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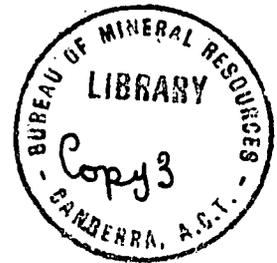
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DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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RECORD 1961 No. 93

BROKEN HILL DISTRICT, REGIONAL GRAVITY SURVEY USING
CESSNA AIRCRAFT, N.S.W. & S.A. 1960

by

M.A. Reid

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

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- Plate 1. Station location map showing Bouguer anomaly values. (Drawing No. G135-15)

ABSTRACT

The results of gravity measurements at some airstrips in the Broken Hill area are presented. Measurements were made using the Bureau's Cessna aircraft for transport. The programme could not be completed because of an accident to the aircraft.

1. INTRODUCTION

In the past, use has been made of regular air services for transport when taking gravity readings to complete the regional gravity map of Australia. To obtain further information, particularly in areas not well covered by roads or commercial airlines, the Bureau's Cessna aircraft is now used when it is available.

A distinct advantage in using our own light aircraft is that gravity readings can be made as close together as airstrips permit and in this respect it was felt that the airstrips used by the Royal Flying Doctor Service would prove highly suitable for Cessna operation. It was decided to commence operations in the Broken Hill Flying Doctor network where the number of airstrips is reasonably high within a radius of approximately 150 miles of Broken Hill. Plate 1 shows the airstrips included in this network.

In addition it was intended to read gravity ties between the Bureau's pendulum stations at Broken Hill and Leigh Creek (South Australia) and Broken Hill and Birdsville (Q'ld).

2. OPERATING PROCEDURE

All readings are referred to the Broken Hill Pendulum Station (Dooley et al., 1961) and for this purpose a subsidiary base station at the Broken Hill airport was used. This subsidiary station was in turn tied to the Broken Hill Pendulum Station.

The operating procedure was governed by the following factors:

- (a) Drift control of the gravity meter
- (b) Speed of the operation
- (c) Micro-barometer control
- (d) Range of the aircraft

As a compromise between (a) and (b) it was decided to read the gravity meter at a base station in the morning, at noon, and on return at night. Sufficient check on instrument drift would be obtained in this way and at the same time as many gravity readings would be made as permitted by (d).

Because of these factors flying was designed to radiate from Tibooburra and White Cliffs as well as from Broken Hill. Plate 1 shows as broken lines the boundaries of the zones that can be flown from each of these three bases.

At each base a ring of sub-bases was to be established, a direct gravity and elevation tie being obtained between the latter and the base station. Traverses in the form of closed loops were then to be flown from the sub-base stations, re-occupying whenever possible stations in adjacent loops. In this manner it was hoped to obtain sufficient control in determinations of both gravity and height, particularly height.

The gravity meter used was Worden No. 169, with a scale value of 0.10563 mgal/div. Elevations were determined by barometric levelling, using a microbarograph to obtain a record of pressure variation at the base station.

3. EXTENT OF SURVEY

Traversing commenced on 16th November 1960. Five sub-base stations were established in the area immediately surrounding Broken Hill. These were at Willangee, Radium Hill, Menindee, Mazar, and Hazelvale. Loop traverses were flown from Mazar and Radium Hill. A gravity tie was made between Broken Hill and Leigh Creek Pendulum Stations (Dooley et al., 1961).

On the occasion of flying the traverse from Willangee the aircraft met with an accident at Willangee and the survey terminated prematurely on 24th November 1960. Prior to this date, several days were lost owing to unsuitable weather, e.g. because of rain, high winds, and dust storms.

4. RESULTS

The results are presented in the accompanying table; the Bouguer anomaly values for the various stations are shown also on Plate 1.

The gravity meter drift tended to be rather erratic during the survey. Other gravity meters had been used in helicopter operations earlier in the year and had not shown such behaviour. The first signs of erratic drift in Worden No. 169 were noticed during a previous survey in June, soon after the meter was evacuated. The erratic behaviour was noted again during calibration tests in Melbourne after returning from Broken Hill.

Some of the data on which the elevations are based are very doubtful; some of the elevations shown in Plate 1 could be up to ± 30 feet in error. The uncertainties are due to several causes, notably the variable weather and the long operating distances from the base stations.

Station positions have been taken from the most accurate maps available; these however are not as accurate as would be desired and there is probably some small error in the latitude and longitude values given for each station.

