PRECAMBRIAN ROCKS OF TASMANIA, PART VI, THE ZEEHAN-CORINNA AREA.

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(With 2 plates and 12 text figures)

ABSTRACT

Low-grade regionally metamorphosed pelites (Whyte Schist) and minor basic intrusives are overlain, probably unconformably, by unmetamorphosed sediments. These comprise the Oonah Quartzite and Slate, Interview Slate and Quartzite, Donaldson Group, Corinna Slate and the Bernafai Volcanics and are in turn overlain, probably unconformably, by the Delville Chert and Savage Dolomite. An extensive Precambrian dolerite dyke-swarm intrudes the Interview Slate. The rocks have been strongly folded and faulted, partly during Precambrian times and partly during the Tabberabberan Orogeny, and intruded by mid-Palaeozoic granitic rocks.

INTRODUCTION

The region between Zeehan, Granville Harbour, Pieman Heads and Corinna is composed of low grade metamorphic rocks and sediments which are overlain by Upper Middle Cambrian and later sediments. A combination of poor outcrop, dense vegetation and structural complexity has prevented a complete understanding of the geology of this area but the results of some reconnaissance work are presented to indicate similarities between the rocks of this area and those elsewhere in the state and to discuss some possible relationships. Emphasis is on the petrographic characteristics of the rocks.

This section of the Rock Cape Geanticline is underlain by approximately meridional belts of Precambrian sediments. A belt of metamorphosed sediments and igneous rocks (Whyte Schist) is flanked on either side by belts of unmetamorphosed sediments whose relationships to each other are not clear. As the Whyte Schist is included in the Older Precambrian of Spry (1962a) and the sediments in the Younger Precambrian, this is the first area studied in which these two groups are contiguous over an appreciable area.

OLDER PRECAMBRIAN

Whyte Schist

The Whyte Schist is an undifferentiated formation of low grade regionally metamorphosed pelite which has been intruded by a number of basic to intermediate dykes. Twelvetrees (1903) first recorded the presence of these rocks and they were briefly described by Spry and Ford (1957, pp. 2 and 4). The Whyte Schist is comparatively uniform in lithology; the main variation being in the proportion of quartzite which only seems to occur along the Pieman River south of Stringer Creek and on the coast north of Duck Creek. The degree of alteration is higher in the northern than in the southern part of the belt and the main rock-types are foliated siltstone, phyllite, mica schist and quartzite.

The tectonic terminology used here follows Spry (1963a and b); S_0 is bedding, S_1 is the foliation produced during F_1 and L_1 is the first lineation; S_2 is the second foliation formed during F_2, &c.

The foliated siltstones are light grey, glossy, rather massive rocks with a weak foliation. In thin section (e.g., No. 8131*) they show what is probably original clastic texture and consist of abundant small (0.2 mm.) quartz grains in a fine-grained matrix composed of quartz (.01 mm.) and muscovite. The larger quartz grains are ragged and lenticular in shape and show undulose extinction; the smaller quartz crystals are elongate parallel to the foliation and have blurred margins. Chlorite, zircon, rutile, magnetite, tourmaline, a carbonate and rare albite are accessories. A chemical analysis, (table I) indicates that the rock was a siliceous siltstone. It is rich in silica (80%); about 15% of muscovite is accounted for by moderate potash and alumina. Lime and magnesia are probably present as accessory dolomite.

In No. 8137 the single dominant foliation (S_1) is formed by a series of very closely spaced surfaces (.05 mm. apart) which intersect and intertwine. In No. 8147 this kind of foliation intersects compositional banding (S_0) at a low angle. No. 8128 is more complex; the foliation is of the type described above but the larger quartz grains are lenticular and oriented parallel to the foliation; small micas also have a distinct preferred orientation in this direction. There is no sign of original bedding and the foliation is taken to be S_1; it is crenulated and an irregular fracture cleavage has developed along some of the folds.

* Numbers refer to the catalogue in the Geology Department, University of Tasmania.

Specimens of argillaceous quartzite from the Pieman River south of Stringer Creek are very similar to the foliated siltstones but are coarser and richer in quartz. No. 9276 is a light grey, laminated rock with slightly crenulated bedding planes which are lustrous due to fine muscovite. In thin-section it consists of large (0.4 mm.) quartz grains (25%) in a matrix consisting of quartz (0.02 mm. diameter) and a little muscovite. The mica occurs mostly in irregular layers about 0.04 mm. thick.

The foliated siltstones become glossy and grade into phyllites with increased development of the foliation; (e.g. Nos. 9268 and 9306 from near Stringer Creek). Light grey, laminated, glossy, fine-grained crenulated phyllites are abundant in the southern part of the Whyte Schist belt and are typified by Nos. 8130, 8133, 8138, 8145, 9268, 9272, 9303 and 9318 from the Pieman River (a mile or so north and south of the Stringer Creek junction). They consist of quartz and muscovite with lesser chlorite and accessory zircon, tourmaline and rutile. A chemical analysis, table I, indicates that the phyllites were originally clay-rich siltstones. Alumina is high (18%) as is potash; the lack of lime appears to be typical of the metamorphosed pelites in the Tasmanian Precambrian.

The more-typical phyllites show a variety of textures, some of them very complex. Specimens such as 9272 from Stringer Creek appear to be comparatively simple with a single major foliation formed by alternate layers richer in quartz or in muscovite (and chlorite). This banding is visible in outcrop where it might be mistaken for bedding, but under the microscope tiny cores of an older S-surface, outlined by muscovite, can be found within the mica layers. The core of one fold is preserved as a helicitic structure within one of the sparse post-tectonic albite crystals. By analogy with the work of Spry (1962a, 1963a, 1963b) this suggests that an older foliation (S_1) has been folded and almost obliterated during the development of a younger foliation S_2. The major foliation (S_2) has been tightly folded into zig-zag crenulations and a weak fracture cleavage S_3 occurs along some axial surfaces. S_1 is also preserved as S_i in albite crystals in No. 8138.

Specimens 8130, 8133 and 8145 are macroscopically laminated phyllites with crenulated laminations. In thin-section the laminations are seen to be irregular lenses and layers alternately rich in quartz or in muscovite with quartz strongly elongate parallel to this foliation.

No. 8147 from Stringer Creek is a dark grey, fine-grained, laminated rock. In thin-section it consists of finely-grained quartz and sericite with the dominant foliation formed by closely spaced bands of parallel mica flakes. This foliation resembles bedding in hand specimen but is actually the second of two foliations. What is probably bedding is shown by broad bands alternately richer in quartz and mica; it has been isoclinally folded and fold-remnants occur within the layers of S_2. Curved trains of parallel mica flakes mark a foliation S_1 obliquely across the limbs and crests of these folds. Within the more-pelitic parts, mica flakes oblique to S_0 and S_2 outline small folds between thin layers outlining S_2. These probably represent folded remants of S_1.

The rocks to the north of Stringer Creek are schists. They are more coarsely grained, richer in mica, glossier and more strongly foliated than the phyllites. No original clastic textures have been preserved and the minerals present are quartz, muscovite, chlorite and albite with accessory magnetite, rutile, sphene and tourmaline. Representative examples are 5794, 8129, 9340, 9342, 9355, 9371 and 9380. Specimens No. 8129 and 9342 are gradational into the phyllites.

Schists from near the intersection of the Pieman River and Nancy Creek (Nos. 9340 and 9380) are lustrous, contorted grey schists with tiny white spots and consist almost entirely of small parallel muscovite flakes with about 15% of quartz as lenticular crystals (0.03 mm.) parallel to the foliation. Albite prophyroblasts up to 0.5 mm. across occur sporadically; sphene and iron-ore are abundant accessories. There is no trace of bedding (S_0) and all surfaces appear to be tectonic. The albite contains inclusions of quartz, sphene and iron-ore tracing out a curved helicitic structure discordant with the foliation of the enclosing matrix; the albite shows "pressure fringes". The albite (and is enclosed S_i) is older than the last stage of the major foliation (S_2) but it is not clear whether it is early syntectonic to the major foliation or whether the S_i represents an older foliation to which the albite is posttectonic. The major foliation (S_2) has been crumpled and the mica flakes and iron-ore rods or flakes, which are syntectonic to S_1, have been bent around the hinges of chevron folds of S_2. This crenulation produces an irregular macroscopic lineation and a fracture cleavage S_3.

No. 8138 from Stringer Creek is a glossy light grey schist; banding (possibly bedding) parallel to the foliation has been contorted into chevron folds. The rock is finely grained and consists of alternate bands richer in muscovite and chlorite or in quartz. Tourmaline, zircon and iron-ore are accessories. Albite is also present as syntectonic crystals showing S-trends whose sense of rotation is opposite to that of the chevron folds; the latter were formed at a late stage because the mica flakes are bent around the crests. The abundant quartz is elongate parallel to the foliation but has somewhat shattered margins, probably attributable to movements associated with the chevron folding.

Albite is abundant in the schist No. 8133 from Stringer Creek. It forms round crystals with fairly straight S_i discordant to the crenulations of S_1 around them. They would appear to be posttectonic to S_1 but formed before S_2.

Amphibolites and Greenschists

Seven dykes of altered igneous rock (fig. 3) have so far been found cutting the Whyte Schist but it is probable that more occur. They are mostly basic but some are intermediate.

The foliation of the Whyte Schist curves around in an arc but the dykes are comparatively straight and trend in a north-easterly direction; in places they are parallel to the foliation and in others discordant. The igneous rocks have been metamorphosed and contain a mineral assemblage (albite, epidote, actinolite or glaucophane, chlorite,

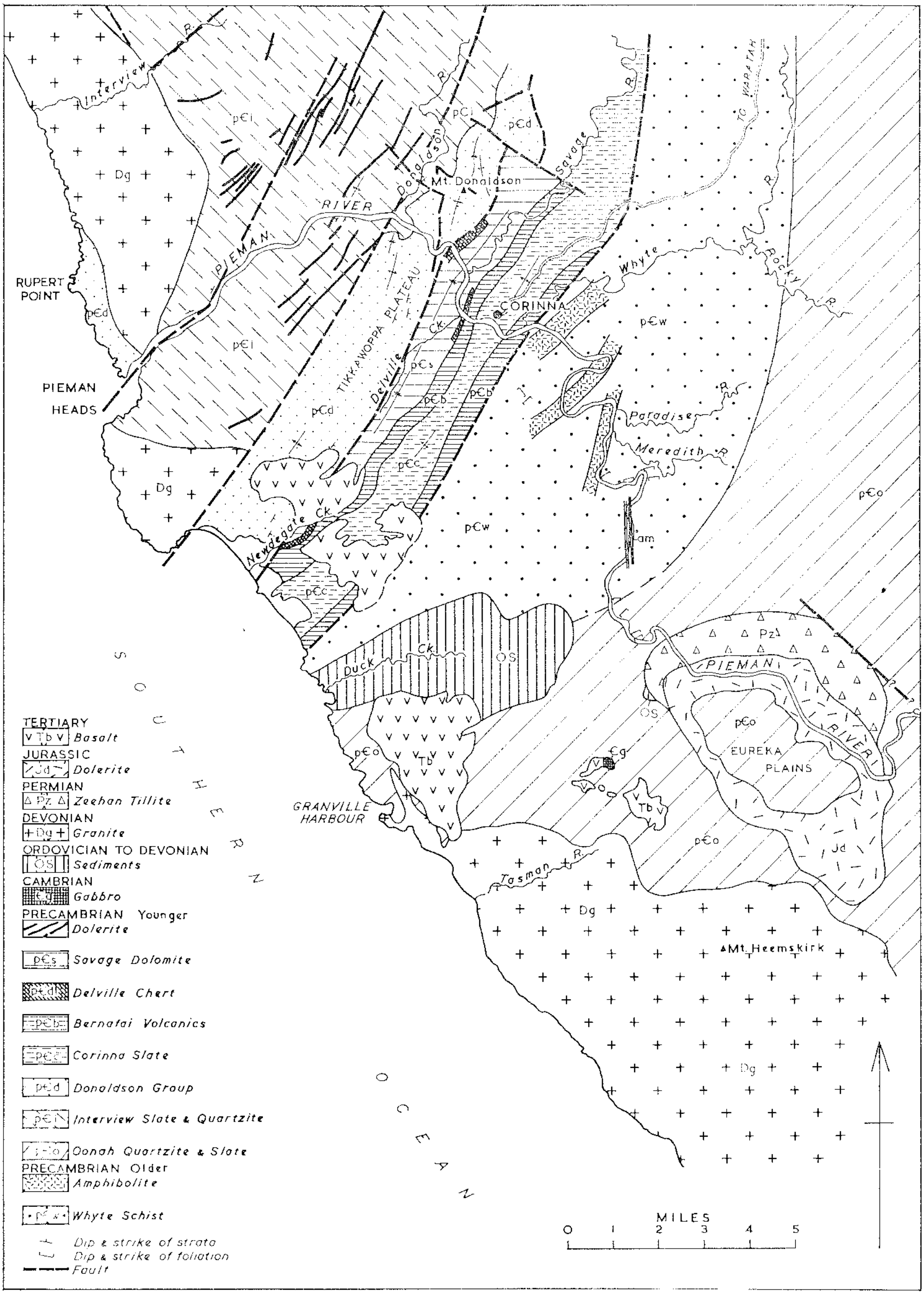


FIG. 1.—Geology of the Zeehan-Corinna Area. (Plate by courtesy of the Geological Society of Australia.)

quartz, calcite, and magnetite) which is compatible with that in the surrounding sediments. However the igneous rocks do not appear to have been as strongly deformed as the sediments. It is possible that part of the metamorphism of the Whyte Schist took place before the igneous injection and part afterwards i.e. the intrusions may have taken place between F_1 and F_2.

The original textures of the igneous rocks have been destroyed. During the metamorphism, sheared zones developed either along the margins of the dykes or within them and a weak foliation was formed, generally at an angle to the dyke margin. Microscope slides show that there is very little difference between amphibolites and greenschists; the greenschists appear to more finely grained and more strongly foliated than the amphibolites and some are banded.

TABLE I

	(1)	(2)	(3)	(4)	(5)
SiO_2	63.38	80.14	62.64	49.20	48.38
Al_2O_3	17.84	6.18	13.87	13.59	11.52
Fe_2O_3	1.68	1.21	1.18	2.78	7.05
FeO	3.05	2.05	3.17	10.98	7.15
MgO	3.49	2.25	6.33	6.66	7.11
CaO	tr	1.64	6.16	8.13	7.10
Na_2O	0.48	0.37	4.99	3.18	4.43
K_2O	4.31	1.45	0.93	0.08	0.30
H_2O+	4.61	3.47	1.12	3.28	2.50
H_2O-	0.13	0.17	nil	0.05	0.06
MnO	tr	0.05	0.11	0.21	0.22
TiO_2	0.85	0.47	0.10	1.63	2.02
P_2O_5	0.12	0.12	nil	0.21	0.12
	99.94	99.57	100.60	99.97	99.96

(1) Phyllite, Whyte Schist, No. 8147, Pieman River.
(2) Schistose siltstone, Whyte Schist, No. 8131, Pieman River.
(3) Amphibolite, Rocky and Whyte Rivers.
(4) Amphibolite, Stringer Creek, No. 8121.
(5) Glaucophane amphibolite, Pieman River, No. 9281.

Analyst: Tas. Dept. Mines.

The specimens from the big bend in the Pieman near Nancy Creek are rather finely grained, irregularly schistose rocks consisting of two forms of amphibole, albite, biotite, chlorite, epidote, and accessory quartz, sphene and magnetite. The foliation is outlined by parallel lenses of sphene aggregates up to 5 mm. long, sub-parallel laths and needles of amphibole, and lenses rich in albite or quartz (fig. 2e). The amphibole occurs as large, ragged crystals of very pale actinolite (averaging 0.3 mm. across) which has partly broken down into tiny laths or needles (about 0.1 mm. long) of medium green or colourless amphibole. Green isotropic chlorite forms irregular masses; albite occurs as fresh, untwinned crystals in irregular aggregates or more typically as round crystals (0.1 mm. in diameter) containing needles of actinolite. Epidote (0.03 mm. to 1mm.) is present and quartz occurs as lenticular aggregates or as thin veins. Twisted, partially chloritized brown biotite is abundant as tiny parallel or randomly disposed flakes.

The coarse amphibole is probably related to an early crystallization stage to which biotite probably formed posttectonically. The small amphiboles are syntectonic to a second stage (as in also the chlorite and some quartz), the albite is posttectonic, the relations of the epidote are not clear but it appears to have crystallized at each stage.

Specimens 8121, 9277, 9273 from near Stringer Creek are massive and green. In thin-section they have an irregularly banded texture and consist of albite and actinolite with epidote, zoisite, chlorite and leucoxene. The actinolite occurs as felted fibres and laths and is pleochroic from bluish green to green. The analysis in table I corresponds to an olivine basalt with high soda.

