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Geology of Portion of the Middle Derwent Area

By

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(WITH 5 PLATES AND 1 TEXT FIGURE)

ABSTRACT

A geological map is presented of an area of some 160 square miles lying between the Middle Derwent and Gordon Rivers. Ordovician limestone abcut 5000 feet thick followed by about 4000 feet of Silurian and Devonian sandstones and shales are folded into a major syncline. These rocks are overlain by less than 1000 feet of Permian sandstones, mudstones and glacial beds and more than 1000 feet of Triassic, freshwater sandstones and shales. The Permo-Triassic rocks are intruded by thick sills and transgressive bodies of dolerite in which large blocks several square miles in area are isolated. Prolonged peneplanation was followed in the early Tertiary by intense epeirogenic faulting forming horsts and graben, the latter being rapidly filled by lake sediments and extensive basalt flows.

INTRODUCTION

The area described is located along the Derwent River from near its junction with the Nive River south-eastwards to just beyond its junction with the Broad River. It extends to the west as far as the Gordon River and includes a large part of the Florentine Valley and portion of the Rasselas Valley. The maps extend about 4 miles east of the Derwent in map square 4577. The total area is approximately 160 square miles. Most of this is heavily vegetated with a range from Notofagus rain forest (up to 70 inches of rain per annum) and eucalypt forest, to savannah woodland and some button grass plain. The heavy vegetation conceals outcrops and greatly impedes movement.

Most of the field work has been carried out by tracing geological boundaries on the ground and transferring these on to aerial photographs. Locally, chain and compass traverses were used, and in the area north-east of the Derwent on map square 4477, a number of existing stadia traverses were used as a control. The Eldon Group rocks which comprise the Gordon Range were mapped largely by photo-geological interpretation, in conjunction with a short ground traverse from either side of the range, to establish the age of these rocks.

The base plans were prepared from aerial photographs using the slotted template method, and all available trigonometrical control. This work, together with the draughting, was carried out by the Survey Section of the Hydro-Electric Commission.

At the time of mapping, little vertical control was available throughout the area and a number of spot heights from aneroid readings were obtained. These heights, together with more recently established bench marks, are indicated on the geological plans.

PHYSIOGRAPHY

The eastern portion of the area consists of steep, rounded, basalt hills north-east of the Derwent. West of the Derwent the country rises steeply at first, to an elevated plateau which slopes gently north-north-east from the Misery Range to the hills forming the west bank of the Derwent. Further west from Mt. Misery, the country falls abruptly to the floor of the Florentine Valley, which reaches a maximum width of about 3 miles near the Settlement. Further downstream from this point, the valley becomes much narrower where the river passes through a dolerite gorge. The west wall of the Florentine Valley is formed by the eastern slopes of the Gordon Range, and the area between the Florentine and Rasselas Valleys is occupied by this Range. The Gordon Range consists of a series of high, parallel, hogback ridges formed by the outcrop of steeply dipping Eldon Group rocks. The Rasselas Valley, occupied by the Gordon River, is a typical button grass plain, a common feature in the south and south-west of Tasmania.

The physiography of the area is controlled closely by the composition and structure of the underlying rocks.

The Derwent Drainage Area.

The steep rise in elevation to the west of the Derwent, is due to the upthrown dolerite sill, which reaches a maximum elevation of about 2500 feet at the Misery Range, and slopes back gently from this Range to the complex post-dolerite fault system running north-north-west along the west bank of the Derwent. East of this fault system, and running parallel to it, is a further fault which is downthrown to the south-west, thus forming a structural trough along which the present Derwent River runs.

The trough has been filled by Tertiary lake sediments and basalts. The latter, in one case, has overflowed the trough, flooding part of the country to the north-east. The Derwent River was born as a result of the post-dolerite faulting, at first as a series of lakes along the floor of the trough, in which it deposited clays, sands and gravels. The later basalts filled the trough so that the course of the Derwent was modified, probably being controlled by the distribution of the various lava flows, and any older rocks which may have protruded through the basalts. This course has since been deeply incised into the underlying Triassic sediments and dolerite.

All the tributaries which join the Derwent from the west are young streams with steep gradients whose courses are strongly influenced by fractures within the uplifted dolerite block. The tributaries from the east have rather more complicated profiles. Where they tumble down over the eastern escarpment of the trough, they are young active streams. Where these streams flow along the trough they have the characteristics of mature streams but become young and active once again as they fall sharply into the Derwent. The Derwent has been able to cut more deeply into the floor of the trough than these small tributaries, thus causing the steep profiles near the junction of these streams.

The Florentine Drainage Area

The Florentine River shows two quite distinct profiles. In the upper part, where the river flows through limestone, it is quite flat and relatively mature. Downstream of this, the river flows first over Permian then Triassic sediments, and finally Jurassic dolerite, before joining the Derwent. The river becomes increasingly steep and exhibits all the features of a youthful stream.

Further interesting features of this valley in its upper reaches are that whilst it has a broad, flat section similar to the Rasselas Valley, its floor is about 200 feet lower, also the valley is never quite as mature as the Rasselas because the base level of erosion is being continually lowered just fast enough to prevent the development of an entirely mature valley.

Loftus Hills (1921) and Twelvetrees (1908) have both reported relicts of high level river terraces, probably higher up the valley and outside the area mapped. The vegetation in this valley is also indicative of its state of maturity. It should be noted that the dense vegetation is due to better drainage in the Florentine than in the Rasselas Valley.

Taking these facts, together with the structure and topography, an interesting picture of the development of this valley emerges. The Florentine River was initiated shortly after the final movements of the Tertiary epeirogenesis. It was first formed in a small, structural trough in a downthrown block between the Gordon Range and the Misery Range faults. Possibly at an early stage it flowed due west through the gap between the Gordon and Tiger Ranges and joined the Gordon River slightly upstream of the present Big Bend. Its development was arrested by quartzite bands in the Eldon Group rocks and a tributary of the Gordon, cutting back around the end of the Tiger Range in limestone, eventually captured it and for a while it flowed on an almost exactly opposite course to the present one. In other words, the present Huntley River would be the beheaded remnant of a stream which formerly had its watershed on the Misery Range.

This course persisted for some time but the development of the Gordon River and its tributaries above the Big Bend was slowed down by a resistant bar of Owen Conglomerate between the Thumbs and Mt. Wright. At the same time, a young and very active tributary of the Derwent, now the lower part of the Florentine, was cutting its way back along a series of shears towards the head waters of the Florentine River at that time. Eventually this stream captured the Florentine and because it has been able to lower its base level more rapidly through dolerite than the Gordon has been able to cut through the Owen Conglomerate, it has completely reversed the drainage of the Florentine, lowered the base of the Florentine Valley faster than of the Rasselas Valley, and will very soon capture the head waters of the Gordon itself.

The Gordon Drainage Area

The Gordon River, where it flows through this area, meanders in a mature fashion across the broad floor of the limestone Rasselas Valley. The limestone, for the most part, is obscured by superficial deposits of Pleistocene fluvio-glacial deposits and Recent river gravels. Tributaries of the Gordon arising in the Gordon Range, show well developed, rectangular drainage pattern typical of folded rocks.

STRATIGRAPHY

Although more than half the area is covered by intrusive dolerite, sediments ranging in age from Ordovician to Recent are exposed:—

		Approximate Thickness in feet.
Recent:	River gravels and fluvioglacial deposits	
	DISCONFORMITY	
Tertiary:	Basalts	1,300
	Fault trough lake sediments	300
	UNCONFORMITY	
Triassic:	'Feldspathic' Sandstone	260+
	Knocklofty Sandstone and Shale	500+
	Ross Sandstone	300+
	DISCONFORMITY?	
Permian:	Ferntree Mudstones	250+
	Woodbridge Glacial Formation	250
	Sandstones and Mudstones	100
	UNCONFORMITY	
Siluro-Devonian:	Eldon Group	4,000
Ordovician:	Gordon Limestone	5,000

All the rocks older than the Permian have been folded, and show evidence of having suffered at least two periods of earth movements. Owing to the lack of fossil evidence in the Triassic sediments and the absence of any sediments between the early Jurassic and Lower Tertiary, the age of the dolerite cannot be accurately determined. The writer has followed the Geological Survey, Hills and Carey, and others, in assuming that the dolerite is of Jurassic age. Similarly, the age of the basalts cannot be fixed precisely but there is no clear reason to insist that they are older than Tertiary.

Gordon Limestone

Limestone was first reported in this area by Gould (1861, footnote). Later, Twelvetrees (1908) reported that the Gordon Limestone in both the Rasselas and Florentine Valleys and described it as Lower Silurian (Ordovician) age, and recognised the synclinal structure. Hills (1921) also described the limestone in both valleys, but assigned a Silurian age to the formation.

Recent work on this formation in the Zeehan area by Gill (1950), tends to confirm the age as Ordovician, but with some reservation. Hills and Carey (1949) ascribe an Ordovician age to the formation and suggest that it ranges from the Lower Ordovician to near the top of the Ordovician. Fossil determinations by Opik (1951) from material collected in the Florentine Valley suggest an age ranging from Middle to Upper Ordovician, but the bottom of the formation is not well exposed, and is complicated by the Misery Range fault, the position of which is difficult to locate exactly.

The lithology of the formation varies considerably from pure limestones through arenaceous and argillaceous varieties, to slates and sandstones. The exact proportions of the impure types is difficult to determine because of the poor outcrops, but certainly, in this area, slates and sandstones form minor proportions. The limestone is a dense, blue-grey rock containing occasional nodules of pyrite; it has a distinctive, fetid odour when freshly broken. The impure varieties have a banded or foliated appearance in outcrop, and split with difficulty along the impure bands. Fossils are frequently found on the weathered faces, in a good state of preservation, apparently being less soluble than the limestone. The formation is fossiliferous throughout, but certain horizons are more fossiliferous than others.

In outcrop, the rock exhibits solution flutings. It is closely jointed in general, and intensely sheared in the vicinity of the faults. The deposition of calcite as veins along joints is common. The rock weathers to a black to reddish, ferruginous loam which is highly fertile where adequately drained. Deep weathering is a feature of this limestone throughout the west and south-west of Tasmania. For this reason, there is always a marked lack of outcrop in limestone areas, and this is particularly so in the Rasselas Valley where the residual soils form a grey-black pug overlain by extensive alluvial deposits. Underground drainage is common in both valleys, and many caverns and sink holes occur in the Florentine Valley. The caverns consist of solution openings along both joints and bedding planes, but with a preference for the joints. They cannot be traced for any distance on account of the low relief and high water table.

The width of the limestone outcrop in the Florentine Valley is about 11,000 feet and the average dip is about 30°. This gives a very approximate thickness of about 5000 feet.

The limestone is overlain by the Eldon Group rocks, apparently conformably, but the outcrops are too poor to discount the possibility of a disconformity between the two groups, as suggested by Gill (1950). However, there appears to be no great change in strike between them. The formation is overlain unconformably by the Permian rocks, which form the base of the Misery Range. No older rocks than the limestone are exposed in this area.

Eldon Group

These rocks form the Gordon Range lying between the Florentine and Rasselas Valleys and reach an elevation of about 2500 feet. As mentioned above, they appear to overlie the Gordon Limestone conformably. The rocks are folded into a syncline and outcrop as a series of steep, hogbacked ridges, which are particularly suitable for photo-geological interpretation. They have therefore been mapped by this method in conjunction with a short traverse into the basal member, from either side of the Gordon Range. Fossils found on these traverses have definitely established the rocks as belonging to the Eldon Group, but no definite correlation has been made with the formations of the Eldon Group.

