

1963/61  
C.3 C

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1963/61

014420

C 3

REGIONAL MAGNETIC SURVEYS IN AUSTRALIA AND  
AUSTRALIAN ANTARCTICA 1960-61

by

J. van der Linden and W.D. Parkinson

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 It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and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.

RECORD No. 1963/61

REGIONAL MAGNETIC SURVEYS IN AUSTRALIA AND  
AUSTRALIAN ANTARCTICA 1960-61

by

J. van der Linden and W.D. Parkinson

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 It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and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.

## CONTENTS

	Page
SUMMARY	
1. INTRODUCTION	1
2. ACCOUNT OF SURVEYS	1
3. INSTRUMENTS	2
4. PRELIMINARY ANALYSIS AND RESULTS	3
5. REFERENCES	5

Table 1. Station locations and magnetic values,  
central Australia.

Table 2. Station locations and magnetic values,  
Antarctica.

## ILLUSTRATIONS

- Plate 1. Coverage of central Australia before and  
after 1961. (Drawing No. G96-43)
- Plate 2. Regional magnetic stations 1961 in relation  
to previous regional magnetic stations;  
Australian (western part) (G96-40)
- Plate 3. Histograms of departure of values at 1961  
stations from 1957.5 contours; central Australia (G96-44)
- Plate 4. Australian observatories and field magnetic  
stations in Antarctica, 1960 and 1961. (G265-44)

## SUMMARY

This Record describes all the regional magnetic work done by the Bureau of Mineral Resources, Geology and Geophysics during 1960 and 1961, with the exception of the survey of New South Wales and Queensland. The surveys form part of a series of surveys carried out in the Bureau's regional magnetic programme. Three elements of the Earth's magnetic field were determined at stations in central Australia, Antarctica, and Victoria. The locations of the magnetic stations and the measured values of the magnetic field are presented in tabular form. The values of the 1961 stations in central Australia were compared with values interpolated from isomagnetic maps of the elements for 1957.5.

## 1. INTRODUCTION

This Record describes all regional magnetic work performed by the Bureau of Mineral Resources, Geology and Geophysics, during 1960 and 1961 with the exception of the survey of New South Wales and Queensland described by van der Linden (1961). Three areas were surveyed, viz. central Australia, Antarctica, and western Victoria. This work is a continuation of the series of surveys made under the Bureau's regional magnetic programme, which includes the publication of maps showing present values and rate of secular variation of the elements of the Earth's magnetic field.

Three elements, viz. declination, horizontal intensity, and vertical intensity, were observed at 51 stations in central Australia, at 12 stations in Antarctica and at two stations in Victoria. One of the stations in central Australia, two of the stations in Antarctica and both of the stations in Victoria were reoccupations of former stations. The others were new stations.

Before the survey of central Australia, there was a large area that was more than 100 km from any magnetic station. This has been reduced considerably, as is shown in Plate 1.

## 2. ACCOUNT OF SURVEYS

### Central Australia

This survey was conducted by J. van der Linden between 2nd May and 10th October 1961. The object of the survey was to cover the region of the Simpson, Gibson, Great Sandy, and Great Victoria Deserts. Fifty new stations were established and the 1957 station at Alice Springs was reoccupied.

The survey covered a distance of more than 10,000 miles, of which 5000 miles was over sandy graded roads and tracks, and 1500 miles was across trackless country. The sandy roads were built for the Weapons Research Establishment. They were smooth, but required four-wheel drive vehicles. The tracks were generally rough but required four-wheel drive only rarely. Progress was slow when travelling away from roads. Four-wheel drive and deflated tyres were necessary to improve traction in the heavy sand. One truck generally went ahead and was followed by the other, which was equipped with a power-winch.

Two petrol dumps were established ahead of the survey, and two more dumps were established by the survey party. Besides the station homesteads, mission stations, and Giles Weather Station, there were only rare opportunities to replenish the water supply. This was done at a large rockhole in the Walter James Ranges, at a pool in the Hale River near Maddigans Point, and at Well No. 22 on the Canning Stock Route. The maximum quantity of water carried was 130 gallons which, in some cases, had to last three men to six weeks.

Weather conditions were good and caused no delays.

Two specially equipped four-wheel drive International AA 120 trucks were used. The general performance was satisfactory and the heavy going was managed fairly well. However, numerous breakdowns occurred. At Alice Springs a Landrover of the Bureau's No. 2 Seismic Party was borrowed for use in the Simpson Desert while the engine of one truck was changed. The front end of another truck collapsed near the Morris-2 magnetic station. A replacement front-end had to be picked up at Meekatharra, 750 miles away. Altogether two engines and four front ends had to be replaced as well as five broken axle shafts and two rear differentials. The probable causes of the breakdowns were the rough terrain, weakness in construction, and the fact that the trucks were in their third field season.

### Antarctica

Some field magnetic observations are generally made by geophysicists en route to, or from, Australian Antarctic bases.

The work done before 1960 has been described by Pinn (1960). Work done during 1960 and 1961 is described in this Record.

Four stations were observed in 1960 and eight in 1961. The Heard Island stations of 1960 and 1961 are on the site of the former observatory, and are therefore reoccupations of a former station. The Lewis Island station of 1960 is an exact reoccupation of the 1958 station. The Chick Island station of 1961 is an approximate reoccupation of the 1960 station. Otherwise, all stations are new. Locations of the stations are shown in Plate 1.

### Victoria

In November 1961 a short survey was made in western Victoria by W.D. Parkinson and R.W. Merrick. Only two stations were read, at Warracknabeal and Portland. Both were exact reoccupations of stations read in 1954.

## 3. INSTRUMENTS

The elements measured in every case were declination, horizontal intensity, and vertical intensity. Declination was observed with an Askania declinometer except at Enderby Land and Dronning Maud Land, where a QHM (quartz horizontal magnetometer) was used, and at Aviation Island, where a HTM (horizontal torsion magnetometer) was used. In these cases, index corrections determined by observations at an observatory were applied. The corrections to Askania declinometers are found to be a small fraction of a minute, and so were neglected.

To determine declination, true north direction is required as well as magnetic north direction. Generally, true north direction is determined by sun observations with an Askania midget theodolite. At Aviation Island and Wilson Hills in the Antarctic, sun observations were impossible and true north was deduced from gyrocompass sighting from the ship Magga Dan. The theodolite is normally used to determine latitude and longitude. Several of the stations in Australia are situated near astro-fixes determined when the roads were surveyed. In these cases, the locations were taken from the astro-fix.

