COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF SUPPLY AND DEVELOPMENT.

BUREAU OF MINERAL RESOURCES
GEOLOGY AND GEOPHYSICS.

~~REPORT NO.~~
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THE GEOLOGY OF THE NERRIMA DOME KIMBERLEY DIVISION, WESTERN AUSTRALIA

by

D. J. Guppy, J. O. Cuthbert
A. W. Lindner.

CANBERRA. A.C.T. 8th March, 1950.

CHIEF GEOLOGIST

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SUMMARY

The Nerrima Dome is 90 miles south-east of Derby in the Kimberley Division of Western Australia. Access is by road from Broome or Derby but is difficult or impossible during the monsoonal period between November and March.

Permian sediments from the lower part of the Liveringa Sandstone and the upper part of the Noonkanbah Shale outcrop in the area. The Liveringa Sandstone, consisting of fine and medium grained sandstones, is exposed in the ridges on the northern and southern flanks of the dome. The Noonkanbah Shale comprises mainly shale and claystone with some calcareous members and is represented topographically by black soil plains.

The Nerrima Dome is part of a system of gentle folds which can be traced over an area of approximately 500 square miles. The angles of dip rarely exceed 5 degrees. Vertical closure of the dome is 250 feet over an area of 30 square miles.

The Freney Kimberley Oil Co. N.L. holds three leases in the area. In September 1939 the company commenced drilling at Nerrima on a site selected by Dr. A. Wade. When drilling ceased in 1941 the bore had reached a depth of 4271 feet. Examination of the bore cores, (Nerrima No. 1 Bore), indicates that the drill has not yet penetrated below the Permian sediments. However, no reliable interpretation of the subsurface geology can be made until more detailed information of surrounding areas is available.

INTRODUCTION

Purpose of Investigation.- Previous investigators in the area have interpreted the Nerrima Dome as a dome closed by folding (Wade, 1936), a dome closed against a transverse fault at the eastern end (Kraus, 1942), and as a westward plunging anticlinal fold probably closed by transverse faulting (Reeves, 1949). The purpose of the present survey is to determine by detailed geological mapping the true structure of the Nerrima Dome.

Situation and Access.- Nerrima No. 1 Bore is 8 miles south-west of Nerrima Homestead (Plate 1). The distance by road from the homestead to Derby by way of Myroodah and Upper Liveringa Stations is about 140 miles. Prior to 1941 the Freney Kimberley Oil Co. used a track which passes through Dampier Downs and Roebuck Plains Stations to Broome, a distance of approximately 200 miles. None of the roads in the area have sealed or paved surfaces, and road travel during the wet season is almost impossible.

The Western Australian Government State Shipping Service has three ships operating between Perth, Broome and Derby and the schedule provides two services a month from Perth to the northern ports.

The MacRobertson-Miller Aviation Co. Ltd. provide a weekly freight and passenger air service to stations between Derby and Wyndham. The aircraft land at Upper Liveringa and Myroodah Stations on alternate weeks.

Climate.- The climate of the Kimberley Division is one of extremes, due mainly to the influence of the north-west monsoon on an otherwise arid region. Two seasons are recognised the "wet" and the "dry." During the monsoonal season of "wet" from December till March, the weather is hot and humid. More than 80 per cent. of the average annual rain falls during these months. The "dry" season lasts from April till November. During the first half of this period the weather is temperate, but after July the temperature rises, humidity is very low, and increasingly hot and dry easterly winds blow almost continually.

The average monthly rainfalls and temperatures for at least the past 40 years have been tabulated to illustrate the climate of the region. (Tables 1 and 2).

TABLE 1.- Mean Monthly Rainfall of Southern Part of West Kimberley Division, W.A. (in points).

Station.	Years	Jan.	Feb.	Mar.	Apr.	May.	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Broome	52	648	568	393	115	61	96	20	11	5	3	56	325	2301
Derby	58	746	562	443	140	75	53	23	9	1	6	83	404	2545
Noonkanbah	42	566	385	290	87	41	32	20	7	2	17	95	274	1816
Halls Creek	52	554	433	292	69	37	26	25	9	16	52	137	316	1966

TABLE 2.- Mean Monthly Maximum and Minimum Temperatures of Southern Part of West Kimberley Division, W.A.

