DEPARTMENT OF MINES

SOUTH AUSTRALIA

REPORT OF THE GRAVITY SURVEY IN THE PEAKE DENISON RANGES.

by

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TABLE OF CONTENTS

SUMMARY:

Geophysical observations were carried out in conjunction with a geological survey of the Peake Denison Ranges during the winter of 1953.

To the east of the main range geophysical evidence would indicate a gradual shelving of bedrock, deepening to the east.

On the western side of the range and some miles west of the edge of the range, there is generally a sudden decrease westwards in gravity values indicating a more sudden deepening of basement rock.

A fault of considerable throw is revealed to the east of Mount Dutton.

Further, a traverse run east and west of Anna Creek station indicates a continuation of a shallow basement ridge southwards.

INTRODUCTION:

The Peake Denison Ranges run discontinuously for 70 miles approximately parallel to the Alice Springs - Port Augusta railway in the far north of South Australia. The range extends from Mount Dutton siding, 25 miles S.E. of Oodnadatta, southwards to the Anna Creek siding.

In this area, where the annual rainfall is five inches or less, the presence of good supplies of underground water is of paramount importance. Fortunately the area lies within the limits of the Great Artesian Basin and generally, reasonable supplies of fair quality underground water are available.

A gravity survey was undertaken in an attempt to determine the structural relationship between the Pre-Cambrian rocks of the ranges, and the adjacent Mesozoic beds of the Great Artesian Basin and in so doing find possible limits of the artesian waters.

Field work was begun in early July and completed in late September occupying 9 weeks in all.

Using Land-Rover as transport a number of traverses were run from both eastern and western edges of the range into the basin.

More detailed work was carried out in the Mount Dutton - Algebuckina area where greater information was required.

PREVIOUS GEOPHYSICAL WORK:

Very little geophysical work had been undertaken in this area prior to this survey. In 1951 Narain on behalf of Sydney University carried out a gravity survey along the Marree to Alice Springs railway as part of a Marree to Birdsville to Alice Springs to Marree gravity tie traverse.

Muckenfuss in a world wide gravity tie established a gravity station at the Oodnadatta airport upon which value all the readings of the present survey have been based.

GEOLOGY:

The Peake Denison Ranges are a series of outliers of Pre Cambrian rocks, which run in a general north south direction. They are made up of quartzites, slates, tillite, dolomite etc. together with some meta sediments and igneous intrusion. The Pre Cambrian sediments are extensively folded and faulted.

Flanking the range on both sides are the Mesozoic sediments of the Great Artesian Basin. These sediments are generally flat lying and consist of Jurassic? sandstones overlain by Cretaceous marine shales and some fresh water upper Cretaceous beds. There is also evidence of Pre-JUrassic sediments in the Mesozoic series.

The so called "desert sandstone" of presumed Jurassic age which outcrops discontinuously along the western margin and in isolated patches to the east of the range is thought to be the main aquifer in the area.

On east side of the range the flats and table lands are often covered with gibbers while to the west as well as the gibbers, sand dunes with interdune claypans cover large areas. Swamps are common in the lowest areas and along parts of the river courses.

METHODS USED:

The gravity meter on loan from the Adelaide University a Carter Y type meter, was used for the survey. No great success had been met with using this meter previously, but with the shock mounted carrying case built by the Department much more reliable results were obtained.

Although the drift of the Carter meter was somewhat higher than drifts generally obtained using the North American Gravity Meter it was regular and the readings are considered quite reliable. The higher drift could be attributed to both the meter itself and to the extremely rough nature of the country traversed. The actual drift was determined by repeating at least one of the early readings on completion of a traverse. The mean drift per hour was then calculated and the gravity differences between stations adjusted accordingly.

Using this method it is thought that the observed gravity values would have an accuracy of better than ½ milligal.

Traverses of varying length were run from the edge of the range into the basin. Stations were made at half mile or mile interval, closer spacing being employed over the supposed edge of the basin.

Each station was marked on the aerial photograph mosaic compiled by the Lands Department. These mosaics were compiled without survey control. Latitude corrections were calculated from these mosaics.

