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THE GEOLOGY OF THE COOKTOWN 1:250,000 SHEET AREA, NORTH QUEENSLAND.

by

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THE GEOLOGY OF THE COOKTOWN 1:250,000 SHEET AREA, NORTH QUEENSLAND

SUMMARY

The Cooktown 1:250,000 Sheet area was mapped geologically by means of interpretation of aerial photographs and by ground traverses during the winter of 1961. Until then no systematic mapping had been done, although there was a considerable body of accumulated information on the distribution of the units and on the fossil content of the Mesozoic sediments.

The area is part of the northern end of the Tasman Geosyncline, including its former western shelf and adjacent stable block; the folded Palaeozoic sediments and the granite belonging to this regime are covered in the north-western half of the area by the epeirogenic Mesozoic fresh-water and marine sediments of the gently synclinal Laura Basin. Other superficial deposits are Tertiary basalt, coastal sand dunes, and semi-consolidated gravel and gritty sand. There are three strong unconformities in the lower part of the column, and a slight unconformity and several disconformities in the Cainozoic part.

The structure of the Precambrian metamorphics is not known; it is complicated and of a plastic style. The extensive older Palaeozoic rocks are strongly folded and cleaved (four successive episodes of folding are recognized), and are intruded by granite in the east. The two Permian formations are faulted outliers of (?)paralic to swamp sediments, whose folding is probably only incidental to their in-faulting.

Vertical movements, including final warping of the Laura Basin, have continued from Lower Cretaceous to geologically recent times; the high relief and varied morphology near the coast, and recent stream capture there, are evidence of continuing instability.

The Palmer gold-rush of the 1870's opened up the area, and its decline was accompanied by the rise of tin-mining (mainly alluvial) in the headwaters of the Annan River, south of Cooktown.

Gold mining has been sporadic this century, but tin-mining has undergone a more gradual decline. Many small patches of old and new stanniferous alluvium probably remain to be discovered in the forest-covered Tinfield. A dredging prospect has been found at King's Plains, part of a river valley abandoned by stream capture at the Annan River gorge; gravity surveys and some drilling will be undertaken in the area during 1962. (See Appendix 1)

Upon completion of the railway last century considerable interest was shown in the many coal deposits of the area. The Permian coals are thick, but are impure and deformed, and the Jurassic coals are thin and impure. There was no commercial coal production, and little interest has been shown in prospects for several decades.

Good prospects exist for obtaining fresh underground water in the basal aquifers of the Laura Basin and in the coastal sand.

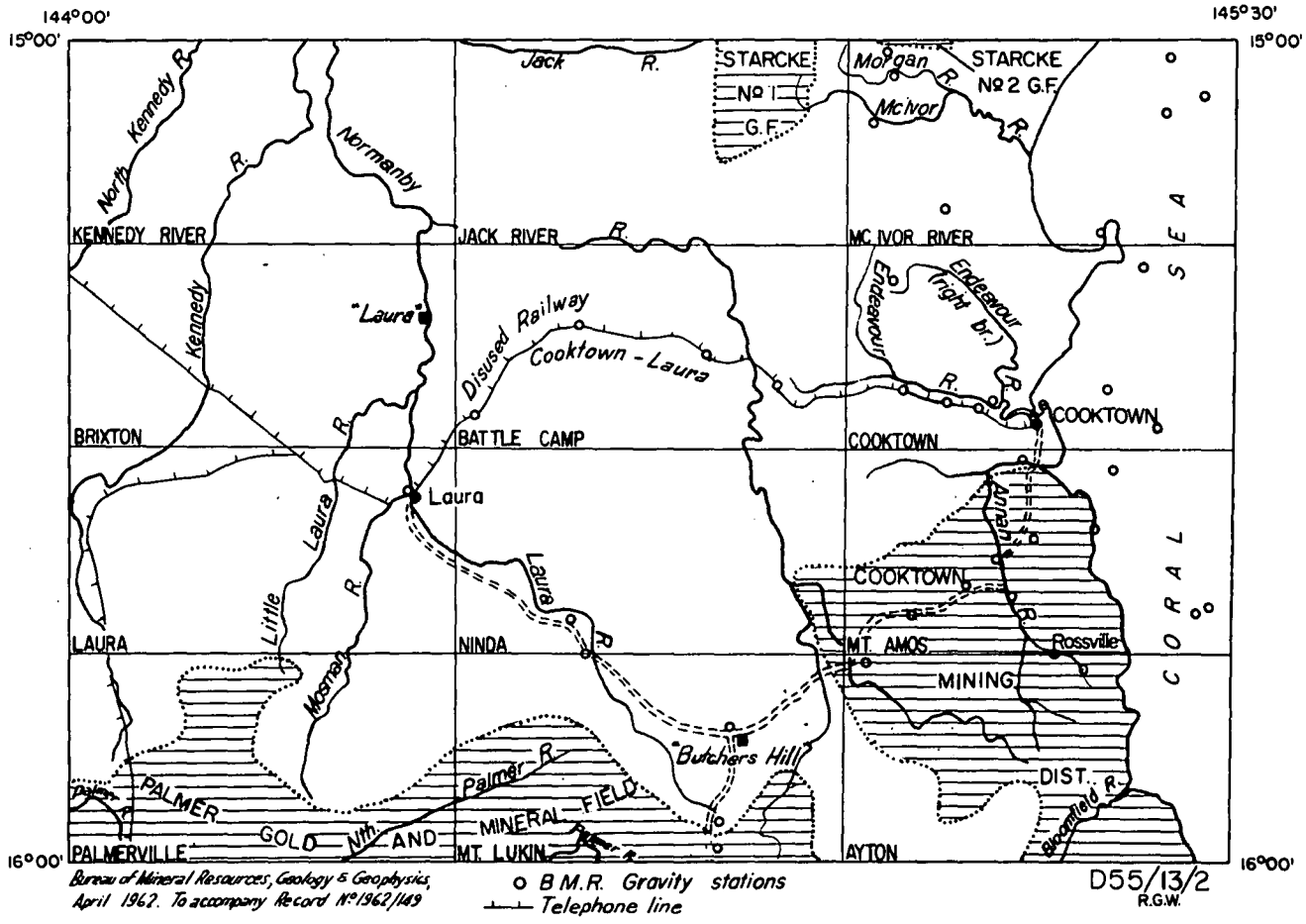
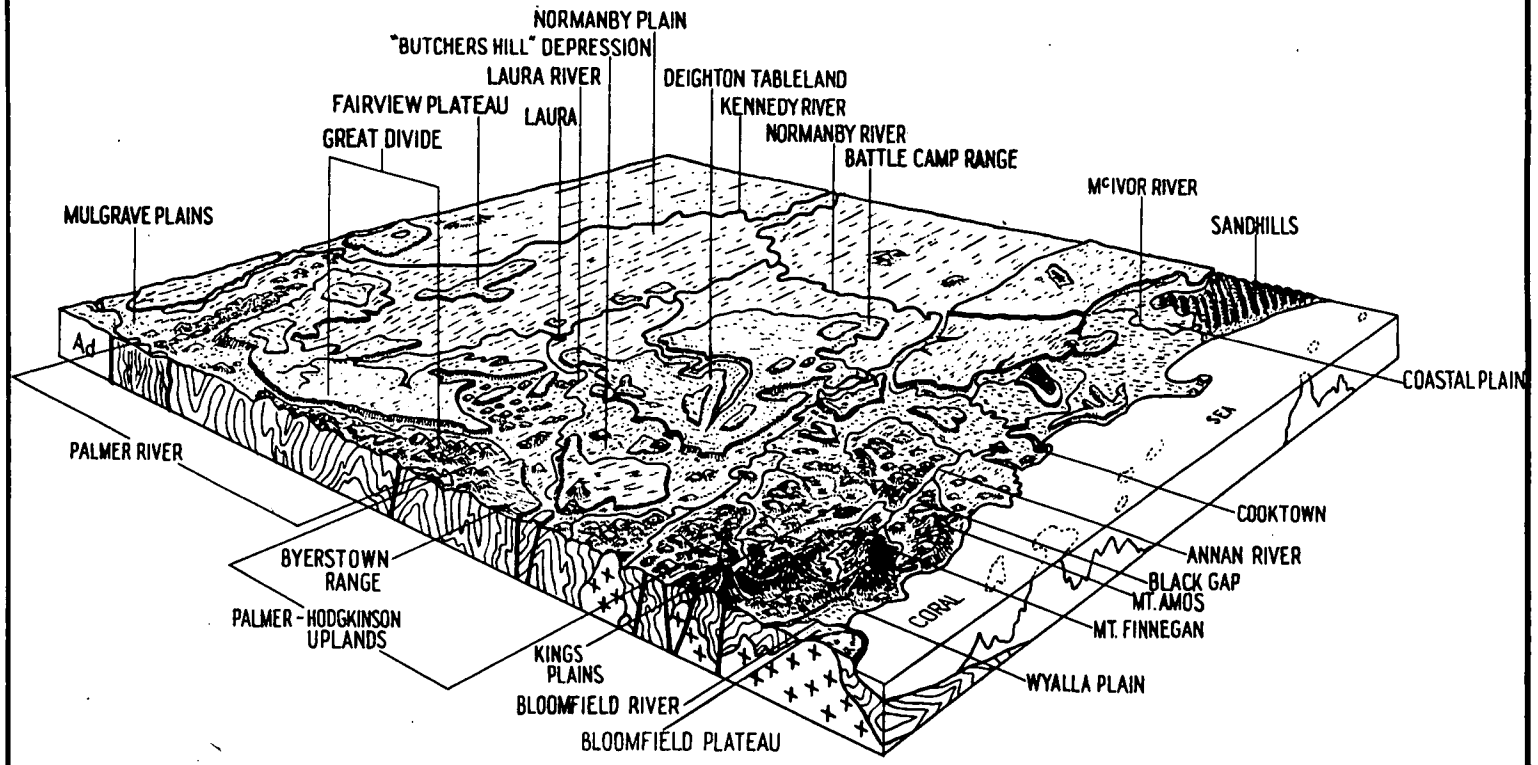


Fig. 1 *Cooktown 1:250,000 Sheet showing main streams, communications, 1-Mile areas, mineral fields and BMR gravity stations. Cooktown Mining District is commonly known as "Annan River Tinfield."*

Fig.2



PHYSIOGRAPHICAL UNITS COOKTOWN 1:250,000 SHEET

Bureau of Mineral Resources, Geology & Geophysics, April 1962. To accompany Record No. 1962/149

D55-13-3
P.A.B.

INTRODUCTION

The Cooktown 1:250,000 Sheet area is bounded by longitudes 144°E and 145°30'E, and by latitudes 15°S and 16°S. It includes small parts of the Starcke No. 1 and Starcke No. 2 Gold Fields, and of the Palmer Gold and Mineral Field, and most of the Cooktown Mining District (Fig. 1). Figure 1 also shows the 1 mile sheet areas, larger streams, main settlements, telegraph lines, and the route of the former Cooktown-Laura railway. The railway was closed late in 1961, and sold for disposal.

Cooktown has wharf facilities for handling light cargo, and an airport used by medium-sized air-craft. Laura township and "Butchers Hill" and "Laura" stations have small airstrips. Cooktown is 220 miles from Cairns by a good gravel road, from which a similar road to Laura branches at "Butchers Hill".

The geological map which these notes accompany was compiled from information gathered by a combined party of the Bureau of Mineral Resources and the Geological Survey of Queensland which was in the field from June to October, 1961. The party consisted of K.G. Lucas, W.R. Morgan, and B.J. Amos (B.M.R.), and L.G. Cuttler (G.S.Q.).

The maps and air photographs covering the Sheet area are listed in Table 1.

The Atlas of Australian Resources shows that the area consists climatically of sub-equatorial coast, tropical highland, and tropical inland (Dept. Nat. Dev., 1954). Most of the area has a small annual range of mean daily temperature, from 20° near the coast to 40° in the south-west. The mean annual temperature is in the range 70° - 80°. Annual rainfall ranges from 100 inches in the south-east to 30 inches in the south-west, and is about 50 inches in the north.

Rain forest covers the mountainous south-east; sclerophyll shrub savannah covers many areas of alluvium, colluvial sand, and Cretaceous clay, mainly in the north-west; however, most of the area supports mixed tropical savannah woodland. Undergrowth is more common on Mesozoic sandstone than in the savannah over folded Palaeozoic sediments.

The prevailing wind is the south-east trade wind, which blows strongly from June to October.

TABLE 1

Maps and aerial photographs covering the Cooktown 1:250,000 Sheet area, D55/13.

Map : 1 inch = 4 miles, military, 1943 (uncontrolled)

Photographs : 1:80,000, incompletely flown by Adastra Airways P.L. in 1960 for Department of National Development. Available from the Division of National Mapping, Canberra.

Parts of the area are covered as follows (see Fig. 1) :

1 mile Sheet Area	Scale M Map P Photographs	Produced by	Date	Available from
Kennedy River	P 1:25,500	Adastra Airways P.L.	1952	Dept. of Public Lands, Brisbane.
Jack River	P Mt.Jack-McIvor R. 1:25,500 cover eastern part	Adastra Airways P.L.	1952	" "
Brixton	P 1:25,500	Adastra Airways P.L.	1951	" "
Battle Camp	P 1:25,500	Adastra Airways P.L.	1951	" "
Cooktown	M 1:63,360	Royal Australian Survey Corps	1946	" "
	P 1:23,270	R.A.A.F.	1943	" "
Laura	P 1:25,500	Adastra Airways P.L.	1951	" "
Ninda	P 1:25,500	Adastra Airways P.L.	1952	" "
Mt. Amos	M 1:63,360 (eastern half only)	Forestry Dept., Qld.	1959	" "
	P ca. 1:25,000	R.A.A.F.	1945	" "
	P ca. 1:40,000	Adastra Airways P.L.	1957	" "
Palmerville	P 1:25,500	Adastra Airways P.L.	1951	" "
Mt. Lukin	P 1:25,500	Adastra Airways P.L.	1951	" "
Ayton	M 1:63,360 (eastern half only)	Forestry Dept., Qld.	1959	" "
	P ca. 1:25,000	R.A.A.F.	1945	" "
	P ca. 1:40,000	Adastra Airways P.L.	1957	" "

PREVIOUS INVESTIGATIONS

In 1872, N. Taylor, geologist with Hann's expedition (Qld. Parl. Pap., 1873), discovered coal and Glossopteris sp. near what was later Fairlight (Jack, 1882), in the south-west, and Cretaceous marine fossils, which have never been re-discovered, in the Battle Camp Range (Jack & Etheridge, 1892).