The basal member of the group consists of interbedded, white quartzite and friable sandstones, with occasional gritty and conglomeratic bands. It contains some indistinct tubicolar structures and at least one band packed with poorly preserved crinoid columals.

The rocks are folded into a broad syncline which pitches gently to the north and is cut by a series of faults. These rocks were first described by Twelvetrees as " sandstones of undetermined age " and later by Hills as Silurian sandstones. The most recent work by Gill (1950) places the age as ranging from Middle Silurian to Lower Devonian. A very rough determination of the thickness of the group from the known dips and width of outcrop, gives a thickness of the order of 4,000 feet.

Permian System

Rocks of this age outcrop under cover of dolerite along the east side of the Florentine Valley and south facing slopes under Wylds Craig. Over all this area the exposures are partly obscured by a cover of scree derived from the overlying dolerite sills. No complete section has been mapped in the area, but no doubt, with careful field work, the individual formations could be mapped.

The best exposure of the Permian strata is in the bed of the Florentine River about 2½ miles north of the Settlement. Here beds close to the base of the sequence are exposed as bars crossing the river. The lowest rocks are impure, pebbly marls containing poorly preserved gastropods and they are interbedded with, and underlie, quartz sandstones which contain rare, indistinct plant remains. Overlying the sandstones are pebbly mudstones and sandstones with fossiliferous bands. The top member of this is extremely fossiliferous, with zones packed with Spiriferids, Pectinacea and *Martiniopsis*. The pebbles in this formation are predominantly quartz and quartzite but there are also fragments of schist, slate, chert and limestone. The formation resembles the Woodbridge Glacial Formation.

Overlying this last formation is about 250 feet of dense unfossiliferous pebbly mudstone which lithologically resembles the Ferntree Mudstone. However, the outcrops in this formation are very poor as they directly underlie the dolerite sill forming Mt. Misery, and are for the most part covered by scree. Some blocks of sandstone, lithologically resembling the Risdon Member of this formation, have been located in this scree, but this member has not been identified *in situ*.

Taking the field evidence that is available, the section appears to be similar to the Permian section, as described elsewhere, but somewhat restricted in thickness:—

Lithology	Palaeontology	Approximate thickness ft.
Jurassic Dolerite (Intrusive)		
Pebbly Mudstones	No fossils observed	250+
Cherty Mudstone		
Greywacke Conglomerates	Spirifids, Pectinacea	
Pebbly Mudstone	*Martiniopsis, Fenestella*	250
Silty Sandstone	Indistinct plant remains	
Pebbly Marl	Small, poorly preserved gastropods	100
Unconformity		
Gordon Limestone		

There is no evidence to show whether the dolerite capping the Misery Range is intruded at the top of the Ferntree Mudstone or not. If it is, this would make that formation very much thinner here than elsewhere.

The Permian rocks are block faulted, closely jointed and tilted, but are not folded. They are not deeply weathered where exposed, on account of the steep slopes, which cause the rapid removal of products of weathering to form extensive scree deposits mixed with fragments of the overlying dolerite sill.

These rocks overlie the Gordon Limestone with a marked unconformity. The actual junction between the two formations is not exposed, but the field evidence, lithology and structure of the Permian rocks favours the interpretation of this contact as an unconformity, rather than a fault. There is no evidence of faulting at the boundary between the rocks and the shape of the boundary certainly does not favour its interpretation as a fault.

Triassic System

Rocks of the Triassic System are the commonest sedimentary rocks throughout the area, and have been mapped in three of the map squares. The quartz sandstones in this system usually outcrop well, and some sections have been measured, but the shales are usually deeply weathered and outcrops are rare. However, a number of diamond drill holes have been drilled in connection with investigations for the Wayatinah B power development in map square 4477 and these provide a good deal of useful stratigraphic information on this system.

However, despite this drilling, great difficulty has been found in correlating between some of the drill holes, owing to rapid facies variation and to the lensing out of beds over short distances. Apparently little reliance can be placed on colour variation, as this appears to be in part at least, a function of the ground water conditions, and the degree of weathering. The general lithology of the members does not lend itself to definite correlation, as individual members, or even groups of members, cannot be identified with certainty over any distance. Correlation on fossil evidence is unreliable with the present state of knowledge of the plant fossils. Since many such zones are present, fossil zones in themselves cannot be used for correlation.

Whilst the lack of detailed correlations, even with the aid of diamond drilling, is to be regretted, it should be taken as a warning against such correlations based on limited field sections measured in different localities. Extremely detailed investigations in similar sediments carried out for the investigation of various sites for the Warragamba Dam in New South Wales, founded on the Hawkesbury Sandstone, have been described by Browne *et al.* (1951). The sections drawn as a result of those investigations also serve to illustrate the complexity in detail of such sediments.

Despite the difficulty of detailed stratigraphy within the sequence, it is quite clear that at least two distinct formations can be recognised, namely the Knocklofty Sandstone and Shale and the 'Feldspathic' Sandstone. The basal sandstone member of the Knocklofty Sandstone and Shale is over 300 feet thick, and may well merit recognition as a separate formation. If so, it is equivalent to the Ross Sandstone of Hills *et al.* (1922).

Ross Sandstone

As mentioned above, over 300 feet of this formation has been encountered in drill hole 8525. It consists of cross-bedded, medium-grained, quartz sandstone. In outcrop it is yellow, but in drill cores it is usually grey with some minor purple and pink bands. The sandstone is micaceous throughout and contains some bands, or lenses, of mica up to 2 feet thick. Claystone bands, never more than 3 feet thick, and clay pellet conglomerates are present as thin bands scattered throughout the formation. Occasional beds of coarse sandstone have been recovered in the cores, but none of the above features are sufficiently persistent to be used as marker horizons.

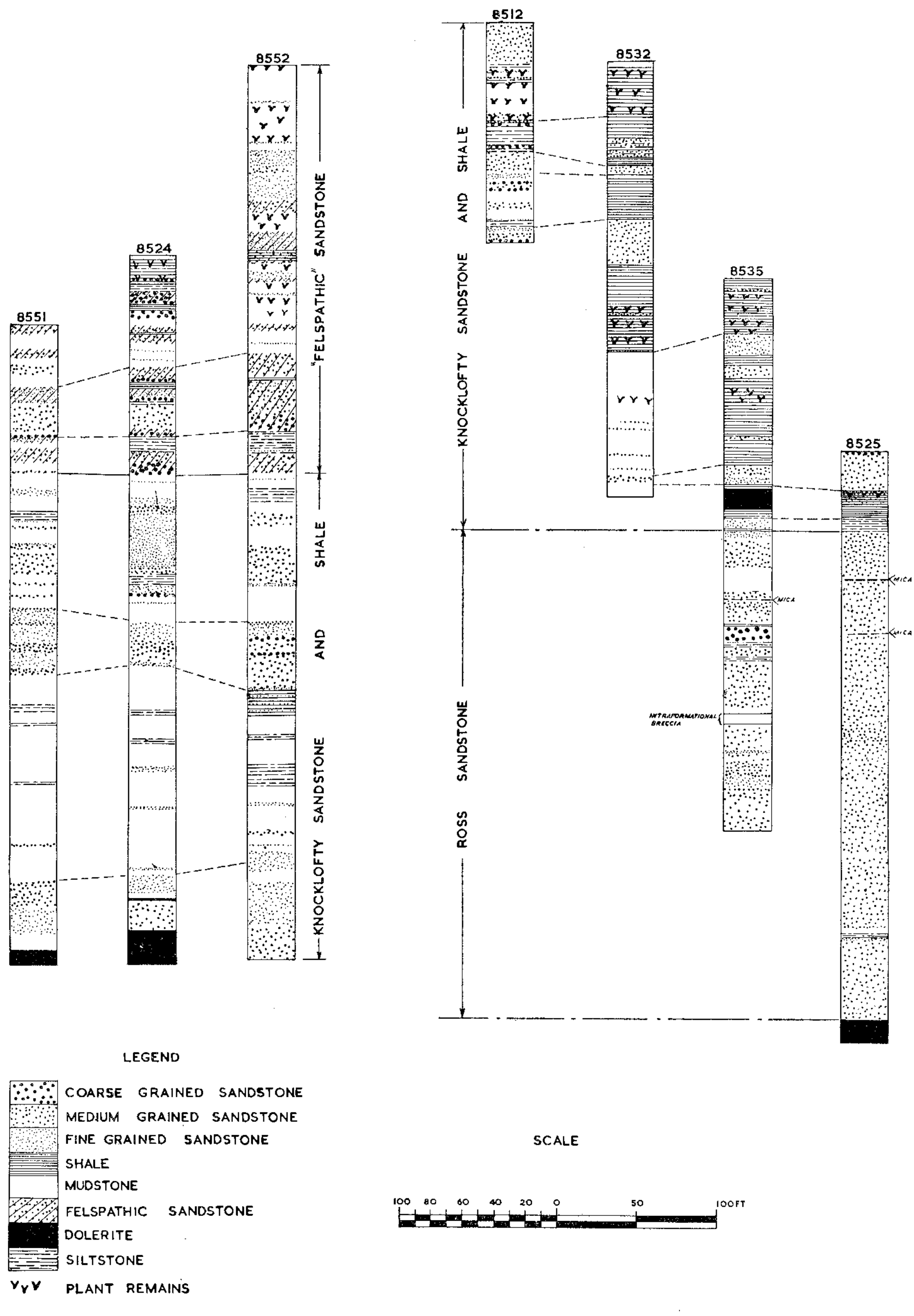
Where this rock outcrops on the east bank of the Derwent, opposite the Florentine junction and along the Florentine River, in the extreme south-west of map square 4477, the sandstone contains sub-angular fragments of milky quartz distributed throughout. These sections may be lower in the formation than the drill cores. The stratigraphy of part of the formation is indicated in the bore logs shown in the text figure.

Knocklofty Sandstone and Shale

Overlying the Ross Sandstone is at least 500 feet of alternating sandstones and shales. The stratigraphic sequence in this formation is broken by the faults indicated on the maps, and the formation could be much thicker than this. Outcrops are poor throughout the area and the stratigraphy is based on the diamond drill cores.

The formation consists of interdigitating sandstones, shales, claystones and mudstones. The sandstones vary from fine-grained and silty types, to coarse grit bands. They are predominantly silicious but the upper sandstone member, just beneath the 'Feldspathic' sandstone is a 'spotty' quartz sandstone containing about 10 per cent of kaolinised feldspar. The sandstones throughout are micaceous, and graphite is present along some of the bedding planes. Sedimentary structures are difficult to interpret from the drill cores, but cross bedding is exhibited by almost all the sandstones, and certain of the cores suggest contemporaneous faulting and slumping in the sediments.

GENERALISED BORE LOGS. WAYATINAH B AREA



The argillaceous sediments range in grain size from dense, cherty mudstone, through silty mudstones, siltstones and silty sandstones. Shales and claystone bands interdigitate with the sandstones and are usually thinner than the mudstone members. Between individual beds the boundaries may be either very sharp or gradational. The general colour of the sediments in drill cores is grey, but pink, green, purple, black and white bands are present. The shales and siltstones particularly, are micaceous and contain many fossil horizons. Clay pellet conglomerate bands up to 2 feet thick do occur, but they rarely exceed 6 inches.

The formation apparently behaved as a receptive host rock for the dolerite intrusion, as minor intrusions are common, particularly in the shale members. Near such contacts there is some hardening of the shales, but very little other metamorphism.

The thick bed of dense mudstones encountered in drill holes is somewhat unusual for Triassic rocks. Elsewhere in Tasmania, the argillaceous Triassic sediments are usually thinly bedded, fissile shales. Whilst many such shale beds are present in this area, over 100 feet of hard mudstones are present. The core is a dense, brittle mudstone, dark-grey to purple in colour, with a distinct mottling of purple blotches. Some thin silt and sandstone bands are interbedded with the mudstone. No fossils have been found in this part of the core.

