TASMANIA
DEPARTMENT OF MINES

EXPLANATORY REPORT

ONE MILE GEOLOGICAL MAP SERIES
K/55-11-52 - DU CANE

by

W. N. MACLEOD, M.Sc., Ph.D., R. H. JACK, B.Sc., and
V. M. THREADER, B.Sc.

Issued under the authority of
The Honourable ERIC ELLIOTT REECE, M.H.A.,
Minister for Mines for Tasmania.

1961

Registered by the Postmaster-General for transmission through the Post as a book.

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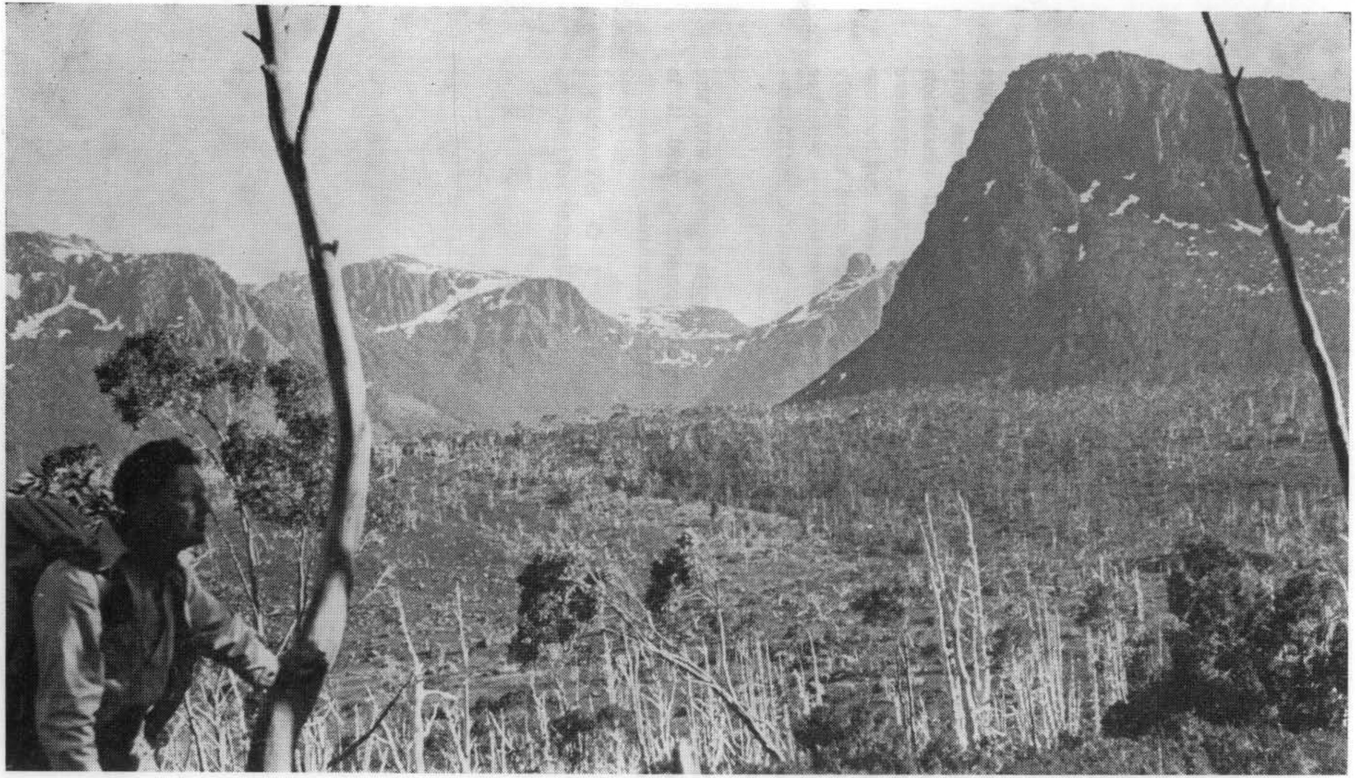
Price 5s.



FRONTISPIECE—General view of the Du Cane Range from Mt. Doris. The broad glaciated valley of Kia Ora Creek is in the foreground.
Photo by J. B. Thwaites.

PREFACE

This Report, the first of a new series dealing with the geology of individual 1-mile Map Sheets, is issued to complement and explain the geological map of the Du Cane Quadrangle, No. 52 of the Military Map Grid which is included in the Devonport Quadrangle K/55/11 (International Grid Reference). It can also be used independently as a reference book of the area.

Geologically, the Du Cane Map Sheet presents a wide range of phenomena dating from Precambrian to Recent times, but the main interest of the area lies in the remains of glaciation which are displayed here in greater abundance than anywhere else in the State. Economically, it has few attractions, but because of its very inaccessibility, together with the rugged and extremely varied topography, it has great interest for the bushwalker, whether his taste inclines towards photography, geology, botany, mountaineering or general bushmanship.

This report will be followed by further reports dealing with the geology of the 1-mile Map Sheets already produced, and it is hoped eventually to cover the whole State of Tasmania.

J. G. SYMONS,
Director of Mines.

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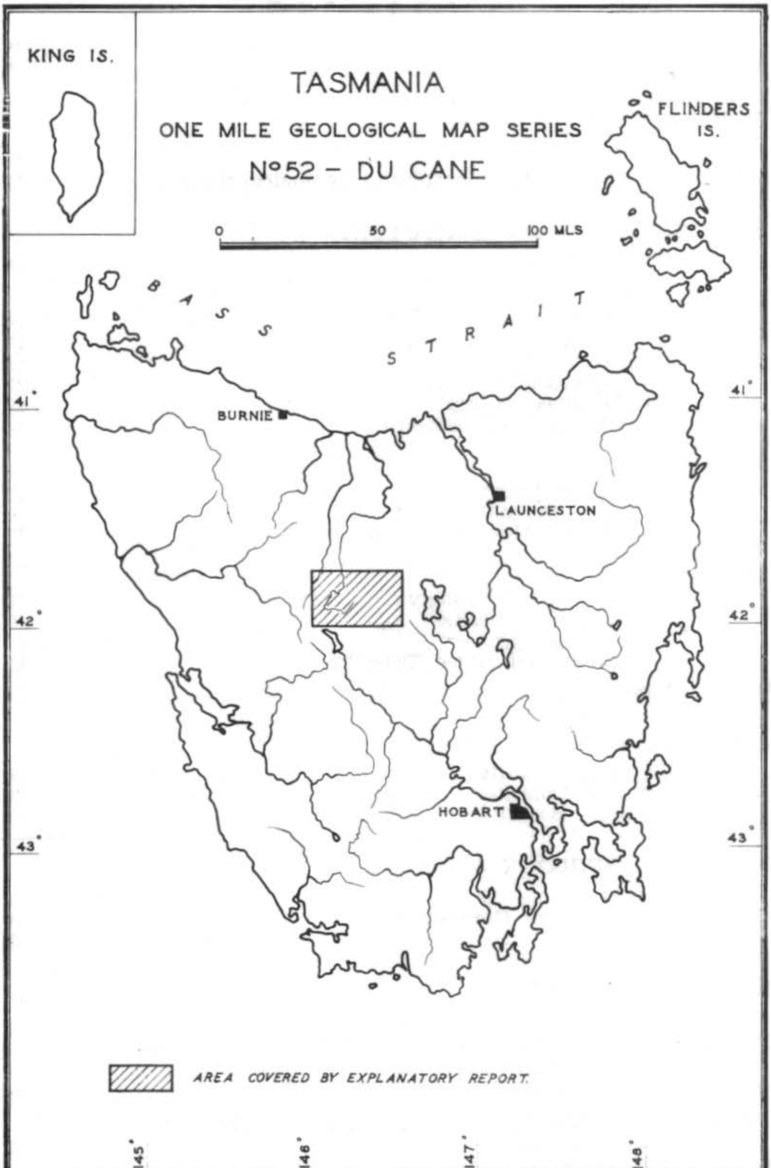

FIGURE 1.—Locality Map.

INTRODUCTION

The Du Cane Quadrangle covers portion of the western section of the Central Plateau of Tasmania between Latitude 41°45′ and 42°00′S. and Longitude 146°00′ and 146°30′E. (see figure 1). Previous geological studies have been mainly in the nature of reconnaissance. A. M. Reid (1919) described the copper and wolfram mineralization in the Forth Valley, the coal occurrences in the vicinity of Mts. Pelion and Thetis, and gave a general account of the geology of the N.W. corner of the quadrangle. I. B. Jennings (1959) outlined the geology of the Cradle Mountain-Lake St. Clair Scenic Reserve, portion of which falls within the western section of the quadrangle. K. L. Burns (1959b) studied the succession of Permian and Triassic sediments in Douglas Creek, and its tributaries on the northern side of the Pelion Range. J. N. Jennings and N. Ahmad (1957) studied the glaciation of the Central Plateau and devoted particular attention to that section which lies within the Du Cane Quadrangle.

The present survey was undertaken between January and April, 1961, as part of the regional mapping programme of the Geological Survey of Tasmania. A complete air photo cover is available together with accurate topographic maps on a scale of 40 chains to the inch, contoured at 50-foot intervals. W. N. MacLeod, Senior Geologist, mapped the S.W. sector of the quadrangle which includes the Du Cane Range and the headwater regions of the Mersey and Wallace Rivers. V. M. Threader, Geologist, mapped the Mersey Valley north of Cathedral Mountain, the Walls of Jerusalem, the Arm River and adjacent areas of the Central Plateau. R. H. Jack, Geologist, mapped the upper Forth Valley and the northern flank of the Pelion Range. R. G. Robinson and W. L. Matthews, Geologists, assisted in the earlier reconnaissance mapping. Petrographic examinations have been made by G. Everard, Mineralogist and Petrologist.

The map sheet has been published separately on a scale of one inch to the mile and simplified map is presented with this Report (figure 2). The eastern section of the quadrangle, which is almost entirely underlain by dolerite, has been mapped largely by photogeological methods.

