COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1962/24

AMADEUS BASIN RECONNAISSANCE GRAVITY SURVEY USING HELICOPTERS, NORTHERN TERRITORY 1961

by

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ILLUSTRATIONS

SUMMARY

This Record describes a reconnaissance gravity survey, using helicopters for transport, over an area described by six 4-mile sheets in the Amadeus Basin, Northern Territory.

The results exhibit considerable gravity relief and in general show a strong east-west alignment of gravity features.

The gravity results show clearly that the Basin consists of two asymmetrical troughs separated by a platform area (here called the 'Angas Downs Gravity Platform'). The troughs show considerable (and as yet undefined) thickness of sediments in their western portions. In the east the Basin narrows considerably, and a trough south of Alice Springs has limited lateral development.

The margins of the Basin are clearly expressed by the gravity results, although the southern margin appears to be interrupted by faulting and is in part covered by Permian sediments. The present gravity work does not show a definite eastern edge to the Basin, but it does indicate a considerable thinning of the sediments to the east.

Many closed anticlines recognized from airphotos agree in position with gravity features. There is also a set of gravity trends striking approximately north-north-west, but the significance of this pattern is not yet known.

1. INTRODUCTION

This Record describes a gravity survey over an area of 42,000 square miles covered by six 4-mile sheets as shown on Plate 1. These sheets were part of a larger area (including portions of the Georgina and Great Artesian Basins) covered by helicopter gravity reconnaissance surveys during the 1961 field season.

The statistics of the operation are included in Appendix A.

A minimum density of one gravity station per 50 square miles was established over the area; this density was increased over certain geological features (e.g. the Waterhouse structure) and where repeat flights were made to places where a significant gravity feature had been located on the first flight.

The portion of the work described in this Record was carried out under the party leadership of B.C. Barlow. Acknowledgement is made to Mr Barlow, to Dr. F.J.G. Neumann, and Mr T. Quinlan (Resident Geologist, Alice Springs) for useful discussions concerning the gravity results.

Results from private company work are not included in this Record.

2. GEOLOGY

Many workers have contributed towards a knowledge of the geology of the Amadeus Basin; the most recent geological reports are those by Quinlan (1959) and the Institut Francais du Petrole (1960). The latter report also includes the substance of geological investigations by geologists of Frome-Broken Hill Company (Leslie, 1960). The geology of part of the Hermannsburg sheet, discussed by Prichard and Quinlan (1960), will also be referred to here.

The most recent geological map (after Quinlan) is shown on Plate 2.

The Amadeus Basin contains a sequence of extensively faulted and folded Proterozoic and Palaeozoic sediments, overlain in places by Upper Permian to Recent sediments. It is generally thought to lie between the Arunta Complex north of the Macdonnel Ranges, and the outcrops of gneiss, schist, etc. which occur along the South Australian border. The nature of the southern boundary of the Basin is not obvious from known surface geology.

The stratigraphy of the Basin, based mainly on lithology, is given by Quinlan (1959) and is as follows:

Age		Formation	Lithology
QUATERNARY			Aeolian sand
TERTIARY			Laterites and 'Grey Billy' profiles etc.
MESOZOIC	JURASSIC	De Souza Sandstone	'Deep Alluvium'. Sandstone, glacial deposits, conglomerate, silty sandstone .
UPPER PALAEOZOIC	PERMIAN	'Finke Series'	
	PERMIAN?	'Pertnjara Series'	Conglomerate, calcareous sandstone
	-	Unconformity -	
	DEVONIAN	Mareenie Sandstone	Quartz sandstone
LOWER PALAEOZOIC	ORDO-VICIAN	'Larapintine Series'	Greywacke, limestone, and shale
	CAMBRIAN	'Pertaoorrta Series'	Shale, sandstone, and quartz
UPPER PROTERO-ZOICS	-	'Pertatataka Series'	Conglomerate
		Disconformity -	
		Bitter Springs Limestone	Interbedded dolomite, limestone, and shale.
		Heavitree Quartzite	Sandstone and silicified sandstone.
ARCHAEAN		Arunta Complex	Granite, gneiss, schist, etc.

Except that some further Series have been introduced by Frome-Broken Hill Company geologists, the information in this table and the geological information shown on Plate 2 are, in general, acceptable to the Institut Francais du Petrole (I.F.P.). However, a fundamental difference of interpretation exists between the I.F.P. (which accepts the Frome-Broken Hill geologists' interpretation) and Quinlan. The I.F.P. postulates shallow Proterozoic basement south of Rodinga, whereas Quinlan allows the possibility of a substantial thickness of Cambro-Ordovician sediments there. The Bureau has done some seismic work to try and resolve this matter, but at the time of writing the results have not yet been fully worked out.

The Basin has been affected by tectonic movements which began in the Ordovician Period and reached their maximum intensity in Upper Palaeozoic time. These movements formed many large anticlines parallel to the northern boundary of the Basin. Several of these structures are shown on Plate 2; these are taken from a map by Brunnschweiler (1957) who considers that several of the structures warrant closer examination. The I.F.P. also considers that some of the structures, particularly in the western portion of the Basin (beyond the present survey area), are favourable for exploration.

A dome (Gosse Bluff), which could be of diapiric origin, is visible in the Hermannsburg syncline.

3. GEOPHYSICAL WORK PRIOR TO 1961

Gravity

During 1957-59 the Bureau surveyed some regional gravity traverses in the area using surface transport. Plate 3 is a preliminary Bouguer anomaly contour map drawn from the results of this work and from surveys by Marshall and Narain (1954) and Richards (1958). Information from subsidized gravity surveys by private companies was used as a guide in this contouring.

The main features of the gravity results at this stage were:

(1) considerable gravity relief, with very steep gradients in the region of Alice Springs.

(2) a gravity 'low' immediately south of Alice Springs; the extent of this feature was not established.

(3) a gravity 'low' in the vicinity of Ayers Rock (not included in the present survey).

(4) a gravity 'low' in the Hermannsburg/Gosse Bluff area which suggested a considerable thickness of Proterozoic and Palaeozoic sediments.

(5) a gravity 'high' trending north-west across the eastern portion of the Charlotte Waters sheet.

(6) a gravity 'high' in the region of the Mann Range (not included in the present survey.

Aeromagnetic

Several long aeromagnetic traverses were surveyed by the Bureau. Three of these are shown as A, B, and C on Plate 2.

Results along Traverse A indicate that 'magnetic basement' west of Finke is shallow, but at the northern end of the traverse (latitude 25°) it deepens to 6000 ft.

Within the area at present under consideration, the profiles on Traverses B and C are very flat and suggest a deep magnetic basement.

Seismic

Some detailed seismic work has been done in the Alice Springs district by Dyson and Wiebenga (1957). The results, however, are of little use in the present discussion. Of greater value will be the results of seismic surveys by the Bureau in 1961 (Moss, personal communication).

4. REDUCTION OF GRAVITY DATA

The results discussed in this Record are preliminary and have been prepared in the field. All work will be re-computed and a distribution of errors will be made later. The preliminary results (i.e. the gravity contours) should not differ materially from the final results, but it is expected that some of the irregularities in the present contours will not be present in the final contours.

Approximately 950 miles of levelling was provided by the Department of the Interior as a control for barometric levelling done during the present survey. This amount of levelling represented the minimum considered necessary for the purpose and generally consisted of north-south traverses near the western and eastern edges of the 4-mile sheets, with occasional east-west ties for surveying purposes.

Methods of distribution of errors (particularly in relation to barometric levelling) have been discussed elsewhere; e.g. see 'Fitzroy and Canning Basins reconnaissance gravity surveys, W.A. 1952-1960' by A.J. Flavelle and M.J. Goodspeed (in preparation). Principally because of the uneven terrain in parts of this area, some of the errors involved in the barometric levels could be considerable (say up to 30 ft). However, after distribution it is expected that Bouguer values will be correct to within $\pm$ 2 milligals.

No figures for rock densities are given in this Record. Surface samples tested showed a variation from 2.6 to 3.0 g/cm^3 for Archaean rocks and a variation from 2.2 to 2.7 g/cm^3 for younger rocks (the Pertnjara conglomerate, for example, can be expected to be one of the denser members of the sedimentary sequence, because it consists partly of dense Arunta Complex material). For the purpose of calculating thickness of sediments, a density contrast of 0.3 g/cm^3 between Archaean and younger rocks has been assumed. This figure may have to be revised when density measurements on core and other samples are completed.

5. DISCUSSION OF RESULTS

Discussion will be concerned mainly with the 40-mile map (Plate 3), as the principal features brought out by the gravity results are best shown on the area as a whole.

Referring then to Plate 3, the gravity results show considerable relief especially on the Hermannsburg and Alice Springs sheets. The general picture is one of considerably disturbed gravity with a general east-west alignment of gravity trends. Some gravity features are clearly related to known (or predicted) geological features; other gravity features, even without geological support at this stage, are sufficiently clear to be classed as definite.

The most prominent feature is the zone of steep gravity gradient (Feature No. 1) which tends in a westerly direction across the Hermannsburg sheet and most of the Alice Springs sheet. This zone has a maximum gradient of about 3 mgal per mile, near its centre on the Hermannsburg sheet. Towards its eastern portion on the Alice Springs sheet the gradient in Feature No. 1 weakens and intersects a strong north-north-west feature (No. 5) expressed in the gravity contours over the eastern portion of the Alice Springs sheet.

The boundary of the Basin lies to the south of Feature No. 1, in a zone intermediate between the Arunta Block and the Hermannsburg syncline. Figures 2 and 3 on Plate 10 clarify this point. It is to be noted that the tight 'bunching' of the gravity contours is well to the north of the Chewings Range.

The steepest gravity gradients on the Hermannsburg and Alice Springs sheets occur in general over Archaean (Arunta Complex) outcrop (e.g. the section along the Stuart Highway, lying between the minus 25 and minus 110 mgal contours is entirely over Archaean outcrop). Archaean rocks north of Alice Springs include outcrops of basic and ultra-basic rocks, but their extent is not known. Presumably these higher density rocks could account for at least some of the gravity 'highs' within the Arunta Complex. They may also account in small part for the steep gravity gradient under discussion.

Other explanations for this gradient, however, seem more likely. If we accept that the average density of the Archaean Complex is 0.3 g/cm^3 higher than that of the sediments in the Basin, then approximately 40,000 ft of sediments would produce a gravity change of the order observed. There is the possibility of extensive overthrusting (and faulting) of Archaean over sediments and there seems to be clear field evidence that this has happened. The process could account for the steepness of the gradients and for the gravity 'lows' which occur within the Arunta Complex both in this Basin and in the Georgina Basin. In addition, as Marshall and Narain point out, there is good reason to expect crustal warping within this area. The marked gravity relief in this Basin is thus most probably due to a combination of the density contrast between basement and sediments, the very great thickness of sediments, overthrusting, and crustal warping.

