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Progress Report on the Study of the Clematis Sandstone and Rewan Formation

by

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SUMMARY

Previous investigations in the Bowen Basin have resulted in a tripartite division of the outcropping Triassic sequence in which the basal Rewan Formation is overlain by the Clematis Sandstone, which in turn is overlain by the Moolayember Formation. The essential features of these units have already been recorded by joint BMR-GSQ reports dealing with the geology of various sheet areas, and a summary of this information is presented in table form in this report. The results of petrographic studies of samples collected by regional mapping parties, and the results of shallow drilling programmes are also tabulated.

The Rewan Formation and the Clematis Sandstone are described from outcrops in the Carnarvon and Expedition Ranges in the south-western part of the area of investigation, from the Carborough Range and Redcliffe Tableland in the north, and from the Dawson Range in the central and south-eastern parts. In the Carnarvon Range area, the Rewan Formation is characterized by labile sandstone and red mudstone. It is overlain by a sequence, about 300 feet thick, of thinly interbedded quartz-rich sandstone and mudstone, which is regarded as the lower part of the Clematis Sandstone. The upper part of the Clematis Sandstone is coarser than the lower part, and in general it lacks mudstone and siltstone. Equivalent subdivisions are shown to exist in the northern and central parts of the basin, but in the south-eastern part only the lower unit is thought to be present.

The most common sedimentary structures observed in the Rewan Formation are trough cross-stratification and primary current lineation. In the lower part of the Rewan Formation the cross-stratified sandstone is commonly in the form of lenses surrounded by mudstone. Cross-stratification is the dominant sedimentary structure of the Clematis Sandstone. Studies of the orientation of cross-stratification in the Rewan Formation and the lower part of the Clematis Sandstone indicate transport inwards from the margins of the basin, but in the upper part of the Clematis Sandstone an overall movement towards the south and south-east is apparent.

INTRODUCTION

The Clematis Sandstone and Rewan Formation are two of the three units which constitute the Triassic Mimosa Group of the Bowen Basin, Queensland. The basal unit, the Rewan Formation, is essentially a red bed sequence of mudstone and sandstone. The Clematis Sandstone is a quartz-rich sandstone sequence lying stratigraphically above the Rewan Formation, and beneath the Moolayember Formation, which is the youngest unit of the group. This report is a summary of the results of a field study of the outcrop of the Rewan Formation and Clematis Sandstone made during the period from June to September 1968. A similar report has been prepared for the Moolayember Formation (Alcock, 1969). The ultimate aim of the study is to investigate depositional environments operative during the Triassic in this area, but the initial work is aimed at establishing a stratigraphic framework from surface exposures.

The two units crop out in the Mimosa Syncline from Theodore in the east to the Arcadia Valley in the west (Pl. 1), and Blackwater in the north. From the Arcadia Valley they extend in a narrow belt westwards and then northwards through the Tambo, Jericho, Galilee, and Buchanan 1:250,000 Sheet areas. The Rewan Formation also extends northwards from the Mimosa Syncline to the northern part of the Bowen Basin where a unit equivalent to the Clematis Sandstone, the Carborough Sandstone, crops out as a series of ranges and tablelands.

Previous investigations

In 1845 Leichhardt saw and described sedimentary rocks in what is now known as the Bowen Basin, during his epic journey from Moreton Bay to Port Essington. By the year 1872 enough information was available for the basin to be roughly outlined on a map of Queensland (Daintree, 1872), and for the succession, the Bowen River Series, to be divided into a lower 'Carboniferous' marine unit and an upper unit containing plant fossils. It was not long after that Jack (1879) divided the succession in the northern part of the basin into an upper (freshwater), middle (marine) and a lower volcanic series. Since that time most authors have retained this three-fold division for the Permian sequence and as late as 1958 the most commonly used terms were Upper Bowen Coal Measures, Middle Bowen Group, and Lower Bowen Volcanics (Smith 1958).

Jack (1879) also reported that the upper (freshwater) sequence, subsequently termed the Upper Bowen Coal Measures, was overlain unconformably by a flat-lying 'coarse grit of well rounded silica'. Reid (1924-25) named this coarse grit the Redcliffe Series, and later (Reid 1928) the Carborough Sandstone. He refuted Jack's contention that the unit lies unconformably on the Upper Bowen, and tentatively assigned to it a Triassic age.

In the southern part of the basin, Jensen (1926) recognized the Upper Bowen and named the unit lying conformably above it the Clematis Sandstone, later specifying the gorge of Clematis Creek as the type area (Whitehouse, 1955). Despite this, Reid (1930), mapping in the same area, included the Clematis Sandstone (and the overlying Moolayember Formation) in the Upper Bowen Coal Measures. However, he did distinguish one 'useful marker bed' the Carnarvon Red member, within his Upper Bowen, which was regarded as being older than the Clematis Sandstone of Clematis Creek by Denmead (in Reid 1930). Oil Search (1936) correlated the Carnarvon Red member with the Clematis Sandstone, and recognized the Upper Bowen sequence between the Middle Bowen Group and the Clematis Sandstone. Oil Search (1936) recognized three units within the Upper Bowen Coal Measures, the top one consisting of variegated clay shale and the middle one sandstone. These two units were later referred to as upper and lower parts of the Rewan Series or Formation (Woolley, 1944; Isbell, 1955; Hill, 1957).

In the course of describing the geology of the Great Artesian Basin Whitehouse (1955) discussed the application of the names Carnarvon and Clematis and preferred Clematis on the grounds of priority and convenience, pointing out that the sandstones of the Carnarvon Range are younger than the Clematis Sandstone. Over the years the use of Reid's term 'Carnarvon Red Member' has been discontinued. Whitehouse tentatively equated the Carborough Sandstone of the northern part of the basin with the Clematis Sandstone. In his interpretation of the sedimentation responsible for the formation of the Clematis Sandstone and other similar sandstone units, Whitehouse assumed continental conditions, and suggested heavy seasonal rainfall with fast run-off in contrast to the environmental conditions leading to the formation of certain calcareous Mesozoic formations such as the Moolayember Formation where there were 'less boisterous conditions' and accumulations of swamp soils.

Isbell (1955), one of the few authors to investigate the mineralogy of part of the Triassic sequence, reported that the three Carborough Sandstone samples he examined contained about 60 percent quartz, 30 percent rock fragments and 10 percent feldspar - the rock fragments being mainly of chert or more rarely fine grained feldspathic igneous rocks.

In 1960 the Bureau of Mineral Resources and the Geological Survey of Queensland commenced a programme of regional geological mapping in the Bowen Basin. One of the principal results of this work has been the publication of 1:250,000 scale maps of parts of the basin together with accompanying reports and explanatory notes; so the general distribution of the Rewan Formation and Clematis Sandstone in outcrop is relatively well known. A summary of the main findings of the regional mapping parties is presented in Tables 1 to 3.

At the northern end of the Bowen Basin the mapping showed that the Carborough Sandstone is Triassic, with the discovery of Triassic plants in the overlying and newly discovered Teviot Formation (Malone et al., 1964). Following the Triassic sequence southwards from the Carborough Range, Veevers et al., (1964) measured 800 feet of Carborough Sandstone at Mount Iffley. In this early stage of the mapping,rocks of the Rewan Formation were unrecognized and included in the Upper Bowen Coal Measures. Farther south, Malone et al. (1963), and Malone et al. (in press) recognized the Rewan Formation lying above the Blackwater Group in the central parts of the basin around Blackwater. The mapping revealed that the Rewan Formation is tightly folded in the east limb of the Mimosa Syncline, and to explain the absence of tight folds in the Clematis Sandstone it was suggested that being more competent than the muds of the Rewan Formation, it adjusted to the folding stress by normal faulting.

The year 1963 saw a mapping programme covering most of the southern part of the outcropping Bowen Basin. Olgers et al. (1966) traced the Triassic sequence southwards along the limbs of the Mimosa Syncline, and showed that cross-stratification trends in the Clematis Sandstone are towards the east in the western limb, and towards the south-east in the eastern limb. Sections were measured in the Clematis Sandstone in the Dawson and Expedition Ranges, including one in Clematis Creek. Jensen et al., (1964) confirmed that the Rewan Formation in the south-eastern part of the basin is abnormally thick (12,000 feet), and suggested that the Clematis Sandstone becomes conglomeratic southwards; a gradual, transitional, change from Rewan Formation to Clematis Sandstone was also suggested. Mollan, Exon & Kirkegaard (1964) working in the south-western parts of the outcropping Bowen Basin, designated a type section for the Rewan Formation, and measured a section there (near Mount Carnarvon). This measured section was extended into the Clematis Sandstone and gave the first clear picture of the Lower Triassic sequence in this area.

Since 1963 joint BMR/GSQ parties as part of the programme to map the Great Artesian Basin, have mapped the Triassic sequence west of the Bowen Basin, recognizing the Rewan and Moolayember Formation and the Clematis Sandstone, as well as the Dunda Sandstone (Vine, Jauncey, Casey and Galloway 1965), a unit lying disconformably beneath the Clematis Sandstone and regarded as a facies equivalent of the upper part of the Rewan Formation (Exon et al., 1966). Farther north Vine et al. (1964) and Vine et al. (1965) distinguished another Triassic unit, the Warang Sandstone which they correlated with the Clematis Sandstone and Dunda Sandstone.

TABLE 1. MAIN FINDINGS OF B.M.R. - G.S.Q. SURVEY PARTIES CONCERNING THE CLEMATIS SANDSTONE.

1:250,000 SHEET AREA	MAIN REFERENCE TO BMR RECORD OR REPORT	LITHOLOGY	THICKNESS		ADDITIONAL NOTES
MOUNT COOLON	Malone et al, 1964.	Quartz sandstone, siltstone.	Carborough Creek.	1500 ft	1. First discovery of Triassic plants in unit conformably above the Clematis Sandstone equivalent; here termed Carborough Sandstone.
CLERMONT	Veevers et al.1964	Brown and purple quartz greywacke, quartz sandstone.	Mount Iffley	+900 ft.	1. Section measured at Mount Iffley shows three divisions (a) basal medium grained, thick to medium bedded brown and purple quartz greywacke overlain by (b) coarse quartz sandstone with some feldspar, overlain by (c) medium to coarse quartz sandstone.
DUARINGA	Malone et al.1963	Quartz sandstone, micaceous siltstone		300'- 400 ft	1. Dark shale and volcanics above it, 6 miles east-north-east of Ardurad Homestead. 2. Basal part interbedded with Rewan Formation.
BARALABA	Olgers et al, 1966.	Quartz sandstone, micaceous siltstone, feldspathic quartz sandstone	Expedition Range Dawson Range	800 ft 1000 ft	1. Results of cross bedding study show transportation towards east in Expedition Range and mainly towards south in Dawson Range. 2. Sections measured in Dawson and Expedition Ranges and in east limb of Rewan Syncline.
TAROOM	Jensen et al, 1964 Dawson Range	Lithic sublabile sandstone, quartzose sandstone, feldspathic sublabile sandstone, volcanic pebble conglomerate, siltstone, mudstone.		1000 ft	1. Bimodal cross-bedding azimuthal distribution; one to south-south-east and other to west-south-west. 2. Sandstone characterized by brown matrix of unknown composition. 3. Lateral gradation into pebble conglomerate at southern end of Dawson Range.
	Carnarvon Range	As above		800 ft	1. Thin beds of red mudstone and green mudstone in basal part of unit and carbonaceous shale towards the top.
SPRINGSURE	Mollan et al. 1964	Quartz sandstone, red silty mudstone, laminated grey siltstone, conglomeratic sandstone, lithic and feldspathic sandstone.	West limb of Rewan Syncline West limb of Reids Dome Western half of sheet area.	800 ft 500 ft 200 ft	1. Appears structurally conformable on Rewan Formation but disconformity present in places because (a) white leached zone at top of brown silty mudstone beneath quartz sandstone: (b) leached zone at top of Rewan in western half of Sheet area (c) Rewan absent south of Tanderra Homestead-local overlap of Clematis along extension of Nogoa anticlinal axis. 2. Fossil plants discovered (a) in lower part of Clematis at Mount Carnarvon and (b) in top part of Clematis 7 miles south of Consuelo Homestead. 3. Measured section at Mount Carnarvon shows lower 150 feet of interbedded quartz sandstone and red silty mudstone, overlain by coarse to conglomeratic sand sequence, and overlain by about 300 feet of quartz sandstone interbedded with brown lithic and feldspathic fine sandstone and silty mudstone.
JERICHO and GALILEE	Vine et al. 1965	Quartzose sandstone with minor interbeds of mudstone and siltstone. Some pebble beds and beds of conglomerate. Argillaceous sediments in thick intervals, grey-white some red and ferruginous.	Southern Jericho South of Central Railway Northern Jericho-southern Galilee Lake Galilee No.1. Marandra No.1. Alice River No.1.	350 ft 100 ft 300 ft 420 ft 397 ft 617 ft	1. Five measured sections 2. Fossil plant collection 6AB1459B Cladophlebis australis, Ginko cf. magnifolia and Dicroidium odontopteroides Plant spores in AOD Maranda No.1 and FD Alice River No.1. 3. Disconformably overlies Dunda Beds.
TAMBO	Exon & Kirkegaard, 1965 & Exon et al. 1966.	Fine to coarse quartz sandstone and fine conglomerate. Thin to very thick bedded tough ferruginous bands.		350 ft	1. No consistent current direction in north but in southern area consistently to north-west. 2. Shallow holes drilled - BMR Tambo No.35 and 36, at top and base of unit. 3. Clematis is shown to overlap older units including Dunda Beds in subsurface.

