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Figures 6A
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THE GEOLOGY OF THE BOULIA AREA, WESTERN QUEENSLAND.

by

J.N. Casey, M.A. Reynolds, D.B. Dow. P.W. Pritchard,
R.R. Vine and R.J. Paten.

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PART 1
of 2

THE GEOLOGY OF THE BOULIA AREA, WESTERN QUEENSLAND.

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SUMMARY

The Boulia 4-mile Sheet area, of approximately 7,000 square miles in north-west Queensland, was mapped in 1957. The mapping established a sequence of 3,000 feet of fossiliferous marine carbonate rocks of Upper Cambrian to Lower Ordovician age, unconformably overlain by Mesozoic (probable Upper Jurassic to Lower Cretaceous) sandstone and marine claystone, which thickens to the south and east to a maximum of 1500 feet in this area. The Mesozoic rocks form the main aquifer and the impermeable cap of the north-west margin of the Great Artesian Basin. About 80 feet of Tertiary sandstone and lacustrine limestone, with chalcedony overlie the older rocks.

Both Palaeozoic and Mesozoic rocks have been folded and faulted, although the main movements took place before the deposition of the Cretaceous sediments. In the Burke River Structure faulting was later than folding. Major tectonic activity had been completed before the Tertiary and the youngest rocks have only a slight regional tilt to the south.

Source rocks for petroleum occur in the Lower Palaeozoic succession where traces of residual petroleum are present in the carbonate sequence; pyrite and gypsum are common in the marine fossiliferous Cretaceous claystone which is evidence for a reducing environment. Siltstone, soft argillaceous limestone, and hard dense limestone beds within the carbonate sequence, or the Cretaceous claystone could form cap rocks. Time breaks occur within the carbonate sequence, and in places the siltstone of the Swift Formation overlies the carbonates disconformably. Hydrocarbons from the carbonates may thus have escaped before the siltstone cap was deposited.

Apart from the Mesozoic sandstone the only possible reservoirs are in the older carbonate rocks, particularly in the dolomitized zones where vugs are numerous, in intraformational breccias, and in limestones which have been sheared and faulted. Basal sands may occur at depth near basement ridges over and along which the Lower Palaeozoic seas transgressed.

Structures, some closed along one side by faulting, occur in the carbonate sequence. The Mesozoic is folded and faulted, but much of the surface structure is a reflection of draping of the younger sediments over older buried ridges, some of which at least are fault controlled. These ridges persist below the poorly exposed Cretaceous claystone in the south-east of the area.

The Mesozoic sandstone forms an intake bed in the Hamilton River area for artesian water. Some bore waters, particularly in the north-east are highly charged with fluorine.

Vertebrate fossils and fish scales (which have a uranium mineral on their surface) in the limestone member of the Cretaceous siltstone, give the rocks a radioactive count of three to four times background.

Lead occurs in at least one place in the Palaeozoic carbonate sequence as a metasomatic replacement deposit on the crest of a sheared anticline; it has not been proved to be a commercial deposit.

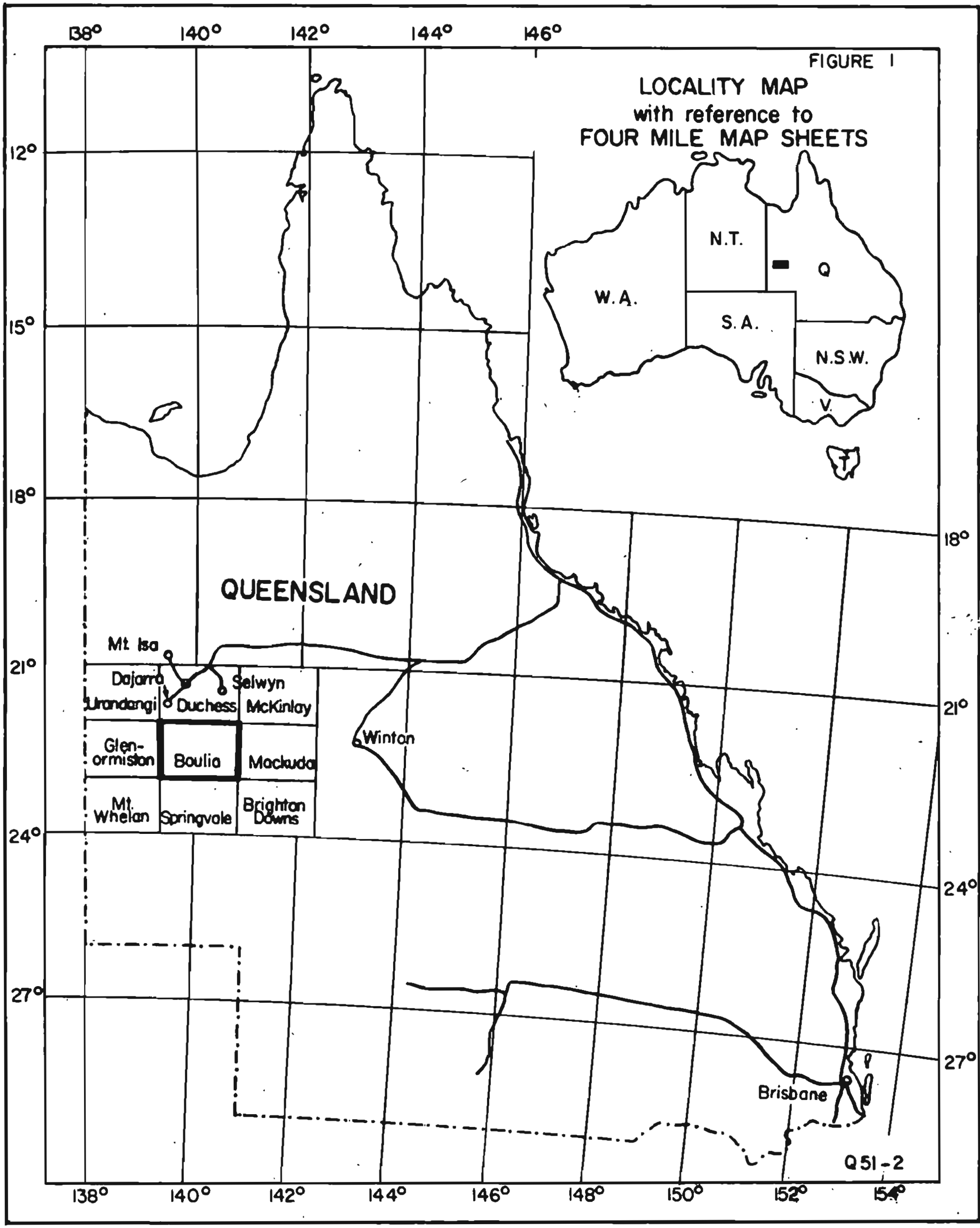


FIGURE 1
LOCALITY MAP
with reference to
FOUR MILE MAP SHEETS
138°
140°
142°
144°
146°
148°
150°
152°
154°
12°
15°
18°
21°
24°
27°
N.T.
Q
W.A.
S.A.
N.S.W.
V.
T.
QUEENSLAND
Mt. Isa
Dajarra
Selwyn
Urandangi
Duchess
McKinlay
Glen-ormiston
Boulia
Mackuda
Mt. Whelan
Springvale
Brighton Downs
Winton
Brisbane
Q 51 - 2

INTRODUCTION

GENERAL

A regional geological survey was started in 1957 to continue to the south the regional mapping of the Cambrian, Ordovician, and Mesozoic sediments of the Northern Territory and North-West Queensland which was begun in 1952 by Dr. A.A. Opik, and to assess the oil prospects of the Georgina Region. Detailed reconnaissance mapping was concentrated on the Boulia (F/54-10) 4-mile Military Sheet area (and this sheet will be published in colour in the geological sheet series.

The authors started mapping on 1st July 1957 and continued for 15 weeks. Mapping was continued in the adjoining areas of Glenormiston, Mt.Whelan and Springvale in 1958 and 1959.

LOCATION

The area shown in Figure 1, is part of the Shire of Boulia, which extends from east of the Hamilton River to the Northern Territory border and is bounded on the north by the Shires of Cloncurry and Barkly Tablelands, on the east by the Shire of Winton, and on the south by the Shire of Diamantina. The only town in the area is Boulia, with a population of 179; besides those living in the town, 185 people are registered with the Boulia Post Office as living in the district. Total population of the Shire is 764 (1954 census).

Boulia is connected by formed gravel roads to the railheads at Winton 250 miles to the east, Dajarra 98 miles to the north, and Selwyn 120 miles to the north-east. A survey was made about 40 years ago by the Railways Department when it was proposed to link Springvale (south-east of Boulia) with the railhead at Winton, but this line was not built. The roads are closed for several weeks during the wet season.

Boulia is connected by a fortnightly plane service with other townships in the area.

Forty-six pastoral stations are situated either entirely or in part in the Boulia Sheet area; they raise sheep and cattle. Fig.2 shows the station boundaries with the homestead indicated by a black square; barrier or netting fences are also shown in the figure.

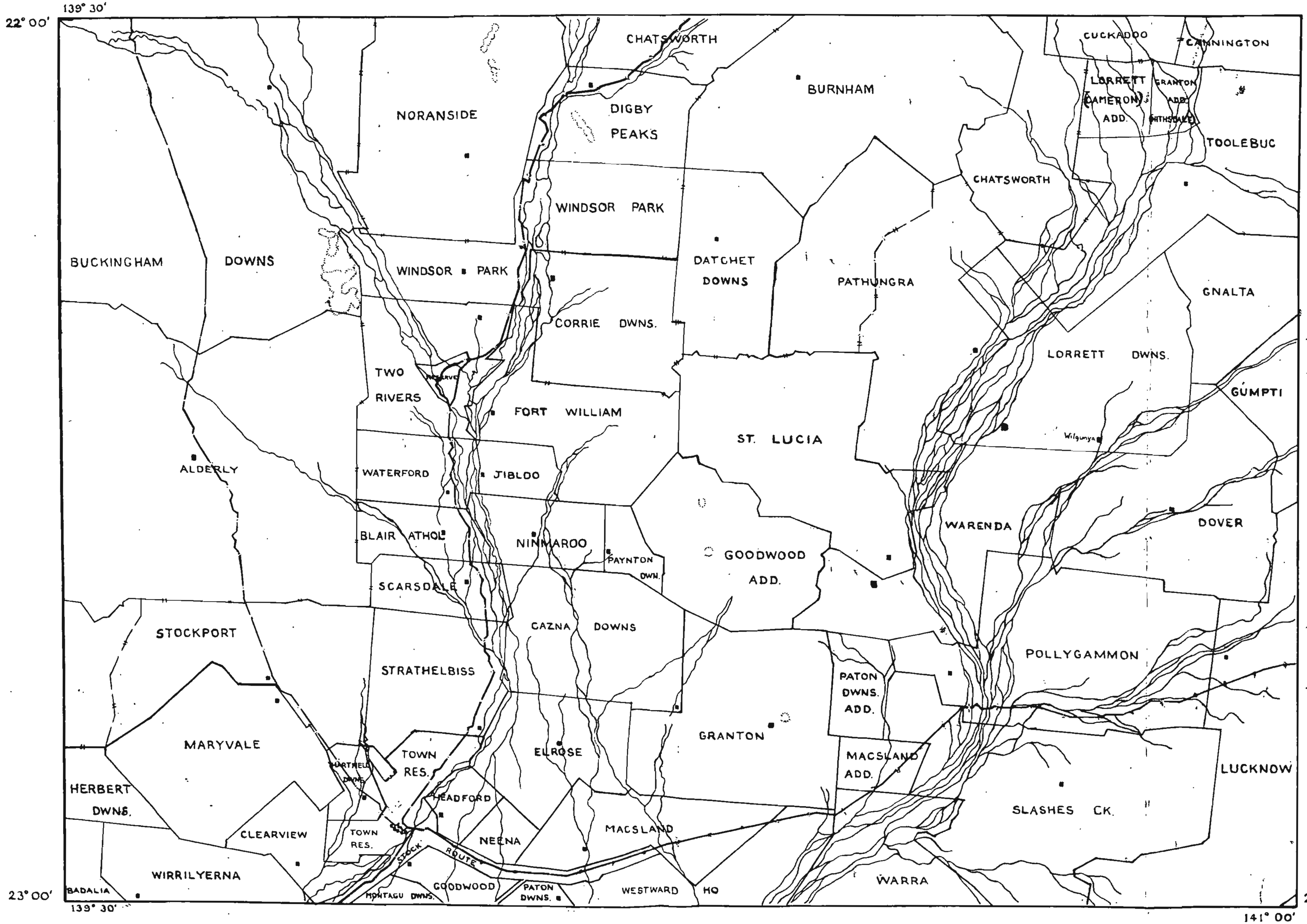


Fig. 2 Boulia 4 Mile Map Showing Property Boundaries and Netting Fences

SCALE

MILES 2 1 0 2 4 6 8 10 12 14 16 MILES

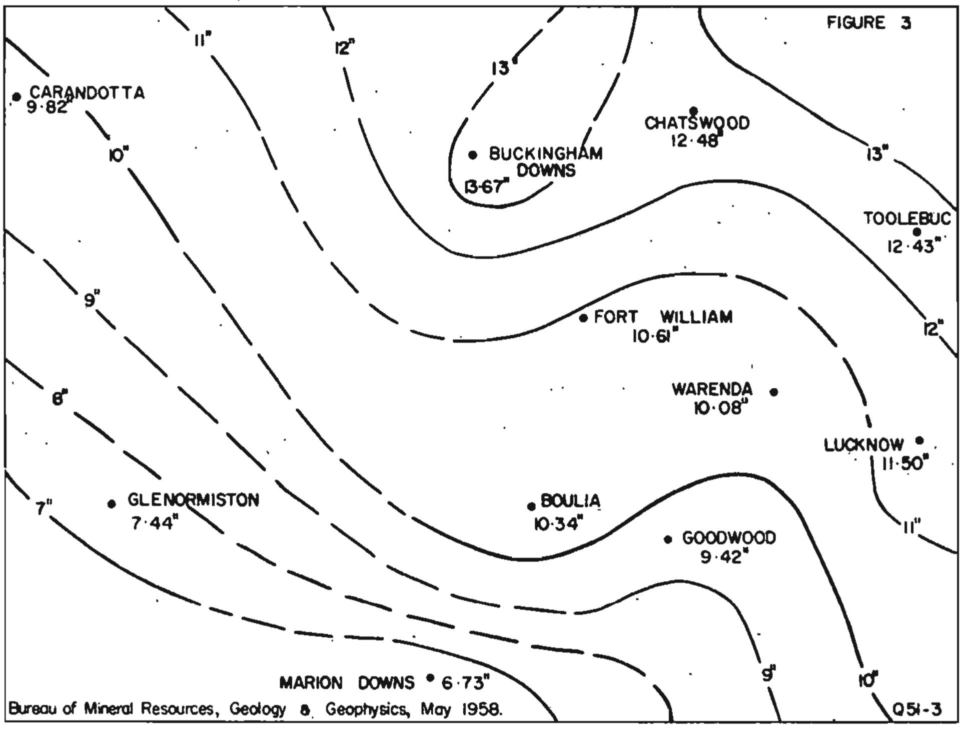
Main Roads

Main Rivers

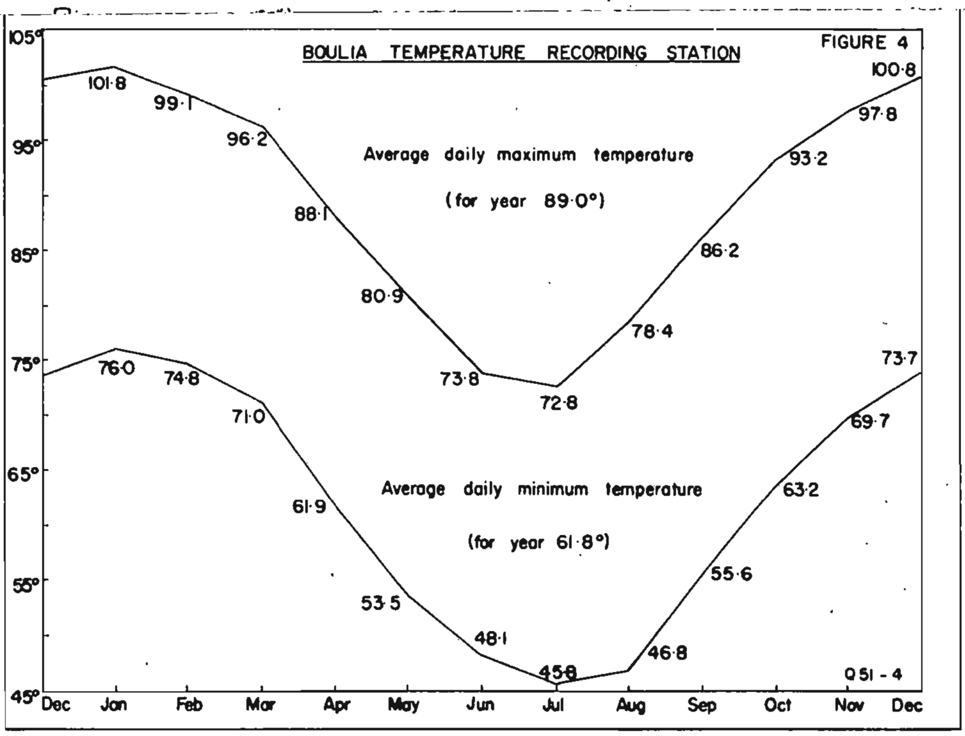
Property Boundaries

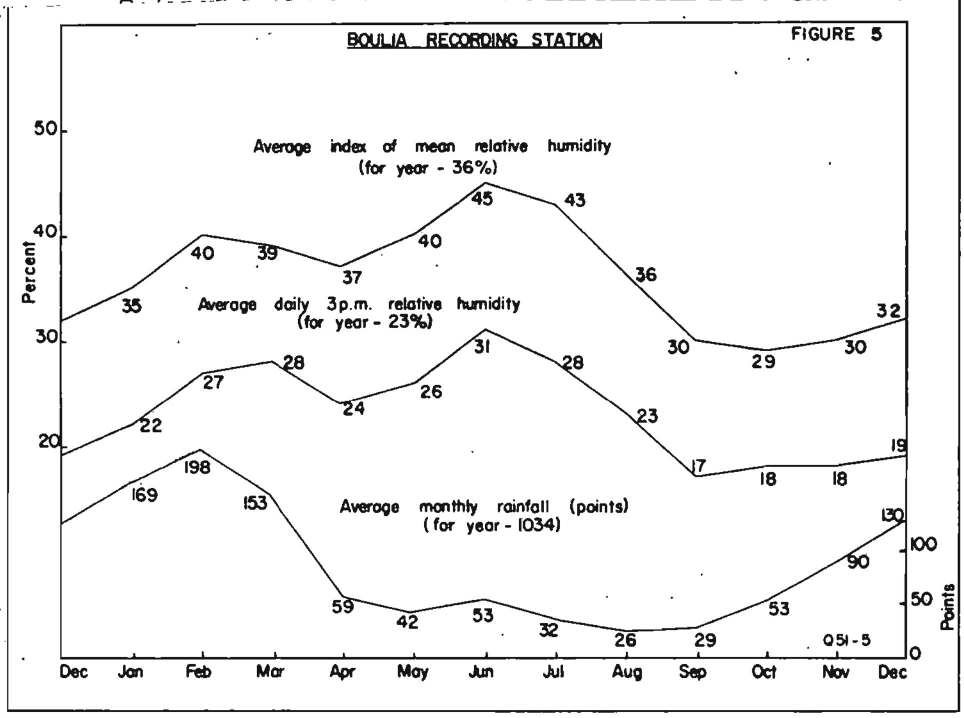
Netting Fences

Station Homestead



Average Annual Isohyets, Boulia District, N.W. Qld.





CLI[illegible]

The Boulia district lies within the 6 to 14 inch rainfall belt (Fig.3). Rain may fall in any month of the year, but the summer rains are the most important - more than 50% of all rain falls within the period December to March. Light winter rains during June and July are a regular feature of the rainfall pattern. August is the driest month. The average monthly rainfall at Boulia is shown in Figure 5 and the records of eight stations in the district are given in Table I.

TABLE I : RAINFALL, BOULIA DISTRICT.

Station	No. Years.	Jan.	Feb.	Mar.	Apl.	May	June	Jly.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave. for year.
Boulia	56	169	198	153	99	42	53	32	26	29	53	90	130	1034
ucking-m Downs	24	295	295	161	74	58	92	44	22	22	48	107	149	1367
atsworth	28	249	285	163	52	60	69	42	8	26	57	85	152	1248
rt lliam	28	206	200	135	34	59	74	46	12	20	62	89	124	1061
enormis-on	44	110	170	97	20	31	41	28	12	21	47	45	117	744
cknow	37	237	260	139	53	54	81	27	14	34	45	82	124	1150
rion wns	30	139	118	69	36	30	48	32	8	20	43	55	75	673
renda	39	212	206	116	41	54	60	37	12	30	48	76	116	1008

Temperature data from Boulia; the only temperature recording station in the district, shows a regular pattern of hot summer and cool winter days. An average daily temperature variation of about 25 C (Fig.4) produces warm nights in summer but cold winter nights. The maximum temperature recorded at Boulia was 11?.2°C and the minimum was 26.4°C.

Humidity is greatest during winter. The Average Index of Mean Relative Humidity is shown in Figure 5. This index is determined from the ratio of the average 9 a.m. vapour pressure to the saturated vapour pressure at the average daily mean temperature it is a good approximation of the daily mean relative humidity. The graph of monthly averages of relative humidity at 3 p.m. daily is also shown in Figure 5.

Winds are variable throughout the year. The prevailing wind is from the south-east and half of the winds in winter are from this direction; less than one-fifth of winds in summer are from the south-east. Cold south-west winds constitute one-fifth of all winds during the winter. These percentages were determined by the Meteorological Bureau, Brisbane.

FLORA AND FAUNA

An annual rainfall of from six to fourteen inches in this area allows the development of an extensive and varied flora. The dry braided courses of the main rivers together with associated flood plains and tributaries provide an area of alluvium which supports the best growth of trees. Such belts of trees thin progressively away from the river banks; grasses develop on the outer margin of the alluvial belt as trees become fewer. The most obvious components of this river flora are the eucalypts, represented by tall river gums, bloodwoods and some ashes. The remainder of the river flora varies with locality. On the Burke River north of Fort William, a major part is taken by pink and white flowering bean trees (Bauhinia spp.), and beefwood is common. Occasional yellow-flowering trees with thick black bark and terete pungent pointed leaves (?Hakea sp.) grow at a short distance from the river and also on some of the dry spinifex ridges. Emu Apple is common, and spreads to some extent on to the surrounding plains. Undergrowth along the river banks varies from rank grasses to a thick prickly scrub, with some creepers. Several genera (Loranthus) of Mistletoe infest much of the river vegetation and some trees in drier areas; at least two species are present near the Burke River, one parasitizing the eucalypts, and the other (L.?excocarpi), the bauhinias and prickly undershrubs.

Where the surface soil of the alluvial flats has been removed after the loss of the grass cover, "clay pans" which support little vegetation develop. The few remaining patches of grass hold the top soil and stand out as ridges up to a foot high above the otherwise flat surface of the pan.

Beyond the limits of the alluvial flats and where the hill country is at a distance from the rivers, there are extensive areas of undulating plain. These make up approximately one third of the whole area, and are mostly treeless and support an extensive growth of Mitchell Grass (Astrebla pectinata). The soil of these plains yields little water and inhibits the establishment of trees. Where the river alluvium overlaps as a thin veneer on to the soil of the plain, some trees do grow. "Established" trees planted in homestead gardens survive in this soil. The grasses grow into clumps up to two feet high, rather than as a mat, and the movement of drainage water between the clumps washes away the intervening soil, leaving the clumps as elevated tussocks and producing a very uneven surface. Small depressions in the surface of these plains become swampy in wet weather and produce small herbs rather than grasses. Carbonaceous matter derived from the decay of these herbs produces a black soil, as distinct from the surrounding brownish soils; this process probably accounts for most of the colour variation in the soils on these plains.

The rocky areas usually rise above the level of the plain, and their flora shows a marked change from that of either of the areas so far considered. On the dry ridges the poor nature and scarcity of the soil and low availability of water is reflected in the appearance of the vegetation. Locally damp areas of fertile soil do, however, support a thick tree growth. Eucalypts are common to most of the drier areas; they are stunted and deformed, and in many cases approach a mallee habit. Most other growth is scrubby, the commonest being Minnaritchie (Acacia sp.) which forms dense thickets. Other legumes are common, and in many areas Eremophila Duttoni, E.Brownii and related species are important shrubs. Spinifex (Trioda sp.) is very widespread, forming thick clumps which cover most of the dry hillsides; where it occurs on the better watered areas (e.g. to the east and south of Black Mountain) it grows to a height of up to seven feet and forms an almost impenetrable barrier. The native willow (Santalum sp.) is common in the dry water courses here. A fern (Cheilanthes sp.) grows in rock crevasses on Black Mountain and in the Swift Hills.

Conditions of water and soil improve in the valleys between the ridges, and a better growth results. In some of the wider valleys and on the gently slpping land at the foot of the hill country, dense pure stands of mulga (Acacia aneura) have developed. Gidgee or Gidyea (Acacia sp.) in this area is scattered, but seems to show some preference for calcareous soils. An almost infallible indicator of the Palaeozoic limestones in this area is turkey-bush, a yellow flowering shrub (family Leguminosae) which forms a dense scrub on many of the limestone outcrops, or areas of limestone masked by a soil cover.

White wood (Atalaya sp.) is very common in some valleys, and spreads onto the higher plains. The mud springs south of Mount Watson form a locally fertile area and support a magnificent growth of red-flowering bottle-brushes (Callistemon sp.); these are further fertilized by the decay of numerous animals trapped in the mud springs.

Animal life is abundant and is mainly centred around the rivers and adjacent plains. These areas are also utilized for grazing, and support 320,000 sheep, 80,000 cattle and some other domestic animals. Large numbers of kangaroos still inhabit the main grazing areas, and also dwell in caves formed under siliceous caps on small flat-topped hills which are common in some parts of the area. Kangaroo pads on the sides of hills are so worn as to be quite conspicuous from a distance and on aerial photographs. Dingoes ravish sheep, and grazing in hilly country is impossible. Trapping is carried out to reduce the numbers of dingoes, and other creatures are sometimes caught in the traps; these include wild cats and foxes. Wild horses and camels are known from the more remote parts of the area. Some rabbits were seen at the entrance to Noranside Station near the Boulia-Selwyn road. A bat specimen from a limestone cave at Digby Peaks was caught and preserved; it has been presented to Sydney University.

A large variety of bird life exists in the area. Emus and bustards are numerous. The emus inhabit scrubby country and plains and near permanent water holes in stream channels. Bustards (or plain turkeys) prefer plains covered with high grass or low scrub; these birds are protected in Queensland. Scavengers include kite-hawks, eagle-hawks and crows. Other large birds frequenting water holes are brolgas, pelicans, herons and spoon-bills. Birds which live in large flocks include white cockatoos, galahs, parrots and finches.

Goannas and other large lizards were seen more often during the 1957 field season than snakes. Snakes such as the brown Copperhead, Downs Tiger, and pythons were seen.

Fish including large callop (Golden Perth or Yellow-belly)weighing up to five pounds, and black bream live in some ofthe large permanent water-holes.

MAPS AVAILABLE AND FIELD METHODS:

Aerial photographs, taken by the R.A.A.F. from 25,000 feet in 1951, have an approximate scale of 1 inch to 3/4 mile and were used to plot all information obtained during field work in 1957; controlled photo-scale base maps (12 maps to cover the 4-mile area) and a controlled one inch to 4 mile cadastral map were prepared by the Army; the photo-scale maps show topography and photo centre and wing points. An uncontrolled photo-mosaic map prepared by National Mapping in 1953 is also available. The map accompanying this report was prepared on the controlled 4 mile cadastral base but redrawn by National Mapping. The controlled 4-mile geological map will later be published in colour.

Barometric traverses were run through most of the area; main road bench-marks and gravity stations surveyed by Department of Interior Surveyors provided accurate height control for barometric work. A diurnal curve was calculated from a battery of three barometers which were read hourly at the base camp near Digby Peaks; usually two barometers were used when readings were taken during traverses.

A gravity party under Mr.Van Son from the Geophysical Section, Bureau of Mineral Resources, also worked in the Georgina Region in 1957; survey work for this party was done by Mr.D.Cook, Department of Interior, Canberra.

No Authority to Prospect or other petroleum or mining tenement was held in the area during 1957, but late in 1958 an Authority to Prospect 54P, covering 43,000 square miles, was taken out by Papuan Apinaipi Petroleum Co.Ltd; it covers the Boulia Sheet area as well as parts of adjoining sheets.

A list of astrofixes determined by the Army in 1957 is given; these formed the basis for the control of the sheet.

Station	Latitude	Longitude
A 176	22°03' 44.8"	139°31'11.1"
A 177	22°04' 19.9"	140°03'16.0"
A 180	22°00' 36.8"	140°58'24.0"
A 181	22°17' 37.2"	139°54'12.3"
A 182	22°14' 52.2"	140°39'27.0"
A 183	22°31' 40.9"	139°30'46.8"
A 184	22°32' 22.1"	140°10'24.6"
A 185	22°31' 48.6"	140°57'46.8"
A 186	22°43' 35.6"	139°51'57.1"
A 187	22°43' 58.4"	140°34'41.5"
A 188	22°55' 12.3"	139°31'54.8"
A 189	22°56' 40.4"	140°02'05.7"
A 204	22°54' 52.6"	139°54'25.5
Boulia P.O.		

These localities are shown on the 4-mile controlled sheet produced by the Army.

An extensive collection of fossils and rock specimens was made at many localities. The Cambrian and Ordovician fauna is being worked on by Dr. A.A. Öpik and Miss J.G. Tomlinson; notes on the Mesozoic plants are included in Appendix B, the Mesozoic microfossils in AppendixA, and the Mesozoic macrofossils in Appendix C. A representative collection of rock specimens for each formation is stored in the Bureau's Museum, Canberra.

PHYSIOGRAPHY

From east to west the Boulia four-mile area includes the following physiographic units:

1. The plains and the scattered low rises and buttes on either side of the Hamilton River. The plains can be divided into 2 parts -

   (i) the areas covered by brown, grey-brown and grey sandy and clayey soils;

   (ii) the areas covered by similar soils together with rubble derived from the eroded Cretaceous sediments and from the laterite and duricrust capping the Cretaceous sediments.

The areas covered by soil alone/mainly lie near the Hamilton River. They grade into the rubble-covered areas which in turn either grade into low rubble-covered rises or lead up to the scattered buttes.

The plains and low rises slope gently from north to south (749 feet at Toolebuc Homestead in the north and 561 feet at the Dam Bore near Slashes Creek Homestead in the south). The plains also slope toward the Hamilton River.

To the east of the Hamilton River the buttes rise about 150 feet above the level of the plain and are capped by laterite. To the west of the river the height of the buttes above the level of the plain is probably slightly less and the cappings are laterite, and a duricrust formed by silicified Cretaceous sediments and by a breccia of this silicified material (Plate 8, Fig.1). The elevation of the tops of the buttes decreases from north to south (918 feet in the north eastern corner of the four mile area and 868 feet just south of Parisian Creek on the eastern edge of the area), and also westwards.

2. The braided channels of the Hamilton, Burke, Wills and Mort Rivers, which contain alluvial deposits of clay; in the northern part, the Hamilton River contains sand. The Hamilton falls from 722 feet on the Selwyn to Hamilton River road in the north, to 515 feet at Bulla Bulla Waterhole in the south; the fall of the Burke river is from 753 feet at the junction of the Burke and Mort to 518 feet at Boulia.

3. The belt of hills and mountains extending from the Swift Hills in the north to Mt.Datson in the south is formed mainly of Lower Palaeozoic sedimentary rocks. The highest point in this belt is Mt.Unbunmaroo (Black mt.) which is 1290 feet above sea level and about 600 feet above the surrounding plains.

4. The plains on either side of the Burke and Mort Rivers and of Wills Creek. In the north these plains are covered by red sand, soil, and brown sandy soil. In the central and southern parts of the area they are underlain by sandstone of the Marion Formation and Noranside Limestone, and in the southern part of the area their surface is covered by alluvial sand, gravel and pebbles deposited by the Burke River.

These plains slope from north to south (763 feet above sea level at Digby Peaks Homestead in the north to 518 feet at Boulia in the south) and they also slope in towards the streams.

5. The plateau, including and extending west and south from the De Little Range, and the low hills and rises it grades into to the south. The plateau is made up of three units:

(i) The scarps on the eastern and to a smaller degree the western and northern sides, rising about 100 feet above the surrounding plains in the north and diminishing in height to the south. These scarps are strongly dissected and are capped by a duricrust of silicified Cretaceous siltstone and a breccia of this silicified material.

(ii) The low hills and rises between the plateau scarps and the central undissected area covered with rubble of the duricrust capping the Cretaceous elsewhere on the plateau.

(iii) The plains in the centre of the plateau covered with brown and grey-brown sandy soil containing patches of limonite pebbles.

The platform surface slopes from north to south and from west to east. It is 820 feet on the top of the De Little Range, 629 feet at the Old Alderly Homestead and 940 feet on top of the scarp, east of Herrod's Tank. In the southern part of the 4-mile area it merges into low rises covered by brown sandy soil and rubble derived from the Marion Formation.

6. The plains and scattered low rises and buttes on the western side of the Boulia four mile area, and extending into the Glenormiston four mile area. The plains are covered by brown sandy soil and brown clayey soil, and there are some claypans and very small saltpans. The low rises are covered with similar soil and with rubble derived from the Cretaceous sediments, The buttes are either capped by a duricrust or the topmost beds are ferruginous.

The plains slope from 845 feet at Herrod's Tank to 450 feet at Wirrilyerna Homestead.

PREVIOUS INVESTIGATIONS

There have been few specific references to the Boulia 4-mile sheet area, but several geologists have worked in adjacent areas and many of their ideas and conclusions are applicable to this area.

Daintree (1872) produced a reconnaissance geological map of Queensland on which the whole of western Queensland north of the Simpson Desert and south of the Gulf Plains was shown as Cretaceous, except for an inlier of metamorphic rocks forming the Cloncurry Gold-field. He named the Cainozoic Desert Sandstone from a section along the upper Flinders River. Because Daintree referred to the "barren characteristics of its disintegrated soil" as one of the main features of the Desert Sandstone, later workers used the term for lateritic caps formed on rocks of various ages over much of Queensland, before the true nature of the material was recognised. The term has now fallen into disuse because of the confusion it caused.

In the same paper (p.278) Daintree recorded the existence of Tellina in horizontal limestone at the head of the Gregory River on the Barkly Tableland, and stated that the rocks probably "belonged" to the Desert Sandstone.

The next fifty years were marked by great confusion over the ages of the rocks present in the area of north-west Queensland.

Hodgkinson (1877) recorded limestone near the De Little Range "south of the Burke River", but from his map it appears likely that his locality was wrong, and he was possibly referring to the Digby Peaks area on the southern side of the Mort River. He also named the Cairns (now Toko) Range and reported the occurrence of "sandstone, outcrop of limestone in places, nodules of same on plain and giddia flats; porphyrised and ordinary quartz largely impregnated with oxide of iron".

Jack (1885) made a fourfold division of the rocks of the Barkly Tableland and adjacent areas into (a) metamorphosed rocks with some small patches of granite and diorite and some very poorly preserved "corals", (b) unfossiliferous limestones of the Barkly Tableland resting unconformably on the above, (c) Downs formation, containing fossils ranging from "low in the Oolitic to high in the Cretaceous", which he subdivided into a lower marine series and an upper freshwater series, and (d) horizontal Desert Sandstone, "partly a volcanic ash and partly a hardened sandstone". In footnotes to a reprint (1898) he noted that the "corals" in (a) were actually occurrences of the mineral scapolite, and that subsequent palaeontological examination had not substantiated the range of the Downs formation.

Jack (1895a) in discussing artesian water referred to the Desert Sandstone as Upper Cretaceous, lying unconformably on the Lower Cretaceous Rolling Downs "formation", below which was a series of soft grey friable sandstones, grits and conglomerates with partings of sandy shale and calcareous sandstones. These arenaceous rocks which, according to Jack formed the main aquifer in the Great Artesian Basin he named the "Blythesdale Braystones".

In the same year Jack (1895b) quoted Hodgkinson's description of the rocks of the Cairns Range, and correlated them with the metamorphic rocks of the Cloncurry Gold-field.

Between the two areas boring for artesian water had been unsuccessful, so he concluded "that the metamorphic rocks of the Cairns Range are continuous to the Cloncurry area either at or very near to the surface". He described a horizontal limestone which occurred on Carl Creek, Riversleigh, and the summit of which was thought to form the Barkly Tableland. This, the Carl Creek Limestone, he correlated with the limestone containing Tellina described by Daintree (1872) and therefore mapped it as Cretaceous, but noted: "It is quite possible that the Carl Creek Limestone may after all prove to be Lower Silurian; although in that case there remains the difficulty that the occurrence of the Tellina at Rocklands has to be explained away". Jack used "Lower Silurian" for the age now called "Ordovician".

The discovery of Orthoceratites, of probable Ordovician age, from the east side of the Cairns Range was reported by Jack (1897).

Cameron (1901) placed the metamorphic rocks of the Cloncurry area in the Silurian and mentioned that they were unconformably overlain by sandstone and limestone of possible Devonian age. Post-Tertiary limestones containing Helix and Isodara, which he regarded as forming the Barkly Tablelands, were correlated with the Tellina limestone of Daintree (1872), and the Carl Creek Limestone of Jack (1895b).

In Dunstan (1913) p.782, mention is made of "mica in four inch books from the Boulia area, Wills country"; and as Wills country on his map (plate 20) extends north only to Fort William, and in this area no Precambrian or igneous rocks in outcrop are known, the mica occurrence is puzzling, unless it has been carried south from Precambrian areas by streams or aboriginals. The reference is given as "office records of the Geological Survey", but investigation has failed to discover the "records". Also on page 801 reference 6939, Dunstan refers to "opal from the Hamilton River" housed in the Geological Survey Museum; the specimen has not been found and no further information was obtained.

Dunstan (1920) correlated the old rocks of the Cloncurry mineral belt and Cairns Range and mapped them as ?Silurian. The limestones of north-west Queensland were mapped as Jurassic (Artesian Water) Beds because of their position below marine Cretaceous rocks and the occurrence of one specimen of "tree fern trunk" at Curridger (now Cooridgee) Waterhole, 16 miles south-west of Boulia, in rocks which he thought were interbedded with the limestones. Dunstan also recorded the existence of mud springs on the Hamilton River and ascribed them to the escape of water through irregularly crushed or crumpled beds, rather than faulted ones. He also recorded 6-foot seams of brown coal in water bores on Sandringham Station (100 miles south-west of Boulia), and coal from bores east of the Hamilton River near its junction with the Georgina River.

The discovery of Cambrian fossils on the Templeton River (north-west of Boulia sheet) was recorded by Saint-Smith (1924), who suggested a Lower Cambrian age for the rocks containing them. The underlying Mt.Isa Series was therefore assigned to the Precambrian.

The following year, Jensen (1925) in describing the palaeogeography of Queensland, regarded the Cambrian as a period of steady sedimentation with a sea extending from near Lawn Hill and Mount Oxide, west over the Barkly Tableland and the Northern Territory into Western Australia. The rocks, now gently folded, he thought were probably deposited in a shallow epicontinental sea, rich in carbonate of lime. The Ordovician sea probably extended over much of Queensland, but most of the deposits were since eroded. North-west Queensland was land from the Silurian until a shallow muddy sea transgressed most of the area during the Cretaceous. This was followed by a regional uplift early in the Tertiary and the formation of lake deposits to the east of the Barkly Tableland.

The first meeting of the Interstate Conference on Artesian Water was held in 1912 and further meetings were held until 1928. The objects of the conferences were "to take into consideration the question of whether the Artesian Water Supply of Australia was in danger of being seriously diminished and, if necessary, to advise as to the best means of combating that contingency", and to inquire into "the whole question of artesian water supply through bores, with a view to devising some means of utilising to greater advantage those underground stores of water, and at the same time protect the interests of the respective States". At the various conferences summaries of geological investigations and drilling activities were presented, and theories of the origin of artesian water were discussed (I.C.A.W., 1913, 1914, 1921, 1925, 1929).

At about the same time Jensen (1923,p.1260; 1926,p.19) stated that Permian sediments appeared to extend westward beyond the coastal Palaeozoic folded belt to underlie the "Walloons" throughout the Artesian Basin, which he thought was trilobed and centred on Surat. He regarded the Permian sediments as promising strate for oil accumulation and the probable source of many of the petroliferous "shows" of western Queensland water bores.

The marginal formations of the Great Artesian Basin were discussed by Reid (1929), who stated that rocks mapped as "Desert Sandstone" ranged in age from Bowen (Permo-Trias) to Walloon. He also discarded the name "Blythesdale Braystones" because in the Blythesdale-Yuleba area the rocks in outcrop are non-porous, and he therefore regarded them as forming a basal member of the Rolling Downs "formation". Because coal had been found in bores "in the Boulia district" and elseqhere in the Walloon Series he regarded the Walloon Series as forming the north-west margin of the Great Artesian Basin.

Whitehouse (1930) followed Reid in eliminating the "Blythesdale Braystones" and suggested that the Rolling Downs "formation" should include all marine beds of the Great Artesian Basin. In this paper he named the "Templeton Series" of Lower to Middle Cambrian age, consisting mainly of banded cherts, and the Ordovician "Glenormiston Series" of arenaceous and calcareous sediments. He claimed that the two series occurred in two distinct basins with quite different structures.

In 1931 C. Ogilvie forwarded trilobites and other fossils from grey limestones "in and around" the Georgina River basin to Whitehouse for identification, and suggested that the rocks should be called the Georgina Limestones. Whitehouse adopted this name and after identifying the fossils suggested, (Whitehouse, 1931), that there was probably a complete sequence of rocks in the region ranging from the upper portion of the Lower Cambrian into the Ordovician.

In a discussion at the Sydney A.N.Z.A.A.S. meeting, Bryan (1932) regarded the tectonic movements and conditions in the Upper Proterozoic as a prelude to and therefore an integral part of those in the early Palaeozoic. He postulated two kratogens, one in north-west Queensland and the Northern Territory (Northern Massif), and the other in southern Queensland (Eastern Massif). Between was a mobile area which rapidly became welded to the stable blocks. Shallow transgressional seas were probably present temporarily over the stable blocks.

Whitehouse in a series of papers (1936, 1939, 1941, 1945a) identified and described fossils he had collected from the Cambrian and Tremadocian rocks of north-west Queensland. In the first of these papers (1936), he divided the rocks into four series based on lithological differences:

Ninmaroo Series	Limestones	Tremadocian
Pituri Series	Sandstones and shales	Cambrian
Georgina Series	Limestones	Cambrian
Templeton Series	Sandstones and shales	Cambrian

Middle Ordovician rocks previously called the Glenormiston Series (Whitehouse, 1930) were renamed the Toko Series and their contact with the older rocks described as probably faulted.

The three older (Cambrian) series were in turn divided into eleven fossil stages based on trilobite faunas. The divisions were emended in later papers. In the paper of 1939 he increased the number of stages to twelve, adding two new stages and deleting one. In 1940, (p.47) he noted considerable lateral lithological variations and concluded that the Templeton Series was a local non-calcareous variant of the Georgina Series. He later decided (Whitehouse, 1941,p.2, footnote) that the fossil zones were of unequal value and needed to be modified, and gave a provisional reduction in the number of stages.

The Ninmaroo Series is named from outcrops in the Boulia 4-mile sheet area. Referring to these, Whitehouse (1936) stated "On Warenda Station east of Boulia there are three large hills - Black Mountain (Unbunmaroo), Ninmaroo and Mt.Datson. These consist of folded limestones of considerable thickness and identical in appearance with the Georgina Limestones. Platy blue limestones precisely similar to those of the Georgina group abound in the lower part of the section. Higher beds have yielded Eoorthis and a colossal wealth of echinoderm ossicles. For a considerable thickness these beds are so matted with pelmatozoal plates that they form typical echinodermal limestones. This Series I propose to call the Ninmaroo Limestones. In one bed high up in the section on Black Mountain I have found a great wealth of ellesmeroceratid cephalopods, suggesting that these beds belong to the Lower Ozarkian (Lower Tremadocian). I have found no trilobites with them; and the beds so very thick above and below this horizon have not yielded fossils significant for precise correlation. A considerable portion of the Tremadocian no doubt is represented by these limestones". It is obvious from this that Whitehouse intended the term Ninmaroo Limestone (or Series) to cover the full sequence of limestones on Black Mountain, Mt.Ninmaroo and Mt.Datson.

Dealing with the late geological history of Queensland, Whitehouse (1940) postulated the existence of two periods of laterization. The evidence for the second period was mainly the subsequent silicification of (a) the ferruginous zone of the laterite profile, and (b) rocks containing fragments derived from the laterite profile. He recorded the existence of Tertiary limestones in several areas of Queensland, assigning most of them to the inter-lateritic period, and correlating the

Tellina-bearing limestone of Daintree (1872) with them. Some of the great soil thicknesses of the black soil plains he ascribed to a pluvial phase in the Pleistocene.

Whitehouse (1945b) reintroduced the Blythesdale Series (formerly Blythesdale Braystones) for the main group of aquifers at the base of the Rolling Downs "formation"; he also postulated a time break in the Lower Albian between the marine Roma and Tambo Series, but conformity between the Tambo and the overlying non-marine Winton Series. The Roma, Tambo, and Winton Series formed the Rolling Downs "formation" of Jack (1885).

A complete summary of Mesozoic and Cainozoic stratigraphy was given by Whitehouse (1954). He named (p.5) the Boulia Shelf as an extension of shallow bedrock along the western margin of the Great Artesian Basin, and stated that the Blythesdale Group (formerly Series) was the aquifer there, although it did not crop out. The Roma and Tambo Formations (formerly Series) were regarded as occurring along the western margin, although due to its transgressive nature only the Tambo Formation cropped out. The Rolling Downs "formation" of Jack (1885) was renamed the Rolling Downs Group and included the marine Roma and Tambo Formations and the non-marine Winton Formation (formerly Series).

In discussing the line of mound or mud springs Whitehouse (1954, p.15) noted that those near Mt. Datson and Elizabeth Springs (Springvale area) are on the line of Ordovician inliers which extends across the Boulia Shelf. The origin of these was ascribed to water from a lower (Bundamba) aquifer bursting through the thin clay cover over a buried bedrock ridge.

Sites for water bores on Chatsworth and Burnham Stations were investigated by Shepherd (19[illegible]5b), who stated that most of the Cambrian limestones were most unfavourable for water supply. He recorded siliceous shales overlying "Cambrian calcareous shales" and lithologically distinct from either the Cambrian or the Mesozoic rocks. Reference was also made (p.269) to a lead deposit near Chatsworth.

As well as papers by Whitehouse on the Lower Palaeozoic rocks of north-west Queensland, and the later rocks of the Great Artesian Basin, several other summaries of the geology of Queensland were published (Andrews, 1937; Bryan and Jones, 1946 David, 1950; Hill, 1951). These in general were based mainly on Whitehous's work.

Reeves (1951) who investigated the area for Vacuum Oil Co., regarded the oil prospects of the Georgina Basin as "unpromising because of the probability that only the oldest formations occupy the crests of folds and have little thickness". On his accompanying map (p.2516) the position of the Basin is approximately that of the Barkly Tableland, most of which is now regarded as consisting of ? Upper Proterozoic Camooweal Dolomite.

By extrapolation, a gravity "ridge" running south from Cloncurry was postulated by Marshall and Narain (1954) after carrying out a regional gravity survey of eastern Australia.

Öpik (1956a) recorded the results of mapping in north-west Queensland, and, in particular, referred to the area north of the Boulia 4-mile sheet. A complete Middle and Upper Cambrian sequence was established in the Undilla Basin and incomplete sections in the Selwyn Range and Quita Creek areas. In the Chatsworth area, immediately to the north of the Boulia 4-mile area, two limestone formations were found; the Pomegranate Limestone and an un-named one (now called the Chatsworth Limestone). The two form a continuation of the Cambrian rocks mapped by the authors in 1957.

Discussing the Cambrian palaeogeography of Australia, Öpik (1956b) stated that the Cambrian rocks of the Northern Territory and north-west Queensland were deposited in two distinct provinces separated by a meridional divide of ?Upper Proterozoic Camooweal Dolomite, which, although of low relief, was sufficient to separate the two faunas. The divide was effective until the western province ceased to exist in middle Middle Cambrian time.

In an unpublished report Öpik (1957) recorded the results of later work which indicated a Lower Cambrian age for the Mt.Birnie Beds, previously regarded as "sub-Cambrian", and named the Chatsworth Limestone which he had previously (1956a) referred to as an un-named limestone on Chatsworth; he corrected the age of this limestone from "uppermost Upper Cambrian, or even Tremadocian" to probable Franconian age.

Much of the geological results from recent surveys in North West Queensland will appear in The Geology of Queensland Volume of the Geological Society of Australia 1959.

Oil companies showed interest in the area during 1956, and two brief summary reports by Thomas (1957) for Frome-Broken Hill Pty.Ltd., and Rowe and Swindon (1957) for Santos were prepared. Geophysical work was carried out in the Boulia area by the Bureau of Mineral Resources in 1957 and more detailed work will continue in 1958 (Neumann,1959).

A recent summary of the geology and possible petroleum prospects of the western part of the Great Artesian basin is given by Sprigg (1958). He records north-east-trending domed anticlines in the south-west of the State, which are thought to overlie 6,000 feet of fresh water, lagoonal and marine Cretaceous sediments. Seismic work indicates sediments to 12,000 feet; the lower 6,000 feet are thought to include Lower Mesozoic and/or Permian permeable sandstone and middle or lower Palaeozoic sediments including Carbonates of Cambrian-Ordovician age. Folding is probably late Cretaceous to Early Tertiary and the folds in marginal parts of the Basin may reflect basement relief.

STRATIGRAPHY.

USE OF THE TERM "GEORGINA BASIN"

The meaning given to "Georgina Basin" by previous authors is confusing because they have used it to mean either a drainage basin, a region, a general locality name, or a sedimentary basin. A brief resume of the history and meaning of the name is given hereunder. The bracketed term at the end of each reference is the authors' interpretation of the meaning inferred by the use of "Georgina Basin".

Jack (1895) first used the name in the title of his paper when he described early bores drilled for water in the area but no further mention of the name was made. (Geographical).

Whitehouse (1931, p.118) referred to a collection of Cambrian trilobites collected by C.Ogilvie from "grey limestones in and around the basin of the Georgina River". (Drainage Basin).

David (1932, p.118) used "Camooweal Basin" as "the eastern extension of an immense belt of limestone extending from the Western Australian border beyond Wave Hill, North East to near Katherine, in Northern Australia, by way of Daly Waters, Newcastle Waters, Anthony's Lagoon and Alexandria Downs to the sources of the Gregory and O'Shanassy Rivers and thence to Camooweal and Boulia. The term 'Camooweal Basin' may be used to denote the eastern end of this important belt where the water is distinctly moving South East. From Camooweal to Boulia the extensive groundwater from these limestones go to reinforce the water in the intake beds of the Great Artesian Basin near Boulia". On David's map (p.116) it occupies an area of similar position to the Barkly Tablelands. The geological age of sediments in the basin is given as Cambrian to Proterozoic (David 1932, table p.118). (Sedimentary basin). It is appropriate to use Camooweal Basin as that containing sediments of the ?Upper Proterozoic Camooweal Dolomite, which seems to have been deposited in a shallow basin.

Whitehouse (1936 p.64) states "the basin of the Georgina River and most of its main tributaries lie in a great tongue of limestones with a general north-south elongation. To these beds the name Georgina Limestone has been given (Whitehouse 1931)"; a map showing the "geology of the Georgina Basin" is also figured in this report but the Basin is not described. (Drainage Basin).

Whitehouse (1940, p.23) referring to Tertiary limestone deposits mentions their occurrence "in the southern portion of the Georgina River basin". (Drainage basin).

David (1950, p.115) refers to the "Georgina Region" as having an area of 60,000 square miles, partly in western Queensland and partly in eastern Northern Territory, and mostly in the basin of the Georgina River. The boundaries of the region are given in a sketch map (after Whitehouse, 1936) entitled "Geology of the Georgina Basin", which extends from Elkedra to Brunette Downs, to Riversleigh, and south to Boulia. The section on p.116 shows a thickening of sediments between Avon Downs and the Georgina River and "the broad structure appears to be that of a shallow synclinal basin or trough with submeridional axis" and "the total thickness of the beds is quite unknown but must be some thousands of feet". On p.694 the Georgina Basin is referred to informally: "the intensity of folding diminishes considerably to the east, and in the Georgina basin the Cambrian beds, with a thickness of some thousands of feet, rest directly on the Older pre-Cambrian platform and are practically horizontal", but further "the Cambrian strata of the Georgina Region were deposited on a block so rigid that they have remained undeformed till this day". Confusion still obviously exists between basin and region. (Drainage and sedimentary basin).

Reeves (1951, p.2485) classified the Georgina Basin as one with no oil prospects, covering 60,000 square miles and containing 2,000 - 3,000 feet of Ordovician? and Cambrian marine sediments. On his accompanying map the position of the Basin is approximately that of the Barkly Tableland. On p.2523 it is stated that the Georgina Basin has no oil prospects "because of the probability that only the oldest formations occupy the crest of folds and have little thickness". (Sedimentary basin).

Noakes (1952) used "Georgina Valley" as one of two physiographic units which form the Barkly Tableland; the second unit was the Barkly Internal Drainage Basin, which was subsequently referred to as the Barkly Basin, thereby inferring a physiographic and not a sedimentary basin. (Drainage area).

Noakes & Traves (in C.S.I.R.O., 1954, p.39), referring to the Tertiary cycle of erosion, state that the Georgina Basin was "already established as in internal drainage basin and the topography of the Georgina Valley was much as it appears now"; no further mention was made of the Georgina Basin but reference is continually made to the Georgina Valley. (Drainage basin).

Stewart (C.S.I.R.O.,1954, p.43) uses Georgina Basin Division as one of his geomorphological units of the Barkly Region which "is drained by the southward flowing Georgina River and its tributaries. (Drainage basin).

Traves & Stewart (C.S.I.R.O., 1954, p.60) use Georgina Basin as a surface hydrological or drainage unit.

Raggatt (1954), and Condon (1956) both figured the Georgina Basin on a map accompanying their reports, but the basin was not defined in the text. The area covered on their map by the outlines of the Georgina Basin is similar to the topographic unit known as the Barkly Tableland, and their figured Georgina Basin extends further to the north-east than the Camooweal Basin figured by David (1932).

Condon et al. (1957, p.51; 1958,p.60) referring to the Georgina Basin, write that "little is known of the detailed stratigraphy and structure of this basin except where it overlaps the Precambrian of the Mt.Isa - Cloncurry area. There, marine Cambrian and Ordovician sediments fill synclinal areas and plunge off the Precambrian geanticline, thickening away from the Precambrian outcrop. Trace petroleum has been reported from these sediments. The Amaroo Bore is at the western margin of this basin". Also in these reports (p.51 and p.60 respectively) is mentioned the Barkly Basin, which, "apparently shallow, contains Proterozoic and Cambrian sediments, probably marine. Little is known of the details of stratigraphy and structure"; this basin apparently forms part of the Georgina Basin of Condon et al. Öpik (1956a, p.3) points out that the Georgina Series (Whitehouse, 1931) included the Camooweal Dolomite (upper Proterozoic or lower Cambrian) "as well as rocks of the Undilla Basin which do not belong to the Georgina Basin at all", presumably referring to the Georgina drainage basin in the sense of Whitehouse (1931). Öpik (1956b, p.242) refers to the Barkly Tableland (which has been referred to loosely as the

"Georgins area" by some authors) as a "grass plain on the Camooweal Dolomite and adjacent Cambrian rocks....It is sometimes referred to as the 'Barkly Basin' but no basin structure is evident, for Cambrian rocks form a blanket and Camooweal Dolomite is an extended sheet".

Noakes, on a map of "Australia - Elements of Geology and Structure" published in 1958 in lexicons of the Stratigraphy of the Australian States, for the Oceaniana section of the International Stratigraphic Index, includes much of the Barkly Tableland in the "Barkly Basin" containing Adelaidean (Upper Precambrian) rocks, presumably the Camooweal Dolomite; the Cambrian of the Undilla Basin (Öpik 1956a) and Lower Palaeozoic of the Boulia area are not included in the confines of his Barkly Basin.

A brief summary of some references to the Georgina Basin is given by Irving, (1958).

The name "Georgina Basin" still leads to much confusion: but, for the purpose of this report, Georgina Basin is defined as, that area of Cambrian and Ordovician sediments in north-west Queensland and central-eastern Northern Territory which is bounded in the south-west, west and north-west by Precambrian (or Eocambrian), in the north probably by Camooweal Dolomite, in the north-east and east by Precambrian of the Mt. Isa-Cloncurry massif, and in the south-east and south it is covered by Mesozoic sediments of the Great Artesian Basin; it contains several thousand feet of marine calcareous and sandy Cambrian and Ordovician sediments.

The Georgina Basin includes the area near Amaroo, north of the Dulcie Range, and the Cambrian in the Duchess to Chatsworth area, but it does not include the Undilla Basin (Öpik, 1956a) which is probably separated from the Georgina Basin by the Camooweal Dolomite.

A sub-surface ridge of granite, the Lucknow Granite, which has been encountered in water bores drilled between east of Toolebuc and Lucknow Homestead, may either form the south-eastern edge of the Georgina Basin, or it may form a divide separating the Georgina Basin from a possible basin containing Palaeozoic sediments east of the ridge; no evidence exists at this stage to postulate a Palaeozoic basin east of the Lucknow Granite.

GENERAL:

All stratigraphic units described have been approved by the Queensland Committee on Stratigraphic Nomenclature, and the units are named in conformity with the Australian Code of Stratigraphic Nomenclature (A.N.Z.A.A.S., 1956).

Lithological descriptions are given in terms of Condon (1953).

Precambrian rocks are referred to in terms originally defined and used by E.K. Carter (in preparation) and White (196[illegible] Precambrian rocks are described as they are the source and basement of the Palaeozoic and Mesozoic sediments; their possible economic significance has been dealt with by Carter and White.

The Cambrian and Ordovician limestones are lithologically very similar; fossils are necessary to fit isolated rock outcrops into the stratigraphic sequence.

The Cretaceous rock bodies have been given names different from Cretaceous units in the eastern part of the Great Artesian Basin. Should a lithological continuity with any of the eastern units be established, the new names will not be valid. Distinctive macrofossil assemblages such as occur in the Roma and Tambo Formations in their type localities do not exist in the Boulia area; although most of the fossils in the Longsight Sandstone are typical of the Roma Formation, some are Tambo forms. The Wilgunya Formation contains mainly Tambo fossils but also some Roma. The mapped units are lithologically distinct but some show transitional boundaries which are described and illustrated under the relevant sections.

The Tertiary formations were deposited in a lake; the Marion Formation may be in part aeolian.

The general stratigraphy of the area is given in Table 2; field relationships of stratigraphic units are shown in Table 3.

TABLE 2.

