossanous formation capping Manganese Hill attracted considerable interest in the early stages of development of the Zeehan field, and Thureau (1888) and Montgomery (1893) were among those who predicted the presence of good ore below the gossan.

The gossan consists mainly of limonite with some pyrolusite, and Jack (1963) has suggested that this has been derived from the oxidation of pyrite and manganiferous siderite in a highly sheared zone in the sediments. According to Blissett (1962) the gossanous material contains up to 10ozs. of silver per ton.

Following a recommendation by Blissett (1962) that drilling be carried out to test Balstrup's Lode below the zone of oxidation, two holes were drilled by the Department of Mines. Traces of galena and pyrite associated with siderite were noted in the drill core (Jack, op. cit.), but no mineralization of economic interest was discovered. The workings of Balstrup's Mine were also cleaned out and have been described by Jack.

The workings did not extend below the zone of oxidation, and the only rich ore extracted from the mine came from No. 4 winze, according to Tilley (1891) and Jack(op. cit.). No production figures are available for Balstrup's Mine.

Tilley reported the following assays of ore from the winze.

	Pb(%)	Ag(ozs. per ton)
"Canary ore"	59	888
Gossan with native silver	27	830
Galena	76	178 to 198
Cerussite	70	15
"Soft sulphide"	73.7	343

In addition, Tilley reported that a bulk sample of gossan and galena from the same winze assayed 119ozs. silver per ton.

The "canary ore" in the above analysis is probably largely bindheimite, since Petterd (1910,p.26) states that bindheimite was known under this name in the mining fields of western Tasmania. It is, however, possible that the "canary ore" in this analysis also included at least some massicot.

Small amounts of cerussite in the fault zone in the workings were noted by Jack (op. cit.). According to Tilley (op. cit.) embolite was found by the original leaseholder (P.M. Balstrup) in a trench near the western boundary of the lease, and bulk samples of material were claimed to assay up to 598 ozs. of silver per ton.

Argent Flat.

The workings of several mines are located on the portion of Argent Flat which lies between Manganese Hill, Queen Hill and the western boundary of the township of Zeehan. The Argent Mines were situated on this part of Argent Flat, while the Nike Mine (also known as the Silver Queen Extended Mine) was situated on the southern slopes of Queen Hill.

Descriptions of the workings of these mines are included in reports by Waller (1904), Vaudeau and Levings (1921), Vaudeau and Williams (1924), Keid (1943), Taylor and Burger (1951a), and Blissett (1962). A large number of lodes were discovered in this area (over thirty according to Waller, 1904), but many were too small to be of economic importance. The most important workings were those known as the No. 2 Argent Mine and the No. 6 Argent Mine. No. 2 Argent is located in the southern portion of the area, while No. 6 Argent lies approximately ½-mile north-east of No. 2, and approximately ¼-mile south-west of the main shaft of the Florence Mine.

Blissett (1962) has given the following description of the general geology in the vicinity of the Argent Mines.

"..... most of the workings are within faulted and sheared Cambrian greywacke, mudstone and shale. The Cambrian rocks are faulted against Devonian Florence Quartzite east of No. 6 shaft, and against Proterozoic quartzite and slate forming Queen Hill north of the No. 2 shaft and west of the No. 4 shaft."

The workings of the Nike Mine lie within the Precambrian Oonah Quartzite and Slate.

From the various accounts of the workings of these mines it is apparent that the ore bodies were fissure veins consisting of galena with variable amounts of sphalerite and pyrite in siderite and quartz. Waller (1904) reported assay figures for galena which show a range from 65 to 78% lead and from 86 to 190ozs. of silver per ton. The majority of the lodes in this area were apparently similar in overall composition, but one lode (No. 15 of Waller) on the southern slopes of Queen Hill was reported by Waller to be composed of quartz with a little siderite and " a good deal of galena and considerable quantities of capillary and felty jamesonite". A specimen in the Tasmanian Museum Collection, No.X3456 labelled "jamesonite" from the "Argent Mine, Zeehan", is in keeping with Waller's description of the ore. This specimen consists of quartz and siderite coated with felted masses of a fine acicular mineral which has been identified as boulangerite by means of an X-ray powder diffraction photograph.

Hyalite was recorded by Petterd (1910), but the locality was described only as "the Argent Mine, Zeehan".

Samples for the preparation of polished sections were collected from surface dumps near the various workings. In addition some polished sections were prepared from specimens in the Tasmanian Museum Collection.

The specimens consist largely of galena and pyrite with minor sphalerite in a gangue of siderite and quartz. Small amounts of arsenopyrite, chalcopyrite, tetrahedrite, boulangerite, bournonite, pyrargyrite, pyrrhotite, marcasite and stannite were also observed in polished sections.

Although the proportions of the major constituents vary considerably between specimens, galena is a dominant metallic mineral in most specimens throughout this area. Tetrahedrite is common in many of the specimens as fine inclusions of variable shape (round, ovate and irregular) and size (0.005 - 0.25mm.) distributed throughout the galena (eg. P.77,394). The tetrahedrite content is highest in specimens collected from the southern and south-western portions of this area. A little tetrahedrite is also associated with bournonite and galena in interstitial areas in massive arsenopyrite and pyrite in some specimens (P.316). Bournonite was observed as inclusions within the massive galena in only one specimen (P.394). The bournonite inclusions are not common in this specimen and occur as small (0.03mm.) bodies of irregular shape.

Boulangerite is also present in the galena in most specimens, and occurs as fine needle - and rod-like bodies distributed through the galena. The maximum length of these bodies is 0.1mm., but the majority are less than 0.03mm. Occasional composite boulangerite - tetrahedrite bodies were noted (P.246). Although occurring mainly as disseminated fine bodies, the boulangerite is occasionally concentrated into small areas, up to 0.15mm. in overall width, within the galena (eg. P.314).

Pyrargyrite was observed in only one specimen (P.80, collected from dumps at the No. 2 Argent Mine) and occurs as occasional fine inclusions sporadically distributed through the galena. The shape of these inclusions varies from ovate to irregular, and the size ranges from 0.02mm. to 0.07mm.

Pyrite is disseminated throughout much of the quartz and siderite gangue, as idiomorphic and subidiomorphic crystals ranging from 0.01mm. up to 1mm., and also occurs as massive material in patches up to several centimetres in width. Pyrite is also associated with galena and sphalerite and appears to have been partially replaced by the sphalerite and extensively replaced by galena (Plate 5, No. 2). In many specimens (eg. P.73) pyrite occurs as idiomorphic crystals (0.01 - 0.1mm) within massive galena, but in others (eg. P.78) galena occupies interstitial areas and fractures within massive pyrite. A small amount of tetrahedrite and chalcopyrite is occasionally associated with the galena in these occurrences within the pyrite. Arsenopyrite is common in occasional specimens (P.315, 316) as clusters of idiomorphic crystals with associated pyrite, and occurs in others (eg. P.83) as fine idiomorphic crystals within pyrite, galena and quartz.

Sphalerite is not abundant in these specimens, and when present is always intimately associated with galena. The sphalerite has apparently been extensively replaced by galena, and occurs as small areas included within galena (Plate 5, No2.). The size of those inclusions ranges from very fine (0.005mm.) up to several millimetres (P.69,73).

Fine exsolution blebs of chalcopyrite are common within the sphalerite, and occasional fine bodies of pyrrhotite are also present. The chalcopyrite blebs are rarely larger than 0.005mm., whereas the pyrrhotite bodies, which are generally rod-like, are between 0.01 and 0.015mm. in length. The bodies of chalcopyrite and pyrrhotite rarely show any alignment in these specimens. Chalcopyrite was also occasionally observed along sphalerite - galena contacts (P.82). In these cases the chalcopyrite forms narrow discontinuous rims (up to 0.01mm. in width) around the sphalerite inclusions. A little chalcopyrite occurs as inclusions, 0.01mm. to 0.03mm. in width, within siderite and galena (P.83) and pyrite (P.79).

Marcasite is rare in these specimens, and occurs only as fine material within massive pyrite (P.83). Stannite is also rare and was observed as fine inclusions within pyrite (P.83).

Stillwell (1950) reported the presence of a little stannite in a specimen of ore from Argent Flat. According to Stillwell's descriptions, the stannite was intimately associated with chalcopyrite and sphalerite.

Assemblages of ore minerals.