No. 9277 from Stringer Creek is much coarser. The large (up to 3 mm.) aggregates of sphene granules have a grid shape which is probably relict after the form of original ilmenite. Albite occurs as large aggregates of interlocking crystals each of which tend to have a round shape (fig. 2f). A few small flakes of muscovite are present.

Some of the less common varieties include No. 9281 which is a bluish rock south of the Stringer Creek-Pieman River junction. It is weakly foliated and consists of 60% glaucophane (crossite, pleochroic with Z=pale yellow, Y and Z=blue, uniaxial negative with strong dispersion) as laths about 2 mm. across. Epidote is abundant (25%) in grains 0.05 mm. across or as 0.5 mm. aggregates. There is 15% of albite and accessory sphene, apatite, magnetite, muscovite, tourmaline and chlorite. The rock is veined with yellow epidote and a little brown hornblende. The analysis in table I indicates that the rock was originally basic and is soda-rich.

No. 9366 from the body at the mouth of the Meredith River is typical of the banded varieties of greenschist. It is a fine-grained, greenish-grey, platy and banded rock. Under the microscope it is seen to consist of coarse bands containing round albite and ragged actinolite with sphene and chloritized biotite, and fine bands composed of albite, zoisite and a little bright green chlorite, chloritized biotite and needles of almost colourless actinolite. It is probable that the banding is due to the metamorphic differentiation of an original uniform igneous rock.

A layer of greenschist cuts the Pieman River about a quarter of a mile upstream from the mouth of the Whyte and causes a constriction of the river. No. 9378 from here is a light greenish grey rock with a weak cleavage, containing elongate, light coloured flakes about ½ mm. across. Under the microscope it is finely grained and weakly foliated and consists of albite, epidote, actinolite, chlorite and sphene. The actinolite is pale green; the chlorite is pale green with anomalous interference colours; the epidote is zoned with yellow cores and colourless rims. The albite occurs as finely-grained aggregates generally with irregular lenticular form; some of the aggregates have a rectangular shape suggestive of original phenocrysts.

A few feldspar-rich meta-igneous rocks have been found and one was described by Spry and Ford (1957) from near the junction of the Whyte and the Rocky Rivers. The analysis in Table I shows that it is intermediate and sodic. No. 8122 appears to form part of the amphibolite mass at the Stringer Creek junction and outcrops on the western bank. Its macroscopic appearance is that of a fine-grained, rather shattered quartzite but in thin section it is seen to consist entirely of albite.

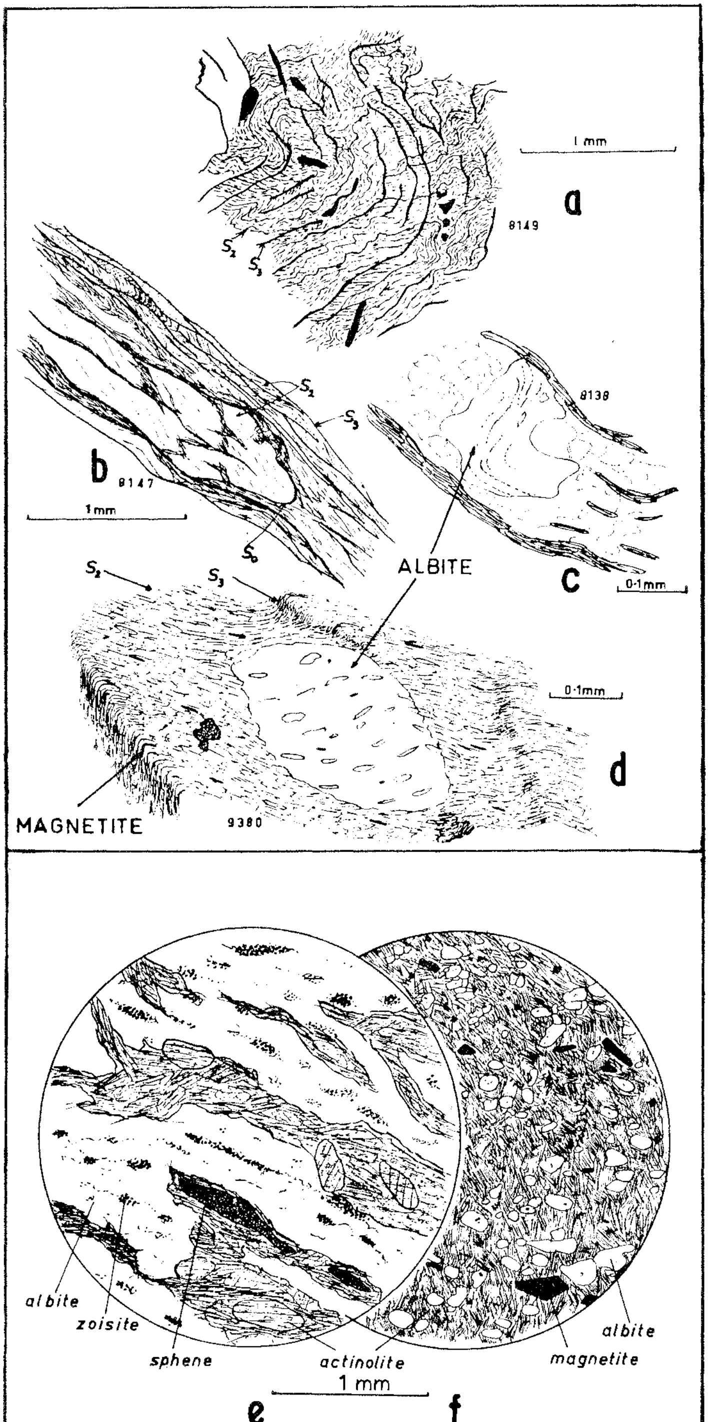
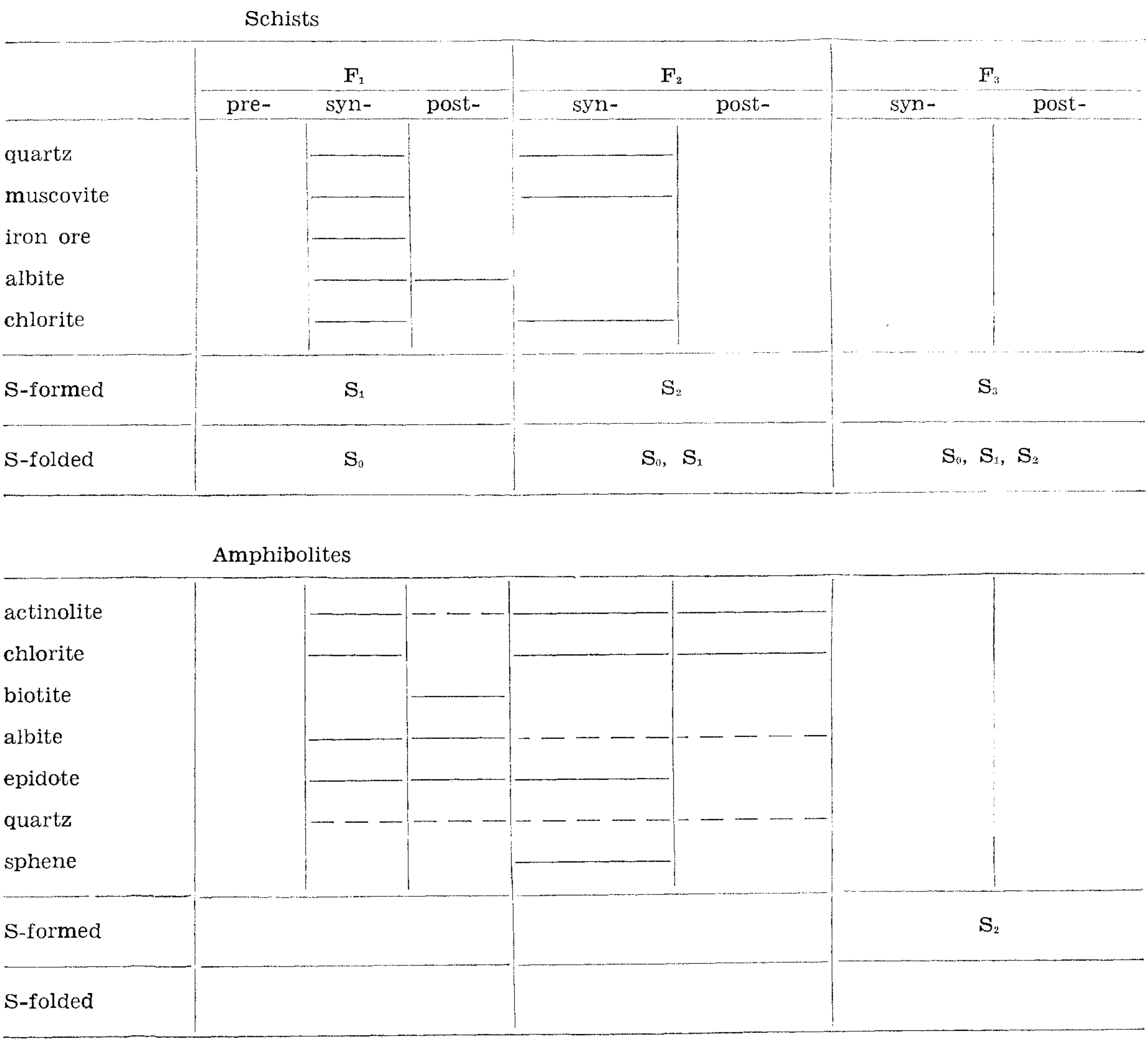


FIG. 2.—Textures of some varieties of Whyte Schist. (*a*) S_2 and S_3 in phyllite. (*b*) Three foliations, possibly S_0, S_2 and S_3, in phyllite. (*c*) and (*d*) Helicitic structure in posttectonic albite. (*e*) Foliated amphibolite. (*f*) Post-tectonic albite and magnetite in amphibolite.

Specimen No. 9406 outcrops on the southern bank of the Pieman River, 1½ miles upstream from the Nancy junction. In hand specimen it is a light coloured, spotted, rather massive rock; it does not closely resemble either a sedimentary schist nor an amphibolite. In thin section it is fine to medium-grained and very irregularly textured; it is not particularly schistose and consists of undulose quartz, green chlorite, albite and a little epidote, magnetite and muscovite. The aggregates of albite and of quartz appear to have been large crystals which have ben crushed. Some of the albite crystals contain S_i at an angle to the chlorite flakes wrapping around them. Nothing is known of the field relations of this rock but it is tentatively regarded as an acid to intermediate representative of the amphibolites.

The amphibolites and related types have been derived from a group of basic (with some intermediate and perhaps acid varieties) igneous rocks by a process involving some shearing at rather low temperatures. The rocks belong to the albite-muscovite-chlorite subfacies of the Greenschist Facies, as do the enclosing sediments. In the absence of evidence suggesting soda metasomatism, the significant soda-content is tentatively regarded as an original characteristic of the igneous rocks.

The presence of only one clearly recognizable foliation in the amphibolites (although there appear to have been two stages in the metamorphism) as contrasted to a possible three foliations in the sediments prevents close correlation of their metamorphic history and suggests that perhaps the igneous rocks might have been intruded after F_1.



Chronology of crystallization and deformation of schists and amphibolites in the Whyte Schist.

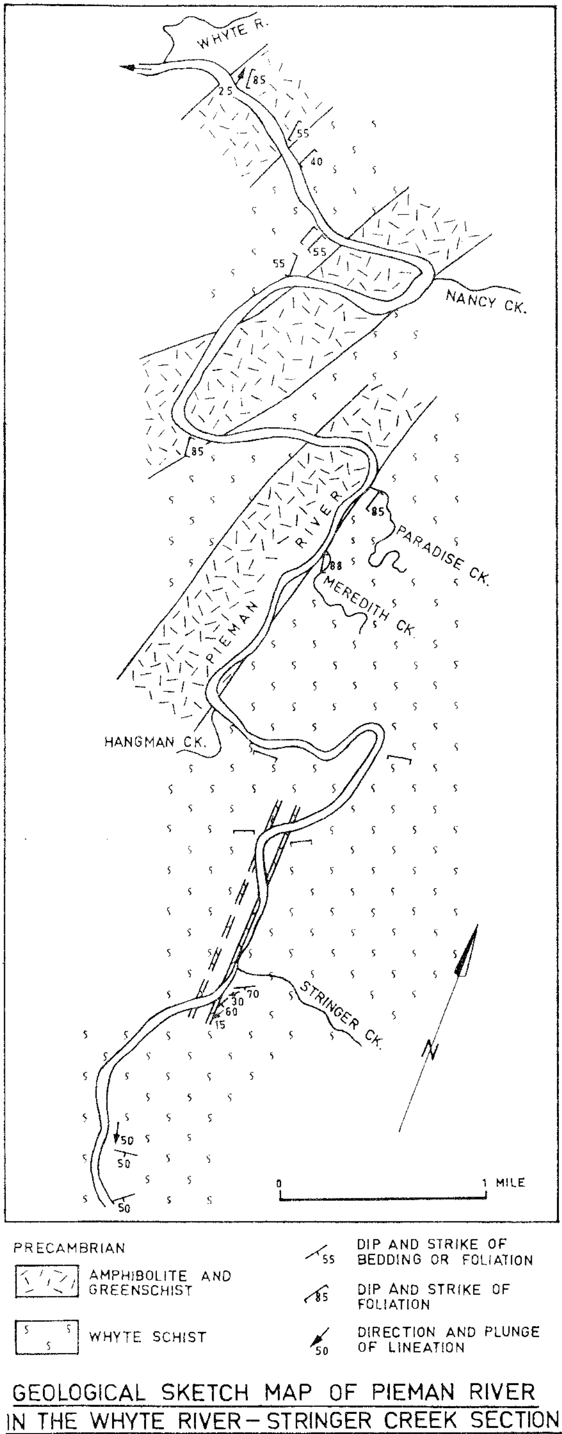


FIG. 3.—Amphibolite dykes within Whyte Schist along the Pieman River.

YOUNGER PRECAMBRIAN

The stratigraphic succession is not clear partly because of poor outcrop and thick vegetation and partly because the major structure is not well understood. The rocks to the east of the Whyte Schist structural high differ from those to the west. The Oonah Quartzite and Slate occurs to the east of the Whyte Schist and may be the oldest of the younger Precambrian sediments. To the west are the Interview Slate and Quartzite, the Donaldson Group, the Bernafai Volcanics, the Corinna Slate, the Delville Chert and the Savage Dolomite. The probable succession is as follows:

Top Savage Dolomite
Delville Chert
Unconformity?
Bernafai Volcanics
Corinna Slate
Donaldson Group
Interview Slate and Quartzite
Oonah Quartzite and Slate
Unconformity

Oonah Quartzite and Slate

A great thickness of white quartzites and grey slates extends from the coast at Granville Harbour, south-east to Zeehan, and north-east across the Eureka Plains to the open country north of the Pieman. The sediments were described briefly by Twelvetrees and Ward (1910) and by Waterhouse (1915); they were named the Oonah Quartzite by Hills and Carey (1949) and the formation was formally defined as the Oonah Quartzite and Slate by Spry (1958). The "Corinna Beds" of Spry and Ford (1957) included part of this formation.

No attempt has been made to subdivide the formation because outcrop is very poor across the mature Henty Surface and no undisturbed stratigraphic succession has been found. The dominant rock is a white, flaggy quartzite with abundant clastic muscovite along the bedding. The slates are grey glossy rocks with a strong cleavage. A fine lineation due to crenulation of the cleavage is present in many specimens. The thickness of this formation cannot be given as the structure is not known in detail and the top is not visible. The sediments are tightly folded on a small scale and also form a large syncline. The area of outcrop is over 200 sq. miles and it does not seem likely that less than 5 or 10,000 of sediments could be present. The formation appears to overlie the Whyte Schist unconformably (this relation is discussed in detail later) and is overlain unconformably by the Owen Conglomerate at Duck Creek and the Cambrian Dundas Group at Zeehan.

Campana and King (1963, p. 14) consider that the Oonah Quartzite and associated slates—

(1) overlie "stressed slates and quartzites of the Davey Group with apparent unconformity" at Oonah Hill,
(2) include the Montana Volcanics,
(3) are probably early Cambrian in age.

There is no evidence to support these conclusions and such statements only confuse the situation. Detailed mapping in the Oonah Hill region does not reveal rocks which might reasonably be correlated with the Davey Group, nor does it suggest an unconformity beneath the Oonah Quartzite. The discovery of volcanics in sediments related to the Oonah (pp. 16, 17 of this paper) makes it important to clarify the position of the igneous rocks in the Queen Hill-Oonah Hill area. Although the structure just north-west of Zeehan is complex, it seems very probable that the Montana Volcanics are continuous with fossiliferous Cambrian sediments and that there is an unconformity between the Oonah and the Cambrian. The igneous rocks found within the Oonah Quartzite near Zeehan are discordant and thus are intrusives; they may have acted as feeders to the Cambrian volcanics. They resemble basic igneous rocks belonging to the Dundas Group elsewhere but do not resemble the Bernafai Volcanics. The evidence given later in this paper and by Spry (1962a) is strongly against a Cambrian age for the Oonah Quartzite and related sediments and Campana and King's (1963, p. 14) acceptance of a Cambrian age appears to be based only on the fact that "they are succeeded by fossiliferous beds of Upper Middle Cambrian age".