Feature No. 2 (Plate 3) represents the axis of a syncline which is variously called the Hermannsburg or Missionary Plains Syncline and can be traced with fair definition from the western edge to about half way across the Hermannsburg sheet. There is a similar but smaller gravity 'low' (Feature No. 4) south of Alice Springs. Feature No. 2 appears to be well away from the northern edge of the Basin, while Feature No. 4 is much closer to the margin of the Basin (particularly its western portion appears to trend in very close to this northern margin). These two gravity 'lows' have about the same order of gravity relief, but whereas Feature No. 4 has a limited development in a lateral sense, Feature No. 2 appears to develop even more strongly to the west, and gravity work carried out on the marginal portion of Hermannsburg sheet confirms this view. (Marginal work has been carried out in the western edges of the Hermannsburg, Henbury, and Kulgera sheets and on the eastern edges of the Alice Springs, Rodinga, and Charlotte Waters sheets except where connections have been made to private Company work. Details of this marginal coverageare included only on plate 3).

Consider, next, Feature No. 15. This 'high' represents a platform (suggested name : the Angas Downs gravity Platform) within the Basin and is located over Ordovician and Cambrian outcrop.

Southwards from the Angas Downs Gravity Platform the Bouguer values decrease with progressively greater steepness until reaching their minimum value in Feature No. 17 which represents a gravity 'low' extending entirely across the Kulgera sheet and agreeing approximately in position with Upper Palaeozoic and Devonian outcrop. Feature No. 20 has been shown separately, but it is possible that this could be the continuation of Feature No. 17. Feature 17 is a trough (suggested name: Mt Connor Gravity Trough) which develops more strongly in its western portion, and again marginal work on the Kulgera sheet shows that this development continues. Thus Features 2 and 17 are comparable in development and each is asymmetrically placed with respect to the Angas Downs Gravity Platform and the northern and southern boundaries of the Basin respectively.

However, the gravity results indicate a feature striking north-north-west (No. 18) and it is possible that the edge of the Basin west of Feature 18 may be displaced to the south. Additional gravity work would be needed to test this contention, but if it is substantially correct then the importance of the trough represented by Feature 17 is probably increased for it allows the possibility of a greater number of closed structures within a deep trough of sediments.

Close to the southern edge of the Basin the gravity gradients steepen and follow a pronounced north-east trend (this is shown as Feature 19). These gradients are not as steep as those associated with the northern edge of the Basin (Feature No. 1) but it is noticeable that the trends of both Features change abruptly in their eastern portions. The gravity results show that the Basin narrows considerably but a definite eastern boundary has not yet been established by gravity work (which here also includes consideration of private company work).

Consider next the gravity trends which are present within this general picture of the basin structure. Reference is made here to various structural trends inferred principally from air-photo interpretation by Brunnschweiler. This structural information is included on the geological plan, Plate 2.

The break in the alignment between Features 2 and 4 has been noted. This break is probably closely related to gravity Feature No. 9 which is considered to represent a north-west-striking fault. That such a fault exists seems clear from the change in character of the gravity contours between Features 8 and 10. The extension of Feature 9 in its north-west portion is, however, doubtful at this stage. Gravity Features Nos. 8, 10, and 11 agree in position with the Hughes and James structures and Chandler Nappe Thrust respectively. The Henbury Anticline also is expressed by gravity Feature No. 12. The Ooraminna and Waterhouse structures over which more-closely-spaced gravity stations were read do not show up as distinct features in the gravity pattern.

Gravity Feature No. 3 is clearly related to the Areyonga Nappe Thrust and the Gardiner anticline. The Trickett Creek Disturbance is probably related to the rather obscure distortion of the gravity contours marked as Feature No. 13. The Angas North Anticline shows a fairly clear correlation with gravity Feature No. 14. Other anticlines shown by Brunnschweiler do not have any obvious correlation with the gravity results.

Thus there is agreement between many of the closed structures (anticlines) and features within the general gravity pattern. The general east-west structural trend (with the additional tendency to arcuate form and especially the more intense turning of beds in the eastern portion of the Alice Springs sheet) is brought out by the gravity results. The presence of an east-west relatively undisturbed gravity zone lying between Features 3 and 13 should also be noted, but its geological significance is not known.

In addition to Features 9 and 18, there are other gravity features which have a north-north-west strike direction. These include Features No. 5, 6, 7, 16, and 23. Features 5, 6, and 7 are within the eastern portion of the northern trough; 16 and 18 are near the margins of the southern trough; and 23 is associated with the Mesozoic-Permian platform (Feature 22) which noses into the south-east portion of the Basin.

Thus, in addition to the dominant east-west trend of the gravity results there is a second set of features which have a north-north-west trend. The significance of this latter trend is not apparent at present, but it may be related to tectonic movements associated with the formation of the Proterozoic Adelaidean Geosyncline. It is noted from the Tectonic Map of Australia that structures in the region west of Oodnadatta which are mainly in Mesozoic outcrop but which are related to pre-existing structures in the Precambrian also have this trend and it is possible that this movement has carried over into the Amadeus Basin. It has been pointed out by Quinlan (personal communication) that this trend is also parallel to the Precambrian trends on the Hale River sheet which may even be pre-Pertatataka in age. However it is considered unlikely that this north-north-west pattern is related in age to the arcuate structural pattern of Brunnschweiler.

Consider next the relation between the gravity results and some geological features within the area under examination. The gravity work indicates the northern edge and portion of the southern edge of the Basin, but because of the presence of crustal warping and extensive overthrusting within the area there is generally no clear relation between the gravity pattern and surface geology. However, exceptions are the Ordovician/Cambrian outcrops in the region of the Angas Downs Gravity Platform (gravity Feature No. 14) and the Upper Palaeozoic and Devonian outcrops associated with the troughs, Features 2 and 17.

The gravity results in the south-eastern half of the CHARLOTTE WATERS sheet (Plate 9) are consistent with the presence of a platform of Mesozoic and Permian rocks which may be a nose protruding into the Amadeus Basin rather than a feature contributing towards any closure of the Basin on its eastern side.

The Macdonnel Ranges do not have any obvious expression in the gravity results. However, there is a negative gravity feature closely associated with Gosse Bluff which is considered to be a salt dome structure. Some detailed gravity work has been done in the region of Gosse Bluff by Frome-Broken Hill, but the results are not included in this report. The present work indicates other gravity 'lows' within this geological setting which could be associated with similar diapiric bodies. More detailed gravity coverage is needed before definite conclusions in this regard can be drawn.

Finally, reference is made to the composite gravity profile (Fig.2, Plate 10) along the section line A-B-B' shown on Plates 2 and 4. The section line A-B was chosen because it was the line of geological cross-section included on Plate 2 of the report by Prichard and Quinlan (1960). A later geological section prepared by Jones (personal communication) and incorporating further field data is included as Figure 1 on Plate 10. Two possible geological sections, Figures 3a and 3b, which could be consistent with the gravity data are also included on Plate 10.

Figure 3b is simply an amplification of the geological cross-section, Figure 1. To account for the obscured gravity profile (Fig.2), this cross-section assumes that the principal density contrast is between the metamorphic rocks and the basic and ultrabasic rocks and that there is little density contrast between the metamorphic and sedimentary rocks.

However, there is reasonable evidence that the density contrast between the metamorphic and sedimentary rocks is not insignificant and may be as high as 0.3 g/cm^3, in which case Figure 3b would not account for the Bouguer anomaly profile of Figure 2. A second cross-section (Fig.3a) is therefore included in which the significant density contrast (approximately 0.3 g/cm^3) is considered to be between the Archaean metamorphics and the sediments. Again it is necessary to assume the presence of basic and ultrabasic material, but at greater depth than in Figure 3b, to account for the observed profile of Figure 2. The possibility of deep-seated mass displacements in the substratum contributing towards gravity variations of such unusual magnitude cannot be overlooked.

Both sections are essentially similar in their Hermannsburg Syncline and Arunta Block portions but interpretation of the intermediate section is doubtful. There is no doubt that the zone between the Arunta Block and the Amadeus Sunkland is one of considerable faulting and thrusting and is much more complex than is shown by either Figure 3a or 3b.

The presence of salt in the Bitter Springs Limestone provides the necessary medium for mobility in Figure 3a. However, it could be argued that earth movements of such magnitude in rocks of this age are rare in Australia though not uncommon in the rest of the world. Short of drilling it is felt that the matter could best be resolved by a seismic traverse over this or a similar line of section.

6. CONCLUSIONS AND RECOMMENDATIONS

Summing up, the broad structural features of the Basin as revealed by this examination of the gravity data are:

(a) a general east-west alignment of the gravity pattern with the northern and southern edges of the basin related to the steep gravity gradients, features 1 and 19.

It is notable, however, that the steep gradient (Feature 1) lies mostly to the north of the apparent northern margin of the basin. Two possible explanations are illustrated by Sections 3a and 3b on Plate 10. In section 3b it is assumed that the steep gradient is due mainly to the density contrast between dense ultrabasic rocks at relatively shallow depth beneath the Arunta Block and the lighter granitic metamorphics of the basement complex. In Section 3a the gradient is assumed to be due to the density contrast between metamorphics of the Arunta Block and the lighter basin sediments. A major overthrust is postulated to explain the presence of light sediments to the north of the surface outcrop.

(b) Two troughs indicated by features 2 and 4 (northern) and 17 and 20 (southern) separated by the 'Angas Downs Gravity Platform', feature 15.

(c) troughs 2 and 17 deepening in their western portions but the Basin as a whole narrowing considerably in its eastern portion. There is no definite gravity evidence for the termination of the Basin on this side within the area covered.

(d) a close correlation between many geological structures (mainly anticlines) mapped from airphotographs and gravity features.

(e) a second set of gravity features with a north-north-west strike direction, the significance of which is not appreciated at present.

Further geological examinations in the northern region of the cross-section shown on Plate 10 would be desirable to see whether or not there is any surface evidence to support one or other of the gravity interpretations. In particular, evidence should be sought for faulting and overthrusting. It is possible that seismic work in this region could yield useful information. Refraction and reflection work should be done across the northern part of the basin to see whether there is any evidence of the postulated overthrust or of sediments lying beneath the Archaean rocks and, if so, to obtain data on their probable thickness and extent.

It is proposed to apply some form of regional correction to the gravity results whereby it is hoped to isolate the gravity effects due to deep-seated bodies and to allow a satisfactory correlation of the residual gravity pattern with the near-surface geology.