Common:	Galena - pyrite Galena - sphalerite Galena - tetrahedrite Boulangerite - galena Pyrite - sphalerite Chalcopyrite - sphalerite Galena - pyrite - sphalerite Arsenopyrite - pyrite
Infrequent:	Arsenopyrite - boulangerite - galena Arsenopyrite - bournonite Arsenopyrite - bournonite - tetrahedrite Arsenopyrite - galena Arsenopyrite - pyrite - tetrahedrite Arsenopyrite - tetrahedrite Boulangerite - galena - sphalerite Boulangerite - galena - tetrahedrite Bournonite - galena Bournonite - pyrite Bournonite - pyrite - tetrahedrite Chalcopyrite - galena Chalcopyrite - galena - pyrite - tetrahedrite Chalcopyrite - galena - sphalerite Chalcopyrite - pyrite Galena - pyrite - tetrahedrite Galena - sphalerite - tetrahedrite Marcasite - pyrite Pyrite - tetrahedrite Pyrrhotite - sphalerite
Rare:	Boulangerite - pyrargyrite - galena Boulangerite - sphalerite - tetrahedrite Galena - pyrargyrite - tetrahedrite Galena - pyrrhotite - sphalerite Pyrite - stannite

Florence Mine.

The workings of the Florence Mine are located on the Florence ridge on the eastern side of Argent Flat. The main shaft is situated on the lower western slope of the ridge. Other shafts in the area are Flaherty's shaft, located near the top of the ridge about 110 yards east of the main shaft, and Currie's shaft, located 55 yards north-east of the main shaft.

The following description of the general geology of the area is taken from Blissett (1962).

"The main shaft and western workings are within highly weathered greywacke, greenish siltstone and green, purple and grey slates forming part of the Cambrian Crimson Creek Formation. East of the main shaft the Cambrian rocks are faulted against disturbed pale grey sandstone, pebbly grits and shale assigned to the Crotty Quartzite (Silurian) which outcrop at the northern end of the Florence Ridge".

Waller (1904) reported that the principal lodes discovered in these workings were known as McKay's, Dunkley's, Horton's, Currie's, Astle's and Flaherty's Lodes. Waller regarded Dunkley's lode as a continuation of Currie's lode, and Blissett (1962) has suggested that Flaherty's Lode formation may not have been a true lode but rather a post-mineralization fault plane.

Galena and siderite are the only minerals reported by Waller, and no silver values of the ore were given. According to Waller, Currie's Lode contained up to 8 feet of solid galena, but most of the production to that date had come from the main workings where Astle's Lode varied in width from a few inches up to two feet.

Another lode, cut in a trench about 400 feet north-east of the main shaft was reported, by Waller, to contain kaolin carrying up to 2,000 ozs. of silver per ton. The silver was presumably in the form of cerargyrite of another of the silver halides. This argentiferous kaolin material passed into a vein of primary galena.

The only material to be found on the surface dumps in the vicinity of the Florence Mine consists of siderite with traces of galena.

Mount Zeehan Mine.

The Mount Zeehan Mine (also known as the New Mount Zeehan Mine) consisted of workings on the first claim to be pegged in the Zeehan field. The main shaft is located within the township, approximately 500 yards north-north-east of the Florence Mine.

Blissett (1962) has described the host rocks as "greywacke, siltstone and shale, believed to be part of the Crimson Creek Formation".

Reports indicate that the ore consisted of galena, with some sphalerite, in a gangue of siderite. Tilley (1891) reported that 22 tons of ore had given bulk assays of 52% lead and 73ozs. of silver per ton, and Montgomery (1893) quoted an assay of 59% lead and 76 ozs. of silver per ton for 40 tons of ore.

Montgomery(1890) recorded barite in No. 2 Lode, and Smith (1893) identified evansite from the Mount Zeehan Mine.

Very little material now remains on the surface dumps, and no specimens suitable for mineralogical examination could be found.

Stormsdown Mine.

The workings known as the Stormsdown Mine, at present operated on a small scale by Mr. D. Dunkley, are located on the north-west slopes of Queen Hill, above the Trial Harbour-Zeehan road and north of the old Zeehan Queen workings.

Blissett (1960) examined and described the workings, which consist of two adits and a small open cut (see Fig.5 of Blissett). The mineralization was described by Blissett, as consisting of irregular masses and veins of pyrite containing very fine-grained tin. Assays were carried out by the Department of Mines on a representative sample of 92 lbs. of soft pyritic ore from No. 1 adit and on 15 lbs. of hard pyritic ore from dumps near the open cut. The soft ore assayed 4.13% tin, and the hard ore 0.58% tin (Blissett,1960). Vanning tests, also carried out by the Department of Mines, gave recoveries of 30 to 50% for the soft ore and 16 to 40% for the hard ore.

The host rocks were described by (Blissett, 1960,1962) as dark shales, siltstones and quartzites with associated spilite flows.

The soft pyritic ore from No. 1 adit consists largely of pyrite and quartz (P.305). Both minerals have been intensively fractured, and the pyrite is extensively decomposed in parts. A sample of this ore was dried, crushed to -200 mesh, and separated in bromoform. The separated fractions were examined under the microscope and the heavy fraction found to contain occasional fine grains of cassiterite, ranging in size from 0.001mm. to 0.015mm. These grains were associated with both the pyrite and the quartz. The fine grain-size of the cassiterite and the intimate association with the pyrite and quartz would account for the poor recovery in the vanning tests.

Hard pyritic material from No. 1 adit also consists largely of pyrite and quartz, but with minor galena and sphalerite. Traces of fine cassiterite were again noted, as grains from 0.005mm. to 0.01mm., within the pyrite and quartz. Sphalerite is associated with the massive pyrite (P.306) as fine inclusions, ranging from 0.01mm. to 0.025mm., and also occurs as occasional patches, up to 2cm. in overall width, within the quartz (P.90). This sphalerite contains inclusions of galena and exsolution bodies of pyrrhotite and chalcopyrite. Galena is disseminated through some specimens, and occurs as occasional areas up to 1cm.in width (P.91). Fine bodies of tetrahedrite, showing a variation in size from 0.005mm. to 0.02mm. and a variation in shape from round to irregular, are sporadically distributed through the galena. Rare inclusions of chalcopyrite were noted in the galena, and minor amounts of arsenopyrite and marcasite are associated with the pyrite.

According to Blissett (1960), exploratory work has shown the presence of at least 300 tons of the soft pyritic ore. Blissett reported that this material extends over a length of 29 feet in No. 1 adit, and he considered that it marked a fault zone which has shattered an irregular pyritic ore body.

Samples collected from the open cut near the entrance to No. 2 adit consist almost entirely of massive pyrite with quartz (P.88,89,304). Pyrrhotite is present in P.88 as fine inclusions of irregular shape, within the pyrite. The size of these inclusions ranges from 0.01mm. to 0.03mm. A trace of fine cassiterite was again noted as rare grains (0.005mm. - 0.01mm.) within the pyrite and quartz.

A further adit, known as Dunn's Tunnel, is located 325 feet north of No. 2 adit of the Stormsdown Mine. Samples collected from the dumps at the entrance again consist largely of pyrite and quartz (P.85-87) but one specimen (P.86) contains a narrow seam of galena, 3mm. in width. Included in the galena are occasional fine ovate-shaped bodies of tetrahedrite, with a maximum size of 0.025mm. x 0.012mm, and rare minute bodies (0.005mm.) of boulangerite. Occasional fine stannite inclusions are sporadically distributed through the pyrite, as irregularly shaped bodies ranging in size from 0.005mm. to 0.03mm. A little sphalerite is present as interstitial material between pyrite crystals in P.85, and the sphalerite contains fine blebs of chalcopyrite and pyrrhotite.

Assemblages of ore minerals.

Common:	Pyrite - sphalerite
	Galena - pyrite
Infrequent:	Arsenopyrite - pyrite
	Cassiterite - pyrite
	Chalcopyrite - sphalerite
	Galena - sphalerite
	Galena - tetrahedrite
	Marcasite - pyrite
	Pyrite - galena - sphalerite
	Pyrite - pyrrhotite
	Pyrite - stannite
	Pyrrhotite - sphalerite
Rare:	Arsenopyrite - galena
	Boulangerite - galena
	Chalcopyrite - galena
	Chalcopyrite - galena - tetrahedrite

Zeehan Queen Mine.

The workings of the Zeehan Queen Mine are located on the north-west slopes of Queen Hill and in the valley of Queen Creek between Queen Hill and Oonah Hill. These workings are also known as the Silver Queen Mine, since the Zeehan Queen Co. Ltd. operated workings developed earlier by the Silver Queen Prospecting Association N.L..

Blissett (1962) has reported that the ore-bodies occur within "a tightly folded sequence of slate, siltstone and pale-weathering quartzite containing flows of spilitic lava, which is considered to be part of the Oonah Quartzite and Slate....".

Partial descriptions of the workings were included in reports by Montgomery (1893, 1895), Waller (1904), and Twelvetrees and Ward (1910). These descriptions were summarized by Blissett (1962).