STRATIGRAPHY OF BOULIA SHEET

AGE	NAME	THICKNESS (IN FEET)	OUTCROPS	TOPOGRAPHY	LITHOLOGY	STRUCTURAL RELATIONSHIPS	FOSSILS
Quaternary	Soils	Up to 40	Extensive	Good grass lands in most cases.	Sand alluvium, brown loam, black limestone soils.	As mantle over older formations	None collected.
Tertiary	Noranside Lst. (New Name)	40+	Burke River near Noranside, Corrie Downs, Fort William.	Forms black soil plains.	Limestone, marl, chalcedony.	It overlies Marion Fm. and lateritised Cretaceous sediments; it is not affected by lateritisation.	Gastropods, ostrocods, algae, diatoms.
	Marion Fm. (New Name)	50	Lower part Burke R. on Two rivers, Strathelbiss, Badalia Stations.	Forms pebbly residual plains.	Sandstone, conglomerate, sandy siltstone.	Overlies lateritised Wilgunya Formation.	Fossil conifer wood.
Lower Cretaceous	Wilgunya Fm. (New Name)	Up to 1140	It extends from the west boundary of the Sheet to the De Little Ra. and Wills Ck., on Burnham Station and east of Black Mountain, from the head of Momedah Creek to east boundary of Sheet.	Forms mesas up to 100 feet high; the mesas in east have ferruginous ironstone slopes and grassy plains at base. Form low lateritised scrubby hills in north.	Siltstone, probably radiolaria-bearing, sandy siltstone, blue claystone, glauconitic sandstone, some sandy beds, gypsum. Tops of mesas silicified.	Is silicified and lateritised, unconformably overlies Precambrian, conformably overlies Longsight Sandstone. Overlain disconformably by Marion Formation.	Gastropods, foraminifera, ?radiolaria.
	Toolebuc Member	30	In a bed parallel to and on east side of the Hamilton River	Grassy plains with boulders and concretions.	Calcareous sandstone and siltstone, limestone, concretions rich in fossils.	As a member of the Wilgunya Formation.	Pelecypods, gastropods forams, radiolaria, fish scales, teeth vertebrates,
	Longsight Sandstone (New Name)	100± exposed 200 bore data	From Herrods Tank to Stockport Stn. on Datchet Downs, Burnham Stn., east side Black Mt., head of Momedah Ck.	Forms ferruginised rubble plains or as prominent bench below overlying siltstone formation.	Sandstone, conglomerate, sandy siltstone.	Unconformably overlies Precambrian and Ninmaroo Limestone; overlain by Wilgunya Formation.	Pelecypods gastropods, foraminifera, plants.
Post Lower Ordovician	Digby Peaks breccia. (New Name)	50	Digby Peaks small outliers near Swift Hills.	Prominent capped mesas.	Silicified breccia of mainly chert fragments.	Overlies Ordovician Swift Formation. It is silicified and lateritised.	
Lower Ordovician	Swift Formation (New Name)	60	Swift Hill, Digby Peaks, west side of Black Mountain.	Hills protected by silicified cap of chert breccia which is normally less than 5 feet thick.	Silicified siltstone chert, sandstone, silicified calcarenite. (places	Unconformably overlies Ninmaroo Limestone in capped by a "subsoil" breccia of which Digby Peaks Breccia is a particular case.	Trilobites, brachiopods nautiloids.
	Ninmaroo Lst. (Whitehouse 1936)	2000±	Digby Peaks, Signal Hill, Cottonbush Ck., Alderley, Black Mt. (E.& W.side), Mt. Ninmaroo, Mt.Datson.	Hills and benches spinifex covered; forms sink holes and rough clay soils.	Calcarenite, intraformational breccia, calcilutite, dolomite, two-tone limestone.	Overlain by Swift Fm., or by Mesozoic formations; underlain by Upper Cambrian Chatsworth Limestone.	Nautiloids, brachiopods, echinoderm, gastropods ribeirioids

Upper Cambrian	Chatsworth Lst. (New Name)	1000±	Core of Black Mt., near Chatsworth Stn.; Mt.Ninmaroo, Mt.Datson and near Dribbling Bore,	Low spinifex covered hills and benches or open plains.	Calcarenite, calcilutite, some intraformational breccia	Conformably overlies the "Pomegranate Limestone" and overlain by Ninmaroo Limestone.	Agnostid trilobites, brachiopods.
	Gola Beds (New Name)	150	Near head of Momedah Creek.	Low spinifex and turkey bush covered rises.	Calcarenite, calcilutite.	Not known yet but about time level of Chatsworth Limestone; unconformably overlain by Mesozoic.	Trilobites brachiopods.
	O'Hara Shale (Opik, 1956)	40	De Little Ra., and south of Buckingham Downs.	Lateritised rises and at base of Cretaceous hills.	Shale, chert, sandstone.	Overlies "Pomegranate Limestone" and is unconformably overlain by Cretaceous sediments.	Sponge spicules.
	"Pomegranate Lst." (Öpik, 1956).	50 (probably 300 in bores)	De Little Ra., near Rocky Tank and in bores on Buckingham Downs.	Low turkey-bush rises or black soil plains.	Calcarenite, calilutite, chert nodules.	Underlying O'Hara Shale or Cretaceous sediments base not exposed but on Duchess Sheet it overlies Selwyn Limestone	Agnostid, trilobites. Brachiopods, Fauna similar to Georgina Limestone of Whitehouse (1931)

Middle Cambrian and Lower Cambrian rocks in section only and do not crop out in the Boulia area.

Precambrian. Metamorphic sediments, volcanics and granite dealt with in text.

TABLE 3.

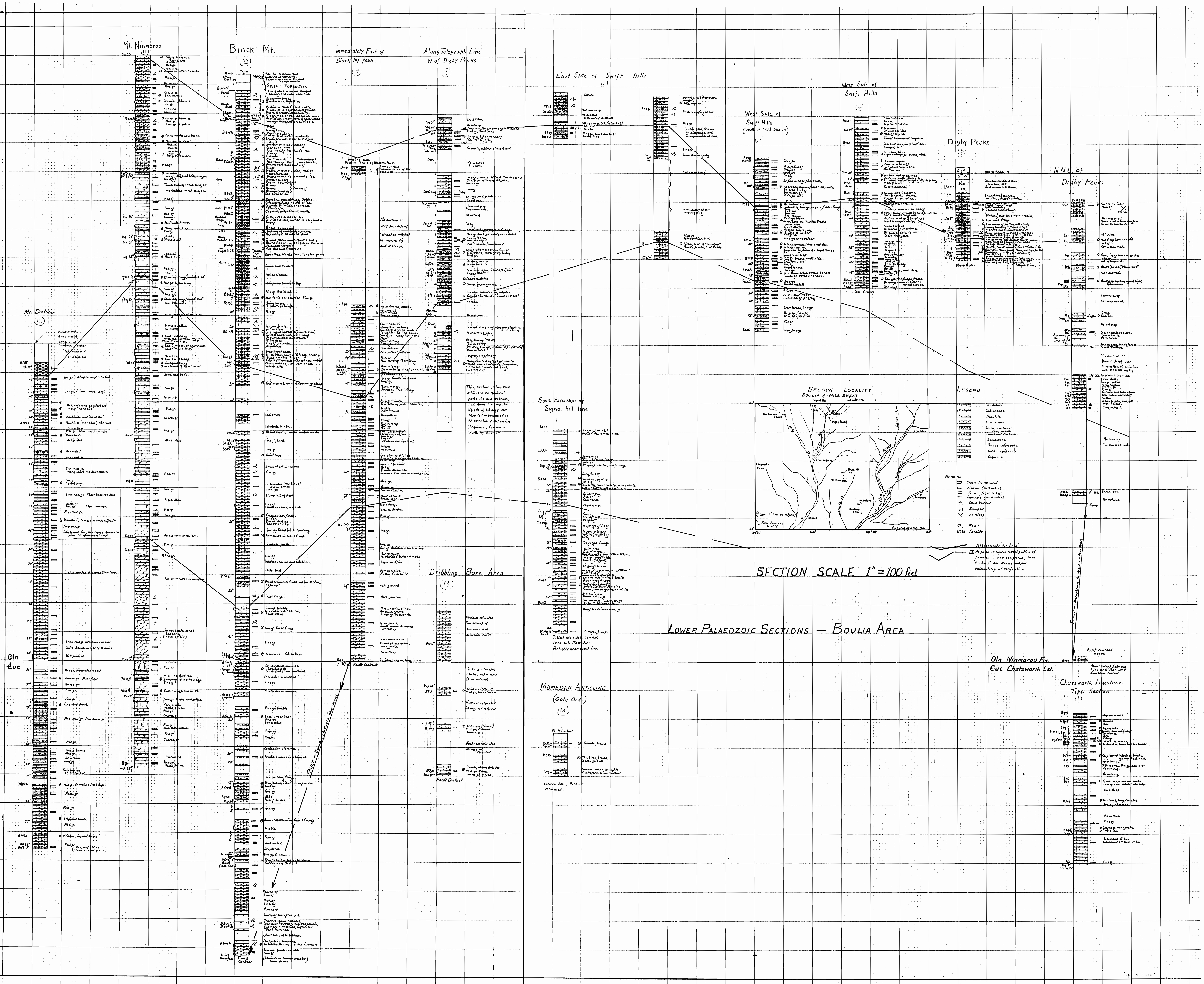
CORRELATION OF MESOZOIC AND PALAEOZOIC UNITS

NORTH WEST QUEENSLAND

Table 3 ahows the correlation of units in the Boulia area with those of other areas in, and forming the margin of, the Great Artesian Basin.

AGE	BOULIA	SELWYN RA. DUCHESS	GLENORMISTON AND QUITA CREEK	GREAT ARTESIAN BASIN
ERTIARY	Noranside Lst. Marion Fm.		Austral Downs Lst. Marion Fm.	Eyrian Series
ETACEOUS	Not recognised Wilgunya Fm. Toolebuc Memb. Longsight Sst.	Not known Undifferentiated	Not known Wilgunya Fm. Longsight Sst.	Winton Fm. Tambo Fm. Roma Fm. Blythesdale Fm.
OWER RDOVICIAN	Swift Fm.	Swift Fm.	Kelly Ck. Fm.	
PPER AMBRIAN	Ninmaroo Lst. Chatsworth Lst. Gola Beds O'Hara Shale Pomegranate Lst.	Ninmaroo Lst. Chatsworth Lst. O'Hara Sh. Pomegranate Lst.	Ninmaroo Lst. O'Hara Sh. Georgina Lst. Mungerebar Lst.	NO RECORD
PPER IDDLE AMBRIAN	No record. Probably complete section.	Selwyn Lst. Devoncourt Lst. Roaring Siltstone ? ? Inca Fm. Beetle Ck. Thorntonia Lst.	Steamboat Lst. Quita Fm. Blazan Shale Beetle Ck. Thorntonia Lst.	
OWER AMBRIAN	No record	Mt.Birnie Beds.	Sun Hill Arkose Riversdale Fm.	

..e Cambrian of Selwyn Range and Quita Creek areas in part after Öpik (1956a).


Mt. Ninmaroo
Black Mt.
Immediately East of Black Mt. fault.
Along Telegraph Line W. of Digby Peaks
East Side of Swift Hills
West Side of Swift Hills (South of next Section)
West Side of Swift Hills
Digby Peaks
N.N.E. of Digby Peaks
Mt. Datson
SWIFT FORMATION
DIGBY BRECCIA
Moot River
This section, about 200 ft estimated on general photo dip and distance, has good outcrop, but details of lithology not recorded — presumed to be essentially calcarenite sequence. Covered in north by alluvium.
No outcrop or very poor outcrop
Estimated without an average dip and distance.
South Extension of Signal Hill line
Dribbling Bore Area
Momedah Anticline (Gola Beds)
Chatsworth Limestone Type Section
Section Locality
Boulia 4-mile Sheet
Legend
Calcilutite
Calcarenite
Dolutite
Dolarenite
Intraformational conglomerate
Intraformational conglomerate
Sandstone
Sandy calcarenite
Oolitic carbonate
Coquinite
Bedding
Thick
Medium
Thin
Laminate
Cross bedded
Slumped
Jointing
Fossil
Locality
Approximate "tie lines"
As palaeontological investigation of samples is not completed, these "tie lines" are drawn without palaeontological verification.
SECTION SCALE 1" ≡ 100 feet
LOWER PALAEOZOIC SECTIONS — BOULIA AREA
Oln Ninmaroo Fm.
Єuc Chatsworth Lst.
Oln
Єuc
Fault contact
Fault Contact

PRECAMBRIAN:

Formations of Lower and Upper Proterozoic age outcropping in the northern part of the Boulia 4-mile sheet area are being described in detail by Carter, Brooks and Walker (in preparation) and by White (1960). The names are used on the Urandangi and Cloncurry 4-mile Sheet maps issued in colour in 1958. This report therefore includes brief notes only on the formations in the Boulia area. The only Precambrian rocks which have not been correlated with rocks described from the north are the "granites" reported in bore logs. Cuttings from a driller's interpretation of "granite bedrock" in an un-named bore about four miles east of Kheri Outstation are granitic. Subsurface "granite bedrock" has been reported at several places in the eastern part of the Boulia area and also south and south-west of the area.

Argylla Formation.

The Argylla Formation is published on the Cloncurry 4-mile Sheet issued in 1958 and extends in a zone 1½ miles wide from north of the area towards Sulieman Creek on Buckingham Downs Station. Outcrop is bounded on the west, and perhaps on the east by faults which have the same trend as the cleavage, generally between 145° and 155°. On Buckingham Downs the formation is composed of lavas and pyroclastic rocks. Carter et al. describe the lavas of this formation as mainly meta-rhyolites, with some meta-dacites and meta-basalts. The pyroclastic rocks near Buckingham Downs are green fine-grained to very coarse-grained tuffs. They have been altered at contacts with rhyolitic rocks in the eastern part of the outcrop zone.

Vertical and steeply dipping gneiss and schist crop out below sediments (mapped as ?Cretaceous) about two miles north-west of Buckingham Downs homestead. They probably belong to the Argylla Formation; cleavage directions, 155°- 160°, are similar to those of the volcanic rocks farther north, and similar rocks occur elsewhere in the formation.

Eastern Creek Volcanics

The name is published on the Urandangi 4-mile Sheet issued in 1958. The southern margin of outcrops of the Eastern Creek Volcanics reaches the northern edge of the Boulia area, 1½ miles west of the Boulia-Dajarra Road (just north of Sulieman Creek). A small inlier of quartzite, two to four miles south-south-west of this outcrop, probably belongs to the formation, as the lithology is very similar to that of outcrops to the north.

Carter et al.(in preparation) consider that the Eastern Creek Volcanics, which in the type area ($1\frac{1}{2}$ - 4 miles east of Mt.Isa) consist of interbedded volcanics and quartzites with some limestone and shale, becomes predominantly quartzite toward the south, i.e. in the Boulia Sheet area. He considers also that the absence of metabasalt in the north edge of the Boulia Sheet is caused by it's lensing out to the south. Silicified sandstone and quartzite with schistose cleavage are the main components of the formation in the Boulia area. They are in part ferruginous. Cross-bedding and ripple marks are preserved in some places. A metamorphosed conglomerate occurs just north of the margin of the Boulia area; altered pebbles are elongated north-south, in the direction of the main cleavage.

Dips in the sandstone at the northern edge of the Boulia area range from 20° to 50°; main dip directions were to south and west. The main dip of sediments of the inlier appeared to be 42° to the east.

Kuridala Formation

The name was originally proposed by White in 1956, but was formally named by Carter (1959) and will be fully described by White (1960). It is named for rocks in the Kuridala area (latitude 21°17'S, longitude 140°30'E), 17 miles north of Selwyn. Rocks of the formation continue south to the north-eastern margin of the Boulia 4-mile area, where they crop out in steep rocky ridges.

The dominant rock type is quartz greywacke, with interbedded laminated siliceous quartz siltstone. The siltstone forms about one-fifth of the sequence. Towards the east-side of the outcrop pegmatites are abundant and have thermally metamorphosed the intruded rocks to muscovite schist. Irregular quartz-tourmaline veins, mostly less than twenty feet long and two feet wide, and small irregular quartz veins are common in the pegmatite zone. One quartz-tourmaline vein 100 yards long and six feet wide was recorded.

The quartz greywacke is medium-bedded and fine-grained to coarse-grained, grading in places to quartz-pebble conglomerate. The rock is composed of sub-angular to rounded grains of quartz set in a finely crystalline sugary quartz matrix, commonly containing angular feldspar grains.

The pegmatites are composed of quartz, feldspar, and muscovite, with some tourmaline. They are usually small and irregular, ranging from a few feet to 100 feet long and six inches to six feet wide. Trends are roughly parallel to the bedding and to major joints.

To the west the rocks lie in open folds along axes trending north-north-east and pitching to the north at 20° to 70°. The beds dip at 60° to 70°. Folding is tighter to the east. Foliated schists with marked lineation are common.

No estimate of thickness was made in the Boulia 4-mile area, but in the type area the formation is approximately 7,000 feet thick and is believed to thicken southwards(White, loc.cit.1960). The formation is assigned to the Lower Proterozoic by White.

Kalkadoon Granite

Small scattered outcrops of granite between Wills Creek and the Argylla Formation on Buckingham Downs Station are probably part of the Kalkadoon Granite. They extend south almost to the junction of Sulieman Creek with Wills Creek. A sharp unconformity or fault apparently delineates the eastern margin of the granite, as the granite crops out in small rises extending west from the west bank of Wills Creek; but it has not been found in the Four Mile Well, 4 miles north of Buckingham Downs homestead, which is a well in the bed of Wills Creek drilled to 200 feet. The rocks from this well were chocolate and light grey, fine to coarse grained arkosic greywacke. They are known to a depth of 83 feet in the well itself and possibly to 200 feet in the bore sunk in the bottom of the well; the driller recorded that the bore penetrated "red sandstone" to the bottom. The greywacke may be part of the Makbat Sandstone discussed below.

The lithology of the Kalkadoon Granite or informally "granodiorite" is described in detail by Walker in Carter et al. (in preparation) and is therefore not discussed in this report.

Makbat Sandstone

The Makbat Sandstone has been named and defined by Carter (1959), and will be fully described in Carter et al. (in preparation).

The formation crops out two miles north of Buckingham Downs, where it forms the hills on the eastern side of Wills Creek.

One of the best outcrops is on the west side of these hills where the following 50 feet plus of exposure is described:-

Top 10+ Quartz sandstone: fine to medium-grained, red, massively bedded, and contains $\frac{1}{8}$" to 1" diameter mud balls; in places becomes feldspathic. These beds grade southwards into a brown siltstone.

20 Quartz sandstone: coarse grained with pebble bands.

15 Conglomerate: with rounded pebbles and cobbles of quartzite, quartz greywacke, amphibolite and white quartz with haematite; matrix is coarse-grained and sub-angular quartz sandstone.

Base 5+ Quartz sandstone: medium to coarse-grained, white and red, thin bedded and laminated; feldspathic or ferruginous matrix. Contains oscillation ripple marks and 6" to 1-foot thick cross-laminated beds.

The formation occurs in a syncline. On the western side its lower part is covered by the alluvium deposited by Wills Creek, but on the eastern side the formation and structure seem to abut the Kalkadoon Granite. No evidence of contact metamorphism was seen along this boundary, and as the sediments near it are strongly jointed and contain small veins of quartz, it is thought to be a fault.

Carter et al. consider that the Makbat Sandstone is Upper Proterozoic, but Öpik (personal communication) thinks that it may be part of the Lower Cambrian Mt Birnie Beds which occur in the central part of the Duchess Sheet area, 20 miles to the north-north-east.

SUB-CAMBRIAN OR LOWER CAMBRIAN

Mt Birnie Beds.

The Mt Birnie Beds were mapped by Dr. A.A. Öpik in 1956 as "Subcambrian"; they crop out on the Duchess 4-mile Sheet area near Mt Birnie, Mt Bruce and Mt Aplin. The Beds are now regarded by Öpik (1957) as definitely of Lower Cambrian age as they contain trilobite tracks and Diplocraterion similar to the Lower Cambrian D.lyelli. The unit consists of 30 feet of siltstone, overlain by 100 feet of dark brown greywacke, followed by 50 feet of green siltstone, then 20 feet of quartz conglomerate and quartz sandstone, capped by 20 feet of quartz greywacke and ferruginous sandstone. Some of the siltstone is reported to be slightly radioactive.

The Mt Birnie Beds are similar to the Makbat Sandstone, although the Makbat Sandstone is more silicified and indurated; the outcrops are not continuous between the two localities and separate names are retained.

Although the Mt Birnie Beds do not crop out in the Boulia area, they may be important as a subsurface unit underlying the Cambrian and Ordovician limestones in the Boulia area.

The Mt Birnie Beds unconformably overlie lower Proterozoic granite and metamorphic rocks; they are overlain by the lower Middle Cambrian Thorntonia Limestone and are separated from it by an erosional unconformity (Öpik, 1957).

MIDDLE CAMBRIAN

Middle Cambrian rocks do not crop out in this area but probably occur at depth. Outcrops have been mapped by Dr. A.A. Öpik on the Duchess 4-mile Sheet area to the north, and on Glenormiston and Urandangi Sheets to the west and north-west.

Öpik (1956a and 1957) has described a sequence of marine bituminous limestone and shale, rich in fossils. The total thickness is about 2,000 feet in the outcrop areas but the subsurface thickness in the Boulia area is not known.

UPPER CAMBRIAN

Pomegranate Limestone

The following information about the Pomegranate Limestone was provided by A.A. Öpik (written communication). "This name was used in unpublished reports between 1954 and 1956. It was published as Pomegranate Limestone (informal spelling) in Öpik (1956a, p.23). The reasons for the informal usage were 1) insufficient information as regards the rocks below and above; (2) absence of a convenient section displaying the lithology and thickness owing to the subhorizontal altitude and undissected topography; (3) the probability of its being the Georgina Limestone.

"It is now evident that in the type locality at the heads of the Pomegranate Creek, Duchess 4-mile Sheet, on a surface of about 300 square miles, the Pomegranate Limestone is outcropping and has a conformable contact with the O'Hara Shale above. This shale is preserved as extended and numerous cappings. The base of the Pomegranate Limestone is not exposed and remains subsurface. The thickness of the limestone in single outcrops is 20 to 25 feet. Considering local rolling and small faults the total exposed thickness is about 100 feet and represents the upper portion of the formation.

"The rocks are: grey fine-grained limestone (calcilutite), 10 feet in thickness, at top of the sequence. Below follow beds of thin bedded bituminous, and fissile laminated limestone with softer, marly, interbeds. Interbedded are sporadic intraformational breccias of the same material.

"The area of Pomegranate Limestone next in size, on Duchess Sheet, is south east of Pomegranate Creek (D120, p.121). This is the most accessible outcrop and therefore commonly visited by geologists. It is about three square miles, with about half outcrop. It contains important fossils (Olenus below, and Irvingella and Pterocephalia above). The limestone is capped here by the O'Hara Shale. Below follows (1) dense entitic limestone, banded grey and pink; it rests on (2) bituminous bedded limestone with one interbed of intraformational breccia followed/below by (3) dark marly limestone with two or three layers of ellipsoids. This bed contains Olenus. The total thickness, combined from all outcrops, is about 60 to 70 feet. The base is not seen.

"On the Boulia sheet area Pomegranate Limestone occurs only in the north-west in the De Little Range. I examined it in 1954 ("Opik 1956a, p.23) and referred to it as Pomegranate Limestone. Exposed are ~~40~~ 50 feet of the top of the sequence. Its fossils however, indicate that it is older than the rocks in the main outcrops on Duchess Sheet. This is explained by the fact that Pomegranate Limestone is thinning northward and westward and replaced by the O'Hara Shale. It is probable that the shaly, sandy and chert beds overlying the "Pomegranate Limestone" at De Little Range is an extension of the O'Hara Shale.

"The probability of the Pomegranate Limestone being an extension of the Georgina Limestone rests with the following considerations: (1) the limestone on the Mt.Whelan 4-mile Sheet area that may be the ill-defined and always misused "Georgina Series" contain the same fossils as the Pomegranate Limestone, that indicates a contemporaneity of deposition; (2) the lithologies are comparable, but not obviously identical.

"However, the meaning of what is the Georgina Limestone is still open: it has been always used as a time-rock term with a very variable time span and never defined properly. It seems, therefore, inappropriate to apply this name to a better known lithic sequence by which the meaning of "Georgina Limestone Series" will be defined in other than the original terms. The distance between the outcrops at the Pomegranate Creek and the outcrops on Glenormiston Station within the boundaries of which the Georgina Limestone Series occurs is about 150 miles. Over this distance no evidence of continuity is present, and only correlation by fossils is possible. For this reason the name Pomegranate Limestone should be used for rocks on Duchess and Boulia Sheets to denote the particular formation for which this name was proposed, and not be replaced by an older name the meaning of which is not clear. Moreover the error in introducing a possible synonym is small when compared with the 'pretence of knowledge of identity' that results when one name (Georgina) is applied for rocks that are separated by a great distance.

."To sum up, the Pomegranate Limestone is a limestone formation in the Duchess and Boulia areas resting below the O'Hara Shale and without its base exposed on the surface. Only the upper portion is exposed and it does not exceed one hundred feet in thickness. The rocks consist of bituminous limestone interbedded with marly limestone and with sporadic intraformational breccias. Its age is lower third of the Upper Cambrian, but varies from place to place, because of its being in parts replaced by the O'Hara Shale. The name is derived from the Pomegranate Creek on the Duchess 4-mile Sheet area. The main outcrop areas are the heads of the Pomegranate Creek and south-east of Pomegranate Creek.

"Considering that all surface occurrences of the Pomegranate Limestone are now mapped, its rocks studied, its age determined by fossils and the thickness estimated as seen on the surface, a formal status (Pomegranate Limestone)for it is suggested".

The inliers of Pomegranate Limestone crop out at the base of the De Little Range and south of Buckingham Downs on the southern side of Valley Creek between latitudes 22°04'S. and 22°20'S. and longitudes 139°36'E. and 139°53'E., in creeks and gullies and on the sides of low rises, which are in places capped by the O'Hara Shale. These rises contrast with the scarps formed by more resistant overlying formations.

Near the Bluff at De Little Range, more than 50 feet of the top of the unit is exposed; it consists of soft, thin-bedded grey and brown-grey fossiliferous marl and sandy marl, with lenses or beds up to four feet thick of hard, thin-bedded, brown-grey and grey calcilutite, some of which contain chert blebs and nodules. In a measured section of 45 feet only twelve feet was of these harder lenses or beds.

Similar rocks crop out on the southern side of Valley Creek, near the road from Buckingham Downs to Buckley's Tank, where a thin bed of grey and light grey calcilutite occurs near the top of the unit.

Lower parts of the unit are covered by alluvium. A dry bore sunk one mile north of Buckley's Tank struck blue limestone at 95 feet and continued in it to 346 feet, where the hole was abandoned. Part or all of this limestone is probably the Pomegranate Limestone.

The Pomegranate Limestone on the Boulia Sheet conformably underlies the O'Hara Shale. The contact is well exposed south of Valley Creek on the western side of the road to Buckley's Tank from Buckingham Downs.

In places near the southern end of The Bluff, the O'Hara Shale is missing and the Pomegranate Limestone is overlain by the Lower Cretaceous Wilgunnya Formation, leached and silicified. The Wilgunya Formation has been deposited on a pre-Cretaceous erosion surface.

Öpik (1956a, p.23) has determined Glyptagnostus reticulatus, Clavagnostus, Homagnostus, Eugonocare, and an "Elvinia?-like trilobite" from a locality in the Pomegranate Limestone near the Bluff. He states that at Pomegranate Creek on the Duchess Sheet area, the "fauna corresponds to the Glyptagnostus-Stage at Glenormiston, or to the Olenus truncatus and O.gibbosus zones of Sweden, and is lower Upper Cambrian".

O'Hara Shale

The O'Hara Shale consists of siltstone, silty sandstone, chert, and conglomerate, conformable on the Pomegranate Limestone and unconformably overlain by Cretaceous sediments.

The formation was named by Opik (1956a) from O'Hara Gap Station on the Duchess 4-mile Sheet, latitude 21°25'S., longitude 140°05'E. It "consists of shale with interbeds of chert and sandstone and is lithologically similar to the Pituri sandstone and shale of the Glenormiston area. The O'Hara Shale rests on the Selwyn Range Limestone, which is believed to be Middle Cambrian, and the formations are separated by a diastem. About 10 feet above the base of the shale a chert layer contains an undescribed fauna which is essentially Upper Cambrian with some upper Middle Cambrian forms". (Opik 1956a. p.22). The thickness is given as 200 feet (Opik, 1956a.p.15).

The O'Hara Shale crops out along Wills Creek and Valley Creek in the north-west corner of the Boulia four-mile area between latitudes 22°12' and 22°20'S. and longitudes 139°43' and 139°53'E. Sediments which are probably part of the formation crop out along Valley Creek and Sulieman Creek on the western side of the Boulia-Dajarra Road.

Mostly the formation caps low rises. In places along the eastern edge of the De Little Range the O'Hara Shale crops out at the base of the scarp formed by the Cretaceous sediments. On the southern side of Valley Creek near the road from Buckingham Downs homestead to Buckley's Tank the bottom part of the formation forms part of a scarp 30 to 40 feet high. It consists of 30 feet of laminated siltstone, the lower 15 to 20 feet of which is dark brown and the remainder purple, fractured and weathered. Well-rounded pebbles up to 6 inches long of quartz, coarse-grained quartz sandstone, and fine to medium grained ferruginous quartz sandstone occur in the middle 5 to 10 feet of the section. The top of the formation has been eroded away.

Further south near the middle of The Bluff, the top 30 feet of the formation is exposed. It is brown laminated siltstone, red and yellow brown laminated very fine-grained silty sandstone, and thin chert beds. Well-rounded pebbles up to 6 inches long are scattered throughout. The bottom of the formation and its junction with the Pomegranate Limestone are obscured by about 15 feet of rubble, sothat the O'Hara Shale is less than 45 feet thick.

On the road from Buckingham Downs homestead to Buckley's Tank, the O'Hara Shale conformably overlies the Pomegranate Limestone. A mile and a half east of this locality the Shale is unconformably overlain by the Marion Formation. Further south, at The Bluff, the Shale is unconformably overlain by Lower Cretaceous sediments; in places the Shale was stripped before the Lower Cretaceous sediments were deposited.

Sponge spicules have been found in chert from the section near the middle of The Bluff. Dr. Öpik (personal communication) considers the spicules to be of Cambrian age, and as the O'Hara Shale overlies the Pomegranate Limestone, which is Upper Cambrian, it is also regarded as Upper Cambrian.

<u>Gola Beds</u>. (New Name)

The Gola Beds are the fossiliferous calcarenite and calcilutite beds cropping out along the Momedah Anticline. The base is not exposed and the top is concealed beneath Cretaceous sediments that unconformably overlie the Gola Beds.

The Gola Beds are named after the County of Gola, because they crop out near the western margin of that County, 46 miles north-east of Boulia at latitude 22°30'S and longitude 140°30'E. The rocks form two small elongated inliers along the Momedah Anticline and occur as low rises covered with turkey-bush. The outcrops are mainly soil-covered, but many beds of calcarenite protrude; the best outcrops are where the dips are greatest near the steep limb of the asymmetrical anticline.

The exposed sequence is estimated to be 150 feet thick. Fine-grained calcarenites and some calcilutites with few thin beds of intraformational breccia (See Plate 1, Fig. 3), were the only rock types observed. The base is not exposed, and sandstone and conglomerate of the Cretaceous Longsight Sandstone rests unconformably on the eroded surface of the beds.

Structure in the Gola Beds is dominated by the post-Cretaceous folding which formed the Momedah Anticline, but at the extreme north of the northern outcrop, dips indicate that this anticlinal structure has been superimposed upon an earlier anticlinal fold, in the limestone, the eastern flank of which dips at about 5° to the north-east. The western side of the fold has been faulted: downthrow is to the west.

Numerous trilobites and brachiopods, including a rich agnostid fauna, were found. Preliminary determinations by Dr. Öpik indicate that the Gola Beds occur near the top of the Upper Cambrian. The relation with the Chatsworth Limestone at the base of Black Mountain is not yet clear, for the faunas are not similar. The Gola Beds probably are equivalent to a poorly fossiliferous part of the Chatsworth Limestone as developed at the base of Black Mountain below the Ninmaroo Limestone, but further work is necessary on the fossil collections of both areas before final conclusions may be drawn.

<u>Chatsworth Limestone</u> (New name by A.A. Öpik).

The Chatsworth Limestone is the formation, consisting of calcarenite and calcilutite with minor calcareous sandstone and coquinite, that rests unconformably on the O'Hara Shale and is overlain by the Ninmaroo Limestone.

The Chatsworth Limestone was named by Öpik (1957) from outcrops on Chatsworth Station in the Duchess and Boulia 4-mile Sheet areas. It had previously been referred to (Öpik, 1956a) as an un-named limestone on Chatsworth. A.A. Öpik has provided (written communication) the following notes:

"The name "Chatsworth Limestone" has not been published previously. It was first used as a field name in 1957 by the Georgina Geological Party (J.N. Casey et al.)

"The history of the concept is as follows: in 1954 I observed that in the Duchess 4-mile Sheet area between the Pomegranate Creek and Chatsworth several flat outcrops of limestone occur that are lithologically different from the bituminous Pomegranate Limestone, and separated from the latter by a sequence of siliceous shale and chert now recognised as the O'Hara Shale. These limestones and their fossils are mentioned in Öpik (1956a, p.23) as "the unnamed limestone" and an uppermost Upper Cambrian, and even Tremadocian, age was assumed. The correct age is Franconian (middle Upper Cambrian).

"The designation "unnamed limestone" was employed because from my reconnaissance in 1954 it became apparent that the main development of this formation should be studied on the Boulia 4-mile sheet in outcrops south of Chatsworth.

"In 1957, in the field, I outlined to J.N. Casey et al my concept of a large Upper Cambrian calcareous formation whose lower part is exposed in the Duchess Sheet area. It was jointl agreed to name the unit "Chatsworth Limestone".

"As regards the occurrence of the Chatsworth Limeston on the Duchess Sheet, the following should be mentioned:

1. A direct contact of the base of the Chatsworth Limestone with the O'Hara Shale is not exposed, but the superposition is evident from the map.
2. The lowermost, and most northern outcrops of Chatsworth Limestone are bedded impure limestones with ripple marks, about seven miles north of Chatsworth.
3. The fossils used for the age determination occur at the locality about four miles north-west from Chatsworth.
4. The rocks and fossils of this locality permit a correlation with the lowermost beds of the main section south of Chatsworth.
5. On Duchess Sheet area, east from Mt.Murray, the Chatsworth Limestone rests with a break on Middle Cambrian, and is apparently overlain by the Ordovician Ninmaroo Limestone (here dolomitic) with a break in between.
6. The Chatsworth Limestone on the Duchess Sheet area is represented by light coloured limestone beds alternating with soft marly layers. Intraformational breccia occur sporadically. In coarse-grained crystalline limestone beds calcite occurs as colourless grains mixed with much brown calcite.
7. Chatsworth Limestone contains only thin and rare bituminous dark layers, which prevail in the Pomegranate Limestone".

The type section is in the Boulia 4-mile area ten miles east-north-east of Digby Peaks Homestead, at latitude 22°03'S., longitude 140°18'E.

On the Boulia 4-mile area The Chatsworth Limestone crops out in the type area, where it forms low, rounded, spinifex covered, rocky hills on which the limestone crops out as benches; and at the base of Black Mountain, Mt.Ninmaroo, Mt.Dalton and at the outcrop near Dribbling Bore.

The type section near Chatsworth and the chain of outcrops at Black Mountain, Mt.Ninmaroo, Mt.Dalton and Drilling Bore are all predominantly grey and dark grey calcarenite and calcilutite, but the detailed fossil examination by Dr.Öpik is not yet far enough advanced to show either fossil similarity or a time break between the faunas of all or any of the outcrops.

At the present state of knowledge it is more appropriate to make all these outcrops part of the one formation.

In the Boulia 4-mile area the Chatsworth Limestone consists of fine-grained calcarenite, in places sandy, and calcilutite, with minor beds of calcareous sandstone, intraformational breccia and coquinite. As the outcrop is not a continuous sequence it is suspected that the formation includes some non-outcropping beds of marl or shale. The rocks are dominantly thin-bedded and laminated with some cross bedding.

The type section is 10 to 12 miles north-east of Digby Peaks and runs from locality B54 base to B50 and from ~~top~~ B791 to B792 top; B791 is on the same bed as B50 but in a different locality.

	Total	Interval	
B792	520	35	Laminated sandy calcarenite with brachiopods (15 feet no outcrop).
	485	10	Calcareous sandstone.
	475	20	Thin and medium-bedded sandy calcarenite Agnostids at 470 feet (B791C).
	455	15	Coarse calcarenite, some sandy calcarenite. Brachiopods at 446 feet (B791B) and Trilobites at 442 feet (B791A).
	440	5	Laminated fine-grained calcarenite and calcilutite.
	435	5	Cross-bedded calcareous sandstone, slumped.
	430	130	Fine-grained sandy calcarenite with trilobites and brachiopods at 425 feet and 430 feet (B50B and C), trilobites, brachiopods, gastropods, blastoids in a coquinite at 370 feet (B50A) and trilobites at 345 feet (B52)- about 40 feet is non-outcropping.
	300	60	Laminated and fine bedded calcarenite and calcilutite (beds up to six inches thick), with trilobites, blastoids and brachiopods at 280 feet (B53).
	245	30	Thin bedded calcarenite, "two tone" calcarenite, some sandy calcarenite with trilobites and a large bivalve (B54B).
B54	0-210	210	Coarse calcarenite with laminated calcilutite; trilobites and shells at 110 feet (B54A).

This 520 feet can be regarded as a minimum thickness for neither the top nor the bottom of the sequence is exposed in this area.

Other sections which show the lithology of the Chatsworth Limestone are as follows:

(a) Inlier near Dribbling Bore, south of Mt.Datson:

About 200 feet:	Fine-grained calcarenite with some medium-grained calcarenite with lenses of coarse-grained calcarenite, in part "two-tone". Thin to medium bedded; some sandy laminae, cross laminae and ripplemarking. Dolomite (secondary) occurs at north end of outcrop. Trilobites and brachiopods.

(b) At the base of Mt. Datson.

300 feet:	Fine-to medium-grained clacarenite with sandy laminae. Minor coarse-grained calcarenite and intraformation breccia. Medium bedded, minor thin bedding.
350 feet:	Fine to medium-grained calcarenite with some oolitic beds. Medium bedded. Trilobites 45 feet from base,

(c) At the base of Mt.Ninmaroo.

375feet :	Fine-grained calcarenite with minor intraformational breccia and coquinite. Thin bedded and laminated with sandy laminae and minor cross-bedding.

(d) At the base of Black Mountain.

450 feet:	Fine-grained calcarenite with minor intraformational breccia, some sandy laminae. Well-to thick-bedded, laminated in part. Some pyrite. Orthid-like brachiopods, trilobites. Underlying dolomite beds of the base of Ninmaroo Limestone.
600 feet:	Fine-grained calcarenite and calcilutite, some coarse-grained calcarenite and friable sandstone. Thin bedded and laminated, grey and blue grey and with bituminous smell when struck. Trilobites (agnostids). Base not exposed.

The relationships of the various outcrops is given in Figure 6.

The rocks have been gently folded into narrow folds trending approximately 350° on the west of the outcrop, north-east of Digby Peaks, near the concealed probable boundary with the Ninmaroo Limestone. To the east of the type section the outcrop is poorer, but the limestones appear to be horizontal.

The line of outcrops to the south is folded and faulted; at Black Mountain and Mt.Ninmaroo and to a lesser extent Mt.Datson. The rocks have been folded into an anticline, and subsequently faulted with a downthrow to the east of at least 1,000 feet.

Preliminary determinations of fossils (trilobites, including agnostids, and brachiopods) collected from outcrops north of the type area suggest a Franconian (Upper Cambrian) age (Opik, 1957, p.8), but the occurrence in the Boulia 4-mile area is regarded (p.9) as "the continuation (upward) of the Upper Cambrian sequence of the Duchess Sheet".

LOWER ORDOVICIAN

Ninmaroo Limestone (Revised Name)

The Ninmaroo Limestone is the thick sequence of limestone exposed at Black Mountain, Mt.Ninmaroo and Mt.Datson which extends north to Digby Peaks in nearly continuous outcrop and reappears on the extreme western margin of the sheet. It is overlain unconformably * by the Swift Formation.

Whitehouse (1936, p.69) originally used the name Ninmaroo Limestone for a limestone series which crops out in "three large hills - Black Mountain, Ninmaroo and Mt.Datson" which "consist of folded limestones of considerable thickness and identical in appearance with the Georgina Limestones. Platy blue limestones precisely similar to those of the Georgina group abound in the lower part of the section. Higher beds have yielded Eoorthis and a colossal wealth of echinoderm ossicles. ....In one bed high up in the section on Black Mountain (contains) a great wealth of ellesmeroceratid cephalopods suggesting that these beds belong to the Lower Ozarkian (Lower Tremadocian)".

The authors now restrict the use of Ninmaroo Limestone to the upper beds (upper two-thirds of the 3,000 feet section on Black Mountain), which contain many ellesmeroceratid cephalopods, brachiopods, and some gastropods, in a lithology of dolomite, intraformational breccia and "two tone" calcarenite. The beds of platy blue limestone and those yielding Eoorthis described by Whitehouse are now included in the Chatsworth Limestone.

Outcrop of the formation is nearly continuous along a belt running from east of Swift Hills in the north of the Boulia 4-mile area to Mt.Ninmaroo in the centre. It is interrupted by alluvial deposits of the Burke and Mort Rivers, and Eastern and Six-mile Creeks and in many places is partly masked by soil. An inlier nine miles, south-south-east of Mt.Ninmaroo, at Mt. Datson is separated from the main outcrop by Tertiary Noranside Limestone.

In the extreme west of the Boulia 4-mile area are small outcrops of current-bedded dolomite containing Ordovician fossils (see plate 3 fig.1) similar to those in the Ninmaroo Limestone outcrops further east. This dolomite is tentatively assigned to the Ninmaroo Limestone, but as it forms part of a

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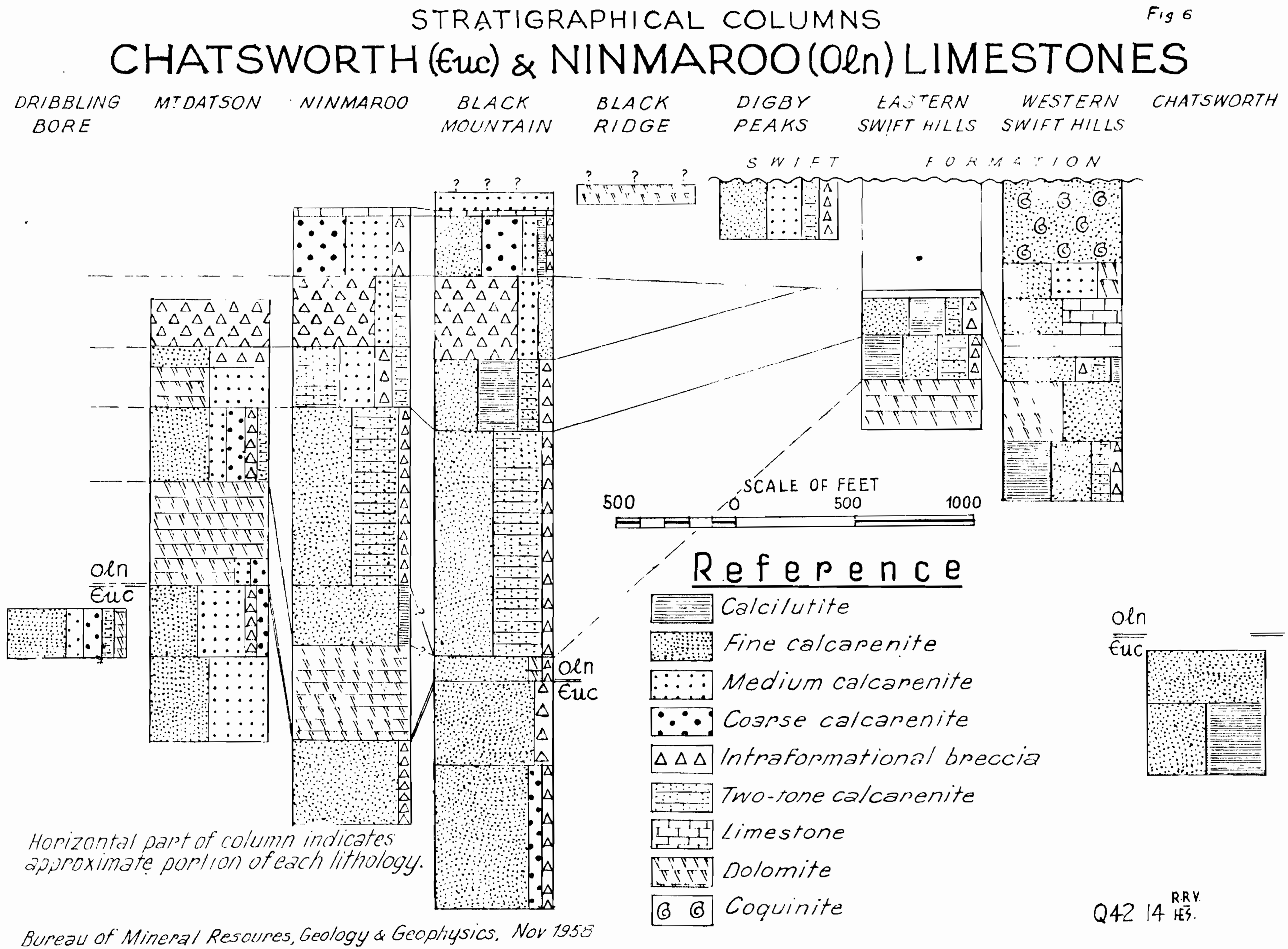
* Recent work has shown the Ninmaroo Limestone to have increasing amounts of dolomite and sandstone to the west and Ninmaroo Formation is now used for this unit of lower Ordovician to uppermost upper Cambrian (Casey, 1959).

Fig.1. Western line of the Burke River Structure at Black Mountain; photo is taken looking west at upthrow side of fault; plain is 400 feet below top and is on downthrow side.

Fig.2. Looking east at the west side of Mt.Datson. Tertiary formation overlies the plain.

Fig.3. Intraformational slump breccia in a thin bed in Gola Beds sequence at Momedah Anticline (locality B794); note the underlying bedded fine calcarenite is still only partly consolidated (left) before brecciation and gouging which caused undercutting. Natural scale.

Fig 6


STRATIGRAPHICAL COLUMNS
CHATSWORTH (Єuc) & NINMAROO (Oℓn) LIMESTONES
DRIBBLING BORE
MT DATSON
NINMAROO
BLACK MOUNTAIN
BLACK RIDGE
DIGBY PEAKS
EASTERN SWIFT HILLS
WESTERN SWIFT HILLS
CHATSWORTH
SWIFT FORMATION
Oℓn / Єuc
SCALE OF FEET
500 0 500 1000
Reference
Calcilutite
Fine calcarenite
Medium calcarenite
Coarse calcarenite
Intraformational breccia
Two-tone calcarenite
Limestone
Dolomite
Coquinite
Horizontal part of column indicates approximate portion of each lithology.
Bureau of Mineral Resources, Geology & Geophysics, Nov 1958
Q42 14 R.R.V. H.E.S.

much larger rock-body in the Glenormiston 4-mile Sheet area which is to be the subject of future mapping and investigation it is not discussed further in this report.**

Black Mountain, Mt.Ninmaroo, and Mt.Datson are fairly steep sided rocky hills, in places precipitous, with marked benches where more resistant beds crop out; Black Mountain is ~~600~~ 400 feet above the plain. (See Plate 1, figures 1 and 2). The only vegetation is spinifex. Outcrops east of the Swift Hills and in the Digby Peaks area are on low, rounded hills, general rocky and spinifex-covered. Areas between these have small isolated outcrops surrounded by rolling grassy plains with plates of Ninmaroo Limestone on the surface.

The most common rock types are fine- and medium-grained calcarenite often dolomitic and sandy, intraformational breccia, and "two-tone" calcarenite and some dolomite; locally the rocks have been dolomitized. Calcilutite and coarse-grained calcarenite are also common with some coquinite, oolitic limestone and calcareous sandstone and with at least one bed of white, dense "reef-like" limestone (856) which may be a chemical precipitate.

Stratigraphic sections were measured across all the main outcrops. Summarized sections, which were used as the basis for the tentative lithological correlation given in figure 6 are as follows:

Mt.Datson

About 200 feet:	Top - intraformational breccia with thin interbedded calcarenite. Exposed in dip slope below unconformity with Noranside Limestone. Not measured accurately.
80 feet:	Interbedded laminated fine-grained calcarenite and thin-bedded intraformational breccia.
170 feet:	Dolomite and medium-grained calcarenite. Medium to thin bedded with some cross bedding. Numerous "mandibles"* with some nautiloids and ribeirioids.
320 feet:	Fine-grained calcarenite, subordinate medium- and coarse-grained calcarenite, minor intraformational breccia and "two-tone" fine-grained calcarenite. Thin to medium bedded. "Mandibles" present in upper 260 feet.
430 feet:	Dolomite. Well jointed, thick-bedded. Medium-bedded with minor calcarenite interbeds and sandy laminae in bottom 100 feet.
Total 1200 feet	Section measured from crest of anticline. Overlies about 650 feet of calcarenite mapped Chatsworth Limestone

** Mapping on this sheet in 1958 shows that this dolomite, although only about 300 feet thick, has a wide areal extent; it consists mostly of dolomite, but contains marly two-tone beds and some intraformational breccias.

* "Mandibles" resemble nautiloid mandibles but have not been positively identified; they may be a type of gastropod.

Note: A section of 2560 feet was measured by C.Brown in this area in 1959.

Mt. Ninmaroo

Top: 20 feet:	Massive white fine-grained limestone. Nautiloids, brachiopods.
260 feet:	Coarse- and medium-grained calcarenite with sandy laminae, subordinate intraformational breccia. Medium bedded, minor cross bedding. Chert biscuits and plates, many styolites. Ribeirioids, brachiopods and echinoderm ossicles.
300 feet:	Intraformational breccia with interbedded "two-tone" and medium-grained calcarenite, some sandy laminae. Medium bedded, minor cross bedding.
250 feet:	"Two-tone" and medium-grained calcarenite with subordinate fine calcarenite and intraformational breccia. Thin to medium-bedded with some slumping. Nautiloids common.
750 feet:	Fine-grained and "two-tone" calcarenite with minor intraformational breccia. Thin-bedded and laminated. Minor amounts of sand and chert nodules and biscuits. In top 350 feet, nautiloids fairly common, "mandibles", ribeirioids and echinoderm fragments.
250 feet:	Fine-grained calcarenite with minor calcilutite. Medium-bedded and laminated, minor cross bedding.
375 feet:	Dolomite. Thick-bedded, minor cross bedding.
Total 2200 feet	Section measured fron near crest of anticline.

Overlies 375 feet of calcarenite mapped as Chatsworth Limestone.

Black Mountain

Top: 75 feet:	Overlying the calcarenites (at B519) is 20 feet of laterised coarse sandstone and conglomerate (Longsight Sandstone) and 20 feet of leached silicified rock (?originally a carbonate of the Swift Formation) separated by a pisolitic soil from the overlying sandstone. Medium-grained calcarenite, sandy. Some chert biscuits and silica blebs. Brachiopods, echinoderm ossicles, gastropods and coprolites (B518). Section has slight petroliferous smell.
20 feet:	Massive white fine-grained limestone. Nautiloids, crinoids, brachiopods, "coral-like" structures, ?gastropods and ?algae.
255 feet:	Fine- and coarse-grained calcarenite, subordinate medium-grained calcarenite, minor cross bedding and chert biscuits. Brachiopods and echinoderm plates.
350 feet:	Intraformational breccia with calcarenite interbeds. Minor amounts of sand, some slumping, cross-bedding and chert biscuits. Nautiloids, brachiopods, "mandibles" and echinoderm plates.

(300 feet continued)

300 feet:	Fine-grained calcarenite and calcilutite. Subordinate "two-tone" calcilutite and intraformational breccia. Silica blebs common. Nautiloids, brachiopods, gastropods, "mandibles", trilobites and algae (B515A) (See plate 3, figure 2).
945 feet:	Fine-grained and "two-tone" calcarenite, minor intraformational breccia. Thin and thick-bedded, laminated in part. Some slumping and chert rolls. Infrequent nautiloids in upper 800 feet.
5 feet:	Dolomite, in two thin beds.
Total 1950 feet	Section measured from crest of anticline.

Overlies 1050 feet of mainly calcarenite and calcilutite beds mapped as Chatsworth Limestone.

Black Ridge

	This outcrop is probably the lithological equivalent of the top beds at Black Mountain and Ninmaroo.
Top:	Dolomite.
About 20 feet:	Thickness not measurable below concealed boundary with Swift Formation.
Base 80 feet:	Dolomite (probably secondary). Medium and thick-bedded, well jointed and travertine coated. Small relic amounts of calcarenite. Chert nodules and layers common. Poorly preserved silicified nautiloids, brachiopods, echinoderm fragments and trilobites.

Digby Peaks

230 feet:	Fine to medium-grained calcarenite with blotchy "two-tone" calcarenite and intraformation breccia. Thin to medium bedded. Minor sandy laminae, silica blebs and cross-bedding. Numerous nautiloids and "mandibles", some ribeirioids.

East of Swift Hills.

Top 160 feet:	Fine-grained calcarenite and calcilutite, subordinate "two-tone" calcarenite and intraformational breccia. Thin to medium bedded. Nautiloids, ribeirioids (B251).
170 feet:	Calcilutite and fine-grained calcarenite with dolomite interbeds, minor, "two-tone" calcarenite and intraformational breccia. Thin-bedded and laminated. Nautiloids.
Base 210 feet:	Dolomite (secondary in part) some lensing calcareous interbeds. Thin bedded. Lead occurrence occurs in this unit.
Total 540 feet	

West of Swift Hills

Top 350 feet:	Unconformably with Swift Formation. Fine- to medium-grained calcarenite and coquinite. Thin bedded and laminated (B231 Nautiloids, brachiopods, trilobites, ribeirioids, echinoderm fragments.
150 feet:	Fine-to medium-grained calcarenite and dolomite. Thin bedded, laminated and massive. Nautiloids, ?ribeirioids, trilobites, echinoderm fragments (B230).
150 feet:	Fine-grained calcarenite and fine limeston. Thin to medium bedded, minor cross-bedding and laminated massive bedding. Brachiopods, echinoderm fragments (B229).
Thin	Unmeasured sequence.
90 feet:	Fine-grained calcarenite with subordinate intraformational breccia, "two-tone" calcarenite and minor calcilutite. Thin to medium bedded.
250 feet:	Dolomite and fine-grained calcarenite. Trilobites, nautiloids, ribeirioids, echinoderm fragments (B237).
Base 250 feet:	Calcilutite and fine-grained calcarenite, often "two-tone", minor intraformational breccia. Thin to medium bedded. Nautiloids. ?ribeirioids, ?bryozoa (B228, B236).
Total 1240 feet.	

Whitehouse (1936, p.69, footnote) records "gneiss" at the base of Black Mountain. No gneiss was seen at Black Mountain; but it may have come as boulders from the Longsight Sandstone which crops out nearby.

The intraformational breccias recorded in the above sections consist of angular and sub-angular fragments of calcarenite or calcilutite elongated along the bedding and set in a matrix of calcarenite or marl frequently with oolites in the matrix. The fragments appear to be derived from the destruction of the underlying beds and to have moved very little. This is shown clearly in Plate 1, figure 3. In some specimens the breccia can be seen filling cavities under beds and incorporating fragments from the beds. The breccias are most common in the upper half of the Ninmaroo Limestone; in the Black Mountain, Mt.Ninmaroo and Mt.Datson outcrops they are sufficiently abundant to dominate about 300 feet in one part of the section. Some breccias occur in the upper part of the Chatsworth Limestone but are not common. Most of the breccias, undoubtedly owe their origin to slumping. Others are possibly due to breaking up of semi-consolidated rocks by wave action or by desiccation on temporary exposure above water.

Many of the calcarenites contain minor visible amount of fine sand. Thin sections of these calcarenites reveal sub-angular grains of quartz and some flakes of muscovite set in a matrix of fine-grained recrystallized calcite. The muscovite flakes are still fresh, but nearly all the sand grains have been corroded and partly replaced. In places the replacement appears to be complete and the previous position of sand grains is shown by calcite pseudomorphs with a grain size comparable to that of the quartz, but much coarser than the recrystallized calcite forming this matrix. Walker (1957) reported "frosting" of sand grains by carbonate replacement in limestones and suggested that the silica released is volumetrically important in locating a source of material for secondary silicification. Silicified coquinites and fossils and one chert nodule which had a sharp external boundary, but a grades internally into a calcareous core are evidence that the chert in the Ninmaroo Limestone is at least in part, secondary. Most of the chert blebs are associated with silicified fossil bands and apparently represent fossils which have been imperfectly replaced. All those so far seen in the Ninmaroo Limestone have been within a few inches of the surface of exposures. It is possible that silica released by the calcite replacement of sand has migrated to the surface and concentrated to form nodules, biscuits, or layers of chert.

In a thin section from B806, west of Black Mountain, laminated calcilutite showed a transition to homogeneous chert within one inch along the bedding; the calcilutite had scattered corroded quartz grains and rare spherical chalcedony bodies (?radiolaria) in fine-grained recrystallized calcite; the transition zone consists of finely crystalline quartz and chalcedony with irregular patches of unaltered calcite in the silica, and some euhedral rhombs of dolomite; the homogeneous chert shows finely crystalline silica, and chalcedony and some opaline silica with 20% dolomite rhombs. Many of the ?radiolaria show outgrowths of chalcedonic silica in optical continuity with the original fibres.

A thin section of intraformational conglomerate, six miles west of Datchet Downs homestead, shows subrounded fragments of fine-grained sandy limestone chaotically jumbled in a coarsely crystalline sandy matrix. The sandy grains have corroded borders and have been replaced by calcite. Interstitial patches of chalcedony replacing calcite also occur in the matrix which also contains mica and corroded felspar grains. The subrounded fragments of limestone have recrystallized margins merging with the matrix.

Dolomites and their origin are discussed in detail later. Some analyses of samples of limestone and dolomitic limestone are included in Table IV.

TABLE IV.

Analysis of dolomitic limestone samples, Lab.Nos. 58/381-89, by J.R. Beevers, 17.2.58.

Ref. No.	Insoluble in 2N.HCl	- Fe_2O_3%	$CaCO_3$%	$MgCO_3$%	Ratio $CaCO_3$% / $MgCO_3$%
B535 : 8 miles west of Hercules Bore.	16.50	0.97	43.23	38.90	1.11
B515M: Black Mountain	2.23	0.14	95.23	-	-
B525 : N.end of De Little Range	18.51	0.03	72.73	-	-
B534 : 4 miles W. Of 7 mile Bore.	17.19	0.03	48.73	33.44	1.46
B516:Blk.Mountain	5.95	0.02	91.73	-	-
W22 : 6 miles W.of Glenormiston HS.	1.07	0.09	54.23	45.54	1.19
B132: Black Ridge	4.24	0.10	52.23	41.59	1.26
G14 : 4 miles E.of Tripod WH.	1.03	0.40	53.20	43.84	1.21
B510b: Blk.Mountain	12.21	0.07	82.23	-	-

All are from Ninmaroo Limestone except B525 Pomegranate Limes... and B510b Chatsworth Limestone.

The thickness of 1950 feet of section measured at Black Mountain is probably nearly the maximum thickness of the formation, although G.Brown in 1959 records 2750 feet of Ninma... and 1550 feet of Chatsworth Limestone (personal communication. In the north, near Digby Peaks the Ninmaroo Limestone is unconformably overlain by the Swift Formation; the limestone was slightly buckled upward before the Swift was laid down.

Buckling or upward movement in the north, relative to the south, would explain why Ninmaroo Limestone areas in the north were eroded before later deposition occurred and the boundary of the overlying Swift Formation is transgressive. The western Swift Hills were an area of least erosion in the north, and it may be significant that it is farthest, laterally from the "Burke River Structure", described below; this structure was probably already forming at the time of the deposition of the Swift Formation.

The major outcrops of the Ninmaroo Limestone are in faulted asymmetrical anticlines arranged en echelon along a line running north-north-west from Mt.Datson. This is the western edge of the Burke River Structure. Minor synclines are imposed upon the main anticlines on Black Mountain and Mt.Datson. Where the anticlines are well exposed the eastern flank is seen to be the steeper; the faults which occur along or close to the anticlinal axes are downthrown to the east. To east and west of the folded zone the limestone is generally horizontal, or gently folded into broad folds with the same north-north-east trend. Some of the movement along the Burke River Structure appears to have taken place while the Swift Formation was being deposited, but as they are also involved in the folding the main movement took place later. There is evidence (see later under Structure) that the Lower Cretaceous rocks were involved in the faulting.

Faulting is later than folding, and at Black Mountain and Mt.Ninmaroo it cuts the fold axes. The Black Mountain structure is shown in Plate 2. Small outliers of sandstone and conglomerate forming the main and subsidiary peaks of Mt.Ninmaroo have been assigned to the Cretaceous Longsight Sandstone on the basis of lithological similarity to that formation. At B519 the conglomerate includes some boulders of silicified sandstone containing probable Middle Ordovician pelecypods (J.G.Tomlinson personal communication) which may have been derived from the Toko Range area 150 miles to the west where similar forms occur Similar sandstones, a little to the east of the fault occur 300 feet topographically lower. If this interpretation is correct the faulting has affected basal Cretaceous rocks, but to a lesser extent than the Lower Palaeozoic formations, which were displaced 800 to 1000 feet by the Black Mountain fault.

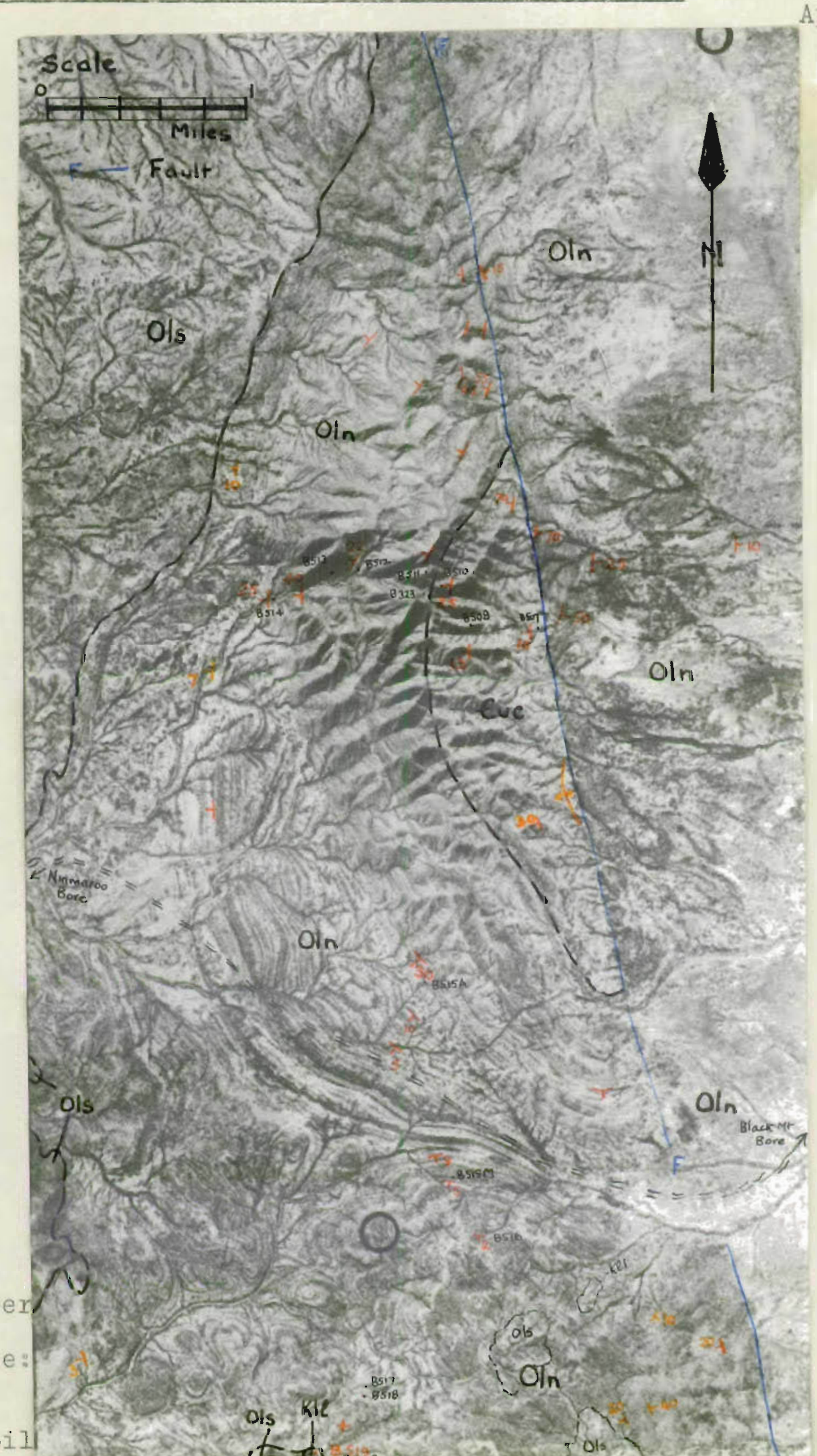
The gently folded limestone, east of Digby Peaks, lies on the continuation of a line along which anticlinal folding and faulting has affected both Upper Cambrian and Lower Cretaceous rocks. This line is nearly parallel to the eastern edge of the Burke River structure and about eleven miles east of the western edge of the structure.

