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PROGRESS REPORT ON

# THE NORTH PIEMAN MINERAL AREA

ZEEHAN

5th November, 1954

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REGIONAL GEOLOGIST

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# THE NORTH PIEMAN MINERAL AREA

## INTRODUCTION

Work on the North Pieman Mineral Area commenced during June, 1949 and has proceeded intermittently to the present date. The following staff has been engaged in this work:-

B.L. Taylor - Geologist and Regional Geologist June, 1949 to present date.

D. Burger - Geologist 4th September, 1950 to 18th June, 1954.

D.E. Sargison - Field Assistant 25th October, 1950 to 29th April, 1953.

A.V. Jackson - Field Assistant 28th July, 1953, to present date.

W.P. Sergeyeff - Field Assistant 11th January, 1954 to 10th May, 1954.

The North Pieman Mineral Area was defined by the then Director of Mines, Mr. W.H. Williams, as follows:-

"Starting from the Rosebery Railway Station and proceeding along the Pieman River to Corinna, thence along the Corinna-Waratah Road to Waratah, thence via a direct line from Waratah to the crossing of the Hatfield River by the Emu Bay Railway, thence along the Emu Bay Railway to the railway bridge over the Pieman River, thence along the Pieman River to the point of commencement, a total area of approximately 450 square miles."

It will be noted that this area is defined by natural boundaries. During the early part of June, 1953, consequent on the establishment of a Regional Office at Lorinna, a conference was held in Hobart between the Director of Mines and Regional Geologists from Lorinna and Zeehan. At this conference, the boundaries of the areas to be served by each of the Regional Offices were defined using the Military Grid. That for the Zeehan Office was defined as follows:-

"Between the West Coast and 370,000 East and between 830,000 North and 890,000 North."

That for the Lorinna Office was defined as:-

"Between 370,000 East and 430,000 East and between 850,000 North and 900,000 North."

It will be noted that the two areas are contiguous along the 370,000 East line. In addition, a systematic system of sheet numbering covering the whole State was adopted, the standard size of sheet being 34½ inches by 22⅔ inches. This, on a scale of 20 chains to the inch covers an actual area of 15,000 yards by 10,000 yards i.e. one and a half of the military grid squares as shown on State maps 8M and 4M. Numbering of these map sheets is carried out as follows:-

From west to east and commencing at 265,000 East and finishing at 625,000 East, lettered from "A" to "Y" at 15,000 yard intervals - and from 620,000 North to 102,000 North numbered "1" to "40" at 10,000 yard intervals.

On this basis, the Zeehan area is covered by 29 map sheets and the Lorinna area by 20 sheets.

ACCESS

Access within the North Pieman Mineral Area is confined solely to tracks and some old tramways in varying states of disuse. Vehicle access is confined to the perimeter of the area as follows:-

(1) The Emu Bay Railway from Guildford to Zeehan. Between the Hatfield River crossing and the Pieman Bridge, this railway forms the eastern boundary of the area.

(2) The road from Zeehan to Rosebery practically parallels the railway and does not provide access to any additional areas.

(3) The road from Zeehan to the "Eight Mile" provides preliminary access to portion of the area.

(4) The road from Waratah to Corinna forms the northern and western limit of the area.

(5) The Granville Tramway continues beyond the Eight Mile for a further distance of approximately nine miles in a general northwesterly direction. This section can be negotiated by four-wheel-drive vehicles for approximately eight miles. Beyond the end of the tramway, there are approximately thirteen miles of pack track connecting to Corinna.

(6) From a point four miles from Zeehan on the Zeehan - Eight Mile Road, the Mines Department has constructed a vehicle track to within one and a half miles of the Pieman River junction with the Stanley. This track can be negotiated by four-wheel-drive vehicles only.

Track access to and within the North Pieman Mineral Area was, in the period 1900 to 1920, fairly well developed and it was possible to reach almost any portion of the area in reasonable comfort. However, following the decline of interest in the field, maintenance on the tracks ceased and they are now considerably overgrown except where recent clearing has been carried out. Existing tracks with a brief idea of their present state are as follows:-

(1) Track from Mines Department Road to the Stanley Reward tin workings. This is a very old track and was the first access from Zeehan to the Stanley Reward area. Originally, the track left the Western Consolidated Tramway near the site of the present Montana Silver-Lead Mine, followed a general westerly direction, crossed the head-waters of the Little Pine Creek, turned northerly to within half a mile of the Pieman River, and thence northwesterly reaching the Pieman just upstream from its junction with the Stanley River. The Pieman and the Stanley were crossed by means of cages and the track then proceeded to the Stanley Reward. The present Mines Department road leaves the Zeehan-Eight Mile road four miles from Zeehan, picks up the old track near its crossing of the Little Pine Creek and then follows the route of the track. At the end of the road, there is a permanent camp consisting of a hut with four bunks, a storeroom and a garage. The whole of the track to the Stanley is over buttongrass except where the Pieman is crossed and for the last 200 yards before reaching the

Stanley Reward and no difficulty is experienced in finding it. The Mines Department has erected an all-weather cage crossing below the Stanley junction. This cage can be operated by one man from either side. Approximate travelling time from the camp to the Pieman River is half an hour and from the River to the Stanley Reward, three and a half hours. At the Stanley Reward, there is an old hut with four bunks.

(2) Track from Renison Bell to Stanley Reward. This is a pack track put in by the Government in the period 1907-1909 to serve the Stanley Reward and the Mount Lindsay area. The distance from Renison Bell to the Pieman River crossing is six miles and the track is picked up opposite a timber cutters camp on the Renison Bell Road just before reaching the overbridge over the E.B.R. The walking distance may be shortened by one mile by crossing over the Argent Dam and picking up the main track approximately 100 yards beyond. The whole of this track has recently been cleared and walking time from the Argent Dam to the River is about two hours. The Pieman River used to be crossed by a suspension bridge but this now cannot be used. A recently constructed cage along side of the bridge also cannot be used owing to faulty construction. However, the river can be waded about one quarter of a mile downstream from the bridge at low water only. From the crossing to the Stanley Reward, is a distance of eight miles the first six miles of which has recently been cleared. Walking time for this section is approximately four hours. From the six mile peg, a dead-end pack track runs for one and a half miles to the old Mount Lindsay Tin Mine. This section has also been recently cleared. At the Mount Lindsay mine there is a hut available with four bunks.

(3) The Mount Ramsay track. This was a pack track. It leaves the Stanley Reward pack track about half a mile from the old suspension bridge on the north side of the river, crosses the Wilson River by a bridge, proceeds east for three and a half miles crossing the old osmiridium field, then runs almost due north along the west side of the Huskisson River passing to the west of Mount Ramsay and reaching the Waratah road some three miles west of Badger Plains. The Bridge over the Wilson River is now of no further use but the river can be waded at low water. This track is in fair condition for four miles from the Wilson River crossing but beyond this point, it is practically obliterated. In 1949-50 the Forestry Commission cleared the northern section of this track from the Corinna Road as access to the Mount Ramsay trig. station. Walking time for this section was stated to be four hours.

(4) Track from Renison Bell to Three Mile Creek. This track is approximately five miles in length. It leaves Renison Bell as a continuation of the main street, follows over buttongrass for half a mile, then in forest along first the east and then the west bank of the Argent River meeting the Pieman opposite the Huskisson River. The bridge across the Argent has been washed away as also have the cages over the Pieman and Huskisson Rivers. The track continues over buttongrass on the north side of the river to meet the Mount Ramsay track at the Three Mile Creek. By turning off the former track at the second stream encountered beyond the buttongrass plain, (Trinder's Creek) and following upstream for half a mile a temporary wooden camp may be found.

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(5) From the Ramsay Track some two miles beyond its junction with the track from Renison Bell, an old pack track leads in a northwesterly direction along the north-eastern side of the serpentine belt, crosses the Wilson River, and goes on as far as the Little Wilson River. This track can be followed with some difficulty as far as the Wilson crossing but beyond this point it is completely overgrown.

(6) From a point on the Ramsay track near the Three Mile Creek, an old pack track skirts around the north side of Riley's Knob, crosses the Huskisson River, and proceeds in a general southeasterly direction crossing the Pieman at the bend near the Rosebery railway station and thence to Rosebery. The section as far as the Huskisson can be followed with difficulty, the latter portion is almost obliterated. Cages over the Huskisson and Pieman have been washed away. The Huskisson can be waded at low water but the Pieman is not wadable at the crossing point.

(7) Chester - Pinnacles track. Some half a mile up the E.B.R. from Farrell Siding an old tram line leads into the abandoned Chester Mine, a distance of approximately one mile. From a point half way up the Chester haulage, a track leads off in a northerly direction crossing the Holloway Rivulet, to the old Pinnacles workings. This track was cleaned out several years ago and has been abandoned for about four years.

(8) From a point just before the E.B.R. Crosses Boco Creek, the Electrolytic Zinc Company some seven years ago formed a track into the Pinnacles and continued it to Silver Falls. This track has been abandoned about four years.

(9) Yellowband Plains Track. From a point on the Waratah-Corinna Road some six miles from Waratah, an old pack track goes in to the Yellowband Plains and beyond. Approximately sixteen miles of this track as far as the Yellowband Creek were cleaned out by the Mines Department in 1947 but has been abandoned since early in 1948.

(10) South of the Waratah - Corinna Road along the Whyte River, there are a number of old mines such as the Cleveland, Washington May, Confidence, Godkin and Whyte River. A loop track connecting these was cleaned out by the Electrolytic Zinc Company in about 1949 - 50 but has since been abandoned for about three years.

(11) At about 34 miles from Waratah on the Waratah - Corinna Road, a short track of one mile leads into the old Cape Copper Mine. The start of this track is several hundred yards on the Corinna side of a galvanised iron Government hut. In 1950, the Forestry Commission extended this track to Mount Meredith for access to a trig station. The walking time from the road to the trig is stated to be six hours.

(12) Some two miles beyond the Government hut, and just before reaching Brown's Plains trig. station, a pack track leads in some three miles to the Rocky River Copper Mine. This track is overgrown but followable. Cages over the Whyte and Rocky Rivers have disappeared.

(13) From the Nancy Landing on the Pieman River a one mile section of track is shown on the plans leading to Frenchman's Peak. No information on this track is available.

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(14) Track from Meredith Landing on Pieman River to Badger Plain. Approximately the first eight miles of this track as far as Whaleback Ridge trig. is through forest along the divide between the Meredith and Paradise Rivers. This is a formed track and, although overgrown, stated to be followable. From Whaleback Ridge trig. to the Stanley River track is over buttongrass and can be found with some difficulty. Beyond the Stanley the track is completely obliterated around the Parson's Hood. No information is available on the section between Parson's Hood and Badger Plains but it is considered highly unlikely that any trace of this section of the track now remains.

(15) David Jones' Track. This leaves the previous track in the vicinity of Whaleback Ridge, skirts around the west side of the Meredith Range, crosses the range south of Mount Meredith, passes the Yellowband Plains, and joins up with the tramway at Mount Stewart, thence via the tramway to the Waratah Road. Little is known of the present condition of this track but it is known that the tramway section is considerably overgrown.

(16) From the Stanley Reward some ten miles of track is shown on the plans running up the Stanley valley to join Jones' track near the Yellowband Plains. A search in the vicinity of the Stanley Reward has failed to reveal any sign of this track.

TOPOGRAPHY

The main drainage of the West Coast between Cape Grim and Macquarie Harbour and extending to the central plateau is divided between three basins - those of the Arthur, Pieman and Gordon Rivers. Between the Arthur and the Pieman there is a narrow coastal strip with a series of small streams flowing directly to the coast and between the Pieman Heads and Trial Harbour there is a similar narrow coastal strip. Between the Pieman and the Gordon basins three much smaller ones occur - the Little Henty, the Henty and the King. Between the King and the Gordon basins there is a further small area of streams flowing direct to the coast.

The North Pieman Mineral Area is wholly within the Pieman Basin (except near Waratah where it includes a very small portion of the Arthur Basin) and covers roughly one third of the area of the basin.

The dividing line between the Pieman and Arthur Basins trends approximately northwest along the line Mount Pearse - Mount Cleveland - Mount Bertha. This is a zone of high elevation and the Arthur River flows near the northern edge of its basin. Similarly, the Pieman flows near the southern edge of its basin. Thus there are long tributaries running from the central dividing ridge to each of the main rivers concerned. In the Pieman Basin, the chief south-flowing tributaries are:-

(1) The Huskisson River with its tributaries the Que, Hatfield, Coldstream and Ramsay River.
(2) The Wilson River with tributaries Pine Creek, Yellowband Creek, Little Wilson River, Harman River and Four Mile Creek.
(3) The Stanley River.
(4) The Meredith River.
(5) The Paradise River.
(6) The Whyte River with its tributaries the Heazlewood, Castray and Rocky Rivers.

West of the North Pieman Mineral Area, there also occur:-

(1) The Savage River.
(2) The Donaldson River.

North-flowing tributaries of the Pieman between Rosebery and the mouth are much shorter. These consist of:-

(1) The Stitt.
(2) The Exe River.
(3) The Ring River.
(4) The Argent River.
(5) Crimson Creek.
(6) An un-named tributary entering the Pieman one mile upstream from the Stanley.
(7) Pine Creek.
(8) The Heemskirk River.
(9) A number of small un-named streams between the Heemskirk and Corinna.

The whole of the West Coast has, of recent geological times, undergone a period of uplift. Consequently, the streams are deeply incised and generally fast-flowing. The Pieman River at Rosebery is approximately 200 feet below the general level of the flats, and near the Stanley River junction, it is about 400 feet below. The Pieman itself appears to have just about reached the stage of base-levelling. At Rosebery the water level is approximately 200 feet above sea level. The river distance between this point and the coast is about 40 miles, giving an average gradient of 5 feet per mile. Along the course of the river, there are no waterfalls but a few rapids occur. Certain stretches show local base-levelling with deposition of alluvium and/or side-cutting of the river banks.

The lower reaches of the main south-flowing tributaries have also about reached the stage of base-levelling but, in general, all the tributaries may be regarded as actively deepening their channels.

There are a number of different rock groups within the area and, when viewed as a whole, the stream pattern does not appear to be directly influenced by the distribution of rock groups. For instance, the Huskisson and its tributaries rise in basalt, crosses in a general S.S.W. direction successively Cambrian sediments, Ordovician to Lower Devonian sediments, serpentine and again Cambrian Sediments. Again, the Stanley River rises in granite and passes into late pre-Cambrian sediments with no apparent change in character. The only definite relationship between stream pattern and land form appears to be the fact that streams flow north and south from the main divide between the Pieman and Arthur Basins. It is considered, therefore, that the stream pattern is a "consequent" one determined by the land surface existing prior to the latest period of uplift. The uplift has been so extensive that the streams have not had time to become "fitted" to the now-existing rock group distribution and the stream pattern is regarded as "stencilled" upon the present land surface.

In detail, a certain amount of modification of the original consequent drainage has occurred but it is stressed, at this point, that the amount of modification is minor only. It applies in general, only to smaller tributaries of the main streams. Examples of this are:-

(1) Where the Huskisson River cuts across the southern end

of the Huskisson Syncline of Junee and Eldon Group sediments. The tributaries show a parallelism in accord with the hard and soft rock types present. The streams have eroded out the softer shales and limestone and the harder quartzites stand up as ridges between.

(2) On the Meredith Range granite a consequent stream pattern is most obvious. This granite has two intersecting joint systems, the major striking northwest and the minor northeast. Streams on the granite show either a parallelism along one or other of these joint systems or a rectangular pattern where the streams cross from one system to the other.

