

## Geology of the Dundas District, Tasmania

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### ABSTRACT

Precambrian schists of the Davey Group are overlain by conglomerates, dolomite, black slates and quartzites of the Carbine Group, which is defined. Unconformably overlying the Carbine Group are 10,000 feet of conglomerate, tuff, breccia, and lava flows alternating with slates which contain Middle Cambrian fossils, defined here as the Dundas Group. The alternation of conglomeratic and finer sediments should persist throughout the Cambrian sedimentary basin and facilitate correlation. The Dundas Group is intruded by serpentine, which is probably of Upper Cambrian age; the Gordon Limestone of Ordovician age transgresses over, or is faulted against, the Dundas Group. Almost horizontal Permian sediments rest on an eroded surface of the Cambrian and Precambrian rocks and have been intruded by a sill of dolerite along the unconformity and another at a higher level.

The main structure of the Precambrian and Lower Palaeozoic rocks in the Dundas area is a dome pitching to north-east and south-west which is associated with other folds trending in the same direction, and cross-folds. Overthrust faulting with horizontal movement cuts the folds.

### INTRODUCTION

#### *Acknowledgments*

This paper presents part of a thesis submitted for the degree of Bachelor of Science with Honours in the University of Tasmania.

Initially the regional survey of the Dundas field was an undertaking of the North Broken Hill Company's Exploration Branch by whom the writer was employed. The initial work in surveying the central Dundas area was done under the direction of Mr. B. P. Webb assisted by Mr. B. G. May and the writer, under the general guidance of Professor S. W. Carey. Mr. P. B. Andrews also assisted with geochemical work and some field mapping. The work on the central Dundas area was done in the summer of 1949-50 and succeeded in establishing the general structure of the Dundas anticlinal high. From this point the work was carried forward by the writer alone although still employed by the company for some time and assisted throughout by the guidance of Professor S. W. Carey.

A stratigraphic sequence was established below the limestone near Mount Misery and several fossil localities were found which have helped to elucidate this Cambrian succession. These fossil localities have been visited by Dr. A. A. Opik of the Commonwealth Bureau of Mineral Resources who has given the determinations recorded in this paper.

*Geography*

Dundas occupies an erosional basin carved in the deeply serrated western flanks of Mount Dundas (3,980 feet) by the Dundas Rivulet drainage system. Continuous plateau and spur country extends northwards from Mount Dundas to Moore's Pimple with highlands of the Goodkin Ridge and Carbine Hill forming an east-west branch arm of the dissected plateau. This high country separates the northern Ring River Valley from the central Dundas area. In the south-west of the area two strike ridges of hard conglomerate, Mount Misery and Mount Razorback, stand well above the softer slates and pyroclastics forming the undulating country between them. Connecting the dividing central arm of the plateau with the hills to the north-west is the Confidence Saddle which links the upstanding massive serpentine of Pine Hill and Commonwealth Hill to the Carbine Hill chain.

From Moore's Pimple radiate three major drainage systems. The Henty catchment to the south-east drains the eastern side of Mount Dundas, the north and west flowing streams reach the Pieman River, while the Dundas Rivulet system originating on the steep western flanks of Mount Dundas flows out across the Zeehan plains as part of the Little Henty River catchment. The erosion rate is rapid and the streams rise and fall rapidly when the ground is saturated. The Dundas tuffs and slates weather to a yellow clay which, when saturated and lubricated by the heavy rainfall, slides, complete with vegetation cover, down the steep rock slopes into the creeks. There are many of these landslides in the area and they often succeed in damming the creeks for a year or two. The topography of the area is young. Deep valleys, steep slopes, sharp ridges, gorges and cliffs are found throughout.

The thick coverage of different types of vegetation over the entire area is so much an obstruction and hindrance to the geologist that some knowledge of its habits is necessary to avoid undue delay in moving through the area. With the exception of the button-grass on the high land and Melba Flat the whole area is covered with dense rain forest and vigorous secondary regrowth. Wherever the tall trees of the myrtle forests or the well grown ti-tree and blackwood stands shut out the light the forest floor is comparatively free from undergrowth and this facilitates traversing. However, the forest fringes, the more sparsely forested high country, and the regrowth areas are almost impenetrable because of the dense mat of tangled undergrowth.

The stream beds provide the only good rock outcrop. Their deep cut valleys in the steep hillsides expose the bedrock almost continuously. The rough stream beds are difficult to traverse but the most valuable information is obtained in this way. Rail cuttings on the disused Zeehan-Dundas railway and the North-East Dundas tram reveal easily mappable exposures, but even in conjunction with stream traverses insufficient data can be gained from this source to determine completely the structure of this closely folded region. Many parts of the area are accessible by timber tracks which, although often more or less overgrown, provide geological information, since their deep gougings have exposed the bedrock. There are occasional outcrops on the sharp spurs but the steep hillsides are covered with scree and vegetation.

Dundas has a cool humid climate. The high rainfall varies markedly with altitude, but actual records for Dundas have not been kept. Zeehan, about five miles to the west, has an average of 98 inches while Mount Read, about three miles to the east of Dundas, records 136 inches. Snow covers the eastern highlands for long periods in winter but by contrast to the incessant winter rains, very hot days and dry periods are often experienced in January, February and March when the streams dwindle rapidly to mere trickles.

### STRATIGRAPHY

#### *Summary of Stratigraphic Succession:*

	Thickness
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#### PERMIAN SYSTEM.

##### Siluro-Devonian:

##### ELDON GROUP—

##### Ordovician:

##### JUNEE GROUP—

Gordon Limestone

##### Cambrian:

##### DUNDAS GROUP—

Misery Conglomerate	500
Climie Slate and Tuff	2,000
Fernflow Conglomerate and Tuff	470
Comet Slate and Tuff	1,050
Fernfields Tuff and Conglomerate	1,950
Brewery Junction Slate and Tuff	2,450
Curtin Davis Volcanics	1,000
Razorback Conglomerate	225
Hodge Slate	530
Red Lead Conglomerate and Tuff	250
Severn Slate	800
South Comet Grit	150
Judith Slate and Tuff	200
 Total for Dundas Group	 11,575 feet

##### Precambrian:

##### CARBINE GROUP—

Higgins Slate and Quartzite	.....	} approx. 2,000 feet
Platt Dolomite	.....	
Maestries Dolomitic Conglomerate	.....	

##### DAVEY GROUP—

Older schists, phyllites and quartzites.

#### *Davey Group.*

The term Davey Group has been assigned by Hills & Carey (1949) to the basal Tasmanian sedimentary rocks of Precambrian age. The exposure at Dundas is on the western flank of Mount Dundas, extending northwards from Comet Creek to Concert Creek.

Originally a group of dominant sandstones with grits and shales, they have undergone low grade dynamic metamorphism to form quartzites and schists. The schistosity strikes S. 60° E. consistently.

The original shaly facies are crenulate mica schists, argillaceous schists and quartz sericite schists. They are strongly crumpled and deformed and for the most part bedding is indiscernable. It is visible in certain localities only where a contact between the various types of schist indicates change in initial lithology. It will be very difficult to subdivide this group.