The Ninmaroo Limestone has been deposited in a quiet shelf environment affected periodically by currents, as indicated by the cross-bedding (see Plate 3, fig.1) and scattered sand grains. Slumping is indicated by the slump structures and intraformational breccias; these breccias are formed either by the break up of semi-consolidated rocks by wave action or by desiccation during temporary exposure above water.

PLATE 2.

THE BURKE RIVER STRUCTURE AT BLACK MOUNTAIN

Approx.
N.



By per

Scale:

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PLATE 3.

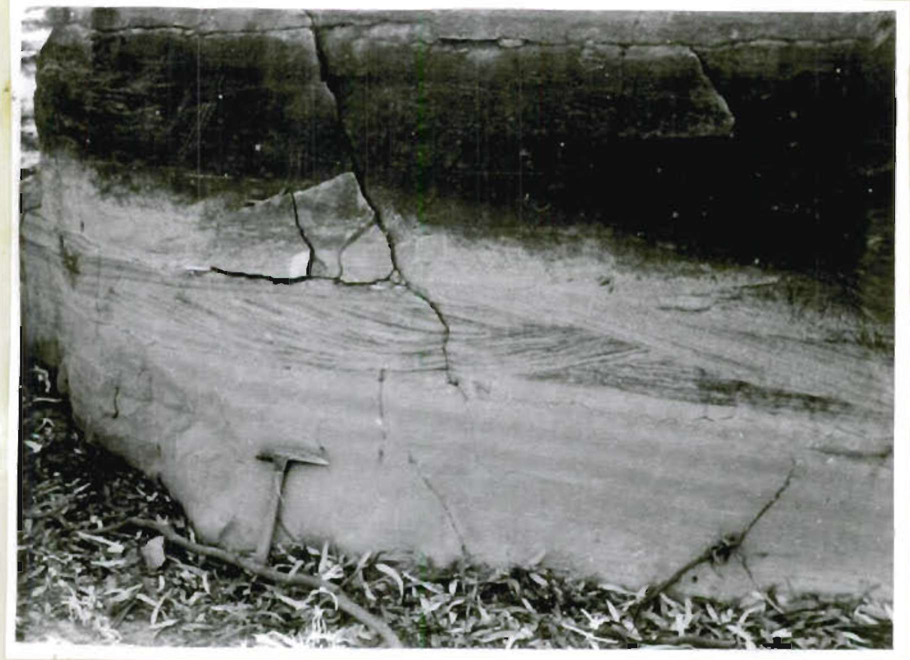


Figure 1. Ninmaroo Limestone showing cross bedding in a dolomite bed; a thin styolite seam is to the left just below main cross bedding. Outcrop is 7 miles west of Herrods Tank (locality G.14) on photo 5005 run 5 Glenormiston; it occurs in a partly filled-in large sink hole. Height of exposure represented here is 3 feet.

Figure 2. Algal growths in Ninmaroo Limestone, on the south-west side of Black Mountain (locality B515A). The colonies grew on a fine calcilutite bed but were killed and buried by a mass of intraformational conglomerate. Note piece of broken algae, upside down, in the conglomerate at right of photo. Height of algae to left is 1 inch (natural scale).

PLATE 4.

Figure 1. Interbedded chert and shale of Swift Formation in cave on east side of Swift Hills, about 8 miles north-north-east of Noranside Station Homestead.
Photograph by Dr. A.A. Öpik.

Figure 2. Swift Hills, eastern side, with caves formed in bedded cherts near top of the Swift Formation.

Although many of the dolomites which crop out along and near the Burke River Structural belts are secondary, some are primary; the primary dolomites and sandy dolomites are very common west of Black Mountain on the Glenormiston 4-mile Sheet.

Many of the fossils collected are undescribed, but a preliminary palaeontological examination of the material by Dr. Öpik and J. Gilbert-Tomlinson show the Ninmaroo Limestone ranges from high in the Upper Cambrian to Lower Ordovician; the fauna from Black Mountain and Digby Peaks is roughly equivalent to the Tremadocian, ranging to early Arenigian. (Tomlinson, 1959; enclosed in this report as Appendix F.) The boundary between the Chatsworth Limestone and the Ninmaroo Limestone was located tentatively on Black Mountain at about 1050 feet above the base of the section. Cambrian fossils were found in the cores of the anticlines of Mts. Ninmaroo and Datson, but the Chatsworth-Ninmaroo boundary can be located there only by extrapolation from the Black Mountain section and it is placed at the bottom of the main dolomite beds. The inlier south of Mt. Datson has so far yielded only Cambrian fossils. North - north-west of Black Mountain only Ordovician fossils were found. In the field, the presence of ellesmeroceroid nautiloids and/or "mandibles" associated with "two-tone" calcarenites, intraformational breccias, and dolomites was taken as an indication of Ninmaroo Limestone, whereas agnostids and orthid-type brachiopods associated with blue-grey calcarenite and calcilutite indicated Chatsworth Limestone.

Swift Formation:

TheSwift Fromation consists of chert, siltstone, silicified coquinite, and sandstone, resting on the Ninmaroo Limestone in places unconformably.

The name is derived from Swift Hills, which lie between latitudes 22°00'S and 22°05'S, and longitudes 140°01'E., and 140°03'E. We named the hills in 1957 after the late Mr. Swift, whose son Jack is manager of Noranside Station.

The Swift Formation crops out in a belt running from the northern margin of the Boulia 4-mile Sheet area, west of the Burke River, to the west side of Black Mountain (Mount Unbunmaroo). At Swift Hills the formation forms low rounded ridges with a small scarp on the eastern side (See Plate 4, fig. 2.); south of Digby Peaks it forms a broad divide with dendritic streams deeply incised in fairly steep-walled valleys. West of Black Mountain it forms low rounded foothills cut by steep-sided flat-floored valleys.

The lithology is predominantly bedded chert (see Plate 4, fig.1) with interbeds of siltstone, sandstone, silicified coquinite, and limestone. At Swift Hills, the type area, the following succession occurs (in descending order):-

10 feet: Chert breccia (Digby Peaks Breccia). Age unknown.

-------erosional surface-------

20 feet: Thin bedded and laminated, white and grey chert, silicified coquinite.

25 feet: No outcrop.

12 feet: Laminated, red and white, fine-grained well sorted sandstone and siltstone, (contact not seen).

-------Ninmaroo Limestone-------

In places the bedded cherts have been eroded away, and the chert breccia rests directly on the sandstone and siltstone. An almost identical section is exposed at Digby Peaks.

Two miles east-north-east of Digby Peaks 60 feet of Swift Formation unconformably overlies Ninmaroo Limestone. Here the lower half of the formation has thin bedded chert with a few silicified coquinite bands containing graptolites; interbedded with white porous siltstone; the upper half contains predominantly thin bedded chert which grades upwards into a six-foot capping of silicified chert breccia (see later under Digby Peaks breccia).

West of Black Mountain at B806, thin-bedded and laminated calcarenite of the Ninmaroo Limestone grades upwards for 20 feet into thin-bedded and laminated chert and silicified coquinite, which resembles some outcrops of the Swift Formation; however, near this locality this is overlain by 40 feet of bedded chert of the Swift Formation.

Most of the bedded, laminated chert from Digby Peaks examined in thin section, shows that the original calcareous coquinite (shell fragments, spines) has been completely replaced by chalcedonic silica, opaline silica and quartz, to form chert; in some places solution and redisposition of silica has all but obliterated the fossil outlines; some rounded hypersthene grains and corroded quartz grains, representing 1% of the rock were noted. Some silicified sandstone from Digby Peaks consists of 30% quartz grains, showing much corrosion, set in an opaline and chalcedonic matrix with accessory amounts of muscovite, glaucophane and hornblende.

Near the base of the formation a porous sandy-textured rock shows relicts of once being a calcarenite and intraformational conglomerate, which was changed by leaching of calcite and deposition of silica giving the matrix irregular cavities which form 20% of the rock; moreover, in places the intraformational conglomerate grades along the strike to this porous sandy-textured rock with corroded quartz grains in a chalcedonic matrix.

The outcrops of the Swift Formation in the north show a marked decrease of detrital quartz from outcrops in the south. South of Eastern Creek very few dominantly sandy beds occur and further south near Black Mountain sandy beds are absent.

At Swift Hills the Swift Formation is nearly horizontal. South of Digby Peaks, it probably dips gently to the south-west to disappear under the Noranside Limestone and alluvium of the Burke River. In some outcrops the beds are irregularly contorted with dips up to 30°. The direction and pitch of fold axes are extremely irregular and the folding is probably due to slumping of semi-consolidated sediments and compaction over an uneven surface of deposition.

The contact with the underlying rocks is concealed at Digby Peaks and Swift Hills, but between two and four miles south-east of Digby Peaks beds of the Swift Formation transgress truncated beds of the Ninmaroo Limestone. The angle of unconformity is probably of the order of 1°, although it was not measured. The contact is exposed one, four and eight miles south-east of Digby Peaks, where cherts of the Swift Formation rest on an old karst topography with maximum relief of about 15 feet. Near B519, west of Mt. Ninmaroo, Swift Formation overlies Ninmaroo Formation with a probable erosional unconformity and is overlain by Cretaceous sandstone and conglomerate containing boulders with middle Ordovician fossils.

Most of the rock types of the Ninmaroo Limestone were apparently represented in the Swift Formation, but the latter contain more coarse detrital material. The environment of deposition may have been similar to that of the Ninmaroo Limestone, but the sea was probably shallower and transgressed the Ninmaroo surface. The minor folding or tilting that occurred before the deposition of the Swift Formation caused the land-mass to the north to be rejuvenated and to shed more coarse detrital material.

The maximum measured thickness of the Swift Formation is about 60 feet at Swift Hills and two miles south-east of Digby Peaks, but as there is evidence of erosion before the formation of the breccia the full thickness is unknown. Bores give no reliable information on the thickness.

Recognisable fossils, including trilobites, brachiopods, nautiloids, and echinoderm fragments, are widespread in the formation, but not abundant; the basal beds contain the brachiopods, and the higher ones the trilobites. They indicate a Lower Ordovician age for the Swift Formation. Recently geologists from Frome-Broken Hill Pty Ltd discovered grapolites from the formation in beds higher than the brachiopods but with the trilobites. (See Appendix F.)

AGE UNKNOWN - YOUNGER THAN LOWER ORDOVICIAN.

Digby Peaks Breccia (Informal, new name).

The name Digby Peaks Breccia is used for a thin sequence of silicified chert breccia beds which unconformably overlies the Swift Formation. Outcrops of the Breccia are too small to be shown on the 4-mile map. It is named from Digby Peaks (latitude 22°07'S. longitude 140°07'E.), which are several peaks 970 feet high and rising 220 feet above the Mort River. See photo, plate 5 fig.2.

The Breccia crops out at Digby Peaks and two miles south of No.34 Bore (Noranside) on the east side of the Swift Hills. At Digby Peaks it is 40 feet thick and consists of a massive siliceous breccia of chert fragments, crudely bedded and extensively silicified ; the breccia pieces are slightly rounded towards the top. It unconformably overlies leached and silicified Swift Formation and the top is exposed.

A sub-soil breccia or "paper-weight" breccia (see plate 8, fig.1) 1 to 5 feet thick occurs in many places over the Swift Formation and Cretaceous siltstone formations; it has been mapped as Tl symbol but the age is in doubt. The sub-soil breccia over the Swift Formation grades downwards into beds of chert which are breaking up in situ; caves form within the sequence of chert beds. The sub-soil breccia probably formed during a late period of weathering. The Digby Peaks breccia may be a particular form of this sub-soil breccia which has been concentrated as a valley, or sink hole fill in the Swift Formation; subsequent erosion has reversed the topography and left the silicified breccia as peaks.

Its age is unknown but it could have formed soon after the weathering and erosion of the Swift Formation.

LOWER CRETACEOUS ROCKS.

General:

In the Boulia 4-mile area rocks, of Lower Cretaceous age rest unconformably on Precambrian and Lower Palaeozoic rocks. They are divided into the following formations:

Wilgunya Formation: (top)	White massive siltstone, sandy siltstone. Blue, grey and white clay, , some ferruginous sandstone. Gypsum and barytes, crystals and concretions. Toolebuc Member of sandy calcarenite, siltstone, and coquinite with concretions.
Longsight Sandstone: (base)	Quartz sandstone, red-brown, ferruginous and micaceous; conglomeratic towards base, silty beds towards top.

Longsight Sandstone: (Casey, 1959).

The Longsight Sandstone consists predominantly of quartz sandstone and minor conglomerate, and unconformably rests on Lower Palaeozoic sediments and Precambrian metamorphic rock, and is conformably overlain by the Wilgunya Formation.

The formation is named after Longsight Peak, a prominent hill, eight miles south-west of Alderley Homestead at latitude 22°30'S, longitude 139°32'E. (see fig.1, plate 5).

It crops out in the strongly dissected area on the western side of the Boulia area, where it overlies stacks of Ninmaroo Limestone (Plate 6, fig.1); it is exposed both in the eastern escarpment of the dissected area, and on the flat-topped residual hills west of this escarpment. It also forms a belt running north-south through the centre of the Boulia Sheet to Mt.Ninmaroo in the south, which is capped by 40 feet of conglomerate and sandstone similar to that in the type area. Small exposures occur in the Momedah Anticline at Momedah Creek, at Pathungra Spring well on the Hamilton River, and in the north-east of the Boulia area, west of Big Sandy Creek, where a micaceous fossiliferous sandstone overlies Precambrian metamorphic rocks.

The formation produces low rises, covered with rounded pebbles and boulders derived from the conglomeratic material in the unit. Some good exposures are found in creeks and low cliffs. The rocks are easily eroded and the topography is dominated by the overlying silicified and laterized Wilgunya Formation.

PLATE 5.

Figure 1. Longsight Peak. Taken from near Rocky Bore, Alderley Station, about 8 miles west-south-west of homestead, looking south-east.
Photograph by Dr. A.A. Öpik.

Figure 2. Digby Peaks -Swift Formation capped by Digby Peaks breccia (valley fill), horizontal Ninmaroo Limestone, covered by spinifex, in the foreground.
Photograph by Dr. A.A. Öpik.

PLATE 6.

Figure 1. Longsight Sandstone overlying Ninmaroo Limestone (dolomite with small caves); "Hidden City", Alderley Station, near junction of Craigie's and Cottonbush Creeks (Glenormiston 4-mile Sheet), about 13 miles west of homestead.

Figure 2. Herrod's Tank - Basal Cretaceous sandstone with plant fossils (Longsight Sandstone) at base of tank; overlain by bentonitic shale (Wilgunya Formation). Buckingham Downs Station, 19 miles south-west of homestead.

The Longsight Sandstone is a quartz sandstone, very fine to medium-grained, red, brown or white in colour; in most places it is ferruginous and micaceous and in some places it is silty, the base is usually conglomeratic. A complete section is not exposed in any one locality, but the following sections are typical:

1. One mile east of Herrod's Tank (B373 Run 4, photo 5109).

Top - 10 feet:	Siltstone (?radiolarian), white, purple and yellow brown (Wilgunya Formation).
10 feet:	Quartz sandstone, felspathic, white, fine-grained with pebbly bands and sandy siltstone. (Wilgunya Formation).
10 feet:	Siltstone, sandy brown (Wilgunya Formation). conformably overlying
30 feet:	Quartz sandstone, red, fine-grained, well-sorted, well rounded grains with ferruginous coating; friable and porous; contains worm burrows (Longsight Sandstone - uppermost part).

2. In Herrod's Tank (see fig.2, plate 6).

Top - 10 feet:	clay (? bentonitic), blue-grey (Wilgunya Formation).
5 feet:	Quartz sandstone, yellow, fine to medium-grained, well rounded, well sorted, ferruginous, with some siltstone beds.
5 feet:	Quartz sandstone, red, as above with pebble lenses.
10 feet:	Siltstone, purple, micaceous and quartz sandstone, felspathic, fine to medium-grained, micaceous; well sorted and rounded; rhythmic deposition. Plant fossils.
5 feet:	Quartz sandstone, purple, poorly sorted, subangular, pebbly with clay pellets and current bedding.

Probably overlies Ninmaroo Limestone unconformably as the tank is a failure and it is reported that when the tank first began to fill with water, the bottom collapsed into a big cave - this was covered by silt when visited in 1957.

3. 4 miles west-south-west of Alderley Homestead.

25 feet:	Siltstone red, purple or yellow, silty sandstone and quartz sandstone, fine-grained, micaceous (Wilgunya Formation) conformable, overlying,
55 feet:	Quartz sandstone, red and purple, well sorted, rounded, fine-grained, ferruginous with clay and silt pellets and stringers; the sandstone unconformably overlies dolomi- of the Ninmaroo Limestone, exposed 2 miles farther south-west.

In the eastern and central part of the Sheet, the following sections illustrate the lithology.

A 95 foot section on the south side of Eastern Creek, 3 miles south-east of Datchet Downs Homestead shows -

Top - 15 feet:	Quartz sandstone, white, silicified with scattered quartz pebbles.
2 feet:	Conglomerate, composed of rounded cobbles of quartz, quartzite, and quartz tourmaline in a quartz sandstone matrix.
40 feet:	Quartz sandstone, ill-sorted, grading to fine conglomerate with few cobbles and boulders up to 18 inch in diameter.
5 feet:	Quartz sandstone, ferruginous and micaceous, with well rounded and well sorted quartz grains
1 foot:	Conglomerate.
2 feet:	Quartz sandstone, coarse ferruginous.
17 feet:	Sandstone and conglomerate rubble with some outcrops of white quartz sandstone.
8 feet:	No outcrop.
3 feet:	Quartz sandstone, white, micaceous, well rounded and well sorted grains.
2 feet:	Conglomerate, with pebbles of quartz and quartzite in a ferruginous sandstone matrix.
	-----------Angular Unconformity--------------
	Ninmaroo Limestone (Ordovician).

Although the top of the formation is not exposed the Wilgunya Formation overlies the Sandstone one quarter of a mile to the east, where it is evident that less than 20 feet of section is missing in this area.

One mile north of Momedah Creek at B320, 95 feet of section overlain by 30 feet of siltstone is exposed as follows:

Top - 20 feet:	Siltstone, brown, sandy.
10 feet:	Siltstone, white massive (Wilgunya Formation) with fossil Maccoyella.
45 feet:	No outcrop. Rubble of ferruginous sandy siltstone
35 feet:	Conglomerate consisting of well-rounded quartz and quartzite pebbles in a ferruginous quartz sandstone matrix.
15 feet:	Quartz sandstone, medium-grained micaceous, cross bedded with indeterminate plant remains
	-----------Angular Unconformity--------------
	Gola Beds (Upper Cambrian Limestone).

Lenses of siltstone and sandy siltstone occur within the sandstone in creek sections near this locality.

In the bed of Momedah Creek, south-west of the Momedah Anticline, quartz sandstone with indeterminate plant remains, micaceous quartz sandstone, fontainebleau sandstone, and conglomerate with angular pebbles are exposed. The creek bed is constricted along this stretch and the outcropping permeable sandstones probably form intake beds for the artesian aquifer to the east.

Pebble and boulder conglomerate ranging in thickness from a few inches to 20 feet overlies an irregular surface of Lower Proterozoic rocks north-east of Burnham Homestead, on the Duchess Sheet and extends south to the Boulia Sheet; pebbles are mainly quartz and quartzite but in places boulders up to 12 feet across occur. The matrix of the conglomerates is dominantly well rounded micaceous quartz sandstone but it varies according to the nearby basement rocks. The underlying mica schists give a matrix consisting mainly of mica, and pegmatities contribute large amounts of mica and felspar.

A small area of flat-lying, leached and lateritized sediments unconformable on Precambrian rocks occurs two miles north-west of Buckingham Downs Homestead.

The following section was measured:

Top - 5 feet:	Conglomerate, light grey to purple, with fine to medium grained sandstone matrix; conglomerate contains Cambrian chert pebbles.
5 feet:	Siltstone, silicified, light brown and grey.
10 feet:	Siltstone, as above, with sandstone, fine-grained red-brown becoming purple near top.
2 feet:	Sandstone brown and red, fine-grained, arkosic.
3 feet:	Conglomerate, arkosic with chert, granite, quartzite pebbles.
	Precambrian granitic gneiss.

Dr. Öpik (pers.comm.) has found indeterminable plant fossils in these rocks at Sulieman Creek; the conglomerate contains angular pebbles of chert with Cambrian fossils. These sediments probably represent the marginal variation of the Longsight Sandstone.

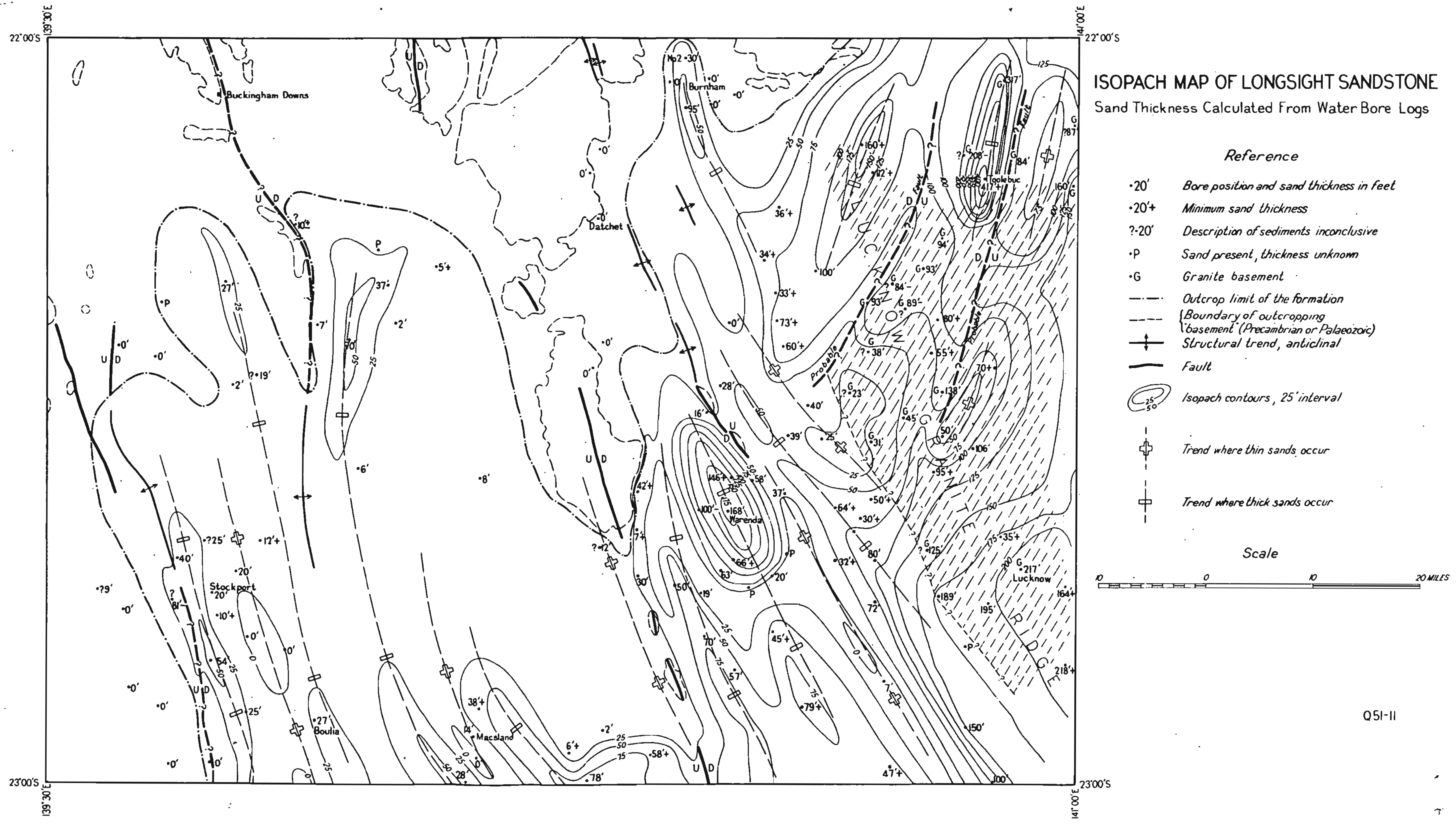
The authors interpret "the small outcrop of gneiss at the base of Black Mountain" reported by Whitehouse 1956,p.69, as being a boulder from the Longsight Sandstone.

Bores show that the Sandstone underlies Lower Cretaceous fine-grained sediments wherever they occur east of the Burke River. East of the Hamilton River the sandstone forms the main aquifer of that part of the Great Artesian Basin which occurs in and around the Boulia 4-mile area.

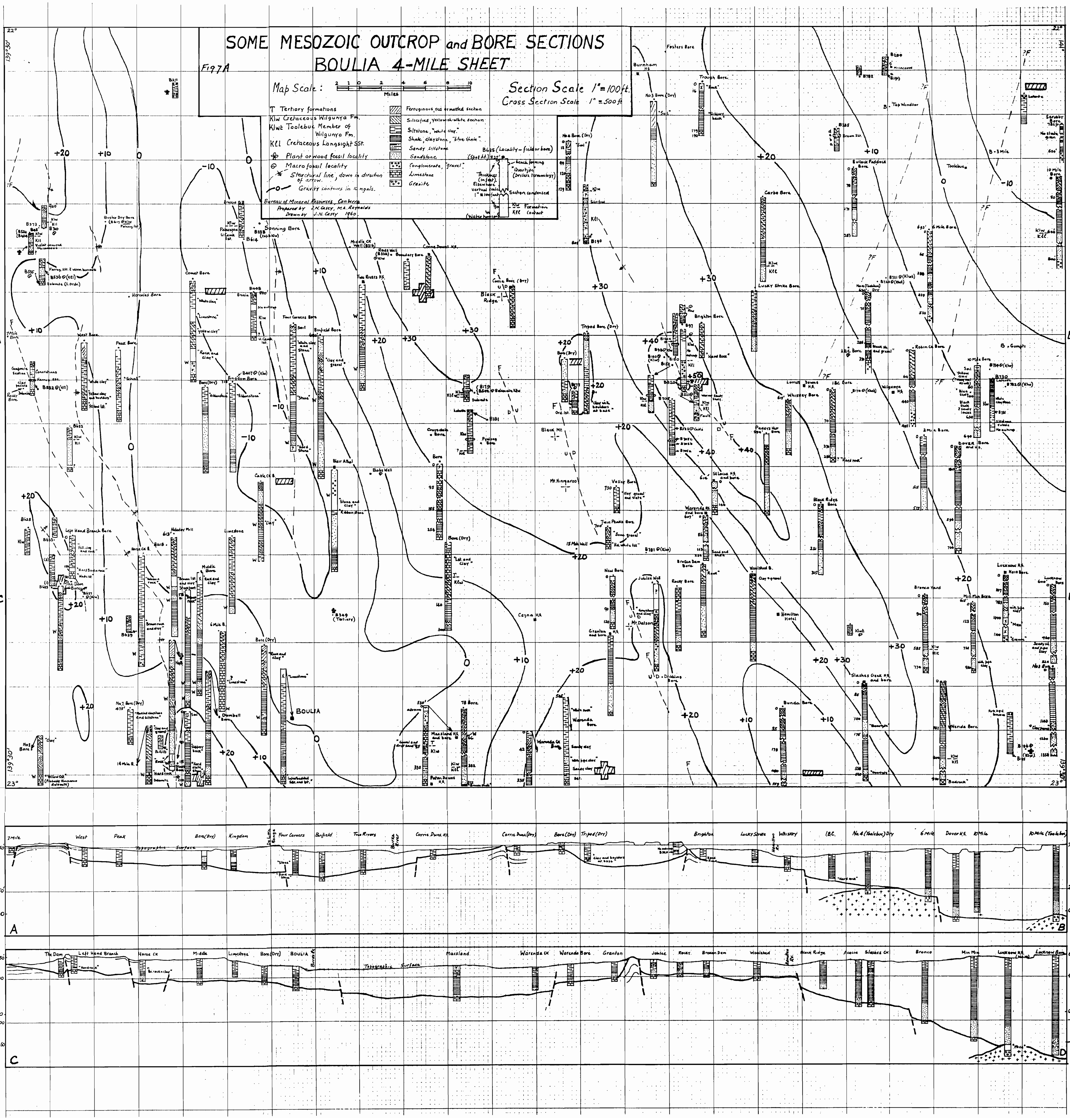
The Longsight Sandstone being a well sorted, coarse sandstone, current-bedded with some plants and shallow-water fossils was deposited in shallow water. Marine fossils were found near Big Sandy Creek in the Duchess 4-mile Sheet area, about 4 miles north of the northern boundary of the Boulia 4-mile Sheet. Some of the sandstone beds, particularly the basal beds which overlie Lower Palaeozoic and older units, may have been laid down in a lagoonal or estuarine environment as indicated by plant fossils.

ISOPACH MAP OF LONGSIGHT SANDSTONE

Sand Thickness Calculated From Water Bore Logs



Q51-11


SOME MESOZOIC OUTCROP and BORE SECTIONS
BOULIA 4-MILE SHEET
Fig 7A
Map Scale: Miles
Section Scale 1" = 100 ft.
Cross Section Scale 1" = 500 ft.
T Tertiary formations
Klw Cretaceous Wilgunya Fm.
Klwt Toolebuc Member of Wilgunya Fm.
Kℓl Cretaceous Longsight SSt.
Plant or wood fossil locality
Macrofossil locality
Structural line, down in direction of arrow.
Gravity contours in 10 mgals.
Ferruginous, red or mottled section
Silicified, yellowish-white section
Siltstone, "white clay"
Shale, claystone, "blue shale"
Sandy siltstone
Sandstone
Conglomerate, "gravel"
Limestone
Granite
Bureau of Mineral Resources, Canberra
Prepared by J.N. Casey, M.A. Reynolds
Drawn by J.N. Casey 1960.
BOULIA
Topographic Surface
A
B
C
D

Plant fossils have been found in purple siltstone at Herrod's Tank, and at G11, 18 miles north-west of Herrod's Tank (See Appendix B.) and at G139 (1½ miles north of Yarrie Rockhole in white siltstone; the last two localities are on the Glenormiston Sheet. These plant-bearing beds may belong to a slightly older unit than the Longsight Sandstone, but the plants probably were washed into estuarine conditions prevalent at the margin of the formation.

The thickness ranges from a few inches near the northern margin of the Boulia 4-mile area, to about 200 feet in Lucknow No.3 Bore in the south-east corner of the area; about 95 feet is the maximum thickness exposed.

Bore records indicate that the Longsight Sandstone extends over much of the eastern part of the Boulia area at depth. Figure 7 shows the subsurface thickness of the Longsight Sandstone from bore records. A comparison between this figure and figure 8, which shows the structure contours at the base of the Cretaceous, verifies the conclusion that the unit thins over basement ridges, indicating that these ridges were in existence at the time the formation was deposited; the anticlinal trend lines indicate edges of the subsurface ridges and not structural features developed after the deposition of the two units.

The Longsight Sandstone is believed to be Lower Cretaceous in age. Lower Cretaceous Wilgunya Formation overlies the Longsight Sandstone conformably, and ?Cyrenopsis sp. of Lower Cretaceous age was found in micaceous sandstone near Big Sandy Creek 4 miles north of the boundary of the Boulia 4-mile area, and other fossils were found on the western margin of the Sheet. The determinations are given in Appendices B. and C. The plants have a range from Upper Triassic to lower Cretaceous, and the marine pelecypods are lower Cretaceous, predominantly the Roma Formation type. Elsewhere in the Great Artesian Basin it has been established that a large marine transgression began in late Jurassic time, and culminated in the lower Cretaceous. The rocks of the Longsight Sandstone were apparently deposited close to a shore-line; so the formation is probably transgressive in both time and space. A relation can thus be postulated with the Blythesdale Group, both units lying in about the same stratigraphical position with the top of the Longsight being younger than the top of the Blythesdale. A complete correlation cannot be made with the whole of the Blythesdale, for Whitehouse (1954) referred to several sandstones and intercalated shales forming a group, not a formation.

PLATE 7.

Figure 1. Small mesas of Wilgunya Formation with flat tops formed by siliceous beds. View from near Momedah Creek to the west towards the Black Mountain ridge in background.

Figure 2. Small rounded buttes of Wilgunya Formation, two miles south of Brighton Gap on St. Lucia Station. Here white siltstone (probably, radiolarian bearing) overlies a bench of ferruginous (?glauconitic originally) sandstone of the Wilgunya Formation.

Wilgunya Formation: (Casey, 1959).

The Wilgunya Formation consists of a sequence of claystone and siltstone with some sandstone and sandy siltstone which overlies the Longsight Sandstone, conformably and forms an impermeable covering to the Great Artesian Basin aquifers, and which thickens to the south and south-east.

The name is derived from the west-flowing Wilgunya Creek which joins the Hamilton River north of the Hamilton Hotel. The type section lies eight miles north-east of Dover Homestead at latitude 22°32'S., longitude 140°50'E.

Over most of the eastern half of the Boulia 4-mile area the Wilgunya Formation forms rolling soil-covered plains. Laterite cappings near the eastern margin of the area form flat-topped hills about 60 feet to 80 feet above plain level. On the western side the formation forms lateritized rises and low scarps. Outcrops of the fresh rock are rare; they occur in steeply incised creeks and on the sides of laterite-capped hills. Bores show that the characteristic blue clay of the formation underlies younger rocks in the southern part of the Boulia 4-mile area and extends in a large tongue, northwards, under the broad valley of the Burke River. The leached and silicified siltstone forming hilltops grade downwards into the blue "claystone." Other outcrops occur in the west as a belt 20 miles wide extending from Valley Creek in the north to the edge of the sheet in the south; this belt is strongly dissected in the north and moderately dissected in the south. Outcrops occur at the De Little Range and as low rubble-covered hills to the west. In the centre and eastern part of the area, outcrops extend from the Sheet boundary in the north, to Cazna Downs in the south. They form dissected plateaux with steep escarpments on the eastern side, e.g. Brighton Gap area. Lateritized outliers east of the escarpment form steep-sided buttes and hillocks (see figures 1 and 2, plate 7). Two inliers of the formation occur west and north-west of Black Mountain in Noranside Limestone.

The lithology is predominantly a poorly indurated claystone with irregular lenses of siltstone up to 30 feet thick; the lenses are prevalent on the west side of the Hamilton River; they are not mapped separately but included in the Wilgunya Formation. A large lens of limestone which crops out along the eastern bank of the Hamilton River was mapped separately as the Toolebuc Member. Gypsum veins and crystals are common in the claystone.

The 120 foot section exposed eight miles north-east of Dover Homestead is the type locality, and a further 630 feet has been penetrated in the nearby Ten-Mile Bore. The section in descending order is: -

8 feet:	Ferruginous laterite cap
20 feet:	Claystone and siltstone, silicified and mottled.
5 feet:	Claystone, red-brown, hard.
15 feet:	Claystone, white massive, no limonite.
20 feet:	Claystone, white and grey, greasy with limonite disc-shaped conrretions up to 18 inches in diamater.
6 inch:	Limonite band.
25 feet:	Siltstone, massive white with barytes nodules and irregular limonite veins. Sample B731).
20 feet:	No outcrop, clay and siltstone rubble.
10 feet:	No outcrop.

The bottom of this section finished at the Ten Mile Bore, the log of which gives a section of the rest of the formation:

10 feet:	Soil and clay.
70 feet:	Clay, yellow (may include Toolebuc Member)
20 feet:	Shale, blue.
530 feet:	Shale, black with some sandy lenses.
	-------------
60 feet:	Sandstone - Longsight Sandstone, aquifer.

At B195 in the south-east corner of the Sheet, near the Lucknow to Springvale road, a 90 foot section of horizontal beds was measured in a hill capped by silicified sub-soil breccia. The top 70 feet were siltstone overlying 20 feet of claystone containing gypsum plates, with a prominent one foot bed of brown sandstone at the base. Although the 1953 Queensland Geological Map shows Upper Cretaceous Winton Formation in this area, we have not been able to recognise the Winton unit in the area mapped on the Boulia Sheet, however, the top 70 feet which contains ferruginous concretionary siltstone and ?glauconitic sandy siltstone beds, maybe the Winton equivalent.

The rocks underlying this section form rolling soil-covered plains; the few exposures seen are of blue clay with small lenses of sandy limestone and laminated siltstone. Small irregular gypsum veins and calcite nodules up to one foot in diameter are common in the blue clay. Bores within seven miles to the north, west and south of this locality have penetrated more than 1000 feet of blue clay with intercalated thin sandstone beds.

Ten miles north-east of Toolebuc Homestead, a similar 60 foot thick section of siltstone and claystone, with gypsum plates occurs; it is capped by 5 feet of laterite.

The Wilgunya Formation thins from 750 feet at the type locality east of the Hamilton River, to 155 feet in Carbo Bore (7 miles north-east of Pathungra Homestead) and to 120 feet further west at B705 and B706 on Momedah Creek, half a mile west of Momedah Anticline; it thickens again west of Black Mountain and thins further west near Alderley Homestead; the No. 3 Bore, in the south-east corner of the Sheet, where 1140 feet of "Shale" (drillers terminology) was penetrated before entering "sandstone and clay" of the Longsight Sandstone aquifer. The lithology also changes from predominantly claystone in the east, to siltstone and sandy siltstone with thin, but prominent, bench-forming sandstones in the Momedah area.

The 120 foot section at B705, Momedah Creek is typical of this change in lithology:

Top 80 feet:	Siltstone, white, massive.
3 feet:	Sandstone (B706 sample), fine grained, ferruginous, bench-forming.
5 feet:	Siltstone, purple and white, sand grains, some ?radiolaria.
5 feet:	Claystone (B705c sample) grey, foraminifera.
2 feet:	Sandstone, Medium-grained, grey, no glauconite, bench-forming.
10 feet:	Claystone (B705b), grey with gypsum crystals, foraminifera.
2 feet:	Sandstone, medium-grained, white, well-rounded grains.
10 feet:	Claystone, (B705a) benthonitic, grey with gypsum veins, forams.

The base is concealed by alluvium, but two miles north of here at B152, 60 feet of a similar section overlies 25 feet of Longsight Sandstone consisting of red, ferruginous, feldspathic sandstone with a coarse (6 inch cobbles) conglomerate at the base. At B152, the top-massive siltstone is only 20 feet thick but the thin bench-forming sandstone below the siltstone still persists, and can be used as a mapping marker in at least the Momedah-Brighton Gap area.

At B150, 17 miles north-north-west of Warenda, 95 feet section predominently of white, yellow or ferruginous siltstone was measured and overlies a bench formed by one foot of sandstone with 20 feet of claystone at the base; this section is important as the siltstone bed immediately above the sandstone bench contains marine Cretaceous pelecypods and gastropods (B150a).

For nearly fifty miles along the escarpment which trends parallel to, and 5 to 10 miles west of the Hamilton River, the sections are similar, with a massive siltstone unit up to 80 feet thick, on top overlying a strong bench-forming 3 to 5 foot thick ferruginous sandstone unit (which may have been glauconitic before weathering) and this in turn over about 20 feet or more of claystone; in some exposures the underlying Longsight Sandstone is visible at the base below the claystone.

On the west side of Black Mountain, the section is similar to that at Momedah Creek, except more siltstone and sand stone occur.. A representative 95 foot section, 3 miles north of Pyalong Bore (Fort William Station) is as follows:-

Top	65 feet:	Siltstone, white, grey or ferruginous, sandy, micaceous.
	10 feet:	Sandstone, yellow, brown, silty, forms marked bench.
	5 feet:	Siltstone, white and grey, sandy.
	2 feet:	Sandstone, white micaceous.
	10 feet:	Siltstone, sandy, micaceous.
	3 feet:	Sandstone, brown, micaceous.
		Base covered by alluvium.

Further west in the Stockport, Maryvale, Alderley area, the Wilgunya Formation forms a similar escarpment range as it does near Momedah-Brighton Gap, and Dover Homestead - Lucknow areas. In this western area (Alderley) the unit becomes thinner (about 50 feet exposed) with siltstone and sandstone interbeds, and much of the section is characterised by silty sandstone or sandy siltstone beds. A representative 55 foot section is exposed 4 miles west of Bengeacca Bore, Alderley.-

20 feet:	Siltstone, brown, yellow or purple, sandy.
2 feet:	Sandstone, fine-grained, silty.
5 feet:	Siltstone, multicoloured, sandy.
3 feet:	Sandstone, red-brown, fine-grained.
20 feet:	Siltstone, multicoloured, some beds sandy.
5 feet:	Sandstone, yellow-brown, medium-grained, well-sorted, micaceous.

At the De Little Range the section is predominantly siltstone, 55 to 70 feet thick, capped by 5 feet of chert breccia which is silicified and mottled (Plate 8, figure 1), with the basal beds containing veins of gypsum, which on weathering appear like soft "fossil wood"; the basal unit at De Little Range is separated by a thin coarse conglomerate form the underlying Pomegranate Limestone .

One mile west of the Dam Bore, Stockport, 75 feet of siltstone, sandy siltstone, and sandstone crop out, and the bore log suggests a further 170 feet of Wilgunya Formation.

Except at the Momedah Anticline and inthe hills west of Alderley Homestead, the Wilgunya formation is either gently folded with dips of one to two degrees, or else it is horizontal. It has been affected by the fault at Momedah giving dips of up to 60 degrees near the fault; dips up to 25 degrees to the east occur west of Alderley where the sediments have been draped over a Palaeozoic high and has been folded along rejuvenated older fold or fault lines.

Very few macrofossils have been collected from the Wilgunya Formation except in the Toolebuc Member; the macrofossils have been found in sandstone, sandy siltstone or siltstone beds and not in the claystone. Evidence for the Lower Cretaceous age of the macrofossils is given in Appendix C.

<u>Toolebuc Member</u> (of the Wilgunya Formation) Casey (1959) -

The Toolebuc Member consists of laminated and thin-bedded sandy calcarenite, calcarenous siltstone and coquinite within the Wilgunya Formation; many calcareous "concretions" weather to the surface.

The name is derived from Toolebuc Homestead, which is near the north-eastern corner of the Boulia 4-mile sheet area.

The Toolebuc Member crops out along a broad belt one to four miles wide, which follows the eastern bank of the Hamilton River. It is poorly exposed and forms rolling soil-covered plains which usually have numerous scattered concretionary boulders on the surface. In places the outcrop is marked by low rises and ridges.

At the junction of Warburton Creek and the Hamilton River the member consists of a laminated and thin-bedded sandy calcarenite and coquinite. A prominent feature of the limestone is the spherical boulders which weather out at the surface. These boulders always show traces of the original bedding but are more compact than the enclosing rock. They show no signs of concretionary structure and are probably formed by solution and re-deposition of calcite after diagenesis.

Slumped beds of calcarenite showing dips of up to 80^{o} occur in areas of horizontal bedding, e.g. two miles east of ABC bore on Lorrett Downs Station.

In outcrop the thickness of the member is probably nowhere more than the 30 feet measured in low rises on the east side of the Hamilton River near Toolebuc Homestead and on the Hamilton to Winton Road. The member is a lens within and probably conformable with the claystone of the Wilgunya Formation. It is not recorded as any lithological or drilling change in the drillers logs of water bores, but as it contains a uranium mineral on the fish scales and bones, which gives the rock a three to four times background count, the member should show well on a gamma-log of the water bores.

The member occurs near the western edge of a marked and continued, eastward thickening of the Wilgunya Formation, and the member may mark the edge of shallow water conditions on the western margin of the Great Artisian Basin and represent an off shore bar, or zone with prolific organic growth in an otherwise muddy sea.

The Toolebuc Member is lower Cretaceous with an assemblage similar to the Tambo Formation; it is richly fossiliferous with many Inoceramus shells and plates, some ammonites and Aucellina, foraminifera (Globigerina) and radiolaria. See Appendix A and C for further descriptions.

Relationships of the Cretaceous Formations.

The two dominant lithologies of the Lower Cretaceous- the sandstone of the Longsight Sandstone, and siltstone/claystone of the Wilgunya Formation, form a variable, and in places mixed sequence in different parts of the Boulia 4-mile area.

Longsight Sandstone: the sands and conglomerate with, in places, silty penses of the Longsight Sandstone are transgressive over an irregular pre-existing land-surface of Precambrian and lower Palaeozoic rocks: they represent a shoreline deposit of an advancing sea (advancing from the south-east) which swamped lacustrine and brackish water lakes that formed on the land surface before the advance of the sea; in these lakes were trapped the plants and wood now found in some outcrops. The sea first covered the southern and eastern parts of the Boulia 4-mile area, extended north in the valley where the Burke River now is, and finally covered the higher land in the west and the ridge of Lower Palaeozoic rocks in the centre. As the sea deepened or transgressed, finer sediments of the Wilgunya Formation formed over the coarser marginal sediments of the Longsight Sandstone. The age of the Longsight is expected to vary; it will be older in the central part of the Great Artesian Basin and in the lakes existing on the margins prior to their inundation by the sea, and will be youngest at the points of farthest extent of the transgression particularly where overlain by Wilgunya Formation. In the Boulia area, we may expect the age to vary from Upper Jurassic, where isolated lakes occurred, prior to the seas transgression, to lower Cretaceous (Aptian) as the sea reached its widest transgression

Wilgunya Formation: it is thickest in the south-east where claystones predominate, thins towards the centre of the area where siltstones and sandy siltstones occur, and pinches out over the Burke River Structure and in the west, where sandy siltstones predominate; it also extends northwards under recent deposits in the Burke River valley.

Except in the Toolebuc Member, macrofossils are not common in the Wilgunya Formation. Whitehouse (1954) referred to clays of the Tambo Formation forming the margin of the Great Artesian Basin in the Boulia area; these clays would be the Wilgunya Formation. The pelecypods and gastropods collected from the Wilgunya Formation (stratigraphically below the Toolebuc Member) suggest a Roma rather than Tambo age, whereas the Toolebuc Member fossils suggest a Tambo age. It is possible that the Toolebuc Member represents the break between Roma and Tambo forms, but the Wilgunya Formation on present knowledge can not be broken lithologically into two scoarate units, the one below the Toolebuc with Roma-type macrofossils, the other above the Toolebuc with, at present no macrofossils.

Further work in 1958 found ammonites in the south-west continuation of the Toolebuc Member onto the Springvale and Mt. Whelan 4-mile Sheet; these ammonites may accurately date the Toolebuc age.

Miss Crespin (pers. comm.) has not yet been able to show differences in the microfossils from either the Roma or Tambo Formation in their type areas or from the Boulia area. Her determination of the microfossils is given in Appendix A.

Until more detailed palaeontological and geological work is done in the Boulia area, or until mapping has positively traced the units through to the Roma and Tambo type areas, Whitehouse's lower Cretaceous divisions cannot be used in the Boulia area; undoubtedly the Wilgunya Formation is the lateral continuation of part, or both of the Roma and Tambo Formations, and the Longsight Sandstone is related to all or part of the Blythesdale Group, but which in places contains Roma-type fossils.

TERTIARY

Marion Formation (Casey, 1959).

The Marion Formation consists of silicified sandy quartz siltstone resting unconformably on lateritized Cretaceous Wilgunya Formation. Its top is the present erosion surface.

The Marion Formation is named from Marion Downs Station, 40 miles south-south-west of Boulia; the hills west of the station are capped by the formation.

The reference section is 5 miles north-west of Strathelbiss Homestead, 14 miles north of Boulia, and one and a half miles east of Six Mile Creek, at Latitude 22°44' south, Longitude 139°47' east.

The formation crops out as a north-south belt extending from Windsor Park in the north to Boulia in the south, along the west bank of the Burke River; the maximum width is about 7 miles. It is separated by the gravels and alluvium of the Burke and Georgina Rivers from the hills on Marion Downs Station west of the Georgina River.

Rounded pebbles of weathered Marion Formation blanket the area, and it is pebbles of this formation that form most of the gibber plains south towards Lake Eyre. The formation produces an undulating, partly dissected grassy plateau with gentle slopes. In places the underlying siltstone of the Wilgunya Formation is exposed. To the west of the main area of outcrop, the Marion Formation and part of the underlying Cretaceous siltstone have largely been stripped by Mucklandama and Limestone Creeks, leaving residuals of siltstone capped by the Formation. Rubble derived from the sandstone of the formation is spread over the intervening low country.

The unit consists mainly of sandy siltstone containing sand grains which vary from fine-grained to coarse-grained; the sand grains vary in concentration so that in places the rock becomes a silicified sandstone or silty sandstone. The sand grains are sub-angular to sub-rounded, some of which are frosted. Chemical analysis of the "silt" matrix shows a low percentage of argillaceous matter - most has apparently been replaced by silica, as in all localities the rock is strongly silicified and much of it is ferruginized. The rock breaks cleanly, has a vitreous lustre, and gives the general appearance of a "billy". Where it is ferruginous, thin sections show that the deposition of iron oxide preceded silicification; individual grains are coated with iron oxides a silica mineral (with the fibrous pattern of chalcedony under crossed nicols but with the relief of opal) fills the interstices.

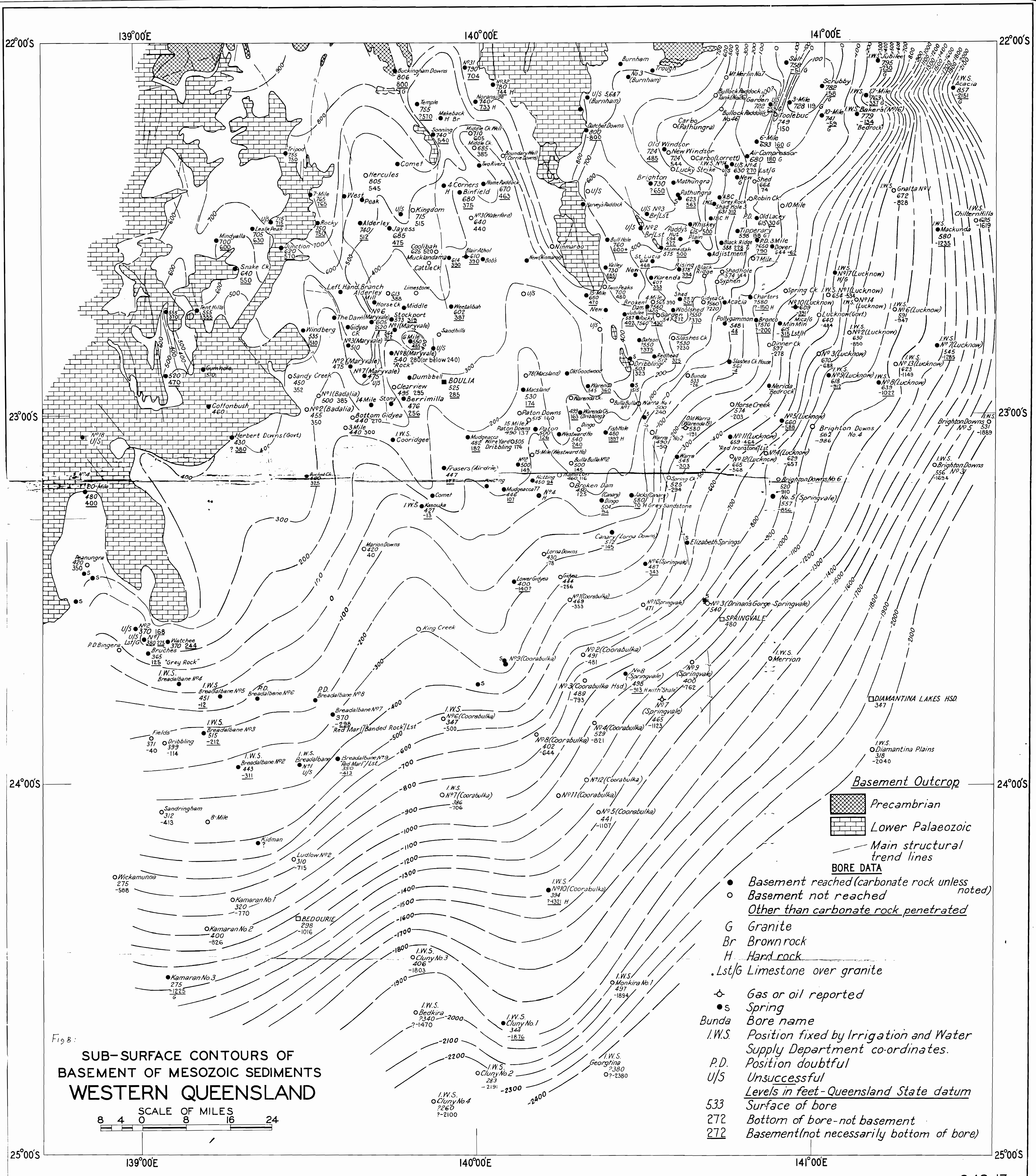


Fig 8:

SUB-SURFACE CONTOURS OF BASEMENT OF MESOZOIC SEDIMENTS

WESTERN QUEENSLAND

Bureau of Mineral Resources, Geology and Geophysics, Canberra, A.C.T. December 1959. (Amended May 1960)

Q42-17

Although in hand specimen the rocks resemble a "quartzite" and break evenly through grains and matrix, it is a silicified sandy siltstone and there is no optical continuity nor intergrowth between the grains and matrix.

Good outcrops of the rocks occur throughout the area. About 20 feet was measured on the west bank of the Burke River, three-quarters of a mile north of Corrie Downs and five feet is exposed overlying a "laterite" developed on Cretaceous siltstone in a gully crossing the Fort William to Ninmaroo road, two miles south of Fort William Homestead. Conifer wood occurs in the five feet of exposed formation five miles north-west of Strathelbiss Homestead where it again rests on lateritized Cretaceous siltstone. In the outcrops half a mile south-west of, and one-quarter of a mile south-east of Edges Bore, and two miles north-west of Kingdom Bore, Alderley Station, five feet of fine-grained sandstone overlies five feet of a coarse-grained sandstone containing rounded quartz pebbles, which rest on lateritised Cretaceous Siltstone.

At the type locality, about 15 miles west of Marion Downs Homestead at S20 (on air photo 5041, run 5, Mt. Whelan Sheet), 20 feet of section was measured; the silicified silty sandstone at the top gives an "ant hill"-like weathered appearance, the structure of which may have an algal origin. The base rests on an eroded, silicified and ferruginised Cretaceous siltstone with pieces of this siltstone in the overlying Marion Formation.

Most of the "gibbers" over the plains south of Boulia are disintegrated Marion Formation.

The Marion Formation forms a medium to thick bedded deposit with some current bedding, with a very coarse sandstone at the base. Jointing produces a blocky surface and the effect of weathering on the blocks produces rounded detrital material.

The formation is sub-horizontal and unconformably overlies the Cretaceous Wilgunya Formation, which was lateritised and partly eroded before the deposition of the later sediments. The relationship of the sandstone to the Noranside Limestone, which was deposited to the east, is not clear as the contact is obscured by the alluvium of the Burke River. On Windsor Park, where the two crop out together, the boundaries are obscured by rubble, but the Noranside Limestone at least in part, overlies the Marion Formation.

The formation is considered to be a freshwater and aeolian deposit derived from streams draining from the Cretaceous clastic rocks in the west into a Tertiary lake which covered much of the western part of the Boulia 4-mile sheet.

The maximum thickness observed is 10 feet, but a total thickness of 30-50 feet is estimated. There is insufficient evidence for any correlation of the Marion Formation with existing Tertiary formations although it is lithologically similar to the Eyrian Series as developed near Lake Eyre in South Australia and to the Moonie Formation of the Inglewood (S.E. Queensland) area.

Fossil conifer wood is found in the formation or as pieces on the surface with Marion rubble; the wood has a range from Permian to Recent.

Noranside Limestone (New Name). (Casey, 1959).

The Noranside Limestone is the formation of limestone and chalcedonic limestone resting unconformably on the Palaeozoic limestones and the Wilgunya Formation. Its top is the present erosion surface.

The Noranside Limestone is named after Noranside Outstation of Chatsworth Station, situated between the Burke River and Wills Creek, 50 miles north-north-east of Boulia.

No section includes all the rock-types of the Formation so reference areas are given for the two main areas: -

(1) White siliceous limestone in a gully crossing the Boulia-Selwyn road 1.2 miles south of Old Noranside Well, at latitude 22°12' south, longitude 140°04' east.

(2) Pink, red, and white, banded impure limestones in Six Mile Creek, 1.4 miles south-south-west of Six Mile Bore (Corrie Downs) on Fort William Station; 0.4 miles south of an east-west dogproof fence, at latitude 22°27' south; longitude 140°12' east.

The Noranside Limestone crops out in a belt 5 to 15 miles wide, and extends from Noranside in the north to the Hamilton River in the south-east. Other smaller areas of limestone occur on Burnham Station; another west of Pathungra Homestead; near Maryvale Homestead and east of old Alderley Homestead and south of Wirrilyerna Station off the Boulia Sheet. Good outcrops are rare; the limestone usually occurs as numerous flat plates and scattered outcrops on a brown or black soil plain.

Basically all rocks in this sequence are similar; they all consist, or have consisted, of precipitated calcium carbonate, seen in thin section as a darkish mass with varying amounts of crystalline calcite veins. Iron oxides, detrital quartz, chalcedonic silica, and organisms have caused variations in the rock.

Most clastic material is at the base of the sequence. The ferruginous material in the basal 10 feet of the sequence is derived from a redistributed soil. Detrital and pisolitic iron oxides give the rock a pink and red colour; the iron oxides are usually present in minor amounts only but in the lowest bed in the sequence they form about 30% of the rock. Iron oxides in the top of the sequence show only as surface staining of the chalcedonic limestone. Detrital quartz grains are present and are similar to the grains in the Marion Formation. They are at a maximum in the lower levels and are apparently absent at the +

Organisms were important in the formation of the limestone. Microfossils (ostracods and diatoms) with gastropods and unidentifiable remains are common. ?Algae are responsible for many structures - aggregations of lime pellets, laminated structures around detrital nuclei, and numerous dark lines throughout the rock. They may be responsible for the breaking up of the bedding in the lower levels. Some apparent algal structures may however, be travertine, which can simulate organic structu-

An irregular zone of siliceous limestone tops the sequence. This is probably due to a later silicification, but the silica may be primary. Chalcedonic silica, and sometimes opal, occur in veins and appear to be replacing the crystalline calci- leaving the finer material unaltered. In this zone, the rock has a "breccia" appearance on the fresh surface, but on exposed surfaces, the silica weathers out as an iron-stained cellular mass. The general sequence is:

Quaternary soil

Irregular siliceous white limestone capping

Non-siliceous white limestone

Grey "earthy" lime and white limestone with included ferruginous matter, which is probably equivalent to

Pink and white limestones containing fossils

Impure calcareous rocks (redistributed ferruginous soil).

Good exposures of the various lithologies occur at the following localities:

1. In the type area near Old Noranside:
   40 feet limestone, siliceous (chalcedonic) white
2. Middle Creek one mile south of Noranside Homestead:
   5 feet, limestone, crystalline, white containing ostracods (B332).
3. One mile NNE of Middle Creek Well (Noranside):
   Top 15 - 20 feet limestone, siliceous white;
   lime, "earthy" grey with some ferruginous matter.
4. In reference area on Six Mile Creek;
   Top limestone, siliceous white
   10 feet no outcrop
   4 - 5 feet limestone, impure, red, white and pink
   1 - foot redistributed ferruginous soil.
   The impure limestone contains poorly preserved diatoms.
5. At a fence corner 1.4 miles north-west of Six Mile Bore on Corrie Downs, B137) pink and white banded limestones crop out and contain a thin shelled, turretted gastropod (?*Bulinella* sp.), ostracods and diatoms (*Diploneis* cf. *eliptica*, *Epithema* sp., *Navicula* sp.)

   Low rises of cellular opal which crop out 2 miles south-east of Limestone Bore on Alderley Station, on Stockport Station one mile north-east of Six Mile Bore and as scree 6 miles west of Boulia are probably spring deposits, and may be equivalent in age to the Mt.Coley Sinter (Mt.Whelan 4-mile area).

