REVIEW OF THE GEOLOGY OF THE MT. MAGNIFICENT AREA

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CONTENTS AND ABBREVIATIONS

PGE

ABBREVIATIONS

S. : Station
H.S. : Hand Specimen
T.S. : Thin Section
M.P. : Microphotograph
P. : Photograph

ABSTRACT

For this thesis work an area in the Mt. Magnificent - Kuitpo region was mapped and studied with respect to stratigraphy and rock types, metamorphism, structure and the relationships between various rock sequences.

Sequences represented are the Archaean 'basement' of augen gneisses, schists and quartzo-feldspathic rocks with tourmaline and magnetite mineralizations, the Proterozoic Adelaidean Series consisting of sequences of shales, phyllitic siltstones, phyllites and quartzitic sandstones with thin, cleaan quartzites, the 'basal' Cambrian beds of limestone, calc-schist and blue shale and the Cambrian Kanmantoo Group rocks, meta-greywaches and phyllitic siltstones with a single, broad marble member.

The sequence was found to be basically conformable throughout, though disrupted by faulting and perhaps indicating periods of non-deposition of some beds. The overall grade of metamorphism is Amphibolite Facies, retrograded to Greenschist Facies. The area is included in a regionally overturned anticlinorium, with fold axis plunging shallowly to the South, basement and cover having been folded together.

The boundary betweenPreCambrian Adelaidean and the first Cambrian beds is found to be apparently conformable, although slight non-deposition or strike faulting is suggested to explain minor incongruencies in correlation with the type section in Stockyard Creek. The subdivision of the Adelaidean in this area into Torrensian, Sturtian and Marinoan is discarded and the whole is treated as a single sequence for the most part.

Thinning of beds in the southern part is as a result of two factors, repetition in the northern part due to thrusting and strike faulting in the southern part causing a disappearance of part of the sequence. Associated with this is a general thinning out of individual beds in a southerly direction due to increase in the distance from the source of material.

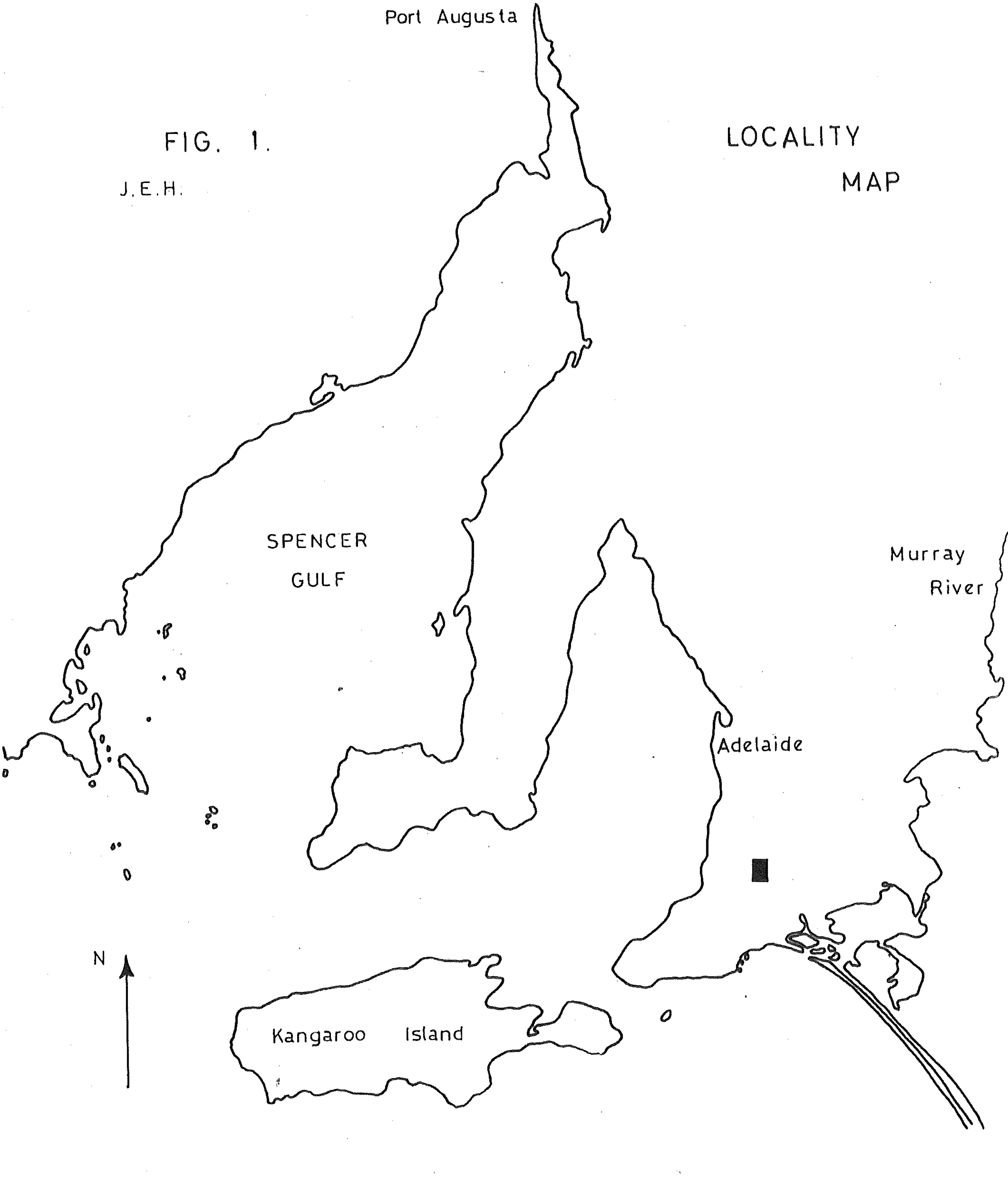
INTRODUCTION

(see accompanying Fig. 1)

The area included in this thesis work is in the Mt. Magnificent - Kuitpo region and covers approximately 17 square miles ; total field work for the project amounted to 30 days, not consecutively. The vegetation cover in the area includes tracts of natural scrub interspersed with fully cleared and semi-cleared land as well as planted pine forests.

Outcrop tends to be sparse and selective, quartzite ridges outcropping well and mostly continuously, forming the prominent, strike oriented high relief in the area; but less competent units, such as shales and phyllitic siltstones, are found only in creek and road cutting exposures. Generally, float is quite common on the gentle slopes of the pastured land and this has been used as an indication of the geology in parts where outcrop is lacking. Clearing of land has restricted outcrop, which is better preserved in the scrubby areas.

Rock units which outcrop in the area include those noted as Archaean, Adelaidean(Proterozoic) Series and the Cambrian Kanmantoo Group, including the underlying 'basal' Cambrian beds, on the Milang Sheet of the Geological Atlas


Port Augusta
FIG. 1.
J.E.H.
LOCALITY
MAP
SPENCER
GULF
Murray
River
Adelaide
N
Kangaroo Island

Recent previous work that has been done in the area is by Horwitz and Thompson (1960) for the Milang Sheet and accompaying report, in the Honours theses of Chappelle and Callen and by Kingsley J. Mills (see Bibliography). The intention of this project, apart from general geological mapping and a study of the metamorphism and structure in the area, is to

(i) try to determine the nature of the contact between the Adelaidean Group and the 'basal' Cambrian beds immediately overlying and

(ii) attempt a correlation of the Adelaidean Group and the 'basal' Cambrian beds with similar units elsewhere to explain the sudden and obvious thinning of the Adelaidean Group in the southern part of the area.

SECTION I : STRATIGRAPHY

ARCHAEAN BASEMENT

Outcrop in the basement complex is limited, being found mostly in steep, scrubby creeks and being absent on all the well cleared pasture land in the area. For this reason, any stratigraphic record is hard to build up and only a general picture of rock types and perhaps the trends of changes in rock types can be attempted.

The major rock type in that part of the complex included in this area is an augen gneiss, grading to a phyllonite (Chappelle), due to the deformation which it has undergone. This augen gneiss is shown in good outcrops, the best and most easily accessible being at S 377/116, in a steep creek bed.

Other rock types that occur are

(a) a more schistose rock with lesser quantities of quartz and more micas, which outcrops poorly and shows a good deal of float material

(ii) an indication of an amphibolite in the far western part of the area and

(iii) various quartzo-feldspathic, magnetite and tourmaline mineralized rocks, including pure feldspars, very coarse grained quartz and feldspar hornfelses, K-feldspar and magnetite rich rocks and rocks consisting only of quartz and tourmaline.

These latter rocks are found only as float and are all found in the same general area, perhaps, because of their composition, giving an indication of hydrothermal effects in their history.

Another rock type, not associated with this last group, but forming float along the top of a prominent ridge that runs parallel to the unconformity surface in the central part of the area, and generally only a few hundred yards west of it, is that shown by H.S. 377/121. This is a non-schistose, highly micaceous rock showing, in thin section, basal sections of muscovite intergrown with quartz. It is significant because of the difference it shows when compared to all other basement rocks, i.e. its lack of schistosity ; an explanation is difficult because it must have gone through the same deformation phase and yet shows little sign of deformation or development of a schistosity.

The augen gneiss mentioned above, which forms about 75% of all basement outcrop found, consists on average of about 40%–50% micaceous minerals, the rest being quartz, occurring as augens or elongated lenses, around which the micas show flow structures; some minerals, especially chlorite, grow as metamorphic 'beards' at each end of the quartz grain, accentuating the augen or 'eye' shape with pointed ends. The quartz shows undulose extinction indicating straining and some show minute fracturing. The undulose extinction tends to be confined to two directions, always nearly perpendicular to each other, sometimes perpendicular and parallel to the schistosity and, at other times, swung round at an angle to the schistosity.

Muscovite dominates as the most abundant of the micas in the basement rocks and usually makes up at least 30% of the rock. The rest is biotite and, in some thin sections, chlorite, along with small grains of secondary quartz which occur with the micas. The relationship between biotite and chlorite can be seen in most sections, with associated magnetite crystals evidencing a retrograde change during metamorphism from biotite to chlorite. In places the biotite and muscovite are intergrown and have a common cleavage plane.

Mineralizations associated with the basement rocks include magnetite in nearly every section, tourmaline in a few and corundum in one section in particular (M.P. 2); the corundum shows well formed zoning. These minerals, especially the tourmaline, together with sericitization which is common also, suggest a wholly or partly metasomatic origin. Occasionally, relict textures of other minerals, e.g. relict shapes of garnets, may be seen in thin section and this is interpreted as indication of an earlier, higher grade of metamorphism in the basement rocks before the Adelaidean sedimentation.

In the more schistose rock type in the basement complex the percentage of micas is much greater and the micas are combined with small amounts of quartz and feldspar which occur, not as augens, but as smaller, equidimensional grains within the mica aggregates. There is no flow structuring in the micas in this rock type. There is a further contrast in that, here, the preferred orientation is a schistosity defined by the micas whereas, in the augen gneisses, it is a gneissosity and defined by the quartz lenses.

The augen gneisses and the schistose rocks occur in alternating layers, this being shown in one area particularly well, i.e. roughly in the central Western part, where a widespread creek system, that has only been partly cleared, shows relatively good outcrop and float specimens. In other places, only the augen gneisses tend to outcrop.

From the outcrop that was studied, no convincing sedimentary structures were noted, so that the question about the origin of the basement rocks remains unanswered. The large quartz grains, transformed into augens by deformation, and the layering of rocks of differing compositions seem to suggest a sedimentaty origin, but examples have been cited of a similar rock type having been produced, through successive deformations, from a non-basic igneous rock.

PROTEROZOIC ADELAIDEAN SERIES

The Adelaidean Series, of Proterozoic age, unconformably overlies the Archaean basement complex, and from the trend of the basal conglomerate outcrop, the unconformity is angular in some places while in others it runs parallel to the regional strike. The concept of division of the Adelaidean Series into Torrensian, Sturtian and Marinoan has, for this work, been discarded on the basis of insufficient outcrop for good correlation and the highly faulted nature of the Adelaidean in the northern part of the area, although the fact that the sequence is, in general, Adelaidean can be confirmed by correlation of a few marker beds.

The sequence begins with a basal conglomerate followed by a heavy mineral banded sandstone showing relict cross bedding. This latter unit can be successfully correlated with the Aldgate

Sandstone of sections further north in the Mt. Lofty Ranges. Following this is a sequence of light-coloured, easily weathered, mottled shales and quartzitic sandstones which occurs only in the north-western part of the Adelaidean outcrop area. Thrusting in the north and alluvial cover in the south confuse the sequence at this point but a chloritic phyllite, which can be traced from the southernmost to the northernmost parts of the map, provides a marker, soon after the first thrust, to continue the sequence.

The best section can be seen in the Finniss River and this is shown in detail in Fig. 4. A series of dark, phyllitic siltstones and shales with individual dark, massive quartzites is overlain by well lineated and, in part, crenulated grey phyllitic siltstones and true phyllites with occasional quartzitic and thinly layered beds and lenses. Following is a sequence where the grain size increases and the beds become more silty, then a characteristic blue phyllitic slate and a green-grey phyllite with metamorphic chlorite segregations. A relatively thick series of grey and blue shales follows before a massive, white quartzite which marks the end of the Adelaidean in this section. The total thickness of the section in the Finniss River is of the order of 1200', although this does not include the whole of the Adelaidean represented in the area. Similar sections can be seen in a road cutting and in a shallow creek approximately $\frac{3}{4}$ mile and 1 mile respectively along strike from the Finniss River section.