The rock has the appearance of having been hardened by regional metamorphism, but this is difficult to believe in view of the extremely local effects produced by the dolerite elsewhere. They exhibit a degree of lithification almost as high as the Permian mudstones. Since this member has only been located in drill cores, it is difficult to offer any firm explanation for the phenomenon. It may be that this is a more common feature of Triassic rocks than is generally realised but it is masked in outcops by surface weathering. Drill holes of comparative depth through Triassic sediments in other parts of the State have not revealed similarly hardened mudstones, but all such holes of which the writer is aware may have been somewhat higher in the Triassic System.

As previously mentioned, no sign of coal seams has been found anywhere in the formation, but plant remains are abundant at certain horizons. No marine fossils have been found whatsoever. The formation passes upwards conformably into the 'Feldspathic' Sandstone. Detailed stratigraphy of the portions of the formation penetrated by bores is shown in fig. 1.

'Feldspathic' Sandstone

This formation forms the uppermost beds of the Triassic System, and is overlain unconformably by Tertiary gravel and basalts. Generally, the formation is deeply weathered and covered by basalt scree. The boundary indicated on the geological map has been determined by obtaining approximate structure contours from drill holes, and plotting these on a contour plan of the area. The formation is dislocated completely by the fault cutting across the Wayatinah B tunnel line.

The base of the formation in this area has been taken as the lowest bed of 'feldspathic' sandstone encountered in the drill holes. However, as there is considerable facies variation and lensing of beds in this area, the base cannot be claimed as being defined in any way. This gives a thickness of at least 260 feet in this area. A further drill hole north-east of this area encountered 360 feet of feldspathic sandstones under a cover of basalt. However, the structure is not known in that area and some beds could be repeated by faulting.

The formation consists of ' feldspathic ' sandstones ranging from fine to coarse-grained, interbedded with siltstones, shales and mudstones. Many of the shale bands contain plant remains. The shales are fissile and micaceous, and again, like the Knocklofty Shales, usually grey and black in colour but sometimes purple, pink and green.

Analysis of the drill cores shows that colour cannot be used as a criterion for identification or correlation but that the colour variation is a function of ground water conditions and the degree of weathering.

As with the Knocklofty Sandstone and Shale, cross bedding, clay pellet conglomerates, and slump structures are a feature of this formatilon. Certain of the sandstone bands have a calcareous matrix and effervesce with acid. The portions of this formation encountered in the drill cores is shown in fig. 1.

Tertiary System

In the interval between the intrusion of the dolerite and the Tertiary faulting, lateritic bauxites were formed on those portions of the land surface where the dolerite was exposed. The laterisation probably occurred towards the end of this interval after the highlands had been denuded, and the surface approached a peneplain. This bauxite has been preserved in down-faulted blocks which were quickly covered by Tertiary sediments and basalts. An exposure of such bauxite underlying Tertiary basalts is indicated towards the north-east of map square 4577. The age of this rock is open to some doubt, and its inclusion under the Tertiary System is therefore tentative. The rock is ferruginous, pisolitic and reddish-brown in colour. It overlies the parent dolerite.

Sub-Basaltic Lake Sediments

Overlying the Mesozoic rocks unconformably, and underlying the Tertiary basalts, is a discontinuous series of lake sediments varying widely in thickness and lithology. The sediments occupy the floor of the structural troughs produced by Tertiary faults, and have been deposited very rapidly into the lower basins of these troughs. The rapid accumulation of these sediments is indicated by the poor sorting and sedimentary structures.

In map square 4577, the Tertiary sediments are mainly confined to the north-eastern portion of the square, and are exposed in cuttings along the Tarraleah Highway. The rocks comprise ferruginous sandstones and claystones displaying cross-bedding and slump structures. They are not highly lithified; some of the sandstones have a limonite matrix and contain limonite nodules. Being rather soft rocks, they form no outcrop except in cuttings, but their presence may often be detected by the limonite nodules scattered through a barren, sandy soil. In the exposures along the Tarraleah Highway, the limonite can be seen to be confined mainly to the bedding planes. It has apparently been introduced after the sedimentation, probably from leaching of the overlying basalts. The sediments contain some plant remains including dicotyledon leaves, but to date these have not been used to determine more precisely the age of these rocks. Some rounded gravels similar to those described below in map square 4477 have been mapped underlying the basalts in both branches of Black Bobs Rivulet where the base of the basalt is exposed. The thickness of the Tertiary deposits is variable, and it is estimated it is of the order of 300 feet in this area.

Underlying the basalts at Long Spur in map square 4477 is a fairly widely distributed deposit of well-rounded quartzitic gravels. From their stratigraphic position in relation to the structure, the gravels are of Tertiary age, yet they apparently contain no dolerite boulders. A close inspection of this horizon has revealed boulders of quartz, quartzite, schist, conglomerate, sandstone and basalt. A similar deposit is located in the same stratigraphic position on the extreme eastern margin of map square 4576, near the centre point of air-photo No. 17370 of King William, run 12. Again, in this case, no dolerite boulders have been located. The thickness of the gravels is difficult to assess, as the lower limits cannot be fixed with any accuracy, but they probably do not exceed 30 feet. Very close to the basalt, the gravel deposit has been extensively silicified to form a dense conglomerate (grey billy) superficially resembling Owen Conglomerate. Such material is exposed at the base of the basalts in the east branch of Black Bobs Rivulet on map square 4577, and again on map square 4576, opposite the mouth of the Broad River in the north-east corner of the map square. Blocks of similar material are to be found on the steep slopes under Long Spur.

The formation of such a deposit containing a little or no dolerite is somewhat puzzling in view of the fact that there is abundant evidence to show that much of the landscape at the time of deposition was composed of dolerite. However, one explanation of the formation of the deposit which is consistent with all the evidence available so far is offered:—

> Between the Jurassic dolerite intrusions and the Tertiary uplifts, widespread erosion took place, so that the land surface was reduced to a peneplain on which the bauxites were developed. In the west of the area, Eldon Group rocks projected through the peneplain surface as monadnocks, and further west and south outside the area, near the Thumbs-Mt. Wright area and Tim Shea, were further monadnocks of Owen Conglomerate and older rocks. Around the base of these hills, extensive talus deposits accumulated.
>
> If the first movement of the Tertiary faulting was to uplift the old core of Tasmania by the boundary faults along the Derwent trough, this would tilt the plateau so formed towards this trough. Renewed erosional processes which must have been initiated by this uplift, would quickly strip off the peneplain's lateritic crust and deposit it into the chain of lakes formed along the Derwent. The laterite was probably fairly thin and underlain by clays over the dolerite and Permian rocks, and by sands over the Triassic sandstones. All this material could be quickly eroded and easily transported, and therefore was swept

into the deeper parts of the Derwent trough. As denudation proceeded further, and before the dolerite bedrock was attacked, the outlying talus accumulations of older rocks would be transported down into the trough on top of the sands and clays already deposited. However, once in the trough, the boulders, being more difficult to transport than the finer sediments, would tend to accumulate as disconnected sheets, whose movement downstream would be barred by any lakes.

The basalt extrusions must have occurred before any wide scale erosion of the dolerite plateau had begun. However, basalts must have been extruded elsewhere before those in this area, to produce the basalt boulders in the gravels.

Tertiary (?) River Gravels

Just downstream of the Florentine junction, the Derwent has cut down through a series of old river gravels. These are composed of rounded dolerite pebbles, cobbles and boulders up to 2 feet diameter, in an abundant matrix of weathered dolerite. A good section through this material about 30 feet thick is exposed in the vertical banks of the river here. The deposit certainly belongs to an older cycle of erosion than the present one, but the exact age is open to some doubt, and they may well be Pleistocene. However, their degree of lithification is indicated by the fact that the material stands in vertical faces along the banks of the Derwent where this river is actively entrenching its course.

Basalts

As described earlier, the Tertiary faults were followed after a short interval by a series of basalt extrusions. These are largely confined to the graben-like structure along the Derwent. At one point near the north-eastern corner of map square 4577, the basalts have overflowed the trough and spilled over the fault scarp.

The basalts outcrop as a series of flows; individual flows rarely exceeding 60 feet in thickness. They vary from massive, columnar basalts, through vesicular types to scoriaceous agglomerates. The field characters of basalts in the Tarraleah area have been described by Prider (1948) and his descriptions match the field observations on the basalts in this area. Edwards (1950) has described the petrology of various basalts throughout Tasmania. From this work, he concluded that there were either two periods of volcanic activity, or else that contemporaneous eruptions of two different magmas occurred.

The field evidence in this area is not conclusive for either of Edward's suggestions. However, the rounded basalt boulders described previously in the sub-basaltic gravels show that if there were not two widely separated periods of vulcanism, then at least the period was long enough for erosion of the earlier basalts to have taken place before the basalts in this area were extruded. Certain other field evidence, such as the distribution of the various flows and their respective levels, also suggests two periods of vulcanism. However, the exposures are rather poor and the evidence cannot be taken as strong enough to establish this.

Where the basalts are exposed in a quarry alongside the Tarraleah Highway in map square 4577, lenses of Tertiary clays are interbedded between the various flows. The sediments consist of creamy white clays with indistinct plant remains. The clays have been laid down in depressions on the top of various lavas, and have been covered by later flows. The clays are not more than 6 feet thick, and most of the beds are thinner than this. In the outcrop, they are very irregular in shape, and although weathered, show signs of baking on the upper surface.

The shape of the base of the basalts indicates the pre-basalt topography in areas where the Tertiary lake sediments are thin or missing. For this reason, the boundaries have been mapped carefully where they are well exposed and aneroid heights are indicated along the boundaries at certain points. Further work on the subject of the pre-basalt topography is being carried out by Carey, and no details of this need be given in this paper.

Contact metamorphic effects of the basalts have been noted earlier in connection with the silification of the underlying gravels. Where the basalts are underlain by clays, the metamorphic effects are usually concealed by talus or landslides, which are common near the base of the basalt, due to the presence of plastic clays which give rise to springs. In these areas the mapped boundary of the basalts may be unreliable. Landslides are also evident within the basalt series, due no doubt to interbedded clays such as have been described earlier. Many such landslips are indicated on the geological maps.

The basalt gives rise to a characteristic physiography consisting of bare, steep, rounded hills, usually almost devoid of vegetation. On the aerial photographs, this topography shows up quite distinctly and often the outcrops of individual lava flows can be followed on the photos for over a mile.

The basalts weather to a fertile, red-brown soil, highly prized for agriculture. Under favourable conditions, the weathering may be quite deep but due to the steep hillsides, the soil rarely has a chance to accumulate. Commonly, the basalts form a chain of steep hills bordered on either side by fertile valleys.

Jointing varies widely with the various types of lavas. Some of the more massive flows have fairly well developed columnar jointing as in the bottom flow of the basalts on Black Bobs Rivulet, whilst others exhibit a " hackly " type of jointing as in the quarry by the Tarraleah Highway, and this jointing no doubt led to the selection of the quarry site.

Quaternary System

River gravels occur along all the rivers throughout the area. Those along the Derwent in map square 4477 have been described earlier and are thought to be Tertiary. Downstream of that map square, Recent gravel accumulations along the Derwent, consist almost entirely of a mixture of rounded dolerite sands, gravels, cobbles and boulders, ranging up to over 2 feet in diameter. Some sandstone boulders are present in the area where the river passes through the Triassic sediments, but even there they are not well represented due to the superior hardness of the dolerite boulders. However, the sand-grade material consists largely of quartz, no doubt derived from the Triassic sediments. Similar deposits are found along the Broad and Repulse Rivers and the lower part of the Florentine River. The Dee River meanders through a wide flood plain throughout the middle part of its course in this area. These river flats are closely cultivated and the composition of the alluvium cannot be determined. However, it is probably similar to that described above but no doubt contains, in addition, basalt boulders from the surrounding hills.