The limitations of the Askania midget theodolite are described by van der Linden (1961).

Throughout the surveys of central Australia and Victoria the horizontal intensity was measured with a horizontal torsion magnetometer (HTM No. 507704). It was standardized at Toolangi Observatory before and after each survey and at Gnangara Observatory during the survey in central Australia. The following corrections relative to the preliminary standards at each observatory were found:

April 1961 at Toolangi - 14 gammas/gauss  
July 1961 at Gnangara + 27 gammas/gauss  
November 1961 at Toolangi + 40 gammas/gauss

Gnangara preliminary standard differs from Toolangi preliminary standard by only a few gammas/gauss. Corrections of +20 and +40 gammas/gauss were adopted for the surveys of central Australia and Victoria respectively.

On the surveys of central Australia and Victoria the vertical intensity was measured with vertical magnetometer type BMZ No. 211. The following corrections were determined before, during, and after the surveys:

April 1961 at Toolangi - 167 gammas  
July 1961 at Gnangara - 172 gammas  
November 1961 at Toolangi - 156 gammas

Corrections of -170 and -155 gammas were adopted for the survey of central Australia and Victoria respectively.

Instruments of the BMZ type are subject to sudden large jumps in correction when carried in a vehicle over rough roads. During the central Australia survey, repeat observations were made at Alice Springs, Giles, Warburton Mission, and Mount Aloysius in case a jump had occurred. The results were consistent, indicating that there were no jumps.

A Watts Z variometer balance was used to determine the extent of local irregularities at all stations in central Australia except for the seven stations along the Canning Basin route. For this traverse the weight of equipment had to be cut down to a minimum.

A Ditisheim pocket chronometer (No. 50098) was used on the surveys in central Australia and Victoria. It maintained a steady but large rate throughout.

Instruments used on the Antarctic surveys are shown in Table 2. Corrections were determined from standardizations at Toolangi Observatory before and after the surveys.

#### 4. PRELIMINARY ANALYSIS AND RESULTS

##### Central Australia survey

A correction to mean of month was made using Gnangara Observatory as reference. Writing X for the instantaneous value of a magnetic element at the time of observation, M for the monthly mean, D for the diurnal inequality at the time of observation, and Y for the departure from normal conditions (e.g. post-perturbation inequality), and writing the subscript F for the field station and G for Gnangara, the observed field value can be expressed by :

$$X_F = M_F + D_F + Y.$$

The instantaneous value at Gnagara is :

$$X_G = M_G + D_G + Y$$

We must assume that Y applies equally at both places and eliminate it, so that the required monthly mean  $M_F$  is given in terms of the observed quantity  $X_F$  by

$$M_F = X_F + (D_G - D_F) + M_G - X_G$$

$D_G$  and  $D_F$  were obtained from Vestine, Laporte, Lange, Cooper, and Hendrix (1948).  $M_G$  and  $X_G$  were obtained from Gwangara traces.

The corrections to mean of month are always small, ranging up to 20 gammas.

The total intensity (F) and inclination (I) were computed from the corrected values of H and Z by :

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

and

$$\tan I = Z/H$$

Values of all stations, reduced to mean of month and to Toolangi preliminary standard, are shown in Table 1.

The corrected values for the five elements were compared with the values derived from the contours of the magnetic elements for the epoch 1957.5 (Parkinson and Curedale, 1962). These contours had to be interpolated across the region devoid of magnetic stations in 1957 (see Plate 1). It is interesting to see whether or not the observations agree with the 1957.5 maps. The differences between the observed values and the 1957.5 values are shown in the histograms of Plate 3. If the isomagnetic lines had been plotted in the correct positions then the mean of the differences should be equal to the secular variation for each element for the interval 1957.5 to 1961.5. A comparison between the 1961.5 values and the secular variation as predicted in 1957.5 is as follows:

Element	Mean departure from 1957.5 values	Mean predicted secular var. 1957.5 to 1961.5	Mean difference
D	2.5' East	4' East	1.5' West
H	-60 gammas	-75 gammas	+15 gammas
Z	-280 gammas	-200 gammas	-80 gammas
I	-10'	-10'	0'
F	190 gammas	100 gammas	90 gammas

The mean difference is smaller than the secular variation in each case.

#### Antarctic surveys

The results of magnetic observations in Antarctica (and Heard Island) in 1960 and 1961 are shown in Table 2. No corrections for transient fields were made because generally no observatory was sufficiently close to the site of observation. To indicate reliability, magnetic conditions at Mawson or Wilkes Observatories are shown by Q (quiet) or D (disturbed). The observations at Chick Island in 1961 were extended over two days. Only the mean values are tabulated.

Victorian survey

Observations at Portland and Warracknabeal were corrected to mean of month using the above formula, but referred to Toclangi Observatory. These results will be used in an analysis of secular variation of Australia to be undertaken in a few years' time. Results are as follows:

South Lat. o ' "	East Long. o ' "	Station	Date 1961	Declin. o ' "	Hor. Int. (gammas)	Vert. Int. (gammas)
36 15	142 24	Warracknabeal	Nov. 17	9 04.6	23,286	-56,104
38 21	141 37	Portland	Nov. 16	8 42.2	21,615	-58,078

5. REFERENCES

- |   |      |   |
|---|------|---|
| PINN, J.D.  | 1960 | Field magnetic observations in Antarctica.<br><u>Bur. Min. Resour. Aust. Rep. 51</u>                                      |
| PARKINSON, W.D. and<br>CUREDALL, R.G.                                     | 1961 | Isomagnetic maps of Australia for the epoch 1957.5, Part 2 - Central and Western Australia.<br><u>Ibid. 62</u>            |
| VAN DER LINDEN, J.  | 1961 | Regional magnetic survey of Queensland and New South Wales 1960.<br><u>Bur. Min. Resour. Aust. Rec. 1961/10 (unpubl.)</u> |
| VESTINE, E.H., LAPORTE, L.<br>LANGE, I., COOPER, C.,<br>and HENDRIX, W.C. | 1948 | Description of the Earth's main magnetic field and its secular changes, 1905-1945.<br><u>Publ. Carneg. Instn 578</u>      |

