COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

REPORT No. 43

(copy 3)

DETAILED GRAVITY SURVEY OF ROUGH RANGE ANTICLINE NEAR LEARMONTH, WESTERN AUSTRALIA

by

J. C. DOOLEY and I. B. EVERINGHAM

★

Issued under the Authority of Senator the Hon. W. H. Spooner, M. M., Minister for National Development
1959

LIST OF REPORTS

1. Preliminary Report on the Geophysical Survey of the Collie Coal Basin - N.G. Chamberlain, 1948.

2. Observations on Stratigraphy and Palaeontology of Devonian, Western Portion of Kimberley Division, Western Australia - Curt Teichert, 1949.

3. Preliminary Report on Geology and Coal Resources of Oaklands-Coorabin Coalfield, New South Wales E. K. Sturmfels, 1950.

4. Geology of the Nerrima Dome, Kimberley Division, Western Australia - D. J. Guppy, J. O. Cuthbert and A. W. Lindner, 1950.

5. Observations of Terrestrial Magnetism at Heard, Kerguelen and Macquarie Islands, 1947 - 1948 (Carried out in co-operation with the Australian National Antarctic Research Expedition, 1947 - 1948) - N. G. Chamberlain, 1952.

6. Geology of New Occidental, New Cobar and Chesney Mines, Cobar, New South Wales - C. J. Sullivan, 1951.

7. Mount Chalmers Copper and Gold Mine, Queensland - N. H. Fisher and H. B. Owen, 1952.

8. Geological and Geophysical Surveys, Ashford Coal Field, New South Wales - H. B. Owen, G. M. Burton and L. W. Williams, 1954.

9. The Mineral Deposits and Mining Industry of Papua-New Guinea - P. B. Nye and N. H. Fisher, 1954.

10. Geological Reconnaissance of South-Western Portion of Northern Territory - G. F. Joklik, 1952.

11. The Nelson Bore, South-Western Victoria; Micropalaeontology and Stratigraphical Succession - I. Crespin, 1954.

12. Stratigraphy and Micropalaeontology of the Marine Tertiary Rocks between Adelaide and Aldinga, South Australia - I. Crespin, 1954.

13. The Geology of Dampier Peninsula, Western Australia - R. O. Brunnschweiler, 1957.

14. A Provisional Isogonic Map of Australia and New Guinea, Showing Predicted Values for the Epoch 1955-5 - F. W. Wood and I. B. Everingham, 1953.

15. Progress Report on the Stratigraphy and Structure of the Carnarvon Basin, Western Australia - M. A. Condon, 1954.

16. Seismic Reflection Survey at Roma, Queensland - J. C. Dooley, 1954.

17. Mount Philp Iron Deposit, Cloncurry District, Queensland - E. K. Carter and J. H. Brooks, 1955,

18. Petrology and Petrography of Limestones from the Fitzroy Basin, Western Australia - J. E. Glover, 1955.

19. Seismic Reflection Survey, Darriman, Gippsland, Victoria - M. J. Garrett, 1955.

20. Micropalaeontological Investigations in the Bureau of Mineral Resources, Geology and Geophysics, 1927-52 - I. Crespin, 1956.

21. Magnetic Results from Heard Island, 1952 - L. N. Ingall, 1955.

22. Oil in Glauconitic Sandstone at Lakes Entrance, Victoria - R. F. Thyer and L .C. Noakes, 1955.

23. Seismic Reflection Survey at Roma, Queensland, 1952-53 - L. W. Williams, 1955.

24. Sedimentary Environment as a Control of Uranium Mineralization in the Katherine - Darwin Region, Northern Territory - M. A. Condon and B. P. Walpole, 1955.

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

REPORT No. 43

DETAILED GRAVITY SURVEY OF ROUGH RANGE ANTICLINE NEAR LEARMONTH, WESTERN AUSTRALIA

by

J. C. DOOLEY and I. B. EVERINGHAM

★

Issued under the Authority of Senator the Hon. W. H. Spooner, M. M.,
Minister for National Development
1959

PRINTED BY DEPARTMENT OF SUPPLY, CENTRAL DRAWING OFFICE, MARIBYRNONG, W.3.

Department Of National Development

Minister—SENATOR THE HON. W. H. SPOONER, M.M.

Secretary—H. G. RAGGATT, C.B.E.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Director: J. M. RAYNER.

Deputy Director: H. TEMPLE WATTS.

THIS REPORT WAS PREPARED IN THE GEOPHYSICAL SECTION

Chief Geophysicist: R. F. THYER.

C O N T E N T S

		Page
	ABSTRACT	(iv)
1.	INTRODUCTION	1
2.	GEOLOGY	1
3.	DENSITIES	2
4.	OPERATIONS	2
5.	RESULTS OF SURVEY	3
6.	CONCLUSIONS AND RECOMMENDATIONS	6
7.	REFERENCES	6

I L L U S T R A T I O N S

Plate 1. Relation between Regional and Detailed Gravity Surveys with Inset Locality Map.

2. Bouguer Anomaly Map.

3. Cross Section A-B, through Rough Range No. 1 Bore.

4. Cross Section along Traverse A-1.

5. Density/Depth Correlation in Rough Range No. 1 Bore.

ABSTRACT

West Australian Petroleum Pty. Ltd., carried out a seismic survey in 1952-53 over the Rough Range Anticline, near Learmonth, W.A. In response to an application by the company, the Bureau of Mineral Resources carried out a gravity survey over the seismic traverses to assist the interpretation of the seismic results.