The quartzites consist of angular to well-rounded grains of quartz with a little weathered feldspar, clay fragments and clastic muscovite in a matrix of fine sericite and chlorite. The matrix of the sandstones has not been appreciably recrystallized and most rocks contain no cleavage; the bedding-plane fissility is due to clastic muscovite flakes.

Chemical analyses of two specimens (Table II) from Oonah Hill, just north of Zeehan, indicate that the rocks are siliceous with an argillaceous impurity. Lime is deficient, potash exceeds soda, and the iron is moderately oxidized. The rocks do not have sufficient labiles to be named graywackes but resemble some quartzose subgreywackes (Pettijohn, 1957, p. 316).

The quartzite from Oonah Hill is light grey and well-bedded with abundant mica along the bedding and many irregular quartz veins. In thin section the rock is composed of small quartz grains (generally not much more than 1/16 mm. in diameter) in a fine matrix of sericite and clay (?) (plate II, No. 1). The quartz grains were originally well-rounded but now have an angular form due to secondary enlargement by authigenic quartz. The large, bent and ragged muscovite and chloritized biotite flakes are clastic. A few grains of a fine-grained aggregate of sericite are probably weathered feldspar.

The quartz in many specimens (e.g. 8022) has been derived from a terrain containing dynamically altered rocks; the quartz grains are elongate and show undulose extinction and deformation lamellae. In many rocks these strained quartz grains are surrounded by a fine sericitic matrix which shows no cleavage or by an unstrained quartz cement; the quartz grains are assumed to have been strained prior to their incorporation into the sediment.

Many sandstones (e.g. 8023) contain chlorite as flakes and sheafs; 8016 contains chert fragments; 8025 is coarse with grains of chert, quartzite and slate. (Plate II, No. 1.)

The pelites interbedded with the quartzites were originally mainly siltstones. No. 8022 is light grey and foliated; microscopically it consists of small quartz grains and large flakes of clastic muscovite and biotite in a sericite-rich matrix. No. 8029 is a non-foliated variety and consists of very fine quartz and sericite with accessory chlorite, zircon, rutile and idomorphic tourmaline.

Sediments West of the Whyte Schist

The sediments in the vicinity of Corinna, between the Whyte River and the sea, are similar to the Oonah Quartzite and Slate in their degree of metamorphism but differ in lithology. The Donaldson Group, Interview Slate and Quartzite, &c., are considered to overlie the Whyte Schist unconformably (as does the Oonah Quartzite) but the stratigraphic relations between the unmetamorphosed sediments to the east and to the west of the Whyte Schist belt are not known.

The Interview Slate and Quartzite underlies the Donaldson Group but the Savage, Delville, Bernafai and Corinna rocks are separated from the Interview and Donaldson by a fault. Steep dips, lack of facings and poor outcrop have so far prevented determination of the structure involving the Savage, Delville, Bernafai and Corinna and although their stratigraphic relations are not certain the following succession is favoured.

Top	Savage Dolomite
	Delville Chert
	Unconformity?
	Bernafai Volcanics
	Corinna Slate
	Donaldson Group
Bottom	Interview Slate

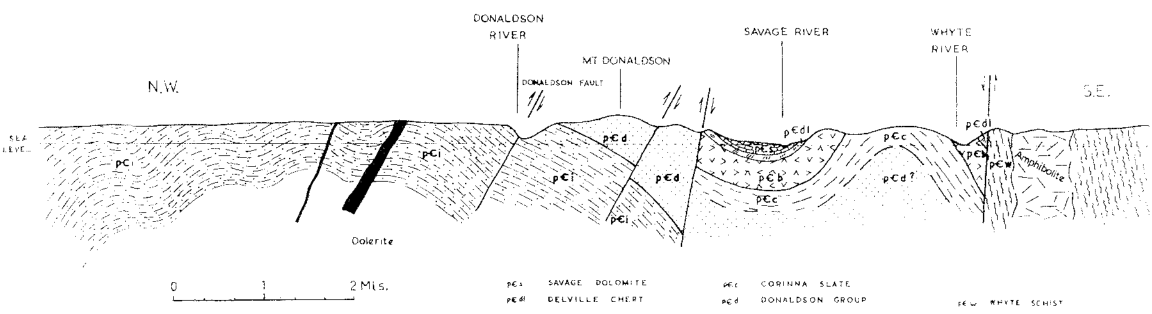


FIG. 4.—Cross section through the Corinna area.

Interview Slate and Quartzite

The argillites occupying a belt of country parallel to the coast between the Donaldson River and the long granite mass north of Pieman Heads were referred to as the "Interview Beds" by Spry and Ford (1957, p. 2) but the formation is now formally defined as the Interview Slate and Quartzite. It underlies the Donaldson Group conformably but the lower limit is not exposed, the beds forming a broad anticline. The thickness is not known exactly as the sediments are repeatedly folded into asymmetrical folds a few tens of feet across but it does not seem likely that the total thickness could be less than 5000′. The type locality is the section along the south bank of the Pieman River from just east of the Donaldson River to the coast. It is possible that this formation is equivalent to the Balfour Slates and Sandstones of Ward (1911) but the area between the Interview Plains and Balfour has not yet been mapped. Slumps, mudflakes (specimens 5771, 5765) and cross bedding are abundant. Most specimens possess a cleavage oblique to the bedding and parallel to the axial surface of visible minor folds.

The argillites (e.g. No. 9389) are light, cream-coloured slates with slightly wavy bedding planes 1 mm. to 1 cm. apart and a weak oblique cleavage. Microscopically, the finer layers contain very small sericite flakes with quartz and very little chlorite; the coarser layers consist of quarts (average 0.03 mm. diameter) and flakes of chlorite (0.1 mm. long) with lesser sericite. Ragged laths of chlorite may have originally been biotite. Accessories are idioblastic mauve and green tourmaline, zircon, pyrite and magnetite. Some of the slates (9349, 9379, 9377) contain a little albite.

Quartzites are thin and not abundant. They are finely grained (e.g. 9351) and massive and contain approximately 85% quartz and 5% albite with the remainder sericite; accessories are chlorite, rounded zircon and rutile.

The formation has been intruded by Devonian granite near the coast and is thermally metamorphosed (Spry and Ford, 1957). An extensive dolerite dyke swarm intrdues this formation over a wide area.

Donaldson Group

At least 1870′ of white quartzite with minor conglomerate and slate overlies the Interview Slate and Quartzite conformably at Mt. Donaldson where the following succession was measured:

Top	Nonesuch Slate	200′+
	Gutherie Quartzite	250′
	Longback Conglomerate	40′
	Tikkawoppa Quartzite	700′
	Gates Conglomerate	40′
	Mametz Quartzite	600′
Bottom	Montgomery Conglomerate	40′
		1,870′

The term Donaldson Beds was used by Spry and Ford (1957) but the sediments are now formally defined as a group. As the massive white quartzites are dominant and the intervening conglomerates discontinuous, it might be considered preferable to regard the beds as a **formation** rather than a **group** but this must be decided in the future after more extensive mapping.

The stratigraphic succession of formations within the Donaldson Group seems fairly clear in general although there are complexities in detail. The beds are structurally disturbed, being thrown into folds ranging from ¼ to ¾ of a mile across, with numerous faults; the more important of these structures are shown in Fig. 6. In addition the slates commonly show contortion with small crenulations several inches across. Coupled with the difficult structure is a lack of outcrop and considerable facies change.

It is difficult to decide just what should be taken as the base of the Donaldson Group, but the most significant sedimentional event was the change from the argillaceous sedimentation of the Interview slates to the arenaceous and rudaceous deposition of the Donaldson Group. The change from

Table II.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SiO_2	87.54	85.46	86.08	61.90	73.96	57.68	46.74
Al_2O_3	6.42	7.76	7.40	14.25	13.05	12.88	14.94
Fe_2O_3	0.46	0.71	0.50	1.00	0.43	3.69	2.90
FeO	0.80	0.51	0.83	3.53	2.89	6.41	10.66
MgO	0.41	0.61	0.51	6.76	1.38	5.63	7.04
CaO	Tr	Tr	0.24	4.39	0.40	4.75	9.60
Na_2O	0.05	0.18	0.18	3.44	4.26	3.04	2.77
K_2O	1.49	2.06	2.19	1.50	2.02	1.70	0.06
H_2O+	1.84	1.83	1.42	2.01	1.53	2.84	3.54
H_2O-	0.15	0.11	0.13	nil	0.17	0.36	0.14
P_2O_5	0.08	0.05	0.03	0.15	0.06	0.15	0.16
TiO_2	0.42	0.45	0.42	0.62	0.39	0.74	1.75
MnO	Tr	Tr	Tr	0.05	0.04	0.13	0.26
	99.66	99.64	100.00	99.60	100.58	100.56	99.93

(1) No. 8091, quartzite, Oonah Hill.
(2) No. 8027, quartzite, Oonah Hill.
(3) No. 7991, quartzite, Burnie Quartzite and Slate.
(4) No. 8045, hornfels, Granville Harbour.
(5) No. 7157, greywacke siltstone, Crayfish Creek.
(6) No. 9270, tuff, Bernafai Volcanics.
(7) No. 9305, altered basalt, Bernafai Volcanics.

Analyst: Tas. Dept. Mines.

the cream slates of the Interview to the black and grey slates of the Donaldson is also striking but is more gradual and dark slates occur interbedded with cream ones along the Donaldson River over a thousand feet below the base of the Donaldson Group.

The conglomerate along the Montgomery Ridge is a convenient formation to use as a base but unfortunately does not appear to occur universally and is absent on the Pieman River. The first conglomerate to appear on the Pieman River is the Gates Conglomerate which occurs just east of Hell's Gates where it is underlain by 600 ft. of Mametz Quartzite.

Montgomery Conglomerate: 0-40′

A white massive conglomerate with well-rounded quartzite pebbles in a sandy matrix outcrops on the northern slope of Montgomery Ridge conformably overlying grey siltstone, cream slate and thin quartzite of the Interview Formation.

Mametz Quartzite: 600′

The Montgomery Conglomerate is overlain by white quartzite and appears to pass laterally into the same rock along Mametz Ridge. The formation thickens to the south and forms the constriction called "Hell's Gates" on the Pieman River and underlies the greater part of the Tikkawoppa Plateau. Near the base it is platy with thin slate beds but is more massive at the top.

Specimen No. 9396 is a light grey, rather vitreous quartzite with boudinage structure from the Mametz Quartzite at Hell's Gates. In thin-section (Plate II, No. 2) it is seen to be composed of clastic quartz grains about 0.3 mm. across which are well rounded and have a high sphericity with a secondary silica cement surrounding each grain and growing in optical continuity with it. The quartz is undulose and shows "deformation lamellae" but the rock appears to be only slightly deformed. Parallel lines of tiny inclusions cut across a number of adjacent grains and possibly represent tiny fractures which have been "healed". A few whispy flakes of sericite are present.

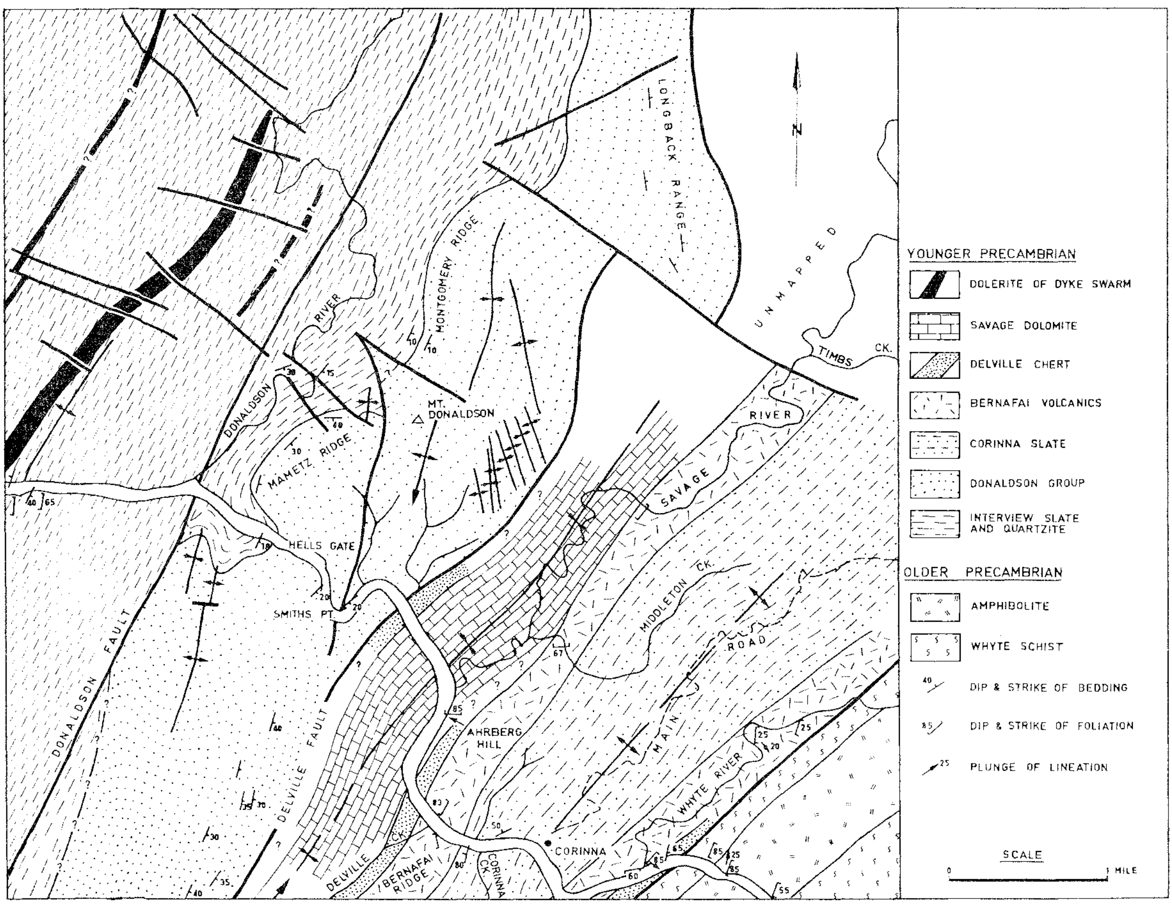


FIG. 5.—Geology of part of the lower Pieman area.

Specimen No. 9399 from Tikkawoppa Plateau, 1½ miles south of Hell's Gates is more strongly deformed. In the hand specimen it is a pure white, very fine-grained, massive quartzite. In thin section it is seen to consist of quartz grains which average 0.25 mm. in diameter set in a matrix of very tiny crystals. The large grains are undulose and contain deformation lamellae; the parallelism of the large elongate grains gives the rock a deformed appearance, and this is supported by the blurred quartz boundaries. A fabric diagram of the large grains (fig. 8a) suggests that the rock has been deformed but it is debatable whether or not a preferred orientation exists. The zero areas are small, the maxima small and low (generally 3%, one 4%), and the symmetry is triclinic.

Specimen 9372 occurs at Hell's Gates in a bed showing boudinage structure. The rock consists of ragged elongate quartz crystals in a finely granular crushed matrix of quartz. A fabric diagram of the large quartz grains (fig. 8b) shows that a preferred orientation is probably present but it is not strong and the symmetry is triclinic. There is some suggestion of two crossed girdles intersecting in a point near the axis of the boudins.

The fabric diagram (fig. 8c) of specimen 2226 (Plate II, No. 4) from the large outcrop on the beach immediately south of the mouth of Newdegate Creek is more conclusive. The rock has a mortar texture and the fabric of the large quartz grains shows a distinct preferred orientation with possibly two crossed girdles intersecting near the lineation. Fig. 9d shows the positions of the optic axes in 70 undulose quartz grains from 2226. There is a much as 30° difference in the spread of the axes within a single grain.

The diagrams are significant. The Donaldson Group is regarded as typical of the unmetamorphosed group of Precambrian rocks and in general is only slightly deformed, in fact its comparative lack of deformation allows it to be distinguished from the older Precambrian. The diagrams show that in places the younger Precambrian sediments may be quite strongly deformed whereas fabric diagrams of Fisher Group quartzite from the older Precambrian at the Mersey River show that these rocks may in places be only slightly deformed.