TABLE 2 - MAIN FINDINGS OF BMR-GSQ SURVEY PARTIES CONCERNING THE DUNDA SANDSTONE

1:250,000 SHEET AREA	MAIN REFERENCE TO BMR RECORD OR REPORT	LITHOLOGY	THICKNESS		ADDITIONAL NOTES
JERICHO & GALILEE	Vine et al. 1965	Lithic to quartzose fine grained sandstone with subordinate thick beds of mudstone, and siltstone. Mudstone red, red-brown, white and grey. Bedding mainly thick to very thick	Northern Jericho Lake Galilee No. 1	200-300' 250'	1. Measured sections 2. Cross-stratification in measured sections indicates transportation towards south-west and south-east; text suggests from east. 3. Plant fossils (White 1965) Thinnfeldia acuta, ?Taeniopteris spatula, Dicroidium odontopteroides, Sphenopteris cf. superba Ginkgo antartica, Araucarites sp, Cladophlebis australis, and Coniopteris delicatula 4. Sand ranges from 30:60:10 to 75:15:10
TAMBO	Exon et al. 1966	Fine to medium grained quartzose sandstone, medium to very thick bedded. Lithic sandstone	Northern Tambo Axial region of Birkhead Anticline	200' 100'	1. Dunda regarded as facies equivalent of upper part of Rewan Formation

TABLE 3 - MAIN FINDINGS OF BMR-GSQ SURVEY PARTIES CONCERNING THE REWAN FORMATION

1:250,000 SHEET AREA	MAIN REFERENCE TO BMR RECORD OR REPORT	LITHOLOGY	THICKNESS		ADDITIONAL NOTES
SPRINGSURE	Mollan et al. 1964	Red brown dense silty mudstone, thin green layers; green and brown lithic quartz sandstone	Type area West limb of Reids Dome Cona Creek Tanderra Homestead Mantuan Downs	1600 ft 1000 ft 400 ft 0 400 ft	1. Type section designated and measured 2. No angular discordance with Clematis, but signs of disconformity - see Clematis 3. Division into upper and lower Rewan confirmed
TAROOM	Jensen et al. 1964 Western area Eastern area	Lithic sandstone, brown mudstone Conglomerate, pebbly lithic sandstone, brown mudstone	1300 - 2500 ft 12,000 ft		1. Plants in eastern area - Dicroidium odontopteroides
BARALABA	Olgers et al. 1964	Chocolate mudstone, sandstone lithic and feldspathic, lithic quartz sandstone	North-east Baralaba South-east Baralaba	850 ft 12,000 ft	
DUARINGA	Malone et al. 1963	Chocolate mudstone, lithic sandstone	1500 ft		1. Disconformably overlain by Clematis - suggested by sharp change of lithology 2. Triassic plants - Danaeopsis, Linguifolium denmeadi Dicroidium feistmanteli? 3. Tightly folded in east limb of Mimosa Syncline.
TAMBO AUGATHELLA BLACKALL	Exon et al. 1966	Sandstone, siltstone, mudstone in equal proportions. Lithic sand grades to sublabile and quartzose sand; very fine to coarse. Grey siltstone interbedded with red and green mudstone	South-east of Birkhead Anticline North-west of Birkhead Anticline	400 ft 200 ft	1. Fossil logs at base of formation in Brumby Sandstone equivalent 2. BMR Tambo No. 34 - Core 2 P3d/P4 spores 3. Scattered cross-bedding measurements in east suggest transportation towards north-west.
LONGREACH JERICHO LAKE BUCHANAN	Vine et al. 1965	Labile and sublabile sandstone, f to vf. In subsurface mudstone and siltstone with minor interbedded sandstone. Mud green, grey, brown, rarely red.	Water bore Jericho 424058 approx Lake Galilee No. 1 Maranda No. 1	1000 ft 1058 ft 632 ft	1. Regarded as Rewan Formation even though characteristic red colour absent. 2. Overlain disconformably by Clematis in part of Jericho (16 miles north-north-east of Jericho township).

Petrographic studies of a few samples from the Triassic sequence have followed the regional mapping reports (see Tables 4 to 6). They have indicated that sandstone of the Rewan Formation is almost invariably poor in quartz and relatively rich in rock fragments from volcanic and sedimentary sources. By way of contrast, the studies suggest a wide range of mineralogical compositions of sandstone from the Clematis Sandstone, the amount of quartz varying between 30 percent and 60 percent; rock fragments between 5 and 45 percent, and feldspar between 0 and 20 percent. In general the amount of quartz is clearly higher than that in the Rewan Formation however.

The relatively few petrographic studies made of sandstone samples from the Dunda Sandstone suggest that it lies mineralogically between sandstone of the Rewan Formation and that of the Clematis Sandstone; the sandstone is less labile than the Clematis and more labile than the Rewan. Rock fragments are consistently either metamorphic or volcanic.

Information regarding the Triassic sequence has also been gathered by shallow stratigraphic drilling by the Bureau of Mineral Resources in 1963 and 1964, and by the Geological Survey of Queensland since 1964. Details of the holes completed are presented in Tables 7 and 8. The drilling has been only in the southern areas of outcrop from Cracow in the east to Tambo in the west. It is understood that the Geological Survey of Queensland has drilled the Triassic sequence in the Theodore area, where the section is thickest, but the results are not yet published. Proline drilling by the Geological Survey of Queensland (Gray 1968a) enabled chip samples to be taken from the Rewan Formation and Clematis Sandstone in the Reid's Dome and Carnarvon Range areas, mainly for palynological investigation.

Sandstone Nomenclature used in this text

A simple code indicating the mineralogical composition of sandstone samples has already been explained and used in a description of Permian and Triassic sediments of the Bowen Basin (Jensen, 1968). The figures quoted by the code represent (as a percentage of the framework) the relative proportions of quartz, to rock fragments and feldspar. The letter 'A' following the figures indicates that between 0 and 5 percent of the total rock is matrix; 'B' represents between 5 and 10 percent matrix, and 'C' greater than 15 percent matrix. A sandstone having a framework composed of 63 percent quartz, 31 percent rock fragments, and 6 percent feldspar, and having 8 percent matrix, would be referred to as (63:31:6/B), but this is normally shortened to (631B). In future reports the code will be expanded further to indicate the type of rock fragments and feldspars forming the rock.

TABLE 4 - RESULTS OF PETROGRAPHIC STUDIES OF SANDSTONE FROM THE REWAN FORMATION BASED ON INFORMATION CONTAINED IN UNPUBLISHED RECORDS OF THE BUREAU OF MINERAL RESOURCES

1:250,000 SHEET AREA	LOCATION	AUTHOR AND REFERENCE TO BMR RECORD	APPROXIMATE STRATIGRAPHIC POSITION	SOURCE OF SAMPLES	SAMPLE NUMBER OR POSITION IN HOLE	ESTIMATE OF MINERALOGICAL COMPOSITION							Type of rock fragments	Average grainsize
						Quartz	Rock Frags.	Feldspar	Matrix	Cement	FeO_x	Mud clasts		
TAMBO	Grid ref. 47859811 47939813 47839848	Galloway 1967/81 Exon 1968	Top of Rewan Formation Upper part of Rewan Formation	Outcrop	6558 1845) 6558 1846) 6558 1848)		25-50	35-65	-				volc, volc	f vf
SPRINGSURE	12 miles west of Mantuan Downs Homestead	Arman 1965/215	Top	BMR Springsure No.3.	100'-110') 160'-167')	15	20	10	25			30		
	2 miles north of Rewan Homestead	Bastian 1965/260	Base to middle	Outcrop in type section (measured section S29)	SP159A) C) D) E) F)	20	68	8	8	1			volc, plut. met. met.	f
	1 mile west of Rewan Homestead	Bastian 1965/260	Base	Outcrop	SP149	30	25	15		30			met.	f
	20 miles south-south-west of Rewan Homestead	Bastian 1965/260	Base	Outcrop	SP487	35	20	15		30				c
EDDYSTONE	About 20 miles south-south-west of Rewan Homestead	Bastian 1965/260	Base	Outcrop	ED 80F) G) ED164)	13	40	2	5	35	15		volc.,	f
TAROOM	Near Moolayember Dip	Bastian 1965/260	Top	Outcrop	T 225A) B)	60	25		10	5			sed. met.	f
			Near Top	Outcrop	T 222B) C) D) E)	30	50	5	7		5		volc, sed, plut, met.	vf-f
BARALABA	Glenmoral road near gap	Arman 1965/215	Near top	BMR Baralaba No.21	30-35') 102')	30	15	10	20			25		f-m
	Glenmoral road 8 miles from Theodore	Arman 1965/215	About middle	BMR Baralaba No. 18	40-50) 50-60) 90-100) 130-140) 170-180) 208)	25	25	20	15			15	met, volc,	f-m
	Glenmoral road 7 miles from Theodore	Arman 1965/215	About middle	BMR Baralaba No.22	40-50) 70-180)	5	15	30	10			40	volc,	f-m
	Junction of Glenmoral road with Theodore - Taroom road	Arman 1965/215	Middle-lower	BMR Baralaba No. 23	80-90) 110-120) 128	10	30	15	15			30	volc,	f-m
						10	35	10			25	15	volc,	f-m
MUNDUBBERA	Near turn-off to South End yard	Arman 1965/215	Near base	BMR Baralaba No.24	20-30') 70-80')	5	50	10		30			volc,	
	Kia Ora homestead area	Bastian 1965/260	Near base	Outcrop	T168	2	50	10		35			volc,	
	Near turn-off to South End yard	Arman 1965/215	At base	BMR Baralaba No. 25	20'-30') 40'-50') 50'-60') 82')	0	70	10	5	15	5		volc,	f-c.

TABLE 5 - RESULTS OF PETROGRAPHIC STUDIES OF SANDSTONE FROM THE CLEMATIS SANDSTONE BASED ON INFORMATION CONTAINED IN UNPUBLISHED RECORDS OF THE BUREAU OF MINERAL RESOURCES

1:250,000 SHEET AREA	LOCATION	AUTHOR AND REFERENCE TO BMR RECORD	APPROXIMATE STRATIGRAPHIC POSITION	SOURCE OF SAMPLES	SAMPLE NUMBER OR POSITION IN HOLE	ESTIMATE OF MINERALOGICAL COMPOSITION							Type of rock fragments	Average grainsize
						Quarts	Rock Fragments	Feld-spar	Matrix	Cement	FeO_x	Shale clasts		
JERICHO	About 30 miles north of Jericho.	Galloway 1967/80		Outcrop	64581457	89	5		6					m
	About 25 miles south-east of Jericho				64581732B	96			4					m
TAMBO	Grid ref. 45910038 44960083	Galloway 1967/81 Exon 1968		Outcrop	T271) T280)	50	30	3	17				met, volc. volc.	f f
SPRINGSURE	16 miles west of Mantuan Downs Homestead	Arman 1965/215	Top of Clematis Sandstone	BMR Springsure No. 4	207-215	60		5	30			5		
	12 miles west of Mantuan Downs Homestead	Arman 1965/215	Lower part of Clematis Sandstone	BMR Springsure No. 3	30-40') 70-80')	70	5		20					f-m
	Mount Carnarvon and east of Serocold Homestead	Bastian 1965/240	Lower to middle	Outcrop-Measured section 529	SP161D	65	15				20			vf
					B	75	20		5					m
					A	70	25		5					m
					SP159J	70	10		20					f
					H	35					60			f
					G	40	30		20		5			vf
	Near Moolayember Dip	Bastian 1965/240	Lower to middle	Outcrop	T229A)									f
					T227E)									f
					F)								sed, met.	f
					A)	65	17		10	5	3			vf
					T226)									vf
					T225F)									m
					C)									vf
BARALABA	29 miles east of Rollston on Bauhinia Downs road	Arman 1965/215	Basal part of Clematis Sandstone.	BMR Baralaba No. 16	40-60') 100-110)	50	5		35		10		))	m-c
	Expedition Range on Bauhinia Downs road.	Bastian 1965/240	Close to base Close to top	Outcrop	BA922) BA923)	80	5	2	10				))	m
	Glenmoral Gap-Dawson Range	Bastian 1965/240			BA83A) B)									
					BA82) T240A) B)	60	20	7	10		3		volc sed	f-m
	Glenmoral Gap - Dawson Range	Arman 1965/215	Base of Clematis Sandstone	BMR Baralaba 20	85'	35	20	15	20	10			volc	f-c
MUNDUBBERA					T215A	30	45	15	10				volc.plut.sed.	m
	Near Devils Nest Homestead -southern end of Dawson Range	Bastian 1965/240		Outcrop	T216	70	10	10	10					

TABLE 6 - RESULTS OF PETROGRAPHIC STUDIES OF SANDSTONE FROM THE DUNDA SANDSTONE

1:250,000 SHEET AREA	LOCATION	AUTHOR AND BMR RECORD	APPROXIMATE STRATIGRAPHIC POSITION	SOURCE OF SAMPLE	SAMPLE NUMBER	ESTIMATE OF MINERALOGICAL COMPOSITION							Type of rock fragments	Average grainsize
						Quartz	Rock Frags.	Feldspar	Matrix	Cement	Iron Oxide	Mud clasts		
BUCHANAN	Grid ref. 42392656	Galloway 1967/80		Outcrop	6458 1452A	43	47	2	8				met.,volc.,	m
	42432658				6458 1452C	70	13		17				met.	m
JERICHO	Grid ref. 43551315	Galloway 1967/80		Outcrop	6458 1460A	32	57	3	8				met., volc.,	f
	43551315				6458 1460B	61	23	1	15				met.,?volc.,	m
	44960224				6458 1731	43	38		18				met.,?volc.,	f
	45160200				6458 1733	54	17	7	16				met.	f
TAMBO	Grid ref. 45929868	Galloway 1967/81			6558 1842B								volc.	m
	46509924	Exon 1968			6558 1843	40	40	10	10				volc., met.	f
	46030052				T270								volc.	f

