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THE GEOLOGY OF THE DOVER DISTRICT

By

G. E. A. HALE

Mineralogist, Tasmanian Museum

WITH 3 MAPS

ABSTRACT

An area of 80 square miles around Dover consists mainly of Jurassic dolerite in the form of sills and dykes. The faulting accompanying the intrusion has cut the area into a series of fault blocks all of which occupy a graben. Some Tertiary faults cut through this graben but they are not very well marked except in the west where they dominate the structure.

The Permian and Triassic rocks are part of an orthoquartzite-limestone suite derived from a low terrain. The Permian rocks show some change of facies and resemble the Marlborough sequence. The Woodbridge Glacial Formation is extremely thin. The Triassic Knocklofty and " Felspathic " formations are of the usual types.

Syenite-porphyry dykes together with gravels, sands, and clays are the only rocks seen that are younger in age than the Jurassic dolerite. All the clays tested were kaolinites with minor impurities.

INTRODUCTION

The area mapped is situated on the western shores of the Huon River and D'Entrecasteaux Channel between White Bluff in the north and Tower Bay in the south. The northern portion extends westward to the Huon Highway but, to the west of Port Esperance, the boundary lies along the foothills of Adamson's Peak. The total area mapped is about 80 square miles.

The geology of the area was done by tracing the outcrops on the ground and locating these on aerial photographs. A base map was constructed from the aerial photos by the slotted template method. The details of tracks and roads were obtained for the most part from the Forestry Commission's Adamson maps, sheets 4, 8, and 12.

Altitudes were taken by aneroid barometer but, as no base readings could be taken to check against, these can only be considered as indicating the order of difference in height of the various localities. In other places, heights have been taken from the form lines of Sheet No. 6 of the Lands and Survey Department's 4 miles to the inch map of Tasmania.

DISCUSSION AND CONCLUSIONS

The districts around Police Point, Dover, and Strathblane were mapped geologically and rocks belonging to the Permian, Triassic, and Jurassic Systems with minor patches of Tertiary and Quaternary age were found to outcrop.

The area occupies a downthrown fault block which is deeply dissected by the Esperance River system and partly submerged. The Jurassic dolerite—the most abundant rock type present—dominates the physiography, capping the highest hills and ridges. The relief is fairly low.

Faulting is seldom pronounced here but close jointing is apparent everywhere. The faulting that accompanied the intrusion of dolerite has cut the country into a patchwork of Permian and Triassic sediments, the latter of which occupy the larger area. Later faulting is revealed in aerial photos as marked lineaments across the dolerite but the faults in the main part of this area show small displacements. In the west of the area, this Tertiary faulting assumes a major role. Here faults of perhaps 500 feet throw have elevated the Triassic sediments to over 4000 feet.

The coarse sandstones interbedded with creamy argillites carrying a predominantly bryozoan fauna of Permian age are considered to resemble the Marlborough Group. This is succeeded by coarse tillitic conglomerate considered to be a thin glacial facies of the Woodbridge Mudstone. Above these a normal to perhaps slightly sandy Ferntree Mudstone is found. One exposure of the Ferntree Mudstone contained a coarse conglomerate bed about four feet thick. The Cygnet Coal Measures appear to have been completely eroded in this area.

The Triassic Basal Grits succeed the Permian beds over a slight disconformity which is indicated by a basal conglomerate in some places, by the undulatory nature of the contact, by the change from mudstones to sandstones, and, more positively, by the inclusion of pebbles of the underlying mudstone in the conglomerate bands. This ' grit ' is rich in red and pink garnet.

The Knocklofty Sandstone and Shales show interdigitating beds of sandstone and shale, saliferous beds, and many sedimentary structures including numerous slump structures. The colour is very variable. This formation may be in the vicinity of 600′ thick.

It is succeeded by beds of the ' Felspathic ' Sandstone which is everywhere overlain by dolerite so that no complete section of this has been seen. This formation carries the coal seams explored on the Strathblane coal field.

The syenite-porphyry at Brook's Bay and the extreme north of the area occurs in dyke form and is probably of Tertiary age. Clays and gravels seen at various places may be of Tertiary or Quaternary age.

At present the rejuvenated streams are eroding towards base-level. The sea-level, although high enough to drown the mouths of the rivers, has not yet reached its former height.

The Permian and Triassic sediments were probably deposited as part of an ortho-quartzite-limestone suite. The mineral content suggests that the terrain was low and composed of metamorphic, acid plutonic, and less abundant basic rocks.

An examination of some clay material shows that it is mainly kaolinite with much quartz and a little illite always present.

PHYSIOGRAPHY

When viewed from Adamson's Peak, it can be clearly seen that the area under consideration belongs to an extensive physiographic unit distinctly different from the more westerly hills. This unit extends along the coast from Mt. Leillateah in the south to the Kermandie Divide in the north and is bounded in the west by the ranges linking the Hartz mountains, Esperance Peak, Adamson's Peak, Mt. Alexandra, La Perouse, and Mt. Leillateah.

The elevation of this country is fairly low, rarely reaching a greater altitude than 1600 feet. Large portions of it reach an elevation of about 600 feet. The relief is subdued by the deep weathering and is not very noticeable because of the smoothing effect of the heavy vegetation.

Without exception the highest hills are dolerite-capped and, in the case of the highest elevations, namely Mt. Esperance and its north-westerly extensions, the mountain south of Port Esperance, Green Hill, and Burns Hill, the dolerite is continuous down to the sea-level. The tops of these hills are usually reached over very steep, scree-covered slopes but in some places (e.g., Burn's Hill to the west) cliffs of about 200 feet in height have been formed. "Ploughed fields" are uncommon because of the low elevation and the rapidity of the weathering in this area. Westward of Green Hill, Triassic sediments stand at 1200 feet.

In general this fits the Midland Type of terrain described by Lewis (1944) in that it has hilly relief and is a mosaic of faulted blocks of Permian and Triassic sediments intruded by dolerite and, after peneplanation and uplift, these blocks have been dissected to form a number of comparatively low ridges. The order of elevation, namely about 2000 feet, also fits Lewis's criteria. However it differs somewhat in that no hills composed entirely of sediment reach the same altitude as the highest dolerite hills.

This whole unit appears to be part of a fault trough bordering D'Entrecasteaux Channel. There is no evidence that this area has been uplifted as a whole since the injection of the dolerite. However it is possible that the seaward (i.e., higher) portion of the area may be due to a more recent uplift. The westerly portion has been formed by differential erosion. Within this larger province, several distinct physiographic provinces can be recognised.

Huon River—Glendevie Area

Lying between the Huon River and a backbone of dolerite which is practically parallel to the shore in this area, is a plateau at a height of between 500 feet and 600 feet occupying a dip slope on the Knocklofty beds. It extends from behind Surges Bay to Desolation Bay. In this area the shoreline consists of a narrow shore-platform showing in many places a wave-cut notch in a cliff of about 50 feet. This cliff extends, except for a few narrow breaks where small streams join the river, from Surge's Bay to Police Point. The distance from the marine cliff to a prominent cliff-forming bed in the Knocklofty Sandstones varies from about 1½ miles at White Bluff to about 440 yards at Desolation Bay. These inland cliffs vary from 10 to perhaps 100 feet in height.

The surface of the plateau dips gently to the south-west and is composed of well-drained ridges of resistant sandstone covered with thick vegetation separating button-grass plains in shale. Towards the dolerite the ground rises in very steep slopes with evidence of landslides occurring where the easily-eroded felspathic sandstones and shales have failed under the load of dolerite.

The creeks in this area have cut deep steep-sided gullies in the escarpment down which they flow in a series of cascades. The creek that falls over the cliffs above the Glendevie-Brook's Bay Rd, unlike most

of the drainage which originates in the dolerite, rises near the escarpment and flows westwards across the button grass plain until it is turned by a sandstone bed along which it flows in a northerly direction to the main north-easterly-trending valley. The head-waters of this creek may eventually be captured by the more vigorous streams flowing to Desolation Bay.

All these creeks are youthful mountain torrents deeply embedded in the soft weathered surfaces of the Triassic sediments so that they often appear as trenches about 2-3 feet wide and 5-6 feet deep.

The next unit is the dolerite ridge stretching in a north-westerly direction from Huon Pt. to Glendevie. This ridge is sharply rounded in a cross section and has few distinct breaks along its length. The altitude of the ridge does not vary much but it is highest in the direction of Glendevie.

A strong lineament in the same direction separates this main ridge from a south-westerly extension of the dolerite which widens considerably towards Pt. Esperance. Another lineament in a somewhat similar direction cuts off the extension that forms the steep hills north-east of the township of Dover. All this area is characterised by steep but not precipitous slopes in the dolerite.

The drainage is not well developed in this area. It tends to be dendritic in the patches of sediments but follows rectangular joint patterns in the dolerite. Swampy areas covered with thick vegetation are connected by straight creeks flowing in relatively shallow beds on the bare dolerite.

The beach along this part of the Huon River except at Surveyor's Bay extends to the marine cliff. In the sediment west from Surveyor's Bay, the shore follows strong joints and a rather wider shore-platform than usual has been formed.

Where the wave action has cut along the strike of sediments, sandy beaches such as that at Surveyor's Bay have been developed. Where dolerite occurs along the shoreline and where there is sufficient protection, shingle beaches are formed but elsewhere the dolerite shores are steep-to and surmounted by cliffs up to 100 feet high. Where prominent joints at right angles to the beach occur, gulches with vertical or nearly vertical sides have been cut out by wave action. All the prominent points in this portion of the river are in dolerite.

Red Cliff Area

The shoreline from Roaring Beach to Esperance Point reflects the increased exposure of the sediments to wave action. The height of the land behind Esperance Point is due to the resistant dolerite which is protecting the sandstones behind it. The only sandy beaches exist at two places where dolerite sills at and below sea level are affording protection.

The sediments have been rapidly undercut and eroded so that a very narrow wave-cut platform exists along this coast. In most places this platform is covered with fallen blocks of sandstone from the marine cliffs which reach a maximum height of 300 feet. Very extensive landslides have been produced by undercutting and this method of coast formation has eliminated the possibility of offshore reefs and stacks which

occur at one point only, namely at Adamson Run 4 No. 25170 at a distance of 1·6″ bearing 79 degrees from the centre point. Prominent joints have been carved out more deeply than the rest of the sandstone but do not provide the same contrast as exhibited in the dolerite.

The detritus from this erosion has been collected on Roaring Beach where extensive source-bordering sand dunes have been formed. These dunes have formed a dune-barred lagoon where a small creek reaches the sea near the westward end of the beach. They have deflected the stream to the west so that it now flows along the foot of a steep dolerite scarp. The dunes reach a height of about 10 feet and are now well anchored by vegetation. These dunes border a flat area which stands about 10 feet above present sea-level and extends back to the dolerite hills. This low area appears to be in dolerite and may represent an old shore platform.

A feature often seen along this part of the shoreline is an old bench at about 40 feet above present sea-level which, in many places, carries sea-shells of similar species to those living in the same areas today. This bench is most noticeable just below the farm-house at Blubber Head (Adamson Run 5 No. 25278, distance 2·7″ bearing 87 degrees.) While it is possible that the shells could represent old kitchen middens, it seems more likely that this represents an old shore-line.

Port Esperance Area

Port Esperance shows the following characteristics of a submergent type of coastline. It is highly indented, contains numerous islands surrounded by reefs, many partially or completely submerged rocks, an uneven bottom while small deltas and mudbanks are forming at the mouths of some of the creeks. The harbour has been enlarged in a north-westerly direction, i.e., in the path of the most vigorous wave action and also away from the dolerite of the southern shorelines. The shape of the harbour has been controlled by the dolerite outcrops particularly by the dolerite of Pt. Esperance.

Hope Island, Rabbit Island, and the little islands inside the mouth of the Esperance River consist of dolerite. They show typical shingle beaches, rounded sparsely vegetated surfaces, and rapidly deepening shores. Faith Island, Charity Island, and the larger part of the small island at Adamson Run 5 No. 25273 distance 2·5″ bearing 179 degrees are composed of Permian rocks, the two former in the Ferntree beds, and the latter in the Woodbridge Tillite. They have rocky shelves, ledges, projecting reefs, and small marine cliffs. Faith Island is the most exposed of these. It shows the typical dense vegetation with a few eucalypts carried on a very thin clayey soil. The vegetation gives the impression that the island is higher than is actually the case. The rock and soil cover stands only 2-3 feet above high water mark and is very small in area. The combination of a high tide and rough sea will eventually convert this to another partially submerged shelf such as can be seen off-shore at the east of the harbour. In the last decade the island has lost about half its area under these conditions.

Very active deposition is taking place inside the mouth of the Esperance River where extensive mud flats and islands have been deposited in sheltered localities. The islands between Raminea and the mouth of Chale Bay have all been built by deposition from the rivers.

Small sand dunes (10 feet high) have been built behind the sandy beaches along the northern shore. These have barred the creeks entering here and small lagoons have been formed. The general shape and character of this area is that of a partially submerged coastal plain.

In many places around the harbour there appears to be two benches. The first one at about 10-20 feet above present sea-level appears to be cut in another level which is represented by the general level of the rounded hills and ridges standing at from 80 to 100 feet above the present water level of the harbour and streams. To the east of the sports ground at Raminea, the surface at the higher level carries gravel.

On looking in a south-easterly direction up the Creekton Rivulet valley, an impression of the former maturity of this valley is gained. However, the rounded surfaces are those rising not from the present stream bed but from a level at about 40 feet above this. The slopes between this 40 foot level and the 100 foot level are fairly smooth and overlapping spurs have been eliminated to a large degree. Above the 100 foot level the slopes rise steeply to the dolerite hill tops.

The present streams show youthful features and are cut into the 40 foot level. Rapids, miniature overlapping spurs, and sheer walls up to 100 feet high demonstrate their youth. As yet no definite undercut banks and slip-off slopes have been developed but, above the present river level near Raminea, some well-developed examples of this phenomenon are to be seen.

Another indication of the youth of this rejuvenated tract is the close relationship between the local joint pattern and the course of the river from the dolerite to Pt. Esperance. There is in this area a complicated system of vertical joints, the main directions of which are approximately 84 degrees and 170 degrees with minor ones at 59 degrees, 125 degrees, and 144 degrees. The strike of the sediments bears 219 degrees. An examination of the map will show how closely the Esperance River follows the rectangular major joint pattern in this locality.

Meads Creek Area

The most rugged topography of the whole area is to be found in the dolerite hills south of Pt. Esperance. These hills which are arranged in long ridges running approximately north to south reach a maximum height of 1635 feet and are higher than any other land in the area being dealt with.

