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THE PETROGRAPHY OF SPECIMENS COLLECTED BY THE 1962  
CAPE MELVILLE FIELD PARTY, NORTH QUEENSLAND

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by

W.R. Morgan

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

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## SUMMARY

Petrographic descriptions of rocks collected by the Cape Melville field Party in 1962 from the Cape Melville, Cocktown, Hann River and Ebagoola 1:250,000 Sheet areas, North Queensland are presented. The two specimens of Pre-Cambrian acid intrusive rocks are biotite tonalite and muscovite-biotite granodiorite. Specimens of Middle Palaeozoic Hodgkinson Formation sediments in the Cape Melville area appear to have suffered incipient contact metamorphism; some pebbles collected from the sediments are derived mostly from an area of low-grade, dynamically metamorphosed rocks quite different in metamorphic character from the Dargalong Metamorphics, which are medium-grade schists and gneisses that crop out to the west of the Cocktown area.

The Upper Palaeozoic intrusive rocks consist of the Puckley Granite, Finlayson Granite, Altarmoui Granite, and some acid, hypapyssal intrusives. The Puckley Granite is characterized by fairly calcic plagioclase and biotite, but contains little or no muscovite. The Finlayson Granite differs in containing fairly sodic plagioclase and some muscovite. The Altarmoui Granite is possibly a complex containing a variety of rock-types ranging between muscovite-bearing and hornblende-bearing granitic rocks. The minor intrusives are all acid porphyries.

The hornfelses associated with the Upper Palaeozoic intrusives are mostly metamorphosed Hodgkinson Formation sediments, and belong to the albite-epidote hornfels facies. One hornfels is a fine-grained acid igneous rock. Another hornfels is a basic igneous rock metamorphosed to the hornblende-hornfels facies.

The specimens from the two Mesozoic formations have fairly similar characteristics; the sandstones are inequigranular to equigranular, and contain sub-angular to sub-rounded grains, suggesting conditions of moderately rapid erosion and deposition. The component grains of the sandstones and the conglomerate pebbles are probably derived from Lower Palaeozoic sediments and Upper Palaeozoic volcanics and intrusives. Some pebbles are also derived from fairly low-grade, dynamically metamorphosed rocks.

The Cainozoic rocks described include varieties of olivine basalt a basalt pebble from a Tertiary gravel, a pisolitic ironstone forming a ferricrete capping on Mesozoic outcrops, and a schist rock occurring as a Recent pebble in the Laura River.

## INTRODUCTION

The specimens described in this report were collected by the Cape Melville party in North Queensland during the 1962 field season. Most of them were collected from the Cape Melville 1:250,000 sheet area, some are from the Cocktown area, and a few from the Hann River and Ebagoola 1:250,000 sheet areas.

The report consists of rock descriptions, together with some summary remarks at the end of each part. The rock descriptions are grouped according to stratigraphical units, beginning with the oldest. The field relationships of the stratigraphical units referred to here may be found in a report by K.G. Lucas (1964).

PRE-CAMBRIAN GRANITIC ROCKS

R.14506 : Biotite tonalite. Hann River, run 1, photo 5153, point 779. The hand specimen is a medium-grained, grey porphyritic rock, speckled with black. Some lineation of the mica was noted.

In thin section the phenocrysts, which measure up to 4.5 mm. are seen to be enclosed in a groundmass that has an average grain-size of 1.3 mm. The plagioclase (about 65%) has a composition of An<sub>40</sub>, and forms sub-tabular to rounded crystals that show faint oscillatory zoning. Quartz (25%) is interstitial; it shows moderate strain effects and some granulation. Biotite (10%) occurs as anhedral, interstitial flakes embedded in quartz. The flakes are slightly chloritized and somewhat distorted. Accessory apatite, zircon, prehnite, and clinozoisite are present.

R.14528 : Porphyritic muscovite - biotite granodiorite. Ebagooola 1:250,000 Sheet area; Creek crossing at "Musgrave". The hand specimen is creamish-grey and coarse-grained; the feldspar phenocrysts range up to about 15 mm.

In thin section the rock is seen to have an inequigranular groundmass with grain-size ranging from 1 mm. to 4 mm. Plagioclase (45%) forms slightly sericitized, roughly tabular crystals that show traces of oscillatory zoning (oligoclase to albite). Quartz (40%) is inequigranular and interstitial, and is moderately strained. Microcline - perthite (10%) is subhedral; it shows crystal faces against quartz, but encloses the other minerals. Biotite and muscovite together form about 10% of the rock; biotite occurs as partly chloritized, slightly distorted books that are pleochroic from pale straw to fox-brown. Muscovite is subhedral. Accessory zircon and acicular apatite are present; granular clinozoisite is associated with plagioclase and biotite.

HODGKINSON FORMATION ROCKSINTRODUCTION

The descriptions of Hodgkinson Formation rocks are set out under three sub-headings - sediments, lavas, and pebbles in the sediments.

SEDIMENTS

R.12730 : Feldspathic sandstone. Two miles north of "Mumburra", Cape Melville run 11, photo 5125, point 628A. The hand specimen is a pale creamish-white, coarse sandstone that has ferruginous joint surfaces. In thin section, the rock is seen to consist of angular to sub-angular grains whose diameters range between 0.25 mm. to 1.5 mm. The grains consist of quartz (80%), smaller amounts of perthite and sodic plagioclase (about 10%), minor quantities of metamorphic quartzite, chert and probable shale, and some interstitial hematite dust. The rock is cut by thin quartz veins.

R.13083 : Lithic sandstone. South flank of the Altarmoui Range, Cape Melville run 7, photo 5025, point 725. The hand specimen is of a dark grey, coarse-grained, hard sandstone. In thin section the grain-sizes are seen to range from 0.5 mm. to 2.5 mm. The grains are sub-angular to sub-rounded, and some are fractured and distorted. The

grains consist of quartz, fine quartzite, chert, shale, andesite, sodic plagioclase, perthite, siltstone, and fine-grained acid igneous rocks. The fairly sparse matrix has been recrystallized to pale green chlorite and some biotite; iron oxide dust and carbonate are present. The shale fragments have also been recrystallized, and fine-grained biotite has formed in them. Accessory minerals are sub-rounded sphene, magnetite, epidote, and zircon.

R.13084 : Sheared greywacke. Cape Bowen - shore platform, Cape Melville run 6, photo 5035, point 730. The hand specimen is a greyish-green, hard, coarse-grained, and somewhat foliated sandstone in which a few flakes of mica can be seen.

In thin section the sandstone is seen to be strongly sheared. The grain-sizes range from 0.5 mm. to 3.75 mm. Coarse grains of distorted and partly granulated quartz, together with subordinate strained and cracked plagioclase and perthite, are enclosed in a sheared matrix. The matrix consists of fine quartz, drawn-out flakes of muscovite and less common biotite, together with granular epidote. Some hydrated iron oxide dust is present. Accessory minerals are sphene and brown tourmaline.

R.14518 : Slightly metamorphosed greywacke. Four miles south-east of the mouth of Wakooka Creek; Cape Melville run 6, photo 5035, point 731A. The hand specimen is of a mottled, grey, coarse sandstone containing flattened clay balls. In thin section, grain-sizes are seen to range from 0.08 mm. to 20 mm. In the rock as a whole the grains are somewhat strained and granulated; some granulated areas appear to have become granoblastic. The rock consists of quartz, minor sericitized plagioclase, microcline, and fragments of meta-quartzite, and shale, and one fragment of a fine-grained calc-silicate rock. The matrix consists of recrystallized biotite and muscovite, together with some epidote. Accessory minerals are apatite and ilmenite (partly altered to leucoxene).

R.14522 and R.14523 : Magnetite-bearing (?) quartzite. Both specimens are from the Byerstown Range; Cooktown run 9, photo 5009, points 642 and 643, respectively. In hand specimen, R.14522 is a dull greyish-red, fine to medium-grained rock that contains some layers of finely disseminated magnetite crystals measuring 1 or 2 mm. The rock is cut by reticulate cracks. R.14523 is dark grey and is cut by thin veins fitted with magnetite.

In thin section, both rocks are seen to be composed almost entirely of an inequigranular mosaic of quartz grains; in R.14522, the grain-sizes range from 0.025 mm to 0.3 mm. and in R.14523, they range between 0.03 mm and 0.07 mm. Slight to moderate strain shadows are present in the quartz in R.14522, but are virtually absent in R.14523.