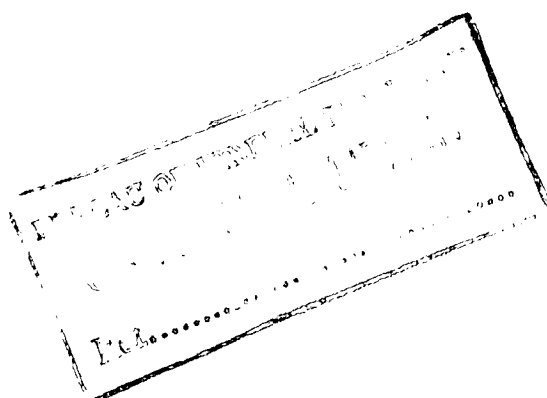




TABLE 1  
REGIONAL SURVEY OF CENTRAL AUSTRALIA (1961)  
STATION LOCATIONS AND MAGNETIC VALUES

South o	Lat. °	East o	Long. °	Station	Date 1961	MEAN FIELD VALUES Based on preliminary 1961 Toolangi Standard					Footnote
						D o	H gammas	Z gammas	I o	F gammas	
22	32	121	31	Rudall	3 Sept	2 09	30663	-43873	55 03	53526	
22	48	120	52	Balfour Downs	5 Sept	1 25	30407	44297	55 32	53729	
22	48	126	44	Desert Oak Forrest	9 June	2 55	30675	43777	54 59	53454	
22	53	122	03	Wells Range	1 Sept	1 57	30482	44127	55 22	53632	
22	55	127	32	Ant Hill Flat	1 June	2 58	30656	43708	54 57	53387	
23	03	128	30	West Point	12 June	3 28	31341	43952	54 30	53982	
23	08	123	02	Well 22	10 Aug	2 01	30121	44184	55 43	53476	
23	18	130	21	Ehrenberg Range	14 June	4 25	30477	44650	55 41	54061	1)
23	18	131	06	Gunbarrel Corner	14 June	4 19	30647	43791	55 01	53449	
23	21	129	22	Mount Leisler	7 June	3 32	30853	44146	55 03	53859	
23	28	124	08	Midway Well Sth.	30 Aug	2 14	30160	44654	55 58	53887	2)
23	48	133	54	Alice Springs C	11 May	4 40	30683	44217	55 15	53820	3)
23	49	128	51	Bonython Range	5 June	3 32	30321	45046	56 03	54302	1)
23	56	125	13	Morris 2	16 Aug	2 37	30286	45519	56 22	54675	
23	56	124	36	Morris 1	14 Aug	2 29	29835	45294	56 01	54237	
24	02	135	19	Caseys Bore	16 May	5 24	30429	44572	55 41	53968	
24	34	133	15	Henbury	9 May	4 31	30076	45269	56 24	54350	
24	40	128	45	Walter James Ra.	4 June	3 31	29570	45760	57 08	54483	
24	44	135	46	Madigans Point	18 May	5 29	30495	45104	55 56	54447	
24	51	127	20	Three Hills	1 July	2 52	29563	46094	57 20	54770	

TABLE 1 (Cont.)

South Lat. '	East °	Long. '	Station	Date 1961	MEAN FIELD VALUES Based on preliminary 1961 Töolangi Standard						Footnote		
					D °	H gammas	Z gammas	I °	F gammas				
24	59	129	21	Mount Curdie	28 June	3	28	29388	46101	57	29	54672	
25	02	128	18	• Giles	1 June	3	23	29388	46217	57	33	54770	
25	05	131	34	Angas Downs	23 June	4	17	29799	45670	56	53	54532	
25	05	130	07	Armstrong Creek	27 June	4	08	29548	46309	57	28	54933	
25	09	133	12	Erlunda	8 May	4	34	29907	45844	56	52	54736	
25	11	125	02	Mount Everard	23 Sept	2	14	29338	46902	57	58	55322	
25	21	131	21	• Ayers Rock	25 June	4	22	29452	46489	57	39	55033	
25	25	123	45	Fame Range	21 Sept	2	10	28981	47217	58	28	55402	
25	25	135	21	Andado	20 May	5	23	29601	45900	57	11	54617	
25	27	126	22	Mulga Swamp	3 July	3	24	29105	46817	58	08	55126	
25	39	125	33	NMF 19	24 Sept	2	31	29031	47613	58	38	55765	2)
25	42	126	40	Warburton Junction	25 Sept	3	38	29246	47701	58	29	55953	2) 1)
25	49	122	<del>49</del> 56	• Carnegie	19 Sept	<del>21</del>	<del>00</del> 56	28588	47445	58	56	55394	
25	54	131	40	Mulga Park	27 May	4	08	29006	45908	58	16	55151	
25	56	121	23	Granite Peak	18 Sept	1	18	28358	47754	59	18	55540	
25	59	128	42	Mount Aloysius	31 May	3	40	29197	47209	58	16	55509	
26	06	127	09	Mount Elsie	26 Sept	2	56	28676	47572	58	55	55549	
27	07	127	53	Mount Cooper	28 Sept	2	47	29144	47066	58	14	55359	
26	08	126	33	Warburton Ra. Mission	4 July	2	15	28601	47572	58	59	55509	
26	10	130	10	Mann Ranges	29 May	3	34	28523	46756	58	37	54771	1)
26	11	131	02	Mount Morris	28 May	4	29	29394	46935	57	57	55380	1)
26	28	120	52	Millrose	17 Sept	1	04	28039	48307	59	52	55854	
26	40	125	49	Warburton Sth	6 July	2	12	28360	48424	59	04	56118	1)

TABLE 1 (Cont.)

