THE GEOLOGY OF THE COLLINSVALE AREA

By

F. L. Sutherland

Queen Victoria Museum, Launceston, Tasmania

(With five text figures and two maps)

ABSTRACT

A cone sheet of Lower to Middle Jurassic dolerite intruded into sub-horizontal Permian and Triassic strata is the dominant geological feature in the Collinsvale area. Within the throat of the cone sheet there was extensive faulting concomitant with the intrusion. The course of intrusion and the pattern of the faulting were controlled by the pre-intrusion structure. The cone sheet is a major centre of intrusion and is joined on its flanks by further dolerite intrusions.

The rocks of the area are complexly broken by tensional faulting associated with Tertiary epeirogeny, and the faulting is markedly influenced by the Jurassic structure. The rocks are strongly jointed.

Almost the whole of the Permian and Triassic sequences are exposed within the area. The Permian System contains both marine and fresh-water deposits, and is exposed to a stratigraphic level low down in the Woody Island Siltstone. Mudstone, limestone, sandstone, and sub-greywacke type rocks form a succession 2,000 feet thick. The Triassic sequence of fresh-water sandstone and shale totals about 1,200 feet in thickness, and overlies the Permian System possibly with a slight unconformity.

Remnants of Tertiary basalts are present.

INTRODUCTION

The Collinsvale Square is the ten-kilo yard square 5072, bounded on the west and east by the grid lines 500000 yds. E. and 510000yds. E. respectively, and on the north and south by the grid lines 730000 yds. N. and 720000 yds. N. respectively.

Mapping was accomplished by recording the field data on aerial photographs. The base map was made by transferring the data onto a grid of 4 inches to the mile, by means of a rectiplanigraph. The grid was constructed by the slotted-template method and the lay down controlled horizontally by 6 trigonometrical stations.

Grid references are given as 6 figure coördinates referred to the State grid system. Specimen numbers are those of specimens catalogued in the Geology Department, University of Tasmania.

PREVIOUS LITERATURE

Comparatively little previous work has been carried out on the geology of the area. Voisey (1938) investigated the Permian rocks along the Collinsvale and Glen Lusk Roads, and Lewis (1946) mapped and briefly described the eastern margin of the area. (Banks 1957, 1958), and Banks and Hale (1957), mentioned some of the Permian outcrops. Hughes (1957), Brill (1956), and Hale and Brill (1955) have described the limestone deposit at the Berriedale Quarry.

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PHYSIOGRAPHY

The topography of the area is rugged and its development has been controlled by the nature of the rocks and the geological structure.

The dolerite has profoundly influenced the topography mainly through the resistance of this rock to erosion. The central cone sheet has been extensively exhumed and is expressed topographically by the Collinsvale basin and the valley of Faulkners Rivulet. All the high parts in the area consist of or are capped by dolerite. Scree and talus deposits skirt the dolerite highlands, and west of Collins Bonnet aprons of dolerite talus spread by periglacial action blanket much of the country.

Faulting has also been important in the topographical development and has exercised a strong influence on the drainage pattern. Many of the streams have cut their courses, in part, along fault lines. The main streams are tributaries of the Derwent River and the present drainage was initiated by Tertiary epeirogenic faulting. The spectacular gorges of the Sorell River and Mount Rivulet, the incised meanders of the Sorell River at Collinsvale, and the steep valleys of Humphrey Rivulet, Knights Creek, &c., have all been cut into the uplifted country bounding the Derwent Graben and the Dromedary Horst (Banks, 1962 *b*). The course of the Sorell River suggests river capture. Faulkners Rivulet, which is a misfit stream, probably marks the old course and the capture took place when the Sorell River cutting back into the Sorell River Fault scarp breached the dolerite wall of the cone sheet.

PERMIAN SYSTEM

The rocks of the Permian System exposed in the area are 2,000 feet thick and include both marine and fresh-water deposits. Some of the poorly sorted marine beds are probably turbidity current deposits (Banks, 1962 *a*) while the presence of faceted pebbles in parts of the sequence indicates glacial contribution. The fresh-water beds near a cyclothemic relationship to the marine beds.

Parts of the sequence show well developed rhythmic bedding, caused by alternations of massive and fissile units, and richly fossiliferous horizons are present. The sequence is Sakmarian to Kungurian in age (Banks, Hale, and Yaxley, 1955, Banks and Hale, 1957) and consists of 18 formations, summarised below with their average thickness.

		? Cygnet Coal Measures	?
Kazanian and Kungurian		Ferntree Mudstone	600 feet
		Risdon Sandstone	15
		Malbina Sandstone and Siltstone	280
Artinskian	Cascades Group	Grange Mudstone	60
		Berriedale Limestone	140
		Nassau Siltstone	60
		Rayner Sandstone	10
	Faulkner Group	Fergusson Siltstone	35
		Altamont Conglomerate	1
		Parramore Sandstone and Siltstone	10
		Jarvis Siltstone	25
		Byers Sandstone	3
		Rathbone Sandstone and Siltstone	20
		Geiss Conglomerate	1
		Bundella Mudstone	140
		Darlington Limestone	100
Sakmarian		Satellite Siltstone	40
		Woody Island Siltstone	?450
			2,000 feet

The formation of the Faulkner Group proved difficult to map separately in the field, and the Group as a whole was used as the mapping unit.

WOODY ISLAND SILTSTONE

These are the lowest Permian beds exposed in the Hobart area and consist of at least 380 feet of siltstone. Measurements made along the creek beds west of Mary's Hope Road indicate that the thickness is probably greater than 450 feet.

The siltstones when fresh are blue-grey to greyish black and weather to dark yellowish brown or light grey. Bedding is thick. An irregular fissility is conspicuous but the true bedding is difficult to discern. Outcrop is very poor and the best exposures are seen in the road cuttings of the Collinsvale and Glen Lusk Roads.

The fresh siltstone is pyritic, and the pyrite is replaced by limonite on weathering. Cavities of a shape suggestive of glendonites were observed on some weathered surfaces. Peebles are rare, being mainly rounded to angular quartzite pebbles less than three inches in size. Limonitic siltstone concretions occur and are commonly one to three inches across. They have a central cavity filled with limonite and clay, and some are lined with quartz crystals. Twinned concretions are seen inclined to the bedding, and are due to the coalescence of two concretions on different levels.

A typical siltstone, peppered with small brown spots, in thin section 30169 consists of angular quartz grains, and clay. The quartz grains form 30% of the rock and no grains larger than 0.15 mm. were seen, the majority being 0.05 mm. The clay forms 50% of the rock and most of the remainder is limonite distributed in blebs and blotches. Other minerals present include feldspar, zircon and rutile grains.

Fossils are uncommon but small ? clam shells, part of a *Gangamopteris* leaf, a few fenestellids, a small *Eurydesma cordatum* and some small spiriferids were found.

Where the siltstones are intruded by dolerite, they have been metamorphosed and silicified along the contact to bluish and dark grey quartzite containing grains of pyrite.

The poor bedding, fine grain size and good sorting suggest that the Woody Island Siltstone was deposited continuously in quiet conditions with occasional deposition of peebles possibly from ice rafts. The pryitic content and paucity of fossils indicate that the environment was reducing and rather inhospitable to life.

SATELLITE SILTSTONE

Approximately 40 feet of fossiliferous siltstone overlie the Woody Island Siltstone, and these beds have been correlated with the Satellite Siltstone (Banks, Hale and Yaxley, 1955). Exposures of the formation are very poor.

Medium dark grey siltstones, which weather yellow-brown, are poorly exposed in the creek at 1,014E-2,811N. The rocks show bedding from one to five feet thick, and irregular fissility. Bryozoa are especially abundant and include *Fenestella, Polypora* and *Stenopora*. *Grantonia*, other spiriferids, ? strophalosians, and pecten shells are also common. *Stenopora* ? *tasmaniensis* and *Peruvispira* were noted from a small outcrop, cut off on both sides by faults, at 857E-834N on the Glen Lusk Road.

DARLINGTON LIMESTONE

Fossiliferous limestones, calcareous siltstones, and siltstones overlie the Satellite Siltstone and have been mapped as the Darlington Limestone. The thickness was measured as 150 feet in the creek at 1,012E-2,809N, 120 feet on the Glen Lusk Road, and between 80 and 100 feet on the southern hillslopes of Mt. Faulkner. The first two values seem excessive and may be due to faulting. The only well exposed section is the outcrop along the Glen Lusk Road.

The basal part of the formation consists of alternations of bryozoal siltstones and calcareous brachiopod siltstone, and is exposed along the branch off the Glen Lusk Road. The bryozoal siltstones are one to four feet thick and contain stenoporids—a few in living position—*Strophalosia*, ? *Merismopteria*, and pecten shells. The brachiopod units are one to two feet thick and contain spiriferids, strophalosians, aviculopectinids, stenoporids, and gastropods. They vary from siltstones containing limestone lenses to poorly sorted silty limestones with arenaceous shell fillings.

This alternation is interrupted some fifteen feet above the base, and the succession continues with calcareous siltstone, some siltstone, and brachiopod limestone. The calcareous siltstones are hard, bluish grey and show slightly irregular bedding. The rock appears well to moderately well sorted in the hand specimen and contains sporadic angular to rounded pebbles. Thin section 30155 of a calcareous siltstone shows 35% angular quartz fragments ranging in size up to 0.8 mm. with prehnitisation of the calcareous matrix. Some units are bryozoal, containing dominantly stenoporids, others are sparsely fossiliferous. The siltstone beds are crumbly yellowish brown, irregularly bedded and are massive to fissile, the fissile parts being rich in fenestellids. The brachiopod limestones vary from moderately well sorted units containing sporadic angular to rounded pebbles to poorly sorted units containing much arenitic material and fragmentary and haphazardly orientated shells.