An elongated high anomaly was discovered parallel to the surface geological axis and about a mile to the east of it. It seems probable that this anomaly is associated with a high feature in Cretaceous sediments, or a buried fault upthrown on the eastern side.

A negative anomaly slightly west of the surface geological axis is believed to be due to thinning of dense Tertiary sediments at the crest of the structure.

Rough Range No. 1 bore was drilled on the western flank of the high anomaly and located oil at a depth of about 3,600 feet.

DETAILED GRAVITY SURVEY OF ROUGH RANGE ANTICLINE
NEAR LEARMONTH, WESTERN AUSTRALIA.

1. INTRODUCTION

The Rough Range Anticline lies in the Carnarvon (North-West) Basin, near the south-western end of Exmouth Gulf (see Plate 1). Its position is approximately latitude 22°30'S, longitude 114°00'E.

The physiography of the Rough Range is an expression of the surface geological structure - an anticline in Tertiary limestones. The underlying geological sequence includes Cretaceous, Jurassic, Permian and Devonian formations of total thickness greater than 10,000 feet.

West Australian Petroleum Pty. Ltd., holds a "Permit to Explore" covering the Carnarvon Basin, and exploration has been carried out during recent years by the Company's geologists, in conjunction with geologists of the Bureau of Mineral Resources, Geology and Geophysics. The structures are described by Craig (1950), Condon, Johnstone, Perry and Crespin (1953), and Condon (1954). These reports contain references to earlier literature on the area.

Geophysical techniques have been used as part of the exploration programme in the Carnarvon Basin. Between 1950 and 1953, the Bureau of Mineral Resources carried out reconnaissance gravity surveys. The results of these surveys have been described by Thyer (1951b) and Chamberlain, Dooley and Vale (1954). Seismic and gravity traverses were surveyed across the Giralia Structure (Vale, 1951; Thyer, 1951a). Later, West Australian Petroleum Pty. Ltd. carried out further detailed seismic work over the Rough Range Anticline, and in February 1953 applied to the Bureau for a detailed gravity survey to be made over this structure to assist the interpretation of its seismic results, before selecting a drill site. The preliminary results were made available to the company early in 1953 and a brief summary was included in the report by Chamberlain, Vale and Dooley (1954).

2. GEOLOGY

The stratigraphy and structure of the area are described in detail in a report by Condon, Johnstone and Perry (1955) to which reference should be made. Only those which are of specific interest in the interpretation of the gravity data are referred to here.

The Rough Range Anticline is a symmetrical structure about 10 miles long, lying a few miles to the south-east of the Cape Range Anticline, from which it is separated by the Dingo Syncline.

It has been mapped at the surface in Tertiary (Miocene) limestone in which it has a closure of about 200 feet. Beneath the Tertiary rocks is a succession of Cretaceous, Jurassic, Permian and Devonian sediments. The anticlinal structure probably persists throughout the sedimentary section, but this is by no means certain. Condon et al (1955, p. 38) list three ways in which the folding may have been produced in the

Cape Range Anticline. These are differential compaction, deposition over pre-existing hills, or vertical uplift due to fold or fault movement in subjacent strata. With a favourable distribution of densities, any one of these could give rise to a gravity high over the anticline.

Condon (1954) suggests that the Rough Range Anticline may be due to a single high-angle up-thrust, but his later views (personal communication) favour deposition over a pre-existing erosional scarp.

3. DENSITIES

The density log of Rough Range No. 1 bore, which was drilled on the anticline by West Australian Petroleum Pty. Ltd., is shown on Plate 5.

The log can be divided roughly into three parts, with different average densities as follows :-

Depth (ft.)	Average Density (gm/cc)
0 - 3,500	2.0 ±
3,500 - 6,800	2.45±
6,800 -10,000 +	2.7 ±

The change in average density at 3,500 feet occurs within and near the base of the Cretaceous sediments. That at 6,800 feet probably coincides with the base of the Jurassic rocks.

There is substantial variation within the zone from surface to 3,500 feet corresponding to various lithological units, but the changes in average density at 3,500 feet and 6,800 feet are definite and quite remarkable. The density of the pre-Cambrian basement rocks is not likely to differ greatly from 2.7 gm/cc. The density changes in the section which are most likely to affect the gravitational field are those at :-

(a) 3,500 feet - a local elevation in the denser sediments below this level, without change in thickness of the sediments above, would produce a local increase in gravity.

(b) 6,800 feet - a local elevation in the surface would, as in (a), produce a local increase in gravity.

In addition to the above, variations in thickness in a dense Miocene limestone near the surface (shown by the two high values at the head of the log) will produce local variations in gravity.

4. OPERATIONS

The gravity survey was carried out by one of the authors (I.B.E.) in March, 1953, using a Worden gravity meter (No. 61). A Landrover was used for transport, and the Company arranged vehicle servicing and camping and messing facilities.

Readings were taken at the seismic shot points, and as these had already been surveyed and levelled, the work proceeded rapidly. The progress of the survey was interrupted by the cyclone of 22nd and 23rd March, which destroyed the West Australian Petroleum Pty. Ltd's. camp and left part of the area unsuitable for traffic for some time. Because of this and owing to other commitments for the gravity meter, the gravity survey was not completed over all the seismic traverses. However, those omitted are not considered important for the interpretation of the results of the survey.