TABLE 7 - SHALLOW HOLES DRILLED BY B.M.R. IN REWAN FORMATION AND CLEMATIS SANDSTONE

STRATIGRAPHIC POSITION	SHEET AREA	LOCATION	NAME OF HOLE	TOTAL DEPTH	CORED INTERVAL	CUTTINGS	LITHOLOGY	REFERENCES	NOTES
Near Rewan/Coal Measures boundary	Mundubbera	Near Hill View Homestead	BMR Taroom No. 25	85'	80-85'	20-80'	Mainly brown mudstone down to 53'; green lithic sandstone to 78', and cored in pebble conglomerate	Jensen et al.1964; Arman 1965;	Basal conglomerate could be regarded as coal measures
Near base of Rewan Formation	Mundubbera	Near turn-off to South End Yd., Delusion Creek road	BMR Taroom No. 24	85'	80-85'	20-80'	Interbedded chocolate-brown mud, green mud, and green lithic sandstone. Core in sand and carbonaceous mud	Jensen et al. 1964; Arman 1965.	
Lower part of Rewan Formation	Baralaba	Junction of Glenmoral Road with Taroom to Theodore road	BMR Baralaba No. 23	130'	120-130'	20-120'	Chocolate brown mudstone with very minor green lithic sandstone. Cored in lithic sandstone.	Olgers et al. 1964; Arman 1965; Evans 1964 (BMR 1964/91)	Evans correlates this with lower part of Tr_1
About middle of Rewan Formation	Baralaba	Glenmoral road, 7 miles from Theodore	BMR Baralaba No. 22	230'	220-230'	20-220'	Interbedded fine labile sandstone and red-brown mudstone. Cored in red-brown mudstone	Olgers et al. 1964; Arman 1965; Evans 1964 (BMR 1964/91)	Evans reports Tr_2
About middle of Rewan Formation	Baralaba	Glenmoral road, 8 miles from Theodore	BMR Baralaba No. 18	210'	200-210'	40-200'	Mainly fine lithic sandstone to 170' then rest in red-brown mudstone with minor sandstone	Olgers et al. 1964; Arman 1965; Evans 1964(BMR 1964/91)	Evans reports Tr2
Top of Rewan Formation	Baralaba	Glenmoral Gap	BMR Baralaba No.21	110'	100-110'	30-35'	Interbedded blue grey fine labile sandstone, grey mudstone and dark purple mudstone. Cored in sandstone and carbonaceous mudstone	Olgers et al. 1964; Arman 1965;	
Base of Clematis Sandstone	Baralaba	Glenmoral Gap	BMR Baralaba No. 20	90'	80-90'	-	Mainly quartz sandstone with minor dark grey mudstone. Cored in sandstone	Olgers et al. 1964; Arman 1965	
Base of Clematis Sandstone	Baralaba	Rolleston to Bauhinia Downs road, 29 miles east of Rolleston	BMR Baralaba No. 16	190'	-	40-190'	Sandstone	Olgers et al. 1964; Arman 1965;	
About Rewan/Coal Measures boundary	Springsure	4 miles south of Mantuan Downs Homestead	BMR Springsure No. 2	180'	170-180'	20-170'	Carbonaceous shale and siltstone with minor fine sandstone. Thin tuff band in core	Mollan et al. 1964	
Rewan Formation	Springsure	Near Rewan Homestead	BMR Springsure No.44	334'	110-120 320-334	10-320	Mainly purplish red and green silty mudstone interbedded with labile sandstone Core 2 carbonaceous	Mollan, Exon and Forbes 1964	
Clematis Sandstone into Rewan Formation	Springsure	12 miles west of Mantuan Downs Homestead	BMR Springsure No.3	205'	-	20-205	Quartz sandstone to 60', then grey siltstone and reddish-brown mudstone interbedded with sublabile sand.	Mollan et al.1964; Arman 1965	
Basal Moolayember Formation to Clematis Sandstone	Springsure	16 miles west of Mantuan Downs Homestead	BMR Springsure No.4	214'	205-214'	0-197'	Grey calcareous labile sandstone with interbedded carbonaceous mudstone. Core contains carbonaceous sandstone and mudstone.	Mollan et al. 1964; Arman 1965	
Rewan Formation	Tambo	[illegible]	BMR Tambo No.34	215'	140-154'	0-215'	Interbedded brown, grey and green mudstone, siltstone and sublabile sandstone.	Mollan, Exon & Forbes, 1965	P3d/P4 spores reported in Exon et al.1966
Clematis Sandstone and Rewan Formation	Tambo		BMR Tambo No. 36	169'	155-169'	0-169'		Mollan, Exon & Forbes, 1965.	
Moolayember Formation to Clematis Sandstone	Tambo		BMR Tambo No. 35	290'	215-229' 292-306'	0-290'	Interbedded carbonaceous mudstone and siltstone with quartzose sandstone Core 2 quartzose sandstone	Mollan, Exon & Forbes, 1965	

TABLE 8 - SHALLOW HOLES DRILLED BY THE GEOLOGICAL SURVEY OF QUEENSLAND IN THE REWAN FORMATION AND CLEMATIS SANDSTONE

STRATIGRAPHIC POSITION	SHEET AREA	LOCATION	NAME OF HOLE	TOTAL DEPTH	CORED / CUTTING INTERVAL	LITHOLOGY	REFERENCE	NOTES
Lower part of Rewan Formation	Baralaba	Delusion Creek road; 15.5 miles at 311°T from Cracow	DRD No.5 (Hillview)	270ft	49-270ft	Mainly sandstone with minor interbedded shale and two bands each 15 feet thick of very hard pebble conglomerate	Gray, 1968(b)	
Upper part of Rewan Formation	Baralaba	Beside Glenmoral road near Gap 13.5 road miles from Theodore	DRD No. 3 (Glenmoral)	147ft	53-147ft	Mainly sandstone in upper part of hole and interbedded shale and siltstone in lower part.	Gray, 1968(b)	
Upper part of Rewan Formation-lower part of Clematis Sandstone	Baralaba	Beside Glenmoral road near Gap 13.7 road miles from Theodore	DRD No. 4 (Glenmoral)	202ft	49-202ft	Mainly sandstone with rare thin beds of shale	Gray, 1968(b)	Boundary between Rewan Clematis taken at change from white quartzose sandstone to green biotite more lithic sandstone.
From ?Moolayember Formation into Clematis Sandstone	Baralaba	Beside Glenmoral road near Gap 14.1 miles west-south-west of Theodore, 530ft. west of range.	DRD No. 2 (Glenmoral)	251ft	37-251ft	Interbedded sandstone and siltstone in upper part grading to a sand sequence below.	Gray, 1968(b)	Possible that whole section is Clematis Sandstone.
Lower Clematis Sandstone	Baralaba	Near Bauhinia Downs-Rolleston road, 14.6 miles at 249° from Bauhinia Downs, 4.8 miles at 245° T from DRD9	DRD No. 11 (Bauhinia Downs)	430ft	58-430ft	Sandstone with minor interbedded shale in sequence up to 15 feet thick	Gray, 1968(b)	No electric logs. Section very weathered; swelling shale.
Moolayember Formation to Clematis Sandstone	Baralaba	West bank of Conciliation Ck 0.6 miles east of Expedition Range.	DRD No. 9 (Bauhinia Downs)	912ft	39-912ft	About 120 feet of sand overlying 60ft of shale. Rest of the section sandstone with increase in permeability and decrease in lithic content and feldspar at 411 feet.	Gray, 1968(b)	Moolayember/Clematis boundary gradational Correlation made with MC Glenhaughton No.1.
Rewan Formation	Baralaba-Mundubbera	East of Glenmoral Gap	DRD13-DRD19 incl.				Data unpublished at present.	

bedded, coarser, and has no interbedded mudstone. Thus there is a clear division of Clematis Sandstone into two parts, and this is confirmed in the log of M.C. Glenhaughton No. 1 (Pl. 3).

In the Carnarvon Range area outcrops of the Rewan Formation and Clematis Sandstone are either too discontinuous or inaccessible to allow the study of the sequence from the top of the coal measures to the base of the Moolayember Formation. Information on the lower part of the Rewan Formation comes from exposures in small creeks near Mount Carnarvon, and from subsurface data and outcrop at Arcadia, 35 miles to the south-east. Reasonably continuous and accessible outcrops of the upper part of the Rewan Formation and lower part of the Clematis Sandstone exist around the edges of the Arcadia Valley, especially where there have been recent rock falls. The most accessible nearly continuous outcrops of the upper part of the Clematis Sandstone occur in small creeks draining the ranges and flowing into the Arcadia Valley.

At Arcadia two well sections and outcrops show that the lower part of the Rewan Formation, is about 1100 feet thick (Pl. 3). The lower 300 feet consists mainly of grey mudstone interbedded with beds of fine sandstone, and with thin beds of mottled red mudstone; small shelly fossils (not described but probably conchostracans) were reported from this interval in one of the wells. The overlying 150 feet of section consists of fine grained, grey-white, sandstone (361B), interbedded with grey-white micaceous clayey sandstone. This is overlain by a bed, about 12 feet thick, consisting of grey-white, lustre-mottled, pebbly, kaolinitic sandstone (280B), which in places contains red-brown mudclasts, green volcanic rock fragments, and large vitreous quartz grains. This bed was marked 'Brumby Sandstone' in a diagram in Reeves (1947), although it has also been termed 'The Malta Grit' (Woolley, 1944). The term 'Brumby Sandstone' has at times been mistakenly applied to the whole of the lower part of the Rewan Formation. Woolley (1944) discovered a very slight angular unconformity beneath the Brumby Sandstone at Arcadia, and at the time it was assumed on structural, palaeontological, and lithological grounds to mark the boundary between the Permian and Triassic, and between the Rewan Formation and the underlying coal measures. The position of the Permian-Triassic boundary is uncertain and in the absence of marine fossils will probably remain so. The boundary between the Rewan Formation and the underlying coal measures has been taken at what is possibly the Brumby Sandstone in the type section of the Rewan, but as the Brumby Sandstone can be recognized nowhere else in the Bowen Basin it is not a satisfactory marker. As explained above, a more useful boundary is at the top of the youngest coal seam or very carbonaceous shale.

Over an interval of 600 feet above the Brumby Sandstone, the outcrop is mainly very fine grained, grey sandstone (442A) which grades into a more feldspathic and lithic sandstone (253A).

Little is known of the rest of the sequence to the base of the Clematis Sandstone in this area. It is assumed to consist mainly of red mudstone with thinly interbedded green sandstone, and Woolley (1944) correlated this interval with the 'Upper Rewan Formation'.

The upper part of the Rewan Formation and the lower part of the Clematis Sandstone are well exposed in the cliffs near Moolayember Dip (section CH, Pl. 2). As in the type section the top of the Rewan Formation consists of interbedded green labile sandstone and red mudstone, and there is a distinct change in the overlying Clematis Sandstone to more quartz rich arenites. The lower part of the Clematis consists, like the Rewan, of sandstone interbedded with siltstone and mudstone; and the change 200 feet above the base to a quartz rich arenite sequence with little interbedded mudstone or siltstone does not coincide with the change in arenite composition.

In Basin Creek (section CD, Pl. 2) the lower part of the Clematis is very thin and poorly exposed. The upper part of the unit however is well exposed and it probably deserves more study. Sandstone of varying grain size dominates the section but both grey-pink siltstone, and mottled light green and red mudstone are present in thin beds.

Expedition Range

The Clematis Sandstone extends over a wide area west of the Mimosa Syncline, forming the Expedition Range, but the underlying Rewan Formation remains almost completely concealed by a thick blanket of soil and alluvium. Although it crops out over a large area, a complete section through the Clematis Sandstone is not exposed, and precise details of the sequence are not known. Section measuring is also hampered by lack of relief and by a low regional dip.

Access to the area north of the Dawson Highway is by a rough track along Planet Creek, and in this area the lower 300 feet of the Clematis Sandstone consists at least partly of very fine to medium grained sandstone (910B) and minor siltstone, the interval being extensively ferruginized in places. This is overlain by a sequence roughly 200 feet thick of coarse to very coarse pebbly quartz rich sandstone (1000 AB) which forms distinctive hummocks up to 50 feet high with vertical sides and rounded tops. Over the next 300 feet the unit is composed of interbedded fine to medium grained sandstone with rare very coarse sandstone bands. Laminated ferruginous siltstone is also interbedded in the sequence.

Northern Bowen Basin

The Clematis Sandstone in the northern part of the Bowen Basin forms a number of ranges and mesas such as the Carborough Range, Mount Iffley and the Redcliffe Tableland. Broadly speaking it lies in the centre of a synclinal structure in this part of the basin, and the Rewan Formation crops out on either side of it.