The region is devoid of permanent settlement and many extensive areas are difficult of access. Entry from the north is provided by a Forestry Commission road which reaches as far as Howells Plains in the Mersey Valley. The only means of access from the south are walking tracks from Lake St. Clair in the Scenic Reserve. During the survey, camps were established by helicopter at Lake

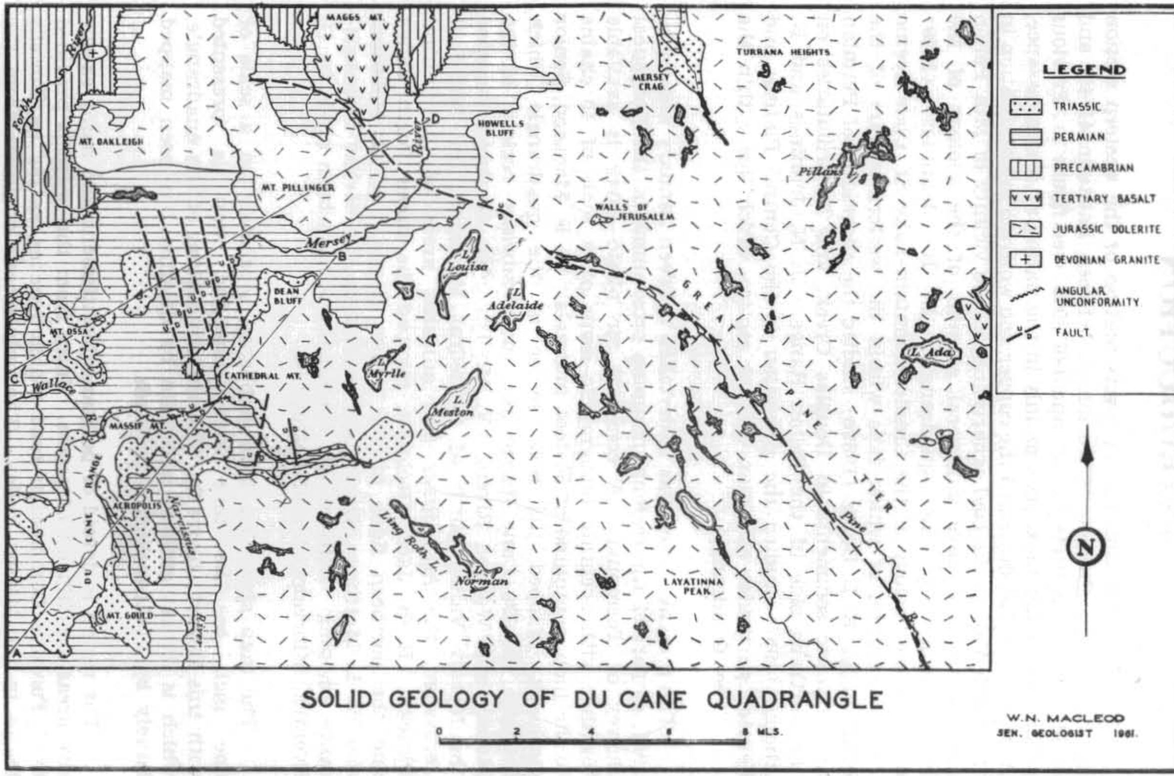

FIGURE 2.—Simplified Geological Map of the Du Cane Quadrangle.

McFarlane, the Walls of Jerusalem and in the Mersey and Wallace Rivers. A Hydro-Electric Commission road provides access to the eastern section of the quadrangle.

Acknowledgements are due to Mr. W. Connell, Ranger, Lake St. Clair, for valuable assistance and advice; and to the pilots of Helicopter Utilities, Pty. Ltd., who were frequently called upon to fly under adverse conditions of weather and terrain.

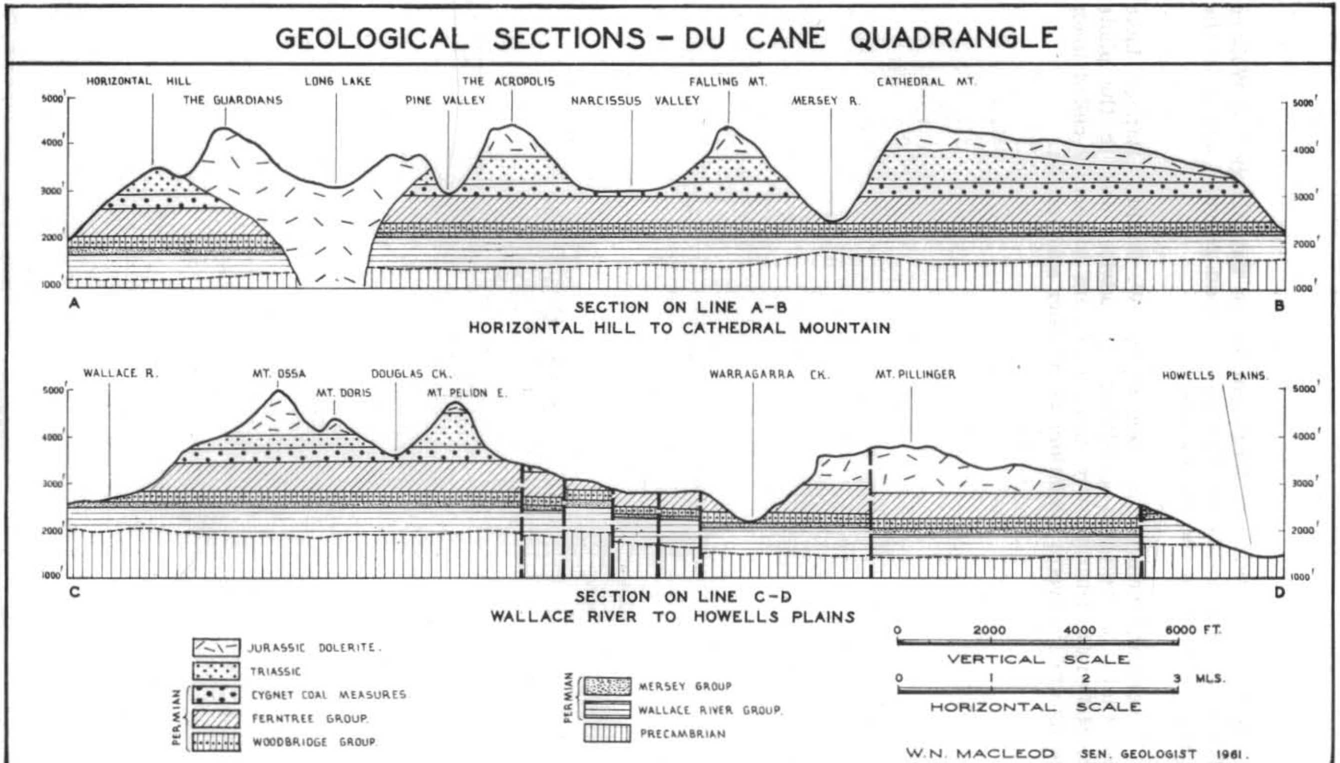

FIGURE 3.—Geological Sections.

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PHYSIOGRAPHY

GENERAL.

The eastern half of the Du Cane Quadrangle is high plateau country with a range in elevation between 3000 and 4500 feet above sea level. The Plateau surface, which extends a considerable distance to the east to Great Lake and beyond, has a gentle fall in level to the south. The Plateau is sparsely vegetated with rocky hills and ridges of dolerite rising several hundreds of feet above swampy plains and depressions covered with glacial deposits and Recent alluvium. Lakes and small tarns of glacial origin are very numerous. On the Du Cane 1:63,360 sheet nearly 5000 lakes are figured. Jennings and Ahmad (1957) estimated that there are about 500 lakes with an area greater than 2.5 acres. The largest lakes, such as Meston, Adelaide and Louisa, are over two miles long, but lakes of this size are exceptional and are probably of tectonic origin. The severity of climate on the Plateau and the swampy nature of much of the ground render the area unsuitable for cultivation. It is used for grazing purposes during the summer months.

The western section of the quadrangle includes portion of the Cradle Mountain-Lake St. Clair Scenic Reserve. This rugged and picturesque region, with a total relief in excess of 3000 feet, includes many of the highest mountain peaks in Tasmania, and provides a striking topographic contrast to the generally level Plateau surface further to the east. The mountains are erosion residuals resulting from the dissection by rivers and ice of the western escarpment of the Central Plateau. Most of the deep valleys in this area, such as those of the Forth, Mersey and Wallace, were established by the rivers following the Tertiary epeirogeny. Glaciation during the Pleistocene deepened the existing valleys, truncated the spurs and attacked the dolerite residuals on the mountain summits by glacier incision and frost action. Degradation of the surface proceeded rapidly once the rivers had cut through the resistant dolerite capping and had been superimposed on the softer, underlying Permian and Triassic sediments. The western boundary of the Central Plateau lacks the sharp topographic definition shown by the northern boundary along the Great Western Tiers.

Glacial topography is most strikingly displayed on the Du Cane and Pelion Ranges in the Scenic Reserve. Here ice and river action has been sufficiently severe to dismember the flat-lying dolerite capping and leave isolated residuals with deep cirque embayments. The pronounced vertical joint systems of the dolerite favour the plucking action of the ice and disintegration by frost action. The mountain summits are ornamented with pinnacles and precariously balanced blocks, particularly on aretes between opposing cirque glaciers.

In the Scenic Reserve dense myrtle forest occurs on the valley walls below the 3000 foot contour. Above this level a sparser alpine flora predominates and most of the higher summits are of bare rock. Valley floors are wide due to glacial action and are covered with button grass and sphagnum mosses, interspersed with dense clumps of ti-tree, horizontal scrub and bauera. The denseness of the vegetation renders many areas difficult of access.

The region is one of high rainfall. In the Scenic Reserve the annual precipitation is of the order of 80 inches, but it decreases eastwards towards Great Lake. During the winter much of the precipitation is in the form of snow and below-freezing temperatures occur almost every night. Frost action is a powerful agent or erosion at the present time and has probably continued as such since the withdrawal of the ice at the close of the Pleistocene glaciation.

The Du Cane Range forms an important triple watershed in Tasmania. The Forth and Mersey Rivers drain to the north to Bass Strait. To the west, the Wallace joins the Murchison-Pieman system which flows to the Southern Ocean on the West Coast, and to the south the Narcissus River enters Lake St. Clair in the headwater region of the Derwent River.

RELATION OF PHYSIOGRAPHY TO GEOLOGICAL STRUCTURE.

The geological structure of the region is comparatively simple. Four main geological units are distinguished, each of which is readily recognizable by a characteristic topographic expression. These are as follows:

4. Tertiary basalt.
3. Jurassic dolerite.
2. Permian and Triassic marine and terrestrial sediments.
1. Precambrian metasediments.

The Precambrian metasediments are mainly represented by quartzite and quartz-mica schist and form the basement rocks of the country. These have been deeply eroded throughout the greater part of Palaeozoic time and are most extensively exposed in the rugged country of the upper Forth Valley. The metasediments are strongly folded on E-W trending axes and weather to prominent strike ridges separated by deep and steep-walled gorges. Within the boundaries of the Du Cane Quadrangle there is no evidence of the thick Lower Palaeozoic sedimentation which covered the Precambrian rocks in areas further to the north and west. Palaeozoic sediments are widespread on the adjoining Middlesex Quadrangle to the north.

The Permian and Triassic sediments were deposited on the irregular erosion surface underlain by the Precambrian sediments. The Permian sequence is similar to that of the Great Western Tiers with an initial thick deposition of marine sediments, succeeded by a brief terrestrial phase of sedimentation and later sediments of marine origin. A coal measure sequence occurs at the top of the Permian and this is followed disconformably by lacustrine Triassic sediments. The total thickness of these sediments in the western section of the Du Cane Quadrangle approaches 3000 feet.

