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TASMANIA
DEPARTMENT OF MINES

GEOLOGICAL SURVEY
EXPLANATORY REPORT

ONE MILE GEOLOGICAL MAP SERIES
K/55-10-59

ST CLAIR

by

A. B. GULLINE

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

1965

D. E. WILKINSON, Government Printer, Tasmania.

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Preface

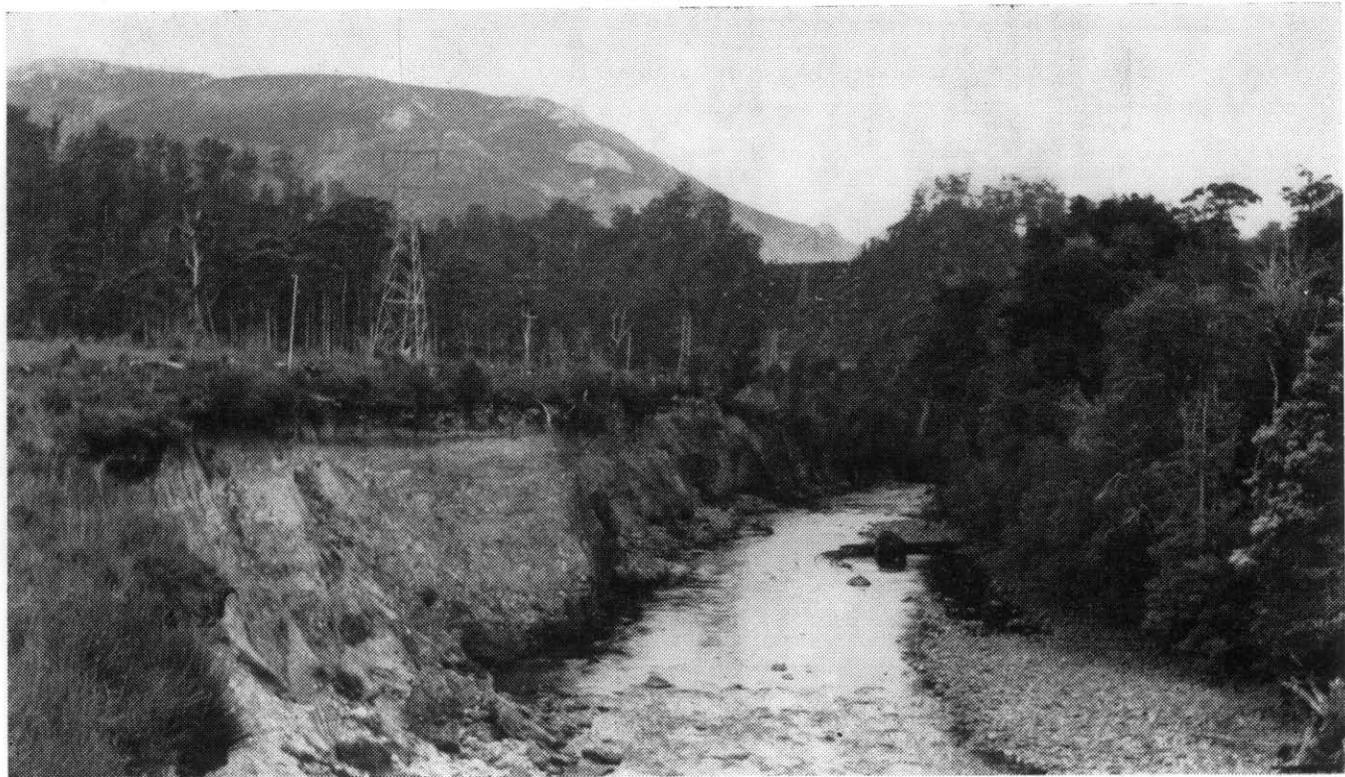
The St Clair Quadrangle, to which this report refers, contains the southern continuation of the glaciated region already surveyed in the Du Cane Quadrangle immediately to the north. Like the Du Cane Quadrangle, the St Clair Quadrangle has little mineral wealth but much to interest the bushwalker, and in addition, its easier access brings it within the range of the tourist. Indeed, a large part of the State's biggest scenic reserve, the Cradle Mountain-Lake St Clair National Park, occurs in this Quadrangle.

Economically, the chief interest is centered in peculiarities of topography and drainage, enabling development of natural and artificial storage lakes to assist in the production of hydro-electricity so necessary for industrial expansion.

The St Clair Map Sheet presents a wide range of interesting studies for a variety of geologists including especially those interested in geomorphology and engineering, and it is to be hoped that this report will be followed by further study.

J. G. SYMONS,

Director of Mines.



Mt Arrowsmith and Franklin River

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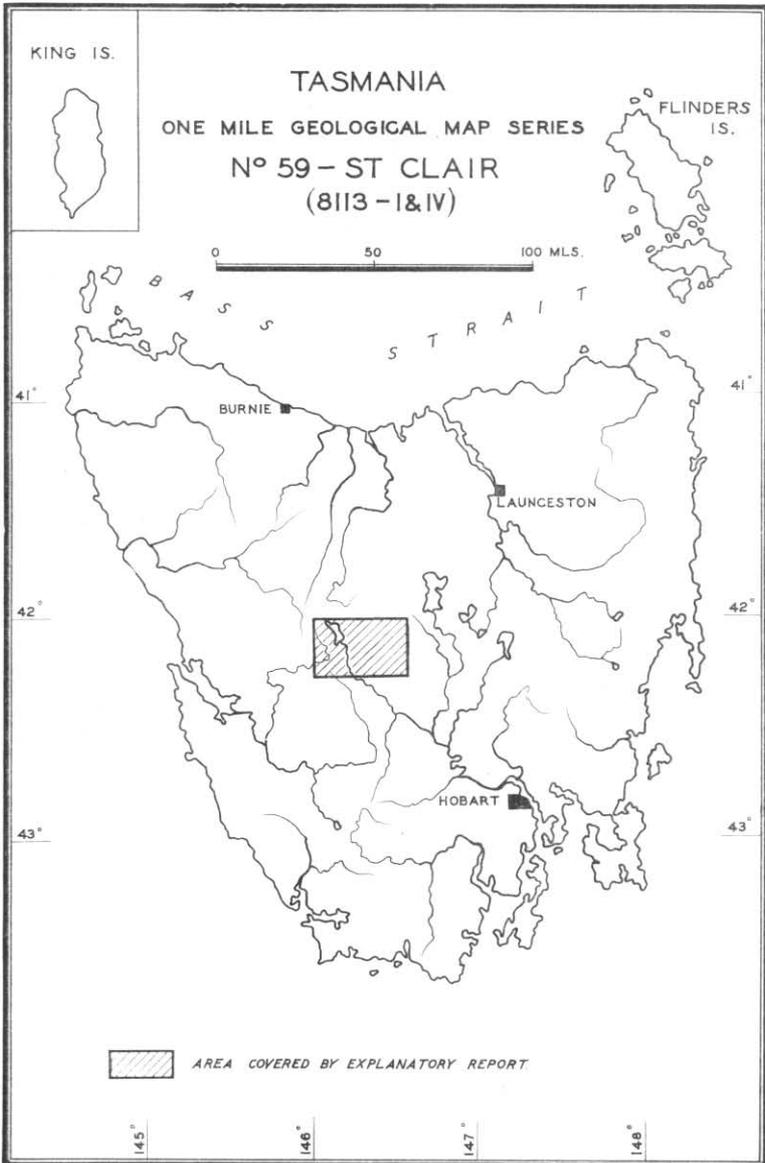


FIGURE 1

5 cm

EXPLANATORY REPORT ON THE ST CLAIR QUADRANGLE

Introduction

The St Clair Quadrangle (1 inch : 1 mile, Geological Map Sheet No. 59) lies between latitude $42^{\circ} 0'$ and $42^{\circ} 15' S$ and longitude $146^{\circ} 0'$ and $146^{\circ} 30' E$, and covers an area of about 450 square miles (Figure 1).

Approximately 95 square miles of the Cradle Mountain-Lake St Clair National Park lies within this area. Access to the area is primarily by means of the Marlborough Highway from the NE and by the Lyell Highway which passes through the Quadrangle from east to west. Foot tracks and timber roads in western and central parts, and secondary and Hydro Electric Commission roads in the east provide access to most of the remaining country. A motor launch can be hired at Cynthia Bay for transport up and down Lake St Clair.

Because of the climate and short growing season little agricultural development exists west of Derwent Bridge but the open plains are used for summer grazing purposes. Along the eastern margin of the Quadrangle warmer and drier conditions and richer soil have led to permanent settlement and development of grazing properties.

High rainfall in suitable catchment areas has resulted in harnessing of the water resources for generation of electricity by the Hydro Electric Commission.

The scenic attraction of the area has been realized and amenities are provided to cater for tourist and bush walker.

Field work was carried out during the drier months of the 1961-62 and 1962-63 field seasons. Mapping was done on aerial photographs on scales of 1 inch : 20 chains and 1 inch : 45 chains and on 1 inch : 20 chains dyelines. Boundaries were finally produced on maps of 1 inch : 40 chains scale. A. B. Gulline, Geologist, mapped the eastern strip from north of Bronte to north of Tarraleah and the SW section. W. L. Matthews, Geologist, mapped a central strip and part of the NW and west, and M. J. Longman, Geologist, spent a short time in the area mapping around the northern end of Lake St Clair and in the Franklin and Surprise Rivers area. Other sections were mapped by combined efforts of W. L. Matthews and A. B. Gulline. A small part of the central north was photo-interpreted following a low level aerial reconnaissance. In the course of mapping the Quadrangle, helicopter camps were installed on Mts Cuvier, Gell and Ronald Cross, the northernmost peak on the Loddon Range, and at Lakes Dixon and Hermione, in addition to camps at Franklin River, the northern end of Lake St Clair and in Scenery Preservation Board huts at Cynthia Bay.