Eurydesma-calcirudites are prominent in the higher parts of the sequence. On the Glen Lusk Road they first appear 80 feet above the base, and the top 15 to 20 feet consists of alternating *Eurydesma*-calcirudites and spiriferid-calcirudites. These beds are massive, two or three feet thick, and foetid when struck with the hammer. Rock fragments are present as rounded to angular pebbles. In the *Eurydesma* units the shells are convex and concave upwards, and are associated with large pectinids, *Grantonia,* strophalosians, fenestellids and stenoporids in a silty matrix. The spiriferid units include *Grantonia,* stenoporids, and ? *Keenia. Calcitornella* occurs in these top beds (Banks 1957, p. 60).

Calc-silicate hornfels have formed along intrusive dolerite contacts. A light greenish grey hornfels collected at 821E-826N in thin section 30156 is a fine grained aggregate of calcite (40%), ? wollastonite (35%), chlorite (10%) and diopside, grossularite, vesuvianite, and sphene. Another hornfels, yellow-green in colour, from 849E-873N in thin section 30157 shows concentrations of diopside crystals (less than 0.3 mm.) on the borders of stenoporid fossils composed of recrystallised calcite. The matrix contains 30% quartz fragments less than 0.3 mm. in size with incipient development of diopside and ? prehnite.

BUNDELLA MUDSTONE

Outcrops of this formation are poor and no complete section is exposed. The thickness of the formation is between 110 and 150 feet.

Yellow-brown siltstones, some of them rich in fenestellids and stenoporids immediately overlie the Darlington Limestone on the Glen Lusk Road, but the succession is disrupted by faulting.

Poorly sorted olive-grey siltstones of this formation outcrop along the Collinsvale Road below the limestone quarry. The bedding is up to two feet thick and consists of alternations of massive and fissile units. The more fissile units are particularly rich in fenestellids. The fauna of the beds includes *Stenopora ? tasmaniensis, S. johnstoni, Fenestella, Polypora, Ingelarella, Grantonia, Streptorhynchus, Strophalosia* (new species), *Keeneia trochiforme, Peruvispira* (with double band), *Eurydesma cordatum, E. ? hobartense, Dielasma, Stutchburia, Aviculopecten ? elongatus, Camptocrinus,* and ostracodes.

The top beds of the formation are relatively unfossiliferous but in places contain small bryozoans, small spiriferids, and ostracodes. Dusky yellow siltstones comprising the top nine feet of the formation are well exposed at 814E-766N. These beds are alternations of fissile and non-fissile units, the latter showing slightly irregular bases. The fissile units tend to be the thicker reaching over two feet in thickness. The sorting is poor and the pebbles generally less than three inches across. A conglomeratic siltstone is a consistent horizon near the top of the formation and in this section the eighth unit from the top is a massive, four-inch thick, pebbly, coarse siltstone.

"Fontainebleu" siltstone lenses were noted in the formation at 1,004E-2,787N.

FAULKNER GROUP

All the formations named in the type section of the Faulkner Group at Mt. Nassau (Banks and Hale, 1957) have been recognised in the mapped area. The Group represents two cyclothems and is about 90 feet thick.

Geiss Conglomerate.—This formation is exposed at 1,002E-2,773N, and on the Glen Lusk Road at 814E-766N. At the latter locality it overlies the Bundella Mudstone with an irregular basal contact marked by layers, nodules, and concretions of limonite. This limonite layer encloses clay pellets, pebbles and poorly preserved stem-like remains, and possibly represents an old erosion surface.

The conglomerate is up to seven inches thick but is not everywhere continuous. It is olive-brown in colour when fresh and is poorly sorted, consisting of numerous pebbles set in a coarse arenaceous matrix of angular quartz, feldspar and mica fragments with a ferruginous cement. The pebbles are up to four inches in size and many are quite angular, although the majority show some degree of rounding. Pieces of silicified wood are present.

Rathbones Sandstone and Siltstone.—This formation is 15 to 20 feet thick. Excellent exposure occurs on the Glen Lusk Road at 814E-766N.

A yellow-grey to yellow-brown sandstone, a few inches thick, overlies the Geiss Conglomerate at this locality. Thin lenses of carbonaceous to siliceous siltstone intervene between the two in places. The sandstone is a poorly sorted coarse to medium grained arenite, rich in feldspar, and contains a few rounded pebbles and fragments of silicified wood. A two-inch thick lens-like body of siliceous siltstone follows, then a three to five-inch thick fine grained, friable, argillaceous and micaeous sandstone.

The friable sandstone member is overlain by seven feet of well-sorted yellowish grey quartzose sandstones, and light olive-grey, fissile and micaceous coarse siltstones. The bedding is variable in thickness and lensing is common. The last five feet become more thinly bedded. Large and small scale current bedding is present and the massive quartzose sandstones show ripple marking with wave lengths up to six inches long. A few poorly preserved plant remains were observed on bedding planes.

The top of the formation consists of eight feet of thinly layered carbonaceous and micaceous fine siltstones. The siltstones are olive-grey weathering to light grey or dun, and form beds two to three inches thick. Small lenses of fine arenitic material are present, and worm castings and tracks were noted on the bedding planes.

A possible paleogeographical reconstruction of the depositional environment is shown in Fig. 1. The environment ranges from marine, represented by the Bundella Mudstone, to fresh-water lacustrine, represented by the well sorted sandstones and siltstones of the Rathbones Formation. The retreating sea was fringed by pockets of pebble beaches forming the Geiss Conglomerate. Behind and between the pebble beaches were sandier beaches forming the first unsorted sandstone member. Fresh-water lakes occupied the land behind the beaches, and marginal reworking on the lake shore formed the friable sandstone member. The beach was littered with pieces of driftwood and there were also shallow pools that filled with silt. The unsorted nature of the beach material indicates a rapid retreat of the sea.

Byers Sandstone.—The formation is only exposed at 814E-766N where it overlies the Rathbones Formation with a markedly irregular basal erosional surface. It is two feet nine inches thick and is a yellowish brown, poorly sorted, pebbly sandstone. The pebbles are mostly rounded, an inch or less in size, and are concentrated toward the base and top. Thin section 30159 shows the rock to consist of angular quartz grains up to 5 mm. in size (40%), small rock fragments of quartzite, slate and mudstone (30%), feldspar grains (5%), a few mica flakes and grains of ilmenite, and a chloritic and argillaceous matrix. The fragments of mudstone were possibly derived from shallow water scouring of the underlying Rathbones Formation in a marine advance.

Jarvis Siltstone.—This formation is very similar in lithology to the top beds of the Bundella Mudstone, but no fossils were observed. It is 25 feet thick at 1,002E-2,771N. Here it is overlain by an 18-inch thick poorly sorted pebbly siltstone in which a dropped pebble was noted. The basal two or three inches are conglomeratic and also contain lenses of coarse unsorted sandstone. This unit was not reported in the type section at Mt. Nassau, and fully completes the double cyclothem.

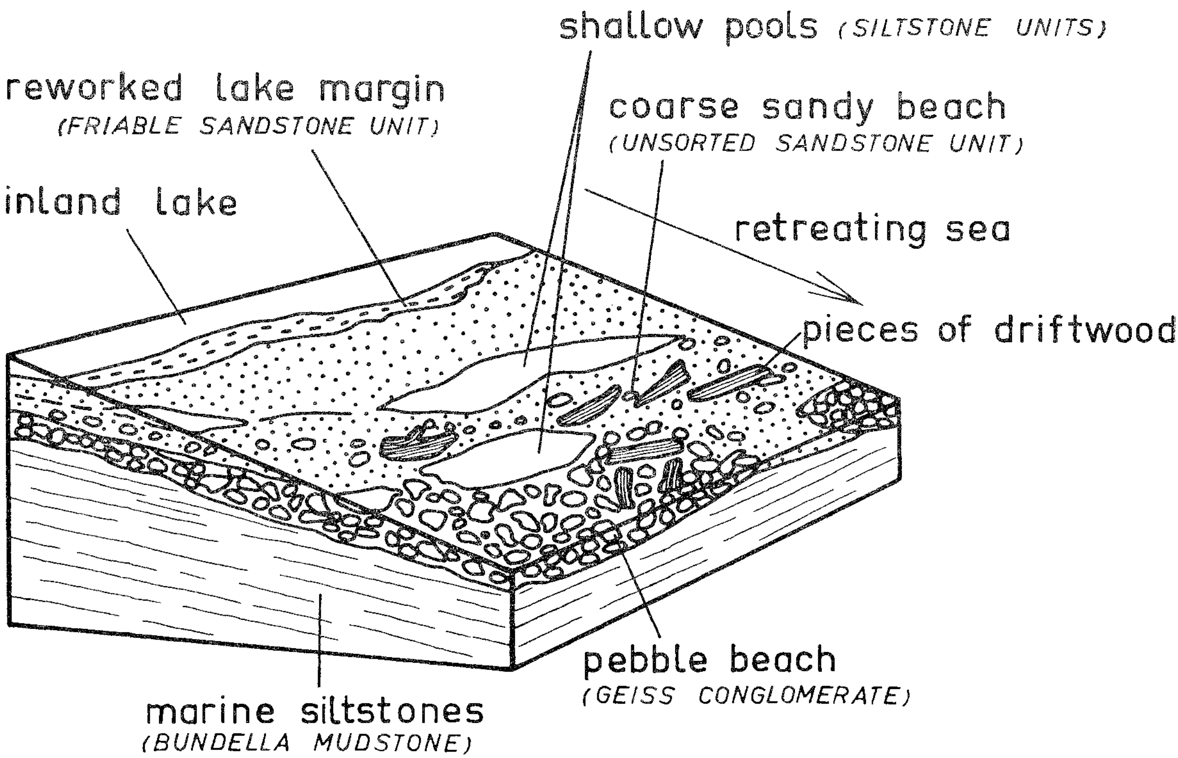

FIG. 1.—Paleogeographical reconstruction of the littoral zone in the Glen Lusk area during the retreat of the Permian sea in Artinskian time.