In progress reports on coal prospects in the area, Jack (1879 a, b.) described the coal-bearing formation at Oaky Creek and The Brothers, south-west of Cooktown, and recorded finding Glossopteris browniana in them. He noted ~~that~~ the stratigraphic relations of the formation and the wide distribution of the overlying almost horizontal sandstone and conglomerate, which contains shale and thin coal in the coastal range north of the Endeavour River. Jack also noted that basalts were poured out over an immature land surface from the McIvor River to the Endeavour River after some erosion of the horizontal sandstone.

Tenison-Woods in 1880 named the two coal-bearing formations, calling the older formation at Oaky Creek the Normanby shales, and the extensive overlying sandstone (which has since proved to be Jurassic) the Dalrymple sandstones. (The older formation has since been more commonly known as the Oaky Creek Coal Measures).

The coal-bearing outcrops of the Little River Coalfield# in the south-west were described in 1882 by Jack, who gave analyses of the coal, and also worked out the stratigraphic and structural relations of the formation.

Alluvial cassiterite was discovered in Wallaby Creek and Romeo Creek, about 25 miles south of Cooktown, in 1885, and many miners turned to this field from the by then failing Palmer Gold Field. Jack reported on the progress of alluvial and lode tin mining in 1887, and also described the rather poor coal prospects in the low-dipping sandstones accessible from the Laura railway. In 1891 he described the lode tin mines in detail.

Maitland in the same year described coal prospects in the Desert Sandstone (a term, then commonly used, which, in this area, included Jurassic and Cretaceous sandstones) north of Cooktown and at Puckley Creek, and gave analyses of the coal (Maitland, 1891a). He found marine Cretaceous shelly fossils (Macoyella(?) sp. and Rhynchonella sp.) near the 55½ mile railway peg, north-east of Deighton.

The next year he described thin sections of some pre-Permian volcanic rocks (of the Hodgkinson Formation) south of the Endeavour River, and noted the irregular relief of the unconformity between them and the overlying Desert Sandstone (Maitland, 1892).

Gold was discovered at Cocoa Creek, in the north-east, in 1892, and lode mining continued there for five years. Rands reported early progress there, and also remarked on the fairly severe deformation of the coal at Fairlight (Rands, 1893).

Jack (1895) reported on Mesozoic coal prospects at Christies Shaft and Stacks Creek, near the railway, and in the following year published a generally unfavourable report on gold prospects in the basal Mesozoic conglomerate north of Maytown, in the south-west (Jack, 1896a). The finding of detrital gold in Mesozoic sediments led to the hypothesis that much of the rich Palmer River alluvial gold was second-cycle, having been derived via an initial concentration in those sediments. Jack also noted that the unconformity on which the conglomerate rests dips north.

Cameron (1907a) published production figures for the Starcke Gold Field, and described the geological and physiographic setting of the lode and alluvial tin deposits in the south-east, and gave historical details of the field (Cameron, 1907b). He noted the presence of some of the placers in relatively mature, perched valleys.

Ball in 1914 observed that small deposits of mercury and copper in altered basic lavas east of Fairlight tend to be accompanied by different alteration products, although they are commonly found together. Dunstan (1917b) suggested that the minerals are solfataric.

The lode and alluvial tin mines and accessory minerals and gemstones of the Tinfield were described fully by Saint-Smith (1916). Later he described the newly-discovered gold-stibnite reefs south-west of Cooktown, detailed their gold values, and noted a drop in values at an intersection of two reefs (Saint-Smith, 1922).

The Powell Duffryn report of 1949 reported favourably on coal prospects in the Little River Coal Field; it was suggested that the outcrops may have suffered oxidation, and that the coal may be of better quality below the surface. The report commented unfavourably on prospects in the Jurassic coals, mainly on account of their thinness, and also on prospects in the Oaky Creek Coal Measures, which, however, were not visited or adequately noted.

Denmead (1949b) reported unfavourably on a manganese show south-west of Cooktown, and recommended that a water bore being drilled south-west of Fairview be deepened to seek the basal Cretaceous sandstone aquifer (Denmead, 1949a). This was done, and water was struck at 860 feet.

In 1960 de Jersey reported on an examination of a coal sample in the G.S.Q. collection, labelled "Deighton River (Christoe (Sic) Bros. discovery)". He found a small assemblage of spores common to the Walloon Coal Measures ((?) Lower Jurassic, in southern Queensland), and one spore which resembles an Upper Jurassic - Lower Cretaceous form.

The Bureau of Mineral Resources conducted a gravity survey over the Barrier Reef and adjacent land in North Queensland from 1954 to 1960 (Dooley, 1961).

A geological party of the Bureau and the Geological Survey of Queensland carried out regional mapping of the Cooktown 1:250,000 Sheet area in 1961, and unpublished reports on the fossils found have been received (Hill, 1961 a,b; Woods, 1961 b,c; 1962 a-c). The results of the palaeontological work have been incorporated in this report.

PHYSIOGRAPHY

Figure 2 illustrates the physiography of the Sheet area. The land is bounded by the Coral Sea, and the eastern boundary of the Sheet area lies within the outer barrier of the Great Barrier Reef. The Coral Sea within the Sheet area is studded with reefs and shoals.

Most of the area is drained by streams which flow towards the north-west corner to join the Normanby/Kennedy River system, which flows sluggishly north to Princess Charlotte Bay. The short streams flowing more directly to the east coast carry a much heavier run-off.

The Great Divide trends westwards from the Laura River, just within the southern boundary of the Sheet area.

The south-eastern part of the area has high relief, and slopes steeply to the rocky coast. The highest point in the area, Mt. Finnegan (3740 feet), is about six miles from the coast. Apart from a few relatively mature, perched, alluviated valleys, this area is characterized by steep slopes, and there are some cliff faces near its southern end. The upper parts of most streams are very steep, and bedrock is exposed in them; the lower parts are boulder-choked in many places, and rapids and rock bars are common.

Further north the near-coastal belt is dominated by escarpments bordering eastern outliers of the Deighton Tableland. Between and east of these is the fairly flat, low, irregular, coastal plain, made up of sand dunes, peaty sand, and alluvial flats, including the McIvor River and Endeavour River flats and estuaries, and the Annan River estuary. The Cape Bedford mass, like Cape Flattery north of the Sheet area, is probably a tied island united with the mainland by dune sands of two ages.

Around Black Gap, at the northern end of this rugged area, is a group of black, boulder-covered hills which support very little vegetation. These hills closely resemble the "metal hills" of the Chillagoe area. Lichen-covered granite boulders five to fifty feet across lie tumbled upon one another to considerable depth, and almost no weathering products are visible near the surface.

The Deighton Tableland (including the Battle Camp Range) is a broad, interrupted belt which lies roughly diagonally across the Sheet area, from north-east to south-west, and forms the raised south-eastern edge of the Laura structural basin. It is made up of resistant Mesozoic sandstone, and slopes gently down from about 1000 feet above sea level towards Laura in concordance with the dip of the sediments. Nevertheless there is invariably a ~~small~~ scarp (20 ft. to 800 ft.) between the Deighton Tableland and the Normanby Plain on which Laura is situated. The Tableland is deeply dissected by many streams, the most important of which are the Normanby and Deighton Rivers. No large streams flow upon it, and its larger interfluves are generally covered by loose sand. In the south-east near "Springvale", the Palmer-Hodgkinson Uplands are encroaching upon it by means of headward erosion and sharp reversal of drainage.

The Palmer-Hodgkinson Uplands in the Cooktown Sheet area are the northern extremity of a monotonous unit, from 500 feet to 1500 feet above sea level, which includes most of the folded Palaeozoic sediments in the Mossman Sheet area (Amos & de Keyser, 1962). It shows a fine drainage pattern characterized by steep-sided gullies and fairly sharp hogback ridges. Ridge crests are commonly roughly accordant, except for the higher ones which are formed by chert and massive greywacke.

The Mulgrave Plains (Amos and De Keyser, op. cit.) cover a very small low area in the south-west of the Cooktown Sheet area, where they roughly correspond with the poorly outcropping Precambrian metamorphic rocks. They are probably a relict Mesozoic planation surface cut upon those rocks.

The Normanby Plain embraces the low, flat land underlain by Cainozoic deposits in the north-west of the Sheet area. It consists of slightly undulating, sand-covered interfluves and the wide flood-out plain ("melon-hole country") of the Normanby River and its associated lagoons and anabranches.

The Fairview Plateau (Denmead, 1949a) and its small outliers nestle in the embayment in the Deighton Tableland around Laura, and rise from 20 feet to 150 feet above the Normanby Plain. As it is formed by a thin, porous gravel it does not support streams, and is generally sand-covered. It is surrounded by a small sloping zone of "rolling downs", which is the outcrop area of the Wolena Claystone.

The Byerstown Range, on the south-central boundary of the area, is a modified remnant of the pre-Dalrymple Sandstone (Jurassic) unconformity which was cut upon folded Palaeozoic sediments, and has been irregularly covered by basalt flows.

The Butchers Hill Depression between the Deighton Tableland, the Byerstown Range, and the Palmer-Hodgkinson Uplands, contains the McLean Basalt. The basalt has displaced the headwaters of the pre-basalt Laura River, whose gravels it overlies. There has been some post-basalt reversal of topography. The top of the flows is up to 200 feet above the lower parts of the depression, but is still about 500 feet below the remnant of the pre-Jurassic surface which forms the northern part of the Byerstown Range.

Thirty miles to the north-west of "Butchers Hill" the Laura River flows through a gorge cut into the Deighton Tableland, to debouch on the Normanby Plain. To the north-east the Depression merges with the Palmer-Hodgkinson Uplands and Kings Plains.

Kings Plains is an east-west chain of connected, alluviated basins, fifteen miles long, linking the Annan and Normanby Rivers. It crosses the strike of the folded Palaeozoic sediments, and the constrictions in the chain coincide with resistant outcrops of chert. Lagoons or seasonal lakes occupy the centres of the two largest basins, and are connected by a sluggish stream. At the eastern end of the chain the Annan River drops sharply through an immature gorge: the ancestral Annan River flowed west through King's Plains until it was captured at this point by a tributary of Oakey Creek. Because the headwaters of the Annan River drain a partly denuded and deeply-weathered tin-field, Kings Plains has been considered an alluvial tin prospect. This was tested in 1962 (See Appendix 1).

TABLE 2

STRATIGRAPHY OF THE COOKTOWN 1:250,000 SHEET AREA

ERA	PERIOD	FORMATION	THICKNESS (feet)	LITHOLOGY	CORRELATION	STRATIGRAPHIC RELATIONS	ECONOMIC GEOLOGY
CAINOZOIC	QUATERNARY RECENT	Alluvium (Qr, Qb)	Up to 200 ?	Grey silty clay, sand and gravel (Qr), black and red clay near basalt (Qb).	=Qs	Overlies other formations in valley bottoms.	Stanniferous unmapped areas in Tinfield, gold.
		Interfluvial sand (Qs)	Up to 25 ?	Loose orange and white sand.	=Qr	Overlies Brixton Formation and older rocks on interfluves.	
		Coastal dune sand (Qd)	At least 300	White sand, vegetated and moving.		Overlies and abuts against older dune sand and Hodgkinson Formation.	Potential water supply, possible heavy mineral concentration.
	LATE CAINOZOIC	Fossil coastal dune sand (Czd)	At least 220	Iron-stained, aeolian, cross-bedded sand.	Approx. = Brixton Formation?		
		Piedmont deposits (fans) (Czt)	Up to 200 ?	Earthy fossil breccia slightly ferruginous.		Overlies Brixton Formation usually below scarp of Dalrymple Sandstone.	
		Brixton Formation* (Czx)	5 to 50 ?	Mottled clayey sand, gritty and pebbly.	= Lynd Formation? (Laing & Power, 1959)	Overlies and abuts against Mesozoic and older rocks; disconformably succeeds Fairview gravel.	
	?	?	?	?	?	?	?
	TERTIARY ?	Piebald Basalt* (Czp)	Up to 100 ?	Olivine basalt	= McLean basalt?	Overlain by alluvium, unconformable on Dalrymple Sandstone and Hodgkinson Formation.	Deep gold leads ?
		McLean Basalt* (Czm)	Up to 200	Olivine basalt, pyroclasts, gravel	= Piebald basalt?	Unconformable on Hodgkinson Formation, disconformably succeeds Dalrymple Sandstone.	Minor aquifer. Gemstones reported under basalts.
	?	?	?	?	?	?	?
	TERTIARY	Fairview Gravel* (Tf)	5 - 20	Rounded quartzose pebble gravel, sandstone, billy.	Approximately equivalent to McLean basalt?	Unconformable on Wolena Claystone and Battle Camp Formation; disconformably succeeded by Brixton Formation.	Road metal.

* New formation.

TABLE 2 (CONTD.)