The ore bodies were worked from four shafts, and although some rich ore was extracted the mineralization was apparently patchy. Several lodes were reported in these workings and it is apparent from the above reports that these were fissure lodes consisting largely of galena and siderite, with pyrite becoming more abundant at depth.

A pyrite - stannite - galena lode, known as Clarke's Lode, was first explored in an adit near the Trial Harbour road and later worked from No. 1 (110 feet) Level and No. 2 (210 feet) Level of No. # shaft. According to descriptions of Montgomery (1895), Waller (1904) and Twelvetrees and Ward (1910), Clarke's Lode was a well-defined pyritic lode four to six feet in width, containing bands of stannite and galena with a little chalcopyrite and tetrahedrite. Table 2 contains partial analyses of picked samples of the stannite ore.

TABLE 2.

Composition of stannite ore, Clarke's Lode, Zeehan Queen Mine.

	(1)	(2)	(3)
Cu(%)	8.9	16	12.4
Sn(%)	8.5	14	12.5
Pb(%)	6	-	6
SiO_2(%)	7	-	-
Ag(ozs. per ton)	57	78	72.4

(1) Picked sample of ore assayed in Oonah Mine laboratory (Twelvetrees and Ward, 1910, p.133).

(2) Assay of 20 tons of ore (Twelvetrees and Ward, 1910, p.134).

(3) Progress of the Mineral Industry of Tasmania (Quarter ending 31st. December, 1904, p.17).

Montgomery (1895) also recorded that ore containing "rich galena and siliceous pulverulent matter carrying carbonate and oxide of lead and chloride of silver" was extracted from the upper workings of No. 2 shaft, and Petterd (1910) reported the presence of atacamite, bindheimite, cerussite and embolite in the oxidized zone of the Queen workings. Petterd also recorded an unconfirmed report of crocoite as small crystals in gossan.

Petterd (op.cit.p.73) described an occurrence of franklinite as "amorphous and crystalline bunches intermixed with galena, mainly at the 200 ft. level, Silver (Zeehan) Queen Mine". In the absence of any specimens or further information, it is not possible to verify this report.

The Tasmanian Musuem collection contains one small specimen of pyromorphite (X.3278) and one specimen labelled "leadhillite" (X.2169) which, according to the records, are from the Silver (Zeehan) Queen Mine. The "leadhillite" has been identified by means of X-ray diffraction as cerussite.

The surface dumps in the vicinity of the abandoned Zeehan Queen workings now contain very little material of use in a mineralogical study. Some samples contain small amounts of sphalerite, pyrite and galena but most of the samples are heavily weathered. The Tasmanian Museum collection contains several specimens of ore from the Zeehan Queen Mine and these provided the majority of the polished sections prepared for this study.

Most of the specimens consist essentially of massive galena, but sphalerite and pyrite are also quite common. Minor amounts of boulangerite, bournonite, tetrahedrite, chalcopyrite, pyrrhotite, arsenopyrite, marcasite, stannite and cassiterite were also observed in the polished sections. The gangue constituents are siderite and quartz. The stannite ore from Clarke's Lode is quite different in composition and will be described separately.

The galena from the Zeehan Queen Mine is invariably sheared and exhibits a distinct anisotropism. Inclusions of other sulphides are common within the massive galena, but the nature of these inclusions varies between specimens. Boulangerite is common in all galena specimens as fine bodies of variable shape and size. The most common shapes of the boulangerite bodies are needle-like and ovate, and these range from very fine (0.001mm) up to 0.5mm. in length. Boulangerite is particularly common in P.247, where it is concentrated into occasional small areas, the largest of which measures 5mm. x 3mm., within the galena. In some specimens (eg. P.94,248) the"needles" of boulangerite are aligned along crystallographic planes in the galena.

Bournonite is common as inclusions within galena in many specimens (eg. P.249,250) but is absent or rare in others. The most frequently observed shapes of the bournonite inclusions are round and ovate, and the size of these bodies varies from 0.005mm. to 0.025mm. Occasional larger irregularly shaped areas, up to 0.25mm. in overall width, were noted in P.249. Composite boulangerite - bournonite inclusions were observed.

Tetrahedrite occurs as inclusions in galena in some specimens (P.248-250) but it is not a common mineral in these samples of Zeehan Queen ore. The inclusions are generally round to ovate in shape, and range from 0.005mm. to 0.03mm. in size. Occasional composite boulangerite - tetrahedrite and bournonite-tetrahedrite inclusions were noted in the galena (P.247,249).

Inclusions of sphalerite are always present within the galena. These are of irregular shape, and the overall width of the inclusions varies from less than 0.01mm. up to 1cm. Occasional specimens of ore consist of massive sphalerite (P.100-102,245) with minor galena occurring as inclusions up to 1mm. in width. The sphalerite is moderately dark in hand specimen.

Exsolution blebs of chalcopyrite and pyrrhotite are present in the sphalerite. These blebs vary between needle-like and ovate in shape and are rarely greater than 0.01mm. in length. The distribution of the chalcopyrite and pyrrhotite through the sphalerite is rather sporadic, the blebs being abundant in some parts but absent in others. P.248 contains occasional irregularly shaped inclusions of pyrrhotite (0.01mm - 0.08mm.) within the galena and pyrite.

Pyrite is common in some specimens (eg.P.94,102) but rare in others (eg. P.95,250), and generally occurs as idiomorphic and subidiomorphic crystals ranging from 0.01mm. to 0.15 mm. Arsenopyrite is present in some specimens (P.102, 248,249) as a minor constituent associated with pyrite and galena. Marcasite is not common but occurs in small amounts within pyrite and galena in P.102 and 248.

Stannite was noted as fine (0.002mm - 0.05mm.) inclusions, of irregular shape, within the galena in P.94. Rare grains of cassiterite were noted within galena and sphalerite in P.93, the maximum size observed being 0.025mm x 0.005mm.

The only sample of stannite ore (Clarke's lode) available for study was a single specimen (X. 341/P.99) in the Tasmanian Museum collection. This is very similar to stannite ore from the Oonah Mine (see pp.116-124) and consists essentially of stannite and pyrite with minor chalcopyrite, galena, bismuthinite, arsenopyrite, tetrahedrite, cassiterite and quartz.

The massive stannite in this specimen is veined by pyrite, galena and chalcopyrite. The pyrite veins are relatively broad, being up to 2mm. in width, and contain quartz as interstitial material between the idiomorphic pyrite crystals. Galena occurs as veins up to 1mm. in width in the stannite, and these veins merge into the pyrite veins. Chalcopyrite is present as abundant very fine criss-crossing and branching veinlets (considered to be segregation veins) ranging in width from 0.001mm. to 0.02mm. These veinlets often merge to form small areas of chalcopyrite within the stannite. Minute blebs (less than 0.001mm.) of chalcopyrite are abundant in some areas of the stannite.

Cassiterite occurs as very fine grains and seams occupying the cores of the veinlets of chalcopyrite. This assemblage has also been noted in stannite from the Oonah Mine (see p.119). These seams of cassiterite are normally no greater than 0.002mm. in width, and only a minor amount of the cassiterite was observed without the surrounding sheath of chalcopyrite.

Bismuthinite occupies occasional areas within the stannite, the largest area observed being 1.5mm. x 0.3mm. Tetrahedrite occurs as small veins within the stannite and also in small interstitial areas (0.02mm.) associated with pyrite and stannite. Arsenopyrite is not common but is present as occasional clusters of idiomorphic crystals associated with the pyrite.

Petterd (1910) reported that stannite from Clarke's Lode assayed 3dwt. of gold per ton.

Assemblages of ore minerals.
(excluding stannite ore from Clarke's Lode)

Common:	Boulangerite - galena
	Galena - sphalerite
	Galena - pyrite
	Bournonite - galena
	Pyrite - sphalerite
	Galena - pyrite - sphalerite
Infrequent:	Arsenopyrite - galena
	Arsenopyrite - galena - sphalerite
	Arsenopyrite - pyrite
	Arsenopyrite - sphalerite
	Boulangerite - bournonite - galena
	Boulangerite - galena - pyrite
	Boulangerite - galena - sphalerite
	Boulangerite - galena - tetrahedrite
	Boulangerite - sphalerite - tetrahedrite
	Bournonite - galena - pyrite
	Bournonite - galena - sphalerite
	Bournonite - galena - tetrahedrite
	Bournonite - sphalerite
	Chalcopyrite - sphalerite
	Galena - marcasite
	Galena - pyrrhotite
	Galena - sphalerite - tetrahedrite
	Galena - stannite
	Pyrrhotite - sphalerite
	Galena - tetrahedrite
	Marcasite - pyrite
Rare:	Cassiterite - galena
	Cassiterite - galena - sphalerite
	Chalcopyrite - galena
	Galena - pyrite - sphalerite - tetrahedrite
	Galena - sphalerite - stannite
	Pyrite - pyrrhotite

Assemblages of ore minerals.
(Stannite ore, Clarke's Lode)

Common:	Pyrite - stannite Chalcopyrite - stannite Galena - stannite Cassiterite - chalcopyrite - stannite Galena - pyrite
Infrequent:	Arsenopyrite - bismuthinite - stannite Arsenopyrite - pyrite Arsenopyrite - stannite Bismuthinite - chalcopyrite - stannite Bismuthinite - galena Bismuthinite - pyrite - stannite Bismuthinite - stannite Cassiterite - stannite Chalcopyrite - galena - stannite Chalcopyrite - pyrite - stannite Galena - pyrite - stannite Pyrite - stannite - tetrahedrite Stannite - tetrahedrite
Rare:	Bismuthinite - cassiterite Cassiterite - galena

Oonah Mine

The workings of the Oonah Mine are located on the south-east side of Oonah Hill, approximately ½-mile north of the Zeehan Queen workings.