7. REFERENCES

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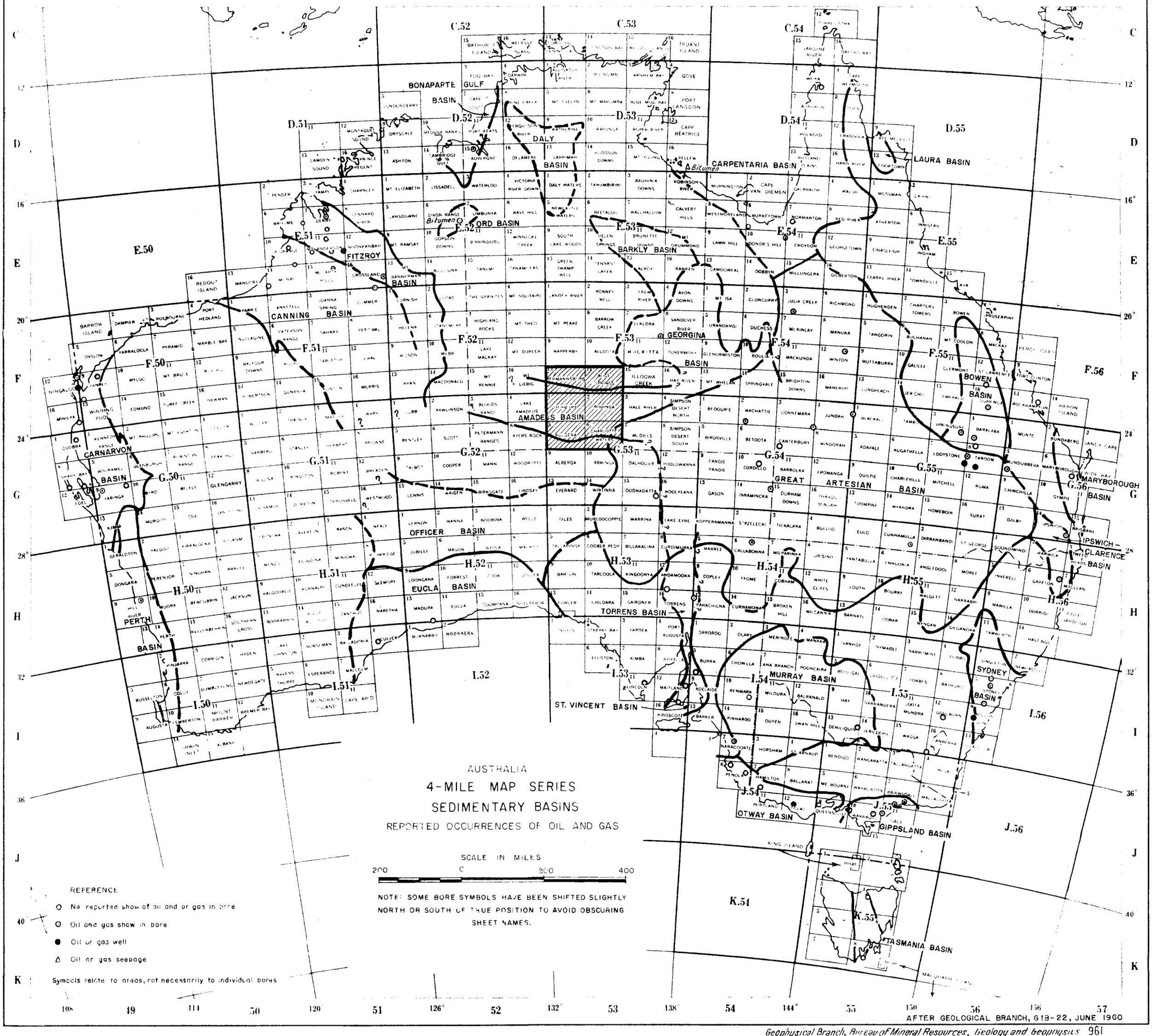
APPENDIX A

Synopsis of survey facts

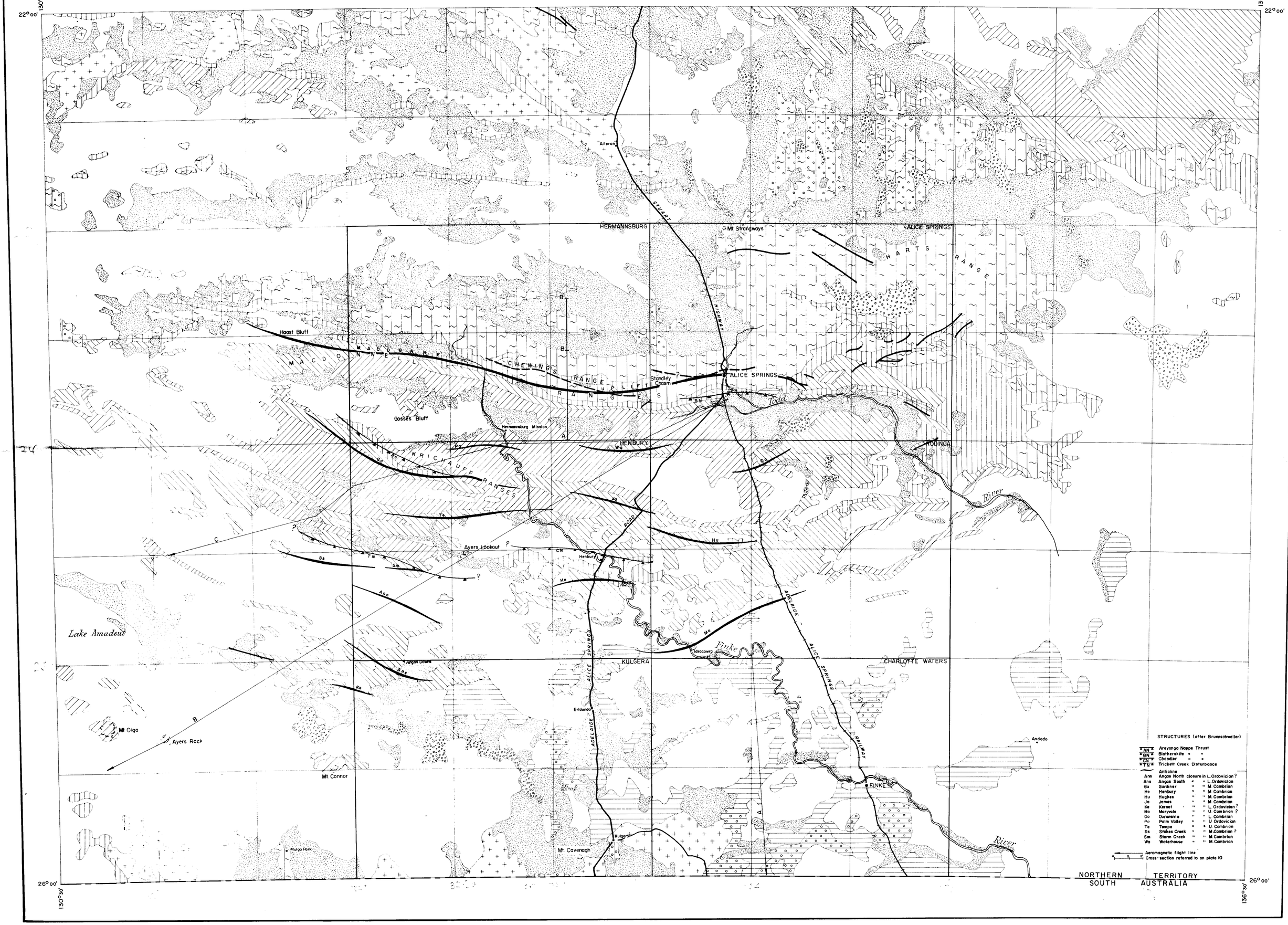
Party Leader:	B.C. Barlow
Other Geophysicists:	Four
Draftsmen:	Two
Other Field Staff:	Mechanic, Mechanic's Assistant, Cook, Cook's Assistant and 3 Field Hands.
Airline and Personnel:	Ansett-ANA. Normally 3 Pilots and 2 Mechanics.
Aircraft:	2: Bell 47J, VH-INF Bristol Sycamore, VH-INQ.
Duration of Survey:	From May 30th to July 14th 1961
Area Surveyed:	Six 4-mile areas (Plate 1). Approximately 42,000 square miles.
Gravity meters:	2: Master Worden No. 548. Sensitivity = 0.08975 milligals per scale division, World Wide No. 35. Sensitivity = 0.11505 milligals per scale division.
Microbarometers:	Askania. Nos. 56296 used continually during survey Nos. 531308, 531333, 5112395, 531306 used at times during survey and performance OK. Nos. 5112362, 5112473 used ..... unsatisfactory.
Total number of new gravity stations established by helicopter.	1088
Number of stations established by ground traverses:	34
Total hours flown on charter:	274
Total days lost through weather:	Nil
Total days lost through aircraft U/S (excluding Sunday or day in lieu for maintenance):	14
Vehicle strength of party:	10 trucks. 2 Bedford 3-ton 4 x 4 (C10675, C10678). 1 Inter. 3-ton 4 x 4 (C85974). 1 Inter. 3-ton 4 x 2 (C90121). 2 Inter. 3-ton 4 x 2 Water Tankers (C84424 and C84425).
Vehicle strength of party:	4 Inter. 1-ton 4 x 4 (C89944, C89985, C90122, C90126).
Main camps established by party:	Alice Springs, Erldunda.
Fly camps established by party:	Pinnacle Well, Mt Chapple Bore, Orange Creek, Gosse Bluff, Palmer Valley, Ringwood, Bundooma, Engoordina, Kulgera.

PLATE I

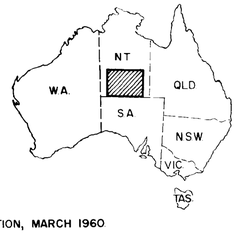


AFTER GEOLOGICAL BRANCH, G1B-22, JUNE 1960

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics 961
TO ACCOMPANY RECORD No 1962/24



LOCATION



FIRST EDITION, MARCH 1960

MAP DATA

PROJECTION: LAMBERT CONFORMAL CONIC STANDARD PARALLELS 24°40' AND 27°20'.

CONTROL: ASTRONOMICAL FIXATIONS BY THE DIVISION OF NATIONAL MAPPING.

DETAIL: BASE MAP FROM 1:1,000,000 I.C.A.O. AERONAUTICAL CHARTS, (1231) LAKE MACKAY, (1232) ALICE SPRINGS, (1343) OODNADATTA (2nd EDITION) AND (1344) PETERMANN RANGES. GEOLOGY FROM DRAFT COPY BY BMR GEOLOGICAL BRANCH AT 12 MILES TO 1 INCH APPROXIMATE SCALE. PLANIMETRY FROM 1:1,000,000 I.C.A.O. CHARTS.

