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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1965/218

REGIONAL MAGNETIC SURVEYS IN AUSTRALIA, AUSTRALIAN ANTARCTICA, AND THE TERRITORY OF PAPUA AND NEW GUINEA DURING 1963

by

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CONTENTS

ILLUSTRATIONS

1965/218

SUMMARY

This record describes all regional magnetic work done by the Bureau of Mineral Resources, Geology and Geophysics, during 1963. The surveys are part of the Bureau's regional magnetic programme.

Three elements of the Earth's magnetic field were determined at stations in Australia, the Territory of Papua and New Guinea, and in Australian Antarctica. The locations of the magnetic stations and the measured values of the magnetic field are presented in tabular form. In Western Australia observations at first-order stations were extended over the daylight hours of at least two days.

Over anomalous areas in the southern part of South Australia and in the eastern part of New South Wales, the magnetic declination was measured at intervals of about five miles. A contour map of the magnetic declination of the southern part of South Australia shows the results of the detailed declination survey. There are local anomalies of about one degree in declination, but these do not affect the smooth pattern of contours on the isogonic map of Australia.

1. INTRODUCTION

This Record describes all regional magnetic work performed by the Bureau of Mineral Resources, Geology and Geophysics, (BMR) during 1963.

The types of surveys and the areas surveyed were :

1. A first-order survey of the southern part of Western Australia;

2. Detailed magnetic declination surveys in South Australia and New South Wales;

3. A regional magnetic survey (including two first-order stations) of the Territory of Papua and New Guinea;

4. Some regional magnetic observations at stations along the coast of Australian Antarctica;

5. A short regional magnetic traverse near Wilkes in Australian Antarctica.

This work was a continuation of a series of surveys made as part of the BMR regional magnetic programme, which includes the publication of maps showing present values and the rate of secular variation of the components of the Earth's magnetic field. Previous work has been described by Finn (1960), van der Linden (1961, 1964, & 1965), and van der Linden and Parkinson (1963).

Three elements, viz., declination (D), horizontal intensity (H), and vertical intensity (Z), were observed at five stations in Australia, at seven stations in the Territory of Papua and New Guinea, and at seven stations in Australian Antarctica. Four of the Antarctic stations were along a 250-mile traverse south-east of Wilkes. Four stations in Western Australia, two in the Territory of Papua and New Guinea, and two in Antarctica were reoccupations of former stations. The others were new stations.

Declination measurements were made at 149 stations in South Australia and at 153 stations in New South Wales. The stations were about five miles apart.

Locations of the magnetic stations and of the declination surveys in Australia and the Territory of Papua and New Guinea are shown in Plate 1. The magnetic stations in Australian Antarctica are shown in Plate 2.

2. ACCOUNT OF SURVEYS

First-order survey of Western Australia

This survey was made in November 1963 by the author and J. Wilkie, who occupied four stations in the south of Western Australia, so completing the first-order survey of Australia started in 1962. The stations at Esperance and Albany had been occupied a number of times since they were first read in the 1910-1914 period. The station at Esperance had become unfavourably situated for future occupations and a new station was established on the nearby airfield. The stations at Zanthus and Alexandra Bridge were recent stations.

The same field procedure was followed as for the 1962 survey (van der Linden, 1965).

Declincation surveys in South Australia and New South Wales

The two surveys were conducted by the author during March and April 1963. The areas surveyed are magnetically anomalous and presented problems in the compilation of the isogonic map of Australia.

In South Australia the survey was along 900 miles of traverse along the roads connecting Kingston, Adelaide, Port Augusta, Berri, Pinnaroo, Tailem Bend, and Bordertown. Declination measurements were made at 149 stations at intervals of approximately five miles.

In New South Wales the survey followed one winding traverse of about 1000 miles, along which 152 declination determinations were made. The traverse followed the roads connecting Wagga Wagga, Narrandera, West Wyalong, Cowra, Bathurst, Wellington, Dubbo, Nevertire, Gilgandra, Tamworth, and Port Macquarie.

Where the traverses passed through areas for which contour maps of the total magnetic intensity (obtained from airborne surveys) were available, station positions were chosen in the least magnetically disturbed places. The field procedure has been described by van der Linden (1965).