The gravity readings were corrected for normal gravity and for elevation. The correction factor adopted for the elevation was 0.0663 mg/ft. This was determined by a statistical method involving the correlation between elevation and observed gravity at several selected stations, after eliminating linear regional effects from both elevation and gravity. The factor chosen corresponds to a density for the surface material of 2.16 gm/cc.

The gravity readings were reduced to absolute values by reference to the 1950 regional gravity survey of the Carnarvon Basin (Thyer, 1951b), which was completed during 1953, and gave 978,818.3 milligals for the observed gravity at station 18-1. The regional work is tied to the Bureau's pendulum stations at Onslow and Carnarvon.

5. RESULTS OF SURVEY

The results of the survey are shown as a Bouguer anomaly contour map on Plate 2. Plate 1 shows the results on a smaller scale, in relation to the regional survey in the North-West Cape Area. Plates 3 and 4 show gravity profiles along two cross-sections and indicate possible interpretations.

In compiling the Bouguer anomaly map on Plate 2, gravity values at several stations of the 1950 regional survey have been used, as well as the readings taken at the seismic shot points during 1953.

The feature of most obvious interest is the high gravity anomaly striking approximately north and passing through shot points A-1/26, A-21/10, A-22/8, A-5/2, A-20/3 and A-18/2. There is a closure of about 1 milligal, and the highest value is at A-22/8.

The coverage of this feature is not good. Owing to the limitations of time and surveying facilities, readings were taken at the seismic shot-points only. It would have been desirable to have two or three additional east-west traverses between lines A-22 and A-23, and more stations are required to the east of line A-22 to delineate the anomaly more accurately. Further traverses are required to the south of A-1 to establish whether the anomaly extends beyond this line.

Subject to the above remarks, the anomaly appears as a long narrow feature, somewhat asymmetrical in that the fall in gravity is much larger to the east than to the west. The gradient on the east flank appears to be steeper than that on the west flank, although the control on the east flank is poor, except at the southern end of the anomaly.

The axis of the anomaly is parallel to the surface axis of the Rough Range Anticline (Plate 2), but is about one mile to the east. This suggests a considerable shift of the axis of the anticline with depth, or a displacement at an unconformity.

The position of the gravity maximum in relation to the axis of the anticline is shown clearly on the cross sections on Plate 3. It is interesting to note that when due allowance is made for a regional gradient to the east, there is a pronounced gravity minimum coinciding with the axis of the Dingo Syncline. There is thus close agreement between the gravity anomalies and the major tectonic features in the area.

The regional map (Plate 1) shows a rapid increase in gravity to the north-west of the Rough Range Anticline. To the south-east of the anticline the gravity continues to decrease, and passes through a minimum between Bullara and Giralia Homesteads. No information is available to the east of the anticline, in Exmouth Gulf. The major component of the steep rise to the north-west has a deep-seated cause associated with the tectonics of the earth's crust.

As the anticline lies in an area where there is a large regional effect, it is difficult to separate the local anomaly from the regional anomaly. However, an attempt has been made to do this, as shown in the cross-sections on Plates 3 and 4. In Plate 3, Figs. 1 and 2, two possible regional anomalies have been used for alternative interpretations of Section A-B,

It is often helpful in assessing the results of a gravity survey over an anticline to assume that the gravity anomaly is due solely to the denser "core" which approximates to a horizontal cylinder. On this basis, calculations are made of the depth to the centre of the cylinder. If a density contrast is assumed between the material of the cylinder and the surrounding material, the diameter of the cylinder, and hence the depth to the top of the cylinder, can be calculated. These calculations tend to give a maximum depth to a major change in density in the sediments (Nettleton, 1940, p. 122).

Estimates for the maximum depth to the centre of gravity of the horizontal cylinder give values of 5,700 feet and 7,000 feet respectively for cross-section A-B, depending on which regional anomaly is adopted (the smaller "half-width" is used in each case). A similar treatment for the section along traverse A-1 (Plate 4) gives a depth of 9,000 feet. The depths to the top of the cylinder would, of course, be less than this, and, assuming a density contrast of 0.3 between the hypothetical cylinder and the rest of the sediments, the maximum depths to the top would be about 3,700 feet and 4,300 feet respectively for the two interpretations of section A-B and about 5,000 feet for traverse A-1. If the density contrast is less than 0.3 then the maximum depths will be less than those calculated.

These maximum depth determinations are useful only as a guide to the order of magnitude of depth to the higher density formation. Actual depths are considerably less than maximum depths calculated by the above method from anomalies due to normal anticlinal structures, particularly when flank dips are small. For example, the maximum depth determination for Plate 3, Fig. 1 is 3,700 ft; yet an anticlinal structure with its apex at a depth of 3,000 ft., 10° dips on either flank and density contrast 0.2, would cause a similar anomaly.

Information on rock densities, provided by West Australian Petroleum Pty. Ltd., is shown on Plate 5, which is a graph of density versus depth for samples from Rough Range No. 1 bore. The densities were determined from cores and ditch samples.

The range of densities in the section from surface to 3,500 feet is large, and density contrasts exist within the formation. If the cause of the gravity anomaly is an anticline, the above interpretations indicate that this exists at least within the Lower Cretaceous sediments and that the axis of the Lower Cretaceous structure is displaced to the east of the Tertiary structure.

