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FIRST ORDER REGIONAL MAGNETIC

SURVEY OF AUSTRALIA

FOR EPOCH 1980.0

MARCH 1978 - JULY 1979

OPERATIONS REPORTS

Compiled

by

A.J. McEWIN

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1980.0 Survey Operation Report

SUMMARY

A first-order magnetic survey was made by BMR throughout Australia and on some Pacific and Indian Ocean Islands from March 1978 to June 1979. Results suitable for the reliable definition of the Earth's vector field and its secular variation were obtained at 64 stations, and used for the production of regional charts at epoch 1980.0

Travel was by Landrover except to some remote stations and islands when air charter, commercial flights or a BMR aircraft was used.

At each station a three-component fluxgate variograph and a base station total-intensity magnetometer were operated for about three days; magnetograms were calibrated by frequent absolute observations; and sun observations were made to determine true north. Earlier stations were connected to present stations to extend the time-series at 22 places.

The observed magnetic elements and adopted station values are given.

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SUMMARY

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(cont.)

TABLES(continued)

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1. INTRODUCTION

The aim of the survey was to obtain values of the Earth's magnetic field at each BMR first-order station to an accuracy of better than 5nT (0.5'), to provide reliable estimates of secular change, for production of isomagnetic charts of Australia for the epoch 1980.0.

The recording equipment, a three-component Advanced Kinetics fluxgate magnetometer and proton precession magnetometer together with ancillary equipment was set up at each station. Each station was to be occupied until at least two nights' magnetically quiet magnetograms were obtained. The magnetograms were calibrated with absolute observations during the occupations, and sunshots were made at all stations to derive the azimuth of the declination reference marks.

Sixty-four first-order stations (Figure 1) were occupied in the fifteen months of the survey between March 1978 and June 1979, with nine changes of party leader in that time (Appendix 1). Travel was by Landrover except to the islands and some remote stations when air charter, commercial flights or the BMR Twin Otter was used.

Wherever possible old stations - for example those established by the Carnegie Institution of Washington - were re-occupied to tie them to the current stations. Both are listed in Table 1.

2. PREPARATION

Planning for the survey started in October 1977 and a comprehensive planning schedule of distances, temperatures, expected rainfall (as an indication of overcast days) and the sequence of station occupation was compiled (Appendix 2). The survey was split into sections, with staff from Mundaring Geophysical Observatory making the Western Australia reoccupations.

Letters were sent before the survey began to all organisations controlling access to the stations, viz Department of Transport, Local Shire Councils, Pastoral Companies; the letters explained the objects and needs of the survey and sought help in providing access and facilities (Appendix 3), so that

most of the problems arising from the occupation of the station could be solved before the field party arrived.

General guidelines for the party leader (Appendix 4), and specific guidelines for the setting up and operation of the variograph (Appendix 5), reduction of magnetograms (Appendix 6) and observations of the sun for azimuth (Appendix 7) were drawn up, as well as a program for calculation of QHM observations on a HP65 programmable calculator (Appendix 8).

3. EQUIPMENT

The variograph used on the survey was a three component (X, Y, Z) Advanced Kinetics (Adkin) fluxgate magnetometer and an Elsec proton precession magnetometer Model 595 (PPM) with a toroidal head. The Adkin recorded the field continuously and the PPM once every sixty seconds on a Toshin DB6 chart-recorder (six channels). A thermograph (BMR construction) recorded the temperature of the Adkin sensor head using an STC F23 thermistor mounted in the top of the sensor. An EMI clock type 100 (with a 24V standby battery pack) provided hourly time marks with a Bulova clock for secondary timing and for time marks on the PPM trace. The PPM was powered by an 18V DC power supply (Figure 2).

The whole system was mounted in four wooden boxes for protection during transport and for easy setting up.

Two Hewlett-Packard Moseley two-channel recorders were used as backups if any channels on the Toshin DB6 failed. A comprehensive spares kit was carried for the Adkin, and PPM.

Details of variograph recording at each station are in Appendix 9.

Absolute calibration was achieved with the following instruments: Askania declinometer, La Cour quartz horizontal magnetometer (QHM) and an Elsec proton precession magnetometer (PPM), all of which were compared before and after the survey at Canberra Magnetic Observatory (Table 2). Secondary QHM's were carried for use as 2π instruments at different latitudes and as spares. These were used at intervals throughout the survey to keep

a check on the instrument differences (Table 2). The serial numbers of the magnetometers together with the values of the magnetic elements observed are listed in Table 3. Instrument corrections for the survey period (Table 4) have been applied. Appendix 10 contains reports of each station occupation.

A Wild compass theodolite T01-104407 was carried for measurement of declination at old stations where there were no marks of known azimuth, or the station position could only be reoccupied approximately. The corrected values of D are listed in Table 3.

Sunshots at each station to determine the azimuth of the D reference mark were made with Hilger & Watts theodolite No. 66006 (Apendix 11).

The variographs were housed in convenient buildings with access to 240V AC power wherever available, with the sensor heads as far from sources of artificial disturbance as possible. These buildings were usually on airports and included at some place or another, the airport terminal, hangars, workshops and Bureau of Meteorology anemometer huts.

A four-man tent was used to house the equipment at 31 of the stations, either owing to lack of facilities or to distance the equipment from artificial disturbances, e.g., traffic. At 18 stations a Honda E800 generator had to be used; two twenty-litre steel jerrycans were adapted as petrol tanks so the generator could be operated continuously overnight.

Concrete foot-pads for the tripods were installed at all stations except Portland, Warracknabeal, Mildura, Cocos Island and Christmas Island. These were levelled and positioned carefully, but the centering of the station marker was not checked.

The only major disruption occurred after the Adkin magnetometer broke down on 29 September. Tests were conducted on the Adkin at Meekatharra on 4 October, in consultation with Canberra HQ, to no avail and it was freighted to Canberra on 5 October. It was returned on 13 October, and the survey recommenced immediately.

4. PERSONNEL AND LOGISTICS

The project leader was P.M. McGregor and G.R. Small was the survey manager; the complete survey was broken down into 10 stages, and the party leaders and the stations in order of completion of each leg are given in Appendix 1 and Figure 1. The field hand for the entire survey was D. Morrison (Appendix 12 - Report on Logistics); Cocos, Christmas, Lord Howe and Norfolk Islands were occupied by the party leader only.

Supervisory visits were made by G.R. Small to the following stations, Portland, Warracknabeal, Mildura, Condobolin, Daly Waters and Wyndham; C. Rochford accompanied the survey to Flinders Island and Hobart.

A Landrover was used for most of the survey, and B. Page (Mundaring Observatory) joined the survey at Marble Bar with a 4WD International for the remote outback stations of legs 3 and 4; he returned to Perth in the Landrover after Neal Junction. While the Landrover was undergoing repairs in Perth the survey continued using the International. The Landrover was railed to Cook, to join the survey for the reoccupation of Emu, and then to Adelaide from Watson. Special permission was obtained for entry to the Woomera Rocket Range and for security reasons a Commonwealth Police officer accompanied the survey party from Maralinga to Emu and return. The International was returned to the Department of Administration and Services, Stores and Transport Section in Adelaide and the Landrover collected from the Mile End railway station.

The BMR Twin Otter was used for reoccupation of the following stations: Gove, Weipa, Parafield (sunshots), Pt Lincoln (sunshots), Etadunna, Flinders Island, Hobart, Lord Howe Island. The station owner at Etadunna was on holidays for the second attempt at reoccupation, and because there was no-one to provide transport to the station, the Twin Otter flew to Maree and a tray-top Toyota was hired from Leigh Creek for the trip to Etadunna.

Norfolk Island was reoccupied using commercial aircraft, and Cocos Island and Christmas Island by chartered Lear Jet from Perth.

Because of delays at Moree and Roma due to equipment failure, Tibooburra, Bourke and Wilcannia were excluded from the first leg and Boulia, Winton, Alpha were included. This enabled the survey to keep to the planning schedule (to finish Parafield by December). Tibooburra, Bourke and Wilcannia were reoccupied from Canberra towards the end of the survey. Other changes in reoccupation order included Alice Springs and Ayers Rock in the second leg, The Granites being occupied from Halls Creek (better access), Giles and Zanthus on the outback Western Australian section, Onslow on the third leg when rain made roads to Telfer impassable and Emu on leg 5 from Maralinga (better access). Five days were lost owing to rain closing roads out of Port Hedland and Marble Bar. For this reason Swindells was not reoccupied.

A new station was established at Warburton in July 1979 by E. Paull.

GENERAL COMMENTS AND RECOMMENDATIONS

These are included as written by each party leader.

Leg 1 M.J. Sexton

The survey progressed relatively smoothly most of the time, instrumental problems and reduction of data in the field led to long nights and little sleep. To reduce the data quickly the variometer system must record the magnetic field faultlessly.

My suggestions are:

1. Airports as sites for magnetic stations, the station markers should last for many years with no interference. Old stations that are still in existence should be kept, and upgraded by marking with a wooden stake and installing concrete blocks for the tripod feet. Having two magnetic stations in a town is an asset.
2. A solution to the level of the ADKIN sensor head drifting during recording must be found. The concrete block used at present works well, but occasional inexplicable drifts in level occur.
3. Intermittent faults in the ADKIN and the Toshin recorder should be eliminated before any future survey.
4. The Land Rover although reliable, with only one breakdown during leg one, proved most uncomfortable, and could be endured for only 200 kilometres. The interior is not sufficiently sealed and one can get very wet during a thunderstorm. Toyotas or Nissans should be used in future.
5. The most serious problem was disturbance caused by cars. The variometers should be set up distant from airport carparks but accessible to 240V power. The best solution to this problem would be to use a "slide-on camper van" for recording. These vans fit on the back of a utility and could be unloaded for recording, with a long extension cable for power, and the vehicle could then be used for transport.

Most motel and hotel rooms in country towns are poorly lit with little table space, the van could be used as an office. Whilst camping, data reduction is impossible at night-time. The recording instruments could be rack-mounted, saving several hours at each station packing and unpacking. This would enable non remote future surveys to be done by one person.

Leg 2 A. McEwin

The survey on leg 2 caught up 4 days in 50 on the scheduled rate of progress. Three days were lost owing to equipment breakdowns. The major breakdown was the Adkin power supply at Ingham; a replacement was sent by air, collected from Townsville and installed within a day and a half.

However, it would have been impossible to keep to the scheduled rate of progress if there had been any major equipment failures in isolated places or delays due to weather.

The rate of progress was only maintained by the geophysicist working long hours on reduction of data at night. Fortunately D. Morrison, the field hand, was extremely capable and keen and took most of the vehicle maintenance and some of the professional workload (reduction of absolutes and meaning of sunshots during observations) off the geophysicist.

The only slight doubts of procedure and operation were due to unfamiliarity. I feel supervisory visits on change-over should be a top priority regardless of airfares etc. What is saved by proper and complete training of the new party leader would more than cover the cost of the airfares (besides preventing poor observing practices being passed on from party leader to party leader).

Equipment

The Hewlett Packard Moseley recorders are totally unsuited to continuous recording under field conditions. The fineness of the detachable nibs on the ink pen system of the Toshin proved troublesome (blockages) Generally the whole ink system of the Toshin was time-consuming and fiddly.

Observations

The target of two full symmetric sets of absolutes (FDHHDF) morning and afternoon was unrealistic under the field and manpower conditions of this survey, especially when sunshots were to be done as well. This target could only regularly be reached with 2 professionals and one field hand or if the stations were occupied longer. The procedure developed (with approval from the survey manager) to do half sets of absolutes (F D H) as often as time permitted during continuous recording.

The sunshots consumed a lot of the available time in observing and calculating the azimuths. This time could have been profitably spent in more thorough calibration and control of the variograph. Unless the need for sunshots is eliminated (permanent azimuth marks), an extra observer or an extra day at each reoccupation should be considered.

Recommendations

1. Magnetic stations on airfields should be (a) tied into existing airport reference points, (b) have a uniquely coloured cone over them, (c) be maintained by the airport groundsmen. To this end approaches should be made to the Department of Transport, or local authorities.

2. National Mapping should be approached to carry out a survey of all our magnetic stations for the purpose of (a) precisely determining latitude and longitude (b) establishing permanent azimuth marks and alternative ones at each station.

3. Sexton's idea of an instrument cab should be followed up. If all recording equipment was permanently rack-mounted several hours would be saved at each station in setting up and closing down.

4. Supervisory visits should be made at all changeovers - it is false economy not to make them.

5. The schedule for the next similar survey should not be as tight and the length of time in the field should be a <u>maximum</u> of 5 weeks for any one leg as the pressure of the schedule affected morale and led to carelessness.

Leg 3 M.W. McMullan

The work load during the remote section of this leg was considerable. B. Page and D. Morrison were employed full time in keeping the vehicles in repair and maintaining the camps. The vehicles were overweight which slowed the survey. Unexpected heavy rain also caused delay. The camping gear would have been completely inadequate under wet conditions.

If dry weather had been maintained then water supplies at the end of the section from Telfer to Carnegie via Swindells would have been very low. Some form of water tank should be fitted to the International truck. Two Internationals would have enabled more water and camping gear to be carried than the Landrover/International combination. They are more comfortable than Landrovers, important for the long distances between stations.

There is sufficient work for two geophysicists in the field (one observing, one calculating) particularly in the remote sections. It is difficult working out results around a camp fire on cold windy nights.

Some form of caravan mounted on the back of a truck or towed for housing equipment with table and lights for working would help.

The vehicles became bogged a number of times in the remote section and together with the mechanical troubles experienced with both vehicles it proved essential to have two vehicles and at least three people.

Leg 3 E.P. Paull

1. The target of occupying two stations per week was only attainable under ideal conditions and with the geophysicist working long hours at night on data reduction. A target of three stations every two weeks would seem more reasonable. This would give more time at each station allowing some of the data reduction to be done during the day. As it was, the field hand,

D. Morrison, when available, calculated QHM and declination observations and meaned sun shot data as the observations were made.

More time should be available for the changeover when the new geophysicist is unfamiliar with the equipment and observing techniques. A two station changeover should be considered under these conditions. More leeway for time lost by bad weather, vehicle and equipment problems, regular maintenance, and travelling between stations should be allowed. The occasional day off could also be taken.

Locating and where possible reoccupying old CIW stations, while very interesting, also took time.

2. Many hours were wasted at each station unloading the equipment, setting it up then later dismantling and reloading it.

3. Working on data reduction at night at "bush" stations was difficult and more time was taken up with the tasks of day-to-day living.

4. The LWB Landrover was not the ideal vehicle for the survey. It was too small, being crammed full of equipment from floor to roof, even with the roof rack. It was also too slow on good roads and not enough power in reserve for indifferent roads, making it difficult to hold top gear. This meant that travelling between stations took longer than it should.

5. The best way to tackle sun shots was to do them all in one day and as soon as possible. This reduced the risk of delays due to inclement weather. They could all be calculated that night and any problems sorted out - a more efficient operation.

6. A calculator with non volatile program storage and a liquid crystal display would be an asset. LED displays are difficult to read in strong sunlight and the rechargeable batteries would not run flat during the day. There would also be no need to load in the operating program each time the calculator was turned off.

7. It is essential to carry a spare battery for remote sections (wireless communication as well). Returning to Warburton from Neale Junction the sealed or 'no-maintenance' battery (not to be confused with low maintenance batteries) in the Landrover exploded. This type of battery is definitely not recommended. The International towed the Landrover for the remaining 50 km.

Leg 5 B.A. Gaull

Approximately four hours per station were lost in equipment unpacking, setting up, dismantling and repacking. This time could be saved if the equipment was rack mounted.

It was discovered at change over that different observers read a fixed setting of circle 508810 differently. This was possibly due to the separation between the graduated scales of the circle and the introduction of an observer paralax error. The circle should be dismantled and cleaned and the separation between the graduated scales reduced if possible.

The schedule should be eased or the size of the party increased. Four days per station was realistic if everything went smoothly and weather was favourable. In reality this was rarely the case. Rain, wind and cloud were experienced at all stations hampering recording, absolute observations and sunshots. The rain had an adverse effect on the recording PPM. The wind blew the cover for the Adkin head away on two occasions, and played havoc with the observing tarpaulin. Equipment failure, expecially the Hewlett Packard recorders, made it difficult to keep on schedule. If one or more of these problems arose then it meant that both members of the party had to spend very long hours on duty. This had its own adverse effect.

It is suggested that similar surveys to Emu in the future are provided with means of measuring radiation levels. A party of radiation experts arrived as we were leaving wearing doscimeters.

Leg 6. M. Sexton

The recommendations made in Leg One still apply. New difficulties experienced during this leg necessitate further suggestions.

The stations on this leg were scheduled to be reoccupied in November (Appendix 1), but delays in survey progress put back the reoccupation until December, a very hot month in northern South Australia. Although observations can be taken, the observer does suffer heat exhaustion and sunstroke. The summer months would be better used elsewhere.

A list should be compiled of instrument repairers in various States. If Austral Exploration Services had not fixed the Toshin recorder in Adelaide, valuable time would have been lost. With local repairers, some instruments could be fixed quickly in the field, and not involve the air freight of items back and forth from Canberra.

A comprehensive spares collection should be obtained, e.g., a second Toshin recorder in Canberra would have eliminated many of the problems that arose throughout the survey.

Most importantly, however, the recommendations of everyone involved on the survey should be considered now. They are: allocations for money, equipment, etc., should be planned years before the event. The equipment should be thoroughly tested before it enters the field. Any equipment which did not perform well on this survey should be superseded or have the appropriate modifications made to it. Finally all the absolute instruments (except QHMs) are in poor condition and in need of maintenance or replacement before future surveys.

Leg 7 A. McEwin

No delays were experienced with sunshots ar Parafield or Port Lincoln. However, this special flight highlighted the need to have several established and accurately determined azimuth marks at each station, so that the progress of the survey is not delayed by overcast weather, or necessitating a reoccupation to complete the azimuth determination. This would reduce the currently very high workload in the single observer.

This leg arrived at Etadunna with equipment improperly tested after repairs and during a severe and prolonged heat wave (maximum 48.5°C). Apart from being very uncomfortable and dangerous for the observer (not acclimatised), the specific operating range of the Adkin was 50°C so the temperatures experienced were not inducive to trouble-free operation.

The BMR aeroplane (VH-BMG) was used to transport the survey party, but was only available for a limited period, this prevented better testing of equipment or selection of a more appropriate survey time; however these circumstances should be avoided in future surveys.

The comments of Leg 2 also apply.

Leg 8 G.R. Small

The Bureau's aircraft VH-BMR (twin Otter) was used to transport the survey party and equipment to Flinders Island, Hobart and Lord Howe Island. This made travel arrangements much easier. A technical officer from the Electronics Repairs and Maintenance section travelled with the party to Flinders Island and Hobart to gain experience in the operation of the equipment under field conditions.

Travel to Norfolk Island was by commercial aircraft, and freight was forwarded in advance to the Bureau of Meteorology who provided space for our recorders.

Lord Howe Island and Norfolk Island were one-man parties. It is considered necessary to extend the reoccupation by at least one day for a one-man operation to allow completion of the work and to be sure the results are satisfactory.

Recommendation

The station on Lord Howe Island should be shifted to a more suitable location, such as the airport.

Leg 9 A.J. McEwin

See comments on Leg 2 and Leg 7.

LEG 10 B.A. Gaull

I recommend more frequent visits to the islands. Time was wasted looking for the station from non-existent or unrecognisable land marks. A new station could be established before building programs have gone past the design stage thus enabling station differences to be determined.

A field hand or technician would have been very helpful, especially in consideration of the high cost of the charter per day. The observer was fortunate in that assistance was available from volunteers.

Parts of the circle-scale of the theodolite supplied were difficult to see and some of the tripods were in need of repair.

6. Results

Mean hourly value plots of the magnetic elements D, H and F were derived from the first order station magnetograms. The instrument corrections adopted for the survey period and applied to the absolute observations used to calibrate the magnetograms are listed in Table 4.

The value of the geomagnetic field around local midnight most closely approximates the quiet level of the field, but to account for magnetic disturbance during station occupation the morphology of the mean hourly value plots were compared with plots of observatory data covering several months; the midnight quiet station value was adjusted to more accurately reflect the longer term quiet field level at the station, as indicated by the observatory data. These values were adjusted to Epoch 1980.0 by applying the secular variation determined from past and present occupations, as well as taking into account up-to-date observatory data. These adopted station values were used to derive the isomagnetic charts for Epoch 1980.0 and are listed in Table 5, together with the secular variation.

The adopted station values for I, Z, X and Y were derived from those for H, D and F using the relations

$$H = F \cos I \qquad X = H \cos D$$

$$F^2 = H^2 + Z^2 \qquad Y = H \sin D$$

and for secular variation

$$\Delta I = (H\Delta F - F\Delta D)/ F^2 \sin I$$

$$\Delta Z = \Delta F \sin I + \Delta I \, F \cos I$$

$$\Delta X = \Delta H \cos D - \Delta DH \sin D$$

$$\Delta Y = \Delta H \sin D + \Delta DH \cos D$$

The survey results will be published as isomagnetic charts of the seven elements of the magnetic field (D, H, F, I, Z, X, Y) and their secular variation for Epoch 1980.0.

Appendix 1

Party Leaders and station occupation order

Leg 1 M.J. Sexton (3 Mar-23 May 1978)

Portland	Warracknabeal	Mildura	Condobolin
Newcastle	Grafton	Moree	Roma
Quilpie	Birdsville	Boulia	Winton
Alpha			

Leg 2 A.J. McEwin (17 May-7 Jul 1978)

Maryborough	Mackay	Ingham	Cooktown
Croydon	Mt. Isa	Ayers Rock	Alice Springs
Tennant Creek	Darwin	Gove	Weipa

Leg 3 M.W. McMullan (4 Jul-5 Sep 1978)

Daly Waters	Wyndham	Halls Creek	The Granites
Derby	Port Hedland	Onslow	Telfer
Carnegie	Kidson		

Leg 4 E.P. Paull (30 Aug-31 Oct 1978)

Giles	Neale Junction	Laverton	Zanthus
Southern Cross	Meekatharra	Mt. Vernon	Carnarvon
Warburton (Jul 1979)			

Leg 5 B.A. Gaull (25 Oct-7 Dec 1978)

Geraldton	Augusta	Albany	Esperance
Eucla	Emu	Ceduna	Port Lincoln

Leg 6 M.J. Sexton (5-23 Dec 1978)

Parafield	Woomera	Oodnadatta	Etadunna (abandoned)

Leg 7 A.J. McEwin (9-13 Jan 1979)

Parafield (sunshots)	Port Lincoln (sunshots)	Etadunna (abandoned)

Leg 8 G.R. Small (17 Jan-22 Feb 1978)

Flinders Is.	Hobart	Lord Howe Is.	Norfolk Is.