Parramore Sandstone and Siltstone.—These fresh-water beds are 10 feet thick and consist of thinly bedded, fissile carbonaceous and micaceous siltstones, with some thin beds of quartzose sandstone toward the top.

Altamont Conglomerate.—This formation is exposed at 1,002-E2,771N. A hard conglomeratic arenite, five inches thick, it is lithologically similar to the Byers Sandstone.

Fergusson Siltstone.—The formation is between 30 and 40 feet thick. The bottom 10 feet consist of alternations of fissile and non-fissile, poorly sorted, dark grey siltstones that weather light-grey or dun. Conglomerate and breccia units similar to those described in the type section are present. The top part of the formation consists of dark grey, mainly fissile siltstones, in which a few small spiriferids were found.

RAYNER SANDSTONE

Good outcrops of this formation occur on the Collinsvale Road both below and above the limestone quarry, at 716E-564N, at 744E-785N, and at 800E-891N. It is five to ten feet thick and consists of pebbly, olive-grey feldspathic sandstone and coarse siltstone. The bedding is massive and thick and the rock is poorly sorted, containing angular to rounded pebbles. In places is similar to the outcrop in the type section at Mt. Nassau, consisting of a relatively unfossiliferous lower unit, a friable central unit, and a fossiliferous top unit. Spiriferids are the main fossils present and include *Ingelarella* and a species with a long hinge line. Fragments of fossil wood and plant stems occur.

A specimen from 856E-816N in thin section 30160 consisted of 40% angular to rounded quartz grains mostly between 0.6 to 1mm. in size in a matrix of fine silt. Angular to sub-rounded fragments of quartzite and quartz up to 8 mm. in size formed 20% of the rock.

CASCADES GROUP

All three formations of the Cascades Group outcrop in the area. The boundaries between the formations are gradational. The thickness of the Group is between 250 feet and 300 feet. The Nassau Siltstone is relatively constant in thickness but considerable facies variation exists between the Berriedale Limestone and the Grange Mudstone.

NASSAU SILTSTONE

This formation is 50 to 60 feet thick and consists of massive and fissile siltstone. It is well exposed on the Collinsvale Road above the crossing of the Tarraleah power line.

The fresh siltstone is grey-black, but weathers medium grey to dun. The bedding is thick, and tends to be obscured by the fissility. The rock is poorly sorted, containing numerous angular quartz grains and pebbles are sparse. Limestone lenses occur and a limestone bed, about one foot thick, is a consistent horizon a couple of feet above the base.

The formation is richly fossiliferous, although the basal beds are rather barren in places, as at 700E-740N and west of Glen Lusk. The fauna is dominated by laminar and ramose stenoporids, fenestellids including both fan-like and frond-like colonies, and strophalosians in many cases as overturned shells. *Ingelarella,* other spiriferids, *Aviculopecten sprenti,* and crinoidal plates were also noted.

BERRIEDALE LIMESTONE

The thickness of the formation is between 130 and 150 feet around Collinsvale and Glen Lusk. Brill (1956) recorded the thirty-foot section exposed in the Berriedale limestone quarry and made correlations with other sections in the Hobart area.

The formation consists of alternations of massive limestone and fissile siltstone. The limestones are thickly bedded, being two to three feet thick, contain an appreciable amount of clastic material, and are best termed calc-arenites and calcilutites. The siltstones are more thinly bedded than the limestones and may be only a few inches thick. The limestone beds show pinch and swell with wave lengths up to 10 feet. Banks and Hale (1957) consider this to be ripple-marking.

Erratics, up to a foot across, are common. Many of them are angular and faceted, but smoothly rounded pebbles are also present. Dropped pebbles can be proved (Banks and Read, 1962). The erratics tend to be concentrated in the siltstones or in the tops and bottoms of the limestone beds (Brill, 1956) and were presumably dropped from ice rafts. Banks and Hale (1957) consider that this supports the view that the siltstones represent periods of glacial advance while the limestones represent periods of glacial retreat.

The clastic content of the limestones increases in the higher beds. Thin section 30161 of a massive limestone from near the top of the formation at 827E-762N shows lenses, patches, and stringers of coarse silt to sand grade material in a very fine grained silt base. The coarser material forms about 35% of the slide, and consists mainly of sharply angular fragments of high to low sphericity, composed of quartz, feldspar, chert, slate, phyllite, and mudstone. The calcareous content appears to be quite low.

A feature of the Berriedale Limestone is "tan, waxy looking shale" beds noted by Hale and Brill (1955) and regarded by them as the product of distant volcanic outbursts. Three horizons of bentonites are visible in the Berriedale limestone quarry. The lowest is overlain by a fissile siltstone with a slightly irregular boundary, but the next band lies between two limestone units. This observed lack of regularity in deposition favours the volcanic hypothesis of Hale and Brill.

The formation contains a rich and diversified fossil fauna (Voisey, 1938; Banks and Hale, 1957; Banks, 1957).

The limestones show extensive prehnitisation along intrusive dolerite contacts. A green hornfels collected at 497E-682N in thin section 30162 consisted of 70% prehnite.

GRANGE MUDSTONE

The Grange Mudstone is between 40 and 70 feet thick around Collinsvale and Glen Lusk, but becomes considerably thicker to the south-east, and at the top of Tolosa St. is 140 to 160 feet thick. The Berriedale Limestone is not exposed at this latter locality but its thickness probably decreases correspondingly, as in Weiley's Quarry, about half a mile away, it measures less than 100 feet.

The mudstones of this formation are greyish black but weather cream and light brown, weathering easily to give poor outcrops. Most beds are less than nine inches thick. The mudstone appears to be better sorted than the siltstone of the Berriedale Limestone and erratics are less common. There is a persitent limestone bed, one foot thick, just below the top of the formation, and an 18-inch thick strophalosian limestone was observed 60 feet below the top at Tolosa St.

An abundance of fenestellids and stenoporids gives the upper beds a strong lamination. The fauna includes *Fenestella,* very fine ramose stenoporids (*Stenopora ? grantonensis*), *Polypora, Strophalosia ? typica, Spiriferellina, Ingelarella, Aviculopecten sprenti,* small coiled gastropods (? *Warthia*) and *Gangamopteris.*

MALBINA SANDSTONE AND SILTSTONE

The succession in this formation is similar to that in the type section (Banks and Read, 1962) but good sections are lacking.

Cream to yellow-brown sandstones and pebbly sandstones belonging to the lower part of Member A are exposed on the Collinsvale Road above the limestone quarry. They overlie the Grange Mudstone but the contact is not clearly seen. The pebbly sandstones are poorly sorted and the pebbles are mostly angular with high to low sphericity. Large spiriferids, including *Ingelarella, Strophalosia,* large gastropods and rare small stenoporids are present. The better sorted finer sandstones contain fenestellids.

Massive poorly sorted sandstones and coarse siltstones interbedded with thinner fissile siltstones outcrop at 584E-578N and probably belong to the lower part of Member A. The massive units are up to a foot thick, show slightly irregular bases, and contain mostly angular, but some highly rounded, pebbles. Some of the massive units contain lenses of richly fossiliferous bryozoal siltstone, otherwise fossils are uncommon and mainly spiriferids. The fissile units are richly fossiliferous in patches containing bryozoans, spiriferids, and gastropods.

The dusky yellow-brown sandstones with subordinate siltstones that outcrop at 830E-700N may belong to the top part of Member A. The sandstone beds are medium to fine grained, massive and about a foot thick. They are poorly sorted being composed of angular grains of quartz, feldspar, zircon and even biotite. They contain flat thin pebbles of slate and phyllite and rare moulds of spiriferids including *Ingelarella.* Pieces of silicified wood were noted in a 15-inch thick breccia-sandstone. The siltstone beds show slump structure and are unfossiliferous.

Members B and D proved difficult to identify separately in the field as they both contain similar fissile siltstones which weather easily to give poor outcrops. Beds of this nature outcrop along the Collins Cap Road past Collinsvale, and on the Tarraleah power line above 838E-703N. Fossils and pebbles are very rare in these beds.

A conglomeratic pebbly sandstone outcrops on the Tarraleah power line above 838E-703N, and was mapped as Risdon Sandstone. However dolerite scree cover prevented definite identification and this may be Member C.

Member E is well exposed in Humphrey Rivulet, above the top end of Tolosa St., and at 080E-640N. This member is 20 to 30 feet thick and consists of cream to light brown siltstones and sandstones. These beds are generally well sorted and pebbles are rare. The top 10 feet contain a profusion of *Strophalosia ? ovalis* and *Terrakea,* associated with fenestellids, stenoporids, and small gastropods. Limestone lenses are common toward the top and in Humphrey Rivulet the final five feet is a foetid, bluish-black, pyritic, silty limestone, containing spiriferids, including *Ingelarella,* and strophalosians.

The depositional environment of the Malbina Formation has been discussed by Banks and Read (1962). They attribute the pebbly, poorly sorted coarser beds to turbidity current deposition rather than glacial deposition.

RISDON SANDSTONE

The formation is 10 to 15 feet thick and outcrops prominently in many localities. It is well exposed on the north-east ridge of Mt. Wellington and at 808E-640N.

It is a thickly bedded, yellow-grey, pebbly arenite, composed of angular to sub-rounded grains of quartz and feldspar. Breccia and conglomerate bands are present, particularly in the basal part of the formation. Many of the rock fragments present are very angular with low sphericity, but some are highly rounded. The fragments are up to five inches across and are dominantly of vein quartz and quartzite.

A few poorly preserved spiriferid moulds, and, in some places, numerous pieces of fossil wood were noted in the coarser bands.

FERNTREE MUDSTONE

The thickness of the formation is about 600 feet. No suitable section was found for detailed measurement, but it appears to correspond more closely with that in the Sandfly-Oyster Cove area (Rodger, 1957) than with that in the adjacent New Norfolk area (Woolley, 1959).