Further north, this same section can be traced up to the massive, white quartzite, which here is followed by a sequence of interbedded white quartitic sandstones and grey shales. This sequence is faulted by along, normal or perhaps thrust fault, which continues south and faults out the beginning of the Kanmantoo in the central part of the area. After the fault, traversing eastwards, there are siltstones and shales with interbedded, massive quartzites, more thrust zones, then the same repeated sequence of quartzitic sandstones and shales, including one black, carbonaceous shale member ; this is followed by, in the north, blue shales and a lensitic unit of bedded sandstones and shales of, perhaps, tillitic origin. If this is so, then these beds could be correlated with the Sturtian described in the Adelaidean elsewhere. However, a sequence of rock units is necessary for such a correlation and outcrop is too scarce to attempt this correlation. There is no outcrop from this point eastwards until S 377/307, which is a limestone very similar in appearance, weathering pattern and composition to those in the 'basal' Cambrian beds in the Finniss River section; again, however, due to lack of suitable outcrop on either side of the limestone, an identification is only suggested.

The basal conglomerate was found in outcrop only once, at S 377/103, in a cutting on a fire-track (Pl.1). This outcrop shows a schistose but quartzitic matrix incorporating detrital material ranging from large boulders (up to 6" long) down to small pebbles and fragments of quartz and relict basement rocks. The detrital material all tends to be rounded, the larger boulders being well rounded and flattened ; in this instance, the flattening is probably due to river washing and sorting rather than to any deformation within the conglomerate, but there is evidence of stretching and shearing in some of the smaller pebbles within the conglomerate.

What has been interpreted as a form of basal conglomerate, in most instances, in order to define an unconformity surface, is more of a coarse-grained grit with smaller (usually only a few mms. across), also rounded grains of quartz etc. in a rather loosely held sandstone matrix, sometimes associated with heavy minerals ; this is probably a transitional rock type between the basal conglomerate and the Aldgate Sandstone.

The source area for the conglomerate is the basement complex previously described and, in fact, instances have been cited, in neighbouring areas (e.g. Wicks, Hons. thesis, '72, pers. comm.), that highly sheared basal conglomerate can be mistaken for basement rock. The unconformity surface can be followed reasonably well by means of this conglomeratic float and is found to be faulted in two places towards the north ; in general, it runs parallel to Blackfellow Creek.

The Aldgate Sandstone is a much more competent, quartzitic sandstone with large amounts of heavy minerals, formed in bands (M.P.1), and showing relict cross bedding. The facing determined by this cross bedding shows the beds to be the right way up. Following this, and only occurring in the north, are loosely compacted sandstones and shales showing red and yellow mottling ; these can be seen in a quarry at S 377/317.

The section in the Finniss River is described in Fig. 4, but a few additional points may be made here. The earlier parts of the section, in the phyllitic siltstones and shales, are much more flaggy and tend to be darker in colour, especially the massive quartzite, which contains a considerable amount of biotite. In this part there is a slight indication of a difference between layering and foliation directions, when the micro-orientation of micas is studied in hand specimen. After this the sequence becomes finer grained and very phyllitic, lighter in colour and showing small, single crystals which are probably limonite pseudomorphs after pyrite. Lineations formed from aligned biotite or chlorite plates, together with small magnetites, showing as short black lines on foliation surfaces, occur throughout all these phyllites. Crenulations are also formed in a few specimens.

Following this, the sequence again becomes silty, incorporating quartzitic lenses as boudinaging features. The limonite pseudomorphs do not occur here. A very homogeneous blue, phyllitic slate grades slowly into a chloritic phyllite showing metamorphic segregations of chlorite as round to ovoid 'spots' about 2mm. to 3 mm. long on foliation surfaces. These give a lineation to the rock and make it a characteristic marker bed. The blue-grey, silty shales which follow intertongue quite perceptibly with the massive, white quartzite in outcrop on the road just before the weir at S 377/204.

The thick sequences of alternating shales, quartzitic sandstones and massive quartzites which occur north of Nth. of Mt. magnificent are difficult to separate into definite units and are further complicated by thrusting and faulting. The member further east which may be correlatable with Sturtian tillitic beds consists of very well bedded quartzitic sandstones and shales (only a few mms. thick) in places and a gritty mudstone with small, rounded pebbles which are hard to identify, in others ; this member appears to die out to the north and south of where it has been indicated (see Fig. 6), but outcrop is rather poor to verify this.

Thin sections cut from a wide range of Adelaidean beds show a small variation in mineralogy. Apart from the pure quartzites, most rocks show the minerals quartz, feldspar, various micas and associated magnetites. The percentage of biotite and chlorite with respect to muscovite is greatly increased from that in the basement, muscovite being a minor micaceous mineral in most cover rocks. The percentage of chlorite in cover rocks is probably an indication of change of composition, some of the rocks in the phyllitic sequence in the Finniss River being dominated by chlorite.

There are no obvious sedimentary structures, e.g. sorting, mud cracks etc., apart from some cross bedding in lower units, indicating beds are the right way up, and a few well-bedded sandstone-shale rocks and schists in various parts of the sequence.

'BASAL' CAMBRIAN BEDS

On the basis of a sudden change to limestone beds and blue-black, carbonaceous shales, which imply more brackish water conditions, a thin sequence of beds in the Finniss River (see Fig. 4),and in a few similar sections to the north, has been correlated with the 'basal' Cambrian beds mentioned in the report on the Milang 1-mile sheet by Thompson and Horwitz (1960). No direct correlations with individual beds in the type section in Stockyard Creek are attempted, although a definite similarity between the two sequences is inferred.

The beds lie apparently conformably on the white, massive quartzite which marks the end of the Adelaidean in this section. The strike and dip of the whole series of beds is too uniform to conteplate an angular unconformity between the two sequences, as well as the fact that there is no direct evidence in favour of the existence ofsuch an unconformity.

Basically, the beds are a calc-schist, fpllowed by a pure cream limestone or marble, then a thin, phyllitic shale and quartzite interbed sequence and a characteristic, blue, carbonaceous shale showing phosphate and limonite weathered features. Above this, and again conformably, is the first competent, blocky phyllitic siltstone and quartzitic meta-greywacke sequence of the Kanmantoo Group. This latter sequence, namely the phosphatic shale and the incoming of the Kanmantoo Group, can be correlated to a reasonable certainty with similar beds in Stockyard Creek (Daily, '63), although a definite correlation of the phosphatic shale with the Heatherdale Shale is not included, phosphatic nodules having been found in other parts of the type section as well, but still stratigraphically close to the Heatherdale Shale.

The calc-schist which overlies the Adelaidean massive quartzite consists of alternating, thin layers of nodular, boudinaged limestone and silty shale. The limestone gives the rock a very characteristic weathering pattern, alternate layers standing up in relief, similar to that at S 377/307 (mentioned previously), but whether or not they constitute the same unit is difficult to tell. There are approximately equal amounts of limey and silty material in the rock and in thin section the silty layers are highly micaceous. The layering is parallel to the regional trend throughout the area. This unit is followed by a thin, perhaps lenticular, buff-coloured limestone, which shows a saccharoidal texture and cannot be called a true marble.

Then, a very fine grained phyllite, which grades into more shaly material, is interbedded with a thin, pure quartzite and the whole sequence is transitional into blue, carbonaceous shales, very light in weight and showing limonite weathering as yellow and orange colours, as well as weathered casts of what were probably phosphate nodules (M.P. 6). These are found only in this section, although a similar (but not identical) rock type, without phosphate nodules, is seen in the far northern part of the area at S 377/604.

Again, no sedimentary structures are noted, including the Cambrian fossils (hyolithids) which have been found in similar sections elsewhere. However, the change in rock type suggests a sudden change in conditions of deposition or a period of slight - or non -deposition after the massive quartzite. Alternatively, a strike oriented fault between the two sequences would account for slight disrepancies, i.e. missing units, in correlation and still allow apparent conformity of beds. (see Section 5). The 'basal' Cambrian beds are found otherwise only in a few sections north oft the Finniss River for a mile or so and apparently die or lens out after this.

KANMANTOO GROUP

Outcrop in the Kanmantoo Group is likewise limited, except in the Finniss River section, and therefore no real attempt has been made, within the scope of this work, to construct a detailed stratigraphic section. The Kanmantoo, here. is included mainly for continuity of argument and was mapped only so far as was necessary to establish the geological history of the complex region in the central part of the area. To the East, the Kanmantoo e Group continues but this was not mapped in detail.

In the Finniss River the Kammantoo Group begins with an interbedded sequence of phyllitic siltstones and quartzitic meta-greywackes, which are conformable with the underlying phosphatic shale of the 'basal' Cambrian beds. Following this is a monotonous sequence of more and less competent siltstones and meta-greywackes, some laminated, some very quartzitic, others quite schistose and all dark with a high biotite content.

Where the units are more competent, they form huge cliffs to the banks of the river (P.6), and in other places, where less competent, the river banks are quite flat. The more competent members occur more frequently towards the beginning of the sequence and the laminated, less quartzitic members more towards the later part of the mapped sequence, i.e. near S 377/806 and S 377/808. Elsewhere, in sections other than the Finniss River, it is usually only the more competent, quartzitic members that are found in outcrop, although at S 377/313, in a road cutting, softer Kanmantoo can be identified and the more schistose Kanmantoo is found in a few creek exposures towards the highly faulted central part of the area.

Marker beds are very hard to find in the Kanmantoo Group, so that structure in the area is difficult to determine. In single outcrops which show only one rock type, it is hard to tell where they fit in the monotonous Kanmantoo sequence. The only obviously different bed in the sequence is a massive limestone band which occurs at S 377/212 and can be followed along and across the river up to S 377/803, at which point it dies out ; along strike, where the band could be extrapolated, there exists a deep, narrow gully between two, rather more competent, ridges. This gully is not continuous and gradually fades out before it strikes the ridge along which the Mt. Magnificent road runs.

The limestone itself is very variable, T.S. 377/212 being only one sample. Some of the variability is shown in P.4, and includes grey and white mottled colours, saccharoidal or welded textures in different parts, banding and layering, deformation, shearing and contortion in several places, and, in a few specimens, siliceous segregations of large muscovite flakes and quartz crystals which have recrystallized in cracks. It gives a flaggy, weathered appearance and has a well developed joint pattern, exposed in a quarry in the limestone band.

In thin section all the Kanmantoo rocks are quite similar, containing quartz, feldspars (including highly sericitized microcline perthite), rock fragments in some of the more greywacke-type members, large amounts of biotite and minor amounts of muscovite and chlorite. The biotite gives a schistosity to most of the rocks, in some cases well defined, in others poorly defined. Biotites and other micas occur as uniformly distributed, short, stunted rods rather than long stringers or aggregates as seen in some of the Adelaidean shales and phyllites ; quartz and feldspars show no straining effects but do show sericitization and other alteration effects. Limonite and other Fe oxides are commonly found and magnetite crystals, occurring with the micas, are found in all sections. Some thin sections show clearly the laminations mentioned earlier, and in this instance the biotites are more segregated.

Cross bedding is seen in some of the more quartzitic units that outcrop to the north of the Finniss River (P.2). This cross bedding shows that beds are the right way up. No other sedimentary structures or fossil evidence was noted.

SECTION II : STRUCTURE

(see accompanying Figs. 2 & 3)

The project area is wholly included on the Eastern limb of a reclined regional anticlinorium, overturned to the West. Structural measurements of layering and foliation in the cover, as well as schistosity in the basesment, are uniform within a range of strike from 0'T to 030'T and a range of dip from 45' SE to 85' SE, but mostly around 75' SE.

Because of this uniformity of general trends over the whole area, these three elements, namely layering, foliation and schistosity in cover and basement respectively, have been plotted together on stereogram plots (Figs. 2 & 3). The scatter of points on these plots is circular, allowing two possible interpretations of the data, and these two are shown on sparate figures. On a regional scale, these can be interpreted as

(i) a shallow fold axis plunging 14' towards 184'T or

(ii) a steeper fold axis plunging 64' towards 118'T.