Prior to this regional survey, little detailed work had been done and much of the area had never been mapped. Mapping of this Quadrangle was aided considerably by information given by Macleod *et al.* (1961) on the Du Cane Quadrangle which bounds it to the north, and as far as possible the nomenclature used there has been extended to the geology of the St Clair Map Sheet.

The author is indebted to Rangers W. Connell and D. Gallagher, Lake St Clair, for friendly co-operation and assistance and to helicopter pilots and to H.E.C. personnel engaged in co-ordinating the various flights.

Physiography

The St Clair Quadrangle west of Lake St Clair and Lake King William is deeply dissected and mountainous, rising from about 1300 feet in the Franklin River to nearly 5000 feet on Mts Manfred, Byron, Cuvier, Olympus, Gell, Rufus, Hugel, Pitt, King William and Goulds Sugarloaf.

East of Lakes St Clair and King William there is a plateau area sloping gently SE, relatively smooth in the NW to dissected in the east and south where more easily eroded rocks occur. The elevation is about 4000 feet on the Traveller Range falling to around 2000 feet in the SE portion with a minimum of about 1400 feet in the Nive River Valley.

From this plateau many small streams flow eastward into the Little Nive, Nive and Pine Rivers which constitute the main drainage system in the east. Small streams also feed the Clarence Lagoon from which the Clarence Rivulet flows first south and then east to its confluence with the Nive River. Further south Dunnys Creek and Wentworth Creek flow east from Wentworth Hills to the Nive River.

On the western edge of the plateau other streams flow into Travellers Rest Lake and the Travellers Rest River flows SW from there into the Derwent River. The Derwent River rises at Lake St Clair which is fed by various streams, in the north the largest being the Narcissus River and in the south the Cuvier and its tributaries. About three miles south of Lake St Clair the Derwent River widens into Lake King William, an artificial lake resulting from damming the Derwent at Butlers Gorge.

Drainage from the eastern flank of the King William Range forms the Guelph River which runs into the west side of Lake King William. The Navarre and Little Navarre Rivers rise on Mt Rufus and run SE into Lake King William. The Surprise, Franklin, Alma and Canning Rivers flow west from the Quadrangle and it is along this western edge that relief and dissection are most pronounced. The present topography of the area has been controlled to a large extent by three main events: intrusion of dolerite during the Jurassic, faulting and volcanic activity in Tertiary times and glaciation during the Pleistocene. River action has had a considerable influence, particularly after the Tertiary epeirogeny

and following the Pleistocene glaciation up to and including the present. It is probable that some river valleys originated along depressions resulting from intrusion of dolerite during the Jurassic.

Vegetation varies with elevation, drainage, the rock type and the aspect or degree of protection available. From Derwent Bridge westward rain forest type flora predominates below 3000 feet whereas to the east eucalypts, tea trees and low scrub cover most of the country. Vast areas of glacial valleys and outwash plains support little other than button grass, moss and small clusters of stunted eucalypts. Above 3000 feet deciduous beech, species of *Richea* and other dwarf scrub constitute the main forms of plant life.

Stands of eucalypts of commercial quality are not uncommon and several timber mills are at present operating in the area. Small stands of King William pine (*Athrotaxis selaginoides*) have been exploited leaving a few scattered specimens. On parts of the western spurs of Mt Ronald Cross and along ridge tops of the Franklin Hills the flora consists almost wholly of impenetrable interwoven horizontal scrub (*Anodopetalum biglandulosum*).

The western half of the Quadrangle has an annual rainfall of 60 to 80 inches, but eastwards it falls off to about 35 inches around Bronte. Snow is common on the mountains and in winter sometimes lies over all the area, remaining on some slopes and under open scree for most of the year.

Most of the topography is a result of Pleistocene glaciation which has left evidence of its existence over most of the area in erosional and depositional features.

The plateau east of Lake St Clair can be roughly divided into an area of glacial erosion and of glacial and fluvio-glacial deposition (Jennings and Ahmad, 1957). The part of the plateau in the St Clair Quadrangle is mainly one of deposition but signs of ice erosion can be detected over a large area. The most common features on the plateau are lakes of glacial origin and roches moutonnées, hills and ridges of boulders and plains with scattered erratics.

West of the plateau, different lithology and more severe glaciation have resulted in greater dissection with erosional features in excess of depositional.

Glacial lakes are extremely numerous on the plateau and are quite common to the west. Lake St Clair is the largest of these and it occupies a valley eroded by ice to a maximum of approximately 2000 feet below the level of the plateau to the east and Mt Olympus to the west. Tertiary faulting in a NNW direction probably led to the development of a valley down which a river flowed until the onset of the ice age. The regional easterly dip of the sediments possibly forced the river to flow in the east side of the valley against dolerite south of Mt Ida. The present valley, widened and deepened by glaciation, shows a sharp deflection where the ice came in contact with the dolerite. It is suggested that pressure of feed material from the west then pushed the glacier east causing erosion of the eastern dolerite until immediately north of the Derwent Basin where dolerite again influenced the glacier to turn SW. This arm of dolerite projecting into the lake, although at some time overridden by ice, formed a barrier which held up the

progress of the glacier and caused over-deepening of the valley. Lake St Clair is moraine dammed at the southern end. Other examples of moraine dammed lakes are Travellers Rest Lake, Lake Ina, Clarence Lagoon and Lake George to name but a few. On the plateau, waterfilled ice-scoured depressions form many lakes and on the shoulders of the mountains there are many cirque lakes. Tarns are common on the flat areas of glacial deposition.

A good example of glacial features is given by the Franklin River Valley above Lake Dixon. The valley has a broad U-shape with Lake Undine in the over-deepened part. On the valley floor roches moutonnées are numerous, often with plucking on the lee end and sometimes on the sides where well jointed dolerite is glaciated. A stream flowing NE into Lake Undine drops out of a hanging valley approximately 250 feet above the lake and a stream flowing north into this hanging valley rises in two un-named lakes in another hanging valley. The larger of these lakes is due to moraine barrage, is shallow and is thus typical, whereas the smaller lake occupies the over-deepened bottom of a cirque. This cirque and two other small ones facing SW have cut into Mt Gell to leave a sharp arete. Near the northern end of Mt Gell frost shattered "windows" and ice spillovers occur and below one spillover true till is present in the form of dolerite and Precambrian quartzite boulders above the base of the dolerite.

Similar features can be recognized in many other parts of the western area.

Apart from glacial lakes there are few of significance. Near the foot of Mt Arrowsmith there are about eight small ponds the largest being Shirleys Pool. These are waterfilled sink holes in Jane Dolomite.

In the course of hydro-electric power development numerous dams, weirs and canals have been constructed. These have resulted in lake and lagoon formation, and diversion of water from natural watercourses to the reservoirs has left temporary and misfit streams in some valleys.

Lake King William, Laughing Jack Lagoon and Pine Tier Lagoon are man-made bodies of water resulting from dams on the Derwent River at Butlers Gorge, Powers Creek and the Nive River respectively. Two small dams, Dunnys and Wentworth, are linked by a canal system which eventually feeds the Tarraleah Power Station.

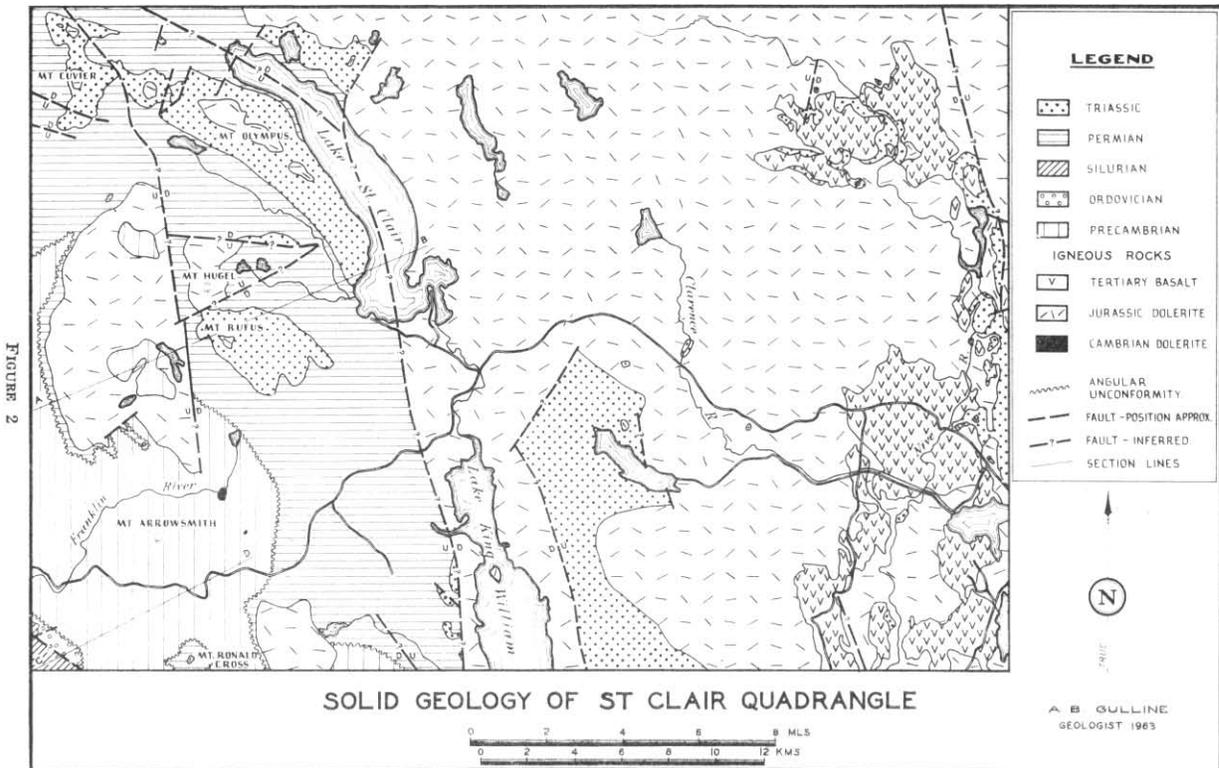
Bronte Lagoon and Bradys Lake occupy broad depressions, formerly marshes, converted to reservoirs by the building of rock fill dams in the required places. These are linked by canal and water flows into Bronte Lagoon from a canal linking it with Pine Tier Lagoon. As a consequence during most of the year no water flows down the Nive River other than that supplied by small tributaries below Pine Tier Dam and in summer the Nive consists of a series of pools separated by gravel and boulders in the river bed.