(3) Between the Wilson and Huskisson Rivers there is a northwest trending belt of serpentine forming a ridge rising about 200 feet. A consequent pattern of minor streams is developed on either side of this.

(4) In two places the Pieman River has deviated somewhat on encountering hard rock bands.

(a) Near the junction with the Wilson River the Pieman makes a U-shaped bend cutting through a hard quartzite ridge.

(b) Below the Stanley Junction the Pieman meets an area of dolerite. It turns abruptly southwest for two miles then west and northwest to flow through the dolerite.

The topography has been modified to a certain extent by the Pleistocene glaciation. This is mainly evident in the vicinity of Rosebery. It appears that the glaciation did not extent much west of Renison Bell. The valley of the Pieman between Farrell and Renison Bell was once occupied by a glacier and the northern slopes of Mount Black, in particular, show a typical glaciated topography. It is probable that the Huskisson River valley was also once occupied by a glacier but there appears to be no evidence of glaciation further west than the mouth of the Huskisson River. In addition to glaciated land forms there is a considerable amount of glacial debris such as that on the Boco and Bobadil Plains and on the "Conglomerate Plain" north of the mouth of the Huskisson River. The most characteristic feature of this glacial debris is the presence of blocks of West Coast Range Conglomerate scattered around on the button grass plains. These range from small size to blocks weighing many tons.

With regard to land forms, the chief feature of the North Pieman Mineral Area is the Meredith Range granite which occupies one third of the total area and stands at a general elevation of 2,000 to 2,500 feet. The chief peaks are the Parson's Hood in the south, Mount Meredith approximately midway, and Mount Stewart in the north. Mount Ramsay is an isolated peak of granite to the east separated from the main mass by the Wilson River.

Around Waratah there is an extensive plateau of basalt now deeply weathered, standing at an average elevation of 2,000 feet. Above this plateau rise the sedimentary peaks of Mount Pearse and Mount Bischoff. These were peaks of the original land surface and have never been covered by the basalt.

North of Farrell Siding there occur Mount Chester and the Pinnacle Hills. These are an extension of the Mount Black range.

Between the Wilson and Huskisson Rivers, the Huskisson Syncline of Junee and Eldon Group Sediments shows a series of parallel ridges and valleys, the ridges being of relatively low elevation. Paralleling this on the southwest, the Wilson River serpentine belt forms another low range.

East of the Wilson River and south of the Meredith granite, there is an area of pre-Cambrian sediments forming a series of rolling hills with elevation from 700 feet to 1300 feet. The remaining portion of the area is occupied by Cambrian sediments which stand at a fairly low elevation.

VEGETATION

In general, the vegetation shows a direct relationship to the rock types. On the pre-Cambrian areas, there is a considerable amount of quartz gravel and thus little plant food. These areas typically support only button grass with scattered patches of eucalypts. In the stream valleys, however, this type of country generally has mixed eucalypt types almost always associated with bauera scrub. The glacial plains also support only button grass. In the serpentine zone, a typical assemblage of rather stunted scrub occurs including banksia, peppermint and stringy barks. The granite country at the highest elevations is generally quite bare but at lower elevations there is again a typical scrub assemblage. On the basalt, there is an open type of forest mostly of eucalypts such as peppermint, stringy bark and swamp gum. The Junee and Eldon Sediments support a mixed type of forest mostly myrtles but with a considerable percentage of eucalypts. The latter are generally found on the tops of the ridges and the former on the slopes and in the valleys. The Cambrian sediments weather to a stiff yellow clay which readily supports the typical West Coast rain forest consisting of myrtle, sassafras, leatherwood, some eucalypts, and occasional blackwood and wattle. In the Stanley and Wilson and along the Pieman west of the Wilson River junction, some Huon Pine occurs.

KNOWN MINERAL OCCURRENCES

Within the boundaries of the North Pieman Mineral Area as originally defined, there occur in varying abundance ores of the following:- lead, zinc, silver, copper, tin, gold, osmiridium, barium, thorium and iron.

Lead-Zinc-Silver

The most extensive area of minerals of these metals is south of the Waratah-Corinna Road between the seven mile and the Heazlewood River. Known prospects are the Gregory, Washington Hay, Confidence, Godkin, Whyte River, Mount Wright, Heazlewood, Jasper and Mount Stewart. Another area is in the vicinity of the Pinnacles including Silver Falls and the Just in Time. This area is fairly obviously a continuation of the Hercules-Rosebery line of lode. The only other occurrence of this group is a small lode on the Stanley Reward flat about which little is known.

Copper

A little copper occurs at the Pinnacles and Jasper mines. The major deposits of this metal occur in a remarkably persistent mineralised belt some six miles west of Corinna. Along this line there occur the Rocky River and Cape Copper mines and several unnamed prospects. The line of mineralisation extends northwards out of the area to the Rio Tinto and Specimen Reef.

Tin This is fairly widely distributed both lode and alluvial deposits occurring. Major deposits in the south are at the Stanley Reward where both lode and alluvial occur and at the Mount Lindsay Tin Mine. Here a remarkably persistent lode zone occurs consisting, not of a fracture filling, but of an impregnation of slates along the bedding. The zone is up to 100 feet wide and has been traced continuously for at least half a mile. The mineral content is complex consisting of magnetite, pyrite, marcasite, pyrrhotite, chalcopyrite, arsenopyrite, rutile and cassiterite, together with a considerable variety of non-metallic minerals.

In the north, the chief deposits, mainly of lode tin, occur at Campbells, Moores, Cundys, Wombat Flats, South Bischoff and the Cleveland. In the centre of the area on top of the Meredith range, there are a number of known patches of alluvial tin. East of the Stanley Reward, along the Wilson and Harman Rivers, alluvial tin occurs in association with osmiridium and gold.

Gold

Some lode gold is associated with the iron-copper belt east of Corinna but as far as it is known, it has not been worked. The remaining gold occurrences are all alluvial. The chief field is that of Corinna and surrounding districts including the Frenchman's Peak and Lucy Spur. The field extends outside the North Pieman Mineral Area to include the Savage River and some of its tributaries. Around the turn of the century, the Corinna area was a flourishing gold field but activity has now ceased. A minor amount of alluvial gold occurs associated with tin and osmiridium near the Wilson and Harman Rivers.

Osmiridium

The major field is that known as the "Wilson River Osmiridium Field". This is an extensive belt of serpentine country located between the Harman and Huskisson Rivers. From the Pieman, it extends northwesterly as a belt between one and two miles in width for approximately eight miles as far as the Little Wilson River. Osmiridium shed from the serpentine was worked extensively in the period 1910 to 1930 both on the serpentine itself and in the small streams flowing off the serpentine. It is a matter of interest that the largest nugget found in this field (Sweeney's Nugget") weighed 1 oz. 19 dwts. 7½ grs.

In the north, the extensive field of the Bald Hills, Heazlewood, Savage River and Nineteen Mile Creek lies mostly outside the North Pieman Mineral Area.

However, a section of this field occurs south of the Waratah-Corinna Road at Mount Stewart. This area is of interest as, in addition to normal alluvial osmiridium, there occurs here one of the two known Tasmanian occurrences of "lode" osmiridium, the other being on a tributary of the Nineteen Mile Creek. In both of these places, osmiridium was extracted by normal underground mining methods.

Some alluvial osmiridium occurs on the Meredith Range in the vicinity of Yellowband Creek but this has not been worked extensively.

Barium

Only one occurrence of barite is recorded - at the Just in Time prospect - but it is probable that it also occurs in the Pinnacles - Silver Falls area as barite is known to be a constituent of the Rosebery type of lode.

Thorium

Monazite sands occur fairly generally in the central portion of the area near the Yellowband Creek and on the Yellowband Plain. Some is also recorded from the Stanley Reward. The monazites are low in thorium - a series of samples from the Yellowband Creek averages 5.0 per cent thorium oxide. It is considered unlikely that these deposits would be suitable for working for their thorium content.

Iron

The major deposits of this metal are in the form of both magnetite and haematite-pyrite bodies in the mineralised zone east of Corinna. Little is known about this deposit other than that it is extensive and persistent. It may be stated at this point that this mineralised belt is worthy of systematic investigation.

A deposit of pyrite occurs at the Chester mine just south of the Pinnacles and is a concentration of pyrite along the Rosebery lode line. It has been worked a number of times for its sulphur content.

PRELIMINARY MAPPING OF NORTH PIEMAN MINERAL AREA

Investigation of available maps quickly revealed that no suitable base maps for systematic work were available. Available maps consisted of:-

(a) Mineral charts. These are correct as far as they go within each group of contiguous leases. However, it was later revealed that isolated groups may not necessarily be in their correct space relationships. Streams are correct where shown as crossing lease boundaries but are only sketched between these points. These charts show no contour or form lines.

(b) Geological Plans in Published Bulletins or attached Typed Reports - These are of extremely variable quality and are on varying scales. Most have been constructed using the mineral charts as a base supplemented by chain and compass or pace and compass surveys. Some show form lines based on aneroid spot heights supplemented by sketching.

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One of these, covering the Corinna Goldfield Area, includes contour lines prepared by the Forestry Commission.

(c) A detailed plan was available for portions of the Rosebery area. This was based on a minor triangulation followed by standard traverses and fill-in by chain and compass. This was the most detailed and accurate plan available but covers only a very small portion of the area. Work on this plan was never completed. During the course of the survey, vertical angles were observed and spot heights calculated but actual contour lines were not drawn.

In 1947, aerial photographs of the Zeehan quadrangle and the southern half of the Corinna quadrangle were taken by Brown and Dureau Ltd. of Melbourne for the Tasmanian Government. These were taken with a camera of focal length 8½ inches. The Zeehan photos were taken at an approximate elevation above sea-level of 11,000 feet giving an approximate scale of 1 : 16,000. The Corinna photos were taken at about 12,500 feet giving an approximate scale of 1 : 18,000. The size of the prints is 9" x 6" so that each photo covers an approximate area of three and a half square miles. Normal overlap of 66 per cent between adjacent photos and 25 per cent between adjacent runs was observed.

In view of the availability of these photos it was decided to utilise them for a base topographic map for subsequent geological work. The northern limit of the photos as at 1949 was a line from Brown's Plains on the Waratah - Corinna Road to a little north of the Pinnacles near the E.B.R. north of Rosebery. Thus the southern portion only of the North Pieman Mineral Area (approximately 200 to 250 square miles) was covered by aerial photography. It was decided, therefore, to ignore the northern unphotographed portion and to prepare base maps and proceed with geological work in the southern portion. The slotted template method was adopted as most suitable for the purpose required. This is in line with methods adopted elsewhere for regional geological and other reconnaissance work.

The only available ground survey was the minor triangulation at Rosebery mentioned above and the survey for the E.B.R. and various roads. None of these were suitably placed for use as control over the proposed area. It was therefore decided to carry out a third order triangulation over the area utilising the base line of the minor triangulation already in existence at Rosebery. This triangulation was carried out by G. Campbell-Smith in 1930 for the Mines Department. A perusal of the original field books showed that the base line had been measured with sufficient accuracy to warrant its acceptance for the larger triangulation. In addition, a latitude observation has been made for the original triangulation.

The base is located on a button grass plain on the west side of the Pieman River north of the Rosebery railway station. The points marking the north and south ends of the base line and also the point on Mount Black were re-located and beacons erected over them. The Electrolytic Zinc Company erected a beacon on the highest point of the Pinnacles. This point was then named "Burns' Peak". Additional points were then erected on:-

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(a) Bald Hill south of Rosebery
(b) Dreadnought Hill east of Renison Bell
(c) Rileys' Knob - a prominent knob at the south end of the Wilson River serpentine belt.
(d) Fenton Peak - Highest point of the divide between the Wilson and Stanley Rivers.
(e) Rose Peak - two miles west of Fenton Peak
(f) The Pincher - the highest point of the track from Zeehan to the Stanley Reward.
(g) Mount Livingstone - highest peak at the south end of the Meredith Range.
(h) Whaleback Ridge - low knob southwest of Mount Livingstone.
(i) Pieman Knob - low knob three and a quarter miles southwest of The Pincher.

The Forestry Commission was, at this time, carrying out a large triangulation in the northwest, their southernmost point being Mount Donaldson several miles northwest of Corinna. In addition to their permanent stations they had erected a number of "intersected points". One of these, just off the Waratah - Corinna Road at Brown's Plains, happened to be well located for Mines Department purposes and was therefore converted into a permanent station by the Mines Department.

The control triangulation therefore consists of fourteen stations. The total number of photos in the lay-down was 318 and trig points appear on 54 of these, giving a frequency of triangulation points to photos of 1 : 6.

A longitude observation using the method of equal altitudes on the sun was carried out at the same point where the latitude observation had previously been made. From tables supplied by the Lands and Surveys Department, Transverse Mercator Co-ordinates of the South Base, the grid bearing of the base line, and the convergence at the South Base, were then determined.

Angular observations were carried out with a Watt's No. 1 Microptic Theodolite taking 16 rounds of horizontal angles and eight observations of elevation at each end of each line of sight, making a total of sixteen observations of elevation also.

The triangulation network consist of six braced quadrilaterals from the line North Base - South Base westwards to the line Mount Livingstone - Whaleback Ridge. From the latter two points a triangle is made with Brown's Plains. Mount Donaldson was intersected from Whaleback Ridge and Brown's Plains. A trial indicated that, over the relatively small area involved, the error between calculation as a plane triangulation and as a spherical triangulation was very small. It was therefore decided to calculate it as a plane triangulation only. This was carried out in the normal manner using the method of least squares for adjustment of triangles followed by the normal three corrections for adjustment of quadrilaterals. It was found that the average closing error of triangles was 11 seconds. The triangulation programme commenced in November, 1949, and field observations were completed in May 1950. Computations were completed in August 1950.

Concurrently with the triangulation work, preparation of the photographs was undertaken. This involved the location of principal points, pass points, and triangulation points, and the making of a template for each photo. With the conclusion of the triangulation

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programme, and the preparation of the templates, the laydown was then commenced and by October 1950 the base topographic sheets were prepared. These, as indicated above, cover an area of 10,000 yards by 15,000 yards and are gridded at 1000 yard intervals. Working sheets are prepared on Kodatrace for ease in handling. Sheets so far prepared are D/24 to D/26, E/24 to E/26, F/24 to F/26 and G/24 to G/26. Sheets D/26, E/26, D/25 and E/25 fall wholly within the Corinna quadrangle, sheets G/26 and G/25 within the Mackintosh quadrangle, D/24 and E/24 are partly in the Zeehan and partly in the Corinna quadrangles and G/24 is partly in the Murchison and partly in the Mackintosh quadrangles. F/24 includes portions of all four quadrangles.

It will be noted that the bearings adopted are grid bearings as per the State maps 8M and 4M. Convergence is relatively minor as the area is close to the 146th parallel along which line grid and true north co-incide. Typical values for convergence are:-

(a) Common point Corinna - Mackintosh - Zeehan - Murchison quadrangles - 337517 E, 859139N - 41° 45' S, 145° 30' E
Convergence is 00° 19' 58.5"

(b) Midpoint southern boundary Corinna quadrangle - 331776E, 858974N - 41° 45' S, 145° 15' E
Convergence is 00° 29' 57.9"

(c) Southwest corner Corinna quadrangle - 309034 E, 859743 N - 41° 45' S, 145° 00' E
Convergence is 00° 39' 57.2"

In this, it can be seen that the convergence along the 41° 45' S line increases at the rate of approximately 10' per quarter degree of longitude or 46 seconds per mile.