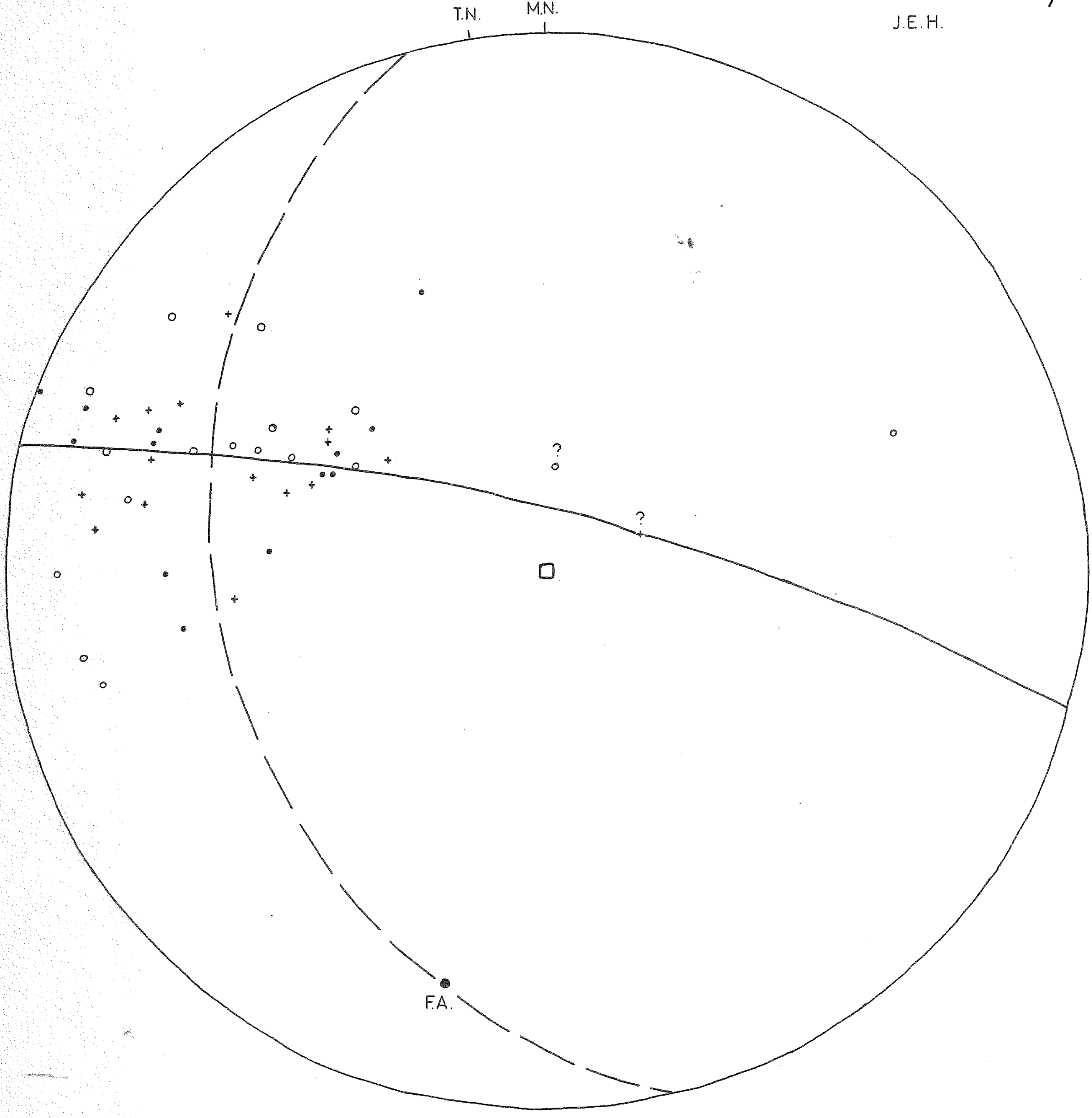
Possible, accompanying axial planes are shown also.

The existence of both these fold axes is supported, or rather, indicated, since the evidence is hardly substantial, by the few reliable lineations and minor fold axes that are present in outcrop. Lineations give directions both steeply SE and roughly N-S and the minor fold axes similarly plunge along a line of

POLES TO LAYERING AND FOLIATION IN COVER AND SCHISTOSITY IN BASEMENT

FIG. 2.

J.E.H.



F.A. : 14° → 184° T

A.P. : dips 28° W
on strike 158° T

Schistosity in basement •

Layering in cover ○

Foliation in cover +

strike roughly N-S, but to the north, shallowly, in the northern part of the area and to the south, shallowly, in the central part of the area. This may be an indication of two periods of folding in the cover rocks, although, obviously, a good deal more data is needed to prove this. The first period involved the formation of the large regional, overturned anticlinorium, with a shallow N-S fold axis, and the second was a much gentler, more open folding, producing a steep SE-plunging fold axis. Two periods of metamorphism noted in the cover (see Section 3) may be associated with these two periods of folding respectively.

On a more local scale, the area is heavily faulted, particularly in the northern part, mainly by thrust faults which are approximately parallel to strike. Although correlations are difficult due to lack of outcrop, there seems to be a repetition of beds in the Adelaidean sequence in this northern section. Evidence is found for one of these thrust faults, the westernmost fault in the Adelaidean outcrop on Fig. 6, at a number of stations, in the form of slickensides on a competent quartzitic sandstone member which occurs mainly as float. Other thrust faults are inferred because of repetition of units, the uniformity of strike and dip of the beds and the fact that facings show the beds always to be the right way up, in a trverse across strike ; for these reasons folding is not plausible as an explanation for the thicker sequences. The major fault which cuts off the early Kanmantoo just east of Nth. of Mt. Magnificent, may also be a thrust fault, but evidence is scarce.

This heavily faulted and discontinuous area is contrasted with the southern part, where an apparently continuous sequence from lowermost Adelaidean through into the Kanmantoo as far as it was followed, and presumably beyond, is seen in many sections, the best being in the Finniss River. Certainly there is no repetition, no obvious thrusting and good outcrop to show conformable beds for

POLES TO LAYERING AND FOLIATION IN COVER AND SCHISTOSITY IN BASEMENT

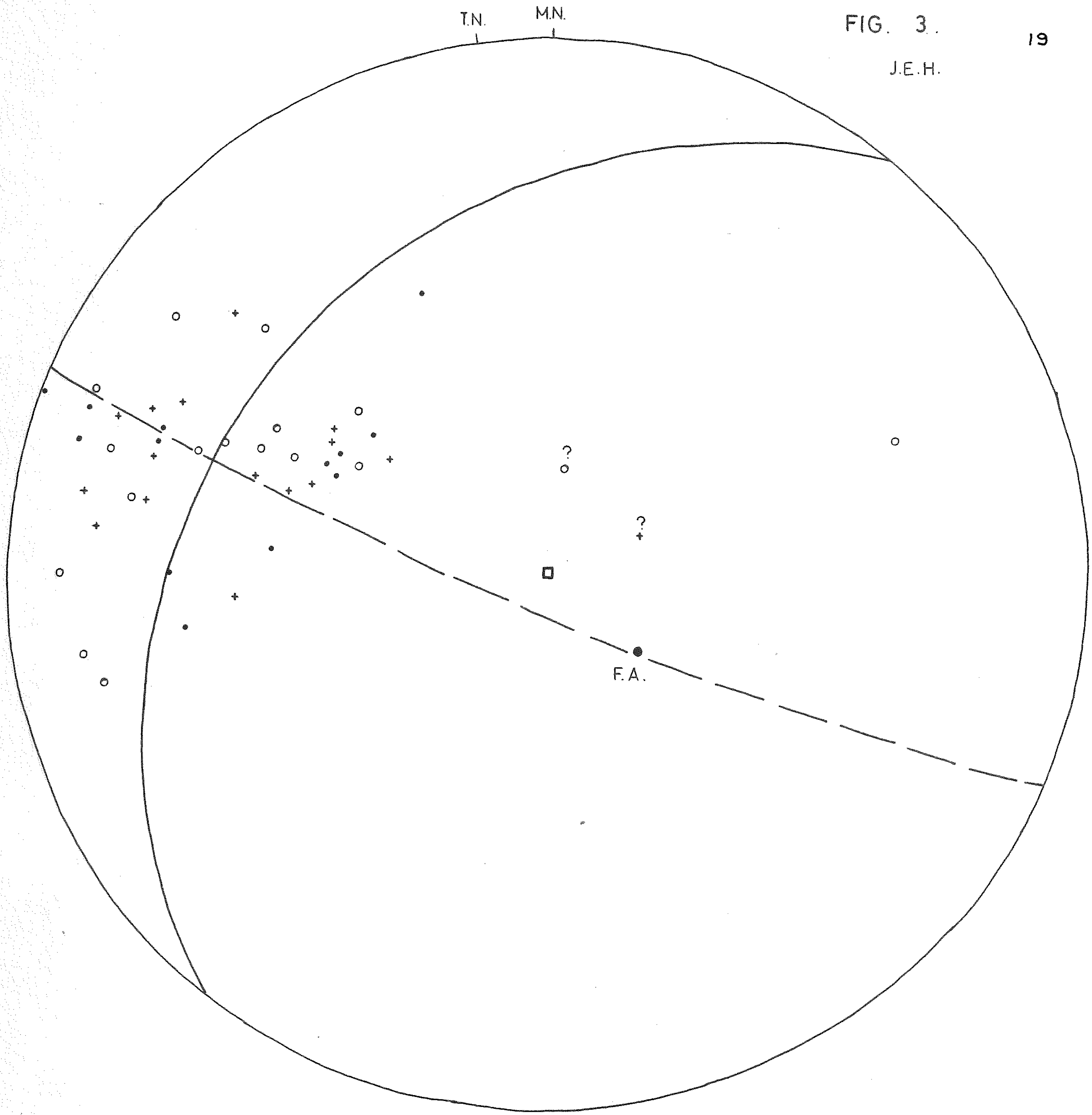


FIG. 3.

J.E.H.

F.A.: 64° → 118° T

A.P.: dips 82° S on strike 104° T

Schistosity in basement •

Layering in cover o

Foliation in cover +

the whole section. However, as mentioned later (Sections 4 & 5), there may be strike faulting in this sequence because of the relatively sudden thinning of the Adelaidean in this area.

Normal faults are also found in the area, the most conspicuous being that which faults Kanmantoo against Adelaidean and runs roughly parallel to Mc Harg Creek in the eastern section of the map. At its eastern end, in a road cutting, there is good evidence for a fault at a sheared contact, but elsewhere the fault is mainly traced by a sudden change in slope of the hillside and by pure quartz float in a narrow band across the paddocks. There is another, small fault running approximately E-W just north of Kuitpo Colony settlement, evidence for this being mainly displacement of beds across the valley which the fault follows ; the displacement across the fault is small.

A third, postulated normal, or perhaps thrust, fault is that against which early Kanmantoo beds cut out, the strike - oriented fault running approximately through Nth. of Mt. Magnificent. Against this fault there are small drag folds apparent in a weathered sandstone member of the Adelaidean, shown in a road cutting approximately half a mile NW of Nth. of Mt. Magnificent, as well as associated minor drag folds in highly sheared shales in a quarry just above the road. At this locality also, there is evidence for the fault where a strongly sheared zone of splintery shales cuts out sharply against a very competent quartzite outcrop. Further north, on aerial photograph interpretation, trends show perhaps further evidence of drag folding against this fault and, towards the south, loose quartz float may also be indicative.

Microstructural features are evident in most of the rocks of the area ; for example, basement rocks have been cataclastically deformed and sheared nearer the unconformity surface on which the Adelaidean is deposited. This is shown by undulose extinction as an indication of straining in quartz, elongated quartz 'augens' and slight fracturing in some of the rocks.

Foliation is developed in all cover rocks, to greater and lesser extents, with the exception of the massive, clean quartzites and some of the more competent quartzitic siltstones in the Kanmantoo Group. This foliation is defined by an alignment of elongated mica plates and is obviously stronger in the more micaceous members. There is no evidence for micro-folding in thin sections ; occasionally two structural elements, i.e. layering and foliation, are seen together in thin section, usually at an angle of about 30', in most other sections being parallel.

The structural relationship between the basement and the cover is reflected in apparent uniformity of structural trends between the two and continuity of trends across the contact. This indicates that, in the latest period of deformation, the basement and cover have probably been deformed together, in the same manner. It is difficult to actually follow individual structural features, e.g. faults, across the boundary due to the major differences in rock type and competency and the complication that the unconformity and associated shearing presents. However, no evidence of faulting or slippage along the contact can be found.

A propsed structural history for the area would include ;

(i) an older, crystalline Archaean basement, deformed and metamorphosed at least once , the original metamorphic grade being quite high, and perhaps retrograded even at this stage.

(ii) erosion of this basement complex providing an unconformity surface

(iii) transgression and deposition of Adelaidean Series, beginning with basal conglomerate and heavy mineral banded sandstone ; the source area for the sediment is the basement complex.

(iv) conformable deposition of 'basal' Cambrian and then Cambrian Kanmantoo beds, allowing for possible non-deposition, in certain areas, of thin members, to account for a general thinning to the south.

(v) deformation and metamorphism to amphibolite facies grade sometime during the Palaeozoic (possibly early Palaeozoic), resulting in the major N-S striking anticlinorium which dominates the present structure.

(vi) further deformation and retrograde metamorphism resulting in Greenschist facies and the gentler SE-plunging fold that overprints the major structure.

SECTION III : METAMORPHISM

Thin section studies (Appendix III) of mineralogy and textures in both basement and cover rocks show that metamorphism, at present, is in the Greenschist Facies stage and has been retrograded to this stage from Upper Amphibolite Facies in the cover rocks and possibly a higher grade in the basement rocks. The main evidence for this retrogression is the very characteristic production of chlorite and associated magnetite crystals from biotite (M.P. 3). Many thin sections, of differential compositions, show this evidence clearly, where magnetite crystals are concentrated solely in the chloritic bands of these highly micaceous rocks ; in other sections, where the composition is not differential, the magnetites are more uniformly distributed. In the Adelaidean Series there is a chloritic phyllite which shows the magnetite production extremely well, especially in thin section (e.g. T.S. 377/315 and M.P.4). This phyllite can be traced from the southernmost section in the Finniss River to the northernmost part of the area, and is apparently unchanged in its length. The magnetite in the phyllite also shows well developed crystal faces.

Mineralogies in the particular rock types show little variation. Basement rocks all contain strained quartz, feldspars in the quartzo-feldspathic rocks and micas, including muscovite, biotite and chlorite. Additionally, magnetites are common in association with micas, tourmaline is a common accessory and, in some cases, (T.S. 377/122) is concentrated as a major constituent ; corundum and relict evidence of garnets are seen, but rarely.

The Adelaidean shales, phyllites and phyllitic siltstones are very uniform in their mineralogy, all containing quartz, felds-pars (including a reasonable amount of microcline perthite), biotite, chlorite and some muscovite. Additionally, magnetites are character-istic. All grades of the transformation of biotite to chlorite, through the green biotite stage, can be seen in the collection of thin sections. Limonite pseudomorphs after pyrite are found in one place, in the Finniss River, but are rare elsewhere.