Station.	Years	Jan.	Feb.	Mar.	Apr.	May.	June.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Broome	44	91.7	91.9	93.2	93.4	88.0	82.5	81.8	85.1	88.7	90.6	92.8	93.1
		79.2	79.0	77.5	72.0	64.7	59.8	57.6	59.9	65.3	71.7	76.5	79.2
Derby	44	94.7	94.8	95.1	94.8	89.7	85.2	84.5	88.2	92.9	96.1	97.1	96.7
		78.9	78.6	77.6	72.5	66.1	60.9	58.4	61.2	66.4	73.1	78.0	79.5
Halls Creek	42	97.9	97.1	95.1	91.9	85.5	80.6	80.1	85.9	92.7	98.2	100.3	99.4
		75.1	74.2	71.1	63.5	56.0	50.8	48.0	52.0	59.1	69.2	74.1	75.3

Mapping Methods.- An area of 130 square miles was mapped by plane-table traverses on a scale of 1:60,000, approximately equal to that of the aerial photographs. A photogeological map was compiled using the plane-table base map as control. The geological map included in this report (Plate 2) is a composite map prepared from the plane-table traverse and the photogeological map.

Surface contours were drawn with an interval of 20 feet. The datum used was ground level at Merrima No. 1 Bore for which a height above sea level of 370 feet was computed from barometric readings.

A structural contour map (Plate 4) was prepared, based on a polyzoal limestone bed 175 feet below the top of the Noonkanbah Shale. The contour interval is 100 feet and all contours are referred to sea-level.

Field work extended over a period of six weeks during September and October, 1948. Mapping methods, the selection of marker beds and thickness of sections are the responsibility of J. O. Cuthbert and A. W. Lindner. D. J. Guppy supervised

the work for the last ten days and examined the cores from Nerrima No. 1 Bore.

Previous Work.- The structural basins surrounding the Nerrima Dome (Figure 1) were noticed by Woolnough (1933) during aerial reconnaissance. He suggested the presence of associated anticlinal folds, but no ground work was carried out to determine the possibility of closure.

Wade, assisted by Waterford, (Wade, 1936; Wade and Waterford, 1937) mapped the area and concluded that the dome was closed.

Kraus (1942) incorporated a plane-table survey of the Nerrima Dome in a general report on the Desert Basin. He doubted the existence of normal closure at the eastern end of the fold and stated that the fold might close in this direction against a transverse fault.

Reeves (1949) examined the area and described the Nerrima Dome as "a gentle fold plunging westward." He stated that any closure was due to transverse faulting.

Subsequent to Wade's report (1937) the Freney Kimberley Oil Co. N.L. began drilling in 1939, and in 1941 the bore had reached a depth of 4271 feet. Operations ceased in 1941 and were not resumed until 1948.

At the time of the survey (September-October, 1948) the company was engaged in repairs to equipment and buildings prior to recovering tools which were obstructing the bore.

TOPOGRAPHY

Three main topographic divisions can be recognised in the area occupied by the Nerrima Dome: the Nerrima Ridge, the Southern Ridges, and the Crestal Flat.

Nerrima Ridge.- The lower beds of the Liveringa Sandstone are exposed in the Nerrima Ridge, which outlines the northern flank of the dome. The northern side of this ridge is a dip slope and is protected by a thick capping of laterite. A steep scarp forming the southern side of the ridge rises about 100 feet above the flat axial region of the dome. The relief of the Nerrima Ridge decreases towards the east and the Ridge trends southwards around the eastern end of the dome where, as a result of the gradually diminishing dip of the beds, it merges into the flood plain of the Fitzroy River. The beds forming the Nerrima Ridge strike south-west near the western end of the dome. Owing to the advanced stage or erosion of the folds, these beds which are high in the exposed stratigraphic section do not effect a complete surface closure here but swing to the west-north-west along the southern rim of the basin to the north-west of the Nerrima Dome.

Southern Ridges.- The southern flank of the Nerrima Dome is exposed in a series of ridges gradually decreasing in relief from west to east. Owing to faulting on the western end of the dome, the ridges extend into the axial region of the fold in a discontinuous belt of high ground, which rises to 100 feet above the level of the plain. The beds are lateritised basal members of the Liveringa Sandstone. Towards the eastern end of the dome the southerly dip of the beds decreases and the resistant sandstone capping becomes progressively thinner and finally disappears. The ridges at the eastern end are lower and more rounded and result from local thickening of the polyzoal limestone near the top of the Noonkanbah Shale. They swing to the south-east along the northern flank of an adjacent basin and gradually merge into the sandy plain.