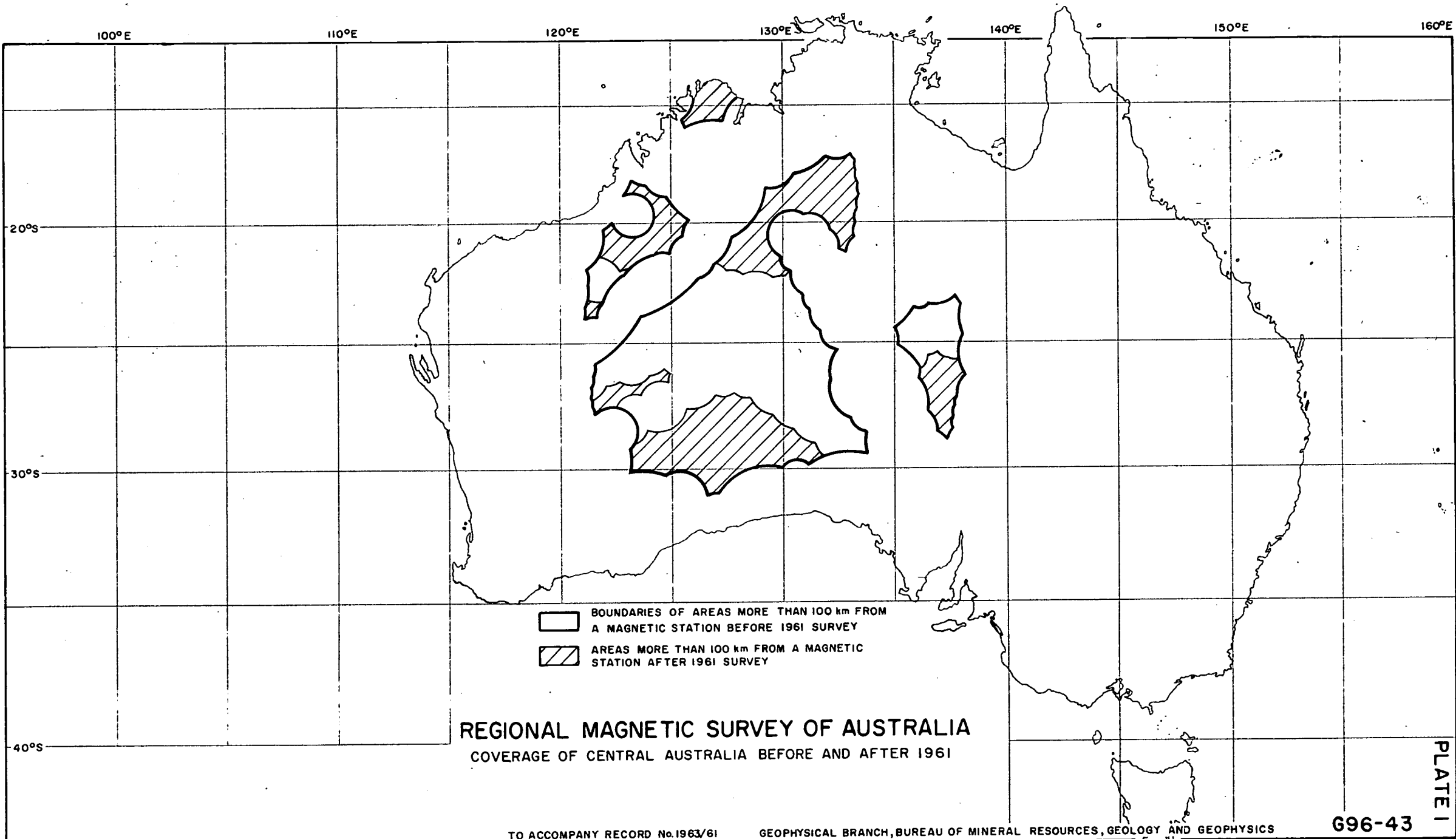
South °	Lat. '	East °	Long. '	Station	Date 1961	MEAN FIELD VALUES Based on preliminary 1961 Toolangi Standard					Footnote
						D °	H gammas	Z gammas	I °	F gammas	
26	53	129	36	Mount Lindsay	30 Sept	4 00	28354	47801	59 20	55579	2)
27	01	125	16	Muggun Rock hole	7 July	2 24	28141	48665	59 58	56217	
27	24	124	21	Mia Mia Rocks	8 July	2 06	27904	49194	60 26	56557	
27	34	130	34	Coffin Hill	2 Oct	3 45	28057	48834	60 07	56321	
27	57	123	01	Cosmo Newbury	10 July	1 25	27283	49827	61 18	56808	
28	13	131	18	Sandiman	3 Oct	4 05	27782	49335	60 37	56620	
28	39	132	13	• Emu	4 Oct	4 31	27426	49525	61 01	57489	
29	02	133	17	Talaringa Well	5 Oct	4 30	27726	50361	61 10	57489	