The upper portion of the Florentine River, where it flows through the limestone, is bordered by an accumulation of alluvium, consisting of quartz, quartzite, conglomerate, sandstone, mudstone, schist and limonite. Very little limestone is present in the gravels due to the softness and solubility of that rock. As mentioned previously, relicts of high level terraces have been described by Hills (1921) in the Florentine Valley, but no such deposits have been observed in this area. No doubt the terraces lie somewhat south of here.

Extensive gravel deposits cover much of the floor of the Rasselas Valley and have been described as glacio-fluviatile by both Twelvetrees and Hills. The gravels are composed of older rocks such as quartzite, conglomerate, schist, &c. They are probably Pleistocene in age, as suggested by Hills.

The various marshes indicated on the plans are depressions in the bedrock filled with peaty soil and clays. Other recent deposits include the extensive scree deposits throughout the area, talus, and soil cover.

Intrusive Rocks

Jurassic (?) Dolerite

The dolerite occurs in all map squares, and is by far the most common rock exposed in the region. It occurs mainly as sills or discordant sill-like masses, transgressing through the sedimentary rocks. Two small dykes have been mapped which cross the Derwent River near the mouth of the Broad River.

The most irregular intrusions are those in the Knocklofty Sandstone and Shale, particularly the shale members. In these rocks, the dolerite frequently ramifies through the sediments, forming complex minor intrusions outside the main dolerite mass. Some such intrusions have been mapped in the Long Spur area, and are indicated on that map. Where thick sandstone members are encountered, concordant sills may be formed, but gently shelving intrusions, as in the Wayatinah B area, are still common. The dolerite sill forming the Misery Range is a concordant sill intruded either into the Ferntree Mudstone or at the top of this formation. However, the base of this sill is covered by accumulations of scree, and some minor transgressions may take place.

Contact metamorphism is a very minor phenomenon. Usually no effects are visible in the dolerite 50 feet away from the contact. At the junction the dolerite is very fine-grained, in places glassy, and always closely jointed. It often develops a platy structure running parallel to the contact.

The sediments also, are rarely altered for more than a few feet away from the dolerite contact. A slight hardening of shales is evident, and occasional thin, quartz veins may penetrate along the joints for a few feet. Some thin, pegmatitic veins within the dolerite masses have been observed. They appear to have been intruded into the main body as a late phase of the cooling process. Frequently, fine grained phases are encountered within the dolerite. They have no apparent relationship to any influences outside the dolerite mass.

The dolerite is well jointed, and exhibits a crude, columnar structure where the edges of sills are exposed. In addition to the cooling fractures, which form the more closely spaced joint pattern of the dolerite, the dolerite sills are divided into large blocks by a system of strong, near vertical joints. These joints appear to be related to the Tertiary fault system, and some of them have been indicated on the geological maps. Close to the Tertiary faults, the dolerite is closely jointed, sometimes developing a similar, platy, joint system to that developed near the intrusive contacts. However, here the chilled margins are lacking.

The dolerite weathers in an irregular fashion. The closely jointed areas near faults are sometimes extensively weathered to at least 100 feet depth, and possibly much more than this. The small fault under Forsters Creek has been shown by diamond drilling to be weathered to at least this depth.

Evidence from other parts of the State shows that such weathering is still extensive at a depth of 400 feet. Drilling and geophysical work on dolerite areas just north of here have disclosed wide areas of deep weathering extending to at least 60 feet below the surface, and apparently unrelated to any structural system. The same conditions could well be expected in almost any part of the area where the dolerite is exposed. At present, no reliable method of predicting such wide scale weathering from surface features is known.

The dolerite gives rise to extensive talus and scree accumulations on steep hillsides. Naturally, the thickness of such accumulations is highly variable, but where investigations have been carried out near this area, an average figure for the thickness of talus deposits would be 30 to 40 feet.

The petrology of the dolerite is described in detail by Edwards (1942) and some petrological work by Prider (1948) describes the chilled margins.

The remnants of the sill which form the cap of the Misery Range is about 600 feet thick, but evidence north and south of this area at Wylds Craig and Mt. Field West respectively indicates that the sill was at least 1500 feet thick, and very probably much more than that.

The age of the dolerite cannot be fixed with exactitude. It post-dated the Permo-Triassic sedimentary cycle which extends high into the Upper Triassic if not actually into the Jurassic. It antedates by a very long period of peneplanation and lateritisation the Tertiary basalts, lake sediments and epeirogeny which commenced early in the Tertiary. The limits of age for the dolerite intrusion are therefore Jurassic to Lower Cretaceous. The common assumption is that it is cognate with the extensive feldspathic tuffs which dominate the upper sediments of the Triassic. This would place the dolerite as probably early Jurassic. Nothing has been found in this region contrary to this view.

Tertiary (?) Dolerite

A small plug of dolerite is indicated near the western boundary of map square 4476 in the Florentine Valley. The plug has been intruded into the Gordon Limestone and has altered the limestone in its vicinity. It is now surrounded by a " halo " of limonite, the approximate boundaries of which have been indicated.

The age of this intrusion is open to some doubt as no petrological work has been done on the rock. In hand specimens, it is a fine-grained, closely jointed, blue-grey rock containing phenocrysts of olivine. The presence of olivine appears to relate it to the Tertiary basalts rather than the Jurassic dolerites, as the former are frequently olivine bearing, whilst the latter tend to be tholeitic in composition.

Structural Geology

Structure of the Pre-Permian Rocks

In Map Square 4376, the Eldon Group rocks and the Gordon Limestone are folded into a broad syncline pitching gently to the north. The eastern limb of the syncline is cut by several faults, the major one being the Gordon Range fault. This fault is clearly shown on the air photos where it cuts the Eldon Group rocks north-west of the Settlement. The syncline opens up considerably north of the fault and the rocks show clear signs of warping. The fault is not exposed in the Florentine Valley because of the poor outcrops in the limestone but there is a distinct change in strike and a flattening of the dip in its vicinity.

In contrast to the clearly defined rupture where the fault cuts the eastern limb of the syncline, there is no sign of a corresponding break in the western limb, and the fault has been indicated as turning slightly north and running along the axis of the syncline.

The age of the fault is open to doubt. It has a similar trend and throw to the Tertiary faults but unlike these faults has warped and folded the rocks. This seems to indicate that the rocks were deeply buried at the time of faulting and would place the fault as older than Tertiary. Also, the associated fractures can be clearly seen cutting the Eldon Group rocks and striking straight into the Permian but no corresponding faults have been found in those rocks. If this is correct, the Gordon Range fault is pre-Permian and probably dates from the time of the folding, that is, presumably, Devonian. The associated fractures are difficult to locate in the limestone; they may not actually extend as far as the Permian rocks. Until further evidence is available the age of this fault is best left in abeyance.

The Permo-Triassic rocks have been broken by the dolerite intrusions with their concomitant faulting. These rocks have later been broken and tilted by the Tertiary epeirogeny.

Structure of the Dolerite Intrusions

The dolerite forms vast sill-like intrusions in the Permo-Triassic rocks, frequently transgressing across the bedding, forming shelving intrusions. Dykes appear to be uncommon and only two small dykes crossing the Derwent near the mouth of the Broad River have been observed.

In general, the dolerite has pried its way upwards through the sediments, uplifting many of them in the process as huge rafts which are now completely surrounded by dolerite.

The boundaries of such sedimentary blocks may be steep, nearly vertical fault-like contacts, or gently shelving intrusions. In the former cases, drag dips can usually be observed in the sediments, indicating that they are upthrown with respect to the dolerite. Occasionally, further movement has occurred along these boundaries during the Tertiary epeirogeny.

Some of the faulting has broken the Permo-Triassic sediments but not the dolerite. These are regarded as being associated with an early phase of the dolerite intrusions and include the fault obliquely crossing the Wayatinah B tunnel line and the fault in the extreme south-west corner of map square 4477, which brings the Permian and Triassic rocks into juxtaposition.

The dolerite appears to have been driven up through the older rocks by virtue of its lower density but upon reaching the Permo-Triassic sediments, which apparently had a density close to the molten magma, it began to intrude these rocks wholesale. As a broad generalisation, to which exceptions can be found, the dolerite behaved in a most irregular manner in the softer shales, but tended to horizontal and vertical contacts forming dykes or sills in the more competent sandstones and mudstone beds. However, the dolerite follows no predictable rules and almost any shape of boundary and form of intrusion seems to be possible. As mentioned previously, the dolerite ramifies throughout the shale beds in a most complex manner and in these cases only the general shape of the boundaries has been indicated.

Rafted blocks have been mapped in several of the map squares. In particular, the blocks on map square 4576 have steep, probably almost vertical contacts resembling normal faults but having chilled margins on the dolerite side and very limited baking and quartz veining in the sediments.

The sediments around Long Spur are also a rafted block and the structure of this is known quite well from investigations carried out by the Hydro-Electric Commission in connection with the Wayatinah B Power Development. Structurally, these sediments consist of a large block having the approximate dimensions of 3 miles square, surrounded on all sides and underlain at shallow depths by dolerite. Portions of the southern and western margins of the block are obscured by alluvium and basalt respectively, but the remainder are well exposed and have been mapped in detail and investigated by means of diamond drilling and geophysical methods. The north and west margins are dolerite intrusions which shelve gently under the sediments, and the continuation of the dolerite under the sediments has been shown by gravity surveys and by diamond drilling. The slope of the dolerite surface under the sediments is in general quite gentle, probably averaging about 10°. However, it is not a plain surface and many irregularities, some probably due to the irregular nature of the intrusion, and some perhaps to small Tertiary faults, are present. Just outside the north margin of map square 4477 a portion of this boundary has been investigated in close detail by drilling, resistivity and seismic refraction work. Contours drawn in the top of the dolerite surface indicate that in detail this surface is quite irregular and there is no reason to believe that this is unusual elsewhere under the blocks. During the rafting process, the block has been broken by at least two faults as shown on the plan, and some dolerite has penetrated to the present surface as minor intrusions above the main dolerite mass. Some other sills likewise intruded above the main mass have been encountered in the drilling in this area.

The portion of the eastern boundary of the block which is not covered by basalt is an almost vertical fault-like contact. It has been exposed in a test pit near the proposed Wayatinah B Power Station site. Also its trace on the map indicates that this contact must be very steep. Where exposed the dolerite is closely jointed, glassy and partly decomposed for some distance from the contact. The Triassic shales and siltstones at the contact are also closely jointed, sheared and highly contorted. The contact zone is about 3 feet wide due to the complex nature of the contact and the lit-par-lit injection of the sediments by dolerite in this zone.

Structure of the Dolerite Plateau

Regional evidence attributes the Tertiary faulting to isostatic adjustments following the removal of material between the time of the dolerite intrusions and the Lower Tertiary. That is, these faults are all uplifts of the higher blocks and not depressions of the low blocks. It is interesting to note that the faulting parallels the fold structures in the Eldon Group rocks. These rocks have been buoyant since the end of the Devonian and the Permo-Triassic sediments thin out in that direction. In fact, it is not established that any Permo-Triassic sediments were deposited south-west of this area. The pattern of the faulting indicates that this area was again buoyant in the Tertiary being the first to adjust itself and being uplifted the most.