Most of the rivers show youthful features in the headwaters, mature characteristics where valley glaciers have been operative and a return to youth beyond the region of glacial deposits.

The effect of Jurassic dolerite on relief and landforms is due to its resistance to erosion and the thickness and conformity of the intrusive body. Most of the higher mountains in the Park owe their existence to a dolerite capping which has protected the comparatively easily eroded underlying sedimentary rocks. The SE tilted central plateau did not suffer deep erosion during the Pleistocene glaciation. It has a comparatively smooth surface but linears, probably faults and well-developed joints representing directions of weakness, controlled to some extent the direction of ice movement and erosion.

Many of the small dolerite hills overridden by ice now have the form of roches moutonnées but glacial striations are not preserved because of rapid surface weathering of dolerite. Small glacial lakes now occupy depressions and ice excavated zones of weakness. Jointing in dolerite resulted in large blocks being plucked from it by the ice and these blocks, now rounded, stud the buttongrass plains and comprise most of the boulders in till deposits.

Tertiary faulting can be shown to be responsible for the location of several river valleys, depressions and scarps. Tertiary basalt had a levelling effect on topography, filling old river valleys and forming plateaus, but much of this effect has since disappeared as the rivers have cut down through the basalt and other rocks to form new valleys.



5 cm

Stratigraphy

PRECAMBRIAN

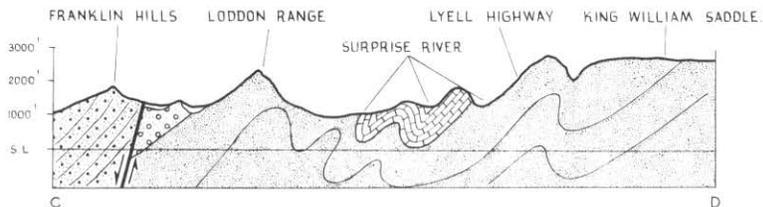
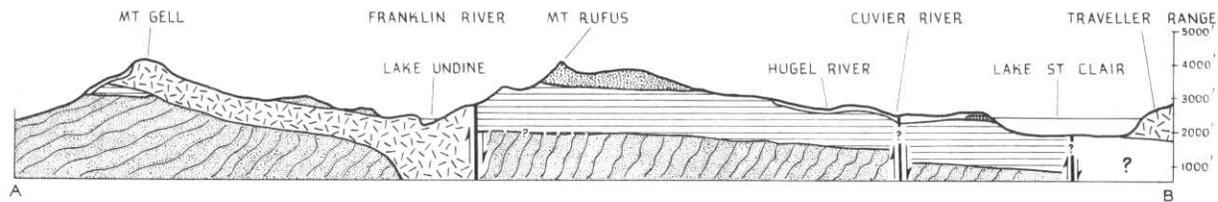
Precambrian rocks, regionally metamorphosed, outcrop along the western edge of the Quadrangle as far east as Lake Dixon and to between King William Range and Lake King William at coordinates 790,600N 416, 500E where glacial deposits prevent any further exposure. Outcrops occur between 1250 feet and 3550 feet a.s.l. the highest being a rafted block in dolerite. The height of the pre-Permian surface is about 3,200 feet on Mt Ronald Cross, 2,600 feet on Mt King William and rises to 3,400 feet on Mt Gell from where it falls northward to 1,900 feet in the Alma River valley. This surface is overlain unconformably by Permian sedimentary rocks.

The Precambrian rocks consist of varieties of schist, quartzite, phyllite, slate and conglomerate with a series of dolomitic rocks which is considered to be the youngest. These metasediments are complexly folded in a NW direction and where totally exposed show differential erosion into ridges and valleys in this direction.

Dolomite at the foot of Mt Arrowsmith has developed many sinkholes which at this level are filled with water but on Mt Ronald Cross caves are present. One steep valley on this mountain was dry at the time of investigation but 800 feet from the top of the Precambrian dolomite an underground stream emerged into the valley. Dolomite outcrops in the Alma River valley, from the foot of Mt Arrowsmith through Mt Ronald Cross to south of the Quadrangle. There is a small exposure about 400 yards west of King William Saddle, and again near Tiger Creek in road cuttings. Further outcrops occur in Carbonate Creek and in the Franklin River (Plate 1). Conglomerate is restricted to an area from King William Saddle northwards to the Franklin River and quartzite, quartz-chlorite schist and black slate and phyllite occupy remaining areas. In the Franklin River valley Precambrian metasediments are intruded by Jurassic dolerite and dolerite of Late Precambrian to Cambrian age. In the far SW corner Precambrian is unconformably overlain by Ordovician sedimentary rocks.

Over the area there is little variation in appearance and grade of metamorphism of a variety of metasediments. A regional NW strike exists and the majority of structural lineations are also in this direction. Tight folding and quartz veining is common as is carbonate veining in the proximity of the dolomite unit.

A section through the dolomite unit was observed between the Surprise River and Mt Ronald Cross but glacial deposits, downwash, deep weathering and dense vegetation allowed little more than rock types to be determined. Beds are generally massive and minor structures could not be found in most outcrops. Dips were obtained where beds were thin and where two different rock types could be distinguished. The succession includes the following rocks: dolomite, limestone, black chert and shale beds, black coarsely crystalline limestone, dark grey dolomitic limestone with lenses of spherulitic chert and dolomitic breccia containing angular fragments and blocks of dolomitic limestone, slate, phyllite and spherulitic chert. On weathered surfaces the dolomitic rocks vary in colour from pale cream to creamy pink.

**LEGEND**

	QUATERNARY
	TRIASSIC
	PERMIAN
	SILURIAN
	ORDOVICIAN
	PRECAMBRIAN DOLOMITE
	PRECAMBRIAN
IGNEOUS ROCKS	
	DOLERITE.

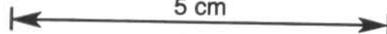
A. B. GULLINE
GEOLOGIST

GEOLOGICAL SECTIONS
ST CLAIR QUADRANGLE

0 1 2 3 4 M.L.S.



5 cm



The position of the dolomite in the Precambrian is in some doubt owing to the similarity of types of the adjacent rocks.

As mapped there appears to be a black slaty shale and a thin pebble conglomerate with slaty matrix overlying the dolomite in Surprise Valley.

No confirmation of this was found in other sections. On Mt Arrowsmith a series of boulder conglomerate, pink and white quartzite and ferruginous greywacke and greywacke grit occurs adjacent to the dolomite but glacial deposits prevent their relationship being determined. The dolomite is underlain by schist and quartzite without signs of unconformity and it is suspected that some schist is interbedded with dolomite. The dolomite shows good cleavage and development of minerals comparable with those in other metamorphic rocks in the locality. The following is a description of a thin section of sheared dolomitic limestone. The rock is a mass of interlocking crystals of carbonate, the average grain size being of the order of 0.01 mm with some crystals as large as 0.2 mm across. Cleavage is represented by occasional bands of fine talc. A few grains of quartz with undulose extinction may be seen.

Folding observed in the Surprise River indicates that the dolomite occupies a recumbent synclinal structure. It may be correlated with the Jane Dolomite (Spry, 1957) in the Mt Mullens area, mapped by Spry and Zimmerman (1959) who also correlated the phyllite, slate, quartzite, and schist, seen along the Lyell Highway from Mt Arrowsmith to the Franklin River, with the Scotchfire Group.

ORDOVICIAN

The Ordovician Junee Group is represented in the area by a quartzitic conglomerate overlain by white to greenish quartz sandstone. These rocks outcrop poorly in the SW of the Quadrangle where Pleistocene and Recent deposits and thick vegetation preclude good exposures. The conglomerate consists of white quartz pebbles up to three inches diameter set in a white silicified quartzite matrix, sometimes ironstained and occasionally friable. The quartzite is medium to coarse grained and some beds contain tubicles at right angles to the bedding plane.

The Ordovician rocks have a topographic expression as small rounded hills rising sharply from an uneven button grass plain and an angular unconformity is assumed between them and the underlying Precambrian rocks. They are correlated with the Owen Conglomerate at the base of the Junee Group on lithological grounds and the presence of tubicolular markings in the quartzite. The rest of the Junee Group is not exposed as the rocks are faulted against Silurian to the SW. From the dip measured on quartzite beds a thickness of approximately 1,550 feet is present.

SILURIAN

Sedimentary rocks of this age form part of Franklin Hills and have a geomorphology of strike ridges with intervening valleys. The altitude decreases SW as silica content and resistance to erosion decreases. Outcrops occur where trees have fallen and in creek beds but are not sufficient to establish a definite correlation with particular formations of the Eldon Group.

On the highest ridge which strikes about 320° M. no outcrop was seen but many angular blocks of quartzite and sandstone are to be found, together with a few fine conglomerate blocks. Towards the top of this unit, poorly preserved fossils occur in large numbers in some beds. Overlying this quartz sandstone is a yellowish weathered shaly sandstone, apparently unfossiliferous, followed by a yellow-brown shale with thin quartzite beds. A thin sequence of black siltstone follows and in this rock unidentifiable fossils, probably worm casts, are present. This is overlain by yellow-brown shale with an increasing number of interbedded sandstone bands. Quaternary deposits blanket the area to the SW just outside the Quadrangle.