Levels were obtained using micro barometers. A base aneroid was read by the cook at the base camp every fifteen minutes to obtain a daily variation curve.

This latter arrangement was not entirely satisfactory in that at times the gravity traverses run were as much as 60 miles from the base camp; the daily variation in barometric pressure is not necessarily the same at points this far apart. However with the personnel available this was the only arrangement possible.

Levels were tied to the Central Australian Railway Line at the sidings.

The levels obtained are considered to be accurate to five feet.

A factor of 0.7 gravity units per foot was used in calculating elevation corrections.

During the closing stages of the survey, all of the gravity traverses except one east from Peake H.S. and one east from Hope Creek were tied together in a tie run and then tied to a base gravity station at Oodnadatta.

Two plans accompany this report. The first on 4 miles to the inch shows the location of the traverses and gravity profiles. The second is a contour plan of the Mount Dutton area on photoscale (1.5 inches to the mile).

Traverses have been numbered according to the Military Sheet on which they are located i.e. N2 is the second traverse on the Nilpinna Military Sheet.

RESULTS & INTERPRETATION:

Traverses east of the main range.

Six traverses were run east of the Denison, Peake ranges into the Artesian Basin. Two of these traverses, one through the old Peake Station and the other run east of Warrina across the range.

a. Traverse N1 - From the western edge of the range across the range to Old Peake Station and thence east.

A positive anomaly of +10 milligals is associated with the range itself. The marginal fault on the eastern edge of the range is accompanied by a rapid decrease in gravity values.

The gravity anomaly east of range decreases to the east indicating a deepening of basement in that direction.

b. Traverse N3 - East of Warrina siding across the range and then east of the range.

No rise in gravity was observed in crossing the western edge of the range at the Warrina siding, which would indicate shallow depth bedrock in the area just west of the range. There is however a sharp decrease in the Bouguer anomaly across the eastern margin indicating a fault along this edge.

Unfortunately this traverse could not be continued far east into the basin owing to an impassable sandy river bed.

c. Traverse U1 - From the edge of the range to Mount Charles and then due east to a point south of Lagoon Hill. This traverse penetrates furtherest eastward of all traverses run.

The aim of this traverse and traverse U2, was to find the relationship between the isolated Pre Cambrian outliers of Spring Hill, Mount Charles, Lagoon Hill and the main range.

The gravity profile shows a uniform decrease eastward in Bouguer anomaly towards Mount Charles indicating a gradual deepening of bedrock from the edge of the range into the basin. There is no indication of a northward extension of Spring Hill on the gravity profile.

Associated with the basement outcrop at Mount Charles there is a 2 milligal positive anomaly. Immediately east of Mount Charles there is a more rapid decrease in gravity readings which could possibly indicate a fault just east of Mount Charles.

A 4 milligal positive anomaly obtained at the end of the traverse indicates a southward continuation the ridge of shallow bedrock which outcrops at Lagoon Hill.

The Little Perry Springs and other mound springs south of Lagoon Hill are due no doubt to this shallow ridge of bedrock bringing the aquifer to or near to the surface.

d. Traverse U2 - From the edge of the Mount Margaret range to Spring Hill and further east.

This traverse would indicate that bedrock lies near to the surface between the main range and Spring Hill but immediately east of Spring Hill where gravity values decrease rapidly bedrock deepens eastwards probably due to a fault marginal to the outliers.

e. Traverse U3 - From the edge of the range north of Hope Creek east.

The gravity profile along traverse U3 indicates shallow bedrock east of the main range similar to U2. At a point 4 miles east of the range bedrock begins to deepen for 3 miles where gravity values again indicate a gentle eastward fall of bedrock.

f. Traverse Cal - From Douglas Well east.

The 5 milligal positive anomaly 2 miles east of Douglas Well is due to an increase in density of bedrock outcrops as basic igneous rock at this point. The gradual fall of gravity values beginning 4 miles east of Douglas Well is due to both change in bedrock to lighter material and gradual deepening of bedrock which is still at shallow depth at the end of the traverse.

Traverses west of the main range.

Six traverses were run west from the western edge of the main ranges, and a seventh was run east and west through Anna Creek H.S. just south of the main range.