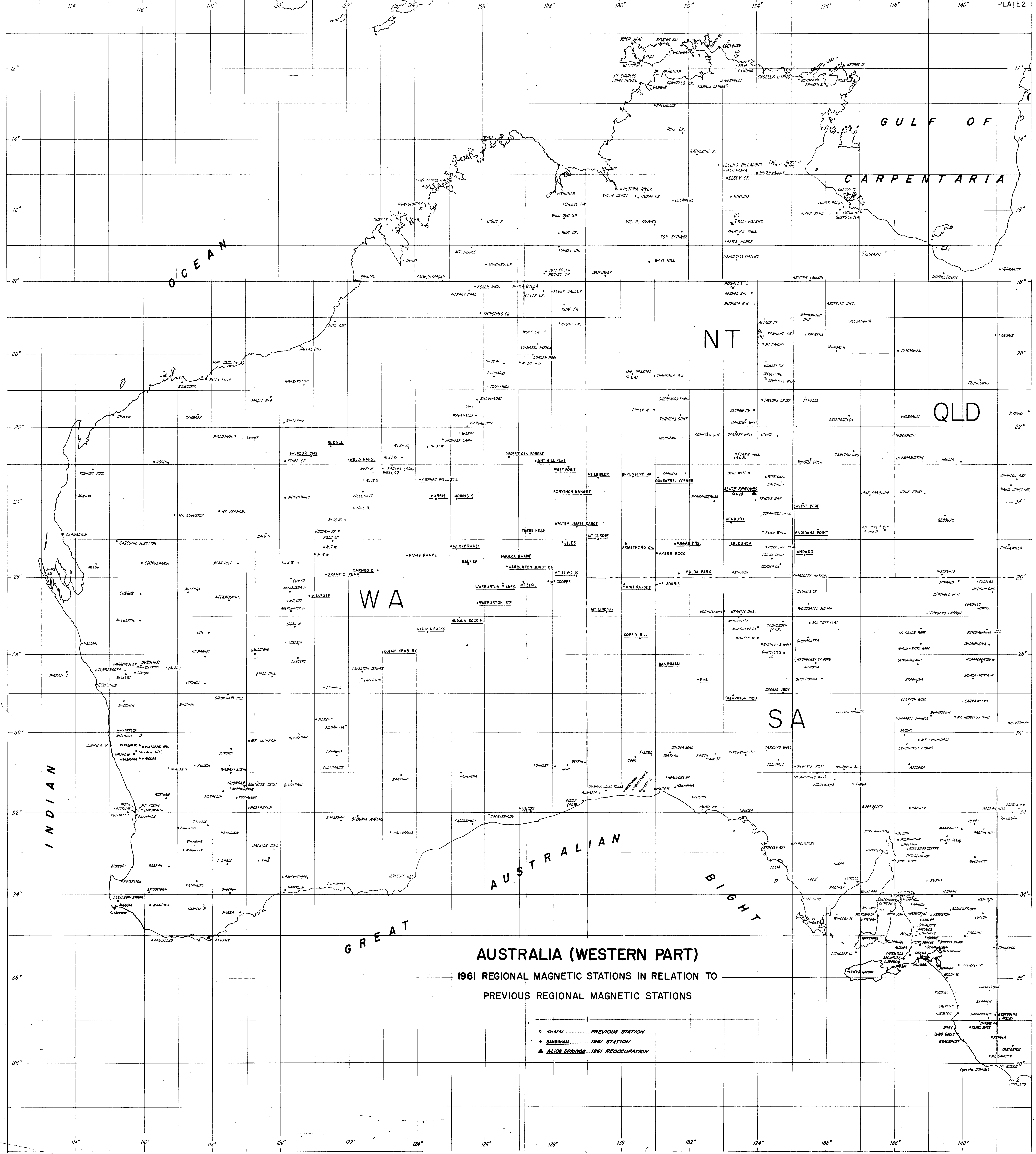
Footnote : 1) Local magnetic disturbance  
 2) Magnetic storm during observations  
 3) Exact re-occupation of 1957 station

TABLE 2  
MAGNETIC OBSERVATIONS ANTARCTICA 1960 - 1961  
Station Locations and Magnetic Values