#### *Carbine Group*

The Carbine Group is defined as that group of formations overlying the Davey Group and unconformably overlain by the Dundas Group. The type section is exposed along the Dundas Rivulet from the serpentine boundary a quarter of a mile downstream from Maestries Station to the boundary with schists of the Davey Group about three-quarters of a mile upstream. No fossils have yet been found and the age of the group is considered as late Precambrian extending possibly into the Lower Cambrian. In the type section the group is about 2,000 feet thick and consists of the Maestries Dolomitic Conglomerate, the Platt Dolomite and the Higgins Slate and Quartzite. This group was referred to by Reid (1925) as the Bischoff Series. The name is derived from Carbine Hill. The lower contact may be an unconformity. The group outcrops around the Precambrian anticlinal core in the Dundas area, although to the east the group is thinned or missing where it has been faulted out by a large north-south overthrust with its downthrow to the east. The group also occurs in the Renison Bell area and in the lower Concliffe Creek Valley. The names Higgins Slate and Quartzite, Platt Dolomite and Maestries Dolomitic Conglomerate are used to designate the rock types within the group, and although an order is suggested it is not claimed to be established. Determination of the succession is important, though difficult, as many locally important ore deposits are in this group.

The Higgins Slate and Quartzite is the uppermost formation and is a succession of black slates and quartzites. The name is derived from Higgins Prospect. The black slates are rolled, contorted and puckered while the harder grey micaceous quartzites occur as thinner, sharply folded beds in the slates.

The Platt Dolomite occurs in the bed of Comet Creek just east of the Platt prospect, some 300-400 feet upstream from the bridge on the South Comet road. Although the outcrop is small the bed is fairly thick, since in testing the nearby Comet ore body a North Broken Hill bore-hole went through some 70-80 feet of the massive bedded dolomite. It is white to dark-grey in colour, often resembling marble. One of the best exposures is on Judith Creek, where a large massive outcrop forming the lip of a waterfall is penetrated for 30 feet by an adit. It contains occasional crystals of galena, specks of pyrite and quartz, and is riddled with calcite veins.

It is suggested that the underlying Maestries Dolomitic Conglomerate is basal in the Carbine Group. It has rounded quartz pebbles, up to two inches in diameter, in a finer silicified or dolomitised matrix. One of the occurrences of this conglomerate has been called a tillite, but it is not clear if all occurrences are correctly correlated or correctly regarded as tillite.

The whole Carbine Group is mineralised. The slates and quartzites near the Comet Mine are extensively injected with quartz veins, some of which are quite wide, while the black slates are pyritic. The Maestries Dolomitic Conglomerate is mineralised with pyrite and galena in small veinlets and sparse crystals. While the whole matrix is more or less dolomitised, there are also wide veins of injected carbonates which occasionally include siderite in addition to magnesite and calcite. This kind of mineralisation is general, but the ore bodies commonly contain pyrite, manganosiderite, dolomite, sphalerite, galena, jamesonite, arsenopyrite and the secondary minerals derived from them. None of the ore bodies in the Carbine Group worked so far has been very large.

#### *Dundas Group*

The Dundas Group is defined as the group of formations exposed in the section along the Dundas Rivulet between the serpentine contact north of the Razorback and Mount Misery, together with those exposed on Spur Track II from a point 800 feet beyond its recrossing of the Dundas Rivulet to the tributary of White Spur Creek. In the latter section the thickness exposed is 1,300 feet while 8,500 feet are exposed in the former; however, the Razorback-Misery section may be cut off at the top by a fault, so that the section may not represent the whole of the Cambrian sedimentation, which probably continues higher. The Dundas Group rests on the Carbine Group with an unconformity and in the type section is overlain by, or faulted against, Gordon Limestone of the Junee Group.

The group consists of tuffs, breccias, lavas, conglomerates and slates. Tuff beds occur on all horizons from bottom to top of the succession and reflect periods of volcanic resurgence. A cycle of volcanic activity, in which tuffs, water-sorted pyroclastics, lavas, volcanic bombs and ejecta-menta were poured into the sedimentary basin, and normal sedimentation as the volcanoes subsided, is characteristic. The long periods of normal sedimentation are represented by thick slate formations with numerous tuff layers and an occasional breccia to indicate that the vulcanism still persisted though relatively quiescent.

No horizon can be traced reliably on lithology alone. The breccias, conglomerates and tuffs occur almost invariably as lenses and the slate thicknesses increase and decrease rapidly. However, alternating rock types have been divided into stratigraphic units, mapped, and named. It is probable that the lithology of the type section will only occur in areas having a similar relation to the centres of vulcanism or the axis of the volcanic belt, but it is hoped that the alternation between volcanic activity and quiescence will be recognisable in the Cambrian sediments throughout Tasmania.

With one exception the breccias and conglomerates of the type section are similar in lithology. This horizon was used as a marker. Despite its lensing, the distinctive lithology of the marker bed and the fossiliferous slates which occur immediately below enabled this horizon to be traced and the complex structure and the stratigraphic relationship of the beds to be successfully determined.

With the exception of the conglomerate on Mount Misery and the Razorback Conglomerate, the beds of the Dundas Group are soft and do not form outstanding outcrops. All members, including the black slates and grey grits, are usually covered with a weathering mantle of yellow soil or clay except where they are exposed by streams, railway cuttings, or tracks.

Both the Fernflow and Fernfields Volcanics contain thick purple slates and fine tuff beds with large sparse siliceous pebbles. It has been suggested that these dropped pebble beds are glacial but no striated boulders have as yet been found at this locality. The glacial origin is most likely, but alternatively there is the possibility of mud flows from steep volcanic slopes picking up the large boulders or a special type of stream erosion where the coarser material is deposited on a sandy stream bed and later covered by additional fine material. In the geological museum at the University of Adelaide, South Australia, is a glacial striated boulder recorded as having been collected by G. A. Waller near the Montezuma Falls and forwarded by him to Professor Howchin. Waller's precise locality is not known but some coarse irregular conglomerate lenses near Montezuma Falls resemble the Zeehan Tillite and the Red Lead Conglomerate high up the South Comet Creek. No more striated pebbles were found and the beds are thought to be stratigraphically equivalent to the Razorback Conglomerate. There is some evidence, then, of glacial activity concurrent with the vulcanism and extending at least well into the Middle Cambrian.

The succession in the Dundas Group is clearly established in the type section from the Misery Conglomerate down to the fossiliferous Hodge Slates, but the lower limit of this section is in contact with the intrusive serpentinite.

This is unfortunate, since although many other fossil localities have been found, no section giving continuous outcrop from a horizon established by fossils to the base of the Dundas Group has been found. It is hoped that dendroids will be found under the Razorback Conglomerate on the crest of the spur east of the head of Spur Track II. The small tributary of White Spur Creek and Spur Track II would then provide almost a continuous outcrop westwards to the base of the Group. Unfortunately, dendroids are very difficult to find in these slates. Being to the east of the area, the degree of metamorphism is higher and they will not break evenly along the bedding planes. The fragments revealed on the rough surface are inconclusive and this was also the case in searching further north at Moore's Pimple.

The mapping and comparison of the lithology to some extent justify the placing of the Hodge Slates towards the base of the Dundas Group. A sequence such as basal tuff, Hodge Slates, Razorback Conglomerate and succeeding higher members would agree with the mapped data much better in the Carbine Track and Fahl syncline area. Also, although there are dissimilar phases, parts of the South Comet Grit resemble closely the Razorback beds. However, the basal tuff on the South Comet Creek contains trilobites and the fauna is thought to be very much lower than that found in the Hodge Slates. Therefore a section extending upwards to the Hodge Slates is proposed. The section on the upper end of Spur

Track II is chosen as the type section for the part of the Dundas Group below the Hodge Slates. An approximate 1,300 feet thickness of sediment occurs on this section from the Hodge Slates to the unconformity.