The hills rise sharply from the coastline and are drained by intermittent consequent streams which follow the rectilinear jointing of the area. Two deep valleys, separated by a relatively low saddle, occupy a lineament running southward from Meads Creek and divides the area into two distinct parts, the higher of which is to the south-west of the lineation. Another lineament running north-west from Tower Bay is occupied by the largest stream of the area. This stream flows south-east. Beyond the high ground but in the same lineament, a deep valley has been cut down which flows a tributary of the Creekton Rivulet.

The creeks of this area have steep youthful valleys and are choked with dolerite boulders. The ground surface is strewn with boulders but bare rock often appears. Dense vegetation covers the valleys and the scattered swampy flats but the hillsides usually carry scattered eucalypts and sedges on a thin, stony soil.

The coast from Pt. Scott to Tower Bay is in dolerite and except towards the southern portion where rectangular inlets have been formed it is relatively straight. The straightness of this coast and its jointed nature apparent at Pt. Scott suggest that this is a faulted coastline. The marine cliff stands at between 100-200 feet above the shore which is steep-to. No reefs or islands appear. There is a narrow shingle beach at Adamson Run 6 No. 25281 distance 1·4″ bearing 257½ degrees but the rest of the coastline is in massive dolerite. It is possible that, exposed as it is to the full force of the wave action, this is a mature submerged coast, a type of coast almost indistinguishable from a faulted coastline.

Raminea Area

The next province to be considered is that lying along the western portion of the area immediately below the foothills of Adamson's Peak. Here two button-grass plains in Triassic sandstone separated by a rounded dolerite ridge standing at an altitude of 1000 feet, show very similar features. The northern plain is called the Raminea Plain while that to the south is known as the Strathblane Plain and both occupy about 2000 acres of low-lying ground.

The Raminea Plain consists of a number of extensive flats of swampy nature presumably developed in shaley beds separating long ridges of quartz sandstone. The sluggish drainage finds its way through these ridges in an easterly direction to the Esperance River which flows along the eastern side of the Plain. The western edge of each plain is bordered by steep dolerite-capped hills separated by creeks showing steep V-shaped valleys in the dolerite but flowing in broad, mature valleys in the softer rocks below.

From the Esperance River's present bed, three main levels occur. In the south the first which is not very extensive stands at 12 feet and it is in this level that the river is at present degrading. The areas at this level stand on what would be slip-off slopes formed at an earlier stage of the present cycle of rejuvenation. However at many places a steep bank has been cut in this level and slip-off slopes are forming at the base of this bank. The cliffs on the undercut slope have been increased in height because the river appears to be following the same course as at the higher level. At the northern boundary of the area, there is a large area covered with alluvium across which tributaries draining swamp land meander before falling down rapids in sandstone to join the main stream.

Another more extensive area stands at about 35-40 feet above the present river level. In the southern part of the plain this level extends back along the tributary streams rising to about 150 feet above the stream at the extreme west of the area. Most of the plain is at this level and, in it, the creeks meander sinuously through the sand weathered from the underlying sandstone which is usually disintegrated to a depth of from 4 to 8 feet.

This 40 feet level has been formed by the dissection of a higher level standing at about 80-90 feet above the river. Looking over the plain this appears to be quite extensive but actually it is composed of isolated hills separated by the main drainage and really occupies only a small area. The tops of these hills are in sandstone or, commonly, in a granule conglomerate. Towards the dolerite, the land rises in steps formed by rises

in shale surmounted by treads in the sandstone beds. Above this, the concave slopes in dolerite rise steeply.

The Esperance River in this area tends to follow the major jointing but, in some places, it has cut along the strike of a soft bed in the Triassic. The river either forms rapids over the beds of hard sandstone or turns against them to cut its bed along the strike of the soft shaley beds. This type of control is also seen in the lower parts of Wobbly and Big Creeks.

From just below the junctions of these creeks and the river, the course is parallel to a cliff in sandstone that rises abruptly either from the river or from the old slip-off slope that occurs to the east of the river bed. This cliff, probably a fault scarp, stands between 120 and 150 feet above the river which is increasing its height at the point just above the main bridge of the tram-line by actively undercutting it.

The contact of the sandstone and dolerite has been cut so that the outcrop is V-shaped down-stream following the dip of the sediments and indicating that the dolerite here is a sill over the sandstone.

Any evidence that this plain was formed as a slip-off slope for the Esperance River which, in this case, would have migrated eastwards to its present position, is missing. The only level on which this could have taken place is the upper one and this is not continuous enough to draw any such conclusion. The valley of the river appears to be mature in cross-section above this point but, as elsewhere in this district, rejuvenation has resulted in a valley-in-valley structure.

Strathblane Area

The Strathblane Plain, although similar in many respects to the above, shows many differences. This is due to the fact that the Creekton Rivulet has not the eroding power of the Esperance River. In some areas (Run 8, 2974 and 2·1″ bearing 126°) it has formed small levees showing that the steam—barred by the dolerite towards Raminea—has reached a local base-level.

The main stream and its tributaries meander sluggishly across the broad swampy plain which is not as well drained as the Raminea Plain. The ridges that traverse the plain are not so high here, standing at the most, only about 10-20 feet above the streams. They are completely weathered to sand in most places but, in a few of the deeper cuttings near the Hastings Road, sandstone has been revealed.

At the north-eastern end of the plain, river gravels have been deposited. Odd pieces of rounded rock fragments have been found quite high on the hills on either side of this creek to the south-west but very little has been seen across the plain itself suggesting that it has been eroded away. The heavy alluvium such as at the north end of the Raminea Plain is missing.

A feature common at both plains is the evidence of heavy flooding. Old tram sleepers, bridges, and bearers have been swept through dense scrub while sand drifts of considerable size are common above ordinary stream levels.

The low divide between this drainage and that flowing toward the south is being rapidly cut northwards. The capture of the Creekton Rivulet is certain and could easily be done artificially now.

From the above it can be seen that the main drainage system and the only considerable one of the area is the Esperance River and its tributaries. The Esperance itself rises in the Hartz Mountains and flows along a remarkably straight south-easterly-tending valley until it is joined in the Raminea Plain by its two main tributaries, Wobbly and Big Creeks. Here it turns southward and finally eastwards through a dolerite-walled gorge into its estuary at Raminea. The Creekton Rivulet joins it from the south-west at Chale Bay which is the drowned mouth of this rivulet.

General Notes on the Physiography

The history of the development of this topography presents many problems such as the age of the various features, the relative merits of uplift against eustatic fall of sea-level in causing the latest rejuvenation, and the fact that the entrance to the Huon River, Pt. Esperance, and Southport are all cut in dolerite.

As there have been no fossils found in the area that are younger than the plants of the Trias-Jura coal measures, the time scale must be based on the Jurassic dolerite that overlies these beds. Therefore the development of the present topography could have dated from the cessation of the dolerite intrusion.

However in view of the evidence from other parts of Tasmania, it is considered that this area forms part of the uplift that occurred during the Tertiary faulting. The higher coastal area is succeeded westward by the lower block containing the two plains. The next dolerite west from there stands at 4000 feet on Adamson's Peak indicating that these uplifts were post-dolerite. If we accept this time scale, the formation of the features must have commenced early in the Tertiary.

The 100 ft. level of the Raminea Plain and elsewhere probably reflects the differential erosion (over the period from the uplift until now) of sediments as compared with the dolerite which everywhere rises from this level. Or it may be due to continued erosion at a higher sea-level than now. A point against the first conception is the occurrence of the river gravels and transported material at about this level in many localities. These river gravels contain boulders of the material now at the surface on the 100 ft. level upstream. Therefore it would seem that river level was at this height for some time whilst the erosion was taking place.

The 40 ft. level indicates that sea-level remained steady at this height above sea-level for sufficient time to allow the streams to achieve a fair degree of maturity. The heavy deposition of alluvium, probably tillitic, in the Esperance valley suggests that this level antedates the last onset of glaciation in Tasmania. The level standing at about 10-15′ indicates another former sea-level.

This glaciation would cause the rejuvenation of the area by the consequent lowerings of sea-level. The old river course as indicated by soundings was excavated to a depth of 120′ below present sea-level and ran along the dolerite shore south of Hope Island.

A point of interest is that although the area is a submerged one, the streams are still degrading. This shows that the sea-level, now rising, has not yet reached the level at which the mature valleys were formed.

It is likely that these changes of sea-level are intimately connected with the Pleistocene glaciation of Tasmania and have therefore occurred after any faulting accompanied by up-lift.

Another point worthy of notice is that the mouths of the Huon River, Esperance River, Pt. Esperance, and Southport have been cut through quite massive dolerite, although in each case an easier alternative route through sediment could have been taken. This suggests that the drowned streams originated in the rocks covering the dolerite. In the process of cutting out their valleys, the streams tended towards the lower sides of fault blocks and in this position were superposed on the underlying dolerite. It is possible that the dolerite was thin in these localities or that the streams attacked along big joint planes or faults.

In general this rejuvenated landscape shows certainly two, and perhaps three cycles in its development.

Chemical weathering processes have been extremely active in this area so that a deep weathered zone, often as much as 20′ and usually about 10′, covers most of the beds. This leads to a general lack of outcrops over the area. This is particularly true of the areas under thick vegetation where often even fragments of rocks cannot be found.

Creek beds, usually useful for providing outcrops, are covered with mixed alluvium from outside the area or choked with sand and mud to such an extent that no outcrops can be seen.

Felspathic sandstone which has been proved to exist by mining operation, does not appear on the surface at any locality. No shales appear except as landslide detritus along the coast and, over large areas, the sandstones have disintegrated to sand to a considerable depth.

The limited Permian rocks are more resistant and outcrops of them can usually be found unless covered with stream deposits. The dolerite also outcrops either as abundant boulders or often in scarps.

However, good but narrow exposures of the rocks are to be found right along the coast, along the shores of Port Esperance, and along the Esperance River. The roads and the very numerous old tramlines with their many deep cuttings also provide a great many exposures.

STRATIGRAPHY

The beds found in this area are restricted to part of the Permian beds, the Trias-Jura beds, the Jurassic dolerite, together with scattered remnants of Tertiary deposits and Recent deposits. Of these, the dolerite is by far the most abundant and occupies more than half of the total area. About 30 per cent of the area is in the Mesozoic beds; Permian rocks occupy less than 20 per cent of the whole area.

A feature common to all beds is the intense jointing present. It would be difficult in the dolerite, in most of the Permian sediments, and in the shales of the Triassic beds to mine a piece of rock a yard square without it breaking along a joint. The Woodbridge Tillite and the Mesozoic sandstones tend, perhaps because of their original compressibility, to occur in larger blocks but even here the jointing is most pronounced. The Ferntree beds often assume the rectangular to polygonal type jointing called tesselated paving. The blocks usually have sides less than a foot in length.

The observation of Banks (1952) concerning the marked abundance of sedimentary structures in the Triassic sediments compared with those in the Permian rocks is amply confirmed in this area. Generally, as he states, the Permian rocks are flaggy or massive with some shaley bedding and lamination. However the shaley beds are definitely very much less apparent here than in the Hobart district. As well as current bedding and rolling strata in the truncated Cygnet Coal Measures of this area, slump structures, current bedding, contemporaneous faulting, and local miniature disconformities can be seen in the Risdon Sandstones and Conglomerates.

Because of the jointing and the rather flat dips of the beds, measured sections could not be accurately determined.

PERMIAN SYSTEM

The Permian rocks in this area outcrop along the Huon River, around the northern shore of Pt. Esperance, in the Dover Rivulet valley, and along the lower reaches of the Esperance River. They appear again in the bed of the Esperance River just beyond the northern boundary of the area and have been reported by Mr. J. N. W. Elliston (personal communication) at Lady Bay. To the west they outcrop in a series of fault blocks along the flanks of Adamson's Peak.

The total thickness of Permian sediments visible in this area nowhere exceeds 1,000 ft. and may be actually considerably thinner. The lowest horizon visible is a silicified fossiliferous mudstone which has been intruded by a dolerite sill near the coal bins of Folkestone. This underlies rocks which are tentatively correlated with the Grange Mudstones (Adamson Run 5 Photocentre 25272 Distance 2″ Bearing 165°).

The topmost formation recognised is the top of the Ferntree Mudstones which may, however, in some places carry the truncated remnants of the Cygnet Coal Measures. The top of the Permian is often the locus of a dolerite intrusion—usually a sill transgressing into the Triassic rocks. Where there is no intrusion, a disconformity under the Basal Grits of the Triassic System is found.

By comparing observations made in this area with the Permian of the Hobart district, it would appear that there is a facies change indicating a shallower environment towards the S-W.

The lowest bed of the Permian in this area, as mentioned above, outcrops on the southern bank of Esperance River at Folkestone. It is a silicified mudstone containing abundant Fenestellidae and Spiriferacea (?). One piece of blue-grey rock composed almost entirely of bryozoans and resembling the Granton Limestone was found inland along the strike. However it was not *in situ* and no more could be found in the thick scrub and soil cover of this area.

Conformably over this is a bed of silicified felspathic quartz-conglomerate containing no fossils. Then follows a thin bed of siliceous siltstone which is also unfossiliferous. Over these beds is a highly fossiliferous mudstone now completely weathered to clay. It is white when dry but, on first digging it out, it has a green colour. The rock is composed mainly of bryozoan molds and has been correlated with the Grange Mudstones.

The next beds to be seen have been weathered to clay but this fine matrix carries nodules and bands of pebbles and cobbles. The larger particles occur with the haphazard distribution typical of a tillite. This weathered material grades up into a massive, medium to coarse grained quartz sandstone. The sandstone contains many tubular plant stems. These appear as carbonaceous films filled with sandstone but show no structure. Another feature of this sandstone is the many iron stained nodules that stand out on the weathered surfaces. Erratics of quartzite, schist, and slate pebbles up to 1″ in diameter are common.

On the western shore of Chale Bay down which no faulting of any magnitude could be detected, a bed of very coarse quartz sandstone or granule conglomerate outcrops in a cliff. This bed from its stratigraphic position corresponds to the Risdon Sandstone but shows unusual features. Truncated current bedding and contemporaneous faulting occur in some beds. The following section has been observed about half a chain from the point at the head of the Bay.

Adamson Run 5 Photocentre 25272 distant 1·1″ Bearing 219°

6″ thin sandy grey soil.

5 ft. white conglomerate containing angular quartz and felspar. Coarser bands (current bedded) lie at oblique angles to the finer bands.

6″ fine shaly material weathering to a brown dust.