The Tertiary faulting has a pronounced south-south-east trend, all the major structures having the greatest displacement run in this direction. At right angles to these structures is another set of fractures having, in general, less displacement along them. The overall pattern of the faults to the west of the Derwent is of a set of south-south-east trending step faults which generally downthrow to the north-east. These have formed a series of roughly parallel blocks tilted towards the Derwent. However, none of the step faults is confined to a single line but is rather a complicated series of faults. A narrow block bounded on either side by such a fault system must inevitably be subjected to complicated stresses during uplift. This tendency to warp the blocks has been taken up by the north-east trending adjusting faults. Because of their origin these faults have, as may be expected, complicated displacements. Some of them are rotational and few of them have the same throw over their full length.

Taking the whole of this uplifted dolerite area as a unit, several interesting features emerge. The fault system of map square 4576 forming the north-eastern boundary of the dolerite plateau has its greatest throw in the south-west corner. However, there is regional evidence of rotational movement in an opposite direction by the Misery Range fault. The warping stresses within the included block have been relieved by rotational movement along the Islet Creek fault.

Adjustments between the individual faults have been taken up in part by smaller faults and in part by differential later movement along the original faults. This is indicated by a series of faults on map square 4476 near the principle points of air photos 17380, 17381, and 17382 King William, run 12. Here, two almost parallel north-north-west trending faults have cut two other almost parallel north-east trending faults. The adjustment between the north-east faults has been achieved by further movement along the portion of the north-north-west fault caught up between them. This movement has in turn tended to warp the small block between the two north-north-west faults and a further adjusting fault has cut this block obliquely. This kind of behaviour points to the extremely brittle nature of the dolerite block. It seems that every small difference of movement has been accounted for by faulting.

The Derwent Graben

East from the Derwent River the Permo-Triassic sediments are again broken by south-south-east trending faults. This one, however, is upthrown to the east, thus forming a graben structure between this fault and the north-east marginal faults of the Misery Plateau. Tertiary sediments and basalts have accumulated within the graben and in some places spilled over the marginal fault scarps. The symmetry of the graben is broken in map square 4477 where the western boundary is disrupted by the fault running east along the Derwent River from the mouth of the Florentine River. However, the general shape of the structural trough is still retained. Since the floor of the trough is now concealed beneath the basalts and Tertiary sediments it is difficult to reconstruct its shape immediately after the Tertiary faulting. The abundant cross faulting in the uplifted blocks leads one to suspect that the floor of the trough is similarly broken and it is pictured as a depressed area trending north-north-east in a series of steps.

Misery Range Fault

Although this fault has a profound geographical expression when viewed from the west, field evidence suggests that there has been comparatively small movement along it. Its physiographic expression is due to the fact that it established the early Florentine drainage and enabled the underlying limestones to be exposed. It is to the soluble nature of the limestone more than to the Misery Range fault that the present valley is due. The Misery Range fault is of Tertiary age. It is downthrown to the west in this area as shown by the rise in the base of the Permian sediments and by the steep dips in the Gordon limestone near the fault. The probable extension of this fault south of the area would run to the east of Mt. Field West and in that area it is downthrown to the east. Thus, this fault when considered along its full length appears to be a rotational fault.

Islet Creek Fault

The Islet Creek fault is the major adjusting fracture in the uplifted dolerite sill forming the Misery Plateau. This fault dislocates all the north-north-west trending fractures. At the north-east end of the fault it is a normal fault downthrown to the south-east. Midway between the

Derwent River and the Misery Range it has little throw and is difficult to trace. The south western end of this fault has less downthrow to the north-west than its opposite extension had to the south-east. The difference in throw at the south-west end is due to the fact that the throw is here divided among a series of small faults all of which cut the north-north-west trending fractures.

The North-East Boundary Faults of the Misery Plateau

This boundary is formed by a complicated series of faults running roughly in echelon fashion. As one fault dies out another one, usually west of it, takes up the throw, eventually dying out to be replaced by a fault further to the west again.

At the eastern edge of map square 4576 the majority of the throw is on the fault which brings the Triassic sandstones against dolerite and crosses the Broad River just north-west of the principle point of photo 17370, King William, run 12. Further north-north-west along this fault the throw diminishes and where it crosses the Repulse River it is a zone of distributed shearing, probably without much throw. As this fault passes from a normal fault to a shear zone the throw has been taken up by the next fault back. This is the fault running roughly parallel to the Dawson Road north-west of the Repulse River crossing. Although this fault can be traced to the eastern edge of the map square the throw is quite small up to the point where it brings the Knocklofty Sandstone into juxtaposition with the dolerite. North-north-west from there it assumes most of the throw of the fault east of it but begins to die out again by the time it is cut by the Islet Creek fault. Beyond Islet Creek the fault can be traced but is again only a relatively minor fault.

These two major north-north-west trending faults are connected near the eastern edge of map square 4576 by a low angle thrust fault which dips at about 20° to the south-west. The next fault back again runs through the old sawmill on the Dawson Road and can be traced right across that map square. Further north-north-west from here the same kind of echelon faulting forms the boundary of the dolerite block to the west but becomes somewhat more complicated as the adjusting faults assume greater throws.

ACKNOWLEDGMENTS

The geological field work has been carried out as part of the regional mapping programme of the Hydro-Electric Commission and the author wishes to express his gratitude to that organisation for permission to publish this article. The base plans and drafting have been carried out by the Survey Section of the Commission to whom full acknowledgment is due. Professor S. W. Carey introduced the writer to the area and has always been ready with helpful criticism and advice. Further help and advice has always been forthcoming from the staff of the geological department of the University of Tasmania, particularly Mr. M. R. Banks. Mr. G. Hale of the Tasmanian Museum logged many of the drill cores and aided with the correlation of the Triassic rocks in the Wayatinah B area. The Australian Newsprint Mills freely gave permission for the author to use their roads and facilities in the Florentine Valley.

REFERENCES

BROWNE, W. R., WATERHOUSE, L. L. AND MOYE, D. G., 1951.—" Preliminary Geological Investigations in connection with the proposed Warragamba Dam ". *Jour. Inst. Eng. Aust.*, Vol. 23, Nos. 4 & 5, pp. 74-83.

EDWARDS, A. B., 1942.—" Differentiation of the Dolerites of Tasmania ". *Jour. Geol.*, Vol. 50, pp. 451-480 & 579-610.

——————, 1950.—" The Petrology of the Cainozoic Basaltic Rocks of Tas." *Proc. Roy. Soc. Vic.*, Vol. 62 (N.S.), Pt. 1, pp. 97-120.

GILL, E. D., 1950.—" Preliminary Account of the Palaeontology and Palaeocology of the Eldon Group Formations of the Zeehan Area of Tas ". *Proc. Roy. Soc. Tas.*, 1949, pp. 231-258.

GOULD, C., 1861.—" Mersey Coalfields " *Legislative Council Paper* No. 50.

HILLS, C. L., 1921.—" Geological Conditions Affecting Water Conservation in the Florentine and Gordon Valleys ", *Tas. Dept. Mines Report*. (Unpublished.).

HILLS, C. L. AND CAREY, S. W., 1949.—" Geology and Mineral Industry ". *Handbook for Tas. A.N.Z.A.A.S. Hobart Meeting*, pp. 21-44.

HILLS, L., REID, A. M., NYE, P. B., KEID, H. G. W. AND REID, W. D., 1922.—" Coal Resources of Tasmania ". *Geol. Survey. Bul.*, No. 7.

OPIK, A. A., 1951.—" Notes on the Stratigraphy and Palaeontology of Cambrian, Ordovician and Silurian Rocks in Tasmania ". *Bureau of Mineral Resources, Geology and Geophysics. Records* 1951-5.

PRIDER, R. T., 1948.—" The Geology of the Country around Tarraleah ". *Proc. Roy. Soc. Tas.*, 1947, pp. 127-150.

TWELVETREES, W. H., 1908.—" Tyenna to Gell River ". *Tas. Dept. Lands and Surveys Report*, 1907-8.

LOCALITY INDEX

	Internat- Grid. Reference K/55 Quadrangle		S.Lat.	E.Long.
Big Bend	Huntly	73	42° 40′	146° 23′
Black Bobs Rivulet	Ouse	67	42° 25′	146° 35′
Broad River	Ellendale	74	42° 34′	146° 38′
Dee River	Ouse	67	42° 21′	146° 38′
Derwent River	Ellendale	74	42° 31′	146° 39′
Florentine River	Huntly	73	42° 37′	146° 27′
Florentine Valley	Huntly	73	42° 37′	146° 27′
Forsters Creek	King William	66	42° 25′	146° 28′
Gordon Range	Huntly	73	42° 31′	146° 24′
Gordon River	Huntly	73	42° 32′	146° 20′
Huntly River	Huntly	73	42° 41′	146° 24′
Islet Creek	Ellendale	74	42° 30′	146° 36′
Long Spur	Ouse	67	42° 25′	146° 34′
Misery Range	Ellendale	74	42° 31′	146° 31′
Mt. Field West	Ellendale	74	42° 39′	146° 31′
Mt. Misery	Ellendale	74	42° 32′	146° 31′
Mt. Wright	Huntly	73	42° 39′	146° 21′
Nive River	King William	66	42° 20′	146° 30′
Rasselas Valley	Huntly	73	42° 32′	146° 20′
Repulse River	Ellendale	74	42° 32′	146° 35′
Settlement (Dawson)	Huntly	73	42° 33′	146° 27′
Tarraleah	King William	66	42° 18′	146° 27′
Thumbs	Huntly	73	42° 41′	146° 20′
Tiger Range	Huntly	73	42° 34′	146° 23′
Tim Shea	Huntly	73	42° 43′	146° 29′
Wylds Craig	King William	66	42° 28′	146° 23′