At the time of the surveys, no declinometer was available and the measurements of the magnetic meridian were made with magnetometer QHM 306, which was mounted on an Askania base-circle.

The geographic meridian was measured by sun observations using the smoked glass mirror provided with the Askania base-circle. These observations were checked with a Watts microptic theodolite for changes in correction at the beginning and end of traverses. The geographic coordinates were obtained from 4-mile military maps, and correct time was taken from a pocket chronometer that was checked at regular intervals with radio time signals.

The weather was fairly good and, on an average, fifteen stations were observed each day.

Territory of Papua and New Guinea

This survey was done during July 1963 by R. Merrick and G. Lodwick, geophysicists of the Port Moresby Geophysical Observatory.

The magnetic stations were reached by aeroplane and locally hired transport. Six stations were on outlying islands and one on the main island. First-order reoccupations were made at Lorengau and Kavieng. The station at Lorengau was tested and appeared to be magnetically very disturbed, therefore a new station was established at nearby Lugos Mission.

At Wunung Plantation, rain prevented astronomical observations and no value for declination was obtained.

Antarctica

As in previous years, BMR geophysicists did some field magnetic work en route to or from Australian bases in Antarctica. Geophysicists engaged in this work in 1963 were J.C. Branson, I. Black, and M. Kirton.

The magnetic stations at Davis and Heard Island were occupied. Lack of time prevented other than declination measurements on Heard Island. The observations at Davis were extended over several days. On the Amery Ice Shelf, readings of D, H, and Z were taken.

M. Kirton, who was measuring the ice cap thickness by seismic and gravitational methods, also read four magnetic stations along the traverse from the depot at S-2 near Wilkes to a point about 250 miles south-east of S-2 (Kirton, 1965).

3. INSTRUMENTS

The instruments used on the surveys are as follows :

Survey	Instruments		
	Declination	Horizontal intensity	Vertical intensity
First-order survey, Western Australia	Decl. 320	QHM 306	BMZ 211
Declination surveys in South Australia and New South Wales	QHM 306	-	-
Antarctica	Decl. 320	QHM 174	BMZ 115
Traverse near Wilkes, Antarctica	QHM 493	QHM 493	BMZ 121
Territory of Papua and New Guinea	Decl. 333	QHM 173	BMZ 221

Instrument corrections have been given by van der Waal (in preparation). All instruments were compared at Toolangi Observatory before and after the surveys.

4. REDUCTIONS AND RESULTS

First-order and regional surveys

All observations were corrected for instrument corrections and for diurnal variation. The latter was obtained from the tables published by Vestine et al (1947). The values thus obtained were averaged for the day on which the observations were made. For the observations made in the Territory of Papua and New Guinea, the correction for diurnal variation was made using the data from Port Moresby Observatory.

The total magnetic intensity (F) and the magnetic inclination (I) were derived from the final values of H and Z using the formulae :

$$F^2 = H^2 + Z^2$$

and $$\tan I = Z/H$$

The values of the magnetic elements are shown in Table 1 for Australia and in Table 2 for the Territory of Papua and New Guinea. Included in the Tables are the yearly mean values for 1962.5 and 1963.0 for the observatories at Gnangara, Toolangi, and Port Moresby.

Declination surveys

No corrections for diurnal variation were applied because the errors introduced by the quick method of observation and by scaling of the coordinates from a map introduce errors of the same magnitude as the correction for diurnal variation.

The observed values are shown in Plates 4 and 5. Each block covers a section of the traverse that has a more or less constant direction.

South Australia. Plate 3 shows the declination contours for the area surveyed in South Australia. These are derived from the observed values. The anomalies in declination are not very large and are of the order of about one degree. There is not a sufficient coverage of stations to outline the correct shape of most of the anomalies.

In the compilation of the isogonic map of Australia (van der Linden, 1964), the contours were smoothed to conform to a regional pattern. Local anomalies were not taken into account. When the contours shown in Plate 3 are smoothed, leaving out local anomalies, they do not alter the regional pattern as presented in the isogonic map of Australia.