Leg 9 A.J. McEwin (1-7 Mar 1979)

Bourke	Wilcannia	Tibooburra	Etadunna
Condobolin (sunshots)			

Leg 10 B.A. Gaull (4-11 Jun 1979)

Cocos Is.	Christmas Is.

Appendix 2

First-order magnetic survey (1980.0)

Party No. 1 Vic, NSW, Qld. — Planning Schedule

Place	Distance km		Day No	Dates	Temp °C	Rainfall m
				February		
Canberra	0	-	0	20		
	1024		1,2			
Portland		1024	3-5	23-25	21	1.5
	279		6			
Warracknabeal		1303	7-9	27-01	31	1.2
	254		10			
				March		
Mildura		1557	11-13	3-5	31	0.9
	660		14			
Condobolin		2217	15-17	7-9	31	1.2
	647		18			
Newcastle		2864	19-21	11-13	24	3.8
	495		22			
Grafton		3359	23-25	15-17	29	3.7
	370		26			
Moree		3729	27-29	19-21	31	1.8
	454		30			
Bourke		4183	31-33	23-25	31	0.8
	340		34			
Wilcannia		4523	35-37	27-29	29	0.6
	531		38			
Tibooburra		5054	39-41	31-02	30	0.5
	1045		42			
				April		
Birdsville		6099	43-45	5-07	31	0.5
	645		46			
Quilpie		6744	47-49	9-11	31	0.6
	490		50			
Roma		7234	51-53	13-15	29	1.5
	493		54			
Maryborough		7727		16	28	4.4
(Parties 1 & 2 overlap at Maryborough)						
Party No. 2 Qld, NT						
Maryborough	0	-	1-03	17-19	27	4.4
			4,5			
Alpha	849	849	6-8	22-24	30	1.3
	431		9			
Winton		1280	10-12	26-28	33	0.6
	370		13			
Boulia		1650	14-16	30-02	29	0.4
	329		17			
				May		
Mt Isa		1979	18-20	4-6	29	0.5
	1269		21,22			
Mackay		3248	23-25	9-11	26	4.0
	528		26			
Ingham		3776	27-29	13-15	27	0.9
	598		30			
Cooktown		4374	31-33	17-19	27	2.0
	635		34,35			
Weipa		5009	36-38	22-24	27	0.5
	1253		39,40,41			
Croydon		6262	42-44	28-30	29	0.5
	1311		45,46			

Place	Distances km		Day	Dates	Temp °C	Rainfall m
				June		
Tennant Ck		7573	47-49	2-4	28	0.2
	379		50			
Daly Waters		7952	51-53	6-8	30	-
	623		54			
Darwin		8575		9	31	-
(Parties 2 & 3 overlap at Darwin)						
Party No. 3, 4 - North, northwest						
Darwin	0	-	1-3	10-12	31	-
			4			
Gove	(by air)		5-7	14-16	31	-
	992		8,9,10			
Wyndham		992	11-13	20-22	31	-
	374		14			
Halls Ck		1366	15-17	24-26	31	-
*	595		18			
Derby		1961	19-21	28-30	31	-
	850		22,23			
				July		
a) Pt Hedland		2811	24-26	2-5	30	-
	500		27			
Telfer		3311	28-30	7-9	31	-
	500		31			
Pt Hedland		3811	32			
			33			
Swindells)			34-36	13-15	31	-
)	920		37			
Kidson)		4731	38-40	17-19	31	-
	920		41,42			
Pt Hedland		5651	43			
	1538		44,45,46			
Carnegie		7189	47-49	26-28	29	-
	896		50-51			
Laverton		8085	52-54	31-02	27	-
	519		55			
				August		
b) Neale Junction		8604	56-58	4-6	27	-
	1109		59,60			
Southern Cross		9713	61-63	9-11	22	-
	370		64			
Perth		10073		12		

* Fit in Granites if schedule and fuel allows: Round trip 1000 km, add 5 days.

a) Party No. 4 joins party No. 3; 1 of No. 3 returns to Canberra

b) Party No. 3 leaves at Laverton for Perth and Canberra after Neale Junction.

Party No. 5 NW W.A.

Place	Distances km		Day	Dates	Temp °C	Rainfall m
				August		
Perth	0	-	0	14		
	500		1			
Geraldton		500	2-4	16-18	21	2.6
	481		5			
Carnarvon		981	6-8	20-22	23	0.7
	533		9			
Onslow		1514	10-12	24-26	28	0.2
	541		13			
Mt Vernon		2055	14-16	28-30	32	0.2
	312		17			
				September		
Meekatharra		2367	18-20	1-3	29	0.2
	757		21,22			
Perth		3124	-			
	324		23			
Augusta		3448	24-26	7-9	17	3.5
	412		27			
Albany		3860	28-30	11-13	18	4.2
	487		31			
Esperance		4347	32-34	15-17	19	2.6
	630		35,36			
Zanthus		4977	37-39	20-22	24	0.2
	1126		40,41			
Eucla		6103	42-44	25-27	22	0.7
	506		45			
Ceduna		6609	46-48	29-01	22	0.8
	409		49			
				October		
Pt Lincoln		7018	50-52	3-5	20	1.7
	673		53			
Adelaide		7691	54	7	-	-

(Party No. 5 returns to Perth)
(Party No. 6 arrives from Canberra)

Party No. 6 SA, NT.

Adelaide	0	-	0	9		
	1703		1,2,3			
Alice Springs		1703				
	555		4			
The Granites		2258	5-7	14-16	35	0.4
	555		8			
Alice Springs		2813	9-11	18-20	31	0.7
	482		12			
Ayers Rock		3295	13-15	22-24	31	-
	315		16			
Giles		3610	17-19	26-28	33	-
	1058		20,21			
Oodnadatta		4668	22-24	31-02	31	0.5
	326		25			
				November		
Coober Pedy		4994	26			
	267		27			
Emu		5261	28-30	6-8	31	-
	267		31			

Place	Distances km		Day	Dates	Temp °C	Rainfall m
				November		
Coober Pedy		5528				
	460		32			
Woomera		5988	23-35	11-13	31	-
	395		36			
Leigh Ck		6363	37-39	15-17	31	-
	240		40			
Etadunna		6623	41-43	19-21	33	-
	830		44,45			
Adelaide		7453	46-48	24-26	24	1.3
	1229		49,50			
Canberra		8682		29		

End of Land Survey

Summary

Party No.	1	2	3	4	5	6
Distance (km)	7800	8600	10100	7300	7700	8700
No stns	13	12	12	8	12	10
No days	54	54	61	42	54	50
Interval	Feb 20	Apr 16	Jun 9	Jul 2	Aug 14	Oct 9
	Apr 16	Jun 9	Aug 9	Aug 12	Oct 7	Nov 29
Start	Canberra	Maryb.	Darwin	Pt Hed.	Perth	Adelaide
End	Maryb.	Darwin	Perth	Perth	Adelaide	Canb.

Appendix 3

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

CNR CONSTITUTION AVENUE AND ANZAC PARADE, CANBERRA
Postal address: P O Box 378, Canberra City, A.C.T. 2601
Please address all communications to the Director

Telephone: 499111
Telegrams: BUROMIN
Telex: 62109

Department of Minerals & Energy
Department of National Development

In reply please quote: 77/1769

Dear Sir,

Regional Magnetic Survey

This Bureau is carrying out a major magnetic survey during 1978 as part of the continuing program to up-date magnetic charts for the Australian region. The survey is planned to start in February and be completed by the end of the year.

The survey calls for 3 days recording of the earth's magnetic field and measurements at our concrete station markers on your airfield. The survey is similar to those carried out in the past.

We seek your co-operation in the following survey. We will need (i) access to a 240 Volt 50 Hz power outlet and about 2 square metres of space to house the recording equipment (if a building and power is not available we will provide our own generator and shelter). (ii) access to our previously established markers on the airport. A plan of the marker's position is enclosed.

The party will be travelling by Land Rover and will comprise a geophysicist and a field hand. We will give notice of an arrival data at your airfield as the survey progresses.

Please advise if there are likely to be any difficulties about this proposal.

Yours faithfully

N G Chamberlain

(N.G. Chamberlain)
Assistant Director (Geophysics)

Appendix 4

First-Order Magnetic Survey (1980.0)

Guidelines for Party Leaders

(Revision 1, 14 April 78)

P.M. McGregor

1. Objective

The aim of the survey is to obtain values of the Earth's main field at each BMR First-Order station. By definition, these values are needed to an accuracy of better than 5 nT (0.5'), to provide reliable estimates of the secular change.

2. Basic procedure

The mainfield level is assumed to be approximated by the values obtaining at 00-03 hours local time on days uninfluenced by transient external variations. Recordings over at least two succesive nights provide this level; the records are calibrated to observatory standards at the beginning, during, and at the end of the recording interval. The records are subsequently reduced to mean hourly values and a station value at headquarters.

3. Methods and standards

Methods and standards of measurement, recording, logging of operations, marking of records and the like are those in use at the magnetic observatories - lower standards are not acceptable. Observations are to be vetted as they are made, to pick up inconsistencies and obvious mistakes; preliminary calculations of all measurements should be made before a station is closed, to assess the performance of the variograph and the need to make more measurements. In particular, it must be noted that the QHM will give erroneous results if exposed to the sun, so the observing shelter must be used always; also, insufficient attention has been paid in the past to getting accurate azimuths so sufficient sun observations are to be made.

4. Observing schedule

A typical schedule for the occupation of a station is:

Day 1 am: set up recorder, magnetometers, theodolite and make sunshots

pm: make sunshots and sets of absolutes
Obtain 1st night's recordings

Day 1 am: Make sunshots and sets of absolutes

pm: make sunshots and sets of absolutes
Obtain 2nd night's recordings

Day 3 am: make sets of absolutes, pack up equipment

pm: drive towards next station (or continue occupation procedure if necessary - see 5)

5. Variations of survey schedule

The planning schedule was designed around climatic conditions and can be varied locally to meet particular circumstances (see para 6 about advising changes).

It may be necessary to omit or prolong a station occupation because of magnetic storms or other unforeseen contingencies (e.g. major holdups through equipment or vehicle breakdowns). Some of the factors to be considered in deciding how to proceed will be:

- the survey schedule; the general schedule is to be adhered to fairly closely but there is some leeway in that Leg 6 may be deferred to early 1979; but the survey must proceed at least so that Party No.5 arrives at Adelaide by mid-December 1978.
- some stations have more weight than others and it may be better to omit a later station to make up a delay at the present station.
- the gradient of the isoporic lines in the region and the history of re-occupations: where the gradient is low a station may be expendable ; if the history is poor the station may be 'non-expendable.

- the epoch of the magnetic storm: after day 1 of storm-time it may be adequate to proceed normally and to use magnetic observatory data to adjust the results; if the storm occurs during day 1 of the occupation it may be necessary to prolong the occupation.

All decisions to omit or prolong an occupation should be taken in consultation with HQ wherever practicable (most places).

6. Operations and administration

(a) The survey is under the general control of the Project Supervisor but routine operations and party management will be attended to by Graeme Small, and logistical matters in WA (legs 4 and 5) by the OIC/MGO.

(b) The Party Leader is responsible for:

- maintaining standards and quality control
- on-the-job party management and progress of the survey
- making progress reports to Canberra

Questions about deleting stations or prolonging occupations will be referred to me by Graeme Small.

(c) Reports are to be made as follows:

- immediately: changes of route, station schedule and next effective mailing address; and undue delays. Telex telephone contacts for each station are to be advised as soon as known.
- weekly: by telephone (or telegram) reverse charges call through the switchboard 499111: to be made late Wednesday or early Thursday morning but in time for the Thursday meeting of Section Heads. The switchboard may not be manned at lunch time and after 5 pm. If the switchboard does not answer you may call Small direct 499265 (officers accepting calls must advise the switchboard of the details).

- fortnightly; written progress report, forms as per attached list, observation forms, recordings and log sheets by registered air mail.

For parties 4 and 5 which include officers from Mundaring Observatory, the weekly reports should be made through the OIC/MGO Phone 295 1979; in this case they must be made on Wednesday in order to meet the deadline.

7. Establishment of new stations

New/replacement station are to be established only as a last resort. The prime purpose of the survey is to obtain accurate secular change values, and exact re-occupations of existing stations are the key. Every effort is to be made to re-occupy a previous station, even if the marker has been lost, by means of the station description. The only reasons for starting a new station should be contamination of the old by artificial fields, or physical inability to re-occupy it (e.g. constructed over).

8. Station differences, old stations

There are many historic stations (some going back to 1910) near First Order stations. If an exact re-occupation can be done 1st order station differences can be made for F and H and if the old azimuth is still visible also for D (If no azimuth use the Compass Theodolite). If station can only be roughly re-occupied 3rd order ($\pm$ 10 nT) differences can be made.

There are also a number of recent new stations where the difference to older stations have not been made. In these cases every effort should be made to obtain 1st order station differences.

Notes on nearby old stations have been included with the station descriptions.

9. Station marking/descriptions

The station is the + mark in a brass plate on a concrete block labelled 'BMRGG Magnetic Station'. To improve the permanency of the stations, concrete slabs will be added to this survey in the form of footings for the tripod wherever approval has been given to do so. Copies of the permits are to be held by the Party Leaders. No concrete pads are to be implaced without these permits unless authoritative approval is obtained locally.

Station descriptions can never contain too much information and should be continually improved and brought up-to-date. Rounds of photographs, sketches and bearings; distances from nearby easily identifiable objects; and markings on airfield plans are some of the aids to finding a station.

10. Photographic record

We lack an adequate photographic record of magnetic surveys. Photographs suitable for displays, publicity, brochures etc are to be taken of all aspects of the survey; they should include stations, country traversed, vehicles, equipment, and personnel. Film is cheap so be liberal.

Fortnightly Returns

1. Attendance Records
2. TA claims
3. Yellow copy of field purchases
4. Record of field purchases FB14
5. Yellow copy of contract petrol purchases
6. Record of contract petrol purchase FB14
7. Vehicle logs yellow copy (or monthly)
8. Summary of fieldhand overtime (for Geophysical Clerk)

Establishment of New Stations

A local total intensity survey both vertical and horizontal should be conducted over several sites to show up any gradients in the vicinities. The new station should be positioned in the area of lowest gradients.

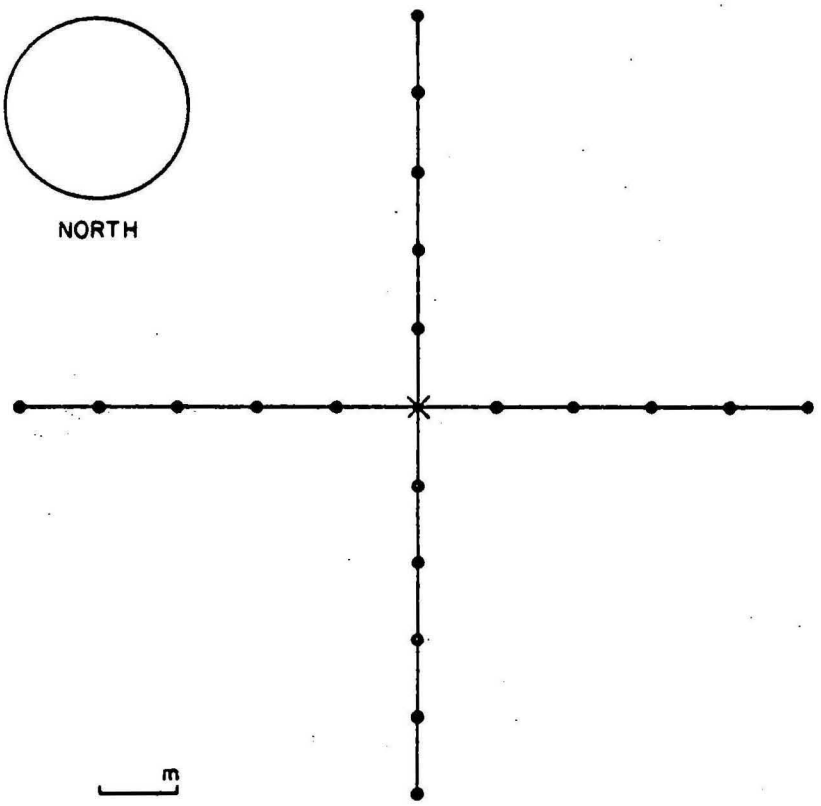
The horizontal survey should be conducted in two parts:

1. At 3 m spacings in 4 directions up to 15 m from centre of mark, and
2. At 0.5 m spacings in 4 directions up to 2.5 from centre of mark.

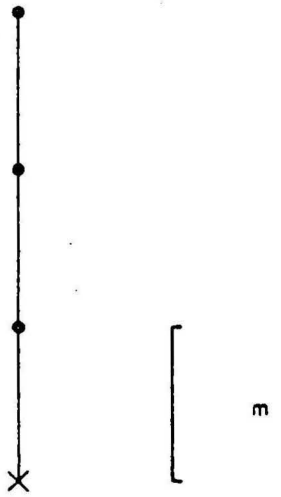
The vertical survey should be done up to about 2 m at spacings of approximately 0.5 m. One segment of the pole for an Elsec sensor is about 0.5 m.

LOCAL SURVEY

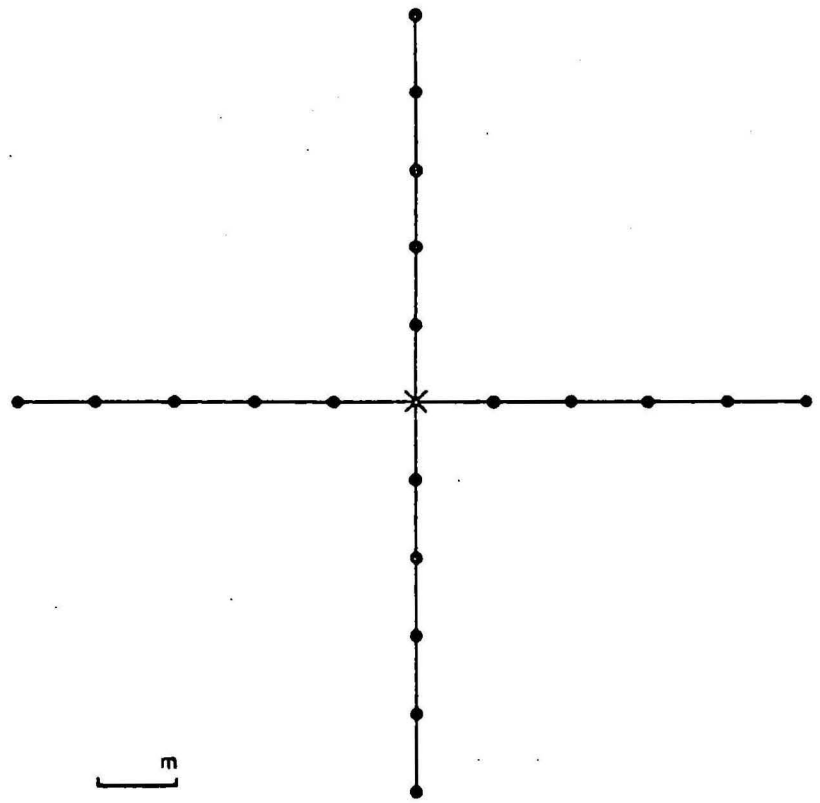
STATION _____ DATE _____ COMPONENT _____

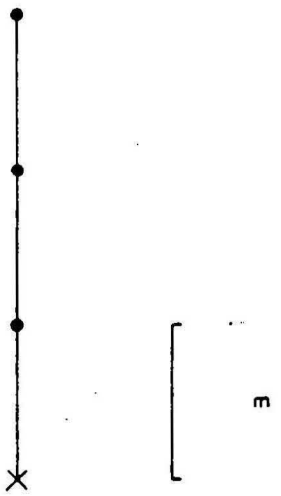


Horizontal survey at instrument height of 1·6 m



Vertical survey over station





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Appendix 5

Variograph guidelines

(R.S. Smith/M.J. Sexton)

The local authorities should be consulted and a suitable site arranged to set up the variograph, preferably with access to 240 volt power, free from magnetic disturbances and within several hundred metres of the magnetic station, though this distance is not critical, it simplifies operation (While the variograph is being set up the field hand can be positioning the concrete tripod feet around the station marker).

Setting up

(1) Plug the recorder and the Adkin in to the power distribution in the rear of the control console and turn both on. (Recorder takes 15 mins to warm up).

(2) Adkin Sensor Head. The Adkin sensor head is placed on a concrete block and then oriented X, north (use compass if necessary). It is essential that the concrete block is bedded firmly in the ground. The slightest movements in level during the recording will result in different components of the field being measured.

Experience has shown that seating the block in sand and packing the sides very firmly, yields the best results. Furthermore, keep the sensor head in the shade whilst setting up. If the head warms up in the sun, it will take hours for it to cool down and the levels tend to change as it cools. Connect Y sensor only and adjust head orientation so that Y coarse reading is 000, and carefully level head. Note thermometer reading. Replace foam cover and firmly fasten down. (A foam box is put over the ADKIN sensor head to minimize temperature fluctuations. It pays to pile dirt up around the edge of the box to improve the insulation and prevent the foam box being blown away, or blown against the sensored head. The better the insulation the better the results).

(3) Plug in the X and Z sensor cables, and thermistor lead.

(4) Connect the time-mark lead from the clock to the relay box at the rear of the recorders.

(5) Connect the analog signal leads from the recorder to the ADKIN (Fine outputs X, Y, Z), to thermograph box, and to PPM output (front panel).

(6) Check pens and paper and start recording.

(7) Set clock to UT - (nearest second).

(8) Annotate record: Time, ADKIN Course and Fine readings, PPM reading.

*Note Y will change from 000 to about 002 when X and Z channels are connected but do not realign the head as orientations of X and Y sensors are correct. The X and Z offset currents cause steps of about 20 nT and 200 nT respectively in Y reading.