1 ft. coarse sandstone with iron stained nodules.

2″ finer sandstone grading from coarser at the bottom to finer at the top.

2′ 6″ light brown sandstone with iron stains and coarse current bedding.

1′ 6″ fine carbonaceous sandstone and shale containing mica and indistinct plant remains on the bedding planes. The top 2″ of this bed becomes pebbly.

2′ 6″ brown conglomerate containing quartz and felspar pebbles up to ¼″ diameter. It is current bedded and is jointed independently to the overlying beds.

6″ The downward extension of this bed is below water level. It is a conglomerate containing sub-angular quartz up to ½″ diameter with some felspar of ¼″ diameter.

The dip of these beds (2 deg. to 285 deg. (mag.)) is the same as that of the Eastern shore of Chale Bay.

The section outlined is conformably overlain by a fine quartz sandstone with subordinate felspar and occasional erratics of granite and quartzite up to 1 ft. in diameter. This occurs in massive unfossiliferous beds and is thought to belong to the Ferntree Mudstone Formation. As heavy jointing occurs throughout the area, the jointing near this contact is not thought to constitute a fault upthrowing the Woodbridge Formation beds, which, in the Hobart area except for the lack of fossils, resemble this bed. Moreover these unfossiliferous beds continue westward to the contact with the dolerite beyond Raminea. Here the topmost beds are identical in lithology with the Ferntree Mudstone of other areas.

The maximum dip recorded in this area was 6 deg. in a direction 29 deg. (mag.) so that the total thickness between the dolerite intrusions would be at a minimum 350 ft. and at a maximum 800 ft. (taking dips as 2 deg. and 6 deg. respectively). Of this thickness about 7/10ths is in Ferntree Mudstones leaving at the most about 250 ft. for Woodbridge, Grange, and part of the Granton Beds.

The above section is not an entirely satisfactory one for this purpose because large parts of the succession have been obliterated by weathering while the waters of Chale Bay and the Esperance River cut across it.

A much more complete section which however is not so thick stratigraphically is found on the opposite bank of Esperance River. This section may be laterally contiguous with the last one, or there may be some small break parallel to the course of the river here.

The beds dip at 5 deg. in a direction of 304 deg. (true) and the top of the Permian beds pass up into the Triassic Sandstones but the exact relation of the two systems cannot be determined along this boundary. Beneath, the beds are intruded by dolerite with some baking. This contact is at 2·5″ bearing 146 deg. from photocentre 25272 Adamson Run 5.

The bottom 90 ft. is composed of a coarse quartz sandstone varying from light olive grey to dusky yellow in colour. Some white mica, felspar, and subordinate iron-stained clay cement compose about 20 per cent of the rock. The remainder is of angular quartz varying from 0·1 to 0·01 inches in diameter. Some fragments of slate were seen of about ·01 inches in diameter. Iron staining is common and the bedding is massive. The quartz is of the vitreous, milky, and blue varieties and suggests a metamorphic provenance. This coarse sandstone is interbedded and interdigitated with finer sandstones and siltstones as well as at least one band of a coarse tillitic conglomerate.

Although no striated pebbles were found, faceted boulders (up to 1 ft. in diameter) of grey and red granite, quartz, quartzite, and slate are scattered haphazardly throughout the beds, often causing indentation in the underlying bedding planes. These indicate a glacial origin.

A bed of conglomerate about 3 ft. thick occurs at 1·5″ bearing 146 deg. from photocentre 25272 Adamson Run 5. This is unfossiliferous and carries numerous boulders of the above-mentioned rock types in a coarse sandy matrix.

Above this bed, the rocks become gradually finer grained lenticular beds of fossiliferous mudstone of creamy white colour carrying abundant bryozoans as well as small molluscs and brachiopods. These beds gradually become coarser again and the felspar content increases.

All the above beds, with the exception of the conglomeratic bed, are richly fossiliferous. In the coarser beds, the fossils are large and include *Platyschisma, Stenopora, Aviculopecten,* various large Spiriferacea, *Mourlonia* (many), other brachiopods mainly spiny productids, Fenestellidae, and, in patches, abundant crinoid ossicles. In the finer layers, these fossils occurred but are smaller in size and are outnumbered by the Fenestellidae which give the rocks a laminated appearance. Nowhere was the original calcareous matter seen; all the fossils are molds. No ostracods were observed in this area.

Conformably over these beds which grade imperceptibly into it there is a light mottled tillite between 20 and 50 feet thick. The bed shows no internal bedding but is cut by webs of limonite, particularly near sea-level. The grain size varies from boulders 3 to 4 ft. in diameter down to clay. Some sorting is apparent for the boulders and pebbles are often found in clumps and stringers showing that water transport had been partly responsible for this deposit. No fossils have been found in these beds.

The coarse constituents are sub-angular to sub-rounded and all show faceting but no clear striations were seen. The larger particles included quartz, quartzite, schists, slate, grey and red granites, and pink quartz. Some fine sandstones occur throughout the deposit. The lack of bedding,

extreme variation of grain size, faceting of pebbles, the uneven distribution, and poor sorting are evidence that this bed was formed under glacial conditions.

These beds weather easily and deeply, especially the sandy patches, to yield a clay rich in very angular quartz particles. The clay may be largely derived from the felspar and mica content of the original rock. This bed has been correlated with the Woodbridge Glacial Formation.

Succeeding this is a 20 ft. bed of coarse sandstone and granule conglomerate composed of quartz and felspar, with subordinate tourmaline, mica, and dark minerals. When fresh, the rocks are brown but when leached are usually white, or, if iron stained, cream or reddish yellow in colour. They are easily weathered yielding a coarse white sand or, if in a water-logged locality, a yellow sandy clay. The felspar content is usually about 25 to 30 per cent and weathers to kaolin before being completely removed. After the clay is removed a porous friable white quartzose rock results.

There is no definite break in the grain size or type of sedimentation to be seen at the base of the beds. The grain size is similar to the underlying beds but the clayey material has been sorted out. The boulders, cobbles, and pebbles are quartz, usually milky but with some blue quartz pebbles. The finer material includes vitreous angular quartz and felspar fragments, slate, schists, and quartzite. The exposure of these beds is not as clear on the southern river bank but the lithology of the rocks is similar. From their stratigraphic position, they are correlated with the Risdon Sandstones.

The grain size declines gradually upwards into the medium to fine, white, red, or yellow sandstones of the Ferntree beds. In these, the fine matrix increases but quartz with some felspar is predominant. The basal beds carry sub-rounded, milky, and clear quartz pebbles up to $\frac{1}{4}''$ diameter in a finer matrix. The texture in these lower beds is similar to the underlying beds. Boulders of granite and quartzite up to 1 ft. diameter occur more frequently in this area than in the Hobart district. Higher in the sequence the typical blue-grey mottled mudstone carrying few erratics up to about 3″ diameter appears. The highest material seen in this locality was a fine sandstone similar to that just over the Risdon beds.

The thickness of the Ferntree here is about 400 ft. which is approximately the same as that in the sections along the Huon river. It will be realised from this that the Permian beds here do not match the Hobart area sequence but it is essentially the same as that described by Prider at Marlborough.

Thus the lowest beds at Folkestone would correspond to the Grange and possibly the top of his Granton facies of the Marlborough Series. The next beds cannot be distinguished here but, on the northern bank, the beds between the dolerite and the Ferntree mudstone are similar in every respect to his Bronte facies. His Woodbridge Formation is similar in that it is of glacial origin, contains the same type of erratic and, in particular, is unfossiliferous, but it is much thicker than at Dover. It is realised that the lower beds of these two sections may be part of the Woodbridge Glacial Formation in which the biofacies has changed as well as the lithofacies. The problem of whether this sequence is part of the Grange or part of the Woodbridge Formation cannot be solved in this area without drilling. In either case, it would be necessary to specify

some change of facies. In this paper, the tillitic horizon will be referred to as the Woodbridge Glacial Formation and the beds below that will be called the Grange Mudstone.

Although the Risdon Sandstone is persistent enough to warrant the rank of a formation, the normal usage of including it as a member in the Ferntree Mudstone will be followed. This name, Ferntree Mudstone, will be applied to all the Permian rocks lying above the Woodbridge Glacial Formation and below the Basal Grits. This is possible because here the Cygnet Coal Measures do not appear to have survived the erosion that followed the deposition of the Permian beds.

Grange Mudstone

The beds along the lower Esperance River are the coarse fossiliferous sandstones as described in the section above having similar variations of colour and grain-size, and carrying the same fossils.

The beds on the shores of Port Esperance are finer-grained, being orange-yellow mudstones sparsely fossiliferous. The fossils are mainly *Stenopora* with a few spirifers, gastropods and pelecypods. Erratics occur in both outcrops. Both types are highly jointed. The jointing becomes more intense and the dips more variable as the dolerite is approached. The baking effect of the dolerite extends for less than ten feet from the contact and in places for only two or three feet. The mudstones and sandstones weather to a white or cream clay.

The micro-and-macro characteristics of these beds indicate that they were formed under glacial conditions in water of medium depth. The detritus was shed from a provenance containing metamorphic and acid igneous rocks.

Woodbridge Glacial Formation

This name, as mentioned above, will be confined to the relatively thin bed of tillitic material lying conformably between Risdon Sandstones above and the Grange Mudstones below. As shown on the map it outcrops on the eastern shore of Chale Bay and across the land lying between the Esperance River and Hopetoun Beach. No other outcrops occur within the area but the formation was recognised at nearly 2,000 feet above sea level on the track to Adamson's Peak where it forms a low cliff.

The characteristics of beds given above show that the material was derived from the same provenance as the underlying beds but that the glaciation had become more intense.

As well as the coarse conglomeratic phase, there are large areas of sand grade material with subordinate erratics. Both types weather to a sandy clay of variable colour. The best exposure of these beds is found along the foreshore between the northern end of Hopetoun Beach at Adamson Run 5 Photocentre 25273 distance 1·2″ bearing 57°, and the slips at distance 1·9″ bearing 57° from the same centre.

Ferntree Mudstone

The basal member of this formation is to be seen overlying the Woodbridge throughout the Permian belt around the mouth of the Esperance River. It is well exposed on the western shores of Chale Bay

and at Adamson Run 5 Photocentre 25273 distance 1·9″ bearing 57°. At the latter locality its relation to the underlying Woodbridge can be clearly seen.

The Woodbridge tillitic beds grade with no perceptible change of grain-size of the sandy portions into the Risdon. But the character of the erratics change so that in comparison to the mixed rock types of the lower bed, the larger Risdon erratics are overwhelmingly quartz or quartzite; pebbles of slate and other fragments are of small grain size (i.e., 2-4 mm. in diameter or less). The sorting has been more thorough in these beds so that less clayey material occurs.

The beds here are between 20 and 30 feet thick and show the characteristics described in the two sections along the Esperance River. The band containing carbonaceous material seen at the Chale Bay also occurs near the slips (co-ordinates given above).

With declining grain-size and an increase in the clay grade material these beds grade into the overlying sandy mudstones or fine sandstones.

The Risdon does not outcrop again in the area but the higher Ferntree beds are well developed along the north of Port Esperance and along the western shore of the Huon River. Another isolated occurrence is at Folkestone and along the Dover Rivulet.

Folkestone

The Permian rocks in this area are divided by a dyke of dolerite. Those to the north-west have been dealt with already, but the rocks to the south-east of the dykes have not been so well exposed and their exact stratigraphic position fixed. The sediments are completely enclosed in dolerite and show some, but not widespread, baking along the boundaries. No fossils have been found in this area and the outcrops along the river bank are weathered to clay, thus obscuring the succession there.

At Adamson Run 5 Photocentre 25273 distance 2·9″ bearing 210° some very soft green-stained yellow clayey material contains pebbles of quartz, sandstone schist, and granite and may represent the weathered outcrop of the Woodbridge Glacial Formation. However the greater part of this locality is occupied by grey, and mottled grey and white fine sandstones or argillites containing some erratics most of which are less than 2″ in diameter.

A quarry at Adamson Run 5 Photocentre 25273 distance 4·4″ bearing 214½° is in a mottled grey-white to brown and yellow rock. The beds show a rhythmic alternation of sandstone and argillite bands, the thickest of which is about 2′ 6″. A few rounded quartzite pebbles of 2″ diameter were seen. The south-western side of this boundary has been hardened by the dolerite which intrudes these beds along a very irregular contact down to the mouth of the Creekton Rivulet. These beds are considered to belong to the Ferntree Mudstone Formation.

The Ferntree Mudstone of the rest of this Esperance River section, i.e., west of the dolerite shows the following characteristics. The lower beds are quartzose sandstones carrying many angular erratics up to 18″ in diameter (usually quartzite). These erratics tend to be found in clumps. The bed at the southern abutment of the Raminea bridge is typical of this phase. Some indefinite plant remains occur.

This coarse phase is succeeded by an argillite which is rhythmically bedded—the beds showing slight changes in grain-size but only few and thin layers become shaley. Large concretionary structures 3 to 4 feet in diameter are common in some beds. These beds are typically blue-grey and white, mottled rocks with very small erratic pebbles and no fossils. They are well exposed in quarries at Adamson Run 5 Photocentre 25270 distance 0·4″ bearing 180° and distance 3·25″ bearing 76½°. The beds above these are not very well exposed but they tend to be sandier towards the top of the succession as at Run 5 No. 25273 distance 3·2″ bearing 307°.

Dover Area

The Risdon Sandstone grades out of the Woodbridge Glacial Formation near the jetty and slip at Adamson Run 5 Photocentre 25273 distance 1·9″ bearing 57°. The contact here, as well as it can be delineated between very similar beds, runs beneath the jetty. The Ferntree continues in the mode of a medium to coarse sandstone with some mudstone along the shoreline until it is succeeded by the Basal Grits at Adamson Run 5 Photocentre 25276 distance 4·5″ bearing 40°.

The coarser beds at sea-level are grey with prominent yellow-grey bands up to a yard in width outlining the many vertical joints. Erratics of quartzite, slate, and serpentine up to 2 feet in diameter are fairly common. These beds are massive. Some bands are almost entirely composed of cobbles.

From about 10 feet above water-level, the bedding becomes less massive and erratics fewer. These argillites—the grain-size has decreased too—are mottled and grey in colour. The rock type continues upwards until overlain by dolerite. All these beds weather white or yellow.

The succession to the east is covered by sand-banks or detritus so that the exact transition into the Basal Grits cannot be followed. However beds which may be portion of the Cygnet Coal Measures consist of blue-grey or greyish-yellow carbonaceous sandy shales with abundant mica on the bedding planes. Current bedding and concretionary structures are usual. Bands of carbonaceous matter occur throughout but no fossils were found here. The contact with the overlying beds is undulatory and probably constitutes a disconformity.