New South Wales. The number of stations occupied was insufficient for the production of a contour map. During the 1964 field season additional traverses were made along the coast and inland, tying to the 1963 traverse (van der Linden, in preparation). The observed values presented in diagrammatic form in Plate 5 indicate the profile along the 1963 traverse.

Australian Antarctica

The results of the magnetic observations in Antarctica are shown in Table 3. No corrections for transient fields were applied as no observatory was close enough to the magnetic stations. To indicate reliability, magnetic conditions at the nearest observatory are shown by Q (quiet) or D (disturbed).

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TABLE 1

First-order stations and observatories, Australia 1963

Station locations and magnetic values

Station	South Latitude	East Longitude	Date	Mean value, November 1963 (based on Toolangi standard)				
				D	H (gammas)	Z (gammas)	F (gammas)	I
Zanthus (R)	31°03.4'	123°33.4'	1 Nov '63 2 Nov '62	+1°08.0' (21)	24212 (20)	-52636 (22)	51938	-65°17.9'
Esperance C	33°41.0'	121°49.0'	6 Nov '63	-0°08.1' (7)	23326 (8)	-55456 (8)	60162	-67°11.2'
Esperance B (R)	33°51.2'	121°51.9'	5 Nov '63	-0°19.8' (11)	23057 (10)	-55243 (10)	59862	-67°20.7'
Alexandra Bridge (R)	34°09.8'	115°11.8'	13 Nov '63 14 Nov '63	-4°08.4' (19)	22126 (20)	-55626 (22)	59865	-68°18.5'
Albany (R)	34°56.9'	117°48.0'	8 Nov '63 9 Nov '63 12 Nov '63	-2°57.6'	22195	-55997	60235	-68°28.0'
Gnangara (0)	31°47'	115°57'	1962.5 1963.0	-2°52.8' -2°52.5'	23945 23940	-53490 -53493	58605 58606	-65°53.0' -65°53.1'
Toolangi (0)	37°32'	145°28'	1962.5 1963.0	+10°22.7' +10°24.2'	22616 22604	-56400 -56395	60766 60756	-68°09.0' -68°09.5'

(R) Repeat station

(0) Magnetic observatory (provisional mean of year)

(21) Number of observations per element at field station

TABLE 2

Regional magnetic stations, Territory of Papua and New Guinea 1963

Station locations and magnetic values

Station	South Latitude	East Longitude	Date	Mean value, July 1963 (based on Toolangi standard)				
				D	H (gammas)	Z (gammas)	F (gammas)	I
Lugos Mission	2°00.0'	147°17.2'	7 July '63	+5°12.4' (2)	37036 (2)	-12613 (2)	39125	-18°48.4'
Lorengau (R)	2°00.0'	147°16.0'	5 July '63 6 July '63	+5°13.5' (8)	36946 (54)	-12916 (46)	39139	-19°16.2'
Kavieng (R)	2°34.4'	150°48.0'	9 July '63 10 July '63	+6°11.2' (8)	36752 (56)	-13156 (50)	39036	-19°41.7'
Buka	5°21.0'	154°36.3'	17 July '63 18 July '63	+6°48.2' (10)	36669 (10)	-16221 (10)	40097	-23°51.8'
Wunung Plantation	5°33.0'	151°29.0'	27 June '63 1 July '63	-	36541 (6)	-17052 (8)	40324	-23°01.0'
Aropa	6°20.5'	155°43.7'	20 July '63 21 July '63 22 July '63	+7°48.7'	36106	-17246	40013	-25°31.9'
Lae	6°43.6'	147°01.4'	28 July '63 29 July '63	+5°42.5'	36906	-19334	41664	-27°38.9'
Port Moresby (O)	9°24'	147°09'	1962.5 1963.0	+6°04.6' +6°05.4'	36402 36393	-22891 -22914	43001 43006	-32°10.2' -32°11.7'

(R) Repeat station

(O) Magnetic observatory (provisional mean of year)