The sediments are flat-lying with a gentle regional dip to the south and are extensively exposed in the western half of the quadrangle where the rivers have cut below the resistant dolerite capping. Steep hillsides, punctuated by cliffs and benches and covered by dense vegetation demarcate the areas underlain by these rocks. The strong and persistent joint systems of the Permian rocks favour the formation of waterfalls in the rivers. The picturesque falls in the Mersey River below Du Cane Hut have been developed in Permian mudstone and siltstone. The

Triassic sediments include numerous units of massive sandstone, particularly in the lower part of the sequence. These form prominent benches on the hillsides, such as those below Mts. Ossa and Thetis and around the flanks of the Gould Plateau, and weather to mesaform hills, such as Horizontal Hill, where the over-lying dolerite has been completely removed.

The Jurassic dolerite covers nearly two-thirds of the total area of the quadrangle. It is highly resistant to erosion and has exerted a profound influence on the physiographic evolution of the region. On the Central Plateau the local physiography is largely determined by strong linear structures in the dolerite of fault or joint origin. These must have controlled the pre-glacial drainage pattern which itself was considerably modified by the action of ice during the glaciation. Existing valleys, trending in the same sense as local ice movement, have been deepened and frequently dammed by moraine to produce elongated lakes.

A prominent feature of the Plateau is the Great Pine Tier which extends without a break for 15 miles from the Walls of Jerusalem to the Cellars in the south-eastern corner of the quadrangle. The tier ranges between 600 and 800 feet in height and is considered to be a major pre-glacial fault scarp. There is a striking parallelism between the trend of this escarpment and the principal trend of linears in the dolerite over a considerable area to the west. Many of these linears may represent minor faults trending parallel to that of the Great Pine Tier.

Another persistent escarpment may be traced from near Junction Lake northwards to Howells Bluff. The large and elongated Lakes Meston and Adelaide lie at the base of this escarpment and are considered to have been formed as a result of overdeepening of a fault trough by transverse ice-scouring across the escarpment.

South of the Mersey River, the Ling Roth Lakes, Lake Norman and Lake Lula occupy a narrow elongated depression which extends for six miles. This depression is parallel to the Great Pine Tier. Such persistent and prominent features clearly predate the glaciation and suggest an important period of block faulting with large differential movements. The faulting may have been synchronous with emplacement of the dolerite or, as seems more likely, to have occurred in the Tertiary during the regional epeirogeny.

Outliers of dolerite form the summits of most of the mountain peaks in the Cradle Mountain-Lake St. Clair Scenic Reserve. The highest peaks, such as Ossa and Pelion West, rise above 5000 feet and there are many others, such as Gould, Acropolis, Hyperion, Walled Mountain and Pelion East, to name but a few, which closely approach this level. The striking concordance of both summit levels and base of the dolerite in the Du Cane and Pelion Ranges clearly suggests dismemberment of a single flat-lying sill. The dolerite intrusion apparently reached a higher level in the Du Cane and Pelion Ranges than on the Central Plateau where the average summit levels are nearly 1000 feet lower. Some of this difference may be accounted for by major faulting and more severe ice erosion.

The only extensive area of Tertiary basalt is found near the northern boundary of the quadrangle where it forms portion of the summit of Maggs Mountain between the Arm and Mersey Rivers. Spry (1958) considered the basalt to have originally occupied a former valley of the Mersey River which has been displaced to the east as a lateral stream and since cut a deep valley about 1000 feet below the level of the basalt capping.

STRATIGRAPHY and STRUCTURE

PRECAMBRIAN

The most extensive outcrops of the Precambrian basement rocks are to be found in the deeply dissected and rugged Forth Valley. Other exposures occur in the Mersey Valley north of Howells Plains and below Cathedral Mountain. Precambrian quartzite is exposed in the Wallace River a short distance beyond the western boundary of the quadrangle.

In the Forth Valley the rock types include quartzite, mica schist and quartz mica schist with a general strike slightly east of north and dips of between 15 and 30 degrees to the SE. The metasediments are abundantly veined by white quartz and locally sheared along planes trending NNW. These shear planes served as structural controls in the localization of copper and wolfram mineralization in the Forth Valley.

The small exposure of Precambrian quartzite near the junction of Kia Ora Creek and the Mersey River is considered to represent a topographical high in the pre-Permian surface. The quartzite beds have a north-westerly strike and dip to the NE at angles between 45 and 60 degrees.

The Precambrian rocks in the northern section of the Du Cane Quadrangle are a southerly continuation of those of the adjacent Middlesex Quadrangle. Spry (1958) described and subdivided the Precambrian metasediments in the Mersey and Forth Valleys. His tentative subdivision is as follows:

Dove Schist 5000′ (?)
Maggs Quartzite 2000′ (?)
Arm Schist 2000′ (?)
Fisher Group 5000′
Howell Group 5000′

The type locality for the Howell Group is along the western wall of the Mersey Valley at Websters Marsh. It includes mica schist, garnet-mica schist, albite-mica schist, mica quartzite and pure quartzite. The schist and quartzite form units up to 200 feet thick and occur in roughly equal proportion. The Fisher Group, believed to overlie the Howell Group, consists of interbedded formations of slate and quartzite with the latter dominant.

In the section of the Forth Valley within the Du Cane Quadrangle the Precambrian rocks include a rapidly alternating interbedded sequence of quartzite and mica schist, whereas in the Mersey Valley near Howells Plain, and below Cathedral Mountain, massive quartzite is dominant with occasional narrow intercalations of schist which are usually less than one foot thick.

In both valleys the rocks have features in common with both the Howell and Fisher Groups and cannot be confidently correlated with either group.

No evidence of an unconformity between the Howell and Fisher Groups has been detected and I. B. Jennings (pers. comm.), from a study of the Precambrian rocks on the adjoining Middlesex Quadrangle, suggests that the Howell Group may be a facies variation of the Fisher Group which passes downwards gradationally from a dominantly quartzitic facies into an alternating assemblage of quartzite and meta-pelite.

PERMIAN

A succession of Permian sediments, approximately 2000 feet thick, is exposed in the deep valleys in the rugged western half of the Du Cane Quadrangle. Permian rocks have been long recognized in this area but they have neither been accurately mapped nor subdivided prior to this survey. In general there is a close similarity to the Permian sequence along the Great Western Tiers (McKellar, 1957; Wells, 1957).

Apart from some block faulting in the Mersey Valley, the Permian sediments have been little disturbed and have a gentle regional dip to the south which averages less than one degree. Between Mt. Pelion East and Mt. Gould, a meridional distance of 10 miles, the top of the Ferntree Group has declined from 3480 feet above sea level at Mt. Pelion East to 2920 feet on the eastern side of the Gould Plateau. The southerly regional dip averages 56 feet per mile. At the southern end of Lake St. Clair, at Cynthia Bay, the top of the Ferntree is below the lake level of 2470 feet above sea level.

The Permian sediments were laid down upon the strongly folded and deeply eroded basement of Precambrian metasediments. Sedimentation continued without serious break through into the Triassic as in other parts of Tasmania. The complete cycle of Permian sedimentation is represented in the sections in the Wallace and Mersey Valleys.

As elsewhere in Tasmania, the boundary between the Permian and Triassic is difficult to define in this region. At the top of the Permian succession there is a thick sequence of lacustrine sediments with coal seams in massive sandstone and conglomerate with frequent shale intercalations. This sandstone is rather similar to that found in the overlying lower part of the Triassic and, in the absence of fossil evidence, the boundary is provisionally fixed at the upper limit of the coal seams for which spore dating indicates an upper Permian age.

North of the Pelion Range the Permian coal measures include numerous thick units of carbonaceous shale interbedded with the massive sandstone, and the upper limit of this shale is regarded as the boundary between the two systems. McKellar (1957) placed the base of the Triassic above similar shale, termed the Jackey Formation, in the Western Tiers section. Further south the shale is less abundant and thinner and the boundary is fixed by the appearance of coarser conglomeratic sandstone with torrential cross-bedding and devoid of coal, such as occurs on the Gould Plateau.

The following subdivisions of the Permian have been made in the Du Cane Quadrangle:—

	Thickness (ft.)
Top	
Cygnet Coal Measures	300-350
Ferntree Group	550-650
Woodbridge Group	90-250
Mersey Group	60-100
Wallace River Group	400-650
Basal Conglomerate	10-50
Base	
Total	2050 (max.)

Basal Conglomerate

The best exposures of the Basal Conglomerate occur in the north-west sector of the sheet, and in adjoining areas of the Murchison Quadrangle, near the northern end of the Scenic Reserve. A. M. Reid (1919) postulated a glacial origin for the thick conglomerate on the southern and eastern sides of Barn Bluff and on the west banks of Lakes McRae and Ellen. The maximum observed thickness is of the order of 100 feet, and most of the boulders consist of quartzite and quartz mica schist derived from the underlying Precambrian basement. The conglomerate includes large blocks up to several feet in diameter.

On the Du Cane Quadrangle the Basal Conglomerate is exposed in the following localities:—

(i) On the Pelion Plains. Three feet of conglomerate is exposed in the creek draining L. Ayr into Douglas Creek.

(ii) North of Mt. Oakleigh. Ten feet of conglomerate overlies the Precambrian.

(iii) In the Forth Valley below Frog Flats. Forty feet of conglomerate is exposed on the western side of the valley and 50 feet on the eastern side towards Mt. Thetis.

(iv) In the Mersey Valley near the unconformity below Cathedral Mountain. Ten feet of conglomerate directly overlies the Precambrian quartzite. Other exposures, in which the thickness ranges between 10 and 40 feet, are seen further downstream in the Mersey River. Below Moses Hut the conglomerate is 20 feet thick and forms a waterfall in the river. Ten feet of conglomerate are exposed north of the Fish River on the East bank of the Mersey.

Most of the exposures are too small to be indicated on the published map. The conglomerate consists of unsorted and subangular pebbles and boulders of Precambrian quartzite and schist in a finer matrix. The largest boulders are up to four feet in diameter but the majority are less than two feet. From the exposures available the conglomerate provides no evidence of glacial origin.

Wallace River Group

The Wallace River Group is widely distributed in the western half of the Du Cane Quadrangle. The best exposures occur in the headwater regions of the Wallace and Forth Rivers and in the Mersey Valley north of Cathedral Mountain. The Wallace River valley is defined as the type area for the group. Here a succession of grey to dark grey and black mudstones with occasional grey sandstones, conglomerate lenticles and fissile black shales, totalling 400 feet in thickness, is well exposed in the river bed. Fine-grained mudstone, in beds one to three feet thick, dominates the lithology of the group which has the same monotonous aspect as the mudstone of the Ferntree Group. Erratics of Precambrian quartzite and schist are common throughout the entire group, and are sometimes sufficiently numerous and aggregated to appear as impersistent lenses of conglomerate. Such conglomerate is particularly abundant in the sections exposed in the Forth Valley on the flanks of Mts. Pelion West and Thetis where it is estimated to comprise about 10 per cent of the sequence. The group is thicker in the Forth Valley; in the Pelion West section it amounts to at least 600 feet.