Stanmore

" Stanmore " homestead is situated at Adamson Run 3 Photocentre 25273 distance 1″ bearing 200°. The rocks outcropping along the road in this vicinity are the typical mottled or grey argillites of the Ferntree Mudstones. The beds are succeeded in the vicinity of the road junction south of " Stanmore " by the Triassic sandstones. To the east the same sequence is observed until at the distance 1·1″ bearing 146° from the same photocentre, the dolerite has intruded and displaced the sandstone.

The exact location of the boundary between the Permian mudstone and the Triassic beds could not be located accurately because of cultivation and soil creep. It is probable that the lower beds of the Permian occur northward along the road but thick detritus from the dolerite and deep weathering combined with the lack of fossils prevented the establishment of this in the mapped area.

Police Point Area

The Ferntree beds in this area outcrop beneath the Basal Grit at Adamson Run 2 Photocentre 2955 distance 3″ bearing 175° and can be followed on very good exposures along the shore to a distance of 0·5″ bearing 220° from the same centre point where it is transgressively intruded by dolerite. A barometer reading taken on the hill to the west of this point gives a thickness of between 300 and 400 feet here. The intense jointing of the beds right along this shore reduces the usefulness of these sections in obtaining thicknesses. The beds dip at 5-6° to 150° (mag.).

As at east Dover, the topmost beds are in carbonaceous, black, grey, and yellow shales carrying much mica. No fossils were found and erratic pebbles are missing. The beds are replaced downwards stratigraphically by massive black mudstone containing indefinite plant stems. The beds are not micaceous and contain quartz pebbles.

Below these the normal type of Ferntree mudstone, grey or mottled, weathering to yellow or white, and containing weathered erratic pebbles gradually appear in the usual rhythmic succession of massive beds. Shaley bands occur, usually of dark-grey colour, but are not so abundant as at Claremont.

The weathered surfaces of the beds are very pitted and irregular. They show indefinite fossil impressions that appear as little convoluted piles on the surface and may represent worm casts. In some beds extending over considerable distances and at different stratigraphic levels indefinite plant stems appearing as circular to oval occasionally branched, notched and, in a very few places, striated pipes are to be seen in considerable numbers.

In other beds large concretionary structures as much as six feet across by two or three feet in height having a flattened spheroidal shape occur in large numbers. These occur at several stratigraphic levels and are especially well developed at Adamson Run 2 Photocentre 2955 distance 2·15″ bearing 181½°. Here they can be seen at all stages of destruction. The walls are usually about 6″ thick and tend to be iron stained but the beds are too structureless to see if the bedding continues through the concretion or not. The walls appear to be enriched in silica giving a case hardened effect that resists weathering more than either the interior of the concretion or the surrounding rock. Cracks cut the walls into various shaped fragments which wash out piece by piece under wave action. The interior of the larger ones are intensely current-bedded and of finer material than the walls although occasionally the reverse is true. Webs of limonitic material traverse this material. In one or two small ones about 1″ in diameter, segmented casts possibly of a plant were seen.

Along the prominent point due south of the centre of Run 2 No. 2955, at a distance of 1·7″, a band of hard conglomerate occurs in these beds. This rock is composed of sub-angular to sub-rounded tabular pebbles, cobbles, and boulders up to a foot in diameter of quartz (predominant) quartz schists, quartzite, sandstone, or mudstone. No granite was seen and the quartz is clear or milky. The finer portion is predominantly quartz, vitreous and angular. The rock is cemented by clayey material and fresh surfaces are a creamy-white colour. The bed is 3 feet thick and conformable with the beds below and above.

White Bluff—Brook's Bay Area

(Adamson Run 2 Photocentre 2953 distance 3·0″ bearing 343°)

In this area the Permian rocks occur in a precisely similar manner—Basal Grits on top of the sandy shales which grade down into the massive carbonaceous beds. These in turn are replaced by the mudstone beds carrying scattered erratics, concretions, and, in this locality, some specimens of silicified wood were obtained. The fossil plant remains (fucoids of R.M. Johnston) are very abundant, but, as with the structures resembling worm casts, the preservation is too poor to allow identification.

Ferntree beds extend from the above point to Surges Bay but the dips are variable (at Brookes Bay it is 12° to 209° (true)) and the beds are interrupted by at least two injections of syenite porphyry so that the thickness which has been estimated at between 300′ and 400′ can only be put forward as an indication of the order of the thickness.

A piece of fossil wood obtained from south of the Brookes Bay Jetty (Picton Run 14 Photocentre 22085 distance 4·2″ bearing 18°) was forwarded by M. R. Banks to Dr. Mary Calder of the University of Manchester from whose reply to Banks the following extract has been taken.

> "No. 20889 Ferntree Mudstone . . . . shows fine structural detail of a coniferous wood, almost undoubtedly *Podocarpaceae*—I should be *most* surprised to find Podocarpaceae in rocks as old as Permian".

She also stated that it was related to the living genus *Phylocladus*.

Banks determined from literature that the lowest age limit of this genus is Upper Triassic and, after visiting the area and agreeing that the rocks undoubtedly belong to the Ferntree Mudstones, has sent another piece of the specimen to Dr. Calder to act as a check.

This is the only indication of the age, of the Ferntree beds in this area. In the Cygnet district though, the overlying Cygnet Coal Measures carry such Permian plant fossils as *Gangamopteris spatulata, Glossopteris Browniana* var. *praecursor* and *Vertebratia australis* which establish these beds as Permian in age.

Summary of Permian Stratigraphy

The Permian rocks in this area are conglomerates, sandstones, siltstones, and claystones. Sandstones predominate and are characterised by the poor sorting of the constituent grains. The mineral fragments are usually extremely angular reflecting the glacial conditions which are further emphasized by the presence of fresh felspar in all these beds.

The dominant mineral, plentiful even down to grain-sizes of ·5 μ as proved by X-ray studies on residual clays, is quartz. It is angular, often shows undulatory extinction, and is, dominantly, a clear vitreous variety although milky and blue quartz is often seen. Felspar reaches a maximum of 30 per cent in few places. It is found both fresh and weathered. One determinable specimen from the Risdon Sandstone was found to be andesine. Mica (usually muscovite) was seen in all specimens and was not confined to the bedding planes. Tourmaline, zircon, pink garnet, rutile, and pyrite were among the minor constituents. Clays where determined were found to be kaolinite with a small percentage of illite.

These minerals together with the erratics show that it is probable that these sediments came from a low-lying glaciated provenance containing metamorphic rocks, acid plutonic rocks, and serpentine. The evidence from this area supports the conclusion of Banks (1952) that the Permian beds belong to an ortho-quartzite-limestone suite and that no vulcanism took place during their deposition.

It can be inferred that the intensity of glaciation reached a maximum during the deposition of the Woodbridge glacials with minor peaks during the Grange and perhaps Ferntree times followed by a reversion of glaciation until finally the Cygnet Coal Measures were deposited under moist cool temperate conditions. It is possible that the solitary conglomerate band in the Ferntree indicates not an increase in glaciation but a response to either orogenic movement elsewhere or to an isostatic readjustment following the removal of the ice load.

During the deposition of these beds, on a stable to mildly unstable shelf, the water was fairly shallow and cold with the depth of the sea responding closely to the intensity of glaciation. However even the Ferntree mudstones were deposited in fairly shallow water. The Cygnet Coal Measures represent a rise in land level which is reflected in the increased coarseness of the rocks at the top of the Ferntree and in the sandstones of the Coal Measures themselves. Lacustrine, swampy conditions prevailed during their deposition.

THE TRIASSIC SYSTEM

Although Triassic rocks outcrop over large parts of the area and fairly complete sections of them are present, there is no place in which it is possible to see all the rock types. The shales rarely outcrop and are usually found as fragments in creek beds or in landslides and the highest beds appear close under the dolerite the scree from which frequently covers them. Inland, all the Triassic rocks tend to weather deeply and usually carry a thick vegetation.

The beds, wherever the succession is clear, begin with the Basal Grits which lie disconformably over the truncated Cygnet Coal Measures and in every outcrop are cut off by a dolerite intrusion which usually cuts through the Felspathic Sandstones. No age determination could be made from this district.

In contrast to the Permian rocks, these beds are very similar to the Triassic rocks of the Hobart area both in composition and in sedimentary structures. Current bedding, unilateral rolling strata, symmetrical current bedding, concretions, contemporaneous erosion and faulting are common wherever the lower beds appear. The higher beds are not well enough exposed to examine them for these features. The shales are usually ripple-marked and the slump structures and current bedding indicate that the direction of current flow during deposition was from the north-east.

"Basal Grit"

This name is applied to a bed of granule conglomerate or coarse sandstone usually about 15 feet thick but somewhat variable in its development that lies with slight disconformity on the eroded Cygnet Coal

Measures. No striking disconformity is seen because the sedimentary structures and minerals of both formations are very similar but there is a distinct difference between these and the Ferntree Mudstones.

The main evidence for disconformity is the inclusion of boulders of Ferntree Mudstone in these beds at Police Point. This evidence is supported by the undulating contact with the underlying shales, the vast increase in heavy minerals, by the inclusion of at least one conglomerate band in the grits, and the increased coarseness of all bands.

The conglomerate band which may or may not lie on the undulatory contact consists of pebbles and cobbles of quartz, quartzite, slate, schist, and mudstone. The interstices between the pebbles are filled with angular quartz very lightly cemented with clay resulting in a rather friable rock. This band varies from 6 inches to 1 foot in thickness but is often missing from the sequence.

The finer material in the Grits is a cream to white but often iron-stained sandstone varying from fine to coarse in grain-size. The sandstone is lightly cemented and composed mainly of angular quartz. It is current-bedded but no slump structures were seen. Lines of pebbles often outline the current bedding.

Quartz, usually vitreous and of metamorphic origin but sometimes milky or blue, makes up about 60 per cent of the rock. Felspar is usually present but often is kaolinised and is never greater in quantity than 10 per cent. Biotite, muscovite (more abundant) and graphite are common. Tourmaline, rutile, topaz, limonite, and a black spinel have been identified from the heavy fraction but the most distinctive mineral is the pink to red garnet that occurs as patches or stringers at almost every locality examined. Some garnet occurs in the Permian rocks but the vast increase here suggests that erosion in the source area had uncovered the garnetiferous schists of the Pre-Cambrian rocks which carry this type of garnet. Epsomite occurs near Police Point.

The shape of the mineral grains and the presence of mica suggests that deposition took place close to the source area in a shallow or near shore environment.

Knocklofty Sandstones and Shales

The beds of quartz sandstone and shale that conformably overlie the Basal Grits in every locality are given this name to avoid the confusion caused by the terms Springs Sandstone and Ross Sandstone. At Brook's Bay the estimated thickness is from 400-500′.

They occupy most of the area mapped as Triassic and have distinctive physiographic expressions. On dip slopes extensive button grass plains are found which consist of ridges carrying a poor eucalypt flora separating large swampy areas. Along the coast steep marine cliffs up to 300 feet high are formed wherever they are found. Inland, cliffs up to 200 feet high are found to form in a massive quartz sandstone which occurs about 150 feet above the base of the formation. Another common feature due to the failure of the shales exposed to moisture are the numerous landslides.

These beds are characterised by their abundant sedimentary structures. They are composed of interdigitating sandstones and shales but these beds do not occur in the same order from area to area. The bedding

may vary from fissile in the shales to massive in the sandstones in which current-bedded and massively-bedded layers interdigitate and alternate. The massive beds usually weather to a coarse honeycombed surface. Concretionary structures are common in all the coarse beds ranging from iron-stained nodules to large structures a yard in diameter. None of the long cigar-shaped concretions seen elsewhere in the System were developed here. Another noticeable feature is the presence of numerous mud-pellet conglomerates seen throughout. The pellets which are usually flattened oval-shaped structures up to 6 inches long and dark cream in colour weather out to leave a characteristically shaped void in a white sandstone. In some places, particularly near Red Cliff, inclusions of Knocklofty shales and sandstone in these clay-pellet beds indicate contemporaneous erosion.

The colour of these sediments is variable. Red, black, brown, green, and purple shales were seen, e.g., red and purple shales outcrop towards the top of the formation at the southern end of the Raminea Plain. The sandstones are white, brown, green, stone, purple, mottled, and, if iron-stained, orange in colour. The sandstones usually weather to a white or yellow colour finally yielding a white or yellow fine sand.

The predominant mineral is quartz which, in the sandstones, commonly constitutes more than 90 per cent of the rock. Silica and iron oxides are the usual cements. Felspar is present at most levels but never constitutes as much as 10 per cent of the rock. Mica, mainly muscovite, and graphite are common especially on the bedding planes of the shaley beds. Some mica is usually scattered throughout the sandstones but very few heavy minerals occur. The quartz is usually vitreous and angular often showing regeneration causing the sparkling effect given by many of the sandstones. The mineral content of the shales has not been examined. In contrast to the underlying beds, the sorting in this formation is very thorough resulting in very even grained beds.

A common feature is the occurrence of lenses of carbonaceous shales found in the massive sandstones as at Red Cliff. The bands are about 6″ thick and of variable extent. The distribution is irregular suggesting that they were formed in small swampy parts of a dune landscape.

A bed not previously reported from this area occurs on the top of hillocks in the south of the Raminea Plain and more extensively just below the " Felspathic " sandstones to the west of Police Point. It is a bed of quartz conglomerate and coarse sandstone whose most distinctive feature is the presence of pebbles of pink quartz as well as the more usual milky quartz. The quartz pebbles usually about $\frac{1}{2}$″ but occasionally up to 2″ in diameter are tabular and sub-rounded. The colour is usually brown-grey to light grey but all examples seen had been exposed and have porous appearance suggesting that some minerals (felspar) has been leached out. On Raminea Plain this bed appears to be about 15′ thick but the amount that has been eroded could not be checked.

These beds were probably deposited in a lake or lakes which periodically dried out. Saline deposits indicate for the lower part a hot, dry climate while the carbonaceous matter probably indicates rather moister conditions at different levels. A slowly sinking floor is indicated by the sorting and sedimentary structures. The minerals present which indicate

by their physical properties that all these sediments were transported by water, suggest that the sediments came from a low terrain containing metamorphic, acid plutonic, and Permian rocks.

"Felspathic" Sandstones

These sandstones do not occupy extensive areas in this district. They outcrop over the Knocklofty Sandstones and Shales but the nature of the succession or the exact location of their base cannot be determined.