No. 9325 is a steel grey, fine-grained slate from this formation on the Tikkawoppa Plateau. It has a cleavage at an angle to the bedding and a fine crenulation. Microscopically it is a poorly sorted, finely grained rock composed of ragged quartz grains (average size 0.08 mm.) in a fine-grained matrix of quartz (0.02 mm.) and sericite. The sericite is directed along a large number of closely spaced surfaces which are oblique to the bedding and apparently also at right angles to the axial surfaces of small creulations of the bedding.

Gates Conglomerate 0-40′

The Mametz Quartzite is overlain by the 40 ft. thick Gates Conglomerate at the eastern part of Hell's Gates. It consists mainly of well-rounded quartzite boulders in a phyllitic matrix and is overlain by the laminated and slaty quartzites of the lower part of the Tikkawoppa Quartzite. The Conglomerate horizon can be followed up the southern side of the Pieman valley and across the Plateau for at least half a mile but its northerly extent is debatable. Despite numerous traverses up the northern face of Hell's Gates no outcrop of conglomerate was found higher than 50′ above river level. Further along Mametz Ridge where the outcrop is better there is still no sign of the conglomerate so that it is assumed to pass laterally into sandstone.

The argillaceous matrix of the conglomerate is strongly foliated but the pebbles show no evidence of having been deformed.

Tikkawoppa Quartzite: 700′

The Gates Conglomerate is overlain by slaty quartzites and massive quartzites which extend from Hell's Gates for about a quarter of a mile to the east. These slaty quartzites pass into pure white quartzites along Mametz ridge and would

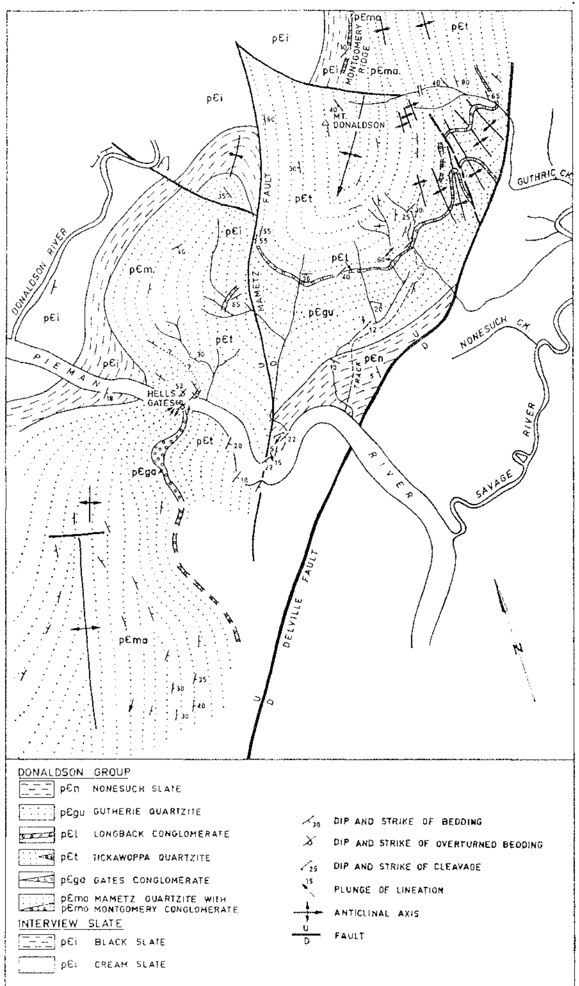


FIG. 6.—Geology of Mt. Donaldson.

appear to be equivalent to the quartzites around the peak of Mt. Donaldson. If the present stratigraphic and structural interpretation is correct, the Tikkawoppa Quartzite is bounded below by the Gates Conglomerate and above by the Longback Conglomerate. It has a total thickness of about 700 feet. It is not possible to separate the Mametz and Tikkawoppa Quartzites where the Gates Conglomerate is absent, and future mapping may show that these two formations should be combined.

No. 9295 is a light grey, coarse sandstone from the upper part of the Tikkawoppa Quartzite near Gutheries Creek. It is an evenly grained rock consisting generally of quartz grains averaging 0.5 mm. across (Plate II, No. 6). The quartz grains are undulose with deformation lamellae but are well rounded and have a quartz cement. Clastic grains of quartzite are distinguishable under the microscope. Zircon is accessory.

Specimens numbered 9405 and 9397 were collected from slaty horizons near the base of the Tikkawoppa Quartzite and are light grey, somewhat lustrous, fissile rocks. In thin section they are finely grained and consist of about 10% of quartz grains averaging 0.2 mm. in diameter in a fine-grained matrix of quartz (from 0.04 mm. downwards) and parallel sericite. They have a patchy texture due to coarser and finer-grained areas. Some clastic muscovite and chloritised biotite are present together with authigenic chlorite and accessory zircon, iron ore and rutile. Tourmaline occurs as well rounded (allothogenic) grains and idioblastic (possibly authigenic) prisms.

Longback Conglomerate: 40′

The basal formations around Mametz Ridge are separated from those of Mt. Donaldson by a fault with several hundred feet throw which disturbs the unity of the stratigraphic sequence, but a comparatively unbroken sequence outcrops from the peak down to the Pieman River to the south. The white quartzite of the mountain top is thought to be the Tikkawoppa Quartzite and this is overlain by a persistent band of conglomerate which outcrops around the southern flank of the mountain. This conglomerate is about 40 ft. thick and consist or well-rounded quartzite pebbles and boulders in a sandy or slaty matrix and is named the Longback Conglomerate.

Most of the conglomerates outcrop badly and are represented mainly by soil containing rounded pebbles and boulders. A number of conglomeratic horizons occur towards the top of the Tikkawoppa Quartzite, but the Longback Conglomerate is more continuous than the others.

Four sections (fig. 7) were measured through the Longback Conglomerate and the immediately overlying and underlying beds. The first section is across the north-eastern slopes of Mt. Donaldson, half a mile north of the Pieman; and the second, third and fourth at quarter-mile intervals to the north.

No. 9259 is a specimen of the Longback Conglomerate from a quarter of a mile north of Hell's Gates. The matrix consists of sub-angular quartz grains 1 mm. or less across, with a moderate sphericity. The grains are undulose and have lamellae but it is not clear whether they have been stressed in this rock or whether they are clastic particles derived from a metamorphic terrain. The larger quartz grains are set in a very fine-grained and undirected mass of quartz and sericite with accessory tourmaline and rutile.

Gutherie Quartzite: 200-300′?

The Longback Conglomerate is overlain by the Gutherie Quartzite which has its type locality along the track from the Pieman River to Mt. Donaldson where it first leaves the forest of the Pieman Valley and rises across the open button-grass spurs, half a mile north of the Pieman. The name was taken from Gutheries Creek which occurs half a mile north of here. It is difficult to measure the thickness but it would probably be between two and three hundred feet. Slate, pebbly slate and quartzite-conglomerate horizons occur within the quartzite.

No. 9318 from the Gutherie Quartzite is a pale grey, lustrous, slaty quartzite with bands rich in sand-grade material, fine-sand grade and silt. Slump structures are visible and a cleavage is oblique to the bedding. The coarser bands are rich in quartz and finer ones rich in sericite. The sericite is parallel to the bedding in the pelitic layers but lies obliquely to give a slaty cleavage in the more siliceous layers. Accessories are idioblastic tourmaline and well-rounded zircon.

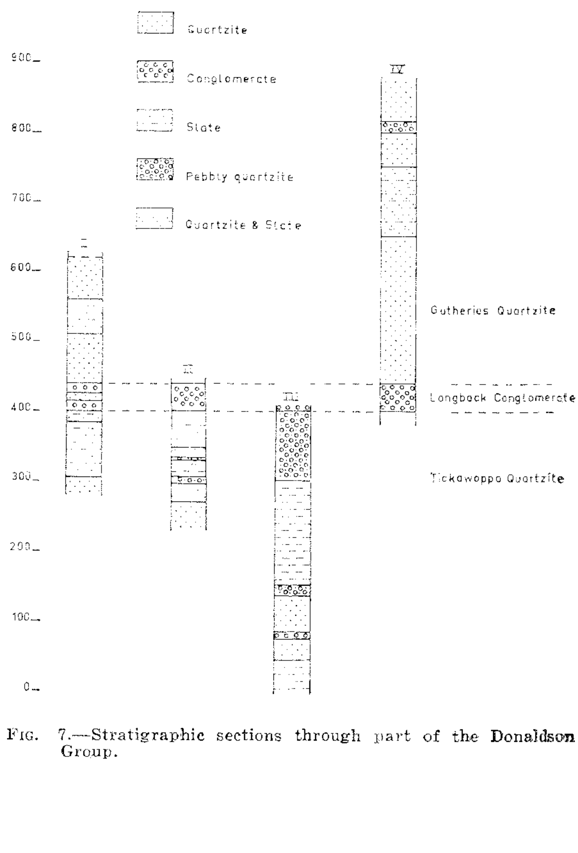


FIG. 7.—Stratigraphic sections through part of the **Donaldson** Group.

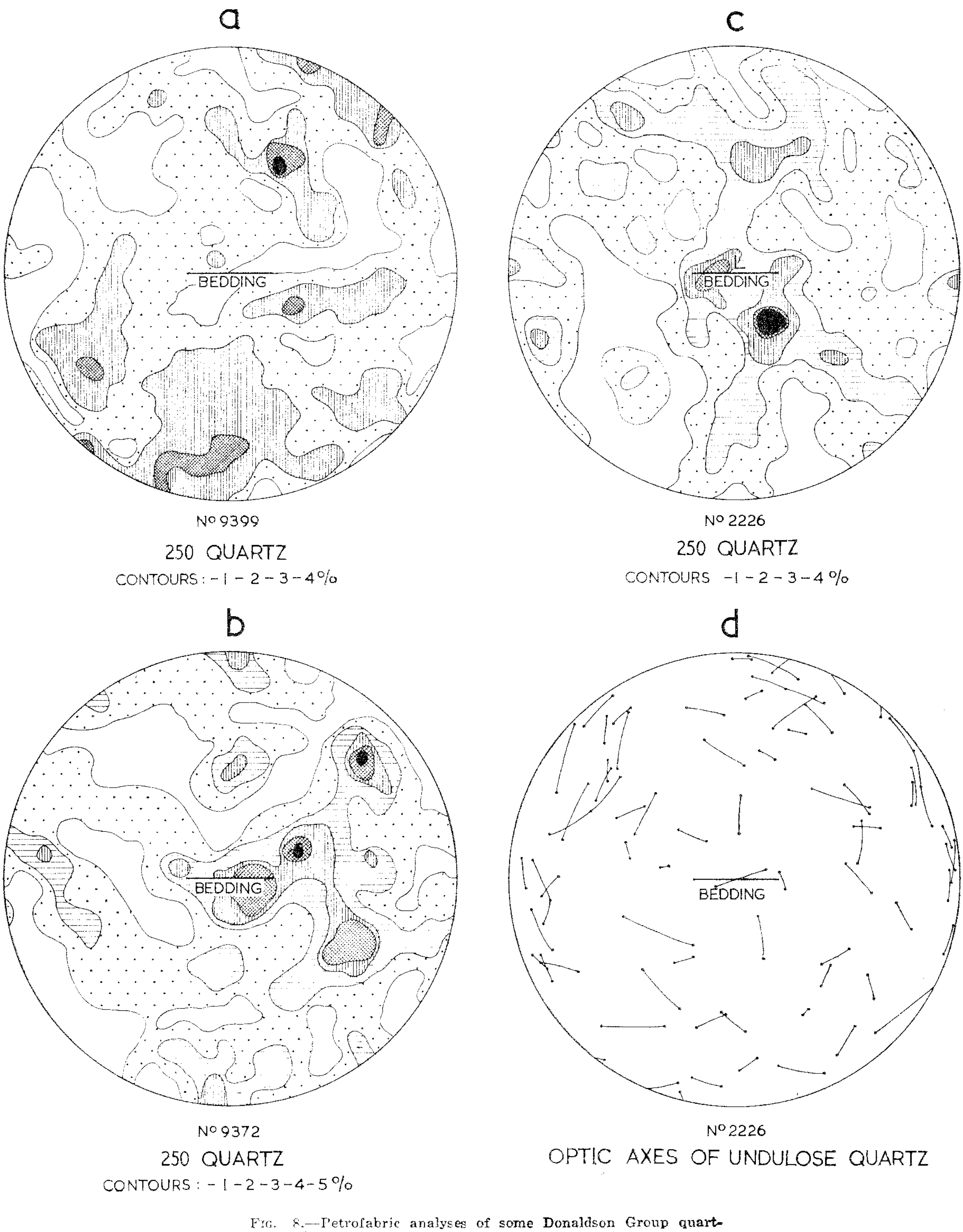


FIG. 8.—Petrofabric analyses of some Donaldson Group quartzites.

No. 9387 represents the Gutherie Quartzite on the south bank of the Pieman, at the big bend half a mile east of Hell's Gates. It is a grey, finely grained, somewhat glossy quartzite. Microscopically it consists of slightly undulose quartz grains with fairly high sphericity and with an average diameter of 0.15 mm. The rock is more deformed than most Donaldson Group quartzites as the quartz cement and the boundaries of the grains have been shattered and granulated. A quartz vein cutting the rock is also undulose and shattered but clastic fragments of chert are still recognisable. A weak foliation is outlined by sparse sericite flakes and there is accessory tourmaline.

Nonesuch Slate: 100′+

The Gutherie Quartzite is overlain by a hundred feet or so of black slate which has its type section at the eastern part of the large bend on the Pieman half a mile east of Hell's Gates where it is well exposed in cliffs. This formation is named after the Nonesuch Creek, a tributary of the Savage, shown in Fig. 6. It seems to be the youngest formation of the Donaldson Group to be exposed as the next bed to the east is the Delville Chert on the other side of the Delville Fault. The Nonesuch Slate is dark grey with bedding (in parts graded) commonly obscured by an oblique cleavage. The thickness appears to be in the order of 200 ft.

Rupert Beds

Spry and Ford (1957) gave the name Rupert Beds to a group of quartzites, slates, conglomerates and dolomite between Pieman Heads and Rupert Point. The lithological similarity to the rocks at Mt. Donaldson was noted. Mapping now shows that the rocks are equivalent as both are in a similar stratigraphic position, i.e., they overlie the Interview Slate on opposite sides of an anticline. The name Rupert Beds will no longer be used.

The sediments along the coast consist of a sequence about 1500 ft. thick of quartzites, 3 conglomerate horizons, phyllites and a thin dolomite. There are striking similarities between the conglomerate specimens 9353 from the "Rupert Beds" and the Gates Conglomerate from the Donaldson Group; the phyllite 9397 from the "Rupert Beds" and 9105 from the Donaldson Group; and the curiously pigmented quartzite of 5792 from the "Rupert Beds" and 9350 from the Donaldson Group.

No. 9353 is the conglomerate from the Donaldson Group south of Rupert Point. It is medium grey in colour, with flaky pebbles of phyllite and rounded pebbles of quartzite in a phyllitic matrix, Microscopically it consists of fragments of very finely grained argillite and quartzite in a matrix of sand-size quartz grains which are undulose, well-rounded and have a high sphericity and which in turn are surrounded by finely grained quartz and sericite. Thermal effects of the nearby Devonian granite are seen in the slight recrystallisation of the matrix and the growth of biotite and muscovite.

A quartzite (No. 9372) from the Donaldson Group at Rupert Pt. is a white to grey rock, with a slight fissility along the bedding planes shown by smears of silvery sericite. A weak lineation is present as the ribs on the foliation planes. Under the microscope it is seen to consist of ragged, somewhat lenticular, undulose grains of quartz averaging 0.3 mm. in diameter but ranging up to 1.5 mm., set in a matrix of finely grained quartz (about 0.04 mm.) with blurred crystal outlines. The foliation is shown by sparse, parallel sericite flakes; accessories are zircon and tourmaline.

The dolomite just south of Rupert Point occurs near the top of the Donaldson Group but was not found at Mt. Donaldson. No. 9346 is a massive dark grey rock laced with white carbonate veins. In thin section it is finely grained but with an uneven texture due to slight recrystallation, it consists almost entirely of dolomite with a little clastic quartz, zircon, iron ore and rutile. The grain size ranges between 1.2 mm. and about 0.005 mm.

The Savage Dolomite—Delville Chert—Bernafai Volcanics—Corinna Slate Assemblage

These four lithological units occur in a block bounded on the east by a fault-contact against Whyte Schist and on the west by a fault-contact against the Donaldson Group.

Savage Dolomite

Massive fawn to grey dolomite with some minor interbedded slate outcrops on the Pieman River for several hundred yards east of its junction with the Savage River and a few outcrops occur up the Savage River. Dolomite occurs in the upper part of the Delville Creek and has been found in diamond drill holes at the Delville-Newdegate Creek saddle.

It has been silicified to a massive chert in some parts and silicified oolite occurs a quarter of a mile east of the Pieman-Savage junction.