The lower part of the formation consists of thick bedded, hard, grey siltstone, 150 to 200 feet thick, which outcrops in many places as steep cliffs. The bedding is one to three feet thick. Some of the beds tend to be fissile toward the top, and thinner beds of fissile siltstone are also present. The siltstones are poorly sorted, consisting of numerous angular quartz fragments in a very fine grained clay matrix, and contain small pebbles.

A horizon of dark yellow-brown, thickly bedded, pebbly sandstone, eight feet thick, outcrops at 855E-695N and is overlaid and underlain by greyish siltstone. These beds are referred to the Ferntree Mudstone and if so then the pebbly sandstone horizon occurs at about 50 feet above the base. The rock is composed dominantly of angular quartz grains and the rock fragments are up to a foot across and very angular. It is very similar to Member "B" described by Woolley (1959).

The lower part of the formation is followed by approximately 200 feet of yellowish, slightly friable, poorly sorted silty sandstone containing rare pebbles.

The top part of the formation consists of poorly sorted greyish siltstones and sandstones. Variations in the coarseness of the constituent material give the rocks a mottled appearance on weathering. Slump structure is common and small scale current bedding was observed. Worm casts on bedding planes and worm tubes at a high angle to the bedding are common. Conglomeratic horizons are present. A poorly sorted, yellowish coarse conglomeratic sandstone outcrops on the north-east ridge of Mt. Wellington, about 450 feet above the base. Poorly preserved spiriferid moulds were found at 567E-180N and on the north-east ridge of Mt. Wellington about 470 feet above the base of the formation. Numerous pieces of lignified wood occur in lenses of conglomeratic siltstone close to the top of the formation at 442E-960N.

The Ferntree Mudstone appears to be a thick deposit of estuarine muds and sands deposited in fairly shallow water. The incursion of coarser material carried in by turbidity currents from time to time is suggested by the conglomeratic and breccia horizons.

CYGNET COAL MEASURES

No outcrop of these beds was found in the area. The formation may be present, but not exposed. Some 30 feet of these beds outcrop in New Town Creek just to the south-east of the area (Lewis 1946, p. 95).

TRIASSIC SYSTEM

The Triassic System is a sequence of lacustrine sandstones, siltstones and subordinate conglomerates. It overlies the Permian System with an erosional break, the nature of which is considered more fully later. The following formations have been mapped:—

"Feldspathic Sandstone"	200 + feet
Knocklofty Sandstone and Shale	600
Springs Sandstone	400
Total Stratigraphic Thickness ..	1200 + feet

SPRINGS SANDSTONE

Massive sandstones dominate the formation and outcrop prominently, in places, as steep cliffs. The thickness of the formation is between 380 and 400 feet.

The base of the formation is nowhere exposed. The basal beds are conglomeratic, as at 029E-451N where a seven foot thick bed of poorly sorted conglomeratic coarse sandstone overlies coarse sandstone with an uneven contact. The pebbles in the conglomeratic beds are dominantly sub-angular to sub-rounded siliceous fragments up to three inches across.

Thick bedded coarse sandstones are particularly common in the lower part of the formation and vary from dirty unsorted types to clean sparkling quartz sandstones. Pebbles are present, scattered both sporadically and in stringers marking the tops of beds. Thinly bedded well sorted sandstones become more common toward the top of the formation. The only fossils seen were fragmentary pieces of wood.

An interesting white sandstone mottled by brown bands was collected at 478E-918N, 100 feet above the base of the formation. In thin section 30164 this is a feldspathic sandstone composed of angular grains of quartz (55%) microcline and microperthite (25%), and bands of triangular, rectangular, and rounded garnet grains. The average grain size is between 0.8 mm. and 1 mm. Shreds of mica are twisted around some of the fragments, and zircon and tourmaline grains are also present. The garnet grains are cemented with limonite giving the rock its brown banding.

Large scale current bedding, scour and slump structures are a feature of the sandstones. The current bedding is festoon in type and overfolding along the margins, attributed to current drag (Read, 1960), is common.

Siltstones and mud pellet conglomerates occur but are comparatively rare and thin. A three-foot thickness of carbonaceous siltstone was observed in the basal beds at 029E-451N.

KNOCKLOFTY SANDSTONE AND SHALES

This formation contains a greater proportion of shaley siltstone than the Springs Sandstone. The siltstones are susceptible to weathering and rarely outcrop. The base of the formation is marked in places by a distinct bench cut in along a siltstone horizon. Beds of greenish siltstone, up to four feet thick are exposed in the Mount Rivulet at 000E-349N. They are massive to shaley, well sorted, and commonly micaceous.

Massive coarse to medium grained sandstones are common, but there is a preponderance of thinly bedded, almost shaley, fine sandstones. The sandstones are yellow to white in colour and are well sorted. The massive coarser sandstones are composed almost entirely of sub-angular to rounded quartz fragments with minor amounts of feldspar and mica, and little matrix. They contain clay pellets, ferruginous nodules and sporadic pebbles. The finer sandstones contain appreciable amounts of muscovite and graphite on the bedding planes. Large scale current bedding, scour and slump structure are a feature of the sandstones just as in the Springs Sandstone. Measurements of current bedding directions made in both formations indicated that the currents came from the north-west, west, and south-west.

Mud pellet conglomerates are present and are more abundant toward the top of the formation. They are lens-like bodies, mostly between one and three inches thick, but reach up to seven inches. They are composed of numerous clay pellets and in same cases pebbles, set in an arenaceous matrix. The clay pellets are ellipsoidal, commonly show alignment parallel to the bedding, and are up to three inches long. They were most probably derived from drying clay beds.

"FELDSPATHIC SANDSTONE"

Exposure of the formation is poor. Some outcrops occur under the dolerite at 122E-036N, and the hillside below is littered with float of laminated chert hornfels.

Feldspathic sandstones with pebbly and conglomeratic phases and interbedded with shaley siltstones are exposed at 200E-043N. The sandstones are olive-grey, medium to fine grained, friable arenites composed of quartz, feldspar and chlorite grains. Feldspar forms up to 30-40% of the rock. The pebbles in the conglomeratic phases are generally well rounded and small, and ellipsoidal mudstone pellets, up to three inches long, are common. The shaley siltstones contain numerous carbonaceous impressions of ? *Dicroidium.*

JURASSIC SYSTEM

The central intrusive body within the area is a cone sheet of dolerite (see structural section) of Lower to Middle Jurassic age (McDougall, 1961). Four differentiation zones (Spry, 1958) have been mapped.

The dolerite is blue-grey to greenish in colour and is composed essentially of plagioclase and pyroxene crystals, with accessory iron ore and residual mesostasis. The dolerite is chilled along intrusive margins and is fine-grained and dark grey.

The petrology of the chilled margins and differentiation zones has been extensively investigated by Joplin (1957), Spry (1958), *et al*, and there is little to add except with regard to the behaviour of the Pegmatitic Zone.

The Pegmatitic Zone is not developed in the steep walls of the lower part of the cone sheet except where the sheet flattens out into shelves, such as at Glen Lusk and just behind Chigwell. In these places it is feebly developed some 100 feet below the top contact and is usually less than 50 feet thick. However, where the dolerite rises from this shelf the Pegmatitic Zone, in places, becomes pronounced and comes up almost to the top of the intrusion, the Upper Zone being not more than 10 or 20 feet thick. This is very apparent above the Collins Cap Road at Collinsvale, at 460E-360N and 482E-725N. Pegmatitic dolerite veins, over a foot wide, cut chilled dolerite along the intrusive contact at 490E-616N. The dolerite at 482E-725N rises steeply, and here the Pegmatitic Zone ends 100 to 200 feet above the base of the rise. Thus these upward bends in the cone sheet have acted as concentrating points for the volatiles during differentiation.

The pegmatites contain blades of pyroxene over 10 cm. long in places. They form veins and irregular patches, and the boundaries with the enclosing dolerite are in cases quite sharp. Thin section 30165 cut across such a contact in a specimen from 490E-614N showed ophitic plagioclase (60%) and pyroxene (35%), with mesostasis and iron ore, passing with only slight gradation into coarser plagioclase (45%), pyroxene (30%), and mesostasis (25%), with ophitic to intersertal texture. In the finer zone the feldspar laths average 1-2 mm. in length with zoning from Ab40 to Ab20, and the subhedral pigeonite and augite grains average 2-4 mm. in length. In the coarse zone the feldspar laths (composition Ab20), pigeonite and augite crystals average 4-8 mm. in length, and the mesostasis is Types 1 and 2 (Spry, 1958).

Some of the rocks from the Pegmatitic Zone are very rich in mesostasis. A specimen from Knights Creek Reservoir at 1,031E-2,360N in thin section 30166 shows 70% mesostasis (Type 1 of Spry, 1958).

An interesting dolerite was collected from 300E-649N in the dyke-like body north of Collins Cap. Thin section 30167 shows this rock to consist of a medium-grained mesh of plagioclase (40%) and pyroxene crystals (30%) and mesostasis (25%). The plagioclase laths are mainly from 1 to 1.5 mm. in length, with zoning from Ab40 to Ab20. The pyroxene forms bladed crystals of pigeonite and augite averaging 1 to 3 mm. in length. Many of the pyroxene grains are rimmed with chlorite, and the optic plane is in some cases parallel to 010, and others normal to 010. The mesostasis is mainly Type 2 (Spry, 1958). This specimen is of interest in that no actual pegmatites were observed at this locality. The high mesostasis content suggests that on the steep uprises of dolerite some of the volatile material remains and becomes distributed in the upper zone even though no pegmatites are formed.

TERTIARY SYSTEM

There is a small outcrop of olivine basalt at 9,938E-2,729N and basalt float on silicified Triassic sandstone at 151E-845N. The basalt is presumably Tertiary in age by analogy with other Tasmanian occurrences.