The Rewan Formation is relatively well exposed in the area about 2 miles south-east of Lake Elphinstone, between the road to Nebo and the Carborough Range. Jensen and Arman (1966) measured about 3500 feet of Rewan Formation in this area, and observations made during the present survey have been added to this basic framework (Pl. 4). The boundary with the underlying unit, the Elphinstone Coal Measures, is seldom exposed, but it is taken at the top of the youngest coal seam or thick carbonaceous mudstone (Jensen, 1968). The lowermost beds in the Rewan Formation are well exposed in a series of road cuttings south-east of Lake Elphinstone where they consist of light brown and grey mudstone with interbedded cross-stratified lenses of fine to medium grained sandstone up to 12 feet thick. The brown mudstone, in places 25 feet thick, contains laterally continuous intervals of mottled deep red and light green mudstone. In the road cuttings these bands form continuous but wavy bands, and it is not clear whether the undulations are a result of Triassic soil processes acting on an uneven surface, or if the bedding has slumped recently. Exposures stratigraphically above this interval are at first mainly of medium grained cross-stratified sandstone and interbedded brown mudstone. Higher in the sequence sandstone becomes less common, and the interval at Lake Elphinstone from about 2000 feet above the base of the Rewan Formation to the base of the Carborough Range consists of red mudstone with minor lenses of sandstone up to 100 feet apart. The red mudstone grades in places to silty mudstone, but overall it is markedly homogeneous, breaking with a conchoidal fracture. Apart from fine lamination which is rarely seen, the only sign of bedding in the mudstone is the presence of randomly spaced green bands from $\frac{1}{4}$ inch to 3 inches thick, which can be traced over 100 feet laterally.

On closer examination the green bands are found to be mottled green and red silty mudstone in which green is the dominant colour. That the green is caused by a secondary process is suggested by the fact that red mudstone is mottled green on either side of small vertical joints, and that the mudstone immediately adjacent to sandstone lenses is also mottled green. Sandstone sequences up to 15 feet thick, such as those illustrated (Pl. 4) are interbedded with thick sequences of red mudstone both near Lake Elphinstone and near the gorge of the Isaacs River through the Carborough Range. In places the sand is red, but minor transgressions of colour across bedding suggest that this colour is secondary in the sandstone. Red-brown sideritic concretions and layers of red mud clasts are common.

The Clematis Sandstone of the northern part of the basin is clearly composed of two units (Pl. 5). The lower unit, which in the Carborough Range is represented by a sequence about 300 feet thick, is seldom exposed, as it lies in the lower half of the hills formed by hard quartz rich sandstone beds of the upper part of the Clematis Sandstone. However, at least two places near Burton Downs homestead, it is exposed in steep gullies caused by rock falls, and is seen to consist of thin to medium bedded, medium to coarse grained sandstone, interbedded with minor brown and, in places, red mudstone (section BJ Pl. 5). Both labile sandstone (631A) and sublabile sandstone (811A-B) are interbedded in the sequence. Beds at the top of this subunit are distinctly richer in quartz than sandstone of the Rewan Formation.

The overlying 800 feet of section (Pl. 5) is markedly coarser, and thick cross-stratified beds of very coarse pebbly sandstone are common, especially in the lower part of the interval. The boundary with the overlying Moolayember Formation is taken at the lowest stratigraphic occurrence of brown mudstone or siltstone. Sandstone in the lower part of this 800 feet section (Samples BF07 to BF11 in section BF-BG) is rich in quartz, but it is more labile higher in the section.

Northern Dawson Range

In the headwaters of Raby Creek, at the northern end of the Dawson Range, lies a thick sequence previously mapped by regional mapping parties as Clematis Sandstone. A number of sections was measured in this area (Pl. 6) mainly in the axial region of a syncline, over a stratigraphic interval of about 2000 feet, from the base of the range to the centre of the syncline. Although the exposure is incomplete it is clear that the lower part of the sequence consisting of brown, micaceous, fine to medium grained sandstone (640C-910A), interbedded with brown and in places red mudstone and siltstone, is markedly different from the upper part which consists only of quartz rich, coarse to very coarse, pebbly sandstone (910B-1000A).

The same distinction between an upper coarse sandstone unit and a lower unit of sandstone with a smaller grain size and with interbedded mudstone is noticeable in the section measured by Olgers et al., (1964) in the Dawson Range about 15 miles south of the Raby Creek area. The lower part of this sequence was at that time placed in the Rewan Formation, and on this basis together with photo-interpretation an intertonguing relationship between Rewan Formation and Clematis Sandstone has been suggested (Malone et al., in press). It is however, felt that in neither the Raby Creek nor the northern Dawson Range sections was the Rewan Formation as defined in the type area encountered.

Southern Dawson Range

Little of the reported 12,000 feet of section in the Rewan Formation of the Theodore area crops out, and no extra information regarding the unit in this area was gathered during the present survey. Shallow stratigraphic holes drilled in the unit in the past, have encountered red and brown mudstone interbedded with green labile sandstone (532C), but no subdivisions have been established within the unit as yet.

The overlying Clematis Sandstone which forms the Dawson Range, is approximately 1000 feet thick (Pl. 6). It differs from the Rewan and Moolayember Formations in that it contains no interbedded mudstone. Rocks coarser than sand-size are rare within the unit in the Glenmoral Gap area, but near Devils Nest Homestead, 10 miles south, there are thin beds of pebble conglomerate interbedded with the sandstone. Farther south, where the Dawson Range dies out, thick beds of conglomerate and interbedded coarse sandstone appear to occupy the interval corresponding to the Clematis Sandstone, although lack of outcrop, and structural complication cause difficulties in interpretation.

Despite the lack of mudstone in the unit, grey and pale pink siltstone lenses up to 3 feet thick and 150 feet long are interbedded with the sandstone. Cliff exposures north of Glenmoral Gap reveal channels up to 6 feet wide cut into the lenses, and the channels now filled with sandstone and large angular blocks of siltstone.

The Clematis Sandstone of the Theodore area is composed of sublabile (811B) and labile (631B-721C) sandstone, and there are no beds of quartz rich sand. Sorting is poor, and a grey-brown argillaceous matrix is common. Interpretation of the original mineralogical composition of the sand is hampered by the fact that there have been at least two periods when the sequence was exposed to deep weathering, once in the Upper Triassic, and again during the Tertiary.

At this stage the upper and lower boundaries of the Clematis Sandstone are difficult to place in this area. The presence of thick beds of mudstone in the Rewan and Moolayember Formations, and their absence from the Clematis Sandstone, probably controls the positive topographic expression of the Dawson Range and the placement of boundaries close to the base of the range is reasonable considering the present state of knowledge.

The mineralogical composition of interbedded sandstone might aid in locating the boundary between the Rewan Formation and the Clematis Sandstone, especially if combined with the presence or absence of thick beds of mudstone. In the lower part of the Rewan Formation, sandstone is composed mainly of volcanic lithic fragments and very little quartz (Arman, 1965; Bastian, 1965b). Sandstone from cores of holes drilled in the middle and possibly upper parts of the

Rewan Formation contains between 5 and 35 percent quartz, and between 15 and 35 percent rock fragments. However sandstone beds cropping out east of the Dawson Range a few miles north of Glenmoral Gap, and assumed to be in the upper part of the Rewan Formation contain between 40 and 65 percent quartz, and in this respect they are not significantly different from sandstone of the Clematis in this area.

SEDIMENTARY STRUCTURES

Rewan Formation

The Rewan Formation is not noted for sedimentary structures, and its appearance in outcrop is much the same all over the basin. Where the unit consists dominantly of red mudstone, thin green bands at the boundaries of slight changes in lithology are the only visible structure (Pl. 7). Fine lamination is commonly preserved in grey mudstone of the unit, but it is rare in the thick sequences of red mudstone, which does however contain in some places small pisolites up to 2 mm diameter, possibly formed by pedogenic processes.

In those parts of the sequence where sandstone is interbedded with the red mudstone, the sandstone forms thin cross-stratified lenses which can be traced over 50 feet laterally and which are up to 6 feet thick. The lenses fill gentle scoop-shaped depressions in mudstone; and abundant shale clasts in the sandstone provide further evidence of contemporaneous erosion of mud deposits. The medium to fine grained sandstone of the unit is trough cross-stratified, but the very fine sandstone is almost invariably flaggy, with strong current lineation on bedding surfaces. In rare instances the lenses of sandstone are formed of large scale cross-strata in sets which become thinner upward; the cross-bedded sandstone grades upward into flaggy siltstone or mudstone (Pl. 8).

Preliminary measurements of cross-stratification mainly in the lower part of the unit (Pl. 9) show that in the eastern and northern parts of the basin sediment transport was towards the west. In the southern and central areas a northerly direction is evident, and the relatively few readings in the Mantuan Downs area in the south-west of the outcrop area reveal a north-westerly trend.

Clematis Sandstone

In most parts of the basin, the two fold subdivision of the Clematis Sandstone based on grainsize and mineralogy is also reflected in a change of bedding characteristics, especially in the Carnarvon Range area. Both subdivisions are dominated by cross-stratified sandstone, but the lower is more thinly bedded and the beds have a greater lateral persistence.

The lower unit is well exposed in a cliff face north of Clematis Creek (Pl. 10) where roughly 50 feet of thinly interbedded sandstone and mudstone lie above the Rewan Formation and beneath a more massive cliff-forming sandstone. Although the bedding at first appears regular and uniform, gentle trough structures are apparent on closer examination. The interbedded sandstone and mudstone is overlain by a continuous section of sandstone, more thickly bedded, which is included in the upper subdivision because of its mineralogy and grainsize.

The upper subdivision generally is more thickly bedded and characterized by high angle cross-stratification which varies in size and shape from place to place, but which is of reasonably consistent orientation. Excellent exposures in the Expedition Range (Pl. 11b) reveal multiple truncation cross-stratification (Stokes 1968), and this is probably common elsewhere but not sufficiently well exposed to be recognized. Some laminae in these cross-beds are graded (Pl. 11a). Sequences in which the scale of cross-stratification diminishes upwards, are not common in the unit but they have been observed in the Expedition Range (Pl. 4) and the Carnarvon Range area (Pl. 13). Other structures observed in the unit include large troughs filled with ripple laminated sandstone (Pl. 14), flaggy sandstone (Pl. 15), and cross-stratified sandstone (Pl. 16). Thinly bedded deposits filling troughs adjacent to cross-stratified sand bars are also present (Pl. 17 & 18a), as well as rare overturned cross-stratification (Pl. 18b).

Preliminary study of the orientation of cross-stratification in the lower part of the Clematis Sandstone (Pl. 19) suggests a southerly direction of sediment transport along the eastern margin of the basin; except in the far south-east in the areas where the unit becomes conglomeratic, where derivation from an easterly source is suggested. Sediment transport in the Carnarvon Range area was towards the north-north-east as in the case of the Rewan Formation, and the same direction was indicated farther west in the Mantuan Downs area. The readings have a wide divergence of directions.

Much the same pattern is revealed by cross-stratification studies in the upper part of the Clematis Sandstone (Pl. 20), except that the northerly direction so prominent in the Carnarvon Range area for the Rewan Formation and lower Clematis Sandstone, is replaced by a south-easterly trend which is also present in the Mantuan Downs area farther west.

CONCLUSIONS

The Rewan Formation consists mainly of interbedded green labile sandstone and red mudstone. In marked contrast, the Clematis Sandstone is dominated by quartz rich sandstone. In the Carnarvon Range area, and in the northern part of the basin the units are separated by a transitional sequence termed here 'the lower part of the Clematis Sandstone', which although it contains red mudstone and siltstone it is thinly bedded. It is characterized by sandstone

far richer in quartz than that of the Rewan Formation, and yet it is more labile than sandstone of the upper part of the Clematis Sandstone (Pl. 3). In the central part of the area of investigation, at the northern end of the Dawson Range, the lower part of the Clematis Sandstone contains very little interbedded mudstone, but the distinction between the upper and lower parts of the Clematis Sandstone is nevertheless quite apparent. The upper part dies out towards the south-east and only the lower part appears to be present at Glenmoral Gap, in the extreme south-eastern area of outcrop.

Preliminary study of cross-stratification has revealed a movement of sediment inwards from the margins of the basin in the case of the Rewan Formation and the lower part of the Clematis Sandstone; but an overall southerly to south-easterly movement in the upper part of the Clematis Sandstone.