Fossils in the quartz sandstone consist of moulds of brachiopods, bryozoa, crinoid columnal plates and possibly cystoid plates. Some of these were examined by Dr. A. A. Opik (pers. com.) who considered their age to be Silurian. The main reason for his determination of Silurian age was the presence of (i) a rhynchonellid brachiopod, and (ii) bryozoa (Trepotomata and fenestrate Cryptostomata) which could not be expected in the early Ordovician and as they are not in Gordon-type limestone they must therefore be younger. They are considered to belong to the fossil assemblage associated with the Siluro-Devonian Eldon Group.

PERMIAN

A succession of Permian sedimentary rocks outcrops in the western area where it rests unconformably on the Precambrian basement. Exposures were seen from Mt Manfred in the north to Mt Ronald Cross in the south in which direction the Permian appears to be thinning (See Figure 4).

The surface of deposition was very irregular and low and high areas with a difference in present elevation of 1,500 feet occur within a distance of about six miles. Block faulting possibly contributes to this difference but on Goulds Sugarloaf a very thick basal sequence suggests a valley in the pre-Permian surface.

This surface has been shown to have been glaciated prior to Permian deposition (Banks, 1962) with ice movement from just north of west and it is possible that glacial valleys occurred in the deposition surface.

The Permian deposits have an easterly regional dip of about 2° except on Mt Ronald Cross where the dip is of the same order in a SW direction.

In the Permian successions on Goulds Sugarloaf and Mt Rufus complete sequences similar to those in the Du Cane Quadrangle were mapped but several groups were found to be thinning out. In the north, difficulty was experienced in determining the base of the Triassic and top of the Permian but further south there is a more pronounced disconformity taken as the contact and at the south-easternmost exposure of Permian the top formation, the Cygnet Coal Measures, is missing.

Subdivision of the Permian in the St Clair Quadrangle is the same as in the Du Cane Quadrangle.

Basal Conglomerate

Throughout the Quadrangle where basal Permian is seen it is represented by conglomerate (See Plate 2). Best exposures are in the Alma River valley, around Mt Gell, in the Franklin River valley west of Mt Rufus, and on Mt Ronald Cross. This unit is of variable thickness as demonstrated in the Alma River where 250 feet occur at one point and a mile further upstream there is approximately one foot.

Very often the massive bedded conglomerate forms cliffs and in the Franklin River valley roches moutonnées have been formed by glacial action.

The basal unit consists of massive beds of open framework conglomerate separated in some cases by thin shale beds. The following section was examined and measured on Mt Ronald Cross.

Top Wallace River Group	feet
Conglomerate—open framework; matrix fine to coarse rock fragments, greenish brown; unsorted boulders rounded and elongated up to 3 feet long; flat-sided boulders striated	70
Shale and sandy calcareous siltstone	3
Conglomerate—unsorted, irregular-shaped boulders ...	30
Thin shale—ripple marked; 2 inch bed sandy limestone with sedimentary folds and slumps	2
Fine conglomerate—pebbles less than 2 inch diameter, matrix of rock fragments fine to coarse ...	4.5
Precambrian	
	109.5

Component boulders appear to be derived mainly from underlying Precambrian schist, quartzite and dolomitic limestone but granite, quartz-porphyry, pre-Permian conglomerate and Silurian quartzite boulders have been noted.

Other occurrences of conglomerate are on Mt Arrowsmith, Mt Pitt and in a small quarry off the Lyell Highway north of Mt Pitt. On the eastern side of Mt King William basal Permian is covered by till but at Lake George the terminal moraine is composed of boulders of basal conglomerate and dolerite.

The conglomerate appears to be of mixed origin in that some boulders are striated and were probably ice rafted and dropped into the normal conglomerate. The large size of many boulders also suggests ice rafting.

At the top, the conglomerate grades rapidly into the Wallace River Group.

Wallace River Group

Rocks of this group are exposed in the western portion of the Quadrangle in the Alma River valley on the flanks of the Cheyne and King William Ranges, and Mts Rufus and Ronald Cross. A small section partly covered by glacial deposits is exposed along the Lyell Highway for about one mile west of King William Creek.

Where exposed, this group weathers to grey shale fragments forming rounded hills.

The lithology shows little variation in colour or rock type being predominantly a succession of dark grey mudstone and shale with some sandstone and minor conglomerate beds. Toward the base in almost black shale, pyrite nodules up to two inches in diameter are frequently found and throughout the group pebbles of various sizes are common, sometimes numerous enough to form a conglomerate lens.

Fossil horizons are not thick and are not always found but in one section in the headwaters of the Alma River five horizons were located. This section has a thickness of 320 feet with fossiliferous beds at the heights shown above the base in the following description.

Height above base (feet)		Thickness (feet)
...	Dark grey pebbly mudstone	40
270	Fossils in mudstone	10
	Conglomerate	2
258	Limestone. Fossils replaced by calcite	10
210	Fossil zone, many pebbles	} Dark grey silty mud- stone with pebbles
130	Fossils, brachiopods and bryo- zoa	
110	Fossil zone rich in brachiopods	
		258
		320

Approximately 1,000 feet of Wallace River Group was mapped on Goulds Sugarloaf. Two fossil horizons were located in the rocks which are lithologically similar to the Alma River section.

At Mt Rufus only the topmost 40 feet are well exposed. Here dark grey sandy mudstone and calcareous sandy mudstone contain fossil marine fauna and terrestrial flora.

On Mt Ronald Cross fossils were located at the top of the section and pyrite nodules are common towards the base. Along the Lyell Highway pyrite nodules and pebbles in dark shaly mudstone are the main characteristics.

A section at the northern end of Cheyne Range shows 210 feet of basal conglomerate overlain by 700 feet of Wallace River Group which is intruded by Jurassic dolerite in fossiliferous beds near the top.

The presence of fossil flora in the upper fossiliferous beds indicates changing conditions of deposition and the overlying beds constituting the Mersey Group were deposited in an estuarine or lacustrine environment.

Mersey Group

Exposed in the Alma River valley and on the side of Mt Rufus, this unit has a thickness of between 80 and 90 feet and is conformable with the under- and overlying groups. On Mt Ronald Cross the group is not mappable as it is represented by lenses of wormcast sandstone which occasionally reach a thickness of two feet.

Lithologically this group consists of feldspathic and quartz sandstone, sometimes with a basal grit bed, and beds of carbonaceous shale. Abundant mica gives the thinner beds marked fissility. Often the carbonaceous remains are present as coal fragments and no identifiable plant remains were observed. Current bedding, flaggy and shaly bedding are common; massive sandstone is often found and is useful as a marker horizon in mapping.

Although approximately the same thickness of this group exists as in the Du Cane Quadrangle there are slight differences in that no coal seam was seen in sections in the St Clair Quadrangle and it is important to note that the group has thinned out to practically nothing at Mt Ronald Cross.

The group graded into the overlying Woodbridge Group as the depositional conditions again reverted to marine.

Woodbridge Group

This unit outcrops in most of the areas of Permian rocks west of Lake St Clair and is generally well exposed forming cliffs and waterfalls. In most sections there are several limestone beds interbedded with mudstone, shale and sandy mudstone; pebbles are numerous (quartz, schist and quartzite) and fossils are distributed through most of the sequence.

In several areas a high proportion of carbonate is present in the matrix and in the Goulds Sugarloaf section limestone and sandy limestone are the dominant rock types.

Thicknesses of Woodbridge Group sections range from 200 to 300 feet showing an increase over the Du Cane section (90-250 feet).

On Goulds Sugarloaf a succession of over 280 feet is identified as Woodbridge Group composed mainly of impure fossiliferous limestone and minor shaly mudstone bands. Above the uppermost limestone band is a fossiliferous, poorly sorted, pebbly sandstone which has been taken as the top of the Woodbridge in the Du Cane Quadrangle. In other areas a unit defined as Risdon Sandstone occupies this position. In this area 10-40 feet occur and as this rock grades up into Ferntree Group mudstone and is markedly different from Woodbridge lithology it has been included in the Ferntree Group in the St Clair Quadrangle.

As mentioned above, limestone is a common lithology as far south as Mt Rufus but this is not so further south. On Mt Ronald Cross a full section may not be present as dolerite caps the peak having been intruded into the Woodbridge Group. Sandstone and sandy mudstone make up the major part of the sequence with rare shale and limestone bands. These rocks are resistant and are exposed on the NW and east sides of the mountain where they form

prominent cliffs. Fossils are common and many sandy beds contain small unidentifiable fossil fragments which weather white against the medium brown of the outcrops. In most parts of this mountain, Woodbridge Group rocks directly overlie Wallace River Group with Mersey Group only occurring as thin sandstone lenses.

From Mt King William a long smooth-topped spur extends NE and its surface is almost a dipslope. On the east side, creeks flow over waterfalls to the forested plain fringes. These creeks are almost parallel following a strong joint direction. Sandy mudstone with some limestone forms most of this section which is over 200 feet thick, but best exposures are almost inaccessible because of their steepness.

Brachiopods, bryozoa and gastropods are the predominant fossil fauna with some beds almost entirely made up of bryozoa. The top of the section is not present in this area and to the west the sedimentary rocks abut against a dolerite intrusion.

Ferntree Group

As previously stated the Woodbridge Group is overlain conformably by a pebbly fossiliferous sandstone which is taken as the base of the Ferntree Group. The Ferntree Group is usually recognized by its massive sandy mudstone beds, thin shale beds, well developed jointing, pale cream weathered surfaces and mottled greyish cream fresh surfaces. This unit occurs mainly in the NW where there are complete sections on Mt Manfred, Goulds Sugarloaf and Mt Rufus. A small exposure is present west of Lake King William and in the NE there is a poor exposure of Ferntree type rock.