Blissett (1962) has described the country rocks as being part of the Oonah Quartzite and Slate with interbedded spilite flows.

Descriptions of the workings at various stages were included in reports by Montgomery (1893, 1895), Twelvetrees (1901a), Waller (1904), and Twelvetrees and Ward (1910), and have been summarized by Blissett (1962).

Twelvetrees and Ward (1910) recognized two parallel lodes, viz. a galena lode and a stannite lode. The galena lode consisted of galena with sphalerite and pyrite in siderite and quartz gangue. This galena was reported to contain up to 127 ozs. of silver per ton. Twelvetrees (1901) recorded that some gossan associated with the galena lode contained silver chloride and native silver, and assayed up to 420 ozs. of silver per ton. The stannite ore is reported as having given assays of from 50 to 120 ozs. of silver per ton. Petterd (1910, p.147) recorded the presence of pyrostilpnite, "closely associated with pyrite in cellular quartz", at the Oonah Mine.

The stannite lode has a complex mineralogy and, with the exception of Clarke's Lode in the Zeehan Queen area, is unlike other lodes in the Zeehan district. Stillwell (1931) reported on the mineralogy of the stannite lode, and Edwards (1951) discussed the significance of the textures of some of the minerals associated with the stannite. Previously published analyses of stannite ore from the Oonah Mine are shown in Table 3.

Twelvetrees and Ward (1910) also reported the discovery of a narrow vein of cassiterite and pyrite "...in the hill east of the gully near the (Oonah) mine".

TABLE 3.

Composition of stannite, Oonah Mine.

	(1)	(2)	(3)
Cu(%)	26.77	5.5	10.7
Sn(%)	23.91	4.5	9.2
Fe(%)	12.11	26–27	
Bi(%)	2.27	0.4–0.45	Tr.
Sb(%)	0.505	–	Tr.
As(%)	Tr.	–	4.4
Zn(%)	0.475	–	
S(%)	32.1	29	29.75
SiO_2(%)	1.4	22–27	23.0
Al_2O_3(%)		4–5	2.20
Ag(ozs. per ton)	97.3	22	63

(1) Stannite. Analysis by J.H. Levings (Annual Report of Secretary for Mines, 1907, p.32)

(2) Bulk analysis of stannite ore (Twelvetrees and Ward, 1910, p. 53).

(3) Bulk assay of 70 tons of stannite ore sold in October, 1903 (Waller, 1904, p.57.)

The majority of the specimens used in this mineralogical study are from the collections of the Tasmanian Museum, Hobart, and the Queen Victoria Museum, Launceston. In addition, further samples were collected from surface dumps near the abandoned Oonah Mine workings. With the exception of two specimens of galena ore, the specimens are apparently from the stannite lode.

The stannite ore consists largely of stannite and pyrite, with minor amounts of chalcopyrite, arsenopyrite, bismuthinite, galena, cassiterite, sphalerite, wolframite, tetrahedrite and bournonite, and trace amounts of boulangerite and covellite. The minor constituents vary considerably between specimens, and the complex nature of the ore is illustrated by the list of observed ore mineral assemblages. The non-metallic gangue consists of quartz with a little siderite and fluorite.

Stannite occurs as massive material showing well-developed lattice and lamellar twinning. In some specimens the stannite and pyrite form well-defined bands, the widths of individual bands varying from 1mm. up to 1cm.

Chalcopyrite, cassiterite and stannite are closely associated. Chalcopyrite occurs throughout the stannite as abundant fine criss-crossing and branching veinlets, as small areas of irregular shape, and as minute blebs. Edwards (1951) interpreted the textural relationships as indicating exsolution of chalcopyrite from the stannite host. The veinlets of chalcopyrite are "segregation veins".

Two forms of cassiterite were noted by Edwards (op.cit). One form (eg. P.16,19) occurs in the stannite, and also in other minerals, as clusters of fine crystals. The individual crystals range from 0.002mm. - 0.075mm. in size, and clusters up to 1mm. in overall width were observed. When these crystals of cassiterite are observed within stannite they are invariably surrounded by a narrow (0.001mm - 0.01mm.) rim of chalcopyrite, which is assumed to have exsolved from the stannite. This cassiterite is considered to be of primary origin.

The second, and more abundant, form of cassiterite was referred to by Edwards as "needle tin". This occurs only within the chalcopyrite veinlets in the stannite (eg. P.15, 96) and is distinct in appearance from the form described above. The needle tin occupies the central regions of many of the chalcopyrite veinlets within the stannite (Plate 6), and, as noted by Edward, the width of the chalcopyrite veinlet is invariably in direct proportion to the width of the seam of needle tin. The central cores of cassiterite are generally between 0.002mm and 0.016mm. in width. In some of the specimens (eg. P.96) examined by the present author, very fine crystalline pyrite is also associated with the seams containing chalcopyrite and needle tin.

The interpretation of the textures will be discussed further in the following section, but Edwards has presented evidence which suggests that the needle tin has resulted from a partial dissociation of stannite, possibly due to fracturing while the stannite was above some critical temperature.

Pyrite and arsenopyrite are often closely associated as idiomorphic and subidiomorphic crystals ranging in size from 0.02mm up to 1mm. Intergrowths of the two minerals were also observed (eg. P.11). Both minerals often appear to have been fractured and the fractures are occupied by other minerals, in particular by stannite, chalcopyrite and bismuthinite.

Tetrahedrite is common in several specimens of stannite (eg. P.13,96,301) and is sometimes associated with the chalcopyrite veinlets within the stannite. Lenticular shaped bodies of tetrahedrite, up to 0.25mm x 0.05mm., were also noted within bismuthinite in some specimens (eg.P.11).

Bismuthinite is a prominent minor constituent of several specimens (eg.P13,17,96) and occurs as small patches up to several millimetres across. Bismuthinite occurs in assemblages with most of the other ore minerals, and the textures suggest replacement of most of these by the bismuthinite.

Galena is not common in the stannite ore and is mainly confined to small irregularly shaped areas (eg. P.15) associated with the massive stannite and pyrite, and as fine inclusions in chalcopyrite and bismuthinite. Occasional fine bodies of tetrahedrite were observed in the areas of galena. Bournonite also occurs as small areas (eg. P.16,17), usually in association with the galena, and the two minerals exhibit "mutual boundaries" texture. Bournonite is closely associated with the tetrahedrite inclusions within the stannite in P.19

Boulangerite was observed as a trace constituent only (P.98,213), and occurs as fine needle-like crystals within bismuthinite and bournonite.

Covellite was noted in trace amounts confined to the chalcopyrite veinlets in the stannite (P.96,98).

Wolframite was reported by Twelvetrees and Ward (1910) and has been observed as a minor constituent in P.13 and 214. The wolframite is associated with pyrite and quartz and occurs as subidiomorphic crystals up to 1mm. across.

Sphalerite is common in only one of these specimens of the stannite ore (P.11) and was not recorded by either Stillwell (1931) or Edwards (1951). The stannite in P.11 has the appearance of having been intensely fractured, with sphalerite occupying the fractures and having partially replaced the stannite along the fractures (Plate 7, No.1). The sphalerite and stannite are occasionally separated by a narrow(0.001 - 0.002mm) border of chalcopyrite, and the sphalerite contains fine exsolution blebs of chalcopyrite.

The two specimens represented by P.300 and 373 are possibly samples of ore from the galena lode. P.300 consists almost entirely of massive galena and quartz gangue. Tetrahedrite and bournonite are present within the galena as round, ovate and irregularly shaped bodies ranging in size from 0.02mm to 0.075mm. Minor pyrite was also noted as fine idiomorphic crystals which appear to have been extensively replaced by the galena. P.373 is an association of siderite, quartz, sphalerite and galena. The sphalerite contains rare minute blebs of chalcopyrite and pyrrhotite, most of which are less than 0.01mm. A little pyrite and marcasite is also present. Stannite was not observed in either of these specimens.