A feature of all of the gravity profiles west of the range is th sudden decrease in Bouguer anomaly which takes place several miles west from the range in the northern area but swings east further south.

A feature of all of the gravity profiles west of the range is the sudden decrease in Bouguer anomaly which takes place several miles west from the range in the northern area but swings east further south.

It is proposed that this line of subsurface discontinuity represents a western edge of a shallow bedrock ridge of which the Peake Denison and Mt. Margaret Ranges are an outcropping part.

It is without doubt pre Jurassic? (i.e. pre desert sandstone) in age since immediately south of Boorthanna Siding, the line of discontinuity swings suddenly eastwards and passes directly underneath a large tableland of undisturbed desert sandstone.

This line of decrease in gravity values can be traced northwards from six miles west of Anna Creek H.S. as far north as Mount Dutton where it runs into the marginal fault on the east of the Mount Dutton range.

This latter point might even suggest a Palaeozoic? fault line which has been opened up in some places during Tertiary times to give the present land features.

a. Traverse N2 - Peake Creek west.

Unfortunately this traverse could not be continued far west due to swampy ground. The traverse showed however a sudden decrease in Bouguer anomaly of 7 milligals six miles from the range. This drop is not as great as the fall on traverses further south.

b. Traverse N4 - From the signpost on the Oodnadatta William Creek road, south west to Old Nilpinna Station and thence west to old Cootanoorina station.

Approximately eight miles from the range, east of Nilpinna there is a decrease in Bouguer anomaly of 10 milligals. The profile indicates a depth to bedrock at old Nilpinna H.S. of at least 500 feet which does not conform with bores which intersect the aquifer at shallow depths in this vicinity. A further decrease

in gravity readings between old Nilpinna and Cootanoorina further west indicate even deeper bedrock at the second locality. This is also contrary to boring data hereabouts. However it is suggested by R.I. Chugg in the hydrological report of this area that this contradiction can be reconciled by the existence of a Pre Jurassic series sediments which lie between the aquifer and bedrock.

c. Traverse C1 - From the Mount Margaret range north west to the Edwards Creek siding and thence due west.

In crossing the western edge of the range a sharp decrease in gravity values would indicate a marginal fault along the range.

The line of subsurface discontinuity represented by a decrease of about 12 milligals is again located about 8 miles from the range.

d. Traverse B1 - From the range south west to Boorthanna siding and thence west.

A marginal fault along the range is again indicated by the gravity values.

The sudden decrease in gravity value along this traverse takes place about 5 miles from the edge of the range. The decrease is of the order of 8 milligals and is very rapid on this profile.

e. Traverse B2 - From the edge of the range just north of Box Creek westwards.

The only rapid decrease of Bouguer anomaly on this traverse takes place in crossing the edge of the range which swings westwards in this vicinity. This would indicate an eastward trend of the edge of shallow bedrock to the edge of the range.

It is between traverses B1 and B2 that this line of subsurface discontinuity passes under the undisturbed desert sandstone.

f. Traverse A1 - Anna Creek siding to the south west.

A marked decrease in Bouguer anomaly of 11 milligals takes place four miles south west of the range.

g. Traverse A2 - East and west through Anna Creek H.S.

Indications of the continuation southwards of the shallow bedrock ridge are given in this traverse where higher Bouguer anomaly persists 3 miles west and 2 miles east of the Anna Creek H.S. To the west of the head station the decline from higher to lower readings is more rapid than on the east, as is found throughout the area.

Results - MOUNT DUTTON, ALGEBUCKINA AREA:

Eight gravity traverses were run in this area in an attempt to find the relationship between the two Pre Cambrian outliers, to test the possibility of a fault east of Mount Dutton and to determine whether the fault on the east margin of the Mount Dutton Range extended as far south as the Little Cadnowie Springs.

The persistence of high positive gravity values north of the Algebuckina outlier indicates a continuation of bedrock at shallow depth towards Mount Dutton. The basement begins to pitch more rapidly downwards about two miles south of Mount Dutton where gravity values decrease at a greater rate.