As the Trealla and Tulki limestones (of Tertiary age) are near the surface and are denser than underlying sediments, they complicate the gravity pattern in the Rough Range area, particularly at the crest of the structure where thinning of these rocks is presumably greatest, due to erosion and/or lensing. The thinning of these sediments would result in a local gravity low, and the negative saddle on the Bouguer map, centred near station 7 on Traverse A-4, may indicate the culmination of the Tertiary anticline.

In Plate 3, Fig. 3, an attempt has been made to obtain a gravity cross-section in which the effect of the higher density Tertiary sediments is eliminated. The resulting profile (dotted) is an approximation only, and when a regional effect (the mean of those used in Figs. 1 and 2) was applied, the maximum depth estimation of 5,400 feet implied a slightly deeper or broader higher-density structure than previous estimates. On this interpretation it would be possible for the cause of the anomaly to be an anticlinal feature at the base of the Cretaceous, corresponding to the density contrast at 3,500 feet. This is hardly possible in the previous interpretations. The axis of the residual gravity anomaly is 1/4-mile east of the position indicated in Figs. 1 and 2 (Plate 3).

The Rough Range gravity anomaly could also be caused by a buried fault with a throw of about 3,000 feet and with the eastern side upthrown, assuming a density contrast of 0.15. The depth to the centre of the fault-plane would be approximately 5,000 to 6,000 feet, and the fault would be almost directly beneath the axis of the surface anticline. The formations in which faulting may have occurred would presumably be pre-Cretaceous (see footnote).

NOTE: Since this report was written, Mr. O. A. Poirier, Exploration Superintendent for West Australian Petroleum Pty. Ltd. has advised that, on their current interpretation of seismic data, an axial fault has been found, intersecting the structure east of the axis, with a down-throw of 1500 feet to the west in the pre-Cretaceous sediments. Owing to subsequent erosion, this has resulted in an abrupt thickening of the Jurassic from less than 300 feet on the east side to 2600 feet on the west side. Post-Cretaceous reverse movement occurred along the fault, up to 800 feet maximum. This would provide a reasonable explanation of the gravity anomaly, with the main effect arising from the discontinuity at 6800 feet in Rough Range No. 1 bore.

Plate 4 illustrates the cross-section along traverse A-1, which crosses the southern end of the North-West Cape Peninsula. It is noteworthy that the Rough Range Anticline still gives a large gravity anomaly as far south as this, although the surface geological axis is not shown continuing to the south (Condon et al, 1953). The traverse crosses the southern end of the Cape Range Anticline. There is a gap in the gravity readings across the axis of the structure from S.P. 58 to S.P. 70; however, there is no suggestion of a gravity high associated with the structure. The general impression is of a very broad synclinal feature. A gravity traverse across the Cape Range near the apex of the structure would be of considerable interest, and this would appear to be a useful step in any further exploration planned on this structure.

It is interesting to compare the Rough Range gravity anomaly with the anomaly disclosed by the detailed gravity traverse across the northern end of the Giralia Anticline (Thyer, 1951a). There, seismic work (Vale, 1951) disclosed an unconformity at a depth of about 3,000 feet, the upper phantom horizon being conformable with the surface anticline, while the lower phantom horizon showed a syncline. The gravity results also showed a syncline, thereby agreeing with the geology below the unconformity. However, the gravity anomaly was much broader than the Rough Range anomaly and it might well have been directly associated with a deep-seated feature.

6. CONCLUSIONS AND RECOMMENDATIONS

A gravity high anomaly has been disclosed with its axis parallel to, and about one mile east of, the surface axis of the Rough Range Anticline. It seems probable that this anomaly represents either a high feature in Cretaceous sediments, or a buried fault in pre-Cretaceous formations.

A gravity low anomaly situated near the apex of the Rough Range Anticline is believed to be due to thinning of Tertiary sediments in this area.

Rough Range No. 1 Bore, which was drilled about one mile west of the axis of the gravity anomaly, discovered an accumulation of oil in the Cretaceous sediments. The relation between the gravity anomaly and the accumulation of oil discovered in the No. 1 bore is not clear at present.

The detailed gravity survey has not been carried far enough to delineate the anomalies accurately. An extension of the survey to the south and east, and more detailed work over the axis of the anomaly would appear to be warranted.

7. REFERENCES

Chamberlain, N.G., Dooley, J.C., and Vale, K.R., (1954) -

Geophysical Exploration in the Carnarvon (N.W.) Basin, Western Australia. Bur. Min. Resour. Aust. Records, 1954, No. 44.

Condon, M.A., (1954) -

Progress Report on the Structure and Stratigraphy of the Carnarvon Basin. Western Australia. Bur. Min. Resour. Aust., Rep. 15.

Condon, M.A., Johnstone, D., Perry, W.J., and Crespin, I., (1955) -

The Cape Range Structure, Western Australia. Bur. Min. Resour. Aust., Bull. 21, 2nd Edition.

Craig, E., (1950) -

Structures of the North-west Basin in Western Australia, World Oil, 130 (4), 210-214.

Nettleton, L.L., (1940) -

Geophysical Prospecting for Oil. McGraw Hill Book Co. Inc., New York.