With regard to magnetic variation, no accurate determination has been carried out. A series of readings were taken with two compasses used at this office on one of the triangulation lines. It was found that the variation from grid to magnetic was very close to minus 10 degrees and this figure has been adopted for all practical purposes.

TOPOGRAPHIC DETAIL FROM PHOTOGRAPHS.

Each photo has a principal point, two transferred principal points and six pass points and, due to the amount of overlap, the available photos actually give two complete areal coverages. The pass points and transferred principal points on each photo form an irregular polygon. On one set of alternate photos these polygons are outlined in yellow and on the other alternate set in green. The green set is used for deliniation of topographic features and the yellow set for photo-geological interpretation and as a base for field mapping.

Topographic mapping so far has consisted solely of deliniation of the stream pattern. It is doubtful whether contouring can be satisfactorily carried out in densely bush-covered terrain with the available photos and equipment and this has not so far been attempted. On each photo, the stream pattern is deliniated within the area of the green polygon.

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Kodatrace overlays are then prepared and detail transferred to the base sheets using a Trorey Anharmonic Rectifier.

PHOTO-GEOLOGICAL INTERPRETATION

This is carried out in a similar manner to stream deliniation using the yellow series of photos and the detail is transferred to the base sheets in the same manner. It is not intended at this stage to give detailed descriptions of the interpretation results as it is considered that these are more properly dealt with under the section dealing with geology. It may be stated, however, that, within the area covered, the igneous rocks - granites and serpentine - and patches of alluvium and recent glacial deposits can be readily identified and their boundaries determined with sufficient accuracy for regional mapping purposes. Of the sedimentary rocks, the divisions of the Junee and Eldon Groups ranging from the Gordon River Limestone up to the Bell Shales can be readily identified and their boundaries and regional structure accurately determined. The Cambrian Group lying below the Junee Group can be readily identified as a unit . However, owing to its having suffered two orogenies, and its densely bush-covered nature, it is only rarely that structure within this unit can be determined from the photographs. A group of presumed late pre-Cambrian rocks occur. These form typical button grass hills and thus strike lines within the group can be determined but the structure within the group is extremely complex owing to its having suffered at least three orogenies.

FIELD PROCEDURE

There is little in the way of access to the North Pieman Mineral Area and thus little artificial outcrop occurs. The E.B.R., the road system between Renison Bell and Rosebery, and a number of old tracks to and within the area provide the only outcrops of this type. On the open button grass areas, a considerable amount of outcrop occurs and is fairly readily reached. However, 80 per cent of the total area is covered with primary myrtle forest with undergrowth of varying density. The thick soil mantle within the forest areas effectively obscures the underlying rocks and it has been found that geological traverses in such areas are practically useless. Fortunately, however, the area has recently undergone rejuvenation. Thus, the stream system is deeply incised and deepening is proceeding, so that, in general, the streams have rock bottoms. The only useful geological traversing that can be carried out consists of systematic work along the river systems. Work of this type so far carried out consists of approximately 20 miles of the Pieman River from the E.B.R. bridge to below the Heemskirk River, approximately twelve miles of the Huskisson River and ten miles of the Wilson River. In addition, traversing has been carried out along the E.B.R. from the Pieman Bridge to the Argent Tunnel, along the road between Rosebery and the Argent Tunnel, and along a number of tracks in the vicinity of Renison Bell and the Huskisson and Wilson Rivers.

Individual photographs are specified by the quadrangle name, followed by the run number, and the

individual photo-number e.g. "Corinna Run No. 1, Photo No. 2643". No confusion arises with the photos used if the first two figures are ignored and the photo specified by the last three figures only. The above quoted photo can be positively specified as "C1/243".

During field mapping, the yellow series of photos are used for location purposes. Taking the above quoted photo as an example, the first point of geological observation within the area covered by the photo was marked as point No. 1 and became, therefore, "C1/243/1". In the field, this point is marked on the face of the photo with a wax pencil and, on return to the office, the point is pricked through, circled in red ink, and the number marked on the back of the photo in ink. The geological details are noted in the field book against the number. In practice, it is seldom possible to cover completely the operational area of any particular photo before proceeding to the next. Thus, work on any particular photo may be carried out at widely spaced times. However, the point numbers on each photo form a consecutive series no matter when the work is carried out.

On return to the office, field notes are transferred to loose-leaf typed sheets. These are kept in systematic form and indexed consecutively according to the photo number. This has four advantages:-

(a) The keeping of a duplicate set of notes minimises the inconvenience through the loss of a book in the field.
(b) It allows the collection together of notes relating to each photo.
(c) The copying out of notes allows cross reference and amplification if required.
(d) In the final copy of notes magnetic records of strike are converted to grid for transfer to map sheets.

During the course of field work, numerous samples are taken. In the field they are given a preliminary location as for field points viz. "C1/243/4" On return to the office, a card is made out with the following information :- Sample Number - Whom Taken By - Date - Location - Field Description - Remarks.

| | |
|---|---|
| Sample Number | These are allotted consecutively according to map sheet numbers. |
| Whom Taken By | Initials of geologist taking the sample. |
| Date | Date Taken. |
| Location | Preliminary location as per the field book followed by the co-ordinate position when the point has been finally transferred to the map. |
| Field Description | As per the field book, followed by further description following office examination. |
| Remarks | Any additional information such as the date the sample was forwarded for petrological examination, assay, etc. together with the report of such examination received. |

In addition to the above, on the top right hand corner of the card is placed a letter indicating the original purpose for which the sample was taken viz:-

"R" - Rock type
"F" - Fossil Content
"M" - Mineral Content
"O" - Ore Sample

As an example a complete card is quoted:-

F/25/1 "RF"

| | |
|---|---|
| Taken by | B.L.T. and D.B. |
| Date | 10. 2. 51 |
| Location | C1/243/4 862600 N - 348420 E |
| Field Description | Fine grained grey brown sandstone slightly fossiliferous. |
| Remarks | -- |

The samples themselves have the numbers painted on them and are kept in a cabinet. Where a sample is sent away for examination or assay, a duplicate is always kept.

## GEOLOGY OF THE NORTH PIEMAN MINERAL AREA.

### (1) SUMMARY

The rocks of the North Pieman Mineral Area range in age from Lower Pre-Cambrian (?) to Lower or Middle Devonian and include both sedimentary and igneous types. Of the sedimentary rocks, there are at least six groups with at least two, or possibly more unconformities. The later members ranging from the Ordovician to Lower Devonian (Junee and Eldon Groups) have been well known for a number of years and elsewhere on the West Coast their structure and stratigraphy has been well worked out. This has been possible because (a) the rocks are highly fossiliferous and (b) the constituent formations and general structure of the group can be readily recognised from aerial photographs.

The pre-Cambrian Group can be readily recognised as a group from the photographs and in the field but the structure within the Group is highly complex and no division into formations has yet been attempted.

The rocks of the Cambrian period are, perhaps, the most extensive in the West Coast area generally and certainly are the most important as, with some exceptions, they are the main host rocks for ore. Paradoxically, they have been up to the past few years, the least known. In 1909, L.K. Ward (Bull.6) gave the name "Dundas Slates" to the rocks occurring at Dundas and presumed them to be of Cambro-Ordovician age. Unfortunately, no clear definition was given and the term fell into disrepute as various workers used the term with different meanings to denote some or all of the rocks (now known to be of Cambrian age) occurring beneath the West Coast Range Conglomerate (base of the Junee Group) and above the pre-Cambrians. The tendency amongst geologists

working in the West Coast was to denote all rocks below the West Coast Range Conglomerate as "Dundas" and to make no attempt to work out the structure. Recent work by the University of Tasmania and the North Broken Hill Coy. Ltd. has been directed towards the elucidation of the structure of these rocks and some progress has been made towards this end. The Mines Department work on the North Pieman Mineral Area has been along similar lines and, as a result of all the work that has been carried out by the various organisations mentioned, a sensible picture of the lithology and stratigraphy and structure of the Cambrian System is beginning to emerge. Two rocks groups have been defined by the University workers and, in the present instance, it is proposed to name three further Groups and one Formation.

The igneous rocks in general are of two types - acidic and basic to ultrabasic. The acidic is represented by the Meredith Range Granite which shows little variation in composition and the basic and ultrabasic by a series of pyroxenites (and their alteration product, serpentine) gabbros and norites. These igneous rocks are of economic importance - the granites as the major mineralisers and the serpentines as a source of osmiridium, chromite and asbestos. Dolerites and basalts also occur but these are of no economic importance.

(2) THE SEDIMENTARY ROCKS

(a) Sequence of the Sedimentary Rocks

This is shown in the following table:-

| SYSTEM | GROUP | FORMATION | LITHOLOGY | CORRELATION |
|---|---|---|---|---|
| | | Unconformity | | |
| L. Devonian to Silurian | Eldon | Bell Shales<br>Florence Quartzite<br>Hill Shales<br>Keel Quartzite<br>Amber Slate<br>Crotty Quartzite | Quartzites, shales and slates | Eldon Group |
| | | Disconformity (?) | | |
| Ordovician | Junee | Gordon River Limestone<br>West Coast Range Conglomerate | Limestone<br>Conglomerate quartzite and sandstone | Junee Group |
| | | Unconformity | | |
| Cambrian | Huskisson | Nineteen formations as yet un-named | Slates, tuffs volcanics, eglte & grits | Dundas Group (?) |
| | Rosebery (Probable equivalent of Huskisson) | Not divided into formations as yet | Shales, quartzites, some eglte and fuchsite agglomerate | |
| | | Crimson Creek Argillites | Green and purple argillites, grey and black shale, some tuffs | Carbine Group (?) |
| | Success Creek | Not divided into formations | Slate, quartzite and breccia | |

| SYSTEM | GROUP | FORMATION | LITHOLOGY | CORRELATION |
|---|---|---|---|---|
| | | Unconformity | | |
| Pre-Cambrian | Davey | Undivided into formations | Schists, quartzites and slates | Davey Group |

(b) Davey Group (pre-Cambrian?)

This group is typically developed on the open button grass plains. South of the Meredith Range, it extends eastwards to the high ridges flanking the Wilson River of which Fenton Peak is the highest point, westwards as far as the Whaleback Ridge, and southwards across the Pieman River to west of Zeehan. The eastern boundary of the Group has been observed in the Pieman River at co-ordinate point 857,100N - 339,800 E. From this point westwards, along approximately nine miles of the Pieman River to co-ordinate point 853,200 N - 331,000 E a splendid section of this group may be obtained. The rocks are extremely variable in character consisting mainly of sandstones and quartzites, usually dark in colour, and an extreme variety of shales and slates. The dominant feature along this section is the presence of mica usually in small white to golden plates arranged parallel to the bedding. Mica is found in all types of rock along the section with the exception of the black shales. The presence of mica indicates a degree of metamorphism but it must be stressed that the bedding in no way has been destroyed and no difficulty is experienced in determining the attitude of the outcrops. No schists are developed along the Pieman River section but these make their appearance nearer the granite mass. The first schists are noted on the Pincher and Waterhouse states (Bull. 15) "Near the granite, the alteration has been intense. The original sediments now consist of schists of which the chief varieties would appear to be quartz-schists, quartz-biotite-schists, quartz-muscovite-schists, quartz-biotite-actinolite-schists etc....In appearance the rocks are bluish when fresh and undecomposed, reddish when oxidised, being bleached white on exposed surfaces.....A thin section of a fairly typical rock from the summit of Mount Livingstone shows a ground mass of quartz grains forming a regular quartz mosaic though with a defined schistose banding. With the quartzite is some clear albite, in places a little sericite in fine shreds is noted and in the ground mass a small quantity of actinolite....The rocks described above all occur near the granite intrusion and may be considered as extreme types. Undoubtedly they owe their present structure largely to the effects produced by the granite intrusion."

Over the whole of the exposed pre-Cambrian Group the effects of silicification are most marked. The effect expresses itself by the production of numerous blebs and stringers of white quartzite. On a regional basis, it is found that these are most numerous along the fringe of the Meredith Range, become sparser going south towards the Pieman, and become more numerous again near the Heemskirk granite. It is quite obvious that the silicification is a result of the granite intrusion and, from the frequency of its occurrence, it may be inferred that the granites dip under the sedimentaries at a fairly flat angle and it is probable that the two granite masses are physically connected at no great depth below the surface. In no case does there appear to be any economic mineralisation associated with the silicification. Very little mineralisation has been found in the pre-Cambrian Group and thus it was not considered expedient at this stage to undertake more detailed work than that described above.

Along the Pieman River section quoted above, the attitude of the beds is extremely variable and it is impossible to determine the structure accurately or to follow any particular bed for more than a few chains. Over the open areas between the Pieman and the Stanley Reward, all the visible strike lines have been plotted from the

photographs. There is a suggestion of parallelism in a northeast-southwest direction in general but, in detail, extreme variations from this occur. At approximately co-ordinate point 863,000 N - 356,000 E, there is a small tight anticline and near co-ordinate point 867,000 N - 328,000 E a fold can be determined west of Mount Livingstone.

The age of this Group was stated to be "probably pre-Cambrian" by Waterhouse (Bull. 15) and subsequent workers have accepted this. Waterhouse admits that the evidence for definite age determination is scanty. He refers to the striking difference between the "pre-Silurian" sediments further west and point to the micaceous nature of the rocks in question. He considers the possibility of their being a continuation of the pre-Silurian sediments but discards this theory as untenable and concludes "However, until further evidence is available, the writer prefers to regard them as being older and to tentatively class the series as of pre-Cambrian age."

The present work has shown that the Group is unconformably overlain by a lower Cambrian Group followed by a Middle to Upper Cambrian Group. On the following counts, then, the present writer would affirm that the age of the Group is pre-Cambrian:-

(1) Its position below known Cambrian Group rocks.
(2) Its unconformable relation to this Group indicating a time interval.
(3) The development of mica not significantly present in the succeeding groups.
(4) The higher degree of contortion indicating that the Group has experienced at least one orogeny before the deposition of the Cambrian sediments.

The low degree of metamorphism exhibited by the rocks of this Group is unusual for pre-Cambrian rocks and is in marked contrast to the pre-Cambrian of the central highlands which are schists in which all trace of the original bedding has been obliterated. On this count, therefore, the present writer would class the Davey Group as above described as Late pre-Cambrian in age.