Ferntree Group rocks exhibit little variation. Sandstone and conglomerate occur occasionally but gritty mudstone with thin interbedded shale makes up most of this group. Because of its resistant nature cliffs and waterfalls are a common development. In gently sloping creek beds where the gradient is slightly steeper than the dip of the mudstone, waterfalls a few feet high are often separated by pavement-like stretches where the creek flows down on bedding plane.

Fossils are generally scarce but in some sections wormcast beds are common and in several localities horizons of fossils have been recorded. These are restricted to a few inches depth in a bed and are numerous but not abundant.

In the upper reaches of the Alma River in a tributary flowing from Goulds Sugarloaf approximately 670 feet of Ferntree Group is exposed as described below.

Top	feet
Sandy mudstone poorly exposed	290
Gap	30
Hard grey-blue mudstone	60
Gap	10
Grey-brown sandstone	20
Dominantly grey mudstone with shale interbedded and some sandstone beds	190
Poorly sorted pebbly sandstone	60
Fossiliferous pebbly sandstone with quartz and feld- spar matrix	10

Fossils were recorded at the base and at 90, 150, 180 and 250 feet above the base and were mainly brachiopods and bryozoa.

In an eastern branch of the Alma River, dolerite intrudes Fern-tree Group at 300 feet above the base of the succession.

Fossils were found in a section on Goulds Sugarloaf at heights of 205 and 255 feet above the base. Limestone occurs 45 feet above the higher fossil horizon.

On the western side of Mt Rufus a fossil horizon occurs 210 feet above the base of the Fern-tree Group in a sandy mudstone and a limestone bed was recorded 280 feet above this. Fern-tree Group mudstone is generally conformably overlain by Cygnet Coal Measures but the Fern-tree immediately west of Lake King William is overlain disconformably by Triassic conglomerate. This may be a local feature or it may extend southwards but to the north the Cygnet Coal Measures are present.

Cygnet Coal Measures

Conformably overlying the Fern-tree Group in the NW area is a relatively thin sequence of feldspathic sandstone, shale, carbonaceous shale, pebble beds and thin coal lenses. The outcrop of these is restricted to west of Lake St Clair and no further south than Mt Rufus. The Coal Hill section was measured from the topmost coal seam downwards. Overlying the coal is a quartz grit and pebble bed taken as the basal Triassic.

	feet	inches
Triassic
Slight disconformity
Coal	0	10
Carbonaceous shale	1	0
Shaly sandstone with carbon on bedding planes	5	9
Carbonaceous shale (lens of sandstone at top)	2	6
Feldspathic sandstone, massive at base, shaly at top	5	0
Interbedded feldspathic sandstone and carbonaceous shale	1	2
Feldspathic sandstone	8	9
Carbonaceous shale with minor sandstone bands	1	11
Feldspathic sandstone	1	0
Carbonaceous shale, rare feldspathic sandstone	3	8
Feldspathic sandstone	0	4
Carbonaceous shale	30	0
Base obscured by scree
Total	61	11

On Mt Manfred, Triassic rocks overlie Cygnet Coal Measures disconformably:—

	feet	inches
Triassic		
Disconformity		
Lenticular bright coal seam	0	4
Lenticular carbonaceous shale	0	3
Lenticular coal seam	0	10
Feldspathic sandstone	10	0
Grey shale	4	0
Massive sandstone	12	0
Fissile carbonaceous shale	5	0
Gap	5	0
Feldspathic sandstone	5	0
Light grey shale	5	0
Carbonaceous shale	15	0
Sandstone grading to massive mudstone	40	0
Total	102	5

Incomplete sections were recorded between Mts Cuvier and Manfred, on Mts Cuvier, Byron, Rufus, Olympus and on Goulds Sugarloaf. In a tributary of Hugel Creek the following section of Cygnet Coal Measures was measured:—

	Approx. thickness	
	feet	inches
Top obscured by Pleistocene till		
Medium, even-grained, micaceous quartz-feldspar sandstone with carbon particles, flaggy bedding	12	0
Similar sandstone but containing mud pellets and shaly parting	6	0
Black and grey shale lenses in current bedded feldspathic sandstone	12	0
Bright coal lens	0	11
Current-bedded feldspathic sandstone with two 3-inch thick lenticular coal seams	12	0
Feldspathic sandstone, some current-bedding; 6-inch pebble bed and black shale at base and some plant remains	16	0
Bed of pebbles and boulders to 4-inch diam.; irregular pebble lenses	2	0
Carbonaceous feldspathic sandstone with pebble bed	4	0
Base obscured by talus and till		
Section exposed (approximately)	65	

On the NE side of this spur basal Triassic rests on massive sandstone which is slightly feldspathic and micaceous. Cliffs up to 30 feet high occur within this sandstone which is exposed for a thickness of 60 feet after which till and massive sandstone talus blocks obscure the outcrop. This is considered to be Cygnet Coal Measures.

Compared with the Cygnet Coal Measures described from the Du Cane Quadrangle this unit in the St Clair Quadrangle shows a decrease in thickness from 300-350 feet to 100-120 feet but coal is still present. The presence of basal Triassic conglomerate suggests that there was considerable erosion after deposition of the coal measures, but no definite unconformity has been proved.

TRIASSIC

Triassic rocks are best represented on mountains in the NW part of the Quadrangle where the succession is usually protected by a dolerite capping—the remnants of sills. In other areas, particularly the eastern margin, the complex and numerous dolerite intrusions have left isolated patches and probably rafted blocks of sedimentary rocks the position of which in the Triassic succession cannot be ascertained accurately. Exposures in the eastern portion are generally poor and subdivision here and in the western part is based on lithological assemblages.

Nomenclature of the Triassic follows MacLeod *et al.* (1961) in most of the area but near Bronte Park a different facies occurs which because of its poor exposure, faulted nature and discontinuity due to dolerite intrusions has not been defined but has been related on dominant rock types to part of the Brady Formation of McKellar (1957). The maximum thickness of Triassic rocks is exposed on Mts Olympus and Ida where approximately 1000-1100 feet of conglomerate, sandstone and shale outcrop. Exposure is not good as benches form where shale is present between massive sandstone units and these benches are generally covered with till, hence only cliffs of sandstone with minor shale bands outcrop. On Mts Olympus and Ida it is possible that the Feldspathic Sandstone of MacLeod *et al.* (1961) is intruded by dolerite as fragments of this rock were observed at the base of the scree. In neither area was there sufficient outcrop to constitute a map unit and the gradational nature of the change in lithology of the sedimentary rocks does not allow a precise intraformational boundary to be defined.

Gould Formation

This is the name given to the basal member of the Triassic by MacLeod *et al.* (1961). Varying thicknesses are found widely distributed over the western half of the Quadrangle and an isolated outcrop occurs in the NE (at 823500N 435000E) and beyond the Quadrangle about one mile east of Pine Tier Dam. The Gould Formation is characterized by torrential current bedding, sparkling white quartz in weathered outcrop, rounded white quartzite pebbles generally $\frac{1}{2}$ to 1 inch in diameter and coarse quartz-feldspar matrix, often with coal fragments included.

Above the coarse beds the sedimentary rocks grade to a medium-grained quartz-feldspar sandstone with very thin shale intercalations. This sequence measures 50-150 feet but around Mts Cuvier, Manfred and Byron any division between the Gould Formation and the overlying Ossa Formation is misleading and Triassic rocks on these mountains are all grouped in the Ossa Formation. The thickness of the coarse basal beds on these mountains is not more than 20 feet.

On Mts Olympus and Rufus up to 150 feet of coarse conglomerate and sandstone have been mapped below the alternating shale and sandstone of the Ossa Formation. Isolated outcrops of basal Triassic occur $\frac{1}{2}$ mile NE of Shadow Lake, $\frac{1}{2}$ mile west of Lake King William and on a ridge of Mt Manfred. In the far NE, the Gould Formation contains boulders up to six inches in diameter in the lowest few feet, followed by pebbly conglomerate with a grit matrix.

The Gould Formation overlies Cygnet Coal Measures disconformably in most areas but at Lake King William Gould Formation conglomerate overlies Ferntree Group and the lower beds of the Gould Formation contain a high percentage of fragments of coal in the matrix indicating erosion of the Cygnet Coal Measures. The contact between the Ferntree Group and Gould Formation is disconformable or is a para-unconformity.

Where the Gould Formation is not recognizable or absent the Ossa Formation rests disconformably on Cygnet Coal Measures. Under these circumstances the disconformity between Permian and Triassic rocks is less pronounced and thicknesses of the Cygnet Coal Measures are greater due to less erosion. In some areas a few feet of Gould Formation exists but is unmappable on this map scale. A marked bench and sandstone cliff often has Gould Formation conglomerate at the top and as little as two feet may protect the underlying sandstone sufficiently to allow cliff formation.

Ossa Formation

The Gould Formation grades up into the Ossa Formation which has characteristics similar to those of the Ross Sandstone (Jennings, 1955). It is identified by massive sandstone interbedded with thin shale bands. The sandstone is buff-coloured, fine to coarse grained, often current bedded and is composed primarily of angular quartz grains with a lesser amount of feldspar. The lithology changes up the section from dominantly sandstone to almost equal proportions of shale and sandstone. In a section in a creek on Mt Olympus from Echo Point, approximately 900 feet of sandstone are exposed. A few thin shale beds are present and gaps in the section probably represent shale horizons. The sandstone beds are generally coarse-grained and throughout have occasional bands and lenses of quartzite pebbles. Some beds are fissile due to concentrations of dark mica on the bedding planes but massive current-bedded sandstone is the general rule. Shale varies in colour through dark green to khaki and grey and beds are rarely more than about one foot thick until near the top of the section. Mudstone and mud pellet sandstone occur in some localities.

On Mt Rufus approximately 700 feet of Triassic rocks outcrop with about 100 feet of Gould Formation overlain by relatively coarse sandstone with interbedded greenish shale up to 20 feet thick. Near the summit pinkish shale has been intruded by dolerite. Mt Ida has a small dolerite cap at least 950 feet above the base of the Triassic. Here again there is a succession of sandstone with interbedded shale becoming more common toward the top and the feldspar percentage also increases.