Specimens numbered 9365 and 9356 are typical. These are fine, evenly grained rocks with a mottled or patchy colouration which causes the rock to appear to be composed of angular fragments of a creamy colour in a grey matrix. Under the microscope, the rock is seen to be composed entirely of shapeless dolomite grains ranging in size from about 0.01 mm. to almost 2 mm. with rare quartz grains. The only variation is in grain size and hence in colour; the rock contains an abundance of finely grained (hence darker coloured) shapes surrounded by somewhat coarsely grained (thus lighter coloured) carbonate. The shapes are very variable, ranging from circular, annular, arcuate, rectangular to nebulous. This is probably due to the incomplete recrystallisation of the dolomite.

The thickness of the bed is not known; it does not seem to be more than few hundred feet but its top is not present and it is probably equivalent to the thick dolomite at Smithton, &c.

Delville Chert

Black slaty chert and quartzite outcrop on a small but prominent hill on the southern bank of the Pieman about three quarters of a mile south of the Savage River junction. Similar rocks occur on the ridge just east of the lower part of the track from the Pieman up to Mt. Donaldson, on the Pieman just east of its junction with the Whyte River and in Newdegate Creek west of the Delville Saddle.

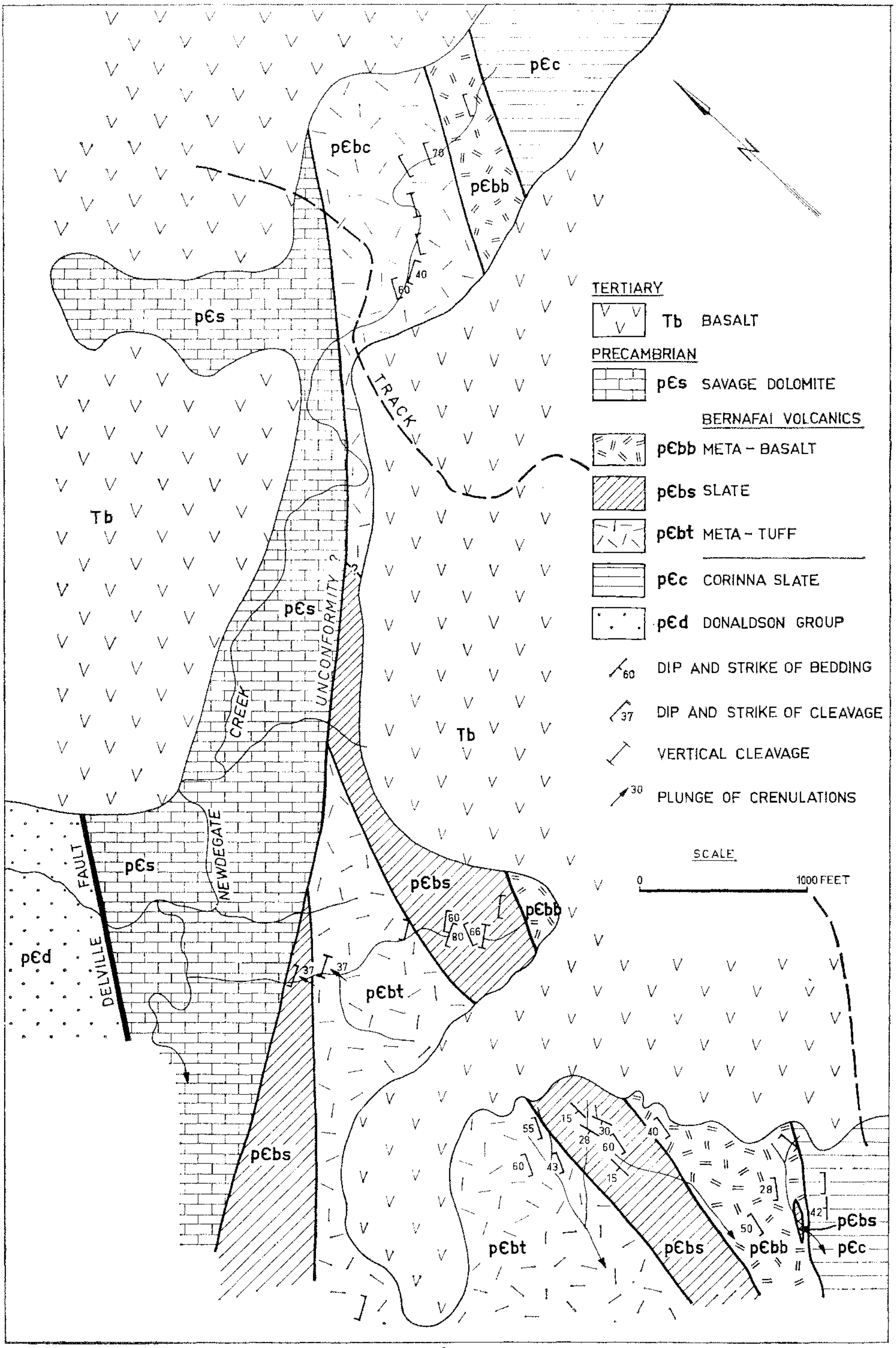


FIG. 9.—Bernafai Volcanics near the Delville Saddle (top left-hand corner of map) showing intercalations of slate. (Geology by A. Spry and R. P. Mather.) The Savage Dolomite appears to lie unconformably on the Volcanics.

The Chert lies between Savage Dolomite to the west and Bernafai Volcanics to the east both on the Pieman and along the strike 3 miles to the south at the Delville Saddle. The formation appears to be of secondary origin and to consist of silicified slate and dolomite.

No. 9352 is a black, rather fissile rock which outcrops on a small promontory on the south bank of the Pieman, 1 mile south of the Savage River mouth. Microscopically it simply consists of extremely finely grained quartz and haematite. The opaque mineral is distributed as patches and lines of tiny granules which, in parts of the rock, give a foliated texture and look very much like a residual slaty structure. This suggests that the rock is a silicified slate.

A rusty black rock with the general appearance of a weathered slate (No. 9363) which outcrops just east of the Whyte River on the northern bank of the Pieman is similar, as is No. 9261, a black, massive chert cut by abundant thin quartz veins on the hill east of the beginning of the Mt. Donaldson track.

Bernafai Volcanics

A thickness of 1300 ft. of rocks of greenish grey colour with a distinct cleavage are exposed in the Pieman River where it cuts the Bernafai Ridge and Ahrberg Hill just west of Corinna. These rocks form a long ridge and are exposed again in the Middleton Creek and Savage River to the north, and near the Delville Saddle to the south.

There are two main rock types in this formation, a tuff and a lava. Both have been so deformed as to obliterate all but the coarsest feature of the original textures and their texture is dominated by a cleavage but they still show sufficient of their original nature to indicate a volcanic origin. The characteristic mineral assemblage is albite-epidote-chlorite-tremolite.

At the Pieman River section the lower 400′ is tuffaceous and the upper 900′ of basaltic origin but the proportion of tuffaceous and normal slate increases to the south (see fig. 9).

No. 9270 is a fine-grained banded rock with a cleavage oblique to the bedding, outcropping in the Savage River where it turns west to cut across the ridge extending north of Ahrberg Hill. It is a greenish mottled rock with coarsely and finely grained bands some of which contain clastic fragments up to 1 cm. across. Under the microscope the more finely grained bands are seen to consist of a mass of parallel needles of fine tremolite with tiny granules of epidote and zoisite, flakes of biotite, albite, and ilmenite grains rimmed with sphene. Chlorite forms small clots. The coarser bands contain less epidote, more albite and much more chlorite and in addition, scattered large (0.2 mm.) grains of quartz of clastic origin. This rock is the result of low grade regional metamorphism on a tuff which was dominantly composed of basic igneous material with a little normal clastic material admixed (Analysis 6 in Table II). A foliation produced by parallel amphibole laths is oblique to compositional layering in No. 2208 (Plate I, No. 5).

The basaltic member is represented by specimens 9307 and 9357 from the south-eastern side of Ahrberg Hill; 9410, 9391, 9305, 9317 and 9331 from the Pieman River end of Bernafai Ridge; 9335 from the Middleton Creek where it cuts the northern end of Ahrberg Hill; 9278, 9291 and 9282 from the Savage River north of Ahrberg Hill; 9409 from the Whyte River, 1 mile above the Pieman; 9262 from the Pieman River immediately east of the Whyte junction; 9398 from the Pieman River immediately east of the Whyte junction; 9398 and 9402 from the Corinna-Zeehan track about 1½ miles south of Corinna.

No. 9305 is from the type locality on the Pieman River at Bernafai Ridge. It is a light greenish grey in colour with a moderately well developed cleavage. Ovoid bodies up to a centimetre across are taken to be relict amygdales. Under the microscope the rock is finely grained and consists of pale tremolite-actinolite, albite, and zoisite. The amphibole occurs as rather large laths (0.15 mm. x 0.1 mm.) which are pleochroic from colourless to pale green and tend to be at an angle to the foliation produced by the preferred orientation of smaller (0.1 mm. x 0.02 mm.) fibrous, medium-green amphiboles. Albite also occurs in several different forms; the larger crystals (about 0.1 mm. diameter occur as bands and lenses and are rather dusty with albite-twinning shown by a few individuals. Irregularly shaped, fresh untwinned albite is abundant as tiny crystals about 0.05 mm. across. Tiny granules of zoisite are abundant and possibly also some epidote. Elongate and lenticular aggregates of finely granular sphene or leucoxene are present. No. 9391 from this locality is similar except that it contains abundant yellow epidote together with some green chlorite and a little bright green biotite. The amygdales consist of radiating fibrous epidote with a core of chlorite. Relict amygdales in 9402 contain epidote (Plate II, No. 6).

No. 9307 from the western side of Ahrberg Hill is similar but contains a little muscovite. No. 9335 from Middleton Creek, like several other specimens, is rich in ferromagnesians and contains only a little albite; this specimen, and also some of the others which lack amygdales may have been tuffs.

Rocks similar to those of Bernafai Ridge and Ahrberg Hill outcrop at the Whyte-Pieman junction and for over a mile up the Whyte River. No. 9409 which outcrops on the Whyte River a mile above its junction with the Pieman shows relict basaltic texture. In the hand specimen it is a pale green rock which is generally massive but with a weak cleavage. Microscopically it is finely grained and consists chiefly of albite, yellow epidote granules and amphibole needles and laths, with a little chlorite. The albite occurs as parallel laths instead of the usual shapeless crystals and these range up to 1 mm. across in size. The feldspar is irregularly twinned, fractured and contains epidote grains; the larger crystals can be seen in an arrested stage of breakdown to aggregates of smaller crystals.. A vein of epidote cuts the rock and magnetite is abundant. This rock is very similar to the rock from the southern end of Four-Mile Beach. This has an irregular texture with large crystals of albite up to 0.5 mm. across in a foliated matrix of actinolite (0.2 mm. x 0.01 mm.) and yellow epidote (0.5 mm.). The reticulate and radiating needles of pale-green actinolite through the feldspar are typical and are also shown by 9409.

No. 9262 is a light coloured, soft rock with a strong cleavage parallel to irregular and lenticular banding, outcropping just east of the Pieman-Whyte confluence. Under the microscope the rock is seen to consist of thin bands alternately rich in chlorite or in pale actinolite needles; albite and a little zoisite are also present and a little biotite occurs in some layers. Some bands are strongly contorted and an oblique fracture cleavage has developed.

The Bernafai Volvanics change in lithology towards the coast; tuff becomes more abundant than lava and beds of non-volcanic pelite are interbedded. The pelite beds are of glossy grey crenulated slate, identical with the Corinna Slate.

Chemical analyses given in Table II suggest that the lavas were originally olivine basalts and show the tuff to be similar to the lava but with a quartzose addition. Possible relations with the amphibolites intruding the Whyte Schist, dolerites intruding Interview Slate, and lavas in the Dundas Group are discussed later.

Corinna Slate

The term Cornna Beds was used by Spry and Ford (1957) to refer to rocks of differing types in the Corinna area and along the Corinna Road. It is recommended that such use be discontinued because the rocks embraced by the term Corinna Beds include those which are now called the Whyte Schist, the Savage Dolomite and the Bernafai Volcanics together with the slates at Corinna itself. The term Corinna Slate is now used to refer to that formation of banded slaty siltstones and slate which occurs along the Pieman River between Corinna and Bernafai Ridge.

No. 9334 outcrops on the northern bank of the Pieman, about a quarter of a mile west of Corinna, just below the Bernafai Volcanics. It is a grey, thinly bedded rock with a weak cleavage at an angle to the bedding. Microscopically, it is very finely-grained and consists chiefly of quartz and parallel sericite flakes with lesser chlorite. Iron-ore and tourmaline are accessories.

Specimens 9383 outcropping 200 yards west of the Whyte-Pieman junction, and 9354 from 1 mile up the Whyte are similar. They consist of thin layers alternately rich in quartz or in sericite; the parallel micas impart a cleavage. Chlorite is present and accessories are sphene and tourmaline.

The Corinna Slate near the coast (in the Delville Saddle area) is similar except that is richer in iron-ore (5-10%) and contains epidote (e.g. 2216). The cleavage of the slate is commonly crenulated with a fracture cleavage along the axial surface of the crenulations (e.g. 2231).

Beds of quartzite a few feet thick are interbedded with the Corinna Slate in the Newdegate Creek. These (2211, 2230) are pale, greenish grey, finely grained rocks consisting of granular quartz (0.05 mm.) and about 20% of parallel green chlorite flakes (0.2 mm.).

STRUCTURE

This whole area of Precambrian rocks forms a major structural high (Rocky Cape Geanticline) separated from the Tyennan Geanticline to the east by a structural low of Palaeozoic rocks. The Whyte Schist belt forms a minor high with younger sediments flanking it on each side and the axis of this structure swings in an arc from east-west at the coast just north of Granville Harbour around to north-south at Browns Plains (north of Corinna), and to a little west of north along the Savage River west of Long Plains.

The different rock types are distributed in a series of belts which are separated in some cases by faults and it is thus difficult or even impossible to determine the relationships between the rocks in each. The minor structures (cleavage, lineation) and the minor folds are not genetically related to the major folds which apparently were formed after many of the minor structures. The major faults are however parallel to the folds and thus some may be related to them; as one fault cuts Devonian granite at Conical Rocks it is probable that some major structures belong to the Tabberabberan Orogeny.

The major structure across the Eureka Plains and extending from Zeehan to Granville Harbour and to the Meredith Range is the Pine Creek Syncline which is more than 10 miles across. The fold is related to the Duck Creek Syncline (Blisset 1960) and is probably, at least in part, a Devonian structure. Ordovician to Silurian sediments overlie the Oonah Quartzite with an unconformity of small angle and a major unconformity is inferred between the Oonah Quartzite and the Dundas Group and later sediments because of the greater deformation of the Oonah Quartzite and structural discordance at the boundary.

A stereographic plot of poles to the major foliation in the Whyte Schist (fig. 11d) shows that the foliation has been folded into an anticline plunging at 45° towards the south east. Bedding is visible in very few outcrops of the Whyte Schist and is restricted to the less altered varieties south of Stringer Creek. Study of thin sections indicates the presence of four S-surfaces in some rocks with the major one S_2; it is generally easy to recognize S_3 macroscopically but from the appearance of S_1 under the microscope there is doubt whether it could be recognized macroscopically. This suggests that the mapped foliation is partly S_0 (bedding) and partly S_2. It appears likely that the strike of S_2 does not differ markedly from that of S_0 on a large scale as the lithology (pelite with quartzite) at the coast north of Duck Creek continues to the east in the direction of the foliation and occurs on the Pieman River. Many of the schists and phyllites show crenulations of the foliation (S_2) up to an inch or so across. Some are symmetrical chevron folds with a fracture cleavage (S_3) along the axial surfaces; others are asymmetrical with a fracture cleavage along the appressed limb. Just south of Stringer Creek in the Pieman, a well foliated amphibolite is crenulated in a similar manner.

Somewhat similar crenulations occur at the north Pieman Head in sediments regarded as younger Precambrian. These crenulations will be shown later to have been refolded, thus the crenulations together with S_3 may be late Precambrian (Penguin) or Cambrian (Tyennan).

At least one foliation, and in places, two lineations are present in the Oonah Quartzite. Small isoclinal folds are common and the rocks are cut by abundant quartz veins.