(c) Success Creek Group

On the Pieman River section between co-ordinate points 857,100 N - 339,800 E and 858,800 N - 343,500 E an entirely different series of rocks can be observed. Going ~~west~~ towards from the first-mentioned point, the first bed met with is a thinly bedded soft grey shale in places much jointed and sometimes approaching slate. The strike is 38° and the dip vertical to steep southeast. The thickness of this bed in the river is very small. It is succeeded by a rather soft breccia containing angular fragments of purple sandstone and white tuff. The matrix is yellow to red fine grained material. The size of the fragments is extremely variable. The breccia contains beds of finer grained material which indicates the attitude as strike 62° and the dip 46° SE. At co-ordinate point 858,000 N - 341,300 E a band of massive quartzite is encountered. This is approximately 1200 feet in apparent width. It consists of a dark grey rather coarse grained massive quartzite in beds up to 18 inches in thickness. A number of attitude observations indicate that the strike is approximately 20° and the dip 55° E. This would make the true thickness of the bed about 1000 feet. From the eastern margin of the quartzite to co-ordinate point 858,000 N - 342,500 E there are scattered outcrops beneath alluvium of highly sheared, contorted and shattered shales on which it is impossible to

obtain accurate attitude readings. At the site of the old suspension bridge (co-ordinate point 859,200 N - 342,800 E) there is a prominent southwest-trending ridge. This is composed of dark grey impure quartzite thinly laminated. At first sight, this appears to be a shale so thin and obvious are the laminae. However, on a closer inspection, the siliceous nature is soon revealed. The strike is about 353° and the dip 75° NE. The width of this bed cannot be determined with accuracy as, on both sides, there is a gradation into shales. However, taking the ridge as revealed on the photographs as being the width of the quartzite, the apparent thickness is 1000 feet and the true thickness approximately 900 feet. This band of quartzite is quite different from the one previously mentioned, the former being thinly laminated and the latter massively bedded. Along the western margin of the laminated quartzite, there is a zone of approximate stratigraphic thickness of 700 feet, along which alternations of shales and quartzites occur. This zone merges into the shattered shale zone above mentioned. On the eastern margin on the laminated quartzite, there is a further transition zone. The quartzite gradually gives place to shales, grey to green in colour and generally fairly thinly bedded. A notable feature of the shales is the increasing presence of pyroclastic material either as very fine white thin tuff bands or as thick bands of medium grained grey brown tuffs. The attitude of this material is quite regular with strikes 313° to 327° and dips northeast between 70° and 80°. Immediately east of the laminated quartzite, and directly opposite the mouth of the Wilson River, there is a zone of fracturing accompanied by outcrops of grey to purple jasperoid material with numerous thin intersecting veins of quartz.

The apparent width of the Success Creek Group along the Pieman River is about 2½ miles. The contact with the underlying Davey Group north of the Pieman is almost due north where as the eastern (upper) contact trends northwesterly. Although the area north of the Pieman has not been traversed in detail, it is known that the Success Creek Group wedges out approximately 2½ miles north of the river. South of the river, the eastern contact trends southeasterly approximately along the Success Creek to within half a mile of Crimson Creek and then swings abruptly to the southwest. The western contact maintains its meridional trend and thus the two contacts converge some 2½ miles south of the river. The laminated quartzite band appears on Dunkleys Tramway in the vicinity of co-ordinate point 854,000 N - 342,000 E. South of this point the group has not been traced but it is believed that it wedges out east of Dunkley's Tramway and south of the above mentioned co-ordinate point. Thus the general occurrence is that of an irregular area with a north-south western margin and an eastern margin which trends first northeast and then north-west.

The main structure lines can be determined with fair precision from the photographs. The western (massive) quartzite north of the Pieman River trends a few degrees west of north and, at the river, a few degrees east of north. South of the river it becomes approximately southwest. The eastern (laminated) quartzite south of the river first trends south-southeast, then shows a series of gradual folds and finally turns to the southwest and again to the south. The breccia and shale underlying the massive quartzite agree in attitude with it. The shales overlying the eastern quartzite generally agree with it in attitude but where gentle folds appear in the quartzite the shales are thrown into complex folds. The shales occurring between the two quartzites are generally considerably contorted.

The age of the Group cannot be directly determined as no fossils have so far been found. It will be shown that the succeeding Crimson Creek Argillites are probably of Lower Middle to Middle-Lower Cambrian in age. As the succession is quite normal, the Success Creek Group are therefore presumed to be of Middle-Lower to Lower-Lower Cambrian in age. It is possible that they may extend into the uppermost pre-Cambrian. They are probably the equivalents of the Carbine Group as described in unpublished work of J.N. Elliston and mentioned by Carey (Geology of Australian Ore Deposits 1953, page 1108) and summarised in Table 1 of that publication as "Claystones, siltstones, quartzites partly dolomitic and Smithton Dolomite of Lower Cambrian or Upper pre-Cambrian age". As no physical connection occurs between the area just described and the type area for the Carbine Group at Dundas, it is considered unwise at this stage to attach the name "Carbine Group" to these rocks. Therefore it is proposed to denote them as "Success Creek Group" and to indicate their probable correlation with the Carbine Group. The term "Group" has been used as it is probable that further work will enable a subdivision into formations to be made.

(d) Crimson Creek Argillites

This is perhaps the most extensive sedimentary formation in the area under discussion. The formation apparently conformably succeeds the underlying Success Creek Group. The most typical section occurs between co-ordinate points 856,000 N - 345,300 E along Crimson Creek, the Pieman River, and the Huskisson River to co-ordinate point 858,000 N - 354,100 E. A line between the co-ordinate points given is approximately at right angles to the general strike and therefore the sections of rivers mentioned may be regarded as forming the type section for this formation. In this type section the general strike is approximately northwest and the dip to the northeast at an average of 72°. The stratigraphic thickness of the type section is then 12,000 feet.

Along the type section, and indeed over the whole exposed portion of this formation, there is a remarkable consistency of rock type. This consists of a fine grained compact mudstone of very constant grain size. The whole has been merely compacted and not subjected to significant regional stresses. Thus there is no fissility developed owing to differences in grain size and the rock cannot therefore be termed a shale. It is therefore termed "Argillite" in accordance with the definition given by Hatch, Rastall and Black (Petrology of the Sedimentary Rocks. 3rd Edition page 121) who state:- "Argillaceous rocks which have been compacted by loading may assume a more or less massive condition and break up on weathering or quarrying either irregularly or along joint planes..... such rocks are spoken of as mudstones. With further induration hard rocks with a conchoidal fracture are formed known as argillites". This term has not so far been used in published descriptions in Tasmania the rocks being referred to as "slates". It is considered that the latter term is incorrect and should be replaced by "argillites".

The general colour of the formation is deep red to purple and this colour is the most characteristic feature of the formation. Locally another type is developed which is indistinguishable lithologically from the purple argillite except that its colour varies from blue-green to deep green. The latter generally occurs in bands ranging from a foot to twenty feet in width. Across the section it is found that there are zones where purple argillite only

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occurs, alternating with zones having alternations of purple and green argillite. It has not been found possible to measure the thickness of all bands but it is estimated that the purple argillite makes up approximately 70 per cent of the total thickness and the green argillite 20 per cent.

Under the description of the Success Creek Group, it was mentioned that the uppermost shales show the incoming of pyroclastic material. The Crimson Creek Argillites are characterised by bands of pyroclastics throughout. The amount increases towards the top of the formation. This is almost always in the form of medium to fine grained tuffaceous material. In no case are there beds consisting solely of pyroclastics to the exclusion of other sediments. Such pyroclastic materials as are present are all of aqueous deposition. The finest material is found as bands not over half an inch in thickness occurring as lenses in the main argillite mass. Coarser material occasionally forms bands up to two to three feet in thickness which have a characteristic speckled appearance. The specks are up to one sixteenth of an inch in diameter. Within these bands, thinner bands of normal sediments are usually found. Pyroclastic material as above described occurs in both the green and the purple argillites. In one case only, a lava has been observed within the argillite formation on the north bank of the Pieman River at co-ordinate point 857,000 N - 346,800 E. The thickness of the flow is about 30 feet and microscopic examination (sample F/24/15) is as follows:-

"A fine grained porous melanocratic rock. The texture is intersertal consisting of feldspar laths in reticulate arrangement, the interstices being filled with pale green crypto-crystalline material which may represent original glass. The principal original minerals are labradorite in twinned laths and euhedral crystals, biotite in irregular flakes sometimes warped and altered in part to chlorite. Accessory minerals are apatite and ilmenite altered to leucoxene. Secondary minerals are, besides leucoxene, interstitial albite and a carbonate showing lamellations due to strain. The larger vessicles are filled with carbonate and a crypto-crystalline aggregate which may be a zeolite or devitrified glass. The rock is a vesicular basalt."

From the percentage figures given above, it will be observed that 10 per cent of the thickness of the formation is unaccounted for. This is made up of grey to black shales occurring as relatively thin bands. One such is located on the north bank of the Pieman at co-ordinate point 858,800 N - 344,700 E. This is a zone of black shale approximately 30 feet thick. With a strike of 340° and a dip of 82° NE it is in complete accord with the attitude of the argillites. Another occurs on the west side of the Owen Meredith lode and crosses Crimson Creek at approximately 855,600 N - 345,300 E. In the upper portion of the type section, a series of such bands occurs between the mouth of the Huskisson River and the upper limit of the formation. In each case, the bands are typical shales, thinly laminated and fissile. Jointing is not developed to any marked degree. In each case, the shales contain syngenetic pyrite. This is usually of a fairly fine grain size, somewhat lighter in colour than normal pyrite and is confined to specific beds within the shales. It is indicative of deposition occurring under reducing conditions. The shales also show pyroclastic

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material usually the extremely thin bands of white very fine grained tuffaceous material. The shales make up a minor portion only of the total thickness and there is no suggestion that any break occurred in the continuity of sedimentation. It is not considered, therefore, that they should be separated as specific formations.

The argillites are relatively rich in iron and readily weather to a stiff yellow clay. At certain points along the Pieman River section this phenomenon can be well observed and every gradation seen between unweathered argillite below and yellow clay soil above. This soil is apparently rich in plant food and thus the argillite formation typically supports a luxurious forest growth.

The areal extent of the formation is, as indicated above, considerable. From the type section quoted it extends northwest along the strike for seven miles butting against the Meredith Range granite at the Parson's Hood. They have been traced for five miles up the Wilson River to the serpentine boundary and along Four Mile Creek to just south of the Stanley Reward. In this area, they unconformably overlie the Davey Group, the intervening Success Creek Group not appearing on the surface at this point. From the type section they curve southwest along Crimson Creek and have been traced continuously along Dunkley's Tramway west and south of the north end of the Zeehan Syncline where they are found to wedge out between the Gordon River Limestone and the Davey Group some two miles north of the Montana Silver-Lead Mine. Thus, on the western side, they may be traced from the latter point to the southern slopes of the Parson's Hood. South of the Huskisson River they continue up the Pieman (interrupted by a zone of serpentine) to co-ordinate point 855,600 N - 353,200 E. South of the Pieman they occur continuously in the Argent River, the Ring River, on the E.B.R. the Rosebery Road formation between co-ordinate point 854,600 N - 351,500 E and Renison Bell (interrupted by ultrabasic intrusions). They continue south from Renison Bell beyond the Argent Tunnel and including the Copper-Nickel Field to just north of Nevada Creek on the Zeehan - Renison Bell Road where they end abruptly on a east-west fault. They extend southwest of Renison Bell towards the Dundas District.

Between a point approximately 853,400 N - 347,700 E and 852,900 N - 347,200 E along the road and rail cuttings there is a series of quite different rocks. They consist of rather massively bedded sandstones, medium grained and light grey to white in colour, intercalated with light grey shales and slates. The series is also noted on the north side of the Argent Dam and up the Owen Meredith Track to the top of the hill (co-ordinate point 854,300 N - 346,900 E.) To the west, north and east they are surrounded by the argillite formation but to the south the extent is not known. It is probable that they are part of the Carbine Group and may even be physically connected to the type area for that group at Carbine Hill.

Over the area between the type section and the mouth of the Wilson River there is a remarkable evenness of bedding, the strike averaging 320° to 330° and the dips northeast between 50° and 85°. North along the Wilson River and up the Four Mile Creek, the bedding is less regular. It maintains a general northwest strike but dips are somewhat

variable to northeast and southwest. In all cases the dips are very steep and there is probably some very close folding along close spaced parallel nearly vertical planes. Upstream along the Pieman from the Huskisson mouth, there is a change of strike to N-S for a distance of one mile to about the mouth of the Ring River. The dip is still fairly steep to the east. Beyond the mouth of the Ring, the general strike becomes north-east again with northeast and southwest dips. Along the section of the B.B.R. from the Ring Bridge to Renison Bell and along the Rosebery Road formation from the eastern limit to Renison Bell, the general northwest, north and northeast strikes are maintained and, with minor exceptions, the dip is steep to the east. Over these sections, there is a considerable amount of minor faulting but not sufficient to obscure the regional structure. In the section between Renison Bell and the Argent Tunnel, similar structural conditions apply but, further south, in the vicinity of the Copper-Nickel Field the more normal northwest strike and steep northeast dip is again observed.

Along Dunkley's tramway, from its intersection with the Owen Meredith Track southwest for 2½ miles there is considerable faulting and contortion. South of the latter point to the southwest limit given above, the bedding becomes more regular once again.

Thus it can be seen that, while the outlying portion of the formation is generally fairly regularly bedded, there is a central zone centred on Renison Bell where there is considerable contortion and fracturing.

These rocks were originally described by L.K. Ward (Bull 6. 1909. page 32) as follows:-

"The greater part of the Dundas Tinfield consists of slate together with the coarser grained sediments.... sandstone, grit and conglomerate. The whole are to be considered as one series and to them the term Dundas Slates has been applied since the typical rock type is a slate.... The slates themselves are green or purple where fresh surfaces can be examined and all varieties weather to a brownish clay." He discusses the age based on evidence of graptolites and indicates the similarity of the rocks to slates in the Leven Gorge which had been shown to underlie Ordovician limestone and concludes "The Dundas Slates may therefore be of Upper Cambrian or Lower Ordovician age."

In 1914 L.L. Waterhouse (Bull 15 pages 39 et seq.) described "Pre-Silurian slates, sandstones and tuffs along the Wilson River and Four Mile Creek area" He also states "They consist of a reddish purple, chocolate, or greenish slate weathering to a brown clay. Coarser varieties are brownish... The series is quite continuous with the series of slates and sandstones typically developed at North Dundas. The main track from Renison Bell to the field gives one the opportunity of tracing this continuity."

In 1918 Hartwell Condor (Bull 26.) covered a similar area to that covered by Ward in 1909. He states "The slates proper are green to purple in colour where fresh but the weathered surface may be brown to yellow. The product of decomposition is a brown clay. The dips and strikes vary largely especially in the vicinity of Renison Bell ..... the slates are seen in

greatest regularity in the bed of the Ring River for about one mile above the railway bridge and in the cuttings of the E.B.R. on either side of the bridge. The strike of the formation adheres very closely to a bearing N 25° W and the dip is steep to the east." He refers to the presence of fine grained tuffs permeated by iron oxide and states that "The tuffs are a marked feature of the Dundas Slates". In places the slates give way to sandstone and Condor refers to the occurrence of sandstone in the Henison Bell Township. He repeats Ward's previous scanty evidence regarding age and concludes by "regarding them as Upper Cambrian or more probable Lower Ordovician age - untilfurther evidence is available they may be regarded as Cambro-Ordovician."

In 1925 A.M. Reid (Bull 36) carried out a survey in the Dundas Area itself. On page 8 under the title "Dundas Series" he states "This suite of rocks indefinitely assigned to the Cambro-Ordovician, has already been described in earlier publications .... this series consists of grey and black slates and quartzites, quartzite, schist and slate, conglomerates, tuffs and breccias, red and purple cherty conglomerate and pyroclastic material of acidic and basic character."

The following points will be noted:-

(1) The original name Dundas Slates given in 1909 was changed to Dundas Series by 1925.

(2) The original description of the rocks is vague.

(3) No subsequent attempt was made to define the series more accurately.

(4) Ward's original Cambro-Ordovician age was readily accepted by subsequent workers.