The age of the Dundas Group based on sound fossil evidence, was first adduced by Thomas and Henderson (1945) who recorded Middle Cambrian dendroids from the Hodge Slate near the Razorback. Later, trilobites were discovered by the author and others and these were determined by Opik (1951A and 1951B) who showed the presence of upper Middle Cambrian in the Dundas Group. More recent discoveries in other areas have extended the time range of the group into the Upper Cambrian.

The term "Dundas" was first applied to Tasmanian rocks of this area by Waller (1905, p. 623) and then by Ward (1909) who published the first definition of this group.

#### *Judith Slate and Tuff*

The basal bed of the Dundas Group is a tuff estimated to be 200 feet thick. It is a weathered, yellow, micaceous, gritty rock seen best in Judith Creek, but also exposed in the upper Frazer Creek area and in the Avon Rivulet. The basal tuff is not very thick and is interbedded with slate. The slate which has a very distinctive purple to purple-grey colour is a very fine silt but has numerous tuff beds in it. The purple Judith Slate occurs on Judith Creek, near the Platt workings, on the crest of the Comet-South Comet divide on the South Comet road, on Spur Track I, on Spur Track II, on the Moore's Pimple Track, on the timber haulage from Severn Rivulet to Higgins and near the Stables.

Fossils are found in basal tuff of the Judith Formation on the South Comet Creek at Station 38, 400 feet upstream from the junction of Stichtite Creek with the South Comet Creek. The fauna has not yet been fully determined but Opik (1951A and B) has provisionally determined *Lorenzella* sp., *Ptychagnostus* sp., *Pagetia* sp. and *Triplagnostus* sp., and has ascribed it to the upper half of the Middle Cambrian, well below the trilobites on Barker Creek and the dendroid fauna of the Hodge Slates.

#### *South Comet Grit*

In the South Comet Creek, 800 feet upstream from the South Comet dam, is a grey grit with an estimated thickness of 150 feet. It is highly siliceous, being composed of small angular fragments of grey and black chert set in a matrix of feldspathic tuff. It is a distinctive bed and is traceable for some distance, but it does not persist right round the central core.

#### *Severn Slate*

This formation, 800 feet thick, consists of purple and black slates interbedded with tuffs best exposed on upper Spur Track II. Many thin bands of tuff alternate with slates, giving a laminar appearance when the slate and tuff material are about equal constituents of the rock. When the tuff predominates, a dark-grey, massive, fine banded rock with dark wavy laminations results. This distinctive rock was observed outcropping north of Mount Razorback, on the Carbine Track, Spur Track II, Skinny

Creek and upper Montezuma Creek. There are thick beds of light-grey dolomitic tuff, both fine and coarse, which are best exposed on the Moore's Pimple Track, Spur Track II and Judith Creek. Among the many fine layers of tuff interbedded in the slates, intra-formational brecciation is common. Their description fits slates from other areas which have been called Farrell Slates.

The formation is represented in the South Comet area between the grit just upstream from the dam and the bold outcrop of Red Lead Conglomerate on top of the spur. The South Comet ore body occurs in these slates.

#### *Red Lead Conglomerate and Tuff*

In the South Comet Creek, just upstream from the Red Lead Mine, is a horizon of conglomerate 250 feet thick. Rounded siliceous pebbles of quartzite and chert are set in a gritty purple tuff matrix. The pebbles range in size from gravels to about one foot, but are mainly one to two inches in diameter. The conformable relation of this bed to the overlying fossiliferous Hodge Slates is quite clear.

A large bold outcrop of this conglomerate was examined on the spur above the South Comet Mine. It contains dark-grey banded chert, tuffaceous yellow sandstone, grey chert, banded slate fragments and fragments of a green jaspery substance. The pebbles are angular, sub-angular, and rounded, up to three feet across and down to very fine tuff. The whole is banded and stratified, with current bedding, and gradation is visible.

The conglomeratic facies does not persist right round the core but is represented by a medium to coarse gritty purple tuff, sometimes with occasional sparse pebbles.

On the upper South Comet Creek the sparse conglomeratic pebbles are set in a very fine purple silt matrix. It was this occurrence which was compared with the Zeehan Tillite near the Montana Western Mine.

#### *Hodge Slate*

This is the main fossiliferous horizon. The fossiliferous black micaeous slates are interbedded with and below the Razorback Conglomerate. There are some tuff beds and graphitic slates which contain a dendroid and hydroid fauna.

The main fossil locality is at the Hodge Tin Mine on the Razorback where dendroids were first recorded by Thomas and Henderson (1945). From a small quarry near a prospect on the Dundas-Comet road dendroids, a small trilobite pygidium and cystoid ossicles have been obtained. A tuff bed beneath the Razorback Conglomerate on the power line 100 yards west of the hut at Bonnie Point on the North-East Dundas Tram yielded trilobites of the agnostid group, *Solenoparia* sp., and *Bathyuriscidae*. A similar tuff bed in the first re-entrant east of Bonnie Point yielded agnostids (perhaps *Homagnostus*) and *Bathyuriscidae* (Opik, 1951A). The age is the same as the beds on the power line, the north-south Bonnie Fault having caused a repetition of the easterly dipping bed. Trilobite

fragments were also obtained from a tuff bed at this horizon beneath the Razorback Conglomerate on the east side of a steep spur north of the Moore's Pimple serpentine. Unfortunately, the dense forest covers the hillside and no bedrock is exposed. The fragments were found in a piece caught in the roots of a fallen tree and no more rock was available to persist with the search.

The dendroid localities are numerous and are indicated on the map. There are numerous places where dendroids are thought to occur, as likely fragments have been found, but only positive identifications are mapped. It should be pointed out that in many cases in order to establish a positive identification the search must be persisted with for some hours. This is especially true of the trilobite localities.

Lavas occur at this horizon. On the Ring River at Ringville and among the dendroid slates on the North-East Dundas Tram, just east of Montezuma, flows and tuffs are found. The flows are not so numerous nor so thick as those in the Curtin Davis Volcanics higher up, but it is thought that they tend to be more vesicular and scoriaceous than the more massive Curtin Davis flows.

The Hodge Slate fauna has been correlated with fossils obtained from a slate band in the keratophyric succession west of the Zeehan Basin. The age is Upper Middle Cambrian and the thickness of the Hodge Slates on the type section at the Razorback is 530 feet.

#### *Razorback Conglomerate*

This is a coarse grey conglomerate containing cherty and jasperoidal siliceous pebbles up to 6 inches in diameter, but mainly less than 1 inch. Both angular and rounded pebbles occur in a matrix of fine silicified grey tuff. They are often banded and mainly grey in colour, but some of the larger pebbles are of pink quartzite. Pieces of black slate and bright red and green fragments of jasper and chert have been found. The thick Moore's Pimple development, especially the upper beds, display these highly coloured fragments making an unusual and striking rock.

The beds are often only represented by thick coarse grey siliceous tuffs but these also contain fragments of black slate. The tuff beds contain occasional volcanic bombs. It is thought that the striated pebble found by Waller was obtained from this horizon.

Since this conglomerate is very different from other pyroclastic breccias of the Dundas Group it is used as a convenient marker bed in the field. The dendroids are found in the black slates just below it and if these are relatively unmetamorphosed, so that they can be split on the bedding planes, good correlation can be readily obtained. The thickness of the conglomerate is highly variable. The hard siliceous conglomerate stands up forming many ridges, and the rapid thickness variation is readily discernable. An average sort of thickness would be 400 to 500 feet. The exposure on the type section at the Razorback is 225 feet.