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PLATE 1

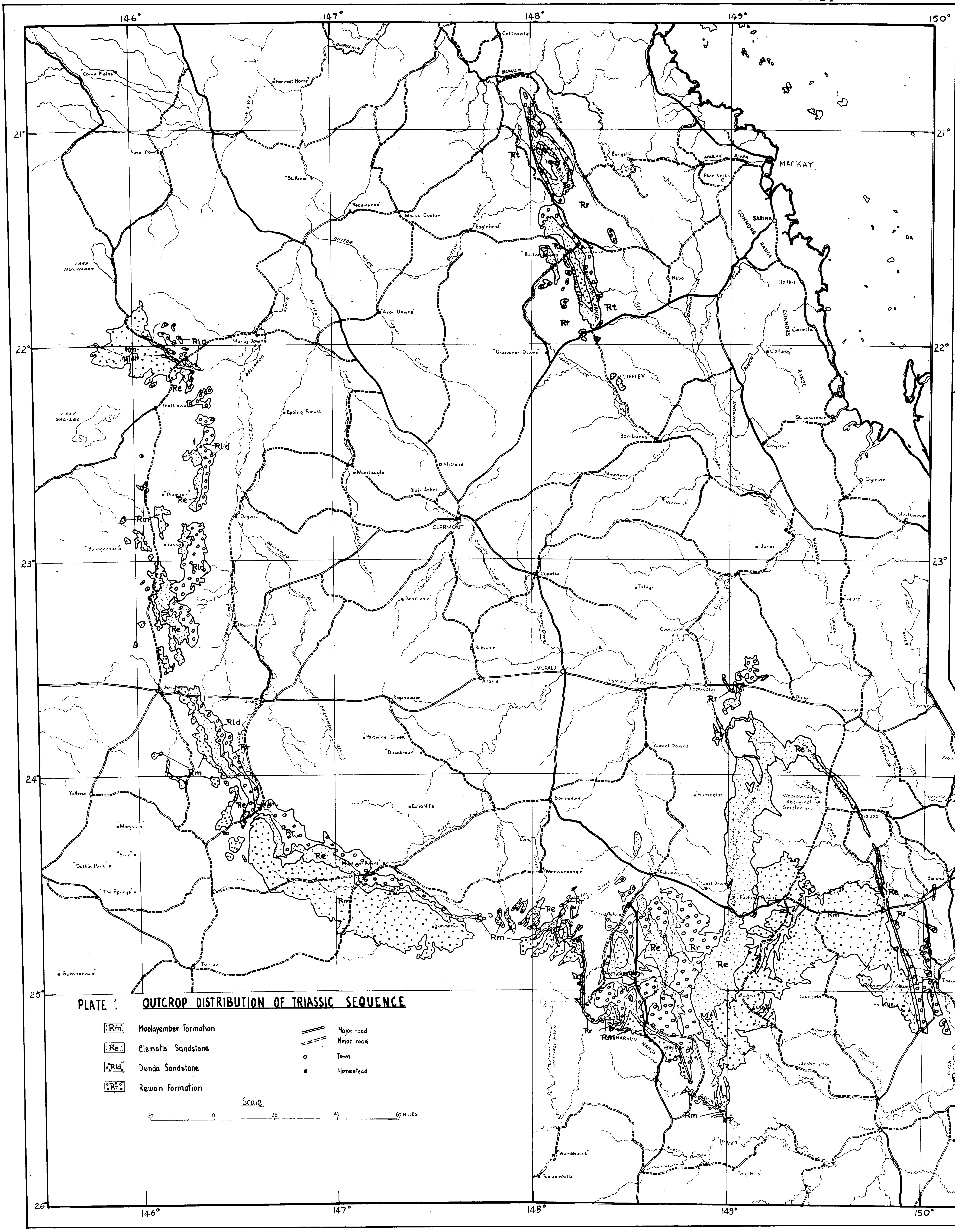
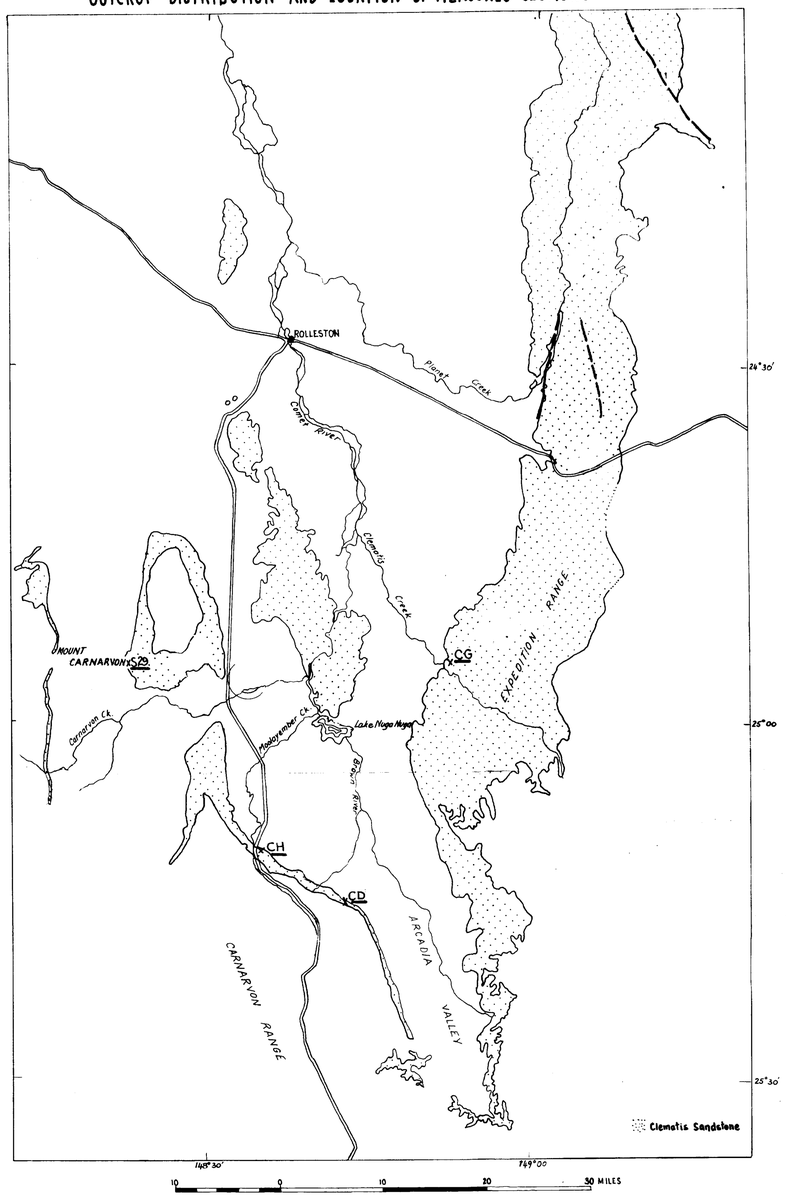


PLATE 1 OUTCROP DISTRIBUTION OF TRIASSIC SEQUENCE

To accompany Record 1969/66

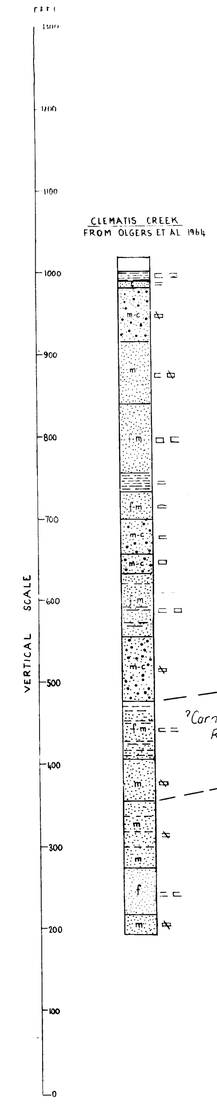
CLEMATIS SANDSTONE - EXPEDITION and CARNARVON RANGES

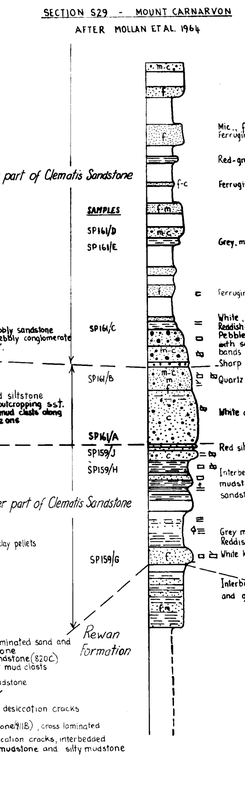
OUTCROP DISTRIBUTION AND LOCATION OF MEASURED SECTIONS

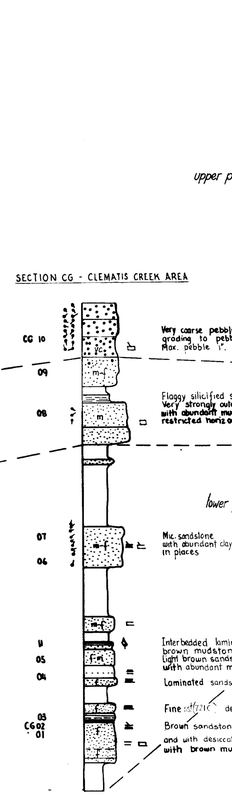


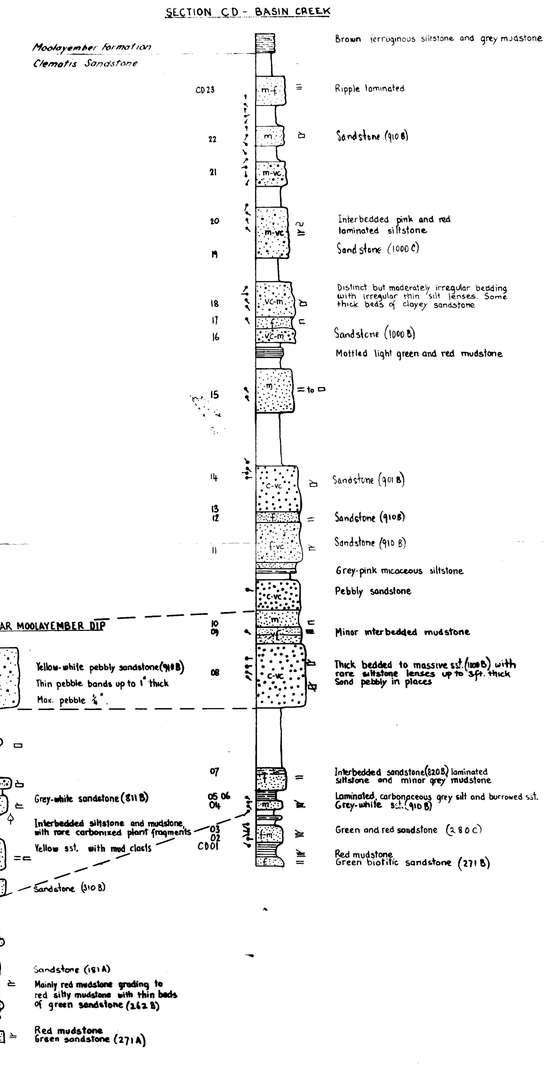
MEASURED SECTIONS

- Cross-stratification orientation
- Laminated
- Thin bedded
- Medium bedded
- Thick bedded
- Cross-bedded
- vf Very fine
- f Fine
- m Medium
- c Coarse
- vc Very coarse









To accompany Record 1969/66

A.R.J. 6.9.69

CORRELATION OF SECTIONS

PLATE 3

Mount Carnarvon
Measured section

35 miles

Basin Creek
Measured section

26 miles

M.C. Glenhaughton No. 1
Oil exploration well

55 miles

80 miles

Northern Dawson Range
Measured sections

136 miles

40 miles

Kerlong and
Carborough Ranges
Measured sections

35 miles

Redcliffe Tableland
Measured sections

MOOLAYEMBER FORMATION

CLEMATIS SANDSTONE (UPPER PART)

CLEMATIS SANDSTONE (LOWER PART)

REWAN FORMATION

SAGITTARIUS SANDSTONE

Moolayember Dip

Glenmoral Gap
Measured section

Shallow well - BMR Baralaba 21

Mount Iffley
Section measured by Veevers et al. 1964

Brumby Mountain
Measured section

Blackwater
B.H.P exploratory well

Vertical scale

250 ft.
0
250
500
750
1000

REFERENCE

vf	very fine
f	fine
m	medium
c	coarse
vc	very coarse
(721B)	sandstone composition code
	conglomeratic sandstone
	sandstone
	siltstone
	mudstone and shale

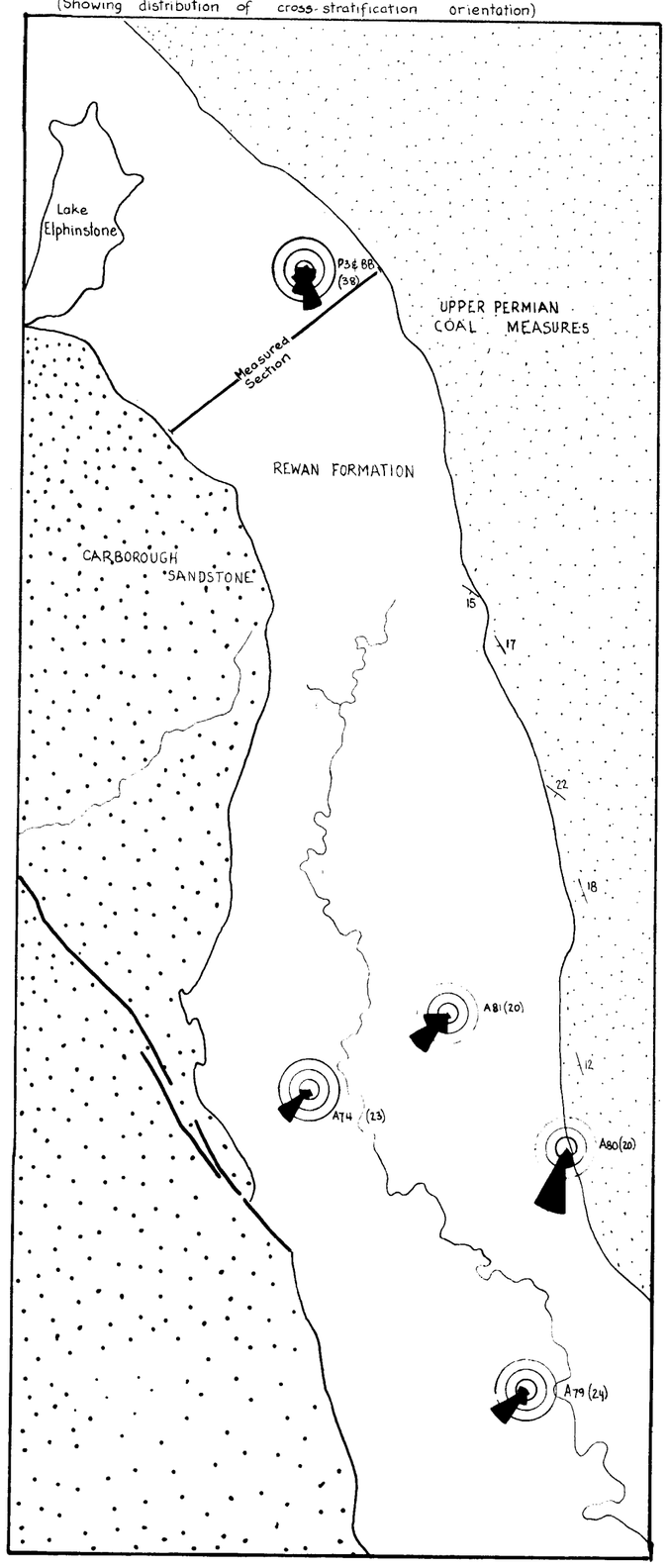
To accompany Report 19/56

PLATE 4

REWAN FORMATION - NORTHERN BOWEN BASIN

GEOLOGICAL SKETCH MAP OF AREA

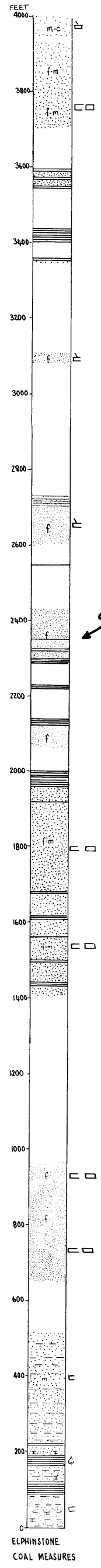
(Showing distribution of cross-stratification orientation)