In R.14522, small crystals of euhedral magnetite are present, together with small amounts of evenly distributed, randomly oriented flakes of very fine-grained (0.01 mm to 0.03 mm) chloritic material. In R.14522, the magnetite forms vein-like segregations that are mostly parallel to one plane; however, some are aligned obliquely to this plane. All are cut by later thin quartz veins.

LAVAS

R.13086 : Partly silicified rhyolite. One mile south-west of Cape Bowen, Cape Melville run 6, photo 5035, point 732A. The hand specimen is a hard, grey rock with sparse phenocrysts enclosed in an aphanitic matrix. A flow-structure can be seen on weathered surfaces. In thin section the sparse, clustered phenocrysts are found measure up to 1.3 mm. and consist of tabular, slightly sericitized albite, and quartz. They are enclosed in a very fine-grained, partly silicified felsitic groundmass containing minor quantities of biotite flakes strung out along flow-lines, and which, in places, form irregular rims around plagioclase phenocrysts.

R.14529 : Sericitized and chloritized porphyritic alkali rhyolite. South of Round Hill, Cape Melville run 1, photo 5123, point 618. The hand specimen is of a hard grey, iron-stained porphyritic rock in which numerous phenocrysts of feldspar and a few of quartz, are enclosed in an aphanitic groundmass. The phenocrysts range up to 5 or 6 mm. across; in thin section they are found to consist of very strongly sericitized plagioclase, and a few rounded crystals of quartz. The ferromagnesian phenocrysts have been completely altered to chlorite, epidote, and leucoxene; they are possibly pseudomorphs after pyroxene. The groundmass has an average grain-size of 0.03 mm. and consists of granular quartz, tabular, mostly sericitized and carbonated sodic plagioclase, and flakes of chlorite and smectite. A single large crystal of garnet is mostly replaced by (?) talc, chlorite, and hydrated iron oxide. In addition to the garnet, accessory apatite, forming prismatic crystals, and tabular crystals of black iron oxide are present.

PEBBLES

R.12729 : Sheared quartzite pebble. Two miles south of the Laura River, ten miles west of "Butchers Hill". Cocktown run 8, photo 5035, point 687. The pebble is a fine-grained, black, siliceous rock showing a slight shear fabric. In thin section the grain-sizes are seen to range from 0.08 mm. to 0.9 mm. The pebble consists almost entirely of elongated quartz grains, whose long axes are parallel owing to the effects of shearing; the grains also have a preferred optical orientation. Small amounts of fine muscovite are strung out between quartz grains and some iron oxide dust is present. The only heavy mineral noted was pink zircon which occurs as rounded grains. Some areas of coarse, sheared quartz in the section probably represent disrupted vein material - these contain no zircon.

R.13085 : Quartz keratophyre pebble. Cape Melville run 6, photo 5035, point 731. The pebble is a dark-grey, porphyritic acid igneous rock; it is well rounded and has moderate sphericity. A piece of matrix still adhering to the pebble is composed of a dark-grey, medium-grained sandstone.

In thin section, the phenocrysts in the pebble are seen to range up to 1.75 mm. and the groundmass has an average grain-size of 0.15 mm. Plagioclase phenocrysts consist of albite, and show chess-board multiple twinning; they are tabular, and are moderately to strongly sericitized. Quartz phenocrysts are rounded. Amphibole phenocrysts are pseudomorphed by fine, randomly oriented reddish-brown flakes of biotite. Some epidote occurs in granular clots. The matrix consists mostly of micrographically intergrown quartz and alkali feldspar; some tabular crystals of sodic plagioclase and small flakes of pale brown biotite are also present. Accessory apatite and leucoxene were noted.

The sandy matrix to the pebble is seen to be a very inequigranular greywacke whose grain-sizes range between 0.15 mm. and 2 mm. The grains consist of quartz, perthite, plagioclase, and chert; they are enclosed in a recrystallized matrix composed of biotite and sericite. Accessory brown tourmaline and colourless garnet are present.

The specimen has suffered low grade metamorphism, probably due to thermal effects; this is shown by the biotite pseudomorphs in the pebble, and the recrystallized matrix in the greywacke. The accessory garnet in the greywacke is partly altered to biotite.

R.13087 : Metaquartzite pebble. Cape Melville run 6, photo 5035, point 732B. The specimen is part of a well rounded, flat pebble whose larger diameter is about four inches; the rock is highly siliceous, fine-grained, and somewhat foliated.

In thin section the rock is seen to consist almost entirely of a mosaic of somewhat intergrown quartz grains that range from 0.1 to 0.4 mm. across. The grains are elongated, and have a preferred dimensional and optical orientation. The few fine muscovite flakes present also have preferred orientation parallel to that of quartz. Small amounts of microcline were observed. The accessory minerals consist of blue tourmaline and apatite. Some intergranular hydrated iron oxide dust is present.

R.14519 : Sheared and granulated quartzite pebble. Cape Melville run 6, photo 5035, point 731B. The specimen is a small sub-rounded pebble about  $1\frac{1}{2}$  inches in its largest diameter, and consists of a greyish-cream, hard, fine-grained rock. In thin section it is seen to be composed mostly of strained and granulated quartz. The grains, whose average diameter is 0.3 mm. have irregular shapes, and are enclosed in an abundant matrix of fine granulated quartz whose average size is 0.05mm. A few plagioclase and chert grains, together with some interstitial sericite and opaque dust, are present.

R.14520 : Marble pebbles. Cape Melville run 6, photo 5035, point 731C. Parts of two small pebbles were submitted. One is a coarse-grained, pale grey marble, which, in thin section, is seen to be sheared and granulated. It contains strongly twinned calcite grains, about 1.5 mm. in diameter, that are enclosed in an irregularly distributed matrix of finely granulated calcite; where the matrix is abundant, a shear fabric is present.

The second pebble is a dark grey, coarse-grained marble, which, in thin section, is fairly similar in texture to the other pebble. There are fewer coarse grains in a more abundant fine matrix. Some opaque (? carbonaceous) dust is present.

#### REMARKS

The Hodgkinson Formation sediments described here are mostly greywacke-type sandstones. These, however, are quartz-rich types, although they do contain grains of feldspar, chert, meta-quartzite, and mica; some contain, in addition, grains of shale, slate, volcanic material, and, in one specimen (R.14518), a grain composed of fine calc-silicate material. The matrix material ranges in abundance from very little, to fairly abundant. It is commonly argillaceous material that, in specimens collected in the Cape Melville sheet area, has been recrystallized to chlorite-sericite and biotite-sericite assemblages. This suggests a low green schist metamorphism. It is difficult to tell, from thin section work alone, whether the metamorphism is regional and took place at the time the sediments were folded, or whether it is an incipient thermal metamorphism resulting from granite intrusion. The specimens collected in the Cape Melville area, fairly close to such intrusions, all show this recrystallization; this suggests that the metamorphism is contact and not regional.



The two specimens of magnetite-bearing (?) quartzite are rather difficult to place; they may be recrystallized cherts. However, the origin of the magnetite is problematical. The Hodgkinson Formation lava specimens are partly altered alkali rhyolites.

The pebble specimens are mostly low-grade, dynamically metamorphosed rocks - several quartzites and two marbles. Their metamorphism is quite different from the recrystallization found in the greywacke matrices discussed above, in that a considerable amount of shearing was involved in their formation. They are rather similar in respect to some of the metaquartzite grains observed in the sandstones. It is probable that they were derived from some area not now exposed that consisted of low-grade, somewhat sheared, metamorphic rocks. They are not at all similar to the medium-grade schists and gneisses of the Dargalong Metamorphics, which crop out to the west of the Cooktown area.

One pebble composed of quartz keratophyre was observed. In this rock, phenocrysts of amphibole are pseudomorphed by masses of fine, randomly oriented flakes of biotite. In addition, the greywacke that forms the groundmass to the pebble is also somewhat recrystallized, the argillaceous material in the matrix having been replaced by a biotite-sericite assemblage. These two facts taken together suggest that the pebble and the greywacke recrystallized at the same time; the random orientation of the mica in the pseudomorphed amphibole phenocrysts indicates hornfelsing; this, therefore, supports the view that the Hodgkinson Formation sandstones examined here have suffered slight contact metamorphism.