Fossils are rare in the Wallace River Group. The only rich zone to be located is situated at 4016E. 8403N. at an altitude of 2100 feet in the upper Wallace River. Here a bed of conglomerate, three feet thick, overlies a grey calcereous greywacke unit of similar thickness which is particularly rich in spiriferids and fenestellids. Other fossiliferous beds have been noted for a short distance downstream, but the fine-grained dark mudstone and siltstone which predominate below this level down to the unconformity with the Precambrian appear to be unfossiliferous.

The Wallace River mudstone, like that of the Ferntree Group is strongly and closely jointed with two persistent vertical systems. These joints influence the drainage pattern and favour the development of waterfalls.

The Wallace River Group presents a more varied lithology further to the east in the Mersey Valley. The group is almost continuously exposed along the river between Lee's and Moses Huts (4110E to 4160E). At the base, overlying the Basal Conglomerate, is 50 feet of fossiliferous mudstone and limestone and mudstone with calcareous lenses, followed by 10 feet of sandstone with erratics and fossiliferous horizons, and capped by 150 feet of mudstone and siltstone with erratics and fossiliferous horizons. Here the lithological assemblage and the abundance of fossils more closely resembles that of the Golden Valley Group of the Western Tiers (Wells, 1957).

A specimen of siltstone from the Wallace River (4016E. 8406N.) was seen in thin section to consist of a fine, even-grained aggregate of angular fragments of quartz, feldspar, muscovite and rock fragments in a fine-grained, brownish, carbonaceous matrix.

The fossiliferous sandstone at 4016E. 8403N. is a fine-grained grey rock with larger grains of glassy quartz up to 2 mm. In thin section it is seen to consist of angular quartz grains averaging 0.2 mm. with minor amounts of calcite, feldspar, biotite, chlorite and muscovite in a very fine grained sericitic matix. Calcareous organic remains are common. The rock can be classified as a sub-greywacke.

Mersey Group

Uplift above sea level followed the deposition of the marine sediments of the Wallace River Group and the sediments of the succeeding Mersey Group were deposited under estuarine and lacustrine conditions. In the Du Cane Quadrangle these terrestrial sediments range in thickness between 60 and 100 feet and are mainly represented by micaceous and arkosic quartz sandstone with thinner units of carbonaceous shale. The sandstone is usually flaggy due to the abundance of mica on the bedding planes and to the presence of numerous fine laminae of shaly, micaceous mudstone and siltstone. The more massive sandstone units are frequently cross-bedded and pinch and swell rapidly along the strike. On weathering the sandstone is sparkling and white to reddish yellow in colour. In many localities it weathers to prominent cliffs and waterfalls which serve as valuable markers in field mapping. In the Forth and Wallace Valleys thin and impersistent coal seams and isolated crescents of lustrous black coal have been noted. The strikingly laminated appearance of the sandstone renders this group the most readily recognizable of the Permian sediments.

The Mersey Group can be correlated with the Liffey Group of the Western Tiers (McKellar, 1957). McKellar subdivided the Liffey Group into four formations as follows:—

Top	Thickness feet
Creekton Formation—Medium-grained quartz sandstone with abundant worm casts	7-12
Woodside Formation—Flaggy, well-sorted medium-grained quartz mica sandstone with several black shale bands up to 1′ thick	25-40
Kopanica Formation—Grey to black shale with thin bands of white sandstone. Shale is micaceous, carbonaceous and carries plant fragments. Sandstone units same as above and below	5-20
Flat-Top Formation—Flaggy, well-sorted, medium-grained quartz mica sandstone with numerous dark grey shale bands	20-35

The Mersey Group has not been subdivided in the Du Cane Quadrangle. A complete section is exposed in Kia Ora Creek. The junction with the underlying Wallace River Group is marked by a thin basal conglomerate and the top by a thick, grey worm-cast sandstone which is overlain conformably by fossiliferous mudstone of the Woodbridge Group. The uppermost sandstone unit corresponds to the Creekton Sandstone of McKellar's section.

The Kia Ora Creek section is as follows:—

Top. Woodbridge Group.

Unit	Thickness Feet	inches
23—Massive sandstone with worm-casts	3	10
22—Alternation of thinly bedded sandstone with black shale	5	0

Unit	Thickness Feet	inches
21—Alternation of thinly bedded sandstone and shale with carbonaceous laminae	4	6
20—Arkosic sandstone with carbonaceous lenticles	0	9
19—Carbonaceous shale	0	7
18—Flaggy micaceous sandstone with carbonaceous laminae	3	7
17—Massive sandstone	6	0
16—Massive sandstone similar to Unit 17	5	0
15—Flaggy micaceous sandstone similar to Unit 14	3	3
14—Flaggy micaceous sandstone with numerous carbonaceous laminae in the ratio one to five of volume	6	6
13—Shale	0	6
12—Micaceous arkosic sandstone	1	8
11—Shale	0	4
10—Flaggy micaceous sandstone	3	2
9—Carbonaceous shale	0	2
8—Fine-grained sandstone, non-micaceous	0	9
7—Flaggy micaceous sandstone	6	0
6—Sandstone and shale, rapidly alternating	3	2
5—Arkosic sandstone	2	6
4—Fine-grained sandstone with thin intercalations which pinch and swell and die out laterally	3	2
3—Shale	0	3
2—Massive sandstone with carbonaceous lenticles	2	10
1—Conglomerate with quartz pebbles	0	3
Base. Wallace River Group Total	63	9

A well-exposed section of the Mersey Group is found in Douglas Creek. This has been measured by K. L. Burns (1959b) as follows:—

Top. Conformably overlain by Woodbridge Group.

Unit	Thickness Feet	inches
18—Laminated and banded sandstone and shale. Sandstone in bands 1 inch-2 inches thick and from 2 inches-4 inches apart in regular pattern. The sandstone weathers yellow, consists of 60% quartz and up to 40% feldpar with rock fragments	10	0

Unit	Thickness Feet	inches
17—Coarse grey sandstone consisting of equal amounts of quartz and feldspar with occasional lumps of soft white material averaging 1/16 in. in diameter. Grains are angular. Large amount of carbonaceous material with plant stems up to 3 inches long. Rock is friable, porous with no bedding. Base conglomeratic with rounded spherical pebbles of quartzite averaging ½ inch but up to 3 inches	3	9
16—Laminated banded sandstone and shale. Similar to Unit 18	18	0
15—A distinctive conglomerate with pebbles of quartzite averaging 1 inch but up to 4 inches. Matrix of glassy quartz, poorly sorted and friable	2	0
14—Sandstone	1	10
13—Laminated sandstone	0	6
12—Sandstone with sole markings on lower surface	0	11
11—Laminated sandstone	0	9
10—Blue micaceous shale. Coherent, porous with weak parting. Contains occasional sub-rounded boulders up to 12 inches and one lenticular band of conglomerate up to 6 inches	8	0
9—Laminated sandstone	2	0
8—Sandstone with flaggy bedding	9	0
7—White, sparkling, coherent, well-sorted sandstone consisting of spherical sub-rounded quartz 80%, feldspar 20% with mica and carbonaceous fragments	4	0
6—Cross-bedded sandstone interbedded with laminated sandstone	1	2
5—Fissile, laminated sandstone with micaceous and carbonaceous laminae	2	10
4—White, fine-grained quartz sandstone with feldspar	3	0
3—Fissile, laminated sandstone. Lenticles of coarse sandstone between carbonaceous and micaceous laminae about ⅛ inch thick	1	6
2—White, fine-grained sandstone with 20% feldspar	1	6

Unit	Thickness Feet	inches
1—Tough, coherent sandstone. 70% quartz, 20% mica, 10% feldspar. Carbonaceous laminae with plant fragments. Occasional pebbles of pyrite	25	0
Base not seen		
Total	95	9

The sandstone of the Mersey Group in the upper Forth Valley below Mt. Pelion West contains abundant plant remains and pyritic nodules. A coal seam, 17 inches thick, was explored in this area in the early years of the century, but the exceptionally high sulphur content, over 10 per cent, rendered the coal valueless for economic purposes. The Mersey Group in the northern section of the Mersey Valley and in February Creek shows a similar lithological assemblage to that of the sections described above.

Thin section examination of a typical Mersey Group sandstone from the Wallace River Valley disclosed a dense interlocking mass of angular grains of quartz, white kaolinized feldspar, rock fragments and iron-stained muscovite. Some grains of albite are still quite fresh and there are rare, slightly worn crystals of zircon. Dark rims of cementing material occur round some of the quartz grains, others show rims of secondary quartz.

Woodbridge Group

The fossiliferous marine mudstone which conformably overlies the terrestrial sediments of the Mersey Group is classified as the Woodbridge Group on the basis of similar faunal assemblage and stratigraphical position to the corresponding sediments in the Great Western Tiers and in other localities in Tasmania. The group ranges between 100 and 220 feet in thickness throughout the Du Cane Quadrangle but few good exposures are available. A section in Douglas Creek has been measured by K. L. Burns (1959b) and is summarized as follows:—

Top. Conformably overlain by Ferntree Group.

Unit	Thickness Feet	inches
11 Fossiliferous pebbly sandstone	8	0
10 Pebbly calcareous siltstone	11	0
9 Fossiliferous, calcareous mudstone	2	6
8 Fossiliferous pebbly sandstone	6	0
7 Siltstone with rare fossils, no pebbles	16	0
6 Calcarenite	11	0
5 Fossiliferous siltstone with rare erratics	16	0
4 Conglomeratic siltstone	12	0
3 Bryozoal siltstone	11	0
2 Fossiliferous pebbly mudstone	8	0
1 Pebbly calcareous mudstone	1	0
Base. Conformably underlain by Mersey Group.		
Total	102	6

Fossils include spiriferids, productids, stenoporids, fenestellids, martiniopsids and pectenids both in the above section and elsewhere.

Excellent exposures of the upper section of the Woodbridge Group are to be seen in the high cliffs forming the main waterfalls in Kia Ora Creek, about half a mile east of the Overland Track. The section is as follows:—

Top

Unit	Thickness Feet	inches
Ferntree Group—Massive sandstone, poorly sorted and unfossiliferous	11	10
Woodbridge Group—Massive conglomeratic sandstone with abundant spiriferids and productids	16	8
Alternating massive sandstone and fissile siltstone with abundant spiriferids and fenestellids	16	5
Conglomeratic sandstone with brachiopods	9	4
Fissile dark grey mudstone, fossils rare	6	9

Base not seen.

The base of the Woodbridge Group is exposed a further quarter of a mile downstream from the falls but the entire intervening area is covered with boulders. Here the total thickness is 215 feet as determined by aneroid barometer.