RELIABILITY: PLANIMETRIC – SKETCH.
GEOLOGICAL – REGIONAL GEOLOGY.

RECONNAISSANCE GRAVITY SURVEY (1961) AMADEUS BASIN, N.T.

REGIONAL GEOLOGY

SCALE IN MILES

10 0 10 20 30 40 50 60

LEGEND

RECENT AND PLEISTOCENE
- Deep weathering profile (laterite) Superimposed on formations concerned.
- Aeolian sands.
- Alluvium, wash, red earth soil, calcrete evaporites, clays, terrace gravels.

TERTIARY
- Chalcedony, calcareous silt, gypseous clays.

MESOZOIC AND PERMIAN
- Undifferentiated sandstones, siltstones, claystones, also silty sandstones, boulder bed, arkose and conglomerate of "Finke Series."

UPPER PALAEOZOIC AND DEVONIAN
- Sandstones, conglomerates, shales, "Pertnjara Series," Mareenie and Dulcie Sandstones.

ORDOVICIAN AND CAMBRIAN
- Sandstone, limestone, dolomite, shale, quartz, greywacke, (includes members of "Pertaoorta and Larapintine Series" and the "Sandover Beds")

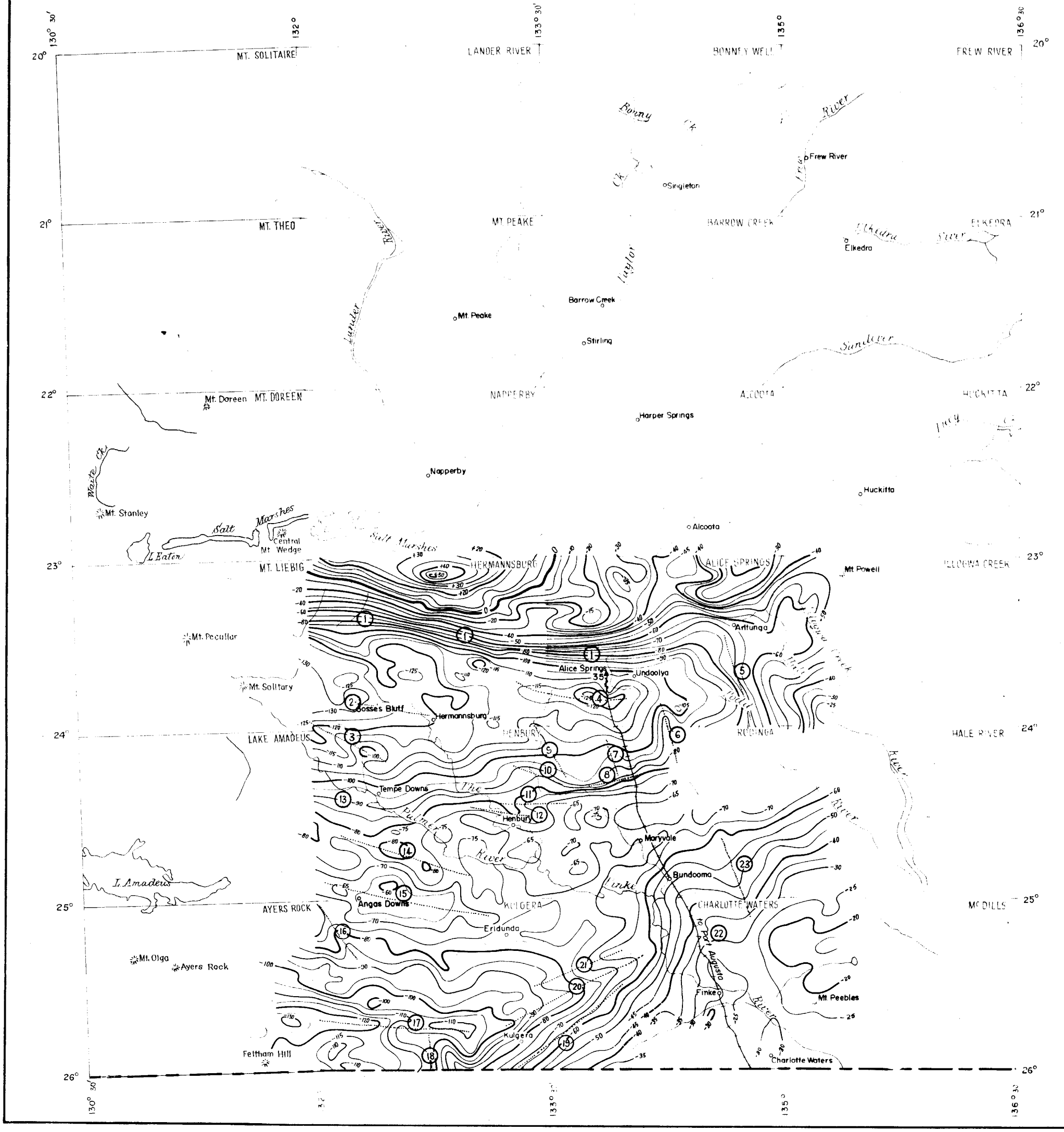
PROTEROZOIC
- Sandstone, quartzite, shale, limestone, conglomerate, boulder beds.

UNDIFFERENTIATED PRECAMBRIAN
- Gneiss, schist, amphibolite, granite, granodiorite, basic intrusive pegmatites, dolerite, "Arunta Complex."
- Granite.

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

G63-28-2

TO ACCOMPANY RECORD No 1962/24



LEGEND

- Isogals, values in milligals
- ▲ 35 B.M.R. gravity pendulum station
- MT. THEO B.M.R. 4-mile gravity map area
- Railway
- (3) Gravity Feature No. 3

RECONNAISSANCE GRAVITY SURVEY (1959-1961) AMADEUS BASIN, N.T.

BOUGUER ANOMALIES

SCALE IN MILES

40 0 40 80 120

Reference - Division of National Mapping 40 miles to 1 inch topographic map

CONTOUR INTERVAL 5 MILLIGALS

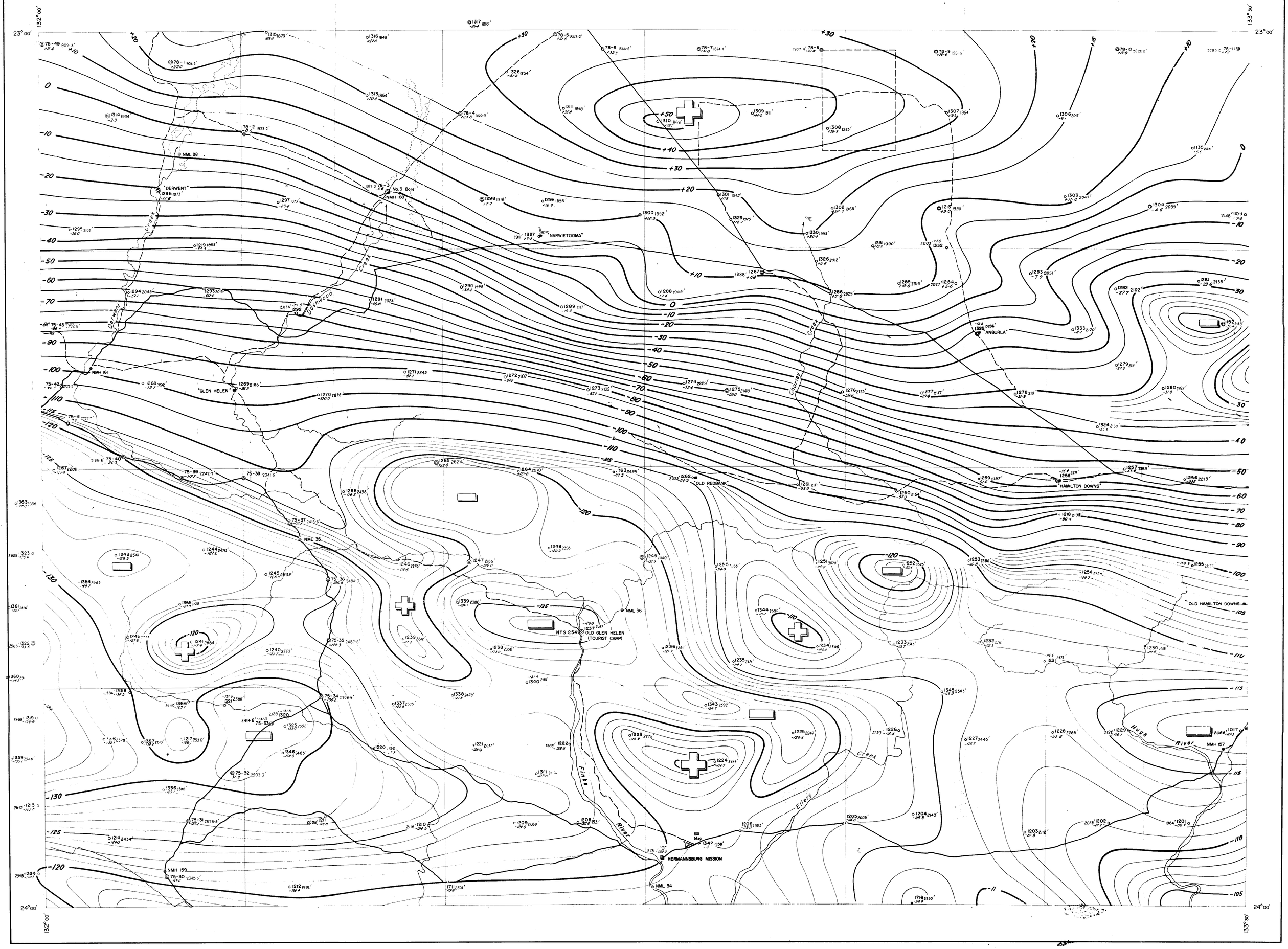
COMPILED AND DRAWN JANUARY 1962

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G 411-2
TO ACCOMPANY RECORD No 1962/24

AUSTRALIA 1:253,440

HERMANNSBURG
NORTHERN TERRITORY

PLATE 4
F 53 - 13 ZONE 4



G 53/12-2-C

LOCATION

MT. DOREEN	NAPPERBY	ALCOOTA
MT. LIEBIG	HERMANNS-BURG	ALICE SPRINGS
LAKE AMADEUS	HENBURY	RODINGA

MAP DATA

PROJECTION: TRANSVERSE MERCATOR, AUSTRALIAN SERIES.

CONTROL: NATIONAL MAPPING 4 MILES TO 1 INCH PLANIMETRIC MAP WITH THE SAME NAME.