It is considered however that the base of this formation lies in the thick belt of cream or yellow plastic clay that occurs in all the localities that have any felspathic sandstones. The formation is overlain by transgressive dolerite sills so that the topmost beds cannot be accurately determined. Green-grey and brown claystone, the latter carrying plant fossils, white quartzose sandstones containing stringers of carbonaceous matter and a yellow micaceous sandstone have been observed in this formation at various localities. The coal seen at only one locality is associated with the brown shaley claystone.

The sequence here is considered to be:—

Dolerite
Felspathic sandstone
Claystone with coal
Quartz sandstone
Clay bed
Knocklofty Formation

However the succession is far from clear and the thick cover of vegetation and weathered rock prevented clarification of this. No dips could be obtained and therefore no thicknesses could be estimated.

The specimens examined were found to be rather porous rocks that showed no effervescence with acid although in thin sections from other areas calcite is very abundant. Here apparently it has been leached out leaving voids.

A thin section of the "Felspathic" Sandstone from the Green Hill area shows that the rock is very similar to specimens from Old Beach and New Town. However, whereas in the above areas the fragments are always very angular and shattered, the Green Hill sample shows subrounded to rounded particles as well as a considerable amount of irregularly crystallized interstitial biotite which is probably due to the effect of the nearby dolerite. Although there is considerable variation in grain-size from place to place, all these sandstones are well-graded. The average grain-size of this specimen lies between 0·2 and 0·5 m.m. The approximate amounts of constituents are as follows:—

	%
Rock fragment	40
Feldspar	20
Quartz	10
Matrix	20
Accessories (mainly micas)	10

The rock fragments are made up of about equal amounts of fine-grained igneous material which appears to be trachytic and a mixture of quartzitic, cherty, and granitic particles. It is difficult to give a name to this rock at present beyond calling it a tuffaceous sandstone but work being carried out at the present time may lead to a more definite classification.

Although a complete heavy mineral analysis was not carried out, pink garnet, tourmaline showing clean uncorroded surfaces, and a dark, opaque, non-magnetic mineral, probably ilmenite, were observed. The garnet, particularly, implies that the provenance of this sediment is similar to that of the lower Triassic beds.

Strathblane Plain Area

The whole South West corner of the mapped area is underlain by Triassic sediments. The main button grass plain from the Old Hasting Road westwards to the forested hills on the other side of the Creekton Rivulet is occupied by the Knocklofty Sandstones and Shales. This formation extends beyond the road to the east near the centre of Adamson Run 8 No. 2972. This break in the dolerite is occupied by Triassic sediments to beyond the boundaries of the area.

Along the Old Hastings Road there are a few exposures of quartz sandstones and siliceous shales but over the rest of the plain no outcrop could be discovered. Except in the north where in the deep cuttings on either side of the Creekton Rivulet some weathered quartz sandstones of brown and white colour can be seen, even the cuttings through the ridges reveal only sand. This sand may be alluvial but it is more probable that it is weathered sandstone about 10′ deep.

The test pit at Adamson Run 8 Photocentre 2974 distance 0·4″ bearing 300°, although full of water, yielded some fragments of quartz sandstone but the fossil impressions reported by A. McIntosh Reid (1922) have weathered away.

Towards the south, the same beds outcrop and are deeply dissected by the creeks flowing towards Southport. The track running west from F.D. 1 8 which is south of the mapped area shows the following succession under the dolerite:—

Knocklofty Shales and Sandstones in white quartz sandstone and shales.
White quartz sandstone of fragile appearance and carrying carbonaceous streaks.
Yellow micaceous sandstone.
Fine grained dolerite.

From the test pit mentioned above going south-west along the old tram line, the sandy soil is replaced along the edge of the thick vegetation by a wide bed of cream and yellow clay which continues along the main tram line to beyond the area.

This clay bed continues up the track to the north until dolerite which appears to be a dyke intrudes it. After crossing the creek which flows along the face of a dolerite cliff, the Felspathic Sandstone is encountered. An exposure in the creek bed shows that it is lying over a fine-grained dolerite contact. Somewhere in this area the main workings of the Strathblane Coal Mine were put down but the vigorous regrowth of scrub prevented the location of this mine. The coal seams here were located in felspathic sandstones. The presence of boulders of dolerite in the deep soil on the western slopes of the hill on which the coal mine is situated suggests that the top of this hill is in dolerite.

The section along the track running west from the bridge over the Creekton Rivulet at Adamson Run 8/2973 distance 2·9″ bearing 33° showed quartz standstones to the edge of the scrub, a clay bed until the

first major bend in the track, then a fine quartz sandstone followed by a gap with no outcrop. At the next major bend in the track, a tunnel (now collapsed) has been driven along a coal seam immediately below a fine-grained dolerite contact. The spoil heap reveals specimens of brown clay stone with plant fossils and anthracitic coal with a hackly fracture. The shale and coal have been intensely slickensided.

Beyond the dolerite sill, the Triassic sandstones are found to outcrop from the valley at Adamson Run 8 No. 2975 distance 2″ bearing 351°, to beyond the junction of the tracks at Adamson Run 6/25294 distance 3·9″ bearing 323°. The northern portion of this track is in quartz sandstone which resembles the Knocklofty Sandstones by the manner in which they form small cliffs along the creeks.

As far as could be ascertained the sediment lying between the Creekton Rivulet and Green Hill is part of the Knocklofty Formation.

Raminea Plain

Here quartz sandstones showing current bedding, slump structures and the voids from which clay pellets have been weathered lie under the dolerite and form an undercut cliff 100 feet high along the eastern bank of the Esperance River. The sandstone reaches a height of 410′ above the river level. At this level, a coarse brown sandstone outcrops.

Along the Esperance River towards the north, shales and sandstone of this formation may be seen in the river bed beneath alluvium. At the Adamson Run 4/25181 distance 2·2″ bearing 296½° the green siltstone which occurs at Police Point outcrops.

Above this the clay beds intervene and are covered with fine-grained dolerite wherever access was obtained. This clay bed with its heavy vegetation is seen along the old tram line between the Adamson track and Big Creek on the western edge of the plain. This hill is capped with dolerite as is the hill to the south of the Adamson track.

The Green Hill track section shows a break in the dolerite at the head of the valley at Adamson Run 5/25265 distance 3·2″ bearing 155°. The most pronounced valley here shows dolerite over shaley claystone to the east with a fault down the valley which upthrows to the west so that the western dolerite stands 100 feet higher. From the valley, shales are followed by Felspathic Sandstone over which lies the dolerite.

Further west two more chilled contacts between the Felspathic Sandstone and the dolerite occur. West of the last outcrop of dolerite the track runs over quartz sandstones. This is continuous along the track to the Strathblane Plain.

Hopetoun Road Area

Here the base of the succession has been covered with landslide detritus so that the first beds to be observed are dark brown micaceous coarse sandstone. These are succeeded by lenticular beds of shale and sandstone outcropping in the cuttings along the road at Adamson Run 4/25177 distance 1·9″ bearing 172°. Quartz sandstones succeed to the border of the area. Similar beds continue westward from here to the Esperance Road along the north of Burns' Hill. Considerable cliffs are formed along the creeks in the massive quartz sandstone.

The scarp behind Francistown is in quartz sandstone interbedded with shales that form step-like flats. The clay pellet conglomerate is well developed about half way up this cliff.

Dover Area

A completely isolated pocket of Triassic sediment in the dolerite occurs along the Dover Rivulet. It is covered to a large extent by alluvium and dolerite scree. At Adamson Run 4/25175 distance 2·6″ bearing 108½° a few fragments of garnet bearing conglomerate were observed in a contact zone that has been furrowed with adits, costines, and prospect pits. At Adamson Run 4/25175 distance 0·7″ bearing 77° a brown ripple marked micaceous shale typical of the Knocklofty Beds outcrops.

Stanmore Area

The Triassic here consists of quartz sandstone and shales. The sandstones are covered with a thick cover of sand. Against the dolerite along their southern contact a dense quartzite has been formed.

The base of the succession has been obscured by cultivation but the presence of the Basal Grit is indicated by the presence of quartz gravel.

Brooks Bay Area

This Triassic section is the most complete mapped in this area. The beds lie disconformably over the Ferntree Mudstones and are overlain by a transgressive dolerite sill.

The Basal Grits, unusual here in that no red garnet was seen, form the base and are about 20′ thick. They are followed by a bed of strongly current-bedded fine sandstone which is fine-grained, white to cream in colour, and quartzose. The joints and current bedding are strongly outlined by iron-staining.

The beds succeeding this do not outcrop except for occasional bands of massive quartz sandstone. At about 150′ above the base of the beds, a medium-grained brown quartz sandstone forms cliffs about 100-150′ high. Although the actual outcrop was not seen, the characteristic voids in white sandstone indicated the presence of the clay pellet bed in this locality. The plateau here lies over this cliff-forming bed and is in shales of variable colour and quartz sandstones.

West of the road, the clayey beds associated with this part of the sequence appear and are followed by a coarse green felspathic sandstone and green shales. The dolerite intrudes over the shales which show baking effects at Adamson Run 2 No. 2953 distance 1·8″ bearing 204°.

At Police Point Adamson Run 2/2953 distance 2·2″ bearing 42° the sandstone has under the influence of the intruding dolerite assumed a polygonal columnar jointing.

Police Point Area

From Police Point southwards along the coast, the Triassic sediments are not continuous. In every locality they are cut off in the Knocklofty Formation by the dolerite. Except in one locality, the only beds that can be seen at the surface are Basal Grits and the quartz sandstones immediately overlying them. At Adamson Run 3, 25157 distance 3·2″

bearing 31° the sandstones overlie the dolerite. The contact is most irregular and the baking intense. The joints in the sandstone are thickly lined with brown iron oxide which, as the sediment weathers, forms a net-work often $\frac{1}{4}$″ high over the surface.

The lowest beds here are siliceous shaley siltstones and fine sandstones often showing unilateral rolling strata, rolling strata, current bedding, and local disconformities. Some of the shales are carbonaceous. Ascending the sequence there follows green current-bedded sandstone and shales, a green shale carrying stringers of hard material and brown spots of iron oxide.

Succeeding this is a 10′ bed of greyish-yellow-green sandstone. This sandstone is spotted and effervesces slightly with acid. The spots are moderate brown to very dusky purple in colour and probably represent weathered siderite. White mica flakes are very common. The average grain-size is ·1 m.m. and therefore the rock is a very fine sandstone. The green colour appears to be associated with the clayey cement.

Then follows 3′ of green shaley siltstone over which lies a 2′ bed of extremely hard quartz sandstone. A thick bed of white medium grained shaley sandstone carrying a vast number of purple-brown spots and nodules follows and, in turn, is overlain by the more usual yellowish quartz sandstone of this formation.

The spotted shaley sandstone which is about 30′ thick carries large cannonball concretions. These may be as much as 3′ in diameter and usually are slightly oblate spheroids.

The bedding, along which the brown spots lie, passes through the concretions without deviation showing that they are authigenic. The brown spots also pass through the structures. The rock which is of the same grain-size as the parent bed effervesces slightly with HCl. This, associated with the colour of the spots, is an indication of the presence of siderite in these beds. This point is supported by the presence on the shore-platform of long rib-like ridges and spheroidal shapes composed of limonite suggesting that an abundant source of iron has been readily available.

A thin section cut from a concretion of 2″ in diameter shows that 80 per cent of the rock is quartz of ·1 m.m. diameter. It is sub-angular to rounded in shape but is usually cracked and shows regeneration. About 1 per cent of the slide is felspar showing multiple twinning and at least one piece of microcline. Biotite was seen although all the mica seen in hand specimen is white. Some iron-staining suggests the presence of siderite but this apparently has disappeared during grinding or has been leached out. The closely packed grains are cemented by a subordinate amount (5 per cent) of clayey white cement. Therefore these are quartz sandstones of the ortho-quartzite suite. A very similar " spotted " sandstone is figured on by F. J. Pettijohn (1949, plate 15).

The beds containing these concretions weather easily so that these structures fall from the cliff face and accumulate on the beach. On breaking up the concretions they are usually found to be homogeneous but some have a skin about 1″ thick of sandstone of the above grain-size enclosing a finer grained sandstone or siltstone.

Symmetrical current bedding shows that the current flowing during the deposition of these beds was from the north-east.

A dirty white coating on the beds here is found wherever there is protection from the rain or spray. This mineral which aids the weathering by scaling off small chips of rock was found to be epsomite and has been reported from Knocklofty beds previously by Reid (1922). It indicates a hot dry climate and shallow water environments.

From this point to Surveyor's Bay the sandstones are yellowish quartz sandstones of the usual Knocklofty type. In the numerous landslides, fragments of pink, white, and brown micaceous ripple-marked shales are found but the outcrops are very few and inaccessible.

The Surveyor's Bay beds show steeply dipping baked shales over the dolerite which outcrops continuously along the beach. In the sandy soil of the orchard here a pebble of Basal Grit was found but was not *in situ*. This outcrop is a floater completely enclosed by the dolerite.

East Dover-Roaring Beach Area

At Shack Corner (Adamson Run 4, 25170 distance 1·8″ bearing 35°) the dolerite intrudes against interdigitating lenses of quartz sandstone and grey-green, and yellow shales. The colour of the sandstone is variable. Usually it is greenish-yellow in colour but has patches of red sandstone showing a concentration of haematite. The shales are ripple-marked, micaceous, and carry black dendrites on the bedding planes.

From here to the dolerite contact at Adamson Run 5, 25279 distance 0·8″ bearing 80°, the cliffs are in massive or current-bedded quartz sandstones with subordinate carbonaceous shaley stringers. The massive beds which often show polygonal shapes produced on the surface by weathering alternate and interdigitate with the current bedded sandstone.

Where intruded by dolerite the effects of the intrusion extend for only a few inches into the sandstone and, in places, for less than an inch.

An interesting section appears on the foreshore on the eastern side of Port Esperance. Here the Basal Grits, extremely rich in garnet, are succeeded by current-bedded sandstones and these by alternating beds of green-brown shales and fine sandstones showing unilateral rolling strata and current-bedding.