Bedding in the Noranside Limestone is indistinct; the lower parts of the sequence show a fine but often irregular bedding. The flat plates of siliceous limestone may be an expression of the bedding, The limestone dips very gently to the south. It is overlain by alluvium of two ages, the later one being that of the present river system.

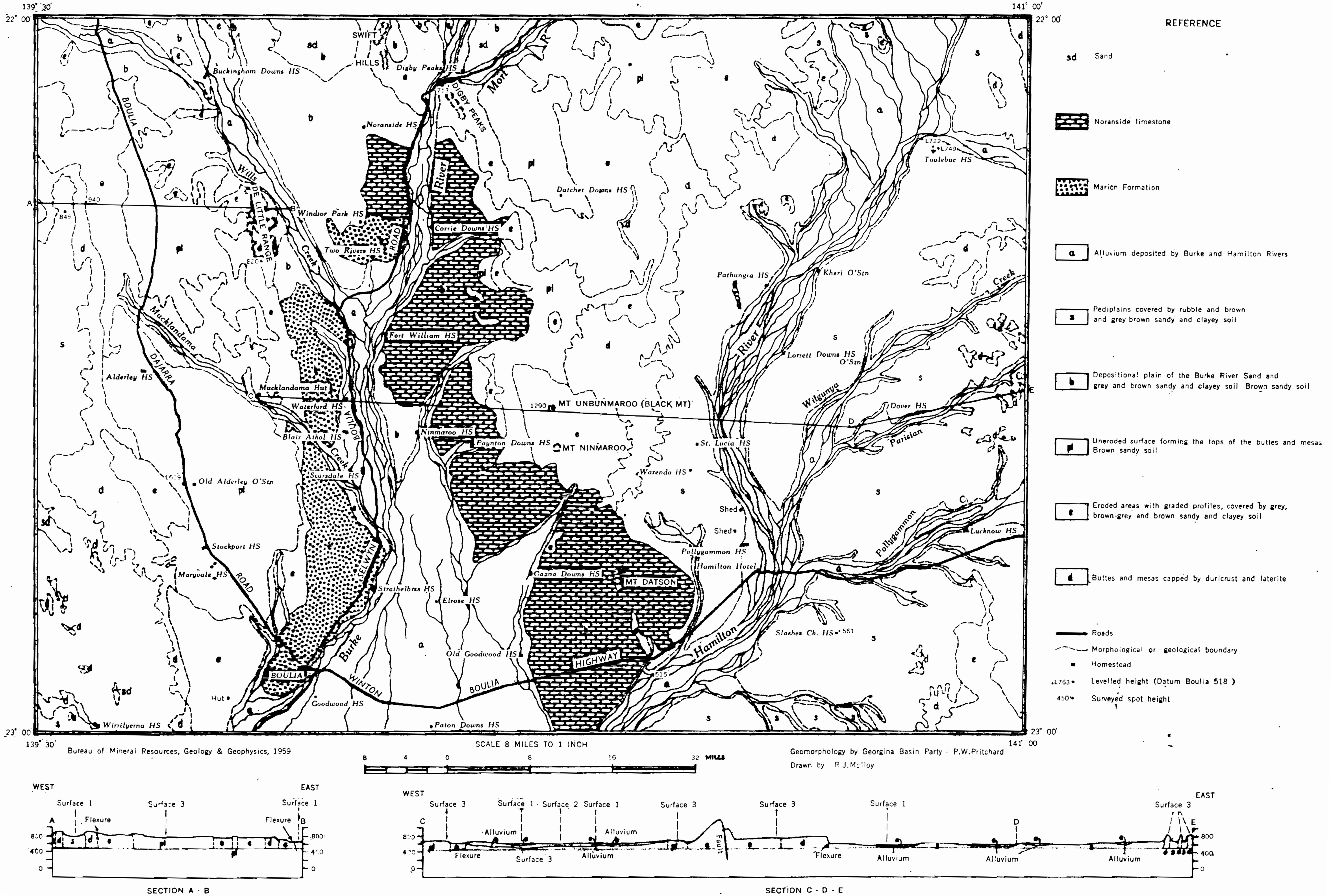
The Noranside Limestone was deposited in a lake which formed in the Burke River valley, and extended from the Hamilton River in the south-east to Digby Peaks in the north. The lake was cut off from a northern lake developed in the Duchess 4-mile area by a ridge of Palaeozoic Limestone near Digby Peaks. A smaller lake formed on Burnham Station. The lime-rich water for the lakes probably came from springs issuing near the junction of the Cretaceous sediments and the Palaeozoic limestones or from the fractured limestones along the Burke River Structure. Lakes of this type can be caused by tilting in the opposite direction to this river flow or by faulting across the valley with the down-throw upstream.

Its relationship to the Marion Formation, which it overlies at least in part, is not clear. Both are lake deposits, and may possibly have both been deposited in the same lake: but no gradation between the two formations has been observed and the limestone is not appreciably richer in quartz grains near outcrops of Marion Formation. Both were formed in linear valleys, which apparently have different trends - the Noranside Limestone trending south-south-east and the Marion Formation south-south-west. On this evidence it is suggested that during a period of erosion after the deposition of the Marion Formation the Burke River shifted to a position further east along the western margin of the Burke River Structure, and within this new valley the Noranside Limestone was deposited.

All lakes in the area were destroyed by a slight tilt of about five minutes to the south (measured on the surface of the Tertiary limestones over 100 miles), combined with gentle meridional warping. This tilting, which is of more than local importance, initiated the present Burke River System. It destroyed the springs, leaving the mud springs near Dribbling Bore, where an extensive lime-pan deposit is forming at the present time, as the most northern leakage of artesian water in this area.

GEOMORPHOLOGICAL UNITS OF BOULIA AREA

FIGURE 9



The diatoms present are identical, (Crespin, personal communication) with a flora found in deposits at Innot Hot Springs in north-east Queensland, at South Yarra in Victoria, at Eight Mile Creek in South Australia and in various spring and lake deposits in south-west Western Australia. This flora suggests a very late Tertiary or early Quaternary age (Crespin, 1947).

GEOMORPHOLOGY

The distribution and most of the outlines of the geomorphic units are controlled by two lineations, one trending north-west, and the other trending east-north-east to north-east. The flexures and faults affecting the Cretaceous sediments in the area trend north-west, but no structural features have been recorded in the east-north-east/north-east direction, although the tilt of the lake in which the Noranside Limestone was deposited is nearly normal to it.

Post-Cretaceous erosional and depositional surfaces are the most important in the present landscape of the area. Older erosion surfaces do occur. The unconformity between the Lower Palaeozoic and the Cretaceous sediments is at present being stripped and dissected in the vicinity of The Bluff and south of Valley Creek on the road from Buckingham Downs to Buckley's Tank. In these localities the Lower Palaeozoic siltstone and very fine-grained sandstone beds near the unconformity are ferruginized and silicified. On the western side of the Swift Hills, at the northern end of the outcrop of the Ninmaroo Limestone, the carbonate beds have been silicified, and manganese stains are abundant. The surface marked by these phenomena is probably the unconformity between the Ninmaroo Limestone and the Swift Formation.

Of the post-Cretaceous land surface the oldest is the surface formed by the laterite and duricrust (surface 3, fig.9), which caps the buttes on either side and the mesa on the western side of the Hamilton River. This surface slopes to the south and west. Westwards it forms the plains adjacent to the belt of hills running from the Swift Hills to Mt.Unbunmaroo, and farther west it is covered by the sediments forming the plains about the Burke and the Mort Rivers and Wills Creek. It reappears on top of the plateau west of the Burke River. In the Burke River area it is covered by the Marion Formation and the Noranside Limestone, which are lake deposits in what is now the broad valley of the Burke River. They pass northwards into and are partly overlain by grey, grey-brown and chocolate soils and by areas of sand. Fossil evidence indicates that the lake existed during late Tertiary or early Quaternary times.

At the present time in the south, the depositional surface 2 (fig.9) of the Marion Formation and the Noranside Limestone is being covered by alluvium deposited by the Burke River; and in the west, on both sides of the Hamilton River. Contemporaneously plains are being formed (surface 1, fig.9) that are similar to the pediplains described by various authors (see Balchin & Pye, 1956).

At some time between the Lower Cretaceous and the late Tertiary the Lower Cretaceous sediments were uplifted and lateritized and silicified. The surface so formed was faulted and upwarped and tilted to the west. A lake then developed in the valley now occupied by the Burke River, and the Marion Formation and the Noranside Limestone were deposited in it, while to the north deposits of grey and brown-grey soils and red sand were forming. Subsequently this area was tilted to the south, the lake was drained, and the present drainage system was initiated. The Burke River occupies the area in which the lake previously existed; the Hamilton River in the east, and the Georgina River (Glenormiston four mile area) in the west, are dissecting the post-Cretaceous laterite and duricrust surface. At the present time an alluvial plain is forming in the central southern part of the four mile area.

Erosion features associated with the fluvial erosion cycle are developed in the plains about the Burke River, on part of the plateau in the western side of the area, and west of the mesas in the eastern side of the area, but elsewhere the surface is being formed by pediplanation and stripping.

Graded erosion profiles are formed on the folded Lower Palaeozoic carbonate rocks except on the eastern face of Mount Unbunmaroo, and, where the relief is less than 50 feet, similar profiles are formed on flat-lying Cretaceous sediments. However, non-graded profiles associated with pediplanation are formed on flat-lying Cretaceous sediments where the relief is greater than about 50 feet.

It seems then that some of the factors affecting the distribution of the two types of erosion processes in the Boulia four mile area are:

(i) lithology
(ii) structure
(iii) the relief in the eroded areas
(iv) presence of a resistant cap.

STRUCTURE

BURKE RIVER STRUCTURES

The main structures in the area are the "Burke River Structures" first recognized and named by A.A.Öpik in 1954 on the Duchess Sheet, he traced them by photo-interpretation across the Boulia Sheet. Öpik (1957) in referring to the structures "as previously observed on Duchess Sheet and reconnoitred on the Boulia Sheet" stated that "they should be considered a prominent tectonic belt of a post-Ordovician age".

The Burke River Structures are the north-south-trending belt of structures which extends from the trough of Middle Cambrian sediments on the Duchess Sheet south across the Boulia Sheet and will include all structures east of the main Burke River and will incorporate such structures as may appear in or through the Mesozoic cover in this area; but the term is not used for those structures west of the Burke River.

Öpik in a paper "Cambrian and Ordovician rocks of Queensland" to be published in 1959 in the Geological Society of Australia publication of "the Geology of Queensland", will refer further to the Burke River Structures.

The main western line of the Burke River Structures runs from near Duchess (the Pilgrim Fault), south near Mt.Birnie, through Signal Hill, west of Digby Peaks to Black Ridge, and south through Black Mountain, Mt.Ninmaroo, Mt.Dawson and Dribbling Bore, with its surface expression visible farther south at Elizabeth Springs and south-west of Springvale; the most southerly outcrop of lower Palaeozoic sediments on this line is at Dribbling Bore.

The main eastern line of the Structures shows near Limestone Creek (Duchess) and continues south past Chatsworth Station to the east of Limestone Bore (Burnham), east of Datchet Downs homestead to Momedah Creek and Momedah Bore, where it is concealed by alluvium of the Hamilton River.

In the <u>Signal Hill Area</u> east of Bore 34, Noranside, the Burke River Structures are represented by faulted and folded dolomitic limestone of the Ninmaroo Limestone, extensive dolomitisation has occurred near the fault and a metasomatic lead deposit has been formed in dolomite which is fractured and forms the core of a tight anticline.

<u>Black Ridge</u> (12 miles north of Black Mountain) is an elongated area of Ninmaroo Limestone which is brecciated and dolomitised; it appears to be faulted on the east side against Swift Formation and dips low to the west on the western side; no fault plane was observed.

In the Black Mountain - Mt.Ninmaroo area Ninmaroo Limestone and Chatsworth Limestone are exposed; they have been folded and subsequently faulted. The fault plane dips steeply east and the sequence is downthrown about 1,000feet to the east; dolomitisation and brecciation has occurred near the fault line. The dolomite beds which dip west and are well exposed to the west of the fault and which mark the base of the Ninmaroo Limestone in this area are probably the stratigraphic equivalent of beds which show brecciation and secondary dolomitisation east of the fault. Within two miles of the fault on the east side the dips decrease from near vertical to horizontal and then reverse to form a shallow syncline with dips up to 1° to the west.

The fault cuts off the eastern part of a dome in which Chatsworth Limestone is exposed and juxtaposes it against Ninmaroo Limestone to the east. The dips on the west side of the fault are up to 35°, but they flatten rapidly to 10° within about 50 yards and then gradually decrease to sub-horizontal as the distance from the fault is increased.

Capping the Swift and Ninmaroo units at B519 is about 30 feet of lateritized sandstone with a conglomerate near the base. The conglomerate has boulders which contain fossils of Ordovician age; these fossils are not like those from the Swift or Ninmaroo units but are younger and resemble those from the Toko Range area. (J.G.Tomlinson pers. comm.) This conglomerate and sandstone is interpreted as being part of the Cretaceous Longsight Sandstone which crops out nearby on the east side of the fault, but at a level 600 feet lower. If the correlation of the units is correct, the Cretaceous has been displaced vertically 600 feet by post-Cretaceous movement. Post-Cretaceous movement can also be demonstrated in the Momedah Anticline.

Mt.Datson - Dribbling Bore: The structure line through Black Mountain also passes through Mt.Datson and Dribbling Bore; it continues to the south on the Springvale Sheet, where it disrupts Cretaceous strata. Pressure water escaping along this line may have formed lakes in which the Tertiary Noranside Limestone and the deposits near Springvale homestead were deposited.

Dolomitisation and brecciation occur in beds near the fault line at both Mt.Datson and Dribbling Bore; downthrow is to the east and the beds west of the fault dip 40° to the west. Ninmaroo Limestone overlies Chatsworth Limestone at Mt.Datson, whereas only travertinized Chatsworth Limestone is exposed at Dribbling Bore (See Fig.10).

Momedah Anticline: The main eastern line of the Burke River Structures has its best development in the Momedah Anticline (See Plate 10,) which crosses Momedah Creek, 11 miles north of Warenda Homestead; although it is not exposed with such topographic relief as structures at Black Mountain, it nevertheless forms an important structure. Upper Cambrian Gola Beds exposed form the most easterly outcrop of Palaeozoic limestone known in this area.

The Cambrian is folded to an asymmetrical anticline trending north-west with 65° dips on the western limb and low dips to the east; the anticline is faulted on the west and downthrown to the west.

The Cretaceous sediments (Longsight and Wilgunya Formations) have been affected by tectonic forces which formed the anticline; the sediments dip low (2°) to the east, east of the structure, steepen to 75° to the west near the fault and become nearly horizontal west of the fault. A ferruginous (?glauconitic) sandstone bed in the Wilgunya Formation, which forms a bench in this area is displaced about 200 feet vertically by the fault. Brecciation, shearing and silicification occur in the zone of steep dips. Two sets of normal faults with throws of up to 20 feet occur at angles to the main fault line.

The Momedah Anticline line can be traced intermittently to the north-north-west towards Chatsworth; the anticline and syncline developed on the western edge of the type area of the Chatsworth Limestone are regarded as being part of the same line.

Any extension of the structural line south-east of Momedah is concealed by the alluvium of the Hamilton River.

The eastern and western lines of the Burke River Structure form the limits of a graben which has preserved the Cretaceous sediments as well as the Ordovician Ninmaroo Limestone

To the west of Black Mountain other parallel north-north-west trending asymmetrical anticline axes are visible in Cretaceous sediments, but erosion has not dissected the younger beds to reveal the underlying pre-Cretaceous structure; however, dips up to 25° in the Cretaceous sediments are common along these structural lines, compared with subhorizontal dips elsewhere. In the asymmetrical anticlines west of Alderley and Blair Athol Homesteads the eastern limb is the steeper, but near Rocky Bore the steeper limb is the western.

All the structural lines are confirmed by the study of water bore information (see fig.8 and section on hydrology) and by the gravity results from work carried out by the Bureau of Mineral Resources in 1957. More detailed gravity work was done in 1958 and 1959 both by the Bureau of Mineral Resources and (in 1959) by Mines Administration. The 1957 gravity results show a positive anomaly (+25 milligals) 10 miles west of Boulia trending north-west, a south-trending negative anomaly (-10 milligals) east of Buckingham Downs and De Little Range, and a north-north-west trending positive anomaly (+30 milligals) from Noranside towards Black Mountain. These anomalies all coincide with "highs" and "troughs" postulated from surface geological mapping and from a study of water bores.

Although the main tectonic movement has followed the deposition of the Ordovician sediments and preceded Cretaceous sedimentation, at least some folding and faulting has followed the Cretaceous; the direction and place of failure in the Cretaceous beds has been in the direction of previous folds and faults in the Cambrio-Ordovician sediments.

If the folding and faulting has taken place at different times along the same general lines, then if a topographic as well as a structural "high"(such as Black Mountain with a relief of 600 feet) was covered by a thick sequence of younger sediments (particularly shales), the younger sediments would not only develop a structure as a result of compaction over the "high" but would have this structure accentuated as a result of any subsequent folding or faulting which is expected to follow the pre-existing structural lines.

Only broad regional tilting to the south has been postulated in Tertiary times in the Boulia area, but farther south, near the South Australian border, domes have been developed in the Tertiary sediments (probably equivalent to the Marion Formation) (Sprigg, 1958).

Structures visible on the ground in Cretaceous or younger sediments in at least the western part of the Great Artesian Basin may not only be structures in the Cretaceous rocks, but probably reflect topographic relief in the underlying lower Palaeozoic carbonate or Precambrian basement rocks; as the topographic relief (as at Black Mountain) are also structural highs, drilling of structures shown by younger rocks may tap some of the petroliferous lower Palaeozoic strata in high structural positions.

ECONOMIC GEOLOGY

PETROLEUM PROSPECTS

The Cambrian-Ordovician rocks have some of the more important requirements of a petroleum-producing sequence, and if they extend to the deeper parts of the basin an interesting, although speculative, area for petroleum exploration is established. Hitherto the limestones in this area have not been investigated for petroleum accumulations.

As the area is in Queensland, it is covered by the Queensland Petroleum Act of 1923-29, which was amended in 1939 and will be again amended in 1959; an area can be selected under an "Authority to Prospect" which requires the holder to engage in exploratory work for a certain period with an outlay greater than a fixed minimum. For more detailed prospecting, a Petroleum Prospecting Permit is required; if oil is discovered a Petroleum Prospecting Lease is taken out. A permit is for 200 square miles and a lease for 100 square miles, and any one person can hold up to five permits and five leases. Queensland has recently been divided into three zones in the 1959 amendment, and prospect holders can take land in each zone. The area covered by the Boulia Sheet was taken up by Papuan Apinaipi Petroleum Co.Ltd., under Authority to Prospect No.54P, which expires on the 31st August,1961., but it is subject to renewal.

The main conditions for petroleum accumulation are given with reference to the Lower Palaeozoic rocks of the Boulia area.

Source: It is accepted in this report that oil is formed in marine or freshwater sediments by micro-organisms (including bacteria) acting on organic matter (either animal or vegetable) under anaerobic conditions. It has been estimated that preserved fossils represent as little as 5% of the total life that existed in beds - unpreserved plankton forms make up most of the remainder.

Source beds exist throughout the Cambrian-Ordovician sediments in the Boulia area, and M.C. Konecki (Appendix D) has analysed samples which were found to contain the equivalent of 13 barrels per acre-foot of oil extractable by toluene. The rocks are dark limestone with a strong petroliferous smell when first broken. Trask calculated that some organic shales near recognized oilfields yield 19 bbls per acre/foot of oil (Hager,1951, p.7). A strong smell of petroleum was reported by the driller when drilling through Cambrian limestone in a bore 8 miles south-west of Glenormiston in 1910 (Tysons Bore) and mention of this was made by Moss (1932).

Dark shales and marls occur in the sequence, but they rarely crop out and their occurrence is known mainly by referring to logs of water bores.

Shepherd (1945a) reports oil shale from a bore on the main Camooweal-Mt.Isa road, in which the sample from 205 - 206 feet yielded an estimated 15 gallons of petroleum per ton from Middle Cambrian limestone.

<u>Reservoir</u>: Although there are few clean sandstones in the sequence which could act as reservoir rocks, dolomites and limestones, which form prolific reservoir rocks elsewhere in the world, could act as reservoir as well as source rocks. The large oilfields in the Middle East tap limestone reservoirs - the limestone has been affected by tectonic movements. The limestones and dolomites in the Boulia area have been tectonically deformed; they are well jointed, vuggy, cavernous and dolomitized although they show much recrystallization of calcite, at least in outcrop. There are few water bores in tectonically deformed areas because these areas are usually too rocky and hilly to be of pastoral value; so no indication of porosity, permeability, or petroleum content can be given from a hydrological study of the deformed areas. But on Chatsworth, Burnham, and Buckingham Downs Stations, where bores have penetrated a considerable thickness of blue, grey, and dark limestones, the rocks have been too dense to yield water or have yielded small quantities of salt or "stagnant" water; this water has not been analysed for trace petroleum but the authors know of no reports of "oil" or "gas" from the drilling logs. Although outcrops are poor, it is our impression that most of the unsuccessful water bores have been drilled in sub-horizontal, undeformed strata.

Analyses of surface samples of limestone have shown a porosity of less than 4% and a permeability of nil; this lack of permeability is either due almost entirely to recrystallization which probably took place after the beds were tectonically deformed, or because permeability determinations were done on "plugs" cut from the samples.

It is expected that basal sands and sandy lenses will occur at depth in the limestone succession, particularly near granite and Precambrian "highs" shown up by structure contour lines drawn on the basis of numerous water bore logs (see fig.8.)

Traces of "oil" or "gas" have been reported from Lucknow Homestead bore, Warenda 19 and Dinan's Gorge (Springvale No.3) bore, all situated near basement ridges or on structural lines; but it is not clear if the oil came from the basal Cretaceous units or from Lower Palaeozoic sediments overlying granite ridges. However, further west on Glenormiston, drillers report "oil scum" from water bores drilled in upper Cambrian limestones viz. Tysons Bore. In Springvale No.7 Bore, 18 feet of oil shale was reported by drillers at 678 feet.

Cap: Shale, soft marl, and soft calcilutite suitable as cap rocks are known throughout the section.

Structure: The anticline at Black Mountain is probably closed in the Upper Cambrian limestone with a cap of soft calcilutite just exposed at the apex; it is faulted on the eastern side. Several other culminations are indicated along the Burke River Structures, including one on the downthrown side of the fault east of Mt.Ninmaroo.

Although time breaks are known in the Cambrian - Ordovician succession, particularly in the north of the area, at Chatsworth and Digby Peaks, these breaks (indicated in most cases by a break in the fossil record) become fewer to the south in what is expected to be the deeper part of a basin.

Oil and gas, or both, usually in trace amounts, have been found in water bores, as well as in some bores drilled for oil in the Cretaceous shales and Cretaceous -?Jurassic sandy sediments of the Great Artesian Basin. Within this basin in Queensland three smaller basins are recognized: Carpentaria Basin in the north, separated by the Euroka Shelf from the Eromanga Basin in the centre which is separated by the Eulo Shelf and Neebine Ridge from the Surat Basin in the south-east (Mott, 1952).

The Boulia area lies in the west part of the Eromanga Basin and it is only reports of oil or gas in bores in this basin that will be considered here. Mott (1952) gives more information from bores in other areas of the Great Artesian Basin.

The Cretaceous sediments are not very thick in the Boulia area, but they thicken rapidly to the south-east and east where they are 1,800 feet thick east of Lucknow (No.7 Bore). The Winton Formation is not recognised as a mappable unit in the Boulia area but Mott (1952) reports that these freshwater deposits have yielded methane but no oil or wax. The Tambo and Roma Formations (viz. Wilgunya Formation and maybe part of the Longsight Sandstone in Boulia area), despite Reeves' (1951, p.2519) statement that "no trace of oil has been encountered in Cretaceous sediments in 5,000 water wells", the marine sediments have yielded traces of oil or gas from many localities in the Eromanga Basin. Oil was found at Stainburn III, Delta N.II, Cleeve, and Tallyabra, gas and wax were reported from near Barcaldine, wax in Springleigh III bore, dry gas in Windorah bore and at 3,270 feet in Bulgroo I (north-west of Quilpie) where pressure was 800 lbs/sq.inch.

The Blythesdale Group (viz. at least part of Longsight Sandstone) is a widespread aquifer containing marine, transitional and freshwater sandstones. Many occurrences of oil or gas are attributed to this unit and referred to as "at the base of the Cretaceous Shales", or "in the aquifer" or in "?Jurassic sandstones". Mott (1952) reports oil from this formation at Kingsborough and Stainburn III near Aramac, at Westland III, Cairnhope II and at Knockaninny near Barcaldine; he reports petroliferous gas at Ruthven I, Binoch II, Langdale and Elderslie I and inflammable gas at Westland II; oil and gas were reported at Lucknow. As well as Lucknow and Warenda 19, Mott's map also shows Bedourie as a "showing of oil or gas not confirmed by analysis but considered important and authentic."

An explanation of the reported occurrence of oil or gas from bores near Boulia is appropriate:

1. Lucknow 10.	Referred to by Moss (1932) as a "small amount of oil met with while drilling" for water. It is figured on locality maps by Gray (1938), Wade (1950) and Mott (1952), who refers to it in the text.
2. Warenda 19.	Figured as occurrence of "gas" on the compilation map of Artesian Basin bores by Moss (1932) and is on the map by Mott (1952). This bore has since fallen in, but local people report "gas bubbling" from the bore.
3. Springvale 3. (Dinan's Gorge)	Occurrence of gas is mentioned in the Irrigation and Water Supply (I.W.S.), Brisbane, logs.
4. Springvale 7.	18 feet of brown oily shale is mentioned in I.W.S. logs and Station records.
5. Blair Athol Homestead.	Station owner reported "a strong oil smell when bore drilled.
6. Kheri Station.	This seems to have been included in error in Condon et al. (1958, table 1a) as the co-ordinates given in I.W.S. logs are wrong and this bore is in fact Springvale 5, which has no record of oil or gas . The I.W.S. logs or Station logs do not show gas in the "Kheri Bore", so the origin of "gas" is not known.

Moss (1932) reports that paraffin wax and petroleum gas have been found in Lower Mesozoic rocks underlying Marine Cretaceous in 17 Artesian bores which include Barenya 5 (total depth 2200 feet), Ensay I (1964 feet), Evesham I (4150 feet), Delta Oil Bore, Thomson watershed (3319 feet), Portland Downs 3 (4163 feet), Thornleigh (4003 feet), Warbreccan (4333 feet), and some mentioned by Mott 1952. Moss however, also mentions that there has been no definite occurrence of free oil in

Artesian bores rilled in Cretaceous rocks except perhaps Elderslie 14, which encountered ?bitumen at 300 feet in Winton Series, and Oakley (10 miles north-east of Longreach) where oil was found at 1700 feet, 250 feet above the Jurassic; but he regards these occurrences as probably from kerosene shale, which does occur in the Cretaceous.

TABLE 5.

SOME BORES WITH TRACES OF PETROLEUM - EROMANGA BASIN

Name	Location	Surface Elev.	Depth Feet	Formations	Petroleum
Roma-Tambo					
Tallyabra	45 m.W. Quilpie	?	2580	Cretaceous	1489' Oil (Mott 1952)
Springleigh III.	50 m.W.S.W. Blackall	968	7009	0-34 Tertiary -3257 Cretaceous -3540 Jurassic -3679 Triassic -4515 Permian	2500' Wax. (Mott 1952)
Cleeve	10 m.E. of Longreach	720	3000	0-23 Tertiary -2110 Cretaceous -3000 Jurassic	1500' traces oil in brown shales and sands. (Mott.1952).
Blythesdale					
Bimerah II	65 m.S.W. Longreach	590	4310	0-3250 Cretaceous -3910? Jurassic	3550'pet.in sands from gas mainly CO_2, (Mott 1952) 4.5% ethane.
Cairnhope II.	60m.N.E. Winton	1000	2732	0-1540 Cret. -2275 Jurassic	2200'black oil in greasy shales above water sand (Mott 1952)
Elderslie I	60m.N.W. Winton	725	3500	No log	Above 3380', 3.5% Ethane, gas (Mott,'52).
Knockaninny	7 m.S. Barcaldine	850	2180	0-800 Cretac. -2000 Jurassic?	2176' oily sludge (Mott,1952)
Langdale	30 m.S.W. Longreach	?	2520	0-2190 Cretac. -2520 Jurassic	Gas.7.7% ethane (Mott'52)
Longreach Oil Wells	Longreach	620	3351	0-2323 Cretac. -2700 Blythesdale -3254 Walloon	2336') Dry 3229) gas 2910' wax 3227'small oil. (Mott 1952)

(Cont.p.84)

Table 5.(Cont.)

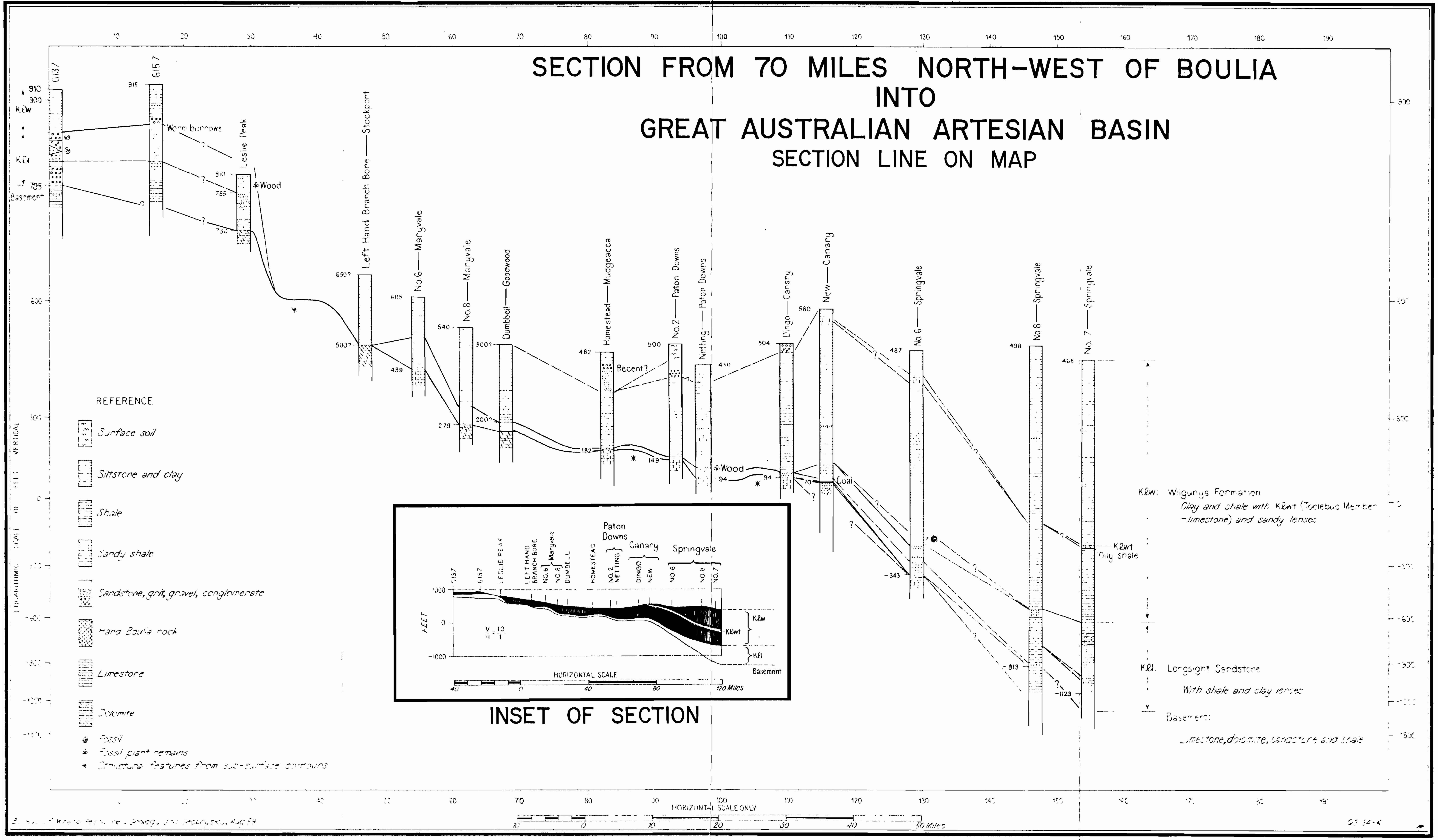
Name	Location	Surface Elev.	Depth Feet.	Formations	Petroleum
Ruthven I.	45m.S.S.W. Longreach	800	4105	0-110 Tertiary -3118 Cretac. -4009 Jurassic	4000'? gas. 2.8% ethane (Mott.1952).
Westland III.	45m.S.W. Longreach	643	2080	0-2000 Cretac. -2080 Jurassic?	2035' dark oil (Mott.1952)
Longreach II	Longreach	620	3298	0-2330 Cretac. -3268 Jurassic -3298 Granite	3230' dark wax (Mott,1952)
Lucknow 10.	At Lucknow H.S.	609	1165	0-783 Wilgunya -1000 sand,pipe clay (Longsight sandstone).	Oil while drilling. Moss 1932 Gray 1938 Wade 1950 Mott 1952.
Warenda 19	5m.N.N.E. Warra H.S.	589	780	0-700 Wilgunya -780 sand and drift sand (Longsight)	Gas. Moss 1932 map. Mott 1952.
Springvale 3 (Dinans G.)	4m.N.N.W. of H.S.	434	1375	No log.	Gas.I.W.S.records.
Springvale 7	18m.S.W.of H.S.	465	1588	0-1139 Wilgunya -1588 Longsight	678-696' brown oily shale I.W.S.& Stn.Recs.
Blair Athol	At H.S.	610	221	0-99 Wilgunya -221 Longsight -226 Limestone	Strong oil smell towards bottom in green sand. Station record.

HYDROLOGY

As the area forms the north-west margin of the Great Artesian Basin, a study of the 360 bores drilled in the Mesozoic and Palaeozoic sediments shows interesting results.

Most of the water tapped by the various stations comes from the Longsight Sandstone which forms the main aquifer in this part of the basin.

During the 1957 survey, and during subsequent surveys in 1958 and 1959 information on the well (or bore) location, depth, water horizons, strata penetrated etc., were requested from owners or managers of stations. This information together with details supplied by the Irrigation and Water Supply Department, Brisbane, has been listed under Stations (the station in alphabetical order) or bore data sheets in Appendix E, but which can be obtained separately from the Bureau on request.



SECTION FROM 70 MILES NORTH-WEST OF BOULIA
INTO
GREAT AUSTRALIAN ARTESIAN BASIN
SECTION LINE ON MAP
G137
G157
Leslie Peak
Left Hand Branch Bore — Stockport
No.6 — Maryvale
No.8 — Maryvale
Dumbbell — Goodwood
Homestead — Mudgeacca
No.2 — Paton Downs
Netting — Paton Downs
Dingo — Canary
New — Canary
No.6 — Springvale
No.8 — Springvale
No. 7 — Springvale
Worm burrows
Wood
Recent?
Coal
Klwt Oily shale
REFERENCE
Surface soil
Siltstone and clay
Shale
Sandy shale
Sandstone, grit, gravel, conglomerate
Hard Boulia rock
Limestone
Dolomite
Fossil
Fossil plant remains
Structural features from sub-surface contours
Klw: Wilgunya Formation
Clay and shale with Klwt (Toolebuc Member - limestone) and sandy lenses
Kll: Longsight Sandstone
With shale and clay lenses
Basement:
Limestone, dolomite, sandstone and shale
LOGARITHMIC SCALE OF FEET VERTICAL
HORIZONTAL SCALE ONLY
50 Miles
INSET OF SECTION
Paton Downs
Canary
Springvale
FEET
V/H = 10/1
HORIZONTAL SCALE
120 Miles
Basement

All bore positions were checked on the ground; no information was available for 75 of the bores; information from the remaining bores enabled a study of the sub-surface geology and aquifers to be carried out; the results of this study are given in Figure 8, a structure contour map on the basement on which the Mesozoic was laid down, and Figure 7 gives the thickness of the Longsight Sandstone penetrated in bores.

The details of the subsurface strata have been interpreted from drillers logs which describe bedrock as "limestone" or "granite"; it was often difficult to decide what strata had been penetrated from the names given by the water bore drillers. In representing the basement, bores which ended in "granite" have been given the granite symbol. Only one sample of rock described as "granite" has been available for inspection; it was definitely granitic. The sample was from an un-named bore, completed in 1957, about 4 miles east of Kheri Outstation. "Limestones", whether "white", "yellow" (?dolomites) or "grey", have not been differentiated because they almost certainly belong to the Lower Palaeozoic formations described in an earlier part of this Report. They are not symbolized on the map; bores represented as full black circles ended in "limestone" basement. The sub-surface contour lines were prepared from the heights relative to sea level at which basement was penetrated. They show the topography of the basement and have facilitated the understanding of the distribution of underground water. They have also yielded more information to confirm the existence of structural trends in the region. It is because of their value in this respect that they have been extended to cover areas south and east of the area represented by the Boulia 4-mile Sheet; the boundary of the sheet is outlined on Figure 8. A section prepared from water bores is shown in figure 11; it extends from the Boulia Shelf south-eastwards into the deeper parts of the Artesian Basin.

Groundwater has been pumped from a few bores, but most water obtained has been under pressure: 40 bores have artesian supplies and the rest are sub-artesian. The flow has stopped at several bores since they were sunk and these are now sub-artesian. 60 unsuccessful bores have been recorded; water was not met, was not in sufficient quantity to warrant pumping, or was too salty. The distribution and properties of the water are discussed in descriptions of the aquifers.

Recent Aquifers:

Water from river gravels is used at the Blair Athol and Goodwood Homesteads. It occurs at a depth of 60 feet at Blair Athol Homestead, which is situated between Mucklandama Creek and the Burke River just north of their junction. At Goodwood Homestead, near the channels of the Burke River on the south side, water was struck at 65 feet. Both supplies are sub-artesian. A good supply of potable water is obtained at Blair Athol; the supply and quality of the Goodwood water is not known. The Blair Athol bore continued to limestone bedrock at 225 feet and passed through Wilgunya Formation and probably penetrated the Cretaceous sandstone aquifer which may have supplemented the water obtained at shallow depth from gravels. The sub-artesian supply suggests that the aquifers are large lenticular beds with impermeable clay cappings. Intakes probably occur at higher levels in the adjoining streams whenever water flows. Other similar aquifers probably occur below or near the principal streams in the area.

Unless these aquifers are fairly large, they could not be regarded as reliable sources of water because they would be influenced by the seasonal variations in rainfall.

Tertiary Aquifers:

The Tertiary (Noranside and Marion) formations consist of white limestone and chalcedonic or opaline rocks, sandstone or unconsolidated sands, and clay, generally red or yellow. The sediments were deposited in a lake and occupy what was probably a low region from Noranside Station in the north to the south central part of the area. Another small patch of Tertiary limestone covers the area around Burnham Station in the northern part. Other lacustrine deposits of the same age occur just south of the south-west corner of the Boulia area; these were formed in a lake which extended along the present course of the Georgina River. The thickness of the beds is difficult to determine because of the similar descriptions given in the bore logs of the Wilgunya Formation (the uppermost Cretaceous rocks in the area) and the Tertiary beds. The bore-log description "white rock" for example could either be the Tertiary Noranside Limestone or white siltstone common in the uppermost Cretaceous formations. Likewise "yellow clay" could be interpreted as either Tertiary or Cretaceous. Interpretation has generally been based on known surface geology. The greatest depth at which water is obtained in beds believed to be of Tertiary age is at Kalkadoon bore, Elrose Station. Sub-artesian supplies are obtained from two beds described as "white limestone" between 72 and 80 feet and between 123 and 132 feet; the beds are separated by "white clay". Eleven other bores supplied water at depths of less than 100 feet from beds of probable Tertiary age.

The supply of water from Tertiary aquifers ranges from 150 to 720 gallons per hour; the average for eight bores, four of which passed through two aquifers, is 680 gallons per hour. Water from four of the bores was too salty and unsuitable for use, or brackish and suitable for stock only. Why salt occurs only in a few bores is not known. However, water entering the Tertiary sediments would have passed over the older rocks of the area and probably carried dissolved salts into the sediments in some places. The concentration of salt near the southern margin of the Tertiary deposits probably results from the solution of salts by the water during its movement southward through the sediments. Aquifers north of the bores from which salty water is obtained therefore give supplies of good water. Comparatively fresh water enters the aquifers at intakes around the higher margins of the Tertiary deposits. Aerial photographs show that some stream channels run from watersheds into Tertiary deposits and disappear before linking with any major stream.

However in most cases, by cementing off the top salty water and continuing through "blue clay" to the underlying Cretaceous aquifer an excellent supply (often artesian) of good water is obtained. This is particularly the case in the area from Granton between the Hamilton and Burke Rivers, south to the junction of these rivers.

Four bores on Wirrilyerna Station penetrated similar beds in the Georgina River Tertiary basin. The rate of supply was 800 to 1800 gallons per hour. All of them yielded salty water. Close's bore-water contained 1316 grains per gallon of total salts and a total hardness (mostly permanent) of 400° (British).

Cretaceous Aquifers:

In the west part of the area, where apparently siltstones predominate over claystones, the Wilgunya Formation contains useful water: thirteen bores derive their supplies from aquifers in it. Productive beds occupy the basin between the Burke River structure and a southern subsurface extension of the De Little Range structure. Beds of the same age occur in an embayment between a subsurface dolomite-limestone ridge and a dolomite ridge in an area west of Boulia; these also supply water. The aquifers occur at depths of 50 to 180 feet. Supplies range from 330 (3 aquifers) to 1500 (2 aquifers) gallons per hour. The water occurs as groundwater or is subartesian. The quality of the water is generally good; the water from two bores was brackish but useful for stock. Where this formation abuts against and overlaps the ridges as well as occupying the low areas between, meteoric water has ready access to the intake beds. Replenishment of supplies in this case depends on seasonal conditions.

But in the east part of the area, claystones of the Wilgunya Formation are at plain level and bores penetrate this impermeable clay before the sandstone aquifers below, although 30 bores derive some water from sandy beds in the claystone, the formation is not regarded in general as an aquifer but as an impermeable cap over the basal sandstones which supply large volumes of artesian and sub-artesian water. The formation thickens along the eastern and southern margins and aquifers occur to depths of 950 feet. Supplies of 300 gallons per hour have been recorded from the formation where it overlies shallow basement along the northern margin of the area from Burnham Station to Toolebuc Homestead. Some of the water is salty. Intakes are probably local. The Hamilton River and many of its tributaries traverse outcrops of the shale and claystone; also, the formation extends in some places to the main watersheds of the area. It is also possible that pressure water from the underlying sandstone formation seeps upwards or has access into the lowest aquifers of the shales.

Longsight Sandstone consists in outcrops of porous, friable sandstone and conglomerate; at depth, it contains small "pipe clay" and shale lenses. The formation is of Lower Cretaceous age and equivalent in part to the Blythesdale Group (Whitehouse, 1954).

The basement of "limestone" and "granite" (water drillers nomenclature) on which the formation was deposited has been discussed already. In late Jurassic or early Cretaceous time, this basement was inundated by water which formed a shore-line against the higher early Palaeozoic formations and Proterozoic rocks which occur along the northern and western margins of the area. The folded and faulted early Palaeozoic limestone and dolomites extended as ridges south to south-east from the shore-line, forming embayments; parts of some of these ridges remain as inliers. Other ridges composed of Precambrian "granite" were covered by water and buried by subsequent deposition. Ridges and embayments are shown by the sub-surface contours in Figure 8. One of these subsurface "granite" ridges extending from Kheri towards Lucknow is called the Lucknow Ridge, and this may have been effective in limiting the eastward extension of the lower Palaeozoic seas; one occurrence of "limestone" has been recorded from water bores drilled east of this ridge (at Mackunda). However, as the Mesozoic sediments thicken appreciably east of the Lucknow Ridge, few water bores penetrate below the Cretaceous-Jurassic aquifers.

The Longsight Sandstone, in part at least equivalent to the Blythesdale aquifer, was not previously recognised in the western edge of the Great Artesian Basin, it is now known to crop out in the central and western parts of the Boulia area and in the subsurface it underlies the Wilgunya Formation.

Water is found at shallow depth near the margin of present outcrop to over 1,000 feet on Lucknow Station. North-north-east and south of Lucknow Station, the basement (Lucknow Ridge) slopes steeply to the east. Although the sandstones thicken over this slope, they have a steep initial dip, and bores east of the Lucknow Ridge have to be deeper than those of the Boulia area to reach water.

Good supplies of artesian and sub-artesian water are obtained from most bores which penetrate the basal Cretaceous aquifers, not only in the eastern part of the Boulia area but in the deeper parts of embayments to the west; the best yield is 687,000 gallons a day from Bunda Bore on Slashes Creek Station. No water was obtained however, from bores penetrating the Longsight Sandstone near its pinch-out against subterranean ridges.

On the basis of his Figure 60 and discussion on the chemical quality of water, Ogilvie (1954) suggests that a body of water (which gives supplies to the Boulia area) moves down the route of the Diamantina River past Birdsville. In Figure 60 lines join localities where water had the same amounts of dissolved salts; they formed contours which showed definite trends. The movement suggested above was based on one of three main trends. The route fits in "with flow lines which one would expect from the distribution of natural spring outlets, which occur....down the western edge of the basin more or less along the '45' [grains per gallon] line for 200 miles from a point north of Boulia". For water to move in this direction, the intake beds would be north-east of Boulia; probably the intake beds north of Hughenden supply the water. As isopotential diagram showing the hydraulic surface at the end of 1948 is included in Ogilvie's report (Figure 8, opposite p.46). The gradient drops from 600 feet at 141°00E to 500 feet above sea level at about 140°30'E in the south-eastern part of the area of the Boulia 4-mile Sheet.

Examination of the known water levels of bores in the area shows that the hydraulic surface is not as simple as determined by Ogilvie. Levels of 700 feet plus occur in the north-east part, on Toolebuc Station, and high levels between 600 and 700 feet trend, one east-south-east from Pathungra Spring bore to IBC bore on Lorrett Downs Station, and the other south-west from No.3 bore on Lucknow Station. The first two high levels probably represent proximity to intake areas below the Hamilton River channels; conglomerate and sandstone occur near the surface in Pathungra Spring which has a well sunk through the alluvium of the Hamilton River. Incidentally, live fish are reported to issue with the water from this spring sometimes.

The high water levels near No.3 bore could indicate intake from the watershed formed by a range of small hills which extend in the same south-west direction from No.3 bore on Lucknow Station. It will be seen from Figure 8 that large areas with no bore control exist in the rest of the area where bores did not penetrate the basement. Many of these bores obtained their water from aquifers in beds younger than the basal Cretaceous sandstone. However, where supplies are obtained from the sandstone, the hydraulic surface gradient is in the same direction as the gradient of the basement. This explains why artesian water supplies have been obtained from the basin-like structure produced by small subterranean ridges and hills below Stockport and Maryvale Stations. Water probably enters the intake beds around the higher edges of the basin where Bengeacca Creek and other creeks cross them. Unfortunately, no information is available on the fluctuations of water levels and their correspondence with local variations in seasonal rainfall; springs near Bulla Bulla waterhole south of Mt.Datson showed signs of occasional outflow, but the periodicity is not known.

The recognition of outcrops of the basal Cretaceous sandstones and of local high water levels in the hydraulic surface in the Boulia area is probably sufficient to suggest that water moving along the Diamantine River route in the Great Artesian Basin (Ogilvie, 1954) is supplemented by water entering from intakes in the Boulia area; also the regional hydraulic gradient in the Artesian Basin which is from east to west (as deduced from the isopotential lines of the main aquifer) is locally modified by intakes in the Boulia area.

The volume of water contributed by this local source, however, does not appear to have altered the chemical and thermal properties of the water in this part of the Artesian Basin. The total salts in solution in water from bores into the basal Cretaceous sandstone on Stockport Station ranged from 37 to 45 grains per gallon. Although some of the analyses may have been affected by water entering the bore from younger formations, they conform approximately with the 45 grains per gallon line which Ogilvie (1954, Figure 60), shows through the Boulia area.** Ogilvie (p.36,38) infers that temporary hardness of water in intake areas is higher than in other parts of the Great Artesian Basin; temporary hardness of 5° and higher was common in intake areas as in the Hughenden area. 15° temporary hardness is recorded in water from Horse Creek bore and 10° in water from Limestone bore on Stockport Station. The basal sandstone formation from which the water is derived is the equivalent of the main aquifer of the Great Artesian Basin, and because of the high temporary hardness of the water, it is probably an intake bed in the Stockport area. The homestead bore which obtained supplies from both the basal sandstone and the overlying Wilgunya Formation yielded water of temporary hardness of 12° (7° due to $CaCO_3$). Temperatures of water from the basal sandstone aquifers, measured at the surface, are known for about 20 bores. For those bores which obtained supplies from the basal sandstone only, an average gradient of 1°F rise for 22 feet of depth was determined; the depth of aquifers were between 50 and 800 feet. This is an average gradient for only part of the area; insufficient data were available to plot lines of equal thermal gradient as done by Ogilvie (1954, Fig.74) but the figure falls within the limits shown by Ogilvie for the area.

Flow has diminished in the Boulia area, although to a lesser extent than in other parts of the Great Artesian Basin. Several bores which originally gave artesian supplies are now sub-artesian: springs that previously flowed continuously now no longer flow or flow only occasionally. Three springs or groups of springs are known in the Boulia area. Pathungra Spring on the west side of the channels of the Hamilton River has ceased to flow; a bore drilled at this position first gave artesian supplies but is now sub-artesian. Leakage of water here before extensive boring commenced in the area undoubtedly resulted from the closeness of the basal sandstone to the surface, giving pressure water from intake beds nearby an easy passage for escape.

** David (1950, Vol.2, p.529, Table 33) gives an analysis of water from "Warenda Station Bore, near Boulia"; this water contained 73 gns./gall. total solids. If this reference applies to the present Warenda Homestead bore, the analysis is of water from the "limestone" bedrock and not derived from the Great Artesian Basin.

Two other groups of Springs, one near Dribbling bore on Granton Station and the other in the channels of the Hamilton River near Bulla Bulla Waterhole on Warra Station, occur along the western structural line of the Bourke River Structure which trends south-south-east from Black Mountain towards Springvale (70 miles south-east of Boulia). Bulla Bulla Waterhole itself is permanent and is apparently spring-fed. The group of springs at Elizabeth Springs, discussed by Whitehouse (1954, p.14), is also on this structural line; Elizabeth Springs is between Black Mountain and Springvale. Whitehouse postulates "either a continuation of this bedrock ridge (from Black Mountain), thinly buried, or a fault zone continuing its general direction" to explain the seepages on this line. Faulting along the line was recognised in 1957 and the subsurface contours of the basement (Figure 8) show a structural culmination, plunging south-south-east just west of the line. A folded and faulted ridge therefore seems a logical explanation for the line of springs. Whitehouse further suggested that Elizabeth Springs supplies are larger than those from springs to the north because "they arise from a lower (Bundamba) aquifer just beyond the limit of the (Boulia) shelf".

Pre-Cretaceous aquifers:

Some useful water is obtained from the rocks which form the basement for the Cretaceous sediments and which drop out in the northern and western margins and central part of the area. Aquifers of large extent are not known; the water occurs in zones of high porosity due to jointing, underground caves, channels in limestone, or dolomitization. Many of the "sandstone" aquifers recorded in the logs of bores drilled in localities of dolomite outcrop are thought to be porous dolomite or sandy dolomite beds. In some places the "sand" that clogs pumps tapping water in these beds is known to be fine dolomite crystals. Both non-pressure and pressure-water supplies have been obtained.

The best yields (500 to more than 1,000 gallons per hour) are from low areas between the structural highs developed in the area, and most bores drilled near or on outcrop or along the highs have yielded poor supplies or no water; these account for most of the unsuccessful bores of the area. Station people who have had drilling experience in the Boulia area regard dolomites as having better water prospects than "blue" limestones; this may be due not only to the higher porosity of the dolomites but also to the structures in which they occur. Only six analyses of water supplies from early Palaeozoic rocks have been available for examination; they show total salts varying from 42 to 107 grains per gallon and total hardness from 11° to 36° (British).

The occurrence and effect of fluorine in water:

Fluorine occurs in water from some aquifers in the Boulia area; it does not appear to be confined to any particular aquifer. Unfortunately analyses of water from some bores on two stations only have been available for examination in the preparation of this report. These show 0.7 to 0.8 ppm fluorine for water obtained on Alderley Station and 0.6 to 0.8 ppm on Stockport Station. Fluorine has also been reported as occurring in water from Wirrilyerna and Pathungra Stations. Mrs.Pulley, wife of theowner of Pathungra Station, stated that their children's teeth had been badly mottled by fluorine. Whitehouse .(1954,p.15), records that in some areas water which moves over granite bedrock contains large amounts of fluorine. The incidence of fluorosis (mottled teeth) on Pathungra Station suggests relatively large amounts of fluorine and therefore possibly confirms the driller's interpretation of "granite" bedrock in nearby bores. The few occurrences of fluorine in the western part of the area may be due to movement of water from the north, where outcrops of granite are known. However, Ogilvie (1954, p.38) points out that although amounts of fluorine are greater for water close to bedrock, its distribution throughout the Great Artesian Basin is so erratic that it is of little use in determining direction of flow. Also, minerals likely to yield fluorine are not necessarily confined to granite. Goldschmidt (1954) suggests that fluorine is produced by weathering of minerals of the mica group and fluorine-bearing hydroxy-silicates such as amphiboles and humite, and by minerals such as villiaumite (NaF) and fluorite (CaF_2) which are probably dissolved by surface waters. Minerals of the apatite group may exchange some of their fluorine for hydroxyl but, as Goldschmidt points out, the importance of this process is questionable; the reverse process, fixation of fluorine from circulating water by bones and other skeletal remains to form fluorapatite, is a comparatively rapid process.

Fluorine could be liberated in solution therefore from most of the formations known in the Boulia area. This question cannot be discussed further without additional analyses. However, the occurrence of fluorine and its effects on human beings and stock could be very important in this area. Fluoridation of town water supplies and results of excess fluorine in water have been discussed with Doctors Crick, Cook, and Hipsley, and Mr. Christiansen of the Public Health Department, Canberra; the information given below is taken from references recommended and made available by them.

In the fluoridation of town water supplies, a balance has been sought between addition of sufficient fluorine to prevent tooth decay (dental caries) and keeping fluorine to a minimum to prevent mottled enamel by "fluorosis". The quantity generally recommended is 1 ppm F. This is equivalent to 1 milligram ingested daily by an adult drinking one quart of fluoridated water. For all practical purposes, the safe upper limit for fluorine ingestion is regarded as 1.5 ppm F (Hobbs, 1954).

The effects of excess fluorine intake are summarized in a table in Shaw (1954, p.93).

Toxic Effect	Amount of Fluorine	Factor of Safety (dilution)
Acute fatal poisoning	5-10 grams.	2500x
Growth depression	50 or more mg./day.	50x
Osteosclerosis (skeletal changes)	8-20 or more mg./day	8-20x
Mottled enamel (enamel hypoplasia or fluorosis)	2-8 or more mg./day	2x

Stock are affected in the same manner as human beings but to a lesser degree. Where there are excessive amounts of fluorine in water, therefore, efforts should be made to reduce it to 1 ppm or to obtain an alternative supply of water. Removal of fluorine is discussed briefly in the report of the United Kingdom Mission to North America (U.K.M., 1953). Various methods suggested are listed below:-

a. By granular tricalcium phosphate, magnesium oxide or hydroxide.
b. By treatment with alum.
c. By lime-soda softening in presence of magnesium salts.
d. By hydroxyapatite anion exchange.
e. By activated alumina.

Unfortunately no mention is made of costs of these methods and the possibility of their economic use for small supplies as required in isolated places such as in the Boulia area. The cost given in Shaw (1954) for the hydroxyapatite method as used at Climax, Colorado, U.S.A., was $120 per million gallons in 1944. The commission of inquiry in New Zealand (C.I.F.P.W.S., 1957) gave evidence that the purchase and cost of operating bone filters was within the range of the average

American family but few filters were in use because of the nuisance of caring for them.

MINERAL DEPOSITS

Lead:

A small deposit of galena occurs near latitude 22°01', longitude 140°03', ten miles north-north-east of Noranside Homestead in the hills east of Bore 34.

The galena forms irregular blebs and patches up to two inches wide in a brecciated and vuggy, thin to medium-bedded brown dolomite which is part of the Ninmaroo Limestone. Usually the patches and blebs of galena are enclosed in travertine which encrusts and partly replaces the walls of joints and vugs. In places, remnants of dolomite occur in the travertine. The faces of many galena crystals are curved.

The deposit lies on the western structural line of the Burke River Structure on the crest of an asymmetrical anticline which trends north-south. Parallel faults lie 150 feet and about half a mile to the west of the axis of this anticline. Well developed joints trending at 110° and 125°, and moderately developed joints trending at 025° and 040°, cut the dolomite near the deposit.

As the deposit is partly a fissure filling and partly a replacement, it is epigenetic. Its relationship to the jointing and its restriction to the crest of an anticline indicate that structure was an important control during its formation. Some lithological control may have been exerted by the dolomite surrounding the deposit, but was probably slight, as the joint and vug walls are only slightly replaced by the travertine associated with the galena.

As there is no evidence of Palaeozoic or later igneous activity in the area, a hydrothermal origin of the deposit can be discounted.

However, there is a possibility that the travertine and the galena may be an old spring deposit. Springs occur at the southern end of the Burke River Structure and they may have existed along the length of the belt before the late Tertiary or post Tertiary southward tilting of the region stopped their flow.

The deposit was reported by Shepherd (1945) and is referred to by Carter et al.(in preparation). According to Mr,J.Swift of Noranside it was last worked about the end of 1956 when a 15' trench, 6' wide and about 6' deep, trending at 120°-130° was sunk.

The deposit gave a Geiger count of 27 c.p.m. compared with 23 c.p.m. over surrounding dolomitic limestones.

Manganese:

Manganese minerals occur at the base of the scarp near the northern end of The Bluff. The minerals, probably pyrolusite and psilomelane, occur as nodules and earthy patches up to 6 inches long in thin chert beds and laminated siltstones of the O'Hara Shale. Specimens of manganese collected by the manager of Buckingham Downs also assayed 3 dwt of gold per ton.

Manganese minerals also occur in the Digby Peaks area. Specimens of rhodocrosite from a lens in recrystallized limestone in the Ninmaroo Limestone 12 miles north-east of Digby Peaks Homestead assayed 13.9% MnO_2. Pyrolusite and psilomelane occur 1½ miles west of Digby Peaks and on the western side of the Swift Hills. Both occurrences are on outcrops of the Ninmaroo Limestone. The occurrence on the western side of Swift Hills seems to be on the stripped eroded surface marking the unconformity between the Ninmaroo Limestone and the Swift Formation.

Uranium:

Fish scales and teeth are common in limestone nodules and concretions of the Toolebuc Member (Wilgunya Formation). Nearly all have a light coating of a pale yellow-green mineral which gives the rock a radiometric count of 3 to 4 times background. In thin section this mineral is bright yellow. A determination by X-ray diffraction was carried out by W.M.B. Roberts who reported the presence of novacekite and some carnotite.

Novacekite in pure form is a hydrated magnesium uranium arsenate; it forms a continuous series with uranospinite, a hydrated calcium uranium arsenate; the arsenate is often replaced by phosphate. The main mineral coating the fish remains in the Toolebuc Member is probably an impure novacekite with some of the magnesium replaced by calcium and some or all of the arsenate replaced by phosphate.

Carnotite is a potassium uranium vanadate; vanadium is present in the shells of most marine organisms.

Gypsum:

Gypsum is widespread in the claystone of the Wilgunya Formation, and is especially noticeable where fresh clay is exposed in tanks in the east of the Boulia 4-mile area. The mineral occurs as small crystals and in places as crystal aggregates up to three inches in size.

Barytes:

Very small quantities of barytes were found in bands of up to one inch thick near the top of the Wilgunya Formation. The only occurrences were between Brighton Gap and Momedah Creek, within 100 yards of the Momedah Anticline.

FEATURES OF LOCAL INTEREST

In the Boulia area there is a pinnacle-like outcrop referred to by local people as a "meteorite" as well as sink-holes, which are locally called "craters" and attributed by laymen to meteorite falls or volcanic activity. They actually result from surface weathering or solution effects.

Meteorite

A supposed "meteorite" occurrence which was causing much local interest in the area was investigated. It occurrs on Stockport Station, 5 miles north-west of The Dam bore on the north-east border of Windburg Plain. It was however, an erosional remnant of the Tertiary Marion Formation; it is 15 feet high and 5 feet across, and has a smooth silicified surface containing patches of dark ferruginous sandstone which may have appeared as "meteoritic iron" to the layman. Lithological specimens are in the Bureau's museum and Plate 8, figure 2, illustrates the form of the outcrop.

This occurrence has nothing to do with that reported by Richards (1930); Richards describes a specimen 19 inches by 13 inches by 9 inches weighing 90 lbs. which was collected in 1925 by Mr. Story, the late manager of Glenormiston Station, from a small plain about 5 miles west of the Homestead, 90 miles west of Boulia, Latitude 22°54'S., Longitude 138°43'E. This specimen is covered by a thin crust of iron oxide which disguises the brecciated character of the mass, but analysis shows it consists of 89.7% Fe, 8.7% Ni (Fe: Nickel ratio 10.3:1) with trace amounts of cobalt, phosphorous, sulphur and carbon; it is described as a brecciated octahedrite with a density of 7.6.