## UPPER PALAEOZOIC INTRUSIVES AND ASSOCIATED HORNFELSES

### INTRODUCTION

The specimens described in this part are of granitic rocks, their associated hornfelses, and acid minor intrusive rocks. All were collected from the Cape Melville 1:250,000 Sheet area. According to field evidence, the granites intrude Middle Palaeozoic sediments, and are unconformably overlain by Mesozoic rocks. Three main granitic intrusives are distinguished; Puckley Granite, Finlayson Granite, and Altanmoui Granite. The Puckley granite occurs in the south centre of the sheet area, the Finlayson at Lizard Island, and the Altanmoui Granite crops out at Melville Range, Cape Melville, and the Altanmoui Range.

This part of the report is divided into three sections dealing with each of the granites, and a fourth section dealing with the minor intrusives. Hornfelses are described with their accompanying granite.

### PUCKLEY GRANITE

#### Granite Specimens

The specimens were collected from six miles west of the Jeannie River Yards; the aerial photograph location is Cape Melville run 10, photo 5071, point 508.

The rock is represented by R.11298, R.11299, and R.11300, and is a porphyritic biotite adamellite. The hand specimen is medium to coarse-grained, grey speckled with black, and contains phenocrysts of feldspar.

In thin sections the rock is seen to be hypidiomorphic-granular; the phenocrysts range up to 5.5 mm. across, and the groundmass has an average grain-size of 1.75 mm. Quartz (35%) is poikilitic

and shows slight stain lamellae. In R.11298 it forms a few phenocrysts. Microcline-perthite (30%) and plagioclase (30%) occur as tabular crystals. The potash feldspar shows slight to moderate kaolinization and some micro-fracturing. Plagioclase (An<sub>55</sub> zoned sharply on crystal margins to oligoclase) has oscillatory zoning and is moderately kaolinized. Biotite (5%) forms somewhat distorted books that are pleochroic from straw to dark red-brown, and which are partly chloritized. Accessory tourmaline, black iron oxide, zircon and apatite are present. The tourmaline is irregularly zoned brown and blue, and forms anhedral, poikiloblastic grains.

R.11298 contains a few indistinct areas that may represent almost entirely assimilated xenoliths. R.11300, in hand specimen, shows the adamellite to be in contact with a large, apparently fine-grained xenolith. In section the xenolith is seen to consist of a rough mosaic of quartz (65%) grains, 2.3 mm. in diameter, poikiloblastically enclosing fine (0.5 mm. long), lean laths of somewhat sericitized sodic andesine (25%) and stubby books of straw to red-brown biotite (10%) 0.5 mm. across.

#### Hornfels Specimen

Specimen R.11297 was collected from the same locality as the Puckley Granite specimens described above. In hand specimen it is a dark bluish-grey, hard, fine-grained rock that shows faint sedimentary structures.

The thin section, which represents the major part of a graded bed, shows the rock to be a biotite-quartz-muscovite hornfels. The coarser part of the graded bed is composed mostly of quartz with subordinate muscovite, and has an average grain-size of 0.05 mm. This material grades gently to a muscovite-rich rock containing smaller amounts of quartz; the quartz here has an average grain-size of 0.02 mm. but the muscovite forms somewhat coarser wispy flakes that, in places, range up to 0.4 mm. across. Euhedral brown biotite is not a common constituent. Accessory apatite and black iron oxide are present. The rock is cut by a few thin sinuous quartz veins.

#### FINLAYSON GRANITE

The specimens described here were obtained from Lizard Island. The aerial photograph location for R.12173 and R.12174 is Great Barrier Reef run 45, photo 5133, point 561; that for R.12175 is the same except that the point number is 562.

R.12173 : Porphyritic biotite-muscovite granite. The hand specimen is pale creamish-white, coarse-grained, and porphyritic. In thin section the phenocrysts, which measure up to 11 mm. long, are enclosed in an hypidiomorphic-granular groundmass that has an average grain-size of 3.5 mm. The rock consists of microcline-perthite (45%), quartz (35%), plagioclase (15%), muscovite (4%) and biotite (1%). Microcline-perthite forms tabular phenocrysts and in the groundmass is euhedral against quartz and interstitial to the other minerals. It is moderately kaolinized. Quartz is poikilitic and shows slight staining. Plagioclase (oligoclase) forms tabular crystals, some of which are slightly sericitized. Muscovite occurs as clusters of intergrown coarse flakes; the small amounts of brown biotite are intergrown with muscovite, and are mostly chloritized. Accessory tourmaline, zircon, apatite and black iron oxide are present. The tourmaline is associated with muscovite, and is pleochroic from colourless to very pale blue or brown.

R.12174 : Porphyritic muscovite micro-adamellite. The hand specimen is orange cream and porphyritic, the phenocrysts being enclosed in a fine-grained groundmass. In thin section, the phenocrysts range up to 2.5 mm. across and the xenomorphic-granular groundmass has an average grain-size of 0.25 mm. Quartz (35%) is unstrained, and forms clustered phenocrysts that show some embayment. In the groundmass it is interstitial, but is enclosed by potash feldspar. Plagioclase (35%) is sodic oligoclase and forms tabular, moderately sericitized crystals in the groundmass and also occurs as phenocrysts. Interstitial potash feldspar (30%) is restricted to the groundmass, and is moderately kaolinized. Muscovite and sparse brown biotite form interstitial and poikilitic flakes. Accessory apatite and zircon are present.

R.12175 : Schorl-rock. This specimen represents part of a tourmaline-quartz segregation in the granite at the north-west end of Lizard Island. The thin section shows it to consist of coarse euhedral to anhedral tourmaline crystals intergrown with coarse quartz. Towards the edge of the segregation the tourmaline becomes more anhedral, and the quartz is more fine-grained. The tourmaline is mostly pleochroic in pale golden brown; some is smoky blue.

#### ALTANMOUI GRANITE

##### Granite Specimens

R.10212 : Porphyritic biotite micro-granite. West of track, one mile north of "Wakooka" Yards. The hand specimen is grey, speckled with black, and has very coarse feldspar phenocrysts enclosed in a medium-grained groundmass.

In thin section the phenocrysts measure up to 15 mm. long, and are enclosed in a groundmass that has an average grain-size of 1 mm. Perthite (45%) forms tabular, phenocrysts, and is sub-tabular to interstitial in the groundmass; it is slightly to moderately kaolinized. Quartz (35%) is anhedral and tends to be granular. It is cracked and slightly strained, and occurs mostly in the groundmass but forms a few phenocrysts. Plagioclase (15%) occurs as phenocrysts and in the groundmass; it forms slightly to moderately sericitized tabular crystals that are zoned from andesine to labradorite. Slightly chloritized biotite (5%) flakes are subhedral to anhedral, and are pleochroic from pale straw to red-brown. Small amounts of muscovite are associated with the biotite.

R.12168 : Porphyritic biotite adamellite. The specimen was collected from the Monument at Cape Melville; its aerial photograph location is Cape Melville run 2, photo 5019, point 555. The hand specimen is creamish-grey, porphyritic and coarse-grained; it is slightly stained by iron oxide. The feldspar phenocrysts measure up to 10 mm. long.

In thin section the phenocrysts are seen to be enclosed in a groundmass whose average grain-size is 3mm. Quartz (35%) is poikilitic, and shows slight strain shadows. Plagioclase (35%) is oligoclase; it forms tabular, slightly sericitized crystals that are sharply zoned to albite at their reins. Microcline-perthite (25%) is anhedral to tabular in the groundmass, and forms tabular, slightly kaolinized phenocrysts. In a few places it shows patchy replacement by albite. Biotite is slightly chloritized. Accessory minerals are apatite, black iron oxide, zircon, (?) orthite, and (?) rutile.

R.12169 : Porphyritic biotite micro-adamellite. Barrow Point; Cape Melville run 4, photo 5057, point 556A. The hand specimen is a pale, mottled-grey rock that is fine-grained and porphyritic. In thin section the phenocrysts are seen to range up to 5 mm. across, and to be enclosed in an hypidiomorphic-granular groundmass whose average grain-size is 0.8 mm. The rock consists of quartz (40%), perthite (35%), plagioclase (20%), biotite (4%), and muscovite (1%). Quartz occurs as rounded phenocrysts, and is poikilitic in the groundmass. Perthite forms sub-tabular to poikilitic crystals that are enclosed by quartz, and which are slightly kaolinized. Tabular phenocrysts and groundmass crystals of plagioclase are moderately sericitized; the phenocrysts have oscillatory zoning, and are composed of sodic andesine zoned to albite. Groundmass plagioclase is albite. Biotite phenocrysts are ragged tabular flakes that are, in places, intergrown with small amounts of muscovite. Biotite is pleochroic from very pale straw to dark red-brown, is slightly distorted, and is moderately chloritized. In the groundmass biotite forms stubby tabular books and very thin small flakes. Accessory black iron ore, apatite, and zircon are present.