Crestal Flat.- The area between the Nerrima Ridge and the Southern Ridges, the Crestal Flat, is occupied by a clayey soil plain typical of areas underlain by Noonkanbah Shale. The claystone and shale members weather to featureless plains on which the thin calcareous members outcrop in lines of small slabs and boulders.

Drainage.- From a low divide at the western end of the dome the Crestal Flat is drained eastwards to the Fitzroy River and westwards to Nerrima Creek by a system of small channels. Gravitational seepage is also important particularly on the eastern part of the dome. Because the fall of the country both east and west of this divide is very slight, most of the Crestal Flat is water-logged for weeks after heavy rain. Drainage on the flanks is mainly directed away from the dome although some small gutters discharge into the Crestal Flat during the wet season.

STRATIGRAPHY

General.- The following table sets out in brief the Permian succession as established by Wade (1936)

TABLE 3. THE PERMIAN SUCCESSION IN WEST KIMBERLEY

Name of Unit	Lithology	Fossils	Thickness
Erskine Series	Estuarine conglomerate grit, sandstone and shale	Plant and some marine fossils.	-
Upper Ferruginous or Liveringa Series	Clay, sandstone and grit	Marine and some plant fossils	1400 feet
Noonkanbah Series	Clay and shale with sandy beds, bedded and massive limestone and calcareous sandstone.	Marine fossils	1200 feet
Lower Ferruginous Series	Flaggy grit and sandy shale with some massive sandstone and grit. Beds are for the most part ferruginous.	Plant fossils	1200 feet
Nura Nura Limestone	Grey sandy limestone and shale with glacial erratics	Marine fossils	20 feet
Grant Range and Willanyie Beds	Boulder clay and tillite with massive lenticular sandstone, grit, arkose, conglomerate, clay beds, and clayey sandstone.	Fossil wood	2300 feet
Kungangie Beds	Conglomerate, boulder beds and boulder clay passing up into red to buff coloured massive sandstone with clayey or sandy shale and thick beds of chert.	Fossil wood	2000 feet

The sediments exposed on the Nerrima Dome are Permian and are included by Wade in his "Noonkanbah Series" and "Upper Ferruginous or Liveringa Series.". Krausé (1942) referred to these stratigraphic units as the "Noonkanbah shale formation.",

the "Liveringa ironsandstone formation," and the "Belina shale formation", the last two being subdivisions of Wade's "upper Ferruginous or Liveringa Series". Reeves (1949) uses the terms "Noonkanbah shale", "Liveringa sandstone" and "Belina shale", and includes the last two in a general term, "Liveringa beds".

In accordance with the recently published Australian Code of Stratigraphic Nomenclature it is proposed to call these formations the Noonkanbah Shale, Liveringa Sandstone and Belina Shale. The Belina Shale is not exposed on the Nerrima Dome but appears in the troughs of the adjacent structural basins to the north and south.

The older Permian formations which are not described in this report will be referred to as pre-Noonkanbah Shale beds.

The Noonkanbah Shale is 1200 feet thick. Reeves (1949) estimates maximum thicknesses of 700 and 600 respectively for the Liveringa Sandstone and Belina Shale.

The upper beds of the Noonkanbah Shale and the lower beds of the Liveringa Sandstone are exposed on the Nerrima Dome. The Noonkanbah Shale ranges up to 1200 feet in thickness and is composed mainly of shale and claystone interbedded with thin beds of limestone, calcareous sandstone and sandstone. Clayey plains on which the calcareous and sandy members outcrop are typical of areas underlain by this formation. The Liveringa Sandstone consists chiefly of coarse, medium and fine grained sandstone with thin lenses of fine conglomerate throughout the section. Thin transitional beds of shale and claystone form the base and top of the formation which attains a thickness of up to 700 feet.

NERRIMA AREA.

Noonkanbah Shale.- Approximately 400 feet of the Noonkanbah Shale is exposed on the Nerrima Dome. The shale and claystone members which comprise the greater part of this section weather completely on exposure and only the highly calcareous and sandy members form recognisable outcrops.