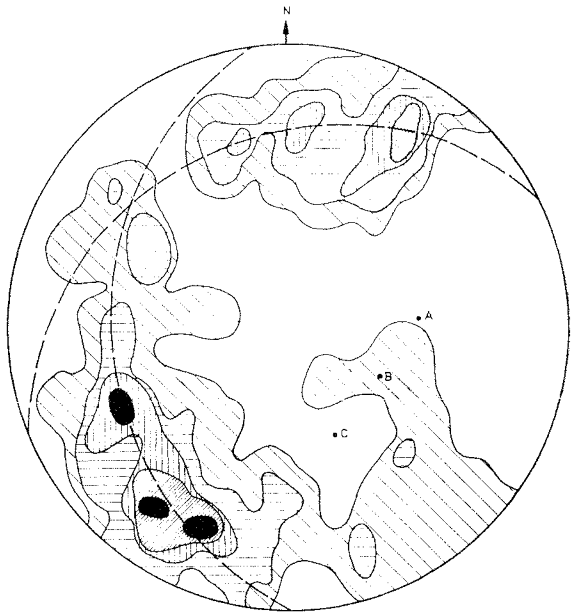
The strike of bedding between Granville Harbour and Zeehan is about 290° with rather steep dips to the north but an equal-area projection of 250 poles to bedding across the whole area reveals a pattern (fig. 10) which is not understood at present. In general terns it represents a large fold (Pine Creek Syncline) plunging at about 60° towards 120° but the poles to bedding do not fall on a simple great circle. The pattern might be interpreted as two partial great circles representing fold axes at pts. A and C in fig. 10 but more likely represent either a non-cylindroidal fold or a cylindroidal fold which has been somewhat refolded. This is supported by a study of the distribution of the poles to 34 fold axes measured in the region between Granville Harbour and Zeehan. The scatter in directions is considerable and the poles to the Pine Creek Syncline and the nearby known Tabberabberan folds (Zeehan Basin and Duck Creek Syncline) are plotted for comparison. The small folds in the Oonah are isoclinal and differ in style from those in the Palaeozoic rocks. They probably consist of more than one generation because discordant folds of different size and style occur in a quarry on the Corinna Road, 2 miles beyond the Montana Mine. The Pine Creek Syncline is probably later than the isoclinal folds but from its abrupt discordance with the Zeehan Basin is unlikely to be wholly Tabberabberan. The scatter of small-scale fold axes and irregularity of outcrop patern suggest that the area was affected by perhaps Penguin, Jukesian and Tabberabberan movements.

The structure further west is more complex as is shown in Fig. 5 but generally speaking, an anticlinal axis trends at 40° through the Tikkawoppa Plateau, Mt. Donaldson and the Longback Range. This belt contains a series of **en echelon** folds trending at between 150° and 200° with flat southerly plunges.

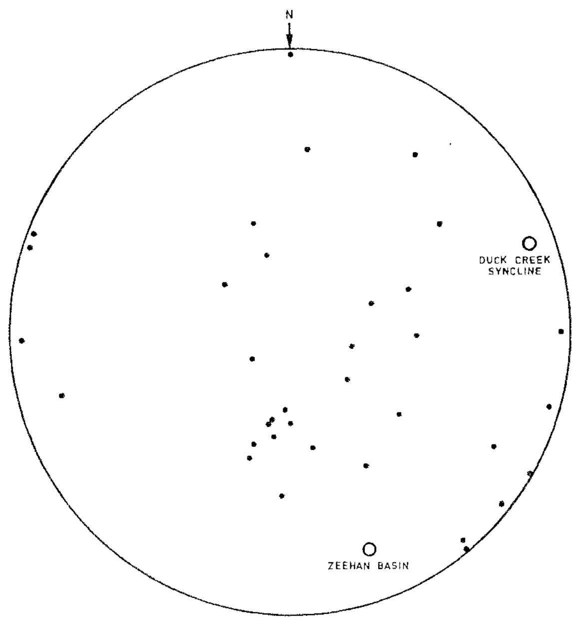
A series of open folds whose axes are nearly horizontal and trend about 35° occupy the crest of a major anticline between Corinna and Pieman Heads.

Small scale folds may be mapped in the more open country around Mt. Donaldson and Fig. 6 shows them to have a complex pattern. Most important of these is the overturned anticline which crosses the Pieman near Hell's Gates. This is really an asymmetrical and overturned crumple on the eastern limb of a large anticline whose axis lies to the west; it cannot be followed for any distance away from the river and the overturning is probably quite limited. Strong drag folding occurs in the overturned beds just east of Hell's Gates just above river level.

The structure on the Plateau to the south consists of an anticline whose axis has a 170° trend about 1 mile south-south-east of Hell's Gates, swinging around to 190° further to the south.



250 POLES TO BEDDING IN OONAH QUARTZITE
CONTOURS 1, 2, 3, 4, 5 %



FOLD AXES IN OONAH QUARTZITE

FIG. 10.—Structure of the Oonah Qartzite and Slate. (*a*) Poles to bedding. The Pine Creek Syncline is outlined. It is possible that the distribution represents two folds (shown by the great-circles) but it is probable that a single, major, non-cylindroidal fold is present. (b) Irregular distribution of fold axes; apparently unrelated to the Pine Creek Syncline or the nearest Palaeozoic folds (Duck Creek Syncline and Zeehan Basin).

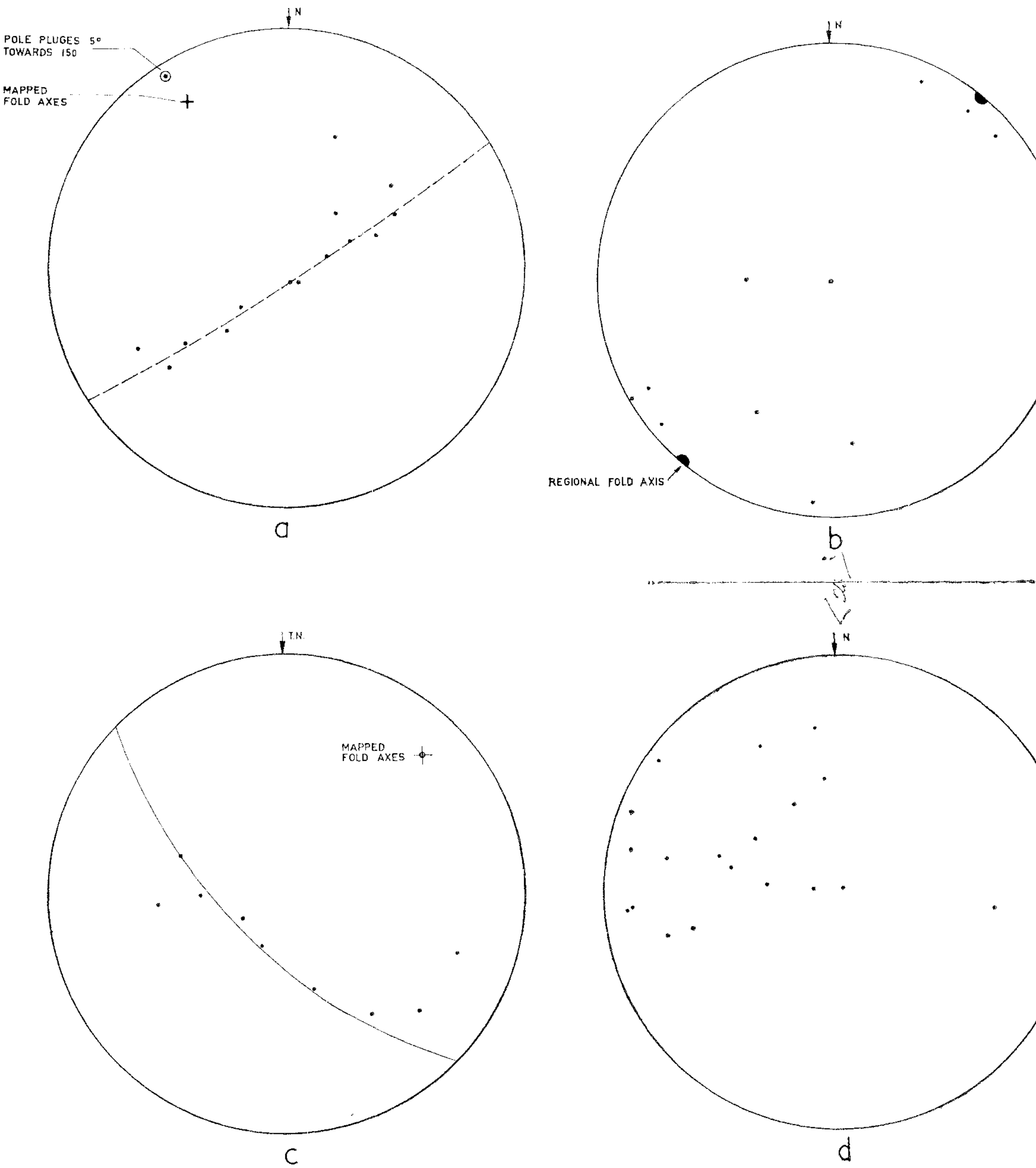


FIG. 11.—Structure of the Donaldson Group. (*a*) Poles to cleavage in slates east of Mt. Donaldson tend to lie on a great circle whose axis is close to the direction of mapped folds. (*b*) Lineations in quartzites at Hell's Gates are irregularly distributed and are probably only fortuitously near the mapped fold axis. (*c*) Lineations at Rupert Point tend to lie on a great circle whose pole is close to the direction of mapped fold axes. (*d*) Poles to foliation in Whyte Schist.

The structure in the button-grass slopes to the south and east of Mt. Donaldson was mapped by walking the outcrop of marker beds such as the conglomerates. This revealed a large anticline plunging at about 30° towards 200° through the peak with a series of small anticlines and synclines whose axes plunge at about 10° towards 130°-150°.

Relation of minor to major structures

The major structure of the area was determined by mapping rock distribution because it was found that the orientations of minor structures were very variable. The beds in the Donaldson Group at Mt. Donaldson and Rupert Point possess a sporadic lineation (crenulation in the pelites and boudinage, mullions, and tight folds in some quartzites) and a cleavage at an angle to the bedding. Mapping shows that the cleavage is not parallel to the axial surfaces of the larger folds nor are the lineations parallel to the axes. The structural picture is by no means clear but evidence of several periods of folding seem to be present and a very brief study of the rocks along the Donaldson River, at Hell's Gates, near Rupert Point, and east of the summit of Mt. Donaldson throws some light on the problem and points the way for future work.

A stereographic plot of the poles of cleavages (fig. 11a) in slates east of Mt. Donaldson shows that although the cleavage direction is widely variable in dip and strike, the poles appear to lie along a great circle. The pole to this great circle plunges approximately at 5° towards 140° and as the independently mapped folds have axes plunging at about 10° towards 150°, it appears that the cleavage is an older structure which has been folded by these folds.

A similar relationship is shown by the lineation in the Donaldson Group rocks between the Pieman Heads and Rupert Point (fig. 11c). The poles of the lineations are scattered but lie on a great circle whose pole plunges at 20° towards 35°. This is close to the direction of the regional folds in this area and it would seem that the lineation is older than the regional folds and has been folded by them (Ramsay, 1960).

In the two examples given above, the newer folds are oblique to the older structural trends so that it is possible to separate them, but at Hell's Gates, it seems that the older and younger trends are approximately parallel thus causing the disruption of the older structural pattern to be incomplete. Fig. 11b shows a plot of the lineations at Hell's Gates and although there is a considerable scatter, they do not lie on any recognisable great circle but tend to cluster around an axis plunging at about 30° towards 220°. The major fold axis here plunges flatly towards 200° but there is too poor a degree of parallelism of the lineations with this direction to suggest that the lineations are cognate with the folds. Small drag folds just west of Hell's Gates have the appropriate asymmetry for this overturned limb and have axial directions between 185° and 205°; these are cognate with the large fold. The axes of the boudins in the Mametz Quartzite here swing between a plunge of 5° towards 240° to 10° towards 40° and thus appear to be older structures unrelated to the fold.

In the Nonesuch Slate in the cliffs near the small waterfall at the large bend in the Pieman, three quarters of a mile east of Hells' Gates, there is a clear example of the lack of relation between the cleavage and major structure. In one outcrop, the bedding of the slate strikes at 210° and dips south-east at 22°; the cleavage strikes at 240° and dips south-east at 5°; a fine lineation (crenulation) plunges at about ½° towards 230°. Here the cleavage is flatter than the bedding and if related to the major structure, would indicate that the slate is overturned and lies on one limb of a completely flat, recumbent fold. Graded bedding however indicates that the bed is the right way up, as does the regional mapping, thus it would appear that the cleavage was formed in a steep position and was subsequently rotated (along with the bedding) to the present sub-horizontal attitude.

The large scale folds trend at 30° generally but swing around to about 0° at the Pieman River three quarters of a mile west of the Donaldson. Dips of bedding are to the east and west at moderately high angles but the cleavage dips fairly regularly west at 65° and strikes close to the trend of the fold axes. With the limited amount of data available, the cleavage here looks as though it is parallel to the axial planes of the regional folds.

The axes of the folds around the Mt. Heemskirk granite mass are oblique to the regional trend in this area and it is possible that the granite intruded diapirically so that the folds are locally parallel to its margins. The granite is wrapped around by Precambrian sediments which dip outwards giving a domal structure with the Duck Creek and Pine Creek Synclines concentric to the granite. It is possible that hornfelses along the north-western contact of the granite, between Granville Harbour and Donnelly's Lookout might be the Whyte Schist.

FAULTS

Three separate fault systems of different kinds can be recognised in this region. The most important set trends at about 30° (parallel to the major fold axes) and divides the region up into a series of belts. Small faults trend at a mean of 15° across the plains between the Pieman, Interview and Donaldson Rivers and minor faults are associated with the small folds east of the summit of Mt. Donaldson.

Donaldson Fault Set

Spry and Ford (1957) first recognised the existence of a major fault running from Conical Rocks across the Pieman and north parallel to the Donaldson River. This fault is prominent at its south-western end where it forms the contact between the Devonian granite of Conical Rocks and the Donaldson Group ;it is recognisable a few miles north-east where it is the boundary between the Interview Slate and the Donaldson Group but is difficult to follow north of the Pieman where Interview Slate lies on both sides.

The Donaldson Fault is at least ten miles long and has a throw of probably about 500′ with the eastern side down. As it shears the granite in places it is probably compressional and this is supported by observations of joints in the faulted zone across the granite which suggest a westerly dip. It seems likely to be a thrust cognate with the regional folding. A number of smaller faults parallel to this occur further to the north-west.

Delville Fault

This runs approximately in a 30° direction but unlike the Donaldson Fault, swings considerably. The small-fold axes in the Donaldson Group, east of the summit, end abruptly at this fault. Silicified breccias outcrop on this line east of the early part of the track from the Pieman River at Mt. Donaldson. The Gutherie Quartzite and Nonesuch Slate strike obliquely into this line and then disappear. Near the Delville Saddle the Bernafai Volcanics swing around and abut against the Donaldson Group across this fault.

Nothing definite is known of the dip or displacement of the Delville Fault. It brings the younger Savage Dolomite against the Donaldson Group, thus faulting out a thickness of at least 2300′ of the Corinna Slate and Bernafai Volcanics, so that it has an east-side-down movement of 3000′+. From its curvature, it may be an old (pre-Tabberabberan) fault.

It is suggested that the contact between the Whyte Schist and the younger beds to the west (near the Whyte River-Pieman River junction) is a fault (Whyte Fault). The younger beds dip towards the older ones, and the Savage Dolomite and beds below it cut out against the schist. On the southern and eastern side of the Whyte Schist, the Oonah Quartzite and Slate appears to rest directly on the Schist but is missing on the northern and western side. This fault turns around parallel to the swing of the strike of the Whyte Schist and thus is probably pre-folding in age; it could be related to the Delville rather than the Donaldson Fault. The Whyte Fault has a west-side-down movement of extremely large magnitude, as it brings one of the youngest beds (Bernafai Volcanics) down against the oldest rock, the Whyte Schist.

Structural Conclusions

The structure of the area is complex and the history is uncertain at present but it is concluded that the Precambrian sediments have been deformed at least twice and that the most prominent cleavage in some rocks, the boudinage, the small-scale crenulations and the preferred orientation of quartz-axes are due to an early period of deformation and that these structures have been disturbed by at least one later tectonic eevnt. The Pine Creek Syncline appears to be a pre-Dundas Group structure, at least in part, but there may be a Tabberabberan element in the major folds through Mt. Donaldson and the Interview River plains as suggested by the following:

(1) the Donaldson fault which is younger than the Devonian (?) granite is parallel to the folds,

(2) these folds appear to continue to the north where they affect the Dundas Group at the Arthur River.

DYKE SWARM

Several hundred thin sheets of dolerite intrude the Interview Slate and Quartzite as shown by Spry and Ford (1957) and fig. I. These trend N.N.E.; some are apparently concordant with the sediments but others are discordant. The largest known is five miles in length; the bodies are commonly over a mile long but only about 200 feet thick.

The rocks are massive with a medium grain size and doleritic texture. Under the microscope the intergranular texture is still preserved but the pyroxene has been completely replaced by fibrous masses of yellow to olive-green actinolite. The feldspars show the original lath shapes but are now composed of cloudy albite with abundant finely granular zoisite. Much of the feldspar occurs as graphic intergrowths with quartz. Large skeletal grids of ilmenite, small flakes of brown biotite and a little chlorite are present.