For these reasons, the term Dundas Slates or Series fell into disrepute and, in an attempt to clarify the matter, Carey (Annual Report of the Director of Mines 1945 Page 25) dropped the term "Dundas" and replaced it with a general term "Pieman System". Palaeontological work by Thomas and Henderson in 1944 ( (1) Thomas D.E. A Critical Review of Tasmanian Graptolite Records . Roy. Soc. Tas. 1944 and (2) Thomas D.E. and Henderson Q.J. Some Fossils from the Dundas Series Roy. Soc. Tas. 1944 ) had shown that portion of the Dundas Series was Middle Cambrian in age. Therefore Carey states that the Pieman System "Probably started in the late pre-Cambrian but probably extends into the Cambrian" In 1949 (A.N.Z.A.A.S. Handbook for Tasmania page 21 et seq) Hills and Carey develop this further under the title "Pieman Group" which was specified as Upper Proterozoic to Cambrian (?). Unfortunately the division into formations applied only to the Zeehan area which is only a facies variant of the main group. Following unpublished work by Elliston, Carey, by 1952 dropped the term "Pieman Group" and replaced it with Elliston's terms "Dundas Group" and "Carbine Group". The Dundas Group, based on fossil evidence was shown as Upper to Middle Cambrian and the Carbine Group on lithological evidence as Lower Cambrian to Upper pre-Cambrian. Referring back to the original description by Ward, it is seen that the Dundas Slates as named by him, consisted of slates, sandstones, grits and conglomerates. It is now known that the sandstone, grit and conglomerates constitute the Dundas Group as specifically defined by Elliston and

divided by him into thirteen formations. The Carbine Group do not appear to be part of Ward's original Dundas Slates as, in the type area, they consist of slate, quartz, dolomite, and doleritic conglomerate, none of which are mentioned by Ward who specifically states that the slates are green or purple, nor do the green and purple slates receive a mention in Elliston's description of the Carbine Group.

Accepting then Elliston's terms Dundas Group and Carbine Group, a large stratigraphic unit covering many square miles of important known and potential mineral-bearing country, has not received mention by Carey whose 1953 paper is the latest published work on the geological structure of Tasmania. This is the suite of rocks described in this section and for them the term "Crimson Creek Argillites" is proposed. As mentioned above, in the type section the stratigraphic thickness is 12,000 feet. Owing to the dominance of the one rock type, with minor variants, the suite must rank as a formation. It is stressed, however, that the time interval represented by this formation is very large and, as far as time is concerned, it should rank as a group. In this connection it is pointed out that the Eldon Group has been defined by Gill and Banks (Silurian and Devonian Stratigraphy of the Zeehan Area. Roy. Soc. Tas 1949) as having a thickness of 5,800 feet. The Junee Group as defined by the above authors has a thickness of 3,500 feet and the Dundas Group as defined by Elliston 11,575 feet.

The Crimson Creek Argillites occur elsewhere within and without the North Pieman Mineral Area. Although no direct work has recently been done on these occurrences, it is considered that their existence elsewhere should be pointed out at this stage. Nye (Bull.33, 1923 Silver-Lead Deposits of the Waratah District) describes in some detail the Dundas Series as occurring in the vicinity of Waratah. He states:- "This series of rocks consists of slate, cherts and breccias. The slates, when exposed on the surface are mainly reddish in colour and are accompanied by a lesser amount of light buff and greyish varieties. Black slates occur at only one locality - to the west of the old Jasper Mine ... these slates are not thinly bedded as a rule. They are composed of a very fine material which cannot be identified in hand specimens .. Under the microscope, the only minerals recognisable are a carbonate and an opaque mineral which is probably haematite ... the beds are massive and great care is required to distinguish between joint and bedding planes. The recorded strikes have a large variation in direction ranging from zero to 135°. The most general appear to be east and west....this rock series is identical with that developed in the tinfield of Northeast Dundas and termed by Ward the "Dundas Slate Series". The purple slates and tuffs and also the chert of the Waratah District agree with those of Dundas as described by Ward." Nye adduces no further local evidence regarding the age but, by means of a rather tenuous correlation with the Heathcotian Series of Victoria, considers the Dundas Slate group to be Upper Cambrian.

A. M. Reid (Bull. 34 Mount Bischoff Tin Field 1923) also describes the Dundas Series as occurring in that area. He describes them as "A complex of tuffs, breccias, basaltic lavas, cherts, slates and basic intrusives of intermediate constitution.... the slate members of the formation are purple to brick red coloured rocks of extremely fine grain size. The only determinable

minerals are secondary calcite and oxide of iron. Narrow bands of grey to black slate also occur.... The thickness of the series as a whole could not be determined with any degree of exactitude but they are not less than 10,000 feet and are probably much thicker." He does not discuss the age of this group.

A.M. Reid (Bull 32. Osmiridium in Tasmania 1921) discussing the Heazlewood and Long Plains Districts states:- "Succeeding these (the pre-Cambrian Group) are grey to black slates belonging evidently to the Dundas Series and therefore of Ordovician age. Intercalated with them are feldspathic sandstones and a dull coloured completely decomposed rock of obscure origin."

The rocks of the Dundas Series also occur in the Leven District and near Mount Claude. Thus it will be seen that the Old Dundas Series as originally named by Ward is of wide distribution and the Crimson Creek Argillites fairly widely spread as evidenced by the continual references in the literature to "Purple slates etc". It is considered that the Crimson Creek Argillite Formation has such characteristic features that direct correlation with the type section can be made no matter where the purple rocks occur.

(c) Huskisson Group

On the "Big Bend" of the Huskisson River, some three and a half miles NNE of Renison Bell there occurs a suite of rocks for which the name "Huskisson Group" is proposed. For approximately one mile, the Huskisson River flows across the strike of these rocks and thus an excellent section is afforded. The general strike varies a few degrees either way from NW and the northeast dip varies between 35° and 80° averaging 55°. A type section has been established along the river between co-ordinate points 857,800N - 350,100E and 859,800N - 350,100E. The group contains nineteen formations with stratigraphic thicknesses as follows going upwards:-

| | | | |
|---|---|---|---|
| Formation No. | 1 - 380 feet | Formation No. | 12 - 260 feet |
| " | 2 - 350 " | " | 13 - 890 " |
| " | 3 - 390 " | " | 14 - 110 " |
| " | 4 - 170 " | " | 15 - 120 " |
| " | 5 - 260 " | " | 16 - 450 " |
| " | 6 - 350 " | " | 17 - 130 " |
| " | 7 - 300 " | " | 18 - 420 " |
| " | 8 - 160 " | " | 19 - 420 " |
| " | 9 - 160 " | | |
| " | 10 - 90 " | | |
| " | 11 - 610 " | TOTAL | 6020 feet |

Detailed descriptions of the formations are as follows:-

Formation (1) This consists of black shales fairly thinly bedded and some cleavage developed but not sufficient to destroy the bedding. The colour varies in places to grey; this formation has been affected by the ultrabasic intrusion and several tongues of serpentine occur within the river section. This will be dealt with more fully under the section on igneous rocks.

Formation (2) This is a mixed formation commencing with coarse massive very compact green grey quartzite, followed by dark coarse shales, then a massive very fine grained conglomerate with pebbles not over ⅛" and alternate fine and medium grained light grey quartzite.

Formation (3) This consists of fine grained thinly bedded very compact dark grey shales showing no development of coarser material. From these three formations fragments of dendroid graptolites were obtained (samples No. F/24/12) determined by J.M. Elliston as of Middle Middle Cambrian age.

Formation (4) This is a massive coarse compact blue grey sandstone or quartzite with no shaley bands.

Formation (5) This is a shale formation colours varying from yellow-brown to grey, fairly compact and rather massively bedded.

Formation (6) This is a mixed formation commencing with a massive very fine grained grey conglomerate consisting of quartz pebbles followed by a fine grained light brown grey shale, then a medium to fine grained laminated conglomerate with discoidal pebbles, then a light grey shale, and finally a very fine grained conglomerate similar to that near the base of the formation.

Formation (7) This consists of massive thinly bedded very compact blue grey shale with numerous thin sandy layers.

Formation (8) A fine grained conglomerate very compact and general aspect dark grey on fresh surfaces and light grey on weathered surfaces. It consists of quartz and chert pebbles, ¼" to ½" in diameter in a coarse sandy matrix. Narrow bands occur containing larger pebbles.

Formation (9) A fine grained thinly bedded compact shale.

Formation(10) A thin formation consisting of a massive tuff the groundmass consisting of a dark grey extremely fine grained material, with irregular feldspathic particles ranging up to ⅛" in diameter distributed irregularly. No bedding appear in this formation, nor does there appear to be any laminated arrangement of particles. It is probable that this is a true pyroclastic bed, the material not having been water sorted.

Formation (11) The formation begins with thinly bedded grey shales becoming more massive towards the top. The whole is extremely compact and in places verges on slate. These shales show a development of white mica in extremely small plates.

Formation (12) A conglomerate formation with cherty pebbles up to ½" in diameter, some a little larger, mostly discoidal, with a sandy cement. The whole is reasonably compact and has a general yellow-brown aspect. Towards the base, there are shaley and sandy layers.

Formation (13) A thick formation consisting of varying types of shales with numerous tuffaceous bands. The whole is generally thinly bedded, very compact, and varying in colour from light brown to light grey. No jointing or cleavage is developed.

Formation (14) A thin formation of black graphitic slate with the bedding preserved but dominated by the cleavage. It is thoroughly and minutely crenulate. Fossils were obtained from this locality (Sample No. F/24/11) and referred to Dr. A.A. Opik of the Bureau of Mineral Resources. In his report (B.M.R. Records 1951/40) he states:-

"It is thoroughly and minutely crenulate which makes all the trilobites (agnostids) hardly recognisable at all. It is rich in sponge spicules, replaced by gypsum (perhaps) and shows abundant, also replaced, chiastolite needles.

Two genera of brachiopods, a Protorthis and an Otusia (?) are better preserved. They are Middle Cambrian genera.

The general character of the rock appears to be similar to the Middle Cambrian hydroid horizon as exposed at the Summit Cutting of the Comstock tram, West Zeehan. Obviously to confirm this correlation, I had to split once more the rock specimens to search for some of these hydroids. Specimens F/24/11B and F/24/11D were split and indeed hydroids of two genera exposed. Though badly contorted and replaced by gypsum, they could be determined as Sphenoecium Chapman and Thomas, and Archaeolophoea Chapman described from the Victorian Cambrian and identified also by D.S.Thomas from the Hydroid bed at Dundas.

The age of the specimens F/24/11 is Middle Middle Cambrian or slightly younger and stratigraphically quite deep below the bed with Glyptagnostus (F/24/10)"

Formation (15) A transition formation consisting mainly of a breccia consisting of white and light and dark grey angular chert pebbles averaging ½" in diameter, firmly cemented within a dark grey sandy matrix. Layers of finer grained breccia occur. Towards the top, shales and sandstones make their appearance. The whole formation is firmly compacted and very massive.

Formation (16) A coarse conglomerate forming a steep sided gorge. The pebbles range up to 3 to 4 inches and are generally well rounded and the colour is generally a light grey with slightly pink layers. Apart from the colour the general aspect of this conglomerate is remarkably similar to that of the West Coast Range Conglomerate.

Formation (17) A transition formation consisting of a coarse brown sandstone. Near the base, there are alternate layers of approximately one inch in thickness of a fine conglomerate and coarse sandstone indicating the transition from the underlying conglomerate formation.

Formation (18) Black Shales. These consist of a black carbonaceous shale with thin sandy laminae which are indurated by pyrite. Fossils were found in this locality (Sample No. F/24/10) and submitted to Dr. A.A. Opik (Reference as above) who states:-

"The fossils are spicules of cf. Protospongia and the trilobite Glyptagnostus Reticulatus (Angelin) of which three complete specimens and numerous fragments are present.

The discovery of Glyptagnostus in western Tasmania is significant and welcome. It signifies the discovery of fossiliferous Upper Cambrian which has been postulated but not yet observed in this State. Glyptagnostus Reticulatus is moreover one of the few time-markers of world wide distribution in the upper Cambrian. It is known from Scandinavia, England, Alabama, British Columbia, Korea, and north-western Queensland.

Below the bed with Glyptagnostus in Tasmania the uppermost Middle Cambrian fauna of Barker's Creek, Dundas, may be expected at not too great a stratigraphic distance. Stratigraphically between the Glyptagnostus bed and the Barkers Creek beds, fossils of the lowermost Upper Cambrian zone (Agnostus pisiformis zone of Europe) should be searched for, as is evident from the following table, showing the relations between the Upper and Middle Cambrian boundaries.

| Time Scale | Scandinavia | W. Tasmania |
|---|---|---|
| Lower Upper Cambrian | Olenus truncatus zone | F/24/10 Glyptagnostus reticulatus |
| | Olenus gibbosus zone | |
| | Agnostus pisiformis zone | Not yet observed but expected. |
| Upper Middle Cambrian | Lenoxyce laevigata zone | Barker's Creek with Blackwelderia ? pilosa |
| | Paradoxides forch-hammeri zone | Approx. position of F/24/11 (may be slightly older) |

Formation (19) A formation of conglomerate verging on a breccia. The pebbles consist of sandstone and grey chert cemented by a sandy matrix. The pebbles are slightly flattened and are parallel to the bedding. The general size of pebbles is ¼" to 1" in greatest diameter. Some fine and some coarser bands occur. The general aspect is a brownish-yellow. A marked jointing crosses the bedding at approximately 220°.

The area covered by this group is extremely small consisting of a maximum of two square miles. The lower limit is the northeast side of the southern end of the northwest-trending Wilson River Serpentine. The general strike of this contact is about 320°. The upper limit is the base of the Gordon River Limestone which trends approximately 300°. Thus the upper and lower limits converge towards the north. The south-western geographical limit is a fault of general north-easterly trend. Thus, in plan, the Group occupy a triangular shaped area.

It has been considered wise at this stage to introduce the term "Huskisson Group" for this suite of rocks, nineteen formations having been recognised, but not having been named.

It is almost certain that the Huskisson Group is the equivalent of the Dundas Group which was named in unpublished work by Elliston and divided by him into thirteen formations totalling 12,000 feet. It will be noted that the Huskisson Group contains five conglomerate formations and the Dundas group also contains five such formations. Opik's palaeontological report indicates the position of the two Huskisson Group fossil horizons as above and below the Dundas Group "Barkers Creek" horizons. Unfortunately, the position of this latter horizon within the Dundas Group is not known to the present writer, so direct correlation between the two groups cannot be made at present.

The characteristic feature of the Huskisson Group which stands in marked contrast to the underlying Crimson Creek Argillite Formation is the rhythmic variation from fine material (shale) through quartzites and grits to conglomerates and back to shales. Five such rhythms occur as evidenced by the five conglomerate horizons. This characteristic indicates the onset of crustal instability which culminated in the Tyennan orogeny at the close of the Cambrian Period.

(f) Rosebery Group

From a point on the Pieman River 855,800 N - 353,400 E upstream to approximately half a mile west of the E.B.R. bridge (861,300N - 356,900E) a further suite of sedimentary rocks occurs. It is probable that this Group is co-eval with the Huskisson Group just described. Loftus Hills (Bull 23. 1915, page 13) states :-

"That the rocks occurring in this vicinity are portion of the Dundas Slate and Breccias and that they are overlain by the Road-Rosebery Schists and Felsites" The rocks have a general similarity to those of the Huskisson Group above described in that they include shales and evidence of pyroclastic deposits. A difference is the almost complete absence of conglomerates and the notable presence of quartzites. A search has so far failed to reveal the presence of any fossils and thus a determination of age and correlation are not possible at the present time. It is considered wise, therefore, to establish the group under a separate name for the time being.