DETAIL: PLANIMETRY FROM N.M. MAP COMPILATION REDUCTIONS, DEPT OF THE INTERIOR GRAVITY SURFACE CONTROL MAP AND TRAVERSE DESCRIPTIONS. B.M.R. GRAVITY STATIONS PLOTTED FROM AIR PHOTOS WITH THE AID OF PHOTOCENTRES. GRAVITY DATA FROM B.M.R. HELICOPTER SURVEY 1961

RELIABILITY: PLANIMETRIC — GOOD
GEOPHYSICAL — GRAVITY RECONNAISSANCE
1961 GRAVITY DATA NOT CHECKED.

HELICOPTER GRAVITY SURVEY 1961
AMADEUS BASIN, N.T.

PRELIMINARY BOUGUER ANOMALIES

4 MILES 0 4 8 12 16 MILES 20
10 KILOMETERS 0 10 20 KILOMETERS 30

LEGEND

- RAILWAY
- ROAD
- TRACK
- HOMESTEAD
- AIR STRIP
- PERMANENT MARKED B.M.R. STATION
- B.M.R. STATION
- GRAVITY STATION
- -93.5 RELATIVE BOUGUER ANOMALY (MILLIGALS)
- 1726' ELEVATION
- WATERCOURSE (NON-PERENNIAL)
- TRIG. STATION
- ASTR. STATION
- 5/4 ISOGALS
- HIGH ANOMALY
- LOW ANOMALY

EXPLANATION

RELATIVE BOUGUER ANOMALIES ARE BASED ON THE OBSERVED GRAVITY VALUE OF B.M.R. PENDULUM STATION No. 35 ALICE SPRINGS ..... 978·653·6 MILLIGALS

FOR THE CALCULATION OF BOUGUER ANOMALIES 2·2 GR/CM³ HAS BEEN ADOPTED AS AN AVERAGE ROCK DENSITY.

ELEVATION DATA — M.S.L.

AIR PHOTOGRAPHY — 1950

TOPOGRAPHY AND CULTURAL FEATURES SHOWN ONLY TO LOCATE GEOPHYSICAL DATA.

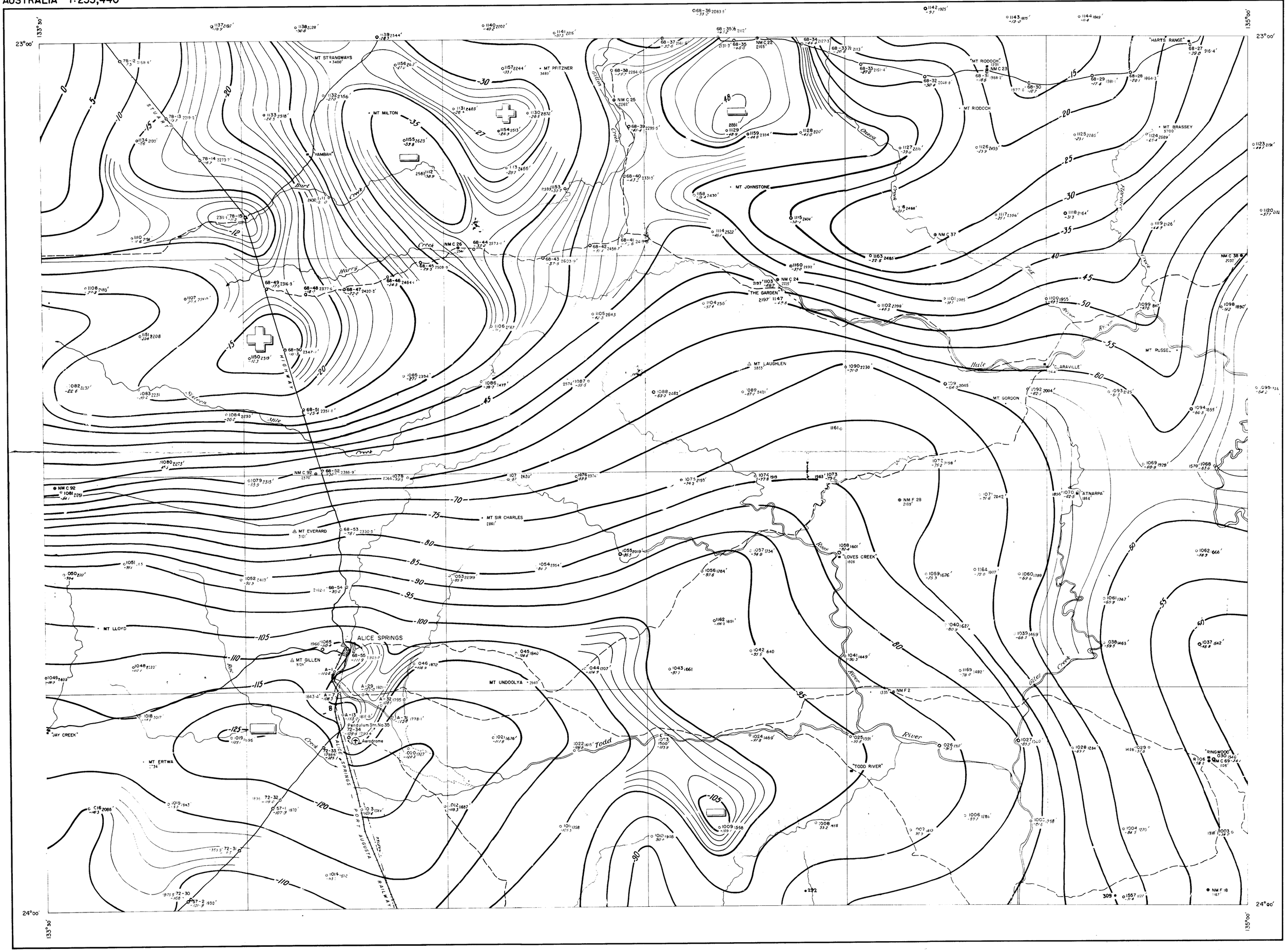
To accompany Record No. 1962/24

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G69-440-2

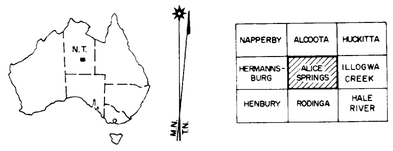
AUSTRALIA 1:253,440

ALICE SPRINGS
NORTHERN TERRITORY

PLATE 5
F53-14 ZONE 5



LOCATION



NAPPERBY	ALCOOTA	HUCKITTA
HERMANNS-BURG	ALICE SPRINGS	ILLOGWA CREEK
HENBURY	RODINGA	HALE RIVER

REFERENCE TO AUSTRALIAN NATIONAL 4 MILE MAP SERIES

COMPILED APRIL 1960
REVISED MARCH 1961

MAP DATA

PROJECTION: TRANSVERSE MERCATOR, AUSTRALIAN SERIES.

CONTROL: NATIONAL MAPPING 4 MILES TO 1 INCH PLANIMETRIC MAP (PROVISIONAL EDITION, AUG. 1959) WITH THE SAME NAME.

DETAIL: PLANIMETRY FROM NATIONAL MAPPING 4 MILES TO 1 INCH PLANIMETRIC MAP AND DEPT. OF THE INTERIOR GRAVITY SURFACE CONTROL MAP WITH THE SAME NAME.
GRAVITY DATA FROM B.M.R. FIELD SURVEY.
1961 MEISER & A. SURVEY [illegible]
[illegible]

RELIABILITY: PLANIMETRIC — GOOD
GEOPHYSICAL — GRAVITY RECONNAISSANCE

RECONNAISSANCE GRAVITY SURVEY (1959 1961)
AMADEUS BASIN, N.T.
BOUGUER ANOMALIES
PRELIMINARY
SCALE IN MILES

4 0 4 8 12 16 20

CONTOUR INTERVAL 1 MILLIGAL

LEGEND

TOPOGRAPHY
- RAILWAY
- ROAD
- TRACK
- HOMESTEAD
- WATERCOURSE (NON-PERENNIAL)
- TRIG. STATION
- ASTR. STATION

GRAVITY
- PERMANENT MARK-O ST
- B.M.R. STATION
- PRIVATE-COMP. STATION
- -12·6 RELATIVE BOUGUER ANOMALY (MILLIGALS)
- 1964·3' ELEVATION
- -5 ISOGALS
- HIGH ANOMALY
- LOW ANOMALY

EXPLANATION

RELATIVE BOUGUER ANOMALIES ARE BASED ON THE OBSERVED GRAVITY VALUE OF B.M.R. PENDULUM STATION
Nº 35 ALICE SPRINGS ..... 978,653·6 MILLIGALS

FOR THE CALCULATION OF BOUGUER ANOMALIES 2·2 GR/CM³ HAS BEEN ADOPTED AS AN AVERAGE ROCK DENSITY.

ELEVATION DATA — M.S.L.