Caves

Sink-holes and caves (by solution): "In compact, well-stratified, and strongly jointed carbonate rocks, the avenues of easiest descent for vadose water are vertical joints and planes of stratification. Those avenues most favourably situated with respect to supply from above and free circulation below are readily enlarged by solution as the descending water passes through them. Enlargement is most effective at the surface, where the water moves most rapidly and where it is freshly charged with carbon dioxide from the atmosphere

PLATE 8.

Figure 1. Silicified sub-soil breccia (part of Tertiary? laterite profile) at south end of Makbat Sandstone outcrops and between Makbat and Wills Creeks on Buckingham Downs Station.

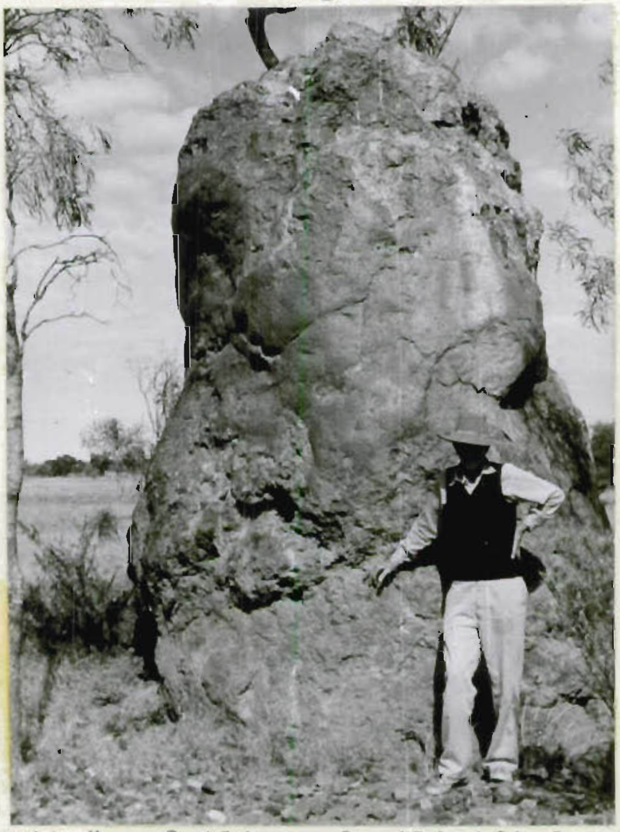


Figure 2. "Meteorite" - Outlier of silicified and partly ferruginized Marion Formation - located on western part of Stockport Station.

and from decaying vegetation, and decreases rapidly downward" (Longwell, Knopf and Flint, 1939). Where solution down the vertical joints is greater than along stratification planes, sink-holes of inverted cone shape develop. Underground caves are more likely to develop when solution is greatest along stratification planes or in joints isolated between stratification planes. Sink-holes and caves are well known in the Boulia area and in at least one place, one mile north-north-east of Digby Peaks, a combination of both occurs. The sink-hole part, shown in Plate 9, figure 1, is about 15 feet deep and 20 feet in diameter at the surface. The cave, with heights varying between 5 and 10 feet and about 30 feet wide, extends underground for about 40 yards from the wall of the sink-hole; many bats live in this cave. Other sink-holes, known locally as meteorite or volcanic "craters", are -

(a) 4 miles south of Craigie's Lagoon on Alderley Station, where red basal Cretaceous sandstone has collapsed into sink-holes in Ordovician dolomites; see Plate 9, figure 2;

(b) 7 miles west of the homestead on Alderley Station where an early stage in the development of the mature (karst) phase of the carbonate erosion cycle has been reached - sink-holes into underground caverns are coalescing to form small solution valleys;

(c) in the south-west corner of Herrod's Tank - the basal Cretaceous sandstone and overlying shale have collapsed into a sink-hole in the underlying Ordovician dolomite.

(d) Near the head of Warenda Creek, east of Black Mountain; this sink-hole was not visited.

Underground caves have been reported in the logs of bores on several stations. Permanent water is obtained from only those caves which have formed below the water table or above which the water table has risen.

B. Caves are also formed by differential erosion of rock faces at the surface, particularly below the hard, siliceous caps of many of the small flat-topped hills in parts of the Boulia area, such as at Digby Peaks. These are formed partly by solution effects along joints and partly by wind abrasion. They serve as dens for wild animals such as kangaroos and dingoes; some of the larger caves, such as those with wall paintings near Black Stump Dam on Tobermory Station (south-east of the Boulia area), were once the refuges of aboriginals.

PLATE 9.

Figure 1. Sink-hole in Ninmaroo Limestone; 1 mile north-north-east of Digby Peaks.

Figure 2: Sink-hole in dolomite of Ninmaroo Limestone and overlying basal Cretaceous (Longsight) Sandstone; 4 miles south of Craigie's Lagoon on Alderley Station.

Caves could be of economic interest for the possible accumulations of guano or skeletal remains they contain, but no such deposits have been found in the Boulia area.

Stylolites: An explanation of their development is given by Longwell et al, (1939,) stylolites are produced by solution-pressure effects and "consist of a series of interlocking small columns of rock, intertoothed like the bristles of two hair brushes forced together. As the rows of columns lie in more or less horizontal belts, they appear on vertical faces of rock as zigzag lines (stylolite seams)." Water percolating along a plane between two soluble beds dissolves the more soluble parts of the upper and lower bed. The less soluble parts of the two beds are forced into one another "in the form of columnar teeth. The rock opposite the end of each column continues to be dissolved more rapidly than the rock between the columns because the greater pressure at the column-ends increases the solubility of the rock". A residue of insoluble material accumulates around the columns, and they stand out on weathered, vertical rock faces. Stylolites have been observed in carbonate formations in the Boulia area, particularly where dolomites occur. It is possible that the solution of the more soluble calcium carbonate (compared with magnesium carbonate) from a dolomitic limestone would tend to result in a dolomite or more dolomitic rock being formed; stylolite seams are in fact, more commonly seen in dolomitic rocks. Apparently large volumes of rock are removed during this solution process; Longwell et al, state: "It has been estimated that in some districts the thickness of soluble rock has been reduced 40 per cent by this process alone."

PROBLEMS

THE ORIGIN OF THE CHERT IN THE SWIFT FORMATION.

Three main theories on the origin of chert may be applied to the chert in the Swift Formation: Primary silica deposited as a gel during sedimentation; deposition of siliceous organisms, notably radiolaria and diatoms during sedimentation; and later replacement of calcareous beds.

Primary Silica

About 16 parts per million of colloidal silica are carried to the oceans by present day rivers (Tarr, 1917); but as the oceans contain only 1 to 5 ppm. of silica, much of the silica brought in by rivers must be deposited on the sea-floor.

The silica may be directly precipitated as a silica gel (Tarr, 1917; Gruner, 1922; Lovering, 1923; Schwartz, 1928; Moore & Maynard, 1929). But these authors do not all agree that silica can be directly deposited as a gel in the open sea, but one method that has not been adequately investigated but which has been suggested, is the precipitation of silica as silicates with clay minerals.

The landmass supplying the Lower Palaeozoic sediments of the Georgina area seems to have been low-lying, and conditions were probably ideal for chemical rather than mechanical weathering. This being so, the rivers would be probably highly charged with silica and conditions would have been favourable for direct precipitation of silica. In this case one would expect the Swift Formation, which was deposited more rapidly, to have a smaller proportion of chert than the Ninmaroo Limestone which was deposited more slowly. The reverse is actually the case and chert is comparatively rare in the Ninmaroo Limestone. Some of the chert of the Swift Formation may have originated as primary silica deposited during sedimentation, but thin section work shows that much of the silica is in fact secondary and has replaced calcite.

Siliceous Organisms

Bramlette (1946) favours the hypothesis that silica has been deposited in the oceans by siliceous organisms, notably Radiolaria. Spherical siliceous bodies which may be Radiolaria are common in some of the chert of the Swift Formation but it is unlikely that they have been an important agent in the deposition of the silica.

Secondary Silica

Microscopic examination of representative samples of chert from the Swift Formation shows that the chert in most cases is composed of secondary silica which has replaced calcite in the original sediment.

There are two possibilities for the origin of secondary silica in the Swift Formation:

(1) The silica could have been deposited with the sediments as a silica gel and later dissolved and reprecipitated, replacing calcareous fossils.

(2) Or the silica could have come from detrital quartz and feldspar in the limestone. Throughout both the Ninmaroo Limestone and the Swift Formation the detrital quartz and feldspar have been replaced by calcite in all stages from slight corrosion on the borders to complete replacement. The silica removed from the

rocks in this manner must have been deposited elsewhere in a more suitable chemical environment (Walker, 1957), conceivably in the upper, more sandy limestone beds which have now been altered to chert beds in the Swift Formation.

As support for this hypothesis the Swift Formation contains more detrital quartz and feldspar than the underlying Ninmaroo Limestone so chert should be more common in the Swift Formation. Also, the rocks of the Swift Formation are more permeable allowing freer movement of meteoric waters and therefore more favourable circumstances for replacement.

DOLOMITE

The mineral dolomite can form in at least five ways (Opik, 1954; Chave, 1954; Cloud and Barnes, 1957):

(1) By precipitation from magnesium-bearing brines;
(2) By diagenetic replacement of aragonite or calcite in calcareous sediments;
(3) By redistribution of $MgCO_3$ contained in the skeletons of lime-secreting organisms;
(4) By metasomatic replacement;
(5) By replacement of aragonite or calcite by magnesium salts dissolved in ground water. Dolomitic rock bodies can then be divided into:

A. Primary deposits formed as precipitates.
B. Secondary bodies formed
  (a) during diagenesis
  (b) after diagenesis
C. Clastic deposits formed of material derived from pre-existing dolomite bodies.

A. Primary dolomite occurs as formations, members or lenses which are interbedded with limestones or evaporites. They show normal stratigraphic relations to associated rock units. The dolomite comprising these formations, members or lenses is usually very fine-grained and compact, and it shows normal sedimentary structures. Such dolomite bodies are poor in fossils. It is thought that the environment necessary for their development inhibited life, but Alderman and Skinner (1957) have recorded that in South Australia plants, copepods (crustacea) and small molluscs exist in the water from which dolomite is now being precipitated.

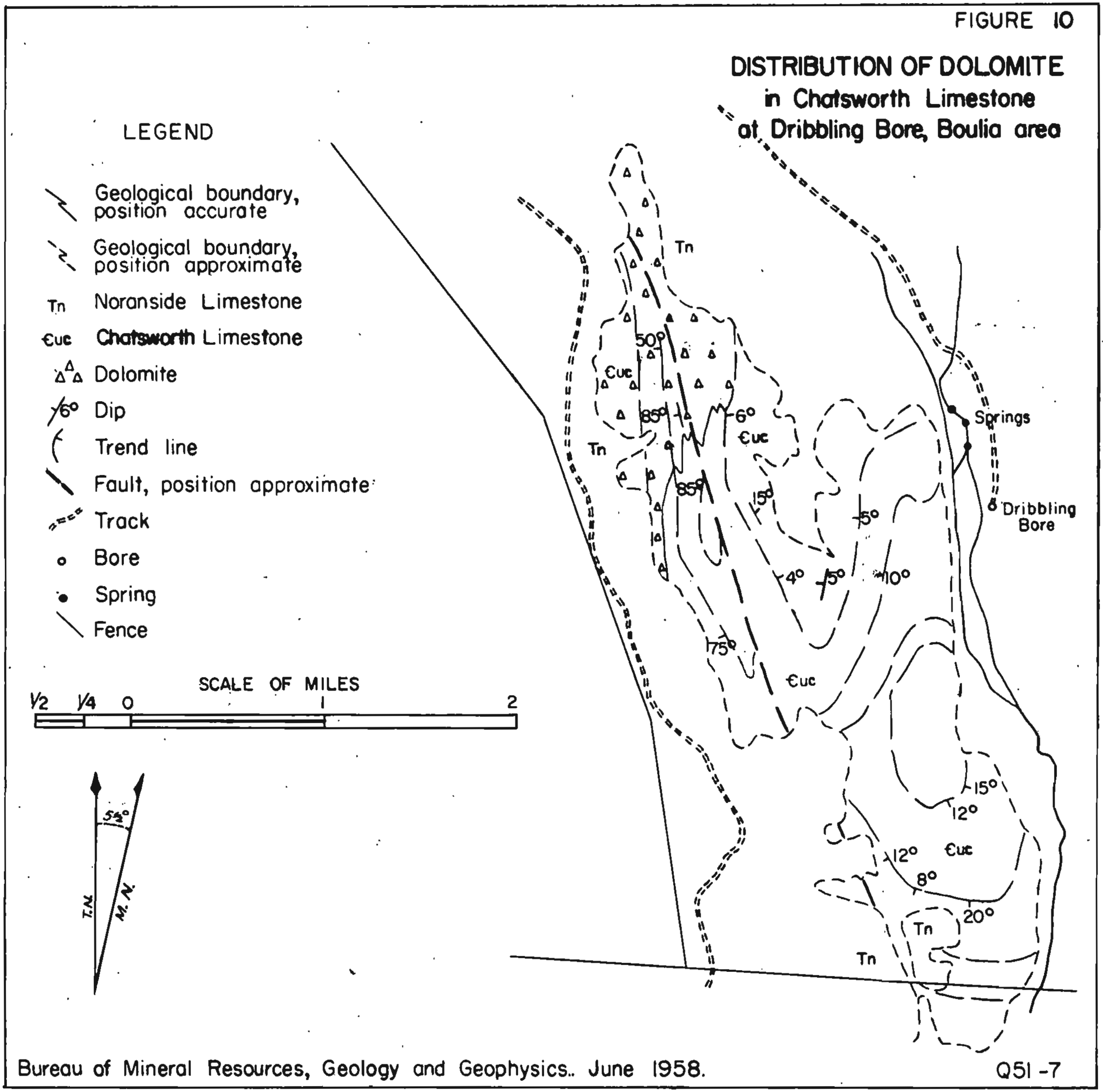


FIGURE 10

DISTRIBUTION OF DOLOMITE in Chatsworth Limestone at Dribbling Bore, Boulia area

Bureau of Mineral Resources, Geology and Geophysics.. June 1958.

B. Bodies of secondary dolomite are usually found in limestone rock units. They occur in patches and there are abrupt changes from dolomite to limestone. There is likely to be structural and/or sedimentary control of the location of these patches. Fossils replaced by dolomite may be numerous.

Secondary dolomite formed during diagenesis is compact, whereas that formed after diagenesis is vughy and often more strongly jointed than the surrounding sediments. Dolomite bodies formed after diagenesis are associated with structural features, (probably including unconformities, where an increase in the proportion of dolomite present may result from the leaching of $CaCO_3$).

C. Clastic deposits of dolomite are hard to distinguish from primary deposits, especially when they are recrystallised. They show normal stratigraphic relations to other rock units and normal clastic-sedimentary structures.

Dolomite rock bodies occur in the Boulia four-mile area in the Ninmaroo Limestone. They can be divided into -

(i) Those bodies which crop out along the Burke River Structure at Mt.Datson, Mt.Ninmaroo, Black Mountain, Black Ridge and in the hills between Swift Hills and the Burke River. The dolomite in these bodies is vuggy and fine to medium-grained. It occurs in thick to thin and sometimes laminated beds, which are commonly well jointed. There is some lithological control of the distribution of the dolomite in each of the dolomite bodies but the boundaries of the bodies transgress the bedding (figure 10).

All these dolomite bodies are of secondary, post diagenetic origin.

(ii) Beds of dolomite which crop out along the Burke River Structural Belt but which are not associated with structural elements. On the western side of the Swift Hills, such beds are formed of very fine and fine-grained dolomite. They are laminated and thin bedded and are interbedded with thin bedded calcilutites and fine and very fine-grained calcarenites, some of which are fossiliferous, sandy, cherty, oolitic or two tone. Some intraformational conglomerate also crops out. Similar sequences occur elsewhere along the belt of outcrop running along the Burke River Structural Belt.

Most of these beds are probably primary deposits, but some may be secondary or at least have undergone a secondary concentration.

(iii) In the Cottonbush Creek area, flat lying dolomite containing minor limestone interbeds forms the Ninmaroo Limestone. The dolomite is thin bedded and shows current bedding. In places it is sandy. It contains few fossils.

This area of outcrop extends on to the Glenormiston four-mile area. The dolomite is probably primary with some beds of secondary dolomite formed during diagenesis.

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APPENDIX A.

MICRO-EXAMINATION OF SAMPLES FROM THE BOULIA AREA, WEST QLD.

by
Irene Crespin

Sixty four samples from the areas covered by the Boulia, Glenormiston, Mt.Whelan and Springvale 4-mile Sheets, were received for examination. The rocks consisted of siltstone, cherty siltstone, sandy siltstone, sandstone, and limestone. Many of the siltstones were unfossiliferous, but some contained Lower Cretaceous foraminifera and radiolaria. Sample B137 is from the freshwater Noranside Limestone, most probably of late Tertiary or Pleistocene age, and B258a is a silty sandstone of probable Cambrian age.

Boulia 4-mile Sheet.

B258a,b,c, from 1 mile west of Sonning Bore, up face of De Little Range.

(a) Base section, 10 feet thick reddish silty sandstone and cream siltstone with sponge spicules and ?radiolaria and well preserved quartz crystals; sponge spicules typically Cambrian (Dr.Öpik, pers.comm.); mapped as O'Hara Shale.

(b) Bed 20 feet thick of siltstone, cream to pink with many grains of brown hydrated iron oxide after pyrite (W.B.Dallwitz, pers.comm.) No microfossils, but mapped as Wilgunya Formation.

(c) Bed 20 feet thick of white to pink siltstone; no microfossils. The lithology is similar to radiolaria-bearing Mesozoic rocks in Western Australia, Northern Territory and Queensland.

Other rocks examined from the Boulia area are siltstones, some of which are cherty. Radiolaria only occurred in some, whereas others contained radiolaria, small pelagic forams and small arenaceous forams.

B97, from hills 2 miles west of Brighton Bore, Pathungra Station. A white radiolarite containing radiolaria (*Cenosphaera* sp., *Porodiscus* sp., cf.*Stylosphaera*) and poorly preserved arenaceous forams (*Haplophragmoides* sp.)

B98, east of Momedah Anticline, 5 miles south-west of Brighton Bore. A white chalky radiolarite with poorly preserved forams (*Haplophragmoides* sp., *Spiroplectammina cushmani*, Crespin, *Trochammina* sp.).

B174, 4 miles east of Lorrett Downs Homestead, run 8, photo 5123. It is a yellowish calcarenite, mapped as Toolebuc Member, containing many radiolaria (*Cenosphaera* sp., and *Dictyomitra* sp.) and rare tests of the pelagic foram *Globigerina*, probably *G.planispira* Tappan.

B310, from a scarp near the track, 1½ miles east of Herrod's Tank, Buckingham Downs. The sample is an ochreous sandstone with rare forams (Spiroplectammina sp.)

B336, from Reid's Well, Windsor Park, run 5, photo 5089. Three cherty siltstone or cherty radiolarite lithologies occur;

(i) dense, hard, cherty rock with Cenosphaera and Amphibrachium;

(ii) chalky, white, siltstone with Cenosphaera, Lithocyclina, Astrophacus, and Amplibrachium;

(iii) chert in which any trace of radiolaria originally present were obliterated by recrystallization and silicification.

B417, Sandy Creek Well, north of Badalia Homestead.

Sample is a sandstone with some siliceous sponge spicules and a few arenaceous forams (Ammobaculites minimus Crespin, Spiroplectammina cushmani Crespin, Trochammina minuta Crespin).

B637, (run 12, photo 5143. 1 mile north-west of Gidyea Bore, Stockport) is in the Wilgunya Formation and contains a rich assemblage of foraminifera including:

Ammobaculites minimus Crespin
A. fisheri Crespin
A. subcretaceous Cushman and Alexander.
Ammobaculoides cf. pitmani Crespin.
Haplophragmoides chapmani Crespin (c)
H. globosa Lozo
Hyperammina sp.
Involutina cretacea (Reuss)
Spiroplectammina cushmani Crespin (c) S. edgelli Crespin
Trochammina minuta Crespin

B720, 3½ miles north-east of Old Kheri Outstation, on the Toolebuc road, and B721, 4½ miles north-east of Old Kheri Outstation, is a calcarenite, mapped as Toolebuc Member, with radiolaria (Cenosphaera sp.) and minute foram (Globigerina planispira Tappan).

B734, 1 mile south-east of 10 Mile Bore, Dover, run 7, photo 5143, is from the Wilgunya Formation, and contains Cenosphaera in a moderately friable siltstone.

B781, 1 mile east-north-east of 9 Mile Bore, Warenda, run 11, photo 5205, from the Wilgunya Formation, contains arenaceous forams (Ammobaculites fisheri Crespin, A. minimus, Haplophragmoides sp., Spiroplectammina cf. edgelli Crespin), Siphotectularia sp.

Arenaceous forams occured in the following sandy siltstone samples, but in all cases, as is characteristic of the fauna in the Lower Cretaceous, most of the tests are crushed: B617, B705, (on Momedah Creek, 1 mile west of the anticlinal axis), ABC Bore (Lorrett Downs), Bob's Well and Blair Athol Homestead. (Blair Athol Station) and sample (a) Kingdom Bore (Alderley).

Haplophragmoides chapmani was especially common in B.705 and ABC bore. Arenaceous foraminifera recognised in a sample from the Kingdom Bore were:

Ammobaculites mininus Crespin
Ammobaculites fisheri Crespin (c)
Haplophragmoides chapmani Crespin (c)
Haplophragmoides sp.nov. (c)
Spiroplectammina cushmani Crespin (c)
Trochammina minuta. Crespin

A second or bottom sample (b) from this bore consisted of unfossiliferous sandstone. It may represent the aquifer bed.

The species listed above were also present in samples from Bob's Well and Blair Athol homestead bore, but were less common.

B.617 (from Buster Dud Bore, Buckingham Downs) contained many siliceous sponge spicules and a few minute arenaceous foraminifera; this bore passed through some Wilgunya Formation and then 200 feet of Cambrian limestone.

Springvale 4-mile Sheet.

S.1 (Springvale run 3 photo 5109, 1½ miles north-west of Spring Creek Bore, Warra) is a fossiliferous calcareous siltstone, mapped as Toolebuc Member, containing abundant fragments of Inoceramus prisms, fragments of fish remains - chiefly scales, a few tests of radiolara, (Dictyomitra cf. australis, Cenosphaera sp.) and numerous tests of the foraminifera Globigerina cf. planispira.

Mt.Whelan 4-mile Sheet.

One sample, W13 from below the chalcedony on the north peak feet of Mt.Whelan, is a hard siliceous siltstone with aggregates of quartz grains, a spiny variety of siliceous sponge spicule, and arenaceous foraminifera (Ammobaculites sp., ? Trochammina).

Notes on the samples

The radiolaria-bearing siltstones and sandy siltstones are widely distributed in North-west Australia, Northern Territory, and western and central Queensland. The writer regards these rocks as being late Lower Cretaceous, most probably the equivalent of the Albian. Rocks lithologically similar to those examined from western Queensland overlie the richly fossiliferous Lower Cretaceous Roma Formation (Aptian) at Mt.Bassett near Roma.

The samples containing the arenaceous foraminiferal assemblages are regarded as the equivalent of the Aptian Roma Formation. The foraminifera have all been recorded from the type section of the Roma Formation at Bungeworgorai Creek, west of Roma (Whitehouse, 1954; Crespin, 1953).

The most interesting feature of this rock collection is the association of planktonic foraminifera (Globigerina) and radiolaria in the siltstones B.174 and B.720 (run 5, photo 5071, 4 miles north-east of Kheri Outstation, mapped as Toolebuc Member). Both these forms occur as deep sea oozes in Recent seas, but they need not necessarily be of deep-sea origin. Bronnimann (1949) states that pelagic foraminifera and radiolaria "may indicate true deep-sea deposits, but they also could have been accumulated in sediments of a shallow sea or of a marginal or even of a land-locked sea...and in most cases their pelagic foraminifera occurrence is probably more useful for assessing possible connections with the open sea than absolute depth."

The arenaceous foraminifera are definitely not open-sea types: they flourished in estuaries or gulfs.

The sample (S.1) from the Springvale area is another interesting one, in which Inoceramus prisms, fish remains, pelagic foraminifera, and radiolaria are associated. Perhaps the foraminifera and radiolaria were floated into the more shallow water area in which Inoceramus and fishes thrived. It is difficult to place this rock in its proper stratigraphic position on the palaeontological evidence from one specimen.

It is possible that the sample from the Mt. Whelan 4-mile Sheet, W.13, belongs to one of the variations of the siltstone beds of Albian age.

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APPENDIX B.

REPORT ON FOSSIL PLANTS FROM THE BOULIA DISTRICT, CENTRAL WEST QUEENSLAND.

by
Mary E. White.

Fossil plants were collected from localities B.196, B.349, B.404, B.417, B.524 on the Boulia 4-mile Sheet and from locality G11 on the Glenormiston 4-mile Sheet; all localities are in the Boulia Shire.

Locality B.196 from Wilgunya Formation, run 14, photo 5087, 3 miles east-south-east of No.15 Bore, Lucknow; indeterminate wood fragments associated with marine pelecypods.

Locality B.349 from Marion Formation, run 12, photo 5153, 6 miles north of Strathelbiss Homestead. Blocks of very well preserved fossil wood were collected from this locality. Internal structure showed the wood to be of Conifer type with very regular arrangement of tracheids. Annual rings are clearly seen. Medullary rays one cell wide and several cells deep occur throughout the wood. There are no resin canals. In longitudinal section the bordered pits on the tracheid walls appear to be in single rows and not much compressed.

Wood of this type cannot be used for age determination as it is of the general type found in coniferous plants from late Palaeozoic to Recent times.

Locality B.404 from Longsight Sandstone, run 4, photo 5109, at Herrod's Tank, Buckingham Downs. This specimen contains several leaves of *Taeniopteris spatulata* McClelland. This is a plant most characteristic of Jurassic strata, but it occurs as well in Upper Triassic and survives into Cretaceous beds in the Styx River Series in Queensland.

Locality B.417 from Longsight Sandstone, run 14, photo 5047, from the bottom of an old well near Sandy Creek bore, Herbert Downs. The specimens from this locality are indeterminate.

Locality B.524 from Longsight Sandstone, run 4, photo 5109, Herrod's Tank. The following plants are identified from this locality:-

(a) *Cladophlebis australis* (Morris). Some of the very large and well preserved fronds of this fern might be referred to cf. *Cladophlebia distans* or cf. *C. Huttoni*, but the smaller examples mingled with them are typically

Cladophlebis australis and there is no reason to suppose that the larger are a different species. Characteristically, pinnules of any species of fern vary a great deal in size and form.

Cladophlebis australis (Morris) is a most characteristic plant of Jurassic strata. It occurs as well in the late Triassic and persists into Cretaceous beds in the Styx River Series in Queensland.

(b) Elatocladus cf. plana (Feist). Purely vegetative fronds of this type have a wide range from late Triassic to Cretaceous strata, and are therefore of little value for age determination.

(c) Small triangular cone scale or seed. Indeterminate,

(d) Indeterminate round seeds which may be of a Cycad type.

(e) Indeterminate stems, wood and plant fragments.

The age of the plant assemblage in B.524 could be late Triassic, Jurassic, or Lower Cretaceous.

Locality G 11 from Longsight Sandstone, run 3, photo 5109, Glenormiston, east of Smoky Creek. At this locality Elatocladus cf. plana Feist. occurs with with Taeniopteris spatulata McClelland and indeterminate round seeds. There are also indeterminate wood and stem impressions. These plants indicate a Late Triassic or Jurassic or Lower Cretaceous age.

APPENDIX C.

THE MACROFOSSILS FROM THE BOULIA AREA, WESTERN QUEENSLAND.

by

Dorothy Hill
University of Queensland

A. Collections of a faunule that is similar to that of the Roma Formation. No such fauna has been reported previously from Western Queensland.

G.1. Glenormiston, run 3, photo 5105, 8½ miles south-west of Pigeon Creek Tank on road to Tripod Water Hole; mapped as Longsight Sandstone.

- Fissilunula ?clarkei very common
- ? Cyrenopsis sp.
- ? Mytilus sp.; very small narrow form, as in G.15 and B.310.
- ? Matica ?variabilis
- Mould of small ?belemnite

G.15. Glenormiston, run 5, photo 5005, 16½ miles west-south-west from Pigeon Creek Tank, mapped as Longsight Sandstone:-

- Fissilunula ?clarkei v.common
- Mytilus inflatus
- Maccoyella sp.
- ? Mytilus sp.; very small narrow form, as in G.1 and B.310.
- ? Thracia or? Cyrenopsis sp.
- ? Syncyclonema
- Belmenite mould

B.310. Boulia, run 4, photo 5109, 1¼ miles east of Herrod's Tank, mapped as Longsight Sandstone.

- Fissilunula ?clarkei v. common
- Maccoyella spp.
- ? Cyrenopsis sp.
- Syncyclonema socialis
- ? Mytilus sp., very small and narrow as in G.1 and G.15.
- Mytilus inflatus
- ? Panope

B. Group of doubtful correlation possibly ROMA rather than TAMBO.

B.100 Boulia, run 7, photo 5153, 3½ miles north of Momedah Creek and immediately east of the anticlinal axis; mapped as Wilgunya Formation.

Maccoyella sp.
This more doubtfully Roma than G.1, G.15 and B.310.

B.320 As above, but one mile north of Momedah Creek.
? Maccoyella ?barklyi

B.722 Four miles west of the Selwyn-Toolebuc and Chatsworth-Toolebuc road junction, Duchess 4-mile Sheet, mapped as Longsight Sandstone.
? Cyrenopsis sp.

B. 97 Boulia, run 6, photo 5019; 2 miles west of Brighton Bore, south of Brighton Gap; mapped as Wilgunya Formation.
? Thracia

B.407 Boulia, run 8, photo 5103, half a mile north-east of Kingdom Bore, Alderley; mapped as Wilgunya Formation.
? Natica ?variabilis

B.521 Boulia, run 8, photo 5118, half a mile south of Momedah Creek immediately west of the anticlinal axis; mapped as Wilgunya Formation.
Mytilus sp.
? Thracia sp.

B.98 Boulia, run 7, photo 5153, one quarter of amile south-east of B.100; mapped as Wilgunya Formation.
? Cyrenopsis sp.
? Thracia sp.
? Syncyclonema socialis

C. Group with faunule similar to that of TAMBO Formation; a collection from 7½ miles south of Moorooka-Beaudesert boundary on the McKinlay - Boulia road about 20 miles south of McKinlay is similar.

B.720 Boulia, run 5, photo 5071, 4 miles north-east of Kheri Outstation; mapped as Toolebuc Member of Wilgunya Formation.
Aucellina hughendenensis very common.
Inoceramus sp.
? Pteropod

B.721 Boulia, run 5, photo 5071, half a mile north-east along road from B.720; mapped as Toolebuc Member.
Aucellina hughendenensis
? Fish scale
Small very low coiled ?gastropod (?new).
Small smooth pectinoid ? Syncyclonema

B.732 Boulia, run 7, photo 5143; $2\frac{3}{4}$ miles south-east of 10 Mile Bore, Dover; mapped as Wilgunya Formation.
Inoceramus sp.

D. AGE UNKNOWN

B.532 Glenormiston, run 8, photo 5135, near Rocky Bore, from a cave; mapped as Longsight Sandstone.
Indeterminate.

APPENDIX D.

EXAMINATION OF OUTCROP SAMPLES FROM THE BOULIA AREA, WESTERN QUEENSLAND.

by
M.C. Konecki

Outcrop samples collected during the course of a geological survey in the Boulia-Chatsworth area were tested for porosity, permeability and fluid saturation.

Ten outcrop samples of limestone from three Palaeozoic formations were tested.

Sample D126: from De Little Range; 1 mile west of Sonning Bore; Boulia 4-mile Sheet.

Stratigraphic position: Pomegranate Limestone (Upper Cambrian).

Lithology: 3 specimens submitted were marked in the laboratory D126 (1), D126 (2) and D126 (3).

Specimen D126 (1) is a brownish-grey very dense, silicified, medium-bedded limestone. No tests were carried out on this specimen.

Specimen D126 (3) is a laminated light grey "sandy" limestone. No tests were carried out on this specimen.

Specimen D126 (2) is a brown-grey, fine-grained hard, medium-bedded limestone. It was tested for density, porosity, permeability and residual fluid saturation.

Results:
Density ("dry bulk"): 2.67
Density ("dry grain"): 2.7
Porosity (average): 1.2%
Permeability (horizontal): zero millidarcies
Permeability (vertical) : zero
Residual Oil Content : zero.

Sample D120. from 12 miles north of Chatsworth Homestead on main Selwyn Road Duchess 4 mile Sheet.

Stratigraphic Position: Pomegranate Limestone (Upper Cambrian); upper part of the formation.

Lithology: Three samples of rock were examined; two were dark brown-grey dense limestone, and the third was grey laminated rather "sandy" limestone. These samples have been numbered D120 (1), D120(2) and D120(3).

Results: Sample D120(1)

Density ("dry bulk") : 2.69
Density ("dry grain") : 2.74
Porosity (average) . 1.44%
Permeability (horizontal) zero millidarcies
Permeability (vertical) zero
Residual oil content zero
Residual water content not measured

Sample D120 (2)

Density ("dry bulk") : 2.67
Density ("dry grain") : 2.73
Porosity (average) : 1.79%
Permeability (horizontal) zero millidarcies
(vertical) zero
Residual oil content zero
Residual water content not measured

Sample D120(3)

Density ("dry bulk") : 2.59
Density ("dry grain") : 2.70
Porosity (average) : 3.95%
Permeability (horizontal) zero millidarcies
(vertical) zero
Residual oil content : 0.17% by weight
4.3% of pore space
13.2 bbls/acre-foot

Sample 120(s) from 12 miles north of Chatsworth Homestead, Duchess 4-mile Sheet.

Stratigraphic Position: Pomegranate Limestone (Upper Cambrian); 10 to 20 feet above sample D120.

Lithology: Limestone, grey-brown, crystalline, fossiliferous.

Results: Density ("dry bulk") 2.72
Density ("dry grain") 2.75
Porosity (average) 1.16%
Permeability (horizontal) zero millidarcies
(vertical) zero
Residual oil content 0.17% by weight
14.7% of pore space
13.6 bbl/acre-foot.
Residual water content 0.123% by weight
10.6% of pore space
9.5 bbl/acre-foot

Sample D124S (1) from 4 miles north-west of Chatsworth Homestead.

Stratigraphic Position: Chatsworth Limestone (Upper Cambrian) About 50 feet or more above top of Pomegranate Limestone.

Lithology: Limestone, very dense, black to dary-grey.

Results:

Density ("dry bulk") :		2.71
Density ("dry grain") :		2.73
Porosity (average)		1.06%
Permeability	(horizontal)	zero millidarcies
	(vertical)	zero "
Residual oil content		0.096% by weight
		9.1% of pore space
		7.5 bbl/acre-foot.
Residual water content		0.137% by weight
		13.00% of pore space
		10.8 bbl/acre-foot.

Sample D124S (2) from 4 miles north-west of Chatsworth Homestead.

Stratigraphic Position: Chatsworth Limestone (Upper Cambrian) 50 feet or more above top of Pomegranate Limestone.

Lithology: Intraformational limestone breccia.

Results:

Density ("dry bulk")		2.75
Density ("dry grain")		2.77
Porosity (average)		0.6%
Permeability	(horizontal)	zero millidarcies
	(vertical)	zero "
Residual oil content		0.013% by weight
		2.17% of pore space
		0.23 bbl/acre-foot.
Residual water content		0.110% by weight
		18.33% of pore space
		8.5 bbl/acre-foot.

Sample B791. from between Chatsworth and Digby Peaks, Boulia, run 1, photo 5141.

Stratigraphic Position: Chatsworth Limestone (Upper Cambrian); near top.

Lithology: Banded, grey and red-brown, medium bedded, hard, crystalline limestone.

Results:

(Cont. p.124)

Results:	Density ("dry bulk")	2.68
	Density ("dry grain")	2.73
	Porosity (average)	1.7%
	Permeability (horizontal)	zero millidarcies
	(vertical)	zero "
	Residual oil content	Zero

Digby Peaks: on the Boulia 4-mile Sheet.

Stratigraphic Position: Ninmaroo Limestone (Lower Ordovician-Upper Cambrian) about 150 feet below Swift Formation.

Lithology: Limestone, grey, hard, very fine grained, thin bedded (1" - 2").

Results:	Density ("dry bulk")	2.73
	Density ("dry grain")	2.76
	Porosity (average)	0.94%
	Permeability (horizontal)	Zero millidarcies
	(vertical)	Zero
	Residual oil content	0.113% by weight
		12.0% of pore space
		8.76 bbl/acre-foot.
	Residual water content	0.147% by weight
		15.64% of pore space
		11.65 bbl/acre-foot.

Sample B507(A1) from Black Mountain; Boulia, run 9, photo 5069.

Stratigraphic Position: Chatsworth Limestone from "core" of Black Mountain (Upper Cambrian).

Lithology: Limestone coarsely crystalline, hard, grey, fossiliferous.

Results:	Density ("dry bulk"):	2.75
	Density ("dry grain"):	2.82
	Porosity (average) :	2.2%
	Permeability (horizontal)	Zero millidarcies
	(vertical)	zero "
	Residual oil content :	0.13% by weight
		5.9% of pore space
		10.1 bbl/acre-foot.
	Residual water content	0.19% by weight
		8.6% of pore space
		14.7 bbl/acre-foot.

Sample B510C from Black Mountain; Boulia run 9, photo 5069.

Stratigraphic Position: Chatsworth Limestone, 950 feet above base of section at Black Mountain and immediately below Ninmaroo Limestone.

Lithology: Grey, fine-grained, dense,?dolomitic limestone.

Results: Density("dry bulk") : 2.71
Density ("dry grain"): 2.77
Porosity (Average) : 1.45%
Permeability (horizontal) : zero millidarcies
(vertical) : zero "
Residual oil content : 0.061% by weight
4.28% of pore space
4.8 bbl/acre-foot.
Residual water content: 0.35% by weight
24% of pore space

Sample B514 from Black Mountain, Boulia, run 9, photo 5069.

Stratigraphic position: Ninmaroo Limestone; 1,800 feet above base of total section exposed at Black Mountain.

Lithology : Grey, dense, finely crystalline, fossiliferous limestone.

Results: Density ("dry bulk") : 2.69
Density ("dry grain") : 2.75
Porosity (average) 2%
Permeability (horizontal) :zero millidarcies
(vertical) :zero "
Residual oil content 0.04% by weight
2% of pore space
3.1 bbl/acre-foot.
Residual water content: 0.13%
6.5% of pore space

Sample B773 from Mount Ninmaroo; Boulia, run 10, photo 5023.

Stratigraphic position: Upper part of Chatsworth Limestone exposed in "core" of Mt.Ninmaroo.

Lithology : Brownish-dark-grey, dense, crystalline limestone.

Results: Density ("dry bulk") : 2.71
Density ("dry grain"): 2.77
Porosity (average) : 2.23%
Permeability (horizontal) zero millidarcies
(vertical) zero "
Residual oil content : zero

Remarks:

Porosity tests were carried out using a Ruska Field Porometer. Permeability tests were made with nitrogen gas using a Ruska Permeameter. Saturation tests were made by extracting samples with toluene in an apparatus and by a method described by Rall and Taliaferro (U.S.B.M., 1946, R.I. 4004.)

The results of tests indicate that the residual fluid content, and particularly the residual oil content, of parts of the formations is not inconsistent with those of source beds elsewhere in the world. The original oil content might have been much higher; more work is required on fresh cores etc.

Pt. 2 of 2

APPENDIX E

to

RECORD 1960/12

by

J.N. Casey, M.A. Reynolds, D.B. Dow, P.W. Pritchard,
R.R. Vine and R.J. Paten (Qld. Survey.)

LOGS OF WATER BORES IN THE BOULIA AREA, NORTH WEST QUEENSLAND.

PART 2 of 2

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

APPENDIX E to RECORDS 1960/12

LOGS OF WATER BO_ _S IN THE BOULIA AREA, NORTH WEST QUEENSLAND.

by

J.N. Casey, M.A. Reynolds, D.B. Dow, P.W. Pritchard, R.R. Vine, and R.J.Paten (Qld.Survey).

The following is an alphabetical list of the stations included in this collection of bore data:

Ardmore
Alderley
Badalia
Blair Athol
Buckingham Downs
Burnham
Cazna Downs
Carandotta
Carlo
Cravens Peak
Chatsworth
Corrie Downs
Cuckadoo
Datchet Downs
Digby Peaks
Dover
Douglas Downs
Elrose
Fort William
Glenormiston
Goodwood
Government Operated
Granton
Gumpti
Hartnell Downs
Jibloo
Kallala
Linda Downs
Lorrett Downs
Lucknow
Macsland
Maryvale
Neena
Ninmaroo
Nithsdale
Noranside
Pathungra
Paton Downs
Paynton Downs
Pollygammon
St.Lucia
Scarsdale
Slashes Creek
Stockport
Strathelbiss
Toolebuc
Two Rivers
Walgra
Waterford
Windsor Park
Wirrilyerna
Warenda

INTRODUCTION

All bores encountered during geological investigations in the Boulia - Glenormiston area during 1957 and 1958, were plotted on air photographs of the area; these were subsequently transferred to a four mile to one inch scale base map. Some bores were not found while in the field; the position of these were plotted from station information or from the records of the Irrigation and Water Supply (I.W.S.) Brisbane, and marked P.D. (position doubtful) on the map.

The bores have been listed under the station which owns them, and the stations arranged alphabetically. A sketch map shows the general position and shape of the various stations referred to.

The information about the bores is, in most cases, a combination of details supplied by station owners and managers, the I.W.S. records, and by water drillers. Many bores visited by the authors still had the sludge drain visible; in these cases, the rock fragments were described as a check against the drillers nomenclature.

The bore logs formed the basis for the discussion on "Hydrology", Isopach and structure contour maps in Casey et al's record 1960/12, Bureau of Mineral Resources.

A legend for the symbols used in the logs is as follows;

blds. boulders
bl. blue
bk.or blk. black.
br. brown
cold. coloured
cl. clay
congl. conglomerate
c.g. coarse grained
dlte. dolerite
fri. friable
f.g. fine grained
gn. green
gy. grey
grt. gritty

grv. gravel
h. hard
Hs. Homestead
I.W.S.(Irrigation & Water Supply, Brisbane.
l. light
lst.or lmst. limestone
m.g. medium grained
pk. pink
ppl. purple
pbls. pebbles
qtz. quartz
qtzte. quartzite
rble. rubble

rbn. ribbon
rk. rock
sh. shale
sst. sandstone
sd. sand
sdy. sandy
slst. siltstone
sch. schist.
slipback. slipperback.
s. soft
st. stone
surf, surface.
sply. supply
w. with
wh. white
w.h. waterhole
y. yellow.

Names in brackets after the bore name, refer to the name registered with the I.W.S. Brisbane.

"L" before figure in altitude signifies known surveyed height; the other altitude figures are barometric results, or method of levelling unknown.

In some cases the licence number (Lic.No.) is given when the registered number is not known. In many cases the licence or registered number was not known for the bore.

In some cases the position of the bores plotted from I.W.S. co-ordinates does not agree with the field position; this is usually because of the inaccuracies of the existing maps when the early bores were drilled (i.e. before 1900).

Unless specifically mentioned, the strata information is the drillers terminology, and in many cases, is far from the correct lithology as used by geologists.

ARDMORE STATION

Homestead Location: 25 Mls W Dajarra

Station Owner: Rochdale Pastoral Co. (E.W. [illegible] - Manager)

Communication: [illegible]

Access: [illegible]

ARDMORE STATION

Altitude: [illegible]

Area: [illegible]

Stock: [illegible] 11,000
Sheep 33,000

Name	Reg.No.	Position	Altitude (above sea level)	Depth to Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hr.)	Quality or Analysis (gr/gal)	Driller and when Drilled	Strata and Remarks
Old Ardmore No.1	549?	8½ miles NW of Hs. (Urandangi)		310'			[illegible]		[illegible]	C.D.1915 24' mill 2 GI tanks 350' of 6" cas.
Lower Pigoon	549a?	4 miles N. of W. of Old Ardmore (Urandangi)		280'	326'		[illegible]	[illegible]	[illegible]	C.D.1917 - 30' of 8" casing 27' mill. -293' of 6" " 1 GI tank -288' of 5" "
Middle Pigoon	549?	4 miles N of Old Ardmore (Urandangi)		350'			[illegible]	[illegible]	[illegible]	C.D.1934 - 30' of 8" casing 27' mill -1100' of 6" " 1 E.T. -386' of 5" "
Homestead No.1	[illegible]	Homestead (Urandangi)	966'	269'			70	[illegible]	[illegible]	C.D.1919 - 30' of 8" casing 27' mill -450' of 6" " 2 GI tanks -100' of 4" "
Homestead No.2	13039?	¾ mile WNW of Hs. (Urandangi)	[illegible]	498½' 385'	462'	401-450 390-385	650		AG & WE Hartig 1955	8-19 red sdy.sl. -262 Lst. -72 pk. cl. -270 Sd. & Lst. -74 sd. -360 Lst. -110 cl. - sd. -370 Xld. Lst. -120 chalk -390 Blue Lst. -126 sd. -448 Interbdd Blue & Xld. Lst. -226 cl. & sm. sd. -46[illegible] brown [illegible] -234 ironstone & cl. -473 Blue Lst. -244 Lst. & sd. -484 Xld. Lst. 498½ Blue Lst.
Jayah	11991	15 miles WNW of Hs. (Urandangi)		318'9" 258	264'	278, 312	Good (1028)	Good	WJ Sinclair 1951	0-19 Rd. sdy. loam. 225-228 Lst. bccia. Kaolin & odd jasper stones. 19-124 Qutz. sd. & sm. Kaolin. -244 Bccia. Kaolin 124-156 Rd. cl. Kaolin, sd. -245 " " Qutze. 156-162 Rd. cl. talc sd. -250 Kaol. bccia. 162-208 Rd. cl. sd. -314 Lst. Kaol. 208-225 Lst. breccia -318 Y. clay -318'9" Lst. Kaol.
Dud (Blacks Creek Yilbung)				275		104			[illegible] Beauchamp 1948-1949	0-36 Y. grvly. cl. 0- 40 Wh. Lst. & cl. -59 sd. stone. 40- 58 Y. Lst. -73 Sch. -74 Wh. Lst. -118 rd. rk. bd. of Lst. at 102 -92 Y. cl. -137 Qrtzt. -152 gravel & sd. -155 Grnt. -160 Wh. clay -168 " " & sand. -212 Y. Qtzt. & sdst. -250 Y. Qtzt. -275 Qtzt. & Mica Sch.

ARDMORE STATION - Page 2

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality or Analysis (gr/gal)	Driller and When Drilled	Strata and Remarks
Yappa Well		Just W. of Old Rochdale Well (Urandangi)	926'	About 30							
Tin or Mungerebar No. 2	9281	About 2 miles NNW of Mungerabar No. 3 (Glenormiston)									Abandoned
9 Mile	5499	**2 miles SW of Woolshed B (Urandangi)**		**275**			**322**	[illegible]	**Good**	**F.Roberts**	**1933 20' mill 1 GI tank 28 8" 322'6" 303'4"**
Lower Split or Bottom Split Creek	5498	**10 miles WSW of Hs.** (Urandangi)		**290**			**350**	[illegible]	**Very Good**	**H.K.Davies**	**1919 27' mill 2 GI tank 30' 8" 350' 6" 320' 4"**
Top Split Creek	5497	**4 Miles WSW of Hs.**		295			350	[illegible]	Very good	H.K.Davies	1919 27' mill 2 GI tanks 30' 8" 323' 6" 301' 5"
8 Mile Rochdale	5504	29 miles N of Hs. **(Urandangi)**		500			630	400	Good slightly warm	A.Wheelhouse	1932 27' mill **2 GI tanks** 30' 8" 612' 6" **530' 4"**
Black's Bore	[illegible]	25 miles N of Hs. (Urandangi)		300			323	about 450	Very good	T.House	C.D. 1935 32' 8" casing 323' 6" " 308' 5" " 27' mill 3¼ pump 1 iron tank
Yilbung		4 miles NNW of Black's Creek Bore		250			350	about 1000	stock only	P.Brushe	1917 27' mill 3 GI tanks 30' 8" 350' 6" 315' 5"
5 Mile	[illegible]	31 miles W of N of Hs. (Urandangi)		540			612	10		P.Brushe	1916 27' mill 2 GI tanks 600' 6" 584' 4"
Woolshed	[illegible]	21½ miles NNW of Hs. (Urandangi)		400			627	about 100	Good	H.K.Davies	1917 22' mill 2 GI tanks 30' 8" 627' 6" 518' 4"
Blackstone or Black Stump		4 miles NW of Dingo Hole B (Mt.Isa)		200			238	200	Fair	A.Steele	C.D. 1956 24' mill 1 GI tank 32' of 8" casing 238' of 6" " 228' of 4" "
Dingo Hole		5 miles N of W of Yilbung (Urandangi)		236			286	200		A.Steel & C.Pearce	C.D. 1937 25' mill 1 GI tank 116' of 6" cas. 287' of 4" "

ARDMORE STATION - Page 3

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis (gr/gal)	Driller & when drilled	Strata and Remarks
Andy's	[illegible]	5 mls.NE of New Mungerebar (Glenormiston)		75			190		Good	V.Beauchamp 7	[illegible]
New Mungerebar (Chummy)	[illegible]	8 mls.WNW of Chummy Tank; 20 mls. E of N of Roxborough Hs. (Glenormiston)		70			120			H.K.Davies [illegible]	[illegible]
Old Ardmore No.2 .12344		8½ mls. NW of Hs. (Urandangi)		315		364,339/362; 320/315	400	Good 1200	Good	W.J.Sinclair 1953	0-12 Red sdy loam 12- red clay & 158 Kaolin grv. & sd. with stony seams 158-184 Limestone & "brachure" (breccia) 184-226 kaolin 226-310 kaolin & yellow clay breccia seams at 278,306 310-318 br. clay & lst. 318-335 kaolin & y.clay 335-344 lst. 344-36- Y.clay & sd. 360-367 lst. 367-400 shale
Pigeon Creek No. 2	11612	4 mls N of W of Old Ardmore (Urandangi)		287		304 291	344½	1250	Brackish; Potable	W.J.Sinclair 1950	0-192? 192-233 buff clay & sh. -260 pumice & clay (cave at 257) -339 lst. & y.clay -344 lst.
Sailor's	12186	9 mls. W of Hs. (Urandangi)				319½ 306	334	1440	Good	W.J.Sinclair 1950	0-31 Br.sdy.loam -165 Qtz.grv. & br.clay -203 Bccia., lst. -240 Br.clay, bccia, lst. w.cgl. -250 Qtz. bccia. -290 Qtz.bccia. clear qtz. & y.clay -315 Qtz. lst., Br. clay -330 Lst. w. shale seam -334 Kaolin
Old Mungerebar	5484	5 mls. NW of New Mungerebar (Glenormiston)		65			110				
Chummy	5486	6¾ mls. NW of Chummy Tank; 2½ mls. NE of New Mungerebar (Glenormiston)		80			172			A.Young & V.Beauchamp 1926	

ARDMORE STATION - Page 4

Name	Reg.No.	Position	Altitude (above sea level)	[illegible] Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis (gr/gal)	Driller & when drilled	Strata and Remarks
Little Black's Ck. or Craigies	12800	38 mls. N. of Hs. ? (Urandangi)		39	114	50,78,118 39	118	760	Brackish; stock only	W.J.Sinclair 1954	0-10 Red sdy. loam -60 Blue shale -67 " " & qzite -84 " " -90 " " & gy.schist -105 " " -106 " " & gy.schist -110 " " -118 " " " " "
Salt Bore	[illegible]	2½ mls E of Hs. (Urandangi)		45			95	Very small	Salty not suitable for stock	J.Brushe	C.D.1923 95' of 6" casing 14' mill 85' of 4" " No tanks
Horse Creek	[illegible]3	4 mls NNW of hs. (Urandangi)		207			480	Fair	Good	H.K.Davies	C.D.1918 1 GI tank 27' mill 448' of 5" casing
Eight Mile Ardmore	[illegible]	13 mls WNW of Hs. (Urandangi)		200			356	Fair	Good	H.K.Davies	C.D.1917 30' of 8" casing 27' mill 352' of 6" " 1 GI tank 287' of 4" "
Pigeon Ck.		12 mls. N of Hs. (Urandangi)		288			406			H.K.Davies	C.D.1915 305' of 6" casing 27' mill 297' of 4" " 2 GI tanks
Mt.Horace	? 6153	40 mls. NNE of Hs. (Urandangi)		195		56',71' (soak) 38'	212	250		C.Pearce	0-3 hornblende schists 3-15 " 18-71 Sch.cl. 71-92 granite 92-122 sch. 122-127 [illegible]z. 127-186 hornblende gneiss 186-191 Qtzite 191-202 " 202-210 water-sand & sch & ha.sh. 210-212 blk.granite C.D.1939 192' of 6" casing 21' of 8" "
Blaze or Mungerebar No.4	8394	About 3 mls.E of Chummy Tank (Glenormiston)		90		112	146	1300		J.Pulman	0-56 Alluvium w.gravel & silica beds 56-76 silica 76-94 white clay 94-112 Blue calc.shl. 112-138 Breccia 138-142 Blue calc.sh. N.B. same as strata for Mungerebar no. 3 C.D.1940
Bob Dalia or Bog Bore or Mung. No. 1	8379	At Bog Tank, 4 mls. SE of Chummy Tank? (Glenormiston)		118		121	155	1200		C.R.Pearce	0-6 congl. -48 cl. -72 [illegible] -144 breccia -155 impur. lst. C.D.1940 32' of 8" casing 154' of 6" "

ARDMORE STATION - Page 5

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis (gr/gal)	Driller & when drilled	Strata and Remarks
Gidya Creek or Gidyea Creek	L1217	35½ mls E of N of Hs. (Urandangi)		130			250	Good	Good	Solling 1914	250'6" casing 156'5" " 22' mill 2 GI tanks (30,000)
3 mile	5503	27 mls W of N of hs. (Urandangi)		352			402	1000	Good	P.Brushe	1915 30' 8" 27' mill 402' 6" 2 GI tanks 352' 4"
Old Six Mile	5502	5 mls NW of Woolshed B (Urandangi)		350			397	Very moderate	Good	Solling & Gardiner	C.D.1914 260' 6" casing 24' mill 60' 4" 2 GI tanks 318' 4"
New Six mile	5501	3 mls WSW of Old 6 Mile (Urandangi)		340			400	Good	Good	H.K.Davies	C.D.1919 30'8" casing 27' mill 1100' 6" 1 GI tank 395' 4"
Goodwins or Goodwyn	5494	7 mls WNW of Hs. (Urandangi)		300			353	About 800	Good	H.K.Davies	C.D.1918 30' 8" casing 24' mill 253' 6" 1 GI tank 345' 4"
Mungerebar No. 3	9280	About 13 mls just S of E of Chummy Tank (Glenormiston)					150				0-6 silt Strata No. 3445 6-11 " & grv. Completed 1940 11-42 alluvium 56-76 silica 76-94 wh.clay 94-112 Blue calc.sh. 112-138 Breccia 138-146 Blue calc.sh. Abandoned cf. Strata of Mungerebar No. 4
Owens Creek No.2	8380	About 9 mls SE of Chummy Tank (Glenormiston)					109				Abandoned 1940
Owens Creek No. 1		About 9 mls SE of Chummy Tank ? (Glenormiston)					150				Abandoned 1940
Gap or McKellar's Yard Bore		7 mls S of E of Cornford B (Mt. Isa)		92			174	Unlimited	Good	C.R.Pearce	C.D.1939 167' of 6" casing 17' mill 140' of 4" " 1 GI tank
Junction Bore		4 mls N of Blackstone B (Mt.Isa)					244	(650 original) Nil		C.R.Pearce	Abandoned 38' of 8" casing C.D.1939 244' of 6" " 27' mill 127' of 5" " 2 GI tanks
Waverley	[illegible]	1 ml WSW of Waverley Dam & 15 mls NNW of Hs. (Urandangi)		251		282	666	None		C.R.Pearce & J.V.Pulman	0-13 Congl. 13-62 Clay 62-666 Impure lst. & calc. shale w. sd. at 457' 483' Abandoned 1940

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck &Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
Dud		¾ ml W of Pigeon Creek Bore (Urandangi) (Was drilled as a Government Bore.									
Dud		3 mls W of Mt. Guide outstation (Urandangi)									
Mt.Guide Well		At hut 44 mls NNE of Hs. (Urandangi)					40	Good	Stock only		
19 Mile Well		about 10 mls W of N of Mt.Guide O.S. (Mt.Isa)					60	Good	Stock only		
Bore		1 ml W of Chummy Tank (Glenormiston)		68			Greater than 100' *				*Measured 23.7.58 Limestone cuttings
Bore		6½ mls W of Chummy Tank; 3 mls SSE of New Mungerebar					98 *		Good		*Measured 30.9.58 Cuttings include white chalky f.grd. sandstone and siltstone and grey f.grd. calcarenite
Toby's Ck. Well							45½				Abandoned but there is a soak 4 feet deep as at 1958 16' mill GI tank
Wire Yd. Soak							4				16' mill GI tank
Carter's Bore		On Black's Creek (Mt. Isa)		1252'			412	Very good	Very good	C. Pearce	C.D.1938 30' of 8" casing 22' mill 412' of 6" " 1 GI tank 357' of 4" " 60' troughing Cost £900
Cornford's Lagoon or Templeton Bore		Headwaters of Yaringa Ck. (Mt. Isa)		214			259½	412	Good	C. Pearce	C.D.1939 259' of 6" casing 21' mill 250 of 5" " 1 GI tank Cost £800
Dud		3 mls NW of Goodwyn Bore (Urandangi)				About 3-400	1800?				Cemented off. Tried for Artesian supply

The following bores were Duds:-

2 Duds - one 2½ mls. N of Junction Bore on Big Toby Creek (Mt. Isa). Another 3½ mls. E of above on Big Toby Creek (Mt. Isa).

Dud - 2 mls. SW of 3 mile Bore (Urandangi)

Dud - 5½ mls ENE of Waverley Dam (Urandangi)

Dud - 1½ mls NW of Middle Pigeon Bore (Urandangi)

Dud - 2½ mls NW of Kahka Dam (Urandangi)

Dud - 4½ mls. E of 5 Mile Bore (Urandangi)

Dud - 2½ mls. E of 8 Mile Dam (Urandangi)

Dud - 4 mls. NE of Gidgea Creek Bore on netting fence (Urandangi)

Dud - 5¼ mls. ENE of Gidgea Creek Bore on netting fence (Urandangi)

ALDERLEY STATION

Homestead Location: 33 miles N.N.W. of Boulia.

Station Owner: T. Borthwick & Sons.

Communication: .. Telephone to Boulia.

Access: Dajarra-Boulia Road.

ALDERLEY STATION

Altitude: 740 feet.

Area: 985 square miles.

Stock: Cattle 10,000.
(Was once sheep, 30,000 pre-war.
Changed to cattle when Borthwick's
bought from Clarence in 1945.)

Name	Reg. No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck (feet) (rose)	Supply (Gal/hour)	Quality or Analysis (gr/gal)	Driller and when Drilled	Strata and Remarks
Homestead (Was Boundary No. 1 or Shed)	1719	Present Homestead	740	228	180	-	Large	–	1920	Bottom in Limestone at 228'
Engine	1090	5 mls. N. S. of Hs.	L687	295	190	-	–	-	–	
Bengeacca	1092	10 mls. SSW. of Hs.	-	230	220	-	–	–	–	
Mucklandina	1091	9 mls. ESE. of Hs.		250	95	–	–	–	–	
Old Station (Was Stn. Well).	1094	12 mls. SSE. of Hs.	L630	120	104	-	-	–	–	
Bosley	1716	9 mls. NNE. of Hs.		203	200	-	-	–	–	
Cottonbush	1715	18 mls. NNW of Hs.	735	245		-	-	Good pH-7.5		
Bore (Ald. Selwyn).	9185	Not known		212		186 184		–	Bode. 1943	8-82 Schist. -150 cl. & blds. -190 Lst. -195 Slickst. -200 sd. & rblc. -212 Lst.
Peak Creek	9954	6 mls. N. of Hs.		325 167		325 167	650		Grigg 1944	12-22 lt. col/d schist -32 Schist -82 Red schist -101 y. schist -111 h. gr. sch. -140 y. sch. -325 sst.
Junction (Alderley 3)	12222	16 mls. WSW of Hs.	620	200 140	180	142, 191 (150gph.)	900	Good ***	Holness 1953	Dolomite chips -190 lst. 0-50 red clay -200 lst.
7 Mile		11 mls. NW. of Hs.	765		240			Fair to good pH7 rusty casing.		Dolomite at surface. Dolomite in cuttings some blue grey limestone. Water did not rise crooked hole.
Rocky (Alderley 10)	?13252	8 mls. W. of Hs.	750	250	–	–	-	Good pH. 7	–	Dolomite at surface. Old Rocky Bore near Longsight Peak.

*** $CaSO_4$ 8.4
$CaCO_3$ 11.1
$MgCO_3$ 15.5
Na_2CO_3 6.9
$NaCl$ 21.4
Hardness 36°
F. 0.8 p.p.m.

Alderley 2.