(9) After the system is in operation and warmed up, check the calibrations. When setting up there are 3 things in particular to check:

a) All leads go to correct connectors; the leads are all labelled but check them after you have set up.
In particular watch that you have the time mark lead from the EMI clock going into the time-mark relay box at the back of the recorder and not the time mark lead from the Bulova chronometer. The latter lead is only used if the EMI clock fails.

b) The ADKIN to recorder cables are connected up correctly (i.e. X→X, Y→Y, Z→Z) and they are connected to the fine outputs of the ADKIN and NOT the coarse outputs.

c) The cables from the recorder to the ADKIN, temperature box, and PPM all look the same at first glance, but they are not interchangeable. The PPM cable is a direct connection, but the ADKIN cables have resistors connected at one end to attenuate the voltage by a ratio of 100 to 1, and the

TEMP cable has an attenuator for 14.3 to 1.
*So long as you don't change anything this should not cause any problems. However, if you do change cables, recording channels, etc; write it down in the Adkin log and make sure that you measure scale values of that component (because it may not remain the same).

d) When commencing recording, make sure the clock is on.. If you haven't started it yet, it is likely to read an even hour, therefore the time mark relay is closed, and all traces are zeroed.

e) With the recorder (and everything else) going allow 20 minutes for things to stabilize.

f) Open the back door of the ADKIN wide. Don't let the door touch the small cables on PCB 027. If the door is closed, it touches these cables and slight vibrations cause the ADKIN to oscillate.

g) On setting up, if the orientation of the head is such that the Y axis reads 006, 007 or 008, everything will oscillate. Just twist the head slightly until the Y coarse reads something else and all will stabilize, then adjust so Y coarse = 000.

h) Check the Power Supply to ADKIN and ensure no cables or cards have worked loose whilst travelling.

When packing up

Things to do

1) Check zeroes of all traces, this is described in the calibration section. (Zero checks should be performed daily anyway).

2) Check the orientation of the ADKIN sensor head. If it is not in the same level as it was when you set up, then carefully readjust the footscrews until the level is reestablished. It

is advisable to adjust one axis at a time (e.g. X axis and then Y axis). Also increase the speed of the Rikadenki recorder. so that the effect of the re-level is well recorded. This adjustment is very useful if the baselines have changed over the period of recording. It enables one to see why the baselines have changed and hopefully apply appropriate corrections.

If there has been no trace range changes on the record, it will be helpful in calculation of scale values if trace range changes (equivalent to 100 nT) are induced after the level adjustment at the end of the record. Keep the recorder on the increased speed and bring a magnetic object up to the head until the ranges change.

Calibration

PPM: Select alternatively 'SET 0' 'SET 100' (front panel) and adjust recorder amplifier 'ZERO' and 'CAL' (NOT gain) for desired span. (probably 50 divisions = 125 mm). Return selector to RANGE 0-109 for recording to prevent excessive 'hunting' between large and small values. The chart records the least significant two counts but will over-range to '109' before decrementing by 100 nT.

Adkin: Remove analog output leads from rear panel, check and adjust recorder 'ZERO' if necessary. Note 'dead-band' or 'backlash' in pen positioning of about 1 mm so short duration hour marks will not reset exactly to centre line. When any fine magnetometer reading reaches trip points set at about +/- 80 to 90 nT the course display is changed by 1 unit, the trace steps by the equivalent of exactly 100 nT, and the fine display resettles at a new value. The amplitude (A) of steps should be measured and a log kept to calculate scale values (S).

$$S = 100/A, \text{ (nT/mm) for X, Y, Z}$$

for Y: $Sd = S.3438/H$ (min/mm)

Thermograph. This was set up for linear voltage output with OV at 0°C, 10V at 70°C, and an attenuator fitted for 1°C per minor division and 10°C per major division. The recorder zero should be set by removing output lead from thermograph box and adjusting ZERO if necessary and a log of thermometer temperatures should be kept as a check on calibration.

Trouble Shooting

Spares kits: These are provided for the ADKIN, and Elsec PPM, with IC's for the thermograph and a full set of all fuses.

Elsec PPM: Swap cards and/or tuner unit with spares to isolate fault. Check suspect card in second PPM unit to confirm fault, and advise HQ. If necessary use only one PPM to determine a station difference and for recording.

Adkin. Each component has 4 printed circuit boards (PCB's) each labled with a number and channel: (Diagram attached)

PCB 027: Automatic field offset generator (AFOG) and fine analog-to-digital converter (FAD)
(Provides stable offset currents and fine counts)

PCB 009: Basic analog magnetometer (BAM)
(Ptovides fine analog output)

PCB 018A: Turn around logic detector (TALD)
(Controls change of sign and smooth passage through zero)

PCB 018B: Up/down counter/decoder (UDC/D)
(Controls coarse count to AFOG and digital outputs)

If difficulties such as instability and failure to lock occur in any one channel, all may be affected, so to isolate the area of the fault, observe the behaviour of each channel (X, Y, Z) during the following tests;

(1) Ensure all cards and connectors are fully plugged in especially small connector on PCB 027 (offset coil drive).

(2) Remove one sensor head cable from rear of Adkin in turn.

(3) Swap sensor head cables to test each channel on each field value (H,D,Z).

(4) Swap cards between 2 channels, only one swap at a time, and leaving one good channel untouched.

(5) Swap IC's and DAC's only if directed.

(6) use the spares pack only after a faulty component is isolated.

(7) If 1 channel unserviceable, abandon Z as this can be calculated from F and H. If 2 channels fail, record H for one night and D for one night alternatively, and advise HQ.

CLOCK: Swap lead to relay unit at rear of recorder and use Bulova watch. Note that hour mark may not occur at 00 mins. Advise HQ. (we can freight replacement).

MOXON: Swap for spare and advise HQ. (worthwhile checking internal fuse).

Recorder: Swap plug in amplifier module with spare, or use entire spare channel. (We can freight complete replacement recorder but it is about three times the weight and bulk).

Power Supply (18 VDC). A replacement can be freighted from HQ on request. If necessary you could probably use a charger and battery on almost any voltage from 12-24V.

GENERAL NOTES

EQUIPMENT

1. Recorder Inks: It is essential to wash the pens thoroughly at the end of recording and soak the nylon pen tips in water. Failure to do this will result in blockages. Red ink contains little fibres and it must

be filled by syringe. All other colours can be filled directly from the containers. It is recommended to use the same colours at each station to represent the different components being measured: e.g.

H - red	D - blue	Z - green
F - black	T - sepia	

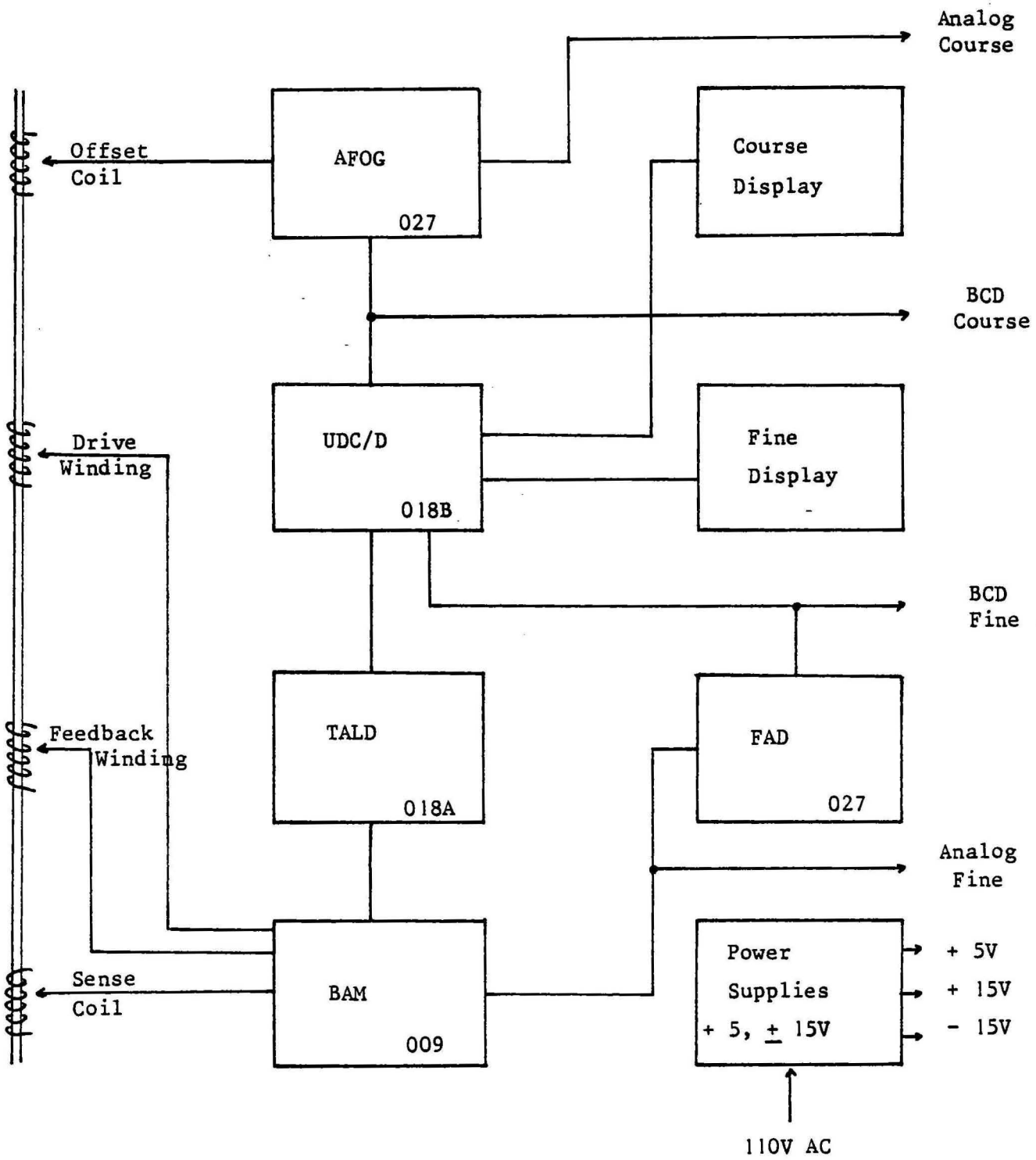
It makes analysis of the record easier and each leg should adhere to a colour scheme.

2. PPM: Try and use only one section of cable. Keep all joins dry and if it does rain put a plastic bag over the PPM head.

3. Try and set up as far away as possible from cars and electric appliances (e.g. refrigerators, hot water services and electric tools). Any sort of switching (thermostats etc) may cause interference and result in noisy records.

4. Honda Generator. Seems very reliable. 20 litres of fuel will last ~20 hours. When using the Honca it is probably a good idea to check it (and all the equipment) before midnight, and to connect up a full tank of fuel. Five minutes spend checking at this time could save a day's observations being wasted. The Honda is due for an oil change every 100 hours so a change after each station.

Adkin Magnetometer



Note: Board 009 Y provides Drive excitation for all three channels, so PCB must be in place in any Y slot.

Appendix 6

Reduction of Adkin magnetograms

(P.M. McGregor)

The Adkin head is aligned so that initially the 'Y' fluxgate reads about zero i.e. the fluxgate is perpendicular to the ambient magnetic meridian; the 'X' fluxgate is then assumed to lie in the (initial) magnetic meridian. (No attention is given in this analysis to Z recordings because the absolute F data from the PPM will be used in most cases).

In general, responses in each horizontal channel will contain components due to changes in both H and D, but for first-order magnetic surveys it will be shown that the effect of the spurious component is negligible. This is a consequence of the requirement that first-order measurements be made in the absence of transient disturbances i.e. that variations about the mean value do not exceed those on magnetically quiet days. In the following it is assumed that departures from the average do not exceed 100 nT or 0.25°.

Refer to the diagram, where

$\bar{H}$ = mean value of H at station

Ho = initial value of H (nT)

Do = initial value of D (deg, min)

Hr = recorded value of H nT (X channel)

Dr = recorded value of D nT (Y channel)

dD = change in D (radians)

dD' = change in D (minutes of arc)

H = measured H (absolute obsn)

D = measured D " "

D variograms

Now

$$\sin dD = Dr/H$$

and in minutes of arc

$$dD' = 3438\ Dr/H$$

$$\triangleq 3438\ Dr/\bar{H}$$

$$= k.Dr$$

where $k = 3438/\bar{H}$

is station 'sensitivity factor' in minutes/nT which contains the effect of H variations, but which may be considered a 'constant' within the limitations stated above.

Examples:

$\bar{H}$	25000	35000
k	0.1375	0.0982
k_{100}	0.1370	0.0980

(k_{100} corresponds to H change of 100 nT)

To reduce the D magnetograms:

- Determine the 'gamma' scale value Sd in nT/mm from trace range-changes
- Calculate the station sensitivity k in min/nT using predicted mean value of H
- Calculate the 'minute' scale value S'd = k.Sd (min/mm)
- Convert the D ordinate (d) from mm to minutes (S'd x d)

$$Bd = D - S'd \times d$$

The derivation of mean hourly values (to give the best estimate of the station mean value) is simply an inversion of the last step, with Bd being the adopted baseline value(s).

If there is a temperature coefficient (Qd) it should be derived from a plot of observed baseline values versus temperature (t). The reduction equation is then of the form

$$D = Bd + S'd \times d + Qd \times t$$

H variograms

We have

$$H^2 = Hr^2 + Dr^2$$

$$= Hr^2 + (dD'/k)^2 \quad \text{(from above)}$$

or $$Hr^2 = H^2 - (dD'.\bar{H}/3438)^2$$

$$\doteq H^2 (1 - (dD'/3438)^2)$$

The RHS $= 0.99998\ H^2$ for $dD' = 15'$ (0.25^o)

i.e. Hr = H in all practical cases.

To reduce the H magnetograms:

- Determine the 'gamma' scale value Sh from the range-changes
- Convert the H ordinate (h) from mm to nT (Sh x h) and obtain the baseline value Bh

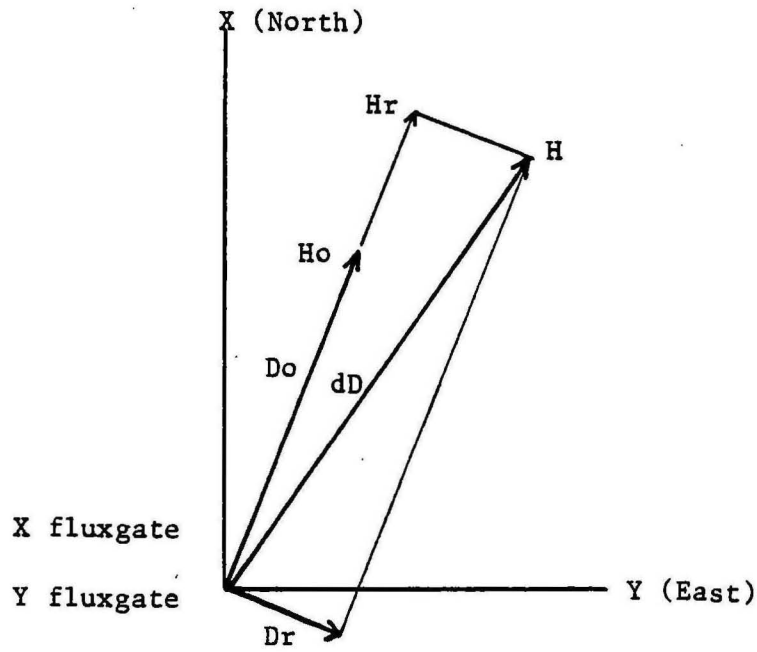
$$Bh = H - Sh \times h$$

The same remarks about MHV and temperature coefficients apply for H as for D above. The complete reduction equation is of the form

$$H = Bh + Sh \times h + Qh \times t$$

Adkin ADM

(in D,H mode)



Do = value of D at installation

Ho = value of H at installation

D = Do + dD, observed value of D at absolutes

H = observed value of H at absolutes

Hr = recorded value of H

Dr = recorded value of 'D'

Appendix 7

Observations of the sun for Azimuth: BMR procedure

(P.M. McGregor)

The fundamental celestial spherical triangle is defined by the three points:

Z - the zenith, fixed by the plumb-bob

P - the (south) celestial pole

S - the sun's centre

The angle Z is the angle between the NS meridian plane and the vertical plane containing the sun i.e. it gives the true bearing of the sun. Therefore the triangle SPZ has to be solved to give Z.

We know, or can find out:

ZP = 90 - Ø where Ø = latitude

SP = 90 - d where d = sun's declination

t = sun's local hour angle.

The last two are obtained from the Nautical Almanac (NA) for the UT date and time of the sun shot. The NA shows (d) as Dec, N (North) or S (South); in order to make the side PS greater than 90° (winter) or less than 90° (summer) we use this convention for the sign of (d):

Dec North, d Negative

The angle (t) is the angular distance of the sun from the meridian (morning shot), or the angular distance of the sun after the meridian (afternoon shot) i.e. it is the time to or from meridian transit, which is called the local hour angle (LHA).

The NA Tabulates values of GHA (values at the UT hour in the body of the NA, interpolation tables for minutes and seconds at the back); GHA is the angle westwards from the Greenwich meridian to the sun's meridian. The LHA is calculated fromthe longitude of the ovservation point via:

$$t = \pm (GHA + \text{east long} - 360^{o})$$

It will range from about $+60^{o}$ (8 am) to -60^{o} (4 pm); we need only its magnitude.

The equation for the derivation of Z in terms of the two sides PS and PZ and the angle t is:

$$\cot Z = \cot (90 - d) \sin (90-\emptyset) - \cos (90-\emptyset) \cos t)/\sin t$$

which reduces to:

$$\cot Z = (\tan d \cos \emptyset - \sin \emptyset \cos t)/\sin t.$$

The only convention to remember is that for the sign of (d) - (north-Negative). A program has been written for the HP-65 pocket calculator based on this equation and convention (see attachment). It requires the entry of: latitude, longitude, UT, GHA at hour of UT, declination. The answer will be expressed as a positive or negative angle. If the answer is Negative the sun's bearing is counted from the North; if the answer is positive the bearing is from the south.

It is unwise and unnecessary to give rules which define which quadrant the sun lies in, and which will cover all situations. Instead a diagramatic plan view should be drawn showing the computed sun's bearing, the circle readings of the sun and reference mark(s), and the derived azimuth of the reference mark. It is re-iterated that the adopted sign convention fixes the datums for the bearing; which side of the meridian it lies is of course fixed by whether the sun-shot was made in the local morning of afternoon.

It is important that observations are made before and after (local) noon, and that the am and pm shots are made at the same local hour angle in order to get comparable results. Therefore it is necessary to be aware of the sun's 'equation of time' (the difference between local mean time and local apparent time), and the difference in longitude (expressed as time) between the local meridian and the standard meridian. The attached graph and example show how to plan when to do the next shot. Examples of the observing form and reduction work sheet are attached.

Note: beware of daylight saving adjustments when deriving local noon.

HP-65 PROGRAM

Observation of the sun for Azimuth

(G.R. Small)

KEY ENTRY	CODE SHOWN	COMMENTS	KEY ENTRY	CODE SHOWN	REGISTERS
LBL	23	Program A lat. long.	STO 2	33 02	
A	11		RCL 6	34 06	
DSP	21	- enter latitude and	1	01	
6	06	longitude as	5	05	
f^{-1}	32	DEC,MIN SEC convert	x	71	
→DMS	03	to decimal degrees	RCL 5	34 05	
STO 8	33 08		+	61	R_3 declination
R/S	84		RCL 7	34 07	increment
f^{-1}	32		+	61	
→DMS	03		3	03	R_4 Sun's declin^n
STO 7	33 07		6	06	
RTN	24		0	00	
LBL	23	Program B	-	51	R_5 GHA
B	12		g	35	
f^{-1}	32	- enter UT HR.MIN SEC	ABS	06	
→DMS	03	(tenths) convert to	STO 1	33 01	R_6 UT
f^{-1}	32	decimal hours	RCL 2	34 02	fractional
INT	83		f	31	part only
STO 6	33 06		TAN	06	R_7 Longitude
RTN	24		RCL 8	34 08	
LBL	23	Program C	f	31	
C	13		COS	05	R_8 Latitude
f^{-1}	32	- enter GHA DEG.MIN SEC	x	71	
→DMS	03	convert to decimal	↑	41	
STO 5	33 05	degrees	RCL 8	34 08	
RTN	24		f	31	
LBL	23	Program D	SIN	04	
D	14		RCL 1	34 01	
f^{-1}	32	- enter sun's declination	f	31	
→DMS	03	DEG.MIN SEC convert	COS	05	
STO 4	33 04	to decimal degree	x	71	
R/S	84		-	51	
6	06	- enter declination	RCL 1	34 01	
0	00	increment	f	31	
+	81		SIN	04	
STO 3	33 03		+	81	
RTN	24		g	35	
LBL	23	Program E	1/x	04	
E	15		f^{-1}	32	
RCL 3	34 03	- compute Azimuth	TAN	06	
RCL 6	34 06		f	31	
X	71		→DMS	03	
RCL 4	34 04		RTN	24	
+	61				

User Instructions

1 Enter latitude in DEG.MIN SEC
- Press A (South positive)

2 Enter longitude in DEG.MIN SEC
- Press R/S

3 Enter UT HR.MIN SEC TENTH
- Press B

4 Enter GHA of hour (UT) from Almanac
DEG.MIN SEC
- Press C

5 Enter Sun declination of hour (UT) of
observation from Almanac
DEG.MIN SEC
SOUTH POSITIVE -
- Press D
Enter increment d from Almanac for declination
SOUTH-POSITIVE
- Press R/S

6 Calculate Azimuth - Press E
answer in DEG.MIN SEC

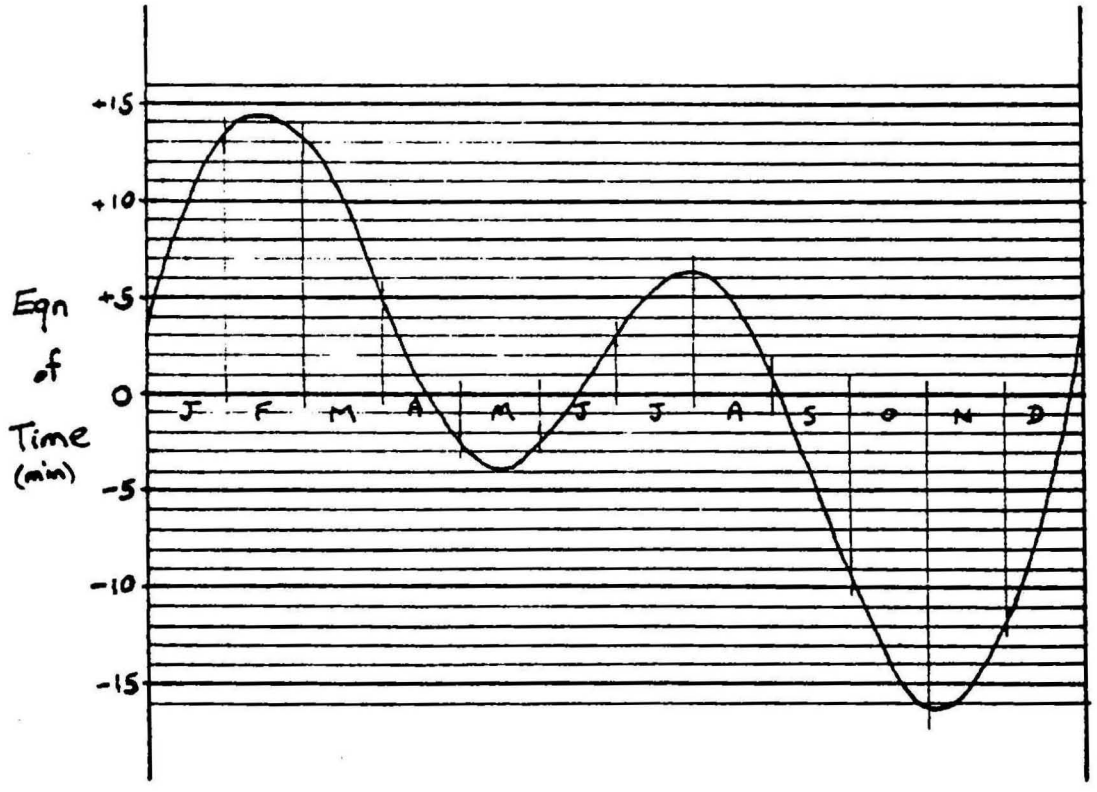
CALCULATION OF TIME OF NEXT SUN OBSERVATION

Date: 13/6/78 Place: Ayers Rock

		hr	min
1.	Local meridian time of noon (UT):	03	16
2.	Equation of time :		-0.5
3.	UT of Local Apparent Noon (1 + 2):	03	15.5
4.	UT of last am/ observation :	01	10.0
5.	LHA (3-4)	02	05.5
6.	UT of next pm/ observation (3 + 5) :	05	25.5
7.	Zone Standard/Summer Time :	2.55 mp	

Notes 1. LMT (1) is shown on station description: it adjusts clock time of noon for the difference between actual and zone-time longitudes.