(2) Number of observations per element at field station

TABLE 3

Regional magnetic stations and observatories, Australian Antarctica 1963

Station locations and magnetic values

Station	South Latitude	East Longitude	Date	Mean value, 1963 (based on Toolangi standard)				
				D	H (gammas)	Z (gammas)	F (gammas)	I
Heard Island (R, Q)	53°02'	73°22'	27 Jan '63	-52°16.0'	-	-	-	-
55 Miles (SP7) (Q)	67°18.3'	112°25.3'	5 Jan '63	-93°36.8'	8212	-65443	65956	-82°50.9'
Amery Ice Shelf (D)	68°29.3'	73°19.8'	14 Feb '63	-69°39.4'	17256	-52666	55421	-71°51.5'
Davis (R, Q)	68°34.6'	77°.58.0'	16-20 Feb '63	-74°25.7'	16605	-54338	56819	-73°00.5'
170 Miles (SP4) (Q)	68°52.1'	113°24'	21 Dec '63	-102°55.6'	8580	-64604	65171	-82°26.1'
190 Miles (SP3) (Q)	69°08.8'	114°00'	16 Dec '63	-102°53.5'	8733	-64550	65138	-82°17.7'
250 Miles (D)	69°56'	114°33'	25 Nov '63	-106°44.6'	8754	-64876	65464	-82°18.9'
Macquarie Island(O)	54°30'	158°57'	1962.5	+25°58.2'	13211	-64337	65671	-78°23.8'
			1963.0	+26°02.8'	13200	-64315	65662	-78°24.0'
Wilkes (O)	66°15'	110°35'	1962.5	-84°54.7'	9241	-64903	65558	-81°53.8'
			1963.0	-85°08.6'	9236	-64876	65530	-81°53.8'
Mawson (O)	67°36'	62°53'	1962.5	-60°30.1'	18333	-48650	51990	-69°21.1'
			1963.0	-60°37.6'	18344	-48606	51952	-69°19.4'

(R) Repeat station

(O) Magnetic observatory (provisional mean of year)

(Q) Magnetically quiet at time of observation

(D) Magnetically disturbed at time of observation

PLATE I

Lorengau & Lugos Mission
Kavieng
Buka
Wunung
Aropa
Lae
Port Moresby
Gnangara
Zanthus
Alexandra Bridge
Esperance
Albany
ADELAIDE
Port Macquarie
Wagga Wagga
Toolangi

LEGEND
- Magnetic Stations
- First Order
- Observatories
- Declination traverse

MERCATOR PROJECTION
EQUATOR 8° 16° 24° 32° 40° 48°
0 100 200 300 400 500 600 700 Statute Miles