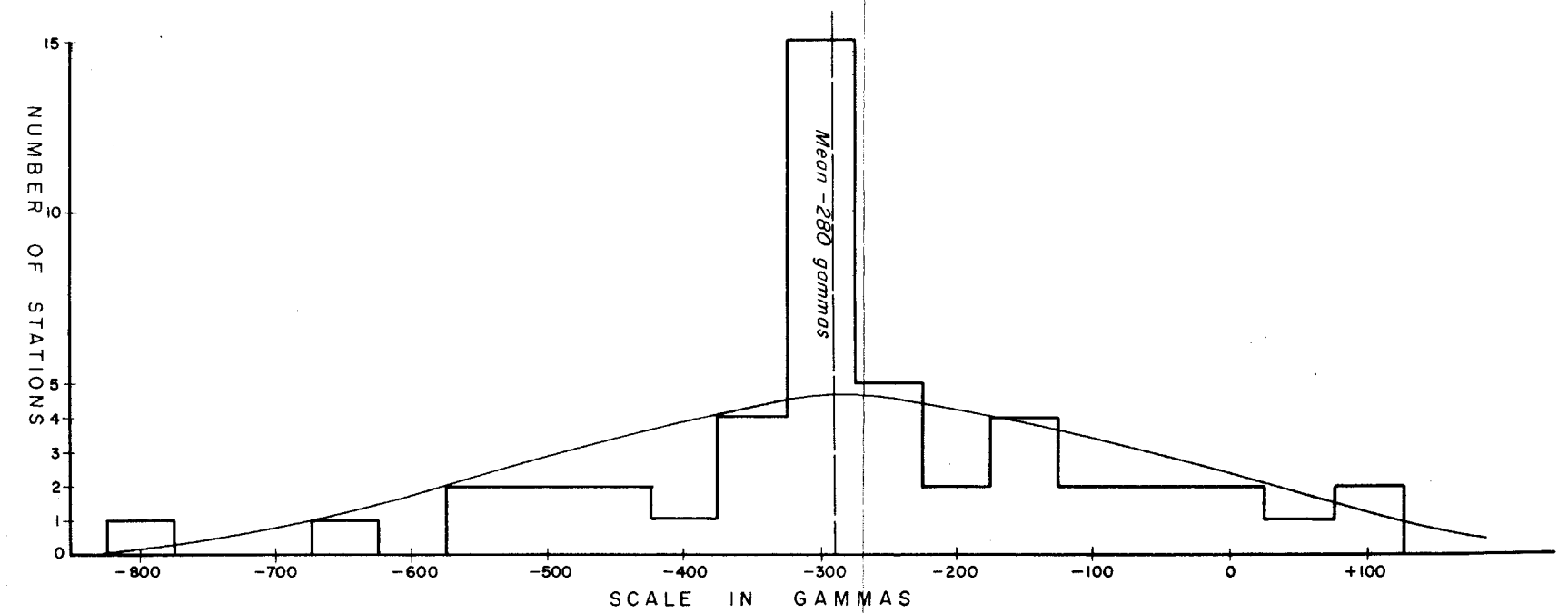
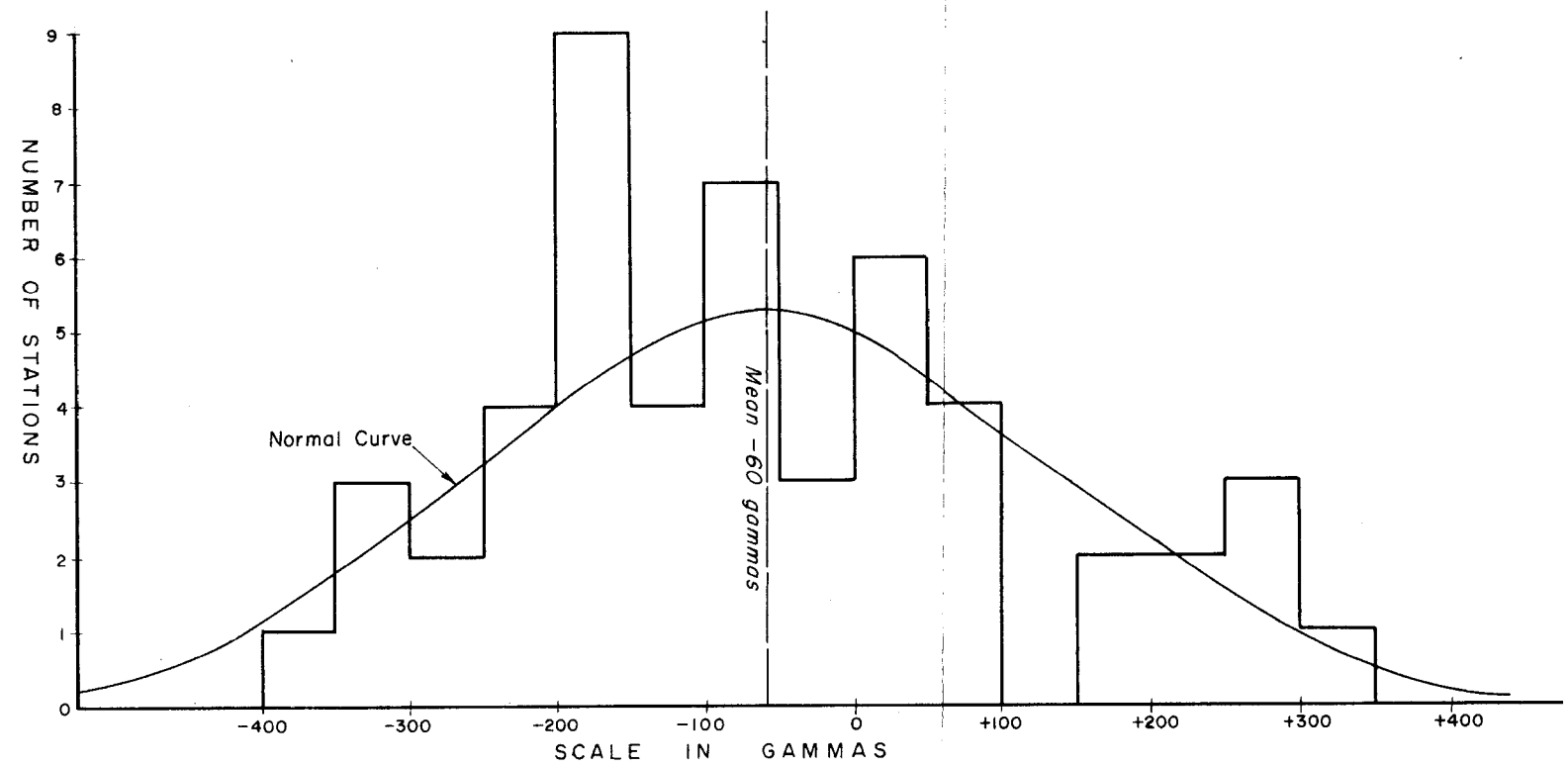
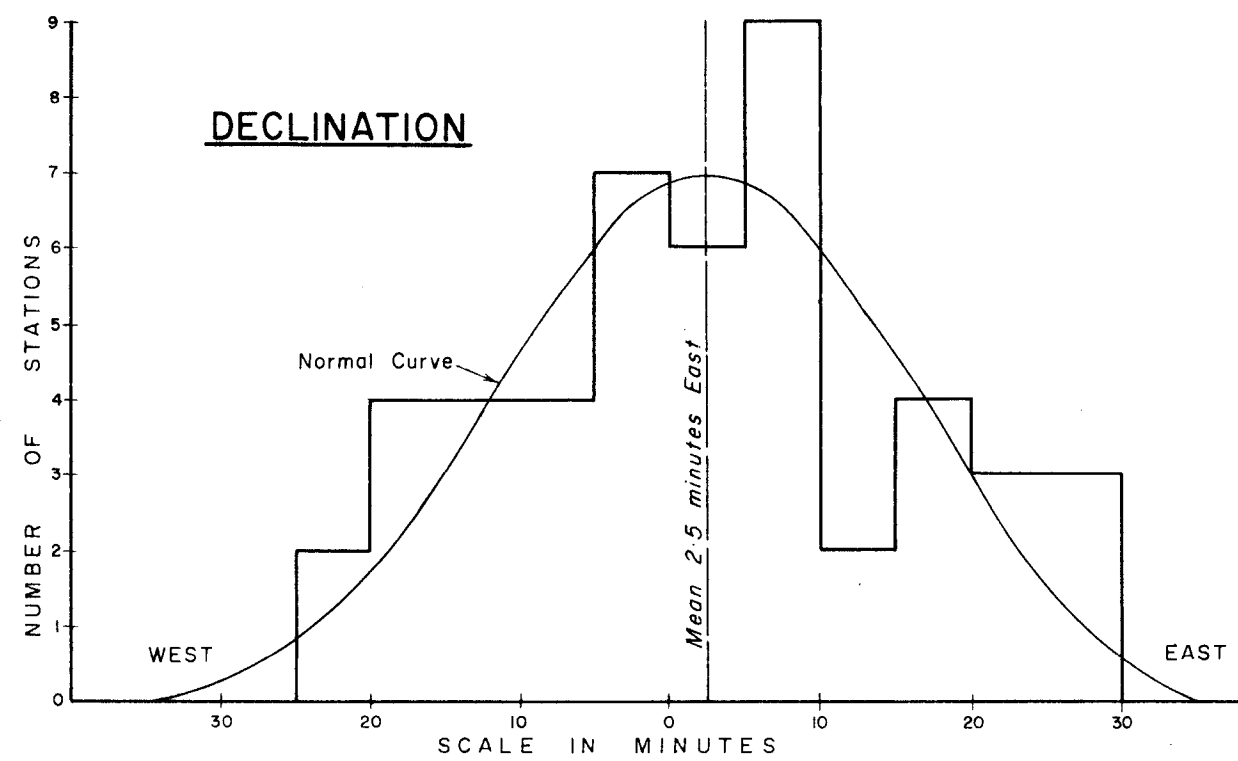
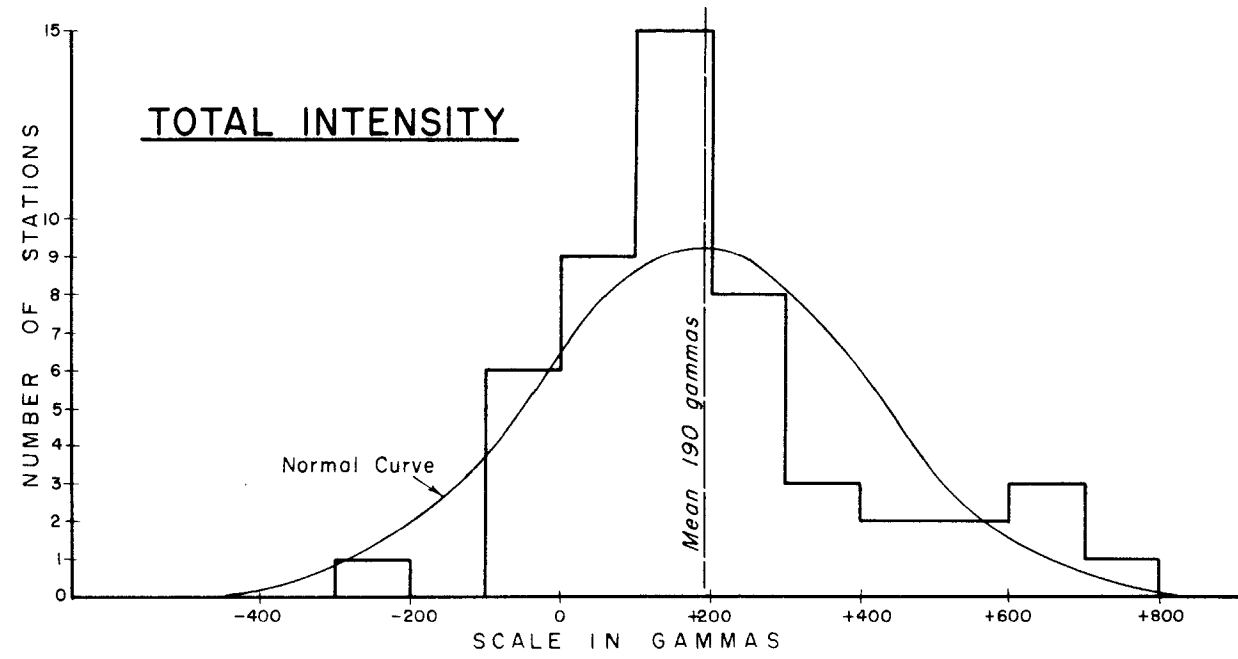
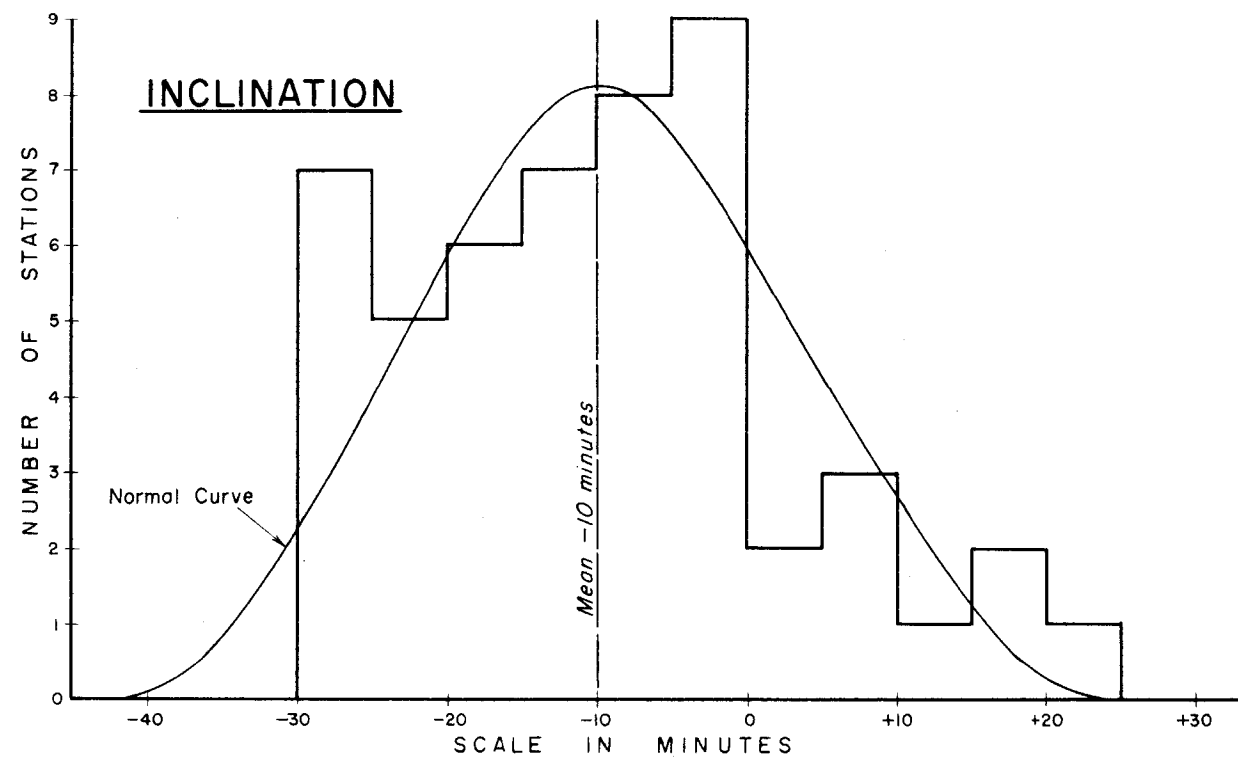
South Lat. °	East Long. °	Station	Date	DECLINATION			HOR. INTENSITY			VERT. INTENSITY			Quiet or Disturbed
				Instr.	G.M.T.	Value °	Instr.	G.M.T.	Value	Instr. BMZ	G.M.T.	Value	
53 02	73 22	Heard Island reoc.	5 Mar 60	Ask 339	08 59	51 32 W	HTM 704	08 26	18422	-	-	-	Q
53 02	73 22	Heard Island reoc.	6 Mar 61	Ask 320	06 20	51 50 W	QHM 174	05 58	18368	121	06 48	-47777	Q
66 06	134 22	Lewis Islet reoc.	28 Feb 60	Ask 042	00 40	63 58 W	-	-	-	221	02 06	-68681	Q
66 39	108 25	Hudson Island	20 Feb 60	Ask 042	00 46	91 48 W	-	-	-	221	02 21	-65472	Q
66 47	121 00	Chick Island A	23 Feb 60	Ask 042	23 50	92 11 W	-	-	-	221	00 31*	-67868	Q