In 1932, K.J. Finucane published in the Chemical and Mining Review (Oct/Nov 1932) a Preliminary Report on the Geological Survey of the Rosebery District, Tasmania. He recognised this group of "slates, quartzites and breccia-conglomerates" having a total thickness of 5000 to 6000 feet and named them the "Rosebery Series". This name is here adopted but, in accordance with modern practice, it is termed the "Rosebery Group". It is not proposed at this stage to establish formation names. Finucane's statement that "from the fact that they underlie the Dundas Series which is of Ordovician age, the rocks of the Rosebery Series have been referred to the Cambro-Ordovician " is now quite untenable.

Followed upstream from the western boundary of the serpentine belt, which crosses the Pieman River at co-ordinate point 855,800 N - 353,400 E, the following rock types are encountered.

(1) A zone approximately 500 feet wide containing a light grey finely foliated rock containing abundant white mica flakes showing marked schistosity. A sample(No. F/24/20) submitted for petrological examination was reported on as follows:-

"Very similar in structure to F/24/18 but more closely sheared. The principal mineral is chlorite. There is also much sericite, phacoidal grains of quartz with undulose extinction and fine quartz or quartzo-feldspathic mosaic and disseminated opaque iron minerals. The quartz recrystallised at an early stage of shearing because the sericite laminae curve around the grains. The rock is a chlorite-sericite schist."

The upper part of the zone shows a merging into light grey, medium grained, slightly sheared tuff.

(2) Finely bedded very compact black shales follow, about 200 feet wide. The strike is meridional and dip 73° to the east.

(3) This is followed by a zone approximately 500 feet wide with a series of compact massive fine grained dark grey tuffs with finer shaley bands showing tuff lenses. Strike is 333° and dip about 70° east.

(4) The succeeding 700 feet is a purplish fine grained tuff with dark and light bands the whole very dense and compact. Strike is 335° and dip 62° east.

(5) The succeeding 300 feet is a fine grained tuff with grey and light grey bands, and carrying pyrite in the joints. Strike is 327° and dip 84° east. There is a break of 300 feet in the river section and then a further 500 feet of similar material occurs.

(6) Dark shales with very fine tuff bands, all very compact and highly contorted - a probable fracture zone. This band is at least 500 feet wide and has been identified in the railway cutting just east of the road crossing near the golf links. At the latter point the strike is 20° and the dip 80° west.

It will be noted that east of the serpentine belt there is a belt of chlorite - sericite schist followed by a broad belt mostly of shales and some tuffs. A further important point is the change in dip from towards the east to towards the west on the eastern margin of the shale belt. This westerly dip is maintained by the sediments up to their contact with the Read-Rosebery Schists.

There is lack of outcrop both in the river and along the road and rail from the black shale to the big bend on the Pieman River near the South Base Trig. A section along the road and rail cuttings and also along the river near the bend reveal the following.

(7) A 150 feet band of "Fuchsite Agglomerate". This shows blebs of the green mica, fuchsite, up to one inch in diameter in a general cherty agglomerate. The mass also contains some siderite and pyrite. The pebbles show a rough parallelism. The E.Z. Coy. geologists advise

(personal communication) that this material contains a small percentage of tin. The band has been picked up on the road, rail and river and the three outcrops indicate a strike a little east of north.

(8) Approximately 150 feet of a very pale slightly pinkish cream rock with a general slightly schistose aspect. A sample from this point (No. G24/3) was reported on as follows:-

"Fine grained light coloured felsitic rock with irregular dark patches. Under the microscope shows irregular angular grains of quartz of all sizes in a fine siliceous matrix. Occasional larger grains show crystalline outlines. There are a few feldspar crystals completely sericitised and sericite occurs as irregular patches and bands parallel to the direction of shearing. There are also bands of greyish isotropic material showing flow structure which is apparently a glass. Glassy structures such as conchoidal fractures and perlitic cracks occur in the crystalline as well as the glassy textures the latter constituting only a very small portion of the rock. The evidence indicates devitrification and the rock is a devitrified sheared rhyolite."

On the road and rail section, a rather similar rock appears east of the agglomerate and a sample (G/24/2) was reported on as follows:-

"Very fine grained whitish strongly sheared rock. There are occasional porphyroblasts and small irregular grains of quartz and of completely altered feldspar in a finely laminated matrix of sericite and kaolin. Shearing is extreme and no trace of original structure remains. The rock may have been originally an arkose or a quartz porphyry which has been strongly sheared and altered by hydrothermal action."

(9) From this point on the Pieman River upstream and then along the Stitt River to co-ordinate point 856,100N - 357,000 E, there is a series of shales and quartzites. The quartzites are usually medium to dark grey highly compact and slightly micaceous, the shales are dark grey, sometimes black. In general, the shales show a considerable amount of extremely fine grained tuffaceous material. The strike along this section is a few degrees west of north and the dip 65° to 80° west. The section along the road and rail east of Natone Creek allows a correlation between two quartzite bands here and on the river section.

From the mouth of the Stitt River upstream along the Pieman River to Hall Creek, and from the Primrose Railway Station along the E.B.R. to Hall Creek crossing, entirely similar material occurs. The strike north of the Stitt River changes slightly from west of north, to north and then to slightly east of north. The dip is constantly to the west between 54° and 80° with an average of 70°.

Between Hall Creek and the road crossing over the Natone Creek, correlations between bands particularly of quartzite can be made. The trace of strike lines shows a slight concavity to the west.

(10) North of the mouth of Hall Creek, outcrops of purple argillite occur for about one third of a mile along the Pieman River. Other outcrops on the bend of the E.B.R. south of the Bobadil Plains and on the Pieman River in the vicinity of co-ordinate point

860,300 N - 355,500 E indicate the presence of a zone of purple argillite approximately 800 feet in width trending slightly west of north and dipping east at 70° to 80°.

(11) Along the western side of the argillite band the Pieman River shows a series of shales and quartzites with some interbedded tuffs. Both shales and quartzites are slightly micaceous. Sample No. G/25/2 at co-ordinate point 860,090 N - 355,240 E from one of the tuff bands was reported on as follows

"Dark green fine grained strongly sheared rock. In thin section, it is an aggregate of fragments of microcrystalline material. Quartz, feldspar, chlorite and secondary sericite and calcite are all present together with dark irresolvable material. The rock is a tuff."

East of the argillite margin opposite the south end of the Bobadil Plains a highly metamorphosed diorite was encountered (sample No. G/24/14) at co-ordinate point 858,540 N - 355,620 E and reported on as follows:-

"A greenish mottled rock. Under the microscope, it is evidently a metamorphosed igneous rock. Structures have been little altered but most minerals have changed completely. Thermal metamorphism has therefore occurred. Feldspars have been largely sericitised, hornblende has altered to serpentine, and a white opaque substance which preserves the habit of the original crystals which were ophitically related to the feldspars; from large skeletal crystals of iron minerals a brown pleochroic biotite mineral has developed. The original granulation was coarse. The original rock was a diorite."

Strike and dip along the section agree with those of the argillite band.

(12) On the eastern margin of the argillite band on the Pieman River near the north end of the Bobadil Plains, there is a 70 feet width of fuchsite agglomerate. This is in general similar to the one previously described but the pebbles are generally larger. Fuchsite is more prominent and occurs in larger masses. It occurs as lenses up to one foot long and up to two inches in width. It is quite obvious from the associated rocks in each case that this agglomerate band is <u>not</u> the same as that occurring west of the Rosebery Railway Station. The band is not seen on the railway at the south end of the Bobadil Plains as the eastern margin of the argillite is obscured at this point. It may occur on Hall Creek between the Pieman and the E.B.R.

(13) Between the agglomerate and the western margin of the sediments (co-ordinate point 861,300 N - 356,900 E) the rocks are mainly shales. A typical type is a thinly bedded shale with bands of alternate light and dark grey. The material is highly compact and on the sheer walls of the Pieman Gorge the shales present a most striking striped appearance. In many cases, the shales contain extremely fine grained tuffaceous material. At least three bands of quartzite occur, all highly compact and slightly micaceous. Two pebble beds occur each about 10 feet wide with pebbles up to two inches rather sparsely scattered in a fine grained argillaceous matrix. Near the bend below the Pieman Bridge, a basalt sill (or lava flow) about two feet wide was observed. Beyond this, thinly bedded shales continue to the margin of the Massive Pyroclastics.

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The whole of this section shows a strike almost due north and a dip to the east of 35° to 80°, the average dip being 70°. Especially towards the north end, there is considerable evidence of minor contortions, such as wavy bedding, numerous small drag folds and minor faulting. This does not in any way obscure the general attitude.

There appears to be two sections within this Rosebery Group. One occurs north and the other south of Hall Creek. The general strike over both sections is approximately meridional with some curvature in the southern section. However, the dip in the northern section is consistently to the east - in the southern section it is mainly to the west. It is not possible to trace a particular band through both sections. A useful band is the argillite band described above. This can be followed southwards to Hall Creek but beyond that point it disappears. If it continued southwards in accordance with the well-defined regional strike line on the southern section it would be met with in the Pieman River near the South Base Trig. It does not occur at this point. All the evidence, therefore, points to the occurrence of a fault approximately east-west occurring along Hall Creek. There is no evidence to indicate the relative movement along this fault. With regard to the northern section, there is no doubt that the beds are normal. At co-ordinate point 860,300 N - 355,700 E, there is an excellent example of ordered sedimentation the material grading from a coarse sandstone to fine slate indicating that the beds are the right way up. With regard to the southern section, particularly along the Stitt River, it has been asserted by the N.Z. Coy's geologists (personal communication) that the west-dipping beds are inverted. This conclusion is arrived at after a study of the bedding-cleavage relationships. In two cases, along the Stitt River section, the present writer observed the bedding to be steeper than the cleavage but, elsewhere along the west-dipping section, the relationships are inconclusive. It is therefore considered that the idea of these rocks being overturned is tentative only and cannot be considered proved. It must be admitted, however, that a rational explanation of the attitude of this section in a large area of predominantly east-dipping rocks, is exceedingly difficult.

(g) Massive Pyroclastics

This Group, so important in the geology of the Rosebery Mine, occurs mainly outside the North Pieman Mineral Area and therefore, beyond remarking that it occurs east of the Rosebery Group, little description will be given here. Downstream along the Pieman River from the E.S.R. bridge for half a mile, this material is encountered. It is a light yellow grey in colour, with coarse feldspar fragments and quartz veins. There is a considerable variation in colour and grain size. Some inclusions of slatey bands and occasional development of schistosity also occur. One sample (G/25/1) was taken from co-ordinate point 861,130 N - 357,430 E and reported on as follows:-

"Light coloured rock with phenocrysts of quartz and feldspar. The quartz and, to a lesser extent, the feldspars, show resorbtion borders and embayments. The feldspar is strongly twinned and the extinction angles on twinned laminae show it to be albite. The matrix is a fine quartzo-feldspathic mosaic somewhat sericitised and contains occasional stringers of quartz. The rock is a porphyrite."

The western boundary is also observed near

the Primrose Railway Station and on the Stitt River a quarter of a mile downstream from the Railway Bridge. Two specimens from the latter area were reported on as follows:-

G/24/5 (co-ordinate point 856,130 N - 357,000 E)

"Medium grained rock consisting of angular fragments of rock containing crystals of clear quartz and smoky twinned feldspar, microcrystalline quartz and carbonate, set in an interstitial matrix of fine quartzo-feldspathic and sericitic fragments. The rock is a breccia possibly of volcanic origin."

G/24/6 (co-ordinate point 856,080 N - 357,160 E)

"Light coloured feldsitic rock with dark patches similar to G/24/3. Under the microscope, in ordinary light the rock is notable for the extensive development of carbonates which occur in irregular patches and scattered rhombs throughout the thin section.

Between crossed nichols, the section shows a micro-crystalline quartz or quartzo-feldspathic mosaic with innumerable patches, some large and indefinite, others much smaller and sharply outlined of sericitic material. The whole is crossed by several fine veins of quartz and one or two of sericite. Patches of sericite occur in the quartz veins and therefore sericitisation must have followed the intrusions of the veins. There are rare deeply corroded skeletal phenocrysts of quartz. Glassy structures are not visible but there is some resemblance to G/24/3 in texture. The specimen is an altered acid lava or hypabyssal rock."

(h) Junee Group

This group has been well described in previous publications such as Hills and Carey (A.N.Z.A.A.S. Handbook for Tasmania 1949, pages 25-27) and Gill and Banks (Silurian and Devonian Stratigraphy of the Zeehan Area, Roy. Soc. Tas 1950, page 262) and its age established as Ordovician. The Group consists of the Jukes Breccias and Conglomerates (lowest), West Coast Range Conglomerate, Caroline Creek Sandstones and Shales and the Gordon River Limestone. In the North Pieman Mineral Area, the Gordon River Limestone is the only formation of this group present. It occurs in structural conformity with the overlying Eldon Group and the general structure will be detailed under the section dealing with the latter Group. It occurs in the typical flat-bottomed valleys formed, usually with a thin veneer of alluvium on top. There appear to be harder crystalline bands in the limestone separated by softer, more argillaceous bands. The latter erode out readily, leaving the former standing as low ridges up to 30 feet above the valley floors. The Huskisson River cuts the limestone between co-ordinate points 860,000 N - 349,700 E and 860,600 N - 349,400 E. Along this section, the strike is approximately 305° and the dip 50° to 55° north. Stratigraphic thickness at this point is therefore of the order of 1,100 feet.

(j) Eldon Group

Approximately twenty three square miles of the North Pieman Mineral Area between the Wilson and Huskisson Rivers and extending east of the Huskisson towards the south end, is covered by formations of the Eldon Group. The Huskisson River between co-ordinate

points 867,400 N - 349,000 E and 860,600 N - 349,400 E cuts right through rocks of this Group and thus an excellent section is afforded.

The Eldon Group in the vicinity of Zeehan and Eden has been well studied by Gill and Banks (Reference as above) and that paper may be accepted as the standard work on this Group. In the North Pieman Mineral Area, the formations encountered are identical with those in the Zeehan and Eden areas and the thicknesses of the formations appear to be similar. There appears, therefore, to be little point in describing the lithology of the Eldon Group further. One point of difference should be detailed however. In the Zeehan and Eden areas, Gill and Banks show the Florence Quartzite immediately succeeding the Keel Quartzite. In the North Pieman Mineral Area, at approximately co-ordinate point 861,600 N - 349,000 E, there is a band of shale definitely occurring between the Keel and Florence Formations. The shale is a grey green colour, fairly thinly bedded with a fine grain size. It does not appear to be fossiliferous. At the co-ordinate point quoted the thickness is approximately 700 feet. Further north along the Huskisson River, where the river again forms a section through the Eldon Group, the same band is again encountered. It is therefore considered that this band is a persistent formation of the Eldon Group and for it the name "Hill Shale" is proposed.

In the Annual Report of the Director of Mines for 1949, page 23, it was pointed out that the Junee and Eldon Groups occur in the form of a syncline and for this feature the name "Huskisson Syncline" was proposed. The structure of the syncline can now be described in greater detail. From co-ordinate points 861,000 N - 351,000 E to 868,000 N - 346,000 E the axis of the syncline is almost due northwest. At the latter point it turns abruptly to 10° east of north. At the southern end, the nose of the syncline occurs near the first mentioned co-ordinate point and, along the northwest portion of the axis, the plunge is fairly flat towards the northwest. The northern end of the syncline is rather vague and the extreme top end is outside the area originally photographed. Sufficient evidence is revealed, however, by the present photographs, to show that the syncline is closed at its northern end also, and that the north end of the axis plunges southwards. In addition to being "bent" in plan, the syncline is also assymetrical. Observations on the western limb reveal a dip to the northeast of 50° to 70°. On the eastern limb, the dips are either very steep to the southwest vertical, or steep northeast. Thus the eastern limb is more steeply inclined than the western, and in places may be considered as overturned. On the western limb, in the vicinity of Limestone Creek, there is a major northeast-trending fault with ahorizontal offset of about three quarters of a mile. This fault does not appear on the east limb but, where it would appear, there is a sharp fold. It is quite obvious that pressure towards the east has been applied to the north and south ends of the syncline against a stable block on the east side near the centre. Thus, the east limb has been in compression and therefore thrown into a fold, while the west limb has been in tension and has fractured. Along the limbs, numerous minor faults more or less in a northwest direction occur. These have all been formed during the major stress movements above described.