R.13082 : Pegmatitic Aplite. Altanmoui Range; Cape Melville run 7, photo 5075, point 722. The hand specimen is a creamish-grey, fine to medium-grained aplitic rock containing segregations of coarse muscovite flakes and feldspar crystals. In thin section the rock is seen to be equigranular for the most part, with an average grain-size of 0.25 mm. The texture is saccharoidal and the rock consists of microcline (50%), quartz (35%), albite (15%), together with small amounts of muscovite and biotite. Small anhedral phenocrysts of quartz are sparse. A few pegmatitic segregations of microcline is graphic intergrowth with quartz are present; these range up to 20 mm. in diameter. Accessory zircon, apatite, and leucoxene are present.

R.13089 : Porphyritic hornblende-biotite adamellite. South-east end of the Melville Range; Cape Melville run 4, photo 5061, point 747B. The hand specimen is a medium to coarse-grained creamish-grey rock commonly containing bluish-grey feldspar phenocrysts. In thin section the phenocrysts are seen to measure up to 10 mm. long, and are enclosed in a groundmass whose grain-size ranges from 0.7 mm to 3.5 mm. The sparse phenocrysts consist of microcline-perthite; some show a relict zoning. In the groundmass, microcline-perthite is interstitial. Tabular, slightly sericitized crystals of plagioclase have in places shown oscillatory zoning; they are composed of sodic andesine zoned to sodic oligoclase. (These are the blue feldspar crystals.) Some plagioclase crystals tend to be intergrown with one another. Quartz is anhedral, and is enclosed by microcline perthite. Biotite is pleochroic from straw to dark brown, and forms subhedral flakes. Small amounts of subhedral, green hornblende are present. An estimate of the percentages of minerals present is :- plagioclase = 40, quartz = 30, microcline-perthite = 25, biotite = 25, hornblende = trace. Accessory minerals are zircon, acicular apatite, epidote, and black iron oxide.

R.13090 : Aplite. Emangin Creek valley; Cape Melville run 3, photo 5041, point 749. The hand specimen is a fine-grained, porphyritic, greyish-cream rock that contains small quartz phenocrysts. In thin section the aplite is seen to consist of microcline (55%), quartz (25%), albite (20%), and very small amounts of muscovite. Quartz forms small, rounded phenocrysts, 0.9 mm. in diameter. The groundmass has an average grain-size of 0.3 mm. in it are rounded grains of quartz, interstitial to tabular microcline, and sub-tabular albite. In some places, albite has partly replaced microcline. Accessory zircon and fine intergranular iron oxide dust are present.

R.14514 : Muscovite-biotite granite. Two miles north of "Wakooka" Outstation. The hand specimen is an aphyric, orange-cream, medium-grained rock which encloses several quartz-tourmaline segregations about 5 mm. in diameter. In thin section the specimen is seen to be hypidiomorphic-granular, and has an average grain-size of 1.3 mm. Aggregates of quartz (40%) forms areas of about 1 to 1.5 mm. diameter, which poikilitically enclose tabular perthite (45%); in one or two places, perthite crystals are brecciated, and the interstices to the crystal fragments are filled with optically continuous perthite. Tabular albite crystals (15%) have moderately sericitized cores. Muscovite (trace) forms tabular flakes that enclose perthite; its textural relationship to fractured perthite (see above) suggests that it crystallized after some movement fractured the perthite crystals. Biotite (trace) occurs as ragged flakes enclosed by perthite. Accessory zircon, black iron oxide, and apatite are present.

R.14516 : Deformed granitic rock. Altanmoui Range; Cape Melville run 7, photo 5075, point 721B. In hand specimen, coarse-grained foliated granite is seen in contact with a fine-grained dark grey sediment. In thin section the granite is seen to be strongly deformed. Quartz forms lenticular, strongly strained grains that are marginally granulated. Sub-tabular sodic plagioclase is micro-fractured; sericitization has taken place on crystal margins and the fractures. Microcline-perthite occurs as strained sub-tabular crystals. Muscovite and biotite are interstitial. Some porphyroblastic brown tourmaline is present. Inclusions of sedimentary material consist of mosaic quartz, with small amounts of biotite and muscovite forming randomly oriented flakes.

D55/9/1 : Porphyritic muscovite-biotite adamellite. Between the mouth of Wakooka Creek and Altanmoui Range; Cape Melville run 6, photo 5035. (Age determination Sample) The hand specimen is pale blue-grey and is strongly porphyritic; phenocrysts of feldspar and quartz measure up to an inch in length, and are enclosed in a medium-grained groundmass.

The phenocrysts, in thin section, consist of microcline-perthite, quartz, and plagioclase. Quartz phenocrysts are subhedral, and have outgrown margins that poikilitically enclose groundmass grains. Roughly tabular microcline-perthite crystals also have somewhat outgrown margins; they show slight kaolinization. Plagioclase phenocrysts are zoned from An<sub>25</sub> to albite, and are moderately to strongly sericitized. The groundmass has an average grain-size of 0.8 mm, and is composed of tabular plagioclase, tabular to poikilitic microcline-perthite, subhedral to poikilitic quartz, sub-tabular partly chloritized biotite, and a few flakes of muscovite.

An estimate of the percentages of minerals is :-  
quartz = 50, microcline-perthite = 25, plagioclase = 25, and trace amounts of biotite and muscovite. Accessory zircon, apatite, and black iron ore are present.

#### Hornfels Specimens

R.12171 : Hornfelsed microgranite porphyry. One mile south-west of Barrow Point; Cape Melville run 4, photo 5057, point 556C. In hand specimen the rock is a creamish-white, leucocratic, fine-grained acid porphyry. In thin section the phenocrysts range up to 3 mm. across, and the groundmass is found to have an average size of 0.1 mm. The rock consists of quartz (40%), potash feldspar (40%), plagioclase (15%), muscovite (3%), and andalusite may be seen; in places, andalusite is partly or completely replaced by sericite. Plagioclase (oligoclase) is roughly tabular; it contains granular inclusions of quartz. The phenocrysts consist of quartz, and are made up of grain mosaics. Accessory sphene and black iron ore are present.

R.12172 : Andalusite-quartz-muscovite hornfels. One mile south-west of Barrow Point; Cape Melville run 4, photo 5057, point 556D. In hand specimen the rock appears to consist of pale creamish-grey banded shale and siltstone; on some surfaces it shows fine crenelation due to a false cleavage. In thin section the rock is found to have an average grain-size of 0.08 mm. For the most part the specimen consists of fine, recrystallized sericite with a few scattered quartz grains. The muscovite has recrystallized along the original fine bedding lamellae. Sparse small poikiloblastic porphyroblasts of andalusite, ranging up to 0.6 mm. across, may be seen. Some very thin beds of quartz siltstone are present, and accessory idioblastic brown biotite is associated with them.

R.13080 : Hornfelsed sandstone. Altanmcui Range; Cape Melville run 7, photo 5075, point 721A. The hand specimen is mottled cream, speckled with black, and is medium to coarse-grained. The thin section suggests that the rock is a strongly metamorphosed sandstone. Grains of quartz and (?) chert range from 0.3 to 1.0 mm. in diameter, and are roughly rounded. The larger quartz grains have been recrystallized to form a coarse mosaic of grains, the individual grains in any one group having an average size of 0.25 mm. The (?) chert grains have recrystallized to form mosaics of fine-grained quartz (average grain-size 0.02 mm), which contain small flakes of randomly oriented brown biotite. A few grains of recrystallized plagioclase are present. Small poikiloblastic porphyroblasts of plagioclase and microcline have grown in the quartz-mica matrix. The rock is cut by a vein, 1.5 mm. thick, formed of microcline, sodic plagioclase, and quartz; the average grain-size of the minerals in the vein is 1 mm.

R.13081 : Hornfelsed sandstone. The locality is the same as for R.13080, except that the point number is 721B. The hand specimen is a hard, medium-grained sandstone that is cut by a vein of pale cream, medium-grained granitic material. In thin section the hornfelsed sandstone has a similar texture to R.13080, except that the grain-sizes are somewhat smaller.