The basalt is vesicular with fillings of chabazite, clay, calcite, and tobermorite minerals. Thin section, 30168, showed euhedral olivine phenocrysts, mainly from 1 and 1.5 mm. in size, in a ground mass of feldspar laths and pyroxene grains, less than 0.3 mm. in size, riddled with grains of iron ore.

QUATERNARY SYSTEM

The Quaternary deposits in the area include scree and talus deposits, soil coverings, and river gravels. The distribution of soils is shown on the Reconnaissance Soil Map of Tasmania, Hobart (1955), Division of Soils, C.S.I.R.O. Deposits of river gravels 15 to 20 feet high are seen in places along the steep gullies of the Sorell River, Humphrey Rivulet, and Knights Creek. A tongue of river gravel covers the lower reaches of Humphrey Rivulet at Glenorchy.

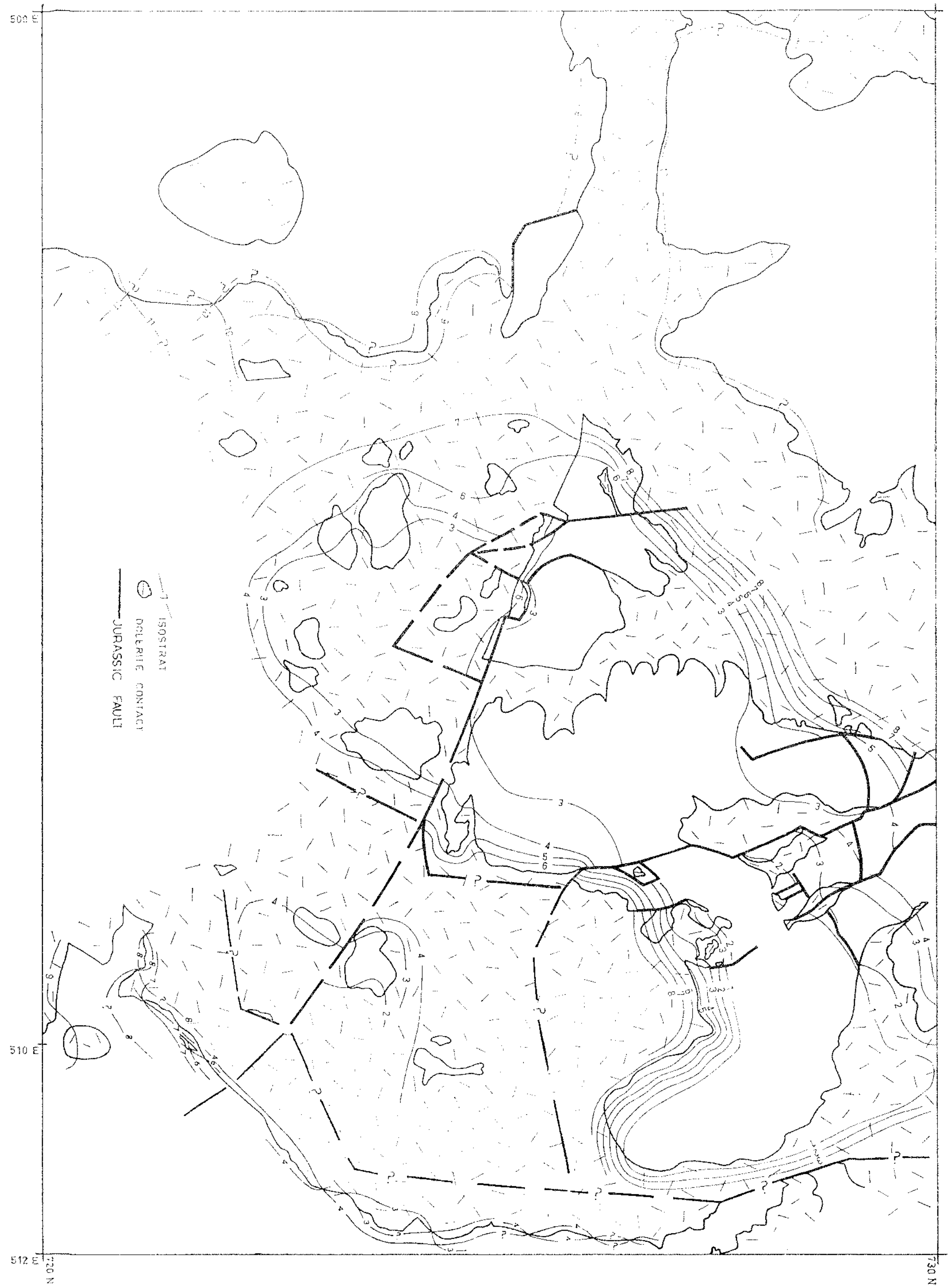

FIG. 2.—Isostrat map of the Collinsvale cone sheet structure. Each isostrat line represents the locus of intersection of intrusive dolerite with the base of a Permo-Triassic formation as follows: 1—Darlington Limestone; 2—Bundella Mudstone; 3—Faulkner Group; 4—Nassau Siltstone. 5—Berriedale Limestone; 6—Grange Mudstone; 7—Malbina Formation; 8—Ferntree Mudstone; 9—Springs Sandstone; 10—Knocklofty Formation; 11—" Feldspathic " Sandstone. N.B.: Around the outer margins of the cone sheet structure, due to insufficient control, alternative sets of isostrats can be drawn and the trends of the isostrat lines are only approximate.

STRUCTURE

1. *STRUCTURAL FEATURES OF THE PERMO-TRIASSIC STRATA.*

These strata are generally sub-horizontal except where dragged against faults. The Triassic System in Tasmania overlies the Permian System disconformably or with a slight unconformity (Banks, 1962 *a*). Variance between the strikes of the two Systems in the Collins Cap area suggests a slight unconformity. A possible unconformity, just to the north-east of the mapped area, has been suggested by Lewis (1946, p. 128). The strike and dip of the Permian beds (with due allowance for fault drags) suggest a gentle basin structure at Collinsvale and possibly an adjoining domal structure east of Glen Lusk.

2. *STRUCTURE OF THE DOLERITE INTRUSIONS.*

The dolerite has intruded the Permo-Triassic rocks in a complex manner, and the intrusions are broken up by Tertiary faulting. The original structure of the dolerite was determined by mapping the dolerite into its differentiation zones and by treating the intrusive contacts according to the "isostrat" method of Carey (1958 *a*) (see Fig. 2).

The Collinsvale Cone Sheet.

In the block bounded by the Cascades and Humphrey's Faults to the east, and the Collins Bonnet and Sorell River Faults to the west, the isostrats fall concentrically inward, indicating a cone sheet centered at Faulkners Rivulet and elongate north-east.

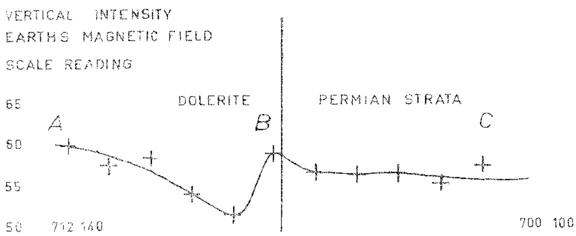

FIG. 3.—Graph of variation in the vertical intensity of the earth's magnetic field observed along traverse across the intrusive dolerite contact west of Oak Hill. The form of the curve suggests the main mass of dolerite is under BC. The small size of the peak compared to the depression is probably due to the subtracting effect of the dolerite at AB.

The eastern and southern walls of the cone rise very abruptly and the contacts are vertical west of Mary's Hope Road and north of Montrose Road. The contact of the southern wall is sill-like in trace above the Collinsvale Road, but was shown to be steeply rising dolerite by a magnetic traverse, along the creek, from 1,140E-2,720N to 1,100E-2,700N (Fig. 3), and by density measurements of dolerite samples collected in a traverse inward from the contact.

The north wall of the cone is less steep, and flattens out into a small shelf just west of Chigwell before rising to form the dyke-like contact below Mt. Faulkner. To the west the dolerite rises against the Glen Lusk Fault, beyond which the cone sheet forms an expansive bowl.

The cone sheet spreads outwards on all sides as an extensive sill-like sheet intruding high Permian or Triassic strata. The sill bodies capping the Mt. Wellington plateau, Mt. Faulkner, the western flank of Collins Bonnet, Collins Cap, and Trestle Mt. are all remnants of this sheet.

The top of the sheet has everywhere been stripped by erosion but the thickness is estimated at about 1,000 feet.

Jurassic Faulting within the Cone Sheet.

Many of the faults within the inner throat of the cone sheet are of Jurassic age, as they stop against dolerite or have unshattered, chilled dolerite or hornfels against them (Fig. 4). No distinctive criteria are present for determining the age of some of the faults, but most of these are probably Jurassic. The faulting within the throat resolves into three stages.

The first stage is faulting of a pre-dolerite age. These faults are cut by dolerite and include the fault at 924E-920N to 831E-856N, the two faults cut by the dolerite mass at 867E-842N, and the fault in the gully between the Collinsvale and Glen Lusk Roads. The eastern end of the last-mentioned fault appears to connect with a thrust fault at 933E-871N. The plane of the thrust dips some 70 degrees to the north-west, and within this thrust block in the quarry at the road junction, is a small "marked horizontal thrust" fault (Lewis, 1946, p. 125). None of the throws on these faults are very large, less than 100 feet for the most part, and they bound an upthrown block in the centre of the cone sheet. This block was presumably upthrust by the intruding dolerite.

The second stage is represented by a system of radial and partial ring faults extending out from the central upthrown block. Radial faults can be seen in the creek beds along the Collinsvale Road at 864E-743N, at 905E-831N, at 845E-925N, and at 933E-874N. The accompanying peripheral faults all downthrow toward the central block. These faults relieved the stress imposed on the rocks by the intrusion of the dolerite cone. In places the dolerite took advantage of these structural weaknesses and its form was partially controlled by the concomitant faulting.