Beyond the fault here, the following sequence was measured:—(No. 1 is the bottom bed of the sequence)

(1)	2′ 0″	Olive sandy shale with unilateral rolling strata.
(2)	1′ 0″	Similar bed but of lighter colour.
(3)	2′ 0″	Blue-grey shale—plant fossils found here.
(4)	3′ 0″	Grey or brown interbedded shales with a superimposed flaggy bedding.
(5)	2′ 0″	Blue-grey to green-grey shales with a knobby weathered surface.
(6)	3′ 6″	Olive-green sandy shales similar to 2.
(7)	1′ 6″	Blue-grey to green shaley mudstone similar to 5.
(8)	20′ 0″	Mixed green, brown, blue-grey and grey sandy shales.
(9)	3′ 0″	Green-grey mudstones with honeycomb weathering.
(10)	6′ 0″	Shales and sandstones of variable colour and thinly bedded. The colour becomes lighter upwards.
(11)	20′ 0″	Current bedded white to yellow massive sandstone beds showing the large honeycomb weathering.
(12)	20′ 0″	Mixed sandy shales and sandstones in 6″ beds which vary in hardness. Some indefinite plant remains were observed.

The dip of these beds gradually flattens out away from the fault zone where it is 79° to 16-18° in an easterly direction.

Bed No. 12 is followed by a sandy beach which obscures the sequence but 120 yards further eastwards, cannon-ball concretions were seen in a green sandstone. About the same distance further eastwards, the marine cliff in quartz sandstone (brown and yellowish) with occasional gritty lenses following the current-bedding continues to the dolerite boundary.

Inland along the strike from the concretionary band, the creek has cut a steep scarp suggesting that the beds in which it flows are easily eroded. If the correlation with the last area is correct this would be in the epsomite-bearing band.

The Triassic beds in this area all carry a deep cover of fine quartz sand. The patches of sandy beach in front of the section described above show red and black pockets and stringers. The red colour is due to the garnet which, in some pockets, is almost completely separated from the quartz and even most of the other heavy minerals. Associated with the garnet is tourmaline, topaz, rutile, and spinel in very minor quantities. The black sand contains abundant ilmenite and magnetite concentrated from the nearby dolerite, rutile, spinel, and a few grains of garnet. It is usually found lower down the beach than the garnetiferous sand.

JURASSIC SYSTEM

Jurassic Dolerite

The Jurassic dolerite occupies the greatest part of the land surface in this district. Large dykes and transgressive sills spreading over the sediments are the usual forms found. In the area, there are some smaller areas of a few acres in extent completely surrounded by sediment but their exact relation to the sediments could not be determined. They are extremely fine grained and usually much jointed. The most feasible explanation for their presence is that they are outliers separated by erosion from the larger masses.

The highest elevation reached in the dolerite, except in the obvious fault blocks of Adamson's Peak, is 1630′. This is in the area south of Port Esperance and the dolerite is continuous from sea level. However, some faulting has occurred and it is estimated that the thickest sill of dolerite here is less than 1000′, but these are fed by broad dykes.

The general composition of the dolerite has been described by Edwards (1942) and the presence of olivine in the chilled margins has been recorded by Prider (1947). A porphyritic, olivine-bearing basalt (the chilled margin of the dolerite) has apparently been taken by Twelvetrees (1915) and Reid (1922) to be part of a Tertiary basalt flow.

However at Hope Island, no sign of any rock except massive dolerite weathered boulders of which sometimes have pitted surfaces could be found. In the other locality, Strathblane, a fine-grained rock, carrying dark coloured phenocrysts in a micro-crystalline ground-mass is often seen. Usually the phenocrysts have weathered out leaving an iron-stained pit in the rock surface. This rock was found *in situ* over the anthracitic coal at Adamson Run 6 No. 25294 distance 0·4″ bearing 144° and is the chilled base of the dolerite sill there.

Similar basalts are found at Adamson Run 5 No. 25273 distance 1·95″ bearing 176° where narrow dykes ranging from two feet to perhaps an inch in width are found in the margin of the dolerite and as a 3″ sill traversing the Grange Mudstone. These are fine grained basalts containing

glomero-porphyritic felspar and pyroxene in a glassy matrix showing incipient crystallization patterns. Some felspar laths can be distinguished in this groundmass. The basalt represents a quickly cooled phase of the dolerite and was probably intruded along cooling joints late in the magmatic cycle. Similar veins are found in nearly every outcrop of the dolerite.

A pegmatitic phase of the dolerite is also often seen. The pyroxene crystals in these segregations which, in this area, are never more than a square yard or so in extent may reach a length of ½″. A good development of this phase can be seen near the bridge at Adamson Run 6/25289 distance 1·6″ bearing 226°.

The main masses of dolerite are the normal, medium to coarse-grained, blue-grey, or greenish dolerite. Columnar jointing occurs in all the large masses but intense jointing near contacts causes either platy dolerite or irregular fragments showing confused jointing.

The only true dyke observed is that reaching the Esperance River near the coal bins at Folkestone. All the other visible outcrops are transgressive sills.

The contact effects are variable even in the same beds. Shales show baking often for a few feet; the quartz sandstones in some places show no sign of intrusion an inch away from the contact but in other places a hard siliceous hornfels several feet thick is formed. At the prospect pits mentioned above at Dover, the graphite present in the original sandstone persists in the hornfels.

The Ferntree Mudstone similarly behaves in two fashions. At the quarries at Folkestone and Raminea the mudstone is intensely baked yielding a blue-grey quartz hornfels. At Raminea the former sediment is hardly recognizable but the mud-balls are preserved as voids giving with quartz pebbles an indication as to the original boundary of the sediment. In contrast to this where the intrusion is dyke-like, on the opposite bank of the Esperance River at Adamson Run 5, 25270 distance 0·6″ bearing 198°, the overlying sill has caused hardly any change in the sediment except a slight hardening immediately below the irregular contact.

TERTIARY SYSTEM

Syenite-Porphyry

Two dyke-like bodies of syenite porphyry are on the north-western shore of Brook's Bay and another on the boundary at the first point west of White Bluff. The rocks are similar in all respects. Both are slightly kaolinised, but not markedly so, on exposed surfaces.

The age of these rocks is not known exactly. At Cygnet similar rocks intrude dolerite and are therefore post lower Jurassic, depending on the age of the dolerite. At Brook's Bay they are intensely slickensided by movement upthrowing the west side of the quarry.

If the slickensides are not due to purely local causes, since the syenite is post-dolerite, it must have been caused by Tertiary faulting which from evidence in other regions is considered to have taken place in the Oligocene or early Miocene. This would mean that the syenite could have been intruded between the time of intrusion of the dolerite and the Oligocene or early Miocene. Both the intrusions here are into Ferntree Mudstones.

At Brook's Bay the inland extension of the dyke is concealed by soil and detritus from the Triassic beds. At White Bluff each end runs out into bays. The little island offshore here is in sediment, showing that the intrusion is in the form of a dyke.

The hand specimen shows vitreous phenocrysts (1·5 x ·5 cms.) of felspar showing multiple twinning and zoning. The grey groundmass includes crystals 3 m.m. long of a dark ferromagnesian mineral, smaller felspar laths and abundant pyrite. The thin sections show that the rock closely resembles the syenite-porphyry (banatite) described by Edwards (1945), from Cygnet.

PLEISTOCENE AND RECENT

Gravels associated with river terraces, for the lack of any evidence as to their age except that they overlie all the above rock types, are assumed to be the result of the increased power of transportation available during the Pleistocene glaciations. It is possible that some of them may be Tertiary in age but this cannot be proved.

The Strathblane Gravels cover the area shown in this locality on the map and are especially well developed on the hill top at Adamson Run 6 No. 25288 distance 4·1″ bearing 336°. Here in the old gravel pits, pebbles of chalcedony, chert, quartzite, schist, granite, mudstone, dolerite, fossil wood, and fragments of shells are cemented with a clayey matrix. These range from sand grade to boulders of sandstone two feet in diameter. This sandstone contains the pink quartz seen in the Triassic conglomerate on Raminea Plain showing that these beds were exposed at the time of formation of the gravel deposit.

A similar gravel but lacking the large sandstone boulders and pink quartz pebbles occurs along the Creekton Rivulet at the north-east corner of the Strathblane Plain. Rather more quartzite occurs here and the peculiar siliceous stone found in the quarry along the Hastings Cave Road frequently occurs. The higher parts of this creek run through deposits of quartz sand.

Along the Esperance River and Big Creek, the slip-off slopes and the extensive cutting-grass and ti-tree covered plain between them is covered with alluvium which is usually from 5-10 feet thick. The unsorted nature of this deposit suggests that it may be a till or a fluvo-glacial deposit very close to its source area.

The deposits usually begin with a layer two or three feet thick composed of boulders of dolerite, quartzite, sandstone, mudstone, and hornfels. Minor amounts of igneous and metamorphic rocks appear to be from redistributed Permian beds. All these larger fragments are held in a clay matrix where the deposit is deep. Above them lie finer beds consisting of a sandy clay.

The alluvium at the northern boundary is not so well sorted as at the junction of the two streams. Boulders of dolerite up to 2′ in diameter occur throughout and the interstitial matter is sand.

Stray water-worn pebbles of silicified wood, rounded quartz, and quartzite pebbles are commonly found well above the present creek beds.

These are often found on the dolerite which now caps the hill so that they are not derived from sediments in their present positions. They could have come from the sediments which originally overlaid the dolerite or been dropped during the early part of the present cycle of erosion.

Sand is being deposited at the present time during floods along the course of the Creekton Rivulet as it flows on to the Strathblane Plain, but elsewhere the streams are actively eroding their beds.

Between Raminea and the mouth of the Esperance River large islands and mud flats are being built up from mud and sand. The creeks entering Desolation Bay are filling this bay with similar material. Similar deposits of pebbles, sand, and mud block the mouths of most of the creeks flowing into the Huon.

Structural Geology

The area as a whole is a downthrown fault block. The date of the formation of this block can be said to be post-dolerite, but, so far, no further evidence has been found in the area to elucidate this matter. The fact that the block-faulting took place later than the dolerite intrusion is shown by the presence of dolerite on the summit of Adamson's Peak.

Dolerite outcrops along the Adamson track at the extreme west of the mapped area. This is replaced to the west along the track by a Permian bed in which one fossil *Stenopora* was present. This is succeeded by the higher Permian beds and then the Triassic. This is again faulted repeating the sequence but beginning higher in the Permian. Another such uplift occurs before the plateau is reached. Beyond the plateau there are further fault blocks before the dolerite which caps the mountain is reached. Therefore, in a horizontal distance of perhaps 1½ miles, there is a vertical uplift of at least 3000 feet.

When the downthrown block is examined, it can be seen that it consists of a number of basins of sediment separated by dolerite. These areas are roughly rectangular in shape, and were obviously formed by the tensional conditions that enabled the dolerite to rise through the crust.

However, superimposed on this Jurassic faulting is a later set of joints. The two sets and all the minor joints caused by the intrusion of the dolerite, especially close to the contacts, give a very broken nature to the rocks. As mentioned previously, in most of the sediments, the jointing has cut the rocks into blocks seldom more than a yard square. It is not unusual to find 4 or 5 sets of joints in the one spot.

Most of the joints are vertical, but in the quarry at Strathblane and also at Raminea, both close to the dolerite, joints with a dip of 70°-80° were measured. This type of joint may be caused by a magma, in this case the dolerite, at an intermediate depth giving insufficient support to the rocks above them.

In this case the forces are relieved by shear failure. Alternatively they would be conjugate shears close to a normal fault. The latter view is weakened by the proximity of the dolerite.

The dolerite itself shows columnar jointing in large outcrops, but the border zones are usually intensely jointed sometimes by sets of joints an inch or less apart and nearly parallel to the boundary, but in other places by numerous irregular cracks.

As well as these cooling joints, many large joints and shear zones can often be seen indicating the post-dolerite faulting. These are often accentuated by the drainage and are very noticeable south of Pt. Esperance. Here they cut the country up into a number of hills separated by dry valleys. A similar joint runs north-westerly from Tower Bay and one nearly parallel to this cuts through the dolerite from Roaring Beach to Glendevie.

An analysis of all the joints measured show a concentration of joints in 4 directions: 39°, 59°, 129° and 169°. The most pronounced joints are those bearing 129° and 169°. These concentrations of joints can be considered to be two sets of conjugate joints: the 39°-129° set and the 59°-169° set. This type of jointing is considered to have taken place under simple shear but the evidence from this area is too conflicting for any statement as to the nature of the forces or the direction of the major active forces to be given.

Because a fault at Police Point bearing 59° displaces the dolerite, it is considered that the 59°-169° set is associated with the Tertiary faulting and this is supported by the big linears cutting the dolerite south of Port Esperance. If this is so, it is thought that the 39°-129° set of joints are associated with the Jurassic faulting and the emplacement of the dolerite.

In general, however, this area is not strongly faulted. Only in a few places can a displacement of more than 200 feet have occurred. This type of faulting has been masked by the thick undifferentiated Triassic and Ferntree beds and by the dolerite. Even in the breaks caused by the dolerite, the throw need never be more than 200 feet. The local structure is most easily followed by tracing the dolerite boundaries.

Beginning in the south-west portion of the map along the Old Hastings Road, a chilled margin is found to lie transgressively over Knocklofty beds from which no dip could be obtained. This dolerite appears to be a sill.

Between this and the dolerite seen across the break filled with Knocklofty beds, a strong lineament runs across the whole area. This lineament, mapped as a fault, extends towards Lady Bay to the south-east. Towards the north-west a gap down which the upper part of the Esperance River flows is cut off finally by the Hartz Mountains. In the south no great displacement can be seen, but where this break crosses the Green Hill track, the dolerite-Felspathic Sandstone contact stands at 900 feet on the east, but on crossing the valley, the same contact is found at 1050 feet, i.e., an upthrow of 150 feet to the west.

The dolerite to the north of this gap extends as a continuous outcrop (see Dover sheet) to D'Entrecasteaux Channel. Between the junction of the Old Hastings Road and the Huon Highway and Strathblane, the dolerite has the form of a dyke with a slightly transgressive sill-like extension over the Permian at Strathblane. Faulting accompanied this intrusion because Permian beds to the north of the break are replaced to the south by beds which from the lack of any cliff-forming beds here must be high in the Knocklofty Formation. This would give a downthrow to the south of about 200 feet. The remainder of the southern boundary which where seen appears to be dyke-like, could not be traversed.

It is along this boundary that the long north-west to south-east lineation from Tower Bay passes. From the heights of the dolerite through which this break passes it seems that this downthrows to the south, but the throw would not be considerable.

On the north of this dolerite, the Raminea Plain is occupied by Triassic sediments which have a general southerly dip towards this dolerite. The dolerite boundary rises transgressively from a height of 150 feet over Knocklofty beds to 900 feet over the " Felspathic " Sandstone.

The cliff along the east side of Esperance River in this area is probably due in part to faulting but until the Knocklofty Formation is sub-divided and the position of the clay-pellet bed determined this cannot be proved.