On the southern nose, the synclinal folding is so sharp that the outer Florence Quartzite has fractured and its ends have a frayed appearance. The shale and

slate formations show a complex crumpling.

The northern end of the syncline has only been examined on photographs but it is obvious that an extreme amount of crushing and crumpling has occurred.

(k) Alluvial Deposits.

As the area is one of recent uplift and base-levelling is still in progress, only a very minor percentage of the surface area is covered by alluvium. All those known are the result of local base-levelling through the occurrence of hard bars. The chief areas are:-

(1) The Stanley Reward Alluvial Flat. This is by far the most important owing to its content of tin. It covers an irregular shaped area of about 500 acres located at the junction between the Meredith Range Granite and the Davey Group, mainly on the western side of the Stanley River. It has been caused by a hard slate bar across the Stanley River. An excellent description has been given by Waterhouse (Bull 15, 1914, pages 130 - 141) and it is not considered that any further description is here required.

(2) Near the Pieman Trig an area of alluvium of several hundred acres was observed during the triangulation programme. An un-named stream flows generally southwards from the Pincher, and runs against the northern edge of a dolerite mass. This mass has caused local base-levelling in the stream with the consequent production of swampy alluvium. No investigation of this flat for possible alluvial mineral deposits has been carried out.

(3) On, and on both sides of the Wilson River Serpentine belt, there occur relatively small patches of recent alluvium. While the areal extent of these has been small, their economic importance in the past has been great, owing to their content of osmiridium, tin and gold. At the present time, they are of little importance.

(4) On the Meredith Range itself, a number of small streams show the development of alluvial wash e.g. the headwaters of the Stanley, Harman and Little Wilson Rivers and the Yellowband Creek. The Yellowband has been a source of tin, osmiridium and monazite, and the other alluvials mentioned, though only seen by the present writer on photographs, should, by analogy, be worth prospecting for these minerals.

(5) Because of its ease of erosion, as compared to the overlying Crotty Quartzite, the Gordon River Limestone on the West Coast typically forms broad flat-bottomed valleys, usually covered with a thin layer of alluvium. One such occurs along the Huskisson River at the base of the Junee Group. This has not been observed to be mineral bearing.

(6) The Corinna Goldfield is of an alluvial nature and much gold was won there in the past. This area has not been visited during the present investigation.

(7) Along the course of the main streams, a slight development of alluvium occurs now and again. These patches are extremely small and are of no economic significance.

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(3) IGNEOUS ROCKS

(a) Sequence of the Igneous Rocks

| System | Formation |
|---|---|
| Devonian | Wilson River Serpentine Complex |
| | Meredith Range Granites. |
| Jurassic | Heemskirk Dolerite. |

(b) Wilson River Serpentine Complex

Within the North Pieman Mineral Area, there is a prominent belt of basic and ultrabasic rocks mostly converted to serpentine forming a ridge of an average elevation of 200 feet. The ridge commences at Keenan Creek which forms the boundary between the serpentine and the Meredith Range Granite. This forms the northern boundary of the belt which, at this point, is about one and a half miles wide. From Keenan Creek, the belt trends southwest maintaining a width of between one and one and a half miles for seven and a half miles to Riley's Knob. Just north of Riley's Knob, the belt attains its maximum width of two miles. Southwest of Riley's Knob, the belt contracts to half a mile in width, crosses the Huskisson and Pieman Rivers, and continues southwards as will be detailed later. East of the Huskisson River, two isolated patches of serpentine occur each approximately half to three quarters of a square mile in area. The centre points of these two patches are at co-ordinate points 865,000 N - 351,500 E and 867,300 N - 350,000 E. A further patch of serpentine has been observed in the Pieman River approximately on line with the two just mentioned at co-ordinate point 855,700 N - 353,400 E. For all these serpentine occurrences in the North Pieman Mineral Area, the term "Wilson River Serpentine Complex" is proposed.

A fairly complete description of the main serpentine ridge was given by Waterhouse (Bull 15, 1915, pages 18 to 24) who records the presence of "Basic rocks, gabbro, norite, pyroxenite and serpentine evidently genetically related to the acidic types.... although there is a considerable variation in the rock types from point to point in the area, the series as a whole is characterised by its low percentage of silica and high percentage of ferro-magnesian constituents." Waterhouse gives detailed descriptions of microscopic examinations of a number of specimens of varying rock types and the reader is referred to the above Bulletin for these descriptions.

On the Huskisson River, some one and a half miles upstream from the mouth, the serpentine belt is encountered and the river runs through it for about half a mile. In this place, it has a quite normal appearance being a pale green and showing no pyroxenite. The western margin is obscured by alluvium but on the eastern margin the contact with the enclosing sediments can be examined in detail. This shows that the contact is not a clean one, but that there is a zone several hundred yards wide over which tongues of serpentine protrude into the sediments. At co-ordinate point 859,830 N - 350,050 E, a peculiar very light grey to white rock was observed with tiny crystals of dark brown mineral scattered throughout. The sample (F/24/8) proved to be a highly altered serpentine and was reported

on by the petrologist as follows:-

"Under the microscope, this rock consists of a mosaic of quartz and carbonate with carbonate predominating. Irregular patches of minute octohedra of chromite - picotite are present. Relict and interaction structures are apparent. Long filaments of fine crystalline carbonate traverse the coarser mosaic-textured carbonate and represent original cross-fibre filaments of chrysotile in serpentine. The rock was therefore originally a serpentine and has been altered to carbonate (largely magnesite) and quartz with minor ferriferous and chromiferous materials remaining."

In the Pieman River at approximately co-ordinate point 856-200 N - 351,100 E, a belt of highly weathered serpentine approximately 700 feet wide was encountered. Other outcrops of the same material on the railway line above show that the trend of this belt is northwesterly. There is no doubt that it is a continuation of the main ridge north of the Pieman. There appears to be a gap approximately three quarters of a mile in the surface exposures between the Pieman and the Huskisson Rivers. On the Pieman, at co-ordinate point 855-700 N - 353,400 E a further belt of serpentine was encountered making a prominent outcrop on both sides of the river. The central section of this belt, about 250 feet wide, consists of what may be called a "Normal" green serpentine and on either side, there is a zone about 100 feet wide which show a marked schistosity in a direction parallel to the strike of the belt. In these two zones, the serpentine is very dark green, and very finely foliated. The joint planes so typical of the normal serpentine have been completely obliterated. A sample of this material (F/24/19) was reported on as follows:-

"Fine grained dark mottled green rock which shows under the microscope a structureless aggregate of antigorite and isotropic serpophite. The rock is a serpentine."

It should be pointed out that the sedimentary rocks on either side of this belt also show this development of schistosity for several hundred feet (refer sample No. F/24/20 described under "Rosebery Group" above.)

The distribution of the basic and ultrabasic rocks in the North Pieman Mineral Area has been detailed. However, they extend south of the Pieman River and, in order to obtain a clear picture of the complex, all the surface exposures must be taken into account.

Starting from Keenan Creek, the westerly belt runs southeast almost as a straight line to the Pieman River with one short break in surface exposure. South of the Pieman, it swings sharply to the south along the Exe River, is encountered on the new Rosebery Road Formation, and then continues S.S.W. and S.W. being picked up in Colebrook and Star Creeks. It then continues S.W. to Pine Hill at which point it curves again to nearly west and follows the course of the Melba Creek. It then crosses the Renison Bell Road along which it is encountered between the crossing of that road by the Northeast Dundas Tram Formation and the saddle over the Argent Tunnel. It continues westwards from the Renison Bell Road approximately one mile into the Copper-Nickel Field. The total length of this belt is eighteen miles. In the area between the Pieman River and Star Creek, the surface exposures are discontinuous, in some places being obscured by glacial deposits. There is, however, no doubt about the essential continuity of the belt. North of the

Pieman, the belt appears to be a single unit but, to the south, there are a number of small exposures paralleling the main belt. These have been observed near the new road crossing of the Ring River, about one mile S.S.W. of the new road crossing of the Exe River, on the old Montana Track half a mile south of Stebbin's Hill, and near the top of Commonwealth Hill. These are shown on the Geological Sketch Map of the North Dundas Mining Field accompanying Bulletin 26. In the vicinity of the Copper-Nickel Field there appear to be a considerable number of these small offshoots of the main belt.

The eastern belt north of the Pieman is rather vaguely defined in that there is not a continuity of surface exposures. There are two sizable masses of ultrabasic rock over a distance of seven miles. From the Pieman, however, where there is an exposure of this belt, there is a continuous exposure along the western flank of the Colebrook Range extending for three miles almost to Ringville. The occurrence of the northern isolated exposures along the projection of the southern continuous belt is sufficient to warrant the assumption that a continuous belt of approximately ten miles exists.

In the vicinity of the new road crossing of the Exe River, there appears to be a connection between the two belts above described. The eastern belt thickens at this point and has been traced as far as the Exe River. An actual surface connection has not been traced between the two belts, the gap at present being several hundred yards. Further work along the Exe River between the road and the railway would probably prove this surface connection.

To complete the picture, it should be mentioned that a further belt of ultrabasic rock occurs in the Dundas Area. This commences on the saddle north of the Razorback Hill between the headwaters of Nevada Creek and a tributary of the Dundas Rivulet, proceeds east forming the Dundas Flats, and curves southwards towards the South Comet. The length of this belt is about five to six miles and it forms a complementary curve to that of the western belt described above.

The relationship between the ultrabasic intrusions and the enclosing sediments has been fairly closely studied during the present investigation, along the Pieman River and on the west belt north of the Pieman. Where the west belt crosses the Pieman, both margins are composed of Crimson Creek Argillites. The argillites are considerably contorted but there appears to be a general parallelism between the bedding and the strike of the ultrabasic margins. Followed north, the sedimentaries on the west side of the belt are consistently Crimson Creek Argillites. At co-ordinate point 850,600 N - 342,300 E, the contact between the serpentine and the argillites is observed in the Wilson River. At this point also, the strike of the serpentine margin is parallel to the argillite bedding.

On the eastern margin, the position is more complex. Between Keenan Creek and Norton Creek the beds succeeding the serpentine are Gordon River Limestone. In many places, the contact is obscured by rubble but sufficient exposures exist to warrant this statement. South of Hill Creek, the Huskisson Group of sediments occurs between the serpentine and the limestone. There the general strike of the serpentine margin is northwest and that of the Huskisson Group is about 300°.

Therefore, proceeding southwards from Hill Creek, it is found that successively older formations of the Huskisson Group overlap the eastern margin of the serpentine, the difference of strikes being of the order of 15°.

Thus, it must be concluded that, while the serpentine in general is concordant with the bedding, it locally shows discordant relationships and therefore must be considered as an accordant intrusion.

(c) Meredith Range Granite.

Approximately one third of the North Pieman Mineral Area is occupied by the granites of the Meredith Range which form the chief topographic feature of the area, rising to 2000 - 2500 feet above sea level. Details of the extent of this granite have been given under the section dealing with topography. Very little actual field work on the granite has been carried out during the present investigation, but some interpretation from aerial photographs has been made. In particular, the characteristic topographic expression of the granite has enabled its boundaries to be determined from photographs with sufficient accuracy for regional mapping. A fairly complete description of the granite itself has been given by Waterhouse (Bull. 15, 1914, pages 26-32) and the reader is referred to that publication. He states that:-

"It includes granite, granite porphyry, aplite, and quartz-tourmaline .... Microscopically, the rock is seen to be a light coloured biotite granite tending to porphyritic in places. The constituents of the normal granite in their order of relative abundance are - orthoclase, plagioclase, quartz, and biotite: tourmaline is sometimes present in addition. The feldspars are usually 1/2" to 1/3" in length with a second generation of smaller crystals in the groundmass. The orthoclase is white, no pink orthoclase being noted on the field. It is the excess of orthoclase which gives the rock its general light-coloured appearance. The plagioclase is not very noticeable in hand specimens. The quartz is in very fresh glassy crystals about $\frac{1}{8}$" to $\frac{1}{4}$" in diameter. Biotite is in scattered crystals throughout the mass, individual crystals being exceptionally $\frac{1}{8}$" across but usually smaller."

In addition, Waterhouse gives details of a number of microscopic examinations carried out.

The chief point of interest mineralogically regarding this granite is the occurrence of quartz-tourmaline veins, dykes and nodules. In this respect, it is exactly similar to the Heemskirk Granite occurring some miles to the southwest.

A striking feature of the Meredith Range Granite which has only been revealed from aerial photographs, is the occurrence of a marked jointing. Two major series of joints appear. The first, and perhaps the most prominent, has a northwest trend in general but occasionally shows slight variations from this. The joints are relatively close-spaced, varying from 50 to 200 feet apart. The joints are not vertical but appear to have a steep dip to the northeast. The second series of joints trends approximately northeast the angle between the two sets being about 80°. This set is not as prominent as the first and is much more widely spaced, the distance between adjacent planes varying between 100 and 500 yards. It is not clear

from the photographs whether the planes of these joints are vertical or inclined.

The occurrence of these joints is responsible for the production of a marked rectangular pattern in the stream system. The major streams tend to flow along the northwest-trending series and their tributaries along the northeast-trending series, thus an almost rectangular pattern is produced the angle of 80° between main streams and tributaries being very prominent. The feature is of considerable help in determining the contact of the granite particularly along its western margin. The slope from the range to the low-lying country on this side is fairly gradual and the lower slopes of the granite are marked by thick scrub and button grass. However, the granitic nature can be definitely determined by the rectangular nature of the stream pattern. An instance of this occurs on the Rocky River. This river heads in the granite north of Mount Livingstone and flows in a general westerly direction to join the Whyte River. As far as co-ordinate point 871,400 N - 329,500 E it shows the rectangular pattern but west of this point the rectangular nature ceases abruptly. The point quoted is therefore on the granite boundary.

In one small area only, the nature of the granite contact has been observed in the field. This is on New's Creek where it is crossed by the Stanley Reward water race. At this point, a knife-edge contact was observed between the granite and the sediments. The sediments, Crimson Creek Argillites? have been altered to hornfels but the original bedding is still apparent.

The general contact has been observed from photographs and, as far as this method will permit, the contact appears to be quite sharp. Instances of this are as follows:-

(1) Contact between granite and Davey Group Sediments in the vicinity of the Rocky River as described above.
(2) Contact between granite and serpentine at Keenan Creek
(3) Contact between granite and Crotty Quartzite along the Upper Wilson River. The river forms a deep gorge, the western wall being granite and the eastern quartzite.
(4) Contact granite and Davey Group Sediments northeast of Mount Livingstone - Livingstone Creek marks the contact.

The age of the granite has not been specifically investigated by the present writer but no evidence has been found which conflicts with the traditional view that it is of Devonian age. Refer Bulletin 15 page 37 and Bulletin 21, pages 59 and 95 for a full discussion of the evidence on age.