The complete thickness of the Woodbridge Group has also been measured in the deep gorge south of Horizontal Hill in the extreme SW corner of the quadrangle. Here the group is 200 feet thick and the upper section includes similar massive, conglomeratic sandstone to that seen in Kia Ora Creek. The middle and lower sections of the group are less well-exposed but calcareous mudstone and calcarenite, rich in fossils, appear to dominate the lithology.

Good sections of the Woodbridge Group are to be found in the Mersey Valley below the Cathedral Mountain plateau. Here the uppermost unit is a coarse, fossiliferous sandstone, 30 feet thick, which is similar to the Dabool Sandstone as described by McKellar in the Western Tiers. This is underlain by 30 feet of mudstone which may be correlated with the Weston Mudstone of McKellar's section.

In most localities the resistant thick sandstone at the junction of the Ferntree and Woodbridge Groups produces prominent cliffs or waterfalls which are useful markers in mapping.

Ferntree Group

The Ferntree Group is the most widely distributed unit of the Permian System in the Du Cane Quadrangle. The maximum thickness is of the order of 650 feet and there is little variation throughout the area which has been studied. The group consists mainly of pebbly mudstones and siltstones with occasional conglomerates and poorly sorted sandstones. The last-named are more common towards the base of the sequence and the superior resistance to erosion of these units usually gives some topographic definition. There is a widespread basal sandstone unit which in places is 50 feet thick. This has been seen in many localities and is regarded as equivalent to the Garcia Sandstone as defined by McKellar in the Western Tiers section, and the Risdon Sandstone in southern Tasmania.

Faulting in the Mersey Valley, on the eastern flank of Mt. Pelion East, has increased the apparent thickness of the Ferntree Group to nearly 1000 feet. The best exposures are to be found in the succession of waterfalls in the Mersey River below Du Cane Hut. All five falls, the Hartnett, Fergusson, Dalton, Boulder and Cathedral, have been developed in rocks of the Ferntree Group. Unfortunately, the height and steepness of the falls restricts opportunity for examination, but the lithological variations may be appreciated from the abundant fresh detritus in the river bed below the falls.

The Hartnett Falls, which embrace the upper horizons of the Ferntree Group, exhibit 70 feet of massively bedded pebbly mudstone in units up to eight feet thick. There are abundant erratics of both Precambrian and Palaeozoic rocks, some of which exceed two feet in diameter. Below the falls, a resistant quartz sandstone forms a well-exposed bench in the river. This unit is at least 20 feet thick and similar resistant quartz sandstone and mudstone occur in the Fergusson Falls, a short distance downstream.

The Dalton Falls, which are nearly 100 feet high, have been developed in dark grey, massively bedded mudstone and siltstone, and expose a wide fault zone with a trend parallel to one of the major vertical joint systems. The fault zone, filled with coarsely brecciated mudstone, is about 50 feet wide and trends in the same general direction as the larger faults in the Ferntree rocks further to the north. Long worm casts are to be noted in the mudstone at Dalton Falls but otherwise the rocks are unfossiliferous.

In the Boulder and Cathedral Falls the Ferntree Group is represented by dark grey to black pebbly mudstone in beds six inches to two feet thick, with occasional horizons rich in spiriferids and fenestellids. This is one of the few localities in the quadrangle where fossil horizons have been recorded in the Ferntree Group. Another such horizon occurs in the mudstone at the crossing of Kia Ora Creek on the main Overland Track.

The lowermost section of the Ferntree Group is well-exposed in Kia Ora Creek between the Kia Ora Falls and the Overland Track. Here sandstone units are increasingly common towards the base and, as mentioned earlier, there is a thick, persistent unit of ill-sorted quartz sandstone, measuring 30 feet, at the top of the falls. This is conformably underlain by richly fossiliferous sandstone and mudstone of the Woodbridge Group.

A well-exposed section of the Ferntree Group is revealed in the headwaters of Kia Ora Creek below Lake McFarlane. Here the succession includes a bench of conglomerate, four feet thick, underlain by a quartz sandstone unit of comparable thickness, and followed downwards by grey mudstone and siltstone which weather to a line of cliffs along the watershed between Kia Ora Creek and the Wallace River.

Exposures of the Ferntree Group in the Narcissus and Pine Valleys are rare and of limited extent, and are usually only found in tributary creeks on the hillsides. The small waterfalls in Cephissus Creek near Pine Valley Hut are formed in dark grey mudstone of the Ferntree Group. All the valley floors in the southern part of the Scenic Reserve are underlain by Ferntree mudstone as is evidenced by the abundance of mudstone boulders in the moraines. On weathering, the Ferntree mudstone develops a distinctive mottled brown and grey colouration.

Microscopic examination of a specimen of Ferntree siltstone from the Boulder Falls (4105E. 8402N.) disclosed a grain size ranging from 1 mm down to very minute fragments. Besides quartz and feldspar, fragments of quartzite, green chloritic material and lava are present. The dark opaque material of the matrix becomes paler on heating and is considered to be largely carbonaceous.

A Ferntree sandstone from the Mersey River (4113E. 8395N.) is seen in thin section to consist of a mass of interlocking angular fragments of clear quartz and albite, averaging 0.1 mm, white opaque material, rock fragments and a little mica. The rock fragments are composed of fine needles of feldspar which show flow alignment and are evidently lava fragments. The cementing materials are partly clay and partly silica, and there is some evidence of replacement by silica.

Cygnet Coal Measures

The coal measures at the top of the Permian succession have been recognized in many localities in Tasmania. In the Western Tiers the sequence has been designated the Jackey Formation and there consists predominantly of black shale with abundant plant fragments. McKellar estimated the thickness to be 140 feet. In the Du Cane Quadrangle the coal measures are thicker and include abundant massive arkosic sandstone in addition to carbonaceous shale. The thickness is believed to be between 300 and 350 feet but some uncertainty exists as the coal measures are succeeded, apparently conformably, by a further 600 feet of massive sandstone and interbedded shale which are similar lithologically but devoid of coal. The boundary between the Permian and Triassic is provisionally placed in the massive sandstone above the uppermost coal horizon. In the south, around the flanks of the Gould Plateau, the coal-bearing sandstone is overlain disconformably by coarse conglomeratic sandstone and grit with torrential cross-bedding. The appearance of this grit clearly indicates a profound change in depositional conditions and this is provisionally regarded as the base of the Triassic. Examination of spores from the coal measures on the northern flank of the Pelion Range has indicated an Upper Permian age (Banks, pers. comm.).

The coal measures are best exposed on the Pelion Range between Mt. Pelion East, around the northern faces of Mts. Doris and Ossa to Mt. Thetis in the west. Here they include an almost equal proportion of massive cream to white sandstone with abundant feldspar and grey to dark grey carbonaceous shale. Around the flanks of the Du Cane Range the proportion of carbonaceous shale is much reduced and massive light grey-green sandstone with carbonized plant fragments predominates in units up to 15 feet thick. This forms prominent cliffs and benches on the valley walls. Coal seams have been noted in all areas where there are reasonable exposures of the group such as the Mersey Valley, Pine Valley, Lake McFarlane, the Gould Plateau and as far south as Byron Gap, beyond the southern boundary of the Quadrangle.

Some localities where the coal seams are exposed are as follow:—

Locality	Co-ords.	Thickness (Max.)	Altitude (Ft.)
Gould Plateau	4066E. 8296N.	3 ins.	3040
Pine Valley	4059E. 8346N.	9 ins.	3050
Upper Mersey	4156E. 8386N.	7 ins.	2850
Lake McFarlane	4046E. 8425N.	6 ins.	3400
Mt. Pelion East	4053E. 8463N.	3 ins.	3520
Mt. Pelion East	4054E. 8463N.	16 ins.	3700
Mt. Pelion East	4051E. 8472N.	16 ins.	3735
Mt. Pelion East	4059E. 8481N.	1 in.	3690
Paddy's Nut	4020E. 8460N.	21 ins.	3785
Thetis Saddle	4013E. 8460N.	4 ins.	3860
Above Du Cane Hut	4092E. 8401N.	8 ins.	3250

Glossopteris and *Gangamopteris* leaves and *Vertebraria* fragments have been found in the Coal Measures near Thetis Saddle at 4011E. 8464N.

TRIASSIC

Sandstone and shale of Trassic age are the host rocks for the dolerite intrusions over the greater part of the Du Cane Quadrangle. The best exposures of these sediments occur in the rugged country of the Scenic Reserve, particularly around the flanks of the Du Cane and Pelion Ranges. The Triassic rocks are known to extend for a considerable distance to the west and south beyond the confines of the quadrangle.

In the Western Tiers McKellar subdivided the Triassic succession into four formations as follows:—

Top	Thickness Feet
Brady Formation—' Feldspathic ' sandstone and dark grey shale in approximately equal amounts	540
Tiers Formation—Grey-green shale and medium-grained sandstone. Sandstone of ' feldspathic ' type	280
Cluan Formation—Fine to medium-grained quartzose sandstone with interbedded dark grey shale and occasional siltstone	460
Ross Formation—Impure medium-grained quartz sandstone	650

The Triassic rocks of the Du Cane Quadrangle have been subdivided into three formations but, as is common elsewhere in Tasmania, sharp, intraformational boundaries cannot be defined. No diagnostic fossils have been recovered and the subdivisions are based on lithological assemblages. The formations are as follows:—

Top

' Feldspathic ' Sandstone
Ossa Formation
Gould Formation

The maximum thickness of Triassic sediments exposed in the Du Cane Quadrangle is of the order of 800 feet on the Gould Plateau. The base of the dolerite is usually to be found within the Ossa Formation, often only a few hundreds of feet above the Cygnet Coal Measures at the top of the Permian succession.

Gould Formation

On the Gould Plateau the Cygnet Coal Measures are disconformably overlain by about 300 feet of massive, cross-bedded sandstone, arkose and conglomerate which have been provisionally assigned to the base of the Triassic System. The basal sequence is conformably overlain by and transitional into the massive sandstone and intercalated shale of the Ossa Formation. The boundary between the formations is arbitrarily fixed at the upper limit of conglomerate lenses.

The coarse conglomeratic sandstone is resistant to erosion and forms prominent benches on many of the mountains in the southern part of the Scenic Reserve; notably Mts. Olympus, Byron, Manfred and Horizontal Hill. The basal conglomerate does not appear to be so well-developed north of the Gould Plateau, and is absent above the Cygnet Coal Measures in the Pelion Range. Coarse gritty sandstone marks the base of the Triassic on the SE side of Mt. Ossa above Lake McFarlane.

The sandstone occurs in massive units, up to 15 feet thick, with abundant white, well-rounded quartz pebbles up to two inches in diameter but averaging about half inch. The matrix is rich in decomposed feldspar which weathers out rapidly leaving a distinctive pitted and sparkling surface on the rocks. The quartz pebbles are concentrated in lenses up to one foot thick which persist for distances up to 20 feet. On the Gould Plateau the conglomerate lenses have a general southerly dip of about three degrees. Most of the massive sandstone displays complex torrential cross-bedding.