The breaks in the dolerite and the steep dips (19°) in the beds near the Strathblane coal mines, added to the presence of quartz sandstone along the track that runs nearly parallel to the western border of the area, suggest that a major Tertiary fault runs down to the west of the dolerite sill crossed near the southern track junction. This could not be checked. It is also probable that strong faulting almost at right angles to this occurs here but no evidence for this could be found inside the area.

The dolerite, along the east boundary of Raminea Plain Triassic, shows, by its erosion pattern where streams cross the boundary, that it is a sill. However, a dyke occupying a fault may occupy the core of this outcrop where it crosses the Esperance River, because the Permian which underlies the discordant sill behind Raminea stands as high as the lowest Triassic west of Burn's Hill.

The scarp on the northern side of Burn's Hill appears to have been caused by the erosion of the Knocklofty beds underlying it. If it is faulted, no evidence for this was found except for a topographical break.

The Permian rocks which, south of the Esperance River, appear to be intruded along a dyke-like contact and cut at Folkestone by a definite dyke of dolerite, are, north of river, covered by the eastern sill-like extension of the Burn's Hill dolerite, which here transgresses from the Ferntree beds over the Knocklofty Sandstones and Shales.

It is likely that a fault passes down the valley west of the Hopetoun Road and passes along the eastern side of the dolerite on the area boundary north of Burn's Hill. If this fault exists and it has not been possible to trace it on the ground, it must pass through the clay pit of the Granton Brick Pty. Ltd. and across the Esperance River near its mouth. In the clay pit there is evidence for a fault between the shore and the top quarry. There is a break here of about 50 feet upthrowing to the west. West of this line the Permian sediments dip at angles from 2°-5° to the west. As the dolerite is approached the dip tends to increase a little. The Permian to the east of this is either horizontal or dips at low angles to just west of north.

The dolerite between Francistown and Dover is a sill transgressing from the Permian on to the Knocklofty, and shows some very irregular boundaries. However there is a fault which cuts across the north-east corner of the Strathblane sheet. This upthrows the block of Triassic shales that occur in the Dover township area.

This patch of sediment whose boundaries are obscured in most places by alluvium appears to be a block which sank into the molten dolerite. The dolerite has intruded over it at all visible boundaries except the faulted boundary around the north-west and northern boundary. The Permian near the school stands higher than the Triassic-dolerite border east of Dover, showing that the intrusion of the dolerite was accompanied by a fault downthrowing the Triassic.

North of this patch of sediment lies another dyke-like intrusion of dolerite linking the dolerite hills on each side of the Huon Highway. The faulting accompanying this intrusion must upthrow the block around Stanmore by at least 150 feet because the Ferntree Mudstone outcrops in this area at between 150 and 200 feet above sea-level. At Dover, the base is at sea level. Looking south from Stanmore the dolerite appears as a sill dipping over the baked sandstone (now a quartzite) towards the south-west.

Along the shore east of Dover, the Ferntree Mudstone dips towards the dolerite which here overlies the Mudstone as a sill. This sill continues over the Permian-Triassic boundary and appears to continue as a sill overlying the Knocklofty beds until at Roaring Beach it becomes dyke-like and the sediments are cut off.

Just beyond the Permian boundary on the foreshore and in the marine cliff on the east shore of Port Esperance, a strike fault breaks the lower Knocklofty beds. The dip on the Dover side of the fault is 10° to the north-east, but to the east the dip at the fault is 18° in the direction of 79°. This dip gradually flattens out away from the fault so that the beds near the next dolerite boundary to the south-east are almost horizontal. This drag indicates that the fault is downthrown to the east, but as the same beds could not be found on either side of the fault, the throw is not known. However, from its stratigraphy it could not be more than 70-80 feet. This fault cannot be traced across country but since its outcrop bears approximately 169°, it is probable that it belongs to the Tertiary fault system.

The dolerite of Point Esperance for some distance occupies a very narrow strip of land along the shore and has a straight contact with the sandstone where visible, but the outcrop is usually concealed by sand.

Near the dyke of dolerite beneath Red Cliff Farm and sawmill, and along the coast to Roaring Beach, a number of fault blocks seemingly connected with the dolerite intrusion are indicated by a number of changes in dips. A small transgressive sill or feeder dyke for the dolerite 200 feet above outcrops at the end of the small sandy beach in this area.

The patch of sediment at Surveyor's Bay, is completely surrounded by dolerite which is fine grained at the contacts seen along the beach where the floor of the sediment is seen over the dolerite.

The patches of sediment near the centres of Run 3 Numbers 25157 and 25156 are actually continuous under a thin belt of dolerite which has so weathered away that in places only a few boulders in a red dolerite soil indicate its former extent. All the boundaries seen are igneous contacts but, in the places shown on the map, the straightness of the contact suggests faulting.

The belt of sandstone along the coast westerly from Surveyor's Bay is overlain by a slightly transgressive sill. Big shears lie parallel to the shore-line here suggesting that this is a fault coast. This patch of sediment is cut off by dolerite which appears to be underlying this patch of sediment and overlying the next patch to the north. These beds dip at from 5°-10° in a direction of 154°. The dolerite covers this bed at its north-westerly extensions.

The dolerite which cuts off this patch of sediment rises transgressively from the shore where it lies over the Basal Grit. At road level it lies over

a current-bedded quartz sandstone and above this it cuts across the Ferntree Mudstone until it meets the fault at Adamson Run 2, 2954 distance 3·5″ bearing 140½° from the photocentre. This block of sediment is on the upthrown side of the fault and dips south-westerly.

The fault here was the only one found that has actually displaced the dolerite but the sedimentary sequence is hard to follow because the outcrops are poor. However it seems that this is a normal fault upthrowing to the south and is Tertiary in age.

The downthrown block which contains Ferntree, Basal Grit, and Knocklofty beds all cut off inland by the continuation of the transgressive sill is also downthrown by Jurassic fault which passes through the gully at Adamson Run 2 Photocentre 2954 distance 1·9″ bearing 180°.

At this locality the dolerite rises (from the transgressive sill about 100 feet thick which is intruded into the Knocklofty sandstones) vertically up the fault plane as a dyke for a height of about 100 feet and then spreads out as a sill again to the west of the crest of the hill.

The fault has upthrown the northern side about 300 feet so that the Basal Grits now outcrops around the hill at about 450 feet and is succeeded by the Knocklofty Sandstone.

From this fault, the dolerite in a dyke-like body has separated the mainly Permian block from the Triassic beds to the west. The western boundary of this body takes an erratic path down to the Huon River just beyond the Police Point road junction. It just allows a very baked contact of Triassic sediment to reach the water's edge here and then spreads diagonally across the main road beyond where the Glendevie-Police Point road meets it. The upper limit and northern edge of this body cannot be traced but apparently it leaves a very narrow strip of sediment along the southern shore of Desolation Bay for the contact is seen about half a chain south of the mouth of the bay which is in Knocklofty Shales.

The Ferntree Mudstones here outcrop from the Basal Grits at Run 2, No. 2954 distance 4·6″ bearing 138° to the dolerite contact at Police Point. The dip of these beds is 5°-8° bearing 155°, but the faulting, together with the lack of a stratigraphic marker horizon, makes it impossible to calculate a thickness. The section up the hill to the Basal Grits from sea-level gives a total of 450 feet here at a maximum.

The next block of sediment dips at 12° bearing 220° from Desolation Bay to beyond the area along the coast and its south-western boundary lies over the transgressive sill behind Police Point and extends to beyond Glendevie.

Along this western boundary, the dolerite transgresses from the Knocklofty beds at about 100 feet above their base until it lies along the " Felspathic " Sandstone under the ridge behind the shelf here.

Although there are big lineaments cutting across this plateau, no definite proof of movement was found in this area. The syenite-porphyry dyke is elongated so that it has the same orientation as some of the joints in the sandstone. This together with the intense slickensides present in the syenite suggests that it intruded along the jointing and that later movement took place in the same line of weakness. The attitude of the slickensided surfaces suggests that the south-eastern side was downthrown but the movement was small as the Ferntree outcrops on both sides with no great change in lithology.

The stratigraphic succession in this area is as follows:—

	Feet
Dolerite	800-1000
"Felspathic" Sandstone	50-100
Knocklofty Sandstone and Shales	450-500
Basal Grits	20
Ferntree Mudstone	70

These heights were taken with an aneroid barometer under variable atmospheric conditions and are not entirely satisfactory but the order of magnitude is indicated by them.

It can be seen that this area is formed of a number of sedimentary blocks which have been floated up and tilted in the dolerite as it was emplaced so that the dolerite body at the base of one block of sediment is over the next block to the north. This means that each block is faulted off and the fault filled with dolerite. On the rising ground inland, the sill forming the ridge covers the inland edge of every block.

The Permian sediments rise to a height of perhaps 200 feet in the Brooks's Bay area, but, in the Stanmore area, their base stands at 400 to 500 feet. This means that a fault upthrowing to the southern side at least 200 feet must run between these two areas. This could, in a similar manner to the faults occupied by dolerite dykes postulated elsewhere, be the core of the sill here or perhaps the fault that passes near the centre of Adamson Run 3 No. 25154, causes this movement. This fault has not been found on the ground in this area where it would traverse the dolerite but it has been mapped by R. Ford in the neighbouring area to the west.

Summary of Structure

To summarize, this area is dominated structurally by the dolerite intrusions of the Jurassic and the associated faults. The area is intensely jointed but no big faults are known over most of the area. The later period of faulting has taken place breaking across the dolerite, but in contrast to the country west of this area where this faulting, which, based on information from outside this area, is Lower Tertiary in age, controls the structure, it is here very subdued and hardly detectable.

Geological History

The geological history of this area began in the Kungurian Epoch (Banks 1952) with richly fossiliferous deposits from a low glaciated terrain under conditions approximating to those of the Ross Sea today. Icebergs dropped large erratics on to the sea floor where a coarse poorly sorted sand was accumulating.

As the epoch passed, the increasing frigidity killed off all life in the sea but some plants still supplied fragmentary evidence of life. The deposits became coarser as the sea became shallower. The landscape in metamorphic and acid igneous rocks remained low but, as the ice erosion continued, a new predominantly quartzite level was reached at the end of the deposition of the Woodbridge Glacial Formation.

With the coming of a more temperate climate, the agents of transportation weakened and the Ferntree beds were laid down from the same low terrain. Marine life here failed to recover but the dark colour

of these rocks and the abundant "fucoids" show that plant life had recovered to some degree. This plant life reached a maximum during the deposition, probably during the Tartarian Epoch, of the Cygnet Coal Measures. The climate was probably temperate to frigid at this time.

A second major pulse of the distant Hunter-Bowen orogenic belt (the first probably occurred at the time of deposition of the Risdon Sandstone) apparently raised the area above sea level at the end of the Permian deposition since the Cygnet Coal Measures have been deeply eroded.

This break in deposition was followed by deposition under monsoonal conditions of the Basal Grits. The seasonal aridity of the early Triassic is shown by the colour of the beds and the presence of salifers. Apparently, deposition took place in a series of shallow fresh-water lakes which dried out periodically to swamps covered with vegetation, sand, and mud. During wet seasons, great streams cut across the dried areas and lakes forming the symmetrical current-bedding.

The deposition of the shales and sandstones indicate that water level fluctuated a good deal and that deposition was probably from low hills separating the lakes and coal swamps formed as the climate became warmer. At about the time of formation of the coal, the volcanic activity heralding the intrusion of the dolerite increased resulting in the formation of the tuffaceous Felspathic Sandstones.

This period of deposition was terminated by the Jurassic faulting and the widespread intrusion of sills and dykes of dolerite. Following this intrusion the sedimentary cover has been removed from the uplifted dolerite blocks leaving no trace and, sometime subsequent to this intrusion, the syenite-porphyry was intruded.

After this peneplanation, the Lower Tertiary faulting occurred cutting across all the sediments, the dolerite, and the syenite-porphyry. This faulting gave the region its present outline and its present topography has been carved from the fault blocks by erosion.

No age can yet be given to the various clay and gravel deposits but it is thought that they and the levels on which they have accumulated are the result of the Pleistocene glaciation.

Very little deposition, except near the mouth of the Esperance River, is taking place at the present time. A minor deposit of sand is being placed along the banks of the Creekton Rivulet but elsewhere the streams are rapidly cutting down their beds. Aided by the removal of the vegetation by bushfires, the sandy weathered surfaces of the Triassic sediments are being eroded very rapidly in some places. As a rule though, the vegetation grows rapidly enough to prevent the denudation of even the steepest slopes.

ACKNOWLEDGMENTS

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I wish to thank the Granton Brick Pty Ltd. for the aid given in examining their clay deposit at Dover, for the frequent use of their living quarters and for transport during field work.

Thanks are extended to Dr. J. S. Hosking for permission to work in the laboratory of the Masonry Investigation Branch of the C.S.I.R.O. and to all members of the staff of this Branch.