ERA	PERIOD	FORMATION	THICKNESS (feet)	LITHOLOGY	CORRELATION	STRATIGRAPHIC RELATIONS	ECONOMIC GEOLOGY
MESOZOIC	LOWER CRETACEOUS — Albian	Wolena Claystone* (Klo)	At least 150	Pale-weathering, olive-grey, silty and sandy claystone with concretions.		Conformably overlies Battle Camp Formation.	
	LOWER CRETACEOUS — Aptian / Neocomian	Battle Camp* Formation (Klc)	At least 475	Thin ferruginous basal conglomerate, glauconitic sandstone, shaly glauconitic sandstone, leached shale.		Conformable under Wolena Claystone; disconformable on Dalrymple Sandstone in Battle Camp Range, conformable elsewhere?	
	JURASSIC	Dalrymple Sandstone+ (Jd)	Up to 1000	Quartz sandstone, conglomerate, grit, shale.		Conformably(?) and disconformably overlain by Battle Camp Formation; unconformable upon all older formations.	Aquifer. Thin, inferior coal.
PALAEOZOIC	PERMIAN	Normanby Formation+ (Pr)	At least 2000	Impure sandstone, siltstone, conglomerate, limestone, and coal; rhyolite.		Unconformable upon Hodgkinson Formation, unconformable beneath Dalrymple Sandstone.	Inferior coal.
	PERMIAN	Little River Coal Measures (Pur)	?	Sandstone, shale, impure coal and limestone.		Unconformable upon Chillagoe Formation, unconformable beneath Dalrymple Sandstone.	Inferior coal.
	PERMIAN TO CARBONIFEROUS	Dyke rocks (unnamed)	Up to 300	Microgranodiorite and microtonalite porphyry	= Trevethan Granite?	Intrusive into Hodgkinson Formation.	
			60	Muscovite-albite microgranodiorite porphyry		Intrusive into Hodgkinson Formation.	
			2 - 15	Uralitized dolerite		Intrusive into Hodgkinson Formation and Finlayson and Trevethan Granites.	
			Up to 140	Granophyric biotite microadamellite porphyry		Intrusive into Hodgkinson Formation and Finlayson and Trevethan Granites.	
		Puckley Granite (Pgp)		Coarse porphyritic adamellite; aplite dykes		All granites intrusive into Hodgkinson Formation.	In Finlayson Granite, rare tin lodes.
		Trevethan Granite (Pgt)		Medium-grained, porphyritic hornblende-biotite granodiorite		Puckley Granite and unnamed granite (near Cooktown and Mt. Piebald) are unconformably overlain by Dalrymple Sandstone.	
		Finlayson Granite (Pfg)		Medium-grained porphyritic adamellite.			
		Mareeba Granite (Pgm)		Coarse porphyritic granodiorite and adamellite			
		Unnamed granite (Pg)		Medium to coarse porphyritic granite.			

* New formation

+ Revised name

TABLE 2 (CONTD.)

ERA	PERIOD	FORMATION	THICKNESS (feet)	LITHOLOGY	CORRELATION	STRATIGRAPHIC RELATIONS	ECONOMIC GEOLOGY
PALAEOZOIC	(?)Lower Carboniferous - Middle Devonian	Hodgkinson Formation (D-Ch)	At least 10,000	Greywacke, slate, minor volcanics and limestone.		Disconformable upon Chillagoe Formation? Unconformable beneath Permian and younger formations.	Limestone
	Lower Devonian - Upper Silurian	Chillagoe Formation (S-Dh)	5000 ?	Volcanics, chert, sandstone, limestone.		Unconformable upon Precambrian rocks, disconformable beneath Hodgkinson Formation? Unconformable below other younger formations.	Weak Cu and Hg mineralisation, limestone.
PRECAMBRIAN	(?)Archaean	Dargalong Metamorphics (Ad)	?	Schist, gneiss, amphibolite, quartzite.		Unconformable beneath post-Cambrian rocks.	

The Wyalla Plain is a small, coastal depression north of the mouth of the Bloomfield River. It is mostly less than 50 feet above sea level, and its surface is sandy, especially near the coast. Inland the surface soil is grey and sandy.

The Bloomfield Plateau is a small triangular plateau bounded to the north by the sea and the Wyalla Plain, and to the south by part of the Palmer-Hodgkinson Uplands (Amos & de Keyser, 1962). Its boundary with the Wyalla Plain is fairly straight, and may be a fault line scarp. Most of the plateau consists of small, rounded hills whose crests are about 600 feet above sea level. The Bloomfield River and its major tributaries, e.g., the Woobadda River and Granite Creek, form deeply-incised meanders in the plateau.

STRATIGRAPHY

The stratigraphic column of rocks cropping out in the Cooktown 1:250,000 Sheet area (Table 2) ranges from probably Archaean metamorphic rocks, through Palaeozoic geosynclinal formations and intrusive granites, and Mesozoic epicontinental sediments, to a variety of Tertiary and Quaternary deposits.

PRECAMBRIAN

The Dargalong Metamorphics are poorly exposed in a small area in the south-west, where they are partly covered by Mesozoic and younger sediments. They are continuous with outcrops in the area of the Mossman Sheet to the south (Amos & de Keyser, 1962), and consist of strongly folded and faulted micaceous schist, gneiss, augen gneiss, amphibolite, and quartzite. They are Precambrian, possibly Archaean (White, 1960).

The outcrop of the Metamorphics is bounded on the east by the major Palmerville Fault.

UPPER SILURIAN - LOWER DEVONIAN.

The Chillagoe Formation crops out in a north-south elongate belt in the south-west of the Sheet area, where it is a continuation of the outcrops in the Mossman Sheet area (Amos and de Keyser, op.cit.). It is essentially the same as in the south.

Fine, even-grained, green sandstone crops out along the western boundary, basic volcanics, chert and green, gritty sandstone are abundant, and unfossiliferous reef limestone is a minor component of the Formation. Slate is abundant, but crops out poorly. The Chillagoe Formation is separated from the Dargalong Metamorphics to the west by the Palmerville Fault, and must be separated from them stratigraphically by a major unconformity. The boundary between the Chillagoe Formation and the Hodgkinson Formation to the east is lithologically distinct and sharp, and is probably faulted; the stratigraphic relationship is uncertain.

MIDDLE DEVONIAN - (?) LOWER CARBONIFEROUS

A complete description of the Hodgkinson Formation in the Mossman Sheet area to the south has been given by Amos and de Keyser (op. cit.) ~~and Lucas (in prep.)~~. The area of outcrop is smaller in the Cooktown Sheet area, but there are no essential litholigical differences from outcrops to the south. The general slight tendency for decrease in psammitic sediments towards the east is weaker than in the Mossman Sheet area, but the increase in the amount of chert towards the east is maintained. A local variation in this generally very uniform formation is the presence of intermediate to acid volcanics and minor limestone in an area from five to 20 miles south-west of Cooktown. The limestone yielded the coral Fasciphyllum conglomeratum (Hill, 1961a) which indicates a middle Devonian age (early Givetian in Germany). Leptophloeum australe and indeterminate lycopod fragments were also found in the formation. (l.c.)

CARBONIFEROUS - (?) PERMIAN

Five different varieties of granitic rocks - one of them not yet formally named - and several suites of dykes intrude the sediments of the Hodgkinson Formation. The exact positions of these granites in the stratigraphic column will depend on radioactive dating. They are not in contact with any of the Permian rocks; the Jurassic Dalrymple Sandstone unconformably

overlies the Puckley Granite and part of the unnamed granite.

The Puckley Granite is a partly concealed intrusive of unknown extent in the centre of the Sheet area. It is well exposed along the railway line from Battle Camp Siding to Puckley Creek, and from there for 12 miles south, west of the Normanby River. A small granite outcrop brought up by a fault in the Deight River 10 miles south-west of Battle Camp Siding may be referable to this granite. A granite body uncovered by erosion of Dalrymple Sandstone 10 miles west of the upper McIvor River appears to be identical with the Puckley Granite.

The Puckley Granite is a coarse-grained, porphyritic muscovite-biotite adamellite. In the type area it is cut by numerous dykes of aplite and medium-grained biotite aplogranite, many of which occupy steep west-north-west joints.

An exposure of Hodgkinson Formation in a railway cutting two miles west of Puckley Creek shows only slight contact-alteration due to the granite.

The granite is overlain by Dalrymple Sandstone.

The main body of the Trevethan Granite crops out along and to the south-west of Trevethan Creek, 12 miles south of Cooktown. Its outcrop ranges from the total exposure of the Black Gap group of "metal hills" to very poor exposure near Trevethan Creek. There may be other bodies of this "granite" between Trevethan Creek and Cooktown. The rock is a medium-grained, augite-bearing, hornblende-biotite granodiorite. Its contacts with the Hodgkinson Formation are involved, and show evidence for the presence of volatiles during intrusion. In spite of its close proximity to the Finlayson Granite their mutual relations are unknown.

The Finlayson Granite crops out in the south-east of the Sheet area as irregular stocks distributed in a belt from Mt. Amos south-south-west to Mt. Boolbun. It has good outcrops, and makes up most of the high mountains in the area, which roughly coincides with the Annan River Tinfield. The Mt. Finlayson Range lies in the

south-east of the Tinfield and includes Mt. Finnegan.

The Finlayson Granite is a medium-grained, porphyritic muscovite-biotite adamellite, in which microcline is the potash feldspar, and is distinguished by having a protoclastic texture throughout. Fine-grained, marginal, porphyritic variants which mostly carry tourmaline are common. Its present exposure is probably near the roof of a batholith. Contact effects upon the Hodgkinson Formation are only slight.

Two bodies of the Mareeba Granite crop out along the southern margin of the Sheet area between the Mulligan Highway and the coast. The western outcrop forms Mt. Amy, and the eastern outcrop is the northern part of a large mass that occurs south of the Bloomfield River, and north of Bailey's Creek (in the Mossman 1:250,000 Sheet area).

The eastern outcrop of the granite has been sampled at Roaring Meg Creek, near China Camp, just south of the Cooktown Sheet area, and is a coarse-grained and porphyritic muscovite-biotite adamellite. Close to its northern boundary on the China Camp/Bloomfield motor track the granite is porphyritic and somewhat finer-grained. The Mt. Amy outcrop is a coarse-grained and porphyritic muscovite-biotite adamellite. Contact effects of the Mareeba Granite on the sediments of the Hodgkinson Formation are slight.

Unnamed Granite

The granite forming Mt. Cook and Grassy Hill at Cooktown is a pale grey, medium-to coarse-grained, porphyritic muscovite-biotite granite (W.R. Morgan, in prep.). A specimen from the western side of Mt. Cook shows it to be hypidiomorphic-granular, and it is only slightly strained. The intrusive contact of the granite with sediments of the Hodgkinson Formation is exposed on the shoreline east and north of Grassy Hill. The granite maintains a uniform grainsize right up to the contact. The contact itself is sharp; the sediments are baked, and biotite can be found in them. A small intrusion of rather similar granite is exposed about one mile west of Mt. Piebald; here

the rock is fairly strongly weathered, and the exposures in this area do not show its contact with the sediments.

The granite has not yet been given a stratigraphic name, because only a preliminary petrographic description has been made. A specimen of granite collected from the Cape Melville 1:250,000 Sheet area is petrographically very similar to this one, and the rock-type may, therefore, have a wider distribution. It is mineralogically different from the Trevethan Granite, and texturally different from the Finlayson Granite. Choice of a formal name could thus await the results of further mapping during 1962.

In the general area of the Annan River Tinfield four suites of formally unnamed dyke-rocks were distinguished:

1. Microgranodiorite and micro-tonalite porphyry containing actinolitic hornblende, biotite, and augite. These dykes have a north-westerly trend, and are up to 300 feet thick. They intrude the Hodgkinson Formation, but none were seen to cut the Finlayson and Trevethan Granites. However, a preliminary laboratory investigation suggests that their petrographical characteristics are similar to those of the Trevethan Granite.

2. A north-westerly trending dyke, 60 feet wide, intruding the Hodgkinson Formation sediments in the Annan River Gorge. This rock is a muscovite-albite microgranodiorite porphyry.

3. Partly and completely uralitized dolerite intruding the Hodgkinson Formation and the Finlayson and Trevethan Granites. They trend roughly north to north-west, and range from 2 to 15 feet thick.

4. Granophyric biotite micro-adamellite porphyry. These have trends similar to those of the dolerite dykes, and, like them, cut the sediments of the Hodgkinson Formation and the two granites. They range up to 140 feet in thickness.

These rocks and the localities where they occur are being described in detail by W.R. Morgan in his report on the igneous

rocks of the Cooktown 1:250,000 sheet area.

PERMIAN

The Little River Coal Measures (Jack, 1882) is a small, elongate body faulted between Precambrian, Siluro-Devonian, and Mesozoic rocks in the south-west of the Sheet area. This formation is mostly covered by thick alluvium; outcrops consist of thick-bedded sandstone, impure coal, thin-bedded fine sandstone, and impure limestone, in grey, silty shale.

Glossopteris sp. was known from the shales (Jack, op.cit.) and two species of Glossopteris and Schizoneura (?) australis have recently been identified from the soft shales (White, 1961). Schizoneura sp. is known only from the Upper Permian and the Triassic of Gondwanaland, and the assemblage therefore indicates a probable Upper Permian age for the Little River Coal Measures.

The Normanby Formation crops out in ~~two~~ three small, elongate, faulted outliers that lie on a north-south line 18 miles west of Cooktown. ~~They~~ It consists of thin, micaceous sandstone, thick feldspathic sandstone, dark silty shale, thick unstable pebble conglomerate, thin impure limestone, impure coal, and rhyolitic rocks. A hundred feet or more of uniform, impure coal crops out near the western boundary of the formation, east and north-east of the peak known as The Brothers. The rhyolitic rocks consist of thick, fine-grained flows, lapilli tuffs, and breccia; they crop out on the eastern side of the main body, and appear to constitute the whole of the ~~northern~~ central outlier, which may, therefore, have been the site of sub-aerial deposition only.

Glossopteris sp. was previously known from the area north-east of The Brothers, and during recent field work more collections were made from there. In addition one mould of the solitary coral, Thamnopora sp., was obtained from (?)basal calcareous conglomerate at the western boundary of the Formation, a mile south of The Brothers. This is the first record of marine Permian rocks north of the Bowen Basin.

The thickness of the Formation and the succession within it are uncertain, but there are probably between 2000 and 5000 feet of strata. There are 600 to 1000 feet of rhyolite in the southern outlier, and possibly more in the ~~northern~~ central one. The low-dipping coal and plant-bearing carbonaceous shale in the west of the southern outlier are possibly younger than the rhyolite in the centre of the outcrop, and the rhyolite may be younger than the marine conglomerate, thin-bedded sandstone, and shale. Thus the rhyolite may divide a fresh-water upper part of the formation from a marine lower part.

JURASSIC

The Dalrymple Sandstone crops out in the broadly arcuate, dissected Deighton Tableland (Fig. 2), which runs diagonally north-eastwards across the Sheet area; it forms the south-eastern margin of the Laura Basin.