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

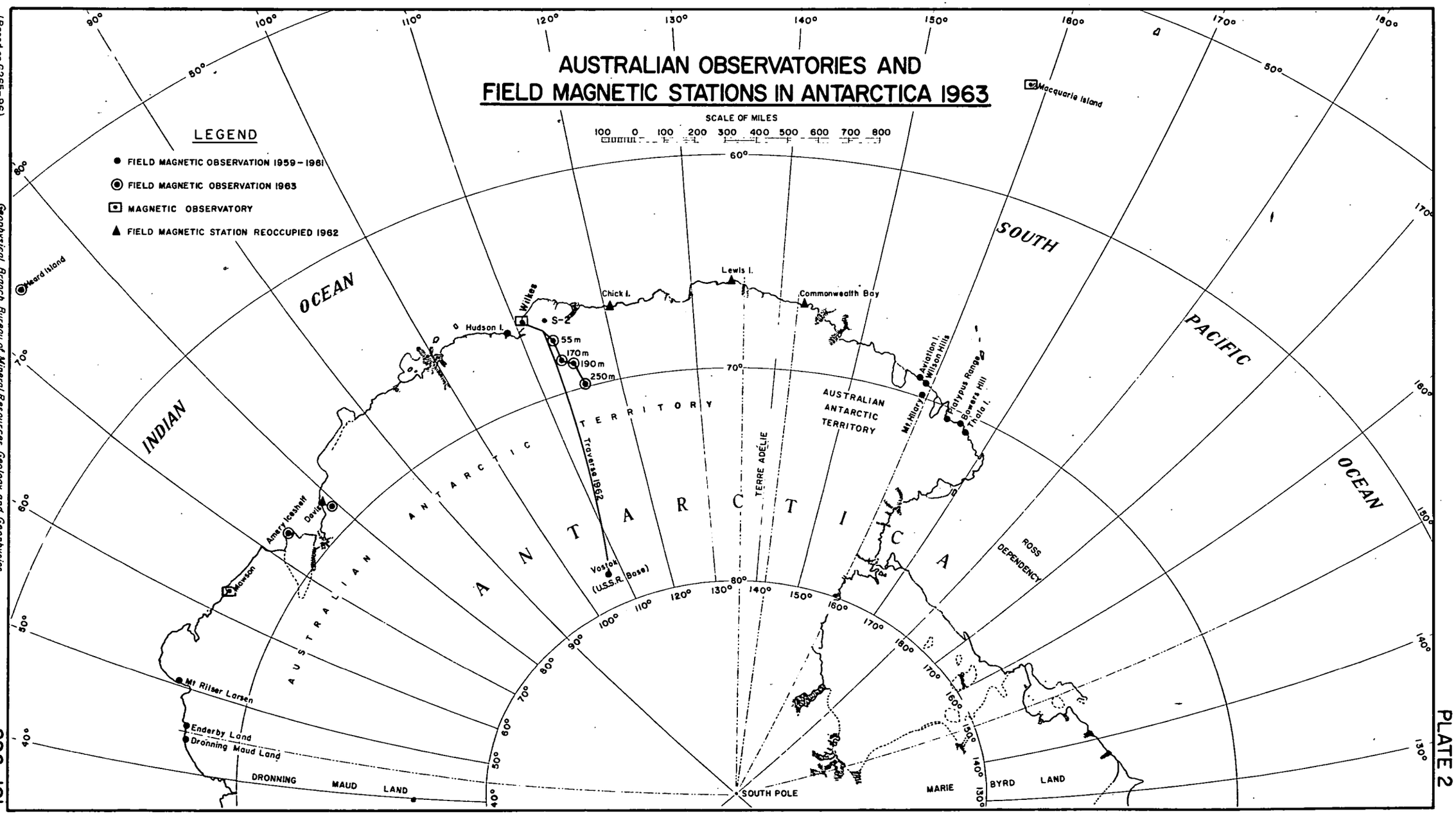
1963 REGIONAL MAGNETIC SURVEY
LOCALITY MAP

G96-99

(Based on G20-14)

TO ACCOMPANY RECORD No. 1965/218

AUSTRALIAN OBSERVATORIES AND FIELD MAGNETIC STATIONS IN ANTARCTICA 1963



(Based on G265-96)