About ¼ mile south-west of the Oonah Mine are the workings of Bradshaw's Lode. Twelvetrees and Ward (1910) reported that the ore consisted of pyrite with some galena and a little chalcopyrite. The ore was also reported to assay 0.3 to 0.4% tin. Similar ore was reported in Pastkuchen's Lode, about 300 yards west of Bradshaw's Lode. The author was unable to obtain specimens of ore from either locality.

Assemblages of ore minerals. - stannite ore

Common:

Pyrite - stannite
Chalcopyrite - stannite
Arsenopyrite - pyrite
Chalcopyrite - pyrite - stannite
Cassiterite - chalcopyrite - stannite
Arsenopyrite - pyrite - stannite
Arsenopyrite - chalcopyrite - stannite
Cassiterite - stannite
Bismuthinite - stannite
Chalcopyrite - stannite - tetrahedrite
Arsenopyrite - stannite

Infrequent:

Arsenopyrite - bismuthinite
Arsenopyrite - bismuthinite - pyrite
Arsenopyrite - bismuthinite - stannite
Arsenopyrite - bournonite - pyrite
Arsenopyrite - bournonite - stannite
Arsenopyrite - bournonite - stannite - tetrahedrite
Arsenopyrite - cassiterite
Arsenopyrite - galena - pyrite
Arsenopyrite - pyrite - tetrahedrite
Bismuthinite - bournonite
Bismuthinite - chalcopyrite
Bismuthinite - chalcopyrite - stannite
Bismuthinite - galena
Bismuthinite - pyrite
Bismuthinite - pyrite - stannite
Bismuthinite - pyrite - tetrahedrite
Bismuthinite - sphalerite - stannite
Bismuthinite - tetrahedrite
Bournonite - chalcopyrite - stannite
Bournonite - galena
Bournonite - galena - stannite
Bournonite - pyrite - stannite
Bournonite - pyrite - stannite - tetrahedrite
Bournonite - stannite
Bournonite - stannite - tetrahedrite
Bournonite - tetrahedrite
Cassiterite - chalcopyrite - pyrite - stannite
Cassiterite - pyrite
Cassiterite - pyrite - stannite
Chalcopyrite - galena
Chalcopyrite - galena - stannite
Chalcopyrite - pyrite
Chalcopyrite - sphalerite
Chalcopyrite - sphalerite - stannite
Galena - pyrite
Galena - pyrite - stannite
Galena - sphalerite
Galena - sphalerite - stannite

Infrequent: (cont.)	Galena - stannite
	Galena - tetrahedrite
	Pyrite - sphalerite
	Pyrite - sphalerite - stannite
	Sphalerite - stannite
	Stannite - tetrahedrite
Rare:	Arsenopyrite - bismuthinite - chalcopyrite - pyrite - stannite
	Arsenopyrite - bismuthinite - tetrahedrite
	Bismuthinite - boulangerite
	Bismuthinite - cassiterite
	Bismuthinite - chalcopyrite - tetrahedrite
	Bournonite - cassiterite - pyrite - stannite
	Bournonite - chalcopyrite - galena - stannite
	Bournonite - pyrite - tetrahedrite
	Cassiterite - chalcopyrite - stannite - tetrahedrite
	Cassiterite - galena
	Chalcopyrite - covellite
	Chalcopyrite - wolframite
	Pyrite - wolframite
	Stannite - wolframite

<u>Assemblages of ore minerals</u> - galena ore

Common:	Galena - sphalerite
	Galena - pyrite
	Bournonite - galena
	Galena - tetrahedrite
Infrequent:	Galena - marcasite
	Galena - pyrite - sphalerite
	Marcasite - pyrite
	Pyrite - sphalerite
Rare:	Chalcopyrite - sphalerite
	Pyrrhotite - sphalerite

Junction Mine.

The workings of the Junction Mine are located approximately 300 yards south-west of the Zeehan-Western Mine and approximately ½-mile north-east of the Oonah Mine.

The host rocks are part of the Oonah Quartzite and Slate (Blissett, 1962).

The workings of the Junction Mine have been mentioned briefly by Montgomery (1893,1895) and Waller (1904). The Junction Lode was worked from four levels, and was apparently a southern continuation of No. 1 Lode of the Zeehan - Western Mine.

It is difficult to obtain a clear picture of the mineralogy of ore from the Junction Mine, but the reports indicate that the ore was low in overall grade and consisted essentially of siderite gangue with small veins and patches of galena. After the Junction Co. ceased operations in 1901 a party of tributors reworked the stopes for kaolinitic gossan containing up to 120 ozs. of silver per ton. Petterd (1910) reported the presence of embolite in the workings.

Very few specimens could be obtained for this study and the mineralogical description which follows may not provide a representative picture of the overall composition of the ore. Two specimens of ore from the Junction Mine were obtained from the Tasmanian Museum collection but only a small number of samples of low grade material could be found in dumps near the old workings.

The main metallic constituent of the specimens is galena, with smaller amounts of sphalerite and pyrite, in a gangue of siderite. Minor amounts of tetrahedrite, boulangerite, bournonite, chalcopyrite and arsenopyrite were also observed.

The massive patches of galena (eg. P.56, 263) contain abundant fine inclusions of tetrahedrite, boulangerite and bournonite. The tetrahedrite bodies vary in shape from irregular to round and ovate, and range in size from 0.001mm. up to 0.075mm. The larger tetrahedrite bodies are occasionally associated with small chalcopyrite bodies and graphic intergrowths between the two minerals were observed (P. 299; Plate 7, No. 2). Boulangerite generally occurs as fine needle-like crystals between 0.005mm. and 0.03mm. in length, but is also occasionally present in areas up to 1mm. in width consisting of masses of the fine needle-like crystals (P.56). Bournonite is less common than the tetrahedrite and boulangerite, and occurs only as fine (0.001mm. to 0.02mm) round and ovate bodies within the massive galena.

Sphalerite is present in the massive galena samples as areas which appear to have been extensively replaced. These areas of sphalerite are normally less than 0.5cm. in overall width, but some specimens (eg. P.53) consist largely of massive pale-brown sphalerite. Galena is present in the massive sphalerite as areas up to 2mm. in width, which appear to have partially replaced the sphalerite. Chalcopyrite exsolution blebs were observed in the sphalerite. These bodies range from 0.0005mm. to 0.003mm. and occasionally show alignment along crystallographic planes in the sphalerite. Some growth zoning was noted in the sphalerite, and in parts the zoning is defined by lines of fine chalcopyrite blebs as well as by colour bands. Boulangerite appears to have partially replaced sphalerite in P.56.

Pyrite is not common in most specimens but does occur as fine (0.02mm. to 0.075mm.) idiomorphic crystals sporadically distributed through the galena and sphalerite. P297 consists of massive pyrite with small irregularly shaped inclusions of galena and chalcopyrite.

Arsenopyrite was observed in P.299 as occasional idiomorphic and subidiomorphic crystals distributed through the siderite gangue, and also occasionally in association with chalcopyrite and tetrahedrite.

Assemblages of ore minerals.

Common:	Galena - sphalerite
	Galena - tetrahedrite
	Boulangerite - galena
	Galena - pyrite
Infrequent:	Boulangerite - galena - sphalerite
	Boulangerite - galena - tetrahedrite
	Bournonite - galena
	Chalcopyrite - galena - pyrite
	Chalcopyrite - galena - sphalerite
	Chalcopyrite - galena - tetrahedrite
	Chalcopyrite - pyrite
	Chalcopyrite - pyrite - tetrahedrite
	Chalcopyrite - sphalerite
	Chalcopyrite - tetrahedrite
	Galena - pyrite - sphalerite
	Galena - sphalerite - tetrahedrite
	Pyrite - sphalerite
	Pyrite - tetrahedrite
Rare:	Arsenopyrite - chalcopyrite
	Arsenopyrite - tetrahedrite
	Boulangerite - pyrite - sphalerite

Hanrahan's Adit.

The workings referred to as Hanrahan's Adit (also known as Gossan Tunnel) are located approximately 50 feet south of the Junction shaft.

According to Waller (1904) the lode discovered in this adit contained pyrite with argentite and pyrargyrite. Waller stated that the ore shoot was 40 feet in length at the adit level, and had been worked in a winze 40 feet deep. The high silver content of the ore is illustrated by the following assay figures. These figures, from Waller (1904, p.58) refer to parcels of ore extracted from Hanrahan's Adit.