There is geological evidence for a fault east of the railway line, near Mount Harvey where the usually flat lying porcellanites have a dip of 30°. Geophysical evidence confirms the presence of such a fault. It runs in a north west direction and appears to split into two faults at a point three miles north of Algebuckina. One ofthese faults continues in almost the same direction as the main fault line while the second strikes due south an d would be the eastern limit of shallow basement at Algebuckina.

The throw of the fault is quite large in the Mount Dutton - Mount Harvey region but appears to decrease further south. Making allowance for strong negative regional gradients eastwards and westwards in the area which tend to complicate the true gravity picture the throw of the fault in the Mount Harvey area is at least five hundred feet. The downthrown block of the main fault and of the two split faults is the east block.

The high gravity values obtained north of Algebuckina decline rapidly to the west along a line which seems continuous with the eastern edge of the Mount Dutton range and trending south. It is likely that the marginal fault along the eastern edge of the range continues south to the Little Cadnowie Springs but it is not probable that it continues much further. This line is a continuation of the line of subsurface discontinuity on the west of the range.

There is a sudden fall in Bouguer anomaly in crossing the western edge of the desert sandstone outcrop which would suggest a deepening of bedrock westwards.

Good supplies of artesian water are available from the bore at the Mount Dutton siding and artesian water flows in fair supply from the Ockenden bore. It is likely that these bores obtain their water from a south westerly direction. Any contribution from the east would be limited by the fault and from the north by the Pre Cambrian outlier.

CONCLUSIONS:

It is likely that artesian water is present in most of the area east of the range except perhaps between the range itself and the Spring Hill outliers. However the hydrostatic pressure of the artesian waters would not be great enough to bring the water to the surface along the edge of the ranges where the elevation is much greater than further east. The

gravity survey in particular the Mount Charles traverse confirm the statement of R.I. Chugg in the hydrological report that "Numerous Springs found east of the Margaret Ranges appear to represent interruption to the eastward fall of the sandstone horizon".

To the west of the range the line of subsurface discontinuity described under results would be the probable eastern limit of artesian water; east of this line the desert sandstone often outcrops.

Artesian water is possibly present in most of the area between Algebuckina and Mount Dutton except where Pre Cambrian anddesert sandstone outcrops. This would be available at shallow depths.

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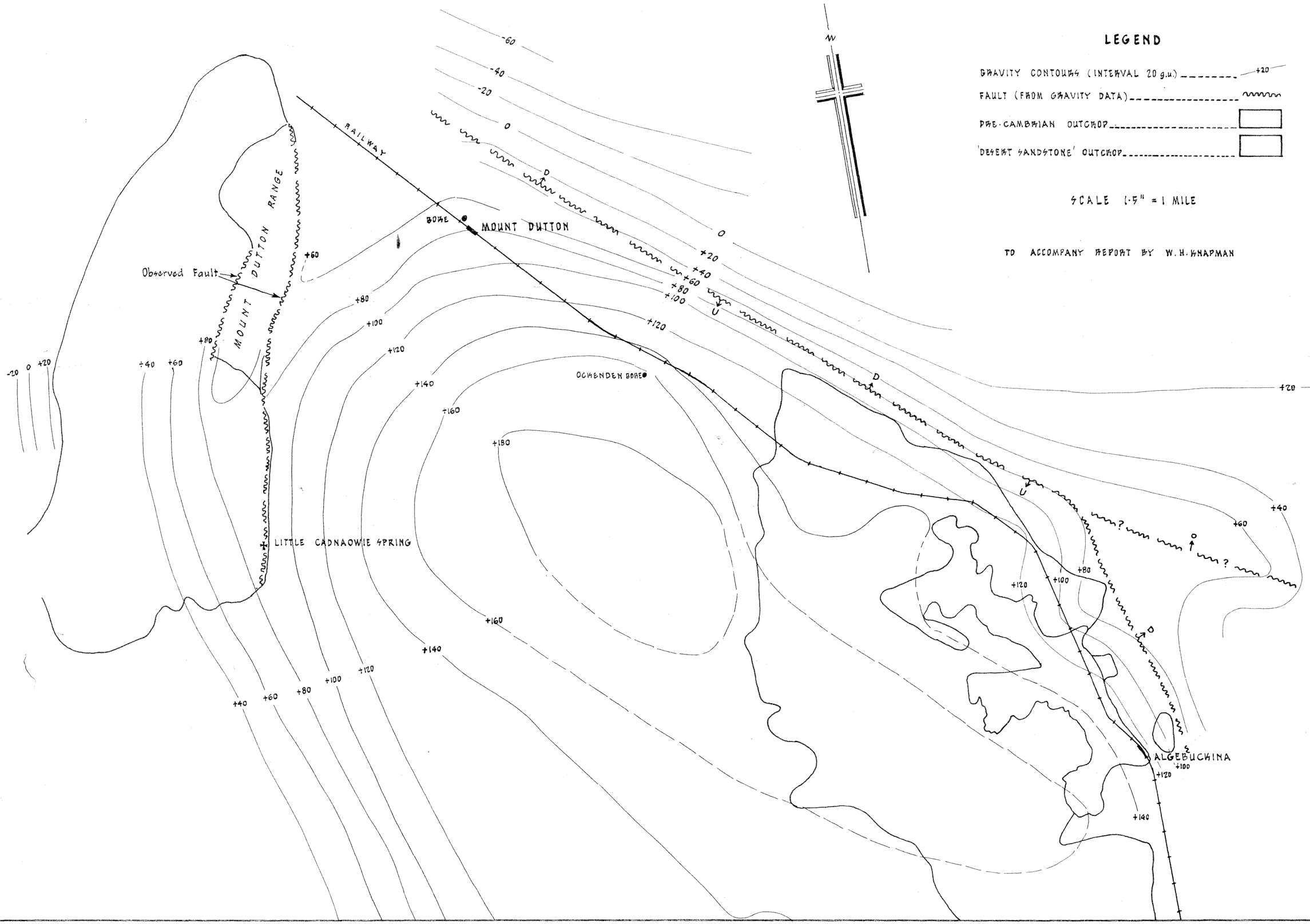
ASSISTANT GEOPHYSICIST