The 'basal' Cambrian beds, a pure limestone, a calc-schist and a carbonaceous shale, show calcite, quartz and some micas, mainly biotite and chlorite, the shale being too fine grained for a definite identification.

Similarly the Kanmantoo beds show quartz, feldspars (mostly microcline perthite), and micas, mainly biotite and chlorite with little muscovite. In comparison with the Adelaidean sediments, the Kanmantoo beds are noticeably less micaceous, the percentage of quartzo-feldspathic material dominating in these units.

Two significant points that arise from a study of the mineralogies are ;

(i) the relevance of the fact that muscovite dominates the micas in the basement, whereas biotite and even, sometimes, chlorite is the most prominent mica in cover rocks. This may provide evidence for postulating a higher grade of metamorphism in basement than in cover before the last retrograde phase of metamorphism ; this is supported by relict textures etc. associated with micas in the basement.

(ii) the observation of strong sericitization in all rock types is indicative of a wholly or partly metasomatic alteration, the sericitization affecting both muscovite and microcline perthite.

Metamorphic lineations in the form of concentrations of very fine grained chlorite in a chloritic phyllite occur in part of the Adelaidean sequence, most notably in the Finniss River section (M.P. 5). These concentrations form small (of the order of a few mms.) rounded, ovoid spots which are slightly flattened and lie within the foliation plane, providing a lineation because their long axes are all parallel ; they probably indicate a metamorphic change from a sedimentary segregation in the rock.

There is no indication of an increase in metamorphic grade across the area, the total width of between 2 and 4 miles being insignificant in the wide, regional isograds across the Mt. Lofty Ranges, running approximately in a SSW - NNE direction. However, decreases in chlorite content or, rather, increases in biotite content with respect to chlorite content can possibly be inferred in a traverse across the Adelaidean from West to East, and also in a comparison of the Adelaidean with the Kanmantoo, there being relatively more chlorite in the Adelaidean. The difference in chlorite content between the Kanmantoo and the Adelaidean may be due to difference in composition, but a change within the Adelaidean could well be an indication of slight increase in grade from West to East.

The grade, in general, is very similar to that in the type section for upper Adelaidean and 'basal' Cambrian units in Stockyard Creek, Delamare, from the regional isograd map of the Fleurieu Peninsula and this is helpful in determining the reliability of correlations of beds between the two areas.

SECTION IV : DISCUSSION ON THE ADELAIDEAN SERIES

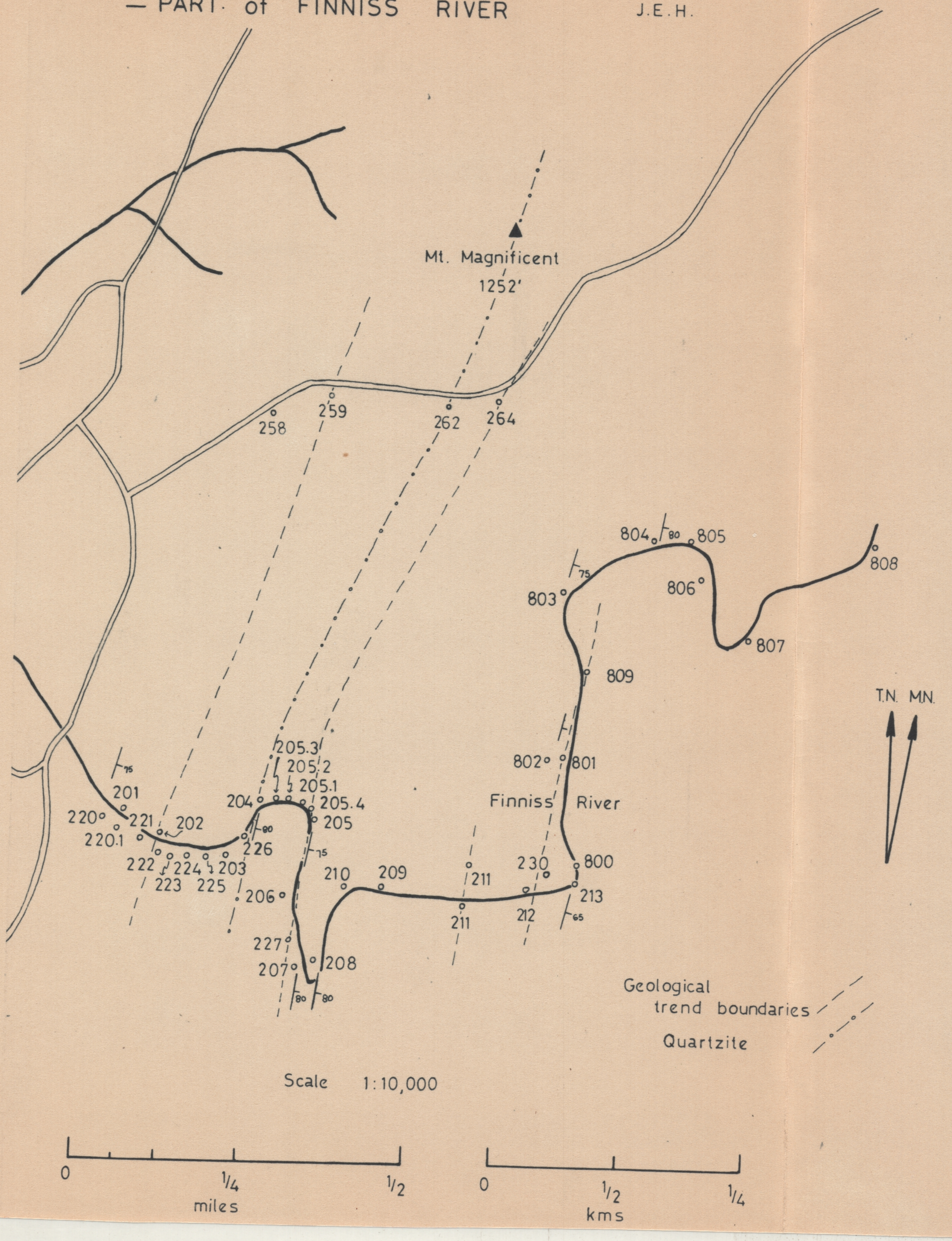
The Adelaidean Series, as mentioned earlier, in this area, is complicated in the north by repeated thrust and normal faults, approximately strike oriented, by means of which certain sequences are repeated and others probably not seen at all. In the south of the area, one continuous sequence is seen and this serves as a good reference for piecing together the outcrop plan in the north ; however, the southern section is not a complete sequence either, its sudden thinness needing an explanation. In its narrowest part, the whole of the represented Adelaidean, from the basal conglomerate to the massive, white quartzite just below the 'basal' Cambrian beds, is no more than 2000' thick, this being near the Kuitpo Colony settlement. Also, in the section in the Finniss River, for example, portions of the Adelaidean that are shown in the north are not represented at all, e.g. the beds that include the mudstone grit which could be of Sturtian glacial origin.

Several factors need to be considered tp assess the geological history of the area and to find a reason for the sudden thinning of the Adelaidean in the south.

(i) the sequence cannot be followed across the valley defined by Blackfellow Creek, due to alluvial cover, especially in the south.

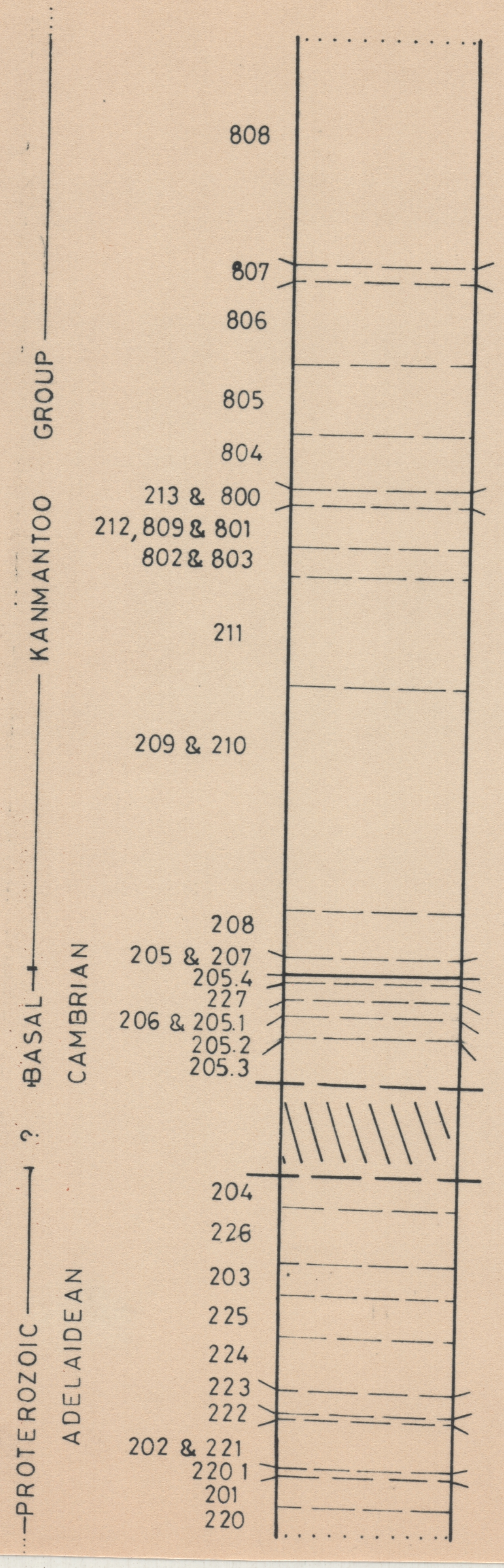
STRATIGRAPHIC SECTION MAP FIG. 4.

— PART of FINNISS RIVER J.E.H.



STRATIGRAPHIC SECTION AND NOTES

Scale 1 cm = 250' true thickness



808	800'+ of competent greywackes and phyllitic siltstones ; lithologies, colours etc. vary slightly on smaller scale
807	50' band of slightly less competent siltstone ; shows Fe weathered staining
806	300' of similar but more quartzitic material
805	250' of alternating phyllitic and quartzitic siltstones
804	200' of quartzitic siltstone–sandstone with fine (2mm) banding ; boudinaged
213 & 800	50' of alternating quartzitic and phyllitic siltstones
212, 809 & 801	150' of banded limestone ; in part white, grey, mottled, brecciated or flaggy & dark
802 & 803	100' of grey, massive meta-siltstone with relatively high biotite content
211	400' of meta-siltstone which forms very prominent cliffs in the Finniss Gorge
209 & 210	800' of more quartzitic, massive, dark siltstone ; very competent, also forms prominent cliffs
208	150' of lighter-coloured meta-siltstone
205 & 207	50' band of dark micaceous phyllitic siltstone
205.4	40' of dark, flaggy, reasonably competent shale-siltstone with Fe staining
227	60' of light to dark grey carbonaceous shale
206 & 205.1	65' of interbedded quartzites and fine-grained phyllites
205.2	65' band of pure buff to cream saccharoidal limestone
205.3	150' of banded calc-silicate ; lime-rich bands form nodules between shaly layers
	Interval due to non-deposition or strike faulting
204	100' band of massive, light grey, clean quartzite, at base grading into underlying silty unit
226	200' of grey and blue phyllitic shales, becoming more silty towards the top
203	125' of flaggy grey phyllites with prominent metamorphic concentrations of chlorite
225	150' of flaggy, finely phyllitic, homogeneous grey-blue slate
224	175' of sandy, dark siltstones
223	75' of very phyllitic, highly micaceous material with chlorite-defined lineations
222	30' band of alternating phyllitic slates and boudinaged quartzitic siltstones
202 & 221	200' sequence of schistose siltstones & shales to lineated & crenulated phyllites
220 1	narrow 20' band of dark, mica-rich quartzite
201	75' of flaggy silty shales ; appreciable biotite content
220	100'+ of black, well-laminated phyllitic shales

(ii) a possible correlation is suggested between well lineated phyllites in the Finniss River section and very similar phyllites and phyllitic siltstones in the type section in Stockyard Creek. These correspond to unit 36 in the stratigraphic section in Daily's 1963 paper on the 'Fossiliferous Cambrian Succession'. Units above and below this sequence in both sections are roughly correlatable also, although there could well be facies variations, considering the distance between the two areas

(iii) one member of this well lineated sequence can be traced from south in the Finniss River to north at S 377/302, and this provides a basis for a decision on which parts of the sequence are missing

(iv) a strike trend, from aerial photography, in the northern part of the area, meets the line of the Blackfellow Creek valley floor at an angle near S 377/317 and appears to be faulted out by a fault approximately following the valley floor.

(v) thrusting movements could easily expose parts of the Adelaidean, which were older, so that they appeared in anomolous succession with younger sequences, although they had been faulted out in a separate area.

From this evidence, but because none of the evidence is without question, a postulated geological history for the Adelaidean, as well as an alternative, are proposed. The concept of an unconformity at the top of the Adelaidean is discarded as an explanation of thinning because of lack of evidence to support it. (further, see Section V).

Within the Adelaidean, a zone of strike faulting is proposed along the valley floor following Blackfellow Creek, as far as the strike continues straight, i.e. until approximately due West of Nth. of Mt. Magnificent.

Along this fault, most of the early part of the Adelaidean after, and probably including part of the Aldgate Sandstone, has been faulted out and the sequence that follows on the other side of the valley is much higher in the series, possibly, on the correlation mentioned above, into the Marinoan. In the northern part of the area, where the fault dies out, a much thicker sequence of the lower Adelaidean shows in outcrop, to the West of the line where the fault would go if it were continued, although thrusting here, again, complicates an already sparse outcrop plan.