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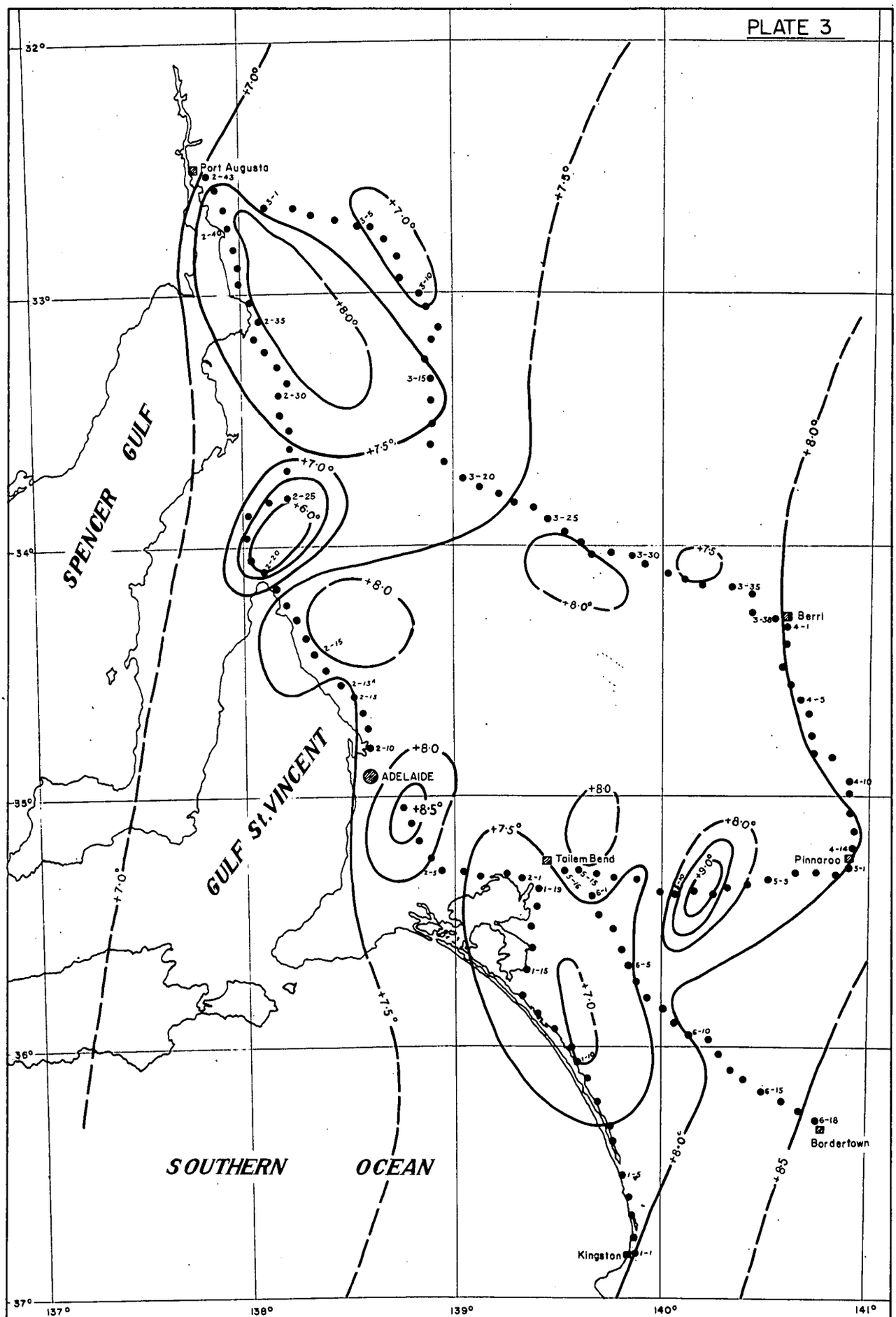
696-101

PLATE 2

PLATE 3



SCALE OF MILES
10 0 10 20 30 40 50

(Based on G96-98)