WHK:BK
17/2/54

Plans accompanying report 54.5
54.6



LEGEND

GRAVITY CONTOURS (INTERVAL 20 g.u.) ——— +20

FAULT (FROM GRAVITY DATA) ~~~~~

PRE-CAMBRIAN OUTCROP ▭

'DESERT SANDSTONE' OUTCROP ▭

SCALE 1·5" = 1 MILE

TO ACCOMPANY REPORT BY W. H. CHAPMAN

S.A. DEPT. OF MINES

Mt DUTTON · ALGEBUCKINA AREA
BOUGER GRAVITY CONTOURS

Associated Drawing	No.	No.	Amendment	Exd.	Date

Rec. No.
D.M.
Compiled from

Approved	Passed
Director of Mines	B.S.G. per R.R.

Drn. W.H.K.
Tcd.
Ckd.
Exd.

Scale 1·5" = 1 MILE

54·6
Bd

Date 17. 1. 54


N
LAGOON HILL
MT CHARLES
Cal
Douglas Well
ANNA CREEK
Anna Creek H.S.
ALGEBUCKINA
MOUNT DUTTON
SEE CONTOUR PLAN
WARRINA
Old Nilpinna
Edwards Creek
BOORTHANNA
Cootanarina
LEGEND
PRE-CAMBRIAN OUTCROP
GRAVITY TRAVERSES
GRAVITY PROFILE (Vertical Scale: 20 Milligalls to 1 inch)
LINE OF SUBSURFACE DISCONTINUITY
CENTRAL AUSTRALIAN RAILWAY AND SIDINGS
SCALE : 4 MILES TO 1 INCH
TO ACCOMPANY REPORT BY W. K. KNAPMAN

S.A. DEPT. OF MINES

PEAKE - DENISON RANGES
GRAVITY TRAVERSES

Associated Drawing	No.	No.	Amendment	Exd.	Date

Req. No.
D.M.
Compiled from

Approved	Passed		
		Drn.	W.K.K.
	B.S.G. per R.R.	Tcd.	K
		Ckd.	
Director of Mines		Exd.	

Scale 4 MILES TO 1 INCH

54 · 5
Bdc

Date 12 · 1 · 54