66 47	121 00	Chick Island B	21 Feb 61	Ask 339	10.0) to ) 11.5)	88 28 W	HTM 154	04.2) to ) 09.8)	5973	211	02.5) to ) 11.0)	-67677	Q
66 47	121 00	Chick Island B	22 Feb 61	Ask 339	05.0) to ) 10.9)	88 32 W	HTM 154	06.0) to ) 09.6)	5964	211	01.4) to ) 10.3)	-67697	D
67 00	50 30	Mt. Riiser Larsen	24 Feb 61	-	-	-	QHM 174	11 48	19781	121	11 24	-45921	Q
67 17	46 59	Enderby Land 1	21 Feb 61	QHM 174	11 17	47 25 W	QHM 174	11 18	18747	121	11 48	-43770	Q
67 34	45 56	Enderby Land 2	19 Feb 61	-	-	-	QHM 174	10 20	18281	121	07 52	-43804	Q
67 44	43 52	Dronning Maud Land	15 Feb 61	QHM 174	08 57	49 20 W	QHM 174	08 57	18853	-	-	-	D
68 35	77 58	Davis	23 Jan 61	Ask 339	06 38	74.8 W	QHM 172	11 41	17028	121	13 26	-54452	D
69 22	158 38	Aviation Island	6 Mar 61	HTM 154	04 22	97.4 E	HTM 154	04 22	4201	211	05 04	-67580	Q
69 38	158 41	Wilson Hills	5 Mar 61	Ask 339	02 46	98.8 E	HTM 154	02 40	4254	211	02 48	-67475	Q