GEOLOGY OF TASMANIA

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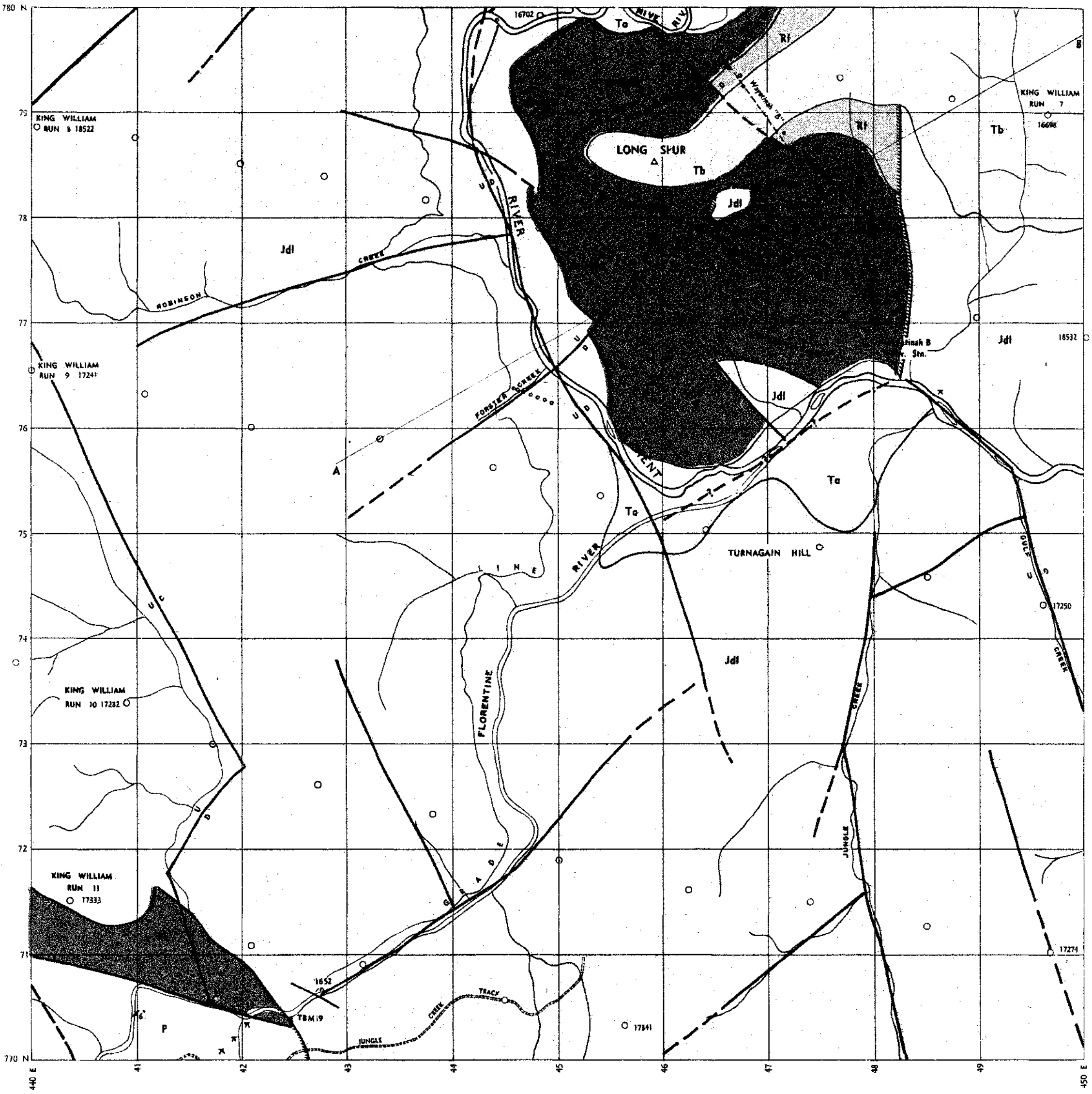
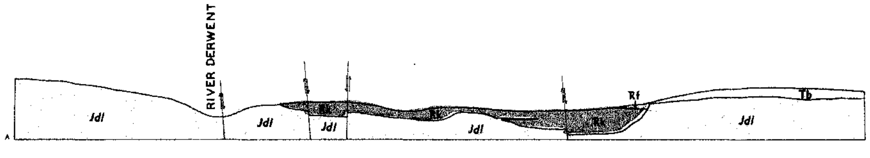
LONG SPUR

44-77





Tertiary System

Ta	RIVER GRAVELS

Triassic System

Rf	FELSPATHIC SANDSTONE
Rk	KNOCKLOFTY SANDSTONE AND SHALE

Permian System

P	UNDIFFERENTIATED PERMIAN SEDIMENTS

IGNEOUS ROCKS

Jurassic System

Jdl	DOLERITE

Tertiary System

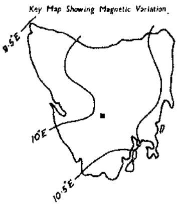
Tb	BASALT

SCALE

0 — 1 — 2 MILES

0 — 5,000 — 10,000 FT.

Key Map Showing Magnetic Variation



Compilation from Aerial Photographs
Trigonometric Station Control by
courtesy The Hydro-Electric
Commission

Origin of co-ordinates 400,000 yds.
West and 1,800,000 yds. South of
True Origin of Zone 7.

Mapped and Compiled by J. B. Jennings.

September, 1954

- FAULT
- FAULT — POSITION APPROXIMATE
- FORMATION BOUNDARY
- STRIKE AND DIP
- DOLERITE BOUNDARIES
- DISCORDANT INTRUSIVE BOUNDARIES
- DISCORDANT INTRUSIVE BOUNDARIES WITH CONCOMITANT FAULTING
- VERTICAL JOINT
- ROADS
- TRACK
- TRIG. STATION
- BENCH MARK
- ANEROID HEIGHT

THE GEOLOGY OF THE LONG SPUR AREA.

SHEET 44-77

PHYSIOGRAPHY.

The Florentine River flows through a steep mountainous gorge in this area to join the Derwent River which is in upper valley tract in this square. The Florentine River and several of its tributaries are partly fault controlled. Most of the hill slopes are very steep especially in the dolerite. The junction of the Florentine River with the Derwent is delayed for about half a mile but the cause of this is unknown.

STRATIGRAPHY.

Permian mudstones and sandstones occur in the south-western corner of this area. Knocklofty Sandstone and Shale occurs also in the south-west and on the lower slopes of Long Spur on which it is overlain transitionally by Feldspathic Sandstone.
These rocks are intruded by dolerite and overlain by flows of Tertiary basalt on the crest of Long Spur. Alluvium occurs in the river valleys.

STRUCTURE.

The dominant structure in the area is a normal fault trending just west of north and downthrowing to the north-east along which the Derwent flows in the northern part of the area. There are adjusting faults parallel and perpendicular to this.

REFERENCE.

Jennings, I. B., 1955: "Geology of the Mid-Derwent Area" **Pap. Proc. Roy. Soc. Tas.** Vol. 89.

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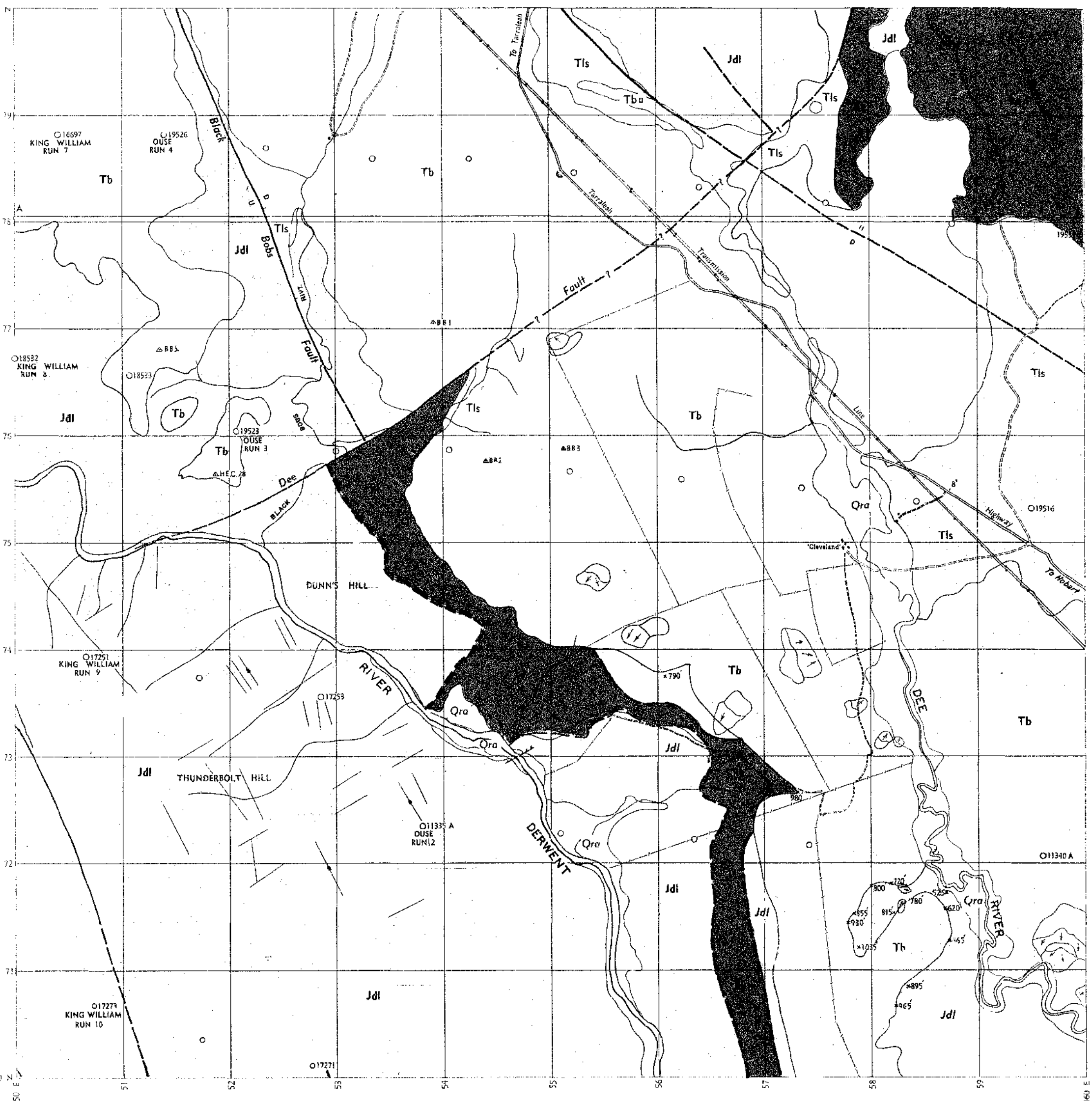
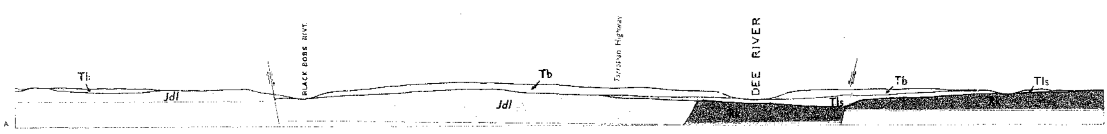
BLACK BOBS

45-77





Quaternary System

Qra	ALLUVIUM

Tertiary System

Tls	LAKE SEDIMENTS
Tba	BAUXITE

Triassic System

KNOCKLOFTY SANDSTONE AND SHALE

IGNEOUS ROCKS

Jurassic System

Jdl	DOLERITE

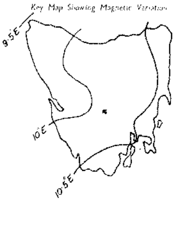
Tertiary System

Tb	BASALT

SCALE

0 — 1 — 2 MILES

0 — 5,000 — 10,000 FT.



Compilation from Aerial Photographs
Trigonometric Station Control by courtesy The Hydro-Electric Commission

Origin of co-ordinates 400,000 yds. West and 1,800,000 yds. South of True Origin of Zone 7.

Mapped and Compiled by I. B. Jennings

September, 1954

FAULT

FAULT — POSITION APPROXIMATE

FAULT INFERRED

FORMATION BOUNDARY

STRIKE AND DIP

DOLERITE BOUNDARIES

DISCORDANT INTRUSIVE BOUNDARIES

VERTICAL JOINT

ROADS

VEHICLE TRACK

TRIG. STATION

BENCH MARK

QUARRY

ANEROID HEIGHT

LANDSLIDE

THE GEOLOGY OF THE BLACK BOBS AREA.

SHEET 45-77.

PHYSIOGRAPHY.

Except for a short distance where it flows over Triassic shales, the Derwent River is in mountain tract in the area and is flowing roughly south-east. Black Bobs Rivulet is similarly mainly in mountain tract. The Dee River is in mountain tract in the north-east corner of the area where it flows over dolerite and sandstone but enters valley tract with meanders and a flood plain on Tertiary lake sediments and basalt. The local valley tract is produced by a resistant dolerite bar downstream.

STRATIGRAPHY.

Cross-bedded quartz sandstones and greenish-yellow shales of Triassic age outcrop in the north-east and near the centre of the square. They are intruded by dykes and sills of dolerite. Bauxite is exposed below basalt below the Liapootah Highway near the northern edge of the square. Tertiary lacustrine sands and clays outcrop in road cuttings in the Liapootah Highway and occur along the valley of the Dee River. Some poorly preserved plant remains are present. Above a silicified gravel there is a thickness of about a thousand feet of basalt in the form of a number of flows with interstratified clays. The basalt probably occupies a former river valley trending south-east.