Other varieties described by Ward (1911) and Spry and Ford (1957) have been sheared so that the igneous texture is partly destroyed.

The rocks are similar to the Cooee Dolerites (Spry 1957) which intrude similar sediments; the trend of the Interview dyke swarm is towards the Rocky Cape-Burnie area where the Cooee dolerites occur.

The analysis in table III shows that the rock is basic and a little richer in soda than potash; the oxidation of the iron and high H_2O values are due partly to weathering. The chemical similarity with the average of two Cooee analyses is apparent.

A dyke south of Pieman Heads has been metamorphosed by the Devonian granite and is thus pre-granite in age but other direct evidence of age is lacking. The present evidence (Spry, 1962b) indicates that the Cooee dolerites are Precambrian.

Table III

	(1)	(2)	(3)
SiO_2	48.38	49.54	46.74
Al_2O_3	14.52	16.59	14.94
Fe_2O_3	5.87	1.46	2.90
FeO	9.21	8.06	10.66
MgO	5.07	5.06	7.04
CaO	7.20	8.69	9.60
Na_2O	2.22	2.22	2.77
K_2O	1.50	2.63	0.06
H_2O+	3.40	3.19	3.54
H_2O-	0.49	0.14	0.14
MnO	0.18	0.17	0.26
P_2O_5	0.22	0.41	0.16
TiO_2	2.20	1.84	1.75
	100.46	99.00	100.56

(1) Dolerite, Interview dyke swarm, Pieman River.
(2) Average of two Cooee Dolerites (4874, 4852).
(3) Lava from the Bernafai Group.

Analyst: Tas. Dept. Mines.

It is possible that some dykes might represent feeders to the Bernafai volcanics which are interbedded with the upper part of the sedimentary succession, the base of which is intruded by the dykes. Chemically there are only slight differences between the dolerite and lava; the Bernafai lava is less oxidized and richer in magnesia, lime and soda, but poorer in iron and potash. The dyke-rocks are generally unsheared and post-folding in age but the lavas are strongly sheared and pre-folding, however, they would appear to be of similar magma type.

CONCLUSIONS

The Whyte Schist is similar in many respects to low grade metamorphosed Precambrian rocks elsewhere in Tasmania and the sediments of the Oonah, Interview, Donaldson, &c., Groups can be correlated with unmetamorphosed sediments at Rocky Cape and elsewhere. This is the only locality, studied by the author, where the "older" and "younger" groups are in close proximity over an appreciable area.

The preferred hypothesis is that the siltstones and shales of the Whyte Schist were partly metamorphosed, intruded by sodic basic to intermediate dykes, then deformed again during the Frenchman Orogeny. After a period of erosion the Schist was overlain by the Oonah Quartzite and Slate, the Interview Beds, Donaldson Group, &c., which where folded, intruded by dolerites and folded again during the Penguin Movement. The Savage Dolomite was deposited, then the area was subjected to further tectonic movements, possibly during the Jukesian (Cambrian) and Tabberabberan (Devonian) epochs.

The area is so densely vegetated and outcrops are so poor that the critical exposures are not visible but there are a number of reasons why the hypothesis outlined above is open to debate. It is by no means impossible, at the present state of knowledge, that the Whyte Schist with its amphibolites could not be equivalent to the unmetamorphosed sediments with the dolerites.

The Whyte Schist is less altered than most other Tasmanian metamorphics and the Oonah Quartzite, Donaldson Group and Bernafai Volcanics are more deformed than many other unmetamorphosed Tasmanian Precambrian sediments. All belong to the lowest sub-facies of the Greenschist Facies and contain members of the assemblage quartz, albite, epidote, chlorite, muscovite, actinolite, magnetite and calcite.

Both the Whyte Schist and the unmetamorphosed sediments show evidence of two periods of deformation. The strip of Whyte Schist is flanked on both sides by "younger" sediments. The Oonah quartzites on the east dip to the east and are probably the oldest of the sedimentary succession. The sediments on the west dip to the east, towards the Schist, and are among the youngest in the succession (Corinna Slate, Delville Chert). This implies a very large fault along the curved western margin of the Schist. The western boundary of the Whyte Schist appears to be sharp, but it is difficult in isolated outcrops to distinguish between Bernafai Volcanics and the amphibolites from the Whyte Schist. Both consist of actinolite, chlorite, epidote, albite and quartz and both form long bodies with the same general trend.

The contact zone between the Whyte Schist and Oonah Quartzite is exposed in the Pieman River gorge and along the coast and appears to be gradational over about half a mile. This zone contains sediments identical with the Oonah Quartzite, sheared quartzites and siltstones similar to Whyte Schist but in a less altered condition, and some unaltered sediments which do not resemble any others in the district. This zone could be interpreted as being gradational between Oonah Quartzite and Whyte Schist or as a complex imbricated fault zone.

The possible equivalence of the amphibolites in the Whyte Schist, the Bernafai Volcanics and the dyke swarm of the Interview River presents a problem. The preferred interpretation is that the amphibolites are oldest; these were followed by a metamorphic period then the Bernafai Volcanics, then folding and finally the dolerites. This is supported by the following facts:

(1) Rocks from the Bernafai Volcanics contain what are interpreted to be relict amygdales thus they are effusive. Altered tuffs occur in this formation. The Volcanics form a definite stratigraphic horizon which is repeated across a fold.
(2) The dolerites are intrusive and form sills and dykes which are long (some miles), thin (up to 200 ft. wide) and appear to extend as a swarm for about 60 miles to the N.N.E.
(3) The amphibolites are discordant with the Whyte Schist in part and are thus intrusive, and occur as tabular bodies from 50 ft. to a half a mile in width and some miles in length. Together with the enclosing schists they extend for some miles to the north.
(4) The dolerites, Volcanics and amphibolites do not change character appreciably for 10 miles in a northerly direction along their length.
(5) The dolerites and Volcanics are quite similar in chemical composition but the amphibolites are much more sodic.

The best interpretation of the relations between what have been called unmetamorphosed sediments or "younger" Precambrian rocks and those called metamorphosed sediments or "older" Precambrian is that they are separated by a major tectonic and metamorphic event, the Frenchman Orogeny. However, it has not been possible to prove that an unconformity exists and that no lateral transition between the two exists. Even though the two groups differ somewhat in lithology, chemical composition and tectonic style, the possibiilty that one represents the other in a more deformed, metamorphosed and recrystallized form has not yet been disproved.

Upper Savage River

A brief reconnaissance, together with study of air photographs, aero-magnetic maps and thin sections suggests that the Whyte Schist and the amphibolites continue into the area of the Savage River Iron Deposit. Hughes (1957) considered the amphibolites associated with the iron ore to be Cambrian in age and although comparison (Spry 1962b) shows some chemical similarities (chiefly high soda), the structure under the microscope (Plate I, No. 3) is quite different from any found in a Cambrian intrusive. It seems likely that the faulted syncline east of Corinna swings in an arc to the north-west, and that the dolomite at the savage River is the Savage Dolomite in the centre of this syncline. It could be separated from the Whyte Schist and amphibolite to the east by the Whyte Fault.

Correlation Within the Rocky Cape Geanticline

Younger Precambrian sediments near Zeehan and Corinna were tenatively correlated with the Rocky Cape Group along the North-West Coast by Spry (1962a). Support for the correlations given in fig. 12 is given below.

The lowest formation of the Rocky Cape Group appears to be the Burnie Quartzite and Slate (Spry 1957) which outcrops between Howth and Somerset; it may continue around the nose of an anticline through the Sisters Hills to the Dip Range, to become the Neasey Quartzite and Slate of McNeil (1961) and Longman and Matthews (1961) around the Arthur River, and further south to the Oonah Quartzite and Slate at the Pieman River.

The formation is exposed along almost 15 miles of coastline where it strikes perpendicularly to the coast; the thickness is not known but it must reach many thousands of feet. It consists of a monotonous succession of thinly bedded quartzites and slaty pelites. The arenites are light-coloured (grey to cream) and massive, flaggy or thinly bedded; the pelites are dark grey to black when fresh and show a cleavage which is well developed in some specimens but poorly in others. The rocks are characterized by an abundance of sedimentary structures including flow-casts, cross-bedding, graded bedding, ripple mark, mud-pellet conglomerates, scour, slumps and flame structure.

The arenites are mainly quartzose subgreywakes (Pettijohn, 1957) e.g. 6152, 6153, 7985, 7986, 7987, 7988, 7989, 7991, 7994, 7996, 7997, 8001, 8003, 8004. These are light grey to brown rocks, rather fine-grained, with an irregular fracture and a weak cleavage; clastic muscovite is common on bedding planes. Under the microscope the rocks consist of approximately 60% quartz and 25% rock fragments in 15% of sericitic matrix. The quartz and rock fragments are angular to subangular with a low to moderate sphericity. The rock fragments are composed of a fine mesh of sericite or a mixture of sericite and chlorite; some were possibly originally feldspar but most are clay-pellets and mudstone-fragments. Cleavage is more prominent microscopically than macroscopically and the matrix has been recrystallized and sheared to form thin layers of similarly oriented sericite, chlorite, haematite and carbonaceous material between the larger allogenic fragments. Twisted clastic flakes of muscovite and (less common) chloritized biotite have been rotated into parallelism with the cleavage which is near the bedding in some specimens but at a large angle in others. Some specimens with a

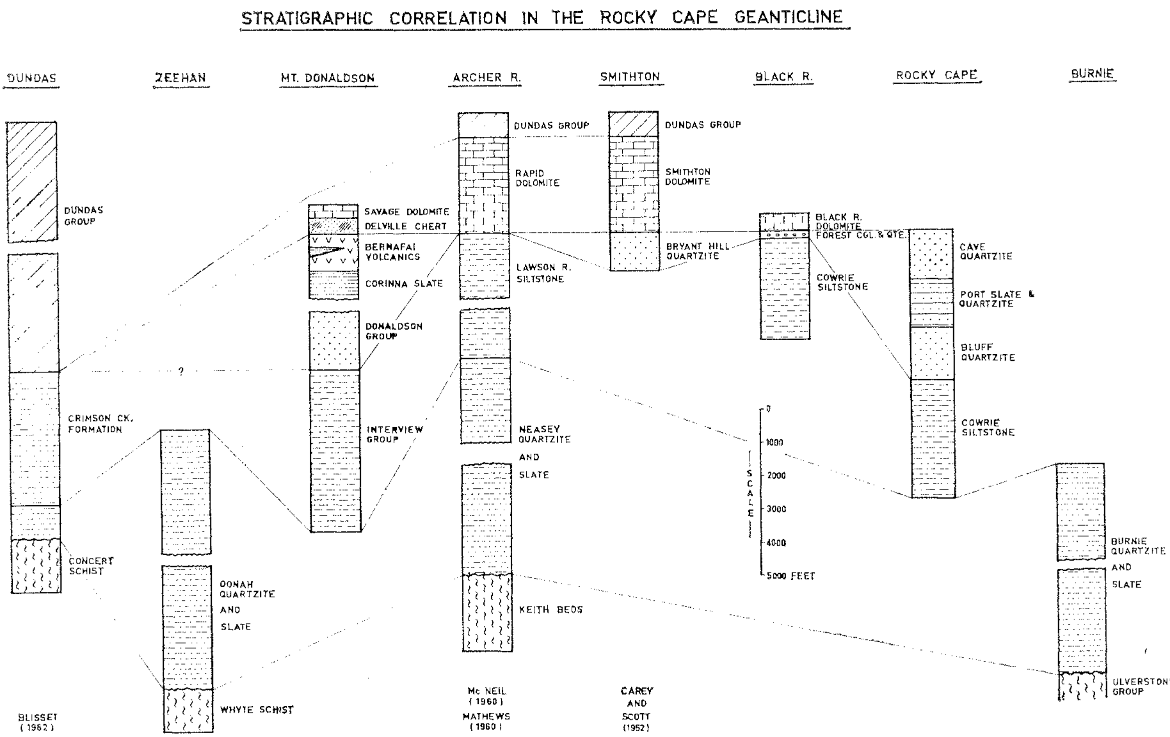


FIG. 12.—Correlations of younger Precambrian sediments within the Rocky Cape Geanticline.

weak cleavage contain quartz with a moderate sphericity and low degree of roundness. Other specimens with a strong cleavage contain quartz grains which are undulose, have deformation lamellae and are oriented with their long axis parallel to the cleavage. It is not clear whether the quartz was originally elongate and strained or whether it developed these deformation features during the production of the cleavage but as some specimens with only a weak cleavage in the matrix contain undulose quartz with lamellae it is probable that most of the clastic particles were already strained before incorporation in the rock. Some quartz has been sericitized. The common accessories are well-rounded zircon and rutile; tourmaline occurs as clastic fragments (some well-rounded, some broken across zoning) but some is authigenic (with spongy outlines or acicular overgrowths).

Dark grey quartzites such as 7988 from Wivenhoe and 6152 from Doctor's Rock and the jet black 6045 from Wivenhoe are rich in carbonaceous material. No. 7987 from Wivenhoe is typical of the micaceous and graphitic fine-sandstones. The bedding planes show abundant black patches of graphitic material about ¼" across, together with abundant muscovite flakes.

Some coarser specimens contain quartzite fragments; 7985 from Wivenhoe has fragments of metamorphic quartzite with strongly elongate quartz. Some specimens from Sulphur Creek have abundant carbonate in the matrix.

Chemical analyses (Table II) show that the subgreywacke No. 7991 is very similar to quartzites from the Oonah Quartzite and Slate.

Quartz-sandstones are uncommon in the Burnie Quartzite and Slate between Howth and Somerset. A small proportion of sandstones (such as 6047 from Sulphur Creek) consist almost entirely of quartz with a little muscovite and very little matrix. Recrystallization of at least some of the quartz forms an interlocking mosaic but some quartz grains may be original clastic grains.

The stratigraphic position of the rocks at Penguin is unknown as they are bounded by Palaeozoic sediments, Tertiary basalt and the sea. They are dominantly of quartz-sandstone and light-coloured slates and thus differ somewhat from the normal Burnie Quartzite and Slate, however it would appear that the upper parts of this formation (e.g. the quartzites at Sisters Hills) become richer in quartz sandstones. No. 8002 from Penguin consists of quartz fragments ranging from 0.04 to 0.3 mm. with a little chert, metamorphic quartzite and patches of interstitial sericite. In parts the rock is crystalline with interlocking undulose quartz but in other parts, original well-rounded quartz with high sphericity shows authigenic rims; both the grains and the over-growths are undulose. The rock contains small tight folds a few feet across and the microscopic texture reflects this deformation. The sparse sericite shows a weak foliation.

The common slates are dark grey to black, fine-grained and have a cleavage oblique to the bedding. Some are contorted and closely crenulated. Clastic muscovite flakes occur on bedding planes and many slates are carbonaceous and dark. No. 3587 from Wivenhoe is typical of the graphitic slates and is a black laminated slaty siltstone. It consists of about 40% quartz as tiny (0.02) lenticular grains, 50% sericite as parallel flakes and layers outlining a strong cleavage, and almost 10% of graphite and iron ore.

The rocks exposed in the road cutting through the Sisters Hills are possibly related to the Burnie Quartzite and Slate but the two are separated by Tertiary basalt. The majority of the rocks resemble the quartz-sandstones of Rocky Cape; they are well-cemented, vitreous sandstones with well-rounded quartz grains and a quartz-cement. Slates and black siltstones are also present. The sediments appear to pass under the Cowrie Siltstone and are thought to represent the upper part of the Burnie Quartzite and Slate.

Cowrie Siltstone

The sediments on the western side of Rocky Cape (Spry 1957, fig. 2) appear to form a regular succession and the lowermost of these was named the Cowrie Siltstone. It was considered to extend west along the coast to Black River but its unbroken continuity is not certain. At Rocky Cape it is overlain by the Bluff Quartzite then the Port Slate and Quartzite and the Cave Quartzite. The Cowrie Siltstone probably lies above the Burnie Quartzite and Slate of the Sisters Hills. Black slates, siltstones and quartzites along the coast at Cowrie Point and for many miles up the Black River are overlain by a conglomerate, chert and the Black River Dolomite at the Black River bridge.

The Cowrie Siltstone consists mainly of grey siltstone with slates and thin quartzites and is characterized by an abundance of sedimentary structures such as flute casts, cross bedding, slump structures and pyrite concretions. It is many thousands of feet in thickness.

The formation is probably equivalent to the Lawson River Siltstone of McNeil (1960) at the Arthur River, 15 miles to the south-west. Matthews (1960) described similar rocks at the Rapid River 10 miles further south. The Interview Slate and Quartzite at the Pieman River is probably also equivalent.