*Curtin Davis Volcanics.*

These do not occur in the type section but are well developed at Montezuma above the Razorback Conglomerate. They are a thick series of flows with interbedded coarse breccias, slates and tuffs. The margins and scoriaceous zones are mineralised and altered. The vesicles are chlorite filled and dolomitisation, silicification and pyritic mineralisation are common. Several mines and adits have been opened in pyritic ore bodies at the margins of the flows. Tetrahedrite, chalcopyrite, galena, sphalerite, bismuthinite and native copper have been won as ores.

The lavas have been described as pyroxene andesite, but are now thought to have been much more basic since slides approximating picrite basalt have been cut. The acidity of the "andesite" slide is probably due to subsequent silicification. The basic character of the rock permits a possible correlation with the King Island lavas (Scott, 1952). In suggesting a correlation with the lavas on the west side of the Zeehan Basin it is just possible that those beneath the Razorback Conglomerate may be equivalent to the Montana Melaphyre Volcanics while the higher Curtin Davis Volcanics may be the same age as the keratophyric tuff. The siliceous Razorback Conglomerate between would then correspond to the Nubeena Quartzite and Slate. The fossil evidence in so far as it is established is to the contrary, since it places the Hodge Slate and keratophyre tuff at the same horizon.

It is probably pointless to attempt correlation of lava flows since they are likely to occur at any horizon in the Middle Cambrian volcanic sedimentation. At least three lava horizons have been mapped in Dundas. The Curtin Davis Lavas are well exposed on the northern end of Goodkin Ridge and form the steep hillside above Montezuma. Their estimated thickness is approximately 1,000 feet.

*Brewery Junction Slate and Tuff*

These are soft yellow-brown slates with occasional bands of purple slate and breccia and many narrow tuff horizons. Light-grey, fine banded slates with occasional fine and coarse tuff beds occur repeatedly. The fine banding of these slates is characteristic and is accentuated by alternating laminae of black slate and tuff. The tuff beds markedly decrease in frequency and thickness towards the top of the formation indicating less volcanic activity and more normal deposition in the sedimentary basin.

These very thick sediments are exposed in the Dundas Rivulet from Dundas Railway Station to Brewery Junction. The less tuffaceous beds towards the top are less competent and have been deformed by a series of uniform folds about 30 feet across.

The thickness is 2,450 feet and probably represents most of the Upper Middle Cambrian, but no fossils have yet been found in these beds.

*Fernfields Tuff and Conglomerate*

The Fernfields Tuff and Conglomerate are exposed in the Dundas Rivulet between Brewery Junction and Fernfields Creek and are 1,950 feet thick in this section. The top of this formation resembles the West Coast Range Conglomerate. It is a coarse siliceous conglomerate with a tuff and

gravel matrix. Beneath this are purple slates with tuff and volcanic ejectamenta and a thick bed of purple slates with large sparse siliceous pebbles which possibly have a glacial origin. The bulk of the sediment is a coarse gritty purple tuff but pyroclastic fragments and siliceous gravels and pebbles occur throughout. The breccia towards the bottom tends to be more truly volcanic, since it is composed entirely of coarse tuff and tuff pebbles. Its contact with the underlying Brewery Junction Slates is very sharp.

#### *Comet Slate and Tuff*

The type section exposes the Comet Slate and Tuff in the Dundas Rivulet in the vicinity of Comet Creek junction and here it is 1,050 feet thick. Very thick beds of light-grey slates and tuffs with occasional grey-purple beds indicate further normal sedimentation with comparatively little volcanic activity. On Barker Creek is a well-bedded, grey-brown siltstone with slaty cleavage, which makes it fairly difficult to split on the bedding. This contains abundant fossils which include the trilobites *Blackwelderia* cf. *biloba* Kobayashi, *Conocephalites* (?), and *Anomocarella* (?) in addition to several agnostids (Opik, 1951A). On the power line, just east of Confidence Saddle, is a lava flow occurring in these slates. It is the highest flow noted in the Dundas Group.

#### *Fernflow Conglomerate and Tuff*

The Fernflow Conglomerate and Tuff is on the Dundas Rivulet in the vicinity of Fernflow Creek where the formation is 470 feet thick. Sparsely siliceous and tuffaceous conglomerate in a purple slate matrix and a similar conglomerate in a coarse tuff matrix are the main rock types. It is possible that these are dropped pebble beds and that this thin horizon is glacial. Purple and brown slates with sparse pebbles and water-sorted volcanic material also occur.

#### *Climie Slate and Tuff*

The Climie Slate and Tuff occurs near the junction of Climie Creek with the Dundas Rivulet and is approximately 2,000 feet thick. Grey purple slate, light grey slate, purple slate and tuff with coarser tuff beds and an occasional pyroclastic breccia indicate a period of relative volcanic quiescence. These beds have been regarded as the top of the Dundas Group, but actually the sedimentation is quite continuous with the conglomerate on Mount Misery which has previously been correlated with the West Coast Range Conglomerate. The alternation of conglomerates with slates is the main feature of the Dundas sedimentation. The tuff beds persist throughout but are much thicker and coarser in conjunction with the conglomerates. The siliceous conglomerates appear to follow the violent volcanic activity and may be due to the deepening of the sedimentary basin by rapid subsidence of the thick volcanics or possibly to concurrent glacial activity.

#### *Misery Conglomerate*

The lower beds of the conglomerate on Mount Misery interdigitate with green chloritic tuffs and grits. The thickness of the conglomerate is irregular. It occurs in lenses and beds which grade out to practically nothing and are interbedded with thick tuffs.

Although the conglomerate was for a long time regarded as West Coast Range Conglomerate there is a probability that the succeeding limestone is faulted or transgressive, and that the conglomerate is merely a very thick development of one of the conglomerates in the Dundas Group. In this case the top of the Dundas sedimentation is missing from the type section.

#### *Junee Group*

The only rock in the area assigned with certainty to this group is the Gordon Limestone on the flat west of Mount Misery. It forms the rim of the Zeehan Synclinal Basin.

#### *Eldon Group*

Conformably overlying the Ordovician limestone is the Eldon succession up to the Bell Shales. These beds are actually outside the area studied.

#### *Permian System*

The only other sedimentary rock in the area is the thin layer of Permian mudstone between the thin Jurassic dolerite sills on the summit of Mount Dundas. This elevated outlier is a small residual resting unconformably on Cambrian strata of the Carboniferous peneplain surface. Permian fossiliferous boulders are found in the Dundas Rivulet stream system.

### IGNEOUS ROCKS

#### *Serpentine*

The transgressive serpentine sills are the important igneous rocks of the area. They have been regarded as contemporaneous with the Curtin Davis lavas but they transgress beds at the top of the Middle Cambrian. Some intrusions at least then are younger than Middle Cambrian. The serpentines are displaced by Devonian faulting and altered by Devonian mineralisation. They are older, and probably much older, than Devonian. Upper Cambrian is the most probable age.

The parent igneous magma for the serpentine was probably a bronzite, since kernels of this material have been found in boulders in the asbestos quarries on Five Mile Hill and over the Great Nevada asbestos adit. The intrusions have all been more or less completely serpentised and asbestos occurs in many of them. The expansion due to hydration has caused crumpling, contortion and many minor faults and breaks in the surrounding rocks. Subsequent Devonian mineralisation has taken advantage of the disturbed zone, and silicification, dolomitisation and mineralisation of the serpentine margins are common.