2. The Equation of Time is tabulated in the Nautical Almanac or it can be read from the graph.



OBSERVATIONS OF THE SUN FOR AZIMUTH

Place : Ayers Rock
Station: Aye B
Mark : Notch in E and of Rock

Date/hr (UT): 13/6/78/01
Theodolite : Watts 66006
Observer : AME

VC	Object	Watch Time min	Watch Time s	Horizontal Circle °	Horizontal Circle '	Horizontal Circle "
R	Mark			223	48	55
1 R	☌	3	43.5	86	56	20
2 R	☌	4	12.3	86	50	00
3 L	☍	5	01.2	267	15	00
4 L	☍	5	34.0	267	07	45
L	Mark			43	48	05
Mean	1 & 4					
Mean	2 & 3					
	Mean	4	37.8	87	02	16
	Mean Mark :					
L	Mark			43	48	00
5 L	☍	8	14.1	266	32	05
6 L	☍	8	35.7	266	27	15
7 R	☌	9	31.3	85	39	00
8 R	☌	10	05.1	85	31	15
R	Mark			223	48	50
Mean	5 & 8					
Mean	6 & 7					
	Mean	9	06.6	86	02	24
	Mean Mark :					

Mean Mark : 223° 48' 26" Mean ⊙ : 86° 32' 20"

	h	min	s		h	min	s
Watch start UT:	01			ΔUT 1 :			
Correction:			+1.0	UT 1 :			
Mean watch time :		06	52.2				
UTC :	01	06	53.2				

(Optional for field use)

First-Order Magnetic Survey

Azimuth of Reference Mark

Date 13/6/78 Latitude 25° 20' 54"

Place Ayers Rock Longitude 131° 03' 42"

1. Sun's bearing

	I	II	III	IV
UT:	00 51 34.3	00 59 11.3	01 06 53.2	
GHA (hr)	180 03 00		195 02 48	
Dec (hr)	-23 10 30		-23 10 42	
d:	-0.1		-0.1	
Bearing:	-38 42 46	-37 05 18	-35 23 44	
Bearing from N:				

(If calculated bearing is +, bearing from N = 180° - bearing)

2. Azimuth of mark

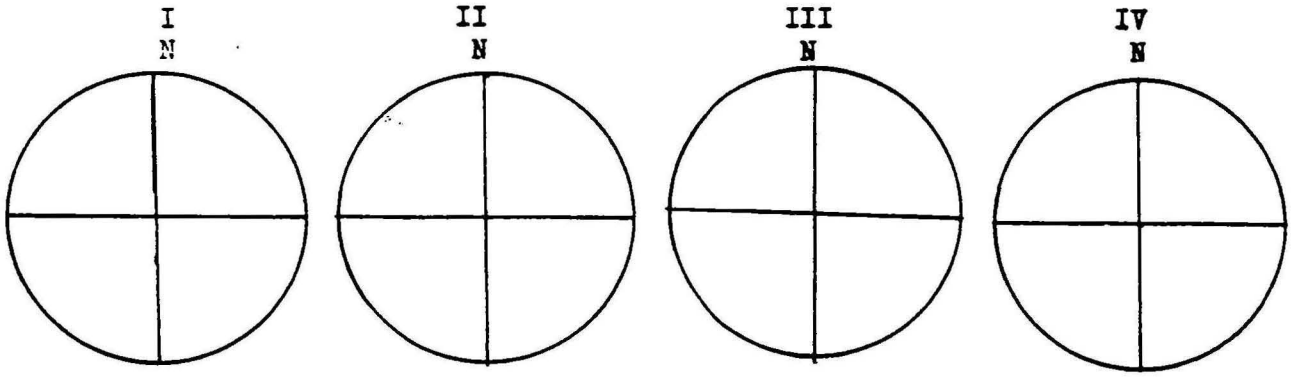
(a)	Mag reading:	89	51	34	88	14	12	86	32	20
(b)	True bearing:	38	42	46	37	05	18	35	23	44
(c)	D	51	08	48	51	08	54	51	08	36
(d)	Mark reading:	223	48	45	223	48	46	223	48	26
(e)	Azimuth mark:	172	39	57	172	39	52	172	39	50
	Mean azimuth of mark:				172	39	53			

(c) = (a) - (b) for a morning shot

(c) = (a) + (b) for an afternoon shot

(e) = (d) - (c)

3. Schematics



Computed: Checked:

Appendix 8

HP-65 QHM Program - Card 1

Temperature + Ø (Metal Circle)

(P. Gidley)

KEY ENTRY	CODE SHOWN	COMMENTS	KEY ENTRY	CODE SHOWN	COMMENTS	REGISTERS
f PRGM	00	Clear	STO	33		R_1 Corrected
LBL	23		+	61		Temp
A	11		5	05		
R/S	84	Enter four	R/S	84		R_2 Ø
+	61	Temperatures	STO	33		
R/S	84		+	61		
+	61		4	04		
R/S	84		RCL 3	34 03	Mean - Degrees	
+	61		2	02		
4	04	Mean Temperature	+	81		
+	81		STO 3	33 03		
R/S	84	Add Temperature	RCL 5	34 05	Mean - Minutes	
+	61	Correction	2	02		
STO 1	33 01	Store	4	04		
RTN	24	End	0	00		
LBL	23		+	81	Decimal	
B	12		RCL 3	34 03	Degress Mean	
STO 2	33 02		+	61		
R/S	84		STO 3	33 03		
STO 3	3303	Enter +, -, -, +	RCL 2	34 02		
R/S	84		2	02	Mean + Degrees	
STO	33	Degrees	+	81		
+	61		STO 2	33 02		
3	03	STO + SUM in	RCL 4	34 04	Mean + Minutes	
R/S	84	Register 2	2	02		
STO	33	STO _ SUM in	4	04		
+	61	Register 3	0	00		
2	02		+	81		
g Rf	35 09	Change register to °	RCL 2	34 02	Decimal	
R/S	84		+	61	Degrees Mean	
STO 4	33 04	Add + Minutes	STO 2	33 02		
R/S	84	to Register 4	RCL 3	34 03		
STO 5	33 05		g X≤Y	35 22	Test if - Mean	
R/S	84	Add - Minutes	GTO	22	is + Mean	
STO	33	to Register 5	3	03		
+	61		g X≷Y	35 07	Interchange	
5	05		3	03		
R/S	84		6	06	Add 360°	
STO	33		0	00		
+	61	Enter Data	+	61		
4	04	down columns	LBL	23		
R/S	84	of QHM Form	3	03		
STO	33		-	51	Take - From +	
+	61		g	35	to give 2Ø	
4	04		ABS	06		
R/S	84		2	02	Give Ø	
STO	33		+	81		
+	61		STO 2	33 02	STO 2	
5	05		RTN	24		
R/S	84					

User Instructions

1 Enter first Temperature
Press A

2-4 Enter Temperatures
Press R/S each time

5 Enter Temp Corr^n (with sign)
Press R/S

6 Enter First Degrees + Reading
Press B

7-9 Enter Degress Reading -,-,+
Press R/S each time

10 Enter 1st Minutes + Reading
Press R/S

11-16 Continue entering '+' & '-' Minutes down QHM form colums - pressing R/S each time

17 Last minutes entry (+) and R/S gives Ø

HP-65 QHM Program - Card 2

QHM 306

(P. Gidley)

KEY ENTRY	CODE SHOWN	COMMENTS	KEY ENTRY	CODE SHOWN	COMMENTS	REGISTERS
f PRGM	00 00		X	71		
LBL	23		X	71	c_2 H cos ø	
A	11		STO 7	33 07		
LBL	23		f	31		
1	01		TF 2	81	Test if 4	
.	83		GTO	22	or 2	
0	00		3	03		
0	00	c_1	LBL	23		
0	00		4	04		
1	01		RCL 5	34 05	c - log sin ø + c_1t - c_2 H cos ø	
4	04		-	51		
6	06		g	35		
STO 3	33 03		ABS	06		
3	03		STO 6	33 06		
0	00	c_2	f^{-1}	32		
EEX	43		LOG	08		
1	01		ENTER	41		
0	00		f	31		
CHS	42		TF 1	61		
STO 4	33 04		GTO	22		
ENTER	41		2	02		
4	04		RTN	24		
.	83		LBL	23		
2	02	c	B	12		
			f	31		
3	03		SF1	51		
1	01					
9	09		f	31		
1	01		SF2	71		
ENTER	41		GTO	22		
RCL 2	34 02	ø	1	01		
f	31		LBL	23		
SIN	04		3	03		
f	31	log sin ø	RCL 07	34 07		
LOG	08		2	02		
-	51		X	71		
ENTER	41		GTO	22		
RCL 3	34 03	temp.	4	04		
ENTER	41		LBL	23		
RCL 1	34 01		2	02		
X	71		RCL 6	34 06		
+	61	c - log sin ø + c_1t	ENTER	41		
STO 5	33 05		2	02		
f^{-1}	32		f	31		
LOG	08		LOG	08		
ENTER	41		+	61		
RCL 2	34 02		f^{-1}	32		
f	31		LOG	08		
COS	05		ENTER	41		
ENTER	41		RTN	24		
RCL 4	34 04					

HP-65 User Instructions

1 After running 1st card enter
2nd card then press either :
A if 2π
B if 1π

HP-65 QHM Program - Card 2

QHM 306

(P. Gidley)

KEY ENTRY	CODE SHOWN	COMMENTS	KEY ENTRY	CODE SHOWN	COMMENTS	REGISTERS
f PRGM	00 00		X	71		
LBL	23		X	71	c_2 H cos Ø	
A	11		STO 7	33 07		
LBL	23		f	31		
1	01		TF 2	81	Test if 4	
.	83		GTO	22	or 2	
0	00		3	03		
0	00	c_1	LBL	23		
0	00		4	04		
1	01		RCL 5	34 05	c - log sin ø + c_1t - c_2 H cos ø	
4	04		-	51		
6	06		g	35		
STO 3	33 03		ABS	06		
3	03		STO 6	33 06		
0	00	c_2	f^{-1}	32		
EEX	43		LOG	08		
1	01		ENTER	41		
0	00		f	31		
CHS	42		TF 1	61		
STO 4	33 04		GTO	22		
ENTER	41		2	02		
4	04		RTN	24		
.	83		LBL	23		
2	02	c	B	12		
			f	31		
3	03		SF1	51		
1	01					
9	09		f	31		
1	01		SF2	71		
ENTER	41		GTO	22		
RCL 2	34 02	ø	1	01		
f	31		LBL	23		
SIN	04		3	03		
f	31	log sin ø	RCL 07	34 07		
LOG	08		2	02		
-	51		X	71		
ENTER	41		GTO	22		
RCL 3	34 03	temp.	4	04		
ENTER	41		LBL	23		
RCL 1	34 01		2	02		
X	71		RCL 6	34 06		
+	61	c - log sin ø + c_1t	ENTER	41		
STO 5	33 05		2	02		
f^{-1}	32		f	31		
LOG	08		LOG	08		
ENTER	41		+	61		
RCL 2	34 02		f^{-1}	32		
f	31		LOG	08		
COS	05		ENTER	41		
ENTER	41		RTN	24		
RCL 4	34 04					

HP-65 User Instructions

1 After running 1st card enter
2nd card then press either :
A if 2π
B if 1π

Appendix 9

STATION	START	END	MISSING RECORD	REMARKS
ALBANY	0348 6Nov	0333 10Nov	F11(6)-00(7) F08(8)-05(9) Z	F, continues noisy till 05(9), 36 hours lost
ALICE SPRINGS	0643 16Jun	0257 19Jun		Isolated noise on X, F and Y duplicated on H.P.
ALPHA	0505 13 May	0010 16May	X05(13)-01(14)	X channel connected to wrong lead
AUGUSTA	0835 1Nov	1000 3Nov	XYZFT11(2)-04(3) F10(3)-00(4) F13(4)-01(5)	F recorded on H.P. Honda failure Noisy F trace due to moisture in connectors. Offsets due to vehicles. Sensor head relevelled 0645 (4th) and 0111 (5th). Total record loss F 48 hours all other elements 17 hours.
AYERS ROCK	0635 12Jun	0156 15Jun	F11(13)-00(14)	Isolated noise on Z, Y and F duplicated on Mosely.
BIRDSVILLE	0722 28Apr 0650 29Apr 0711 30Apr	0653 29Apr 0705 30Apr 0425 1May		Significant disturbance due to cars
BOULIA	0657 2May 0138 3May	0136 3May 0417 4May	F10(3)-00(4) XYZFT19-22(4)	F tripod broke All elements, Toshin paper drive jammed.
BOURKE	0515 2Mar	0200 4Mar	F05-07(2) Z05-10(2) Z07(3)-02(4)	Adjusting proton Z unstable, minor noise till 07(3) Z unstable Recurrent spiles on X and Y. 06(3)-02(4)
CARNARVON	0600 22Oct	0955 24Oct	Z F23(22)-03(23)	Total loss F noisy Recording PPM131 u/s, swapped for PPM 120 at 03(23).
CARNEGIE	0639 21Aug	0046 24Aug	XYZFT179210-01(22) XYZFT05-06(23) X15-23(23) F06-07(23)	Instability on X channel 07-16(21) Recorder jammed Generator stopped Instability on X channel Power supply failure
CEDUNA	0700 27Nov	0700 30Nov	X19-20(28) Z08(28) Z16-23(29)	Z recorded on HP High frequency oscillations on X Disturbance HP jammed
CHRISTMAS I.	0839 8Jun	0700 11Jun	XYZFT21(10)-00(11)	Recorder stopped chart speed, 100mm/hour 01-03(11). Timing from Bulova, correction - 6.5 min.
COCOS I.	1221 4Jun	0730 7Jun		No timing except Bulova on F trace. Minor offsets due to vehicle traffic. Head relevelled 0722(5).
CONDOBOLIN	0117 18Mar 0017 20Mar 0713 21Mar	0000 20Mar 0710 21Mar 0228 22Mar	XYZFT20-21(18) F23-04(18/19) Z16(20)-08(21)	Power failure F head fell over
COOKTOWN	0620 29May 0725 30May	0710 30May 2248 30May		Y and Z channels interchanged at 07(30)
CROYDON	0555 1Jun 1100 2Jun	0800 2Jun 2330 2Jun	XYZFT08-11(2)	Record jammed Chart and absolutes missing
DALY WATERS	0100 6Jul 0100 8Jul	2318 7Jul 0055 9Jul	XYZFT04-05(6) F07-09(7) F12(7)-00(8) F12-23(7) XYZFT23-24(8)	Generator stopped Recorder jammed
DARWIN	0821 23Jun	0024 26Jun		F and Y duplicated on H.P.
DERBY	0200 24Jul	0240 26Jul	F03-06(24)	Minor instability in X channel 02-04(25)
EMU	0842 22Nov	0100 25Nov	Z22(22)-10(23) Z22-24(23)	Time correction of - 1min 04-08(24) Z recorded on HP Record loss Z 16 hours
ESPERANCE	0545 11Nov 1045 12Nov	1035 12Nov 0752 14Nov	F22(11)-02(12) F20(12)-08(13) F00-04(14)	Magnetic storm 01-12(12) F recorded on HP HP paper jam - F loss due to bad zero adjustment Head releveller 0911(12) and 0050(13). Total F loss 19 hours

STATION	START	END	MISSING RECORD	REMARKS
ETADUNNA	0500 17Dec	1030 18Dec	15(17)-07(18)	Honda generator failed also at 10(18) - station closed
	1241 11Jan	0200 12Jan	YZ13-23(12)	Y and Z unusable. Adkin unstable due to heat station closed
	0654 9Mar	2310 10Mar	XYZFT05(10)	Record disturbed from 22(9) but usable
EUCLA	0334 16Nov	0353 20Nov		F on H.P. - minor noise due to rain. Head relevelled 1010(17)
FLINDERS I.	0440 18Jan	0045 20Jan		Minor instability and offset in Y.
	0050 20Jan	0120 21Jan		
GERALDTON	1040 25Oct	0450 29Oct	Z - total loss	Power failure. T trace very faint from 00(26).
			XYZFT05(27)	T channel changed 03(28), no time marks on T till 08(28)
GILES	0042 2Sep	044 4Sep		Square wave interference on Z.
GOVE	0705 26Jun	0047 29Jun		F and Y duplicated on H.P.
GRAFTON	0810 29Mar	0700 30Mar		
	0700 30Mar	0315 1Apr		
HALLS CREEK	0257 14Jul	1714 16Jul	XYZFT09-24(15)	Recorder jammed. Time marks from Bulova until 01(15)
HOBART	0100 22Jan	0615 24Jan		
	0620 24Jan	0000 25Jan		
INGHAM	0114 25May	2338 26May	XYZT03(25)-04(26)	Slight noise on X
	0023 27May	0002 28May	Y23-24(26)	
KIDSON	0523 26Aug	0845 27Aug	Z07(26)-00(27)	
	0848 27Aug	0100 28Aug	H04(27)	
			Z04-07(27)	Z channel suspect
LAVERTON	0932 16Sep	0150 29Sep	XYZFT02-08(19)	Paper jam
	0208 19Sep	0945 20Sep	F11-13(19)	F noisy head blown over
			F Y05(20)	F on manual, Y pen jammed
LORD HOWE I.	0400 31Jan	0240 1Feb		
	0250 1Feb	0055 2Feb		
	0100 2Feb	0410 3Feb		
MACKAY	0520 22May	2345 23May		Small oscillations on Z
MARYBOROUGH	0725 17May	2330 17May		Noise spikes until 01(19) Adkin moved and reset up
	0000 18May	0050 19May		at 03(19) as location unsatisfactory
MEEKATHARRA	0915 14Oct	0208 17Oct		F on H.P. F noisy from 10-16(14)
MILDURA	0250 15Mar	0825 16Mar		
	0825 16Mar	0219 17Mar		
MOREE	0739 4Apr	0610 6Apr	XYZT08(4)-07(8)	Adkin u/s
			F10-13(5)	Pen dried out
			F22-23(5)	
			F07(6)-07(8)	
	0624 8Apr	0803 9Apr	T00-24(9)	T trace missing
	0830 9Apr	0530 10Apr	XYZ06(10)	
	0536 10Apr	0300 12Apr	XYZFT17-24(11)	Clock failed
MT. ISA	0112 6Jun	0232 7Jun	F02-08(6)	F and Y partly duplicated on H.P.
			Z15(6)-03(7)	
	0242 7Jun	0110 9Jun	F00-03(7)	
			X03-04(8)	
MT VERNON	0324 18Oct	1430 19Oct	F05-14(18)	
	1500 19Oct	1000 20Oct	Z14(18)-10(20)	
			F05-06(19)	Repairing F connector
NEALE JUNCTION	0800 9Sep	0100 13Sep	XYZFT02-04(11)	Minor instability on X trace
NEWCASTLE	0445 23Mar	2000 23Mar	XYZFT20(23)-02(24)	Power failure
	0130 24Mar	1420 25Mar	XYZFT22(24)-01(25)	Adkin output unstable DB6 pens oscillating
	0748 27Mar	0400 28Mar	XYZFT14-23(25)	
NORFOLK I.	2030 19Feb	2200 22Feb	XYZFT01(20)-06(20)	
ONSLOW	0635 9Aug	0144 11Aug		Instability on X channel 17-23(10)

STATION	START	END	MISSING RECORD	REMARKS
OODNADATTA	0710 13Dec	0317 15Dec	F23(14)06-08(15)	Z recorded on H.P.
	0322 15Dec	0119 16Dec	X12(15)	
PARAFIELD	0610 6Dec	0251 7Dec	Z18-23(6)	Paper jamming
	0742 8Dec	2335 8Dec	FXYZT03(7)-08(8)	Chart drive failure. Z recorded on H.P.
PORT HEDLAND	0200 28Jul	0700 1Aug	Y15(31)-07(1)	25min power failure 00-01(31)
PORT LINCOLN	0930 1Dec	0843 3Dec		Z on H.P. Head relevelled 0020(2)
	0900 3Dec	0200 5Dec	XYZFT16-23(3)	Toshin paper drive failed. Head relevelled 0150(5)
PORTLAND	0118 6Mar	2000 6Mar	XYZ20-23(6)	Pen jammed
	2224 6Mar	2200 7Mar	YZ08(7)	Channels swapped
	2217 7Mar	0020 9Mar	T10-23(8)	
QUILPIE	0545 24Apr	0533 25Apr		
	0543 25Apr	0117 27 Apr		
ROMA	0730 13Apr	0532 18Apr	XYZT07(13)-07(18)	Adkin failure
	0624 18Apr	0710 19Apr		
	0715 19Apr	0115 21Apr		
SOUTHERN CROSS	0929 26Sep	0326 29Sep	XYZFT22(26)-02(27)	Honda stopped
	0800 30Sep	0900 20ct	XYZFT04(29)-09(30)	X and Z oscillating
			Z09(30)-10(2)	
			Y09(30)-10(1)	Losses due to Adkin instability and recorder failures
			Y16(1)-01(2)	
			X06(1)-10(2)	
			F06(1)-15(1)	
			T06(1)-10(1)	
			F T24(1)-01(2)	
TELFER	0040 15Aug	0039 18Aug	XYZFT15-24(15)	Recorder jammed
			XYZFT05(16)	
			XYZFT21-24(16)	Recorder jammed
TENNANT CREEK	0432 20Jun	0035 22Jun		F and Y duplicated on H.P.
THE GRANITES	0300 18Jul	2224 20Jul	X,Z10(18)	Instability on X channel 07-13(18)
			XYZFT13-23(18)	Recorder jammed
			XYZFT19-20(20)	Generator stopped
TIBOOBURRA	0456 5Mar	0011 6Mar	XYZFT21-23(5)	
			X16-23(6)	X very noisy
			XYZFT23(6)	
WARRACKNABEAL	0132 10Mar	0414 11Mar	XYZFT05-09(12)	Adkin head repositioned. Relevel at 05(11)
	0422 11Mar	0403 12Mar		
	0406 12Mar	0154 14Mar		
WEIPA	0626 29Jun	0018 2Jul		F and Y partly duplicated on H.P.
WILCANNIA	0700 13Mar	2300 14Mar	Z00-23(14)	
WINTON	0506 6May	1800 7May	Y11-14(6)	Pen dried out
	0747 8May	0345 10May	Y10-14(7)	Channel u/s
	0405 10May	2340 11May	XYZFT19(7)-08(8)	Adkin power supply and clock failure
			XYZT08(8)-04(10)	
WOOMERA	0211 10Dec	0038 12Dec	Z14-22(11)	Z recorded on H.P. paper drive stopped
WYNDHAM	0327 11Jul	0350 13Jul		
ZANTHUS	0800 22Sep	0900 25Sep		Minor instability on X.