The rocks resemble the Burnie Quartzite and Slate in some ways but slaty siltstones are the dominant rock type and feldspar is an important constituent. The coarse siltstones near Cowrie Point (e.g. 6155) are grey, weakly cleaved rocks. They are composed of quartz (30%) feldspar (25%, albite and a little microline), muscovite (3%) in the abundant (40%) sericitic matrix. The larger clastic particles have a low sphericity and are angular. The feldspar is fresh, and the quartx non-undulose and free from inclusions; the sericite matrix is weakly foliated. Some rocks contain angular slate fragments. Well-rounded zircon, tourmaline and rutile are accessory. A little authigenic biotite has developed. Even fine-grained mudstones (e.g. 6157, 6151) contain about 20% of feldspar and clastic muscovite is present. Only about 20% authigenic sericite is present so that the rock is a siliceoue siltstone with greywacke affinites and an analysis of No. 6157 from Crayfish Creek (Table II) shows that soda exceeds potash and the iron has a low state of oxidation.

The general appearance of the texture requires comment. All of the Cowrie siltstone specimens sectioned have a distinctive appearance under the microscope and resemble low grade hornfelses. The quartz is not undulose, the feldspar is comparatively free from inclusions and the small quartz grains in the matrix have blurred interlocking boundaries. McNeil (1960, p. 50) remarked that specimens from this formation at the Lawson River "were indurated and have undergone very low grade thermal metamorphism". The cause of such metamorphism is not apparent; the formation is cut by many basic dykes but the metamorphism does not seem to change in intensity according to the distance from the dykes and there do not appear to be sufficient dykes to cause this alteration.

Bluff-Bryant Hill Quartzite

The Cowrie Siltstone is overlain by 1500′ of quartz sandstone named the Bluff Quartzite by Spry (1957). It is a light coloured quartz-sandstone with cross bedding, ripple marks and worm tracks.

In thin-section the sandstones (7912 from Bryant Hill, 7186 from Rocky Cape) consist of well-rounded quartz grains with moderate to high sphericity and a silica cement which surrounds the grains as a rim in optical continuity with the grains. A few flakes of muscovite and fragments of chert are present. Most of the quartz grains are undulose and many have deformation lamellae; the undulose extinction continues into the secondary cement. The rock is partially recrystallized with interlocking quartz crystals occuring in patches. Accessories are well rounded zircon and tourmaline.

The quartzite at Jacobs Boat Harbour and in the cliffs east of Sisters Beach is very similar and may be equivalent to the Bluff Quartzite. White quartzite with pinkish spots about ¼″ across is common; a thin section shows that the spots are due to pigmentation by haematite. Similar rocks occur at Mt. Donaldson and Rupert Point in the Donaldson Group which is probably the equivalent of the Bluff and Bryant Hill Quartzites. No. 6158 consists of quartz grains 1.5 mm. across, a few flakes of clastic muscovite cemented by a film of sericite and about 15% of haematite as irregular, intergranular masses.

The Cowrie Siltstone at the Black River Bridge on the Bass Highway is overlain without angular discordance by about 75′ of white quartzitic conglomerate followed by a similar thickness of quartz sandstone. This is overlain by a few tens of feet of chert then the 100′ + Black River Dolomite (Gulline 1959). It is proposed to name this formation the **Forest Conglomerate and Quartzite** from the village of Lower Forest near which the rock occurs. It is probably equivalent to the Bluff Quartzite. The chert and dolomite is correlated with the Smithton Dolomite and the Savage Dolomite.

The Cowrie Siltstone appears to be overlain by the 1300′ + Bryant Hill Quartzite (Carey and Scott, 1952; Gulline, 1959) near Smithton. The Bluff Quartzite is lithologically identical with the Bryant Hill Quartzite and they are considered equivalent.

The Donaldson Group near Corinna is similar in lithology to the Bluff Quartzite and the overlying Port and Cave formations. The Donaldson Group follows the Interview Slate and Quartzite which is thought equivalent to the Cowrie Siltstone.

Port Slate and Quartzite

Approximately 1500′ of thinly bedded quartzite and slate overlie the Bluff Quartzite at Rocky Cape. The argillities are grey to black, laminated and contain sandy lenses, mud pellet conglomerates and slump structures. The sandstones are cross-bedded and ripple-marked quartz-sandstones like the Bluff Quartzite.

Cave Quartzite

The Cave Quartzite is the youngest formation at Rocky Cape. It is more than 1500′ thick and is lithologically indistinguishable from the Bluff Quartzite. It dips into the sea and its upper limit is not visible. A specimen (6111) from just north of the jetty at the old port is a fine-grained grey quartzite with flaggy bedding and ripple marks. In thin-section it is well sorted and consists of well-rounded quartz grains with high sphericity and roundness ranging from 0.04 to 0.6 mm. with the majority 0.1mm. across. The quartz grains in part of the rock have a quartz cement in optical continuity with the grains but in other parts the grains have sutured margins, are elongate and interlocking and have been partly recrystallized and deformed.

Smithton Dolomite

A very thick dolomite with interbedded chert and minor limestones outcrops around Smithton and has been described by Nye, Finucane and Blake (1934), Hills and Carey (1949), Carey and Scott (1952), Hoskings and Hueber (1954), Spry (1962a) and Gulline 1959). It is several thousand feet thick and varies from light grey to cream. The coarse-grained varieties tend to be thickly bedded whereas the finer grained tend to be thinly bedded. Silicification has produced white and grey cherts from massive dolomite, and rocks resembling cherty conglomerates from oolitic limestone (Carey and Scott, 1952). Nye, Finucane and Blake (1934) included an identification of crinoid ossicles by Chapman but it has not been possible to confirm this. The dolomite, (e.g. 5483) in thin section is generally dark, fine-grained and structureless but partial recrystallization has produced irregular patches of coarser, paler crystalline dolomite. Oolitic dolomites are not uncommon and these contain simple and multiple oolites in which most, if not all, of the internal structure has been destroyed.

The Smithton Dolomite overlies the Bryant Hill Quartzite at Smithton with **apparent** conformity but dolomites which are correlated with the Smithton overlie other formations, implying a regional unconformity. To the south of Smithton the dolomite overlies Cowrie Siltstone; McNeil (1960) found at the Arthur River that the Rapid River Dolomite (correlate of the Smithton) overlay the Lawson River Siltstone (correlate of the Cowrie). The Black River Dolomite (correlate of the Smithton) overlies the Forest Conglomerate and Quartzite at the Black River Bridge. Detailed mapping of the contact between the Savage Dolomite and the Bernafai Volcanics at the Delville Saddle also indicates discordance.

Conclusions

The Burnie Quartzite and Slate is similar to the Oonah Quartzite and Slate. The Cowrie Siltstone resembles the Interview Slate which is overlain by the Donaldson Group with which may be correlated the Bluff, Bryant Hill and Cave Quartzites, plus the Forest Conglomerate and Quartzite and the Port Slate and Quartzite. A small quantity of amygdaloidal basic igneous rock at Sulphur Creek (Spry 1957, p. 90) might possibly be equivalent to the Bernafai Volcanics. These rocks mentioned above are overlain unconformably by the Smithton and Savage Dolomites which are lithologically very similar and presumably equivalent. The dolerite dyke swarm at the Pieman Heads appears to continue through to the North West Coast where members have been described as the Cooee Dolerites.

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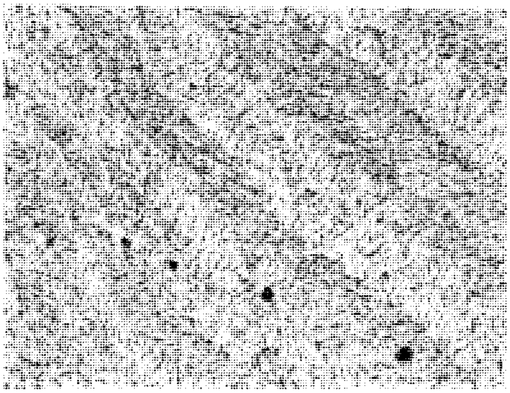

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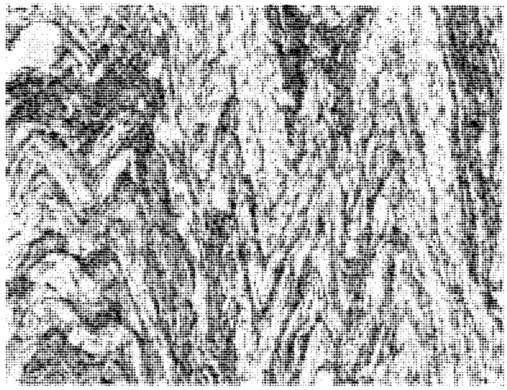

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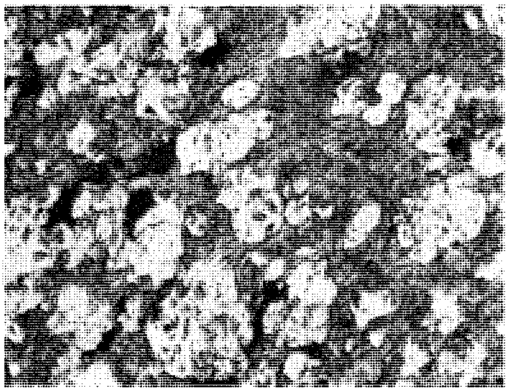

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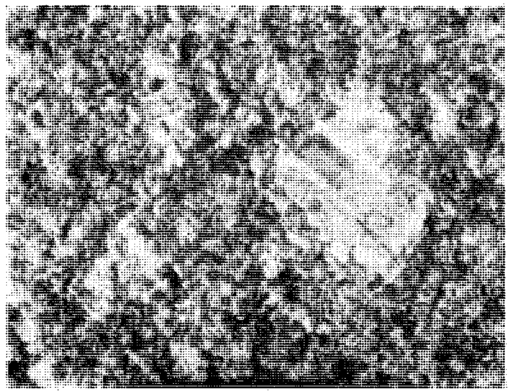

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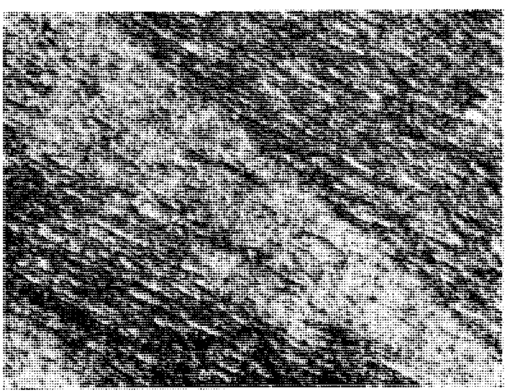

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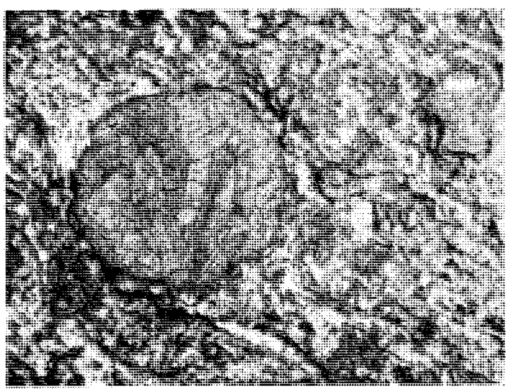

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PLATE I—

No. 1.—Whyte Schist (No. 9371). Foliation crenulated to give a fracture cleavage. Bedding not visible. x 17.

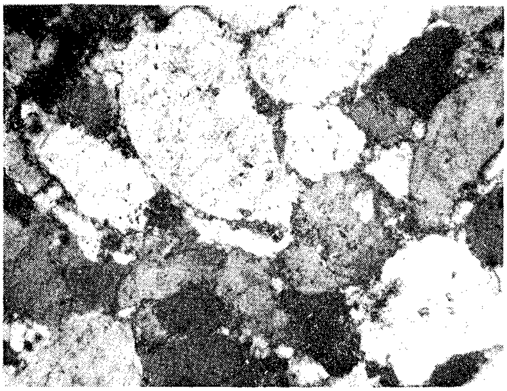
No. 2.—Whyte Schist (No. 8129). Strongly crenulated foliation is probably S_2. x 7.

No. 3.—Amphibolite from Whyte Schist (No. 9401). Round crystals of albite in foliated amphibole. x 35.

No. 4.—Altered basalt from Bernafai Volcanics (No. 9409). x 12.

No. 5.—Altered tuff from Bernafai Volcanics (No. 2208). Foliation due to parallel amphibole needles is oblique to compositional layering (bedding). x 12.

No. 6.—Altered basalt from Bernafai Volcanics (No. 9402). Epidote-filled amygdale in foliated matrix. x 12.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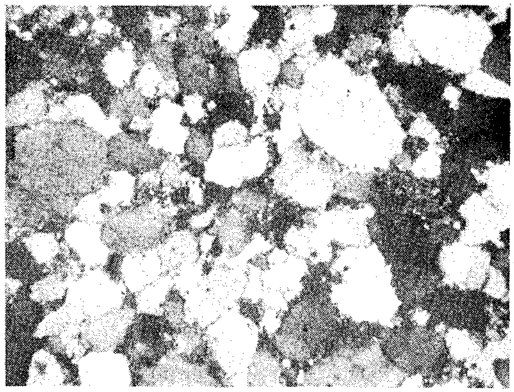
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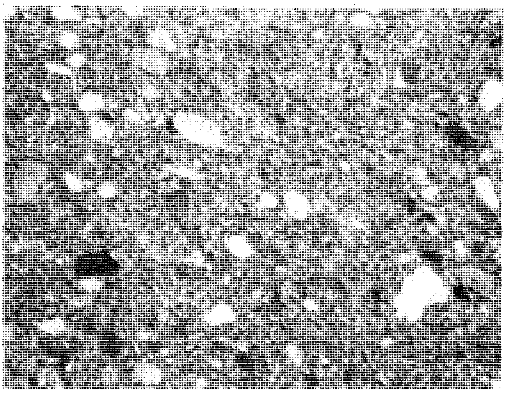
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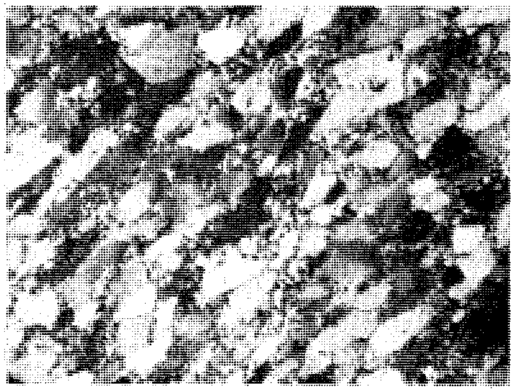
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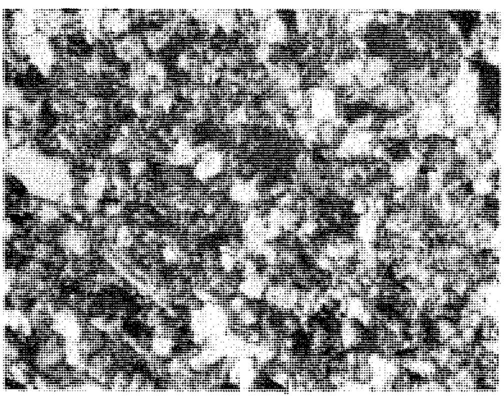
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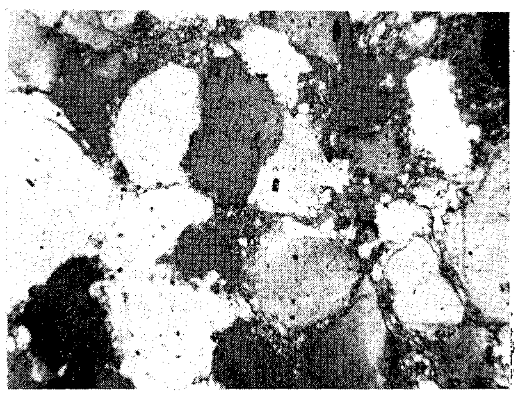
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PLATE II—

No. 1.—Oonah Quartzite (No. 8025), Montana Mine, Zeehan. Quartzose sandstone type with well-rounded quartz and little matrix. x 18.

No. 2.—Quartz sandstone from Tickawoppa Quartzite (Donaldson Group) Hell's Gates. x 18.

No. 3.—Slaty siltstone, Donaldson Group (No. 9397). x 18.

No. 4.—Deformed quartzite (No. 2226) from Donaldson Group at the mouth of Newdegate Creek. x 18.

No. 5.—Oonah Quartzite (No. 8027) Montana Mine, Zeehan. Subgreywacke type with anguler quartz and clastic muscovite flakes in a sericitic matrix. x 45.

No. 6.—Tickawoppa Quartzite (No. 9295), pebbly quartz sandstone, Mt. Donaldson. x 18.