(d) <u>The Heemskirk Dolerite</u>

In Geological Report No. 6 (Reconnaissance of the North Heemskirk Tin Field) by L.L. Waterhouse 1915, page 9, mention is made of the occurrence of "Diabase" forming "the bulk of the northwest portion of the spur of Mount Heemskirk which is crossed by the Cattle Track and known as the Gentle Annie Rise ..... The rock appears to be composed almost entirely of grey feldspar and greenish pyroxene (augite) and proves to be diabase. It is similar in all respects to the diabase so widely distributed throughout the island which forms huge sills intrusive into the Permo-Carboniferous and older rocks ... and which is regarded as being of late Mesozoic age."

These rocks are now termed "dolerite", the old term "diabase" having been discarded. The dolerite described by Waterhouse has been traced northwards into the North Pieman Mineral Area. The eastern boundary cuts the Pieman at co-ordinate point 853,200 N - 333,100 E. The contact then proceeds northwards to a point half a mile west of the Stanley River mouth and then swings W.N.W. Beyond this point it has not been traced in detail. The western boundary follows the general course of the Heemskirk River - in fact the river is located along the contact - to 200 yards upstream from the lower Heemskirk Falls. At this point it turns sharply W.N.W. paralleling the Pieman River at between a quarter and one third of a mile from the river for three and a half miles. Beyond this point, it has not been traced but photographs indicate that it continues for at least three miles further. Thus there is within the North Pieman Mineral Area at least four to five square miles of dolerite.

The change in the course of the Pieman River downstream from the Stanley River junction has obviously been caused by the presence of the dolerite mass. At the mouth of Pine Creek, the Pieman swings west again and enters the dolerite 300 yards beyond. It is a strange feature that, from this point, the river flows within the dolerite and not along the contact. A marked change in the character of the river valley occurs. The river is generally about 300 feet wide at water level and the banks, though steep, are not precipitous. Within the dolerite, the width at water level narrows to about 150 feet and both banks rise sheer from the water's edge forming a gorge. The depth of the gorge from the general level at the top of the south bank is about 400 feet. On the north bank, a thickly wooded hill rises a further 600 feet approximately, making a total exposed depth of dolerite of about 1000 feet.

There is no doubt that this dolerite is of the same age as that forming the central plateau etc, but here the association is different. Whereas, on the central plateau the dolerite forms a sill roughly along the junction of the Permian and Triassic Systems, in the North Pieman Mineral Area, its boundaries appear to be vertical and it is enclosed by the pre-Cambrian Davey Group. It appears most likely that the Heemskirk Dolerite occurrence is a dyke and formed a feeder channel for the molten magma, which subsequently spread out to form the sill. It is a matter of interest, that the nearest dolerite to the Heemskirk occurrence, occurs at an elevation of about 4,000 feet on the top of Mount Dundas where it shows the normal association resting on Permian sediments. As the dolerite is of Jurassic age and the period of mineralisation was Devonian, the dolerite is of no significance in the search for ore except in so far as it may conceal pre-existing deposits.

(4) SEQUENCE OF GEOLOGICAL EVENTS

The earliest sediments are of late pre-Cambrian age. At the close of this sedimentation an orogeny ensued before the succeeding Success Creek Group were laid down. It is probable, though not proved, that at least one further orogeny occurred within the period represented by the Davey Group.

The Success Creek Group and the succeeding Crimson Creek Argillites appear to be conformable. Upstream from the Wilson River junction a graduation from the shales to the argillites has been observed. It is not clear whether the Huskisson and Rosebery Groups are conformable with the Argillite formation. In both

cases, the contact is occupied by serpentine. It does not appear, however, that the attitudes of the beds in the different groups show any marked divergence and it would seem that they are conformable.

At the close of the Huskisson sedimentation in the Upper Cambrian, a major orogeny ensued. This has been termed the Tyennan orogeny. Following this orogeny, sedimentation again ensued during the Ordovician and Lower Devonian and the Junee and Eldon Groups were laid down. In the Middle Devonian following the close of the Eldon sedimentation, the Tabberabberan orogeny ensued. This was the most important event in West Coast geology since it brought the ultrabasic and acidic rocks which are the source of economic mineralisation. It is probable that later sediments were laid down over the West Coast area but have since been removed by erosion. Evidence in favour of this is the existence of Permian sediments near Eden siding and near the top of Mount Dundas and the existence of a dolerite dyke near the Heemskirk Range which is considered to be a feeder of the main dolerite sill.

The traditional view with regard to the serpentine is that it was the first igneous phase of the Tabberabberan orogeny and was followed by the Meredith Range and other granites. Carey (Geology of Australian Ore Deposits) Table 1, page 1108 places the serpentine in the Tyennan Orogeny and states:-

"Some authors consider gabbro, pyroxenites and serpentine belong to the Devonian diastrophism." The present writer holds to the traditional view given above on the following grounds:-

(1) The serpentine is approximately interbedded between Crimson Creek Argillites and either Huskisson or Junee Group sediments. i.e. between Lower Cambrian and either Middle to Upper Cambrian or Ordovician sediments. This does not preclude the serpentines from being of Cambrian age.

(2) Two major faults occur roughly at right angles to the trend of the serpentine belt in both cases offsetting Junee and Eldon sediments and therefore later than Lower Devonian in age. These faults were produced during the Tabberabberan orogeny. The offsetting along these faults is of the order of half to three quarters of a mile. If the serpentine had been in existence before Middle Devonian, these faults would have offset the serpentine also. This does not occur and is therefore conclusive evidence that the serpentine post-dated the faulting and it must be concluded that the serpentine along with the granite was intruded along lines of weakness during the latter stages of the Tabberabberan orogeny.

## (5) GEOLOGICAL STRUCTURE

The complete structural picture cannot be determined from the present available evidence but sufficient evidence is available to enable a generalised account to be given.

Commencing from the Stanley River and going eastwards successively younger beds are encountered as far as the axis of the Huskisson Syncline, and from this line eastwards older beds are encountered. Thus, the area between the Stanley River and approximately the position of the Pinnacles Hills is synclinal in form.

The study of the Junee and Eldon sediments shows that this syncline is asymmetrical, the axial plane dipping to the east at 70°. This then is the major folding of the latest orogeny.

North of the Pieman there is a minor development of Huskisson Group sediments and a major development of Junee and Eldon sediments. In the vicinity of Renison Bell and along the Carbine Range, the older Carbine sediments appear. South in the Dundas district, there is a major development of Dundas Group sediments, which are the equivalent of the Huskisson Group. This shows that a broad anticline occurs with an east-west trend. It is considered that this anticline is also asymmetrical with the axial plane dipping steeply to the north. This is deduced from the relative abundance of Middle and Upper Cambrian sediments on either side of the axis.

There are therefore two major fold axes occurring, one approximately 30° west of north and the other about east-west, both being somewhat asymmetrical. The intersection of these two axes occurs between the Colebrook Creek and the Exe River south of the new road formation. Superimposed on this folding there appears to have been a "tearing" movement. When the Huskisson and Zeehan synclines are observed in plan, they are seen to have approximately the same axial directions but the Zeehan syncline is offset to the west with respect to the Huskisson syncline. The Huskisson syncline has a definite curved form being convex to the west. The Zeehan syncline shows a similar convexity to the east although this is not so pronounced. It appears that pressure from the west has been applied to both ends of the Huskisson syncline and from the east to both ends of the Zeehan syncline. Thus a tearing action has taken place, offsetting the two synclines and forming their curved outlines.

The net result of these movements has been that the general area Rosebery - Renison Bell - Crimson Creek - Copper-Nickel Field - North Dundas - Ringville - Williamsford - Rosebery, is a structural "high" occurring at the intersection of two fold axes roughly at right angles to each other and, further, it has been subjected to considerable stress from the east-directed pressure to the north and the west-directed pressure to the south. Thus it has been considerably contorted and fractured. The chief structural feature which has emerged from the present investigation is the extreme contortion and fracturing of the general area above specified. This had made it a most likely area for potential mineralisation.

Although the present writer has not extended the work outside the area of the two major folds, some evidence has been obtained to show that further folds exist parallel to the two mentioned. It is considered that, when the complete picture is formed, it will be shown that, over the North Pieman area and extending southwards to include the Dundas and Zeehan districts, there are a series of east-west trending anticlinal and synclinal axes, and that between Rosebery and the sea coast there is another series of such axes trending slightly west of north. The structural highs produced by the intersections of these fold axes, especially where fractured by tearing movements, are potential areas of mineralisation.

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## ADDENDUM TO "PROGRESS REPORT ON THE NORTH PIEMAN MINERAL AREA"

Since the above report was written, three important papers have appeared in "The Papers and Proceedings of the Royal Society of Tasmania" Volume 88 published in September 1954. They include the work by Elliston in the Dundas region referred to in the main report as "unpublished". The three papers concerned are listed as references at the end of this present report. In view of the availability of these papers, some further detail can be given regarding the correlation of rock groups occurring in the North Mineral Area with those occurring elsewhere.

Elliston (page 164) defines the Carbine Group as "that group of formations overlying the Davey Group and unconformably overlain by the Dundas Group." It consists of the Higgins Slate and Quartzite (uppermost) which is a succession of black slates and quartzites, the Platt Dolomite white to dark grey in colour, and the Haestric's Dolomitic Conglomerate. In view of the rather widespread use of the term "Carbine Group" in recent publications, it is rather disappointing to find that the type definition is rather sketchy. With regard to the North Pieman Mineral Area, the publication of this definition and description is not of much use in correlation. All that can be said is that the Success Creek Group is still probably the equivalent of the Carbine Group but no correlation between formations of the two groups is possible. It is pointed out that Elliston (page 179) considers that the ore-bearing slates and quartzites at Renison Bell are "almost certainly Carbine Group correlates". This is in line with the views expressed in the main report (pages 22 and 42).

With regard to the Huskisson Group, the publication of Elliston's definition of the Dundas Group along with the fossil determinations previously described allow direct correlations between the two groups to be made. These correlations are shown in Table 1. Points which have been considered in making this correlation are as follows:-

(1) The occurrence of fossils in formations 18 and 14 on either side of a conglomerate represented by formations 17, 16 and 15. The position of fossils in formation 14 is stated by Opik to be just below the Barker's Creek horizon which is part of the Comet Slate and Tuff formation. It would appear, therefore, that the Blackwelderia biloba horizon of the Dundas Area occurs between formations 15 and 14.

(2) Formation 18 is then correlated with the Climie Slates and Tuffs which are therefore of Lower Upper Cambrian age.

(3) The fossils therefore allow formation 16 (coarse conglomerate) and its transition zones (formations 15 and 17 to be absolutely correlated with the Fernflow Conglomerate and Tuff.

(4) Having established this correlation, the four remaining conglomerates in each group may then be correlated. This is legitimate and, in fact, amounts to correlation by "rhythms" or "pulses" rather than by lithology, following the original correlation by fossils.

(5) This correlation is supported by the fact that it brings formation 10 into correlation with the Curtin-Davis Volcanics. In the Dundas Region, these are

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these are evidently representative of the major period of vulcanism and it is to be expected that the effect of the major vulcanism would be more widespread. It is pointed out that formation 10 is the only true pyroclastic bed in the Huskisson Group and thus represents the period of major vulcanism there.

(6) The Razorback conglomerate is correlated with formations 8 and 9. Elliston states (page 169) that this is "a grey conglomerate of cherty material in pebbles mainly less than 1 inch" and points out its distinctly different aspect from the remaining conglomerates in the Dundas Area. The similarity of this conglomerate to formation 8 will be seen on referring to the main report. (page 26)

Table 1

Correlation of Huskisson and Dundas Groups

| Huskisson Group | Dundas Group |
|---|---|
| Formation 19 (Breccia-conglomerate) | Misery Conglomerate |
| Formation 18 (Black Slate) | Climie Slates and Tuffs |
| Formation 17 (Transition) | Fernflow Conglomerate and Tuff |
| Formation 16 (Coarse Conglomerate) | |
| Formation 15 (Transition) | |
| Formation 14 (Black Slate) | Comet Slate and Tuff |
| Formation 13 (Shale and Tuff) | Fernfield Tuff and Conglomerate) |
| Formation 12 (Cherty Conglomerate) | |
| Formation 11 (Grey Shale) | Brewery Junction Slate and Tuff |
| Formation 10 (Coarse Tuff) | Curtin-Davis Volcanics |
| Formation 9 (Shale) | Razorback Conglomerate |
| Formation 8 (Cherty Conglomerate) | |
| Formation 7 (Blue-grey Shale) | Hedge Slate |
| Formation 6 (Conglomerate) | Red Lead Conglomerate and Tuff |
| Formation 5 (Shale) | Severn Slate |
| Formation 4 (Quartzite) | South Comet Grit |

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| | |
|---|---|
| Formation 3 (Grey Shale) | Judith Slate and Tuff |
| Formation 2 (Quartzite, shale and conglomerate) | -------- |
| Formation 1 (Black shale) | -------- |

It is observed that there are five conglomerates occurring in each group, each representing a "rhythm" or "pulse". Carey and Banks, (page 262) referring to Elliston's work state "this sequence of orogenic sediments.....implies at least six orogenic pulses". It is obvious that these authors have included the South Comet Grit as representing a pulse. With this the present writer is in agreement. On the correlation established, the South Comet Grit is shown to be equivalent to formation 4 which is a massive coarse compact blue-grey sandstone or quartzite. It is a facies variant of the grit.

It is seen that the lowest formation of the Dundas Group, the Judith Slate and Tuff is correlated with formation 3 of the Huskisson Group. Therefore, on the Huskisson section a further pulse is represented by formations 1 and 2 which are respectively black shale and conglomerate/quartzite.

The Huskisson Group, therefore, extends upwards to approximately the same horizon as does, the Dundas Group but extends downwards further, and it is now shown that there are at least seven orogenic pulses occurring between the lowest and highest unconformities of the Tyennan Orogeny.

It will be noted from an examination of the thicknesses of the various formations in the two groups that total thickness of the Dundas Group is approximately twice that of the Huskisson Group. This indicates a thinning of the sediments. An interesting point is that the thinning is mainly confined to the finer sediments, the thicknesses of the conglomeratic horizons being approximately equal in both groups.

The position with regard to the Crimson Creek Argillites has still not been clarified - there is no description of a large thickness of such rocks given by Elliston under either the Dundas or the Carbine Groups. Bradley (Pages 221-223) describes the Dundas Group as occurring in the Lynch Creek area south of Queenstown and there divides the Group into the Lynch Conglomerate, Battery Volcanics and Miner's Slate Formations. It was suggested by Carey (personal communication) that the Crimson Creek Argillites may be equivalent to the Miner's Slate formation but the description of the latter formation by Bradley in no way corresponds with the argillites. It is therefore considered that the Crimson Creek argillites are still not described in published literature. It was pointed out in the main report that there is a gradation between the Success Creek Group and the Crimson Creek Argillites and the writer is of the opinion that the argillites are a formation of the Success Creek Group which may be equivalent to the Carbine Group.

Carey and Banks (pages 245 - 269) discuss the Tyennan Orogeny and give reasons for naming three separate unconformities related to this orogeny. With this course, the present writer is in full agreement. Using the new nomenclature, the unconformity between the Gordon River Limestone and the Huskisson Group on the Huskisson River must be referred to as the Jukesian Unconformity. The contact between the Huskisson Group and the Crimson Creek Argillites on the Huskisson River is obscured by the presence of serpentine and it cannot be determined whether unconformity exists or not. If present it should be termed the Stichtan Unconformity. The Tyennan Unconformity has not been recognised in the North Pieman Mineral Area.

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