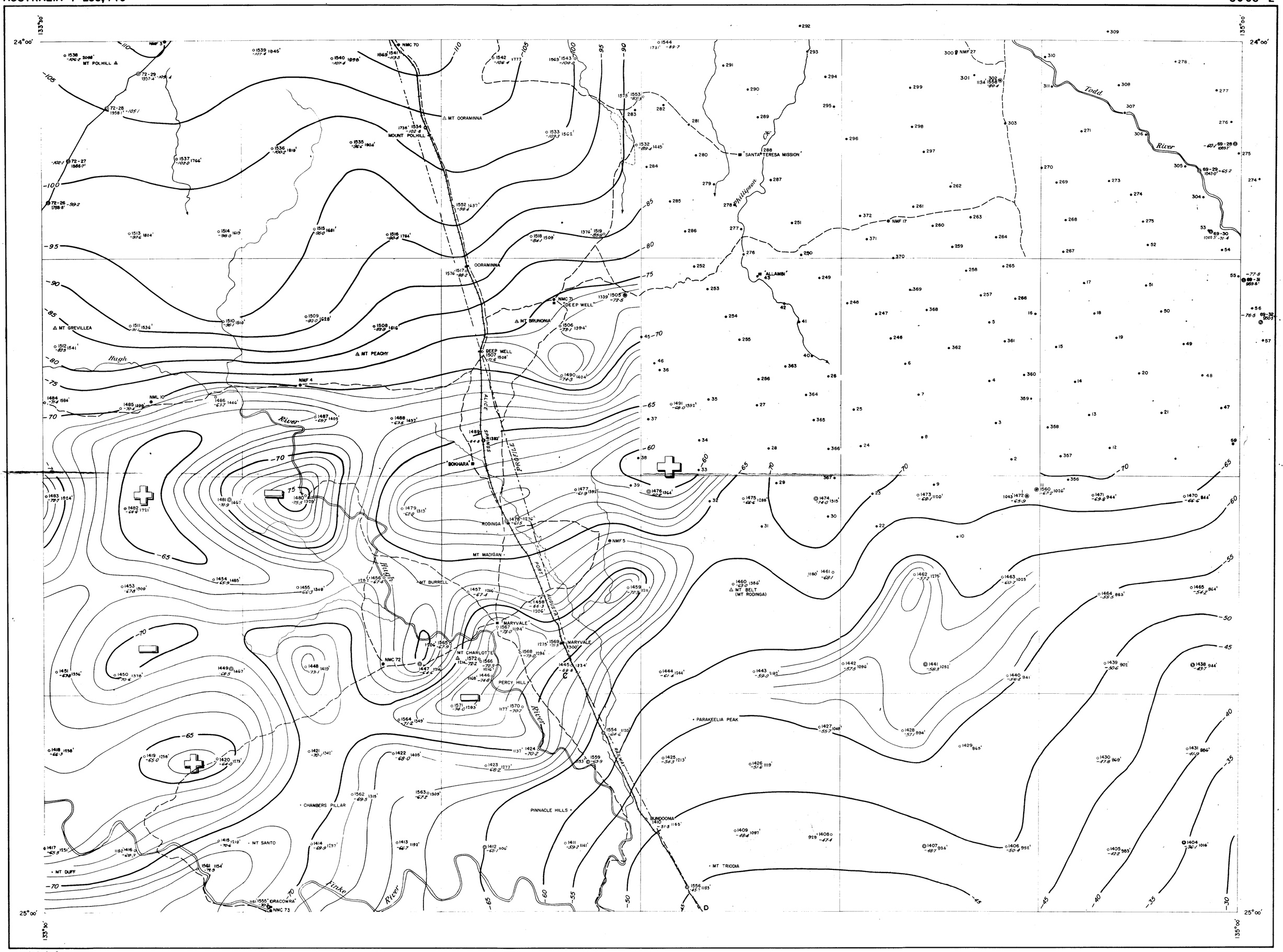
NOTE: TOPOGRAPHY AND CULTURAL FEATURES SHOWN ONLY TO LOCATE GEOPHYSICAL DATA.

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G69-73-2
TO ACCOMPANY RECORD No1962/24

AUSTRALIA 1:253,440

RODINGA
NORTHERN TERRITORY

PLATE 6
SG 53-2



G 53/B2-2-C

LOCATION

HERMANNS-BURG	ALICE SPRINGS	ILLOGWA CREEK
HENBURY	RODINGA	HALE RIVER
KULGERA	CHARLOTTE WATERS	McDILLS

MAP DATA

PROJECTION: TRANSVERSE MERCATOR, AUSTRALIAN SERIES.

CONTROL: NATIONAL MAPPING 4 MILES TO 1 INCH PLANIMETRIC MAP WITH THE SAME NAME.

DETAIL: PLANIMETRY FROM N.M. MAP COMPILATION REDUCTIONS, DEPT OF THE INTERIOR GRAVITY SURFACE CONTROL MAP AND TRAVERSE DESCRIPTIONS. B.M.R. GRAVITY STATIONS PLOTTED FROM AIR PHOTOS WITH THE AID OF PHOTOCENTRES. GRAVITY DATA FROM B.M.R. HELICOPTER SURVEY 1961

RELIABILITY: PLANIMETRIC — GOOD
GEOPHYSICAL — GRAVITY RECONNAISSANCE
1961 GRAVITY DATA NOT CHECKED.

HELICOPTER GRAVITY SURVEY 1961
AMADEUS BASIN, N.T.

PRELIMINARY BOUGUER ANOMALIES

4 MILES 0 4 8 12 16 MILES 20
10 KILOMETERS 0 10 20 KILOMETERS 30

LEGEND

- RAILWAY
- ROAD
- TRACK
- HOMESTEAD
- AIR STRIP
- WATERCOURSE (NON-PERENNIAL)
- TRIG. STATION
- ASTR. STATION
- PERMANENT MARKED B.M.R. STATION
- B.M.R. STATION
- GRAVITY STATION
- -93·5 RELATIVE BOUGUER ANOMALY (MILLIGALS)
- 1726' ELEVATION
- 5 / 4 ISOGALS
- HIGH ANOMALY
- LOW ANOMALY

EXPLANATION

RELATIVE BOUGUER ANOMALIES ARE BASED ON THE OBSERVED GRAVITY VALUE OF B.M.R. PENDULUM STATION No. 35 ALICE SPRINGS ..... 978·653·6 MILLIGALS

FOR THE CALCULATION OF BOUGUER ANOMALIES 2·2 GR/CM³ HAS BEEN ADOPTED AS AN AVERAGE ROCK DENSITY.

ELEVATION DATA — M.S.L.

AIR PHOTOGRAPHY — 1950

TOPOGRAPHY AND CULTURAL FEATURES SHOWN ONLY TO LOCATE GEOPHYSICAL DATA.

To accompany Record No. 1962/24

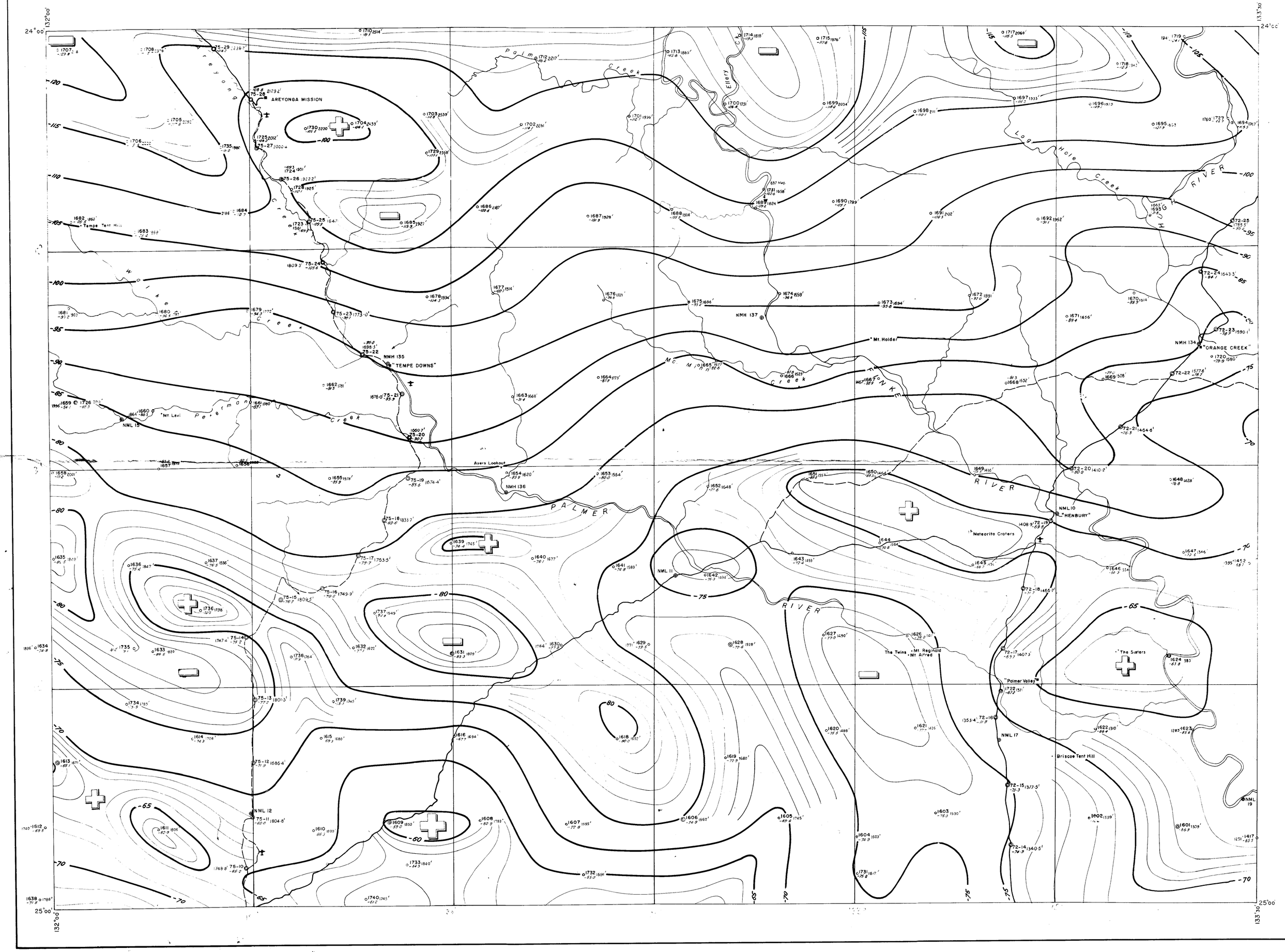
GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G69 — 438-2

AUSTRALIA 1:253,440

HENBURY
NORTHERN TERRITORY

G 53-1

PLATE 7
ZONE 4



LOCATION

MT LIEBIG	HERMANNSBURG	ALICE SPRINGS
LAKE AMADEUS	HENBURY	RODINGA
AYERS ROCK	KULGERA	CHARLOTTE WATERS

MAP DATA

PROJECTION: TRANSVERSE MERCATOR, AUSTRALIAN SERIES.

CONTROL: NATIONAL MAPPING 4 MILES TO 1 INCH PLANIMETRIC MAP WITH THE SAME NAME.

DETAIL: PLANIMETRY FROM N.M. MAP COMPILATION REDUCTIONS, DEPT. OF THE INTERIOR. GRAVITY SURFACE CONTROL MAP AND TRAVERSE DESCRIPTIONS. B.M.R. GRAVITY STATIONS PLOTTED FROM AIR PHOTOS WITH THE AID OF PHOTOCENTRES. GRAVITY DATA FROM B.M.R. HELICOPTER SURVEY 1961

RELIABILITY: PLANIMETRIC — GOOD
GEOPHYSICAL — GRAVITY RECONNAISSANCE
1961 GRAVITY DATA NOT CHECKED.

HELICOPTER GRAVITY SURVEY 1961
AMADEUS BASIN, N.T.