Thyer, R.F., (1951a) -

Detailed Gravity Traverse, Northern End Giralia Structure, North-west Basin, Western Australia, Bur. Min. Resour. Aust., Records 1951, No. 68.

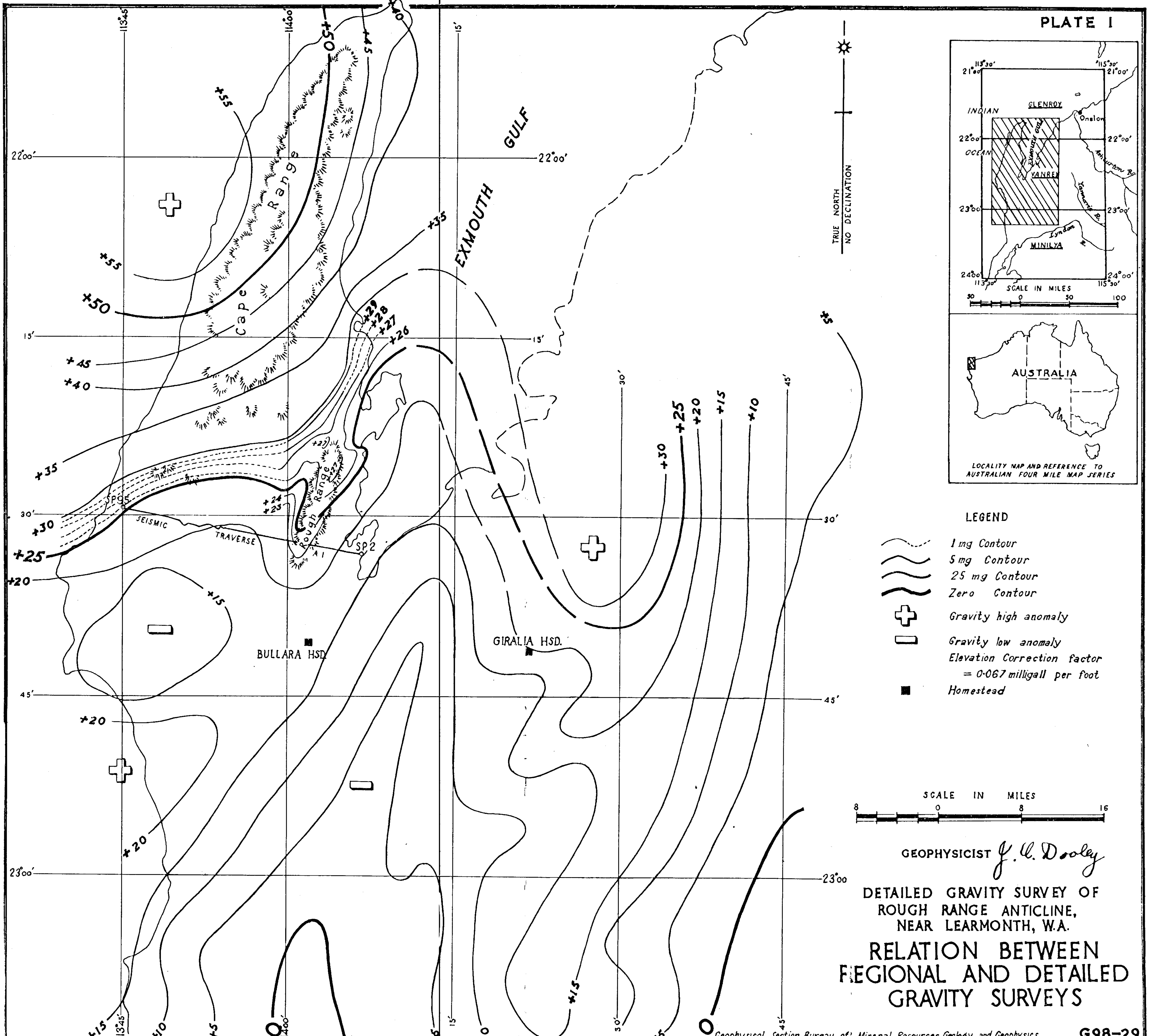
Thyer, R.F., (1951b) -

Gravity Reconnaissance (1950) North-west Basin, Western Australia. Bur. Min. Resour. Aust., Records 1951, No. 69.

Vale, K.R., (1951) -

Report on Giralia-Bullara Seismic Reflection Traverse, Western Australia. Bur. Min. Resour. Aust., Records 1951 No. 62.

PLATE I



GEOPHYSICIST J. C. Dooley

DETAILED GRAVITY SURVEY OF ROUGH RANGE ANTICLINE, NEAR LEARMONTH, W.A.

RELATION BETWEEN REGIONAL AND DETAILED GRAVITY SURVEYS

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics.