Many ore bodies have been worked in the margin of the serpentine which has been the source of chromite, tin, copper, nickel, iron, sulphur and carbonates. There is reasonable prospect of finding further tin mineralisation associated with the margin of the serpentine in areas such as the Hodge workings or Pine Hill.

The very deep weathering of the serpentine is thought to be due largely to the Devonian hydrothermal activity. Wide aprons of decomposed rock occur in Dundas, especially at Kapi. The decayed serpentine resembles a red-brown tuff for which it has often been mistaken. How-

ever, there are still fragments of fresher serpentine and if the weathered rock is examined closely outlines of previously embedded crystals can be seen preserved in the decayed rock. On the map this weathered serpentine is not differentiated from the fresh, nor is the hydrothermally altered rock. Where the ultra-basic rock has reacted with acid magmatic fluids a suite of contact gabbros, hornblendite, feldspar porphyries and quartz porphyries has resulted.

The quartz porphyry sketched by Ward (1909) has been roughly indicated but although it was visited no attempt was made to map its boundaries in the field. They are largely covered by scree.

#### *Jurassic Dolerite*

Two thin dolerite sills occur on the summit of Mount Dundas. The lower is intruded along the unconformity at the top of the Cambrian rocks which were exposed during the Carboniferous peneplanation. It is overlain by a thin section of Permian mudstone followed by a second sill which forms the summit of Mount Dundas. The dolerite is similar to the large sills found in Eastern Tasmania but no very coarse-grained rock was seen.

A dyke of fine grained basic igneous rock outcrops on the Carbine Hill Track as it passes over the saddle, and another is seen in a cutting on Wallace's Tram where it cuts the Fernflow Conglomerate. There is no evidence to indicate that these dykes may not also be Jurassic in age, but it is quite possible that they are Tertiary.

### DISCUSSION ON STRATIGRAPHY

#### *Structural Relations of Rock Groups*

The Eldon Group forms the centre of the Zeehan Syncline and it conformably overlies the limestone and conglomerate of the Junee Group. Commonly an unconformity is found at the base of the Junee Group, as at Howth, Cethana and Tim Shea, but it is clear that the Cambrian succession underlies the conglomerate on Mount Misery without break. The upper beds of the Climie Slate and Tuff interdigitate with this conglomerate. However, it is not clear that the conglomerate on Mount Misery is West Coast Range Conglomerate as has been thought. Its lithology is similar to that of the West Coast Range Conglomerate, but other conglomerates lower in the Dundas Group, although they do not occur in thick beds, are also very similar. There are three possibilities for the relation of the Misery Conglomerate to the immediately succeeding limestone rim of the Zeehan basin:

- (i) Assuming the Mount Misery Conglomerate to be merely a thick development of one of the conglomerates of the Dundas Group, the limestone may transgress over it as at West Zeehan.
- (ii) The conglomerate may be faulted against the limestone. A major fault is known to pass across the limestone flat immediately west of Mount Misery. Supporting these possibilities is the continuation of Dundas Group rocks down the Dundas Rivulet, beyond the horizon of the Misery Conglomerate. Also the fossils found on Barker Creek indicate

the age of the Comet Slate and Tuff as Upper Middle Cambrian. This leaves only some 2,500 feet of sediment to represent most of the Upper Cambrian which is a period as long as the entire Permian. The unconformities beneath the West Coast Range Conglomerate in other parts of the State further support these two possibilities.

(iii) The conglomerate on Mount Misery has been regarded as West Coast Range Conglomerate and the sedimentation as continuous. Unfortunately, close examination of contact between the limestone and the conglomerate is precluded by the fall of scree from the steep western slope of the mountain on to the limestone flat.

Further work down the Dundas Rivulet from the Queenstown Road will perhaps give an indication as to which of these possibilities is correct. Meanwhile, the evidence is in favour of either transgression or faulting, which means that the Upper Cambrian sediments are missing from what has been defined in this paper as Dundas Group.

The thick Dundas succession rests unconformably on the contorted slates and quartzites of the Carbine Group. The only exposure of this unconformity seen is inconclusive but the evidence for a major break is strong. The junction of the Carbine Track and Wallace's Tram is on the upper Great Northern Creek at the Stables. Further up Wallace's Tram, 100 feet from the Stables, in the bank of a small tributary is exposed an irregular contact of slate and tuff. The slates are contorted and puckered and belong to the Carbine Group. The tuff is relatively unfolded and appears to be less altered. Since the exposure is only for a few feet, not enough of either bed can be seen to give the true relation. However, it does seem that the irregularities of the closely folded slates penetrate across the bedding of the tuff. Evidence of a fault nearby confuses the positive establishment of the tuff as basal in the Dundas Group. The Razorback Conglomerate occurs just downstream from the Stables and bears a faulted relation to the Carbine Group at the Stables. The whole of the Dundas Group from the Hodge Slate down is faulted out. Therefore, if this tuff belongs to the Judith Slate and Tuff it must be a small tongue remaining on the upthrown side of the fault.

The best evidence for the unconformity is in the Avon Rivulet in the vicinity of the track from Higgins to Moore's Pimple. The basal Dundas tuff bed here overlies first the slates and then the quartzites of the Carbine Group as it is traced round the contour. On Judith Creek also the marked change in metamorphic grade noted was put down to an unconformity as no evidence of faulting could be seen. The radical change of dips supports this but is not in itself conclusive evidence, as the folding of the lower members of the Dundas Group precludes constancy of dip direction for more than a few hundred feet. The Judith Creek section clearly establishes the Dundas-Carbine contact. Bedded primary dolomite is not found in the Dundas Group nor is purple slate found in the Carbine rocks. Sharply folded slates, however, are common to both.

The evidence set out above is supported by the mapped relationships of the rocks and in total is considered sufficient to postulate a major unconformity at the base of the Dundas Group. Fossil evidence indicates that the Judith Slates are the lowest of the three fossil zones, and probably Lower Middle Cambrian in age. This would put the depositional break in the Lower Cambrian.

The relationship of the Carbine Group to the schists of the Davey Group is not clear nor was the problem studied at length. A clear exposure of the unconformable contact of these beds with the Davey rocks would be required to show the relationship, since the close folding and fracturing make other evidence unreliable. Reid stated (1925, p. 7) "Directly succeeding, but unconformable with the Proterozoic schists, is a series of grey and black fissile slates, sandstones, conglomerates and quartzites . . ." However, he give no supporting evidence for this unconformity. It is doubtful whether an unconformity exists. The area mapped as Davey Group is determined solely on grade of metamorphism. In every traverse the boundary was established with difficulty, since it is entirely transitional. It is clear, however, that there are two groups of rocks. Once the transitional boundary is crossed the Davey rocks are entirely micaceous foliate schists, crenulated schists, high-grade phyllites and ropy quartz mica schists. The rock is dominantly quartzitic, being derived from argillaceous sandstones. On the other hand, although the Carbine rocks contain many, and often thick, quartzite horizons, they are dominantly slates, and contorted black slates occupy most of the area mapped as Carbine Group. The difference in lithology as distinct from the metamorphism warrants two formations. No fossils have been found in the Carbine Group and its age is still uncertain. It is thought to be Late Precambrian, but perhaps it extends into the Lower Cambrian. The Davey Group is certainly Precambrian.