Orientation of cross-strata represented by rose diagrams - each circle representing increment of 10%. Site number (eg A79) accompanied by number of readings in brackets

1 0 1 2 3 4 5 MILES

SECTION P3



SAMPLES

P3/19

P3/18

P3/17

BD02/A to M
P3/16

BD01/A to G

BC03

BC02
P3/15
BC01

BB06

BB05
BB04

BB03

BB02

BB01

P3/14

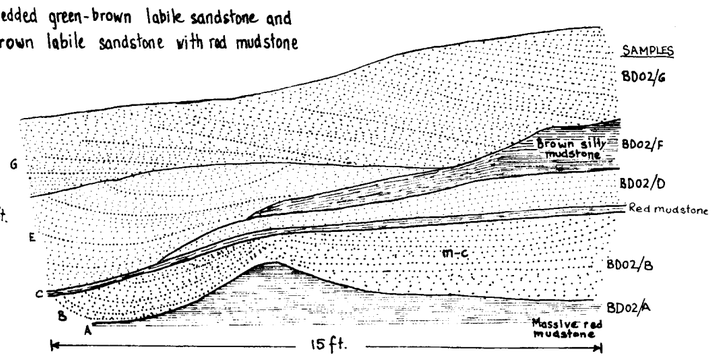
BE01 to BE08

Grey-white quartz-rich sandstone

Light reddish brown sandstone

Red mudstone, mottled green

Interbedded green-brown labile sandstone and red brown labile sandstone with red mudstone



Red mudstone grading in places to red silty mudstone with rare thin bands ¼ inch to 3 inches thick of green, and mottled red and green mudstone of great lateral persistence and uniform thickness (BD01/A, B & G)

Interbedded with red sandstone (BD01/C) and green sandstone with red mud clasts (BD01D)

Slightly calcareous and carbonaceous green brown lithic sandstone

Mainly green calcareous labile sandstone with minor interbedded brown and red mudstone

Brown lithic sandstone with red mud clasts and ferruginous clay matrix

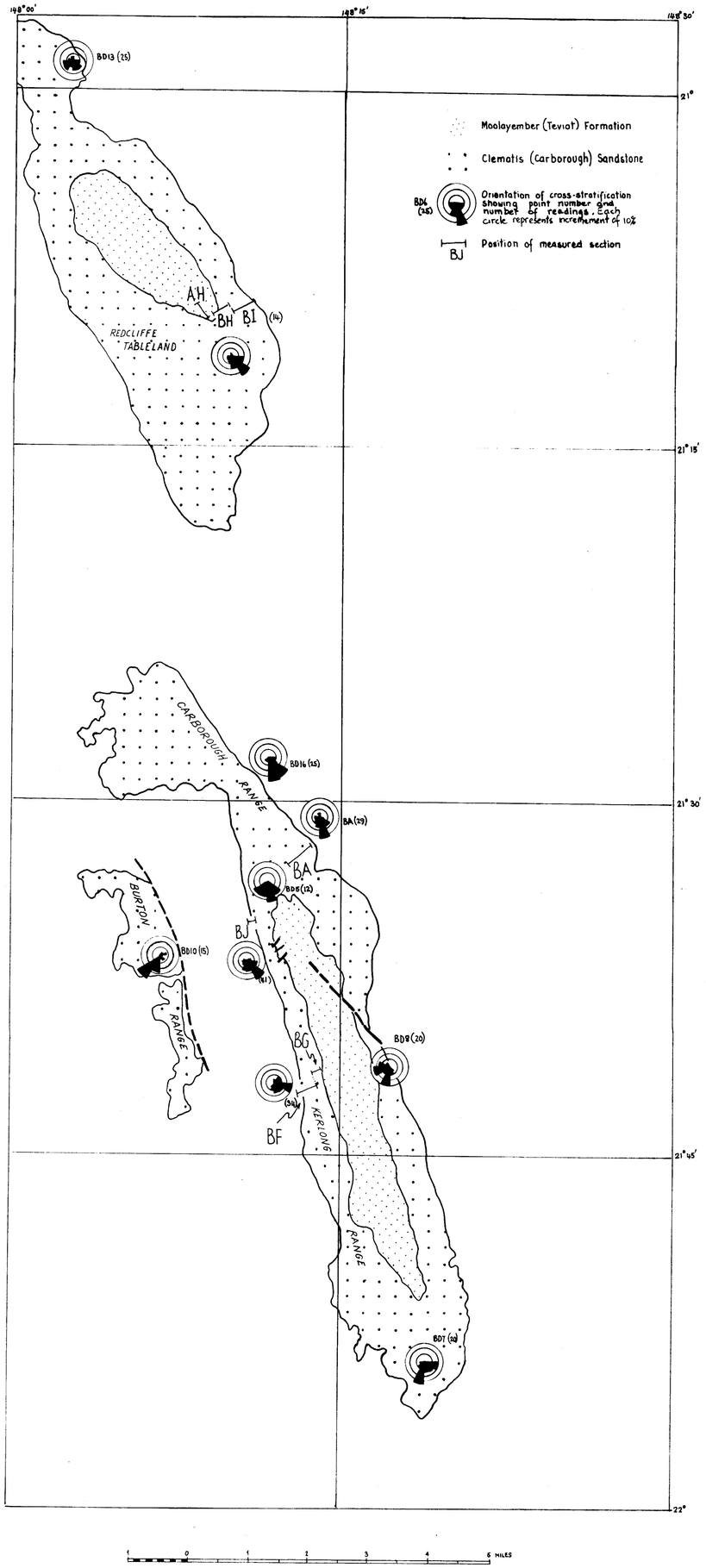
Mainly thinly bedded green bown mudstone and silty mudstone interbedded with lenses up to 15 ft. thick of fine to medium grained, medium to thick bedded cross-stratified sandstone. The brown mudstone contains thin horizons up to 2ft. thick of mottled red and green mudstone with rare sideritic concretions. Sand shale ratio about 0.7

ELPHINSTONE COAL MEASURES

To accompany Record 1969/66

CLEMATIS SANDSTONE - NORTHERN BOWEN BASIN

OUTCROP DISTRIBUTION

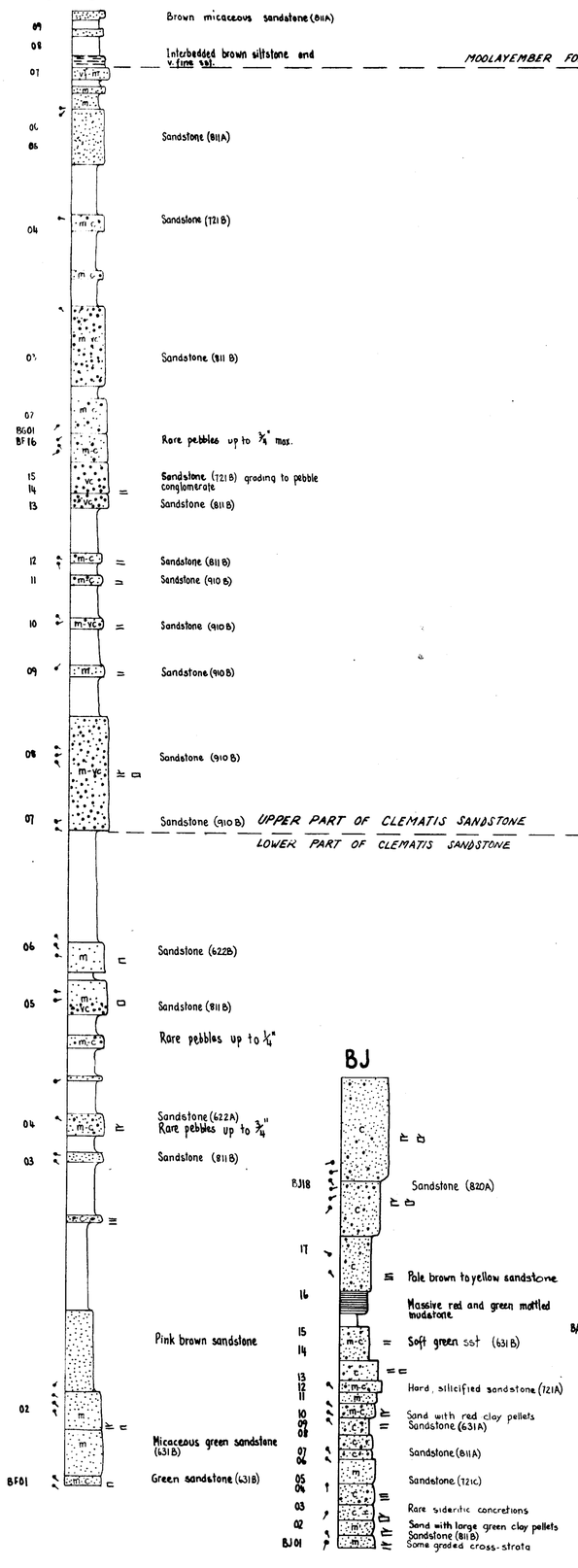


MEASURED SECTIONS

↙ Cross-bedding azimuth
BG05 Sample number
Laminated
Thin bedded
Medium bedded
Thick bedded
Cross bedded

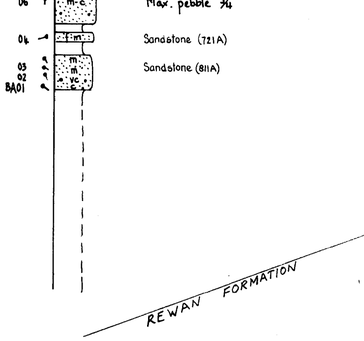
vf very fine
f fine
m medium
c coarse
vc very coarse