The vein is an aplitic micro-granodiorite; it has an average grain-size of 0.5 mm, and is somewhat granular; it consists of oligoclase, quartz, microcline-perthite, and small amounts of muscovite and dark smoky-brown biotite. The biotite in the hornfels is red-brown.

The contact with the hornfels is sharp; fine flakes of muscovite have been formed in the hornfels in a zone about 5mm. thick adjacent to the contact.

R.13088 : Epidote-hornblende-plagioclase hornfels : South-east Melville Range; Cape Melville run 4, photo 5061, point 747A. The hand specimen is hard, dark grey, and fine-grained, and show fine lamination. In thin section, about 60% of the rock is seen to consist of granoblastic, untwinned, intermediate plagioclase with an average grain-size of 0.05 mm. Most of the remainder is composed of subidioblastic grains of brown hornblende. The hornblende forms thin folia, each about 0.2 mm. thick, the individual grains are about 0.15 mm. in diameter, and are crystallographically oriented obliquely to the foliation. The hornblende is pleochroic :- X - pale straw, Y = Z = brown. Some clinozoisite is intergrown with the hornblende. Octahedral black iron ore is present. The specimen is probably a metamorphosed basic igneous rock.

R.14511 : Altered chialstolite hornfels. South-east of Wakooka Creek mouth. Cape Melville run 6, photo 5035, point 734. The hand specimen is a creek pebble of hard grey rock containing tabular chialstolite prisms between 1 and 10 mm. long. Zones of dark grey material, about 1 to 2 mm. thick, surround most of the chialstolite prisms, are somewhat more coarse-grained than the remainder of the groundmass.

In thin section the chialstolite prisms are seen to be completely sericitized. They do, however, have the typical zonal arrangement of inclusions - these now consist of fine iron oxide dust and biotite flakes. The groundmass is composed mostly of fine sericite flakes, together with granular quartz and some biotite flakes; the average grain-size is 0.015 mm. Much opaque dust, average size 0.002 mm. is also present. The zones around the chialstolite prisms have much the same composition, but are somewhat coarser-grained about 0.08 mm. In some places, however, the zones are more quartz-rich.

R.14512 : Hornfelsed greywacke and mudstone. Temple Creek; Cape Melville, run 3, photo 5041, point 750B. In hand specimen, a somewhat weathered, coarse-grained granitic rock is seen in contact with granular sandstone. About two inches from this contact, the sandstone has a very irregular contact with a fine-grained ferruginous sediment.

In thin section, the sandstone is seen to have an average grain-size of 0.5 mm. It is composed of roughly equigranular, sub-rounded to sub-angular quartz grains that have a high sphericity. The rock has an open texture, the intergranular spaces being filled with a recrystallized matrix composed mostly of sericite, with, in some places, small amounts of biotite. The sericite flakes in the matrix range from 0.1 mm. to 0.6 mm. in length, and are intergrown with quartz.

The fine ferruginous material is seen, in section, to be a hornfelsed mudstone, and has an average grain-size of 0.05 mm. It is composed of fine sericite and some granular quartz. Lath shaped, randomly oriented flakes of ferruginous and chloritized biotite are also present; these become more ferruginous towards the contact with the sandstone.

R.14513 : Hornfels. South of Eumangin Creek; Cape Melville run 3, photo 5043, point 751. The specimen consists of interbedded biotite-muscovite-quartz hornfels and quartz-muscovite-biotite hornfels.

The hand specimen is a somewhat ferruginous and friable rock consisting of thin beds of quartzose and micaceous material; rodding on a weathered surface is due to the intersection of bedding planes and false cleavage planes. A vein of micaceous aplite, about an inch thick, cuts the specimen obliquely to both the bedding and the false cleavage.

In thin section the quartzose layers are seen to consist of an inequigranular mosaic of quartz grains and small amounts of randomly oriented flakes of biotite and muscovite. The average grain-size is 0.1 mm. and the layers are 3 to 4 mm. thick. They are separated by micaceous layers that range from 1 to 20 mm. in thickness, and which consist of fine muscovite, biotite and quartz.

R.14515 : Muscovite-quartz hornfels. "Muck River" track; Cape Melville run 4, photo 5061, point 755. The hand specimen is a rust-coloured, fine-grained siliceous rock in which folded beds are seen to be 2 to 3 mm. thick. The rock is cut by quartz veins ranging from 1 to 10 mm. in thickness. In thin section the rock is found to be composed mostly of a mosaic of quartz grains whose sizes range from 0.03 mm. to 0.1 mm.; a few grains are 0.8 mm. in diameter. Some thin contorted beds, about 1 mm. thick, are composed of muscovite and small amounts of biotite.

R.14517 : Andalustic-cordierite-quartz-muscovite hornfels. Altamoui Range; Cape Melville run 7, photo 5075, point 724. The hand specimen is a dark grey, fine-grained rock, and has on its weathered surface numerous small pits suggesting that some mineral has been weathered out. In thin section, numerous poikiloblastic cordierite porphyroblasts, about 0.8 mm. across and some ididioblastic andalusite porphyroblasts are enclosed in a matrix composed of granular quartz and muscovite flakes, together with small amounts of biotite. The average matrix grain-size is 0.02 mm. Some opaque dust is present, and accessory apatite was noted.

R.14525 : Biotite-chlorite-muscovite-quartz hornfels. Altamoui Range; Cape Melville run 7, photo 5075, point 721A. The hand specimen is a pale grey, slightly ferruginous, very friable, and fine-grained rock showing a slight fine lamination. In thin section the specimen is seen to have an average grain-size of 0.05 mm. and to consist of a fine mosaic of quartz grains together with about 10% of randomly oriented chlorite flakes. Relict bedding is indicated by a few layers in which biotite and chlorite are concentrated to form 40% of material. Some biotite is present in a few places, and appears to have developed from chlorite due to progressive metamorphism. In some places, small porphyroblasts of muscovite are present. Scattered grains of golden brown, poikiloblastic tourmaline were observed; some minute grains of this mineral are also present. Other accessory minerals noted are granular leucocoxene, apatite and zircon.

#### MINOR INTRUSIVES

R.12170 : Granophyric and porphyritic biotite micro-adamellite. One mile south-west of Barrow Point. Cape Melville run 4, photo 5057, point 556B. In hand specimen the rock is grey, and has an aphanitic groundmass enclosing phenocrysts, measuring up to 20 mm. across, of feldspar, quartz and mica. In thin section the phenocrysts are seen to be embedded in a granophyric groundmass that has an average grain-size of 0.1 mm. The groundmass consists mostly of granophyrically intergrown quartz and slightly kaolinized alkali feldspar, together with subordinate tabular sericitized plagioclase, and flakes of chlorite. The phenocrysts consist mostly of clustered, slightly embayed and sericitized plagioclase (sodic andesine zoned to albite), with smaller amounts of biotite, and sparse quartz. The biotite is pleochroic from straw to fox-brown, and is somewhat distorted. A rough estimate of the percentages of minerals present is : quartz - 35, alkali feldspar - 35, plagioclase - 25, and biotite - 5.

R.13077 : Porphyritic chloritized micro-adamellite. Cape Melville run 9, photo 5055, point 714A. The hand specimen is a hard, grey porphyry. The phenocrysts, which measure up to 5mm. across, are enclosed in an aphanitic groundmass which, in thin section, is seen to have an average grain-size of 0.08 mm. The phenocrysts consist of embayed quartz, tabular, almost completely sericitized plagioclase, and completely chloritized biotite. The groundmass contains tabular plagioclase and interstitial quartz and alkali feldspar, together with some flakes of completely chloritized biotite. Quartz and alkali feldspar form micrographic intergrowths. Some amygdale-like structures contain chlorite and carbonate; carbonate also forms a minor alteration product of plagioclase. Accessory prismatic apatite is present. A rough estimate of the percentages of minerals present is : plagioclase - 45, quartz - 25, alkali feldspar - 25, chlorite and carbonate - 5.



R.14524 : Porphyritic chloritized biotite microgranodiorite. Thirty miles north-west of "Starcke". Cape Melville run 9, photo 5055, point 714. The hand specimen is grey, mottled with green, and contains numerous phenocrysts of quartz, feldspar and some ferric minerals, enclosed in a fine groundmass.