Ossa Formation

The Ossa Formation is the most widespread formation of the Triassic system in the Du Cane Quadrangle. It is defined as the massive quartz sandstone with frequent narrow shale intercalations which disconformably overlies the Cygnet Coal Measures along the northern flank of the Pelion Range. The top of the formation has not been seen due to erosion and dolerite intrusion, but a 600 feet thickness of these sediments is exposed on the flanks of Mt. Pelion East and 400 feet can be seen on the Gould Plateau. This sandstone is the main host rock for the dolerite intrusions in the western section of the quadrangle and can be broadly correlated with the Ross Formation in the Western Tiers section. In the Du Cane Quadrangle the proportion of shale appears to be greater in the lower section of the Triassic than in the section described by McKellar (1957).

On Mt. Pelion East, and below the dolerite of Mt. Gould, the sandstone is white to buff-coloured, strongly cross-bedded and contains fragments of plants. The interbedded shale is greyish green and individual units are generally less than three inches thick. Exposures beneath Mts. Doris, Ossa and Paddy's Nut are limited by heavy dolerite scree, but there are good exposures above Du

Cane Hut below Falling Mountain and Castle Crag, and on the opposite side of the valley below the dolerite capping of Cathedral Mountain.

The sandstone above Lake McFarlane is typified by a fine-grained, porous white sandstone with opaque white grains of kaolinized feldspar. The angular quartz grains may have dark rims of cementing material, and little space is found between the interlocked grains. However, the grains tend to be arranged roughly in rings with open spaces at the centres. Grain size averages about 0.5 mm and some grains show twinning.

The flat-lying contract between the dolerite and sandstone is exposed continuously for several hundreds of feet at the south-eastern corner of the summit ridge of Mt. Gould. The dolerite has caused recrystallization of the sandstone over a width up to 15 inches to produce a clear glassy quartzite, and is itself greatly reduced in grain size to a texture resembling that of a fine-grained basalt.

'Feldspathic' Sandstone

The 'Feldspathic' Sandstone is confined to a limited area in the vicinity of the Walls of Jerusalem on the Central Plateau. This is believed to represent the youngest phase of Triassic sedimentation in the quadrangle and may correspond to the Tiers Formation as defined by McKellar. The exposed thickness of the formation is 150 feet. Buff-coloured, friable sandstone, white to creamy white sandstone with plant fragments and dark greenish grey shaly mudstone outcrop on the south-eastern and south-western flanks of the Temple and beneath the dolerite on the Wailing Wall at Damascus Gate. The sediments occur at altitudes between 4350 and 4500 feet. The section is as follows:—

Top

Buff-coloured sandstone— 50 feet.

Sandstone with plant fragments—50 feet.

Dark green-grey shaly mudstone—50 feet.

PLEISTOCENE

Glacial Morphology

The effects of the Pleistocene glaciation are strikingly displayed over the entire area of the Du Cane Quadrangle. The eastern area, occupied by the Central Plateau, was almost entirely covered by a thick ice cap and large piedmont glaciers covered the Du Cane and Pelion Ranges to the west.

The glacial geomorphology is in such an excellent state of preservation that Jennings and Ahmad (1957) were largely enabled to reconstruct the pattern of ice movements. They distinguished the major zones where glacial erosion and deposition respectively held sway and discussed, in some detail, the modes of formation of the numerous lakes.

The majority of lakes are considered to have been dammed by moraine barrage or produced by overdeepening by ice flow. Between the Great Pine Tier and the Ling Roth Lakes many

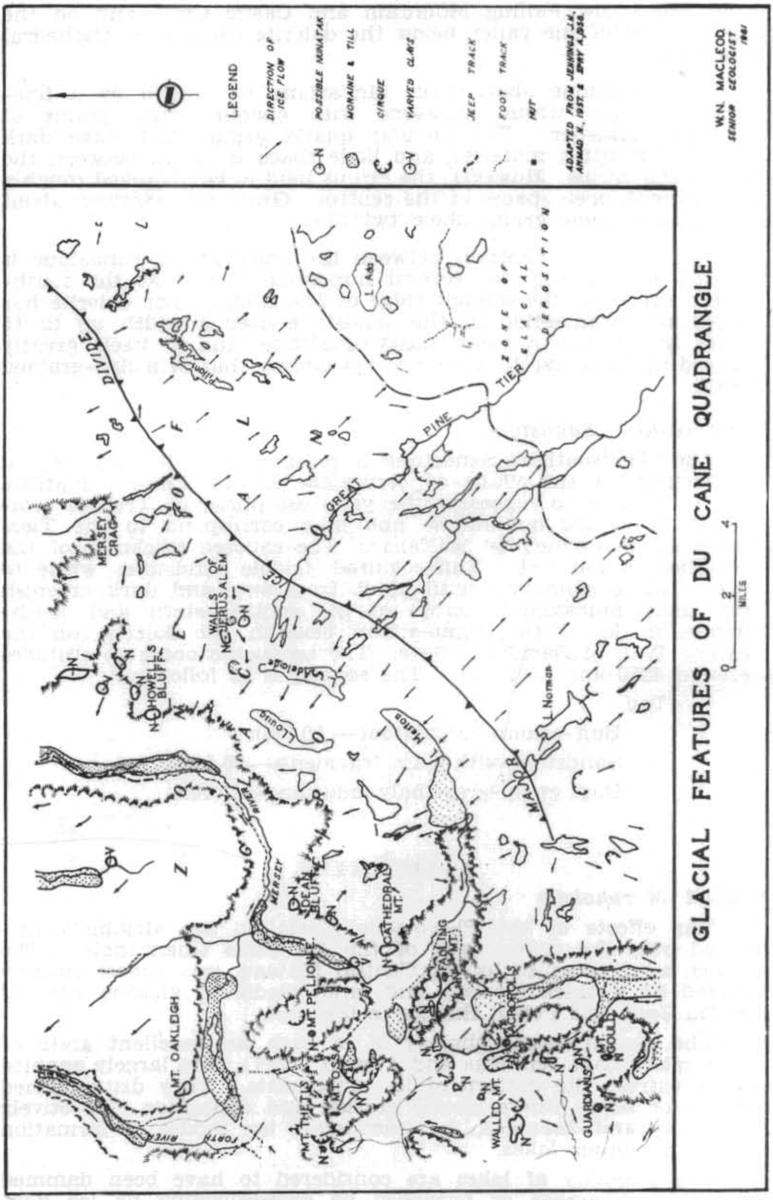

FIGURE 4.—Glacial Features of Du Cane Quadrangle.

of the lakes are markedly elongate in plan and the direction of elongation coincides with that of the dominant structural lineaments of the dolerite in this section of the Plateau. It would appear that the coincidence of structural trends and direction of ice movement favoured the development of such elongate lakes. Other elongated lakes, such as Meston and Adelaide, lie across the direction of ice movement and probably resulted from the overdeepening of a pre-existing trough by transverse ice movement.

Dolerite is an almost ideal rock for the preservation of major morphological features produced by ice action. The well-developed and close vertical jointing facilitated ice-plucking. Deeply quarried faces were produced on lee slopes in contrast to the smoother and gently graded onset slopes. The Central Plateau abounds in roches moutonees which indicate both local and general directions of ice movement.

Jennings and Ahmad deduced the former existence of a major ice divide which extended from the Mountains of Jupiter in the south, north-eastwards to the vicinity of Pillan's Lake. For considerable distances on either side of the divide glacial erosion was predominant and it would appear that even the highest summits in that region, such as Mt. Rogoona (4400 ft.), were overridden by ice. To the west of the divide the ice spilled over into the headwater valleys of the Mersey and Narcissus Rivers, widening and deepening them and truncating the spurs. To the north the ice filled the Mersey Valley as far north as the junction with the Arm River which lies beyond the northern boundary of the quadrangle (Spry 1958). To the south the overspill of ice from the Traveller Range joined with the large valley glaciers descending from the Du Cane Range, deepened the present valley occupied by Lake St. Clair, and deposited the extensive terminal moraines south of the lake around Derwent Bridge. It is possible that some of the higher, frost-hewn cliffs and peaks of the western escarpment, such as Cathedral Mountain, Dean Bluff and Howells Bluff, may have remained as nunataks above the general level of the Plateau ice cap. (See Figure 3).

The most spectacular effects of the Pleistocene glaciation are to be observed on the Pelion and Du Cane Ranges. It is apparent that a subsidiary ice cap occupied the central section of the range centred on the Labyrinth and the ice moved radially outwards as valley glaciers to the Wallace River, Long Lake, Pine Valley and the Narcissus Valley. The profile of the Guardians suggests that this range is a large roche moutonee due to overfilling and southward movement of the ice from the deep trough now occupied by Long Lake. The northern side of the range has smooth slopes in the upper levels but a precipitous quarried face above Lake Marion on the southern side. The elevated and serrated peaks of Mts. Gould, Hyperion, Acropolis and Geryon, all of which approach 5000 feet in altitude, were probably nunataks even during the most intensive phase of the glaciation. Such peaks exemplify incision by opposing cirque glaciers during the advance and retreat of the ice.

In the Pelion Range, Mt. Ossa (5305 feet) has been deeply incised by radial glaciers, particularly on the eastern side. Lake McFarlane occupies the floor of a large cirque in a hanging valley above the headwater basin of Kia Ora Creek. A heavy morainal barrage dams the lake at the eastern end along the lip of the hanging valley. The great cirques on Mt. Thetis and other peaks at the western end of the Pelion Range are amongst the most impressive scenic features of the region.

The valley profiles beneath the dolerite cappings reflect the lithological variations of the underlying Permian and Triassic sediments and these profiles have been accentuated by glacial erosion. Ice abrasion of the massive sandstone and intercalated shale of the Cygnet Coal Measures and the Triassic Gould and Ossa Formations, has produced a stepped profile with vertical or overhanging cliffs, sometimes 100 feet high, separated by short steep slopes. Such profiles are clearly exhibited on the northern slopes of Mt. Ossa and below Mt. Gould. In the Ferntree and Woodbridge Groups of the Permian, where mudstone and siltstone predominate and lithological variations are less abrupt, smooth and steep slopes of more even gradient are produced.

Glacial Deposits

Extensive moraines, composed mainly of large assorted boulders of dolerite and Permian mudstone cover the floors of most of the valleys in the Scenic Reserve. Exposures of the underlying sediments are to be seen only in areas where Recent river action has been sufficiently vigorous to cut through these deposits as in Kia Ora Creek and the Wallace River. In general, the morainal deposits are less than 20 feet thick, but in the flatter valley floors the till is irregularly distributed in hummocks separated by small lakes and swamps. The till usually supports a comparatively sparse vegetation of sphagnum mosses and button grass, in contrast to the valley walls which are usually clothed in dense myrtle forest with ti-tree and horizontal scrub.