The Glen Lusk Fault represents the third stage of the faulting and is a strong tangential fracture marking off the inner throat of the cone sheet. It throws down toward the central part of the cone. The throw is just over 100 feet at the north end, whereas to the south the throw increases to 250 feet. Later Tertiary movement along part of the fault probably accounts for the increase. The fault was an important line of intrusion for the dolerite.

A series of faults branches off the north end of the Glen Lusk Fault and these abut against the dolerite wall rising up to Mt. Faulkner. The fault on the ridge at 731E-931N is a thrust, the fault plane dipping some 70-80 degrees to the south. The throws of these faults increase as they approach the dolerite wall.

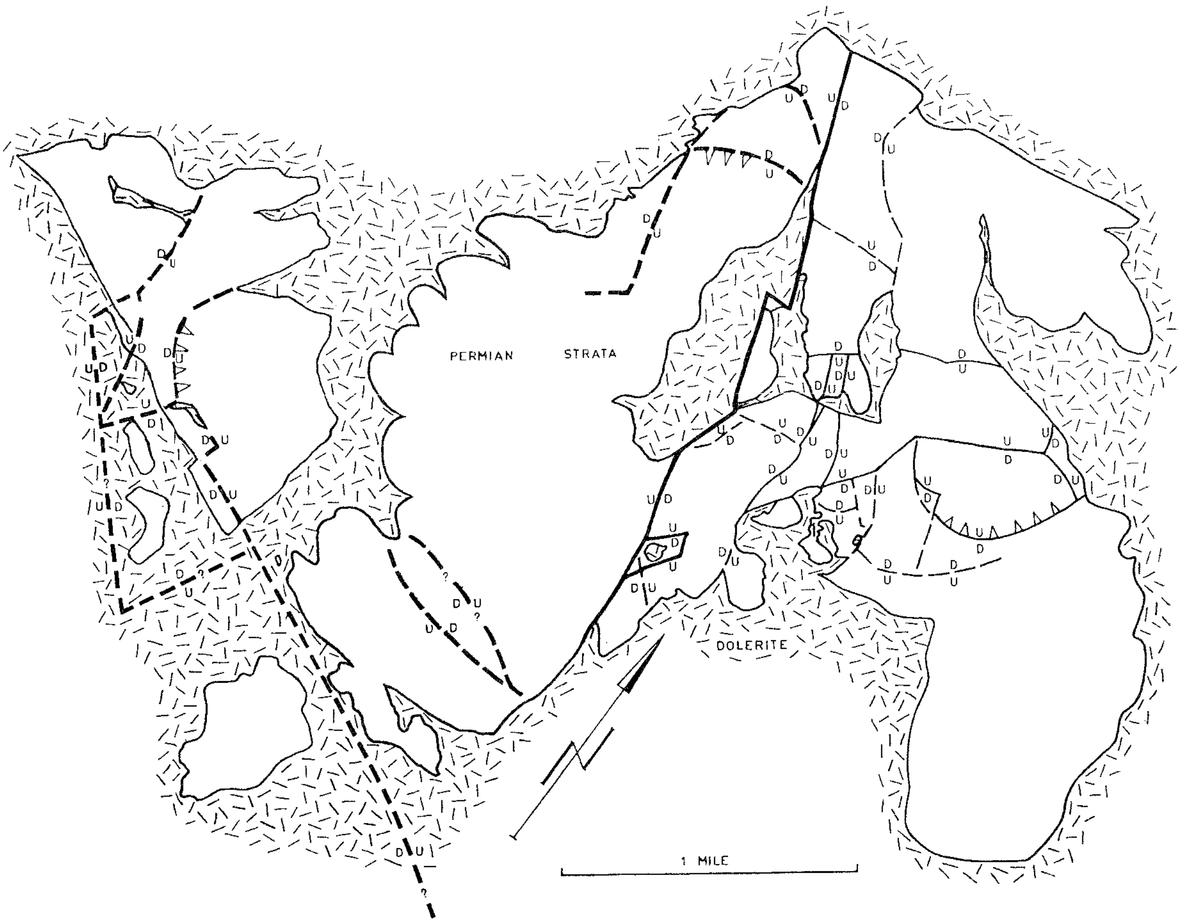

FIG. 4.—Map showing the concomitant faulting within the dolerite cone sheet. The thin unbroken fault lines represent the first stage of the faulting, i.e., the upthrown block within the throat of the cone; the thin broken lines the second stage, i.e., the radial and partial ring faulting; the thick unbroken lines the third stage, i.e., the tangential Glen Lusk fault; and the thick unbroken lines the faulting associated with the Collinsvale basin sructure.

Concomitant faulting is associated with the up-stepping of dolerite west of Collinsvale. A fault beginning at 538E-678N stops at a small plug of dolerite at 553E-604N sidesteps to the south-west, then continues and is cut off by dolerite at 629E-567N. The fault is a thrust west of the dolerite plug. The fault plane dips about 70 degrees east and the throw is 150 feet. East of the dolerite plug the nature of the fault is not evident and the throw is 200 feet. The structure is interpreted as a line of thrusting giving way laterally to a zone of tension up which rose the plug of dolerite.

A physiographic high in the dolerite to the south-east forms an extrapolation of this line of faulting and suggests it continued right across the cone sheet. The high shows up as a strong linear on the aerial photographs and passes out of the dolerite as the fault in the cheek at 1,031E-2,307N. This fault has the same amount and sense of movement as on the fault at Collinsvale. No brecciation of the dolerite is visible where the linear crosses Knights Creek and it marks a petrographic change in the dolerite from a differentiate on the elevated side, characteristic of central levels of the dolerite body, to a differentiate, on the subjacent side, typical of a higher level. All this suggests Jurassic faulting concomitant with an upstepping of dolerite. Block subsidence associated with this line of faulting (Fig. 4) is suggested by the dislocation of isostrats to the south-west. The apparent dislocation may be caused by the inward dip of the strata toward the centre of the basin structure at Collinsvale, but calculations suggest that dips of about 15 degrees would be required. This is somewhat higher than the observed dips. Subsidence following upthrusting is also compatible with the same behaviour inferred in the faulting within the throat of the cone sheet.

The fault at 493E-682N downthrows 150 to 200 feet to the west, and the throw diminishes southward. Dolerite is intruded up into the beds on the downthrown side, but does not appear in the beds on the upthrown side. This fault is possibly another thrust concomitant with an upstepping of dolerite.

Influence of the Permo-Triassic Structure on the Cone Sheet Intrusion.

The cone sheet appears to have intruded up into a dome of Permian strata. The doming was possibly caused by the vertical push of the intruding dolerite, but the indications of an unconformity between the Permian and Triassic strata in the area suggest it was possibly epi-Permian folding. The cone sheet near Geeveston is also centered in a dome of Permian strata (see Banks 1962 *a*) and there is some suggestion that the cone sheet at Bloomfield occupies a domal structure (see Anand Alwar, 1960). This may be a purely fortuitous association but there is a possibility that the domes exercise a selective control as sites of intrusion, since their potential for relief of upward stress through radial and concentric fracturing is greater than that of basins.

The intruding dolerite pushed out the top of the dome, i.e., the central upthrust block, and the upward stress was relieved by the radial and concentric fracturing. Where the dolerite cone met the adjoining basin structure to the west the rocks fractured along the Glen Lusk Fault, suggesting that the basin structure imposed a greater resistance to the upward passage of the dolerite.

Beyond the Glen Lusk Fault the intrusion appears to have been controlled by the basin structure, and it expands out into a basin-shaped sill. The dolerite, finally, breaks through the strata along the thrusts north of Glen Lusk and at Collinsvale, the latter thrust forming a fracture for the uprising of magma across the whole cone sheet. The thrusts suggest intrusive pressure, possibly built up by the dolerite flowing downward into the basin structure.

Dolerite Intrusions joining the Cone Sheet.

The western side of the cone sheet is met by a dyke-like body north of Collins Cap, and the fault at 191E-625N is probably a concomitant fracture. This dyke-body is formed at the meeting of intrusions rising from the north and from the south. It is joined to the south by a transgressive sill that intrudes the Grange Mudstone in the Mount Rivulet at 004E-511N. The Collins Cap Fault was concomitant with this intrusion. It downthrows 200 feet at Collins Cap, but the throw decerases northward where it splits into several small faults against the dyke-body.

The dyke-body is joined on its northern side by a sill appearing in Triassic strata at 227E-858N and by an intrusive mass west of Malbina. The country between is broken by concomitant faulting, apparently under a tensional stress that operated across the two dolerite uprisings. A source of these northern intrusions is presumably the sill that rises from low in the Permian System north of the Derwent River (Read, 1960).

A plug of dolerite, in the Sorell River at 471E-940N, rises up to join the Mt. Faulkner sill body. This is either an off-shoot of the cone sheet from below river level or a feeder from the sill north of the Derwent River.

There are several possible interpretations of the line of intrusion from north of Collins Cap to south of Collins Bonnet. The intrusion consists of a lower dyke-body and a higher-sill body that caps Trestle Mt. and Collins Cap. A pocket of Triassic sandstone at 347E-342N has been downthrown by at least 200 feet in relation to the sandstones of Collins Cap and is separated from them by dolerite. This displacement is either dilational or caused by a Jurassic fault beneath the dolerite. These contacts may represent:

(1) The base of the ascending cone sheet,
(2) The dolerite sill in the Mount Rivulet rising up to meet the cone sheet,
(3) The cone sheet and the Mount Rivulet sill joining and rising as a dyke before turning outward as the sill body.

None of these three cases can be chosen on a consideration of dilation effects, as all of the thicknesses of the dolerite bodies are not known. The dolerite of the Collins Bonnet massif and Trestle Mt. falls trangressively to the south-west, and another interpretation is that here the cone sheet is arching over and falling in the opposite direction, as in the Scott Arch of the Huonville cone sheet (Carey, 1958 *a*).