			Ag. (ozs. per ton)
1.	5tons	7cwt	513.5
2.	4	14	134.3
3.	9	15	49.25
4.	11	10	136.0
5.	28	0	30.0

Only one specimen of ore could be found in the nearby dumps, and comparing this with the description of Waller (1904) it would not appear to be completely typical of the ore. This specimen consists largely of galena in a gangue of siderite and quartz. Minor amounts of tetrahedrite, pyrargyrite, boulangerite and argentite were observed in polished section. Pyrite was not observed.

Tetrahedrite inclusions in the galena are common and are evenly distributed through the galena. The shape of these inclusions is variable, the majority are rather irregular and others are ovate. The size of these bodies ranges from 0.005mm to 0.1mm.

Pyrargyrite occurs as occasional inclusions sporadically distributed through the galena (Plate 8, No. 1). Most of these inclusions approximate to round or ovate shapes, but others have a "crescent" shape, and some irregular shapes are also present. The maximum dimension of the pyrargyrite bodies is generally about 0.05mm. and is rarely greater than 0.08mm.

Boulangerite was noted as very fine rod-like bodies, 0.002 mm. to 0.01mm. in length, within the galena. In some parts these bodies show alignment along two crystallographic directions in the galena.

A small amount of argentite was also observed in the galena. The argentite bodies observed were round (0.025mm. diameter), ovate (0.05mm. x 0.015mm.) and an irregular shape (approximately 0.09mm. x 0.05mm.).

<u>Assemblages of ore minerals.</u>

Common:	Galena - tetrahedrite
Infrequent:	Boulangerite - galena Galena - pyrargyrite
Rare:	Argentite - galena Galena - pyrargyrite - tetrahedrite

Zeehan-Western Mine

The abandoned main shaft of the Zeehan - Western Mine is located approximately ½-mile north-east of the Oonah Mine, on the eastern side of the Corinna road about one mile from the junction with the Trial Harbour Road.

The host rocks have been described by Blissett (1962) as follows.

"The host rocks are contorted black to greenish-grey shale and slate with alternations of dark micaceous siltstone and pale grey quartzite, and a number of interbedded flows of spilite or keratophyre ("melaphyre"). The beds are probably the upper part of the Oonah Quartzite and Slate ———— and they were tightly folded along N.W. trending axes during the Tabberabberan Orogeny."

Waller (1902b) described a total of eleven lodes, of which No. 1 Lode ("Main Lode") was the most productive. No. 1 Lode was worked for 700 feet from the surface to No.2 (110ft.) Level. According to Waller, the lodes are fissure veins consisting principally of argentiferous galena in a gangue of siderite with some calcite and quartz. Waller noted that pyrite and chalcopyrite were present in the ore in the lower levels but almost absent in the upper levels. Small amounts of sphalerite were also noted by Waller. In a later report, Waller (1904) remarked that at the northern end of No. 8 (500 ft.) Level the galena ore gave way to a tetrahedrite - chalcopyrite assemblage. The tetrahedrite was reported to contain 270 ozs. of silver per ton but was present in only small quantities.

Published assay figures of the galena cover a range in silver content of 86ozs. per ton up to 165ozs. per ton.

Specimens available for mineragraphic examination were again limited. One specimen of ore was obtained from the collection of the Geology Department of the University of Tasmania (specimen no. 11996), and several samples of galena concentrates were obtained from the Tasmanian Museum collection. The surface dumps near the workings are poor in mineralized material and provided only a small number of suitable samples. Nevertheless the overall mineralogy of the specimens examined is in good agreement with the descriptions by Waller (1902b, 1904).

The most obvious features of all specimens examined in polished section are the abundance of galena and the high content of tetrahedrite, bournonite and boulangerite as inclusions in the galena. Minor amounts of pyrite, sphalerite, chalcopyrite, pyrargyrite, arsenopyrite and covellite are also present.

Tetrahedrite is common in all specimens of galena as inclusions of variable shape and size. The shapes observed range from round and ovate to completely irregular, and in some specimens elongate rod- and crescent-shaped bodies are common. The tetrahedrite bodies are generally less than 0.07mm. in maximum dimension, but in P.292 irregularly shaped areas up to 1 mm. in overall width were observed. One specimen (P.293) collected from the dumps near the main shaft is in keeping with the description by Waller (1904) of the tetrahedrite-chalcopyrite material on No. 8 Level. This specimen consists almost entirely of an intergrowth of tetrahedrite and chalcopyrite. A small amount of galena is present as round and ovate inclusions (0.03 to 0.08mm) in the tetrahedrite, and traces of fine covellite were also noted in the tetrahedrite.

Bournonite is common in most galena specimens but the distribution is less uniform than that of tetrahedrite. The bournonite inclusions in the galena are commonly much finer than the tetrahedrite inclusions in the same specimen, and the two minerals do not often occur as composite inclusions. The inclusions of bournonite are mainly round or ovate in shape (Plate 8, No. 2) and, although the size ranges from 0.001mm. up to 0.12mm., the majority of these bodies are less than 0.02mm. In P.292 bournonite is present in patches up to several centimetres across, and these areas contain inclusions of galena and boulangerite. The latter mineral is particularly common in these bournonite areas as fine-needle-like crystals which occasionally form small clusters and narrow seams.

Boulangerite varies considerably in abundance between specimens, being common in some samples (eg. P.292) and infrequent in others (eg. P.377). The boulangerite occurs as fine rod-like and needle-like bodies within the galena and occasionally forms composite inclusions with tetrahedrite or bournonite.

Pyrargyrite is a conspicous minor constituent in some specimens (eg. P.377) but is rare or absent in others (eg. P.292). In the samples of galena concentrates it is again noticeable that pyrargyrite is common as inclusions in some grains of galena but absent in others. In view of the uniform tetrahedrite content of the galena, it is likely that the observed variations in the silver content of the ore were largely due to variations in the abundance of pyrargyrite. The inclusions of pyrargyrite in the galena are mainly ovate in shape, but narrow crescent-shaped bodies were also observed. The ovate bodies range from 0.02mm. up to 0.1mm. in length, while the crescent-shaped bodies have a maximum length of 0.2mm.

Sphalerite is not abundant in these specimens, and occurs mainly as areas which appear to have been extensively replaced by the massive galena. These inclusions vary from a few microns up to 1mm. in width, and minute exsolution blebs of chalcopyrite can be observed within the sphalerite. These blebs frequently exhibit alignment in crystallographic directions in the sphalerite. One specimen (P.295) consisting largely of siderite gangue, contains an area of sphalerite measuring 2cm. x 1cm.

Pyrite occurs in most specimens as clusters of fine idiomorphic crystals (0.015mm to 0.05mm) in the galena, these crystals having apparently been extensively replaced by the galena. Occasional allotriomorphic areas of pyrite, up to several millimetres in width, are present in the galena (eg.P.378). The pyrite in these areas appears to have undergone fracturing, and many of the fractures are occupied by galena and tetrahedrite. One specimen (P.294) consists almost entirely of massive pyrite with only very small amounts of galena, tetrahedrite, chalcopyrite and sphalerite occupying fractures and intergranular spaces in the pyrite. According to the description by Waller (1902b) this sample would be more typical of ore from the lower levels of the mine.

Rare isolated crystals of arsenopyrite were noted in the galena (P.380). These crystals exhibit the idiomorphic rhomb shape characteristic of arsenopyrite, and textural relationships indicate that these have been extensively replaced by the galena.

Assemblages of ore minerals.

Common:	Galena - tetrahedrite Bournonite - galena Boulangerite - galena Galena - pyrite Pyrite - sphalerite
Infrequent:	Boulangerite - bournonite Boulangerite - bournonite - galena Boulangerite - bournonite - galena - tetrahedrite Boulangerite - bournonite - tetrahedrite Boulangerite - galena - sphalerite Boulangerite - galena - tetrahedrite Bournonite - galena - tetrahedrite Chalcopyrite - galena - tetrahedrite Chalcopyrite - pyrite Chalcopyrite - pyrite - tetrahedrite Chalcopyrite - sphalerite Chalcopyrite - tetrahedrite Galena - pyrargyrite Galena - pyrite - sphalerite Galena - pyrite - tetrahedrite Galena - sphalerite - tetrahedrite Pyrite - sphalerite Pyrite - tetrahedrite
Rare:	Arsenopyrite - galena Covellite - tetrahedrite

Zeehan-Montana Mine.

The workings of the Zeehan - Montana Mine are located to the south-east of the Zeehan - Western Mine. The main shaft (Montana No. 1) is situated a few yards west of the Corinna Road, about ¼-mile north-north-west from the junction with the Trial Harbour road. The No. 2 shaft (originally the Silver Queen No. 1 shaft) is located approximately 200 yards north-east of the road junction, and other smaller workings are located on the lower western slopes of Montana Hill, east of the Corinna road.