After this, a continuous sequence can be followed the length of the area up to the massive, white quartzite, the sequence showing, in individual beds, a general thinning to the south. Several faults and thrust faults from here towards the East make correlation hard, although it is suggested that a good part of the sequence may be Sturtian, continuing into the Marinoan when the beds appear more similar to those in the southern section.

An alternative is that the well lineated phyllites be correlated with lower Torrensian, indicating a very sudden thinning within the area mapped, from north to south, and a part of the upper Adelaidean missing along a strike fault just before the 'basal' Cambrian beds begin.

In general, with both suggestions, there is the observation that thinning is taking place within each bed as a result of increasing distance from source material, and that this, combined with faulting somewhere in the sequence, provides an adequate explanation for the thinning shown.

SECTION V : DISCUSSION ON CAMBRIAN - PRECAMBRIAN BOUNDARY

An unconformity, in the project area, between the Pre-Cambrian Adelaidean and the Cambrian 'basal' and Kanmantoo Group beds is discarded. Evidence for an unconformity is not obvious and evidence to the contrary, in places, is convincing; uniformity of strike and dip across the area and apparent conformity between beds in contact in the good section in the Finniss River, provide arguments against an unconformity. A period of non-deposition without erosion or limited deposition, on the other hand, is not discarded. As already mentioned, it appears that individual beds thin to the south and this could provide an explanation for the smaller missing beds in a correlation scheme.

A discussion on the Cambrian - PreCambrian boundary necessarily involves ideas on the Adelaidean sequence also, because correlation of units within the Adelaidean is so tenuous ; the discussion is therefore considered with reference to the two proposals put forward in Section IV.

If the uppermost beds in the Adelaidean part of the Finniss River section can be correlated with those near the top of the Marinoan, then a general, continued correlation will follow into the 'basal' Cambrian and the Kanmantoo beds, incorporating a calc-schist and limestone sequence, then phyllitic siltstones and greywackes, such that a complete, conformable sequence with only slight discrepancies, and these probably due to facies variation, will result.

If, on the other hand, the alternative proposal for the Adelaidean is considered, then the upper part of the Adelaidean must have been faulted out, along strike, and parts of the transitional beds into the 'basal' Cambrian probably also disappeared.

Further north, where sections are poorer, the situation is more confusing and the 'basal' Cambrian beds die out such that, at S 377/313, Kanmantoo rock is identified resting on a shale and quartzitic sandstone sequence that may be correlatable with the uppermost part of the Adelaidean in the Finniss River section. This could be interpreted as facies variation or thinning also, but from a southern source in this instance.

Finally, the suggestion of a conformable boundary, but with diastems and periods of non deposition, seems a plausible conclusion.

ACKNOWLEDGEMENTS

My thanks in this project are due especially to my supervisor, Dr. R. Oliver, for his time and helpful suggestions and criticisms throughout the year, to Dr. A. Milnes for his interest and early introductory talks on the subject of the Kanmantoo type section and to Mr. and Mrs. G.G.McEwin of Meadows for their kind hospitality and encouragement during my field work weeks earlier on. Finally, thanks go to some of my fellow Honours students for discussions on this and associated work during the year, especially S. Wicks, M. Davies and A. McEwin, who were all working on similar projects concerned with the basement inliers on Fleurieu Peninsula.

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P.1 ; BASAL CONGLOMERATE AT STATION 377/103

P. 2 : CROSS BEDDING IN CREEK AT STATION 377/902, SHOWING BEDS THE RIGHT WAY UP

PLATE II

P. 3 : MINOR FOLDS IN LIMESTONE AT STATION 377/307

P. 4 : MOTTLED AND VARIABLE LIMESTONE BLOCK AT STATION 377/212

PLATE III

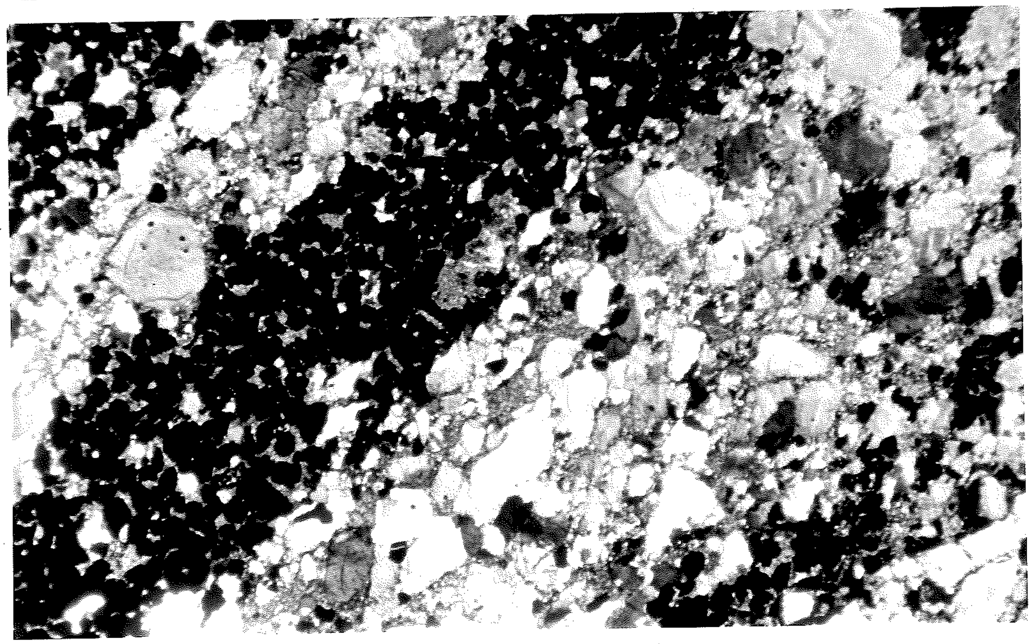
P. 5 : MASSIVE QUARTZITE AT STATION 377/204

P. 6 : MASSIVE CLIFFS FORMED IN COMPETENT KANMANTOO AT STATION 377/209

PLATE IV

M.P. 1 : MAGNETITE – QUARTZ BANDS IN T.S. 377/105b.
X–POLARS

M.P. 2 : CORUNDUM CRYSTAL SHOWING ZONING IN T.S. 377/108.
UN–X–POLARS



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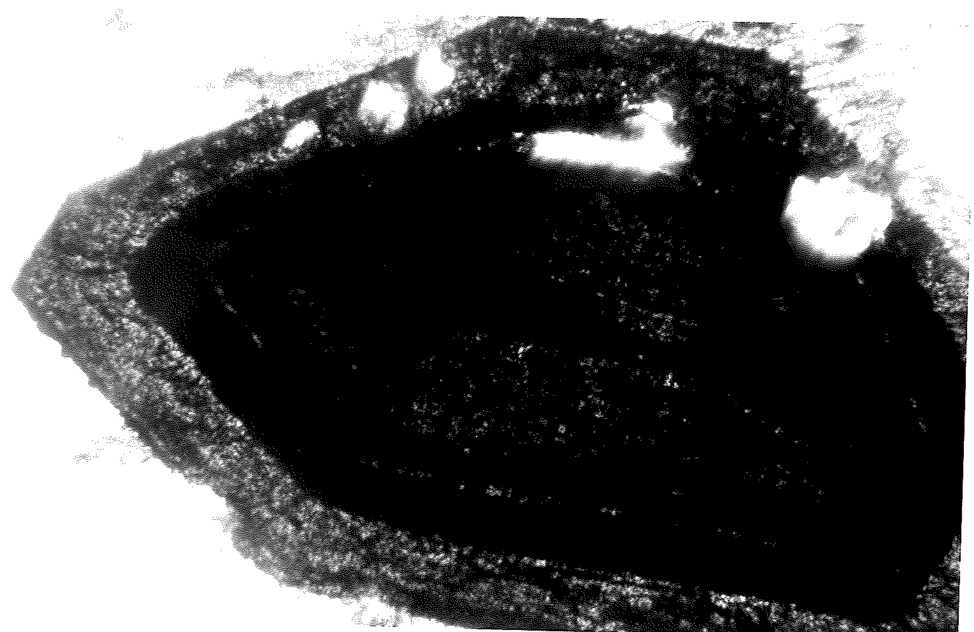

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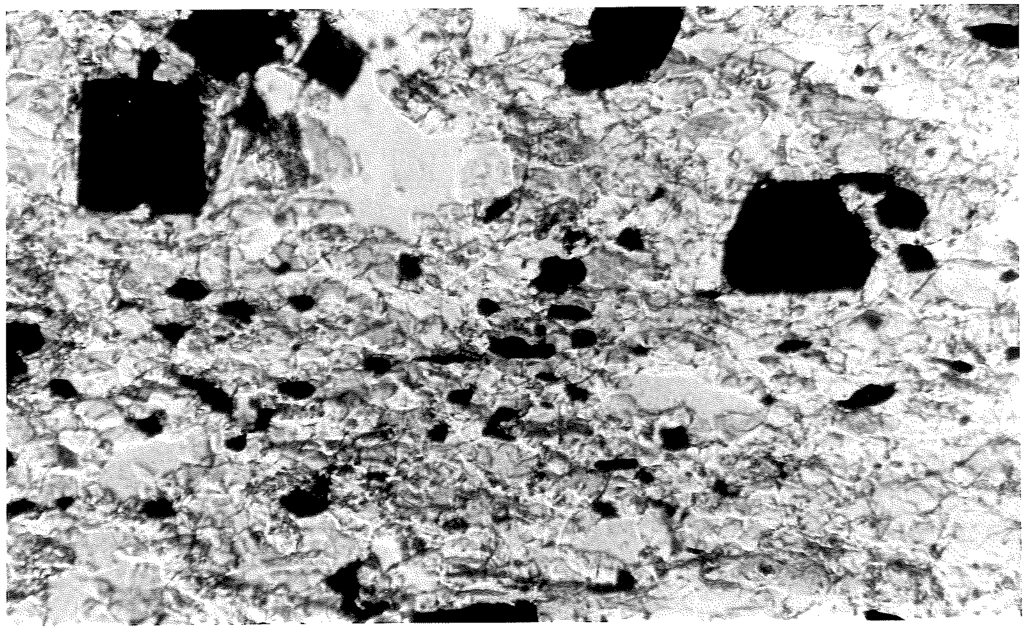
PLATE V

M.P. 3 : MAGNETITE CONCENTRATIONS IN CHLORITE LAYERS IN T.S.
377/205.3. X-POLARS

M.P. 4 :WELL FORMED CRYSTAL SHAPES IN MAGNETITES IN T.S.
377/315. UN-X-POLARS



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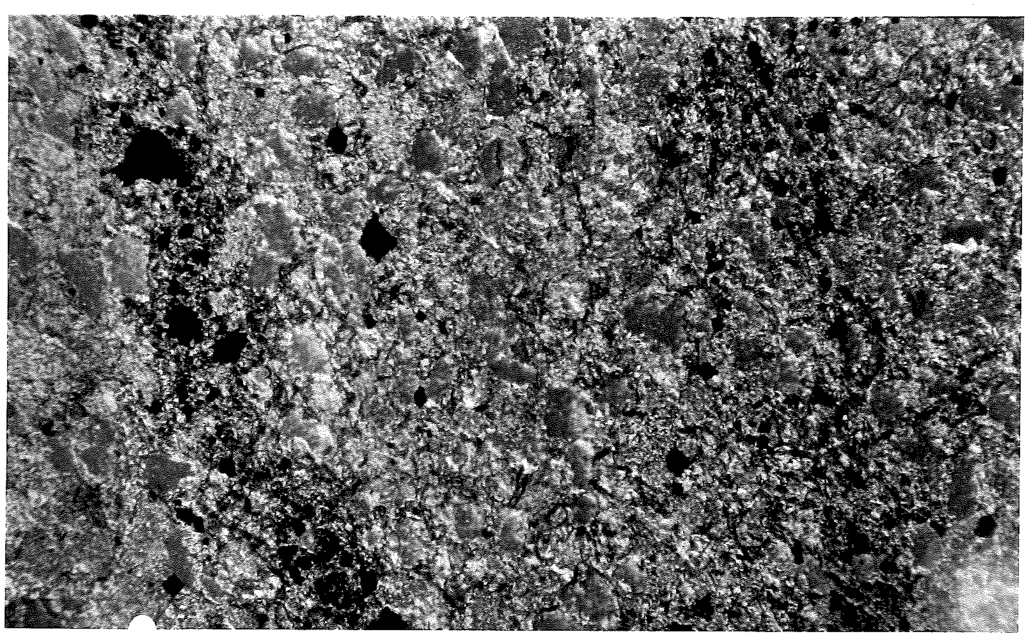
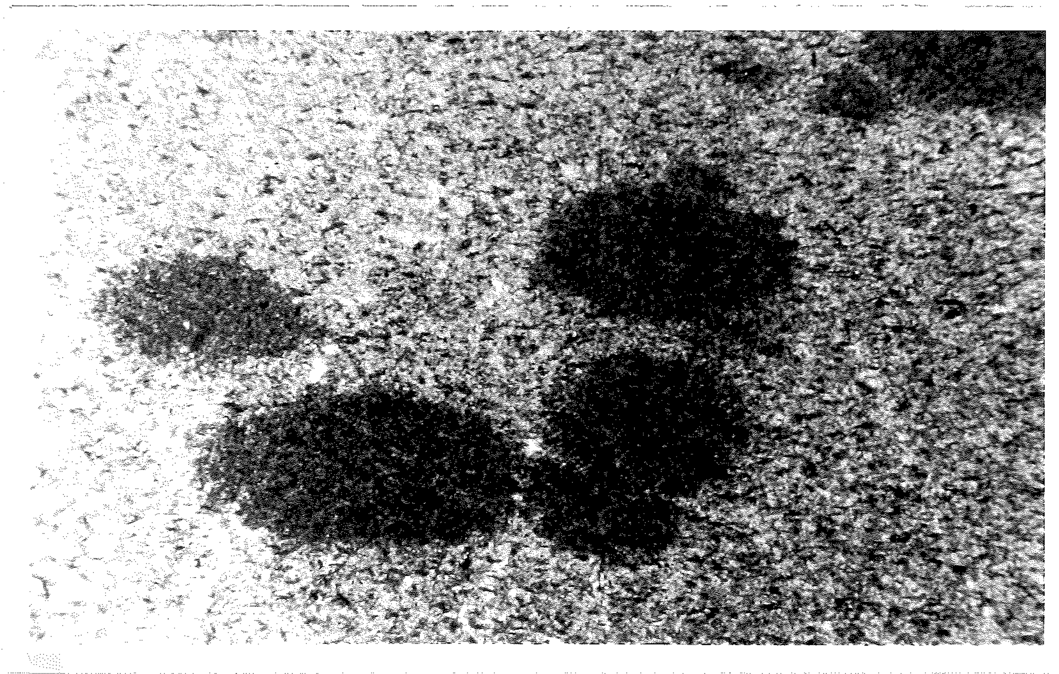