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck (feet) (& rose).	Supply (Gal/hour)	Quality of Analysis (gr/gal)	Driller and when drilled.	Strata and Remarks.
J.S. (Jayess)	13022	5 mls.E. of Hs.	685	285 160	220	? 1[illegible]	900	Good pH.7	Close 1947	0-3 red soil - 80 lst.bldrs. -210 y.shale -285 lst.& layers of shale.
Old Station Well	1093	7 mls.SSE of Hs.	L649	122					Abandoned	
Dud.(Cotton-bush 5.)	1723	6 mls.WNW of West Bore, 2 m.E.of Deep Ck.	760	157					Ab.1920	No water [illegible] filled in to about 100'.Si[illegible]c.sst.on surface. [illegible] on ground at the hole.
Gum Creek	1088	S.fr.Edges. 1 m.N.of Stockport By. on E.s.ofCr.	557	280					Abandoned	
Limestone Yellow W/h.	1087	4.m.E.of Old Station.	598	250	95					
Peak Cr.2.	1717	100 yds.fr. Peak Cr.		260						
Kingdom (Alderley 7)	13145	11 mls.ENE of Hs.	715	200	180	180 150	1460	Good	A.Heness 1956	0-2 top soil -49 ribbon st. -75 slipbak. -951 sst. -154 slipbak. -165 sst. -181 shale -183 sst. -200 sst.
West	10197	6 mls.NNW of Hs.		300	266	285 220	450		Close, 1945	2-10 s.? & bldr. -35 sst.& red r. -43 boulders -53 wh.sdy.cl. -79 pk.sdy.cl. -106 wh.cl. -134 y.cl.bldrs. -150 y.lst. -283 sst.w.water. -293 y.lst. -300 lst.
Snake Creek (Alderley 2).	11769	25 mls.WSW of Hs.	640	350 170	220	270-290 170	1200	V.good pH 7.5 $CaSO_4$ 4.6 $CaCO_3$ 8.4 $MgCO_3$ 9.3 Na_2CO_3 1.7	Close 1951 NaCl 18.5 hardness 23. F.0.8 p.p.m.	0-2 red grv. -10 cl.& bldrs. -87 bldrs. -350 lst. Dolomite cuttings.
Leslie Peak (Belmore)	12725	27 mls.W. of Hs.	705	316 200	250	280 200	1700	Good pH.7	A.Heness 1954	0-12 top soil -20 sst -33 [illegible] -74 sst. -316 lst. Cuttings blue-grey lst. Reported water got below limestone in "granite".
Mindyalla (Alderley 4)	12232	28 mls.W. of Hs.	700	375 240	300	(150 gph) 240, 35[illegible] 240	Unlimited (1,000)	Good pH.8. $CaSO_4$ 7.8 $CaCO_3$ 7.3 $MgCO_3$ 10.1 Na_2CO_3 0.5	A.Heness 1953 NaCl 20.8 hardness 25. F. 0.7 ppm.	0-15 red cl. -100 y.cl. -130 lst bldr. -1[illegible] lst. -179 cave (filled up) -375 lst. Dolomite chips seen.
Edges (Alderley Holding 3.)	1089	12mls.S.E. of Hs.		250	200					

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & rose. (feet)	Supply (Gal/hour)	Quality of Analysis (gr/gal.)	Driller and when drilled.	Strata and Remarks.
Dud (Alderley No.6).	13085	2½ m.WSW.of Kingdom Bore		250			No water		A.J.Heness 1955	0-4 red soil -20 ribn.st. -42 " " -55 slipbak. -149 sandstone -177 slipbak -179 sandstone -250 limestone Abandoned.
Dud.(Cotton-bush. 3)	1721	4mls.SSW. Cottonbush Hut on E.bnk.of Ck.	720	172 100						Position known, bore has casing only above ground.
Dud.(Cotton-bush 4)	1722	Near Tanite W/h in C/bush Ck.		124						Position not seen.
Dud.		2 mls.W.of Peak Ck.bore on Gidyea & pebble flat.					300		Very old pre 1930	Not seen.
Dud (Old Rocky)	1724			186						Strata No.2964, not seen. Originally thought to be [illegible] Longsight Peak but no bores known in vicinity by Mr.Sammon.
Dud		4½m.E.of Leslie Pk.bore,near Leslie Peak.								Dolomite
Dud (Alderley 4)	13251	4mls.SW.of Rocky Bore		300						Not seen.
Shaft (D)		2mls.SW of 7 mile.		Ab.20						Bore commenced and bit jammed· hole dug to extricate bit; abandoned. Dolomite,limestone section shown.

BADALIA STATION

Homestead Location: 30 miles West of Boulia.
Station Owner: and Manager: L.McGlinchey
Communication Telephone, Boulia.
Access: Boulia - Glenormiston Road.

BADALIA STATION

Altitude: 460 feet
Area: 69 square miles.
Stock: 4,000 Sheep.
200 Cattle.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & rose. (feet)	Supply (Gal/hour)	Quality of Analysis (gr/gal.)	Driller and when drilled.	Strata and Remarks.
Homestead (Bedrule)		Glenormiston 4-mile Sheet.	460	78 59		50			R.Close 1948	
No.1 (Badalia)	13163	3½mls.SE of Hs.	500 app.	115 46	98	98 87	600	Good potable	E.J.Robinson 1956	2-19 y.cl. 19-36 y.sand 36-59 reddish sst. 59-77 y. sst. 17-88 grey shale 88-115 yellow sandstone.
No.2. (Glen-ormiston)		4mls.S. of Hs.	455	102 53½		99	750	Good stock.	D.A.McGlinchey 1952	0-90 lst.* 90-102 sst. *Chippings of white siltstone and white limestone found near bore.
No.3 (Badalia)	13164	Springvale 4m. 3mls.SE. of No.2.	450	115 84	65	42,90 37	650	Good potable	E.J.Robinson 1956	0-101 Limestone 101-115 white clay and limestone.

BLAIR ATHOL STATION

Homestead Location: 23 miles North of Boulia.
Station Owner: D. Huie.
Communication: Telephone to Boulia - listed as Hylas Exchange.
Access: Boulia - Selwyn Road.

Altitude 612 feet.
Area: 44 square miles.
Stock: 7,000 sheep.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal)	Driller and when drilled.	Strata and Remarks.
Homestead (Blair Athol)	13101	Present Hs.	610	226 45	72	60 43	1400	Good Potable	A.J.Heness 1955.	0-20 sdy.soil -38 gravel -60 gravel -70 stone -91 st.& cl. -99 rbn.st. -178 sst. -194 sst.& shale -215 shale -221 shale & sst. -226 grey lst. Apart from congl.pebbles (from grvl.) there is much silicified shale. (?Radiolarite). The "shale & sst." in a gr[illegible]gy clayey sst. Swells when wet Reported v.strong petroliferous smell when drld. Also reported that bore from 221-226 penetrated grey lst. but no cuttings seen.
Old Homestead (Loxa)	4870	100 yds.W. of Hs.	608	217		56 & 212 37	Large	Good	1915	Bottomed in hard lst. at 212. Rep.this bore went back to a trickle in 1955 before new bore put down. Since then has yielded good supply.
Cattle Ck.		7mls.WSW of Hs.		178 75		97 & 178 80 & 75	1500	Good	A.J.Heness 1953	0-20 red cl.&sst. -50 sst. -165 y.cl. -178 y.cl.& sst. Water at 97' was brackish and gave only 800 gph.
Coolibah		7mls.W.of Hs.	625	105 50		95 50	900	Good	A.J.Heness 1953	0-7 red soil -60 sst. -105 yellow clay.
Mucklandama	4871	4½mls.W. of Hs.	L614	223				Good pH.7 Warm water	1915	Finished in hard limestone at 223'.
Bobs Well		4mls.ESE of Hs.		227						Finished in grey limestone.
Ninmaroo	4861	1½ mls.N. of Hs.		120						Position not known - results from I.W.S. Records.

BUCKINGHAM DOWNS STATION

Homestead Location: 57 miles North of Boulia.
Owner: Australian Pastoral Co. **Manager:** Keith Dixon.
Communication: Telephone to Dajarra.
Access: Boulia - Dajarra Road.

Altitude 806 feet* (surveyed).
Area: 1,200 square miles.
Stock Cattle, approx.25,000.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal)	Driller and when drilled.	Strata and Remarks.
Homestead (No.5.)	7503	Present Hs.	806*	112 38	80	25(80 gls.) & 110.	Tested at 1200(1938) 800 (1957)	Good (v.hard)	H.James 1938	0-8 red & white rock. 8-112 soft granite.
Hercules	10523	20mls.SSW of Hs.	L805	284 266	276		Large	Good (warm water)	A.Heness 1952	

 Buckingham Downs Station.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal.)	Driller and when drilled.	Strata and Remarks.
Comet	1727	18mls.S.of Hs.		223	218	185	Large	V.good	?1922	0-5 surface cl. 95-155 y.cl. 5-15 red rock cl. 155-185 rock & cl. broken. 25-65 white cl. 185-212c.gvl.& sst. 65-95 limestone 212-218 gy.lst.
Four Mile Well	1709	4ml.N.of Hs.	840	of well 83'6" to btm./bore 200'6" 24		200 181	600	Good	1936	0-83 ? 83-200 red sst. Chocolate and light grey greywacke fragments at surface.
Ten Mile Well	1708	Duchess		36 28½	32		Good	V.good (v.soft)		
Top Makbat	1710	5mls.NE of Hs.		240 50*	198		1200	V.good		* goes back when pumping.
Desert-Dud	10354	Glenormiston Sheet.		400			150		C.R.Pearce. 1941	
Cottonbush Dud		Glenormiston Fr.Tripod W/h.		1st. 75 2nd.370					C.R.Pearce	
Pigeon Creek Tank. (Big Sulieman)		13¾mls.W.of Hs.							Herrod Bros. 1950	Hard seams of only few inches met at 12 foot depth.
Old Hercules (Abandoned)	1725	Next to Hercules Bore--10 ft.east.		289 253			Good	Poor	1922	Sand came in at 260'.
Old Tripod Glen/ston Sh.	10522	W.side Tripod W/h.	710 app.	250					1918	
Tripod Glen/ston Sh.	10355	½m.E.of Old Tripod		298					1942	
Buckingham Downs (II)	13108	Just SE.of Old Tripod		248		230			1955	Strata 6751. 95-169 grey lst. 0-5 red soil 169-205 grey-bl.lst. 5-95 decomp.lst.205-248 y.decomp.lst.
Dinner Creek. (No.10.)	10346	Duchess Sh.		Old bore 180 New bore230 104	165	160 104	300	Poor but alright for stock leaves wh.crust in pipes	C.R.Pearce. 1940(Sunk) 1951(drld.)	
Camel Ck.	10352	12ml.N.of Hs. 3ml.fr.Cambrian (Duchess Sheet)		293	290	240	Unlimited.	Good (rather hard)	C.R.Pearce 1941. S.Carter,Geol.	
Rufus Ck.	10348			320	186	276	Unlimited	For stock only (high iodine, salt content)	do.	
Cork Hole (Dud)	10349			420					1941	
Gum Holes (Dud)	10347	1ml.down ck. fr.Rufus bore.		286			None		1940	
White Wood (Dud)	10353	On Cottonbush Ck. N.of Tripod Bore.		502 250 app.			30		C.R.Pearce 1941	Noted calcareous sludge and lst. fragments near bore hole on surface.
Lower Makbat (Btm.Makbat).	1711	4mls.E.of Hs.		220	180		400	Good (fairly soft)		

 Buckingham Downs Station.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal)	Driller and when Drilled.	Strata and Remarks.
Chinaman Well	1713	3mls.W.of Hs.	815	203 Well to 72	88		100	Good (Fairly soft)		
17 Mile Well Sulieman	1706	Duchess Sh. Urandangi.	880	39'6 32	35	36,38.	Unlimited	V.Good		
17 Mile Well Wills-Dud	1707	Duchess 4m.		60						
Temple	10904	7½mls.SSE of Hs.	755	206 130	173 (150)	140 & 200 136 & 130	Unlimited (35,000)	V.good	G.Gregg 1945	0-184 gritty cl. 200-206 schist. 184-200 limestone.
Cambrian	10351	Duchess 4m. N./Wallala Tank.N.of Hs.		135	ab.104	100	250*	good,soft, sl.sweet	1941	* 480 gph. with engine.
Dud (Dingo Ck.)	10905	1ml.N.Buckley Tank.		346		326(soak)			1945	0-95 schist. -346 blue limestone. Abandoned.
Dud(Buckingham Downs)	10906	At Cork H.1½m. E.of main rd. wh.Dingo Ck. joins C.H.Ck.		1384		190 (V.small sup).			G.Beauchamp about 1931	In grey limestone. Abandoned.
Dingo Ck.Dud. (Buckingham 1)	7510	2½m.W.of main rd.at Crossing at Dingo Ck.		561		317,321,528.	35		1935	(Tested (1936) at 425 feet for 120 gals.in 42 hrs.)
Buster Dud	10350	V.close to B/ham No.1		281,			No supply		1941	
Abes Camp Dud (Buckingham 3)	7512	On Dummy Bore Ck.2½m. E.of main road.		570			78		1936	
Christmas Ck. Dud (B/ham 2).	7511	Jnct.of Christmas & Valley Cks.		235			2½		1935	
Slater's Well		nr.Beefwood dud.								
Old Buckingham.	1712	near Homestead		55						I.W.S.co-ordinates give position 1 mile south of Homestead.
Buckingham 7.	7504			232					1930	0.79 red & y.cl. .99 pk.& red rks. -202 y.clay -117 red & y. rocks. -232 brown rock.
Buckingham 8.	7505	Ab.1 ml.W.of B/ham 7. (I.W.S.position).		224					1930	0.58 red cl.&grvl. -83 red cl.&wh.rk. -94 wh.clay -108 wh.cl.& sst. -120 v.hd.sst. -154 wh.& pk.cl. -163 pk.cl. -175 pk.& y.cl. -201 s.y.red rk -210 y.rock. -224 hd.rock.
Buckingham 4.	7513			203					1936	
Buckingham 9.	9275			49					1934	0-19 red cl. -49 wh.hd.rk. Struck hard slanting rock and abandoned hole.
Beefwood Dud.	10524	Nr.10ml.yard E.of Sulieman Ck.Crossing of Boulia-Dajarra Rd.		300					1918	Penetrated 200 feet of granite.
Buckingham Downs II.)	13108			248		230			1955	0-5 red soil .95 decomposed lst. -169 gy.lst. -205 gy.bl.lst. -248 y.dec.lst.
(Hercules (7)	1725			289					1922	

BURNHAM STATION

Homestead Location: 66 miles NN.E. of Boulia.
Station Owner : W. Grimshaw (Now part of Chatsworth Station)
Communication: Phone to Noranside
Access: Boulia - Selwyn Road.

BURNHAM STATION

Altitude:
Area: 74, 780,) 114, 530) acres.
Stock: Cattle, 3,500.

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Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck (feet) (& rose).	Supply (Gal/hour)	Quality or Analysis (gr/gal).	Driller and when Drilled.	Strata and Remarks.
Emu B.(Hillingdon No.1)	7469	3m.NNE of Hs.Duchess.		150 90-100	97	97 90	Unlimited	V.good	E.Golden ?1925/26	White limestone to 97 feet.
Param B.		10m.NE.of Hs. Duchess Sh.		200 dry					A.Wheelhouse Ab.1946	
Clarkes No.1.		Nr.Fostars		200 dry					Clarke	
Clarkes No.2.		Nr.Chalk dam		?297 dry					Clarke	
Fostars (Hillingdon)	13160	4m.ENE. of Hs.		169 80	103	80 80	1000	Good potable	A.J.Heness. 7-15/5/56.	0-32'red soil -168'6" lst. - 80'slipbak.
Trough Hole (Hillingdon 3)	13191	6mls.E.of Hs.		190 70	195	0 70	200	Good	A.J.Heness 2-13/7/56.	0-179' slipbak -190 dark lst.
Ding B (Burnham 12)	7739	2½mls.W. of Hs.		311		dud soak @ 250			J. James 1934	red rock / dark limestone.
No.1.	12683	2½mls.NNE. of Hs.		157		112 112	6		A.Heness 1955	0-27 red cl. 116 gy.wh.lst. -36 congl.rk. 124 white lst. -66 y.clay 157 slaty lst. -75 9"grvl.bnd. Abandoned 112 y.clay
No.2.	12684	3m.NNE of Hs.		130		100 100	60		A.Heness 1955	-10 red cl. 129'9 lst. -25 wh.chlky.cl. Abandoned. -55 sd. w.grvl.
Dud (Burnham 4)	13193	9mls.SW. of Hs.		200 120		120 120	30	Good	A.Heness Jr. 21/5-16/6 1956	-12 red soil 179 grey lst -99 slipbak 200 blackish lst. -120 sst. Abandoned
Dud (Burnham 3)	13192	3mls.SE. of Hs.		190 180		180 180	8	Good	A.Heness Jr. 18-27/6/56.	-60 red soil -85 slipbak. -190 black ls -180 sst. Abandoned.
Present Hase B. (Burnham 10)	7737	Homestead		412 90	130	130 90	60	V.good domestic	James 1934?	0-130 red rk. 130'-4'2 dk.ls. slipbak
Duds. (Nos.5,6,7,)	7732/3/4.	6mls.SW. of Hs.		120-550 dry					D.Grimshaw 1928?	Red rock, cavernous dark limestone.
Beauchamp B. (Burnham 8.)	7735	9mls.WSE.of Hs. just W.of Limestone Bore.		175 dry					Beauchamp 1928?	" " "
Limestone B. (Burnham 2).	7730	8mls.WSW of Hs.		378 90	278	278 90	800	Good Stock	J.James 1934?	" " "
Top Lily Pad. (Burnham 9).	7736	5mls.SSE of Hs.		400 dry					J.James 1934?	" " "

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (Feet)	Depth(s) water struck & rose. (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal).	Driller and when drilled.	Strata and Remarks.
House B. (Creek Soak)				600 ?90	330	?0 (rock) 330(7'6 cave) 90	originally 500 rdc. 60	Good stock	J.James ab.1923 to 330. Deepened by D.Grimshaw to 600' ab.1925.	Practically all dark lst. some red rock on top.
Tripod B.		4mls.E.of Hs.		450 ab.90	450	230 90	700		J.James ?1926	" " "
Sullivans (Burnham 4.)	7731	4mls.ESE. of Hs.		550 dry					D.Grimshaw ?1916.	" " "
Dry		½ml.E.of Hs.		150 dry					J.James ?1926	" "
Dry		¼ ml.SE.of Hs.		150 dry					J.James ?1926	" " "
Dud (Burnham Dud)	7738	Ab.1ml.E.of present hse. (IWS.posn.)		100					1934	

CAZNA DOWNS HOMESTEAD

Homestead Location: 23 miles E.N.E. of Boulia.

Station Owner: McNamara (Sold to L.McLear in 1959)

Communication: Telephone to Boulia

Access: Boulia-Winton Road.

CAZNA DOWNS HOMESTEAD

Altitude: 580 feet.

Area:

Stock: 20,000 sheep(approximately).

Name	Reg.No.	Position	Altitude	Depth and Water Level	Pump Depth	Depth(s) water struck & rose	Supply	Quality	Driller and when drilled	Strata and Remarks
Cazna Downs Dud.	11237	½ml.N.of Top Beantree		300		Dud			R.Close 1948	0-2 soil, 2-6 clay, 6-12 river grvl., 12-20 lst., 20-80 lst.& cl., 80-110 y.cl., 110-140 wh.cl.small bldrs., 140-300 bk.shale. Abandoned.
Top Beantree (Cazna Downs)	11238	11mls.NW. of Hs.		200 90		134 90	9,600		1948	0-2 soil, 2-8 cl., 8-18 grvl., 18-20 wh.rock., 20-30 red rk., 30-80 Fullers clay., 80-90 red.cl.& bldrs., 90-95 red rock, 95-130 wh.rock., 130-140 pink clay, 140-200 y.shale.
Lower Beantree (Cazna Downs)	11327	7mls.WNW. of Hs.		112						
Sandhill B.		15mls.NW of Hs.	575							
River B.		2mls.W.of Sandhills B.	565							
Shed at Lauwellar (O/station)		11mls. W. of Hs.	560							
4-Mile		3mls.NNW. of Hs.								
New		10½mls.NNW of Hs.		222					1940 or 1950.	
Dud.		4mls.WNW.ofHs.								
Shilling		10mls.WNW "								
Gum Creek		7 mls N.of Hs.								

CARANDOTTA STATION

Homestead Location: 70 mls WSW of Dajarra

Station Owner: Western Queensland Pastoral Co. (North Qld. Past. Co

Communication: Telephone to Dajarra or Urandangi

Access: Main road from Dajarra

CARANDOTTA STATION

Altitude: 572 feet

Area:

Stock: Cattle 6,000. Sheep 62,000

Name	Reg.No.	Position	Altitude (above sea level)	Depth to Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks	
Homestead	9283	Homestead	572	50	100	Salt 60) Fair 90) Fair 180) Good 220)	223	10,000 g. per day			0-6 Surface soil -23 Limestone -60 br.pink rock -66 gy.caving rock -223 br.pink rock	
Spell paddock	12586	2 mls ENE of H.S.		106		(54 (138 (54-45 (138-84	150	1600	Bad Unsuitable for stock Ca sulphide 132 gr/gal $CaCO_3$ Mg sulphide 52 gr/gal $MgCO_3$ 26 " " $MgCl_2$ 83 " " NaCl 441 " " F_2 1.7 p.p.m. H 260° C		0-4 Black soil -25 Hard clay -101 Br. & wh. sticky clay -105 Hard quartz stone -114 Br. & wh. sticky clay -146 S St. OR 0-5 y. clay -45 Lst. -54 Br.clay -84 Lst. & blk. clay -140 White clay -150 Br. clay & lst.	
Manfred	12924	7 mls E of Hs. Manfred Ck. & ½ ml from Manfred Well		75	98	124	137(124)	1000	Good	Hartig 1955	0-19 Red soil -24 clay -52 lst. -71 clay -73 lst. -78 clay -80 lst. -113 lst. -124 Br.lst. -137 lst.	
Dud Top Yarrie (Carandotta 25)	12787	22 mls ESE Hs. 1½ mls from Kallala Bound.				315	415	Poor	–	Hartig 1954	0-25 Red soil & grv. -126 Red S St. -128 Y. & bk. clay -270 Bl. clay -281 Bl.gy. lst. -284 Br. lst. -300 shale -306 rusty lst. -320 Khaki lst. -327 lst. & chalk -415 caves	Dark streaks on slurry drains when drilling through grey lst. - has smell Abandoned

CARANDOTTA STATION - Page 2

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
Top Yarrie	Lic.No. 1025	S side of creek from Dud		185	214	140-136 190-185	244	Unlimited 1160	Good	Hartig 1958	0-25 Red soil -y.clay & sand -58 Y.clay & sand -60 Clay & sand -68 Lst. -78 Lst.- patches clay -99 Lst. -107 Br. lst. -114 gy. lst. -125 lst. -129 Br. lst. & clay -138 shale & lst.-clay pockets -188 lst. -190 Cryst. lst. -211 Broken lst. & clay -244 Shelves lst.-pockets clay Caves at 120' and 129-138
H.S.Bore			[illegible]	48 (120' Stn. infm.)		60 161 215	220(160' Stn.infm)	Unlimited (Stn.infm. 350 g.p.h.)	F.F.S. only		0-9 soil Rest rock nearly hard C.D.1941 3¼ pump — 120' 4" casing 17' mill — 30' troughing Overheal & earth tanks
No. 1 Bore	6895	5 mls E.		92	88		99	600	F.F.S. only		0-5 br.s. -10 congl. -15 lst. -20 congl. -24 h.lst. -36 soft lst. -90 Wh. & y. clay -[illegible]4 red congl. -99 lst. C.D.1918 88' 2" pipe 3¼ pump 16' mill earth tank 160' troughing
No. 2 Bore	6896	16 mls N.		94	120		124	800	F.F.S.		C.D.1918 120' 2" pipe 3" pump 30,000 g.i.tank 120' troughing
No. 3 Bore	6897	19 mls. E.		106	125		150	800	F.F.H.		C.D.1918 125' 2" pipe 3¼ pump 16' mill Water Hole & 40' troughing
No. 4 Bore	6898	21 mls. E of Hs.		113	140	121	167	800	F.F.H.		0-5 br.s. -13 red congl. -16 lst. & cl. -36 red congl. -82 red rock -112 h.congl. -116 rotten sst. -119 v.h.r. -1[illegible]0 soft w sst. -167 [illegible] 140' of 4" casing 3¼ pump 18' Mill 40' troughing & waterhole C.D.1918

CARANDOTTA STATION - Page 3

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks	
No. 5 Bore		22 mls. E.		112	140		165 (123 Stn)	600	F.F.H.		0-5 br.s. -20 y.congl. -30 red congl. -45 rotten lst. & cl. -125 sand -150 grv. & sand -155 red sst. -165 congl.	140' 4" casing 3¼ pump 18' mill 50' troughing & waterhole C.D.1918 Pumps up good deal of fine sand
No. 6 Bore		25 mls N.E.		161	180	173	226	Unlimited	F.F.H.		0-5 br.s. -22 drift -34 h.red r. -35 y.r. -85 red.congl. -226 y.congl.	150' 4" casing 3¼ pump 21' mill 50' troughing & waterhole C.D.1918
No. 7 Bore		18 mls N.E.		146	150		152	500	F.F.S.			150' of 2" cas. 3¼ pump 20' mill 50' troughing & waterhole C.D.1919
No. 8 Bore		14 mls N.E.		165	170		177	700	F.F.H.			150' 4" casing 3¼ pump 21' mill G.I.Tank 60' troughing
No. 9 Bore		At Hs.		90			133	Good	Brackish			Abandoned
No. 10 Bore (17 Mile Ck)	6904 (IWS)	26 mls E.		130	152		167 (104 IWS)	1800	F.F.H.		152' 5" casing 4¼ pump 20' mill 50' troughing of water hole	C.D.1925 (1922 IWS)
No. 11 Bore Also Kallala Waters		18 mls North of Hs.		150	175		200	1700	F.F.S.		Bl.s. Red cl. Yel.cl. v.h.yel.r. h.w.r. Red cl. V.h.w.r. h.yel.r. h.br.r. h.yel.r. red sandy r.	v.h.yel.r. h.w.r. ribst. h.yel.r. 175' 5" casing 4¼ pump 20' Mill Earth tank 150' troughing
No.12 Bore		13 mls N.E.		109	135		163	Unlimited	F.F.S.		C.D.1922 135' 4" casing 3½ pump	20' mill Earth tank 150' troughing

 CARANDOTTA STATION - Page 4

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
No.13		8 mls N.		124	157	86 138	161	800	F.F.S.		0-5 bl.s. -9 gr.cl. -25 w.r. -30 v.h.gr.r. -51 v.h.w.r. -58 h.yel.r. -69 w.r.bldrs -80 h.yel.r. -84 w.r. & bldrs. -86 water bearing -99 h.w.r. -121 gr.cl.st. -134 w.r. -138 water bearing -161 gr.r. 157' 5" casing 4¼ pump 10' mill 150' troughing Pumps sand
No. 14		14 mls E.		109	138		169	Unlimited	F.F.S.		C.D.1925 138' 5" casing 4¼ pump 20' Mill Earth tank 150' troughing
No.15	6909	16 mls S.E.		64	90		104	2500	F.F.S.		C.D.1925 95' of 2" pp. 3¼ Pump 20' Mill E.T. 150' troughing
No.16	6910	24 mls S.E.		107	126		152	2000	F.F.S.		C.D.1925 126' of 5" casing 4¼ pump 22' Mill E.T. 60' troughing
No.17		14 mls E.		130	170		187	1800	F.F.S.		C.D.1925 170' of 2" pip. 3¼ Pump 20' Mill E.T. 150' troughing
No.18	6912	28 mls S.E.		93	130		143	2000	F.F.H.		Yellow clay. Water in cream lst. C.D.1926 120' 5" cas. 4¼ Pump 20' Mill E.T. 180' troughing
No.19		5 mls E. of Hs.		98	128		135	1000	F.F.S.		C.D.1926 128' 5" casing 4¼ Pump 18' Mill E.T. 180' troughing
No.20		10 mls E.		123	140		150	1000	F.F.S.		Hole gradually sanding up. C.D.1927 140' of 4" cas. 3¼ Pump 18' Mill E.T. 180' troughing
No.23 (Heifer)		10 mls N.W. Cross Moose Ck.		75	82		90	2000	F.F.S.		C.D.1918 82' of 2" pip. 3¼ Pump 12' Mill E.T. 60' troughing
No.24 (Binyeah)		16 mls N. Beanyah		108	110		120	800	F.F.H.		C.D.1918 110' of 4" cas. 4¼ Pump 10' Mill 3000 cemented tank 100' troughing
No.25 (Quontoch)		21 mls N.		125	170		185	1000	F.F.H.		Cf. "Top Yarrie" called Carandotta No. 25 by IWS C.D.1926 170' of 4" cas. 3¼ Pump 16' Mill E.T. 60' troughing

CARANDOTTA STATION - Page 5

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks	
No. 26 (Dolmon's)		24 mls N. of Hs.		166	200		206	Unlimited	F.F.H.		C.D.1934 200' of 4" casing 3¼ Pump	20' Mill E.T. 40' troughing
No. 27 Halfway		25 mls N.W.		175	185		190	800	F.F.S.		C.D.1916 185' of 2" pip. Otherwise unequipped	3¼ Pump
Warwick No. 1		At Warwick Hs.		180	210		220	Unlimited	F.F.H.		C.D.1928 210' of 4" cas. 3¼ Pump	22' Mill E.T. 50' troughing
Warwick Worill No. 2				170	200		210	Unlimited	F.F.H.		C.D.1928 200' of 4" cas. 3¼ Pump	20' Mill Iron tank 60' troughing
Warwick No. 3				145	190		200	Unlimited	F.F.H.		C.D.1930 190' of 5" cas. 4¼ Pump	25' Mill E.T. 60' troughing
Warwick No. 4				164	190		200	Unlimited	F.F.S.		Pumps fine sand C.D.1932 190' of 4" cas. 3¼ Pump	E.T. 20' Mill 100' troughing
Gunyabilly		8 mls W of Warwick		150	178		180	Fair	F.F.S. Slightly brackish		Abandoned because salt C.D.1920.	Not used now
Warwick No.5	9054			175	150		207	Unlimited				
Warwick No. 6				156	176		206	Unlimited				
											Many of the bores near the H.S. are very salty la gely Na Cl with Na, Ca and Mg carried as chlorides and sulphates. NOTE: All outer casing in bores is 6" black to bottom.	
Coonah Bore ('Coonah Well)	6923	18 mls E of Hs.		126			141	1800			4" pump casing 3¼ " " 17' Mill	3000 g.i. tank 170' troughing
Archie Well		5 mls N		79	78		124	900	F.F.S.		78' 2" pumping 2¾ pump 80' troughing	1 3000 g.i.tank 16' Mill
Q.T.Well		25 mls E		161	163		164	400	F.F.S.		163' 4" casing 3¼ Pump 18' Mill Bore in Well 1939	2 3000 g.i.tanks 60' troughing
Top Q.T.				163	187		204	Unlimited	F.F.H.		Lic. No. 4057	
Elimang Bore		13 mls N.		104	120		156	1000	F.F.H.		5" casing 50,000 g.i.tank 80' troughing	4¼ Pump 16' Mill

CARANDOTTA STATION - Page 6

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
5 Mile Well		5 mls N of Hs.		98	100	70	103	2000	F.F.H.		Sub soil about 20' Yellow sandy clay. Rest mottled "slippery-back" shale. 5" casing, $4\frac{1}{4}$ Pump, Earth tank, 16' Mill, 50' troughing
Yarri Well		22 mls E		223	227		230	500	F.F.S.		C.D.1891 6" casing with 4" pump casing $3\frac{1}{4}$ pump, 2 3000 g.i.tanks, 20' Mill, 50' troughing
Rockwood	6922	9 mls E of Hs.		118			158 (98' IWS Well)	1100	F.F.S.		130' 5" casing, Earth tank, $4\frac{1}{4}$ Pump, 80' troughing, 18' Mill, C.D.1937
Woolshed Bore		16 mls E of H.s.		142	156		170	800	Good		C.D.1940, 16' Mill, $3\frac{1}{4}$ Pump, Earth tank, 4" crs., 200' troughing
Royal Bore		12 mls E of Hs.		134	145		152	800	Good		Bore sanding up C.D.1918, 17' Mill, $4\frac{1}{4}$" Pump, 80' troughing, Cemented iron 30,000 g. tank
Gidya Bore	6915	16 mls SE		110	140		180 (212' IWS)	1800	F.F.S.		C.D.1918, 20' Mill, conct. 30,000 G.I. tank, 50' troughing
Burnt Well		24 mls E.		100			132	800			
Burnt Well	6926	On rd. to No. 3 from road-short cut					145				C.D.1917, Abandoned 1932

CARLO STATION

Homestead Location: 50 Miles S.S.W. of Glenormiston.

Station Owner: R. Graham

Communication: [illegible]

Access: [illegible]

Altitude:

Area:

Stock: [illegible]

Name	Reg.No.	Position	Altitude (above sea level)(feet)	Depth and Water Level	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
Carlo		About 4 mls N of Old Carlo Well		21	33	35 21	50	972	Good; slightly brackish but potable	E.J.Robinson 1955	0-5 sub-soil -8 hd.rock -35 red sst. (v.clean sd after washing) -50 hd. red & y. sst.

CRAVENS PEAK

Homestead Location: None.

Station Owner: C.Robinson & E.Campbell

Communication: Uninhabited

Access: W.from Glenormiston to Toko Range.

Altitude: 840'

Area:

Stock: None

Name	Reg.No.	Position	Altitude (above sea level)(feet)	Depth and Water Level	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
Cravens Peak	13028					340	380	150	Brackish	E.J.Robinson 1955	0- 25 gy. cl. - 90 sdy.sh. -340 gy.sdy.sh. -344 sst. -362 dirty cly.sst. -380 red cl.

CHATSWORTH STATION

Homestead Location: 68 miles N.N.E. of Boulia
Station Owner: Australian Estates Co.Ltd.
Station Manager: Mick O'Neill.
Communication: Telephone Exchange (Noranside) to Boulia or Cloncurry.

CHATSWORTH STATION

Altitude: 846 feet (surveyed)
Area: 1,311,360 acres (incl.Noranside).
Stock: Cattle 30,000 (incl.Noranside).
Access: Boulia-Selwyn Road.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	(Depth(s) Water Struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal).	Driller and when Drilled	Strata and Remarks.
Coronation	[illegible]	35mls.N. of Hs.							June 1951	
West Burke	13081	15ml. NW. of Hs.		130 95		105 to 95	960		7-13/11/55.	Sand in bore-siltcasing used. 0-50 clay -70 cl.& s.rk. -90 soft rock. -130 clays w.rble. Licence applied forafter drilling. No reference to sand in log.
Dons	13080	8ml.plain		160 128		132 to128 level	2,000		30/11/55 10/12/55.	0-25 cl.& sd. -50 y.cl.& rble. -70 gy.lst. -86 s.lime rk. -109 y.clay. -142 dy.rble. -160 limestone.
Bullock Pdk. (IWS.Ref. Chatsworth 46)	10622	29 mls.ESE of Hs.		283 163		(202 sm.sply. (250 (275 gd.sply.	1,290		Wilson 1945	0-78 red cl. -81 slipbak. -171 blue cl. -283 sandstone.
Lilly(IWS.Ref. Mt.Merlin 7.)	13079	2mls.S.of Hs.		96 65		75	1,200	Good	Dec.1955	0-35 cl.& sand. -85 Limestone.
Royal Souvenir		50 mls NNW of HS		150			2,000		Dec.1954	
Chatsworth 1.	2034	24 Mls NW of HS		3266 100		200',300'	(200'-600 (300'-900		1895	0-91 [illegible] -230 bl.gry.qtz. -340 v.h.bl.& wh. qtz -450 h.rk-lk.lst. -580 wh.&gy.lst. -640 h.gy.lst. -690 Do do strk.s. -2214 b.s/r.28 s/sl.r.12 -2301 bk.s/rock. -2325 h.slate -2[illegible] h.bk.s/rock. -2438 h.wh.s/rock -2466 s.shale -2505 h.s/rock. -2548 lime rock. -2573 h.rock. -2603 r.pipe cl. -2643 sst.&pipe cl.streaks -2670 s/r.red pipe cl. -2724 r.pipe cl./sst. -2749 s/r bl.sh. 2778 s/r p.cl. - 2818 h.s/rock. 2840 sh.s/r -2902 sh.s.s/r & pipe cl. -2971 s/r r.p.cl.3019 s/r str.w/rock. -3174 r.p.cl. -3200 h.rk. -3238 pipe cl.-3266 h.rk.
Webbs		Burke-Lst. Cks.Junct.		124			1,200		Aug.1954	
Pilgrim Well	7518	Nr.Duchess Rd. & Pilgrim Ck.		90 or 102 52			600			
Pilgrim 1. (IWS.Chatsworth 45)	12916	Nr.boundary fnc.Duchess Rd.		127 90		96	1500	Potable	Mar.1954	0-6 river soil -24 sand -36 y.limey cl. -58 K.lime -94 limestone -124 rubbly l.seam. -127 solid grey limestone.
Haseloff (W.bank Pilgrim Creek.)				157			960		Dec.1954	
Prickley Bush (on " " Ck.)				220			2000		1954	
Burke Yards		7 mls.NNW of Pomegranate Bore.		130					July 1954	
Bryans		4mls.N.of do.		150			960		Sep. 1954	
Pomegranate			924*						Mar. 1951	* Surveyed level.
Wangaratta (Chatsworth)	10727	25mls.N.of Hs,		190 or 205 IWS. 170		170 146	1400		1946	0-30 cl.w.grvl. at 10'. -40 cl.& grvl. -60 cl.& kaolin -95 kaolin -110 Kaolin & sst. -125 kaolin -150 kaolin & br.cl. -165 Kao.& br.basalt -205 basalt.

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Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal).	Driller and when drilled.	Strata and Remarks.
Double Crossing (or Merlin No.5)	12918	19 mls.N. of Hs.		(73		60 to 50'level	1800	Potable	Stn.Plant Sep.1953	0-60 soft black schist. -72 quartzite.
Gin Creek		4mls.E.of Dble.Cr.Bore.		65			900		1953	
Wilsons		Top of Coolibah Ck.		220			1400			
Mistake									Mar.1951	
Galah (No.19)	7544	20mls.WNW of Hs.		129 or 135 115			1400		C.Cockcroft 2/9/16 - 14/1/17	0-8 br.loam & grvl. -31 sand drift. -122 calc.cl.slate & lime. -126 rble.& sst. -133 hd.bk. rk. slated. Pump Test: 1500 gph.supply unlimited.
Coolibah (No.41)	9707	15mls.WNW of Hs.		112		110 104	3000		Godfrey Brs. 1943	0-2 soil -4 clay & gvl. -12 hard sst. -47 red sst. -53 grey rock -74 layers of gy.y., and green rock. -109 wh., red & y.rk. -112 broken bldrs.& grvls. Pump Test: 1800 gph.
Beauchamp		3mls.N.of Ibis bore.		190			800			
Ibis (No.15?).				140			2000			
Swift	13244	12 mls.NW. of Hs.		150			1250		Mar.1951	No strata details.
8 Mile			872*	150			480		June.1952	* Surveyed level
Mort Bore (Mort R.(ISW)	10726	26mls.NE of Hs.		196			760	Good	Wilson 1946	0-8 cl.& sd. -11 drift s. -24 sd.& cl. -28 Rk.& lime basalts. -32 V.f-g.gy.r. -41 free rk.& mica. -69 v.firm rk. -73 free rock. -75 v.hd.flint bldr. -78 hard rock -99 hd.gy.rock. -100 flint bldrs. -103 free rock -115 hd.gy.rock.* *-117 hd.flint. -149 qtz.& mica. -178 ironst. seams some rotten & flaky. -190 qtz.& mica. -195 free granite -196 granite floor.
Success		4mls.S.of 8 Mile							Dec.1952	
Mt.Merlin		5mls.N.of Hs.							Dam.	
Sandy Ck.		of. 16mls.ENE./Hs.							Dam (25,000 cub.yds.) July 1951.	
Western (On Noranside)	7560	7mls.NW of Big Ibis (No.).		326 or 260 195		↓224, 290↓ 336↓ ↓212 207, 195↓	1400		Royle Bros. June/Aug. 1936.	-0-3 bk.surface. -15 l.red pbly.s. -58 hd.red rk. -86 y.clay. -100 red clay. -105 wh.cl. -114 red cl. -123 wh.cl. -186 y. cl. -198 gy.sst. -216 gy.& bk.lst. -231 gy. lst. -244 y.clay -249 wh.rock. -264 y.clay -270 y.cking sst. -286 y.clay -290 clay rock -294 grey shale -324 y.clay -326 white rock. Pump Test: $4\frac{1}{4}$" pump for 24 hours - 1900 gph. and 2400 for last 2 hrs.w/o reducing supply.

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Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal)	Driller and when Drilled.	Strata and Remarks.
Dud	7553	6mls.S.of 8 Mile		279					1920	
Bullock Pdk.		25mls.ESE of Hs.							Dam 1953	
Bullock Pdk. Bore (Chatsworth	7551	Nr.Bullock Dam		245 80		(97 no sply. (240 inc.sply. 160 to 80' lvl.	1200		Beauchamp June 1920	0-85 surface form. -111 hard sand rk. -121 gravel -245 sand rock.
7/8 Mile or Burns Dam.		6mls.W.of Hs.							Dam 1953	
Red Rock Tank.		10 mls.SW. of Hs.							Earth Tank	
Noranside Well 5 Mile Bore.	7520	5mls.S.of Hs.	807*	132(stn.rec 102			Poor 350 (stn.rec.)		* Surveyed level	
Beresford Well	12917	5mls.W.of Hs.		(130 Bore (124 Well 80		85	Potable 1000		Sep.1953 Bore. 1954 Well	0-80 clay & rubble. -130 limestone rubble.
Homestead Earth Tk.		1ml.N.of Hs.							Dam 1953	
Home Bore (No.30 Duffer)	7555	W.of Hs.		(180 (185(stn.rec.)		(83 (94 (102	(80 (180 (stn.rec.)		Dec.'25 to Jan.'26.	0-9 sfce.s. -24 Ironst. -26 Hd.gy.rk. -35 y.sdy.rk. -45 y.pug. -72 wh.chalk or cl. -95 gy.lst. -98 brown lst. -116 gy.lst. -185 hd.gy.lst.
One Mile Bore		1 ml.S. of Hs.		140					June 1952	
Monastry		4mls.W.of Pomegranate		125			1200		1953 Bore	
Tin Hut Waterhole		On Lst.Ck. 7m.E.of Webbs Bore.							Normal Waterhole	
Centre 8 Mile Tank			851*						Dam	Surveyed level.
Dud. (IWS Chatsworth 38)	9460	4ml.NNW.of Hs.		148			nil		1943	0-2 red soil. -20 bldrs.& grnt. -50 red clay -70 opal rock -90 cream rk. -148 lst.
Dud (IWS Mt.Merlin 39)	9604	3ml.NNW. of Hs.		360			nil		1943	0-2 Black soil -8 clay -360 limestone.
Dud (IWS Mt.Merlin 40)	9697	N.E.OF Hs.		435			100		Godfrey Brs. 1943	0-1 black soil -20 clay -35 blds.& rk. -75 white clay. -100 crm.col/d.rk. -435 limestone.
Dud (IWS Mt.Merlin 42)	9731	S.of Hs.		250					1943	0-2 red soil -8 red clay & grvl. -35 Red sst. -45 wh.& y.sdy.cl. -58 white clay. -70 grey rock -88 grey lst. -250 lst.
Dud (IWS Chatsworth 43)	9768	1ml.S.of Hs.		117					1943	0-2 red soil -6 red cl. -19 red sd.rk. -30 sd.& bldrs. -45 white cl. -92 cream col/d. rock. -117 limestone.

Name	Reg.No.	Position	Altitude (above sea evel) feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal)	Driller and when drilled.	Strata and Remarks.
Dud (IWS Chatsworth 44)	10621	20ml.ENE. of Hs.		181		soak at 140	nil	salty	J.T.Wilson 1945	0-50 sand & cl. -60 firm grty.rk. -67 fairly hd.gy.rk. -92 v.hd.flint " " -95 ironstone -110 dolerite -113 ironstone -139 gy.dolerite & quartz. -140 ironstone -150 lst.& flint blds -181 gy.thick grnt.
Dud (IWS Mt.Merlin 4)	12915	14mls.NW. of Hs.		180			nil		23/9/54	0-7 clay -180 grey limestone.
Dud (IWS Pilgrim 10)	12777	33mls.NW. of Hs.		142			nil		J.Amesbery 2-26/2/54.	0-15 surface soil -100 soft wh.st. -142 soft yellow stone.
Dud (IWS Mt.Merlin 6)	12919	17mls.NNE. of Hs.		220 160		160 nil	v.small	bitter	Stn.Plant Oct.1953.	-150 cl.& soft rk. -200 hard rock -220 quartzite.
Dud (IWS Mt.Merlin 7)	12920	28mls.ESE of Hs.		220 170		170 nil	small supply	good	Stn.Plant Nov.1953	0-180 clay & s.rk. -200 hard rock -220 hard quartzite.
Dud (IWS Mt.Merlin 8)	12921	30mls.SE. of Hs.		190 120		120 nil	v.small	potable	Stn.Plant May 1954	0-120 soft schist rock. -190 hard black rock.
Not named Mort River	12922	27 mls.NE. of Hs.		80 45		75 to 45 level	900	potable	Stn.Plant Sep.1953	-50 soft rock -80 sandstone.

CORRIE DOWNS STATION

Homestead Location: 44 miles East of North of Boulia.

Station Owner: Jim Wheeler

Communication:

Access: Boulia - Selwyn Road.

CORRIE DOWNS STATION

Altitude: 710 to 715 feet.

Area: 110 square miles.

Stock: 8,000 sheep.

Name	Reg.No.	Position	Altitude	Depth and Water Level	Pump Depth	Depth(s) water struck & rose	Supply	Quality	Driller	Strata and Remarks
Homestead No.1 (Corrie No.3)	6391	At Home-stead.	710-715	110 70	80		unlimited	good	1926	
Homestead 2. (Corrie No.4).	12514	" "	715	110 70	80		unlimited	good	A.& R.Heness 1952	
I.W.S.Records	"	" "		174 60	87 60		600		R.A.Heness 1953	0-7 red clay. -73 yellow clay. -174 limestone.
Bloodwood		6mls.E. of Hs.	735	92 80	90		unlimited	good		
Boundary (Harvey No.2)	12510			104 50	73 50		1550 orig. 7/800 1951.	good	A.& R Heness 1951	0-10 siltstone 10-70 sand 70-73 clay 73-94 sand 94-103 sand 103-104 limestone.
Garden (Harvey No.3)	12511			127 98		98-116 98	300 @ 98 1000 @ 116 now unlimited	good	A.& R.Heness 1953	0-9 red clay 9-12 stone 12-16 limestone 16-101 clay 101-120 limestone
Bramby Lagoon (Corrie No.17)	6389	2½mls.of Hs.		62 50	60		unlimited	good	A.& R.Heness ?1925	

 Corrie Downs, Cuckadoo and Datchet Downs Stations.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal).	Driller and when drilled.	Strata and Remarks.
Crooked Hole (Well)	6390	3mls.E.of. Hs.	710	72 60	65		700	Good	J.C.Wheeler 1925	0-8 soil 8-9 drift sand 9-34 conglomerate 34-58 slippery back 58-72 gy."chalky" rk. w.ironstone seam.
Boundary or River Well.		2mls.WSW of Hs.		60 40	50		1000		J.C.Wheeler	0-10 soil -25 sst.wh. "chalky" -55 sst.wh.& y.shaly w.chert lenses. -60 drift sd.w.water.
Black Ridge (Corrie)		8½mls.ESE of Hs.		260 dry					A.& R.Heness.	0-7 red clay 7-73 y.cl. 73-260 grey limestone (cavernous)
Black Ridge (Harvey No.4)	12512			160 dry					A.& R.Heness 1952	0-7 red cl. 7-73 y.clay 73-160 grey limestone (cave 26ft.deep at bottom).
6-Mile (Harvey No.1)	12509	11mls.SE. of Hs.		150	140		500	good	A.& R.Heness	0-9 red cl. -12 stone -16 lst. -102 clay -120 limestone
Robinson's (Harvey No.5)	12513	4½mls.SE. of Hs.		130 90	100			good	A.& R.Heness 1952	(S.6546) 0-9 red cl. -12 " 12-16 limestone 16-80 clay 80-102 kaolin 102-131 limestone.
Blueback	4843	8mls.S.of Hs.		130 80	90				?1910	No information
"Harvey"(Old Station Bore)	4875	Ab.2m.s.NW of Harveys (St.Lucia)		124 dud					?1915	"
Robinson-Dud	4821	?5mls.SSE/Hs.		400						"

CUCKADOO STATION

CUCKADOO STATION

Homestead Location:

Access: Selwyn-Middleton Road.

Name	Reg.No.	Position	Altitude	Depth and Water Level	Pump Depth	Depth(s) water struck & rose	Supply	Quality	Driller and when drilled	Strata and Remarks
Bustard Ck. No.3.	8010	11mls.N.of Toolebuc		279 S.A.		256, 265.			1939	0-38 sd.& grvl. -108 gy.& y.cl. -255 grey shale -265 sandstone -270 water sand -279 shale.
Northdale No.2.	11189	10mls.N.of Toolebuc		286 S.A.					1948	0-2 soil -38 hard grvl. -77 Y.& wh.cl. -238 grey shale -267 grey rock -286 grey rock.

DATCHET DOWNS STATION

Homestead Location:

Owner: Datchet Downs Pastoral Co.

Manager: Arthur Cardro

DATCHET DOWNS STATION

Altitude: 800 feet.

Area: ?122 square miles.

Name	Reg.No.	Position	Altitude	Depth and Water Level	Pump Depth	Depth(s) water struck & rose	Supply	Quality	Driller and when drilled	Strata and Remarks
Station (Gum Creek)	5569	100yds.N. of Hs.	800	107 104			Plentiful.	good	Golder 1926	yellow sst. white sst. yellow sst. bottom in limestone.
Stockyard	5568		810	135			"	v.good	"	yellow sandstone whole depth.

DIGBY PEAKS STATION

Owner: Gilbert Price with D.& J. Price.

Communication: Phone to Noranside (Chatsworth)

DIGBY PEAKS STATION

Altitude: 770 feet.

Area:

Stock: Cattle 2,000

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & rose (feet)	Supply (Gal/hour)	Quality of Analysis (gr/gal)	Driller and when drilled.	Strata and Remarks.
Homestead		At Hstd.	770				F.at.400	good		
Jiggamore	11970	4mls.E. of Hs.	780	101 60(62)	80(75)	101 62	G. 1400 (21,600/day)	good	J.Price 1951	0-25 alt.cl.& rk. 50-91 blue shale. 25-50 y. sst. 91-101 y.sst.
Dud		½ml.SW.of Hs.		120						Water struck but could not control "sand".
Dud		4mls.S.E.of Jiggamore		100						Struck a boulder, so moved 1 mile west. Some water in bottom of bore.
Dud		3mls.SE.of Jiggamore.		250		?150	80			White, cream, yellow and light grey limestone - some dolomite of Ordovician unit. (J.N.C.)

DOVER STATION

Owner: Grimshaw

Communication: Radio, Cloncurry.

DOVER STATION

Altitude: 644 feet.

Area: 10,000 acres.

Stock: 10-12,000 sheep.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & rose (feet)	Supply (Gal/hour)	Quality of Analysis (gr/gal)	Driller and when drilled.	Strata and Remarks.
Shadhole No.1.	4829	11mls.SW. of Hs.	574	430 Artesian		95,186: 38?,43? 10 Surf.	150,000		Station Plant Mch/Apr.1912.	0-30 river bed. 195-205 grvl.drift. 30-60 y.clay 205-380 blue shale. 60-95 grvl.sst. 380-400 sandstone 95-135 slipbak. 400-415 pipe clay 135-186 blue shale 415-430 sandstone. 186-195 sandstone
House Bore No.1.([illegible])	[illegible]	At Hstd.	644	674				1913 Total solids 40.8 $CaSO_4$ 1.6 Na_2CO_3 26.5 NaCl 11.2 Fluorine 3.8 ppm. Hardness 1°.		
House Bore 2. (Dover No.4)	13201	At Hstd.	644	714 85	90	600-706 90- 85	300) 1,000)	Good Total solids 56.6 $CaSO_4$ 0.3 Na_2SO_4 2.4 Na_2CO_3 26.1 NaCl 7.6 Fluorine 1.5 ppm. Hardness (0.2)?	A.& R.Heness 1956	0-3 red cl. -590 black shale -160 y.clay -596 grey " -180 y.clay & sh. -600 sh.& sst. -280 grey shale -630 artesian sd. -335 blue shale -650sst.& grvl. -375 grey shale -706 sandatone -430 black " -714 limestone -498 grey "

DOVER STATION

Owner: Grimshaw
Communication: Radio, Cloncurry.

Altitude: 644 feet
Area: 10,000 acres.
Stock: 10-12,000 sheep

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal).	Driller and when drilled.	Strata and Remarks
3-Mile	12140	3 M. WNW		575' 60	67	515-550 60	1100	Total Solids 50.[illegible] $CaCO_3$ 0.7 $MgCO_3$ 0.3 Na_2CO_3	R.W.Close 1952	0-2 soil 90-515 bk.shale 2-10 clay 515-550 art.sand 10-40 y.shale 550-565 sst. 40-90 blue " 565-575 lst. NaA 13.4 Fluorine 3.0ppm Hardness 1
7-Mile (Dover No.2)	12[illegible]	4½M. SW		625' 20'	23	530 20	1500	Total Solids 44.8 $CaSO_4$ 1.4 Na_2SO_4 1.4 $MgSO_4$ [illegible]	R.Close 1954	0-21 soil 30-75 bl.shale 2-10 clay 75-530 bk.shale 10-20 y.shale 530-625 sst. 20-30 wh. " Na_2CO_3 27.1 NaA 13.8 Fluorine 2.7 ppm Hardness 1.8
10-Mile (Dover No. 3)	12928	9m. N		700 75		630 75	1000	Total Solids 79.8 $CaCO_3$ 0.8 $MgCO_3$ 2.4 Na_2CO_3 24.8 NaA 47.2	R.Close 1955	2-10 clay 643 sand 80 y.shale 695 sst. 100 bl. " 700 br. sdy sh. 630 bk. " Organic Matter Present Fluorine 2.0 Hardness 4
Sheep Ck.	4817	7½m.SSE	610	904 Artesian				Total solids 48.8 $CaSO_4$ trace Na_2CO_3 36.2 NaCl 11.9 Hardness 1		

DOUGLAS DOWNS STATION

Owner: H.R. Newman & Sons
Manager: J.D. Newman
Communication: 'Phone & Radio

Altitude: 730 feet (Barometer)
Area: 93,000 Acres
Stock: Cattle and Sheep.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal).	Driller and when drilled.	Strata and Remarks
Old Suva New Hole				300	183	180-247 167	1028	good potable	0-147 J.Hindon 147-300 W.J.Sinclair 1957	124-seams of quartzite 147-quartzite & lst. 152-Chalcedony seam 160-Quartzite & lst. 160-180 lst. & breccia 180-192 lst. 192-232 lst.& Kaolin 232-277 Kaolin or porous lst. 277-300 Kaolin & y. lime or Y.cl.

 Douglas Downs and Elrose Station.

DOUGLAS DOWNS

Owner: H.R. Newman & Sons
Manager: J.D. Newman
Communication: 'Phone & Radio

Altitude: 730 feet (Barometer)
Area: 93,000 Acres
Stock: Cattle and Sheep.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (gal/hour)	Quality or Analysis (gr/gal.)	Driller and when drilled.	Strata and Remarks
Old Suva Abandoned	Nil									
Old Suva	Nil									
Suva Hut New Bore				159'6"		184'5" 159'6"	v. poor	good	W.J.Sinclair 1958	0-3 br. loam w.hvy.cl. content 3-18 lighter cl. content 18-26 sdy. br. loam 26-103 br. cl. sd. & kaolin. 103-123 breccia 123-128 breccia & lst. 128-157 lst. w. seam chalc. at 132-141 157-183 Bccia. & lst. 183-187 Decomposed lst. & bccia 187-198 Bccia & lst. 198-230 Lst, Bccia and y. cl. 230-258 lime bccia kaolin & y. cl. 258-277 kaolin, y.cl. & grv. 277 Jasper boulders 277-286 kaolin & bccia 286-315 " & y. cl. in small seam lst. at 289'. 315-337 bccia & kaolin w. occasional seams of sst. at 333' continuing.
No. 6, No. 7				290					W.J.Sinclair 1950, 1951	
No. 8						240 approx.			W.J. Sinclair 1952.	

ELROSE STATION

Owner: Wells
Communication: Phone Boulia

Altitude: 560 feet
Area:
Stock: 9-10,000 Sheep.

Name	Reg.No.	Position	Altitude (above sea level) (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (gal/hour)	Quality or Analysis (gr/gal.)	Driller and when drilled.	Strata and Remarks
Woolshed (Elrose)	12433	1½mls.SSW of Hotel	545	92 63	63	65 63	720	good stock	R.J.Robinson 5/10/53-16/10/53	20 - soil 42 - sdy. drift 82 - wh. lst. 88-wh.cl. 92-Drift sd. & ferruginous grv.
Kalkadoon	12432	6mls.SW of Hotel		132 66-62	80-65	72-80/123-132 66-62	150-600	Potable	R.J. Robinson 26/10/53-13/11/53	10 - soil 39 - sdy. grv. 62 - sdy. cl. 80 - wh. lst. 123 wh. cl. 132 wh. lst.

ELROSE STATION

Homestead Location: 16 mls. N.E. Boulia
Station Owner: Wells.
Communication: Telephone to Boulia.
Access: off Boulia - Hamilton road.

Altitude: 560 feet.
Area:
Stock: Sheep 9-10,000.

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck (feet)	Depth	Supply (Gal/hour)	Quality or Analysis (gr/gal)	Driller and when Drilled	Strata and Remarks
Woolshed	12433	1½ mls.SSW of Hstd.	545	92 63	63	65		720 + gph	Good Stock	R.J.Robinson 5/10/53 to 6/10/53.	0-20' soil -42' sandy drift -82' white lst. -88' white clay -92' drift sand and ferrugenous gravel.
Kalkadoon	12432	6 mls SW of Hs.		132 66 (IWS 62)	80 (IWS 65)	72-80 (123-132IWS)		150 (600 IWS)	Potable	R.J.Robinson 26/10/53 to 13/11/53.	0-10' soil -39' sandy gravel -62' sandy clay -80' white lst. -123' white clay -132 white lst.
Bronte	4872	5 mls ENE	550	58							
Old Elrose Well	5686	At Woolshed B	545	80						1924	
Old Kalkadoon	5687	At Kalkadoon B		80						1924	
Homestead (Maidstone No.1)	7202	Hs.	560	98						1925	Position correct but bore data may not be for this bore.
Plum Pudding (Elrose No.1)	6287	4mls. SW of Hs.		96						1937	
Cockatoo (Maidstone No. 2)	7203	4½ mls E of Hs.	550	115						1934	Position correct but bore data may not be for this bore.
Bore	11067	4½ mls W of Hs.on 5 Mile Creek.		62						1947	0-20 Red clay -22 White quartzy rock. -62 Red Sst.

FORT WILLIAM STATION

Homestead Location: 40 mls. N.N.E. Boulia
Station Owner: Ernie Kirkham.
Communication: Nil.

Altitude: 653 feet.
Area: 142 square miles.
Stock: Sheep approximately 1,500.

Fort William	4819	Homestead	653	500							
Top Eastern	4820	5 mls. NNE of Hs.	680	400							
Pyalong	4845	12½ mls.SE	690	145							
Limestone	5859	2½ mls.SE	671	250							
Croysdale	4860	8½ mls.SE	615	160							
9-Mile	4842	10 mls.E	690	150							

GLENORMISTON STATION

Homestead Location: 75 mls. W. Boulia
Station Owner: Glenormiston Pastoral Coy. (Collins White & Co.)
Manager: Martin Hayward.
Communication: Radio 8HG Cloncurry

GLENORMISTON STATION

Altitude : 472.8 feet.
Area: 2897 sq. miles.
Stock: 13,000 cattle.