The lowest outcropping beds appear as discontinuous lines of small flags of polyzoal limestone between 200 and 250 feet stratigraphically below the junction of the Noonkanbah Shale with the Liveringa Sandstone. Above these beds are alternating thin limestone and calcareous sandstone beds with intercalated shale and claystone.

Only in the upper 180 feet of the formation are beds sufficiently defined to be regarded as mappable units. Thin bands of red marl are interbedded with some of the shaly fossiliferous limestones. The sediments are fine-grained and partly micaceous with a slight increase in the grainsize of sandy members towards the top of the formation.

The uppermost fossiliferous limestone bed is overlain by micaceous calcareous sandstones which alternate with and finally give place to the ferruginous micaceous sediments of the Liveringa Sandstone. This gradational change from a dominantly shaly and calcareous facies to a sandy facies extends through a stratigraphic interval of about 20 feet. These transitional beds are here regarded as forming the junction between the two formations. Because of lateral variations the junction cannot at present be more precisely defined.

The Noonkanbah Shale is found to a depth of 800 feet in the Nerrima No. 1 Bore. Thin calcareous beds, common in the outcrop section and in the upper 500 feet of the core, are not represented between 500 and 800 feet. Below 500 feet the shale and claystone are interbedded with thin sandstone members which become progressively thicker and more abundant until at 800 feet the bore passes into massive sandstones. The structural contour map indicates that the top of the section exposed in the bore is about 400 feet stratigraphically below the junction of the Noonkanbah Shale with the Liveringa Sandstone. An approximate thickness of 1200 feet for the Noonkanbah Shale is obtained from these figures.

The lowest bed which can be traced on the ground is 190 feet below the Noonkanbah Shale - Liveringa Sandstone junction and is represented by lines of small limestone flags containing fragmental Polyzoa. A similar bed 15 feet higher in the section contains Polyzoa brachiopods NS23 (Plate 2). Both beds form distinct continuous outcrops on the south-east part of the dome but elsewhere they are poorly represented on the surface.

At locality NS17 small limestone flags containing pelecypods, brachiopods and Foraminifera occur in association with polyzoal limestone about 140 feet stratigraphically below the top of the Noonkanbah Shale. In the absence of similar assemblages elsewhere on the dome this outcrop is thought to represent a local lensing member having a maximum stratigraphic thickness of 5 feet.

The interpretation of structure in the area is based largely on the mapping of the Strophalosia kimberleyensis marker bed which is represented by lines of slabs and boulders on the northern and southern flanks of the dome. This bed contains two distinct fossil horizons separated stratigraphically by 10 feet of clayey and sandy limestone which readily weathers to clayey soil. The lower of these horizons (NS 5 and 6) is characterised by a number of fossils in which Spirifer is the dominant fossil. The fauna of the upper horizon (NS7) consists almost exclusively of complete fossils of Strophalosia kimberleyensis Prendergast which form a solid mass up to 18 inches in thickness. The Strophalosia kimberleyensis bed is 75 feet below the Noonkanbah Shale - Liveringa Sandstone junction.

A limestone bed containing large brachiopods was noticed in two localities (NS 8 and 18) about 25 feet below the top of the Noonkanbah Shale.

Liveringa Sandstone.- The basal beds of this formation are siltstone, fine-grained ferruginous sandstone (which in some places is felspathic), and medium-grained ferruginous sandstone. Coarse sandstone appears in the upper beds, and thin lenses of fine conglomerate occur throughout the formation.

From examination of outcrops and bore logs it was concluded that the ferruginous character of the Liveringa Sandstone is superficial and results from leaching which in some places may be related to lateritisation during the Miocene Epoch. Outcrops of the sandstone are more ferruginous than those of the finer sediments.

Some of the various concretionary patterns resulting from this leaching are restricted to particular beds and may be of use as local horizon markers.

Not more than 100 feet of the Liveringa Sandstone is exposed in the ridges flanking the dome, but between it and the basins to the north, the section, up to the base of the Belina Shale, attains a thickness of 500-600 feet.

Both marine and plant fossils are found in beds of the Liveringa Sandstone. The flora is of the Glossopteris type (Wade 1936) but in the beds exposed on the Nerrima Dome it is represented only by fragmentary pieces of fossil wood. The marine fauna, mainly pelecypods and gastropods, contrasts with the dominantly braciopod fauna of the underlying Noonkanbah Shale.