The formation was named Dalrymple sandstones (Tenison-Woods, 1880) after the Dalrymple Range, 10 miles north-west of Cooktown. That name is modified here to conform with modern convention. Other names have been used since (especially Laura Sandstone - see Denmead in Hill & Denmead, pp.306-307).

The Dalrymple Sandstone consists of 200 feet to 500 feet of conglomerate, grit, sandstone, and minor shale; it may constitute most of the section in the Deighton bore, which reportedly reached granite basement at 1200 feet.

In most places the basal bed is a massive conglomerate, which contains most of the thin lenses of plant-bearing and coal-bearing grey shale. Above this are white to grey, gritty, quartz sandstone, lenticular conglomerate, grit, and minor pale siltstone and shale. The sandstone commonly contains limonitised tree trunks, and the siltstone disoriented stems, roots and seeds. Cross-bedding is common in the sandstone; sets are up to eight feet thick. In the Sheet area the cross-bedding has no main bias; all that can be said is that it is seldom directed from

the north-west; in the south-west it tends to be directed away from the Chillagoe Formation.

A diastem may be represented by a ferruginised conglomerate 40 feet above the base 12 miles south-east of Laura, north of the Laura River. Near the railway west of the Battle Camp Range the formation is usually homogeneous, i.e., it consists mainly of medium-bedded, fine sandstone and siltstone (part of the Welcome Valley Beds of Maitland, 1891a).

The sandstone rests with a major angular and erosional unconformity upon folded Palaeozoic sediments and granite. This unconformity dips generally towards the north-west axis of the Laura Basin (Denmead, op.cit., p.306), but is very irregular over the Puckley Granite, in the Battle Camp area (a relief of 1200 feet in 1 mile at Stacks Creek).

Lower Cretaceous sediments appear to rest disconformably upon the Sandstone from "Battle Camp" homestead to Cone Mountain, as the Sandstone is limonitised below the persistent Cretaceous basal conglomerate. However, this boundary is not easily found south-west of the Battle Camp Range, and there may, therefore, be no disconformity elsewhere.

Woods (1961c) identified, inter alia, species of Cladophlebis, Coniopteris, Otozamites, Taeniopteris, Brachyphyllum, and Elatocladus, and states that a Jurassic age, rather than Cretaceous is indicated by the presence of species of Otozamites (O.cf. bunburyanus, and O.cf. feistmanteli) closely comparable with Jurassic forms; furthermore (p.6), "the abundance of conifers, including some resembling those occurring in Lower Cretaceous as well as Jurassic rocks, suggests the age is most likely to be Upper Jurassic."

LOWER CRETACEOUS

The Battle Camp Formation crops out in an arcuate belt which rests upon and is flanked by the Dalrymple Sandstone round the south-eastern end of the Laura Basin. Its outcrops over much

of the Deighton Tableland are discontinuous erosion remnants, and it is possible that the upper part of the formation has been stripped from there. The exposed parts of the formation is thickest and coarsest in the Battle Camp Range, where it is about 500 feet thick, and it becomes thinner and fine-grained south-west from there. However, it may be as much as 500 feet thick in the "Fairview" area, where it consists of claystone, the upper part of which is known only from boreholes. In the type area, at the north-eastern extremity of the Battle Camp Range, nearly 600 feet of sandstone and conglomerate are exposed. A limonitic conglomerate about 200 feet up is thought to be the base of the Cretaceous section. Above this are about 400 feet of massive, scarp-forming, glauconitic sandstone, quartz sandstone, and conglomerate. On top of this section are small remnants, up to 80 feet thick, of leached, variegated, white siltstone. Taylor, the geologist of the 1872 Hann expedition, collected fossils identified by Etheridge Sen. as Hinnites cf. lavetrix and Ostrea cf. sowerbyi from the junction of a conglomerate and a greenish sandstone at the base of the scarp-forming sandstone in this part of the Range (Jack and Etheridge, 1892.) The specimens are not extant, and determinable fossils have not since been found at or near the locality.

A probable lowermost Cretaceous (Neocomian) fauna including Maccoyella sp. nov. has been identified (Woods, 1962a) from a basal Cretaceous conglomerate resting upon the Dalrymple Sandstone on the southern spur of Cone Mountain, two miles south of Battle Camp Siding. A probable Neocomian fauna, including a species of Maccoyella resembling the new species (Woods, op.cit.), was found at Maitland's locality (Maitland, 1891) near the 55½ mile railway peg, about four miles north-east of Deighton Siding. Woods (1962d) has described a new species of Hatchericeras, a Neocomian ammonite, from the bed of the Normanby River near "Lakefield", six miles north of the boundary of the Sheet area.

The existence of a disconformity between the Battle Camp Formation and the underlying fresh-water Dalrymple Sandstone in the Battle Camp - Cone Mountain area is indicated by the presence of a persistent, ferruginous, basal conglomerate which contains marine fossils. This area was probably the south-eastern shore of a Lower Cretaceous sea.

The base of the formation is not easily found elsewhere. Quartzose sandstone with accessory glauconite crops out round Laura and in the scarps 20 miles west of "Fairview", and appears to overlie the Dalrymple Sandstone conformably.

In the western half of the Sheet area generally there are probably 100 to 200 feet of sandstone, rarely richly glauconitic, at the base of the formation. This is overlain by a distinctive rock type which crops out intermittently from "Laura" homestead to Laura township, and 6 miles south of Red Bluff in the south-west. It is a roughly stratified, chaotic (organically disturbed?) sand-shale mixture containing Rhyzocorallium sp., and it marks the transition up into claystone. In most exposures the claystone has been deeply weathered and leached to form the pale and variegated siltstone capping commonly seen in Western Queensland.

The thickness of claystone, which forms the upper part of the formation, is known only between the approximate limits of 100 feet and 500 feet (maximum possible in bore R11224, see Fig. 3). There is no marked unconformity with the overlying Wolena Claystone, but the precise relationship is unknown.

The small outcrop on the Coen road, near the western boundary of the Sheet area, is leached, white siltstone which contains the belemnite Peratobelus sp. and fish remains.

The Wolena Claystone is a poorly exposed Cretaceous formation which crops out in a small area of "rolling-downs" country round the margin of the Fairview Plateau. The Parish of Wolena contains most of the eastern outcrop.

It is a soft, olive-grey, silty and sandy claystone with calcareous concretions. It weathers to a deep grey-brown, clayey soil, but for about ~~200~~ 160 feet directly beneath the Fairview Gravel it consists of deeply weathered, white (leached) siltstone like that referred to above.

The formation is richly fossiliferous, in contrast to the siltstones of the upper part of the Battle Camp Formation. The upper Albian ammonite Myloceras sp. and the typically "Tambo" lamellibranchs Ancellina hughendenensis and Inoceramus sp. were determined by Woods (1962a).

Fossiliferous horizons have been found up to 150 feet below the top of the formation near "Fairview", and similar fossiliferous sediments were reported by Denmead (1949a p. 41) 200 feet below the level of the Plateau, four miles south-east of "Fairview".

Both Cretaceous formations are unconformably overlain by the Fairview gravel, but as there is no continuity of outcrops from Wolena Claystone to the underlying Battle Camp Formation their mutual relationship is unknown; there is no evidence for a structural or sedimentary break. The upper formation has been erected because its outcrop is circumscribed by Cainozoic sediments, and because it contains a distinctive Albian fauna.

The possible correlations between these Cretaceous sediments and formations in adjacent areas are set out in Table 3.

TERTIARY

The Fairview Gravel is a poorly consolidated, kaolinitic quartz gravel, generally about 15 feet thick, which is represented by several outcrops (mostly small) in the central-west of the Sheet area. It contains minor, thin, white, cemented sandstone and grey billy.

The type area is the Fairview Plateau (Fig. 2), on which "Fairview" Homestead is situated. Smaller outlying plateaux are capped by the gravel, but there are some outcrops not so easily

TABLE 3

Correlation Table of post-Jurassic Rocks, Cooktown 1:250,000 Sheet Area.

AGE	FORMATION	POSSIBLE EQUIVALENT		
		In Cooktown Area	In Adjacent Areas	In Great Artesian Basin
Late Cainozoic	Brixton Formation		Lynd Formation (Laing and Power, 1959)	
Tertiary?	McLean Basalt	Piebald Basalt, Fairview Gravel?	Atherton Basalt	
Tertiary	Fairview Gravel	McLean Basalt?	Louisa Formation (Woods, 1961a)	
Lower Cretaceous — Albian	Wolena Claystone		Trimble Formation (Woods, op. cit.)	Tambo equivalent
Lower Cretaceous — Aptian—Neocomian	Battle Camp Formation		Wrotham Park Sandstone and Blackdown Formation? (Laing and Power, op.cit., Woods, op.cit.)	Roma and Blythesdale equivalent.

20.

visible, e.g., the "borrow pit" beside the new road at Laura. The Gravel overlies leached Wolena Claystone and the softer part of the Battle Camp Formation and is commonly overlain by loose sand.

Its approximate equivalence to the McLean Basalt (Table 3) is suggested only for the reason that reversal of topography has raised the top of each formation by comparable amounts above local streams (20 to 150 feet for the gravel; generally 200 feet or more for the Basalt, which lies farther east, where erosion is more active). It is assigned a probable Tertiary age on this evidence, and on the evidence for several younger erosional and depositional episodes.

(?) TERTIARY

The McLean Basalt crops out in the south-central part of the Sheet area; Mt. McLean is a modified cone a mile west of the main road five miles south of "Butchers Hill". The main body of basalt occupies the Butchers Hill Depression (Fig.2).

Bouldery river gravel constitutes the base of the formation in many places, and contains minor granitic fragments whose source may underlie the basalt, as no large granite outcrop is known in the vicinity. A 180-feet section one mile south of "Springvale" consists of four basalt flows; 30 feet of gravel overlie the bottom flow. A road cutting nearer "Springvale" has exposed a few feet of pale siltstone bearing Dicotyledonous plant remains, apparently at the local base of the formation. Elsewhere basalt rests directly on the Hodgkinson Formation. In the Tinfield remnants of basalt overlie stanniferous gravel and siltstone. At two localities in the west, stratified (?) biotite - bearing lithic and lapilli tuff is exposed at or near the base of the effusive rocks.

The basalt is fine-grained to medium-grained and olivine-bearing. The main body consists of at least one thick (100 ft.) medium-grained basalt flow, and there is at least one less extensive later flow, which appears to have issued from Mt. McLean, in the south. At least 16 former vents are recognisable on morphological grounds from the air photographs. Several of them lie on known faults. Those inspected are

composite lava and cinder cones. Several contain basalt and basalt bombs rich in inclusions such as pyroxene or spinel aggregates, and ultrabasic and acid rock fragments.

Many of the small, steeply inclined flows between the main body and Mt. Boolbun in the east were probably not connected with the main body, except, perhaps, by distal ends of flows in the ancestral Normanby River.

The Piebald Basalt is separated from the McLean Basalt by the east-west belt of high land south of the Endeavour River. It consists of disconnected bodies, some very small, cropping out from the east branch of the Starcke River, north of the Sheet area, to west of Flaggy Siding. It forms the floor of the McIvor River valley, where its base is not visible, and elsewhere rests on Hodgkinson Formation, and an unnamed granite west of Mt. Piebald; more elevated bodies rest on Dalrymple Sandstone. Mt. Piebald is a fairly large, modified cone from which a flow descended to the north. At "Boiling Springs" ~~Miller's farm~~, on the north-eastern edge of this flow, is a spring which, until fifty years ago, was hot. An inclined flow (or flows) from the Mt. Rose group of vents almost filled the Endeavour River valley.

The basalt is fine-grained to medium-grained and olivine-bearing, and at several vents is rich in xenoliths, including granite (west of Mt. Piebald). About ten vents have been recognised on the air photographs.

LATE CAINOZOIC (Late Tertiary to Pleistocene)

The Brixton Formation is an extensive, thin (5 to 50 feet) blanket of mottled, poorly consolidated, kaolinitic sandstone, which contains gritty and pebbly lenses. The site of the former "Brixton" homestead is the east bank of the Kennedy River, three miles north of the Coen Road ($15^{\circ}24'S$, $144^{\circ}11'E$); the formation is exposed there and to the south-west along the Kennedy River and its tributary creeks for 12 miles upstream.

The formation is probably co-extensive with the Normanby Plain (Fig.2). It probably underlies much of the interfluvial sand and

alluvium of the Plain, and is well exposed at the base of the scarp forming the western margin of the Deighton Tableland, and in many streams draining the area.

It rests disconformably upon leached Wolena Claystone (e.g., 12 miles south-west of "Brixton") and is unconformable upon the Mesozoic sediments of the Laura Basin as a whole. An erosional break separates it from the older Fairview Gravel. Small outliers of the Formation east of the extensive, probably continuous, main body are overlain by a fossil piedmont deposit (see below), and both units are being eroded today. The Brixton Formation is, therefore, probably Late Tertiary or Pleistocene. It may be equivalent to the Lynd Formation of the Carpentaria Basin (Laing & Power, 1959).

At many places below the scarps bounding the Deighton Tableland (Fig.2) and in other steep places, there are inclined fans of consolidated, earthy breccia which constitutes a fossil piedmont deposit. Blocks of Dalrymple Sandstone up to 20 ft. long, and, in places, boulders of chert from the Hodgkinson Formation, are set in a mottled, ferruginous, pebbly earth.

A deposit of this type has been observed to overlie the Brixton Formation in three places : in the Cooktown Sheet area at Earls Creek, 15 miles south-east of Laura; in the Cape Melville Sheet area south-east of the Jeannie River crossing; and in the lower Mulgrave River valley south-west of Cairns, where the underlying material is only to be compared with the Brixton Formation.

The best exposure of older dune sand is on the northern side of the isthmus about four miles west of Cape Bedford. It is a badlands-type gully and sea-cliff exposure, 220 feet high, and consists of poorly consolidated orange, yellow, and white sands. Aeolian cross-bedded sets 10 feet to 140 feet thick are separated by white kaolinitic sands from four inches to two feet thick.

This section has a thin, pisolitic, iron-enriched capping. Similar deposits overlapped by the newer dunes north of the mouth of the McIvor River contain tin, limonite-cemented, horizontal sandstone beds.