STRUCTURE.

The area has been broken by faults of two ages. The Jurassic faults trending north-east occur near the junction of Black Bob's Rivulet and the Derwent and about a mile downstream. The Tertiary faults trend N.N.W. across the area.

ECONOMIC GEOLOGY.

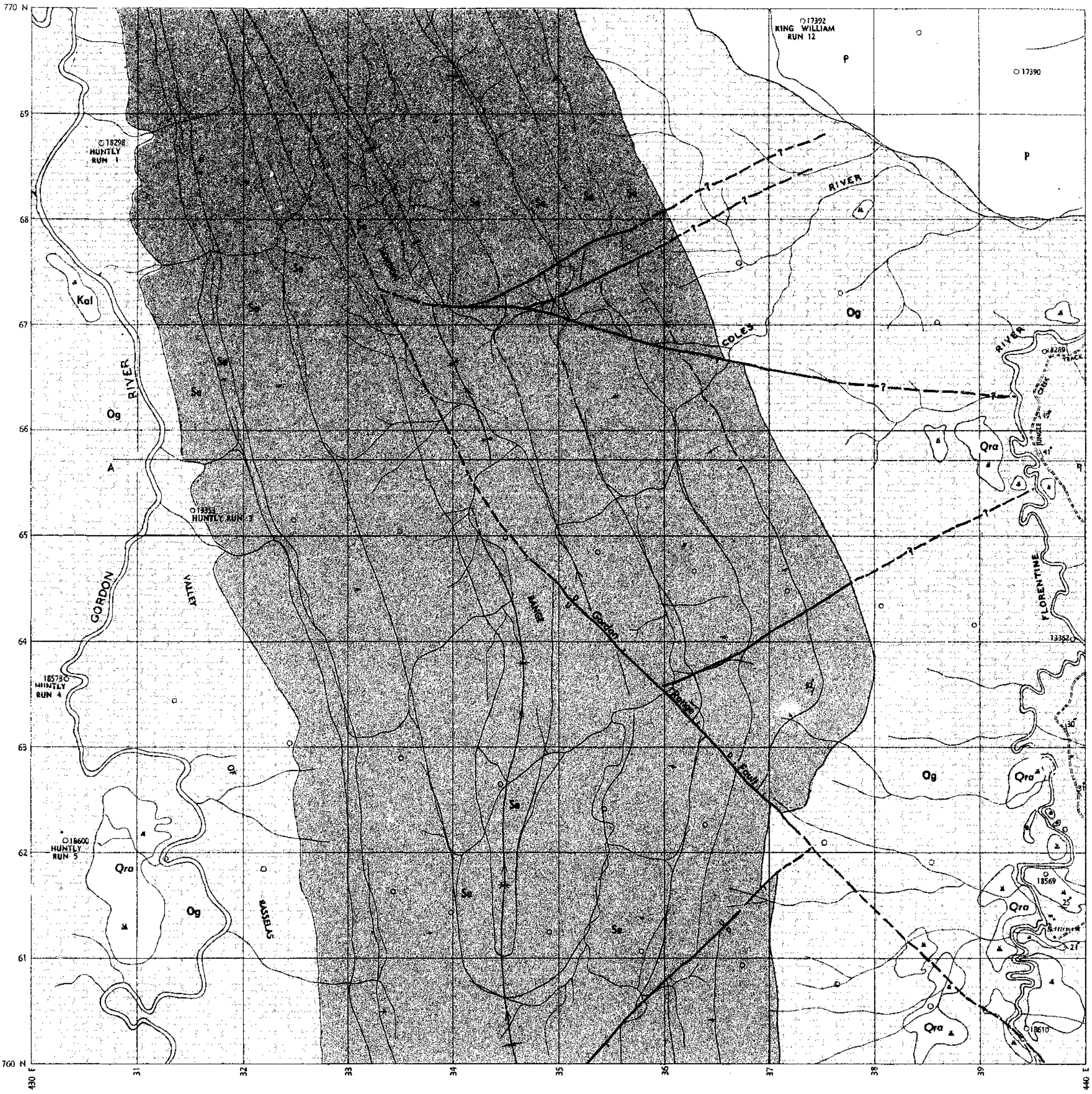
Abundant road metal, dolerite or basalt, occurs in the area. Small outcrops of bauxite occur near the northern boundary of the sheet.

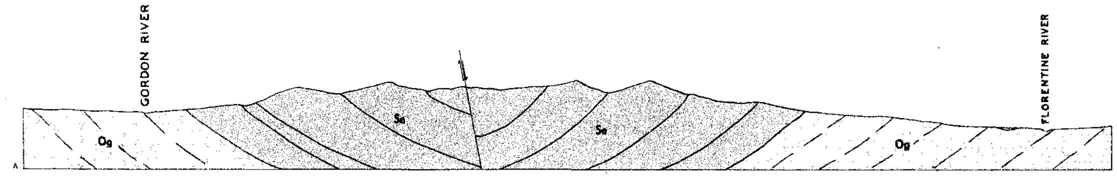
REFERENCE.

Jennings, I. B., 1955: The Geology of the Mid-Derwent Area. **Pap. Proc. Roy. Soc. Tas.** Vol. 89.

GORDON RANGE

43-76





Quaternary System

Qra	MARSH DEPOSITS

Permian System

P	UNDIFFERENTIATED PERMIAN SEDIMENTS

Eldon Group

Se	UNDIFFERENTIATED
Se	
Se	
Se	
Se	

Junee Group

Og	GORDON LIMESTONE

SCALE

0 — 1 — 2 MILES

0 — 5000 — 10,000 FT.

Key Map Showing Magnetic Variation

Compilation from Aerial Photographs
Trigonometric Station Control by courtesy The Hydro-Electric Commission

Origin of co-ordinates 400,000 yds. West and 1,800,000 yds. South of True Origin of Zone 7.

Mapped and Compiled by I. B. Jennings.

September, 1954

- FAULT INFERRED
- FAULT WITH DOWNTHROW INDICATED
- FAULT — POSITION APPROXIMATE
- FORMATION BOUNDARY
- FORMATION BOUNDARY POSITION APPROXIMATE
- SYNCLINAL AXIS
- TREND OF OUTCROP
- STRIKE AND DIP
- VEHICLE TRACK
- TRACK
- π BENCH MARK

THE GEOLOGY OF THE GORDON RANGE.

SHEET 43-76.

PHYSIOGRAPHY.

The Gordon Range runs northerly through the centre of the map square with the flattish floored valleys of the Gordon and Florentine Rivers on either side. The range consists of cuestas and hog-backs of Eldon Group rocks. The Gordon River flows in a mature plain with swamps to the west of the range. The tributaries flowing into the Gordon from the Gordon Range are in mountain tract and show a well-defined trellis pattern. The Florentine River flows in a mature valley to the east of the range and its tributaries from the Gordon Range also show a trellis pattern.

STRATIGRAPHY.

Gordon Limestone of Middle and Upper Ordovician age occurs in the floor of the Gordon and Florentine Valleys. It is richly fossiliferous on some horizons near Benjamin and contains some sandy beds. It is overlain by quartzites and shales of the Eldon Group with a basal sandstone with tubicolar structures which may be the Crotty Quartzite. About fifteen hundred feet of Permian sediments overlie the Gordon Limestone unconformably. The basal beds are arkosic followed by limestones with interbedded quartz sandstones, and these are followed by sandstones, conglomerates and pebbly mudstones.

STRUCTURE.

The dominant structure is a northerly plunging syncline, symmetrical at the southern boundary of the sheet but asymmetrical further north due to the effect of the Gordon Range Fault which trends north-westerly at first but then runs north along the centre of the syncline. This fault and its associated minor faults are considered to be Tertiary in age. Flat-lying Permian sediments overlie the Gordon Limestone unconformably.

ECONOMIC.

Immense reserves of limestone are present in the Florentine Valley ond road metal could be quarried from the Crotty Quartzite on the eastern side of the Gordon Range.

REFERENCES.

Carey, S. W., and Banks, M. R., 1954: Lower Palaeozoic Unconformities in Tasmania. **Pap. Proc. Roy. Soc. Tas.** Vol. 88, pp. 245-270.

Jennings, I. B., 1955: Geology of the Mid-Derwent Area. **Pap. Proc. Roy. Soc. Tas.** Vol. 89.

Opik, A. A., 1951: Notes on the Stratigraphy and Palaeontology of Cambrian, Ordovician and Silurian Rocks in Tasmania. **Bur. Min. Res. Geol. & Geophys.** Recs. 1951-5.

Twelvetrees, W. H., 1908: Tyenna to Gell River. **Dept. Lands and Surveys Dept.** 1907-08. **Parl. Paper** No. 13, 1908.

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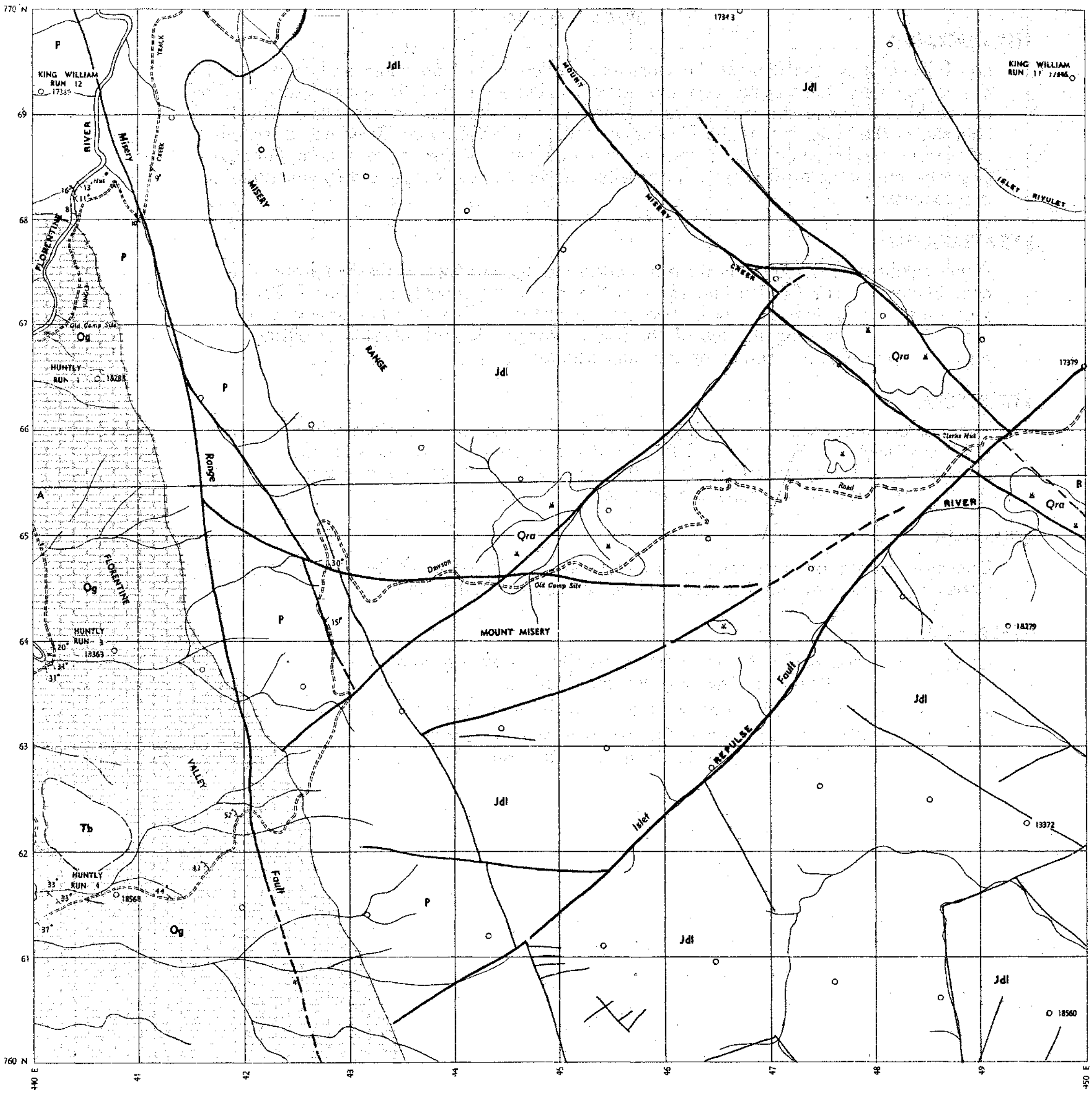
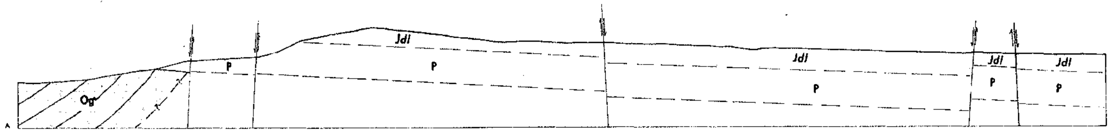
MISERY RANGE