#### CORRELATION OF DUNDAS GROUP WITH OTHER AREAS

##### *West Zeehan*

The Dundas rocks dip westwards beneath the Zeehan Synclinal Basin. Their occurrence would then logically be expected on the west limb of the syncline. Here the West Coast Range Conglomerate is well represented on Mount Zeehan to the south of the syncline, but further north the thick development of conglomerate is missing and the succession found is:—

Limestone (Gordon Limestone)  
Keratophyric tuffs and slates  
Quartzites (Nubeena Quartzite and Slate)  
Basic volcanics (Montana Melaphyre Volcanics)

Compared with the eastern limb of the syncline, these rocks have been altered, mineralised and subjected to complex folding and faulting. Because it is not so clear, the succession is not known in such detail as at Dundas.

Fossils were located in the Summit Cutting on the Comstock Tram in a comparatively unaltered black slate which would be at the base of the keratophyric tuff succession. The fauna is equivalent to that of the Hodge Slate at Dundas which is well down in the succession. It is just

possible that there is sufficient thickness in the keratophytic tuff for all the formations of the Dundas Group above the Hodge Slate to be represented.

On the T.L.E. Tram to the Swansea Mine, west of Zeehan, the distinctive lithology of the Razorback Conglomerate was recognised. Unfortunately, the grade of metamorphism is too high to allow dendroids to be found in the associated black slates and a positive correlation made. This bed is well below the fossils of the Summit Cutting, but the total thickness represented between the T.L.E. occurrence and the limestone on the rim of the Zeehan Synclinal Basin is only a little less than the 8,500 feet exposed on the type Dundas section, between Mount Misery and Mount Razorback. Nearby at the Swansea Mine is an outcrop of tillite of the Zeehan Glacials which is regarded as stratigraphically below the Razorback Conglomerate. Although metamorphosed the rock does resemble some of the conglomerate formations of the Dundas Group. It is made up of pebbles and boulders set in a feldspathic, gritty matrix. The Swansea occurrence compares with the Red Lead Conglomerate outcropping at the crest of the spur above the South Comet Mine. Structural and further palaeontological work will need to be done west of Zeehan to sort out the relation of the fossiliferous keratophytic tuff, the so-called Razorback Conglomerate, and the tillite.

A little further north, where the structure at the western margin of the Zeehan basin is more straightforward, a section was studied in detail to try to establish a correlation. Starting from the Zeehan Glacials, just east of the Montana Western Mine, a traverse was made to the limestone on Dunkley's Tram, over an easterly dipping sequence of finely bedded feldspathic shales and slates, tuff beds, quartzites and lava flows which occur immediately before the limestone.

The following similarities with the Dundas Group were noted:—

- (i) Each succession of volcanic activity, i.e., lavas and tuffs, is followed by a thick series of slates or normal sediments.
- (ii) The coarser tuffs resemble the Dundas pyroclastic breccias.
- (iii) The lower lava flow resembles the Curtin Davis Volcanics.
- (iv) The black slates and fine banded tuffs are dolomitised and are similar to those associated with Curtin Davis Volcanics.
- (v) Some of the slates are similar, especially in the presence of numerous interbedded thin tuff beds.

The section differs from that of the Dundas Group in the following respects:—

- (i) Total thicknesses of slate or "normal sedimentation" between the successive volcanic periods is much less, as is that of the volcanics themselves.
- (ii) Coarse pyroclastic breccias and siliceous conglomerates do not occur.
- (iii) Hard thick massive quartzites and pale-grey feldspathic slates do not occur in Dundas, but these may be due to alteration.
- (iv) The degree of metamorphism is very much greater in this section. The slates are sub-phyllites and micas are developed in the tuff bands.
- (v) The contortion and folding of the slates considerably exceeds that of the softest Dundas beds.
- (vi) No amygdaloidal lava of the coarseness of the Montana Melaphyre Volcanics found just before the limestone, has been found among the Curtin Davis flows.

The similarities outweigh the differences, especially if the comparison is made with the lower Dundas Group from the Razorback marker down.

It is a reasonable assumption that the lavas are equivalent to those at Curtin Davis. The Zeehan Glacial Formation at the Montana Western Mine is conformable in this sequence, which indicates its stratigraphic position as below the Curtin Davis Volcanics and the Razorback Conglomerate. On comparing a fresh specimen of the tillite at Montana directly with a specimen obtained from high up the South Comet Creek it was agreed that they were identical, although the position of the South Comet Creek rock was obscure at this time. The rock in South Comet Creek is now regarded as Red Lead Conglomerate. Other higher conglomerates in the Dundas Group are also suspected of having a glacial origin.

Summarising all this evidence the following conclusions may be drawn:—

1. The limestone at the base of the Zeehan synclinal structure is transgressive. It is deposited over the West Coast Range Conglomerate at the south end of the basin and laps over successively older members of the Dundas Group northwards.
2. The keratophytic slate and tuff are equivalent to the upper formations of the Dundas Group.
3. The succession from the Montana Western Mine to Dunkley's Tram contains the Montana Melaphyre Volcanics. It is equivalent to the lower part of the Dundas Group.
4. The Zeehan Glacials are possibly equivalent to the Red Lead Conglomerate in the Dundas Group. If this is true the tillite can not be much older than Lower Middle Cambrian.
5. Glacial activity was probably contemporaneous with the early volcanic activity of the Cambrian sedimentation.

### *Poiseidon*

A visit was made to the Poiseidon-Bon Accord area, west of Renison Bell, to attempt a correlation. This area is 4 or 5 miles to the northwest of Dundas. Although no positive fossil correlation was obtained, purple slates, pyroclastic breccias, tuffs and the Razorback Conglomerate were recognised, indicating that the rocks probably belong to the Dundas Group.

### *Hercules*

A traverse was made from the Razorback Conglomerate north-eastwards to the Hercules Mine, to correlate these rocks with the Dundas Group. The degree of metamorphism is high and increases eastwards. Since the structure is not entirely understood, it is not possible to obtain a rigorous correlation with the type section of the Dundas Group of which it should be the equivalent. Rocks traversed were:—

- (i) Razorback Conglomerate: There is a thick development of this siliceous conglomerate on Moore's Pimple. The beds dip east so that this horizon is the lowest.
- (ii) Thick dolomitic slates and tuffs (Brewery Junction).
- (iii) Pyroclastics (Fernfields). The hydrothermal alteration has recrystallised the feldspathic tuff and large phenocrysts of feldspar are embedded in a light-grey matrix. The initial fragmental nature of the rock is still discernible but it is little wonder these rocks were earlier regarded as "porphyroids".
- (iv) Further slates.
- (v) A siliceous conglomerate which resembles the Razorback Conglomerate.
- (vi) Slates.

- (vii) Grey sheared dolomitic tuff. This is the host rock of the Hercules ore bodies.
- (viii) Black slates. Because of their proximity to a tuff somewhat resembling an equivalent to the Razorback Conglomerate in Dundas they were examined for dendroids. The grade of metamorphism proved too high.
- (ix) Sheared massive pyroclastics referred to locally as E.M.F. (Eastern Massive Fragmental). They have been described by Hills (1914b) under the heading of Read-Rosebery Schists and Felsites.

#### *Mount Jukes*

A sequence of slates and metamorphosed pyroclastics has been described from this field by Hills (1914a). A "brecciated conglomerate" is also discussed and appears from the description to correspond to one of the thicker Dundas pyroclastic formations.

#### *Mount Farrell*

In the purple Severn Slates many of the thin tuff lenses show intraformational brecciation. This and the rhythmically alternating bands of tuff and slate each about 2 inches thick make the rock quite distinctive. Rock of this type is recorded from Mount Farrell.

#### *Leven Gorge*

The Leven River, north of Gunn's Plains, cuts a section through a series of alternating slates, lavas, pyroclastics and tuffs.