Some of the more fossiliferous beds of the Liveringa Sandstone appear to be useful as horizon markers, but because of the lithological similarity of these beds it was more convenient to base most of the structural mapping on the better defined limestone beds of the Noonkanbah Shale. Marker beds in the Liveringa Sandstone were used to define the north-eastern flank of the dome (NS 19, 21, 15, 12)

All the fossil localities and species from each are arranged in stratigraphic sequence in Table 4.

STRUCTURAL GEOLOGY

GENERAL

The Nerrima Dome.- The Nerrima Dome is in an area of low relief in which low-dipping sediments form a series of basins and domes that outcrop over an area of 500 square miles. Aerial photographs reveal four basins in the vicinity of the Nerrima Dome (Figure 1). The low-lying area north of The Nerrima Ridge is occupied by a basin which extends westward for about 24 miles to Nerrima Creek. The eastern end of this basin is about 9 miles north of the Nerrima No. 1 Bore. One mile south of Myroodah Homestead the beds of the Liveringa Sandstone outcrop in a low scarp forming the northern flank of a basin of which the southern flank outcrops about 7 miles south of the homestead. The elevated country between these two basins is mainly sand-covered but although conclusive evidence is lacking it is probable that this elevated area is occupied by a dome.

On the south-eastern flank of the Nerrima Dome, the Strophalosia kimberlevensis marker bed and stratigraphically higher beds swing to the south-east and form the marginal beds of a basin which can be traced for about 12 miles in a south-easterly direction to Mt. James.

Five miles north-east of Nerrima Homestead, across the Fitzroy River, is a basin with an approximately east-west axis.

TABLE 4

FOSSIL LOCALITIES AND ASSEMBLAGES FROM THE NERRIMA DOME IN DESCENDING STRATIGRAPHIC SEQUENCE

FORMATION	PREDOMINANT FOSSIL CLASS	NUMBER OF SPECIMEN	FOSSIL DETERMINATIONS
Liveringa Sandstone.	Pelecypoda	NS 14	Ferruginous intraformational conglomerate with worm tubes
		NS 9	Pleurophorus Nov. sp.
		NS 10	Stutchburia nov. sp.
		NS 11	Pleurophorus nov. sp., Allorisma nov. sp., Stutchburia nov. sp., Oriocrassatella ?sp Cardiomorpha sp., Atomodesma cf. exarata Wanner, Streblochondria nov sp., Warthia cf. micromphala (Morris)
		NS 13	Aphanaia nov. sp.
	Gastropoda	NS 12	Cardiomorpha sp., Bellerophon sp., Euphemites cf. emerii (Eth.), Mourlonia nov sp., Shansiella nov. sp.
		NS 19	Euphemites emerii (Eth.) Prodentalium nov. sp.
		NS 21	Nuculana cf. basedowi (Eth.), Euphemites sp. ind., Warthia sp., Prodentalium nov. sp
		NS 15	Euphemites emerii (Eth.), Warthia cf. micromphala (Morris), Shansiella nov. sp., Prodentalium nov. sp.
Noonkanbah Shale	Brachiopoda	NS 22	Small fragments of brachiopod and pelecypod shells
		NS 8	Polyzoal and crinoid limestone with Chonetes sp. ind., Streptorhynchus luluigui Hosking, Streptorhynchus sp., Spirifer sp. ind., Bellerophon sp. ind.
		NS 18	Chonetes sp., Streptorhynchus nov. sp., Spirifer sp. ind., Aviculopecten cf. sprenti Dana, Aviculopecten sp.
		NS 7	Strophalosia kimberleyensis Prendergast, Aviculopecten sp. ind.
		NS 6	Calceolispongia sp. ind., Spirifer nov. sp.
		NS 5	Strophalosia kimberleyensis Prendergast, Linoproductus cf. cancriniformis Tschern., Taeniothaerus subquadratus (Morris)
		NS 17	Calceolispongia sp. ind., Chonetes sp., Linoproductus. sp. ind. Spirifer sp. ind., Cleiothyridina cf. macleayana (Eth.), Posidonomya ?nov. sp., Myalina ?sp., Hyperamminoides acicula Parr
		NS 23	Polyzoal limestone with Chonetes sp.
		NS 16	Polyzoal limestone with Hexagonella sp., Stenopora sp.
		NS 1	Polyzoal limestone

This basin can be traced for about 6 miles to the east.