Blissett (1962) has described the host rocks in the No.1 workings as "intensely folded and shattered alternating dark slate, siltstone and pale grey quartzite, with interbedded flows of spilitic lava, believed to be the upper part of the Oonah Quartzite and Slate." Blissett also reported that "to the south-east they (the slates and quartzites) are overlain by deeply weathered purplish and grey shale, siltstone and greywacke assigned to the Crimson Creek Formation---" and that the No. 2 workings are "almost entirely within the latter sequence".

Descriptions of the workings were given by Twelvetrees (1901a), Waller (1904), and Twelvetrees and Ward (1910). The most extensive workings were the No. 1 workings. This shaft extended to a depth of 830 feet, and eight levels were developed, the deepest being No. 8 at 800 feet. A total of nine lodes were reported in the No. 1 workings. These have been described (Waller, 1904) as fissure bodies and apparently consisted essentially of galena in siderite gangue. According to Twelvetrees and Ward (1910) the silver content of the ore did not vary with depth, and the highest silver content reported in ore from the No. 1 workings was 115ozs. per ton for ore carrying 67% lead. This was an assay of a picked sample from No. 2 Lode on No. 3 (295ft.) Level.

The No. 2 workings extended to a depth of 500 feet and two lodes were worked from a total of five levels. The ore in the No. 2 workings was more pyritic and was reported to be lower in silver content.

Polished sections were prepared from specimens obtained from the Tasmanian Museum collection and from samples collected from the dumps in the vicinity of the abandoned workings.

The main constituents of these specimens are galena, pyrite and sphalerite in a gangue of quartz and siderite. Minor amounts of boulangerite, bournonite, tetrahedrite and chalcopyrite were observed in polished sections. Plumbogummite and pyromorphite are associated with galena in one specimen (X.2083), and Petterd (1910) recorded matlockite as small quantities associated with galena.

Several of the specimens consist essentially of massive galena with inclusions of boulangerite, bournonite and tetrahedrite. Boulangerite is the most abundant of these three minerals and occurs as disseminated fine needle-like crystals ranging in length from 0.002mm to 0.025mm. The boulangerite is occasionally concentrated into narrow seams and veins, and small irregularly shaped areas up to ½mm. in overall width.

Bournonite is common in some galena specimens (eg. P.107, 108) but less common in others (eg. P.109). The inclusions of bournonite in galena are generally round or ovate, and vary from 0.005mm. to 0.03mm. Composite boulangerite-bournonite inclusions are also common, and small irregularly shaped inclusions of bournonite, up to 0.075mm. in width, occur within the boulangerite areas. One small area in P.107 consists of a fine intergrowth of bournonite and chalcopyrite with subordinate boulangerite. This area measures approximately 1.5mm x 1mm.

Tetrahedrite is rare or absent in some galena specimens (eg. P.107) but is common in others, particularly P.109. The tetrahedrite occurs in the galena as irregularly shaped bodies ranging in size from 0.005mm. up to 0.05mm. Some of these bodies are located around the margins of sphalerite inclusions in the galena.

The sphalerite content varies considerably between specimens. In P.107-109 sphalerite is present only as small areas, generally less than 1mm. in overall width, in the massive galena. P.286 consists of sphalerite and galena in approximately equal proportions and P.287 consists largely of sphalerite with subordinate pyrite and galena. Galena appears to have extensively replaced the sphalerite and in P.286 the two minerals are intimately associated in a "replacement intergrowth" texture. Chalcopyrite blebs are rare in the sphalerite in these specimens.

Pyrite also varies considerably in abundance between specimens. Some specimens (eg. P.290,291) consist mainly of pyrite and quartz, but the specimens of massive galena (eg. P.108) contain pyrite as only occasional fine (0.01mm to 0.075mm.) idiomorphic crystals which appear to have been extensively replaced by the galena. The massive allotriomorphic pyrite specimensappear to have undergone extensive fracturing, with some of the fractures now occupied by chalcopyrite (eg. P.291). A little chalcopyrite is also present in the intergranular areas in the massive pyrite, some of these patches of chalcopyrite reaching 0.5mm. in overall width, and the pyrite appears to have undergone partial replacement.

Plumbogummite is present as an earthy white coating on specimen X.2083. When examined closely, this specimen can be seen to consist of galena which has been partially oxidized to red-brown pyromorphite which has, in turn, undergone alteration to plumbogummite. This feature was also noted by Baker (1963) who has reported on the same specimen.

Assemblages of ore minerals.

Common:	Boulangerite - galena
	Galena - sphalerite
	Bournonite - galena
	Galena - tetrahedrite
	Pyrite - sphalerite
	Galena - pyrite - sphalerite
	Boulangerite - bournonite - galena
	Chalcopyrite - pyrite
Infrequent:	Boulangerite - bournonite
	Boulangerite - bournonite - chalcopyrite
	Boulangerite - pyrite
	Bournonite - galena - sphalerite
	Galena - pyrite
	Galena - sphalerite - tetrahedrite
Rare:	Chalcopyrite - sphalerite

Montana Silver-Lead Mine

The workings of the Montana Silver-Lead Mine, abandoned since 1958, are situated a short distance west of the Corinna road 2 miles, direct line, north-north-west from the junction of the Corinna and Trial Harbour roads. This mine marks the northern extremity of the Zeehan mineral field. The original workings at this locality were known as the May Queen workings, and later became known as the Montana Western Extended. The lease was taken up by the Montana Silver-Lead Co. N.L. in 1939.

Blissett (1962) has given the following description of the general geology of the area.

"The country rocks are a monotonous series of alternating pale grey saccharoidal quartzite, siltstone and green, grey and black shale or slate which form part of the Oonah Quartzite and Slate ——. The beds were tightly folded and faulted during the Devonian Tabberabberan Orogeny. The folds strike north-west with reversals of plunge produced by cross folding. Fault and shear zones provided zones of weakness trending north-north-west or north-north-east along which mineralisation took place later in the Devonian. After long peneplanation, Permian tillite was deposited across the eroded Proterozoic rocks and during intense faulting, probably in Tertiary times, Proterozoic quartzite and slate were thrust over the Permian glacial formation."

The mine workings have been described in reports by Blake (1936, 1938, 1939) and Taylor and Burger (1951b, 1952, 1953). The main workings consist of the "Adit Level", and levels at 100 feet, 150ft., 200ft. and 270ft., with a smaller intermediate level above the 100ft. level.

Blake (1936) reported the presence of six parallel lodes at the surface, but Clarke's Lode ("Main Lode" of Taylor and

Burger, 1951b) was the only lode worked underground. According to Taylor and Burger (1951b) the lodes are irregular fissure veins with a maximum width of about eight feet. From descriptions in the above reports, in particular that of Taylor and Burger (1951b), it is apparent that the ore consisted of galena, with minor amounts of sphalerite, pyrite and chalcopyrite, in a gangue of quartz and siderite and a little calcite. Blake (1936) reported some tetrahedrite associated with galena, and Taylor and Burger (1951b) claim to have identified bornite in one specimen. In view of the complete absence of bornite in any of the polished sections of the Zeehan ores, and in view of the absence of any other record of bornite in the area, this hand specimen identification is regarded as doubtful.

The following assays of twelve representative specimens of ore from the mine were reported by Taylor and Burger(1951b).

	Pb%	Ag(ozs./ton)	Zn%
1.	48.4	87.5	9.1
2.	3.7	4.1	4.2
3.	25.0	25.8	14.6
4.	17.7	38.1	8.3
5.	27.4	11.0	0.3
6.	0.9	1.9	0.2
7.	37.6	19.5	3.4
8.	47.5	41.1	0.9
9.	62.4	86.2	5.3
10.	24.0	15.3	1.4
11.	65.4	111.2	3.5
12.	60.4	66.5	1.8

A further series of seven channel samples collected by Taylor and Burger from the adit workings gave values ranging from 0.5% to 18%Pb, 0.6 to 16.2 ozs. Ag per ton, and 0.4% to 2.2%Zn. Assays on eight samples collected by Taylor and Burger from ore lenses on the 150ft. level gave values from 1% to 24%Pb, 1.6ozs. to 34.3ozs.Ag per ton, and 1.3% to 5%Zn.

Apart from one specimen of high grade lead ore (P.251) obtained from the Department of Mines, the only material available for study consisted of specimens collected from the dumps. These specimens consist of galena, sphalerite and pyrite in a gangue of quartz and siderite. Minor tetrahedrite, chalcopyrite and bournonite were also noted in polished sections. No high grade specimens of ore were obtained from the dumps, all specimens contain a high proportion of the non-metallic gangue associated with the ore minerals.

In most of the specimens galena is the major metallic constituent, but sphalerite and pyrite are often intimately associated with the galena. Sphalerite has apparently been extensively replaced by galena, and highly corroded remnants ranging in size from a few microns up to 2cm. are found within the areas of galena.