1 mm

PLATE VI

M.P. 5 : METAMORPHIC CONCENTRATIONS OF CHLORITE IN T.S.
377/203. UN-X-POLARS

M.P. 6 : SEGREGATIONS OF PHOSPHATE AS NODULES IN T.S.
377/205.4. X-POLARS



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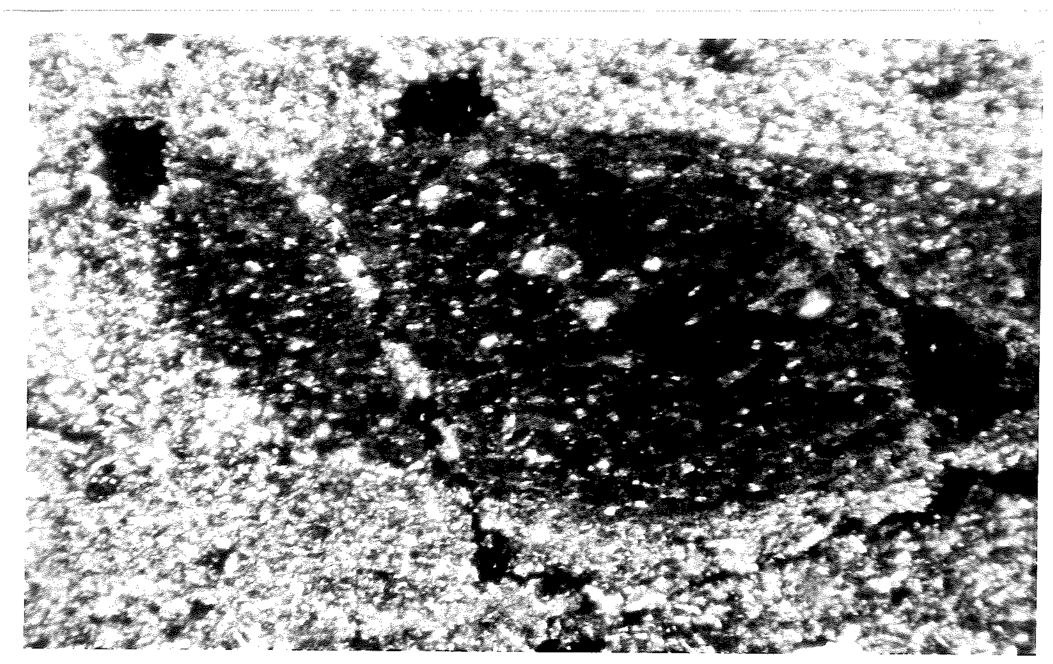

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APPENDICES

APPENDIX I : LISTS OF HAND SPECIMENS AND THIN SECTIONS

A : Hand specimens accompanied by thin sections

B : Hand specimens without thin sections

APPENDIX II : HAND SPECIMEN DESCRIPTIONS

A : Specimens accompanying thin sections

B ; Other specimens, without thin sections

APPENDIX III : THIN SECTION DESCRIPTIONS

APPENDIX I : LISTS OF HAND SPECIMENS AND THIN SECTIONS

A : Hand specimens accompanied by thin sections

Basement rocks

1. 377/178
2. 377/850a
3. 377/116a
4. 377/116b
5. 377/158
6. 377/173
7. 377/121
8. 377/153c
9. 377/108
10. 377/172
11. 377/122

Cover rocks

12. 377/205.3
13. 377/307
14. 377/205.2
15. 377/212
16. 377/217
17. 377/366
18. 377/337
19. 377/105b
20. 377/218
21. 377/801
22. 377/805
23. 377/808
24. 377/208
25. 377/203
26. 377/315
27. 377/602
28. 377/352
29. 377/210
30. 377/259
31. 377/806
32. 377/387
33. 377/205.1
34. 377/211
35. 377/601
36. 377/803
37. 377/205
38. 377/201
39. 377/302
40. 377/800
41. 377/205.4
42. 377/388
43. 377/105a
44. 377/905

APPENDIX I : LISTS OF HAND SPECIMENS AND THIN SECTIONS

B : Hand specimens without thin sections

<u>Basement rocks</u>

45. 377/153a
46. 377/153b
47. 377/153d
48. 377/157
49. 377/171

<u>Cover rocks</u>

50. 377/202
51. 377/220
52. 377/221
53. 377/222
54. 377/220.1
55. 377/202a
56. 377/227
57. 377/213
58. 377/255
59. 377/263
60. 377/264
61. 377/310
62. 377/313
63. 377/317
64. 377/347
65. 377/357
66. 377/393
67. 377/401
68. 377/501
69. 377/500
70. 377/604
71. 377/710
72. 377/711
73. 377/103
74. 377/106
75. 377/907b
76. 377/612

APPENDIX II : HAND SPECIMEN DESCRIPTIONS

A. SPECIMENS ACCOMPANYING THIN SECTIONS

Basement rocks

1. 377/178

Quartzose gneiss ; gneissosity defined by slight elongation of quartz and some feldspathic grains. In this specimen quartzo - feldspathic material dominates micaceous material ; approximately 80% quartz and feldspars, 20% micas. Some opaques associated with micas. Larger quartz grains up to 1.5 mm.

2. 377/850a

Augen gneiss with quartzose porphyroblasts as lenses or 'augens' in a matrix of flow-structured micas, mainly muscovite. Opaques associated. Fe - weathering stains the rock reddish.

3. 377/116a

Augen gneiss with muscovite around large fragments of quartz. Muscovite shows flow banding ; opaques (magnetites) associated. Quartz tends to be segregated more than in other, similar specimens, making 'augens' larger and more obvious. Reddish colour due to Fe weathering a feature here also.

4. 377/116b

Similar augen gneiss ; notably not Fe rich , the colour being more of a grey. Chlorite is also noticeable in this specimen, making up about 10% of the rock.

5. 377/158

Schist, being distinct from the more common augen gneiss ; schistosity is defined by alignment of micas, which make up

40% of the rock. Opaques are associated with the micas. The remaining 60% of the specimen is quartz and feldspar, as individual grains rather than the 'augens' of the majority of basement rocks.

6. 377/173

Magnetite - rich, banded quartzo - feldspathic rock ; quartz and feldspars tend to be segregated, forming bands of predominantly one or the other ; mineralizations are formed of magnetites in thin bands .

7. 377/121

Muscovite gneiss ; basically consisting of quartz and muscovite, the latter occurring as obvious flakes on the surface. Roughly equal quantities of quartz and muscovite. Good crystals of quartz developed as recrystallized quartz in cracks. Some, but minor, gneissosity developed by quartz grain elongation.

8. 377/153c

Very coarse - grained, quartzo - feldspathic rock , with obvious muscovite content. Muscovite constitutes about 5% - 10% of the rock, the rest being half each of quartz and feldspars. The muscovite shows no preferred alignment and there is no gneissosity or schistosity developed. The feldspars show good crystal faces in hand specimen and opaques are associated with the feldspars.

9. 377/108

Good example of the augen gneiss which makes up the majority of basement rocks found in outcrop in the area ; classically micaceous material (mostly muscovite) enclosing 'eyes' or augens of quartzitic material. This porphyroblastic quartz makes up about 40% of the specimen ; there may be other quartz in the matrix. Corundum is present as an accessory. The specimen shows a good lineation on the cleavage surface developed due to alignment of micas in the matrix.

10. 377/172

Amphibolite consisting of 60% amphibole (probably hornblende) and 30% 'silicate', possibly plagioclase although grain size is too fine to tell in hand specimen. The amount of opaques is significant, being 10% ; these are uniformly distributed throughout the rock. A granoblastic texture, a rock of igneous origin.

11. 377/122

Quartz - tourmaline rock with elongated equigranular grains giving prominent gneissosity. Approximately equal amounts of quartz and tourmaline ; some slight Fe weathering apparent.

Cover rocks

12. 377/ 205.3

Calc - schist , well banded and rather irregularly laminated grain size is fine but calcareous and siliceous bands can be distinguished as well micas (from colour, possibly chlorite and muscovite), which give a prominent schistosity. Calcite veins approximately 2mm. wide cross cut the schistosity. The rock shows a cavernous and very characteristic weathering pattern in the field.

13. 377/307

Very limey calc - schist ; much less uniform than limestones found higher in the section. Veins of segregated pure calcite help to give the rock a very uneven texture and a cavernous weathering pattern. Shows minor folds in the field.

14. 377/205.2

Limestone or lightly metamorphosed marble. Granoblastic, white, almost pure calcite. Saccharoidal texture ; no indication in hand specimen of a preferred direction.

15. 377/212

A grey limestone - marble. This specimen shows a uniform, grey, saccharoidal limestone but in the field the locality shows a variety of banded, pure, sheared, mottled and coloured limestones. In general these are all granoblastic and show no preferred directions. There are siliceous mineralizations occasionally which have recrystallized in cracks.

16. 377/217

Pure white quartzite, well welded texture. Forms prominent ridges throughout the area.

17. 377/366

Granoblastic pure white quartzite, this being a weathered specimen.

18. 377/337

Impure quartzite with weathered patches, some recrystallized veins of quartz ; also heavy minerals in veins and bands (magnetites?). One surface shows well - developed slickensides, perhaps indicative of a fault.

19. 377/105b

Magnetite - rich quartzite, showing little else but magnetite and quartz, the magnetite as grains just less than 1 mm. and forming bands varying up to 1 cm. in width and usually less than 1 cm. apart.

20.377/218

Calcareous meta - siltstone. Fine grained and grey with dark irregular laminations which could be segregations of micas and which give an indication of schistosity.

21. 377/801

Same limestone band as 212. Dark grey with wide bands or veins of pure calcite ; these are branching veins. The micaceous content is shown by a slightly phyllitic sheen on the surface and by occasional large muscovite flakes.

22. 377/805

Slightly phyllitic, high mica content schist. Grey, too fine grained to detail the mineralogy. Schistosity strongly developed but no other directions evident.

23. 377/808

Similar phyllitic schist but softer, lighter in colour and with a well developed schistosity.

24. 377/208

Massive schist or meta - siltstone with quartz, probably some feldspar and a high proportion of biotite and muscovite. There is a schistosity developed due to segregation and orientation of biotites. The section is cut perpendicular to the schistosity plane so that the micas are elongated but stunted. There are two other prominent faces on the specimen but the composition is too uniform to decide the nature of these surfaces.

25. 377/203

Phyllitic slate, very fine grained and with a well developed schistosity ; too fine grained to allow identification of minerals. Phyllitic nature is shown by micaceous minerals on cleavage surfaces ; metamorphic mineral segregations are elongate on cleavage surfaces, giving a lineation. There is some segregation into sandy and less sandy patches, perhaps an indication of layering, parallel to schistosity.

26. 377/315

Light coloured phyllitic slate with very prominent, characteristic lineations formed on cleavage surfaces ; these are short black lines made up of single biotite or chlorite flakes with associated tiny magnetite grains.

27. 377/602

Well bedded,small scale sequence of sandstone and shale layers. Particular layers are not continuous but show boudinaging, forming lenses. Cleavage is well developed in the fine grained shaly layers ; the coarse sandstone layers are very quartzitic. The angle between the layering and the cleavage in the shaly bands is about 30'.

28. 377/352

Slightly phyllitic schist ; coarser grain size than the true phyllites. Grey colour with good biotite content. Schistosity developed but no particular layering or lineation.

29. 377/210

Very similar rock to 377/208. Contains quartz and feldspars as well as biotite. Schistosity shown but not a typically schistose rock; no layering or lineations.

30. 377/259

Phyllite with very high micaceous content. Schistosity extremely well developed ; lineation (very fine black lines) well shown on schistosity surfaces. Chlorite occurrence obvious on this surface also. Light coloured ; used as a marker bed.

31. 377/806

Semi - competent, dark, quartzitic siltstone ; schistosity not very noticeable.

32. 377/387

Less competent, more sandy schist. Schistosity developed but not a schistose rock. Slightly saccharoidal texture. No directions other than schistosity shown.

33. 377/205.1

Very fine grained slate ; flaggy, shows good cleavage and good joint surfaces. No obvious lineation.

34. 377/211

Competent schist or meta - siltstone with quartz, feldspars and micas. Schistosity reasonably well shown.