The whole suite resembles the Teewah Sands of southern coastal Queensland (Coaldrake, in Hill & Denmead, 1960, pp.406-407).

QUATERNARY

A large body of dune sand extends from Cape Bedford north to Lookout Point in the Cape Melville Sheet area, and covers about 250 square miles. About ten percent of the area is covered by moving (i.e., un-vegetated) sand, and almost ten percent is covered by fresh-water lakes. All the dunes, vegetated and un-vegetated, are longitudinal dunes or probable remnants of them, parallel to the prevailing south-east trade wind. They are the elongate blowout and wind-drift dunes of Melton (Melton, 1940), formed by wind in conflict with vegetation.

The wasting sand which covers many of the low interfluves west of the Deighton Tableland is probably derived by weathering of the Brixton Formation in situ, rather than by direct release from the Mesozoic sandstones. In the flatter areas many of the broad streams are choked with sand derived from this blanket.

Alluvium is extensive in the west. In the south-west it is shallow and sandy, but in the north-west it is silty mud, and is probably fairly deep in the flood-out plain of the Normanby and Kennedy Rivers. Alluvium derived from basalt is extensive in the coastal plain round the McIvor and Morgan Rivers.

The abandoned "Kings Plains" reach of the ancestral Annan River is filled with riverine sands and gravels, capped by Recent lagoonal muds.

STRUCTURE

The rocks of the Cooktown 1:250,000 Sheet area fall into two distinct tectonic and sedimentation regimes, made up of the Precambrian and Palaeozoic rocks, on the one hand, and the Mesozoic and Cainozoic rocks, on the other. The tectonic history is summarized in Figure 4.

The older, deformed regime is the stabilised western part of a Palaeozoic geosyncline and its adjacent older stable block of

Precambrian rocks; these two elements are separated by the Palmerville Fault.

The near-shore Chillagoe Formation and the largely off-shore Hodgkinson Formation have both been subjected to the several deformative episodes of the Upper Palaeozoic orogeny, whose imprints differ in intensity across the area.

The structure of the Palaeozoic sediments is very similar to their structure in the adjacent Mossman Sheet area (Amos and de Keyser, op.cit.; Amos, 1961). Four episodes of deformation have been detected in the Cooktown Sheet area (Amos, 1962). The effects of the last of these are localised in the south-east.

B_1 folds : The first folds are directly observable only in the west, within five miles of the Palmerville Fault, where later movements were minimal. Elsewhere their presence is apparent only from the general steepness of the bedding and varied attitudes of the steeply-plunging later folds. The B_1 folds have gently-plunging to horizontal axes and sharp hinges. They have a slaty axial-plane cleavage which is rarely visible on fold limbs, and there are few mesoscopic structures to aid field identification.

B_2 folds are poorly developed in the area. They are open, broad-hinged steeply-plunging folds, superimposed upon the steep bedding of the B_1 folds. Their axial planes are vertical, and trend east or north-east; no associated cleavage or lineation has been observed. South of Cooktown such mesoscopic folds are cut by S_3, the cleavage congruent with B_3 folds.

B_3 folds and associated cleavage S_3 are the most obvious structures in the Hodgkinson Formation. The folds are well displayed on the aerial photographs, especially in the west of the area; the cleavage is stronger in the east, where it is the dominant fabric element in most outcrops.

The cleavage S_3, an axial plane slaty cleavage, is approximately vertical, and trends north to north-west

throughout the area. Its intersection with the bedding is marked by a lineation (L_2). The B_3 folds are tight, similar folds whose limbs are up to five miles long in plan. They plunge steeply, parallel to the intersection of the bedding and the cleavage.

In many places thin, sandy beds have been transposed along the cleavages. This has developed a new lamination, mainly in the east and south-west; elsewhere the sandy beds have been broken up by the cleavage into separate lenticles, which are elongated in places and form tectonic "conglomerate."

B_4folds : A localised zone of B_4 folding extends from the Daintree River in the Mossman 1:250,000 Sheet area north-north-west to Sporing Creek, a tributary of the Granite Normanby River, and westwards from that line for about 12 miles. The folds are mesoscopic and macroscopic kinks in the S_3 cleavage; they have one steep limb approximately parallel to the regional S_3 orientation, and one sub-horizontal limb up to 300 feet across. Hinges are sharp, but not fractured. The fold axes plunge 20° to 30° north-west in the map area, but are shallower further south. A poor axial-plane strain-slip cleavage dips at 20° to 30°. B_3 fold axes and their associated lineation (L_2) are also deformed by this fold system.

At South Cape Bedford, Nob Point, and Indian Head, north of Cooktown, the Hodgkinson Formation shows anomalously mild deformation, and at South Cape Bedford these rocks are apparently faulted against normally deformed, strongly cleaved rocks of the same formation. Two deformations may be recorded there. At Nob Point a gently south-plunging, open fold is accompanied by a weak vertical slaty cleavage. At Indian Head these structures appear to have been rotated by another movement (Amos, 1962). Strike faulting accompanied the Late Palaeozoic orogeny, and much of it post-dates the formation

of the main cleavage. Some of the B_3 folds have faulted limbs.

The Palmerville Fault is a major structure or lineament (Hills, 1955). It may have a Precambrian history, and was the site of the western boundary of the Palaeozoic geosyncline. It is the northern end of Hill's Tasman Line (Hill, 1951). The fault has a history of multiple movement, including post-Lower Cretaceous uplift on the east (Amos, 1962).

Oblique and block faulting have affected the Hodgkinson Formation south of Oaky Creek, and Mesozoic sediments and underlying granite in the upper Deighton River; such faulting may partly control the coastline and distribution of off-shore reefs.

Several of the extinct Cainozoic basaltic volcanoes are situated on known faults.

A broad, ill-defined fracture zone trends north-north-west across the Sheet area along the Granite Normanby and Normanby Rivers. Several basalt vents lie along it in the south, and in the north it marks the ~~eastern limit of Cretaceous sedimentation~~ western boundary of the Deighton Tableland.

Structure of the Permian Formations. The two Permian formations are structurally similar in being elongate, faulted, and folded outliers emplaced by late Permian or Triassic movements on strike faults. They are indurated but not generally cleaved, and their folding may have accompanied their downfaulting.

The main outlier of the Normanby Formation consists of generally steeply-dipping beds flattening towards the west in a small area, near The Brothers, where mesoscopic faulted folds plunge at about 10°S. Stereographic projection of bedding planes in this area indicates gently south-plunging fold axes, and the structure there is apparently a simple, faulted, south-plunging syncline. At the northern end visible folds plunge 30°S to 50°S. Some north-east trending faults have disrupted these folds. (Amos, in prep.)

In the northern outlier, dips in the rhyolite are mostly moderately steep; stereographically deduced fold axes plunge gently north and north-east (Amos, op.cit.).

Fig. 3

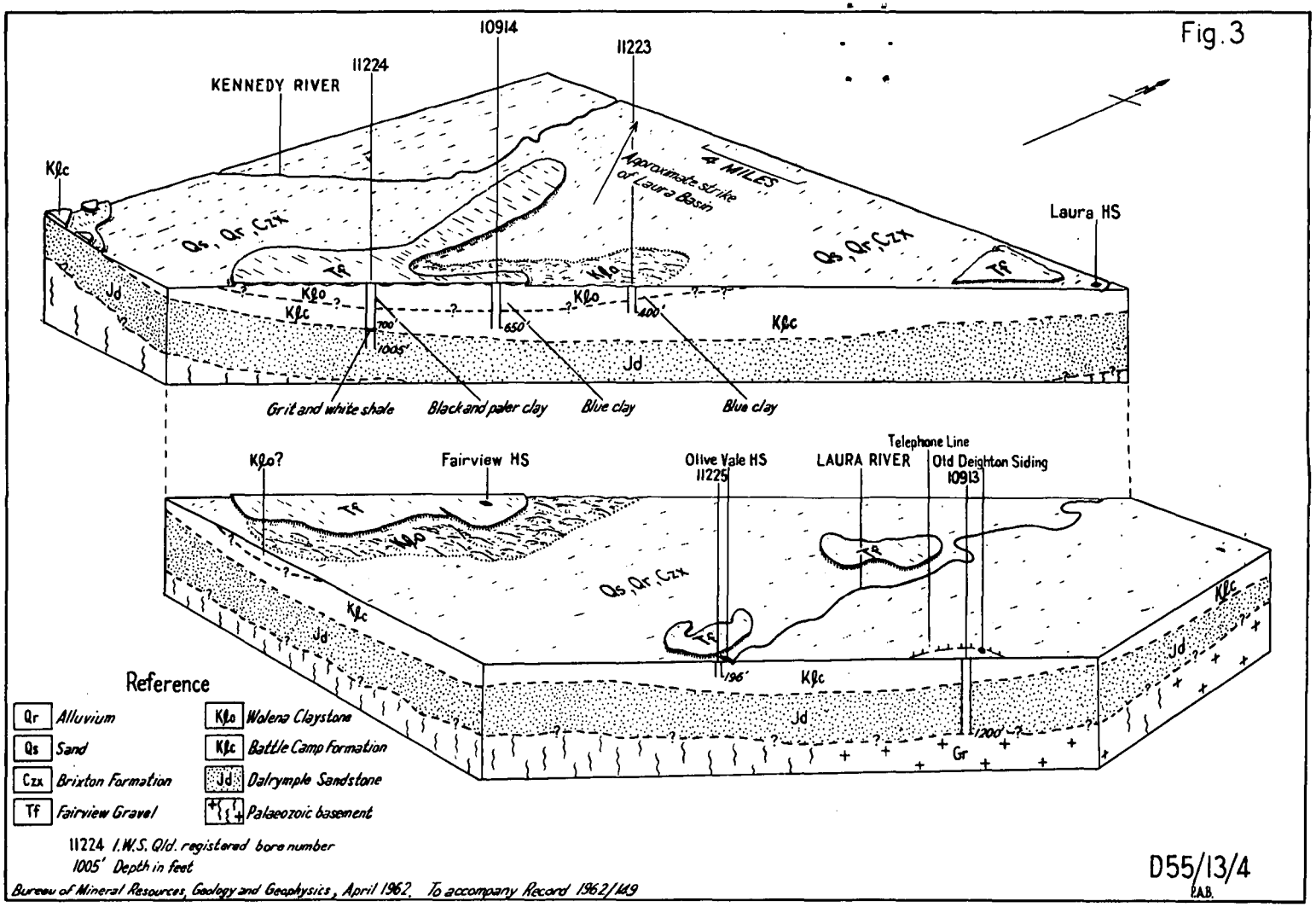


Diagram showing structure of the Laura Basin, and interpretation of water bore logs in the Cooktown 1:250,000 Sheet area

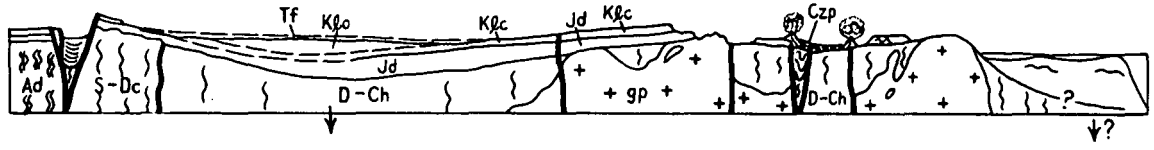
Fig. 4

POST CAMBRIAN GEOLOGICAL HISTORY, COOKTOWN 1:250,000 SHEET AREA

i *Erosion, deposition of terrestrial sheet deposit, sand dunes etc.*

Stage h – Tertiary

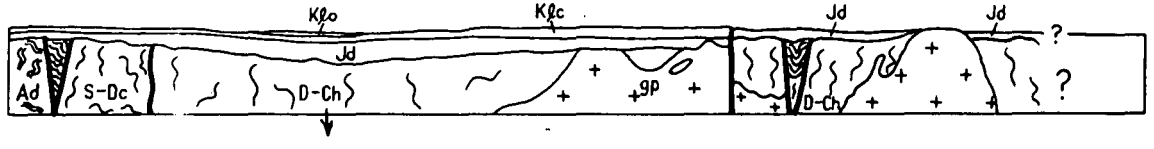
h *Sub-aerial exposure, deposition of gravel (Tf) and basalt (Czp)*



Stage g – Lower Cretaceous (Albian)

g *Local depositional break, continued sagging and marine Lower Cretaceous sedimentation (Klc, Klo)*

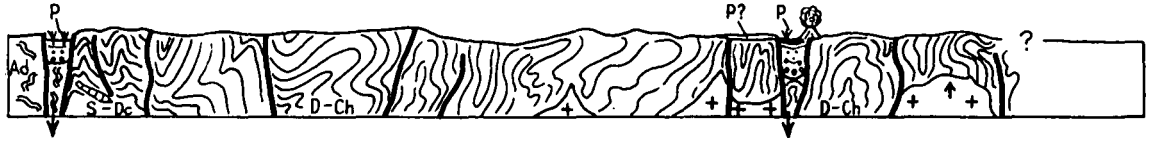
f *Erosion, initiation of Laura Basin, fresh-water Jurassic sedimentation (Jd)*



e *Faulting and folding of Permian rocks, emplacement of granites (?gp)*

Stage d – Permian

d *Marine and swamp sedimentation and and rhyolitic vulcanicity probably localised by N-S rift faulting (P and P)*

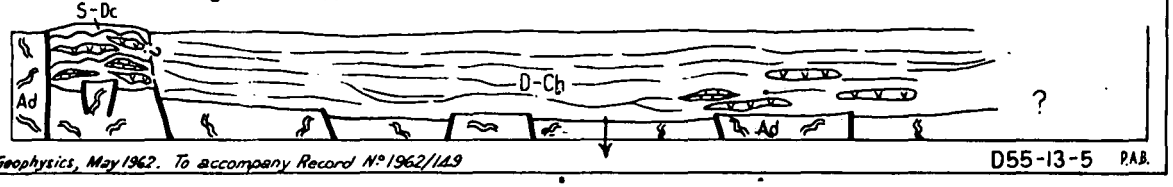


c *Carboniferous orogeny, emergence, and uprise of granite*

Stage b – Upper Devonian

b *Formation and clastic infilling of Hodgkinson Basin (D-Ch)*

a *Initiation of Tasman Geosyncline by failure of Archaean metamorphics (Ad), shelf deposition of Chillagoe Formation (S-Dc)*



Bureau of Mineral Resources, Geology and Geophysics, May 1962. To accompany Record N°1962/149

D55-13-5 P.A.B.