In thin section the phenocrysts are seen to range from 0.26 mm. to 6.5 mm.; the groundmass grain-sizes range between 0.05 mm. and 0.1 mm. The phenocrysts consist of rounded and embayed quartz, tabular, moderately to strongly sericitized plagioclase, some slightly to moderately kaolinized orthoclase, and completely chloritized biotite. Some prehnite is intergrown with chlorite. The groundmass contains granular quartz, tabular plagioclase, interstitial potash feldspar and flakes of chlorite and muscovite. Zircon, leuoxene, and epidote are accessory. An estimate of the percentages of minerals present is :- plagioclase - 50, quartz - 30, orthoclase - 20, with small amounts of chlorite and muscovite.

R.14601 : Silicified acid porphyry. "Mumburra", Starcke Goldfield. The specimen represents the porphyry dykes which are closely associated with the auriferous quartz lodes. The hand specimen is a medium to fine-grained, creamish white rock that is somewhat stained by iron oxide, and which is cut by ferruginous veins. A few rounded quartz phenocrysts may be seen.

In thin section the quartz phenocrysts are seen to measure about 1 mm. across. At first sight the matrix is apparently of sericite and quartz occurring interstitially to them. Close examination shows each of the apparent spherulites to be composed of a single grain of quartz, the arrangement of minute inclusions in the grain suggesting that the quartz is pseudomorphing spherulitic structures. The specimen is cut by veins, up to 2.5 mm. thick, containing quartz and small amounts of hydrated iron oxide.

#### REMARKS

The Puckley Granite specimens described here are petrographically fairly similar to those, described by the writer (1964) of Puckley Granite in the Cooktown 1:250,000 sheet area; they are adamellites containing potash feldspar, fairly calcic plagioclase, and biotite; little or no muscovite is present. Likewise, the granitic specimens from Lizard Island are fairly similar to the Finlayson Granite in the Annan River Tinfield area. However, in the case of the Lizard Island specimens, an absolute correlation with the Finlayson Granite would be hard to make without some method more positive than thin section examination.

From the few specimens available for examination, it seems possible that the Altanmoui Granite intrusions form a complex with a variety of types ranging between muscovite-bearing and hornblende-bearing granitic rocks. If detailed mapping of the Altanmoui Granite outcrops is ever carried out, it is possible that the intrusives would be divided into two or more separate petrographical and stratigraphical units. There have been too few specimens described so far for any conclusions to be made.

The minor intrusive rocks are all acid porphyries, ranging between micro-adamellite and micro-granodiorite. One silicified porphyry was described.

All except one of the hornfels specimens are of low-grade metamorphosed Hodgkinson Formation sediments and a minor intrusive rock, and are referable to the albite-epidote hornfels facies. The one exception, R.13088, from the Melville Range, has been metamorphosed to the hornblende-hornfels facies; subsequent diaphthoresis resulted in epidote's forming in this rock.

MESOZOIC ROCKSINTRODUCTION

In the area of the Laura Basin two formations of Mesozoic sediments are present - the Dalrymple Sandstone of Jurassic age, and the Cretaceous Battle Camp Formation. Descriptions of specimens from both formations, and of pebbles enclosed in the sediments, are given in the following pages. The account is divided into two main parts, one for each formation; each part is sub-divided into two sections, one dealing with the sediments, and the other with pebbles.

DALRYMPLE SANDSTONE - JURASSICSediments

R.12728 : Quartz Sandstone. Cooktown run 3, photo 5009, point 671. The hand specimen is a pinkish-cream, coarse-grained, rather friable sandstone with small clots of interstitial argillaceous material. In thin section the grain-sizes are seen to range between 0.25 mm. and 1.3 mm. The grains consist mostly of sub-rounded to rounded quartz (with moderate strain shadows), together with a few chert grains. The cement is mostly in the form of silica outgrowths on quartz grains; small amounts of interstitial argillaceous material are present.

R.13076 : Micaceous sandstone. West of Jeannie River; Cape Melville run 9, photo 5055, point 710. The hand specimen is a hard, purple-grey, medium-grained micaceous sandstone. The thin section shows it to have an average grain-size of 0.3 mm, and to consist of angular to sub-angular grains enclosed in a fairly sparse argillaceous matrix. The grains consist mostly of quartz; some chert, muscovite, and biotite are also present. Accessory minerals are apatite (enclosed in quartz), sphene, zircon, and green tourmaline.

R.13078 : Ferruginous argillaceous and micaceous sandstone. Altarmoui Range; Cape Melville run 7, photo 5075, point 718A. The hand specimen is of a medium to fine-grained olive-green sandstone. In thin section the rock is seen to be inequigranular, with grain-sizes ranging between 0.025 mm. and 1.4 mm. The angular to sub-angular grains are enclosed in a fairly abundant ferruginized argillaceous matrix. The grains consist mostly of slightly to moderately strained quartz, together with small amounts of chert, microcline, and muscovite. Accessory pale green to blue-brown tourmaline is present.

R.14507 : Quartz greywacke. Upper Deighton River; Cooktown run 5, photo 5047, point 817. The hand specimen is of a dark grey, medium-grained, faintly laminated sandstone. In thin section, angular quartz grains, some rounded chert grains and a few distorted flakes of chlorite and muscovite are seen to range between 0.03 and 0.3 mm, and to be enclosed in an abundant fine-grained matrix. A few iron oxide grains are present. The matrix consists of fine quartz, clay minerals, and hydrated iron oxide; some cavities are filled with brownish chloritic material. Thin veins containing hydrated iron oxide cut the rock.

R.15064 : Quartz sandstone. West side of Bay Hill; Cape Melville run 3, photo 5037, point 812. The hand specimen is of a pale pinkish-white, inequigranular sandstone containing some mica flakes and some interstitial cream argillaceous material. It is rather similar to some Cretaceous specimens (R.15048/9/59, described on pages 17 and 18); however, it is more micaceous than R.15048 and R.15059.

The thin section shows the specimen to be inequigranular, the grain-sizes ranging up to about 4mm. The sub-angular to sub-rounded grains consist mostly of moderately strained quartz, together with small amounts of chert, meta-quartzite, metamorphic quartz siltstone, and muscovite. Some interstitial argillaceous material is present. In general, the rock has rather more muscovite, the quartz is more strained, and the rock is more inequigranular than the Cretaceous specimens referred to above.

### Pebbles

Both the pebble specimens described here were collected from a conglomerate bed in the Dalrymple Sandstone on Flinders Island. The aerial photograph reference is Cape Melville, run 1, photo 5007; R.12166 is from point 538A, and R.12167 is from point 538B. Both points are on the western spur at the northern end of the island.

R.12166 : Tourmalinized andalusite-quartz-muscovite hornfels. In hand specimen the pebble is a hard, fine-grained dark grey rock showing a faint layering; it is cut by a few contorted pink siliceous veins that measure 1 to 3 mm. in thickness. In thin section the specimen is seen to be a metamorphosed thin-bedded and false-cleaved siltstone-slate rock. It contains layers of fine-grained sericite, the recrystallized flakes, 0.1 mm. in size, being parallel to the original bedding laminae. Small subhedral crystals of greenish brown tourmaline are present in fair amount in the sericite layers. Tabular areas of fine sericite, 1.2 mm. across, represent pseudomorphed andalusite. Granoblastic quartz occurs in layers 1.8 mm. thick; these layers are graded, and the grain-sizes range from 0.08 mm. at one side of the slide to 0.03 mm. at the other.

R.12167 : Silicified porphyry. In hand specimen the pebble is seen to be a pale olive-cream porphyritic rock in which phenocrysts of weathered feldspar and some quartz are enclosed in a very hard, aphanitic groundmass. The thin section shows the rock to consist of an equigranular mosaic of quartz grains, 0.4 mm. across, enclosing very fine sericite flakes and opaque dust. The sparse phenocrysts consist of tabular crystals of completely sericitized feldspar, and pellucid, embayed quartz crystals.

Remarks: The hornfels pebble probably represents hornfelsed sediment eroded from the Hodgkinson Formation, and suggests the presence of Upper Palaeozoic granitic rocks underlying the Dalrymple sandstone in the vicinity of Flinders Island. The silicified porphyry is probably an altered volcanic eroded from the Hodgkinson Formation.

### BATTLE CAMP FORMATION - CRETACEOUS

#### Sediments

R.13079 : Quartzite. Altamouli Range; Cape Melville run 7, photo 5075, point 718B. The hand specimen is a medium-grained, slightly friable, white quartzite which, in thin section, is seen to be fairly equigranular with an average grain-size of 0.5 mm. It consists almost entirely of sub-angular to sub-rounded quartz grains; small amounts of chert are present. The rock is cemented by silica outgrowths on quartz veins. Accessory sub-angular, faintly green zircon is present. Rutile, apatite, and euhedral zircon form inclusions in quartz.