Partial sections outcrop on Mts Byron (650 feet), Cuvier (585 feet), Manfred (490 feet) and Coal Hill (210 feet) and there is possibly some exposed on Goulds Sugarloaf.

At Wentworth Hills almost 600 feet of quartzose sandstone, shale and micaceous and feldspathic sandstone outcrop poorly and are overlain by dolerite and faulted out to the north and west.

In the NE small areas of Ossa type sandstone and shale have been preserved below basalt cappings. In general, they overlie dolerite. Further south scattered sandstone exposures appear to be rafted blocks in the dolerite.

Brady? Formation

From Bronte Lagoon to just north of Pine Tier Lagoon a strip of Triassic rocks outcrops complexly associated with thin dolerite intrusions. The lithology is different from the Triassic elsewhere in the Quadrangle. Outcrop is poor except in road and canal cuttings and in river banks. Faulting and intrusive bodies have disrupted the occurrences and some are rafted sheets in the dolerite. Dips range from vertical to a few degrees but in the Nive River just below Pine Tier Dam dips are between 20° and 50° in most instances. North and south of this section dips appear to be flatter but exposures are too poor to give accurate readings. Thicknesses can only be estimated under such conditions and 200 feet would be the maximum exposed.

The different lithologies encountered in these sections place them at a higher level in the Trias than Ossa Formation. Rock types observed are grey-green feldspathic sandstone, similar to that of the "Feldspathic" Sandstone (Jennings, 1955), coal bearing black shale and a variety of coloured shales. Light green and whitish shales outcrop in the Nive River and contain well preserved remains of plants of the genus *Phyllothea* (Prider, 1948). White weathering quartz sandstone is also present in beds up to 2 feet 6 inches thick. It is often ripple marked, cross bedded and sometimes has worm casts on bedding planes.

As no section was built up with accuracy or certainty, it is proposed to correlate these beds with those of part of the Brady Formation described by McKellar (1957) which fit the description reasonably well and are not a great distance away to the north. Prider (1948) referred to these beds as "the clayey facies" of the Triassic in this area.

TERTIARY

The Tertiary deposits consist of interbedded sub-basaltic sand and clay, generally poorly consolidated but sometimes indurated to quartzite by basalt. They are restricted to the eastern part of the Quadrangle and outcrop poorly as thickness is limited to a few feet. Excavations reveal several areas of Tertiary deposits under Quaternary deposits and sub-basalt sand lenses are often delineated by low bushy scrub and rabbit burrows.

Baking and alteration by basalt have resulted in formation of white quartzite, carnelian, chalcedony and jasper. The thickest observed Tertiary deposit underlies Quaternary in the canal joining Bronte Lagoon with Bradys Lake where over 10 feet have been cut. Claystone is generally brown, sometimes black, and no fossils were found in the exposures. Sand deposits up to 5 feet thick were found between dolerite and basalt and are stained brown with iron oxide. The age of these sediments has been estimated from their relationship to the basalt and by their resemblance to dated sediments overlain by basalt.

QUATERNARY

These deposits constitute the most common superficial rock type in the Quadrangle and they are distributed throughout with the greatest accumulation in the vicinity of Lake St Clair. There are several types of sediment including swamp and marsh deposits, alluvial, fluvio-glacial and glacial deposits and talus.

Swamp, Marsh and Alluvial Deposits

In the east, thin swamp and marsh deposits occur around Bronte Park, west of Bronte near the Lyell Highway, between Bronte Lagoon and Bradys Lake and in other scattered localities. Where sections of these deposits were seen, brown peaty material is underlain by black clay with vegetable remains in turn underlain by lighter coloured sandy clay. Prider (1948) deduced that in some of the larger marsh areas near Bronte the clay is underlain by Triassic rocks.

Few wholly alluvial deposits were recognized; in most cases rivers are degrading through glacial and fluvio-glacial material and depositing outside the Quadrangle. Some resorting of glacial moraine has occurred leaving gravel and boulder lenses and large boulders in river beds, the smaller sized grains and rock fragments having been removed.

Talus and Scree Deposits

Deposits of this type occur extensively on the slopes of dolerite-capped mountains around Lake St Clair and on the King William Range, Mt Gell, Cheyne Range, Wentworth Hills and in the area north of Bronte Park. In many localities glacial till, derived predominantly from dolerite, is hardly distinguishable from dolerite scree. Close examination of the deposits usually reveals quartz fragments which are taken as a criterion of glacial deposits. True scree recognizable on the higher mountains has developed mainly since the retreat of the ice and is continuing to form at present by frost action and gravity breaking up the columnar dolerite and basalt.

In younger scree slopes angular blocks, sometimes 30 feet long and of varying widths, make up the scree. Other mantles of scree extend to small cols along the mountain top and are considered to be caused by ice spillovers (Jennings and Ahmad, 1957). This

type of scree is recognizable by two and occasionally three characteristics:—

- (1) Lack of dolerite cliff above;
- (2) Small valley or depression on mountain top at head of scree;
- (3) Rare occurrence of foreign rock type in scree.

Glacial Deposits

Extending across the Quadrangle from SW to NE is the main belt of deposition of several extinct glaciers and part of the Central Plateau ice sheet; consequently morainal material blankets large areas of this belt.

The characteristics of this cover are hummocky hills with many boulders, mainly dolerite, protruding above the soil surface. The hills are usually tree-covered and are separated by button grass plains. The shape of the hills depends on type of moraine or rather the position they were deposited in relative to the glacier.

Of the constituent boulders dolerite predominates even above Precambrian bedrock and Permian and Triassic rocks are usually represented by small boulders and pebbles, rock flour and fragments in the moraine. Ordovician quartzite boulders and Owen type conglomerate boulders occur occasionally and are probably derived from the Permian basal conglomerate. Partial sections of moraines have been seen alongside the Lyell Highway west of Lake St Clair, in the Derwent River and at the southern end of Lake St Clair and there appears to be a definite layering of the glacial deposits.

At the top is a layer of coarse till which may grade down or change sharply into thinly laminated, moderately lithified and consolidated sediments ranging in grain size from medium sandstone to claystone.

Thicknesses range from a thin veneer to about 100 feet but the maximum thickness is unknown. In fluvio-glacial deposits in the Franklin River a maximum of 60 feet has been cut (Plate 3). At the southern end of Mt Olympus about 100 feet of moraine rises above the Triassic as a sharp ridge or lateral moraine. Similar moraines of comparable thickness occur near Mts King William I, Pitt and Gell. In the Surprise River 30 feet of till has been cut through in places. Towards the east the deposit gradually becomes thinner.

Only two types of moraine have been distinguished on the map; terminal moraine which may be arcuate or straight across the direction of ice movement and lateral which may be fairly straight, e.g., southern end of Mt Olympus; or sinuous as on Mts Rufus and King William I.

Glacial deposits can be recognized from 1200 feet above sea level to over 4000 feet and are found wherever there is a flat area as is commonly the case where Triassic and Permian rocks form benches. Only on very steep slopes, exposed areas and in streams

can outcrop of older rocks be expected. An effect of glacial deposits has been to give temporary mature tracts to some of the rivers such as the Derwent above Lake King William.

The age of these deposits is Pleistocene, the evidence being from carbon dating of fossil wood found in varves at the head of Linda Valley (Gill, 1956) ($26,480 \pm 800$ years B.P.).

Igneous Rocks

CAMBRIAN ? DOLERITE

Two small outcrops of altered dolerite have been mapped between King William Saddle and the Franklin River. The larger outcrop has been cut through by the river and appears to be in the form of a dyke striking in a northerly direction. The second outcrop is a small roche moutonnée rising a few feet above ground moraine on Burns Plain. A very small occurrence was noted between the Lyell Highway and Surprise River at the highway's closest approach to the river.

The age of this intrusive rock is not known with certainty but as it intrudes Precambrian quartzite and schist, it is younger than these. The mineral assemblage is similar to the Cooee Dolerite (Spry, 1957) which Spry considered as Younger Precambrian to very early Proterozoic but so far no definite evidence for the upper limit of the age has been forthcoming.

A specimen of this dolerite was described by Everard as follows: "The specimen is a fine grained greyish green rock with dark green irregular inclusions up to about 3 or 4 mm long.

In thin section the rock is a structureless mass of interlacing needles of actinolite and granular albite sometimes showing twinning. Apatite is plentiful in small prisms showing cross fractures and opaque white leucoxene after ilmenite is fairly common.

The dark green inclusions consist of serpentine and chlorite with some remaining hornblende. They are probably the product of original phenocrysts of pyroxene. The rock is a hydrothermally altered gabbro or dolerite".

JURASSIC DOLERITE.

This rock is present in several intrusive forms but generally there is little variation in composition. It outcrops in most parts of the Quadrangle varying in size of outcrop from small residual cappings to vast sheets and it is intruded into many different horizons.

Simple sill-like intrusions cap Mts Ronald Cross, Rufus, Olympus, Hugel, Byron, Cuvier, Manfred, Ida and possibly Wentworth Hills. The original thicknesses are not known as erosion has reduced them considerably. On Mts Byron, Cuvier and Manfred 500 feet, 400 feet and 350 feet respectively of dolerite form caps over 500 feet, 600 feet and 750 feet respectively of Triassic sedimentary rocks, suggesting that these caps are residuals of the same sill which was transgressive and thinning to the west. The heights of the intrusion of dolerite into Triassic rocks on Mts Ida and Olympus suggest that these two peaks are residuals of one sill. North of Mt Ida at the edge of the plateau a feeder channel may be present as dolerite outcrops to creek level below the Triassic on Mt Ida and the Permian east of Narcissus River.

On Mt Hugel, dolerite is intruded at the top of the Ferntree Group, on Mt Ronald Cross near the top of the Woodbridge Group, on Mt Gell just above the basal conglomerate and on Mts Pitt and King William at about the middle of the Permian succession.