Name	Reg. No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal)	Driller and when Drilled	Strata and Remarks
Jewlerry Well No.1		Near Rocky W.H.		56			Large	Good for cattle but not for horses		Fallen in Abandoned. New 20 mile Na_2CO_3 2 gr/gal. $CaSO_4$ 152 $MgSO_4$ 39 NaCl 76 $Ca(HCO_3)_2$ 14 MgCl 9 $Ca(NO_3)_2$ 7 Total 299
20 Mile No.2	2840?	20 ml. S of H.S.		80' original 58' in 1936 few feet from surface	56' (Has bore)	42'	Large	Good for stock corrodes iron quickly		Finished in 1st. Na_2CO_3 22 gr/gal. $CaSO_4$ 85 $MgSO_4$ 105 NaCl 41 Hardness 150° (Clarke) (1943)
							-58 y. clay -62 gy. clay. -65 gy. lst. pumped for 12 hours at 1440 g.p.h. Water level 37 ft. Good stock water. Analyses, see above "New 20 Mile"			New hole 8' north of above drilled in 1959 by J. Robinson. 0-10 grey clay 10-15 y. clay -45 y. sst.porous -49 hd.wh.sst. -51 water bearing soft wh.sst. (xln)=dolomite
Coorabulka Well No.3		In bed of lake Near Marked Tree Dam		64			Large	Sweet water flooded by river.		
Dud No.3 Bore		18 ml. N. Waraltha W.H.		360'			Salt Water			In limestone.
Dud Bore (Glenormiston No. 4).	2842	4-5 ml. NE of Rocky W.H. and some distance NW of 20 ml. Bore.		903'				Salt	1916	In limestone all way. Trace of oil.
Tyson No.1 (No.4)	2826	8 ml. SW of H.S.		1810'	150' (when tested 1932)	230' (and) 1700-1600' (salt water) IWS records	Large	Salt	?1909; abandoned in 1932 as bore	Pump at 150' gave large supply water. Total Solids 1056 gr/gal. (NaCl) Cl_2 780 $(CaCO_3)$ Alkali 14 $(CaSO_4)$ Sulphate 257 Hardness 500 °Clarke (Analysis in 1932)

 GLENORMISTON STATION

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Depth Water Struck (feet)	Supply (Gal/hour)	Quality or Analysis (gr/gal)	Driller and when drilled	Strata and Remarks
4 mile Well No.5 (2 wells)		Bed of 4 mile Lake 4 ml.S.of H.S.		30'& 40'			720 g.p.h	Sweet water		
Linda Well No.6(2 wells)		33 mls.N.W. of H.S.	L507	45'& 54' Deep- ened by 21' 1935. 35'			720 g.p.h.	Good water		Spoils of lt.brown med.grained dolomite, weathered soft.
Cook's Well No.7	?2845	5 mls.w.of Rocky on Linda Ck.		89' (18 IWS)			1800 " for 4 hrs.	Sweet	Before 1915	Not used as in poison country. Took 3¼ hrs. to empty at 1800 g.p.h. and then took 1 hr. to refill.
Minnaritchie Well No.8	2846	7 miles S.W. from Top Rocky W.H. Linda		106' 75'			1850 g.p.h.	Fair stock water. (scours)	About 1913	NaCl 138 gr/gal Insol. 6.0 Fe & Alumina 2.0 $MgSO_4$ 48.3 $MgCO_3$ 6.3 $CaCO_3$ 28 Soda 8 Total 237 (1914)
Toko Bore No.9	?2829	Where Mulli- gan cuts through Toko Ra.		449' 120	229' in 1915		Good	Too scour- ing for stock	1915	Struck rock at 200' & rocky stone at 400'. Insol. 18 gr/gal Fe & Alumina 1 $MgSO_4$ 200 $MgCO_3$ 21 $CaCO_3$ 23 $CaSO_4$ 108.8 NaCl 674 Total 1046 (1915)
Wheelaman Ck.No.10	2830	Foot of Toko Ra.on Wheela- man Ck.	L600	307' 145'	222'	70' salt 289-307 (good from fissures in 1st.)	1400 g.p.h.	Stock water	1915	At 240' 1st.; 260 1st.,shale; 280 1st.,felspar;307 felsite Silica & Insol. Fe, Al_2O_3 3 $CaCO_3$ 20 $MgCO_3$ 8 MgCl 3 $MgSO_4$ 16 NaCl 107 Total 160 (1915)

GLENORMISTON STATION

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck (feet)	Supply (Gal/hr)	Quality or Analysis (gr/gal)	Driller and when drilled	Strata and Remarks
Dynamite Ck (Pituri) No.11	2831	Near Jnc. Dyna.& Pituri Ck		400'		27'	Large, salt		1916	Abandoned because salt could not be shut off. ?-110 br.& blk clay -126 white clay & sand -131 yel.clay & sand -159 blue-grey rock -190 yellow rock -202 red rock -21[illegible] yellow rock -217 red rock -222 clay and stone -242 blue rock -275 grey rock -310 clay & white stone -340 blue rock -371 b[illegible] rock & sand -400 blue rock
Black Gin Creek No.12	2850	Abt.5 ml. above jnc. w.Pituri C		608'		Fresh near surface salt at 600'	No supply with pump at 240'		1916	In limestone. I.W.S.list another bore near here R.No.2832 "Bloodwood" depth 600' drilled 1916. Water at: 60 ft. fresh 230 " bitter and salt. 570 " salt.
Kellys Crk. No.13	2851	3-4 ml. above Tarawa Dam		27'		Salt at 27'			1920	Abandoned. Could not shut off salt.
No.14 Bore	2839	10 ml.SSW Tyson; 7 ml. NNW of Rocky WH		152' 70' (in 1942 88')	100' 100'	80' small 120' good (in 1942)	1800 gph.	Good	1916	Insol. 5 gr/gal. Fe,Al2O3 2.5 " $CaCO_3$ 19.5 " $CaCl_2$ 10.1 $MgSO_4$ 40.4 $Na2SO_4$ 31 NaCl 167.4 Total 276 (?1920)
Dud No.15	2853	Near Tysons Bore 10 ml. SW of H.S		274' 72'	150' in 1921	82' small salt; 179'		Salt but stock may drink it	1921	Abandoned in 1923. Used during 1922 drought 0-3 soil - 23 yell.rock - 38 white rock - 48 yell.rock - 78 white rock - 82 yell.rock & water -175 white rock -185 water -205 white rock -225 yell.rock -255 brown rock -274 white rock Insol. 10 gr/gal. Fe,Al2O3 11 $CaCl_2$ 39.6 $CaCO_3$ 38.4 $MgSO_4$ 145.5 NaCl 361.5 Total 606 (1921)

GLENORMISTON STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller and when drilled	Strata and Remarks
Dud No.16	?2854	10 mls W of Hs. 4 mls S of 10 Mile waterhole		136 77	150 in 1921	76 166-170	2000 for 6 hrs.	Stock water scours a little Insol. 10 gr/gal Fe, [illegible]O3 9 NaCl 393 $CaSO_4$ 62 Total 626 $MgSO_4$ 152	1921	Abandoned. Used in 1922 but in poison country. 0-4 sand -18 rubble -26 wh.rk. -36 Y.rk. -56 Y.rk & cl. -66 br.rk. -76 Y.rk. -156 Y.rk. -186 wh.rk.
Dud No.17		30 mls W of Hs. on Wheelman Ck. Abt.10 mls below Wheelman bore		533		69 } 132 }	Small	Good	Sept 1921	Abandoned. Blue, brown, red & Yellow rock and then into soft white stuff; finishing in "Calcareous sand", described by Govt.Geologist; probably lsts. below. See No. 17 (IWS)
Dud No.18	2856	Nr. turnoff to Polly Lookout 11 mls S of Hs.		150						Abandoned in 1927 0-3 soil -11 clay -150 blue grey lst.
Peelunga No.19 well	2858	14 mls S of 20 Mile bore	420	66'well with 6' bore in bottom 7'		38 sm.supply fresh 66 good in fine gy.sd.	700	Fair Good for stock NaCl 53 gr/gal $CaCO_3$ 24 " $CaSO_4$ 10.5 " Total 89.6 " H 21° Too hard & saline for domestic supply. New Peelunga NaCl 60 gr/gal $Ca(HCO_3)_2$ 8 [illegible] 16 $NaHCO_3$ 14 Na_2SO_4 15 Total 113	1934	0-3 soil -7 red cl. -8 s.red.stone -65 blue cl. -66 h.gy.sd.rk. and bore sunk about 6' in sd.rk. Collapsed in 1958. 1959 J.Robinson drilled one in Mch - couldn't get casing through 3' h.gy.sd.rk 61-64, 50' S.W. of old well. 2nd bore in May, 90' SE of old well 0-6 red cl. -29 y.cl.(slipbak) -54 gy.shl. -62 gy sdy sh. -63 h.gy sd rk. (1st water) grey fresh sh.when dry & calc.sample -70 sst.w water v.f.grd.wh.sd. -80 v.dark gy sdy cl w sample pyrites -82sst w water -83 hd.wh.sd.rk. -84 sd & cl. w water w gravel sample -90 hd.y.sst. Tested for 12 hrs at 1300 gph gave drawdown to 54'. Good quality potable. Water level 8'.
10 Mile Bore No. 20	8172	14 mls W of Hs. on 10 Mile Ck.	L491	77 31		28- 58	1100 for 6 hrs.	Stock water NaCl 217 gr/gal $CaCO_3$ 23 " $CaSO_4$ 84 " Total 349	1934	0-10 sand -20 gy.sd.rk -56 creek bed mixture w. bars of sst. -58 h.wh.sst. -74 Y.cl. & sst. -77 h.rk. ?lst.
No. 21 Bad gidgea poisoning this locality	8171	33 mls W of Hs on Wheelaman Ck 10 ml below Wheelaman Bore	L549	209	192 in 1935	(77→450 gph (189→sm.supply	700	Stock only NaCl 137 gr/gal $CaCO_3$ 21 " $CaSO_4$ 44 " H 120° Clarke	May 1935	0-4 soil -60 wh.y.gy & red sst. -62 blk.sst. -73 soft sst. -77 soap stone -81 river rble.w.water 450 gph -157 wh.sst. w. h.bars -161 bl.stone (?dolerite) -182 h.wh. stone -185 bl.gy.lst. -189 porous lst -209 bl.lst.
Dud No. 22		3 mls W of Tyson Bore N of Mt. Margaret (Mt. Idamea)		129		101 sm. supply salt				Abandoned 1935. 0-2 soil -10 h.gy.cl. -24 sd & cl. -26 Chalk & sst. -49 red soil w. billy. -112 cl.w.h.wh. stone,lst.w.blk. markings -129 cl.& gy.& wh.lst.

GLENORMISTON STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller and when drilled	Strata and Remarks
Homestead	2843			50						IWS record
Dynamite Ck.	2849			294					1916	IWS record
Glenormiston No.17	2855			1510					1926	IWS record
Tyson's No.2	2827			700					1910	IWS record. Strong smell of kerosene from bore.
Tyson's No.3	2828			500					1910	IWS record
(Pituri Ck)	2857	Co-ordinates gives position near 9 Mile W/h.		1400					1927	IWS record
(Cannock)	2834	IWS co-ordinates gives position 3½ mls S of W of Tyson's No.28		120		20 120			1917	IWS record

GOODWOOD STATION

<u>Homestead Location</u>: 5 mls. S.E. Boulia

<u>Station Owner</u>: Dan C. Howard & T. W. Flood

<u>Communication</u>: Telephone Boulia

<u>Access</u>: Off Boulia and Hamilton road.

GOODWOOD STATION

<u>Altitude</u>: 520 feet

<u>Area</u>: Old Goodwood 17 sq.miles
Headford (Three Rivers) 14 sq.miles
Black Mt. 113 sq.miles
Clearview 28,000 acres
Kewpies 3 sq.miles

Stock: 16,700 sheep (1700 cattle on Black Mt.)

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller and when drilled	Strata and Remarks
Valley (New)	10306?	50 yds N of (Old) Valley Bore	730	144		129? 129?	Unlimited	Good domestic	J.B.Miller 28/2/56-15/3/56	Soil; -42 h.cl.congl.rk.; -45 slate; -49 lst.; -61 cave; -129 lst.; -138 lst.; -144 lst. Cuttings include green shale, gravel & sand.
Valley (Old)	4874	7 mls NE of 15 Ml Well	730	124 SA				Fresh		Bottom in lst.
Twin Peaks (Black Mountain)	13061	4 mls NE of 15 Mile Well (2 Bores)*	700	221 160		214 160	500	Potable	Miller 1955	2-10 Y.sdy.cl.; -11 wh.rk.; -30 Y.sdy.cl.; -214 H.wh.lst.; -221 soft sst. Cuttings include yellow siltstone, white non-calcareous shale or shaly siltstone, qutz gravel, gypsum. *1st hole to 170' in 1954? was dud; 2nd hole alongside.
15 Mile Well (Goodwood No.2)	12354	9 mls S Black Mt.		132 SA		110 80	900		Close 1953	2-4 clay; -40 lst.; -42 h.rk.; -108 Y.sh.; -120 sst.; -132 Y.lst.
Old 15 Mile Well	4792	(Warendack) 9 mls S Black Mt.	L650	1075 SA 80°F(surface)		109) 187) 410)	2000		1890	0-69 clay; -187 sand; Congl. at 109; -410 lst.; -1047 sandstone; -1075 limestone
Bloodwood	4835	Abt.2 mls NE? of Valley Bore	654	170 SA		115 165			1912	Position doubtful. Abandoned. 0-165 sand & gravel Bottomed in lst.
Headford No.1	7286	3 mls E of Hs.		100 SA						
Headford Homestead	7287?									

GOODWOOD STATION

GOODWOOD STATION

Name	Reg. No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Clearview	11389	9 mls W Boulia	495	200 SA					1948	3-10 clay -60 lst -110 Y.cl. -150 blk sh. -160 Sst. -200 blk.sh.
Berrimilla (Clearview)	2963	8 mls WSW Boulia	L476	220 SA		32			1922	Bottomed in limestone
Clearview (Dumbbell)		6½ mls WNW of Boulia		268		240↓ 68	Unlimited	Good	J.B.Miller 1957	0-112 red & wh.cl. (wh."chalky" siltstone. -215 gy,bl.sh.,sdy in parts w. some gypsum -240 Sst.f.g. to c.g.,micaceous -268 Dolomite
(Old Goodwood) 5 Mile (Goodwood No.3)	12517	3 mls ESE		100 63	71		720		E.J.Robinson 27/11/53-5/12/53	8 red sub-soil -16 red sst. -31 Y.sdy cl. -100 red sdy.cl.
(Old Goodwood) 9 Mile (Goodwood No.3)	12944	7 mls ESE		102 62	62	65↓ 62	14000 (test) pumping at 600 g.p.h.	Good stock	J.B.Miller 4-11/8/55	2 soil -60 red sdy.cl. -102 red h.rk.w. veins of sd.
(Black Mt.) Ninmaroo Ck (Goodwood No.2)	2811	2½ mls W Black Mt.	695	350					1929	
(Old Goodwood) Goodwood H.S.	12094	At Goodwood Hs.	520	133 SA		65			1952	0-3 red soil -15 gy.sdy cl. -40 cl.& grv. -65 Y.cl.& grv. -85 gravel -90 Y.clay -98 Lst. -133 Y.sst.

GOVERNMENT OPERATED

Name	Reg. No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Sonning	11877	8½ mls WNW of Windsor Pk Hs.	740?	250 120		↓190 120	840	Very Good	Close 1951	0-5 clay -20 gravel -81 rock -180 soft rk. -190 sdy.shale -200 rock -245 limestone -250 gy.limestone
Binfield	11435	Boulia-Selwyn Rd-6 mls SW of Two Rivers Hs.	680	312 83		(140(200gpd) (290↓ 80	1050		Close 1949	2-15 clay -40 sandrock -45 red cl.grv. -65 Y.cl. & blds. -80 red cl.& blds. -120 wh.cl. -140 yellow clay -145 sandstone -235 blk.shale -305 sandstone -312 Y.lst.
40 Mile Well	324		660	47 SA						
25 Mile Well (Nisbit's)	323	Boulia-Glenormiston Rd, 4½ mls NNW of Wirrilyerna Hs.	480	110 SA					1920	
Herbert Downs	5104	2 mls. E. of H.S.		64 SA		32↓ 25	1200	Brackish	1936	0-10 surf.cl. -17 wh.rk. -20 Y.cl. -26 blds. -27 wh.blds -30 blds. -32 h.wh.rk. -40 wh.clay -45 sandstone -46 wh.rock -49 boulders -52 h.wh.rock -64 limestone

GOVERNMENT STATION GOVERNMENT STATION

Name	Reg.No.	Position	Altitude above sea Level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Min Min	321	On stock route 18 mls E of Hamilton H	615	951 Artesian		747 to 200 760 } 820 } to surface 870 }	213,050 gpd		1925	3-18 gravel -123 Y.clay -223 bl.sh. -343 dark sh. -735 dk.gy.sh. -749 s.gy sd & water -870 water bearing sd. -930 pipeclay & sd. -940 lst. -951 V.hard rock
Lucknow	4115	Stock route 4½ mls E of Lucknow	640	1124 SA		970) 1060) 41 ↓	880		Beauchamp 1942	0-150 Y.clay (hard rock 49-52) -260 bl.sh. -265 gy.rk. -960 bl.sh. -970 greensand rk. -1000 sdy.sh. -1030 br.rk.,sdy sh.,drift sd. pipe clay -1040 lst. -1124 drift sand
Warenda or Bloodwood	5114	Stock route 26 mls E of Boulia	545	196 Artesian		48 and 182	180		1936	-5 clay -38 wh.rk. -110 cl.&rble. -135 sdy.cl. -146 clay -182 sdy clay -184 rock -186 lst.
15 Mile well	322	Stock route 16 mls E of Boulia	L509	365 65					1915	480 lst. No sst. met with
Boulia Town	5766	In town	525	244 SA				Good	1927	0-6 Cl.&wh.rk. -91 Y & pk.cl. -196 bl.sh. -216 wh.lst. -226 Sd. & grv. -236 Pipe clay -244 Lst.
Boulia Town No. 2	10928	In town	525	271 SA		200 and 240			1947	4-35 lst. -65 wh.cl. -105 Y & blk cl. -124 dark sh. -145 dark cl.& blds. -175 blk sh. -200 dark sdy sh. -220 blk.sh. -240 Sst. -271 Alternating Sst.& lst.
Aboriginal Reserve Well	8092	1 ml SE of Boulia	610	55 SA		53			1938	-50 hd. shale 0-25 stony earth -40 flaky sh. -55 rock Not used
Boulia No.3	12571	Boulia	525	247 SA		220			1954	0-5 blds -25 lst. -50 wh.lst. -90 wh.clay -100 Y.sdy.sh. -130 br.sdy sh. -220 blk.sh. -247 Sst.
New Hamilton Hotel	6833	At hotel	540	278 SA ?98°				V.good domestic	1939	
Old Hamilton Hotel		At Hotel	540	?50						

GRANTON STATION

Homestead Location: 30 mls. east-north-east Boulia

Owner:

Manager: Mr. Campbell

Communication: Telephone to Boulia

GRANTON STATION

Altitude: 561

Area: 180 sq. miles

Stock: Approx. 20,000 sheep

Homestead (Granton No.1) Abandoned well	7239	At Hs.	L561	68 SA				Salty	Abt. 1924	
Yellow Hole (Granton No.2)	7240	4 mls S of Hs.		250 SA					1925	
Brolga (Granton No.5)	7242	7 mls SW of Hs.		199 SA					1935	
McNamara (Granton No.6)	7243	7 mls W of Hs.	580	120 SA					1925	

GRANTON STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller and when drilled	Strata and Remarks
Stumpy (Granton No.7)	7244	9 mls SW of Hs	565	350 SA					1932	
4 Mile (Granton No.9)	7245	4 mls WNW of Hs.	L576	268 SA					1935	
Dribbling	4825	6 mls SE of Hs.	L503	180 Artesian			12000 gpd	Good drinking	1897	Bottomed at 180' in Sst.
Andrew's (McRae's)	4847	8½ mls NNW of Hs.	L607	125 SA						
Jubilee Well	4851	6 mls NE of Hs.	587	205 57		120↓ 57↑	1000	Brackish	R.Close 1951	65' well deepened by 6" bore 0-60 ? -135 Y.clay -67 gy.stone -155 gravel -60 clay -185 Sst. -82 lst. -205 gy.lst. -95 red grv.
Closes (Jubilee)	12050	3 mls NE of Hs.	L584	90 32	40	35* 32	33600 gpd	Good	Close 1952	* Water from sand and gravel between 35 and 90 feet according to Mr. Campbell 0-4 clay -60 yellow sst. -6 lst. -90 blue sst. -20 clay
New (Granton No.3?)	12813	5 mls N of Hs.		135 65		90↓ 65	900	Good	R.Close 1955	10-20 clay -120 sandstone -90 y.shale -135 limestone
Mountain		3 mls ENE of Hs.	L570							No information
Dud Bore (Granton No.2)	11246	2½ mls NNW of Hs.		212 SA		212			1947	0-2 soil -80 lst.blds. -212 caving clay formation Hole full of rotten clayey rock like gypsum & according to Mr.Campbell tools jammed
9 Mile Bore		8 mls NNE of Hs.	L569							

GUMPTI STATION

Homestead Location: 65 mls. N.E. Boulia

Owner: Gibson

Manager:

Communication:

GUMPTI STATION

Altitude:

Area:

Stock: Sheep

(Sandila No.2)	7094	18 mls ENE of Lorett Downs		750 S.A.					1923	

HARTNELL DOWNS STATION

Owner: L. Walkley; sold in 1959

Manager:

Communication: Telephone to Boulia

HARTNELL DOWNS STATION

Altitude:

Area: 15 sq. miles

Stock: 2,000 sheep

Homestead	1700	4 mls. NW Boulia	498	216 90	170		40 gph	Stk.water only	1914-17	
Bore		2½ mls NNW of Hstd.		187 66	76		Unlimited	Good	1955 A.J.Heness	

JIBLOO STATION

JIBLOO STATION

Owner: Campbell
Manager:
Communication: Nil

Altitude: 625'
Area:
Stock: not stocked in 1957

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hr)	Quality or Analyses (gr/gal)	Driller and when drilled	Strata and Remarks
House	4863		625'	140 ' S.A.						

KALLALA STATION

KALLALA STATION

Owner:
Manager: –
Communication: Telephone Dajarra; 40 mls. W. Dajarra

Altitude: L724
Area:
Stock: Sheep

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hr)	Quality or Analyses (gr/gal)	Driller and when drilled	Strata and Remarks
Quewar New	10724			223' 160'	180	206↓ 160	1300		R.C.Beauchamp C.D.1946 6" cas.to bottom 4½ pump	0-4 Surf.soil -40 br.lst. -56 br.lst.& cl. -100 red cl. -174 grav. -192 yl.&red cl. -206 sst. -216 yl.cly.& grav.
Top Quewar	10723			254' 224'	232	228↓ 224	1400		R.C.Beauchamp C.D.1946 6"cas.to bottom	1-4 Sur.soil -8 br.cl. -14 grav. -44 br.lst.&Cl. -72 br.lst -90 br.cl. -132 br.cl. -164 wh.b'kn.lst.&Cl. -180 wh. " lst.&Cl. -228 wh.cl. -236 sst.br. -254 wh.sst.
Q.T. Bore	9855			425 245	425	↓147 & 410 142	Upper supply 250; bottom unlimited		C.R. & F. Pearce	0-3 red cl. -20 sandy loam -38 red grav.cl. -56 " " " -76 " " " -98 Blue Sdy.Cl. -118 Grey " " -138 br. " " (-142 cave in lst) -149 Blue lst. -180 " " -186 " " w.hard streaks -196 Blue lst. -204 " " -215 " " -227 lst.w.chert bds -260 lst.& cl.beds -305 lst." " " -314 " w.chert " -350 soft blue lst. -411 yl.cavey lst. w.Xln.lst.in caves -425 red mud which would not support casing. From 150-300 ft.small amounts of gypsum and several oily shale laminae were met.
Ocngeran				226 186	224	↓186 & 210 186	About 280		E.Emblem C.D.1941 2? ft. mill 4" piping 3½ pump	
Blue Bush	8902			176½ 152	156	160↓ 152	672 gph		E.Emblem C.D.1941 20 ft.mill 164 5" cas. 4½ pump	0-2 cl. -4 rock -12 cl. -18 rock -29 cl. -31 rock -51 cl. -53 rock - 70 cl. -74 rock -82 cl. -176½ rock
Red Bank	8899			315 190	190	↓190(small), 260 190	Unlimited		A.E.Wheel-house C.D.1942 20 ft.mill 314' 6" cas. 4½ pump	0-21 red cl. w.gravel seams -29½ gravel -123½ soft rd.rk. -161½ " wh. " -315 wh. rock

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hr)	Quality or Analyses (gr/gal)	Driller and when drilled	Strata and Remarks
Pinnacle Bore	9087			259 238	238	238	380 gph	Good	A.E.Wheelhouse C.D.1942 20 ft.mill 254 6" cas.	0-2 Red cl. -77 "& wh.chalk -83 ironst.grav. -113 red & wh.chlk. -134 wh.hard rock -142 Blue Diorite -177 wh.hard rk. -178 Blue Diorite -184 wh.hard rock -194½ blue hd.rk.
Q.T.Bore Abandoned L.No.6101		30 ft. from QT New Bore		169		151↓ 143	520*	Good	A.E.Wheelhouse C.D.1942	0-6 red cl. -21 gravel -144 sft.red & yl.rock -147 cave -151 grey hd.rk. -169 " " " *Gave only 60 gph after 3000 gls.had been pumped from it.
Queewa Well		14 mls E. of H.S.;25m. NECarandotta 60 ft. from New Quewar		186' (present depth only 164) 161'			3000 p.d.			Timber in well collapsed and new bore drilled 60 ' west
Coonamulla Well		8 ml.SW H.S. 18 mls NE Car-andotta		168' 126'			100 gph	Good		Sucks in air in morning and blows it out at midday. Also collapsed (probably good - 30,000 gl.tank at site originally)
Abandoned Bore		8 mls. NW. [illegible] of Q.T. Bore		410'		About 350'	About 60			Sinker bar or bit in hole abandoned.
Q.T.Bore Dud		40 yds.nth.of abandoned QT bore		144'						Drilled by A.E. Wheelhouse in 1942. He was unable to keep hole straight after 110 ft and after reaching 144 ft. abandoned the bore.
Kallala	8899			226 150	190	180-217	560		C.R. Pearce C.D. 1943	0-6 surf loam -26 creek grvs. -48 Red cl. -72 yel. cl. -104 y. sdy. cl. -126 y. cl. w. h. streaks -149 y. cl. -174 gravel. -184 soakage -206 water grv. -212 sand -219 cherty h. rock. -226 h. lst & qtz.
House	9260			about 185' 291	190	214-260	unlimited 960	good for household use & gdn. Total 41.6grs $CaSO_4$ 5.6 $CaCO_3$ 6.2 $MgCO_3$ 8.6 Na_2CO_3 3.0 NaCl 16.2 H 21.0 F_2 0.8	C.R. Liddy 1954.	0-10 top soil -30 cl. & grav. -60 clay -73 rock -177 wh. chalk -213 y. cl. -225 sandstone -248 wh. stone -259 soft y. cl. -291 sandstone.
Old House				about 185' 190 230	190	about 210	unlimited	" " "		
Oonagran				264		180 (no supply) 2[illegible], 256	246→250 gph 256→650 "	Good	R. Murphy 1958	0-6 soil -17 sdy.red cl. -70 red cl. & grav. -96 y. cl. & lst. -144 y. cl. & chalcedony -237 y. cl. & kaolin -245 y. cl. & chalcedony -246 grav. & brown sst. -255 y. cl. & chalced. -256 grav. & wh. sst. -264 y. cl. & chalced.

LINDA DOWNS STATION

Owner: M. Fennell and G. Coleman
Manager:
Communication: P.O. Urandangi

Altitude: 571 feet
Area:
Stock: Cattle

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hr)	Quality or Analyses (gr.gal)	Driller and when drilled	Strata and remarks
Homestead		At H.S.	571'	200' 100'	120'		Fair,500 gph	Stk.water only		In Tertiary lst., marl,chalced. for top few feet then into brn.Ordovician dolomite. Bore put in bottom of a well 100' deep. New bore (1960)near-bye to 121' in dolomite.Main water 80 -97 ft.at 600 gph.Stk.water only.
Bonny Doon		22 mls.NE of H.S.	584'	Abt. 300' 150	240		Poor	Stk.water	Beauchamp Abt.1923	Probably through Ordovician dolomite-limestone
Martins		6 mls.E of H.S.	590'	104' 96'	99		Good,1200 gph	Stk.water		In Tertiary,probably into Ordov. dolomite
Dud (Kelly's Ck)	2833	1 ml.N.of Boowonba Dam Position doubtful	?530'	30'		30'		Salt	1916	Station says depth 61 ft. struck fair water but "sand" fouls up the pumps.
Top Well		10 mls.N. of H.S.	535'	130' 60'	80'		Fair	Stk.water		In Ordovician dolomite-limestone Station says depth 91 ft.
Dud		Abt.10 mls. E of Bonny Doon.Pos. doubtful		Abt. 300'						
Dud (Euwarra)		4 mls.SSW of H.S.near waterhole	?580'	108'			Good	Good		Supposed to have struck water but "sand" fouled pumps. In dolomite.
Dud		4 mls.NNW of H.S.on edge of pln.	613'							In dolomite but too hard to drill far into.
Jacob's Well		9 mls.NE of H.S.in Pit-ari Creek		72'			Good	Bad, salty		Floods filled in well and water saline. Position doubtful.
Walayah		Bore in a well at Wala-yah W.H.	520'	76'			Good	Good		In dolomite after passing through some Tertiary lst.
Well		22 mls.S.of H.S.where Linda Ck. crosses boun.fence	617'	60'			Fair	Good		
Well		14 mls.WSW of H.S.on Kelly Ck.	?600'	200'			Poor	Good		

LORRETT DOWNS STATION
(includes WILGUNYA, KHERI, BENARES)

Owner: Beauchamp & Co.
Manager: Cameron
Communication: Radio at Wilgunya to Cloncurry

Altitude: 625'
Area: 154,000 acres
Stock: 20,000 sheep; 750 cattle

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hr)	Quality or Analyses (gr.gal)	Driller and when drilled	Strata and remarks
I.B.C. Wilgunya No.2	12486	3 mls E of Hs.		298 15		65(723 gpd) 287 15	17352 gpd	Salt	S.Beauchamp 1953	0-68 Y.clay -70 h.rock -270 bl.shale -287 sst. -293 sst.& grv. -298 h.rock
Kheri No.1	6549	9 mls NNE of H.S.		340 S.						

LORRETT DOWNS STATION

LORRETT DOWNS STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Shed	4805	12 mls N.E. of Hs.	664	590 SA 101°F		590 surface	161,600 gpd	Fresh	1892	0-30 red clay -55 shale -195 black -510 shale -590 sst.
Robin Ck. (Benares)	11268	10 mls E.N.L.		495 32		445 32			Beauchamp 1948	0-15 clay -64 Y.clay -440 bl.shale -460 sst. -495 gravel
A.B.C. (Wilgunya)	11905	5 mls NE of H.S.		380 45	63	380 45	45,500 gpd	Fresh	S.Beauchamp 1951	0-65 Y.clay -340 Bl.shale -342 gy.rock -355 drift sand -380 grvl.sst. -gy. rock at 380
3 Mile	4831	3 mls NNE		400 Artesian					1912	
Homestead (Shadhole Ck 2)	4830		618	755 ?Artesian		201			1912	In pipe clay at bottom
Carbo (Kheri)	7633	11 mls N of Hs		201 40		82) 95) 201) 40	Unlimited	82 Salty 85 " 201 Fresh	Beauchamp 26/3/1939	0-58 Yellow clay -94 blue shale -95 grey rock -201 white sand & mica
Wilgunya Hs.		8 mls E of Hs								
Shadhole 3B	4832	3 mls NNE 1 ml E of 3 mile	631	320 Artesian		275) 316) surface		Very Good	1912	Bottom in limestone. IWS position
Old Lacey&s? (Woolgunnia)	4801	11 mls E	615	653 Artesian 95°F		233) 446) 485) surface	111,000 gpd	Fresh	1892	0-233 Y.& blk shale -269 sst. -446 blk.sh. -584 sst. -653 granite Position doubtful
Lacey's New (Wilgunya)	12125	11 mls E of Hs	?615	670 SA		630			1952	0-2[illegible] gy.cl. -70 [illegible].cl. -120 bl.sh. -340 blk.sh. -342 br.rock -590 blk.shale -670 sst.
New		10 mls NNE of Hs.		424		407			J.Robinson 1957	407-424 granite

LUCKNOW STATION

LUCKNOW STATION

Homestead Location: 75 mls. E. of Boulia

Owner: Q.N. Pastoral Co.

Manager:

Communication: Boulia

Altitude: 609 feet

Area: 800 square miles

Stock: Sheep

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
No. 1	3455	7 mls ENE (Mackunda sheet)	L654	1411		1020) 1100) 1128) surface	525,110 gpd	Fresh	1896	0-500 blk.sh. -1020 bl.sh. -1030 sst. -1188 drift sand -1411 no record
No. 2	3456	12 mls ESE (Mackunda sheet)	L630	1571 21		1445) 1480) stopped flowing 1910	250,000 gpd	Good	1900	0-220 yellow shale -1445 blue shale -1480 sst.w.sand drift -1571 No good record
No. 3 (Lockarock No.4)	3457	9 mls SSE	670	1358 50(1924)		1140 flow 1358 flow stopped flowing after 1910	Unlimited	Good $MgSO_4$ accumulates in water during periods when not pumped	1901	-14 cl.& sst. -1140 shale -1260 clay & sst. -1358 sand & clay seams

LUCKNOW STATION

Name	Reg.No. Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
No. 4	3458 27 Mls SSW (Springvale sheet)	L625	1286 17(1924) 122.5°F		1140 1165 1192 1232 1241 Stopped after 191[illegible]	375,000 gpd	Good	1907	0-73 red,yellow blue clay -783 bl.sh. -798 copi sh. -1110 blk.sh. -1140 pipe clay -1286 pipe clay,drift sd.w.qutzite bds.
No. 5	3459 20½ mls S (Springvale sheet)	L660	1307 19		1143 1171 1180 1200 1210 1225 1248 1307 surface-ceased to flow 1911	125,000 gpd		1908	0-3 red cl. -23 wh.sst. -63 y.sh. -123 bl.cl. -125 lst. -205 bl.sh. -209 lst. -750 bl.sh. -850 blk. sh. -1128 bl.sh. -1148 sdy.sh. -1171 sd & pipe cl. -1180 sand -1210 pipe clay -1225 sd & qtz seams -1248 sd w pipe clay -1307 lst.
No. 6	3460 (Mackunda sheet)	L591	1538 Artesian		1450, 1452 1485 1490 1500 1505 1510 1513 surface	630,000 gpd	Good	1909	0-5 red cl. -105 y.cl -200 bl.sh. -250 sdy sh. -450 gy shl -500 blk sh. -505 lst. -600 blk sh. -631 bl.sh. -670 blk sh. -750 gy.sh. -990 blk sh & drift -1000 lst. -1008 blk sh. -1013 ? -1090 blk sh. -1093 lst -1280 blk sh. -1285 gy sh. -1380 blk sh. -1382 pyrite -1400 pipe cl. -1450 sst. -1485 pipe cl. -1538 alternating layers of sst. & cl.
No. 7	3461 27 mls ESE of Hs. (Mackunda sheet)	545	1837 Artesian		1759 1763 1765 1780 1785 1790 1798 1808 surface	636,000 gpd	Good	1910	0-5 red cl. -97 Y.sh -202 Y.sh.w.bands lst. & qtzite -302 bl.sh. -304 qtzite -334 bl.sh. -338 qtzite -623 blk sh -626 qtzite -786 bl sh. -787 qtzite -1104 bl.sh. -1106 qtzite -1221 bl sh -1226 qtzite -1286 bl.sh. -1289 qtzite -1490 bl.sh. -1499 qtzite w. pipe clay -1669 bl.sh. -1700 sh.w.qtzite -1730 pipe clay -1804 sst w.qtzite -1830 sst w.pyrite -1837 lst.
No. 8 (Kunjara)	3462 21 mls SE (Mackunda sheet)	639(IWS) (662 IWS)	1734 10(1924)		260(soak) 1496 1585 1595 1605 1610 1615 1620 surface - ceased flow 192[illegible]	Unlimited	Good	1911	0-8 red cl. -141 Y.sh.w.thin lst.bds. -590 gy.sh.w.qtzite & sst bds. -1492 blk sh.w.bds as above -1661 quartz, pipe cl. & sand -1734 limestone
No. 9	3463 13½ mlsSSE (Mackunda sheet)	618	1533 Artesian		1167 1195 1265 1305 1360 7" above surface from 1167'.Ceased in 1926	166,480 gpd	Good	1913	0-10 red cl. -54 Y.sh. -78 " " -650 gy.sh. -652 qtzite -870 blk sh. -872 qtzite -1131 blk sh. -1134 qtzite -1160 pipe cl. -1178 sd. -1200 pipe cl. -1210 s sst -1346 pipe cl. w.sd seams -1351 h.sst. -1389 pipe cl. -1411 s wh sst. -1413 pipe cl. -1515 s wh sst. -1530c.dry grv. -1533 lst.

LUCKNOW STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
No. 9A	3464	Abt. 12 mls SSE of Hs.		115					1911	
Station Bore	3465	Homestead	609	1165 SA		784 800 885 900 905 930 955 7" above casing	176,360 g.p.h.	Fresh	1914	0-107 Y.sh. -400 gy. sh. -783 blk sh. -784 qtzite. -805 sd.w.pipe cl. -815 drift sd. -876 sd.w.pipe cl. -900 s.wh.sst. -950 gy sst. w. sand seams -955 pipe clay -1000 h.gy.sst. -1100 mica - 1165 granite
No. 11	3466	27 mls SSW (Springvale Sheet)	659	1175 25 (1924)		896 920 930 955 980 995 1000 896' rose to 100' level water rose to 27' level	Unlimited	Fresh	Hannay 1914	0-16 ironstone -70 Y.sh. -101 pk.sh. -102 ironstone -585 gy sh. -593 sedimentary rk. -900 blk.sh. (Qtzite 670-671, 857-858,870-871) -920 pipe cl. -922 coarse sd. -930 pipe cl. -932 sand -957 sst. -980 pipe clay -982 gravel -1000 pipe cl. w. sand. -1110 hard sst. -1123 white qtz. -1174 red ironst. -1175 lst.
No. 12	3467	31 mls SSW (Springvale sheet)	665	1233 31(1924)		950 1016 1033 1060 1087 1233 to 10' level	Unlimited	Fresh	Hannay 1914	0-7 red cl. -133 Y.cl. -135 ironstone -209 gy.sh. -210 ironstone -225 gy. sh. -227 qtzite -906 gy.sh. (Qtzite 331-332, 369-371,409-410, 450-2,474-5,574-6, 704-5,742-3,760-2, 905-6) -980 blk sh. -1087 alt.pipe cl. w.sand -1093 wh.qtz. -1130 hard sst. -1133 qtz. -1184 hard sst. -1187 white qtz. -1208 sst. -1210 ? -1229 sst. -1233 white qtz.
No. 13	3468	22 mls SE of Homestead	623	1772 (Artesian)		333 1548 1636 1653 1695 1706 1715 333' supply rose to 320' Remainder to 7½" above casing Ceased flowing 1928	303,000 gpd	Good	1916	0-15 white sst. -90 y. sh. -104 gy. sh. -110 sst. -130 gy. sh. -135 hard sst. -230 gy. sh. -233 qtzite -260 gy. sh. -322 bk. sh. -324 qtzite -364 gy. sh. -366 qtzite. -455 gy. sh. -457 qtzite -550 gy. sh. -555 green sst. -575 gy. sh. -600 sandy sh. -602 qtzite -660 gy. sh. -746 bk. sh. -770 gy. sh. -832 bk. sh. -834 qtzite -860 bk. sh. -867 qtzite -902 gy. sh. -904 qtzite. -1012 gy. sh. -1014 qtzite -1039 grey sh. -1040 qtzite -1093 bk. sh. -1100 sdmtry. rk. -1253 bk. rk. -1254 qtzite -1284 bk. sh. -1288 qtzite -1340 bk. sh. -1344 qtzite -1376 bk. sh. -1380 qtzite -1485 bk. sh. -1489 qtzite -1519 bk. sh. -1521 qtzite -1547 bk. sh. -1550 sand -1570 pipe clay -1590 sst. -1597 congl. -1704 sd.&sft.ssd. -1706 congl. -1726 hard sst. -1770 soft sst. -1772 congl.

LUCKNOW STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
No. 14	3469	12 mls E. (Machunda sheet)	—	1513 50(1924)		1202 1322 1324 1202' rose to 75' 1322') 1374') rose to 60'	Unlimited	Good	Hannay 1918	0-7 ironstone -119 y. sh. -1089 gy.sh.w. qtzite.sd. bands -1131 sft.bk. sh. & sst. -1137 gr. sh. -1140 sst. -1200 bk. sh. -1201 drift -1224 pipe clay -1226 sand -1295 pipe clay -1319 sd. w. water -1323 hard sst. -1336 pipe clay -1340 sd. w.water -1360 pipe clay -1364 sd. bearing water -1404 sst. -1417 pipe clay -1513 fine sst.
No. 15	3470	15 mls S.	—	1245 63(1924)			Unlimited	Good	1918	
No. 16	3471	13 mls N.E. (Machunda sheet)		1352 57(1924)			Unlimited	Good	1912	
No. 17 (Pollygammon)	7759	10 mls N.E. (Machunda sheet)		1388 SA					1940	0-9 hd.ironstne. -73 clay -396 gy. sh. -538 dk.gy.sh. -598 green sh. -647 brown sh. -1031 grey sh. -1044 sh. -1078 drift sand. -1294 sdy. & sh. rk. -1328 very hd. grey sandrock & mica. -1336 hd. qtzite & mica. -1388 granite
No. 18 (Darr Ck.)	7950	19 mls S.E. (Machunda sheet)		1660'					1940	

MACSLAND STATION

<u>Homestead Location</u>: 15 mls. E. of Boulia, off main road.

<u>Owner</u>: Brian McGlinchie

<u>Communications</u>: 'Phone Boulia

<u>Manager</u>:

<u>Altitude</u>: 530 feet

<u>Area</u>:

<u>Stock</u>: 12,000 sheep

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
House B. (Macsland No. 3)	12284		530'	356 + 22'	34'	82 - 70 185 - [illegible] 342' - 2[illegible]	600 at 82' - 150 at 185' - 1100 gph at 342' -	Brackish Potable very good	E.J. Robinson 15/7/1953 - 25/9/1953.	0-13 soil -40 sdy. gravel. -45 sandrock. -55 white lst -82 gnish.white decomposed lst. -90 wtr.worn, grv. & drift sand. -95 yellow clay. -100 grey shale. -184'6" blue shale. -185 grey sst. -330 blue shale. -341 gy. sd. clay. -342 very hd. rk. -343 drift sand -356 sst. water worn gravel. Bottomed in grey lst.

MACSLAND STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Goodwood B.	?12081 cf. Drilled 1951	4 mls N.E.	--	100' 63'	71'	71' - 100'	720	Good	E.J. Robinson 27/1/1953 5/12/1953	0-8 rock -16 red sst. -31 y. sdy. clay. -69 reddish sandy clay. -100 white lst.
78 (15 Mile)	12706	3 mls N. of H.S.		375' 16'6"	23'	60 190 208 340	1000	Good	E.J. Robinson 12/6/1954	0-12 red sfce. clay. -32 y. sdy. cl. -58 red sst. -66 drift sd. (slight seepage at 60') -81 y. clay. -191 gy. shale -195 sdy shale. -208 grey sh. -209 grey sst. -332 gy. sh. -337 sdy. clay. -340 sst. -341 drift sand -372 sst. -375 browny gy. shale.
Warenda Ch.B.		7½ mls ESE		239 (Artesian)	--	235 239 Surface	600	Good	E.J. Robinson 12/2/1957 - 9/3/1957.	0-4 soil -20 sandy clay. -42 red sst. -57 y. clay. -233 gy. shale. -235 qtz. rock. -239 sst.
Derelict	4865	7 mls ENE		283 51		80 97 51	1900		1915	Bottom 8' in hard lst.
Redhead	4811	7 mls SW Hamilton Hotel	L512	410 Artesian		130			1893	0-27 soil & gravel -130 shale -187 sst., -192 lst. Hole deepened to 410' in 1896 but no log recorded. Position Approx. Bore drilled in 1915 about 2 miles south of Redhead finished at 293' after penetrating 8' hard lst. Water at 80, 97 ft.

MARYVALE STATION

Homestead Location: 15 mls. NW of Boulia

Owner: Smith, Bowden & Co.

Manager: G. T. Smith

Communication: 'Phone Boulia

MARYVALE STATION

Altitude: 564

Area: 96,000 acres

Stock: Sheep (10 - 12,000)
Cattle (100)

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
No. 1	1095	West side of Bengeacca, opp. H.S.	564	255 Flowing		230 pumping supply 255 main. surface.	Unlimited 50000 gp day.	Good	V. Beauchamp 1920	Probably same as No. 5. 220-230 coarse gravel 252-255 limestone.

MARYVALE STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
No. 5	9601	Homestead	567	180 85	150	100 - small soaks deeper at 141,156.	300	Good, slightly hard	G. T. Smith 1943	6-56 Rock, qutz. congl. (Mottled claystone and siltstone). -100 yellow clay -141 blue shale -156 sandy rock -180 blue shale.
No. 2		11 mls S.W. of H. S.	475	100 90	95	90	Unlimited	Good, hard.	J. Shepley	50 to 60 feet of clay then rock to bottom.
No. 3 (Maryvale No.3)	7788	10 mls WSW of H. s.	510	196 140	150	160 140	1600	Good, slightly hard.	J. Shepley 1938.	20 to 30 feet of clay then rocks and pebbles until solid limestone at bottom. Surface collapsed around casing.
No. 4		8 mls SSW of H. s.	500	340 60 *	150	60 (small soak) 200 (fair supply) 240 (big supply)	Good	Good	D. Shepley	Similar to strata in No. 8. * Falls to 100' when pumping. Cf. Montagu Downs L. No. 9301 Depth 205 Drilled 1943
No. 6 (Bengeacca . 3)	12019	5 mls W of H. s.	605	364 about 150	300	250 275 250	600	Very good, soft potable	A. Henness Snr. 1952	0-85 Clay * 85-166 sandstone 166-300 limestone (grey) * upper 40 feet composed of mottled claystone and siltstone.
No. 7 - Dud		11 mls SSW of Hs.	475	250			Tested at 1700 gph & pumped dry		A.Henness Snr.	Abt. 60 ft of mottled siltstone & claystone, overlying grey limestone. cf. Bengeacca (4) depth 150', Reg.No.6203, drilled 1935.
Dud - next to No. 7			475	425			100 gph before pumped dry		A.Henness Jnr.	
No. 8 (Bengeacca 4)	12827	4½ mls S of Hs.	540	300 112	150	135 280 112	1700 gph	Good	J.Hinden 1955	0-3 soil -40 red rk (mottled beds) -43 sst. -47 wh.rk. -61 sst -66 Y.cl. -78 br.cl. -89 Y.cl. -130 Bl.sh. -150 Y,sst, -154 bl.sh. -186 Y.sst. -207 bl.sh. -261 sst. -280 rock -284 sst. -300 rock
Dud (Maryvale 2)	1096	Not located but abt. 7 mls WSW of Hs.	564	250						
Dud (Maryvale 3)	1097	"		328						

NEENA (QUEEN VERA) block of Mudgeacca

Homestead Location: None

Owner: S. Halfpenny & Evans

Manager: -

Communication: None

Altitude:

Area: 11,959 acres

Stock: (see Mudgeacca)

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Old Well	7131 Replaced by 9476		540	70					1920	

NEENA (QUEEN VERA) STATION (block of Mudgeacca)

NEENA (QUEEN VERA) STATION (block of Mudgeacca)

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
New Queen Vera (Neena)	11900	on 9 Mile Creek	545	95 65	75	75↓ 65	600	Good Total 112.2 $CaSO_4$ 17.3 $CaCO_3$ 8.3 $MgSO_4$ - $MgCO_3$ 2.6 $MgCl_2$ -	R.W.Close 1951 Na_2CO_3 29.3 NaCl 47.4 gr/gal. Organic matter - H 24 pH - F ppm 1.3 21/2/52 Date analysis	0-1 red grv.soil -30 red cl.& grv. -55 Y.sdy cl. -65 wh.cl. -70 wh.rock -95 pink clay
Neena or Old Queen Vera	9406		540	86 70	82	76↓ 70	960	Good Stock Total 108.4 $CaSO_4$ 17.6 $CaCO_3$ - $MgSO_4$ 7.8 $MgCO_3$ 8.4 $MgCl_2$ 3.3	A.Henness 1953 Na_2CO_3 - NaCl 65.2 gr/gal. Organic Matter 5.0 H 32.9 pH 6.8 F ppm 1.3 23/2/54 Date analysis	0-3 loose soil -23 red clay -76 Y.sst. -84 limestone -86 lst.sd.

NINMAROO STATION

NINMAROO STATION

Homestead Location: 25 ml . NNE of Boulia

Owner: Datchett Downs Pastoral Co.

Manager: Phil Cardro

Communication:

Altitude: 590 feet

Area: 12,000 acres, 37¾ square miles

Stock: 12,000 sheep

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Woolshed		3 mls WSW of Hs.	590	90						
Station	13207?	Homestead		155 70	87	149↓ 70	1000	Good	J.Hinden 1956	0-5 sub soil -45 red rock -73 clay -102 brown rock -152 sandstone -155 rock
Tank		3 mls ENE		298					J.Hinden 1956	
Bottom Beantree (Datchett Downs 2)?	13153?	2 mls SE of H.S.		128 or 310 ?		75			Close 1954	1-5 clay -6 boulders -25 gravel -30 red sst. -31 bl.lst. -65 Y.lst. -100 Y.sst. -128 Y.lst.
Top Beantree		2½ mls NE of H.S.		190 approx					Close 1955	
(Datchett Downs) Unnamed	13152	5 mls E. of Hs.		273 50		180) 254)↓ 50	900	Good	Close 1955	-6 clay -8 Lst. -15 Boulders -95 lst. -155 Y.sh. -180 bl.sh. -185 Sst. -254 bl.sh. -262 sst. -273 grey lst.

NITHSDALE (Granton additional property)

NITHSDALE (Granton additional property)

One Dud Bore

Mr. Campbell stated water contained too much iodine (he possibly meant fluorine).
This is possibly the dud bore shown on the Cannington(Banning)-Nithsdale boundary on the McKinlay Road.

NORANSIDE STATION

Homestead Location: 55 ml . N. of Boulia
Owner: Australian Estates (Chatsworth)
Manager: J. Swift to 1959; B. Dooland later.
Communication: Noranside Exchange (Chatsworth)

NORANSIDE STATION

Altitude: 744 ft
Area: Approx. 275 square miles
Stock: Cattle
Information on early bores from Noranside Improvement Book held by Fonkira Pastoral Co., 185 Mary Street Brisbane.

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Sinclair Well No. 43	7524	5 mls W of Hs	755	130) →149) (Improvements Book) 115 W.L.			3000 (J.Swift) Unlimited (Improvements Bk)	Good	Bore casing put down & well filled in	
Noranside Well No. 48	7521	5 Mls E of Hs.	722	(120 (72-Imp.Book 63 WL			1600		?deepened in May 1955	
Middle Ck Well - No.47	7523	7 mls SSW of Hs	710	105 56 WL			500(Impr.Bk) 750 960	Good drinking		Well deepened 35' to depth of 105' in June 1913. 2 drives 10' each way at 68'. Bottom of well in pure chalk country
Homestead (No.35) No.46	7562	Noranside Hs.	740	302 WL (100-J.Swift (108-Impr.Bk)		90→300 gph 184→large supply 280→ " "	8 1400 gph(Swift) 3000 gph(Impr Bk)	Very Good drinking	Royle Bros. 1/6/27-4/7/27	0-5 surface soil -184 sd drift -7 gravel -200 red cl & rk -41 h.gy.rk -211 red rk-fairly hard -54 s.red honeycomb rk. -101 h.gy.rk. -234 Y.rk -134 Y.cl. -262 red rk & cl. -156 Y cl. & rk. -280 gy rock -178 gy rk -285 sst -302 h brown rk Casing seated at 262' Pump test - 4$\frac{1}{2}$" pump at 142'7" 3,000 gph and could not lower water level
Middle Ck Yards No.45		4 mls SW of Hs	720	100 or 120			1400		D.Anderson 1953	Abt. 80' of soft slate
Scrubby No.18	7543	20 mls SSW of Chats.Hs.		(170 Impr.Bk (162 WL 146		154 ↓ 146	(1500 Impr.Bk (1450		Cockroft 10/8/16	0-6 red clay -127 light coral col'd rock -18 wh.rk -132 yellow clay -30 red rk -140 rble & congl -46 wh.grv. -154 gy rock -64 red & wh cl -167 rubble -71 Y.clay -170 grey rock -81 brown cl -86 brown rk -120 gy rock Pump test- 4$\frac{1}{4}$" pump at 160'→1500 gph & could not lower water level. 3 bores on site - 2 abandoned - 1 cave at 108'-2 boulders at 126' - 3rd successful.
Four Corners No.31	7556	6 mls NNW of Hs	790	(213 Impr.Bk (150		145 small Supply 210 good "	1200	Hard on metal	Feb-April 1926	0-20 red surf soil -158 red clay -86 Y.clay -180 Y.clay -142 red rock -188 red clay -145 Y.rock -190 Y.rock -147 wh.rock -210 Y.coarse sand rock -153 Y.rock -156 Y.clay -213 hard rock Pump test-4$\frac{1}{4}$" pump for 11 hrs at 960 gph could not lower water level

NORANSIDE STATION

NORANSIDE STATION

Name	Reg. No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Deadlock No.32 (No.32b)	7559	6 mls NE of Hs	780	(164 Imp.Bk (190		(120 small Supply (132 good "	1000	Good	Royle Bros Mar-Apr 1927	0-3 soil -23 red clay -36 congl.grv.& cl. -74 h.gy rock -94 soft brn rk -112 soft Y.rk -120 grey rk -164 hard gy rk Pump test- pump at 132'-2000gph
Big Ibis No.34	7561	10 mls NNE of Hs	825	(202 Imp.Bk (250 wl 174		(178 small Supply (194 good " ↓ 174'	(700 (1500	Excellent	Royle Bros Sept.1926-Mar.1927	0-3 soil -9 gy grv & cl -91 soft red rk -106 fairly h gy rk -110 " h brn rk -118 hard boulders -120 slipbak -160 h rk patches of blds -162 clay -176 h gy rk -178 gy grv & cl -186 h gy rk -188 gy cl & grv -194 gy rk - caves & crevices sand at 194' -202 gy rk - crevices & caves & hard to drill Pump test- $3\frac{1}{2}$" pump at 190' -1200 gph without lowering water level
Makeback No.44 (No.36)	7563	7 mls WSW of Hs		(202 Imp.Bk (190 wl 125		(143 small Supply (173 good Rose to 125'	1200	Good	Royle Bros 12-22/7/27	0-5 blk soil -45 red cl w. pieces of rk -51 brn grvy rk -56 h red rk -92 brn grvy rk -107 red rock -131 wh rk w. pcs of ironstone -143 red & wh.rks -148 red rk -171 red & wh.rk -174 h.red rk -179 Y cl & rk -187 Y cl w.grv -202 H brn slaty country Pump test- $4\frac{1}{4}$" pump for 10 hrs-3000 gph & could not lower water level
Home Paddock No.2		4 mls NW of Hs	760	(160 or (150				Good	D.Anderson 1955	
No. 36		4 mls SE of Hs	745				1200	Fairly Good	1955	
No.16	7541	14 mls NW of Hs (Duchess sheet)		162			nil		C.Cockcroft 20/9/15-12/11/15	0-16 red clay -99 mica schist -119 brn cl & mica -128 ironstone & mica -139 blk. sd. & mica -162 mica schist Abandoned
No.17	7542	13 mls NW of Hs (Duchess sheet)		176			nil		C.Cockcroft 22/11/15-12/2/16	Abandoned 1-10 red cl loam -28 red rk -77 red rk & mica -86 red clay -92 gy rock -176 mica schist
No.32	7557	5 mls NNE of Hs		53			nil		Royle Bros Apr-May 1926	Abandoned 0-3 soil -14 Y cl.& rk. -18 wh cl & rk. -53 h wh.rk.

PATHUNGRA STATION

Homestead Location: 6? mls. NE of Boulia

Owner: G. Pulley

Manager: -

Communication: Radio to Cloncurry

PATHUNGRA STATION

Altitude: At Dingo Creek Bore 636'

Area:

Stock: Sheep

Name	Reg. No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Dingo Creek Bore	4849?	At Hs	636	195 Artesian?					1913	

PATHUNGRA STATION

PATHUNGRA STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Corona	4827	10 mls SSW		64 SA					1913	
Pathungra Well	4854	Nr Pathungra Spring Bore (IWS position)	640	20					1913	
Mathungra Bore		3 mls WSW of Hs		105 73	69	93-94 73	800	good	1957	0-20 sdy clay -47 drift sand -73 cl & grv -105 gy lst. 0-73 angular Qu.sst. Qu.conglm. 73-105 Grey lmst.
Lucky Strike		4 mls WNW		140 33		109 33	390	Good	1957	0-5 subsoil -48 wh clay -80 Y.cl -107 gy sh -109 sand rk -140 sst. 0-80 Radiobrite etc 80-107 Bentondii clay 107-140 Qu.sst. fine conglm.
Windsor Bore		7 mls NW	?724	180 85	87	180 85	650	Good	1957	0-2 sub soil -6 red grv -28 wh clay -70 Y.clay -105 gy sh -138 sdy gy shale -146 sdy gy shale -147 sand -180 sst. 0-70 Radiobrite etc 70-146 Benton.clay 146-180 qu.sst.conglm. } Geological Interp.
Carbo Bore		11 mls N of Hs		190 SA	88	190	750	Good	1957	0-10 red grv -16 red rock -24 wh.clay -95 Yellow clay -154 grey shale -190 sst. 0-95 decomp.radiobrite etc. 95-154 Bent.clay 154-190 qu.sst.conglm. } Geol. Interp.
Brighton Bore (GAP)	7293	7 mls W of H.S.		110 SA			Unlimited		1939	0-5 clay -78 yellow clay -110 hard rock
Pathungra Spring Bore	4833	4 mls SW of H.S.	623	120 SA		24 & 60 surface	More than 5000 gpd		1912	0-60 ? 60-120 lst.
Old Mathungra	4855	Near New Mathungra		16 SA						Position doubtful
Old Windsor	4858	Near New Windsor	724	242 SA		122 } 195 } 242 }				Position doubtful 0-239 unknown -242 lst.

PATON DOWNS STATION (Additional Holding Imperial)

Homestead Location: 15 mls. ESE of Boulia

Owner: G, J & B. Schofield

Manager:

Communication: Run from Paton Downs (phone to Boulia)

PATON DOWNS STATION (Additional Holding Imperial)

Altitude:

Area: 38 sq.miles

Stock: Sheep

(See Paton Downs, Springvale sheet for other bores)

Name	Reg.No.	Position	Altitude	Depth and Water Level	Pump Depth	Depth(s) Water Struck & Rose	Supply	Quality or Analyses	Driller & when drilled	Strata and Remarks
Paton Downs Homestead	11204		515	355 18	34	72 34	1000	Good, domestic $CaSO_4$ 5.9 $MgSO_4$ - Na_2SO_4 - $CaCO_3$ 0.3 $MgCO_3$ 0.3 gr./gal. Na_2CO_3 24.5 NaCl 17.1 °Clarke 5 F2(ppm) 1.2	R.Close 1948	0-3 soil -38 sdy clay -72 cl & grv -100 sand w.salt water at 72' -104 red sst -112 y.clay -327 bl.shale -339 grey sst -341 grey rk -355 grey sst

PATON DOWNS STATION (Additional Holding Imperial)

PATON DOWNS STATION (Additional Holding Imperial)

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Rocky (Imperial No.2)	11985	8 mls W of Hamilton Hotel		164 40	80	130 ↓ 40	28800 gpd	Potable $CaSO_4$ 7.2 $MgSO_4$ 5.2 Na_2SO_4 2.6 $CaCO_3$ - $MgCO_3$ -	R.Close 1951 Na_2CO_3 19.4 NaCl 51.9 °Clarke 10 F2(ppm) 1.0	0-2 blk soil -30 wh lst -50 wh.cl -80 bl.sh. -110 bl sdy shale -111 rock -130 sst -164 grey lst
Broken Dam (Imperial)	11984	8 mls NW of Hamilton Hotel		170 30	59	140 ↓ 30	24000 gpd		R.Close 1951	0-1 soil -3 grey cl. -10 red sdy cl -20 Y.cl -26 rock -50 Y.sdy clay -92 blue shale -95 rock -158 sst -170 grey lst
Weaner	4816	6 mls WNW of Hamilton Hotel	L541	310 SA	40				1896	
Datson (Imperial No.3)	12862	8 mls WSW of Hamilton Hotel		178 30		70 - 60 110 → 30	1100	Good	Heness 1955	0-10 surface clay -30 soft wh.rk -105 bl shale w 10 gph salt at 70' rose to 60' -175 sst. -178 lst.

PAYNTON DOWNS STATION

Homestead Location: 25 mls. NE Boulia

Owner: Dougall Price

Manager: -

Communication: None

PAYNTON DOWNS STATION

Altitude:

Area:

Stock:

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Paynton No.3	11969			119 58	91	62) 119) 60 58	9600 gpd	Good	J.Price 1951	0-9 red clay -25 white rk -36 grey sst -38 bl clay -39 river grv 39-62 white rock -83 yellow sst -88 drift sand -119 yellow sst.
21 Mile	4846	3 mls E	L 654	145						

POLLYGAMMON STATION

Homestead Location: 3 mls. NNW Hamilton Hotel

Owner: J. & B. Schofield

Manager:

Communication: Phone to Hamilton Hotel

POLLYGAMMON STATION

Altitude: 575'

Area: 232 sq.miles

Stock: 12,000 sheep
3,000 cattle

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Syphon	12011	10 mls NE of Hs.		450 SA		420 ↓ surface	10000 gpd Pump test at 20' gave 1000 gph	Very Good	R.Close Completed 12/1/52	-2' soil -10 clay -40 yellow shale - 420 blk or bl.sh. - 450 sst.
Gidgea Ck (No.2)	12098	6 mls NE of Hs		340 Artesian		340 ↓ surface	35000 gpd		R.Close Completed 22/9/52	-2 soil -15 yellow clay -65 Y.shale -308 blk shale -310 sst -340 Artesian sand
Bronco Yard (Sheep Ck) No.3	12861	15 mls E of Hs		785 Artesian		(592 (785 10) surface)	20000 gpd		A.Henness Completed 15/4/55	-4 red soil -94 yellow clay -585 bl.shale -774 sst. -785 sst. According to information of Mr. A.A.Henness Jr., black shale from 145' to 210' was harder than normal shale: it smelt like malthoid. Finished in quartz with pyrites, black mica for 67½ feet.