Fossils have been found in one or two localities and correlated with the Barker Creek (Comet Slate and Tuff) fauna of upper Middle Cambrian age. It was also suggested by Opik (1951c) that a lower Upper Cambrian horizon in the Leven Gorge may be correlated with the upper fossiliferous horizon on the Huskisson River.

#### *Huskisson River*

The Huskisson River exposes a section of Cambrian rocks although they are of somewhat different lithology from that of the Dundas area. The vulcanism seems somewhat subdued in comparison with the type locality but the alternation of slates with conglomerates and tuffs persists. A fossil locality of Upper Cambrian age and another which may correspond to the Comet Slate and Tuff on Barker Creek have been found on the river section (Opik, 1951b).

### CORRELATION OF CARBINE GROUP WITH OTHER AREAS

There is little positive data on which to base a rigorous correlation of Carbine rocks with others outside the area. The name Pieman Group was formerly given to these old closely folded slates and quartzites, volcanics and tillites below the Junee Group and younger than the old schists. This name therefore included both the Dundas and Carbine Groups as at present defined. The work in Dundas has established the relationships to the younger and older rocks so that the name Carbine Group will now apply to the older group around the central Dundas core. Reid (1925, p. 7), and Finucane (1947) have referred to these rocks as Bischoff Series, and they are described by Reid as similar to rocks at Rosebery and Mount Bischoff. They are probably equivalent.

The ore bearing slates and quartzites at Renison Bell were examined, and in view of their relation to the Dundas rocks immediately west in the Poiseidion-Bon Accord area they are almost certainly Carbine Group correlates.

In the group is a primary, bedded dolomite and it is probable that this is the equivalent of that found at Smithton and Black River.

#### STRUCTURAL GEOLOGY

##### *Folding*

The structure of Dundas is essentially domal. The successively younger beds dip away from the central core of Davey Group schists. The Carbine Group is continuous round the core but is considerably thinner to the east. Folds of three magnitudes are present. The largest is the anticlinorium of the Dundas structural high on which there are four or five folds about half a mile wide and on these local folding occurs with interaxial distances of 50 to 100 yards.

The smaller folding can be readily determined locally by the dip observations and the usual field methods. The large domal structure can be determined on rock types but the intermediate folding is the most difficult. The beds are usually not discernible on the air photographs and cannot be traced by walking outcrops because exposures are mostly limited to creek beds. Fortunately, the faults can be traced on the aerial photographs and where their position is suspected confirmatory evidence is usually forthcoming. Careful mapping of the rock types and taking sufficient dip observations to be more or less statistical is the only method of working out the complex structure. This work is made difficult by the violent relief and vegetation which often made it almost impossible to obtain information where required.

The main fold axis of the Dundas anticlinal high trends north-east to south-west and pitches from central Dundas in these directions. A reversal of pitch to the north-east almost immediately brings up the Carbine rocks in the Concliffe re-entrant. This reversal persists across the northern boundary of the map and brings up the Carbine Group again at Renison Bell. To the east and west the beds in general dip away from the old core. However, the west limb is confused by the intrusion of large masses of serpentine. In the eastern margin of the Zeehan Basin is a bulge indicating some sort of a major depression. It is thought that this major cross structure persists across the Dundas area and is represented by the pitch reversal just indicated. On Colebrook Hill there would be the intersection of the two folds. The axis plunges to the south-west and passes out into a gentle fold in the younger sediments which merely lap round the anticlinal nose. The serpentine sill is intruded in this locality at the unconformity between the Dundas and Carbine Groups. It turns round over the plunging nose of the anticline showing up the fold. A small north-south trending fold on South Comet Creek is also reflected in the serpentine.

The Carbine Syncline is the next largest fold in the area. It is a trough extending south from Confidence Saddle to Carbine Hill where it turns west towards the Grand Prize Mine. It contains the younger Dundas rocks, such as are exposed on the type section, and which do not

occur elsewhere in the area mapped. It was from near the centre of this syncline that the abundant fossils of the Barker Creek locality were obtained.

The folding and faulting in the Bonnie Point corner is the most complex in the whole area. The rim of the Goodkin Syncline is visible on the aerial photographs since the almost vertical Razorback Conglomerate stands up as a strike ridge revealing the fold. However, this is the only fold in the area which is visible in this way. The northward pitch of these folds represents the regional dip away from the central core. The axis of the Dundas anticlinal high comes through just east of the Fahl Syncline and the marker bed is refolded on this complementary anticline to appear again in Concliffe Creek.

The Ramesdale Syncline is a smaller fold and is fairly simple although quite sharp. The marker on the west synclinal limb is readily traceable along the east side of the Great Northern Creek re-entrant. The fold is asymmetric, the west limb dipping gently and the east limb being almost vertical. The asymmetry and north pitch represent the regional dip away from the core. The complementary anticlinal crest to the west is missing, being faulted out by the Good Intent Fault. However, the structure is more or less part of the larger Carbine Syncline of which it represents the east limb.

The axis of the north-south trending Nevada Anticline passes in the vicinity of the Great Prize and southwards to the Nevada Mine where it turns eastwards; the core is occupied by the massive serpentine north of the Razorback. The marker horizon is anticlinally arched over the area, dipping north-east at the northern margin of the serpentine and south-west on Mount Razorback, which is a great strike ridge on the south-western margin. The successively younger beds then dip south-westwards in conformity with the structure of the large Zeehan Synclinal Basin.

The Carbine Group has undergone at least one additional orogeny and in consequence is much more closely folded. No serious attempt has been made to work out the detailed structure of the group but such a task, although extremely difficult, may be well rewarded as it is in this group that most of the mineral deposits occur. The massive quartzites fold competently with regard to the softer slates. They are brittle and fracture readily whereas the more plastic slates are rolled, puckered and contorted into fantastic shapes. Zig-zag folding seems to be characteristic of the thinner quartzite strata of the group, and invariably brecciation occurs in the apex of the folds. The mineralising solutions have taken advantage of the numerous fractures and folds to percolate through the rock depositing the valuable lodes. However, since the close folding and fracture of the rock are on a small scale, so also seems to be the deposition of ore.

#### *Faulting*

The complex faulting of the area was worked out mainly from the aerial photographs. The linear structures show up and were traced on the photographs. They were checked with recorded evidence of faulting from the field books and where not in agreement the existence of the faults was investigated in the field. Many of the linears were deleted

from the photographic interpretation when field evidence was not forthcoming. The fault pattern is dominantly north-south with repeated down-throw to the west. The Argent, Kapi and Concliffe Faults are the main ones of this pattern. None of the faults in the area is thought to be either Jurassic or Tertiary but it is quite possible that some of them may have moved again in these later times.

The Montezuma Thrust is a large overthrust upthrown from the west and displaying considerable lateral movement. It is actually fairly straight but the thrust apparently dips at a low angle (say 50°) to the west and it is the intersection of this inclined plane with the violent topography which is responsible for the irregularities of its trace on the map. The amount of movement on the thrust is not known but is estimated to be about 1,000 to 1,500 feet. The fault zone is quite wide and right along its length the rocks have been crushed and contorted for some distance on either side of the fault. This is especially noticeable where the thrust crosses the Carbine rocks and the old core. The fault zone is heavily mineralised and wide lenses of solid pyrite have been found. Carbonates and especially quartz veins occur along it and in the subsidiary fractures running from it.

The following data have a bearing on its age:—

- (i) It cuts Davey and Carbine rocks and the rocks of the Dundas Group up to the lavas in the Upper Middle Cambrian.
- (ii) It is heavily mineralised, presumably by the Devonian mineralisation.
- (iii) It does not affect the Permian and dolerite capping of Mount Dundas under which it passes.