Appendix 10

Station Occupations Reports

The following summaries describe the occupation of each station, with the observer(s) initials after the date of occupation. Details of magnetograph recordings are given in Appendix 9.

ALBANY C

(6-10 Nov 1978) BAG

Setting up: The recorder was set up in the tent about 50 m from the nearest workshop, from which power was obtained. The workshop is about 300 m to the north of the magnetic station. The original wooden stake with a cross was replaced with the standard BMR station marker.

Azimuth mark: The top of the windsock on the east side of the airstrip.

Observations: Only one set of morning and one set of afternoon sun-shots were completed. It was not possible to re-occupy the old station B at Centennial Oval as the Albany Show was being held at the oval.

Equipment: The Hewlett Packard recorder failed and was returned to Perth for repairs; the F trace was connected into what is normally the Z trace in the Toskin recorder. 36 hours of F was lost owing to a poor contact in the sensor lead. A change in Adkin sensor level caused a minor base-line jump at 2348 UT on Nov. 6.

ALICE SPRINGS E

(16-19 June 1978) AME

Setting up: The equipment was set up in the anemometer hut (key from Met.) about 50 m from the magnetic station.

Azimuth marks: T.V. tower on the hill to the left of 'The Gap', NW of magnetic station.

Equipment: No problems were experienced other than initial instability. All traces were recorded on the Toshin with Y and F duplicated on the Moseley.

Old Stations: The following stations were found to be unoccupiable:

A (1912, 37) - no trace of the stockyard was found. Rangers in charge of the old telegraph station didn't know which were the officers' quarters, the only remaining reference mark.

B (1945) - new road works over station which was near chainage reference.

D (1957) - towers of D.C.A. transmission site have been changed and one of the new towers contaminates the mark.

ALPHA A

(May 13-May 16) MJS

Setting up: The Airport terminal was isolated from the town and any visitors. The honda generator was used.

Azimuth Mark: The right hand (back) carrier of the terminal building.

Observations: Observations went smoothly except that the declinometer fibre was broken again. This occurred because the clamping mechanism was faulty.

Equipment: Good quality records were obtained. The "dawn dusk" step was observed again and was calibrated by absolute measurements on either side of the step.

AUGUSTA D

(1-5 Nov 1978) BAG

Setting up: The recorder was set up in the tent about 75 m SE of the magnetic station, the generator providing power.

Observations: No sunshots were taken due to rain.

Equipment: The Honda generator failed owing to carbon deposit build up. A 2.5 KVA generator was obtained from a local garage while the Honda was repaired.

The F trace was at times spurious due to moisture in the connector in the PPM cable. A plastic bag tied over the sensor head and cable connector improved the situation.

Baseline jumps were introduced at 0645A on 4NOV'78 and 0111Z on 5 NOV'78 when the Adkin sensor head was relevelled.

AYERS ROCK B

(12-15 June 1978) AME

Setting up: The equipment was set up in the tent (with Honda power) 50 m from the magnetic station to the N of the runway.

Azimuth mark: A prominent notch in the east end of the Rock (break in slope) to the south of station.

Equipment: Initial instability of the Adkin was experienced (X and Z). After it stabilized no further problems occurred.

Old Station: Close reoccupation of station A (1961) was achieved. There was no trace of the marker, but using old photographs I believe the reoccupation was within 1 metre. THere was a depression in the gound and also a broken 30 cm red white wooden dropper at this site. A 1 m, 13 cm creosoted pine post, was installed protruding 0.5 m. This was used as the station marker for the observations.

BIRDSVILLE B1

(April 28 May-May 1) MJS

Setting up: The magnetic variometer system was set up in the local police station. Although this provided a sheltered home and a source of power, it was unfortunately a very busy place (second only to the pub). Consequently, there is a lot of interference on the records due to cars and inquisitive children on bicycles.

Equipment: The observing PPM was still being used to record total intensity as well as absolutes at the observing station.

Azimuth mark: Base of the light structure on the windsock.

Observations: No rounds of angles were made, as nothing else of a permanent nature could be seen.

BOULIA C

(May 2-May 5) MJS

Setting up: The recording equipment was installed in the terminal building and as no power was available at the airport, the Honda generator was set up for the first time. The Honda worked well and gave no problems. Good magnetic records were obtained, although the magnetic field was rather active and the paper drive jammed for a few hours one morning. The PPM tripod collapsed one night giving erratic total field recordings.

Azimuth Mark: Gable of iron shed to the east.

Observations: Many sun observations were made and rounds of angles were taken to a number of reference points around the airport. The active magnetic conditions made observing a little difficult and probably another days' observations should have been taken. However, heavy

rains were forecast and the roads out of town were expected to be cut. It was decided to leave as soon as possible and reach the bitumen beef road before it was impossible to do so. When we arrived in Winton, we heard that the road to Boulia was under water.

Old Station: An old station exists at the local primary school and an approximate reoccupation was made using the compass theodolite.

BOURKE C

(2-4 Mar 1979) AME

Setting up: The local shire council was contacted and the D.O.T. caretaker (a shire employee) met at the airport. The equipment was set up in the D.O.T. workshops (240V) at the airport near the terminal area. The head was set up on the concrete floor of the parking bay. It was a long weekend (Bourke races), so the workshop was not used by D.O.T. employees during our stay. The magnetic station was about 3.4 km away, near the main entrance to the airport.

Azimuth Mark: The right hand NDB Tower.

Equipment: Initial problems were experienced in setting up due to loose cards in the Adkin and Elsec PPM's. These were solved after 5 hours of fiddling.

A D fibre was broken - replaced and hung. All elements were recorded, but the last 20 hours has spikes on the record, probably caused by the refrigerator cutting in and out.

Old Stations: Bourke A 1913, A1 1923, B 1945 are all unoccupiable due to earthworks and contamination.

CARNARVON D

(22-24 Oct 1978) EPP

Setting up: The equipment was set up in the tent on open ground to the north of the RFDS hangar outside the fence surrounding the hangar. A power lead was run from the hangar. Permission was obtained from the RFDS chief pilot through the OIC of Department of Transport.

The station marker is no longer covered by a cone but is surrounded by 3 short star pickets. These were removed for the occupation and replaced afterwards to prevent the marker being mangled by the mower.

Azimuth mark: The top dead centre of a radio mast (red top, white base) to the SE of the magnetic station.

Equipment: Problems, similar to those at the previous station, were experienced in tuning the recording PPM (No 131) however it worked perfectly for absolutes so the two PPMs were swapped around. Thus PPM 120 became the recording PPM from 0300 on 23 October. The fly sheet tore and blew down on 24 October breaking the fibre and thermometer (No 2387) of QHM 290.

1914 Station A: The Gascoyne Hotel still exists in virtually original condition but the small foot bridge and the creek at the north end of Foss Street has gone. A reoccupation was made using the remaining reference "about 800 feet NNE of Gascoyne Hotel ... in line with the NW end of the hotel." This location puts the station in the middle of a dirt road, the extension of Foss Street. The bearing from the hotel is good but the distance dubious. F, H and compass theodolite observations (D) were made.

CARNEGIE A

(21-24 August 1978) MWM

Setting up: The equipment was set up in a tin shed near the magnetic station with power from the Honda generator.

Azimuth mark: The windmill to the west.

Equipment: The Adkin X channel was unstable at times. The recorder jammed on the night of the 21st resulting in nine hours record loss. These two faults required an extra nights recording. The power supply for the PPM developed a fault so the spare power supply was used.

CEDUNA D

(27-30 Nov 1978) BAG

Setting up: The recorders were set up in the tent some 40 m SW of the machine shed at the Ceduna airport. Power was obtained from the shed. The recording tent was 1 km away from the magnetic station.

Azimuth Mark: Base of the light structure of the windsock near the terminal.

Observations: Cloud and rain hampered sunshots.

Equipment: The equipment performed well at Ceduna. Two hours of the H trace were lost owing to a high frequency, variably amplitude occillation in the H component. The cause of this effect was not known.

Eight hours of Z trace were lost when the Hewlett Packard recorder failed.

Old Station: A reoccupation of station C was made. The estimated error of location was 5 m. The concrete tank and other reference points mentioned by the previous observer were no longer there. The cricket pitch referred to in the station C description is located 200 m NE of what is now the golf club house.

CHRISTMAS ISLAND B

(8-11 June 1979) BAG

Setting up: Station A (1959) was abandoned because an underground steel oil pipe had been installed only meters from the station. A new magnetic station was established at the air field of Christmas Island. A local magnetic survey was carried out to ensure low gradients at the site. The recording equipment was set up in the air terminal some 200 m SW from the magnetic station.

Azimuth Mark: TDC of windsock 1 km at N end airstrip.

Observations: Observations normal.

Equipment: The secondary timing system was used because the EMI was producing spurious pulses. The following record was lost:

1410 - 1530 UT on 10 JUN '79
1922 - 0041 UT (i.e. 10 JUN-11JUN '79)
0248 UT - 0314 UT on 11 Jun '79.

The chart speed was varied as follows:
0041 UT on 11 JUN' 79 from 60 to 100 mm/hr
0314 UT on 11 JUN '79 from 100 to 60 mm/hr

COCOS ISLAND A,C

(4-7 June 1979) BAG

Setting up: The recording apparatus was set up in the old meteorological building (still occupied) on the eastern side of the airstrip. Station (A 1946,70) was not found until the 3rd day. A Department of Construction map was found by the local surveyor which provided the additional information required to locate the station. Because of this, the work was doubled as a new station (1979 station C) was put in less than 5 m away from the 1970 station.

Azimuth Mark: TDC of old control tower mast (left) on (or behind) the control tower block.

Observations: Control observations were made from both magnetic stations: 7 sets from the 1979 station and 3 sets from the 1970 station. All sunshots were taken from the 1979 station, and the azimuth was transferred to the 1970 station. The number of sunshots were reduced because of persistent inclement weather.

Equipment: The variograph recorder worked well and all 5 elements were recorded on the Toshin recorder. However the EMI clock produced spurious time marks, so manual time marks were put on the record at intervals.

CONDOBOLIN C

(March 18-March 22) MJS,GRS

The terminal building was used to set up the recording instruments. The ADKIN and PPM sensor heads were in front of the building towards the landing apron. Unfortunately, cars visited the airport and caused noisy recordings. A violent storm blew the PPM head and tripod down one night resulting in five hours lost data. Furthermore several power failures occurred in the towns electricity supply during the storm. Fortunately everything started up again when the power was restored. The DB-6 recorder developed faults, with one of the amplifiers giving no output and another having different zero positions on different ranges.

Observing conditions were terrible. Strong winds and heavy dust storms prevented observations on two days and resulted in a broken QHM thermometer when the observing shelter blew down during a set of absolutes. Only two morning sets of sunshots were taken, although rounds of angles were made to several other marks. To add to the misery, heavy rain began to fall on the last day.

Condobolin has two old magnetic stations. The 1913 C.I.W. site (A) was under a new bitumen road and impossible to reoccupy. The magnetic station (B) at the racecourse (established in 1945) was located and reoccupied.

COOKTOWN C

(29-30 May 1978) AME

Setting up: There was no caretaker during occupation (new one arriving in 2 weeks). The equipment was set up in the D.O.T. maintenance workshops (240v) with the head through fence to the east towards the groundman's house. This turned out to be a bad site as the groundsman takes out trucks and tractors during the day causing trace displacements on the record. There is no power at the terminal. The magnetic station was 150 m away.

Azimuth mark: Centre of the wind sock to the NW.

Equipment: I was not happy with the performance of channel 1(Y) so I interchanged Y and Z at 07 on the 30th.

Old Stations: Station A(1912) was reoccupied. No markers were found, the area has been cleared but regrown. The following measurements were used to locate the station: a) 366'6" from NE corner of fence around doctors(?) house; b) 233'6" from the extrapolation of Nth fence of hospital; c) Azimuth to SW corner of doctor's house (from Sth) 122° 37.9' (allowing for D). The mark used was the Lighthouse on 'grassy' hill (1962 Azimuth 195° 01.9' from Sth). The station was marked by yellow pegs, the station mark used was the centre top of the one flush with the ground. The other (protruding 6") was placed 6" to the East towards the track. The station marker is 4 m W of the top of the nearer dirt bank along the track, 8.24 m NE from a small gum tree with a 15 cm blaze cut at head height.

CROYDON B

(1-2 June 1978) AME

Setting Up: The equipment was set up in the terminal building with the head outside. No 240v power was available so the Honda was used. The magnetic station is on the opposite side of the runway.

Azimuth Mark: The septic system (NW), flu (above roof) of new terminal

Equipment: Module 1 on the Toshin recorder was unserviceable. The temperature lead to the Toshin was replaced (loose contacts in plug). The paper drive on the Toshin jammed at 08 on 2nd, was unjammed at 11 pm (LT). Chart 2 from 11 pm on 2nd to 2330 on 2nd was lost together with two sets of absolutes, either in Canberra or at Croydon when packing up.

Old Stations: Exact reoccupation of the old station A(1912) was achieved. A BMR concrete marker (no top) was found on vacant land NE of the hospital next to and on the E side of a graded earth road. The hospital is on the W side of the road. The station marker of 1938-40 was found lying on its side 2.8 metres from the mark (graded out in road making operation), and was re-erected to protrude 8 cm above gound 1 metre of E of present mark which exactly replaces old mark.

DALY WATERS

(6-9 July 1978) MWM, GRS

Setting up: The equipment was set up in the tent about 50 metres from the magnetic station at the airport. The Honda generator was used to supply power.

Azimuth mark: Centre top of a post (with a cross piece) to left of water tank near (left of) hangar.

Equipment: Carbon build up caused the Honda to fail. The combustion chamber was decoked and no further trouble was experienced. The F channel on the recorder stuck on the night of 7th, - necessitating an extra day's recording.

1912 Station A An unsuccessful attempt was made to find the 1912 station eight kilometres south of the telegraph station. The area is now covered with scrub and none of the land marks described in the 1912 reports could be identified.

DARWIN E

(23-26 June 1978) AME

Setting up: The equipment was set up in the tent outside the D.O.T. compound (on terminal side) 240v was obtained from electrician's huts. It was a quiet site. It is a 5 minute walk to the magnetic station in front of the tarmac of the light aircraft hangar with easy access between the two.

Azimuth mark: Down pipe of guttering on control tower to the NE of the station.

Equipment: Problems were experienced with the absolute Elsec PPM due to loose cards.

DERBY B

(24-26 July 1978) MWM

Setting up: The equipment was set up in the tent between the hangar and the magnetic station. Mains electrical power from the hangar was used for the equipment.

Azimuth Mark: Far left tower.

Equipment: There were no problems with the recorder or the Adkin. The securing nut at the top of the declinometer came loose and a fibre was broken in the afternoon of the 24th. The D readings were scattered, possibly due to kinks in the new fibre.

EMU B

(22-25 Nov 1978) BAG

Setting up: The recorders were set up in the aluminium Nissen hut which stands on the hill overlooking the airstrip. The generator was used to

power the recording apparatus. The magnetic station (B) is alongside the air strip and about 1 km away from the recorder.

Azimuth mark: Stove pipe of Nissan hut.

Observations: There was a lack of satisfactory marks, so 2 more were installed and were tied in to marks used previously by a round of angles.

Equipment: Fifteen hours of Z were lost when the Hewlett Packard recorder failure. Minor baseline changes were introduced by relevelling the Adkin head at 0327UT on 23 NOV '78 and at 0710UT on 23 NOV '78.

The old station A (located under a cairn of rocks) was reoccupied.

ESPERANCE C

(11-14 Nov 1978) BAG

Setting up: The recording tent was erected 50 m S of the airport terminal from which power was supplied.

Azimuth Mark: The closer of the two towers to the SE.

Observations: All observations were carried out as per normal except that cloudy conditions persisted and disallowed a full set of sunshots.

Equipment: The X, Y, Z and T components were recorded on the Toshin recorder and F and Y on a replacement Hewlett Packard recorder, sent from Canberra.

Except for 22 hours loss of F recording no other loss was incurred. There were 2 minor baseline changes produced when the Adkin head was relevelled at 0911 UT on 12 NOV '78 and at 0050 UT on 13 NOV '78. The F loss was caused when the recorder zeroed and also when the drive mechanism failed on the Hewlett Packard recorder.

ETADUNNA A

(17-19 Dec 1978) MJS

Setting up: The recording equipment and field camp were set up at Lake Killalpaninna. This is about 15 km from the absolute station. Conditions were extremely hot and windy and camping by the lake was a necessity.

Azimuth mark: Base of the Lutheran Cross to the south west.

Observations: Magnetic and sun observations were not difficult although sunburn and heat exhaustion were a problem.

Equipment: Unfortunately the Honda generator developed a fault in the alternator. A Kawasaki generator was borrowed from the local station owner but it too failed after several hours. As a result insufficient magnetic recordings were made and the station was abandoned and reoccupied at a later date. A good series of sun observations and round of angles were made before leaving.

(11-12 Jan 1979) AME

Setting up: The equipment was set up in old sheds between the homestead and the station with the Honda in the old garage.

Equipment: Problems were experienced with the Adkin with channels Y and Z oscillating. I was unable to remove the noise but managed to decrease it to about 2nT. On the morning of 12 Jan an unsuccessful attempt was made to rectify the problem by replacing IC's, with no success, X started oscillating as well. The extreme heat of upper 40's was very close to the operating maximum of the equipment and possibly compounded the problems. The equipment was packed up in disgust and the party returned to Canberra.

(9-10 March 1979) AME

Setting up: The equipment was set up in the double tin garage near the second house with the head on a concrete path and the Honda behind the water tank.

Equipment: All components recorded satisfactorily, the Honda generator only stopped once. Several trace offsets were recorded due to passing semi trailers.

EUCLA C

(16-20 Nov 1978) BAG

Setting up: The recording apparatus was set up in the tent approximately 40 m W of the SW corner of the westernmost corner of the motel. The magnetic station is located about 60 m S. The power lead for the recorders was plugged into our motel room, 40 m away.

Azimuth mark: Apex at hangar at Airport.

Observations: All observations were carried out as normal.

Old Stations: A close reoccupation of
within 1.5 m. It was difficult to locate as trig points mentioned were either unrecognizable or absent. With the aid of a local resident, Mr H. Gurney, the old roads mentioned in the description were located.

Eqipment: The equipment performed satisfactorily and no loss of record occurred.

FLINDERS ISLAND B

(18/21 January 1979) GRS

Setting up: The equipment was set up in the tent at the back of the D.O.T. offices. Power was obtained from the office.

Azimuth Mark: Top dead centre of nipple on hill to SE. Secondary mark was base of windsock post to the south.

Equipment: Minor instabilities occurred on the Y trace. Heavy rain resulted in some tilt in the Adkin head during the occupation.

Old station: An attampt was made to find the site near the Whitemark hotel but the area appears to have been built over.

GERALDTON C1

(25-29 Oct 1978) EPP, BAG

Setting up: The equipment was set up in the tent in a paddock about 80 m SW of the airport terminal building. A power lead was run from an external power point on the western corner of the terminal building.

Azimuth Mark: The near windsock, about 180 m NNW of the station. This was the best of three former marks, the other two being decrepit windmills. A mark worth considering next time is the Department of Transport radio mast directly behind the terminal building.

Equipment: As for the previous station, only X, Y, F & T were recorded. The T trace became very faint and the felt pen was changed at 0300 on 28 October. PPM 131 and PPM 120 were intercompared at 0400 UT on 29 October. The Y display jumped dramatically for no apparent reason.

The Adkin magnetometer was turned off and the Y channel printed circuit boards reseated. When the recorder was turned on the power supply failed. The reason appears to be that there is enough play

in the strip connectors for the printed circuit boards to become offset allowing successive pins to be shorted out. The mating of the PC board to the strip connector cannot be observed unless all PC boards are removed and replaced in sequence. The station was closed at this juncture.

GILES A

(1 4 Sep 1978) MWM, EPP

Setting up: The equipment was set up in the tent near a store hut situated between the workshop and the observation block containing the balloon shed. Power from the store hut was used.

Azimuth mark: A trig point on a ridge of hills to the north of the station was taken as the mark.

Equipment: There were no major recording problems. A regular persistent square wave pulse of unknown origin appeared on the Z trace. Continuous rain on 1 September prevented any magnetic observations being made that day.