The Little River Coal Measures are poorly exposed, but outcrops show considerable variations in attitude; internal deformation was probably non-affine, and accompanied the downfaulting.

The Laura Basin. The Cooktown 1:250,000 Sheet area contains the south-eastern end of the Laura Basin, which consists of a gently-dished, north-west plunging blanket of Jurassic and Lower Cretaceous sediments with a probably maximum thickness of about 1500 feet in the "Fairview" area. The lower units cropping out round the margin of the Basin generally dip towards Fairview at about 5^{o} (Fig. 3).

The following evidence suggests that the Basin is deepest at "Fairview":

1. The youngest and most fine-grained sediments of the basin crop out there.
2. The northernmost outcrops of the lower sediments (sandstones) of the sequence east of the Palmerville Fault dip towards "Fairview", not towards the north. However, this could be an effect of the Palmerville Fault.
3. The isolated outcrops of Cretaceous siltstone on the Coen Road near the western boundary of the area (one four miles within the boundary, and one at the Hann River crossing) are thought to be stratigraphically below the Albian clay at "Fairview" (Woods, 1962a,c).
4. The outcrop of Neocomian (lowermost Cretaceous) sandstone containing a granite pebble near "Lakefield," six miles north of the Sheet area (Woods, 1962d).

The Basin probably continued to sag after deposition ceased. Faulting has caused minor displacements, chiefly along the Palmerville Fault, which has dropped Mesozoic sediments about 200 feet to the west.

Regional gravity surveys conducted by the B.M.R. in coastal North Queensland between 1954 and 1960 indicate low Bouguer anomaly values where granite is known to exist (Dooley, 1961, map G69-307-1; Profiles B-B and C-C). The map also suggests that granite

may underlie some of the Cainozoic and Mesozoic deposits between "Butchers Hill" and Battle Camp Siding. ~~Immediately east of the coast, the profiles show sharp increases to such high values of the Bouguer anomaly, that the crust there must be oceanic.~~

ECONOMIC GEOLOGY

INTRODUCTION

Mining activity began with the discovery of alluvial gold at Palmerville, just outside the south-west corner of the Sheet area (Amos & de Keyser, 1962) in 1873, and gold production reached a peak in the same decade. It declined to a low level during the next two decades, and many of the miners turned to alluvial and lode mining in the Starcke Gold Fields, and to alluvial tin mining in the Annan River Tinfield (Fig.1), which between 1885 and 1960 produced 12,568 tons of cassiterite concentrates having a total value of £1,323,335 (Cuttler, 1962). Considerable interest was shown in the several coal prospects of the area during and after the laying of the Cooktown-Laura railway, but there has been no commercial production of coal.

METALS

Antimony. Auriferous quartz-stibnite veins were mined for five years near Cocoa Creek, at the southern end of the Starcke No. 1 Gold Field. The west-north-west trending vein on the First Call Claim was rich in stibnite where it was thickest (about 30 inches) (Rands, 1893,p.3). Attempts were made later to recover the antimony as well as the gold (Cameron, 1907a,p6), but they were apparently unsuccessful.

Holmes' Antimony Lode (Saint-Smith, 1922) is a north-east striking quartz-stibnite vein about half a mile north of the "Mundic King" gold mine in the group of mines six miles ~~were~~ west of Cooktown. The antimony ore, apparently mostly cervantite, also carried a trace of gold and 0.1 oz. silver/ton. There is no record of production from the lode, and no other mention of it. Antimony ore was mined on a small scale at Quinn's Hill, five miles from Cooktown; a total of at least six tons of approximately 50 percent ore was taken in 1942 and 1945, and an area under alluvium was prospected in 1946 (Shore, 1946, Denmead 1948)

Gold.

Palmer Gold and Mineral Field.

Alluvial gold was worked intensively last century in the bed and banks of the Palmer River, mainly from the junction with Fish Creek upstream to Byerstown, in the Mossman 1:250,000 area to the south (Amos and de Keyser, op.cit.).

The basal conglomerate and sandstone of the Dalrymple Sandstone, overlying the Hodgkinson Formation in the headwaters of the Mosman River and Cradle Creek, contains detrital gold. Jack (1896a) who led a Government prospecting party to find the source of the alluvial gold, reported the largest areas of auriferous rocks above the unconformity along Chinky Creek, a tributary of the Mosman River. He expressed the opinion that the basal Mesozoic sediments may be the major intermediate source of the Palmer River alluvial gold. Clappison (1940b) reported that testing of the conglomerate from 1936 to 1938 yielded values up to 5 dwt. per ton. The deposit is not economic; the auriferous basal conglomerate has a maximum thickness of only five feet, the values are erratic, and the leads difficult to follow northwards down the old stream beds.

This conglomerate is probably the source of the small quantities of alluvial gold which are won by prospectors in Shophard Creek and the headwaters of the Mosman River.

Starcke Gold Field

The auriferous quartz-stibnite veins near Cocoa Creek, a tributary of the McIvor River, yielded 1,108 ozs. of gold from 1,139 tons of ore (mostly from the First Call Claim) between the discovery of gold in 1892 and cessation of mining in 1896 (Cameron, 1907a,pp.6-7). Much of the gold was fairly coarse (Rands, 1893,p.3; Ball, 1909,p17). The First Call lode strikes west-north-west and dips steeply, and is crossed at right-angles by leaders which coincide with a thinning and slight displacement of the main lode (Rands,loc.cit.)

Other gold shows. Gold was discovered south of Six Mile Creek, 4½ miles south-west of Cooktown, in 1921. The lodes strike west-north-west and north-south, and dip moderately steeply. The ore contained 1 oz. to 4½ ozs. of gold per ton, a little silver, and some base metal sulphides

(Moran, 1921,p385). Saint-Smith (1922) observed that sphalerite accompanied the highest gold values. An antimony lode crops out half a mile north of the "Mundic King", at the northern end of the group. In spite of the high values and fair continuity of the lodes mining ceased in 1923 because of the high cut-off grade dictated by the necessity to ship ore south for crushing, and because water and bad air were encountered in the workings. Small scale open-cut mining, crushing, and treatment were undertaken from 1940 to 1953. Saint-Smith (1916, pp.158-159) recorded several localities in the Annan River Tinfield where gold had been obtained in trace amounts as a by-product of tin-washing, and concluded that it probably originated from small quartz veins in the folded sediments.

Manganese. The only manganese prospect reported is Bott's manganese lode, south of Oaky Creek, 14 miles south-west of Cooktown (Denmead, 1949b). Bodies of low-grade siliceous psilomelane up to three feet wide crop out discontinuously along the eastern flank of a concordant quartz blow (probably a chert-there is jasper on the same hill) in the Hodgkinson Formation. The deposit is uneconomic.

A similar deposit, in which psilomelane and cherty rock are associated, was recently prospected to a shallow depth by a bulldozer a few yards south of the Cooktown-Cairns road, two miles west of the Granite Normanby River, but proved to be very small and irregular.

Mercury. Cinnabar and oxidised copper minerals were prospected early this century east of the Little River Coalfield in the south-west of the Sheet area. The minerals are commonly associated (see "Copper"), but cinnabar is accompanied by the greater degree of alteration (kaolinisation or sericitisation) in the country rock (basic metavolcanic rock of the Chillagoe Formation), and is less widespread than are the copper minerals. The deposits are small and irregular, and are not economic. Dunstan (1917b) thought they were the product of solfataric action.

Silver. No silver ore has been mined in the area. The gold from Starcke Gold Field No. 2, outside the Sheet area, was argentiferous, but no silver is reported in gold from Cocoa Creek.

The Six Mile group of gold mines, south-west of Cooktown, produced some argentiferous ore. The "Mundic King" yielded ore which assayed from 9 dwt. to 1 oz. 4 dwt. of silver per ton, and 13 dwt. to 4 oz. 10 dwt. of gold per ton (Moran, 1921).

Tin. Alluvial cassiterite was discovered in the Wallaby Creek and upper Annan River valleys in 1885, and tin production from the Cooktown Mineral Field (which includes China Camp, in the Mossman 1:250,000 Sheet area) reached a maximum (1051 tons of concentrate) in 1888, when there were about 800 miners on the field (Cuttler, 1962.) Many of the miners came from the Palmer River Gold and Mineral Field, whose richest alluvial deposits had been exhausted by then. Total recorded production from the Field from 1885 until 1960 was 12,568 tons of concentrate whose aggregate value was £1,323,335 (Cuttler, op.cit.). Of this quantity over 7400 tons had been won by 1905 (Cameron 1907). In 1960, production was just over 30 tons of concentrate, still mostly from alluvial sources.

Saint-Smith (1916) noted that cassiterite occurs in modern stream alluvium, old alluvial terraces, granite, and (rarely) in the folded sediments near granite contracts. Many of the deposits worked by sluicing are deeply weathered granite which contains disseminated cassiterite and stanniferous, tourmaline-rich veins and patches. Such deposits are commonly difficult to distinguish from adjacent and overlying alluvial or colluvial stanniferous "wash".

The rich, early-worked deposits were mostly modern stream alluvium, but some of the longer-producing alluvial areas are high up in relatively gently-graded stream headwaters (Cameron, 1907), such as those at Big Tableland, Romeo, and Poverty. These high deposits (especially Poverty) are fairly old ((?) Tertiary) and apparently related to an earlier, more mature physiographic cycle. The deposits at Poverty, which lie 1800 feet above sea level, are consolidated, mottled, clayey grit and sand, and clay, i.e., they are finer-grained than the younger deposits.

Stanniferous deep leads have been worked at Shipton's Flat and north-east of the "Jubilee" workings, but they may not be as old as the Poverty deposits.

Jack (1887) noted that the cassiterite at Wallaby Creek was coarser than that at Romeo, and was accompanied by more tourmaline. Most of the cassiterite slugs found (up to 100 lb.) come from the Wallaby Creek Valley, in both young and older alluvials.

Cassiterite showing all the common "colours" (white, ruby, etc.,) has been found at many places in the Tinfield.

The known mines, including the alluvial ones, tend to be concentrated on or near granite/sediment boundaries.

On account of the mountainous terrain and the immaturity of the valleys, only relatively small-scale alluvial mining is possible within the Tinfield. In 1898 suction-dredging was attempted in Wallaby Creek, but the recovery plant was ineffective, and the dredge was lost in a flood (Cameron, 1907).

In 1961 a B.M.R. geological investigation revealed a large dredging prospect at "Kings Plains", 10 miles north-west of the Tinfield. The prospect consists of 15 miles of abandoned, alluviated river valley, the former east-west reach of a river (the upper part of the present Annan River) which drained north from the Tinfield, and flowed west to join the Normanby River. This ancestral Annan River was recently captured by a tributary of Oaky Creek at the elbow at the eastern end of the alluviated section which was left stranded with two lagoons on its surface.

Small quantities of alluvial cassiterite and tourmaline are reported south of Battle Camp siding.

Mining of lode tin began in 1887, and small, rich lodes at Mt. Amos and Mt. Leswell were soon worked out. The Lion's Den mine, near Mt. Amos, produced nearly 50 tons of tin before closing down in 1891.

The lodes in granite are tourmaline-rich segregations and pipes (Jack, 1891), possibly largely accumulations on joints (Cameron, 1907b). Some are quartz-tourmaline veins up to six feet wide. The Collingwood lode (Mt. Leswell area) and Mt. Browning lode (later the Phoenecian, near Mt. Amos) are on granite/sediment contacts (Cameron, op.cit.). Many of the lodes in the granite are steep and are traceable

for several chains in a north-north-west, north-south, or north-north-east direction, but some are irregular, variously plunging pipes. In many of them quartz, tourmaline, and cassiterite are accompanied by wolfram and arsenopyrite. Several lodes assayed up to 20 percent metallic tin in rich patches.

Production from lode mines has been very low (usually below 10 tons of concentrate p.a.) since about 1920 .

Tungsten. Wolfram is a fairly common mineral in tin lodes at Mt. Amos, Mt. Hartley, and the Romeo district in the Annan River Tinfield (Dunstan, 1913b, Min. Refs. 7928-7934), but has been mined for itself for only very short periods at Mt. Hartley and Romeo. The Mount Hartley Wolfram lode workings, near the eastern branch of Mt. Hartley Creek, were largely inaccessible in 1914 (Saint-Smith, 1916, p.157). They followed a steeply-dipping, two-feet wide quartz/wolfram vein, which strikes north-north-west in granite.

The Clearwater deposit, south of Romeo Creek, was discovered by the presence of alluvial wolfram. The wolfram is concentrated in quartz veins cutting deeply-weathered granite, and was recovered by sluicing.

Saint-Smith (op. cit., p. 165) reported that tin concentrates from both Wallaby Creek and Romeo Creek contain yellowish to white grains of scheelite.

OTHER METALS

Arsenic. Arsenopyrite is the most common sulphide in the tin lodes, particularly in the Mt. Amos area, and it is also found in some of the placer deposits in the Tinfield. Dunstan (1917a, p.176) recorded the finding of a mispickel lode near Battle Camp Siding, but no other mention of it has been found. It is presumably in the Puckley Granite.

Cobalt. An occurrence of cobalt mineral at the Asmus claim, in the Mt. Hartley District of the Annan River Tinfield, is recorded (Dunstan, 1913b, Min. Ref. 1834A). The mineral was associated with pyrite and arsenopyrite in quartz.

Copper. Copper mineralisation is known only in the Little Kennedy River area in the south-west, where it was prospected early this century, but found to be small and irregular. Oxidised copper minerals and cinnabar are irregularly disseminated in altered basic volcanics of the Chillagoe Formation east of the Permian coal measures, and are thought to be of solfataric origin (Ball, 1910, 1914; Dunstan, 1917b). Their mode of occurrence is similar to that of copper shows and orebodies in the western half of the Mossman 1:250,000 Sheet area (Amos and de Keyser, 1962). Cuprite and malachite were also reported in a lode three miles north of Palmerville, in the same area (Dunstan, 1913b, Min. Ref. 2427).