35. 377/601

Very fine grained brown schist or slate ; shows two definite directions for sets of planar surfaces, at about 35' from one another, one being a prominent cleavage or schistosity. Concentration of minerals alomg schistosity planes.

36. 377/803

Rather uniform meta - siltstone. Schistosity poorly developed, mica flakes evident on surface. Light grey in colour.

37. 377/205

Phyllitic slate ; dark blue-grey and very fine grained. Shows very fine lineation on schistosity surface,due perhaps to crenulations or to mineral segregations -- too fine grained to tell.

38. 377/201

Very fine grained, strongly cleaved, flaggy dark slate. Unable to identify minerals due to fine grain size. No obvious lineation ; some indication of layering parallel to schistosity.

39. 377/302

Grey phyllitic slate ; shows well developed schistosity; Fe weathering in veins which are roughly parallel tothe schistosity. Highly coloured phyllitic slates are associated.

42. 377/800

Siltstone showing transitional coarse and finer layers ; there is an angle of about 25' between the layering and a prominent surface on the specimen, which could be schistosity or a joint surface. Micaceous minerals show on the layering surfaces.

41. 377/205.4

Blocky or very flaggy blue shale, showing good joint surfaces Very fine grained, hard to tell schistosity direction, no apparent lineation. Yellow and red weathering colouration on joint breakage surfaces.

42. 377/388

Blue slate showing good cleavage ; also shows a good banding on the cleavage surface which could be related to the original layering (bands up to 2 or 3 mm. wide).

43. 377/105b

Coarse grained, magnetite - rich meta-sandstone or quartzite ; large quartz grains and feldspar laths (up to 5 mm.) in a finer grained (1 mm. to 2 mm.) matrix of sub-rounded quartz and feldspar (plagioclase mainly) grains and some muscovite. Associated muscovites are finer again (1 mm.) and are concentrated in bands about 2 mm. wide and an average of 5 mm. apart parallel to the banding. Roughly 30% of the rock is cementing material, 60% quartz and feldspars and 10% magnetites.

44. 377/905

Pinkish quartzitic sandstone, competent and with no obvious schistosity. Feldspar content appreciable.

B. <u>OTHER SPECIMENS, WITHOUT THIN SECTIONS</u>

<u>Basement rocks</u>

45. 377/153a

Very light, friable, extremely porous and weathered quartzo-feldspathic gneiss. Fairly large mica content ; most of the feldspar has been weathered to clay minerals. This specimen is included to show the variety of rocks in the basement.

46. 377/153b

A single feldspar crystal containing tourmaline mineralization ; again to show variation.

47. 377/153d

Part of a highly micaceous schist also part of the basement complex, showing good schistosity and lineation.

48. 377/157

Basically quartz and tourmaline, which have been formed in bands at an angle to two parallel containing surfaces.

49. 377/171

Relatively fine grained quartzo - feldspathic gneiss ; good banding is shown by segregations of quartz and feldspar. Appreciable magnetite content.

Cover rocks

50. 377/202

Phyllitic shist showing two definite layers, one a phyllite, the other a more schistose layer. The phyllite shows the same biotite-magnetite lineation as described in phyllites earlier. Schistosity is only well developed in the more phyllitic layer, the mica content of the schist layer is lower and its grain size much coarser. Definite layering is seen in the rock and the schistosity is parallel to this layering.

51. 377/220

Black, well laminated, flaggy phyllitic shale.

52. 377/221

Crenulated mica-schist or phyllite ; shows the same biotite or chlorite lineations as do the other similar rocks in this part of the section. This specimen also shows single crystals of limonite pseudomorphs after pyrite.

53. 377/222

Crenulated phyllitic schist with alternating, boudinaged thin bands of coarse quartzitic material between fine phyllitic bands. The same lineations are found here also.

54. 377/220.1

Dark micaceous quartzitic siltstone, very competent and with pinkish and dark colouration, the pink perhaps being only a weathering effect.

5 5. 377/202a

A sandy layer in a sequence of sandy siltstones and phyllites; the rock is quite schistose and gives a good lineation defined by biotite or chlorite flakes. Highly micaceous.

56. 377/227

Blue-grey carbonaceous shale showing Fe weathering and highly weathered phosphatic nodules. On this evidence it is reasonable to correlate this unit with similar shales in the 'Basal' Cambrian type section, but not necessarily with the Heatherdale Shale.

57. 377/213

Grey schist or siltstone showing definite laminations or fine banding. The mineralogy shows most obviously quartz although feldspars and micas are noted also. There is no definite cleavage shown.

58. 377/255

Interesting black slate or shale ; showing what at first glance appears to be graptolites, but which are probably a chemical effect of precipitation along a crack.

59. 377/263

Prominent pure grey quartzite.

60. 377/264

Blocky blue-grey carbonaceous shale as before, showing red and yellow weathering effects.

61. 377/310

Friable white sandstone, weathered ; forms a small syncline in a road cutting due West of McHarg Creek.

62. 377/313

Light, loosely consolidated schist or meta-siltstone. Brown in colour, relatively high biotite content. Not very fine grained, shows good schistosity and elongation of minerals on schistosity surface.

63. 377/317

Flaggy sub-arkose. Small rounded grains (1 mm.) of quartz and feldspar in a sedimentary matrix cement with micas giving a slight schistosity. Fe weathering and staining.

64. 377/347

Highly weathered, crenulated schist ; shows boudinaging and large scale crenulations

65. 377/357

Prominent, white pure quartzite.

66. 377/393

Meta-siltstone with high biotite content. Weathered red, shows a vague schistosity.

67. 377/401

High biotite content, quartzitic meta-siltstone. Very hard, very competent. Biotite flakes give rough lineation ; schistosity not very well developed.

68. 377/501

Pinkish (weathered ?) high mica content siltstone. Similar to 377/401.

69. 377/500 (2 specimens)

One specimen is a grey-brown, reasonably soft phyllitic schist, with a good schistosity developed.
The other is more sandy, coarser grained and shows bands of different competencies. The schistosity here is not so well developed, the rock being more quartzitic. There are a few irregular dark bands and mica flakes are evident on the surface in places.

70. 377/604

Light grey-blue, reasonably competent slate ; very fine grained. Yellow colouration apparent and a schistosity is seen. There is perhaps an indication of two surfaces at 30' to each other, as seen before.

71. 377/710

Very soft, black slate ; carbonaceous. Good slaty cleavage developed.

72. 377/711

Very schistose, brown phyllite, showing possible crenulation effects and a lineation on one surface.

73. 377/103

Basal conglomerate ; basically a matrix of rounded quartz, feldspar and heavy mineral grains with large, rounded and perhaps stretched pebbles and cobbles embedded in it.
There is some mica content and a schistosity or gneissosity is developed in the rock.

74. 377/106

Coarse grained, heavy mineral banded quartzite ; grains of quartz and magnetite in a cementing medium. Heavily Fe weathered, grains tend to be sub-angular to sub-rounded. Detrital product.

75. 377/907b

Biotite rich quartzitic siltstone ; rather fine grained, biotite gives it a patchy, dark colour but there is a pinkish tinge also. The pinkish material tends to be concentrated in patches and could either be K-feldspar or be due to a weathering effect.

76. 377/612

Very fine grained, non schistose, dark mudstone (siliceous, non micaceous) with rounded quartzose and dark pebbles about 1 mm. across ; possibly of tillitic origin and therefore tentatively correlated with Sturtian glacials. There is only one outcrop so its extent is hard to tell but it is definitely of an unsorted nature.

APPENDIX III : THIN SECTION DESCRIPTIONS

Basement rocks

1. 377/178

Quartzose gneiss ; quartz makes up about 80% - 85% of the section, both in porphyroblastic lenses and in the matrix between the porphyroblasts. Quartz grains vary from 1.5 mm. as lenses down to 0.1 mm. in the matrix. The matrix or ground mass is a mosaic of fine grained quartz and microcline perthite (both equidimensional)and micas, mostly muscovite, that show flow structures around the quartz lenses. The magnetite content is appreciable. The rock is best described as a gneiss rather than a schist because the gneissosity is defined by elongation of quartz lenses more than by the mica content.

2. 377/850a

Augen gneiss or quartz - mica schist ; quartz lenses, approximately 3 mm. long and constituting 55% of the section, included in a flow-banded fabric of shredded muscovite-sericite, about 25%, and fine grained quartz, about 10%. The quartz shows good strining effects as undulose extinction, the direction of which tends to be either parallel to or perpendicular to the direction of schistosity in the section. A very strong schistosity is defined by alignment of shredded aggregates of micas, the quartz lenses being elongated parallel with this direction and so contributing the analogy with a 'gneiss'. Quartz lenses are surrounded by weathered zones of limonite.

3. 377/116a

Similar augen gneiss although this section shows quartz lenses as making up only 40% of the section and the micas include biotite as well as muscovite. Again there are quartz 'augens' surrounded by a matrix of muscovite-biotite (30%), fine grained quartz (20%), and an appreciable magnetite and Fe oxide content. In this section the quartz in the matrix tends to be concentrated into pockets and lenses rather than being uniformly distributed ; the grain size in the matrix is about 1 mm. Magnetites, showing both good crystal faces and irregularly outlined grains, appear to be randomly distributed.

4. 377/116b

Very similar to 377/116a ; the muscovite is more obviously sericitic and some chlorite is evident in the micas also. The chlorite tends to form metamorphic 'beards' at either end of the quartz lenses and this , together with the fact that 377/116a and 377/116b come from the same locality, suggests a composition banding, since chlorite is found in one and not the other. Biotite is also present and minor magnetite is associated with the presence of chlorite.

5. 377/158

Quartz-mica-schist, being distinct from the augen gneiss, which is the more common basement rock ; here the micas are responsible for a very strong schistosity and the quartz lenses much less significant. Quartz lenses in this section tend to consist more of aggregates of small grains rather than single large grains. The micas include equal amounts of sericite and biotite, the biotite occurring as long stringers in flow structures around the lenses. There are also basal sections of biotite and magnetites and other Fe oxides are associated with the micas.

6. 377/173

Coarse grained, granoblastic, quartzo-feldspathic hornfels.

Grains are equi-dimensional but in-equi-granular and grain sizes range from less than 0.1 mm. up to greater than 5 mm. Constituents include 30% quartz, 20% plagioclase, 50% K-feldspar, mainly microcline perthite, and an appreciable magnetite content. The rock is of detrital origin but has been recrystallized to produce a texture of interlocking grains. The feldspars have been considerably sericitized. Irregularly outlined magnetites, other opaques and Fe staining from detrital cement are all evident in the section.

7. 377/121

Hornfelsic rock consisting basically of quartz and basal, highly birefringent sections of a variety of muscovite ; the muscovite gives a pseudo-uniaxial figure on some low birefringent grains. Grain sizes range up to 2 mm. for quartz and 0.5 mm. for muscovite. The muscovite forms in aggregates of bladed crystals rather than being uniformly distributed and there are opaques (magnetites ?) associated with it.

8. 377/153c

Very coarse grained silicate rock ; no schistosity, consists of large crytals of quartz and microcline perthite together with aggregates of poikiloblastic muscovite. Grain size is extremely coarse, ranging to 1 cm. and perhaps beyond, within the limits of the thin section. Quartz occurs also as secondary growths of small grains around larger primary grains and as inclusions (down to 0.05 mm.) in microcline perthite and muscovite ; the muscovite in turn occurs as inclusions in quartz and microcline perthite.

9. 377/108

Similar augen gneiss to those described , which make up the majority of basement rocks found in outcrop. The same constituents and textures are present, as described before ; roughly 60% is quartz, 40% micas. Quartz grains are anything up to 5 mm. long, flow banding and 'beard' textures as previously mentioned are noted. Additionally, in this section, there are large, well formed corundum crystals showing obvious zoning.

10. 377/172

An amphibolite with 60% amphibole, 30% quartz and feldspar and 5% - 10% opaques (probably magnetite). The amphibole is most likely to be hornblende and actinolite and occurs in randomly oriented aggregates of consistently oriented (i.e. within each aggregate) needles or bladed crystals. Between the amphiboles are irregularly shaped quartz and feldspar grains with a grain size of about 2 mm. ; different feldspars are difficult to distinguish. Magnetites are associated with the emphiboles, some irregular, some with good crystal faces in outline and make up about 5% of the section.

11.377/122

Quartz - tourmaline granulite ; tourmaline occurs in laths with well defined longitudinal crystal faces but poorly defined end faces and also as polygonal crystals with slight zoning. The laths appear in aggregates, each showing a different extinction due to different orientation, but all laths within a single aggregate showing the same extinction. Between the aggregates are interlocking grains of strained quartz. In the section there are roughly equal quantities of quartz and tourmaline.

Cover rocks

12. 377/205.3

Calc-schist or metamorphosed calc-silicate. Equigranular rock of calcite, quartz, feldspars and micas ; the grain size is approximately 0.2 mm. and the quartz and feldspars are mostly equidimensional. Sericitization of some of the feldspars is noted as well as some alteration to kaolinitic minerals. In the section there is roughly 45% quartz, 45% feldspars and 10% green biotite and chlorite, which occur as long stringers and which give a prominent schistosity ; magnetites are concentrated along the micas. There is one large (3 mm.) pure calcite vein cross cutting the schistosity, where the calcite grains are elongated parallel to the direction of schistosity.