G98-29

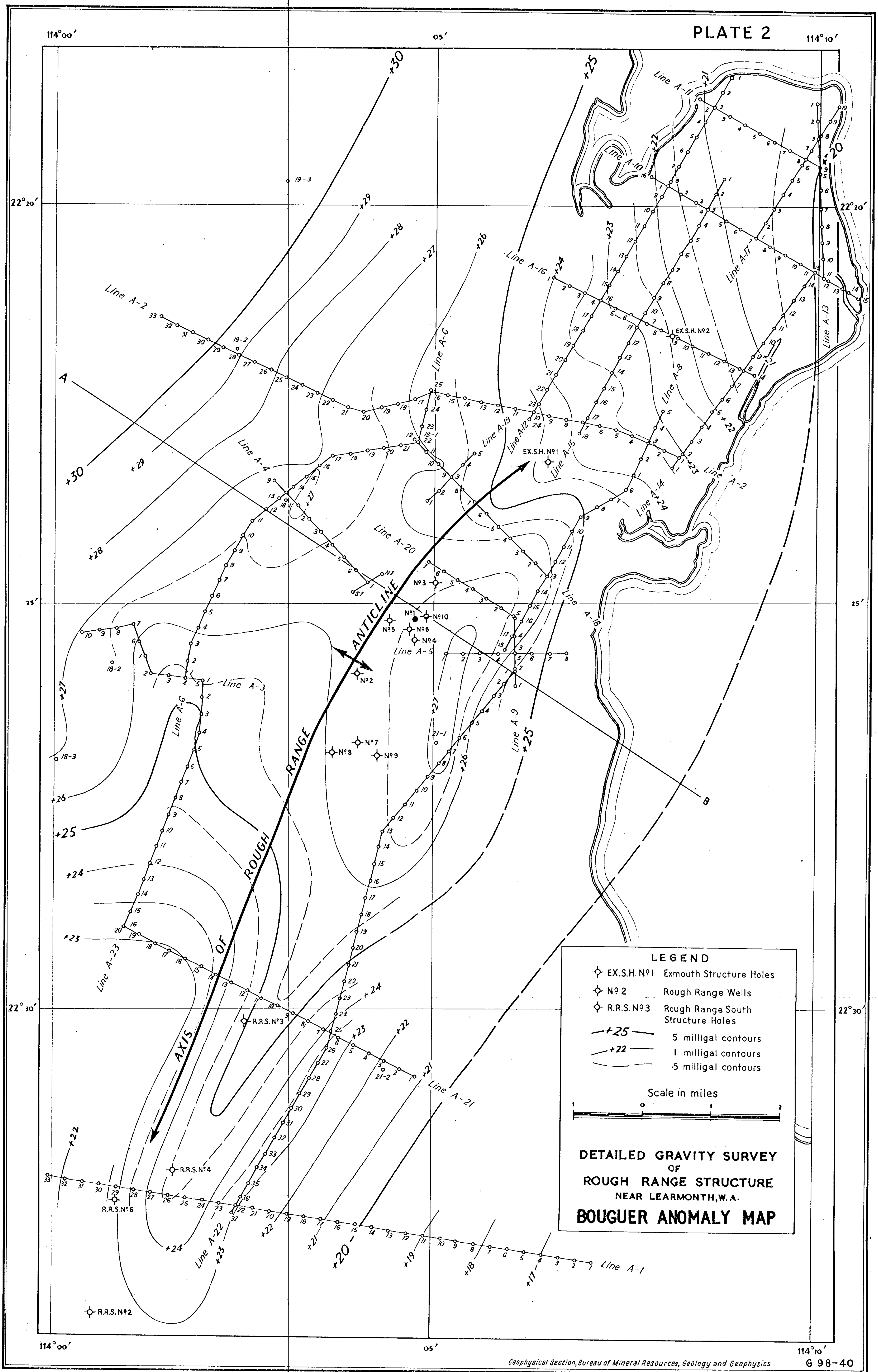
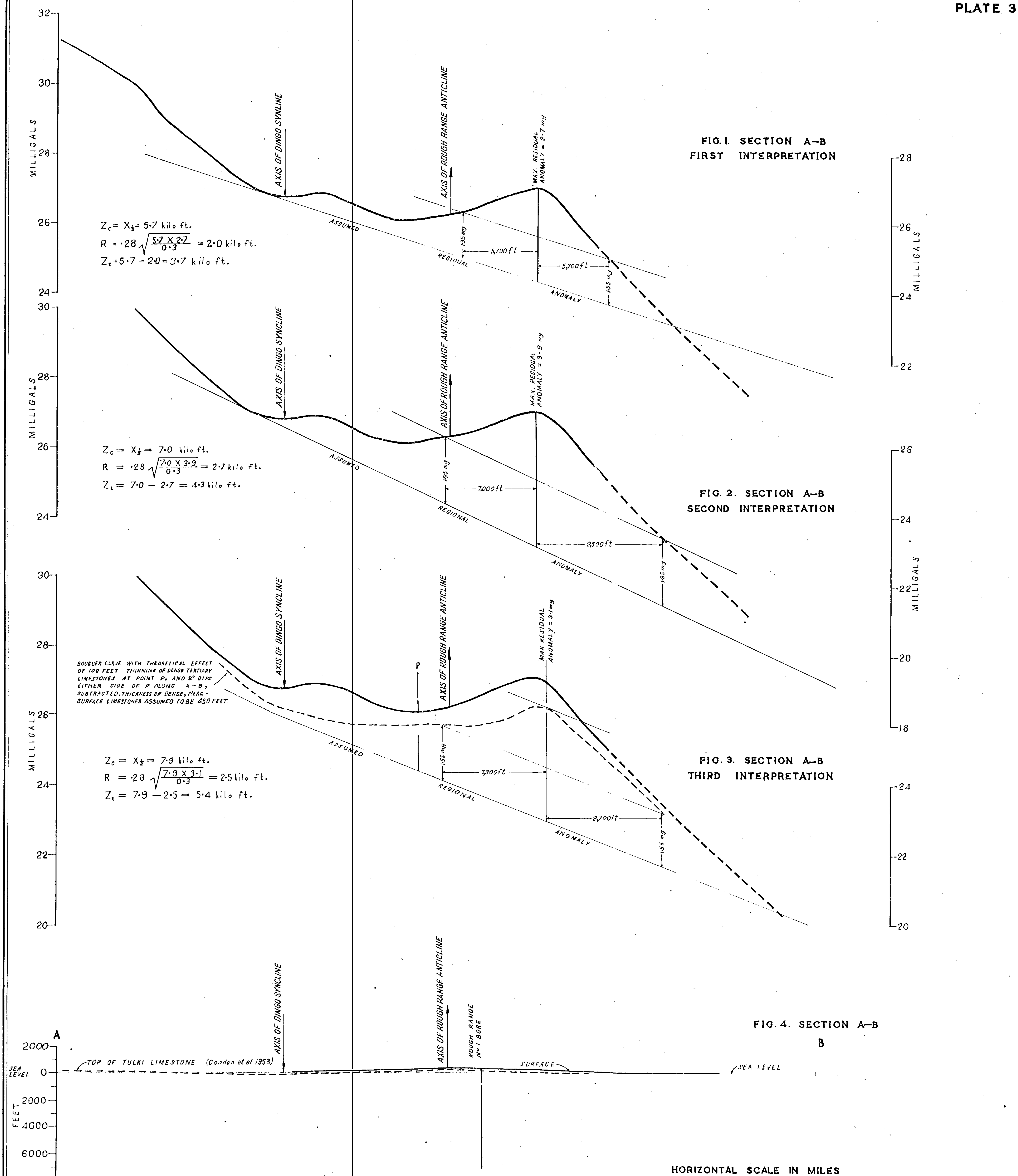