PRELIMINARY BOUGUER ANOMALIES

4 MILES 0 4 8 12 16 MILES 20
10 KILOMETERS 0 10 20 KILOMETERS 30

LEGEND

- RAILWAY
- ROAD
- TRACK
- HOMESTEAD
- AIR STRIP
- WATERCOURSE (NON-PERENNIAL)
- TRIG. STATION
- ASTR. STATION
- PERMANENT MARKED B.M.R. STATION
- B.M.R. STATION
- GRAVITY STATION
- -93·5 RELATIVE BOUGUER ANOMALY (MILLIGALS)
- 1726' ELEVATION
- 5 / -4 ISOGALS
- HIGH ANOMALY
- LOW ANOMALY

EXPLANATION

RELATIVE BOUGUER ANOMALIES ARE BASED ON THE OBSERVED GRAVITY VALUE OF B.M.R. PENDULUM STATION No. 35 ALICE SPRINGS ..... 978·653·6 MILLIGALS

FOR THE CALCULATION OF BOUGUER ANOMALIES 2·2 GR/CM³ HAS BEEN ADOPTED AS AN AVERAGE ROCK DENSITY.

ELEVATION DATA — M.S.L.

AIR PHOTOGRAPHY — 1950

TOPOGRAPHY AND CULTURAL FEATURES SHOWN ONLY TO LOCATE GEOPHYSICAL DATA.

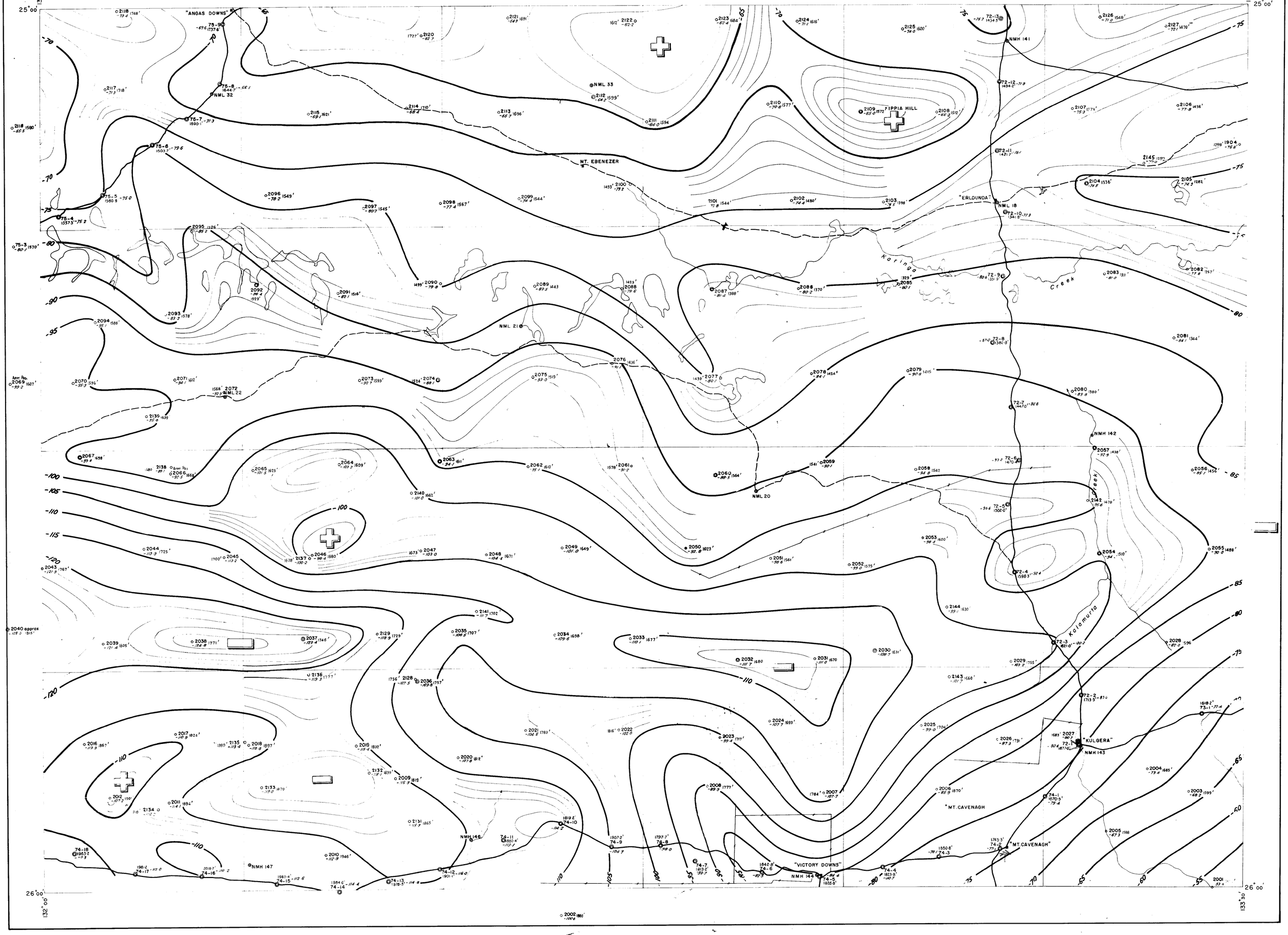
To accompany Record No. 1962/24

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G69-439-2

AUSTRALIA 1:253,440

KULGERA
NORTHERN TERRITORY

G 53-5 PLATE 8 ZONE 5



LOCATION

LAKE AMADEUS	HENBURY	RODINGA
AYERS ROCK	KULGERA	CHARLOTTE WATERS
WOODROFFE	ALBERGA	ABMINGA

MAP DATA

PROJECTION: TRANSVERSE MERCATOR, AUSTRALIAN SERIES.

CONTROL: NATIONAL MAPPING 4 MILES TO 1 INCH PLANIMETRIC MAP WITH THE SAME NAME.

DETAIL: PLANIMETRY FROM N.M. MAP COMPILATION REDUCTIONS, DEPT. OF THE INTERIOR GRAVITY SURFACE CONTROL MAP AND TRAVERSE DESCRIPTIONS. B.M.R. GRAVITY STATIONS PLOTTED FROM AIR PHOTOS WITH THE AID OF PHOTOCENTRES. GRAVITY DATA FROM B.M.R. HELICOPTER SURVEY 1961

RELIABILITY: PLANIMETRIC — GOOD
GEOPHYSICAL — GRAVITY RECONNAISSANCE
1961 GRAVITY DATA NOT CHECKED.

HELICOPTER GRAVITY SURVEY 1961
AMADEUS BASIN, N.T.

PRELIMINARY BOUGUER ANOMALIES

4 MILES 0 4 8 12 16 MILES 20

10 KILOMETERS 0 10 20 KILOMETERS 30

LEGEND

RAILWAY
ROAD
TRACK
HOMESTEAD
AIR STRIP
WATERCOURSE (NON-PERENNIAL)
TRIG. STATION
ASTR. STATION
PERMANENT MARKED B.M.R. STATION
B.M.R. STATION
GRAVITY STATION
-93·5 RELATIVE BOUGUER ANOMALY (MILLIGALS)
1726' ELEVATION
ISOGALS
HIGH ANOMALY
LOW ANOMALY

EXPLANATION

RELATIVE BOUGUER ANOMALIES ARE BASED ON THE OBSERVED GRAVITY VALUE OF B.M.R. PENDULUM STATION
No. 35 ALICE SPRINGS ..... 978·653·6 MILLIGALS

FOR THE CALCULATION OF BOUGUER ANOMALIES 2·2 GR/CM³ HAS BEEN ADOPTED AS AN AVERAGE ROCK DENSITY.

ELEVATION DATA — M.S.L.

AIR PHOTOGRAPHY — 1950

TOPOGRAPHY AND CULTURAL FEATURES SHOWN ONLY TO LOCATE GEOPHYSICAL DATA.

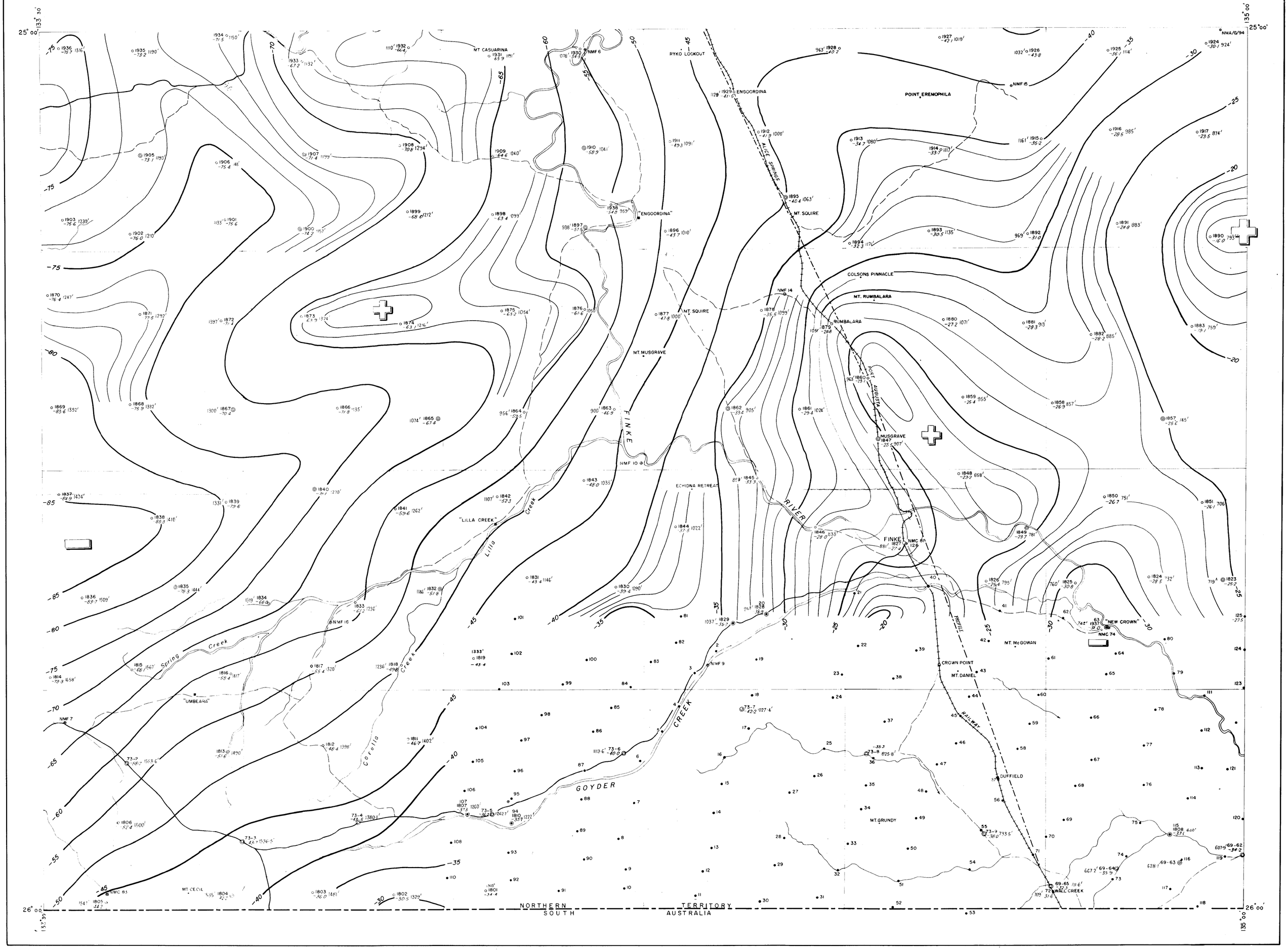
To accompany Record No. 1962/24

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G69-441-2

AUSTRALIA 1 : 253,440

CHARLOTTE WATERS
NORTHERN TERRITORY

PLATE 9
SG 53-6



G 83/82-6-0

LOCATION

HENBURY	RODINGA	HALE RIVER
KULGERA	CHARLOTTE WATERS	McDILLS
ALBERGA	ABMINGA	CALHOUSIE

MAP DATA

PROJECTION: TRANSVERSE MERCATOR, AUSTRALIAN SERIES.