\*  
on 24 Feb 61

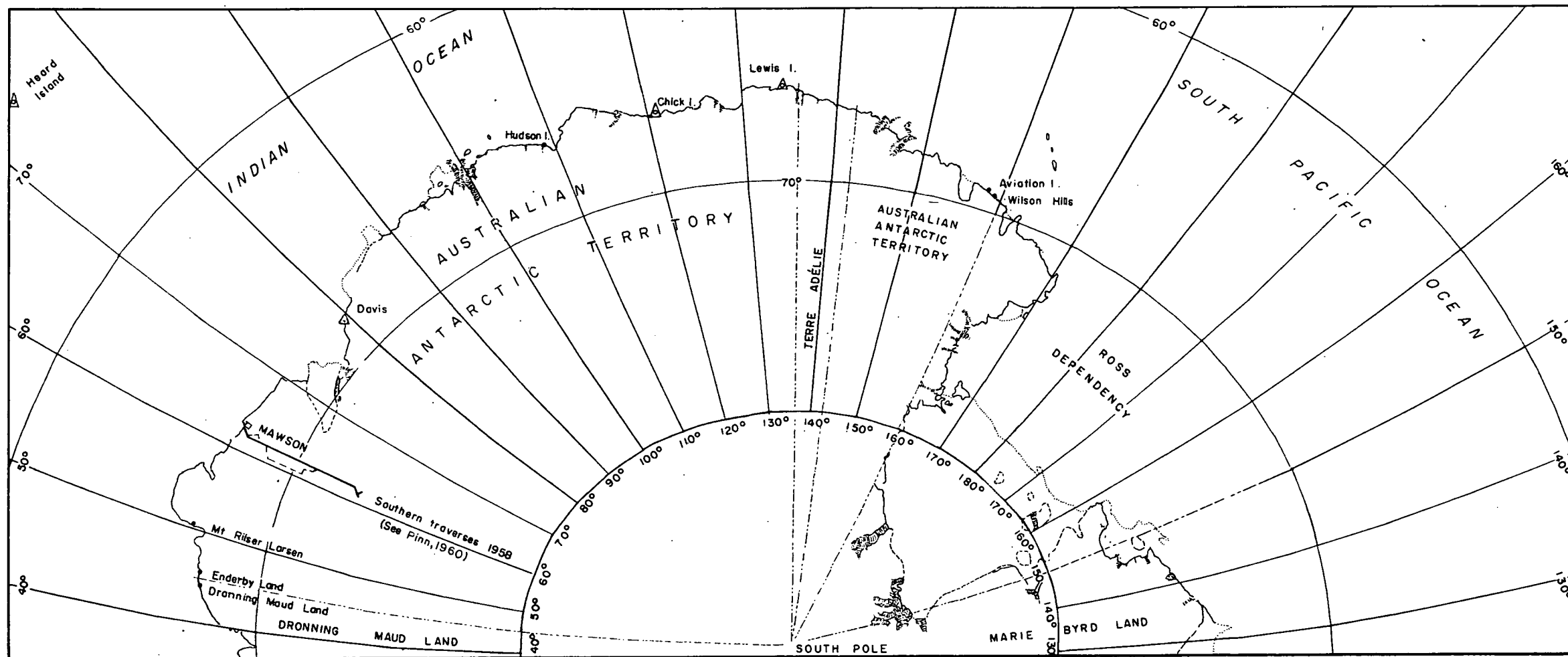




- KULBERA ..... PREVIOUS STATION
- SANDIMAN ..... 1961 STATION
- ▲ ALICE SPRINGS ..... 1961 REOCCUPATION

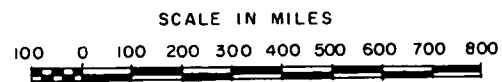


CENTRAL AUSTRALIA  
HISTOGRAMS OF DEPARTURE OF VALUES  
AT 1961 STATIONS FROM 1957.5 CONTOURS



LEGEND

- FIELD MAGNETIC OBSERVATION 1960-1961
- ◻ MAGNETIC OBSERVATORY
- △ FIELD MAGNETIC STATION REOCCUPIED IN 1959-1961



AUSTRALIAN OBSERVATORIES AND  
FIELD MAGNETIC STATIONS IN ANTARCTICA  
1960 AND 1961

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G 265-44

TO ACCOMPANY RECORD No. 1963/61