In most of the valleys thick sections of Triassic sandstone have been subjected to ice erosion, but fragments of these rocks are rarely observed among the macroscopic components of the till. It is apparent that the thickness of the massive sandstone units, their friability and weakly developed jointing, rendered them resistant to the selective plucking action of the ice, and they were reduced, probably in situ, to finer detrital material. In contrast, the harder and closely jointed Permian mudstone is abundantly represented amongst the till boulders.

The most extensive glacial deposits are to be found in the Narcissus Valley between the Du Cane Gap and the head of Lake St. Clair. The till is aligned in well-defined ridges parallel to the length of the valley, and these ridges fan out and multiply beneath the great cirque between the Acropolis and Falling Mountain. This fan-like alignment of moraine ridges is considered to have been developed during the retreating hemicycle of the glaciation by streams of melt water issuing from beneath the ice and resorting the moraine.

Hummocky till, with a high proportion of boulders of Permian mudstone, is widely distributed in Pine Valley and the valley of Marion Creek, south of the Gould Plateau. Similar deposits cover the headwater plain of Kia Ora Creek. Extensive glacial deposits underlie the Pelion Plains and are common in the Mersey Valley as far as the northern boundary of the quadrangle. Boulder clay, up to 20 feet thick, has been noted in the headwaters of

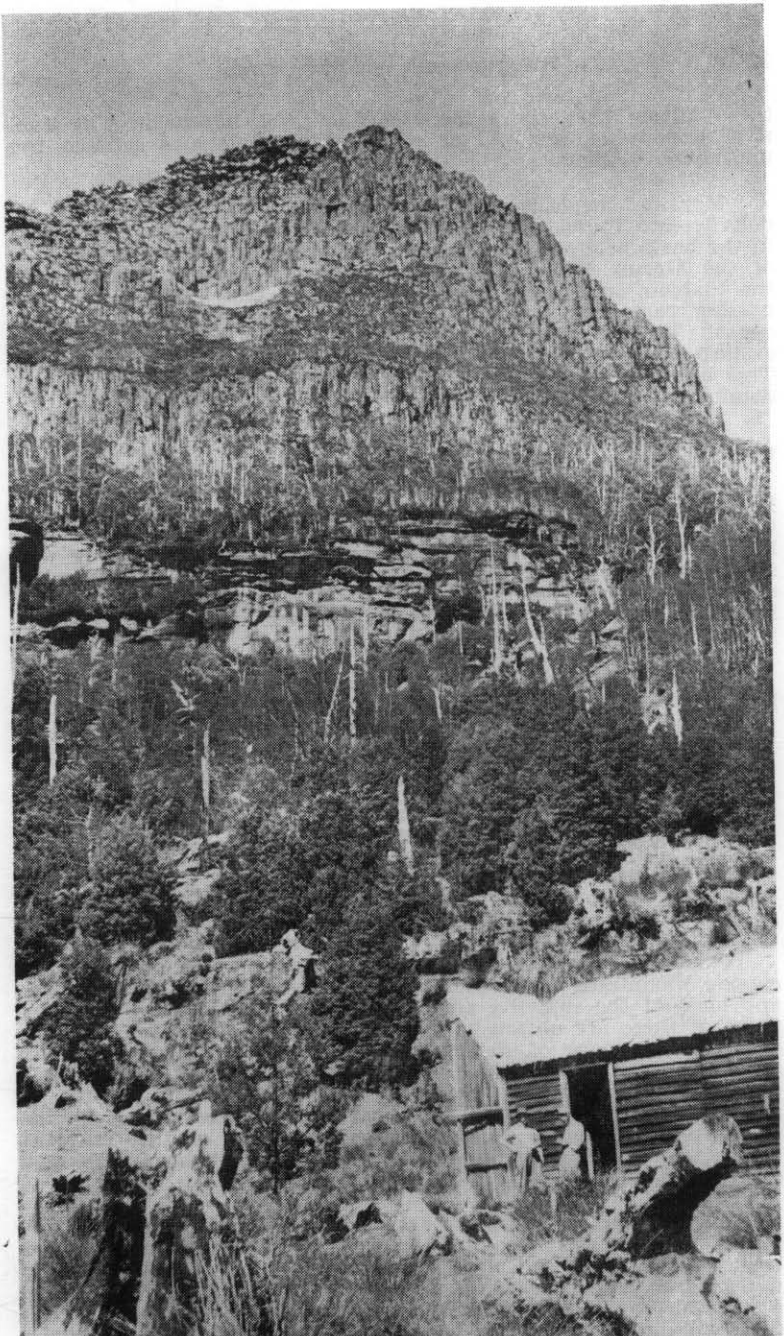

FIGURE 5.—Columnar dolerite overlying horizontal triassic sandstones near Du Cane Hut.

[Photo by J. B. Thwaites.

the Wallace River above the 2300-foot level, but below this level river action has removed or resorted the drift and exposed the underlying sediments.

Morainal deposits, composed mainly of coarse boulders of dolerite, are found as a thin veneer overlying Triassic sediments in the basin between Lake Meston and Junction Lake at the source of the Mersey River. Elsewhere, near the western boundary of the Plateau, such deposits are rare and of restricted extent. On passing eastwards from the ice divide, however, the superficial deposits become more extensive and cover large areas in the south-eastern sector of the quadrangle around the Pine and Little Rivers. This area of the Plateau is one in which glacial deposition was dominant.

Varved Clay

Pleistocene varved clay is well-developed in the Mersey and Fish Rivers, and to a lesser extent in the Arm River and Warragarra Creek (Spry 1958). Twenty feet of varved clay is exposed in the Mersey River below Cathedral Mountain and includes logs of fossilized wood up to three feet in diameter. There are other smaller exposures downstream to Lee's Huts. The clay of the Fish River is 50 feet thick and is overlain by 200 feet of boulder clay with interbedded varves.

The localities of the varved clay are summarized in the following table:—

Locality	Co-ords.	Elevation	Thickness (Ft.)
Mersey R.	8446N to 8483N	1940-2050	20
Fish R.	4213E to 4219E	2240	50
Arm R.	8550N	2240	5
Warragarra Ck.	8500N	2320-2330	10

Talus and Scree Deposits

Since the retreat of the ice until the present time, the dolerite-capped mountains have been subjected to vigorous frost action, and most of the summits are aproned by extensive scree deposits. Some of these are obviously due to recent landslides, for example, the southern slope of Falling Mountain and the large rock fall on the western face of Cathedral Mountain. Others are probably of glacial origin due to the spillover of ice and abrasion and plucking of the edge of the escarpment as is exemplified by the heavy block moraines along the western slope of the Traveller Range, and in other spillover zones further north on the Plateau escarpment.

Examination of many of the higher peaks in the Du Cane Range suggests that the greater part of the scree deposits has been formed by major block slides. Planes of weakness develop well behind the exposed cliffs and, at a certain stage of weakening, a large block will slide with its base pointed outwards and in most cases will disintegrate to smaller blocks during subsidence. Examples of the disorientation, subsidence and sliding of large masses of dolerite can be seen on Massif and Walled Mountains. On the western side of the summit of Massif Mountain, a large zone of dolerite, perhaps 500 feet in diameter, has subsided and the columns are lying horizontally in contrast to the consistent vertical attitude in other parts of the summit area. On the eastern side of Mt. Gould there is a large subsided block, 150 feet long and 50 feet thick, which has clearly slid base outwards from the cliffs and survived disintegration on impact. Many other examples of such sliding of large blocks are in evidence. The piecemeal wedging of small blocks along joint planes by frost action is a continuing process affecting both the cliffs and the fallen large blocks. Both processes have made important contributions to the impressive scree and talus deposits which surround the peaks.

FAULTING

The Permian and Triassic sediments and the dolerite have been disturbed by normal faults of steep dip with a general trend between NW and N. The faulting is probably related to the Tertiary epeirogenic movements. The most seriously affected area is in the Mersey Valley between Mt. Pelion East and Howells Plains where NNW-trending faults have been detected.

The easternmost fault of this group traverses the Mersey Valley near the southern end of Howells Plains. The downthrown block is on the western side and the displacement is of the order of 500 feet. On the Central Plateau the continuation of this fault is indicated by the escarpment of the Great Pine Tier. Four miles to the west another fault traverses the valley and its continuation across the Cathedral Plateau is marked by the long trough from Chapter Lake to Cloister Lagoon.

The faults between Mt. Pelion East and Lee's Huts on the Mersey River have an aggregate downthrow to the east of about 300 feet, this increasing the apparent thickness of the Ferntree Group to over 900 feet.

Several large faults occur in the Mersey Valley south of Cathedral Mountain. The northernmost of these has a throw to the south of over 200 feet and the Permian sediments adjacent to the fault plane are tilted to dip south at 10°. The large fault zone exposed in Dalton Falls is about 50 feet wide and within the zone the Ferntree mudstone is intensely brecciated. In Campfire Creek a near-vertical fault with a throw of 150 feet has been detected by repetition of the Cygnet Coal Measures in the creek bed and from its topographical expression. The Mersey Valley abruptly narrows upstream from the fault where the valley floor is underlain by the more resistant massive sandstone of the coal measures.

Another large fault, downthrowing to the east, traverses the dolerite and Triassic sandstone on the north side of the upper Mersey Valley. The dolerite base is displaced 400 feet vertically. The continuation of this fault on the southern wall of the valley has not been detected.

IGNEOUS ROCKS

Birthday Granite

The small granite intrusion in the Forth Valley is presumed to be of Devonian age, and is the source of the wolfram, tin and copper mineralization in this district. The granite is discordantly intrusive into the Precambrian quartzite and quartz mica schist. The granite contains biotite and muscovite, with the latter predominating in some exposures, pinkish white feldspar and coarse quartz. Tourmaline, molybdenite and arsenopyrite have been noted. Near the contact the granite commonly develops large phenocrysts of feldspar and abundant biotite.

Jurassic Dolerite

The base of the great dolerite sill shows a general uniformity in level over a wide area along the western escarpment of the Central Plateau. The base is usually masked by heavy scree but sufficient exposures are available to indicate that the level lies between 3600 and 3800 feet above sea level. In the Pelion Range the base is slightly higher. On Mts. Thetis, Ossa, Doris and Pelion East the dolerite base is seen at levels between 4200 and 4400 feet. In the Du Cane Range, further south, the base level is at 3800 feet with the exception of the area around Long Lake and on the southern side of the Guardians where the contact between the dolerite and sediments is steeply-dipping and seen to descend as low as 2600 feet. It seems likely that this zone may represent the throat of a plug-like intrusive centre. If this is so, the transition of intrusive form from steeply dipping plug to horizontal sheet must be very abrupt as the dolerite base at nearby Mt. Gould and Walled Mountain appears to be almost horizontal as in other parts of the Du Cane Range.