POLLYGAMMON STATION POLLYGAMMON STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Black Ridge Pollygammon No.4	13019?	10 mls NNE of Hs		315 18		251½ 6 ↓	1400 gph		A.Henness Completed 12/8/55	-6 red clay -20 Y.clay -37 soft wh.rk -55 yellow clay -251 blue shale -315 sst.
Woolshed Pdk No. 5	13020	2½ mls NW		180 21		155 ↓ 21	1200 gph	Potable	A.Heness 17/9/55	- 4 red clay -22 cl & grv -72 Yellow cl. -155 blue shale -175 sst -180 lst.
Acacia	13394	9 mls ENE		503 23		180,230,420 surf- 10 ace	480 gpd 1680 gpd 48000 gpd		A.Heness 28/9/57	10 Yellow clay -30 gy clay -230 bl.shale -235 sst. -420 blue sh. -500 sst. -503 lst. Specimens of concretionary pyrite from blue shale at 420' just above water horizon; pyrites common from this stratigraphic posn. in this part of basin.
Pollygammon	4795	8 mls E of Hs	546	511 93°F Artesian		83 228 428 500 surface		Good drinking	1891	0-30 clay -228 shale -428 sh & sst -429½ qtzite -500 sst. -511 lst.
Charters	4876	14½ mls ENE		734 SA		375) 583) 375 rose to 200 583 to surface			1925	0-66 Y.clay -78 rock -140 blue sh. -141 h.streak -313 bl.shale -315 h.streak -420 bl.shale -423 h.streak -583 bl.shale -692 gy.shale -708 grn.sh. & qtz. -726 h.rock -734 limestone (375-380 greenstone)
House Bore (Barry's lagoon)	7295	Homestead	575	254					1933	
Drafting Yard	4800	?2 mls NW of Hs	L547	208 83.5°F Artesian		208			1892	0-136 shale -177 lst. -208 not stated Position doubtful
Garden	4814	4½ mls W of Hs	L547	275 Artesian		275			1896	Bottomed in sst.
Spring Ck.		20 mls ENE of Hs		742 70		707 to 730 35 ↓	760 gph at 71'	Very Good	Heness 1957-58	0-11 red clay -93 Y.clay -278 gy.shale -309 bl.shale -365 blk shale -707 bl.shale -730 sst. -742 sst. with clay (not water bearing)

ST. LUCIA STATION ST. LUCIA STATION

Homestead Location: 12 mls. NNW of Hamilton Hotel

Owner: V. Gibson ; old in 1959.

Manager:

Communication: Phone Boulia

Altitude: 614 feet

Area: 218,000 acres

Stock: 20,000 sheep

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Bull Hole	4873	10 mls WNW of Hs.	760	160 SA			Unlimited	Fresh		Bottom in limestone. Supply from white limestone.
Momedah (Tilky)	4804	3 mls NE	575	75 79°F 10'		75	5000 gpd		1892	Bottom in limestone.
(House Paddock) Homestead	4834		614	160 SA		146		Good	1912	0-146 gravel & sand -160 lmst.
Little		5 mls NW of Hs.		300			320 gph	Smelly		

ST. LUCIA STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
St.Lucia No.3 Dud	13022	10 mls N of Hs.		200		dry			Hindon 1955	4-28 sst. -38 light brn.rk. -200 grey lst. Abandoned.
Dry Paddock Dud							5 gpd			Passed through lot of grey lst.
Tripod Dud		14 mls NW of Hs		130						Abandoned because it silts up.
St.Lucia No.2 Dud	13023	7 mls NNW of Hs		300 62½		156 206 296↓ 62½	360 gph	Potable at 206' Odoured at 296'	Hindon 1955	3-5 gravel -48 clay -64 sst. -79 brown rock -300 grey lmst.
Dud ? (St.Lucia Dud)	12992			202 125		195↓ 119	1600gph	Potable	Hindon 1955	3-23 gravel -41 clay -201 lmst. Position doubtful(IWS)
Harvey's Paddock Dud	12993	17½ mls NW of Hs		251		dry			Hindon 1955	4-6 gravel -42 sst. -79 clay -106 grey lst. -112 cave -251 lst.
Harvey's		21 mls NW of Hs	750							
Dud		10½ mls N of Hs (West of St.Lucia No. 3)		132		30				
Warendah 11A	4802	Abt.2 mls E?	535	178 SA		115			1892	0-22 red clay & sd. -62 wh.pipe clay -72 red sh. -112 blk sh. -115 Qzite -170 sst. -178 lst. (Taken from IWS Records)
Dud		½ ml down stream from Tripod Dud Bore		184		80-126	50 gph		1958	0-20 red grv. -80 sst.c grd.wh. -126 sdy cl lt.gy -170 Y.cl.(slipbk) -184 Y.cl.w big quartz boulders

SCARSDALE STATION

Homestead Location: 2[illegible] mls. N. of Boulia

Owner: J.H.Price & Bros.

Manager:

Communication: Telephone to Boulia

Altitude: 61[illegible]

Area: 27,000 acres

Stock: 9,000 sheep

(From I.W.S. Records only)

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
New Cattle Ck (Scarsdale)	12170	5 mls WSW of Hs.		168 70	98	↓58,119,164↓ 48 ,48, 46	3000gpd	Good	Stn.Plant 1953	0-5 clay -45 red rk or sst -58 wh.rk. -72 Grv. & cl. -164 hard rock -168 white rock
Homestead (Scarsdale No.2)	12171	Homestead Bore	61	66 31	60	↓32,72 32	9600gpd	Good	Stn.Plant ?1949	0-9 loam -32 wh.rock -42 red sst. -72 rock
House Well	6106	At Hs.	61[illegible]	67 31			Good	Good	Well with bore in bottom 1934	
Telegraph				72 31	36	31			1953	
Old Cattle Ck	6105			228			120gph		1915	Abn.
Junction				187	40		Good	Salty	1914	(Abn.) A well 60' deep nearby (filled in) gave better water.

SLASHES CREEK STATION

Homestead Location:

Owner: A.C. Thornton

Manager:

Communication: Radio Cloncurry

Altitude: 561 feet

Area: 283 square miles

Stock: 500 cattle
7,000 sheep

Name	Reg.No.	Position	Altitude above sea Level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr.gal)	Driller & when drilled	Strata and Remarks
Station No.1	4796	Homestead	561	715 102.5°F Artesian	Pumping from pit around casing at surface	556 approx surface	495,000 gpd	Domestic	1891	0-85 yellow rk -140 blk rock -175 qtzite -293 sh.w.bds of silica -558 shale -565 qtzite -715 lst.
Slashes Ck.	12435	12 mls WNW		300 Artesian		290↓ surface	10,000 gpd		R.Close 1953	2-70 grey sh. -75 rock -85 bl.shale -250 blk shale -255 grey rock -300 sst.
Bunda	4797	8 mls WSW	533(L)	559 101.5°F Artesian		183' 487'↓ surface	687,000 gpd	Fresh	1891	-55 Y.shale -178 blk shale -183 drift sand -480 black shale -559 sst.
Horse Creek	4798	7 mls S	574(L)	777 110°F Artesian		In sst. (743-777)↓ surface	327,000 gpd		1892	-110 Y.shale -312 black sh. -342 qtzite -730 blk.sh. -735 sst. -743 clay -777 sst.
Dinner Ck	4818	9 mls ENE	597	875 Artesian		875↓ surface		Good drinking	1897	In sst. at bottom of hole
Nerida	9074	9 mls ESE		953 30		800,940 800 to 37' 940 to 30'	800→1000 gph 940→2000 gph		Beauchamp & Close 1926; Close 1955	-8 surface clay -104 y.clay -106 hard streak -182 y.clay -427 bl.shale -430 hard streak -700 bl.shale -800 dark shale -950 sst. -953 bed rock

STOCKPORT STATION

Homestead Location: 2[illegible] mls. NNW of Boulia

Owner: G. Beauchamp

Manager

Communication: Telephone to Boulia

Altitude: 573 (surveyed)

Area: 30[illegible] sq. miles

Stock: 14,000 sheep

Name	Reg.No.	Position	Altitude above sea Level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr.gal)	Driller & when drilled	Strata and Remarks
Homestead (Stockport No.1)	1101	Present Hs.	573	264 14" (IWS 3')	20	220) 254)↓ 3'	Good	Good $CaSO_4$ 6.7 gr/gal $CaCO_3$ 6.9 $MgCO_3$ 4.4 Na_2CO_3 7.7	Beauchamp 1921 NaCl 18.8 Hard 17°	3-64 brn rk -74 pink cl. -104 Y.clay -210 bl.shale -220 coarse sst. -234 sticky blk.sh. -254 wh.sst. -264 lst.
Windburg	11811	18 mls W of Hs.	535	394 200	340	In wh.lst from 24-380 ft.Main at 190 & near base 200↓	Good	Good $CaSO_4$ 4.2 $MgSO_4$ 4.3 $MgCO_3$ 3.8 Na_2CO_3 11.1	J.McGovern 1951 NaCl 24.1 Hard 11° Fluorine o.7ppm	4-24 volc.clay -380 wh.lst. -394 grey lst. Tested "white lst" with acid- it is lst. J.N.C.
The Dam (Maryvale)	9120	12 mls W of Hs.		209 (IWS)		103↓ 67	11,000 gpd	Good	S.Beauchamp 1943? (194? IWS)	0-30 soil & Y.cl. -125 Y.cl & fine green sand -170 blue shale -179 green sandy shale -187 limestone
Gidyea Creek (Stockport No.6)	6575	9 mls WSW of Hs.		240 190	227	224' in wh.lst.	400 gph	Not good $CaSO_4$ 23.1 $CaCO_3$ 8.2 $MgCO_3$ 4.0 Na_2CO_3 10.6	1938 NaCl 52.8 Hard 30°	Blow of air issues from above casing. 0-4 soil -50 clay -230 yell.rock -240 white lst.

STOCKPORT STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Left Hand Branch (Stockport No.2)	11750	8 mls NW of Hs		323 260	290(310)	260(323) 260	960 gph	Good $CaSO_4$ 9.0 $CaCO_3$ 7.4 $MgCO_3$ 12.3 Na_2CO_3 0.6 NaCl 26.5 Fluorine 0.8 ppm	1951 Hard 3°	0-150 yellow cl. & rock -160 hard Boulia rock -260 white lst. -290 blue sst. & lst. -310 wh.lst & Yellow rock -315 cave -323 wh & grey lst.
Alderley Hill (Blue bush No.5)	5282	5 mls N of Hs	613	225 45	90	110,145		$CaSO_4$ 6.0 $CaCO_3$ 6.8 $MgCO_3$ 6.6 Na_2CO_3 5.6	1937 NaCl 14.9 H 19°	0-4 soil -80 Y.cl. -84 brn.rk. -110 brn.lst.& cl. -145 bl.sst & sh. -168 bl.sh. -200 tough bl. slate -225 white sst.
Horse Ck (Stockport)	11735	5 mls NW of Hs.		254 48	103	228 45	2400 gph	Excellent $CaSO_4$ 3.0 $CaCO_3$ 9.2 $MgCO_3$ 5.1 Na_2CO_3 4.1	McGovern 1951 NaCl 17.8 H 17° Fluorine 0.6 ppm	4-138 volc.rk -192 brn rk & cl. -200 blk cl -240 sdy sh & sand rock -254 hard sst & rubble
Middle (Peters)	11282	3 mls NE of Hs.		275 70	110	250 & 275 70	1200 gph	Good	G.Beauchamp 1943	0-30 h.rk & cl -100 clay -130 y.sst. -150 bl.sh. -165 grey sst -245 blk shale -250 black rock -270 white sst. -275 grey lst.
6 Mile (Loxa No.4)	9704	6 mls. SE of H.S.	550	210 110	150	176 & 189	Poor		1943	4-65 yellow clay - 176 limestone -188 Porons lst. -210 Grey lst.
Limestone	9121	6 mls. NE of H.S.		212 14'	31'	197 14	Na_2CO_3 8.6 NaCl 17.2 Hard 12°	$CaSO_4$ 2.4 8.6 $CaCO_3$ 8.5 17.2 $MgCO_3$ 1.5 H.12°	Beauchamp 1940	0-32 yell.clay -37 white clay -137 yell.clay -200 bl. shale -212 sst.
Loxa Mill	1098	6 mls. E. of H.S.		321 80'	90'		Good	Good $CaSO_4$ 1.8 $CaCO_3$ 10.6 $MgCO_3$ 1.8 Na_2CO_3 10.6 NaCl 18.2 H. 14°	Donohues ? 1920	
Flowing Bore (Loxa No.2)	1099	5 mls. SE of H.S.		210 Flowing	5'		Good	Good $CaSO_4$ 5.4 Na_2CO_3 10.0 $CaCO_3$ 7.8 NaCl 17.8 $MgCO_3$ 1.0 Hard 13°	Donohues 1924	
Dud	10521	Between Flowing Sandhill bores near S. boundary ½ from bottom pdck.		200 50'		145'	160gph		1945	0-4 soil -50 pk. rock & clay -100 yell.clay -150 blue shale -170 bl. shale & Sand supply of water -190 black shale -200 grey lst. Bore 1 ml. E. on Strathabiss (Gibsons) dismantled in 1951.
2 Duds		At Policeman W.H. Another 2 mls. E along fence								Finished in grey lst. Probably after passing some white lst.
(New)	13802	Between 6 ml. and Flowing Bore		280'		260-280	1,000gph	good, cold	J.B.Miller 1958	100-260 blue shale 260-280 white sand.
Bengeacca (Stockport 4)	8388	6 mls. WNW of H.S.		225 175	215		Poor	Good	1936	$CaSO_4$ 6. gr/gal. $CaCO_3$ 7.3 $MgCO_3$ 1. Na_2CO_3 11.1 NaCl 17.5 Hard 13°.

STRATHELBISS STATION

Homestead Location: 1 1.. NNE of Boulia
Owner: Campbell
Manager: –
Communication: Phone to Boulia

STRATHELBISS STATION

Altitude: 57
Area:
Stock: Sheep

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality or analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Weetalibah	2814	9 ml. NW of Hstd.	602	245 30		230 30	10,800 gph.	V. good	R. Close 1943 (deepened)	?-245 grey lst. (at least 30' of lst. from 215'). Abandoned
Boundary	6829	7 ml. NW of Hstd.		205'					1920	Abandoned.
Weetalibah No.1	2812	6 ml. NNW of Hstd.	597	265					1919	Abandoned.
Weetalibah No.2	2813	6 ml. N of Hstd.	593	295					1921	Abandoned. Near old yard and ruins of old Hs.
Sandhills (Strathelbiss)	12660	8 ml W. of Hstd.		120 75		80-95↓ 75'	660gph.	Good	E.J. Robinson 1954	0-2 Red surface soil. -10 Red rock -34 yell. rock -80 white clay -95 white chalk rock -120 yell clay. Cuttings of black sh. and white siltstone.
6 Mile	6832	4 mls. WNW of Hstd.		200'					1923	equipped and working October 1957.
Strathelbiss No. 2	12695	1 ml. NE of Hstd.		110 31		↓48, 84 31	660 gph.		E.J. Robinson 1954	0-4 subsoil -14 Red,sdy,cl. -26 drift sand -34 yell. rock -37 sdy. cl. -57 Redish slst. -64 Red soil -83 Red slst. -110 yell. rock.
Homestead	6380	Hs. Bore	57?	70					1923	
Gibson (Sandhills)	6831	8 ml. WSW of Hstd.		220					1923	Abandoned in 1951. Road leading in direction disused.

TOOLEBUC STATION

Homestead Location: 45 mls. NNE of Hamilton Hotel
Station Owner: Australian Agricultural Company.
Manager: Mr. Dingle
Communication: Radio Cloncurry.

TOOLEBUC STATION

Altitude: 749 feet.
Area: 527 square miles.
Stock: 5,000 sheep
7,000 cattle

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth(s) Depth Water (feet) Struck & Rose (feet)	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
Station Toolebuc No.1	4592		L749	917 33 100°F	560	20,000 gals. per day.	fresh ("soda")	1893	0-110 clay -480 blk shale -560 snd. & grv. -745 sandstone -770 quartz rock -877 sandstone -897 driftsand Analysis (grains per gallon) Total Solids 68.0 Silica - Iron - Ca SO4 1.7 Ca CO3 - Mg CO3 1.1 Na_2 CO3 31.8 Cl_2 - Na Cl 30.7 Organic matter - Hardness (°) 3 Fluorine (ppm) 10.0 Government Analyst 1950.
6 ml. or Spell Paddock * Toolebuc No.2.	4593	6 mls. SW of Homestead.	L693	533 38 95°F	441↓ Surface (2½ lb. per sq. inch pressure)	12,040 gals. per day. Analysis (grains per gallon) Total Solids 104.0 Silica - Iron - Ca SO4 2.3 Ca CO3 - Mg CO3 1.6 Na_2 CO3 19.5 Cl_2 - Na Cl 78.5	fresh ("soda")	1893	0-55 yel. clay -65 blk. shale -68 sandstone -288 bl. shale -303 sandstone -439 black shale -533 sandstone bottomed in granite Organic matter - Hardness (°) 4 Fluorine (ppm) 1.4 Government Analyst 1950. * Also called "Garden" in St.Rec.Bk.
Salt * Toolebuc No.3.	4594	9 mls. N of Hstd. on river.	L758	809 50	226	small * Also called "Garden" in St.Rec.Bk.	stock only (Abandoned in 1923)	1894	0-50 yel. clay -225 bl. shale -226 sandstone -346 blk shale -396 pipe clay -418 sandstone -448 gr. shale -492 blk shale -520 sandstone -809 sandstone Bottomed in granite
Toolebuc No.4.	4595	Abandoned 13 mls. SSW of Hstd.	630	456	182	small (soak only)		1894	0-75 yel. clay -286 blue shl. -370 blk. shl. and grvl. -380 limestone -456 granite Station Rec.Bk. states hole bttmd. in granite after passing through 10ft. of limestone.
Air Compressor Toolebuc No.5.	4596	10 mls. SW of Hstd.	680	500* 30 95°F	407↓ Surface (2 lb per sq. inch pressure	17,700 gals. per day. Analysis (grains per gallon) Total Solids 52.95 Silica 1.38 Iron trace Ca SO4 - Ca CO3 1.20 Mg CO3 trace Na_2 CO3 36.00 Cl_2 14.20 Na Cl - Total Solids 56.0 Silica - Iron - Ca SO4 1.0 Ca CO3 - Mg CO3 trace Na_2 CO3 37.1 Cl_2 - Na Cl 14.2	"soda"	1894	0-40 clay -150 blue shale -407 shale -500 sandstone Bottomed in granite. ← By IWS in 1931. * Ceased flowing by 1921. Organic matter - Hardness (°) 1 Fluorine (ppm) 8.0 ← By Government Analyst in 1950.

TOOLEBUC STATION

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck &Rose (feet)	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
10 Mile Toolebuc No.6	4597	9 mls E of Hs.	L741	879 15	150	640	48000 gpd Analysis (grains per gallon) Total solids 66.0 $CaCO_3$ - Silica - $MgCO_3$ trace Iron - Na_2CO_3 47.4 $CaSO_4$ 0.8 NaCl 15.8 Organic Matter — Fluorine (ppm) 12.0 H 1° Govt. Analysis 1950	Fresh	1894	0-80 y.cl. -640 bl.sh. -800 sst. -879 like granite
17 Mile Toolebuc No. 7	4598	Mackunda 4 Ml 20 mls ENE of Hs.	L763	1196 18	111	838	Large Total Solids 48.0 $CaCO_3$ - Silica - $MgCO_3$ trace Iron - Na_2CO_3 30.3 $CaSO_4$ 0.8 NaCl 10.9 Organic Matter - Fluorine (ppm) 6.5 H 1° Govt.Analysist 1950	Fair	1895	0-85 Y.cl. -475 bl.sh. -800 blk.sh. -1100 sst. -1196 granite
3 Mile Toolebuc No. 8	4599	3 Mls NE of Hs.	L728	609 8	220	525	6000 gpd Total Solids 66.0 $CaCO_3$ - Silica - $MgCO_3$ trace Iron Na_2CO_3 36.5 $CaSO_4$ 1.0 NaCl 25.4 Organic Matter - Fluorine (ppm) 12.5 H 1° Govt. Analysist 1950	Good	1895	0-65 Y.cl. -119 bl.sh. -525 blk.sh. Bottomed in granite -609 sst.
Jubilee Toolebuc No. 9	4600	Mackunda 4 Mile 21 mls ENE of Hs.	795	1024 2		970	Good Total solids 40.0 $CaCO_3$ - Silica - $MgCO_3$ 0.4 Iron - Na_2CO_3 26.5 $CaSO_4$ 1.0 NaCl 9.9 Organic Matter - Fluorine (ppm) 7.0 H 1° Govt.Analysist 1950	Good	1898	0-35 red cl.& grv. -124 Y.cl. -216 Bl.cl. -218 Lst. -523 Bl.sh. -581 Blk.sh. -916 Bl.sh. -957 Bl.sh & rotten sst. -961 Bl.sh. & sd. -1000 sst. -1024 drift sand Bottomed in granite
Abandoned Toolebuc No. 10				231		162	Dry in 8 minutes		1898	Bottomed in granite
Abandoned Toolebuc No.11				446 or 438					1898	Bottomed in granite
Garden Toolebuc No.12 Abandoned	4603	2 mls NW of HS.	722	495 95°F	240		no good Total solids 72.0 $CaCO_3$ - Silica - $MgCO_3$ 1.1 Iron - Na_2CO_3 23.8 $CaSO_4$ 2.7 NaCl 41.6 Fluorine (ppm) 12.0 H 3° Govt.Analysist 1950		1898	0-10 rk. & Y.sh. -256 bl.sh. -464 no strata -495 granite
Scrubby Toolebuc No.13	4604	11 mls NE of Hs.	782	711 90	208		Good Total solids 88.0 $CaCO_3$ - Silica - $MgCO_3$ 1.1 Iron - Na_2CO_3 44.5 $CaSO_4$ 1.7 NaCl 36.3 Fluorine (ppm) 13.0 H 2° Govt.Analysist 1950	Excellent	1898	0-103 no strata -166 Bl.sh. -496 No strata -624 bl.sh. -711 rotten granite
Abandoned Toolebuc No.14	4605	In Bullock Paddock 14 mls SSW of Hs.*		395 11	115	S.A.	5000 gpd pumped 11000 gals on test	Very Good	1898-9	0-175 red cl.,y & bl.sh. -301 blk.sh. -305 rock -394 Bl.sh. & sst. -395 red granite Bottomed in granite

*IWS report that Air Compressor bore must be either No.14 or No.15;
No.14 = 1 ml. NW of fossil sst.outcrop
No.15 = 1 ml. E of " " "

TOOLEBUC STATION

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Abandoned Toolebuc No.15				359			No good		1898-9	Bottomed in granite
Baker's Hole Toolebuc No.16	4607	15 mls E of Hs.	779	913 30		913	Good	Good	1899	0-280 red cl.,bl & Y.sh. -574 Bl.sh. -729 Bl.sh. w.hard streaks -832 bl.sh. -835 hard rock -913 sst. 913 bedrock
	12591	18 mls NNE of Hs.		700 320	35	680- 700 250	150	Good Total solids 60.6 $CaCO_3$ 1.20 Silica - $MgCO_3$ - Iron - Na_2CO_3 34.1 $CaSO_4$ - NaCl 23.1 Organic matter present Fluorine (ppm) 6.0 H 1° Govt.Analysist 1956	1954	0-12 wh.chalk -95 Y.cl. -104 Y.cl.&ironstone -254 Bl.sh. -263 Sst. -273 ironstone -680 Bl.sh. -688 Sst. -700 sand
Abandoned Toolebuc 17A	4610	8 mls NW of Hs. next to No. 17	767	200		100	Soak		1915	
Abandoned Toolebuc 17		8 mls NW of Hs.							1915	Inspected by IWS during drilling - no further information in Stn.Rec.Bk.
Toolebuc No.18	4609	9 mls NW of Hs. near Selwyn Rd.		500						
Ivy	4608	9 mls NNE of Hs.		516 SA	160		Very Good	Good		
Edwards	4620	7 mls SE of Hs.		686 SA	142	646	Good	Good Total solids 86.0 Na_2CO_3 57.2 $CaSO_4$ 0.8 NaCl 24.7 $MgCO_3$ trace Fluorine (ppm) 13.0 H 1° Govt.Analysist 1950	1925	
Propstick	4621	6 mls NNE of Hs.		681½ SA	151	446?	Good	Good Total solids 88.0 Na_2CO_3 19.0 $CaSO_4$ 4.8 NaCl 57.8 $MgCO_3$ 1.0 Fluorine (ppm) 12.0 H 6° Govt. Analysist 1950	1925	

OTHER BORES MENTIONED IN STATION RECORD BOOK (no other information available)

Name	Reg.No.	Position	Altitude above sea level (feet)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) water struck & rose (feet)	Supply (Gal/hour)	Quality or Analyses (gr/gal)	Driller & when drilled	Strata and Remarks
Whitewood		Abt.1½ mls E of Hamilton River, 800 yds S of Emu Ck.		425 111				Good		Bannings Selection - 1932
Quartpot		Left bank of Quartpot Ck. abt. 2 mls from McKinlay Rd.		761 89			Good	Brackish suitable for stock	1922	
Lake				623	220		Good	Very brackish		
9 Mile ("Tooleybuck" on 4M75 Lands Dept.map)		2 mls SW of NE corner of Sitapur Holding								

TWO RIVERS STATION

Homestead Location: 4[illegible] mls. N. of Boulia

Station Owner: Mick & Jack Clarance

Manager: Fred Dean

Communication: Telephone to Boulia

TWO RIVERS STATION

Altitude: 69

Area: 53,000 acres

Stock: 11,500 sheep
300 cattle

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
Home Paddock (Lurnea)	12534	4 mls S of Hs.	670	215 90	110	40 207 90	Unlimited	Good	A.Henness 1954	0-40 top soil -130 slippery back -205 shale -207 sandstone -215 Limestone
Brabazons (Sheep Camp?)	4837	10 mls SSW of Hs.	662	2 40					Cleared 1951 after long disuse	
Bluff	4840	7 mls WSW of Hs.	610	15 90	95		Unlimited	Good	Warenda Bore	
Four Corners	Lic 8405 ?	7½ mls SW Of Hs.		274 104	130	104) 268) 104	Unlimited	Good	A.Henness 1951?	0-9 Red soil -35 white clay -46 stone -101 white clay -115 stone -160 yellow clay -176 stone -265 Blk. clay -267 Sandstone -272 Sand -274 hard stone
Wooley		3 mls SW of Hs.		76 66	73	73 66	Unlimited	Good	A.Henness 1951	White siltstone (R.J. Paten ob..)
Turnstile	4839	8 mls SSW of Hs.			80		Good	Slightly brackish (soda)	1928?	
Double	4838	9 mls SW of Hs.		2 100	105		Unlimited	Slightly brackish	Warenda Bore	
Homestead	13366	Homestead	69	255 200	214	70) 198)	1000	Good	A.Henness 1957	0-5 top soil -100 chalky white toprock -120 pink chalky rock -140 yellow clay -198 blue shale -235 sand st. -255 blue lst.
Woolshed (Corella)	4844	Woolshed Middle Ck.		12 30	54		Unlimited	Good	Warenda Bore	

WALGRA STATION

Homestead Location: 1 mls. SSE of Urandangi

Station Owner: North Australian Estates (Buckland). Sold in 196

Manager: Robertson (Wilkinson relieving in 1958)

Communication: Phone to Urandangi and Carandotta

WALGRA STATION

Altitude: 505

Area:

Stock: Was sheep, now cattle

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks	
Bannockburn Well	6243	10 mls SE of Racecourse Bore		151	146				Before 1927	Probably Old Bannockburn - New Bannockburn is a dam.	
Serpentine Well		9 mls SSE of Hs.	523	5 30	46		4000	Good fresh water	Cook 1919	Abandoned because of no supply	
Halfway Bore		Halfway between Threeways & Hardens Corner Bores		161 94			4500	Salt	1919	Abandoned	
Channel Well		3 mls WSW of Hs		53 45			4500		R.M.Cook 1920	Abandoned	
Homestead Well		Near Hs.		47 40			2000 for 6 hours				
Top Moontah		6½ mls NE Moontah Bore		4 2				Too salty	F.Beauchamp 1928	Abandoned	
Majors	6236	4 mls NNW from Junction Duck & Winyers Cks. 8 mls W of Wapita		12 100	(?262IWS) 140		1200	Good NaCl 66 gr/gal $CaCO_3$ 25 " $CaSO_4$ 31 " Hardness 65°		0-20 surf.s. -100 y.cl. -120 rock	C.D.1926 18' Mill 1 tank 240' troughing 120 6" cas. 120 5" cas. £1011 Cost
Duck Creek		14 mls up Duck Ck from junction Winyers Ck		362 340	360	280 340	700	Good Drinking		0-15 surf.s. Rest blk. & wh. lst.	C.D.1926 20' Mill 1 tank 120 troughing 90 6" cas. 300 4" cas. £1540 Cost
No. 2	6238	Bullock Pd. 7 mls SE of Bannockburn		92 72	79		1200	Fair Stock Water	R.Sefton	0-8 surf.s. -28 rubble -48 Blds. -74 y.cl. -79 rock -84 rubble (water) -89 y.cl. -92 rock clay	C.D.1930 17' Mill Earth tank 60' troughing 90' 6" cas. 54' 4" cas. £679 Cost

WALGRA STATION

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality of Analysis	Driller and when drilled	Strata and Remarks	
No. 3	6239	Bulock Pd. 11 mls SSE of Bannockburn		115 62	80	100	1200	Salty	R.Sefton	0-10 surf.cl. -20 lst -70 red cl. -100 pink cl. -115 rot.sst. Mill dismantled 1942	C.D.1930 17' Mill Earth tank 115' 6" cas. £580 Cost
Cachinda	6232	4½ mls S of Racecourse Bore		228 142			400	Fair stock Salty & bitter	J.Beauchamp	0-200 y.cl.& soil -228 lst.	C.D.1927 18' Mill Earth Tank 180' troughing 180 6" cas. 20 6" perf. 180 4" cas. £1148
No. 1 Easter Bore	6233			151 131	138		1200	Good stock Brackish	R.Sefton	0-40 surf.s. -90 y.clay -100 rubble -150 y.cl. -157 rock	C.D.1930 18' Mill 72 troughing 126' 4" cas. £835
Napita	6235	4½ mls W of Deamrah Bore		36[illegible]	324	160	250	Hard & saline; Fit for Stock NaCl 59 gr/gal $CaCO_3$ 21.7 " $CaSO_4$ 27.0 " H 60		0-15 surf.soil -145 h.rock -200 wh & bl.lst. £1644 Abandoned	C.D.1926 20' Mill 1 tank 96' troughing 192' 6" cas. 350 4" cas.
Towalayah	6227	9 mls SW of Bannockburn		196 191	184		800	Brackish but drinkable		0-9 surf.cl. -91 y.cl.S.R. 101 br.r. 196 cl. & yel.r. Not used £1049	C.D.1927 Mill Earth tank 120' troughing 172' 6" cas. 18' 6" perf. 175' 4" cas.
Halfway		16 mls SW of Hs.		377 94	314	100	300	Good stock water		0-15 s. _317 lst. w. bands qtzite Abandoned £1432	C.D.1927 20' Mill 1 tank 240' troughing 218' 6" cas. 375' 4" cas.
Middle		11 mls SSW of Hs.		500 ?12[illegible]		[illegible] small 4[illegible]- 5[illegible]	300	Good stock		0-6 surf.s. - 360 lst. - 361 dolom. - 500 lst.	C.D.1927 Mill 1 tank 240' troughing 250' 6" cas. 480' 4" casl. £2114
Mumgala		5 mls NE of Racecourse Bore 2 holes sunk			54		300	Fair stock Salty	A.J.Affleck	0-3 surf.s. 65 rock Not used	C.D.1928 12' Mill 2 tanks 180' troughing 60 6" cas. 65 4" cas. £701
3 Ways		Headwaters 3 Way Ck. 1 ml S of the Ck.		128(?215)126			Good	Fit for Stock	P.Brushe	C.D.1918 193' troughing 120' 7" cas.	27' mill 2 tanks £1800

WALGRA STATION

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
Harden Cnr.		14 mls WSW of Hs.		3-9 98	163	98 207	2500	Fit for Stock	F.Dean	C.D.1919 £2200 27' Mill Earth Tank 208' 8" cas.
8 Mile Bore				18	100 approx				McInnes	C.D.1914 150' troughing 100' 6" cas. 100 5" cas. 15' Mill 1 tank
Moonah Creek Bore (?Binyeah area)				18	140 approx		Good	Good	McInnes	C.D.1914 60' troughing 100' 6" 140' 5" 24' Mill Earth tank £1175
Maude Ck.		10 mls Hs.		1 5		68-90		Too Salty		Abandoned 0-30 h.lst. -43 clay desert sst. -54 h.lst. -70 desert sst. -86 h.lst. -88 clay main water -105 h.sst. Mill 2 tanks 108' 6" cas. 90' 5" cas. Cost £1755
Heifer		1 ml N Junct. Maude & Moontah Cks.		94 28	85	72	2300		Utility Co 1927	0-10 cl. -41 lst. -53 red oaka -67 y.congl. -72 h.lst.(water) -80 qtz. -97 irst. Not used Mill 1 tank 80' tro. 95' 6" cas. 19' 8" cas. Cost £772
Walbo	6225	4 mls SSW junct. Middle Ck & Georgina Rd		86	80	77	1500	Good stock. Too salt for Humans	Utility Co.	C.D.1926 0-11 surf.s. -77 lst. -86 h.lst. Cost £977 Mill Earth tank 180' tro. 86' 6" cas. 77 5" cas.
Brooks		6 mls ESE of Threeways Bore		65	54	52	700	Fit for Stock Not for humans	Utility Co. 1927	0-4 surf.s. -65 lst. £844 1 Mill 1 Earth tank 180' Tro. 65' 6" casl 75' 4" cas.
Dud (Hs.)	7324	4 mls N of Napita Bore		500 150 (approx.)			Insufficient		A.J.Affleck 1928	Slurry drain has a white and cream dolomite, grey, green and brown dolomitic siltstone. Powder of drain is very calcareous. Abandoned
Top Homestead				402				Too salty		Abandoned
Moontah		Headwaters Moontah Ck 3 mls from N.T. border	646	706 115	153	297,681 147 sm. Big sup-Supply ply porous in with rock sst.	4500	Good	P.Brushe	0-7 surf.s. -32 wh.rock -104 Bl.r. -155 gr.r. -205 w.r. -271 gr.r. -289 Bl.r. -295 gr.sst. -381 Bl.r. -501 w.r. -524 gr.r. -671 Bl.r. -681 w.r.(water) -706 dk.bl.r. almost black at bottom C.D.1927 20' Mill 1 tank 120' Tro. 158' 5" cas. £2100 Not used

WALGRA STATION

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
Racecourse	6244	23 mls S of Hs.		58	150	73 82	206	3000	Salty Destroys tanks		Not used. Spoils of lt brown dolomite and some Ta l ., chalc. C.D.1918 27' Mill 193' tro. 3 Tanks 190' 8" cas. 140' 5" cas. £1800
Deamrah - Old	6234	9 mls SW of Racecourse Bore					216		Stock Water	1926	Drift sand in bottom
Deamrah - New (Walgra)	11858	Beside old bore		116	149	140 sm. 203- 207 good	207	2000	Slightly sweet stock water. Fair only to drink	J. Hayes 1951	0-140 pug & y.cl. -185 pug clay -200 cl. & rubble -203 gravel -207 Sst. with drift sand in bottom Drift sand causes replacement of pumps every month.

WARENDA STATION

Homestead Location: **10** mls. NNW of Hamilton Hotel

Station Owner: Beauchamp

Manager:

Communication: Boulia

Altitude: 607 feet

Area:

Stock: 15,000 sheep approx.

Name	Reg.No.	Position	Altitude (above sea level)	Depth and Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
Homestead	4799		607	S.A. 80°F		300↓ 53↑	315	20,000 gpd		1892	0-86 red clay w.sst. band -113 sst. -254 sand & shale -315 lst.
Frasers (dud)	11933	4 mls E of Hs. IWS position not known by Mr. Beauchamp					164			1952	0-24 yellow clay -70 " " -80 blue clay -164 black sh. 164 Hard sst.
Rising (Palparara)	4793	6 mls ENE of Hs.	578	Artesian 85°F		165↓ surface	184	49,000 gpd	Fresh	1892	0-85 clay -147 shale -184 sand 184 lst.
Frasers (old)	4826	6 mls E of Hs.	563	Artesian		surface	200			1897	
Home Paddock	4803	3 mls E of Hs. IWS position not known by Mr. Beachamp	532	3 78°F		50↓ 3	60	1650 gpd	Fresh	1895	0-60 bottom on lmst. Records show depth of 175 ft.
Shed (7 mile)	4836	6 mls SE of Hs	557	14		115 250↓ 14	250	25000 gpd	Good	1912	250' sst. Bottomed in limestone
4 Mile	?7636 4810	4 mls S of Hs.	L565	?81°F		110	or 120 176			1912 1893	0-55 y.sh. -110 Blk.sh. -176 Qtzite Two bores. Log given is for one drilled in 1893. Water supply position bores 4 miles apart.
Nommeda 56	4852	7 mls NNE of Hs. in river channels	575				120				Position doubtful. Another bore 20' deep (Nommeda 57) is ½ mile NW of this position.

WARENDA STATION

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when Drilled	Strata and Remarks
Nomedah No. 3	4794	7 mls NNE	L 579	(Artesian?) 82°F		54 68 Surface	340	4224 gpd	Fresh	1891	0-30 drift sand -91 no record -111 sst. -126 congl. -275 hard lst. -340 hard lst.
Nonmeda 57	4853	7 mls NNE	575				20				Bores Nonmeda 56,57 drilled between 1914-18. Gave good water but caved in. Further drilling 1940-45 yielded salty water.
Paddys Hut (Tailing Yards No 16)	4808	9 mls NNE	L 594	(Sub-A) 83°F		160 Surface	172	23000 gpd	Fresh	1893	0-25 ? -70 y.shl. -133 blk.sh. -172 sst. 172 Lmst.
Whiskey (Warenda No.3)	13002	12 mls NNE	615	40		123 40	123	1400	Good	Beauchamp 1955	0-10red clay -40 y.clay -75 bl.sh. -115 sst. -123 grey lmst.
Warenda No. 5	13004	6 mls NE of Hs.		40		?	270	2400	Good	Beauchamp 1955	0-25 red clay -80 y.clay -150 bl sh. Position doubtful -250 sst. -270 grey lmst.
Plain (Warenda No. 4)	13003	11 mls NE of Hs.		5		223 5	223	2400	Good	Beauchamp 1955	0-20 red cl. -70 y.clay -85 coarse sd. -140 blk sh. -185 bl sh. -210 white sst. -223 grey lmst.
Tipperrary	4806	22 mls ENE of Hs.	L 598	Artesian 94°F		430	440			1892	0-20 red cl. -395 blk sh. -440 sst. - Granite
Adjistment		11 mls ENE of Hs.				- 10	365?				
Bore (Warenda No.2)	12156			SA		198	198			1952	0-20 clay -60 y.cl. -100 bl.sh. -110 bl.sst. -198 bl. lmst. Position doubtful probably Adjustment
Blackridge	4807	14 mlsENE of Hs.	L 588	Artesian 90°F		360	363			1893	0-20 ? -70 y.sh. -329 blk sh. -360 wh sd. -363 Granite Position approx.
Jacks		2½ mls SW of Hs.									Log not known. Compare "Warenda 21A, R.No. 4815".
Bloodwood		4½ mls SW of Hs.									Log not known. Compare "Warenda 4 Mile R.No.7636".
Warenda 21A	4815	1 ml E of 4 Mile *					100			1898	Position doubtful. * IWS position.
Dud		½ ml N of Bloodwood									
Dud		4 mls just N of W of Hs.									
Bore		3 mls WNW of Hs.								Beauchamp Being drilled 1958	Shale w. gypsum. Sand w.small supply of water & w. seam of coal grey limestone. <100' June 1958.

WATERFORD STATION

WATERFORD STATION

Homestead Location: 25 mls. N. of Boulia
Station Owner: G. Schofield
Manager: Aboriginal
Communication: None

Altitude: 625 feet
Area: 30,000 acres
Stock: 3,000 sheep

Name	Reg.No.	Position	Altitude	Water Level	Pump Depth	Depth(s) Water Struck & Rose	Total Depth	Supply	Quality of Analysis	Driller & when Drilled	Strata and Remarks
Homestead (Lagoon Paddock)	4841	At Hs.	L 625				130	Not good	Brackish	Very old ex-Warenda	

WATERFORD STATION

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and remarks
No. 3	11178	4 mls N of Hs. Near Ft. William Ck.	640				196	Good	Good	R.Close 1948	0-2 Blk soil -8 cl. & grv. -10 red rock -35 ppl rock -45 wh rock -100 y.lmst. -156 y.sh. -184 y.sdy.sh. -196 blk.sh.
Back Hill	9738	Head Mosquito Ck.6 mls NW of Hs.					223		Good	1943	

WINDSOR PARK STATION

Homestead Location: 45 mls. NNE of Boulia

Station Owner: D.Grimshaw

Manager:

Communication: None

Altitude: 715 feet

Area: 86,000 acres (incl.80 sq.mls. addition area)

Stock: Cattle 2000 approx
Sheep 4000 (was sheep 12,000 to 1950)

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and remarks
Homestead		Present Hs.	715				300 approx				White siltstone. Hole not completed.
Middle Ck.		1 ml SW of Hs.	635	60	120	90 & 300	well 300 bore	Unlimited	Good	D.Grimshaw 1925	Well and bore. Siltstone in well. Got water in Sst. aquifer at 300' under a "chalky" siltstone
Top Bore		4 mls WNW of Hs.	720	140	160		400 approx	Unlimited	Good	D.Grimshaw 1925	Same as in Middle Ck well
Reids Well (Front well)		4 mls ESE of Hs.					60	Fair	Good	Was Hs of Reid before 1924	Purple, grey & white siltstone from well.
Stranger Well	7522	7½ mls ENE of Hs.	740	70(60)	74		80 (82)	Unlimited 47000 gpd	Excellent	Depth inc. by 14' in 1913	Tert. lst. and chalcedony
Dud	12682	15 mls ENE of Hs	880				212		Nil	A.Heness 1954	0-17 red soil -55 cl. & grv. -150 lst. cave in parts -165 wh. lst. -212 slaty lst. Probably Ordv. Abandoned
Dud	12877	16½ mls ENE of Hs.	835			173	231	Drilling supply only.30 gph		A.Heness 1954	0-56 Red cl. & grv. -72 cl. -85 lst.,blds. & cl. -100 cl. & blds. -170 wh.lst. -182 y.lst. -190 grey lst. -231 slaty lst.

WIRRILYERNA STATION

Homestead Location: 22 mls. WSW of Boulia

Station Owner: D. A. McDougall

Manager: G. McDougall (Part Owner)

Communication: Road - no telephone

Altitude: 450

Area: 118,000 acres

Stock: Sheep 11,000
Cattle 100

Name	Reg.No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and remarks
Bottom Gidyea (Boulia Downs 2.)	5450	Spring Vale 4 ml sheet.	440	35	50	68(sm.) 144↓ 35	168	33000 gpd	Slightly Brackish:good stock water	J.T.Shepley 1937	0-10 surf.cl. -22 Br.cl.& pbls. -41 Wh.sst. -47 h.wh.rk. -68 wh.rk. -77 h.wh.rk & quartz -102 Y.sst. -163 red sdy rk. -168 wh.cl. Some water contains fluorine

WIRRILYERNA STATION

WIRRILYERNA STATION

Name	Reg. No.	Position	Altitude (above sea level)	Water Level (feet)	Pump Depth (feet)	Depth(s) Water Struck & Rose (feet)	Total Depth	Supply (Gal/hour)	Quality of Analysis	Driller & when drilled	Strata and Remarks
Homestead (Boulia Downs)	5449	Homestead	450	45½	50	95	160	Unlimited	Good	Beauchamp 1921	
Top Gidyea (Boulia Downs 1)	5779	3 mls NE Hs.	465	44	60 approx	95	115	Unlimited	Good	J.T.Shepley 1937	0-15 surf.cl. -92 Y.cl. -35 wh.sst. -93 River bed sd &rble. -47 wh.cl. -115 wh.cl.
14 Mile (Berrimilla No.2)	12539	6 mls ENE Hs.		72	88	114*↓ 72	142	760	Potable	Robinson 1954	*IWS give 114' as depth; station records show 104'. Driller Robinson stated water rots casing. Water obtained in dolomite under grey shale ("slippery back") 0-19 cl. & sdy grv. -104 Grey sh. -41 Y.sst. -112 H.rk. -79 Y.sdy cl. -142 Lst.
Stony (Berrimilla)	11883	10 mls ENE Hs.		150	195	208↓ 138	208	800	Bitter -like *Epsom salts	A.Heness Sr.1951	0-15 Red soil -200 H slate stone -95 soft stone -137 slipbak. -208 Sst. * Rots casing
Robinson's	12927	Springvale 4 ml sheet	435	23	24	29) 64)↓ 23	83	1100	Salty	Robinson 1955	1-4 drift sand -64 Y.sdy.cl. -16 sdy cl. -83 drift sand -36 Lst.
3 Mile (Wirril-yerna) (Lewis Lagoon)	12495	Springvale Sheet	440	23	35	(27Salt (102↓ 25	140	800) 920)	Potable	Robinson 1954	3-17 Lst. -101 gy.cl. -21 Qtz rk. -102 Sst. -31 Lst. -105 drift sand -52 wh.cl. -111 sdy grv. -57 Y.sdy cl. -112 Y.sst. -58 gy.sst. -121 Y.sdy sh. -82 Y.sdy cl. -140 sand rock
Wirrilyerna No. 2	12496*	Springvale Sheet	440	18		40↓ 18	75	1800	Brackish	A.Henness Sr.1951	3-4 wh.rk -38 Lst. -10 cl.& blds. -75 Wh.sdy.cl. *The registered number 12496 applies to a bore, not used, drilled about 200 yards north along creek from 3 Mile Bore; Closes bore abt. 1 ml. W. of 3 Mile bore, has also been given Reg. No. 12496 by IWS.
25 Mile	9042	4½ mls N of Hs.		75-80	90	95	115 approx	Unlimited	Good	A.Henness Sr. 1950?	
Cooridgee (Maloga)	9769	Sprinvale Sheet		48 approx	65	54) 78) 100)↓ 54	103	24000 gpd	Good	C.R.Pearce 1943	0-16 Red loam & cl. -78 Red Sst. -34 Y.cl. -90 Y.water sd. -52 Red Sst. -103 Red Sst. H.bottom
Salt (Dud)		1 ml W of Robinson's (Springvale Sheet)					75?			1950?	Water unsuitable for stock
Close's (Dud)	12496*	1 ml W of 3 Mile (Springvale Sheet)		20		30-35	58	Unlimited	Salt	1951?	Water unsuitable for stock * The registered number 12496 applies to a bore, not used, drilled about 200 yards north along creek from 3 Mile Bore, has also been given Reg. No. 12496 by IWS.

LOWER ORDOVICIAN FOSSILS IN THE AREA OF BOULIA 4-MILE SHEET, QUEENSLAND.

by

Joyce Gilbert-Tomlinson

Note:
For Swift Beds,
read Swift Formation.

APPENDIX F.

INTRODUCTION

Geological mapping of Boulia 4-mile Sheet, western Queensland, was carried out in 1957 by the Georgina Geological Party (leader J.N. Casey). Two formations of Ordovician sediments have been recognized - the Ninmaroo Formation and the Swift Beds. They constitute the most easterly known exposures of fossiliferous Ordovician in northern Australia.

Both formations are lower Ordovician in age. The Ninmaroo Formation is essentially Tremadocian, although its uppermost part may be early Arenigian; the Swift beds are early, but not initial, Arenigian. Late Arenigian and younger Ordovician fossils are not known to occur in situ in the area, but a pebble containing younger Ordovician fossils has been collected from a conglomerate that is considered to be Mesozoic (Cretaceous) in age.

The Ninmaroo Formation rests with apparent conformity on late Upper Cambrian limestone (Chatsworth Limestone) in the Black Mountain section; the Swift Beds are unconformable on the Ninmaroo Formation at Digby Peaks, but no angular discordance can be detected between the two formations in the area west of Black Mountain.

The fossils of the Ninmaroo Formation are well preserved. Those of the Swift Beds are mostly too fragmentary for determination, but comparatively well-preserved material has been secured from this formation at Digby Peaks by Mr.D.J. Taylor, palaeontologist to Frome-Broken Hill Pty.Ltd. The fossils include a graptolite, and, in order to present as complete a picture as possible of the Ordovician faunas of the Boulia area, advance notice of this first discovery of Ordovician graptolites in Queensland is incorporated in this report.

Few Ordovician fossils are described from northern Australia, and none at all from Queensland. The fossil identifications are therefore tentative, and the generic names here cited may be changed when the fossils are systematically studied.

NINMAROO FORMATION

The Ninmaroo Formation was first recognized, and named, by Whitehouse (1936, p.69), who recorded the presence of ellesmeroceroid nautiloids, echinoderm ossicles, and an orthoid brachiopod in the Black Mountain section. He concluded that the "Ninmaroo limestones" were Tremadocian in age.

Thickness and extent.

The Ninmaroo Formation, as mapped by the Georgina Geological Party, is about 2,000 feet thick. It is typically exposed in the folded and faulted country of Mt.Ninmaroo and Black Mountain (which form the western part of the Burke River Structure), where its lower contact with the underlying Upper Cambrian limestone is exposed in anticlinal cores. The upper contact against the overlying Swift Formation is also exposed in the Black Mountain section, on the western side of the mountain.

The above-mentioned exposures are part of a long belt stretching from Mt.Merlin to Signal Hill Ridge in the north, to Mt.Datson and Dribbling Bore in the south. They are near the eastern edge of a very large rock body, extensively developed on Glenormiston Sheet (west of Boulia Sheet), and from there extending north onto Urandangi Sheet and south onto Mt.Whelan Sheet. Near the Queensland/Northern Territory border the formation disappears under the younger Ordovician sediments of the Toko Range Syncline (Toko Beds, Casey, 1959), and re-emerges in the Northern Territory. The most westerly known exposure occurs near Burnt Well (Tobermory Sheet), west of the Toko Range. Farther west still, in the area of the Dulcie Range (Huckitta Sheet), the formation cannot be recognized, and is apparently replaced by sandstone containing a different fauna.

The thickness of 2,000 feet mentioned above refers to the Black Mountain section. The formation is about 1,200 feet thick in the Glenormiston exposures (Casey in Condon, 1958), and is probably even thinner in the Northern Territory, although no measurementsare at present available for the western exposures.

Structural relationship with Upper Cambrian.

In the Black Mountain and Mt.Ninmaroo sections, the Ninmaroo Formation rests with apparent conformity on late Upper Cambrian limestone (upper part of Chatsworth Limestone). The Chatsworth Limestone in the Black Mountain is about 1000 feet thick. It contains several horizons of late Upper Cambrian (Trempealeauan) trilobites, of a dikelocephalid (saukiine) fauna unique in Queensland but comparable with trilobites in the Upper Cambrian sandstones of central Australia - for example, the Ross River (Öpik, 1956), and the Huckitta area (Casey & Tomlinson, 1956). Orthoid brachiopods similar to those of the Huckitta area also occur in this upper part of the Chatsworth Limestone, but, unlike the central Australian sandstones, the Chatsworth Limestone contains no ribeirioids.

At present, the boundary between Cambrian and Ordovician is drawn between the highest trilobite bed and the lowest nautiloid bed, at a thin,(at Black Mountain), but prominent bed of dolomite. Between the two fossil horizons is a 200-foot sequence of sediments without diagnostic fossils. The boundary, as at present drawn, is convenient for mapping, but future study of the fauna of the uppermost trilobite bed in the Black Mountain section may necessitate an adjustment of the actual time-boundary.

Lithology and fossils.

Although about five lithological units can be distinguished in the Ninmaroo Formation at Black Mountain, only two main rock types contain distinctive fossils: (i) a dark grey mottled (two tone) limestone with softer interbeds, and (ii) a yellowish-white or greyish-white limestone, consisting mainly of discrete echinoderm ossicles. The mottled limestone has a very high clastic fraction, as can be seen when the fossils are etched. In the Black Mountain section the mottled limestone is dominant in the lower part of the sequence, whereas the lighter-coloured echinoderm limestone is confined to the upper part. Elsewhere, the stratigraphic relationship of the two rock types is less straightforward, and it is possible that they merely reflect different environments, and have no particular stratigraphic significance.

(i) In addition to Black Mountain, notable localities for the dark mottled limestone are Noranside Station (B 401), Digby Peaks (B 11, B 527), and Signal Hill Ridge (D 130), on the boundary between Boulia and Duchess Sheets. The fossils are almost invariably silicified.

The commonest fossils belong to three animal groups: gastropods, nautiloids, and ribeirioids. Preliminary examination indicates that these fossils are represented by numerous individuals of relatively few species. Gastropods are represented by large opercula resembling, but probably not strictly identical with, Ceratopea Ulrich. Probably two distinct genera are included under this name. No large shells that would fit these opercula have been noted in the Black Mountain section (see Yochelson & Bridge, 1957), but another genus, resembling Scaevogyra Whitfield, is present; it seems to be confined to a single bed (B 515 B). As noted by Whitehouse (loc.cit.), the nautiloid cephalopods are ellesmeroceroids. Several forms are present, but they have not yet been studied in detail. Three genera of ribeirioids are present: Eopteria Billings, Euchasma Billings (2 species), and, in higher levels, cf. Ribeiria Sharpe.

Other groups are rare, both in species and individuals. Brachiopods are represented by the syntrophioids Huenella Walcott and Syntrophinella Ulrich & Cooper (or Tetralobula U. & C.); monoplacophorans by Proplina Kobayashi and cf. Archinacella Ulrich & Schofield; trilobites by a leiostegiid (perhaps a new genus) and a possible asaphid (indet.); and echinoderms by cystid "roots". Calcareous algae occur as thin interbeds on Black Mountain (B 515A) and at Digby Peaks (B 527); the cell-structure (filaments) has been observed.

(ii) The light-coloured echinoderm limestone is characteristically developed in the upper levels of the Black Mountain section, on the western side (B 515 I, B 515 L, B 518). Some silicification is apparent, but it is by no means universal. Surface silicification is not uncommon.

At the above-mentioned localities, discrete echinoderm ossicles constitute the greater part of the rock. No complete calices have been found. Of other groups, the commonest fossil is an orthoid brachiopod externally resembling the Finkelnburgia of the overlying Swift Beds (q.v.); it is commonly associated with the echinoderm ossicles to the exclusion of other fossils. Elsewhere, at the Swift Hills and in the upper levels at Digby Peaks, for example, orthoids and echinoderms are associated with "Ceratopea" and nautiloids resembling those of the dark mottled limestone. Loc.B 230 (Swift Hills) also contains a fragmentary fossil which may be an undescribed ribeirioid or even a pelecypod. The only identifiable trilobite is an undescribed kainellid (at B 171, 8½ miles north of Black Mountain, and at B 72, 6½ miles south-east of Digby Peaks). At B 171, this trilobite is associated with an undescribed ostracod.

Age

The Ninmaroo faunas are "Pacific" in aspect and can be dated as lower Canadian by the North American scale. This is roughly equivalent to Tremadocian of the European scale. The ostracod at Loc.B 171 suggests an early Arenigian age for the uppermost part of the formation.

Exact dating of the bulk of the formation, and particularly of its lower part, in terms of the standard European section is not possible, mainly because of the lack of fossils common to the Pacific and European sequences. The Eopteria-Ceratopea association suggests that basal Canadian (and therefore basal Ordovician as understood in North America) is not represented in the Ninmaroo Formation (Twenhofel et al., 1954), and this inevitably prompts the question: "Is there a faunal break between Cambrian and Ordovician in the Black Mountain section?".

No unequivocal answer can yet be given. In the first place, future study may prove that the uppermost trilobite bed, now dated as late Upper Cambrian, should instead be assigned to the earliest Ordovician. On the other hand, the fauna of this bed may still be Cambrian in age and the basal Ordovician may be represented by the almost-unfossiliferous 200-foot interval immediately above it.

Finally, it is by no means certain that the Cambrian-Ordovician boundary of the Pacific scale coincides exactly with that of the European scale. Hence, the Eopteria-Ceratopea fauna may be older than shown on the North American Ordovician Correlation Chart (Twenhofel et al., loc.cit.)

Faunal evidence for a break is thus inconclusive at present. Nevertheless, the composition of the faunas, as well as the lithology, indicates a marked change in environment during the course of deposition of the Black Mountain sequence. There is a striking contrast between the "dirty" Ordovician limestone with abundant ribeirioids and almost no trilobites and the comparatively clean Cambrian limestone with abundant trilobites and no ribeirioids. It strongly suggests tectonic unrest in late Upper Cambrian or early Ordovician time, and the possibility of a consequent clision of faunas cannot be neglected.

Comparison with other areas

Among the known Tremadocian formations of northern Australia, the Ninmaroo is unusual both in lithology and fauna. It is the only known Tremadocian carbonate sequence; in central Australia (the MacDonnell Ranges and the Dulcie Range, for example) the Tremadocian is represented by sandstones containing different trilobites and ribeirioids.

The Ninmaroo Formation provides the only Australian records of Eopteria and Ceratopea, and the only concentration of ellesmerocenoids. In the wealth of ellesmerocenoids it is comparable with occurrences in eastern Asia, North America, and the Arctic. In composition the faunas are very similar to those of the Wanwanian Series of southern Manchuria (Kobayashi, 1933) and the Beekmantown Group of North America (Sando, 1957).

SWIFT BEDS

The Swift Beds were named by the Georgina (1957) Geological Party (Casey, 1958).

Thickness and extent

The formation is about 60 feet thick. The main occurrences are in the Swift Hills; at Digby Peaks, where the hills of this name are composed of Swift Beds; and on the western side of Black Mountain. The Kelly Creek Formation of Glenormiston Sheet and the Toko Range is to be correlated with the Swift Beds and probably the two formations are part of the same rock body. Farther west, in the Dulcie and Tarlton Ranges, for example, the formation hasnot been identified.

Structural relationship with Ninmaroo Formation

At Digby Peaks the Swift Beds rest with a marked unconformity on the Ninmaroo Formation; elsewhere, no angular discordance can be detected.

Lithology and fossils

The main rock-type is an impure limestone, recrystallized and commonly silicified, containing abundant fragments of fossils which are mostly indeterminable. An interbed of pink siltstone containing comparatively well-preserved fossils occurs at Digby Peaks.

In the limestone, the commonest fossil is the brachiopod *Finkelnburgia* Walcott (or a closely related genus); other fossils include syntrophioid brachiopods, gastropods, nautiloids, possible ribeirioids, asaphid and kainellid trilobites, and echinoderm ossicles.

The fossils in the pink siltstone were collected by Mr.D.J. Taylor; they include a kainellid trilobite (probably a new genus), an asaphid trilobite, and a graptolite identified by Mr.Taylor as *Sigmagraptus* cf. *laxus* (T.S.Hall)(personal communication).

Age. *Sigmagraptus laxus* is a Victorian species of the Bendigonian Stage, which is dated as early, but not initial, Arenigian (lower part of the zone of *Didymograptus extensus*). Approximately the same age can be derived from the shelly fossils of the formation and its correlate, the Kelly Creek Formation (Casey in Condon, 1958) of the Toko Range. As far as can be determined, the fossils of the Swift Beds are similar to those of the upper part of the Ninmaroo Formation and suggest that, in spite of the spectacular unconformity at Digby Peaks, the time-interval between the deposition of the two formations was short.

ORDOVICIAN PEBBLES IN MESOZOIC CONGLOMERATE

Pebbles containing Ordovician fossils have been collected at one locality on Boulia Sheet and at another on Glenormiston Sheet. They both occur in the basal conglomerate of the Cretaceous Longsight Sandstone.

The Boulia material consists of a single pebble of sandstone in scree on the south-western side of Black Mountain, overlying the Swift Beds (B 519 A). It contains numerous indeterminate pelecypods, a gastropod resembling Helicotoma Salter, and fragments of asaphid trilobites. It is probably derived from the Nora Formation of the Toko Group, which is provisionally dated as late Arenigian to early Llanvirnian (passage from lower to middle Ordovician).

The Glenormiston material (Roxborough Downs, G 300) consists of two lithologies, each with its own fauna. The first is a sandy limestone with chert blebs, containing a possible Raphistomina, another gastropod (indet.), a fragmentary endoceroid nautiloid, and the ribeirioid Euchasma. It is probably derived from the Kelly Creek Formation, the Toko equivalent of the Swift Beds. The second is a sandstone, containing the pelecypod Ctenodonta, an indeterminate gastropod, two undescribed asaphid trilobites, and another trilobite, possibly a bathyurid. The trilobites are typical of the Nora Formation.

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