The dolerite contact along Tolosa Street can be shown by the relative displacement, through faulting, of intrusive contacts and differentiation zones, to be sloping down to the east. Thus this contact may represent the upstepping of a sill rising from the east. A sill rising from the north-east intrudes Grange Mudstone in the Lenah Valley area (Lewis, 1946, p. 95) and extrapolation of this sill indicates that this would also be the stratigraphic level of intrusion at Tolosa Street. If this is the case then the blocks of Permian rocks exposed underneath Mt. Hull at 900E-418 N and at 922E-444N are probably " windows " in the base of the sill where it rises to meet the cone sheet in an arch structure along the line of Mt. Hull. The Mt. Wellington sill extends outward from this arch-like meeting. Thus there are two sill sheets in the same vertical section at the north-east spur of Mt. Wellington, the lower one intrusive into Grange Mudstone, and the higher one intrusive into the top of the Ferntree Mudstone and the base of the Triassic System.

The low stratigraphic level of the rocks beneath the floor of the sill rising from Tolosa Road as compared with the roof rocks is the reverse of what would be expected on dilational grounds. Thus it appears the sill rose up along a large Jurassic fault. It is likely that Humphrey's Fault is the old Jurassic fault with renewed Tertiary movement. Humphreys Fault joins the Cascades Fault which in the nearby Claremont area is Tertiary movement along a Jurassic fault line (Read, 1960). The Glen Lusk-Hull Fault line also appears to be Tertiary movement along a Jurassic fracture that joined Humphrey's Fault.

The pattern of intrusion in the mapped area, with regard to the approach of intrusive bodies on almost all sides, places the cone sheet as a major intrusive centre in the Hobart district.

3. *THE POST-DOLERITE TENSIONAL FAULTING.*

The age of the post-dolerite tensional faulting in Tasmania is late Mesozoic and/or early Tertiary with continued movement throughout the Cainozoic (Banks, 1962 *b*, Solomon, 1962). The dominant trend in the faulting is north-westerly (Banks, 1958 *b*), but there is no marked preference for this trend in the mapped area and the controlling factor is the Jurassic structure. Steep dolerite margins and Jurassic faults regulate most of the faulting.

The Cascades-Humphrey's-Austin's Fault System.

The first phase of tensional failure under the Tertiary epeirogenic stresses was faulting along old Jurassic faults that followed the circumference of the cone sheet. The Cascades Fault (Lewis, 1946) changes abruptly in trend just west of Rosetta Road where it approaches the cone sheet, and then faults the north-east margin of the cone sheet. The throw here is at least 2,200 feet down to the east and probably about 3,000 feet. Humphrey's Fault (Lewis, 1946) follows the eastern and south-eastern margin of the cone sheet but the throw cannot be determined. It is marked by a distinct scarp and the fault probably continues up onto the Mt. Wellington plateau upthrowing the Mt. Connection block. Austin's Fault (Lewis, 1946, p. 98, not as marked on his map) also parallels the south-east margin of the cone sheet and downthrows 300 to 350 feet to the west.

The Collinsvale-Hull Fault System.

Adjustment fracturing at right-angles to the faults following the circumference of the cone sheet gave a system of radial faults that cut across the dolerite margins and the earlier faults. The important faults of this system are the Collinsvale, Hull (Lewis, 1946), Valleydale (Lewis, 1946) and Knights Creek Faults. The Collinsvale Fault is a major fault that continues westward across the whole of the cone sheet and out of the mapped area. It is not the Collinsvale Fault as defined by Lewis (1946), which does not exist—Lewis mistakenly took the intrusive inner margin of the cone sheet for a fault contact.

Most of the radial faults link up with the Collinsvale Fault through cross-fractures. Patches of roof rocks east of the cross fault at 950E-530N indicate a downthrow of about 500 feet to the east. The Hull Fault terminates at 891E-622N, where it splits into several faults, and some of the tension was taken up by movement along part of the Glen Lusk Fault.

A feature of the Collinsvale Fault, along the Collins Cap Road, is the adjustment cross-faulting. The largest adjustment faulting, however, took place where the Collinsvale Fault passes out of the cone sheet. On the southern upthrown side the adjustment was made by a downthrow of the cone sheet (Collins Bonnet Fault), while on the north downthrow side adjustment was made by uplift (Sorell River Fault). From here the Collinsvale Fault follows the margin of the dolerite dyke-body north of Collins Cap, its upthrow side forming a steep and high scarp.

Collins Bonnett-Sorell River Faults.

The Collins Bonnet Fault is difficult to prove conclusively. The outcrop of Triassic sandstone at 347E-342N is cut off against dolerite to the east. This appears to be a fault contact rather than an igneous one, but the exposure is not sufficiently good for certainty. A small physiographic trough joining this exposure to the Collinsvale Fault suggests the presence of a fault. Further along this line, on the saddle between Mt. Connection and Collins Bonnet, there is an apparent change from Upper Zone dolerite to a dolerite rich in ferromagnesians, that probably represents a lower differentiation zone. If this change is caused by faulting, then a tentative estimate of the throw would be 600 feet down to the east.

The Sorell River Fault is expressed by a saddle seen in the Sorell River gorge, and the fault terminates in a downthrown wedge formed by cross-faulting.

4. *JOINTING*

Jointing in the Dolerite.

The characteristic columnar jointing of the Tasmanian dolerites is well developed in the dolerite sheets of Collins Bonnet, Collins Cap, and Trestle Mt. This jointing has been regarded as a system of cooling joints (Hale, 1958), but Carey (1958 *b*) regards it as an expression of epeirogenesis.

The jointing in the dolerite is often blocky, as the rock is also cut by strong sub-horizontal joints. Inclined and curved fractures are also common. Close vertical jointing is common along intrusive margins and extends into contact hornfels, as at 527E-722N, where it has obliterated the bedding in baked Bundella Mudstone.

Joint planes are smooth or show fluting and surface roughness. Calcite and zeolites form common joint fillings. Chabazite is very common, stilbite is found near 427E-638N, and the rare zeolite, gonnardite, occurs at Knights Creek. As far as is known this is the first recorded occurrence of gonnardite from intrusive rock.

Measurements of joint directions were taken at 60 feet intervals commencing at the base of the sill rising up onto Mt. Wellington along Humphrey Rivulet. Curved joints, considered to be mainly cooling joints, were not measured because of the difficulty of plotting strikes. Approximately 225 joint directions were taken.

The joint pattern (Fig. 5*b*) shows two major directions of near vertical joints, a set at 330 degrees and a set at 275 degrees. The set at 330 degrees corresponds well with the dominant Tertiary trend of tensional failure (Banks, 1958 *b*). The east-west trend has been reported by McDougall (1959) and Rodger (1957). There is some development of jointing normal to both these trends. There are also joints dipping approximately 20-30 degrees to the north-west. These joints probably developed parallel to the base of the sill sheet, which is transgressive upward to the south-east. The relationship between the joint pattern and the Tertiary faulting in the vicinity is not complete. The set at 330 degrees is in accord with the trends of the Knights Creek and Valleydale Faults just to the north, and the set at 275 degrees is possibly related to the fault across Humphrey Rivulet at 847E-158N. However, there is little expression in the joint pattern of the Humphrey's and Austin's Faults.

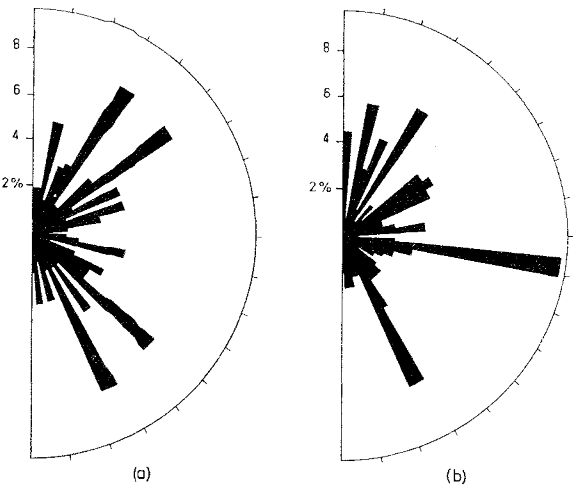

FIG. 5.—Joint frequency diagrams—Humphrey Rivulet (*a*) Permian strata, (*b*) Jurassic dolerite.

Jointing in the Permo-Triassic Strata.

The Permo-Triassic rocks, as elsewhere in Tasmania, are cut by strong vertical cross-jointing with subsidiary inclined fracturing. Two joint directions are generally dominant, intersecting at angles between 70 and 90 degrees. A third median vertical direction is present in many cases. In places only one of the joint directions is well developed as in the pavement of Ferntree Mudstone exposed at 482E-922N.

Where the strata are inclined the jointing is always normal to the bedding. This is well illustrated at 478E-627N, where beds of the Malbina Formation are dragged up against the Collinsvale Fault and dip at about 30 degrees. Thus the jointing was either imposed prior to the Tertiary faulting or formed as radial tensional joints on the bend of the fault drag.

Joint directions were taken in the Permian rocks outcropping in Humphrey Rivulet below the dolerite sill sheet. Measurements were made at 25 feet intervals and approximately 150 readings were taken. The joint pattern (Fig. 5*a*), although not very strongly developed, gives the characteristic directions at 210 and 310 degrees, and a median direction at 230 degrees. There is a joint direction corresponding to the major Tertiary trend at 330 degrees. The pattern is similar to that of the jointing in the Permian rocks in the South Arm-Sandford area (Green, 1961).