Small quantities of native copper were reported in tin lodes at Mt. Amos, in the north of the Tinfield (Saint-Smith, 1916, p.159).

Iron. A small, probably shallow body of nodular, concretionary limonite crops out along the track about two miles south of "Battle Camp" homestead.

Lead. Galena was a common minor mineral in the Mt. Amos tin lodes, but has never been mined for itself (Saint-Smith, op. cit., p. 159).

Molybdenum. Molybdenite is reported in small quantities in the Mt. Amos tin lodes and near Slaty Creek (Saint-Smith, op. cit., p. 159).

NON-METALS.

Coal. Coal is common in three formations, but has never been mined economically.

Thin seams of coal and coal-bearing shale and sandstone occur in the shale-bearing part of the Dalrymple Sandstone. They are mostly in the eastern part of the Sheet area in the lower 100 feet of the formation, but some in the Battle Camp Range and Welcome Creek area are higher. Few seams are thicker than 1 foot, and they generally have a high ash content (8 percent to 46 percent - Dunstan, 1913b, pp. 266-267). Coal from a ten-inch seam at the base of cliff-forming sandstone at the head of the Stacks Creek, south of Battle Camp Siding, reportedly burnt satisfactorily in a locomotive (Jack, 1895).

Christie's shaft and bore penetrated 346 feet of sediment near the 38 mile railway peg, and found a ten-inch seam, containing 12 percent ash, at 120 feet.

A 192-foot bore near the head of Stacks Creek found no appreciable thickness of coal (Jack, 1895).

The Permian coals are thicker than the Jurassic ones, but are generally impure, steeply-dipping, and quite strongly deformed.

The Little River Coal Measures excited early interest because of their position on the projected railway to the Palmer Gold Field, and because of the relatively low ash content of the coals according to some analyses (most 6 percent to 10.8 percent, Dunstan, op. cit., pp. 276-277). The seams are up to 20 feet thick, but are steeply-dipping and faulted, and the coal is heavily slickensided (Jack, 1882; Rands, 1893). Jack thought that the southern outcrops showed some thermal alteration, and that the coals had undergone surface weathering, and should improve with depth.

Rands (op. cit.) and the Powell-Duffryn report (1949, vol. 2, p.307) recorded higher ash contents (14 percent to 46 percent), but the authors of the report (op. cit., pp. 301-303) consider that this is probably due to oxidation of the exposures.

The Oaky Creek Coalfield (Normanby Formation) received little attention after Jack's investigation (Jack, 1879a, b). At least 100 feet of shaly coal crop out in Coal Creek about a mile north-east of "The Brothers", half a mile west of the old Byerstown-Cooktown road, and smaller outcrops may be found in neighbouring gullies. The Coal Creek exposures are less intensely folded than is general elsewhere in the formation, but the coal is faulted and crushed. No analyses are known.

Limestone. Three outcrops of fairly pure white to grey limestone are known in the Sheet area. One, in the Chillagoe Formation in the south-west, was visited by Jack, who described it as an unfossiliferous marble (Jack, 1887, p.12). The other two are in the Hodgkinson Formation, respectively north and north-west of "Kings Plains" Homestead. The smaller (western) one is about three miles north-east of the junction of the

East and West Normanby Rivers, and is half a mile east of an old road. The larger one is in the Barrons Range, about five miles east of the old Byerstown road, and is best reached from "Kings Plains".

"The series of vertical limestones interbedded with slate (which) outcrop between the Lookout and Barron Ranges along the road from Hamilton to King's Plains" (Maitland, 1891) probably are the brown-weathering, thin, clayey limestones of the Normanby Formation.

Large deposits of coral limestone lie off the coast, from the few dead fringing reefs to the outer barrier reef, which is generally outside the Sheet area.

Water. The current need for water search in the area falls into two types:

(a) for tin sluicing in the south-east,

(b) for pastoral purposes in the west.

(a) Much of the scrub-covered tinfield in the south-east receives over 80 inches of rain a year, but, as most of this falls during the three-month "wet season" from January to March, alluvial tin mining, particularly in the higher, smaller streams, is also very seasonal. Before motor-driven pumps were available, many long and costly flumes were built to carry water to the workings, and provide a "head" of pressure for hydraulicking. There is little room for water storage in the mountainous Tinfield. All but the smallest dams are unlikely to survive most wet seasons, and are therefore costly and dangerous. For these reasons there seems little chance of overcoming the seasonal water shortage at many of the workings. The very small-scale, sporadic gold prospecting in Shephard Creek and the Mossman River headwaters in the south-west also depend largely on seasonal availability of water.

(b) Five water bores have been sunk into the Mesozoic sandstones of the Laura Basin, and three of them produced useful water; the now derelict Deighton bore produced a small artesian supply. The successful bores, except for the Deighton bore, passed through Cretaceous clays, and all reached either basal Cretaceous or Jurassic sandstone aquifers (Denmead, 1949a, p.42; and Fig. 3, this report). Those which stopped in

Cretaceous clay at "Fairview" tapped only a poor supply of very salty, probably connate water (Denmead, op. cit., p.41). That the Dalrymple Sandstone (Jurassic) is an aquifer is obvious from the number of small springs which can be found below cliffs of it; e.g., in the dry season of 1961 water was impounded in small gullies, draining north from cliffs of the Sandstone, by embankments of the new Laura road about 10 miles south-east of Laura. The Little Laura River and Bridge Creek, which both rise in the Sandstone, have remarkably strong and constant flows, for relatively small streams, in the dry season.

For the rest, graziers rely on the excellent permanent water supplies in the large waterholes of the Normanby and Kennedy Rivers.

Vast supplies of fairly potable water lie untapped in the sand dunes of the north-east, where almost a tenth of the surface is covered by fresh-water lakes associated mostly with modern longitudinal dunes. The lake water is commonly discoloured and flavoured by peat, but is apparently potable. The water table appears to rise at least 100 feet above sea level, as evidenced by the lake levels, within the main body of dune sand. As the annual rainfall is about 60 inches, this area has considerable water supply potential.

The basal gravels of the McLean Basalt are a minor source of water, e.g., the Pandanus Spring at "Springvale".

A spring which runs out of basalt at Miller's homestead, north of the old vent of Mt. Piebald, ran hot until 50 years ago (Mrs. Miller, pers. comm.).

OTHER NON-METALS

Beach Sands. Very minor beach concentration of heavy minerals from the dune sands has taken place, e.g., on the lee shore west of Cape Bedford, where heavy minerals in the same relative proportions have been detected in the dune sand as in the beach concentrate (Greaves, 1962). Ilmenite makes up 70 percent of each concentrate, and zircon most of the remainder; minor constituents are rutile, tourmaline, and magnetite. The ilmenite and magnetite probably come mainly from the Cainozoic basalts, but the

other minerals are of granitic and metamorphic origin; they may have come as second-cycle detrital minerals from the Dalrymple Sandstone.

Building Stone. The pale grey, porphyritic granite at Cooktown has been mentioned as a possible building stone (Ball, 1905). The ~~Dalrymple~~ Mesozoic Sandstone has been used to construct culverts on the Cooktown-Laura railway. (l.c.)

Gemstones. Corundum is known from Wallaby Creek and Jones Creek in the Tinfield, and a few sapphires have also been found in the alluvial deposits, namely in Wallaby Creek at Rossville (with chalcedony and rock crystal), at Hurricane Gully Claim, and at the Mary Claim, a t the Tabletop, Shiptons Flat (Saint-Smith, 1916, p.160).

Gemstones (including sapphire?) have been reported from gullies north of "Butchers Hill" and the McLean basalt (Ball, 1910, p.8). Ball thought they came from the sub-basalt gravels, but as the basalt itself contains xenoliths of deep-seated rocks and minerals, it is possibly the source of the alluvial gemstones (cf. deposits at Anakie and Rubyvale in the Emerald area).

Kyanite was identified by Saint-Smith (op. cit., p.161) from concentrates obtained in Wallaby Creek, half a mile downstream from Rossville.

Magnesite has been deposited in small quantities round the McLean Basalt:

(a) encrusting bedrock and cementing stream rubble in streams draining from the Basalt.

(b) as nodules in black soil resting on or otherwise derived from basalt.

Monazite is recorded in very minor quantities in cassiterite concentrates (Saint-Smith, op. cit., p.165).

Quartz. Rock crystal, smoky quartz, amethyst, and rose quartz are fairly common in the alluvial workings, and a tourmaline-bearing rose quartz vein crops out about a mile north-west of Rossville.

Sagenite (clear quartz with macroscopic rutile needles) is known in alluvium at Shipton's Flat (Saint-Smith, op. cit., p. 161).

Road Metal. Fairview Gravel, taken from the outcrops at Laura and "Olive Vale", has been used as a road metal in places where the natural surface readily turns to "bulldust". On the main roads weathered rocks of the Hodgkinson Formation, rubble from the base of the Dalrymple Sandstone, and stream gravel have been used.

Salt has been reported at Lake Emma, north of old Welcome Siding and west of "Battle Camp" homestead (Dunstan, 1920, p.3). However, the lake contains fresh water, and salt was not seen in the vicinity, nor do the residents of "Battle Camp" know of any there.

Topaz. Rare finds of topaz have been reported from wash in the Tinfield (Saint-Smith, op. cit., p. 165).

PROSPECTS

Although a variety of minerals has been discovered in the Cooktown 1:250,000 Sheet area output has been significant for only two - cassiterite and gold. It is possible that more gold reefs may be discovered in the east, but the present prospects are mainly for the recovery of tin in the south-east.

Although the rich, accessible cassiterite placers have been worked out, there is probably a large quantity of the mineral still to be won by alluvial methods, mainly in less obvious sites removed from the present stream courses. These might be either perched remnants of old alluvial deposits, or deeply weathered granite containing disseminated cassiterite or scattered tourmaline-cassiterite patches. Apart from the initial difficulty of finding such deposits in the jungle-covered area, their mining must justify the expensive operations of providing access and water to the workings.

Rich lode mines were worked early in the history of the field, mainly round Mt. Amos, and it is probable that other economic lode deposits exist: most of the present outcrop of the Finlayson Granite is still in the tin-producing zone of the intrusion.

Apart from the lode and alluvial deposits within or very near the granite source, it is possible that there is a large, low-grade dredging prospect at "Kings Plains". The prospect is an east-west chain of alluvial basins, once the course of the Annan River, which recently was captured by a short coastal stream at the Annan River gorge, leaving this reach stranded. The basins are filled with eluvial material and lagoon muds as well as river deposits. Fine, cassiterite-bearing gravel and coarse, cross-bedded sand were found about 15 feet below the surface at the eastern end of the prospect.

During 1937 the Broken Hill Pty Co. Ltd carried out boring in two areas along the Annan River. The first area tested extended from above the falls on Wallaby Creek to $\frac{3}{4}$ mile below the Mungumby Creek junction with the Annan. The deepest ground was 78 ft. on a line of bores about $\frac{1}{2}$ mile above Nunn's Forks; downstream the ground became progressively shallower. About 50 boreholes were put down along four lines; the yield was below $\frac{1}{2}$ lb. tin per cubic yard, and the concentrates assayed only 52 percent (Dept. of Mines, Qld., 1937, p.68). (It is not known whether this percentage is tin or tin oxide). According to Saint-Smith (1916, pp. 77-79) earlier testing in the same general area and in the Mungumby Creek flats had yielded average values of about 1 lb. of cassiterite per cubic yard. It is, perhaps, surprising that values in the Annan River flats were not higher so close to Rossville, where very rich alluvial pockets have been found.

The second area tested was along the lower Annan River from Poole Lagoon down nearly to the Annan bridge, where several lines of bores were put down (Qld. Dept. Mines, loc. cit.). On the right bank bores were from 20 ft. to 105 ft. deep, and the best values were under 1 oz.. On the left bank, opposite Alligator Point, a line of bores running north penetrated ground which became deeper away from the river; at 20 chains north a bore penetrated to 155 ft. - 142 ft. below sea level - without reaching bedrock. Only traces of slime tin were recovered.

The results obtained by B.H.P. may tend to confirm the suggestion that the Annan is a relatively young major stream. The remnants

of the more mature drainage system, along which the larger cassiterite placers are found, mostly drain west-north-west; thus, not much cassiterite may have been released to the present Annan River, either below the gorge formed by the postulated recent capture, or between Wallaby Creek junction and the gorge. On the other hand, it is possible that the low values found in the lower reaches of the Annan are attributable merely to progressive dilution, and not to the possibility that the Annan formerly drained less of the Tinfield than it and its tributaries drain at present. It is hoped that geomorphological studies, geophysical work, and boring to be undertaken in 1962 will provide information which will lead to a better understanding of the history of streams and the formation of tin-bearing placers in the area. (See Appendix 1).

The low, coastal Wyalla Plain in the south-east may also be worth prospecting for alluvial cassiterite. However, the history of drainage of the area, and the depth of colluvial material there are not known; it is also possible that the area has a recent marine history. Judging from its largely rectilinear boundaries and their steep slopes, it may be a faulted depression overlying granite and/or the Hodgkinson Formation. It appears that the most mature surviving drainage system of the area trends west-north-west from very near the present coast, and also that it was the main locus of concentration of alluvial cassiterite. Because of this, and because the Mt. Finlayson Range seems to be barren of tin, it is unlikely that the recently exposed granite in the Tinfield to the north-west would have shed much cassiterite to the Plain. However, there is a possibility of cassiterite supply from the Bloomfield River. Alluvial cassiterite has been won at China Camp, on Baird Creek, and at Bourgamba, on Alexandra Creek, a tributary of Roaring Meg Creek. All these streams are headwater tributaries of the Bloomfield River. If they also formerly drained to the north-west to join the ancestral Normanby River system (Laura Basin drainage, Jurassic to Early Tertiary), stanniferous alluvial deposits may have accummulated in the approximate area of the present divide (or wind gap , if this hypothesis is correct) between the granite Normanby River and the Bloomfield River.