BF - BG

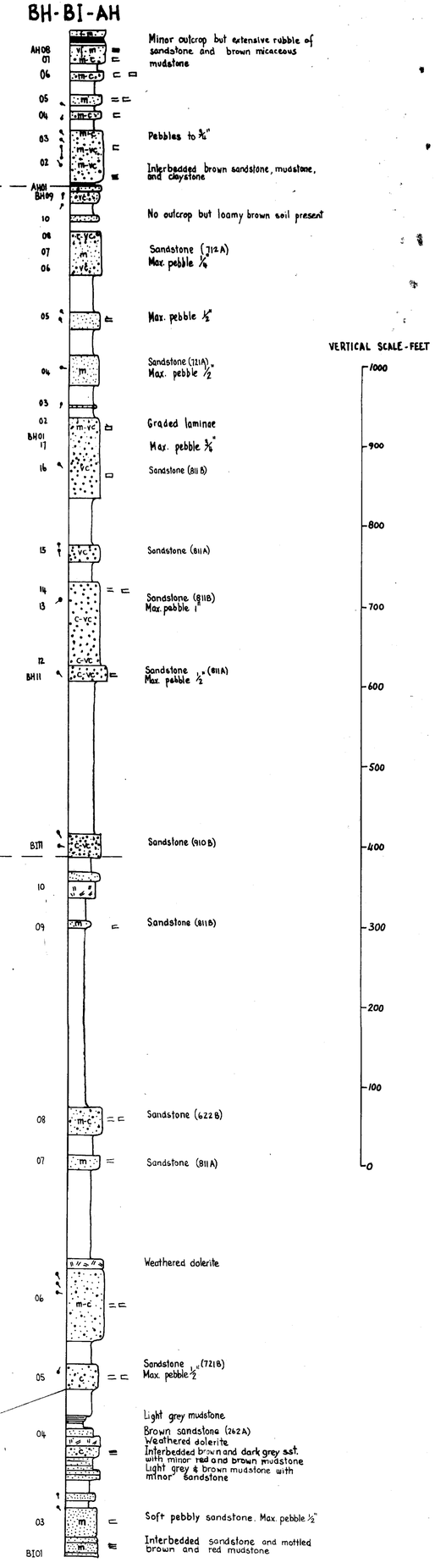


BJ

BA



BH - BI - AH



VERTICAL SCALE - FEET
1000
900
800
700
600
500
400
300
200
100
0

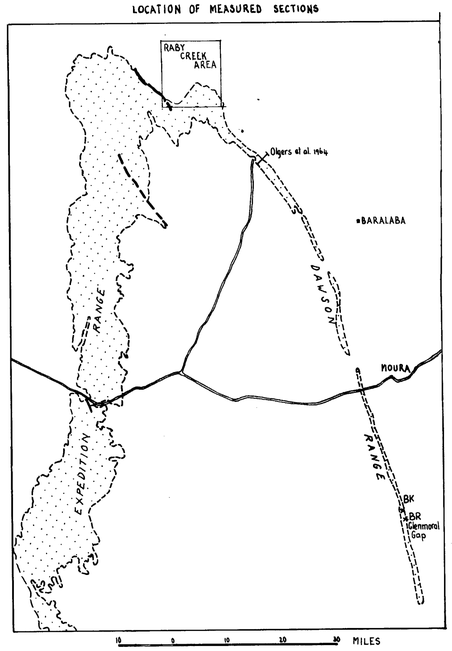
To accompany Record 1969/66

A.R. Jensen Dec. '68

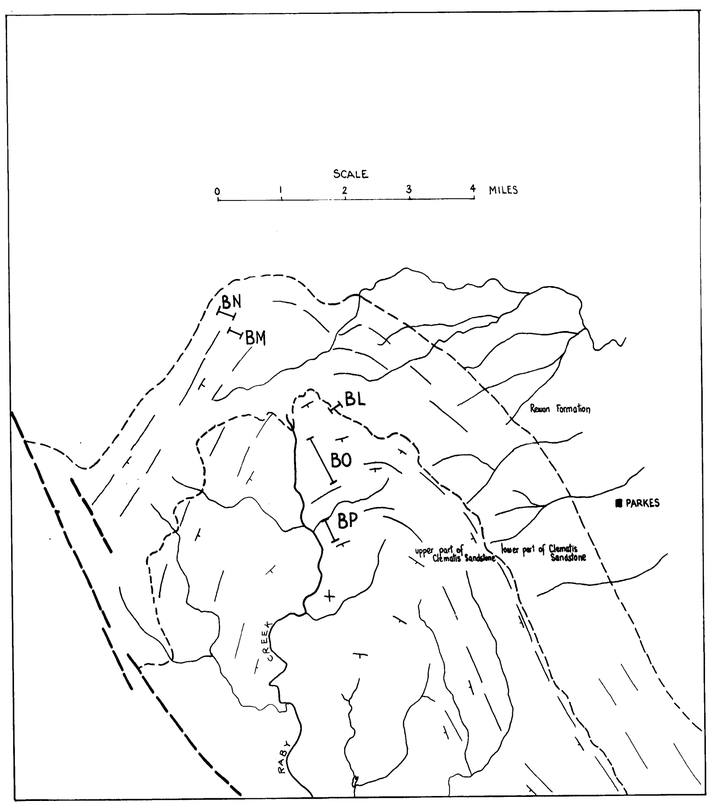
CLEMATIS SANDSTONE - DAWSON RANGE

PLATE 6

LOCATION OF MEASURED SECTIONS

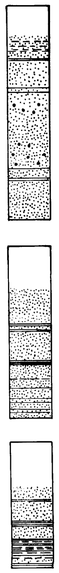


GEOLOGICAL SKETCH MAP OF RABY CREEK AREA AND LOCATION OF MEASURED SECTIONS



SHALLOW STRATIGRAPHIC HOLES GLENMORAL GAP

GRAY 1968



DRD Nº2

DRD Nº4

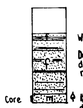
DRD Nº3

BMR BARALABA Nº 20

Mainly friable quartz sandstone

Interbedded quartz sst. and dark blue-grey mudst. with light grey sandy laminae. Gritty lithic quartz sandstone

BMR BARALABA Nº 21

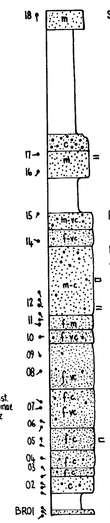


Weathered iron stained sst.

Dark blue grey hard lithic sst.; dark grey mudstone and purple mudstone

Feldspathic quartz sandstone, dark grey to black mudstone grading to fine muddy sandstone with plant remains and abundant carbonaceous fragments; some biotite

SECTION BR
GLENMORAL GAP



Sandstone (721C)

Pebble bands - max. pebble 1"

Rare pebbles to 1"

Sandstone (721B). Rare pebbles up to ½"

Sandstone (721 B)

Sandstone (811B)

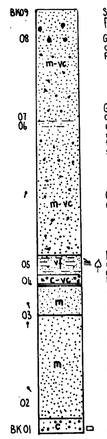
Sandstone (721B) - thin pebble bands, max pebble 1"

Sandstone (721C)

Sandstone (632B), minor graded laminae fine ripple lamination

Brown sandstone (632B)

SECTION BK
TWO MILES NORTH OF GLENMORAL GAP



Sandstone (820B) extensively ferruginized in places

Grey-brown sandstone conglomeratic in places Pebbles to 1"

Grey-white sandstone (550B) with lenses of siltstone, 50 to 150 feet long filling gentle scour troughs, and in places strongly eroded by narrow channels up to 6 feet wide which are filled with sand and siltstone blocks

Grey-white to buff, weathered sand with thin beds of white very fine mic. Sandstone commonly replaced by iron

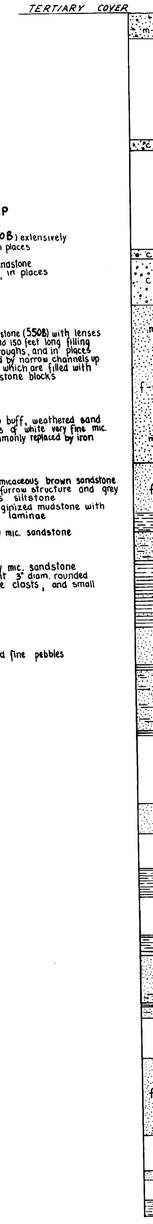
Interbedded micaceous brown sandstone with rib and furrow structure and grey carbonaceous siltstone
Brown ferruginized mudstone with black iron laminae

Brown slightly mic. sandstone

Brown slightly mic. sandstone with abundant 3" diam. rounded pink siltstone clasts, and small mud clasts

Sandstone with scattered fine pebbles

NORTHERN DAWSON RANGE - OLGERS ET AL. 1964



Iron stained quartz sandstone

Heavily iron stained coarse quartz sandstone

Mottled cream and red brown poorly consolidated quartz sandstone. Large white sub-angular quartz pebbles scattered throughout

Banded yellow to red brown quartz sandstone with minor white mica especially in rare flaggy beds

Buff poorly sorted quartz sandstone with a yellow limonitic clay cement

Cream quartz sandstone, prominent joints filled with limonitic clay and white mica

Weathered olive green to brown feldspathic sandstone. Some fine micaceous laminae

Red brown siltstone and fine sand grading into banded red to brown and grey-green shales with 4" to 12" bands of green siltstone

Buff sandstone with numerous micaceous bands

Weathered grey and buff shale and mudstone
Brown micaceous san with numerous siltstone bands

Weathered grey shale

Buff quartz lithic sandstone

Yellow-brown friable shale and micaceous siltstone

Yellow friable shale and mudstone with thin lenses of siltstone

Brown micaceous flaggy sandstone with some siltstone beds at base

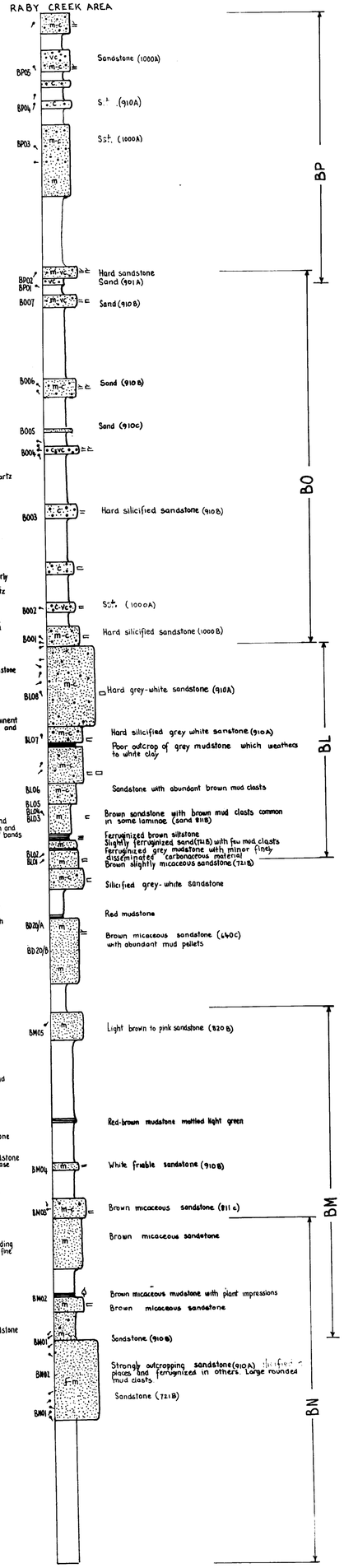
Brown shale
Buff sandstone with a few silty bands

Buff feldspathic sandstone grading into laminated partly mic white fine sandstone and siltstone

Red and brown feldspathic sandstone

Brick red shale and siltstone with abundant mica

MEASURED SECTIONS
RABY CREEK AREA



Sandstone (1000A)

S.st. (910A)

S.st. (1000A)

Hard sandstone
Sand (901A)

Sand (910B)

Sand (910B)

Sand (910C)

Hard silicified sandstone (910B)

S.st. (1000A)

Hard silicified sandstone (1000B)

Hard grey-white sandstone (910A)

Hard silicified grey white sandstone (910A)

Poor outcrop of grey mudstone which weathers to white clay

Sandstone with abundant brown mud clasts

Brown sandstone with brown mud clasts common in some laminae (sand 811B)

Ferruginized brown siltstone
Slightly ferruginized sand(721B) with few mud clasts
Ferruginized grey mudstone with minor finely disseminated carbonaceous material
Brown slightly micaceous sandstone (721B)

Silicified grey-white sandstone

Red mudstone

Brown micaceous sandstone (660C) with abundant mud pellets

Light brown to pink sandstone (820B)

Red-brown mudstone mottled light green

White friable sandstone (910B)

Brown micaceous sandstone (811C)

Brown micaceous sandstone

Brown micaceous mudstone with plant impressions

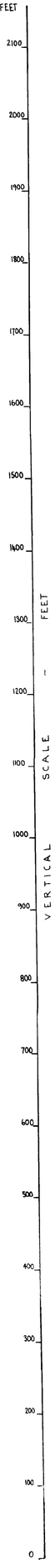
Brown micaceous sandstone

Sandstone (910B)

Strongly outcropping sandstone(910A) silicified in places and ferruginized in others. Large rounded mud clasts

Sandstone (721B)

FEET



= laminated
= thin bedded
= medium bedded
= thick bedded
~ cross-bedded
vf very fine
f fine
m medium
c coarse
vc very coarse

BR01 Sample number

To accompany Record 1969/66

A.R. JENSEN Dec. '68

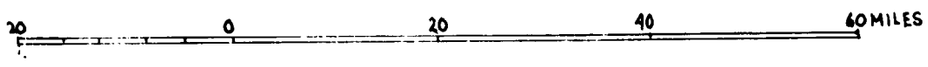
a. Rewan Formation. Red mudstone sequence with thin bands of green mudstone. BMR Neg.799/2

b. Closer view of red mudstone with a green band near top of photo. Note vertical green (white) patch near hammer representing alteration along a joint. BMR Neg.799/1

a. Rewan Formation; cross-stratification in a sandstone lens, decreasing in size upwards
BMR Neg.844/14

PLATE 9

ORIENTATION OF CROSS-STRATIFICATION
REWAN FORMATION



Field location number···· BF-J
Number of readings ····· (16)

To accompany Record 1969/66

A.R.J Feb. 1969

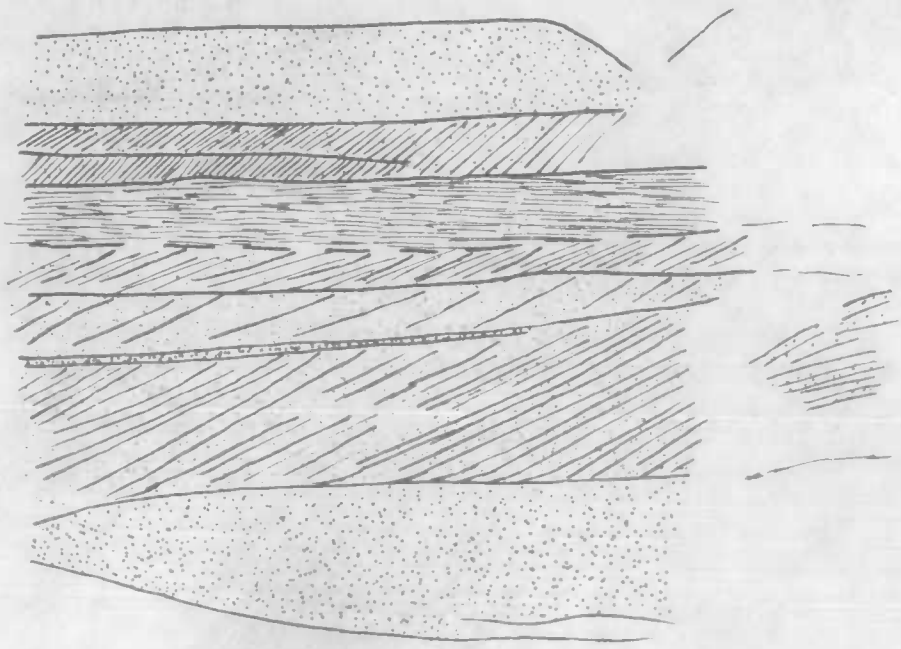
PLATE 10

Thinly bedded sequence at the top of the Rewan Formation and base of Clematis Sandstone. North of Clematis Creek.
BMR Neg. 30A-33A

a. Upper part of Clematis Sandstone; graded bedding in cross-stratification - Planet Creek area
BMR Neg.844/11