13. 377/307

Similar calc-schist composed of segregations of calcite in a mosaic of equigranular quartz, biotite and calcite grains. The grains of calcite which have been segregated are larger, being approximately 0.5 mm., whereas all other grains are nearer 0.1 mm. Roughly 60% of the section is calcite, both in segregated patches and in the main body of the rock,; 20% is quartz and is uniformly distributed and the rest (20%) is biotite. The biotite shows no well defined crystal faces although the grains do occur as elongated plates giving a definite, strong preferred orientation ; the biotite tends to be concentrated near the calcite segregations and also in segregations of its own, with which are associated considerable formations of magnetites.

14. 377/205.2

Nearly a true marble, almost 100% calcite ; equidimensional grains, granoblastic texture ; with a few grains of quartz. The grain size is a maximum of 0.5 mm.

15. 377/212

Equigranular,lepidoblastic calc-schist showing a mosaic of calcite, quartz and longitudinal biotite plates. Approx-mate grain size 0.2 mm. and approximate percentages, 10% biotite, 25% quartz and 65% calcite. Both quartz and calcite grains show a tendency to elongation parallel to the preferred orientation of the biotite, but calcite grains slightly more so.

16. 377/217

Pure, white quartzite ; the most prominent in the area. Nearly granoblastic texture, 100% quartz, grains slightly elongated in one direction.

17. 377/366

Truly granoblastic, pure quartzite ; no elongation of grains. Grain size approximately 0.5 mm.

18. 377/337

Impure quartzite, 80% - 90% of the section being quartz, while the rest is long stringers of biotite together with magnetites and other Fe oxides ; the section shows red staining due to Fe oxide weathering. Quartz grain size varies from 0.1 mm. up to 0.5 mm. except in a segregated quartz band parallel to schistosity within the micas, where they reach 2 mm. Micaceous stringers tend to occur in segregated bands.

19. 377/105b

Lightly metamorphosed, magnetite-rich sandstone-quartzite. Alternating bands of quartz grains and sub-rounded magnetite grains embedded in a clay cement which has been metamor-phosed to sericite. Band width 6 mm., grain size of both quartz and magnetite 0.5 mm. In places there is a secondary re-crystallized quartz cement. In the magnetite bands there are a few detrital quartz grains, in the quartz bands there are muscovite bands or grains. The quartz grains show fracturing and staining and some elongation parallel to the banding (i.e. bedding) direction. Fe oxide staining is associated with quartz grain boundaries.

20. 377/218

Calc-schist with micas, quartzo-feldspathic grains and possibly calcite ; grain size 0.1 mm. Quartzo-feldspathic material about 60%, micas 20%, calcite 20%. The non-micaceous minerals are elongated into ovoid lenses ; the micas, probably biotite, show flow structures around these lenses. There are Fe oxides and possibly tourmaline associated.

21. 377/801

Calc-schist consisting of calcite, quartz, muscovite and biotite in a lepidoblastic fabric of intergrown grains ; there are also pure calcite veins through the rock. Calcite--as veins (max. grain size 1.0 mm.) and as small grains (max. grain size 0.5 mm.); together they make up 50% of the section. There are less calcite grains the further away from the vein-concentrated calcite. Quartz--makes up 15% of the rock with a maximum grain size of about 0.3 mm.; equidimensional grains with a fairly uniform distribution. Muscovite--grain size about 0.5 mm. and accounts for 10% of the section; occurs as laths and irregular basal sections in segregated patches between calcite veins. The laths are roughly oriented in the same direction as the biotite but are more random than the biotite, tending to show two preferred orientations perpendicular to each other. Biotite--occurs as small, elongate plates with no distinct cleavage ; the grain size is approximately 0.1 mm. and biotite makes up 20% of the rock. It shows a very strong preferred orientation and tends ~~tends~~ to be concentrated along the edges of the calcite veins, proportion decreasing away from the veins . Magnetites tend to be concentrated with the micas.

22. 377/805

Phyllite consisting of quartz, feldspars and biotite; the biotite makes up 50% of the section, the quartz and feldspars the other 50%. Approximately equigranular, lepidoblastic fabric, with some segregation of the quartz, where grains are larger; otherwise grain size is about 0.1 mm. The biotite grains give a well defined schistosity to the section, the quartz grains show no elongation. In a single vein parallelt to the schistosity there are larger quartz grains and sericitized feldspars, which show remnant twinning, as well as biotite, associated magnetites and other Fe oxides. The opaques are associated only with the vein and do not appear elsewhere in the section.

23. 377/808

Fine grained phyllite with quartz-feldspars and biotite-muscovite. The quartz and feldspars are approximately 0.1 mm. equidimensionally and the biotite and muscovite are approximately 0.2 mm. in length. There are slightly more quartz and feldspars than biotite and muscovite. The micas give a strong schistosity to the section ; biotite and muscovite can be seen growing together with a common cleavage surface. Minor magnetite occurs, uniformly distributed throughout.

24. 377/208

Similar phyllite with quartz, feldspars, biotite and isolated stringers of muscovite. The quartz and feldspars average 0.2mm., the micas are between 0.1 mm. and 0.2 mm. long. The micas give a schistosity and quartz and feldspar grains tend to be parallelly elongated in this direction, some extensively so. There are veins of quartz concentrations cross cutting and perpendicular to the schistosity. Micas make up about only 30% of the section.

25. 377/203

perpendicular to the plane of lineation.

Phyllite with green biotite, chlorite, quartz and feldspar as constituents. Grain size is very small, micas make up 60% of section. There are segregations of green biotite-chlorite into ovoid shapes as a metamorphic effect ; these ellipses are a couple of millimetres long on a megascopic scale and give a characteristic lineation on schistosity surfaces. The biotites define a schistosity within the rock and the metamorphic segregations have their long axes parallel to the preferred direction of the biotites.

parallel to the plane of lineation

In this section the pinacoid shape of the biotite-chlorite laths is well seen and the ovoid shapes of metamorphic segregations described above is verified from another angle.

26. 377/315

perpendicular to the plane of lineation

Phyllite consisting of 60% micas and 40% quartz, feldspars or both. Most of the mica is muscovite but there is also biotite and also chlorite, the muscovite occurring aslong, shredded aggregates or stringers, the biotite as lenses within these aggregates and the chlorite as intergrowths with the muscovite. Quartz and feldspars occur as elongated grains in lenses parallel to the direction of mica orientation. The length of most grains averages 0.5 mm. There are magnetites associated with the micas.

parallel to the plane of lineation

This particular section shows a high concentration of chlorite (about 40%) along with quartz, feldspars, biotite, some muscovite and associated magnetites. The magnetites are preferentially associated with the chlorite and vary in size down to 'dusty' magnetite from a maximum of about 0.2 mm. Some of the smaller magnetites are elongated parallelto the schistosity which is developed by the chlorites.

27. 377/602

Lightly metamorphosed, well bedded sandstone-shale rock. The sandstone layer shows rounded, detrital grains of quartz, plagioclase and rock fragments, mostly greater than 1 mm., cemented by authigenic silicate cement and associated with intergranular Fe oxides, the cement being recrystallized into secondary quartz. The shale layer shows recrystallized quartz together with muscovite and remnant detrital Fe oxides as cement.

28. 377/352

Phyllitic schist showing biotite, quartz and feldspars ; Biotite makes up 30% and quartz and feldspars together 70%, being in the proportions quartz 30%, plagioclase 20% and K-feldspar 20%. Grain size of the biotites is approximately 0.5mm. and that of the quartz and feldspars between 0.1 mm. and 0.2 mm. The biotite gives the section a rough schistosity due to orientation of prismatic crystals and tends to form slight flow structures around the quartz grains ; in places the biotite is partly altered to chlorite and is associated with red Fe oxide staining. The quartz and feldspar grains are slightly elongated parallel to the mica schistosity.

29. 377/210

Phyllitic schist with biotite-muscovite and quartz-feldspar assemblages, in the proportions 30% biotite-muscovite, 50% quartz, 20% feldspars. Maximum grain size of 0.2 mm. Very similar to 377/352

30. 377/259

Phyllite similar to 377/315, schistosity due to biotite and chlorite grains, elongation of quarts and small magnetites parallel to this schistosity. Quartz content here is relatively higher and there is more biotite with respect to chlorite. There are also no larger magnetite grains.

31. 377/806

Quartzitic hornfels of equidimensional, approximately equigranular grains of quartz, plagioclase, K-feldspar and aggregates of basal sections of biotite ; grain size is fine, from 0.1 mm. to 0.2 mm.. The feldspars are sericitized and and there are tiny needles of muscovite uniformly scattered throughout the section. Percentages are 15% biotite, 10% plagioclase, 35% quartz and 40% K-feldspar. There is no obvious schistosity in this section.

32. 377/387

A phyllite with brown biotite in a mosaic of quartz and feldspars ; viz. 25% biotite, 75% quartz and feldspars, the grain size of between 0.1 mm. and 0.2 mm. making the two silicates hard to distinguish. There is also green biotite and some chlorite included with the brown biotite ; also a good quantity of uniformly distributed opaques associated with the micas.

33. 377/205.1

Very fine grained (less than .025 mm.) phyllite, presumably with similar minerals to other phyllites in the section, but the grain size being too small for definite identification. FRom pleochroic colours, there is probably biotite present, making up half the section, and the rest is quartz and feldspars as a mosaic. The fine biotite gives a schistosity.

34. 377/211

Mica-quartz-feldspar phyllite, short rodded micas giving a schistosity. Grain size small, 80% quartz and feldspars, 20% micas, minor opaques.

35. 377/601

Similar phyllite, very fine grained. Micas 50%, quartz and feldspars 50%, small opaques uniformly distributed. Micas give a schistosity.

36. 377/803

Uniform, fine grained (0.1 mm. to 0.2 mm.) phyllite with micas, quartz and feldspars, the micas giving a schistosity and the quartz and feldspars being elongated parallel to this. Quartz veins run through at an angle to the schistosity. The micas make up 25% of the section and include brown biotite, chlorite and some muscovite.

37. 377/205

Phyllitic schist with biotite, quartz and feldspars. Most of the biotite is basal sections showing little or no pleochroism. 30% of the section is micas, some chlorite and muscovite among biotite ; grain size averages 0.1 mm. although some grains are a little larger. The micas give a rough schistosity and some of the feldspars show a graphic intergrowth with quartz.

38. 377/201

Fine grained phyllite (0.1 mm.) with olive-green biotite, quartz and feldspars, the latter two being hard to distinguish due to fine grain size. A rough schistosity is developed. An interesting point is that there are no opaques shown in this section, whereas they are a common feature in nearly all the other rocks of the sequence. Tourmalines are present as an accessory.

39. 377/302

perpendicular to the plane of lineation.
Phyllitic schist of muscovite and biotite aggregates as long stringers enclosing elongated quartz grains in lenses or pods. There is a good schistosity and micas occur in segregation bands or patches. Quartz and feldspar makes up about 50% of the total, muscovite 15% - 2o% and biotite 20% - 25%. There are black opaques (magnetites ?) associated with the biotite-rich areas and Fe oxides (perhaps ilmenite) occur as veins, as staining and as small isotropic grains.

40. 377/800

Bedded schist with alternating micaceous and less micaceous bands ; the minerals include biotite, some chlorite, quartz, feldspar and basal sections of muscovite. The overall grain size is fairly uniform and reaches a maximum of 0.2 mm. with an average of less than 0.1 mm. In the micaceous bands biotite and chlorite together make up 20% of the section, muscovite 10%, quartz grains 10% and the remaining 60% is a felted matrix, either highly sericitized feldspars or a re-crystallized detrital cement ; it is difficult to identify exactly. In the less micaceous bands, biotite and chlorite account for 10%, muscovite 5% - 10%, quartz and feldspars 30% and the remaining 50% is the same matrix. There are opaques associated with the micas and also limonite as crystals and as staining in segregated patches. In these patches the concentration of muscovite seems to be higher.

41. 377/205.4

Very fine grained slate with quartzo-feldspathic and micaceous material which is hard to identify in detail. The mica seems to be green biotite or chlorite with small amounts of muscovite and makes up 15% - 20% of the section ; the rest is quartzo-feldspathic and with some larger segregated quartz grains.

The majority of the material is highly sericitized or altered. There are cross cutting veins perpendicular to the schistosity enriched in limonite and showing larger quartzo-feldspathic grains. There are also segregations, non crystalline, of a material possibly rich in phosphorous ; the total extent of the segregations gives, in three dimensions, a nodular shape ; the long axes of these nodules are parallel to the schistosity. There are also accessory opaques associated with the micas.

42. 377/388

Slate with basal sections of chlorite showing anomolous birefringence ; very small needles of muscovite together with the chlorite make up 30% of the section and give a schistosity to the section. The remaining 70% of the section is highly sericitized quartzo-feldspathic material ; accessory opaques up to 0.2 mm. are uniformly distributed.

43. 377/105a

Magnetite rich rock of detrital origin showing semi-rounded grains of quartz, feldspar and rock fragments (5 5%) in a fairly open cement of sericite and fine grained quartz (35% - 40%) and associated opaques (5% - 10%). The detrital grains are sub-rounded to sub-angular, mostly equidimensional but slightly elongated ; straining is evident. The magnetites are concentrated in the cement and with the sericite. Accessories include tourmaline.

44. 377/905

A granulitic rock made up of quartz and feldspar grains in an interlocking, holocrystalline fabric with a few mica grains and some opaques; there is a slight preferred orientation shown by elomgation of a few grains but, generally, they are equidimensional. Grain size ranges up to 0.5 mm. and there is 50% quartz, 15% plagioclase, 30% K-feldspar and less than 5% micas and opaques. Sericitization of feldspars and Fe weathering.

FIG. 5. SAMPLE DISTRIBUTION MAP

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FIG. 6. INTERPRETATIVE GEOLOGICAL MAP

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