Low north-westerly and south-westerly dips five miles west of the Nerrima Dome suggest another dome on the same line of folding as the Nerrima Dome, and lying between it and the western tributary of Nerrima Creek. The beds in this area are extensively faulted and are mainly covered with sand and salt pans. Wade (1936) refers to this fold as the Tutu Dome.

A major zone of faulting extends from Mt. Fenton through Mt. James and Moulamen Hill South and continues in a north-westerly direction as far as Geegullie Creek (Wade 1946, p.44).

NERRIMA DOME.

The Nerrima Dome is a low, extensively faulted fold about 16 miles in length and 8 miles in width. The axis of folding curves in a gentle arc from south-east to west-south-west. On the northern flank of the dome the dip of the outcropping beds ranges from 3 to 5 degrees, gradually decreasing from west to east. A general flattening of the fold on the southern flank and at the eastern end results in dips of 3 degrees and less, although local irregularities due to faulting and minor folding give rise to dips as great as 7 degrees. Anomalous dips of 10 and 12 degrees at the western end of the dome are due to faulting.

Faulting.- The dome is extensively faulted on the northern flank and eastern end. Most of the faulting on the northern flank is a result of the shearing of minor folds.

The beds on the eastern side of most of the faults on the northern flank have an apparent displacement to the south. The greatest horizontal displacement measured is 9000 feet. These faults can be traced up to 3 miles northwards in beds of the Liveringa Sandstone. They continue into the limestone members at the top of the Noonkanbah Shale but in the incompetent claystone and shale members, which occupy the crestal portion of the dome, there is little evidence of faulting.

The structure of the western end of the Nerrima Dome is not well defined. The beds outcropping on the northern flank are displaced by a strike fault and appear again in the axial region in a low ridge consisting of beds of the Liveringa Sandstone, and in a small flat area in which the Strophalosia kimberlevensis marker bed outcrops (MS 12, Plate 2). The vertical displacement is about 400 feet. Both the ridge and the limestone bed terminate towards the east against an oblique fault which strikes in a south-westerly direction. This oblique fault is the eastern boundary of a down-faulted "hinge-block" and has a maximum vertical displacement of 300 feet at the northern end. To the west the Strophalosia kimberlevensis bed curves southwards, ends abruptly against an east-west fault, and does not reappear elsewhere on the south-west portion of the dome. Lateritised beds of the Liveringa Sandstone outcrop to the south of this east-west fault. The comparison of fossil assemblages of the Liveringa Sandstone to the north and south of this fault suggests that the downward displacement to the south is small. As the dips are low, beds of the Noonkanbah Shale must be close to the surface south of this fault.

The eastern end of the dome is comparatively free from faulting and no evidence was found to substantiate a suggestion (Kraus, 1942, p.42) that the eastern end is closed against a fault striking south from Nerrima Homestead.

The depth to which the faulting on the Nerrima Dome persists is unknown but on surface evidence most of the faulting dies out in the Noonkanbah Shale. Some of the larger faults may extend into the older sandstone formations as indicated by slickensiding and contortion in the core of Nerrima No. 1 Bore at

several depths below 1800 feet.

Closure.- The highest bed on which closure was established in the field is the polyzoal limestone bed 175 feet below the junction of the Noonkanbah Shale with the Liveringa Sandstone. The bed is represented by lines of small flags and pebbles. It can be traced with some difficulty on the eastern end of the dome where the stratigraphically higher beds have been weathered away. The structural map is based on the top of this limestone bed. The highest projected point on the bed is 700 feet above sea-level.

The eastern end of the dome is closed to the 300 feet contour. At the western end of the closure extends only to the 450 feet contour resulting in a depth of closure of 250 feet over an area of approximately 30 square miles. The area of drainage from surrounding basins is about 300 square miles.

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Dr. C. Teichert of the University of Melbourne, and Miss I. Crespin, Commonwealth Palaeontologist, determined respectively the mega and micro-fossils mentioned in this report.

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PLATE V

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. – Outcrop of Strophalosia kimberleyensis marker bed.

Fig. 2. – Tracing the Strophalosia kimberleyensis marker bed along north-east end of the dome.

Fig. 3. – Plane table over polyzoal marker bed on south side of dome.