The measured gravity interval between Broken Hill and Leigh Creek Pendulum Stations is 135.9 mgal. The difference between the two pendulum values is 134.9 mgal (Dooley et al., 1961). No distribution for the discrepancy has been attempted, for the following reasons:

- (1) a good tie has been made between Leigh Creek and Frome Downs,
- (2) a fairly good tie has been made between Broken Hill and Mooleulooloo, and
- (3) a poorer tie (including two meter resets) has been made between Mooleulooloo and Frome Downs.

Therefore the value of Frome Downs has been referred to Leigh Creek Pendulum Station as datum (noted in Table 1), and the value of Mooloolooloo has been referred to Broken Hill Pendulum Station.

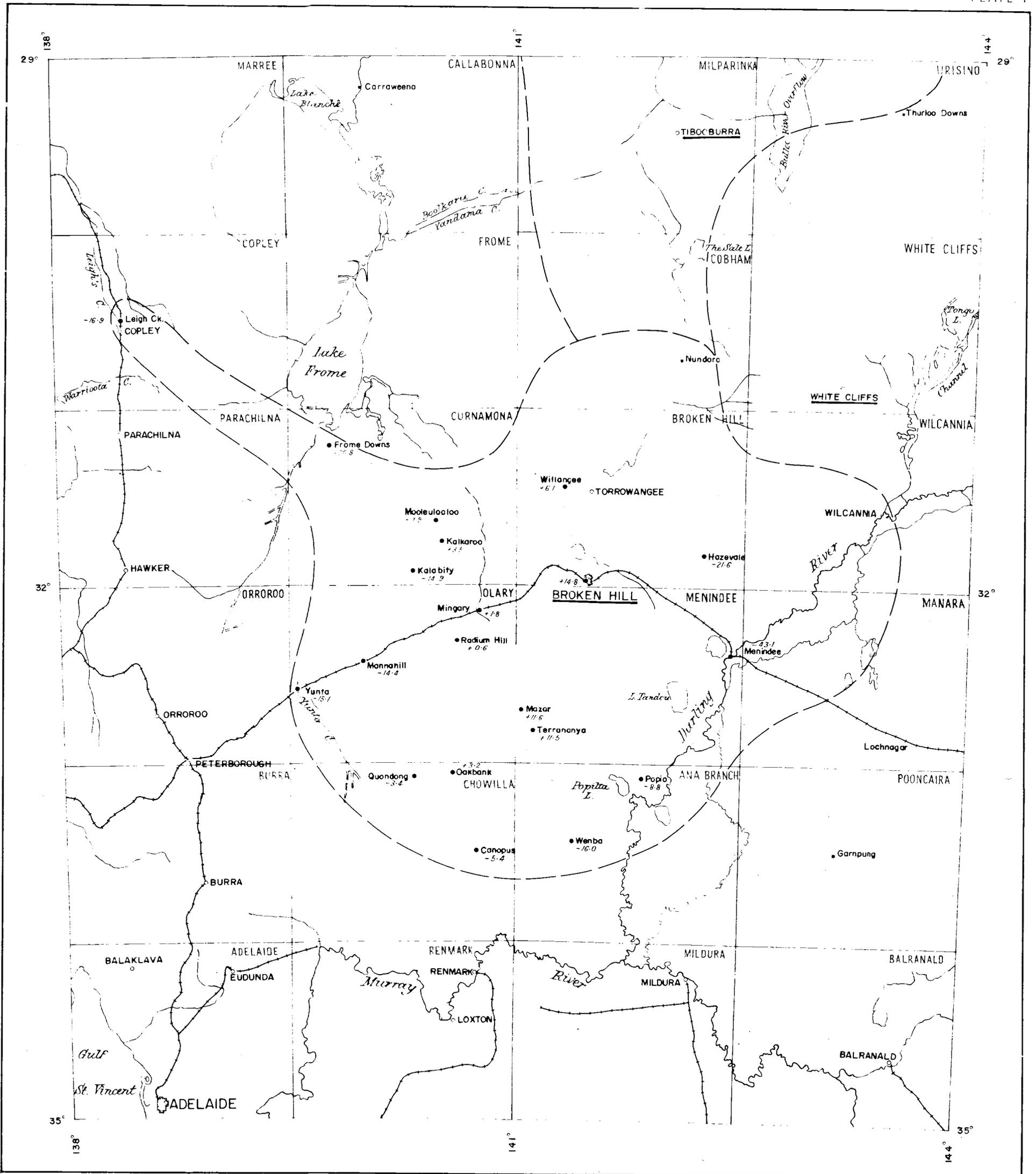
5. RECOMMENDATIONS

Insufficient work has been done to form definite conclusions regarding the gravity results. Many minor troubles have been encountered and overcome and it is felt that there is no reason to assume that the performance of a gravity meter will be upset by this type of flying.