Mt Gell and the Cheyne Range are formed of dolerite from a feeder channel or source centred in the Franklin River valley near Lake Undine. The dolerite is faulted against Proterozoic and Mesozoic sedimentary rocks in the east and to the west of the fault large masses of Precambrian metasediments have been rafted on the dolerite.

The intrusion on the west side of Mt Gell is probably into Wallace River Group, south into the top of the basal conglomerate and northwards along the Cheyne Range it transgresses through Wallace River and Woodbridge Groups and is near the top of the Ferntree Group at the northern end of the range. Outcrops of the dolerite-sedimentary rock contacts are mostly covered by glacial and scree material making it difficult to prove that the intrusion is part of a cone sheet which it resembles in shape and characteristics.

The dolerite along the King William Range has been intruded up through the Precambrian and into the Permian. At Lake George dolerite extends down into the lake and the glacial debris is mostly Permian basal conglomerate indicating that this also is a feeder channel area. On the western side of this range no intrusive contacts were seen but from the outcrops mapped it is probable that the dolerite overlies Wallace River Group rocks.

Part of the Central Plateau falls in the Quadrangle and is considered to be a large thick sill of dolerite. It extends as a fairly flat surface dipping slightly to the SE from east of Lake St Clair. There is a scarp on the western edge from Mt Ida to the southern end of Lake St Clair, on Bedlam Walls and west of Lake King William which probably represents the western extreme of the dolerite of the Plateau.

On the eastern edge and between Derwent Bridge and Bronte there are several outcrops of sedimentary rocks which suggest that the Plateau sill was transgressive or split into several sills with sediments between. Also, the uneven landscape is possibly a result of erosion of other areas of sedimentary rocks.

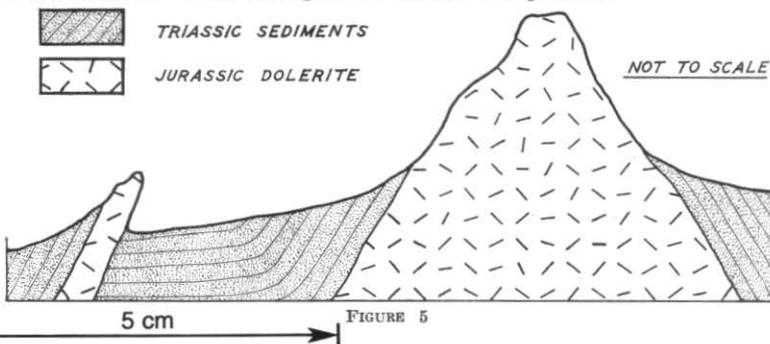
In the area north of Bronte outcrop is slightly better and the complex nature of this part of the dolerite is illustrated by the occurrence of several very thin sills and numerous dykes. The latter, which may join sills, have acted as feeders for sills or may be offshoots from sills.

The tops of dolerite intrusions have been seen in two areas: on the eastern side of Mt Gell and near Bronte Park. At Mt Gell the surface of the dolerite with the rafted Precambrian blocks is relatively even and smooth; at Bronte the dolerite for the most part is level but numerous dyke-like ridges and hills occur at the top of the intrusion.

East of the Pine and Nive Rivers there has been a major uplift in the dolerite level and this may be a continuation of the Great Pine Tier of the Du Cane Quadrangle. Just east of Pine Tier Lagoon coal measures considered to be high in the Triassic occur up to a height of 2,500 feet. Further east, the dolerite top is at about 2,900 feet and resting on this surface a short distance outside the Quadrangle are Triassic rocks. These are quartz sandstone and pebble conglomerate which occur as basal Triassic further west. The uplift in this area is then 400 feet plus the thickness of the Triassic System which is not known in this particular locality but it probably over 1,000 feet, giving a value of the order of 1,500 feet.

Thicknesses of sills vary from a few feet to over 1,200 feet in the plateau east of Lake St Clair. At Mt Gell the intrusion has an estimated thickness of 1,400 feet and a similar thickness exists on King William Range up from Lake George.

Dykes have been mapped from 10 feet to 200 yards wide. Where observable they become narrower upwards. A small transgressive sill in Serpentine Creek (Plate 4) has a thickness of from 2 to 3 feet and intrudes Triassic rocks. It has been described by Everard as follows: "In hand specimen the rock has a fine-grained greyish-green groundmass in which are occasional green phenocrysts about 1 mm across. Thin stringers of calcite are present.



"In thin section the rock is a fine felted mass of feldspar needles averaging 0.25 mm. Sphene is common in small crystals and clumps of grains. The groundmass is greenish and microcrystalline and may represent a devitrified glass. Phenocrysts of a ferromagnesian mineral completely altered to serpentine are present".

The field occurrence of this rock suggests that it is a dolerite but because it is an altered basic intrusive it may be a contaminated basalt dyke or sill.

Occasionally the sedimentary rocks intruded are dragged to such an extent that they are almost concordant with both walls of the dykes. The altitude of the beds is probably dependent on whether the dolerite followed an open fault or pushed up through the sediments. The various dyke-sediment relationships encountered in the Nive River about $\frac{1}{4}$ mile below Pine Tier Dam are represented diagrammatically in Figure 5.

TERTIARY BASALT.

Basalt is limited in distribution to the eastern part of the Quadrangle. In this area basalt outcrops from a height of 2,950 feet downwards filling pre-basalt depressions and capping some hills. Where large areas exist the landscape is very level and where several flows occur benches have been formed.

The basalt extends in a belt from the north near Gowan Brae southwards bordering the Nive River. The basalt is no longer continuous but has a width of five miles at Gowan Brae while outcrops occur for six miles west of Bronte near the Lyell Highway and for $5\frac{1}{2}$ miles west of Bradys Lake.

Thicknesses of 250-350 feet, measured vertically, have been exposed SW and east of Gowan Brae and in the vicinity of Bronte along the Nive River while a possible thickness of approximately 600 feet exists near the southern edge of the Quadrangle south of Wentworth Dam.

The age of the basalt has been determined from *Fagus* flora in underlying Tertiary sediments near Tarraleah (Prider, 1948, p. 144). These fossils are Late Miocene, hence overlying basalt is of Pliocene or later age.

Few intraflow sediments were noted, though some thin sand and clay layers occur irregularly. Differences in the characteristics of the basalt are not uncommon between flows. Near the confluence of the Nive and Little Rivers a lower flow, vesicular at the top, is overlain by a tachylitic basalt exhibiting ropy structure. Higher up in the flow the basalt is massive and shows columnar jointing. Basalt seen in this area is fine grained, generally vesicular, grey to black in colour and olivine and iddingsite crystals can be seen in the hand specimen.

Most of the outcrops appear to be flows but there is a possible vent plug at 822,000N, 432,000E. Here a hill of massive columnar jointed basalt rises over 100 feet above the surroundings and the nearby basalt flows. It is slightly coarser grained than other basalt in the vicinity but the exact relation of the outcrop to the adjacent rocks is obscured by glacial deposits.

In this northern area basalt appears to lie almost horizontally on hills except where it has filled pre-basalt valleys. In several places the displaced rivers have cut across the direction of the old valleys. Between the Little River and Pine River the basalt thickens eastwards and this pattern is repeated west of the Nive River at Bronte and further south. This feature can be explained as being due to the regional tilt of the surface and Tertiary faulting with upthrown blocks to the east. This resulted in wedge shaped depressions which when filled with basalt have a maximum thickness at the eastern edge and thin out to the west.

Structure

The structural configuration of the country is broadly a dissected western lowland of Precambrian to Silurian sedimentary rocks rising sharply eastwards to a level at about 2,200 feet. This is the pre-Permian surface and has a regional east to SE tilt and upon it were deposited Permian and post-Permian sediments.

Precambrian rocks in the western region have a predominant NW strike with minor flexures towards the west. Structural features observed in road cuttings, rivers and other outcrops show that rocks have been subjected to severe stresses and folding. The trend of the folding as indicated by strike, minor fold axes, boudins, mullions, plications and other structural linears, is in a WNW direction.

Asymmetric minor folds indicate a major anticline to the NE and a syncline to the SW. The Ordovician and Silurian sedimentary rocks occupy part of the NE limb of a syncline the axis of which strikes in a similar direction to the Precambrian structures. Faults of considerable magnitude have downthrown these rocks so that they now outcrop about two miles NE of the main syncline.

The influence of the Tyennan Geanticline in controlling the direction of the Tabberabberan folding (Solomon, 1962, p. 336) is thus illustrated in this area.

East of King William Saddle the main structural features are faults of varying magnitude, the largest of which have a north to NW trend. Minor faults do not appear to favour a particular direction but are usually associated with the larger movements. Faulting contemporaneous with the Jurassic dolerite intrusions (chilled dolerite and baked sediments) have been recognized on Mt King William and in the Franklin River Valley in the headwaters region from west of Lake Dixon northwards. A vertical contact on Mt Gell is also Jurassic in age.

Tertiary faults are more common and considerable displacements have been caused by them. The fault observed at the western side of Lake King William is probably the same one as runs along the west side of Bedlam Walls and probably continues under Lake St Clair until cut off south of Mt Ida. Evidence supporting this contention is that dolerite outcrops exclusively on the eastern side of the fault in the area restricted to this structure. This fault is suggested as a control in the formation of Lake St Clair (Figure 2) and has the upthrow to the west. Again the Franklin River Fault has the upthrown block to the west giving a pattern of stepped block faulting.

A large displacement is suspected north of Bronte Park in the possible extension of the Great Pine Tier uplift. The displacement with upthrow to the east is of the order of 1,500 feet and this movement results in a downthrown block between Lake St Clair and Bronte Park.

A fault east of Lake King William and another fault west of the Lake form a small graben. The downthrown block is dolerite with Permian west of it and Triassic east of it. The Derwent River

flowed down this depression until dammed to form Lake King William. Smaller faults occur in the NW of the Quadrangle, north of Mt Rufus. Displacements on these range from 50 to 400 feet.