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Locality Index

Brook's Bay	43° 14′	147° 2′
Claremont	42° 46′	147° 16′
Dover	43° 19′	147° 1′
Glendevie	43° 14′	146° 59′
Police Point	43° 15′	147° 3′
Raminea	43° 20′	147°
Roaring Brach	43° 18′	147° 5′
Southport	43° 27′	147°

GEOLOGY OF TASMANIA

STRATHBLANE

48-66

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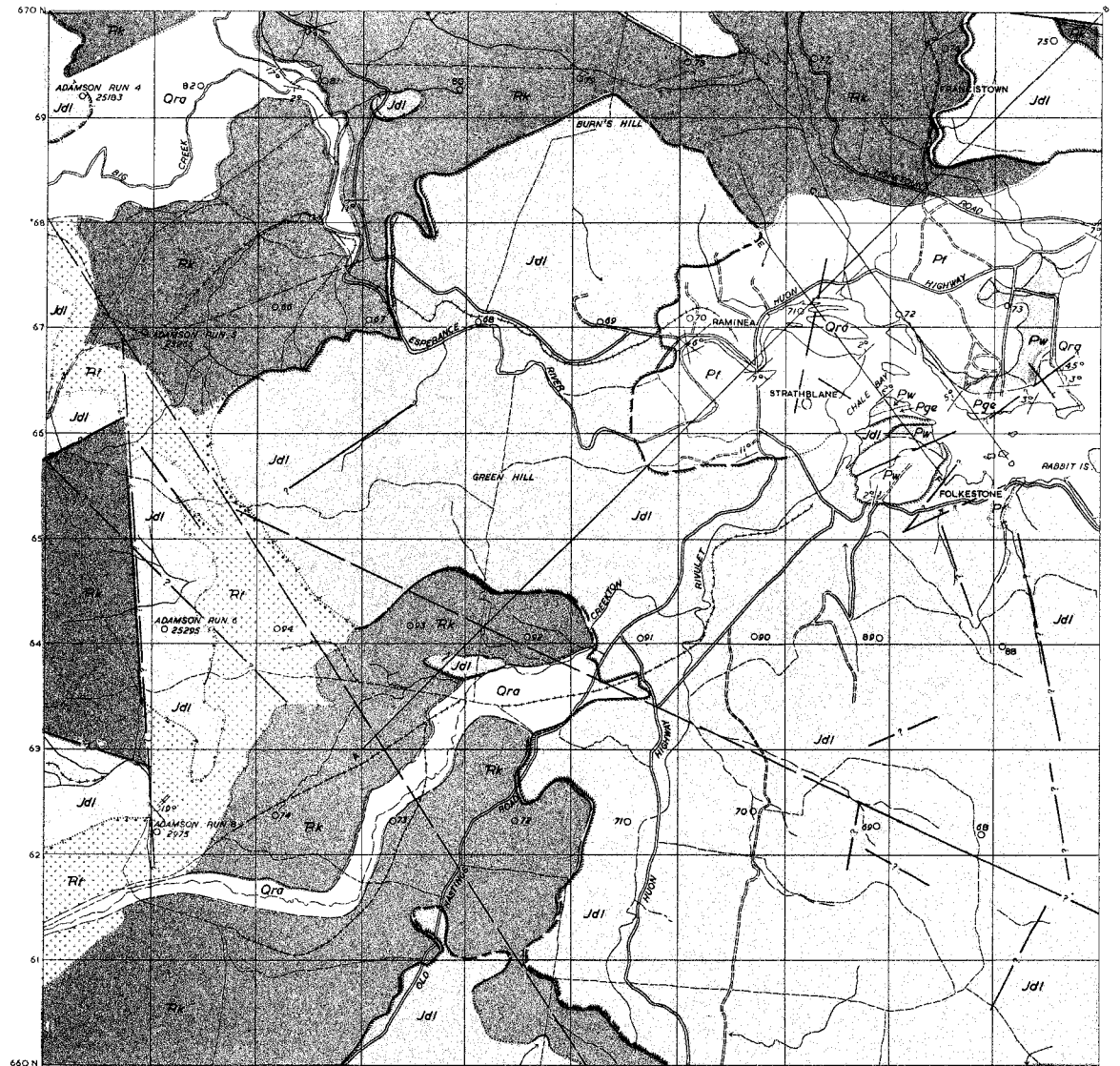

— FAULT WITH DOWNTHROW SIDE INDICATED
— FAULT — POSITION APPROXIMATE
—?— FAULT INFERRED
— FORMATION BOUNDARY
·····?····· BOUNDARY CONCEALED
DOLERITE BOUNDARIES
— CONCORDANT SILL
— DISCORDANT INTRUSIVE BOUNDARIES
— DISCORDANT INTRUSIVE BOUNDARIES WITH CONCOMITANT FAULTING
JOINTS
70° STRIKE AND DIP
ROADS
VEHICULAR TRACK
TRACK
DISUSED TRAMWAY
TELEPHONE LINE

— SCALE —
0 1 2 3 4 5,000 10,000
2 MILES

KEY MAP SHOWING MAGNETIC VARIATIONS
9° 50' E
10° E
10° 50' E

Compilation from Aerial Photographs. Trigonometric Station Control by courtesy Lands and Surveys Dept. Origin of co-ordinates 400,000 yds. West and 1,800,000 yds. South of True Origin of Zone 7.

MAPPED AND COMPILED BY
G E HALE *JANUARY 1952*

Quaternary System
RECENT SERIES
Qra ALLUVIUM
Triassic System
Rf FELSPATHIC SANDSTONE
Rk KNOCKLOFTY SANDSTONE AND SHALE
Permian System
Pf FERNTREE MUDSTONE
Pw WOODBRIDGE GLACIAL FORMATION
Pge GRANGE MUDSTONE
Jurassic System
Jdl DOLERITE

GEOLOGY OF TASMANIA

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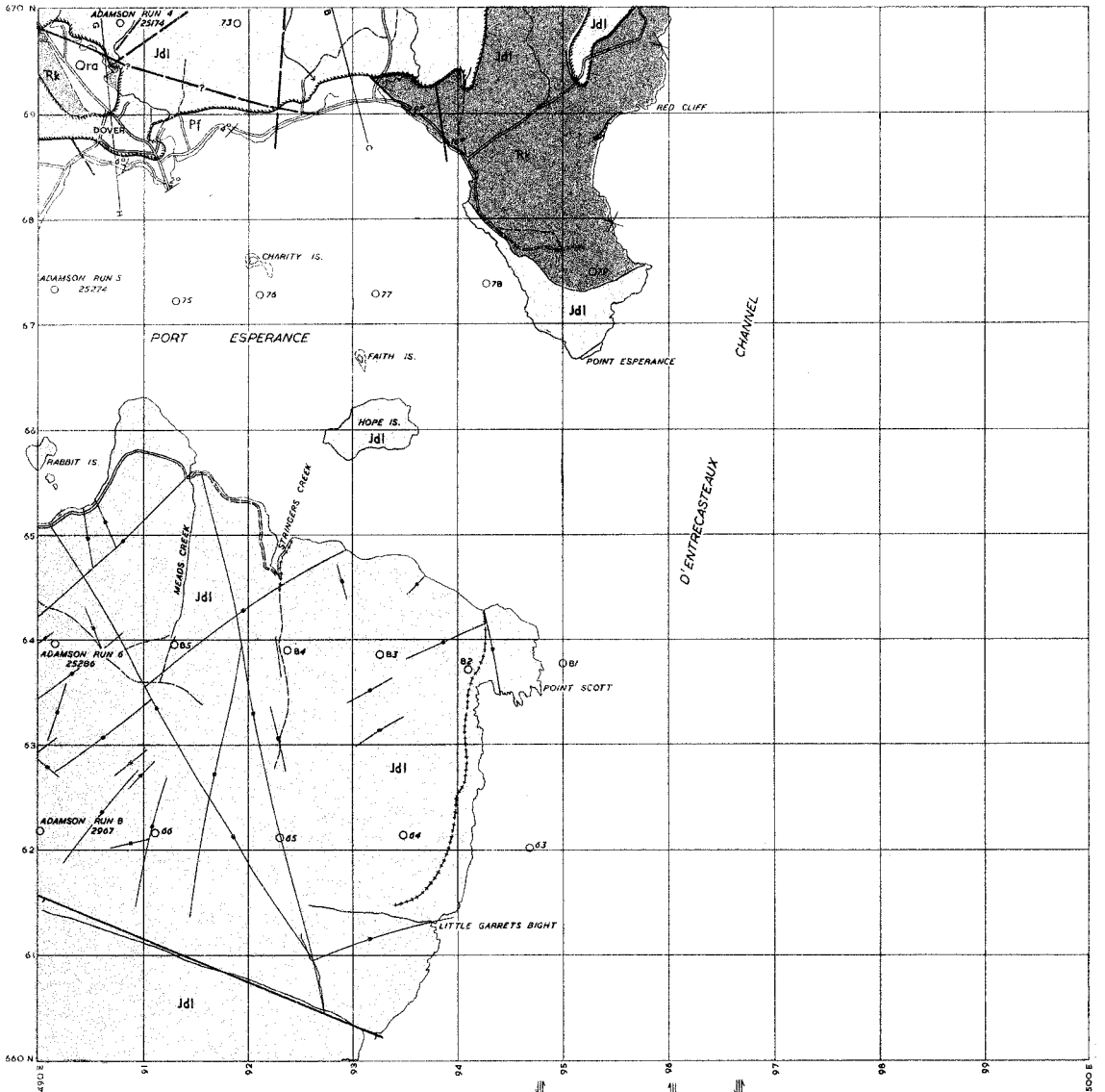
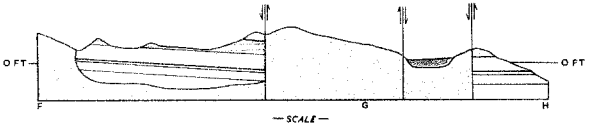
DOVER

49-66



For section line F-G and section B-C see Police Point, map square 49-67.



— SCALE —

0 1 2 MILES

0 1 2 3 4 5,000 10,000

- FAULT WITH DOWNTHROW SIDE INDICATED
- FAULT — POSITION APPROXIMATE
- FAULT INFERRED
- FORMATION BOUNDARY

DOLERITE BOUNDARIES

- CONCORDANT SILL
- DISCORDANT INTRUSIVE BOUNDARIES
- DISCORDANT INTRUSIVE BOUNDARIES WITH CONCOMITANT FAULTING
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- ROADS
- VEHICULAR TRACK
- TRACK
- DISUSED TRAMWAY

Compilation from Aerial Photographs. Trigonometric Station Control by courtesy Lands and Surveys Dept. Origin of co-ordinates 400,000 yds. West and 1,800,000 yds. South of True Origin of Zone 7

MAPPED AND COMPILED BY G E HALE JANUARY 1952

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Jurassic System
- Jdl DOLERITE

GEOLOGY OF TASMANIA

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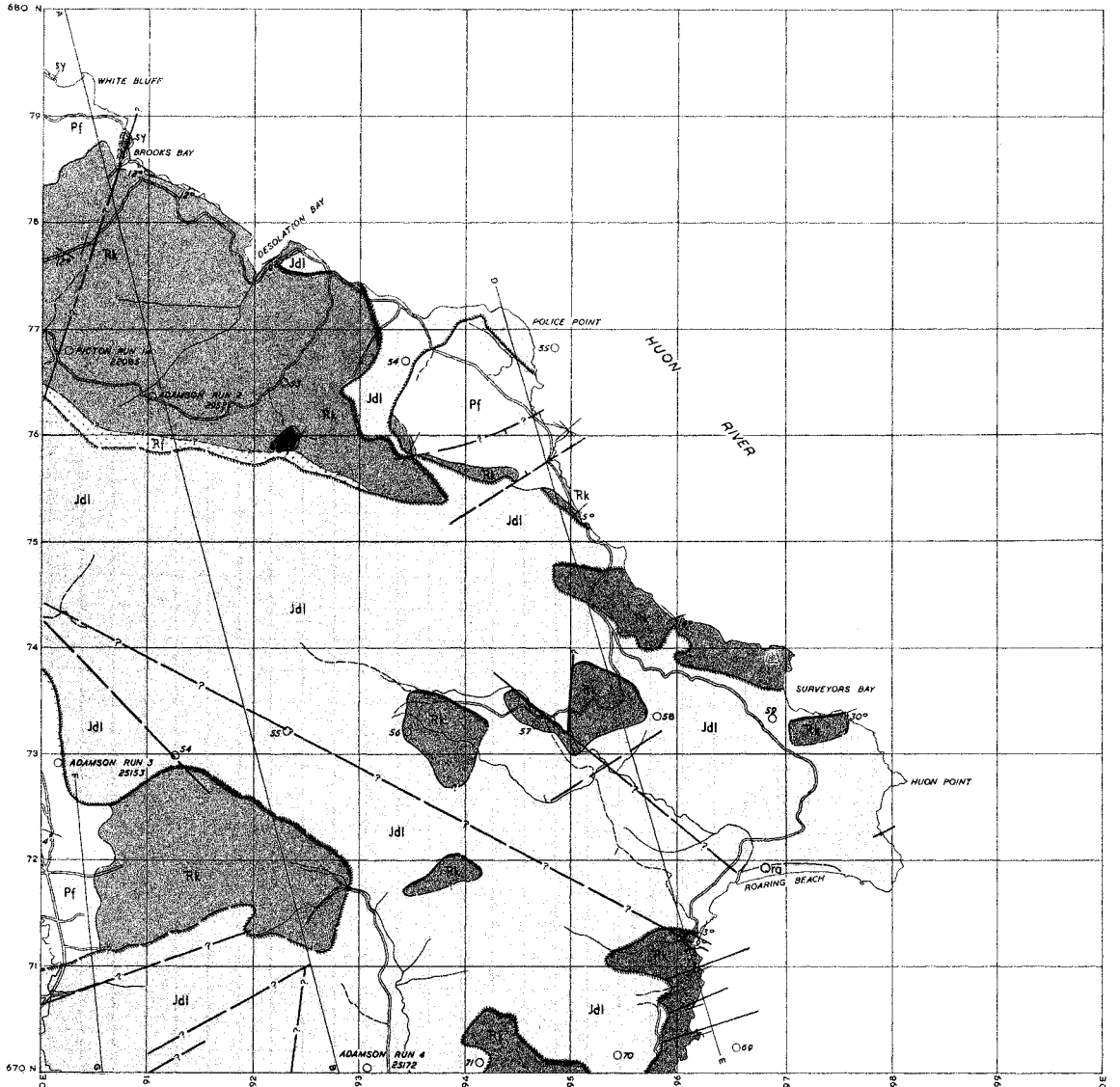
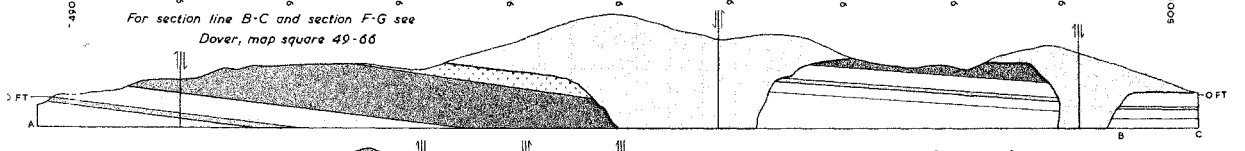
POLICE POINT

49-67



For section line B-C and section F-G see Dover, map square 49-66



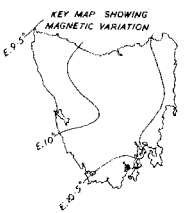
FAULT WITH DOWNTHROW SIDE INDICATED
FAULT – POSITION APPROXIMATE
FAULT INFERRED
FORMATION BOUNDARY
DOLERITE BOUNDARIES
CONCORDANT SILL
DISCORDANT INTRUSIVE BOUNDARIES
DISCORDANT INTRUSIVE BOUNDARIES WITH CONCOMITANT FAULTING
JOINTS
STRIKE AND DIP
ROADS
VEHICULAR TRACK
TRACK

— SCALE —

0 1 2 3 4 5,000 10,000

0 2 MILES

KEY MAP SHOWING MAGNETIC VARIATION



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SYENITE