PLATE 2
114°00′
05′
114°10′
22°20′
25′
22°30′
AXIS OF ROUGH RANGE ANTICLINE
LEGEND
EX.S.H. Nº1 Exmouth Structure Holes
Nº 2 Rough Range Wells
R.R.S. Nº3 Rough Range South Structure Holes
+25 5 milligal contours
+22 1 milligal contours
·5 milligal contours
Scale in miles
DETAILED GRAVITY SURVEY OF ROUGH RANGE STRUCTURE NEAR LEARMONTH, W.A.
BOUGUER ANOMALY MAP
Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics
G 98-40

PLATE 3



DEPTH ESTIMATION FROM RESIDUAL GRAVITY ANOMALIES

(NETTLETON P. 122)

$X_{\frac{1}{2}}$ = HALF-WIDTH OF ANOMALY (SMALLER VALUE)

$Z_c = X_{\frac{1}{2}}$ = DEPTH TO CENTRE OF GRAVITY OF HORIZONTAL CYLINDER WHICH APPROXIMATES TO ANOMALOUS FEATURE.

σ = DENSITY CONTRAST, TAKEN AS 0·3

$R = 0{\cdot}280\sqrt{\frac{Z_c \cdot g_{max.}}{\sigma}}$ kilo ft. = RADIUS OF CYLINDER

$Z_t = Z_c - R$ = MAXIMUM DEPTH TO TOP OF CYLINDER

J. C. Dooley

GEOPHYSICIST

HORIZONTAL SCALE IN MILES

1 0 1 2 3 4

VERTICAL SCALES AS SHOWN ON PROFILES

DETAILED GRAVITY SURVEY OF
ROUGH RANGE ANTICLINE NEAR LEARMONTH, W. A.