GOVE B

(26-29 June 1978) AME

Setting up: The equipment was set up in the tent near the Meteorological absolute enclosure with 240v from a power point in the enclosure. The Magnetic station is on the other side of the strip, necessitating a drive around the NW end of the strip (don't go near NDB at NW end strip on the N side - puts it off the air).

Azimuth mark: Was the centre of the yellow top of NDB beacon to the NW.

Equipment: No problems were experienced.

Old Stations: The Eldo tracking station site A(1969) (up to 1976) was easily found, and F, H and D (compass theodolite) were measured.

GRAFTON A

(29 Mar-1 Apr 1978) MJS

Setting up: A corner of the airport terminal building was used to set up the recording equipment. Cables were run out of a window and the sensor heads were placed towards the landing apron.

Azimuth Mark: Steel tower on a distant hill.

Equipment: The records were often affected by cars visiting the relatively busy Grafton air terminal. Initially attempts were made to have people park elsewhere. This situation eventually became impossible because of the large number of cars involved. Heavy rains flooded the area around the ADKIN sensor head, changing the levels and resulting in significant baseline shifts in all components. Fortunately these changes were recovered through absolute observations. Amplifier problems in the Toshin recorder continued, but all components were adequately recorded.

At Grafton, the first of the concrete foot pads was placed around the magnetic station. This made setting up the different tripods very quick and simple. Unfortunately torrential rain turned the sea into a quagmire and all observations were done in bare feet. Mosquitoes were a nuisance at dawn and dusk.

HALLS CREEK D

(14-16 July 1978) MWM

Setting up: The equipment was set up in the tent near the magnetic station and power was obtained from the airport garage.

Azimuth Mark: Top centre of anemometer tower.

Equipment: The Bulova clock provided the time marks until 0100 UT on the 15th. The EMI clock was used to provide timing for the rest of the period. The paper jammed in the recorder on the night of the 15th resulting in the loss of a night's record which necessitated an extra day's recording. The recorder also jammed on the night of the 16th for five hours.

Old Station: The magnetic station C (1962) was found after much digging was done in the wrong places and observation of D, F and H were made at this station.

HOBART F

(22-25 January 1979) GRS

Setting Up: The equipment was set up in a DCA building across the runway from the terminal. It was isolated and away from traffic and close to the observing station. The building was airconditioned and power was available.

Azimuth Mark: Centre of light on top of control tower, secondary mark, TV tower on Mt Wellington.

Equipment: Good records were obtained. An extra night's recording was made as a large storm started during the occupation.

INGHAM B

(25-28 May 1978) AME

Setting Up: The equipment was set up in an old delapidated terminal lounge (?) between the aero-club and toilets. 240V was obtained from the aeroclub hangar using a long power lead. The station is halfway

down the runway near the windsock - a reasonable distance to walk. The Aeroclub people were friendly and helpful.

Azimuth Mark: The top left hand corner of the water tower to the NE.

Equipment: The power supply of the Adkin failed - and a replacement was sent to Townsville and was collected by the field hand. Only F and T were recorded from 0140 on 25th to 0400 on 26th. After the new power supply was installed all components were recorded.

Old Stations: A close reoccupation of station A(1965) was achieved, although the marker was not found, but exact measurements were taken. A drain (sunken ground) passes within 2 feet of the station. Two marks were used for declination a) windsock b) gable of aeroclub hangar. Azimuths from 1965 description (from south) were a) 74° 43.2' for b) 115° 00.5'.

KIDSON A

(26-28 Aug 1978) MWM

Setting up: The equipment was set up in the tent close to the magnetic station and power was supplied by the Honda generator.

Azimuth Mark: Remains of the windsock to the east.

Equipment: The Adkin Z Channel output was suspect until 00 UT on the 27th. Component cards were swapped between the X,Y. and Z channels, causing jumps in the X and Y outputs but the Z output was more realistic. The system worked until 04 UT on the 27th when all channels jumped and the Z channel output became suspect. Switching the Adkin off and on several times seemed to solve the problem. The equipment worked satisfactorily for the rest of the occupation.

LAVERTON D

(16-20 Sep 1978) EPP

Setting up: The equipment was set up in the tent with a power lead to the airport terminal. A key was obtained from the Trans West representative, Mrs West.

Azimuth mark: The south edge (left hand side) of the stand, supporting a water tank on a hill behind Laverton was used as the mark.

Equipment: Tuning the recording PPM proved difficult. This was initially overcome by moving the head about 5 metres; however the problem recurred. Conditions were very windy for most of the occupation making it impossible to take any observations on one afternoon. The tripod supporting the PPM head blew over on two occasions. Record loss from this cause and also from a paper jam totalled 7 hours. Continuous small oscillations occurred on the D trace.

1912 magnetic station A: The old oval on the north side of town was found, half washed away by the ever encroaching creek. Two concrete cricket pitches were found, the older had not been used since 1918. The south fence and goal posts were missing. The jarrah marker peg was not found but it could still be there as it seems likely to be on high ground. If an old map of the oval could be located then distances and bearings to the peg from the old cricket pitch could be calculated.

LORD HOWE ISLAND C

(31 Jan - 3 Feb 1979) GRS

Setting up: The equipment was set up in and power provided from the Meterological Bureau offices.

Azimuth Mark: Remains of windsock pole on Rabbit Island.

Equipment: Frequent large offsets in the recording traces were caused by the Met radar.

Station: The station is in a public park and reinforced concrete seats had to be moved from near the station before observations could be made. The station should be shifted to the airport at the first available opportunity.

MACKAY B

(22-23 May 1978) AME

Setting up: The equipment was set up in the anemometer hut between the runway and the fire station (240V). The space available was a bit cramped due to a central pole in the hut, but the site was quiet. The head was put on a concrete slab of an anchor to one of the stays to the mast. The magnetic station is on the other side of the runway so it means a long trip (vehicle essential) on the outside perimeter road of the airport. The D.O.T. Administration Officer and staff were very helpful.

Azimuth mark: The centre top gable roof of the water tower to the NW.

Equipment: No problems.

MARYBOROUGH C

(17-19 May 1978) MJS, AME

Setting up: The recorder was first set up by Sexton in the D.O.T. maintenance workshop with the head towards the terminal: this was considered to be unsatisfactory. The Adkin was moved to the verandah of the groundsman's residence. The station was within easy reach (150 metres).

Azimuth mark: The centre base of lightstructure of the windsock to the NE.

Equipment: In the D.O.T. maintenance workshops noise spikes were appearing on the record about every 35 minutes. The equipment was moved to the verandah of the ground man's residence which proved to be a quiet site.

MEEKATHARRA B

(14-17 October 1978) EPP

Preamble: On advice from HQ the survey proceeded to Meekatharra, arriving on 3 October in the hope that the problems with the equipment would resolve themselsves on the trip; i.e. be pounded out by the truck journey as is often the case. Tests conducted on 4 October in collusion with HQ revealed many faults on the Adkin printed circuit boards. Both power supplies failed in the process, although this was later found to be only blown internal fuses. The survey returned to Perth on 5 October and the Adkin magnetometer and associated equipment was airfreighted to Canberra for repairs.

At Mundaring Geophysical Observatory G. Woad repaired the Wild Compass Theodolite. Loose screws inside beneath the compass card allowed the telescope assembly to wobble. Comparisons of the field instruments were made at Gnangara Magnetic Observatory.

The Adkin recorder was collected from the airport on Friday 13 October and checked. All but two of the printed circuit cards had sprung the top rail and some were completely free. When these were all replaced, the magnetometer worked. Channel B as well as A on the Toshin recorder was now unserviceable. The survey returned to Meekatharra.

Setting up: The equipment was set up in the tent with power coming from the BMR seismograph hut.

Azimuth mark: As in 1969 the light tower behind the airport terminal (and not the DCA building) was used. The centre of the tower at the orange and grey paint interface was taken as the mark.

Equipment: Four hours of F recording were lost on 14 October due to interference. Repositioning the sensor head cured the problem.

1912 Station A: The recreation ground was found but no fences remained. The gable roofed shed had gone. The Catholic church blew down many years and a new one had been built on the same site. The water gauge on the tank at the Luke Creek trigonometric station still existed, but an accurate station location could not be established and a reoccupation was not attempted.

MILDURA C

(15-17 Mar 1978) MJS, GRS

Setting up: The recording equipment was installed in a Bureau of Meteorology anemometer hut. This building was relatively isolated from sources of artificial disturbances and passing motor cars although conditions were cramped and hot inside the hut.

Equipment: No problems were experienced with any of the instruments.

Azimuth Mark: Left hand edge of the water tower in Mildura.

Observations: A round of angles was taken to the various windsocks around the airport. Magnetic observations went smoothly except that the declinometer clamping mechanism was unreliable.

Old stations: The old C.I.W. station A(1911) is in the middle of a well kept football oval and could not be found. Underground watering systems have now made this locality useless.

MOREE D,E

(3-4 Apr 1978) MJS

Setting up: The ADKIN variometer was installed in the airport terminal with the sensing head on the lawn towards the apron. It was a very convenient location and relatively undisturbed.

Azimuth Mark: Beacon on the silo to the north.

Observations: Observing conditions were pleasant and when the Adkin was returned to Canberra for repairs a new magnetic station E was created and the azimuths to various marks determined. The new station E was tied to the previous station D(1965) and the azimuths for D were checked against those of previous surveys.

Equipment: Unfortunately the Adkin refused to work and despite Geoff Thomas (BMR technical officer) being flown out by BMR aircraft, it was necessary to return the Adkin and the Toshin recorder (which had been giving problems) to Canberra for repairs. It was found that part of the Adkin power supply had failed and needed replacing. The Toshin recorder worked perfectly in Canberra and no faults were found. The Moxon power supply for the temperature probe also gave problems but was easily fixed.

Old Stations: The previous magnetic station was reoccupied but a search for the earlier 1912 station A showed that it was somewhere on the fence line of a primary school.

MT. ISA A

(6-9 June 1978) AME

Setting up: The equipment was set up in an anemometer hut 34 metres from the magnetic station (240v and phone), an ideal set up.

Azimuth Mark: Was the right hand top edge of right hand pressure tank to the south.

Equipment: Initial problems were experienced with pen tips clogging. The take up spool of the Hewlett Packard was unserviceable so the paper was left to hang.

MT. VERNON A

(18-20 October 1978) EPP

Setting up: The equipment was set up in the tent under a shady tree with the Honda generator.

Brian and Lorraine Reick run the cattle station. They are friendly and obliging folk. Mail and supplies come from Meekatharra and contact can be made through R.F.D.S. at Meekatharra (outpost radio).

Azimuth mark: The pre 1968 mark no longer exists as the wooden fence has been replaced by a metal one. The 1969 mark (357° 54.5') is a hill with no well defined features, and was not used. The cliff face of a hill NE of the station was taken as the mark.

Equipment: Considerable difficulty was experienced in tuning both PPMs when connected to the recording sensor. The problem was eventually cured by reterminating a co-axial connector on the head cable. (Crimped connectors are very difficult to repair in the field). X, Y, Z, and T were recorded on the Toshin recorder and F on the HP recorder until the gearbox of the latter failed at 1100 on 18 October. F instead of Z was then recorded on the Toshin recorder (from 1400 on 18Oct). On 19 October trouble was experienced with the T pen sticking, although this responded to a bit of a tickle.

NEALE JUNCTION A

(9-13 September 1978) EPP

Setting up: The equipment was set up in the tent under a shady tree. Honda power was used.

Azimuth mark: The centre of a star picket next to a bench mark 70 metres north east of the magnetic station was used. This had been used as a mark on previous surveys.

Observations: Cloudy conditions hampered sunshots and caused some delay.

Equipment: A total of 3 hours record was lost due to power problems. The X trace exhibited some instability (spikes) and the X and Y pens occasionally interfered with each other .

NEWCASTLE A

(23-28 Mar 1978) MJS

Setting up: A Bureau of Meteorology anemometer hut was again chosen to install the recording instruments. This hut is only 20 metres from the absolute station and was ideal.

Azimuth mark: Right hand edge of RAAF watertower.

Equipment: Unfortunately very heavy rain fell and the building leaked slightly, resulting in smudged records. The hut was also infested with ants which made things uncomfortable. Nevertheless, all the instrumentation worked well and even the heavy rainfall did not affect the orientation of the Adkin sensor head.

Observations: Observing conditions were miserable, but not impossible. The absolute station was under 20 cm of water and overnight the box containing the absolute instruments was submerged. Consequently the observing PPM suffered water damaged and was air freighted back to Canberra. Sun observations were made, when the weather cleared, as well as rounds of angles to windsocks and aerials around the airfield.

NORFOLK ISLAND B

(19-22 February 1979) GRS

Setting up: The equipment was set up in and power supplied by the Meteorological Bureau office at the airport.

Azimuth Mark: Revolving Beacon on Mt Pitt. A round of angles to previously used marks was made.

Equipment: Trouble was experienced with the recorder jamming. This was solved by removing the paper from the take-up spool and letting it hang down, weighted. The declinometer fibre was broken during the freighting of the equipment to the Island.

ONSLOW B

(9-11 Aug 1978) MWM

Setting up: The equipment was set up in the tent to the rear of the airport terminal. Electrical power from the terminal was used to run the equipment.

Azimuth Mark: Windsock pole.

Equipment: The new felt tipped pens on the recorder were a great improvement over the ink pens. The equipment gave no problems.

OODNADATTA B,C

(13-16 Dec 1978) MJS

Setting up: A disused building provided accommodation for the recording apparatus. Power was supplied from a nearby Department of Transport workshop.

Azimuth Mark:

a) Cairn on knoll of hill above the town.

b) Black line on water tower.

Equipment: In general everything went well except that the recording PPM tended to get very hot and become erratic. It was eventually taken out of the rack to allow more ventilation. This cooled it sufficiently to give reliable operation.

Observations: Sunshots were taken at the new station C(1973) near the terminal buildings as well as the older station B(1969) (on the eastern side of the airport).

Old Station: A search was made for the original CIW station A (1911) but it could not be found.

PARAFIELD A

(5-9 Dec 1978) MJS

Setting up: The recording system was set up in the recording tent, near the fire station which provided power via a long extension cord. The absolute station was a few hundred metres away and easily located.

Equipment: The Toshin recorded F, T and Y components, the Hewlett Packard Z. Everything worked well until the paper drive on the Toshin recorder stopped. Attempts were made to fix it without success. Finally it was taken to Austral Exploration Services. They not only repaired the chart drive but also fixed an intermittent fault in one of the channels.

Observations: Magnetic observations were hampered by the Toshin recorder failing and reasonably strong winds. Cloud prevented sunshots being taken. Nevertheless sufficient magnetic observations were made to provide control of the magnetograms.

PARAFIELD A

(9 Jan 1979) AME

Sunshots for leg 5 were completed.

Azimuth mark: Base (centre) of Uniroyal Tyre Chimney to North, silver with black top.

PORT HEDLAND D

(25 Jul-1 Aug 1978) MWM

Setting up: The equipment was set up in the tent to the rear of the Meteorological building at the airport. Mains power was supplied from the Meteorological building.

Azimuth mark: Base of lightstructure of the windsock behind shed.

Equipment: The only piece of equipment to give trouble was the declinometer which gave erratic readings. It was examined and pieces of fibre were found protruding from the clamp and were restricting the magnet's movement. A new fibre was put in on the 29th; readings improved.

PT LINCOLN C

(1-5 Dec 1978) BAG

Setting up: The recording tent was set up 35 m SE from Pt Lincoln Flying Club. Power came from the club room.

Observations: No sunshots were possible because of adverse weather conditions.

Equipment: The Adkin head cover blew off during the first set of absolutes. X, Y, F & T elements were recorded on the Toshin recorder whilst Z was recorded on the Hewlett Packard recorder. 7 hours of recording was lost on the Toshin recorder. Baseline changes occurred at 2300UT on 1 Dec when the Adkin head cover blew off and at 0035UT on 2 Dec when the Adkin level was adjusted.

PT LINCOLN C

(10 Jan 1979) AME

Sunshots for leg 5 were completed.

Azimuth mark: Top centre of left (furtherest) NDB tower.

PORTLAND B

(6-9 Mar 1978) MJS, GRS

Setting up: The recording instruments were installed in the local aeroclub clubhouse which has mains power and is only 100 m from the absolute station.

Azimuth mark: Chimney to the north.

Observations: Observing conditions were ideal. Sunshots were taken, and a round of angles was made to the secondary azimuth marks which were a windsock and a chimney to the south.

Equipment: Soon after setting up, it became apparent that the instrumentation was sensitive to electrical interference (in this case, a refrigeration thermostat). Problems were also experienced in trying to make the box containing the Adkin sensor head sufficiently stable. Nevertheless, quite good magnetic records were obtained over a three day period with only minor artificial disturbances due to passing cars.

Old Stations: An exact reoccupation of the 1912 Carnegie Institute of Washington (CIW) site A was made. This station is still magnetically quiet and suitable for magnetic observations. Many of the old azimuth marks still survive and were used. However, the reference measurements defining the station were out of date and a new set of measurements was made to existing landmarks.

QUILPIE A

(24-27 Apr 1978) MJS

Setting up: The airport terminal was used for recording at Quilpie and proved to be an excellent site.

Azimuth mark: Right hand edge of right hand fuel tank.

Observations: Observing went as normal. A set of intercomparisons with all 3 QHMs was made and the normal round of angles to various marks was made.

Equipment: Reasonably good records were obtained and although the recording PPM failed, the observing PPM took its place and full records were obtained.

RABBITS FLAT A

See The Granites

ROMA D

(14-21 Apr 1978) MJS

Setting up: The recording apparatus was set up in a large shed of the airport caretaker. It was well away from vehicular traffic and was a fairly good location.

Azimuth mark: Tower on a distant hill.

Observations: Magnetic observations and sunshots were taken as usual.

Equipment: Problems occurred with the Adkin power supply. A new power supply was sent from Canberra and replaced the Adkin's own internal power supply. This cured a number of other problems with the Adkin and made it more reliable.

Old Stations: There are two old stations in Roma. The 1912 CIW station A is near an artesian bore and was only approximately relocated. The other station C is at the airport and was easily found. Both of these stations were reoccupied with the compass theodolite being used to measure the declination at the 1912 station.

SOUTHERN CROSS B

(26 Set-2 Oct 1978) EPP

Setting up: The equipment was set up in the tent near the station with Honda power.

Azimuth mark: A faded white patch about 1 metre from the ground on the windsock post was touched up with white plastic paint and used as the mark.

Equipment: Some trouble was initially experienced stabilising the X trace. The declinometer played up and 2½ hours were spent hanging the weight. The honda generator ran out of fuel on 29 September and when restarted (with no load) the X and Y traces would not stabilise. The problem could not be solved and recording of only X, F & T recommenced at 0915 UT on 30 September. The power was off from 0540 on 01 October (due to the power plug vibrating out of the generator) until 0930 UT when the X trace was swapped for Y.

Bad instability on the Y trace occurred from 1400 until 0100 on 02 October.

1912 magnetic station A: A close reoccupation, probably to within 20 cm was made and H, D, and F was observed. The compass theodolite was found to be unserviceable so sun shots were done. The old reserve is now

owned by the pony club and the station position falls on a trotting track. The north and east fences of the old Wesleyan cemetery (barely recognisable) can still be discerned, although the jarrah fence posts have mostly fallen over. There is now a sewerage settling pond about 30 m west of the station. The water tank on the hill and Church of England church still exist; however the Commercial Hotel and the railway lines have vanished.

The old cemetery is just east of the caravan park along Great Eastern Highway on the northern side of the road. A display of headstones is set in concrete in a banked semi-circle and the cemetery lies behind this. The azimuth mark used for D was the belfry (apex) of a church between the Catholic and Anglican churches. A detailed station map was made.

TELFER A

(15-18 Aug 1978) MWM

Setting up: The equipment was set up in the tent near the windsock and electrical power supplied by the Honda generator.

Azimuth mark: a) Windsock Pole west of north;
b) 'Vee' in the hills to the south.

Equipment: The recorder jammed on the night of the 15th resulting in eight hours record loss necessitating staying an extra night. The Honda stopped for one and half hours on the 16th. The recorder jammed again on the 17th resulting in three hours record loss. The Declinometer fibre was broken on the 18th and a new fibre was put in.

TENNANT CREEK C

(20-22 June 1978) AME

Setting up: The equipment was set up in an old tin garage behind the D.O.T. workshop. 240v was obtained from the workshops.

Azimuth mark: A trig point on the hill to the ENE (not the cairn to the W of the point which is easier to see).

Equipment: No problems were experienced. All components were recorded on the Toshin with F and Y duplicated on the Moseley. However, the groundsman persisted in driving his vehicle around the workshop, affecting the records.

THE GRANITES C

(18-20 July 1978) MWM

Setting up: The equipment was set up in the tent close to the magnetic station with the Honda supplying power.

Azimuth mark: Trig point on granite outcrop.

Equipment: The Adkin was difficult to set up with the X component being very unstable. The paper continually jammed in the recorder necessitating constant checking. A night's record was lost on the 18th when the paper jammed. The equipment worked satisfactorily for the remainder of the occupation. The Honda generator stopped occasionally but was easily restarted.

Old Stations: The Rabbit Flat station A was re-occupied on the 20th and observations of D, H, & F were made.

TIBOOBURRA A

(5-6 Mar 1979) AME

Setting up: The equipment was set up in a shed at the main airport several miles out of town (Honda power). This was less than 100 metres from the magnetic station.

Azimuth mark: Right hand NDB tower.

Equipment: All components were recorded. Several brief periods of instability, with oscillation for 7 hours on the last night were experienced.

WARBURTON A

(27 Jul-1 Aug) 1979) EPP

Introduction: A first order magnetic field station was established at Warburton in conjunction with a maintenance visit to the BMR seismograph. The marker was sited in the apex formed by the two runways, about half a kilometre from the Warburton community buildings.

Setting up: The equipment was set up on the external rear verandah of the most easterly house, with the fluxgate head in the centre of the backyard. This was not entirely satisfactory as vehicles driving on a ring road running near the house caused interference. Fortunately, the road was able to be closed off for the duration of the occupation. In future it would be better to set up the magnetometer closer to the station marker and run off generator power.

Azimuth mark: The northern NDB tower to the NW of the station was taken as the mark.

Equipment: Considerable trouble was experienced with random offsets on the Y channel. The problem was traced to a dirty connection of the Y sensor plug on the back of the Adkin recorder. Two power failures caused minor record loss.

WARRACKNABEAL C

(10-14 Mar 1978) MJS, GRS

Setting up: The airport terminal was used to house the recording instruments and a thick concrete slab was used as a base for the Adkin sensor head. This block proved to be very stable when bedded firmly into the ground. It was subsequently used throughout the survey.