R.14552 : Silty shale. Fifteen miles south-east of Laura; Cooktown run 6, photo 5059. The hand specimen is a fine-grained, fairly soft, creamish-white rock; a somewhat irregular and lenticular ferruginous layering is present. In thin section, angular grains of quartz ranging from 0.002 mm. to 0.4 mm. in diameter, and some minute, aligned sericite flakes, form 20 to 25% of the rock and are embedded in a matrix formed of exceedingly fine-grained argillaceous material. A bedding effect is given by some layers that contain fine hydrated iron oxide dust; the layering is roughly parallel to the alignment of the muscovite flakes.

R.15046 : Glauconitic calcareous sandstone. Cape Melville 1:250,000 sheet area; Normanby River crossing, north-east of "Lakefield". The hand specimen is a hard, dark greenish-grey, medium-grained sandstone; a few flakes of mica and a granitic pebble are present.

In thin section, angular to sub-angular, and rounded grains with an average grain-size of 0.15 mm. are seen to form about 50% of the rock, and are embedded in a granular matrix of calcite. The grains consist mostly of angular quartz and roughly tabular, partly carbonated sodic plagioclase; rounded glauconite grains, some flakes of muscovite, grains of sericite and ferruginous meta-quartzite, ferruginous slate, fine intermediate volcanic material, and a single grain of hornblende are also present. The glauconite forms about 5% of the rock. The rock has a somewhat tuffaceous appearance that could have resulted from the erosion of an older tuff of the Permian volcanics that are known in the region.

R.15047 : Glauconitic calcareous sandstone. South of "Battle Camp"; Battle Camp run 2, photo 45, point 1612. The hand specimen is a dark greenish-grey, medium-grained pebbly sandstone. In thin section this specimen is very similar in appearance to R.15046; however, it contains more quartz and less plagioclase and glauconite. Pebbles of altered vitric tuff, meta-quartzite, and some (?) glauconitic material are present. The average grain size is 0.23 mm. and the calcite matrix forms about 40% of the rock.

R.15048 : Quartz sandstone. Flinders Peak, Flinders Island; Cape Melville run 1, photo 5007, point 539. The hand specimen is a pale creamish-white, slightly ferruginous, coarse-grained sandstone. In thin section the rock is seen to be inequigranular, the grain-sizes ranging between 0.5 mm. and 3 mm. The grains are sub-rounded to sub-angular, and are cemented by silica outgrowths, together with small amounts of argillaceous material. They tend to be multiple, and consist mostly of quartz, with small amounts of chert, sodic plagioclase, fine siltstone (probably metamorphic), meta-quartzite, and potash feldspar. Minor quantities of interstitial hydrated iron oxide dust are present.

R.15049 : Quartz sandstone. South-west end of Blackwood Island, Flinders Group. Cape Melville run 2, photo 5027, point 547. The hand specimen is similar in appearance to R.15048; a few flakes of white mica are present, and the rock is rather more ferruginous. The thin section is also fairly similar to that of R.15048, except that a few flakes of muscovite and biotite are present, and that there is a larger quantity of quartz.

R.15054 : Lithic and feldspathic sandstone. Jeannette Hill; Cape Melville run 7, photo 5063, point 601. The hand specimen is a somewhat friable, burrowed, buff-brown, medium-grained sandstone in which a few flakes of mica can be seen. In thin section the sandstone is seen to be fairly equigranular, with an average grain-size of 0.13 mm. In general, the grains are angular to sub-angular; 75% of them are quartz, and the remainder consist of plagioclase, potash feldspar, micaceous siltstone, chert, pale biotite, altered basic volcanic material, and slate. Interstitial ferruginous argillaceous material is not abundant; some silicification is indicated by outgrowths on some of the quartz grains. Accessory brown tourmaline is present.

R.15055 : Calcareous sandstone. Jane Table Hill; Cape Melville run 7, photo 5063, point 602A. The hand specimen is a hard brownish-grey, medium-grained sandstone containing some fine-grained, dark grey lenticles and bands about 2 to 10 mm. thick. In thin section the specimen is seen to be fairly similar to R.15046 and R.15047. It has an abundant granular calcite matrix that forms about 60% of the rock, and in it are set angular to sub-angular grains that have average grain-size of 0.12 mm. The grains consist mostly of quartz, but small amounts of plagioclase, feldspar, perthite, chert, biotite, and muscovite are present. The fine-grained layers noted in the hand specimen are formed of roughly spherulite-like growths of carbonate, and probably represent a somewhat recrystallized calcite mudstone.

R.15057 : Ferruginous, calcareous and micaceous sandstone. South end of Bathurst Range; Cape Melville run 6, photo 5047, point 611A. The hand specimen is a fine-grained, cross-laminated greyish-purple micaceous sandstone. In thin section the rock is seen to be equigranular, and has an average grain-size of 0.13 mm. The grains are sub-angular to angular. Quartz forms about 80% of the rock; the remainder consists of muscovite, biotite, micaceous siltstone, and feldspar. The matrix, forming about 5% of the rock, consists of calcite, hydrated iron oxide, and some argillaceous material. Accessory zircon and green tourmaline are present.

R.15058 : Lustre-mottled sandstone. South end of Bathurst Range; Cape Melville run 6, photo 5047, point 611B. The hand specimen is a pale buff fine-grained micaceous sandstone showing a slight ferruginous banding. Fresh surfaces have a dull sheen due to the optical continuity of the calcite matrix. In thin section the texture of the rock is seen to be similar to that of R.15046/7 and R.15055 in that angular to sub-angular sand grains, of average grain-size of 0.13 mm, are enclosed in a calcite matrix forming about 60-70% of the rock. However the matrix in the other specimens is formed of fine to medium-grained granular calcite; in this specimen the calcite forms grains about 4 or 5 cm. in diameter that "poikilitically" enclose the sand grains.

The grains consist mostly of quartz; biotite, muscovite, hematite, (?) glauconite, slate, and partly carbonated feldspar are also present. Accessory minerals are zircon, green tourmaline, and brown tourmaline.

R.15059 : Slightly argillaceous quartz sandstone. Five miles north-west of "Wakooka" Out-station; Cape Melville run 6, photo 5039, point 738C. The hand specimen is a rather friable, slightly ferruginous creamish-white, medium to coarse sandstone. In thin section the average grain-size is seen to be about 0.65 mm. The rock consists almost entirely of sub-rounded to sub-angular quartz grains, but some chert and meta-quartzite are also present. The cement is composed mostly of silica outgrowths on quartz grains and the remainder is argillaceous material. Very minor quantities of acicular apatite, prismatic greenish zircon, and acicular brown zircon form inclusions in quartz; one sub-rounded brown tourmaline grain was observed.

R.15060 : Highly ferruginous sandstone. Five miles north-west of "Wakooka" Out-station; Cape Melville run 6, photo 5039, point 738B. The hand specimen is a very friable, ferruginous sandstone containing some sparsely oolitic layers. In thin section the rock is seen to contain angular to sub-angular grains, ranging from 0.1 to 1.2 mm, enclosed in a limonitic matrix that forms about 30% of the rock; some chalcedony and argillaceous material are also present in the matrix. The grains consist of quartz and very minor quantities of meta-quartzite, chert, and siltstone, and some flakes of muscovite. A few round ooliths of chamositic material are present.

R.15061 : Highly ferruginous sandstone. Cooktown run 4, photo 5043, point 762. The hand specimen is a fairly hard, dark reddish-brown, ferruginous sandstone. In thin section angular to sub-angular grains, with an average size of 0.65 mm, are seen to be enclosed in an abundant matrix of hydrated iron oxide, argillaceous material, and some chalcedony. The grains have fretted margins as though some corrosion has taken place. They consist of quartz, some chert, a few flakes of muscovite and biotite, very sparse plagioclase, and a few grains of probable glauconite.

R.15062 : Argillaceous sandstone. Hills north-west of "Koolburra". Hann River run 5, photo 5159, point 770. The hand specimen is a pale creamish-grey, slightly friable, laminated sandstone. In thin section the sand grain-sizes are seen to range from 0.03 mm. to 0.6 mm. The grains are angular to sub-angular, and consist mostly of quartz; some chert, microcline, meta-quartzite, and intermediate volcanic grains, and muscovite flakes, are also present. They are enclosed in a very abundant matrix composed of roughly alternating layers, a few millimetres thick, consisting of brown montmorillonite and pale brown kaolinite. The layers are somewhat contorted.