Decapitation of this ancestral Normanby River system by Boolbun Creek, a tributary of the Daintree River, and the Bloomfield River, both short, steep, coastal streams with entrenched, cleaned-out channels, has resulted in the removal of all traces of an older surface in this area. Any river placer deposits belonging to the earlier cycle would have been removed and re-deposited at the mouths of the Bloomfield and the Daintree Rivers. Whether the cassiterite was re-concentrated or diluted would depend upon the hydraulic conditions of the estuaries. The depth and conditions of deposition of the Wyalla Plain deposits are unknown. Prospecting in the area should include an attempt to work out its geomorphological history.

Appendix 1

RESULTS OF ALLUVIAL TIN INVESTIGATION, KINGS PLAINS

Between May and December, 1962, a gravity survey and percussion drilling programme were completed in the Kings Plains area by the Bureau of Mineral Resources (Best and Dallwitz, 1963). Fourteen gravity traverses, designed to outline the probable basement profile, were completed across the central zone of the east-west valley from a constriction 6 miles west of the Annan River Gorge to the head of the Mungumby Creek valley, 3 miles south-east of the Gorge. Eleven of the fourteen holes drilled to an aggregate footage of about 1,900 feet yielded information useful to the investigation, and of these six reached basement, and provided satisfactory sampling results. Of these six, one was in a line of nine holes drilled 3½ miles west of the gorge, and the other five were drilled near the west bank of the Annan River ½ mile south of the gorge.

The drilling confirmed the presence of coarse fluvial sediments below the fine-grained alluvium of the modern, aggraded valley floor. The depth of alluvium in the eastern (upstream) holes, near the present Annan River, was 135 to 150 feet, and, in the western holes, 150 to 167 feet or more. In all holes 40 to 70 feet of ferruginous mottled sandy clay (cf. Brixton Formation) overlay 80 to 120 feet of dominantly coarse stream sediment (clayey medium sand, clean, fresh, feldspathic coarse sand, grit, and pebbly sand, including water-saturated, unstable, or "running" sand) and minor black or dark grey, pyritic clay. Much of the sand was also pyritic, and some was cemented with pyrite.

Rough heavy mineral concentrates were prepared by panning in the field, and these were analysed after heavy liquid and magnetic separation in the laboratory. Cassiterite was found in several concentrates from the western line of holes, and was common in those from the eastern line, but the overall grade in each hole was not economic. Tourmaline and other granitic minerals were abundant in all preliminary concentrates, which generally had 5 to 10 times as much magnetic heavy mineral as cassiterite.

Four of the five eastern holes yielded bulk values from 2.1 to 5.2 oz. cassiterite per cubic yard (re-calculated to 72% Sn on the basis of chemical assay of the heavy, non-magnetic concentrate, and assuming a 25 percent volume loss of material as "fines" before bulk measurement of cuttings from the drill-hole - Best and Dallwitz, p.9). The highest value obtained in the western line was 1.5 oz. cassiterite (72% Sn) per cubic yard. The greatest concentrations of heavy mineral, and especially of cassiterite, were found in the lowermost 20 to 40 feet in each hole; values ranged up to 13 oz. (72% concentrate) per cubic yard for the interval below 100 feet in the eastern holes.

As a result of the investigation it was suggested that the Mungumby Creek Valley, morphologically continuous with the Kings Plains valley across the postcapture Annan River north of Helenvale, is a prospect. This valley would have received none of the Annan River bed load, but should have received all the detritus dropped down the steep western side of Big Tableland, all of which appears to have drained west into the valley for a long time. Big Tableland has been one of the main producing localities of the Annan River Tinfield in the past. It lies across a granite/sediment contact, and has yielded tin by sluicing in the superficial sediments and deeply-weathered surface of the Tableland; the rich Lion's Den Lode was worked on the western scarp, overlooking the Mungumby Creek valley.

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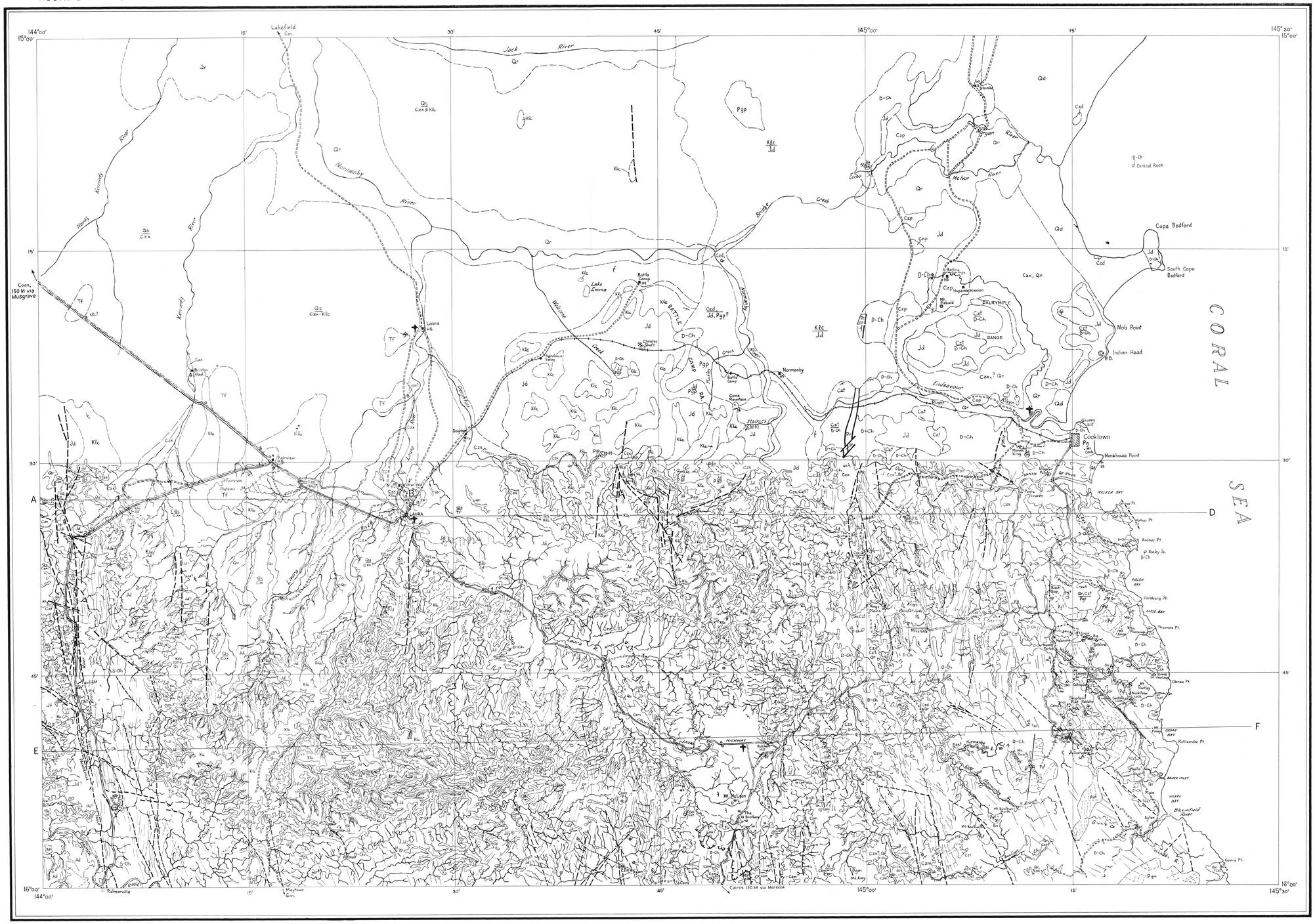
AUSTRALIA 1:250,000

COOKTOWN
QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SD55·13



Reference

CAINOZOIC	QUATERNARY		Qr	Alluvium - Grey silty clay, sand and gravel
			Qb	Alluvium - Black and red clay (basalt derived)
			Qs	Interfluvial sand - Loose orange and white sand
			Qd	Younger dune sand - white sand
			Czd	Older dune sand - Iron-stained, aeolian cross-bedded sand
			Czt	Piedmont fans - Eartly fossil breccia, slightly ferruginous
	TERTIARY (?)	Brixton Formation	Czx	Mottled clayey sand, gritty and pebbly
		Piebald Basalt	Czp	Olivine basalt
		McLean Basalt	Czm	Olivine basalt, pyroclasts, gravel
	TERTIARY	Fairview Gravel	Tf	Rounded quartzose pebble gravel, sandstone, billy
MESOZOIC	LOWER CRETACEOUS	Wolena Claystone (ALBIAN)	Klo	Pale weathering, olive-grey, silty and sandy claystone with calcareous concretions
		Battle Camp Formation (APTIAN-NEOCOMIAN)	Klc	Conglomerate, glauconitic sandstone, shaly sandstone, leached shale
	JURASSIC	Dalrymple Sandstone	Jd	Quartz sandstone, conglomerate, grit, shale
PALAEOZOIC	PERMIAN	Normanby Formation	Pr	Feldspathic sandstone, siltstone, conglomerate, limestone and coal ; rhyolite
		Little River Coal Measures	Pur	Sandstone, shale, impure coal and limestone
	PERMIAN (?)	Puckley Granite	Pgp	Coarse, porphyritic adamellite; aplite dykes
		Trevethan Granite	Pgt	Medium-grained hornblende-biotite granodiorite
		Finlayson Granite	Pgf	Medium-grained porphyritic adamellite
		Mareeba Granite	Pgm	Coarse, porphyritic granodiorite and adamellite
		Unnamed Granite	Pg	Medium to coarse porphyritic granite
	? LOWER CARBONIFEROUS-MIDDLE DEVONIAN	Hodgkinson Formation	D-Ch	Greywacke, slate, minor volcanics and limestone
	LOWER DEVONIAN-UPPER SILURIAN	Chillagoe Formation	S-Dh	Volcanics, chert, sandstone, limestone
PRECAMBRIAN	ARCHAEAN	Dargalong Metamorphics	Ad	Schist, gneiss, amphibolite, quartzite

- Geological boundary
- Fault, showing relative vertical movement
- Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed boundaries are dotted, faults are shown by short dashes.
- Strike and dip of strata
- Overturned strata
- Vertical strata
- Horizontal strata
- Trend of bedding
- Dip of strata - Air-photo interpretation
- Direction of sediment transport
- Joints
- Strike and dip of cleavage
- Dyke or vein { gy : granophyric mi : microgranite am : alkali microgranite; t : tonalite d : dolerite }
- Basic volcanic vent
- Macrofossil locality (Marine)
- Plant fossil locality
- Mine
- Alluvial workings
- Mn Minor mineral occurrence — Mn Manganese, Sb Antimony, C Coal, Cu Copper, Au Gold, Hg Mercury, Ag Silver, Sn Tin, W Tungsten (Circle around mineral symbol indicates unexploited deposit or prospect)
- Water bore - Artesian
- Water bore - Sub-artesian
- Water bore - Saline
- Well
- Tank
- Wind pump
- Abandoned bore; Abandoned settlement (Hamilton, LAURA MS) Homestead
- Telegraph line
- Landing ground
- Road
- Vehicle track
- Railway (abandoned)
- Scorp
- P. D. Position doubtful

Compiled and issued by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development, in conjunction with the Geological Survey of Queensland. Southern half of topographic base compiled by the Royal Australian Army Survey Corps 1961; northern half compiled by Department of Public Lands, Queensland and issued by Australian Army Survey Corps 1943. Aerial photography, 1960-62, by Adastra Airways Pty. Ltd.; vertical coverage at 1:63,000 complete except for south-east corner. Transverse Mercator Projection.

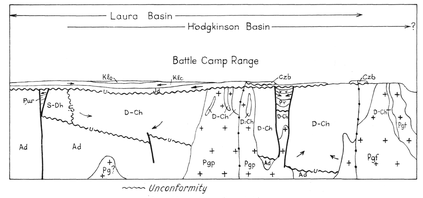
INDEX TO ADJOINING SHEETS
Showing Magnetic Declination
EBAGOOLA · CAPE MELVILLE · NANN RIVER · COOKTOWN · WALSH · MOSSMAN · CAIRNS
ANNUAL CHANGE 2'E

Scale 1 : 250,000
5 0 5 10 15 MILES
5 0 5 10 15 20 25 KILOMETRES

GEOLOGICAL RELIABILITY DIAGRAM
B Reconnaissance - traverses and air - photo interpretation
C Air - photo interpretation
D Uncontrolled topographic base, traverses and air - photo interpretation

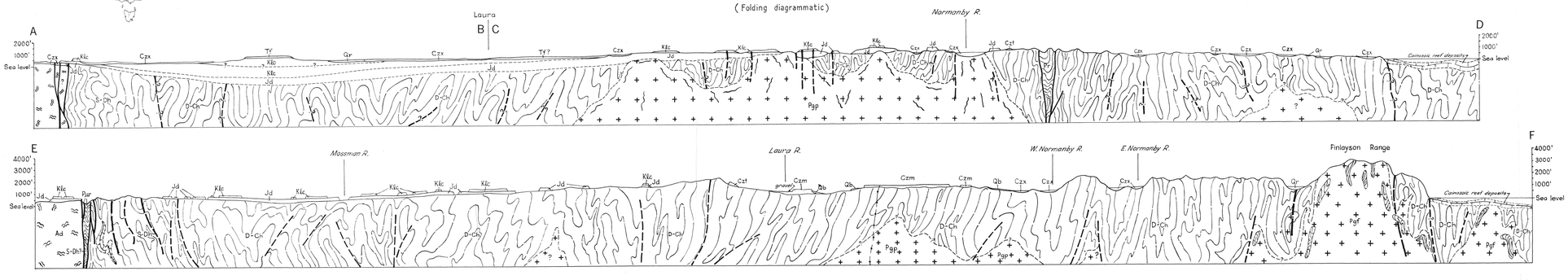
Geology by: K.G.Lucas, W.R.Morgan, B.J.Amos (B.M.R.) L.G.Cuttler, J.T.Woods (G.S.Q.) 1961
Compiled by: K.G.Lucas 1962
Drawn by: P.J.Brown

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



Sections

Scale 1/4
(Folding diagrammatic)



COOKTOWN
SD 55-13