CONTROL: NATIONAL MAPPING 4 MILES TO 1 INCH PLANIMETRIC MAP WITH THE SAME NAME.

DETAIL: PLANIMETRY FROM N.M. MAP COMPILATION REDUCTIONS, DEPT OF THE INTERIOR GRAVITY SURFACE CONTROL MAP AND TRAVERSE DESCRIPTIONS. B.M.R. GRAVITY STATIONS PLOTTED FROM AIR PHOTOS WITH THE AID OF PHOTOCENTRES. GRAVITY DATA FROM B.M.R. HELICOPTER SURVEY 1961

RELIABILITY: PLANIMETRIC — GOOD
GEOPHYSICAL — GRAVITY RECONNAISSANCE
1961 GRAVITY DATA NOT CHECKED.

HELICOPTER GRAVITY SURVEY 1961
AMADEUS BASIN, N.T.

PRELIMINARY BOUGUER ANOMALIES

4 MILES 0 4 8 12 16 MILES 20
10 KILOMETERS 0 10 20 KILOMETERS 30

LEGEND

- RAILWAY
- ROAD
- TRACK
- HOMESTEAD
- AIR STRIP
- WATERCOURSE (NON-PERENNIAL)
- TRIG. STATION
- ASTR. STATION
- PERMANENT MARKED B.M.R. STATION
- B.M.R. STATION
- GRAVITY STATION
- −93·5 RELATIVE BOUGUER ANOMALY (MILLIGALS)
- 1726' ELEVATION
- 5/4 ISOGALS
- HIGH ANOMALY
- LOW ANOMALY

EXPLANATION

RELATIVE BOUGUER ANOMALIES ARE BASED ON THE OBSERVED GRAVITY VALUE OF B.M.R. PENDULUM STATION No. 35 ALICE SPRINGS ..... 978 653·6 MILLIGALS

FOR THE CALCULATION OF BOUGUER ANOMALIES 2·2 GR/CM³ HAS BEEN ADOPTED AS AN AVERAGE ROCK DENSITY.

ELEVATION DATA — M.S.L.

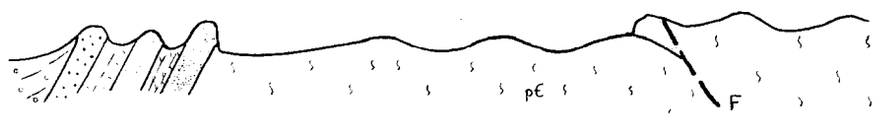
AIR PHOTOGRAPHY — 1950

TOPOGRAPHY AND CULTURAL FEATURES SHOWN ONLY TO LOCATE GEOPHYSICAL DATA.

To accompany Record No. 1962/24

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G69-442-2

FIG. 1. GEOLOGICAL CROSS-SECTION



Section, approximately 340°, 15 miles west of Alice Springs. (After NO. Jones)

FIG. 2. GRAVITY

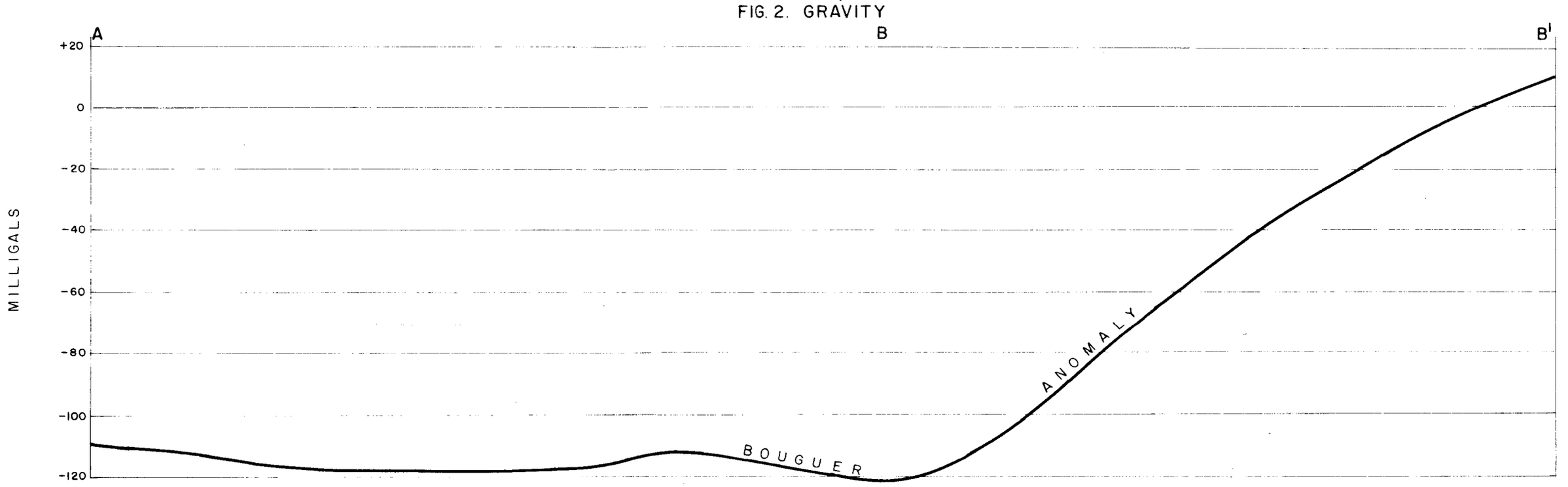
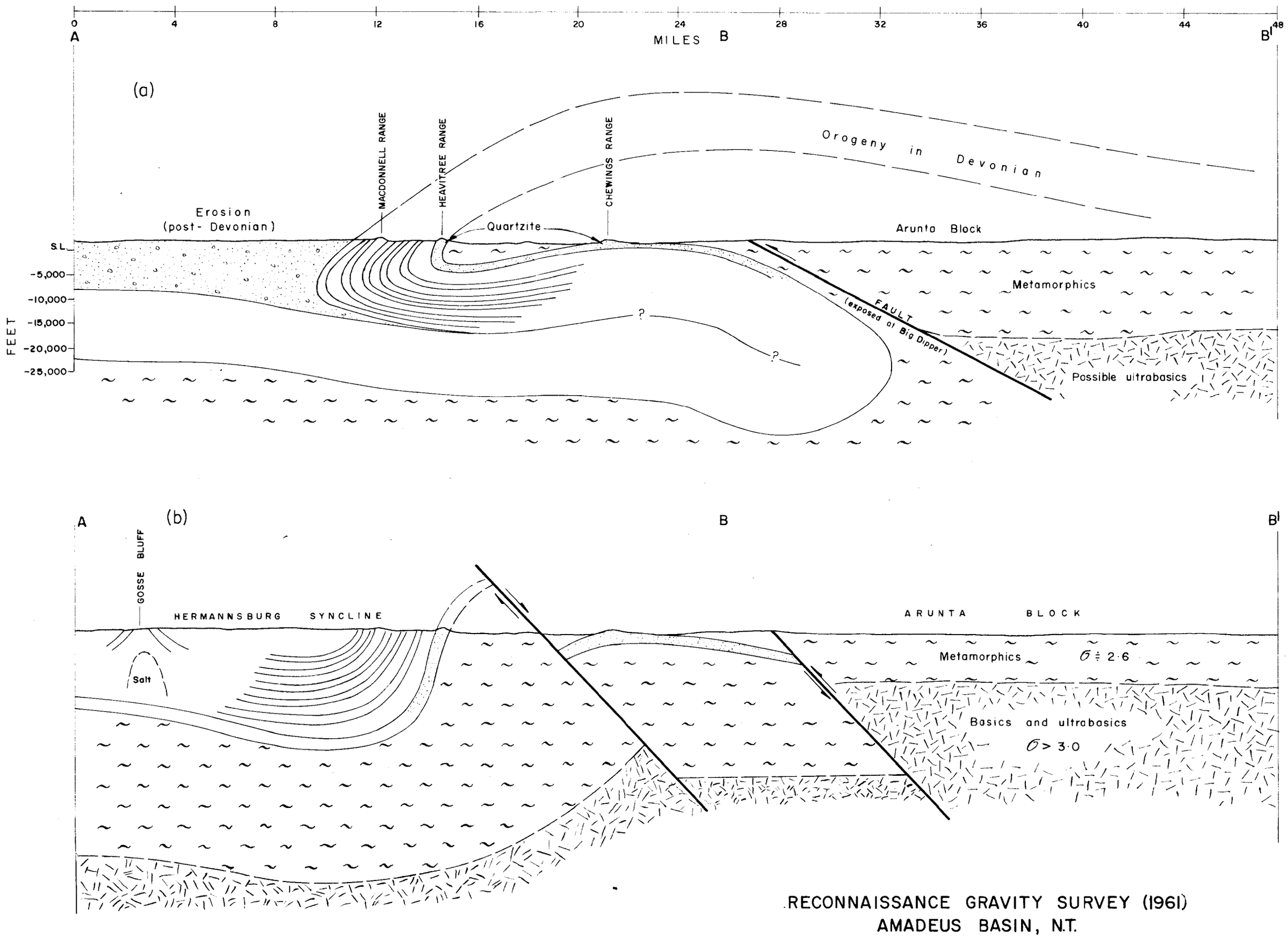


FIG. 3 GEOLOGICAL CROSS-SECTIONS INFERRED FROM GRAVITY DATA



RECONNAISSANCE GRAVITY SURVEY (1961)
AMADEUS BASIN, N.T.

GEOLOGY AND GRAVITY CROSS-SECTIONS

SCALES AS SHOWN

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G 411-3
TO ACCOMPANY RECORD No 1962/24