—+7·0°— East Declination Contour

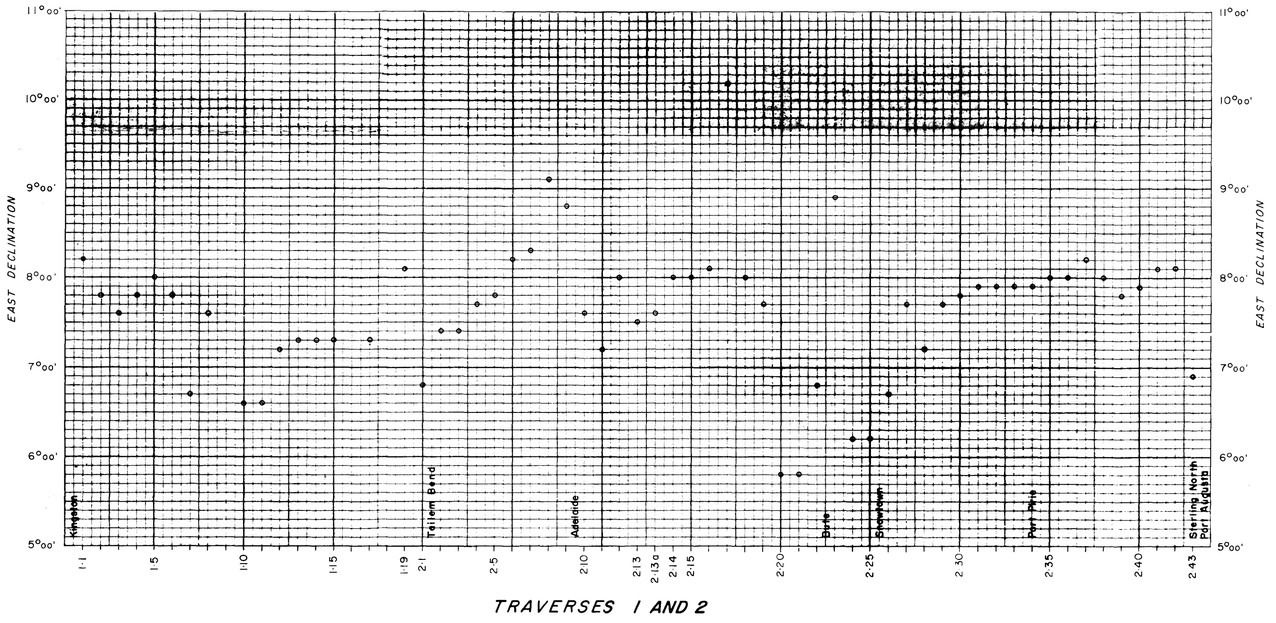
3 · 35 Traverse 3, Station 35

MAGNETIC DECLINATION SURVEY
SOUTH AUSTRALIA 1963

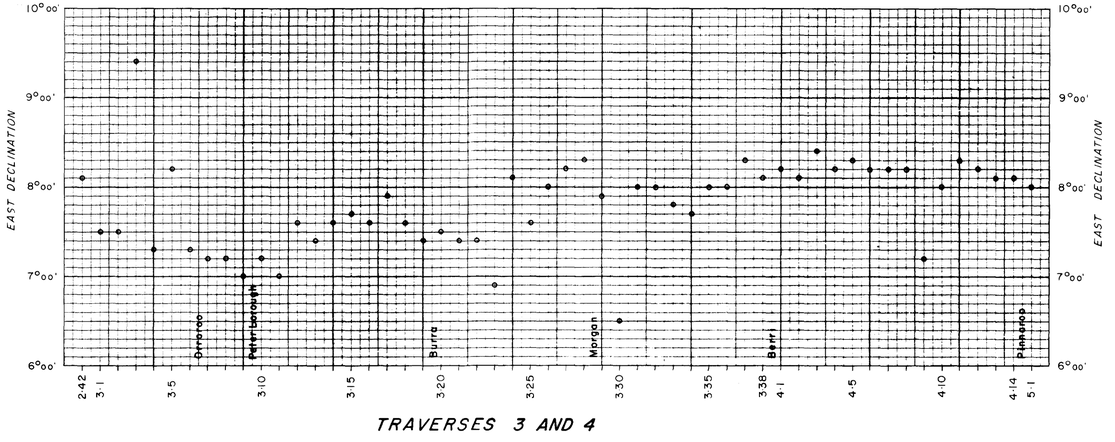
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics.

G96-100

TO ACCOMPANY RECORD No. 1965/218



TRAVERSES 1 AND 2



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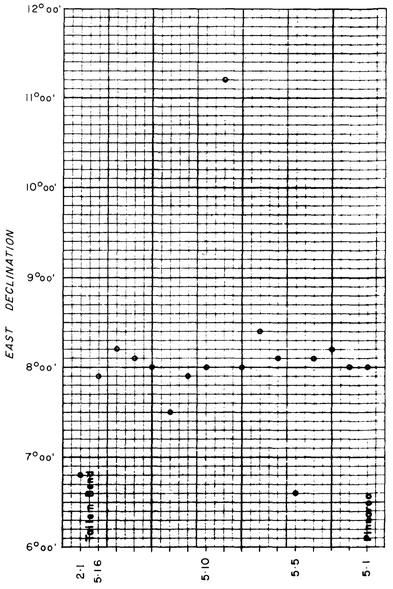

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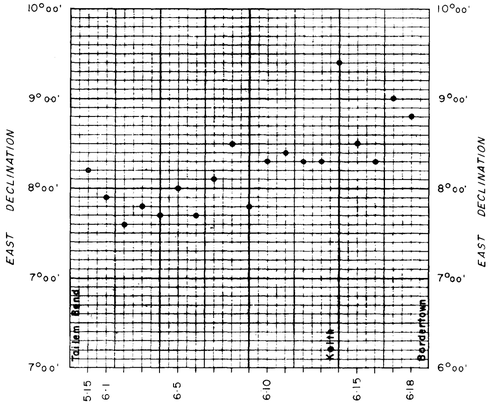