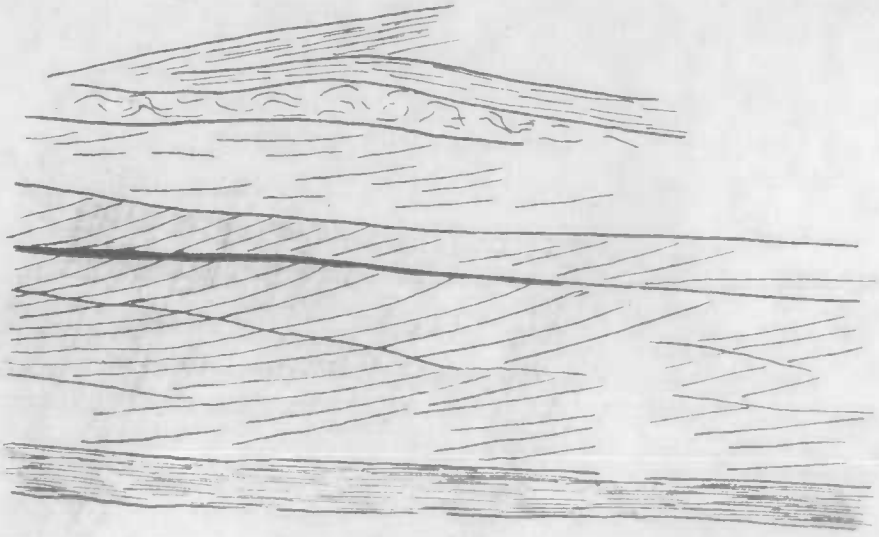
b. Upper part of Clematis Sandstone; multiple parallel-truncation, planar, cross-stratification in the planet Creek area.
BMR Neg.844/13

Upper part of Clematis Sandstone - Planet Creek area. Massive sandstone overlain by cross-stratified sandstone with scale of cross-stratification decreasing upwards. B.M.R. Neg.844/12

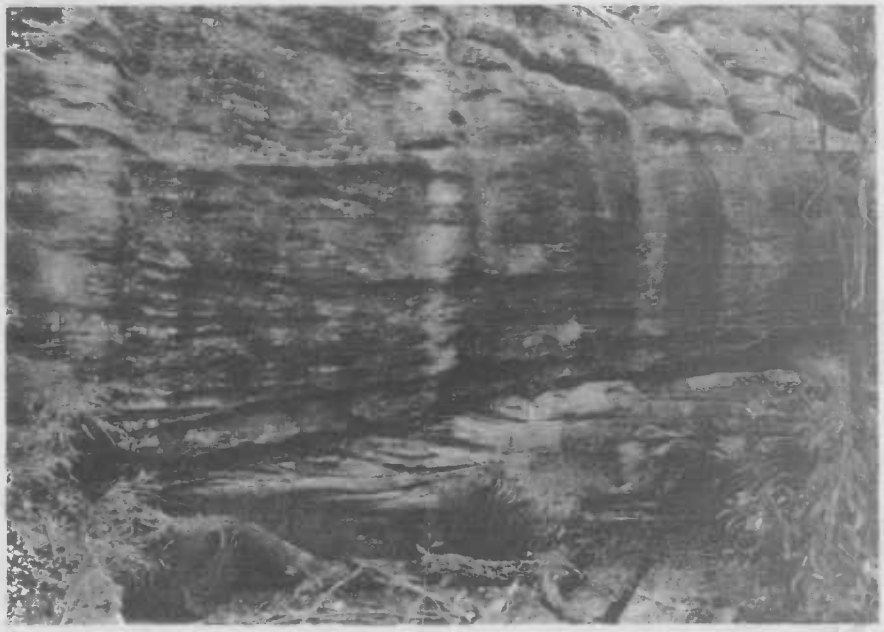


Sketch of sedimentation units in above illustration

Upper part of Clematis Sandstone in Spring Creek.
Cross-stratification decreasing in size upwards
BMR Neg. 844/15A



Sketch of bedding in photo above



Upper part of Clematis Sandstone - Planet Creek area.
Part of a large trough filled with ripple laminated sandstone
BMR Neg.844/10

PLATE15. Upper part of the Clematis Sandstone - Spring Creek.
Large trough structure filled with laminated sandstone
BMR Neg. 844 21A, 23A

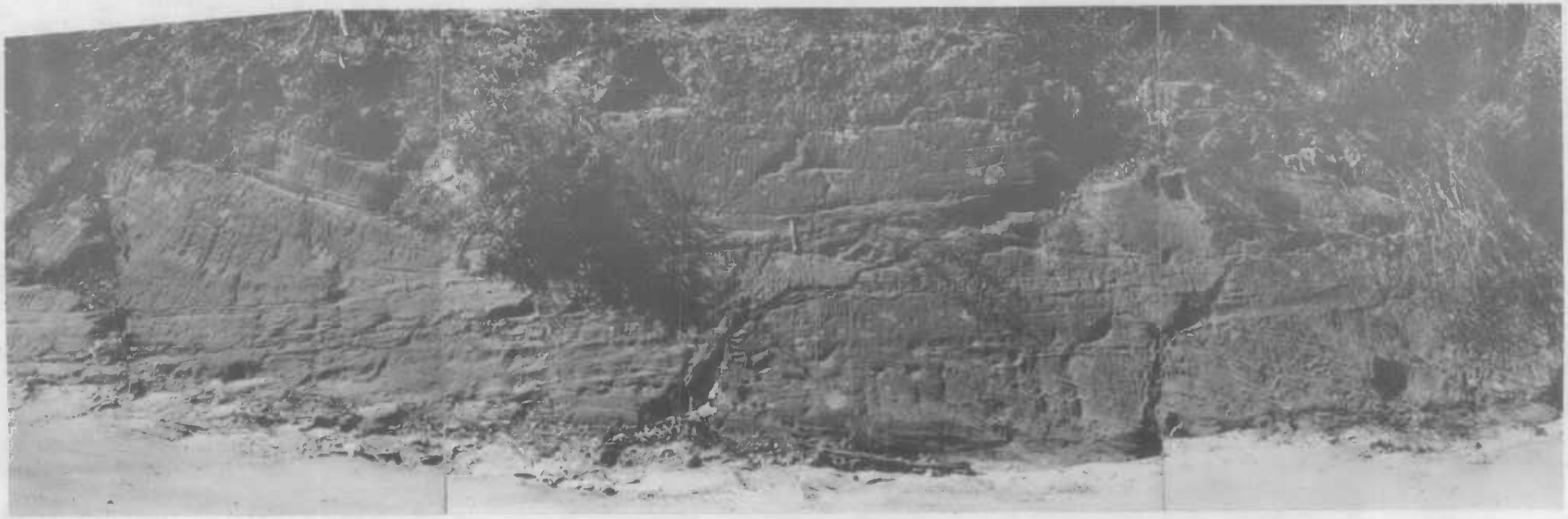
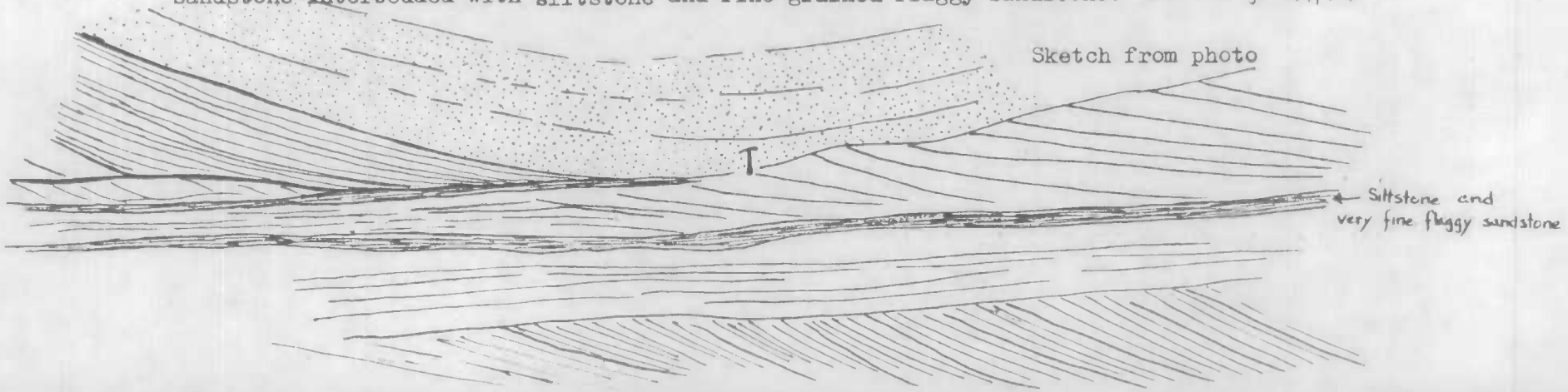
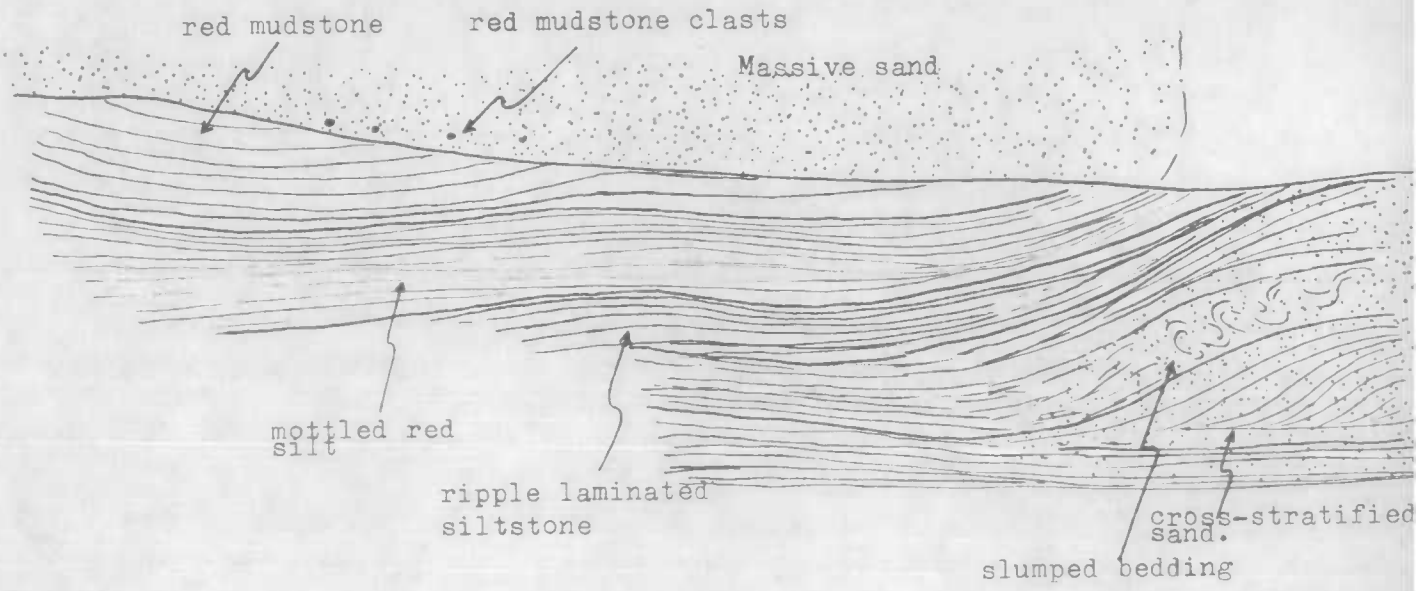


PLATE 16 Probably in upper part of Clematis Sandstone - Expedition Range. Trough cross-stratified sandstone interbedded with siltstone and fine grained flaggy sandstone. BMR Neg. 844/4-6



a. Upper part of Clematis Sandstone - Bogarella Creek Trough-like structure, possibly a swale behind a point bar, filled with fine sandstone, siltstone, and red mudstone
BMR Neg. 844/2-3

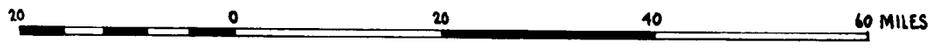


b. Sketch from photo

a. Probably in the upper part of the Clematis Sandstone, Expedition Range. Medium bedded sand unit grading laterally into a thin bedded unit forming a small trough structure
BMR Neg.844/7

b. Upper part of the Clematis Sandstone - Bogarella Creek. Overturned cross-stratification
BMR Neg.844/1

ORIENTATION OF CROSS-STRATIFICATION
LOWER PART OF CLEMATIS SST.



Field location number..... BF-J
Number of readings ..... (16)

To accompany Record 1969/66

ARJ Feb. 1969

ORIENTATION OF CROSS-STRATIFICATION
UPPER PART OF CLEMATIS SST.

147°E
21°S

BD13 (23)

BH-I (14)

20 0 20 40 60 MILES

Field location number.... BF-J
Number of readings..... (16)

BA+BD5 (23)

BF-G+BD8 (37)

BD7 (19)

BO+BP (29)

CF34 (24)

CF31+32+CB (41)

CF10 (10)

CF14 (21)

CF45+3+CE (32)

CG (18)

CD (35)

25°S
147°E

25°S
150°E

To accompany Record 1969/66

ARJ Feb. 1969