Azimuth mark: Centre of Apex on top of wheat silo.

Observations: Hot and windy conditions made observing difficult and resulted in the breakage of the upright poles and the fabric of the observing shelter. These conditions also made it difficult to see the azimuth mark through the dust and heat haze. Alternative azimuth marks closer to the magnetic station were chosen and a round of angles observed.

Equipment: Magnetic disturbances due to visiting cars were generally infrequent although of large amplitude.

Old Station A: A thorough search for the old station A (1945) at the racecourse proved fruitless. The race course has changed considerably in recent years and although the old station is probably magnetically undisturbed, it could not be located with any confidence. Any future attempts to find this station should use old parish plans in conjunction with the present-day ones.

WEIPA B

(29 Jun-2 Jul 1978) AME

Setting up: The equipment was set up in the tent near the windsock and light aircraft parking bay. 240v power was obtained from one of the spot light poles of the light aircraft parking bay. The magnetic station was opposite on the other side of the runway.

Azimuth mark: The light pole nearest to the windsock to the SSW.

Equipment: Initial instability problems were experienced with the Adkin. This was solved by checking all connections.

WILCANNIA D

(13-15 Mar 1979) AME

Setting up: The equipment was housed in the tent in the backyard of a block of government units in Wilcannia, with power coming from one of the units. The airport is a reasonable distance from Wilcannia but security of equipment left at the airport overnight was questionable.

Azimuth mark: Left hand edge of the green water tower in Wilcannia - the top is just visible over the scrub.

Observations: The round of angles included several unsatisfactory marks (doubts on their permanency). The Azimuth mark used in 1977 (flag pole) has been removed. No other problems were experienced

Equipment: The equipment operated without trouble and good records were obtained.

WINTON B

(6-12 May 1978) MJS

Setting up: As the Winton Show was in progress and future magnetic surveys may be done by aircraft, it was decided to install the recording instruments and establish another magnetic station at the airport. The terminal building provided a good recording location. It was large and a reasonable distance from the car park.

Azimuth Mark: Top centre of water Tower.

Observations: The declinometer fibre was broken whilst unclamping the instrument and resulted in lost observations whilst the new fibre was installed and hung. Sunshots were taken at both the new and old magnetic stations.

Equipment: After a severe electrical storm, problems were again experienced with the power supply to the Adkin and a new one was flown in from Canberra. An unexplained instability in the Adkin output developed around dawn and dusk giving a baseline step overnight. Fortunately observations had been made either side of these steps to show the baseline changes.

Old Station A: The magnetic station at Winton is located at the show-grounds and has been in existence since 1913. A reliable station difference was determined..

WOOMERA A1

(10-12 Dec 1978) MJS

Setting up: The equipment was housed in a disused building in the G range complex with power coming from another nearby building. The location was ideal for magnetic recording.

Azimuth Mark: Top left hand corner of brown steel box.

Observations: Observing went smoothly despite the wind. Several sets of sunshots were made and azimuths to various marks determined by rounds of angles.

Equipment: One of the channels of the Toshin recorder showed instability and the H.P. recorder jammed for a few hours one morning.

WYNDHAM C

(11-13 Jul 1978) MWM, GRS

Setting up: The equipment was set up in a tent to the side of the hangar at the airport with a long extension lead bringing power from the hangar.

Azimuth mark: Vertical edge of mountain cliff line to SW.

Equipment: At 0730 UT on 11 July the Adkin X channel started to oscillate. The oscillation was removed by switching the Adkin off and on several times.

Old Station A: An unsuccessfully attempt was made to find the 1914 magnetic station A opposite the Six Mile Hotel.

ZANTHUS A,B

(22-25 Sep 1978) EPP

Setting up: The equipment was set up in an outside disused "dunny" of a vacant fettler's hut near the rear (south) fence. The fluxgate head was positioned on the other side of the fence. Power was taken from the hut.

Azimuth mark: A water tank on a tower almost due north of the magnetic station and just visible over the trees was used. The western edge of the top of the tank was taken as the mark.

Equipment: An extra 25 mm of foam cladding was stuck onto the foam box insulating the fluxgate head. Small oscillations of the Y trace experienced at Laverton vanished but were replaced by some instability in the X trace.

Trains pulling in at the station caused baseline jumps. One minor paper jam occurred. Overcast conditions and rain on 24 & 25 September caused delays.

Zanthus A (1959

A reoccupation to within 50 cm was made. The runway had been widened and the 4 x 2 jarrah peg had gone. The telescope of the theodolite positioned on magnetic station B (1975) was used as the mark for declination. A yellow plastic peg was driven in to mark the position of the occupation, and a second yellow peg was placed 10 m north of this, as the former peg will probably be removed next time the airstrip is graded. An up to date station description was compiled.

Appendix 11

AZIMUTH MARKS

ALBANY C	Center of windsock	(EWS)	59°	26.6'
ALICE SPRINGS E	T.V. tower on hill to left of the Gap	(TVT)	334°	39.0'
ALPHA A	Corner of terminal with tank behind	(BLG)	22°	47.6'
AUGUSTA D	Base of windsock	(WSX)	48°	53.2
AYERS ROCK A	Gable of Rangers Cottage	(GRC)	27°	41.0'
AYERS ROCK B	Notch in east end of rock	(ERK)	172°	39.0'
BIRDSVILLE B1	Base of light structure of windsock	(WSK)	356°	30.4'
BOULIA C	Apex of gable on iron shed	(GIS)	82°	44.5'
BOURKE C	Right hand NDB tower	(NDB)	348°	12.7'
CARNARVON D	Red and white radio mast	(RMT)	137°	59.4'
CARNEGIE A	Westerly windmill	(WWN)	272°	41.6'
CEDUNA D	Base of terminal windsock light structure	(WSK)	306°	21.8'
CHRISTMAS I. B	Windsock pole	(NWK)	13°	00.9'
COCOS A, C	Old control tower mast	(WNW)	328°	05.6'
CONDOBOLIN B	Flag pole of judges box	(FGP)	308°	01.7'
CONDOBOLIN C	Top centre of closer silo.	(SLO)	253°	26.5'
COOKTOWN A	Light house of Grassy hill	(LHS)	15°	01.9'
COOKTOWN C	Centre base of windsock	(WSK)	335°	54.1'
CROYDON A	SE corner of hospital building	(SEH)	293°	30.8'
CROYDON B	Flue on terminal building septical tank	(FLU)	331°	16.4'
DALY WATERS B	Post to the left of water tank stand	(PST)	6°	08.1'
DARWIN E	Gutter down pipe on control tower	(GCT)	55°	09.3'
DERBY B	Far left hand tower (Top Centre)	(TOW)	17°	53.7'
EMU B	Tall stove pipe on nissan hut	(SPN)	208°	41.7'
ESPERANCE C	Closer of 2 towers to SE (Top Centre)	(NDB)	125°	03.0'
ETADUNNA A	Base of Lutheran Cross to SW	(LUX)	259°	18.3'
EUCLA C	Apex of hangar at Airport	(HNG)	174°	49.2'
FLINDERS I. B	Top dead centre of nipple on hill	(HSE)	139°	07.9'
GERALDTON C1	Windsock (Base of light structure)	(NNW)	324°	47.5'
GILES A	Trig point on hill	(NTP)	15°	24.7'
GOVE B	Centre of yellow top of beacon	(YTB)	333°	45.4'
GRAFTON A	A. Steel tower on hill	(TOW)	25°	08.5'
	B. Windsock	(SWK)	172°	30.0'
HALLS CREEK D	Top centre of anemometer tower on met. base in town	(MET)	317°	04.7'
HOBART F	Centre of control tower light pole	(CCT)	184°	10.2'
INGHAM A	Centre line of windbag	(WSK)	245°	43.2'
INGHAM B	Top left hand corner of water tower	(WTK)	33°	07.2'
KIDSON A	Remains of windsock	(WSX)	80°	37.6'
LAVERTON D	Left hand face of water tower scaffolding	(LWT)	236°	15.8'

LORD HOWE I. C	Remains of windsock pole on Rabbit Is.	(WRI)	184°	31.5'
MACKAY B	Water tower - centre top of gable roof	(WTW)	286°	21.6'
MARYBOROUGH C	Near windsock - base of light structure	(SWX)	48°	58.0'
MEEKATHARRA B	Light tower behind terminal building	(TLT)	311°	15.4'
MILDURA C	Left hand edge of tank on water tower	(LTK)	57°	39.3'
MOREE D	Beacon pole on north silo	(POS)	350°	11.3'
MOREE E	Beacon pole on north silo	(POS)	355°	58.6'
MT. ISA A	Right hand edge, right hand pressure tank	(TNK)	173°	08.5'
MT. VERNON A	Vertical cliff face	(VCF)	46°	28.0'
NEAR JUNCTION A	Star post (centre) to right of bench mark	(*MB)	57°	40.7'
NEWCASTLE A	Right hand edge of water tower	(RWT)	106°	24.7'
NORFOLK I. B	Revolving beacon on Mt. Pitt	(LIT)	351°	36.3'
ONSLOW B	Windsock, base of light structure	(WSK)	6°	35.6'
OODNADATTA B	Knoll on hill above town (Cairn)	(CRN)	355°	01.4'
OODNADATTA C	Line on water tower (Painted black)	(LWT)	6°	41.2'
PARAFIELD A	Base of Uniroyal Tyre Chimney (Silver with a black top)	(UTC)	357°	16.5'
PORT HEDLAND D	Base of light structure of windsock	(WSK)	218°	20.1'
PORTLAND A	Top of steeple of Roman Catholic Church	(RCS)	189°	55.2'
PORTLAND B	Centre of black and white chimney	(CHI)	358°	33.6'
PORT LINCOLN C	Top of left (furtherest) NDB tower	(NDB)	20°	09.6'
QUILPIE A	Right hand edge of righ hand fuel tank	(RTK)	95°	06.5'
ROMA D	Tower on hill (distant)	(TOW)	120°	34.6'
SOUTHERN CROSS A	Belfrey of Church between Catholic and Anglican Church	(BLF)	254°	26.4
SOUTHERN CROSS B	Windsock base	(WSK)	275°	35.8'
TELFER A	A. Windsock pole	(WSK)	343°	56.7'
	B. 'V' in hills	(VEE)	193°	28.2'
TENNANT CREEK C	Trig point on hill (not cairn to W)	(TPT)	12°	26.4'
THE GRANITES C	Trig point on granite outcrop	(TRG)	188°	39.0'
TIBOOBURRA A	Right hand NDB tower - top centre	(NDB)	7°	14.7'
WARRACKNABEAL C	Centre of Apex on wheat silo	(SIL)	347°	25.5'
WEIPA B	Light pole nearest windsock	(LPL)	205°	35.2'
WILCANNIA D	Left hand edge of green water tower in town (top just visible)	(WTW)	184°	37.6'
WINTON A	Rear of Grandstand	(RGD)	6°	02.6'
WINTON B	Top centre of water tower	(WTW)	240°	30.8'
WOOMERA A1	Top left hand corner of brown steel box	(LCB)	321°	47.6'
WYNDHAM C	Vertical edge of cliff	(CLF)	230°	52.6'
ZANTHUS A	Station B	(STB)	119°	47.2'
ZANTHUS B	West edge of water tank railing (top) visible above trees	(WWT)	1°	35.6'

Appendix 12

Report on Logistics

(D. Morrison)

The statistics used in this report were compiled for those sections of the survey in which I was directly involved, beginning with the fourth station, Condobolin.

Logistics

Travel

During the entire survey five vehicles were used at varying stages. The Landrover which left Canberra in early March was joined by the International 30 cwt lorry at Marble Bar in early August. In early September a Valiant (from Mundaring Observatory used for a changeover at Warburton Mission between geophysicists was written off in a major accident. The Landrover was sent to Perth in September for repairs, and the International continued until Adelaide. The Landrover, after repairs, was freighted by train to Cook, used for the Emu station and loaded onto a train at Watson for delivery to Adelaide. The International was put into store in Adelaide in early December and the Landrover continued, arriving in Canberra at the end of December. The BMR planes, the Aero Commander and Twin Otter, were used for small sections of the survey. The Aero Commander flew to Moree when equipment problems occurred. The Twin Otter flew the party to Gove, Weipa, Flinders Island, Hobart and Lord Howe Island, and to Parafield, Port Lincoln and Maree (Etadunna) in January. For the reoccupation of Etadunna a Nissan 4 x 4 utility was hired from Leigh Creek. The reoccupation was thwarted by excessive heat.

The second Landrover was used in April 1979 to complete those remaining outback stations in NSW, including Etadunna in SA. In view of the figures and particularly the fact that the majority of the distance travelled was on formed roads and tracks, the Landrover as an off-road vehicle was out of place for these sections. Where remote travel was involved the total remote track travel came to 6,221 km, 16.5% of total travel, the remote travel being from Halls Creek to The Granites return,

Marble Bar to Telfer return, Meekatharra to Laverton via Giles and from Cook to Watson via Emu.

The Landrover was generally unsuitable for touring with heavy payload. It was cramped and cumbersome and grossly overloaded. The gross laden weight of the Landrover was 3,300 kg, 620 kg over the maximum specified laden weight of 2680 kg. This led to high maintenance and repair cost and time allocation at the most critical stations - those in the most remote areas.

The International could handle the load of equipment and cruise comfortably at 100 km/hour on the open road. The low average travel time must be analysed considering that 5,592 km were travelled on remote tracks from Marble Bar to Telfer return, Meekatharra to Laverton via Giles and from Eucla to Yallata via Emu, 29.5% of total mileage.

However with extra fuel and water requirements on board even the International was carrying excess weight. The vehicle hadn't been fitted with the specified long range fuel tank or a water tank which meant more drum fuel and water took up valuable space and added to the size of the unstable load.

Generally the International proved more reliable mechanically; it was easier to drive and easier to work on. 9.64% hours of total travel time was required to keep the vehicle operational compared to 41% hours of total travel time for the Landrover.

Progress

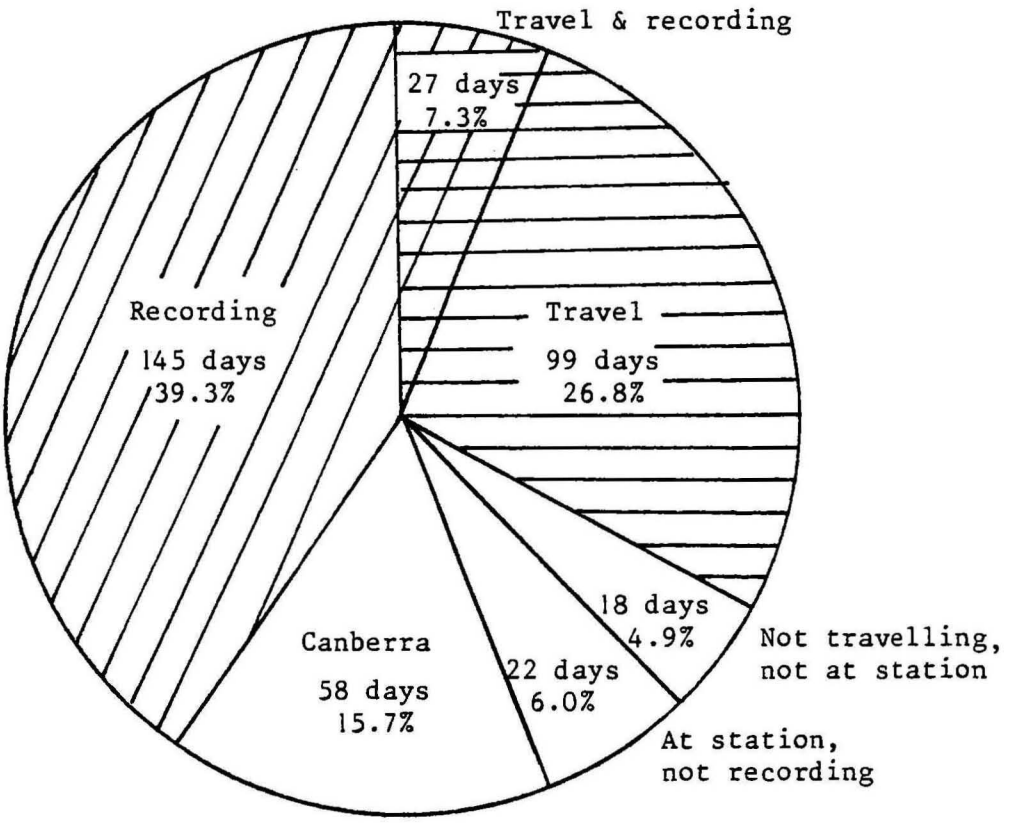
The survey spent 43 nights under canvas, occupied 4 stations totally uninhabited and very remote, 8 stations regarded as remote and the remainder ranging from outback town, through to regional city. It travelled a distance of 62 000 km by road vehicles and used 14 224 litres of fuel, see Table 1.

The survey encountered problems which added three months to the original date of completion. Such problems mainly revolved around the recording equipment, which on three occasions required shipment to Canberra for repair and on numerous other occasions required fixing in the field.

Weather also played a role in slowing things down with continuous rain and cloud along the southwest coast of Western Australia, dust storms at Laverton and Southern Cross, continuous high wind along the west coast and generally windy conditions at most stations and airport locations and extreme temperatures exceeding 40°C at Mt Vernon, Eucla, Emu, Woomera, Oodnadatta and Etudanna.

The vehicles were loaded and unloaded more than 60 times. Setting up and dismantling time was approximately 2 hours each way - a total of 240 hours, i.e., 30 eight-hour working days.

For the total of 369 days under consideration 99 days were spent travelling between stations, 145 days were spent recording at first order magnetic stations, 27 days included both travel and recording, 22 days were spent stationary at magnetic stations not recording, generally due to equipment problems. Eighteen days were spent stationary but not at magnetic stations, again due mainly to equipment problems. A total of 58 days were spent back at the office in Canberra. No days were lost because of vehicle problems.



Fuel

For the most part fuel was easily obtainable through normal outlets. Some outback garages however would not accept either contract petrol orders or field purchase orders because of previous problems recouping payments from either government departments or oil companies.

However, sections of the survey entered remote areas where fuel supplies couldn't be guaranteed. The route which began at Marble Bar, to Telfer, Swindles, Kidson, Carnegie, Giles and Laverton had guaranteed supplies at Marble Bar and Laverton which necessitated arrangements to be made for either fuel to be dumped or availability of fuel to be sounded out for the intermediate stations.

A breakdown in communication to the survey party and information relative to amounts of fuel dumped and its whereabouts brought about the situation of excess fuel. Five drums of super and one of standard were dumped at Carnegie station. Only 3 could be loaded, the rest remained. Had the survey been advised of the amount dumped it could have reduced the amount of fuel carried into Carnegie. Information regarding details of the second dump at Warburton Mission was also indecisive. It was a coincidence that both locations for the fuel dumps retailed petrol to the travelling public.

These pro b lems could have been avoided had better communication with the survey been maintained and sufficient advance enquiries been made to establish the status of fuel outlets.

Camping Equipment

Camping gear overall was sufficient; however a pre-survey set-up could have weeded out a few unnecessary items which were carried the entire distance unused.

Up until the 17th July 1978 all that was used from the camping equipment was the sleeping gear. On that date, 4½ months from the outset of the survey, we set up our first camp at The Granites. It was an unnecessary waste of space and added weight burden to carry the 2 large trunks involved for that time and never have opened them.

WE camped regularly from the 17th July until the end of September then not again for 2 months when we did 3 days in November at Emu. Late in December, early in January 1979 and again early in March 1979 we camped at Etudanna, each time only for a couple of nights.

Honda Generator

The Honda generator was included in the equipment as a back-up 240V source for those magnetic stations without power. It was also used as a power source for camping. Normally fuelled with standard, it ran consistently giving very little trouble. Whilst in Northern Territory and North West of West Australia standard fuel was unobtainable. The generator ran happily on super. Twice the head was removed and the carbon build-up scraped off. The brushes failed after 1000 hours of running. Other than normal maintenance, no further problems arose. One litre of fuel produced approximately 1 hour of power. See Table 2 for details. Total hours of running was comparable to that of total vehicle running times.

Communication

As a general rule contact was made with Canberra once a week (more often if problems arose) when information on the movements of the survey, the state of the equipment and personnel matters were exchanged.

For first order stations which directly involved the cooperation of other people in more than normal circumstances, personal contact prior to arrival would have been an advantage on more than one instance. Such stations as Gove, Weipa, Telfer, Mt Vernon, Carnegie, Zanthus, Emu, Woomera and Etudanna. Such contact not only shows courtesy but gives up-to-date information about fuel, accommodation, facilities, etc.

The example that stands out is the occupation of the Emu station. Official permission from the Weapons Research Establishment was gained, and we were to call at the Maralinga Commonwealth Police post on our way to Emu. We had arranged for the Landrover to be left at the Cook siding, and fuel, food and water for the expected duration of the trip were arranged. The Landrover was collected and both vehicles proceeded to Maralinga. On our arrival we were advised that we would have an escort vehicle and that

food, water and fuel for the trip had been provided. The Landrover, our food, water and fuel were all unnecessary. A phone call to the OIC at Maralinga a few days before could have saved the unloading and reloading of the Landrover and the time involved. The Landrover could have gone from Perth to Adelaide direct.

Possible Hazards

Apart from the human element of non-compatability which in itself is a dangerous situation, travelling in a single vehicle in remote areas showed up the need for two obvious precautions.

The following obvious shortcomings of the winch must be considered before any hazardous manoeuvre is considered, it will only work efficiently in a forward direction and when the anchor point is in front, in a situation where backing out is the best method, the winch cannot be used: if the motor won't run or the vehicle is on its side or roof, the winch cannot be operated.

There is a real need to carry a mechanical hand winch with pulley blocks and cable which will allow the recovery of the vehicle by one person, even if only to right the vehicle allowing access to the battery so as to make a call for assistance. There are numerous winches available on the market.

The other situation became obvious when we had a battery explode. In that situation the vehicle is immobile, not even cranking will produce enough current to run the motor. The radio instantly becomes useless. The battery doesn't have to explode to render the vehicle immobile!

The obvious solution is a second battery, either carried separately or built into the engine bay, that can be charged all the time yet isolated so as only one battery is used at any one time.