Pyrite is commonly present as fine (0.02mm. to 0.1mm.) idiomorphic crystals disseminated through the galena and sphalerite, and showing apparent partial replacement by both minerals. Pyrite also occurs as patches of subidiomorphic material up to ½cm. in width, and many of these areas contain fine veins and irregularly shaped inclusions of galena.

Tetrahedrite is common as small inclusions of irregular shape within the galena in most specimens. The size of the tetrahedrite bodies ranges from 0.03mm up to 0.12mm. Occasional larger areas of tetrahedrite, up to 1mm in overall width, were observed (P.114,204), and in these areas the tetrahedrite is associated with galena in a texture which approaches a graphic intergrowth (Plate 9, No. 1). A little chalcopyrite is associated with the tetrahedrite. In P.251 chalcopyrite forms occasional irregularly shaped areas, up to several millimetres in width and length, within the massive galena, and tetrahedrite occurs as small inclusions within the chalcopyrite.

Fine exsolution blebs of chalcopyrite are common in much of the sphalerite. These bodies range in size from less than 0.001mm up to 0.005mm., and many show alignment along crystallographic directions in the sphalerite. Some poorly defined growth zoning was observed in the sphalerite (P.110), and this is partially defined by parallel lines of chalcopyrite blebs as well as by alternating colour bands. A little chalcopyrite also occurs in narrow veinlets within the sphalerite. These veinlets range from 0.002mm up to 0.005mm. in width, and are assumed to be segregation veinlets which have exsolved from the sphalerite host.

Bournonite is common as inclusions in the galena in the massive ore specimen (P.251) but was not observed in other specimens. In P.251 the bournonite inclusions are mainly within the size limits 0.01mm to 0.035mm., but occasional larger bodies, up to 0.8mm. were observed. The finer bodies are generally round in shape but as the size of the bournonite bodies increases the shape becomes less regular.

Assemblages of ore minerals.

Common:	Galena - sphalerite
	Galena - pyrite
	Galena - tetrahedrite
	Chalcopyrite - sphalerite
Infrequent:	Bournonite - galena
	Chalcopyrite - galena
	Chalcopyrite - galena - tetrahedrite
	Chalcopyrite - pyrite
	Chalcopyrite - pyrite - tetrahedrite
	Chalcopyrite - tetrahedrite
	Galena - pyrite - sphalerite
	Galena - pyrite - tetrahedrite
	Galena - sphalerite - tetrahedrite
	Pyrite - sphalerite
	Pyrite - tetrahedrite
	Sphalerite - tetrahedrite

Tasmanian Crown Mine

The Tasmanian Crown Silver Mining Co. Ltd. held leases covering the eastern slopes of Montana Hill, to the east of the Zeehan-Montana Mine, and also covering part of the flat to the east of Montana Hill.

Blissett (1962) has given the following description of the geology of the area concerned.

"Highly folded and disturbed slate, siltstone and quartzite (Oonah Quartzite and Slate) forming Montana Hill are faulted to the east against Ordovician Gordon Limestone. As in the rest of the Zeehan district, the decomposed limestone has given rise to a swampy buttongrass flat across which Main Creek flows."

The main shaft, located in the valley of Main Creek, was sunk to a depth of 200ft., with levels at 100ft. and 170ft. Montgomery (1890, 1893, 1895) reported the presence of several lodes in the area. These were siderite lodes with galena and sphalerite, but the ore was apparently rather patchy.

It was recorded by Montgomery (1893) that a parcel of 40 tons of ore from the Tasmanian Crown Mine had, on concentrating, yielded 11 tons 9cwt of galena, assaying 71.5% lead and 92ozs. 2dwt. 9gr. of silver per ton. Another parcel of 10 tons of ore yielded 13cwt. of concentrate, assaying 75% lead and 52ozs. 11dwt. 20gr. of silver per ton. Montgomery (1890) also reported that about six tons of galena, assaying 114ozs. of silver per ton, were produced from a small shaft on Montana Hill near the southern boundary of the lease.

Petterd (1910) recorded small amounts of melanterite and voltzite in the workings of the Silver (Tasmanian) Crown Mine.

Very few specimens of ore could be obtained from the dumps near the workings, and only two specimens were available in the Tasmanian Museum collection. The main minerals represented in these specimens are galena, sphalerite and pyrite in a siderite gangue. Small amounts of boulangerite, tetrahedrite and chalcopyrite were observed in polished sections.

Galena is the major constituent of P.384 and 385, and occurs in approximately equal proportions with sphalerite in P.186 and 262. Boulangerite and tetrahedrite are common in P.384 as fine inclusions within the galena, but were not observed in other specimens. The galena in P.385 contains no associated ore minerals, the only other mineral present being a small amount of siderite. The boulangerite inclusions in the galena in P.384 are particularly abundant. The most common shapes of these bodies are round (0.005mm to 0.03mm. in diameter) and needle-like (0.005mm. to 0.05mm. in length), but occasional irregularly shaped bodies up to 0.1mm. in width were also noted. Many of the needle-like bodies show alignment along crystallographic planes in the galena.

Tetrahedrite inclusions in P.384 are less abundant than the boulangerite bodies and are more sporadically distributed. The shapes of the tetrahedrite bodies are generally irregular and the size range observed was 0.02mm. to 0.05mm. Occasional composite boulangerite-tetrahedrite bodies are present.

Sphalerite is rare in the massive galena but is common in P.186 and 26[illegible], and has apparently been extensively replaced by the galena. Chalcopyrite is present as minute (0.0005mm to 0.005mm.) blebs in the sphalerite.

Pyrite is not abundant in most specimens and occurs as small idiomorphic crystals distributed through the galena and sphalerite. One specimen collected (P.307) consists entirely of allotriomorphic granular pyrite and interstitial quartz.

Assemblages of ore minerals.

Common:	Galena - sphalerite Galena - pyrite Pyrite - sphalerite Boulangerite - galena
Infrequent:	Boulangerite - galena - tetrahedrite Chalcopyrite - sphalerite Galena - sphalerite - tetrahedrite Galena - tetrahedrite

Despatch Mine

The main shaft of the Despatch Mine is located on the limestone flat to the south-east of Montana Hill, and is approximately 600 yards north-north-west of the Zeehan post office.

The host rock is the Ordovician Gordon Limestone.

Very few specimens of ore are available from this mine, and in the absence of earlier descriptions of the content of the ore it is not possible to judge to what extent these specimens are representative samples. Montgomery (1893) recorded galena but made no further comment on the composition of the ore. No production was recorded from this mine.

The specimens collected consist almost entirely of galena, pyrite and sphalerite, with only minor amounts of chalcopyrite, boulangerite, arsenopyrite, marcasite and pyrrhotite with a siderite gangue.

The relative proportions of the three major components vary considerably between specimens. P.308 and 309 consist largely of galena and pyrite, whereas P.310 is essentially a specimen of massive sphalerite.

Pyrite is present in both galena and sphalerite as idiomorphic crystals showing a considerable variation in size (0.01mm. to 5mm.). Textures suggest that the crystals have been extensively replaced by galena and partially replaced by sphalerite. A little arsenopyrite and marcasite occur in association with the pyrite, the former as small (0.05mm) idiomorphic rhombs. Pyrite is also present in the sphalerite (P.310) as clusters and veinlets of fine crystals. The size of the individual crystals in this form is generally between 0.01mm and 0.02mm. This form of pyrite has been observed in sphalerite in other mines in the district (eg. T.L.E. and Stonehenge Mines).

Galena from the Despatch Mine contains few inclusions, and if these specimens are typical of ore from the mine then the ore was low in silver content. Boulangerite is present as occasional fine blade-shaped bodies up to 0.03mm. in length (P.309). Tetrahedrite and bournonite were not observed.

The sphalerite is moderately dark in hand specimen and inclusions of chalcopyrite are common. These chalcopyrite inclusions range from fine blebs (0.001mm to 0.01mm) to small elongate and curved bodies measuring up to 0.05mm. x 0.02mm. The latter bodies tend to occur in clusters in areas free of the fine blebs. Pyrrhotite is present as rare ovate shaped blebs (0.01mm x 0.005mm.) in the sphalerite and very rare round inclusions (0.02mm in diameter) in the galena (P.308).

Assemblages of ore minerals.

Common:	Galena - pyrite
	Galena - sphalerite
	Pyrite - sphalerite
	Chalcopyrite - sphalerite
Infrequent:	Arsenopyrite - galena
	Arsenopyrite - galena - pyrite
	Boulangerite - galena
	Galena - marcasite - pyrite
	Galena - pyrite - sphalerite
Rare:	Galena - pyrrhotite
	Pyrrhotite - sphalerite