It is recommended therefore that the survey be continued using the Cessna aircraft. A system whereby a mobile field assistant maintains a second microbarograph or microbarometer within the area of operation should give better elevation control.

6. REFERENCES

- | | | |
|---------------------------------|------|-----------------------------------|
| DOOLEY, J. C., McCARTHY, E., | 1961 | Pendulum measurements of |
| MADDERN, C. A., KEATING, W. D., | | gravity in Australia |
| and WILLIAMS, L. W. | | 1950-51. <u>Bur. Min. Resour.</u> |
| | | <u>Aust. Bull.</u> 46. |



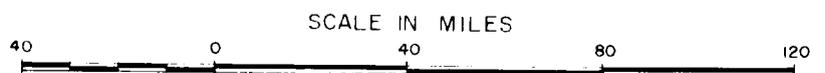
• Gravity station (aerodrome or landing ground)

BURRA 4 mile map area

Gravity station positions from Royal Flying Doctor Service map, Dept. of Civil Aviation HS-2179 at 1:1,000,000 scale.

Bouguer values calculated in milligals
Average rock density = 2.67 g. cm³

REGIONAL GRAVITY SURVEY (1960)
BROKEN HILL AREA, N.S.W. & S.A.
BOUGUER ANOMALIES



Reference - Division of National Mapping 40 M to 1" topographic map

TABLE 1

AREA : BROKEN HILL

DATUM : BROKEN HILL PENDULUM STATION AND M.S.L.

METER : WORDEN 169

DATE OF SURVEY : NOVEMBER 1960

DENSITY VALUE : 2.67 g/c.c.

SENSITIVITY : 0.10563 mgal/div.

Station	Latitude	Longitude	Elevation	Observed Gravity	Normal Gravity	Free Air Correction	Free Air Anomaly	Bouguer Correction	Bouguer Anomaly
Broken Hill P.S.	32° 00.0'	141° 26.5'	938 ft.	979,455.30	979,496.8	88.2	+46.7	32.0	+14.8
Willangee	31° 27.8'	141° 19.2'	581	424.84	453.6	54.7	+25.9	19.8	+ 6.14
Radium Hill	32° 20.6'	140° 38.0'	681	484.41	524.7	64.1	+23.8	23.2	+ 0.6
Menindee	32° 23.5'	142° 24.3'	232	471.62	528.6	21.8	-35.2	7.9	-43.1
Mazar	32° 45.4'	141° 04.1'	348	549.13	558.5	32.7	+23.4	11.9	+11.6
Hazelvale	31° 46.0'	142° 12.0'	406	432.00	478.0	38.2	- 7.8	13.8	-21.6
Mooloolooloo	31° 39.0'	140° 30.8'	341	440.25	468.6	32.1	+ 3.8	11.6	- 7.9
* Frome Downs	31° 13.1'	139° 46.0'	166	397.17	433.9	15.6	-21.2	5.7	-26.8
Popio	33° 04.3'	141° 50.0'	202	563.50	584.4	19.0	- 1.9	6.9	- 8.8
Terrananya	32° 53.7'	141° 08.7'	274	564.88	569.8	25.8	+20.8	9.3	+11.5
Wenba	33° 29.0'	141° 20.5'	176	591.89	618.4	16.6	-10.0	6.0	-16.0
Canopus	33° 30.2'	140° 42.0'	204	602.46	620.1	19.2	+ 1.6	7.0	- 5.4
Quondong	33° 04.7'	140° 19.2'	368	559.49	584.9	34.6	+ 9.2	12.5	- 3.4
Oakbank	33° 03.2'	140° 35.0'	298	568.15	582.9	28.0	+13.3	10.2	+ 3.2
Mannahill	32° 26.1'	139° 59.0'	1207	445.38	532.2	113.5	+26.7	41.1	-14.4
Yunta	32° 35.2'	139° 32.5'	998	469.61	544.6	93.9	+18.9	34.0	-15.1
Kalabity	31° 55.0'	140° 18.5'	624	437.71	490.1	58.7	+ 6.3	21.3	-14.9
Kalkaroo	31° 45.2'	140° 30.3'	701	437.72	476.9	65.9	+26.8	23.3	+ 3.5
Mingary	32° 07.5'	140° 44.5'	662	469.00	507.00	62.3	+24.3	22.6	+ 1.8
Leigh Creek P.S.	30° 28.6'	138° 24.9'	630	320.40	375.1	59.3	+ 4.6	21.5	-16.9

* Gravity Datum for Frome Downs is Leigh Creek P.S. (see text).