In the bank of the Nive River at 815000N 444900E a small fault has a considerable effect on Triassic rocks on either side of it. Up against the fault Triassic shale is dragged to a vertical attitude and a few feet further away shale and sandstone are folded into at least two anticlines and synclines with about 2 feet 6 inches amplitude and 15 feet wavelength (Plate 5). On the other side of the fault more competent feldspathic sandstone dips at 30°.

Economic Geology

Small quantities of coal, dolomitic limestone, chalcopyrite and monazite are found in the area but there has been no production of any mineral. Dumaresq (1863) reported on an expedition to look for gold at Mt Arrowsmith but nothing was found. Selected samples from the area were assayed, the best sample showing only "the faintest trace". Of the minerals occurring none have been found in sufficient quantity to encourage more than surface prospecting.

During a period when the level of water in Lake St Clair was very low a sample of Recent sand was collected in Cynthia Bay. Examination of this showed that the sand consists of well sorted angular grains averaging 0.5 mm of pink garnet and yellow monazite in about equal amounts with lesser amounts of quartz and opaque minerals. No further samples could be collected to confirm the presence of monazite by analysis and radioactivity as the lake level rose between visits.

Coal occurs as thin beds and lenses in the Cygnet Coal Measures. The coal is high in sulphur content present as pyrite and is too thin to be of economic value.

Copper sulphide and hematite have been found in small quantities in quartz veins in the Franklin River near the Cambrian? dolerite intrusion. Traces have been found between Tiger Creek and the dolerite but no concentrations of possible economic value were observed.

In the valleys of the Surprise and Franklin Rivers and Carbonate Creek and up a spur of Mt Ronald Cross an extensive deposit of carbonate rock has been mapped. This is a mixture of limestone, dolomitic limestone and dolomite most of which could have agricultural uses but at present there is no demand. Two samples from the Lyell Highway were partly analysed with the following results:

	Silica %	Lime (CaO) %	Magnesium oxide (MgO) %
No. 1 44-ft. sample	4.64	29.34	19.96
No. 2 35-ft. sample	3.60	29.74	20.87

Economically important to the area are the water resources which are conserved in natural and artificial lakes. A total of 637 square mile feet of water is at present available from the major lakes for producing electricity and a lesser but substantial quantity from the various dammed lagoons.

Materials of construction for roads have been obtained by quarrying and stripping scree and fluvio-glacial deposits. Crushed dolerite aggregate has been used in the concrete for such structures as dams and flumes and was quarried and crushed close to the damsite as the dams are sited across gorges cut in this rock. Clay and rock fill dams have been built with clay cores and either fresh dolerite or basalt all of which have been produced in close proximity to the structures.

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ST CLAIR QUADRANGLE



PLATE 1. Dolomitic breccia in Franklin River

5 cm

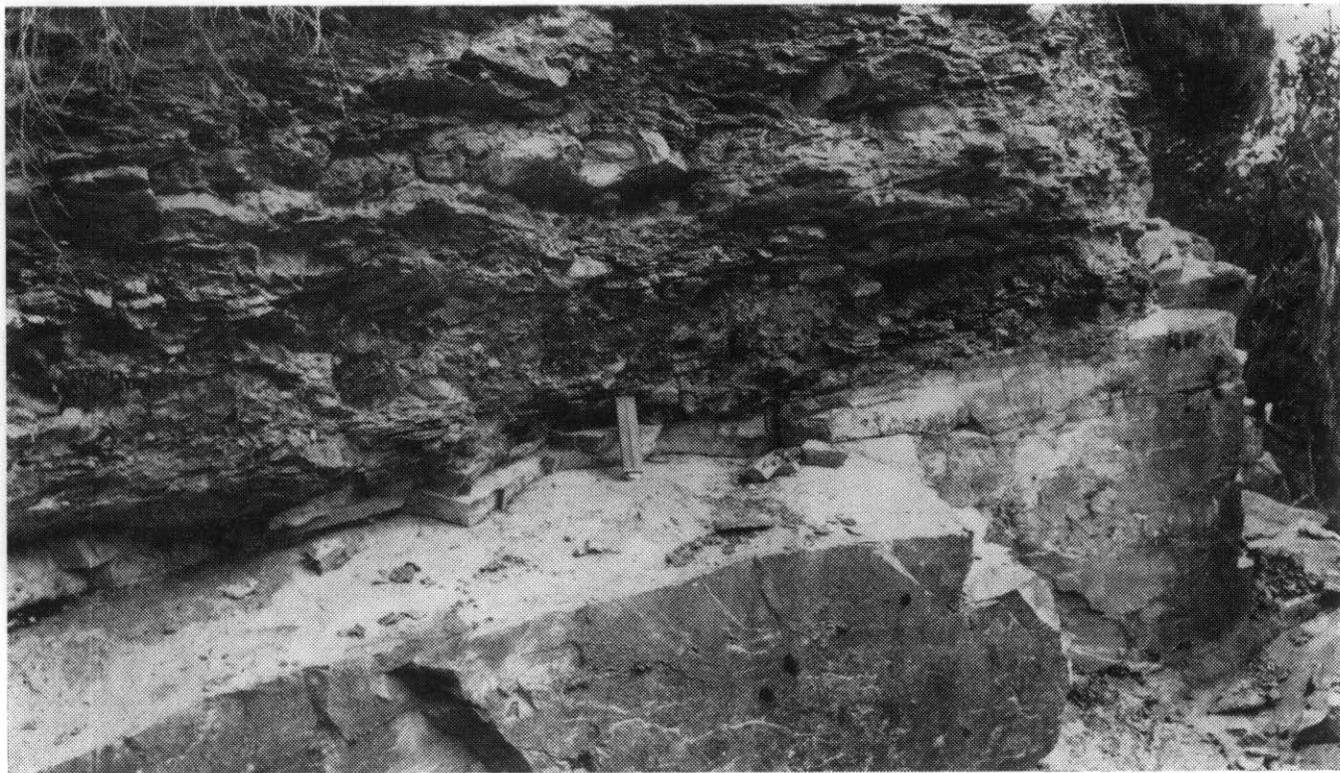


PLATE 2. Permian basal conglomerate unconformable on Precambrian rocks

5 cm

ST CLAIR QUADRANGLE

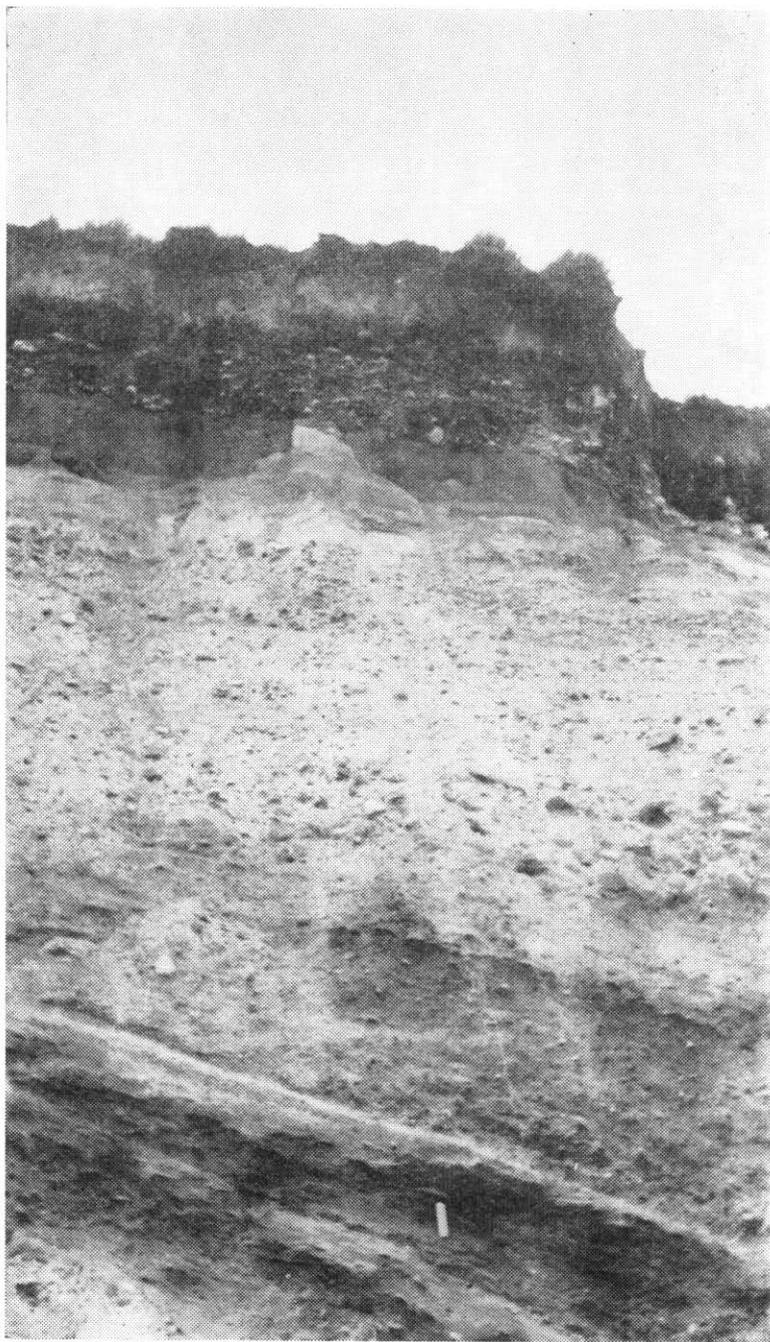


PLATE 3. Fluvio-glacial sediments in Franklin River

5 cm



PLATE 4. Thin sill transgressive into Triassic rocks—Serpentine Creek

5 cm



PLATE 5. Compressional folding in Triassic rocks—Nive River

5 cm