It is possible that the dolerite may be reduced in level in the Long Lake-Guardians area by faulting along E-W trending zones cutting Gould Saddle and the southern part of the Labyrinth. There is no field evidence to indicate faulting, and the dolerite in the steeply dipping transgressive contact zone on the eastern side of Gould Saddle is chilled and fine-grained as in the more common horizontal intrusive contacts.

There is a striking difference in level between the base of the dolerite at Mt. Pelion East and along the southern escarpment of the February Plains between Mts. Oakleigh and Pillinger. At Mt. Pelion East the base of the dolerite is seen at 4400 feet above sea level where it is intrusive into Triassic sandstone about 600 feet above the Permo-Triassic boundary. Three miles north at Mt. Oakleigh the level of the dolerite base varies between 3100 and 3300 feet and here it intrudes mudstone of the Wallace River Group which is low in the Permian succession and only 200 feet above the unconformity with the Precambrian. Further east, along the escarpment below Mt. Pillinger, the base of the dolerite is as low at 2600 feet, and here it intrudes mudstone of the Ferntree Group near the top of the Permian succession, whereas on the opposite side of the Mersey Valley at Dean Bluff the dolerite of the main plateau intrudes Triassic sandstone of much higher stratigraphic level. These pronounced differences of both absolute and stratigraphic levels of intrusion would seem to suggest that the dolerite of the Mt. Oakleigh-February Plains plateau has originated from a separate intrusive centre to that of the Pelion Range and the Central Plateau.

Tertiary Basalt

Tertiary basalt forms the summit capping of Maggs Mountain and extends beyond the northern boundary of the quadrangle to the Berriedale Plains and Gad's Hill on the adjoining Middlesex Quadrangle. This area has been closely studied by A. Spry (1958) who provided petrographic descriptions and chemical analyses of the basalts, and discussed their past and present geomorphological relationships. No further studies of basalt were made during the present survey.

Spry subdivided the basalt into separate flows and considered that the following general sequence holds quite well in all three localities:—

Top

Glomeroporphyritic basalt ..	50 feet.
Porphyritic olivine basalt ..	250 feet.
Semi-ophitic basalt	20 feet.
Porphyritic olivine basalt ..	60 feet.

Base

There are several small areas of basalt near the eastern boundary of the quadrangle near Lake Augusta and O'Dell's Lake. This area has been largely mapped by photogeological means and it is possible that there are some undetected areas of basalt in the south-eastern corner of the quadrangle.

ECONOMIC GEOLOGY

A. M. Reid (1919) described the mineralization in the NW section of the Du Cane Quadrangle, and the following account is largely summarized from his observations. There has been practically no mining activity in the district for the past thirty years, and there seems little prospect of revival under present day conditions.

COPPER

Copper deposits occur in Precambrian rocks on the Pelion Plains between Mt. Oakleigh and the old Pelion Hut. The lodes were discovered by H. Andrews in 1892 and various spasmodic and ineffectual attempts were made to develop and explore the deposits prior to their acquisition by the Mt. Pelion Co. N.L. This company undertook extensive developmental work and proved the presence of several parallel sulphide lodes trending between N.10°W. and N.10°E. with westerly dips between 45 and 60 degrees. Most of the known lodes have been investigated by surface-cutting, tunnels and shafts but, in all cases, the concentrations of economic minerals proved to be too low to be of commercial value. Galena, sphalerite, chalcopyrite, pyrite, magnetite and arsenopyrite are the principal minerals in the lodes.

K. L. Burns (1959a) re-examined the old workings on the south bank of Douglas Creek, ENE of the old Pelion Hut. Here the country rocks are laminated quartzite and phyllite tightly folded on E-W axes. Intersecting the Precambrian structures is a system of shears and brecciated faults with a general southerly trend, and these shears provide the structural control for the mineralization. The main drive, 220 feet long, was driven on a brecciated normal fault which forms the east wall. The lode is eight to 12 inches wide and contains pyrite, chalcopyrite, sphalerite and galena.

The Barn Bluff copper mines are situated in the extreme north-western corner of the quadrangle in the valley of Commonwealth Creek at an altitude of nearly 3000 feet. The lodes were discovered in 1898 by H. Andrews and the main development work was undertaken by the Barn Bluff Options Development Mining Company between January, 1901 and April, 1903. During this period the main tunnel was driven 448 feet, Nos. 2 and 3 tunnels 25 and 30 feet respectively, and the orebody was exposed at surface in 18 open cuts over a length of 600 feet and a width of 450 feet. No further development work has been carried out since.

The Precambrian metasediments in this area consist of folded, intercalated quartzite and mica schist with a general E-W strike. The sediments are traversed by a large chloritized dyke, 250 feet wide, with a NW trend. On the western side the dyke appears as a chlorite schist, while on the eastern side, near the mine workings, it is a dense, dark green rock, partly chloritized and impregnated with chlorite and a little chalcopyrite. On the south-western side of the chlorite dyke, large masses of white, opaque quartz containing pyrite outcrop at several points over a distance of 30 chains. On the north side of Commonwealth Creek and the eastern side of the chlorite belt are the actinolite ore bodies.

Mineralization occurs in both the chloritized basic rock and the actinolite-bearing zones of the quartzite. The ore in the chlorite zones consists of dense pyrite, arsenopyrite, specularite and pyrrhotite with subordinate chalcopyrite, silver and gold. The values are too low to be of economic grade. The actinolite orebodies consist of alternating bands of actinolite and quartzite, heavily impregnated with pyrrhotite, pyrite, specularite, arsenopyrite and, in a lesser degree, with chalcopyrite, galena and sphalerite. Cassiterite has been detected and gold and silver are constant, though erratic, components. Assay of the ore from various localities gave the following results:—

Locality	Copper (%)	Tin (%)	Gold (oz./ton)	Silver (oz./ton)
No. 1 Tunnel	0.16	....	Tr.	1.2
Crosscut, No. 1 Tunnel	0.40	....	Tr.	0.8
Open Cut, North Bank	0.10	....	Tr.	0.8
Open Cut, No. 7	2.32	0.22	0.05	2.3
Open Cut, No. 8	1.65	0.27	Tr.	3.6

WOLFRAM AND CASSITERITE

Wolfram-bearing quartz veins occur on the eastern side of the Forth Valley, between a point about two miles north of Mt. Oakleigh and the northern boundary of the quadrangle. These were discovered in 1916 and most of the development was done shortly afterwards by the Mt. Pelion Mining Co. and other operators.

The Mt. Pelion Wolfram Mine. This is the largest and best developed mine in the district and was initially operated by the Mt. Pelion Mining Co. from which it takes its name. It was re-examined by J. Elliston in 1951 when the lease was held by Messrs. Bloomfield, Knight and Martin. The veins occur on the steep hillside above the narrow flood-plain of the Forth River and consist of wolfram-bearing quartz veins with a general N-S trend filling fissures in the enclosing quartzite and mica schist which themselves are strongly folded on E-W trending axes. The veins dip to the east at angles between 60 and 70 degrees. The principal ore mineral is wolfram with which is associated cassiterite, molybdenite, arsenopyrite, chalcopyrite and pyrite. The minerals are erratically distributed through the quartz gangue and the highest grades are confined to shoots within the veins or on the walls.

The main vein has been opened by an adit about 130 feet long and is exposed by about 50 feet of trenching on the surface. Its continuity has been established for 500 feet laterally and 300 feet in depth, and it shows no sign of diminution at the extremities of exposure. The lode channel branches and anastomoses but the total width of the mineralized zone remains fairly constant at about 12 inches.

The average grade of ore is difficult to determine accurately. Assayed samples collected by Reid gave values of 4.6 per cent WO_3 and 0.3 per cent Sn. The limited and unreliable production figures that are available suggest that the grade of the ore is much lower: between 1.0 and 1.5 per cent. Elliston calculated that about 5000 tons of ore are available with average grade of 1.7 per cent WO_3.

The Cliff Lodes lie about 350 to 400 feet east of the main lode with which they are parallel in strike and identical in dip. This lode system consists of a number of veins from one to four inches wide with others between eight to 12 inches. The veins can be seen to occupy sharply defined fissures in the valley of Reid Creek. Arsenopyrite is the principal sulphide mineral with appreciable amounts of wolfram and cassiterite which are relatively more abundant in the narrower veins.

The Big Blow Lode. This lode is exposed in open cuts at a point about 50 chains south of the tunnel of the main wolfram veins described above. The lode is up to 10 feet wide with a meridional trend cutting across the enclosing metasediments which here have a NW trend. The dominant metallic components are sphalerite, pyrite, hematite and galena with subordinate amounts of chalcopyrite, cassiterite, ferromanganese and arsenopyrite. Accessory mineral constituents are actinolite, epidote, calcite and fluorite with minor amounts of feldspar and quartz. Assays of a number of samples revealed a small, but fairly consistent, silver content of between 3 to 12 dwt. per ton while the content of gold rarely exceeds 3 dwt. per ton. The tin content of the lode ranges between a trace and 1.20 per cent, and a zinc content as high as 5.43 per cent was recorded.

The Birthday Mine. This mine is situated about three-quarters of a mile north of the Mt. Pelion wolfram mine on the exposed area of the Devonian granite. Mineralized quartz veins occur in fissures in the granite and the minerals include wolfram, molybdenite, cassiterite, chalcopyrite, covellite, pyrite and arsenopyrite. Several lodes have been exposed in trenches.

Other wolfram and cassiterite occurrences are the Lone Pine Prospect, 1½ miles north of the Birthday Mine; the Hartnett Prospect, a little over a mile south-west of the Lone Pine Prospect on the west bank of the Forth River; the Brook Prospect, which lies high up on the flank of Mt. Oakleigh. The last named is a large pyritic orebody contained in quartz schist. It conforms in strike and dip to the general trend of wolfram-bearing lodes in the district.

For fuller information concerning these occurrences the reader is referred to A. M. Reid (1919) who visited the area when the greater part of the development and exploratory work was in progress.

COAL

The occurrence of coal seams has been briefly discussed under the section on Stratigraphy. Reid provided a description of the coal occurrences in the Barn Bluff and Mt. Pelion districts and outlined the principal physical and chemical characteristics of the seams.

The coal in this region is of Permian age and corresponds to the Cygnet Coal Measures in southern Tasmania. The seams are best developed along the northern flank of the Pelion Range between Mts. Pelion West and Pelion East, a distance of about five miles, where the coal is interbedded with massive sandstone and carbonaceous shale. The coalfield extends considerably to the south and west. Mapping has revealed the continuation of the coal measures between the Pelion Range and the southern boundary of the Du Cane Quadrangle and coal has been reported in the mountains west of Lake St. Clair beyond the southern limits of the mapped area. From exposures available it seems unlikely that the seams increase in thickness to the south. The thickest seams recorded are those near the Thetis Saddle. To the south the thinness and lateral impersistence of the seams, combined with the ruggedness and inaccessibility of most of the country, render the occurrences of no economic value under present conditions.

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