TRAVERSE 6

LEGEND

3·35 Traverse 3, Station 35

DECLINATION SURVEY SA 1963

VALUES OF MAGNETIC DECLINATION AS MEASURED ALONG ROAD TRAVERSES

Note: Distances between stations are not to scale

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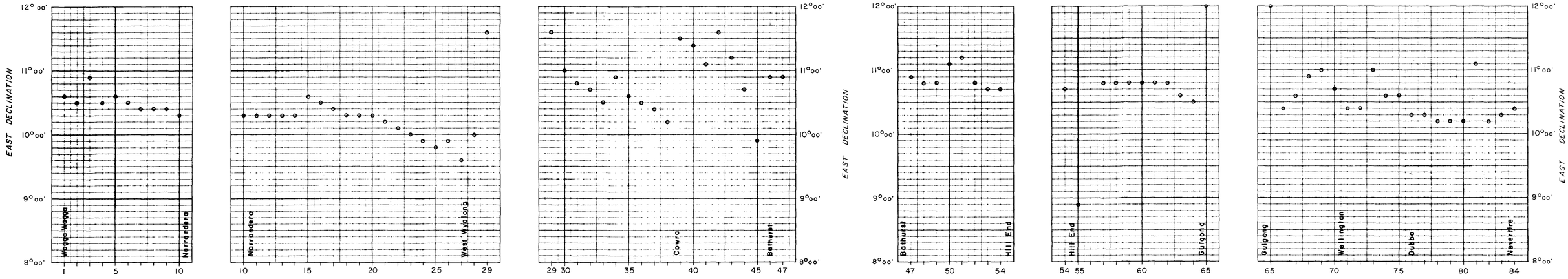

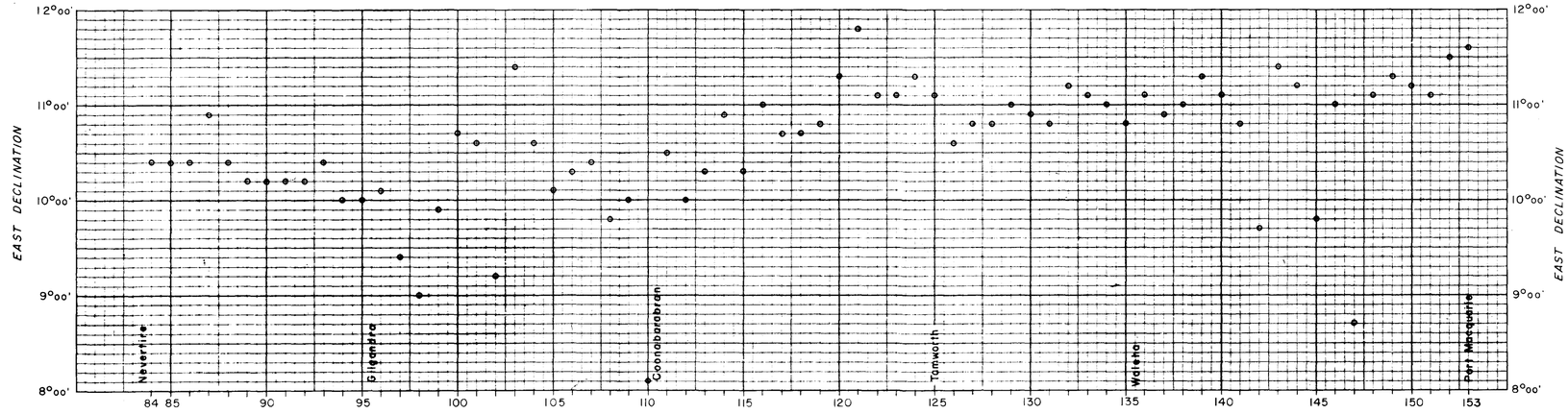

DECLINATION SURVEY NSW 1963

VALUES OF MAGNETIC DECLINATION AS MEASURED ALONG ROAD TRAVERSES

Note: Distances between stations are not to scale

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G 96 – 103

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