It is probably Devonian in age.

The Argent, Kapi and Concliffe Faults displace the serpentine and the sediments at the top of the Middle Cambrian. The Concliffe Fault does not seem to have disturbed the pre-Permian peneplain which it crosses just east of the summit of Mount Dundas. Moreover, they must be pre-mineralisation and Devonian seems a most probable age. The Argent Fault was not examined in the field but is thought to be contemporaneous with the Kapi and Concliffe Faults. All three faults downthrow to the west and tilt the strata eastwards so that a succession of blocks occurs with strata all east-dipping. The fault zones are more or less mineralised and some ore bodies occur, especially in Kapi Creek and on the saddle between Pine and Commonwealth Hills. This area might be worthy of closer investigation since the pre-serpentine fault would form a mineralising channel, which would allow extensive alteration of the ultrabasic rock.

The Severn Fault, which trends north-west is the oldest in the region since it is cut by the Montezuma Thrust and the Great Northern, Miklos and Good Intent Faults.

Other smaller faults include the West Comet, Kosminsky fractures, Red Lead, Platt, Fahl, Bonnie Faults and two small fractures west of Goodkin Ridge. All of these have valuable ore deposition on them. They may be considered as adjusting faults to the main fracture pattern.

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## LOCALITY INDEX

	Quadrangle International Grid (K/55)	Latitude	Longitude
Avon Rivulet	Zeehan 50	41° 50'	145° 27'
Barker Creek	Zeehan 50	41° 52'	145° 25'
Black River	Smithton 21	40° 53'	145° 18'
Bon Accord	Zeehan 50	41° 48'	145° 24'
Bonnie Point	Zeehan 50	41° 49'	145° 27'
Brewery Junction	Zeehan 50	41° 53'	145° 24'
Carbine Hill	Zeehan 50	41° 51'	145° 25'
Carbine Track	Zeehan 50	41° 51'	145° 26'
Cethana	Sheffield 37	41° 28'	146° 10'
Clinie Creek	Zeehan 50	41° 55'	145° 24'
Colebrook Hill	Zeehan 50	41° 48'	145° 28'
Comet Creek	Zeehan 50	41° 53'	145° 25'
Comet Mine	Zeehan 50	41° 53'	145° 25'
Commonwealth Hill	Zeehan 50	41° 48'	145° 25'
Comstock Tram	Zeehan 50	41° 53'	145° 19'
Concert Creek	Zeehan 50	41° 52'	145° 26'
Concliffe Creek	Zeehan 50	41° 50'	145° 28'
Confidence Saddle	Zeehan 50	41° 49'	145° 25'
Curtin Davis Mine	Zeehan 50	41° 51'	145° 27'
Dundas	Zeehan 50	41° 53'	145° 24'
Dundas Rivulet	Zeehan 50	41° 55'	145° 22'
Dundas Station	Zeehan 50	41° 53'	145° 24'
Dunkley's Tram	Zeehan 50	41° 54'	145° 20'
Fernfields Creek	Zeehan 50	41° 53'	145° 24'

	Quadrangle International Grid (K/55)	Latitude	Longitude
Fernflow Creek	Zeehan 50	41° 54'	145° 23'
Five Mile Hill	Zeehan 50	41° 58'	145° 22'
Frazer Creek	Zeehan 50	41° 50'	145° 26'
Goodkin Ridge	Zeehan 50	41° 50'	145° 27'
Grand Prize Mine	Zeehan 50	41° 51'	145° 24'
Great Nevada Mine	Zeehan 50	41° 51'	145° 23'
Great Northern Creek	Zeehan 50	41° 50'	145° 26'
Gunn's Plains	Sheffield 37	41° 18'	146° 01'
Henty River	Strahan 57	42° 02'	145° 18'
Hercules Mine	Zeehan 50	41° 50'	145° 30'
Higgins	Zeehan 50	41° 51'	145° 26'
Hodge Tin Mine	Zeehan 50	41° 52'	145° 24'
Howth	Devonport 29	41° 05'	146° 01'
Huskisson River	Corinna 43	41° 39'	145° 27'
Judith Creek	Zeehan 50	41° 54'	145° 26'
Kapi	Zeehan 50	41° 49'	145° 25'
Kapi Creek	Zeehan 50	41° 49'	145° 25'
Leven Gorge	Devonport 29	41° 16'	146° 03'
Leven River	Devonport 29	41° 15'	146° 10'
Little Henty River	Zeehan 50	41° 56'	145° 11'
Maestries Station	Zeehan 50	41° 53'	145° 25'
Montana Western Mine	Zeehan 50	41° 51'	145° 17'
Montezuma	Zeehan 50	41° 50'	145° 27'
Montezuma Creek	Zeehan 50	41° 50'	145° 27'
Montezuma Falls	Zeehan 50	41° 50'	145° 27'
Moore's Pimple	Zeehan 50	41° 52'	145° 28'
Moore's Pimple Track	Zeehan 50	41° 52'	145° 27'
Mount Bischoff	Valentine's Peak 36	41° 26'	145° 31'
Mount Dundas	Zeehan 50	41° 55'	145° 27'
Mount Farrell	Mackintosh 44	41° 44'	145° 34'
Mount Jukes	Lyell 58	42° 11'	145° 36'
Mount Misery	Zeehan 50	41° 54'	145° 23'
Mount Razorback	Zeehan 50	41° 52'	145° 24'
Mount Read	Murchison 51	41° 51'	145° 32'
Mount Zeehan	Zeehan 50	41° 54'	145° 18'
North East Dundas Tram	Zeehan 50	41° 50'	145° 25'
Pieman River	Corinna 43	41° 40'	145° 08'
Pine Hill	Zeehan 50	41° 48'	145° 25'
Platt Prospect	Zeehan 50	41° 53'	145° 26'
Poiseidon	Zeehan 50	41° 48'	145° 24'
Queenstown Road	Zeehan 50	41° 55'	145° 22'
Red Lead Mine	Zeehan 50	41° 54'	145° 25'
Renison Bell	Zeehan 50	41° 48'	145° 25'
Ring River	Zeehan 50	41° 48'	145° 27'
Ringville	Zeehan 50	41° 48'	145° 27'
Rosebery	Murchison 51	41° 49'	145° 32'
Severn Rivulet	Zeehan 50	41° 50'	145° 27'
Skinny Creek	Zeehan 50	41° 54'	145° 25'
Smithton	Smithton 21	40° 52'	145° 07'
South Comet Creek	Zeehan 50	41° 54'	145° 25'
South Comet Mine	Zeehan 50	41° 54'	145° 25'
South Comet Road	Zeehan 50	41° 54'	145° 25'
Spur Track I	Zeehan 50	41° 53'	145° 26'
Spur Track II	Zeehan 50	41° 52'	145° 26'
Stables	Zeehan 50	41° 51'	145° 26'
Stichtite Creek	Zeehan 50	41° 54'	145° 25'
Summit Cutting	Zeehan 50	41° 53'	145° 19'
Swansea	Zeehan 50	41° 55'	145° 18'
Tim Shea	Hunlty 73	42° 43'	146° 29'
T.L.E. Tram	Zeehan 50	41° 55'	145° 18'
Wallace's Tram	Zeehan 50	41° 50'	145° 25'
White Spur Creek	Zeehan 50	41° 53'	145° 29'
Zeehan	Zeehan 50	41° 58'	145° 20'