The joint pattern for the Permian rocks in Humphrey Rivulet when compared with the pattern for the jointing in the overlying dolerite sheet shows similarities, but the correspondence is not marked. The major Tertiary trend is present in both patterns at 330 degrees, but examination of the readings taken in the Permian rocks showed that most of the joints of this trend occur in the contact hornfels at both ends of the outcrop. Lack of correspondence between joint direction trends in Permian strata and dolerite bodies also occurs in the joint patterns for the South Arm-Sandford area (Green, 1961) and the Pontville-Dromedary area (McDougall, 1959). These facts tend to suggest that the sedimentary strata and the dolerite failed under the Tertiary tensional stresses in differing manners. The most obvious inference is that the sedimentary strata failed in part by shear jointing, while the more brittle dolerite and contact hornfels failed by tension jointing. Some of the jointing in the Permian rocks is probably related to the epeirogeny and dolerite intrusion in the Jurassic. It is noticeable that the trend of the steep dolerite contact across Humphrey Rivulet is approximately parallel to the jointing trend at 310 degrees. Also the trends of Humphrey's and Austin's Faults and of the dolerite contact along Tolosa Road are approximately parellel to the jointing trend at 230 degrees.

5. *BASALT LAVA FLOW*

The remnants of Tertiary basalt at 151E-845N and at 9,938E-2,729N indicate a flow sloping down to the north. The Collinsvale Fault was probably the line of ascent of the lava.

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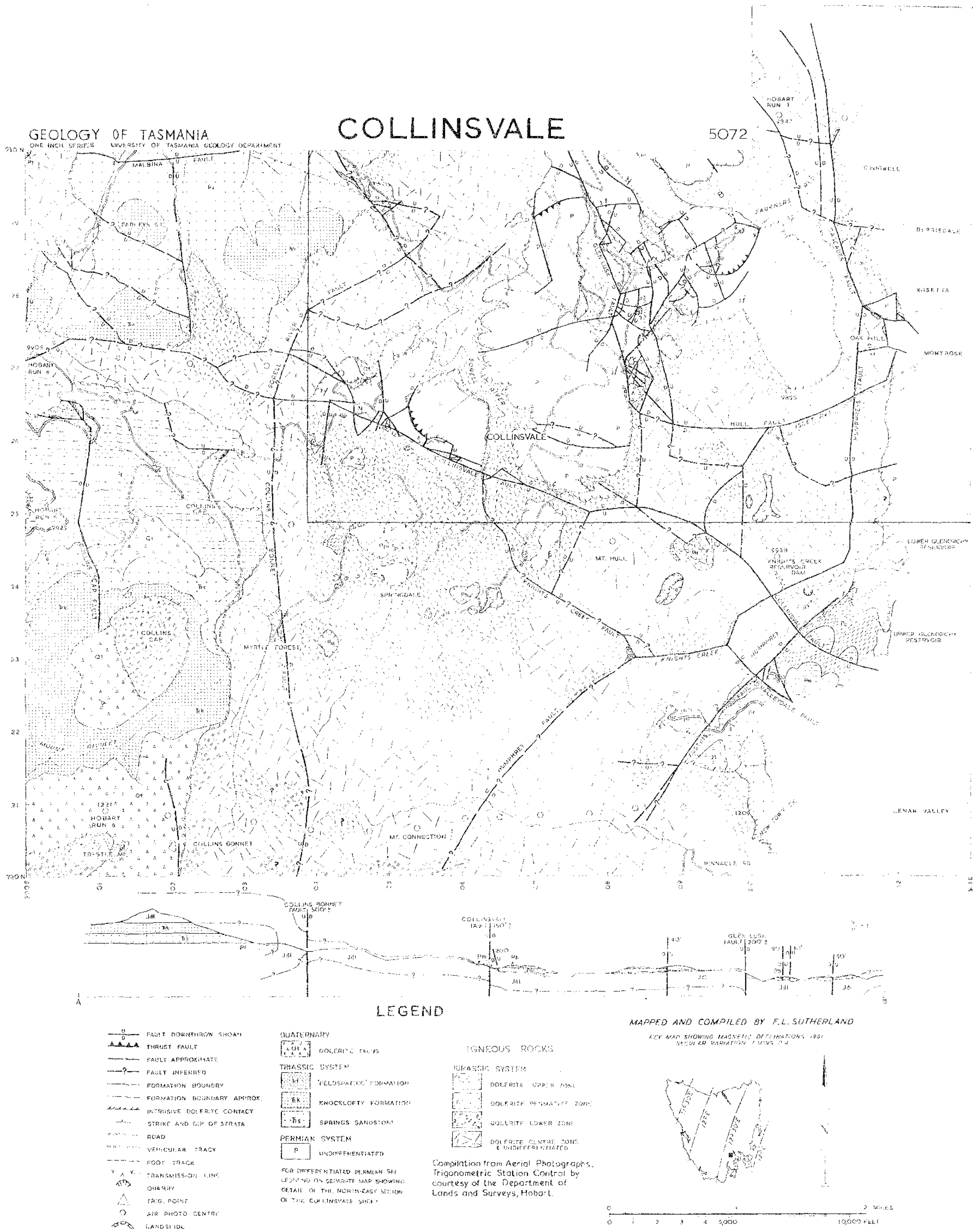
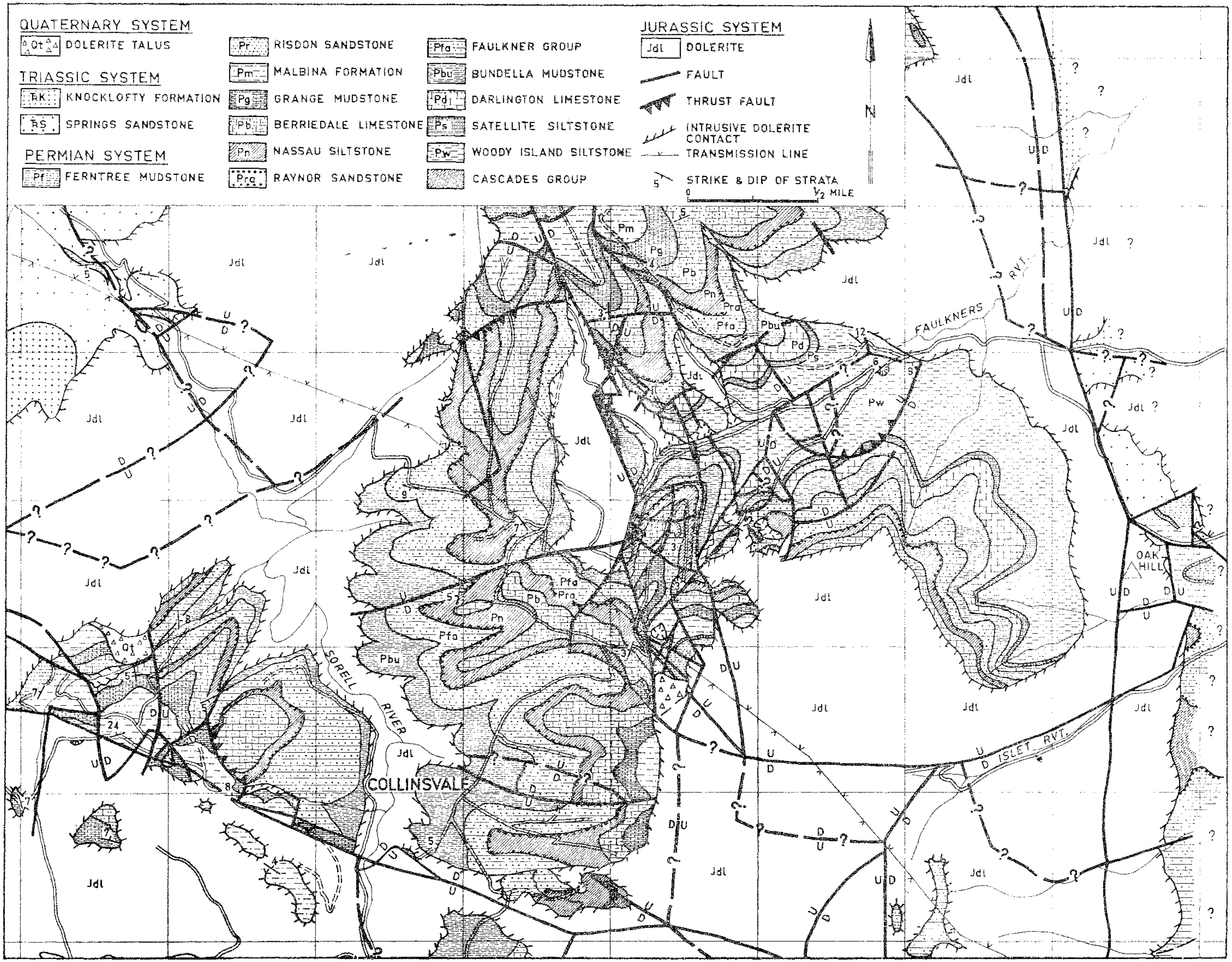


N.B.—This map is part of a one-inch series, but the scale in this paper has been reduced by approximately one quarter.


QUATERNARY SYSTEM
Qt DOLERITE TALUS
TRIASSIC SYSTEM
TRK KNOCKLOFTY FORMATION
RS SPRINGS SANDSTONE
PERMIAN SYSTEM
Pf FERNTREE MUDSTONE
Pr RISDON SANDSTONE
Pm MALBINA FORMATION
Pg GRANGE MUDSTONE
Pb BERRIEDALE LIMESTONE
Pn NASSAU SILTSTONE
Pra RAYNOR SANDSTONE
Pfa FAULKNER GROUP
Pbu BUNDELLA MUDSTONE
Pd DARLINGTON LIMESTONE
Ps SATELLITE SILTSTONE
Pw WOODY ISLAND SILTSTONE
CASCADES GROUP
JURASSIC SYSTEM
Jdl DOLERITE
FAULT
THRUST FAULT
INTRUSIVE DOLERITE CONTACT
TRANSMISSION LINE
STRIKE & DIP OF STRATA
0 1/2 MILE
N
FAULKNERS RVT.
ISLET RVT.
SORELL RIVER
COLLINSVALE
OAK HILL

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