R.15063 : Glauconitic sandy shale. Near Paradise Creek; Hann River run 2, photo 5103, point 800. The hand specimen is a pale grey, slightly ferruginous and somewhat micaceous, fine-grained rock. The thin section shows a few grains of quartz, glauconite, and some flakes of muscovite and biotite, ranging between 0.03 mm. and 0.4 mm.; they form about 5 to 10% of the rock, and are embedded in an entirely argillaceous matrix (? kaolinite) which has been reconstituted, and shows uniform extinction over the area of the thin section.

R.15065 : Ferruginous quartz sandstone. East side of Bathurst Heads; Cape Melville run 4, photo 5067, point 814. The hand specimen is a coarse, slightly friable quartz sandstone. The rock is inequigranular, and grains range up to 4mm. in diameter. In thin section the rock is seen to be composed mostly of sub-angular grains of quartz; other grains noted are chert, muscovite, sheared quartzite, and potash feldspar. The cement is mostly silica, which forms outgrowths on quartz grains; some iron oxide and argillaceous material are also present as cement. A few rounded (?) glauconite grains are also present.

#### Pebbles

R.15051 : Felsite pebble. Laura River, one mile upstream from crossing south-east of Laura. Cooktown run 6, photo 5061, point 591A. The pebble, in hand specimen, is a white-cream aphanitic rock that has a chalk-like appearance, but which is fairly hard. In thin section the rock is seen to be exceeding fine-grained (average grain-size of 0.002 mm.). It is composed of intergrown quartz and (?) sericite. Some fine ferruginous material is present, and the rock is cut by thin ferruginous veins.

R.15052 : Silicified porphyry pebble. Laura River, about two miles south-east of Laura; Cooktown run 6, photo 5061, point 591B. The hand specimen is a hard, fine-grained porphyry in which feldspar phenocrysts, which range up to 3mm. across, are altered to a clay mineral. In thin section the groundmass is seen to be composed mostly of an inequigranular mosaic of somewhat intergrown quartz grains that range in size from 0.05 mm. to 0.4 mm. Some fine iron oxide and interstitial sericite are present. The phenocrysts are pseudomorphed by clay minerals. Zircon is the only primary accessory mineral.

R.15053 : (?) Devitrified ignimbrite pebble. Locality as for R.15052, point 5910. The hand specimen is a very fine-grained, pale green, rather soft porphyritic rock. In thin section the sparse phenocrysts range up to 0.75 mm. in diameter, and consist of embayed quartz and silicified (?) feldspar. They are enclosed in a very fine-grained devitrified and somewhat silicified chloritic and sericitic groundmass showing a relict flow-like texture rather similar to ignimbritic eutaxitic texture. Accessory zircon is present.

R.15056 : Schorl-rock pebble. Walker's Hill, north of Lakefield; Cape Melville run 9, photo 5039, point 605. The hand specimen is pink mottled with black, and is a hard, medium-grained rock. In thin section an inequigranular mosaic of quartz grains that are intergrown with clusters of radially arranged, very pale green acicular tourmaline crystals. The quartz grains range between 0.3 and 1 mm. across. Accessory sphene and zircon were noted, and fine hematite dust is present.

#### REMARKS

In general, the rocks from both formations have fairly similar characteristics. The sandstones are inequigranular to equigranular, and have sub-angular to sub-rounded grains, suggesting that moderately rapid erosion and deposition took place. The sandstone grains and conglomerate pebbles have been derived from a variety of sources - Lower Palaeozoic sediments and Upper Palaeozoic granites and volcanics; some grains also appear to have derived from fairly low-grade dynamically metamorphosed rocks. No grains obviously derived from the (medium-grade) Dargalong Metamorphics were observed.

#### CENOZOIC ROCKS

Included in this part are descriptions of a ferricrete capping (R.12732), a basalt pebble (R.12726) contained in Cainozoic gravels, two basaltic rocks from Cainozoic lavas in the Starcke River area (R.12731 and R.14530), and a schorl-rock pebble from Recent gravels in the Laura River (R.15050).

R.12726 : Basalt pebble. Quarter of a mile west of the Laura road, 8 miles west of "Butcher's Hill". Cooktown run 8, photo 5035, point 691A. The pebble comes from a gravel which has been included in the McLean Basalt. In hand specimen the pebble is strongly weathered; it consists of a thick envelope of ferruginous material enclosing, at the centre, a small core composed of fresh, dark grey, fine-grained basalt. In thin section, the rock is seen to consist of small porphyritic crystals measuring about 1mm. across, composed of partly iddingsitized olivine, clusters of small prisms of colourless augite, and a few octahedra of magnetite, enclosed in brown glass; the glass forms more than 75% of the rock, and is partly altered to palagonite. A few amygdalae containing zeolitic material are present. Some euhedral crystals of apatite, measuring 0.7 mm. by 0.1 mm. are present in the amygdalae. The pebble, in all probability, results from erosion of the Cainozoic alkaline basalts that occur in the neighbourhood of this locality.

R.12731 : Xenolithic olivine basalt. Four miles south of "Mumburra"; Cape Melville run 12, photo 5011, point 631. In hand specimen the basalt is fine-grained and porphyritic; phenocrysts of pale green olivine range up to 2mm. across. Some ultramafic inclusions, measuring up to about an inch in diameter, have thin reaction rims.

In thin section the basalt is seen to consist of calcic plagioclase laths measuring about 0.13 mm. by 0.03 mm., augite prisms 0.03 mm. across, and small prophyritic crystals of olivine 0.3 mm. in diameter, together with octahedral black iron oxide and interstitial glass. Carbonate and chlorite are present in the amygdales.

The xenolithic inclusions consist of single and intergrown grains of olivine, clinopyroxene, and orthopyroxene. Some grains of orthopyroxene have clinopyroxene exsolution lamellae; commonly orthopyroxene grains have reaction rims of finely intergrown olivine and clinopyroxene. Small amounts of olive-green spinel were seen to be associated with one inclusion.

R.12732 : Pisolitic sandy ironstone. One mile south of the new "Battle Camp" road; Cooktown run 3, photo 5007, point 661. The specimen comes from ferricrete capping on a Jurassic Dalrymple Sandstone outcrop. In hand specimen is an aggregate of coarse ferruginous pisolite which range up to 1 inch in diameter.

In thin section the pisolites are seen to consist of hydrated iron oxide. A few grains of quartz, 0.3 mm. in diameter, are present, but none appear to have acted as cores for the pisolites. The pisolites range down to 0.2 mm. in diameter, and the interstices between them are filled with hydrated iron oxide, and in places, silty argillaceous material. Some chalcedony also occurs in a few cavities.

R.14530 : Nepheline basanite. Starcke River, about four miles south of "Mumburra". The hand specimen is a dark grey, fine-grained, sparsely vesicular rock. In thin section, the specimen is seen to contain a few prophyritic crystals of somewhat embayed olivine, measuring up to 0.5 mm. enclosed in a fine matrix composed of randomly oriented pale green augite prisms about 0.1 mm. long by 0.02 mm. wide, octahedral grains of black iron oxide 0.003 to 0.03 mm. across, and some tabular crystals of nepheline, 0.05 mm. across. All these minerals are enclosed in a pale brown glass that makes up 50% to 60% of the rock. The nepheline crystals are euhedral against the glass, but partly enclose augite and black iron oxide. A few amygdale-like pockets contain strongly ferruginous, dark brown palagonite which encloses sparse microlites of augite and (?) plagioclase; the rims of these amygdales are lined with tabular nepheline crystals. Small cavities within the amygdales are filled with carbonate surrounded by a thin lining of analcite.

R.15050 : Schorl-rock. One mile south-east of Lura (Cooktown 1:250,000 sheet area). Pebble from recent deposits in the Laura River. The pebble, in hand specimen, consist of very hard, medium-grained, mottled greyish-black material. In thin section it is seen to be formed of inequigranular anhedral quartz grains, ranging from 0.3 mm. to 1 mm. across together with segregations of felted, sub-radially arranged acicular tourmaline. The tourmaline is, in places, intergrown with quartz in such a manner as to suggest that it has replaced feldspar in graphic intergrowth with quartz. The tourmaline is pleochroic from straw to deep green. Accessory sphene and zircon are present.

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