44-76





Quaternary System

Qra	MARSH DEPOSITS

Permian System

P	UNDIFFERENTIATED PERMIAN SEDIMENTS

Junee Group

Og	GORDON LIMESTONE

IGNEOUS ROCKS

Tertiary System

Tb	BASALT

Jurassic System

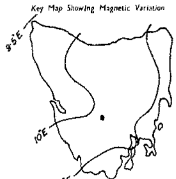
Jdl	DOLERITE

SCALE

0 — 1 — 2 MILES

0 — 5,000 — 10,000 FT.

Key Map Showing Magnetic Variation



Compilation from Aerial Photographs
Trigonometric Station Control by courtesy The Hydro-Electric Commission

Origin of co-ordinates 400,000 yds. West and 1,800,000 yds. South of True Origin of Zone 7.

Mapped and Compiled by F. B. Jennings

September, 1954

- FAULT
- FAULT — POSITION APPROXIMATE
- FORMATION BOUNDARY
- FORMATION BOUNDARY POSITION APPROXIMATE
- STRIKE AND DIP
- DOLERITE BOUNDARIES
- CONCORDANT SILL
- VEHICLE TRACK
- TRACK

GEOLOGY OF MISERY RANGE.

SHEET 44-76.

PHYSIOGRAPHY.

Low hills occur on the floor of the Florentine Valley east of Benjamin and to the north-east give rise to the steep talus slopes and sub-vertical dolerite cliffs of the Misery Range. From the top of the Misery Range the surface falls gently to the north-east towards Islet Creek. Caves are common in the limestone of the Florentine Valley. The Florentine River has a mature, meandrine course on the limestone but enters a mountain tract where it flows onto Permian sediments. Drainage on the dolerite plateau north-east of the Misery Range is very immature and swamps are common.

STRATIGRAPHY.

Richly fossiliferous Gordon Limestone of Ordovician age outcrops in the Florentine Valley, especially near Benjamin. The Gordon Limestone is overlain unconformably by about 1500 feet of Permian sediments with limestones, glacial beds and mudstones. The Permian sediments are intruded by a sill of dolerite forming the top of the Misery Range. A small plug(?) of olivine basalt outcrops near the south-western corner of the map square.

STRUCTURE.

The Gordon Limestone dips steeply west and is overlain by a conformable sequence of Permian sediments dipping N.E. at about 10°. The Florentine Valley originated as a graben between the Gordon Range Fault, downthrowing to the north-east and the Misery Range Fault downthrowing to the south-west. The faults are post-dolerite in age.

ECONOMIC.

Extensive deposits of limestone are available in the Florentine Valley. Limestone, Permian sandstones and mudstones and dolerite could all be used for road metal.

REFERENCES.

Carey, S. W., and Banks, M. R., 1954: Lower Palaeozoic Unconformities in Tasmania. **Pap. Proc. Roy. Soc. Tas.** Vol. 88, pp. 245-270.

Jennings, I. B., 1955: Geology of the Mid-Derwent Area. **Pap. Proc. Roy. Soc. Tas.** Vol. 89.

Opik, A. A., 1951: Notes on the Stratigraphy and Palaeontology of Cambrian, Ordovician and Silurian Rocks in Tasmania. **Bur. Min. Res. Geol. and Geophys.** Recs. 1951/5.

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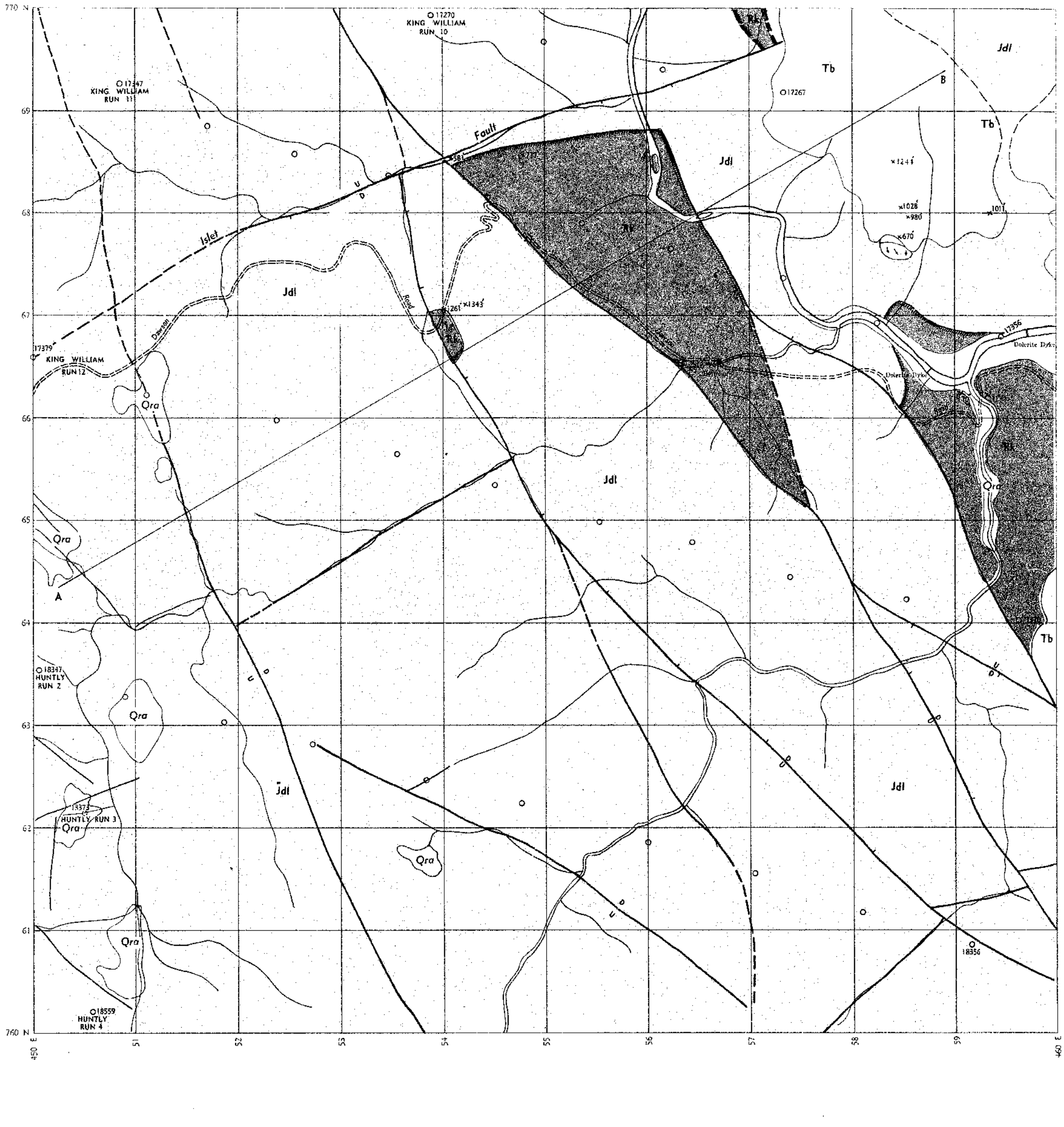
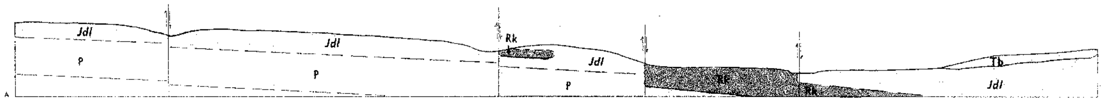
REPULSE

4.5-76





Quaternary System

Qra — MARSH DEPOSITS AND ALLUVIUM

Triassic System

Rk — KNOCKLOFTY SANDSTONE AND SHALE

IGNEOUS ROCKS

Tertiary System

Tb — BASALT

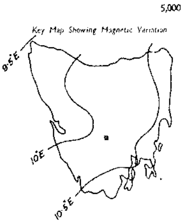
Jurassic System

Jdl — DOLERITE

SCALE

0 — 1 — 2 MILES

0 — 5,000 — 10,000 FT.



Compilation from Aerial Photographs
Trigonometric Station Control by courtesy The Hydro-Electric Commission

Origin of co-ordinates 400,000 yds. West and 1,800,000 yds. South of True Origin of Zone 7.

Mapped and Compiled by J. B. Jennings.

September, 1954

FAULT

FAULT POSITION APPROXIMATE

FORMATION BOUNDARY

FORMATION BOUNDARY POSITION APPROXIMATE

DOLERITE BOUNDARIES

DISCORDANT INTRUSIVE BOUNDARIES

DISCORDANT INTRUSIVE BOUNDARIES WITH CONCOMITANT FAULTING

STRIKE AND DIP

VERTICAL JOINT

VEHICLE TRACK

LANDSLIDE

THE GEOLOGY OF THE REPULSE RIVER AREA.

SHEET 45-76.

PHYSIOGRAPHY.

The area is mainly a deeply dissected youthful dolerite plateau sloping to the N.N.E. into the Derwent and cut by streams such as the Repulse River. The Derwent River is in valley tract with a flood plain developed towards the eastern boundary of the sheet and as many as four terraces. The north-eastern portion of the sheet consists of bare basaltic hills. The Derwent follows a course determined by the Tertiary faulting and the basalt. It follows the south-western margin of a structural trough. The Repulse and Islet Rivers are consequent streams on the dolerite plateau.

STRATIGRAPHY.

The oldest rocks present in this area are massive, cross-bedded sandstones and thinly-bedded micaceous shales of Triassic age. These have been intruded complexly by dolerite in the form of sills near the base and higher in the Triassic, and as dykes. Sub-basaltic clays and gravels of lacustrine and fluviatile origin outcrop beneath basalt at the eastern and north-eastern parts of the area.

STRUCTURE.

The main structure is a conformable sequence of Permian and Triassic sediments dipping N.E. at about 10° and intruded by dolerite sills and some dykes trending mainly just west of north and just north of east. This structure was later broken by faults of Tertiary age trending N.W. with a complementary set at right angles. The north-westerly faults mainly downthrow to the north-east.

REFERENCE.

Jennings, I. B., 1955: Geology of the Mid-Derwent Area. **Pap. Proc. Roy. Soc. Tas. Vol. 89.**