CROSS–SECTION A–B
THROUGH ROUGH RANGE No1 BORE

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics. G98–27

PLATE 4

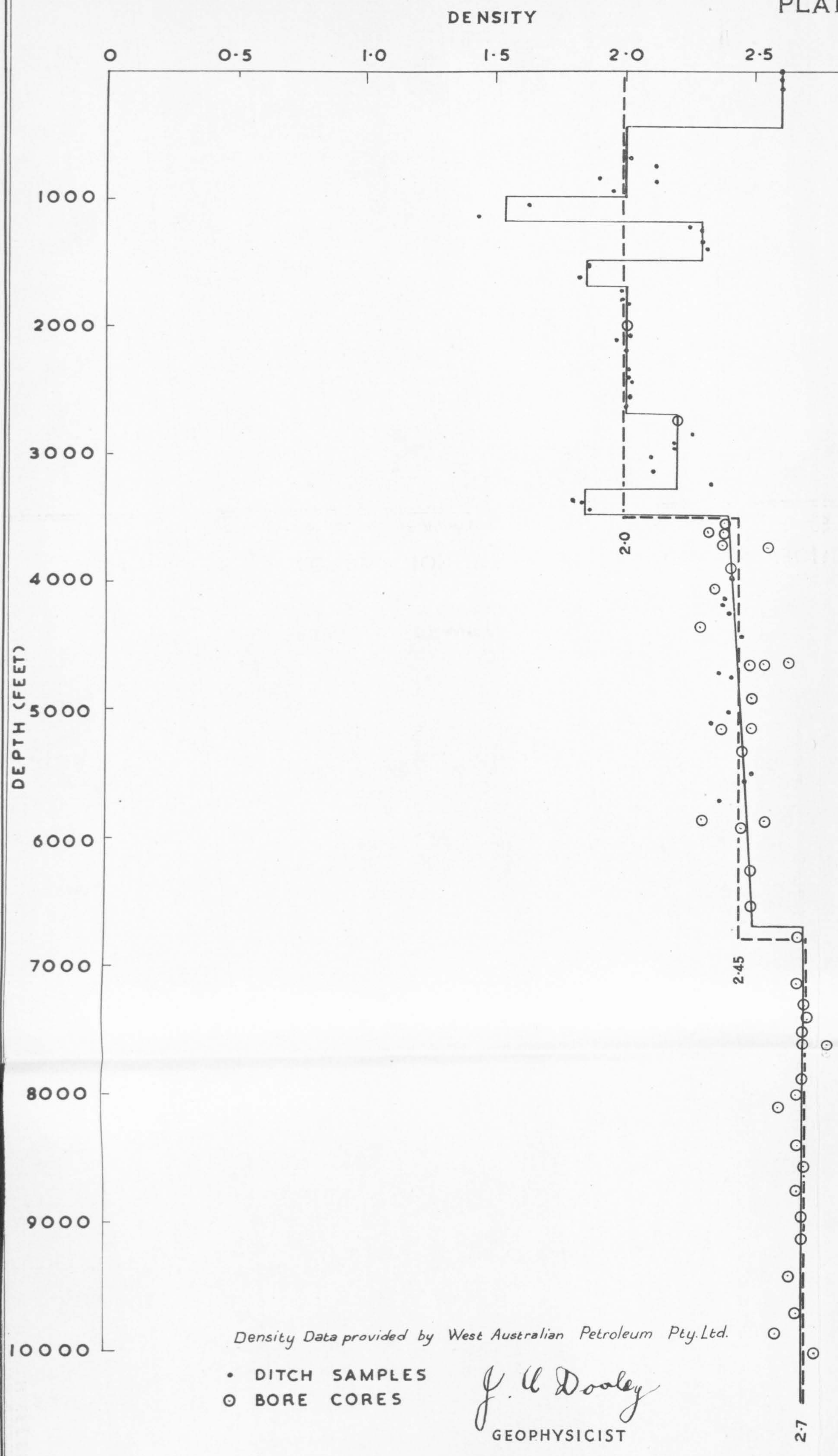
DETAILED GRAVITY SURVEY OF ROUGH RANGE ANTICLINE, NEAR LEARMONTH, W.A.

CROSS SECTION ALONG TRAVERSE A-1
GEOLOGICAL SECTION WITH DEPTH ESTIMATION AT ROUGH RANGE STRUCTURE

J. C. Dooley
GEOPHYSICIST

GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G 98-28

PLATE 5



J. C. Dooley
GEOPHYSICIST

DETAILED GRAVITY SURVEY OF
ROUGH RANGE ANTICLINE, NEAR LEARMONTH, W.A.

DENSITY/DEPTH CORRELATION IN ROUGH RANGE No. I BORE

Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics G 98-39

25. Papers on Tertiary Micropalaeontology - I. Crespin, F. M. Kicinski, S. J. Patterson and D. J. Belford, 1956.

26. Eruptive Activity and Associated Phenomena, Langila Volcano, New Britain - G. A. Taylor, J. G. Best and M. A. Reynolds, 1957.

27. Magnetic Results from Macquarie Island, 1952 - P. M. McGregor, 1956.

28. The Identification of the Boundary between Coal Measures and Marine Beds, Singleton - Muswellbrook District, N.S.W. - M. A. Reynolds, 1956.

29. The Geology of the South-west Canning Basin - D. M. Traves, J. N. Casey and A. T. Wells, 1957.

30. Magnetic Results from Heard Island, 1953 - J. A. Brooks, 1956.

31. Magnetic Results from Macquarie Island, 1953 - P. B. Tenni and J. A. Brooks, 1956.

32. Geophysical Investigations for Radioactivity in the Harts Range Area, Northern Territory - J. Daly and D. F. Dyson, 1956,

33. The Tuluman Volcano, St. Andrews Strait, Admiralty Islands - M. A. Reynolds, 1957.

34. Magnetic Results from Heard Island, 1954 - K. B. Lodwick, 1957.

35. Magnetic Results from Macquarie Island, 1954 - C. S. Robertson, 1957.

36. Geophysical Survey of the Rye Park Scheelite Deposit, New South Wales - J. Horvath and R. J. Davidson, 1958.

37. The Geology of the Coastal Area between the Lower Gascoyne and Murchison Rivers, Western Australia, by M. C. Konecki, J. M. Dickins and T. Quinlan, 1959.

38. Papers on the Stratigraphy and Palaeontology of Western Australia.

39. Magnetic Results from Mawson, Antarctica, 1955 - W. H. Oldham.

40. Magnetic Results from Mawson, Antarctica, 1956 - P. M. McGregor.

41. Summary of Oil Search Activities.

42. Isogonic map of Australia and New Guinea, showing predicted values for the Epoch 1960.5 by W. D. Parkinson.

43. Detailed Gravity Survey of Rough Range near Learmonth, Western Australia by J. C. Dooley and I. B. Everingham.

44. Magnetic Results from Toolangi Observatory, Victoria, 1949-51, by C. A. van der Waal and J. A. Brooks with preface by J. C. Dooley.