Appendix 12

Table 1

Vehicle Use

	Landrover (LWB) SZI-285	International (30 cwt) ZSU-431	Nissan (Hired)	Landrover (LWF) 094-702	Total
Dates	13/3-23/12/78	27/7-9/12/78	12/1-13/1/79	1/3-18/3/79	
Distance (km)	37,872	19,072	450	4,517	61,911
Fuel (litres)	7,782	5,577	-	840	14,199
(cost)	1,934	1,422	300	223	3,879
Driving - Traverse (hours)	555	300	-	68	923
- Station (hours)	90	37	-	4	131
- Total (hours)	645	337	-	72	1,054
- km/hour	59	57	-	64*	
- Economy (km/l)	4.9	3.4	-	5.4	
Other details					
Repairs (>1 hour to complete)	44	19	-	-	
General Services	8	3	-	-	
Flat tyres	5	5	-	-	
Hours to keep vehicle operational	265	33	-	-	

* The high average travel rate is because of the short distance and the good fast road surfaces which were encountered. The weight of equipment had been considerably reduced with all unnecessary gear remaining in Canberra.

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Appendix 12

Table 2

Honda Generator E800

Hours of running	1056
Fuel (litres)	1201
Oil (litres)	7
Total maintenance and running cost ($)	376
Running cost/minute (cents)	0.5
" /Kw hour (cents)	44
Workshop services	2

Table 1

Station Details

STATION		LATITUDE ° '	LONGITUDE ° '	LOCAL MERIDIAN TIME hr.min.
ALBANY	C	-34 56.7	117 48.3	0409
ALICE SPRINGS	E	-23 48.4	133 53.9	0304
ALPHA	A	-23 39.3	146 35.2	0214
AUGUSTA	D	-34 19.3	115 09.0	0420
AYERS ROCK	A	-25 20.6	131 02.0	
AYERS ROCK	B	-25 20.9	131 03.7	0316
BIRDSVILLE	B1	-25 54.6	139 21.1	0243
BOULIA	A	-22 54.7	139 56	
BOULIA	C	-22 54.8	139 53.5	0240
BOURKE	C	-30 03.1	145 57.1	0216
CARNARVON	A	-24 53.2	113 39	
CARNARVON	D	-24 52.9	113 39.9	0425
CARNEGIE	A	-25 48.2	122 56.7	0348
CEDUNA	C	-32 07.7	133 39.5	
CEDUNA	D	-32 07.8	133 42.8	0305
CHRISTMAS I.	B	-10 26.9	105 41.4	0457
COCOS I.	A	-12 11.9	96 50.1	
COCOS I.	C	-12 12.0	96 49.8	0533
CONDOBOLIN	B	-33 06.0	147 09.4	
CONDOBOLIN	C	-33 03.8	147 12.8	0211
COOKTOWN	A	-15 28.6	145 17	
COOKTOWN	C	-15 26.8	145 11.2	0219
CROYDON	A	-18 13.1	142 15	
CROYDON	B	-18 12.9	142 15.2	0231
DALY WATERS	B	-16 16.4	133 22.4	0307
DARWIN	E	-12 25.0	130 52.2	0316
DERBY	B	-17 22.2	123 39.8	0346
EMU	A	-28 38.9	132 13.2	
EMU	B	-28 37.8	132 11.9	0311
ESPERANCE	C	-33 41.1	121 49.3	0353
ETADUNNA	A	-28 43.1	138 38.0	0245
EUCLA	B	-31 43.0	128 53.0	
EUCLA	C	-31 40.9	128 52.8	0324
FLINDERS I.	B	-40 05.4	147 59.5	0208
GERALDTON	B	-28 47.1	114 37.7	
GERALDTON	C1	-28 47.8	114 42.2	0421
GILES	A	-25 02.1	128 18.0	0327
GOVE	A	-12 22.6	136 49.4	
GOVE	B	-12 22.6	136 44.4	0253
GRAFTON	A	-29 46.0	153 01.2	0148
HALLS CREEK	C	-18 14.7	127 40.3	
HALLS CREEK	D	-18 14.0	127 40.0	0329
HOBART	F	-42 49.7	147 30.2	0210
INGHAM	A	-18 39.5	146 09.0	0215
KIDSON	A	-22 41	125 05	0340
LAVERTON	D	-28 36.7	122 25.3	0350
LORD HOWE I.	C	-31 31.4	159 03.9	0124
MACKAY	B	-21 10.1	149 10.8	0203
MARYBOROUGH	C	-25 31.4	152 43.7	0149
MEEKATHARRA	B	-26 36.6	118 32.7	0406
MILDURA	C	-34 13.8	142 05.1	0232
MOREE	D	-29 29.9	149 51.1	0201
MOREE	E	-29 29.9	149 50.8	
MOUNT ISA	A	-20 40.0	139 29.4	0242
MT VERNON	A	-24 13.8	118 14.2	0407
NEALE JUNCTION	A	-28 17.3	125 49.0	0337
NEWCASTLE	A	-32 47.8	151 50.1	0153
NORFOLK I.	B	-29 02.1	167 56.2	0048
ONSLOW	B	-21 40.3	115 06.7	0420
OODNADATTA	B	-27 33.6	135 27.2	0258
OODNADATTA	C	-27 33.4	135 26.4	0258
PARAFIELD	A	-34 47.5	138 38.6	0245
PORT HEDLAND	D	-20 22.6	118 37.8	0405
PORTLAND	A	-38 20.4	141 36.3	
PORTLAND	B	-38 23.1	141 37.4	0234
PORT LINCOLN	C	-34 36.3	135 52.4	0257
QUILPIE	A	-26 36.5	144 15.2	0223
RABBIT FLAT	A	-20 12.3	130 01.0	0320
ROMA	A	-26 34.0	148 48	
ROMA	C	-26 33.7	148 46.7	0205
ROMA	D	-26 33.0	148 46.5	
SOUTHERN CROSS	A	-31 13.8	119 21	0403
SOUTHERN CROSS	B	-31 14.5	119 21.5	0403
TELFER	A	-21 42.3	122 13.7	0351
TENNANTS CK.	C	-19 37.6	134 11.0	0303
THE GRANITES	C	-20 33.6	130 21.3	0319
TIBOOBURRA	A	-29 26.9	142 03.2	0232
WARRACKNABEAL	C	-36 19.4	142 25.3	0230
WEIPA	B	-12 40.8	141 55.5	0232
WILCANNIA	D	-31 30.9	143 22.7	0226
WINTON	A	-22 23.9	143 03.5	
WINTON	B	-22 22.0	143 04.9	0228
WOOMERA	A1	-31 06.1	136 46.9	0253
WYNDHAM	C	-15 30.6	128 08.8	0327
ZANTHUS	A	-31 03.4	123 33.4	
ZANTHUS	B	-31 02.2	123 34.1	0346

Table 2

INSTRUMENT COMPARISONS

STATION	DATE	INSTRUMENT A	INSTRUMENT B	DIFFERENCE A-B nT	DIFFERENCE A-B nT/H x 10^5
		QUARTZ HORIZONTAL MAGNETOMETER			
Canberra	10-2-78	460	173	-31.6	-132
		461	173	-29.7	-124
		462	173	-32.0	-134
	13-2-78	460	290	-27.0	-113
		461	290	-30.7	-129
		462	290	-35.2	-147
	14-2-78	460	306	-11.9	- 50
		461	306	-12.8	- 54
		462	306	-12.8	- 54
	17-2-78	462	290	-31.5	-132
Newcastle	28-3-78	173	290	4.4	17
		173	306	24.8	97
		290	306	20.4	80
Grafton	31-3-78	173	290	1.5	5
Roma	20-4-78	173	290	6.5	22
Quilpie	26-4-78	173	290	6.6	23
		173	306	25.0	87
		290	306	18.4	64
Mt. Isa	7-6-78	173	290	1.7	5
Alice Springs	17-6-78	173	290	3.5	12
Port Hedland	31-7-78	173	290	7.4	24
		173	306	29.6	95
Gnangara	10-10-78	PVM B/116/B	173	-29.2	-124
		PVM B/116/B	290	-35.3	-150
	30-10-78	PVM B/116/B	293	- 7.3	- 31
		PVM B/116/B	306	-11.0	- 47
		306	293	2.3	10
Gnangara	30-5-79	173	293	31.1	133
	3-6-79	173	293	29.0	124
Canberra	25-7-79	460	306	-15.7	- 66
		461	306	-18.9	- 79
		462	306	-16.2	- 68
	22-1-80	460	173	-34.7	-146
		461	173	-35.4	-149
		462	173	-36.4	-153
		DECLINOMETER		MINUTE OF ARC	
Canberra	14-2-78	630812	509320	1.1'	
Gnangara	11-10-78	509320	509319	0.8'	
Canberra	22-1-80	640506	509320	1.0'	
		DECLINOMETER AND WILD COMPASS THEODOLITE			
Canberra	15-2-78	630812	Wild TO 104407 Correction		-36.2'
Port Hedland	31-7-78	509320	Wild TO 104407 Correction		-36.2'
Mt. Vernon	20-10-78	509320	Wild TO 104407 Correction		-37.6'
		PROTON PRECESSION MAGNETOMETER			
Gnangara	10-10-78	595/120	595/116	-2.5nT	
		816/1025	595/116	-1.9nT	
	11-10-78	595/120	595/116	-2.2nT	
		816/1025	595/116	-1.6nT	
Geraldton	26-10-78	595/131	595/120	4.8nT	
Gnangara	30-5-79	MNS2-1	595/144	1.6nT	
Canberra	22-1-80	595/120	595/116	-1.0nT	
		MNS2-2	595/120	0nT	
		MNS2-2	816/1024	-2.0nT	

Table 3 Values of magnetic elements

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
ALBANY C								
			QHM 293					
7 Nov 78	0033	3 24.6W	0047	21736	0013	60159		
	0110	3 25.3	0059	21736	0016	60146		
	0237	3 22.9	0249	21710	0223	60131		
	0309	3 21.8	0258	21711	0314	60112		
	0342	3 19.7	0352	21707	0332	60110		
	0412	3 18.1	0402	21710	0417	60095		
	0709	3 12.2	0722	21721	0657	60102		
	0744	3 13.1	0734	21722	0749	60100		
	0823	3 13.4	0833	21733	0815	60103		
	0851	3 14.1	0842	21734	0855	60105		
	0924	3 14.2	0933	21743	0919	60107		
	0959	3 14.3	0940	21742	1006	60110		
8 Nov 78	0354	3 17.5	0407	21725	0343	60100		
	0431	3 16.2	0418	21721	0436	60109		
	0720	3 13.5	0759	21729	0658	60117		
	0823	3 13.8	0811	21734	0828	60120		
9 Nov 78			0912	21679	0857	60130		4
			0922	21720	0929	60134		
			0936	21716	0952	60131		
			0945	21712				
10 Nov 78							4	
ALICE SPRINGS E								
			QHM 173					
16 Jun 78	0738	4 47.4E	0747	30092	0733	53749		
	0813	4 47.1	0808	30091	0819	53758		
17 Jun 78	0018	4 46.4	0026	30106	0019	53761	6	6
	0103	4 45.9	0052	30105	0107	53755		
	0517	4 48.5	0257	30104	0242	53758		
	0617	4 48.9	0525	30070	0505	53731		
	0659	4 48.5	0608	30069	0611	53731		
	0755	4 48.3	0720	30083	0644	53740		
			0745	30083	0749	53750		
18 Jun 78	0125	4 45.4	0133	30115	0110	53761		
	0221	4 44.4	0214	30117	0717	53740		
	0727	4 50.1	0735	30073	0811	53748		
	0807	4 49.4	0758	30079	-			
19 Jun 78	0118	4 43.6	0124	30102	0111	53756		
	0145	4 43.5	0140	30097	0148	53751		
	0238	4 44.9	0246	30094	0230	53748		
			QHM 290					
17 Jun 78			0709	30075				
ALPHA A								
13 May 78					0547	52513	4	4
					0716	52527		
			QHM 173					
14 May 78	0229	8 21.6E	0244	30548	0216	52513		
	0311	8 22.4	0256	30546	0319	52511		
	0542	8 25.6	0558	30540	0530	52515		
	0622	8 25.6	0609	30538	0629	52520		
	0648	8 24.9	0701	30545	0638	52521		
	0724	8 24.2	0711	30547	0734	52528		
	2244	8 20.7	2258	30590	2230	52550		
	2326	8 20.7	2311	30589	2332	52538		
15 May 78	0121	8 20.4	0137	30569	0108	52525		
	0201	8 20.6	0148	30569	0210	52523		
	0410	8 23.8	0422	30561	0358	52518		
	0442	8 24.8	0431	30559	0447	52520		
	0523	8 26.6	0534	30571	0513	52524		
	0553	8 26.8	0542	30572	0552	52533		
	0702	8 25.3	0713	30580	0651	52542		
	0730	8 24.3	0721	30581	0736	52543		
	2143	8 22.4	2158	30583	1308	52537		
	2225	8 21.5	2210	30584	2130	52547		
					2234	52549		

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
AUGUSTA D								
			QHM 293					
1 Nov 78	0921	4 12.1W	0936	21212	1025	60426		
	1005	4 16.9	0952	21205	1026	60425		
2 Nov 78	0719	4 10.7	0736	21222	0016	60448		
	0805	4 12.1	0752	21224	0840	60353		
3 Nov 78	0330	4 19.7	0443	21209	0055	60349		
	0510	4 12.0	0452	21214	0518	60364		
	0620	4 10.8	0632	21216	0608	60424		
	0738	4 10.9	0717	21223	0756	60407		
	0806	4 11.7	0818	21222	0906	60437		
	0903	4 13.8	0837	21227				
	0922	4 13.9	0930	21218				
4 Nov 78	0025	4 25.4	0035	21236	0018	60437		
	0109	4 26.0	0052	21233	0114	60441		
	0144	4 26.3	0152	21220	0136	60442		
	0221	4 24.9	0205	21224	0226	60445		
	0711	4 10.5	0723	21210	0701	60364		
	0755	4 11.4	0738	21216	0760	60367		
			0834	21232				
5 Nov 78	0205	4 24.4	0134	21237	0322	60366		
	0222	4 24.3	0235	21223				
AYERS ROCK B								
			QHM 173					
12 Jun 78	0701	4 20.3E	0709	28901	0736	54993		
	0731	4 19.8	0723	28904	0747	54992		
	0754	4 19.6	0802	28901	2344	54997		
	2352	4 18.0	2358	28912				
			0020	28910				
13 Jun 78	0027	4 17.5	0147	28907	0031	54998	3	4
	0139	4 15.8	0333	28899	0121	54995		
	0342	4 17.2			0346	54985		
	0625	4 20.0	0634	28905	0615	54975		
	0719	4 19.8	0712	28906	0722	54993		
	0800	4 19.8	0807	28910	0755	54993		
	2332	4 19.5	2340	28917	2335	55000		
14 Jun 78	0139	4 17.3	0147	28905	0151	54991	3	3
	0307	4 17.7	0315	28901	0301	54989		
	0343	4 18.5	0336	28901	0347	54988		
	0521	4 19.1	0527	28902	0449	54988		
	0559	4 19.8	0554	28901	0603	54990		
	0636	4 20.6	0643	28901	0631	54989		
					2357	55006		
15 Jun 78	0004	4 17.3	0012	28931	0031	55007		
	0028	4 18.3	0021	28931	0112	55003		
	0119	4 17.5	0125	28922	0145	54994		
	0141	4 17.3	0135	28917				
AYERS ROCK A								
13 Jun 78	0429	4 22.1	0437	28888	0419	54959		
	0450	4 22.3	0443	28885				
BIRDSVILLE B1								
			QHM 17					
28 Apr 78	0757	6 37.2E	0811	29114				
29 Apr 78	0004	6 32.9	0017	29130	0723	54583	2	2
	0045	6 31.2	0030	29136	0815	54582		
	0735	6 37.6	0759	29132	2325	54588		
	0812	6 37.5	0749	29141				
30 Apr 78	0615	6 40.2	0630	29114	0540	54571	4	4
	0657	6 38.4	0644	29112	0750	54577		
	0719	6 38.7	0740	29118				
1 May 78	0145	6 34.8	0158	29171	0125	54567		
	0221	6 36.4	0208	29124				

Value of magnetic elements

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
BOULIA C				QHM 173				
2 May 78	0728	6 43.2E	0749	30643	1300	52387	5	5
	0801	6 41.0	0741	30655	2338	52415		
3 May 78	0011	6 37.2	0025	30761	0021	52405		
	0043	6 35.3	0033	30763	0353	52391		
	0422	6 39.8	0439	30748	0517	52399		
	0502	6 43.6	0449	30757	0640	52402		
	0704	6 43.7	0717	30746	0754	52412		
	0738	6 42.7	0726	30741				
4 May 78	0037	6 40.2	0055	30710	0006	52399		
	0122	6 37.0	0107	30703	0155	52362		
	0223	6 40.4	0236	30682	0312	52356		
	0259	6 41.2	0247	30676	0440	52378		
	0503	6 41.9	0525	30659	2229	52428		
	0537	6 42.8	0514	30660	2348	52425		
	0727	6 42.6	0740	30632				
	0811	6 37.2	0757	30647				
	2334	6 35.8	2311	30778				
	2355	6 36.3	2321	30781				
BOULIA A								
4 May 78	0656	640.8 *						
BOURKE C				QHM 293				
2 Mar 79	2313	9 17.6E	0740	26796	0724	56377		
	2342	9 17.7	0747	26791	0750	56371		
			2322	26779	2303	56375		
			2335	26765	2346	56360		
3 Mar 79	0107	9 19.5	0114	26771	0057	56356	6	5
	0306	9 26.3	0313	26789	0259	56361		
	0428	9 30.0	0436	26792	0422	56357		
	0530	9 31.1	0537	26796	0542	56367		
4 Mar 79	0117	9 20.2	0125	26758	0110	56336		
	0145	9 21.5	0138	26755	0150	56334		
CARNARVON D				QHM 290				
22 Oct 78	0833	1 25.0	0847	27705	0817	54675		
	0917	1 27.1	0906	27706	0922	54698		
	0941	1 27.8	0954	27708	0931	54699		
	1019	1 27.8	1008	27707	1026	54693		
23 Oct 78	0905	1 25.8	0916	27719	0849	54692	6	6
	0943	1 26.5	0932	27711	0949	54696		
	1001	1 27.3	1011	17715	0955	54699		
	1027	1 27.8	1019	27713	1031	54701		
24 Oct 78	0316	1 33.6	0326	27732	0306	54694		
	0355	1 32.1	0346	27736	0400	54682		
	0630	1 24.8	0642	27736	0620	54675		
	0710	1 26.5	0658	27733	0714	54682		
	0735	1 26.7	0746	27733	0724	54684		
	0814	1 26.1			0817	54692		
CARNARVON A				QHM 173				
24 Oct 78	0906	1 25.3*	0931	27756	0915	54696		
CARNEGIE A				QHM 173				
21 Aug 78	0742	1 46.0E	0752	28094	0736	55332		3
	0812	1 44.7	0803	28092	0815	55344		
	0827	1 44.5	0836	28094	0822	55345		
	0852	1 44.0	0845	28095	0857	55351		
22 Aug 78	0058	1 41.0	0106	28112	0050	55369	3	3
	0126	1 40.8	0119	28110	0129	55365		
	0243	1 40.1	0252	28095	0207	55362		
	0309	1 39.4	0300	28094	0312	55357		
	0636	1 43.5	0643	28087	0628	55338		
	0702	1 43.9	0654	28087	0706	55341		
	0734	1 44.0	0741	28086	0727	55343		
	0802	1 44.1	0754	28086	0806	55347		
23 Aug 78	0023	1 40.9	0030	28108	0015	55369	6	3
	0056	1 40.9	0048	28105	0059	55368		
	0117	1 39.0	0155	28106	0141	55368		
	0147	1 39.5	0209	28107	0110	55366		
	0736	1 44.1	0744	28089	0730	55345		
	0805	1 44.3	0757	28092	0808	55348		
	0824	1 43.8	0833	28093	0818	55349		
	0852	1 42.9	0845	28095	0856	55355		
					2358	55369		
24 Aug 78	0006	1 42.3	0015	28116	0035	55371		
	0031	1 41.7	0024	28116				

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
CEDUNA D				QHM 293				
27 Nov 78	0806	5 01.7E	0818	24808	0750	58702		
	0832	4 59.7	0824	24806	0835	58707		
28 Nov 78	0250	5 03.7	0302	24802	0239	58663		
	0317	5 04.1	0309	24807	0322	58664		
	0556	5 06.3	0610	24819	0541	58694		
	0632	5 04.3	0621	24818	0636	58700		
29 Nov 78	0237	5 01.8	0253	24814	0732	58711		
	0315	5 03.6	0305	24818	0814	58711		
	0742	5 00.5	0752	24824				
	0810	5 00.1	0801	24825				
	2323	4 53.0	2336	24817				
			2350	24815				
30 Nov 78	0001	4 51.3	0206	24800	0137	58671		
	0155	4 57.3	0216	24800	0140	58672		
	0228	4 59.4	0429	24810	0230	58666		
	0420	5 06.4	0437	24808	0233	58667		
	0445	5 08.3			0410	58666		
CEDUNA C1					0457	58669		
30 Nov 78	0634	5 22.0*	0607	24983	0553	58650		
CHRISTMAS I. B				QHM 173				
8 Jun 79	1005	0 19.9W	1029	35012	0959	46008		
			1043	25007	1053	46009		
9 Jun 79	0201	0 23.2	0212	35059	0134	46040		3
	0241	0 21.2	0231	35055	0246	46047	1	2
	0309	0 21.8	0318	35062	0303	46048		
	0341	0 22.2	0332	35059	0345	46049		
	0703	0 20.8	0714	35049	0632	46028		
	0857	0 18.8	0849	35031	0901	46018		
	0927	0 18.0	1006	34999	0913	46014		
	1022	0 19.1	1015	34995	1026	45992		
10 Jun 79	0308	0 21.4	0317	35069	0255	46059		
	0334	0 21.2	0324	35062	0339	46043		
	0916	0 16.7	0925	34992	0904	45998		
	1009	0 18.9	1000	34994	1014	45994		
11 Jun 79	0245	0 20.2	0251	35065	0235	46048		
	0305	0 19.9	0257	35065	0532	46041		
	0353	0 19.8	0553	35051	0640	46027		
	0543	0 20.9	0601	35054				
	0629	0 19.9						
	0637	0 20.5						
COCOS I. C				QHM 173				
5 Jun 79	0410	3 35.3W	0438	33106	0349	46866		3
	0449	3 34.6	0528	33116	0452	46860		
	0519	3 34.2	0658	33103	0511	46861		
	0712	3 33.2	1015	33061	0718	46849		
	1005	3 30.6	1025	33060	0956	46834		
	1035	3 31.3			1039	46834		
6 Jun 79	0404	3 34.3	0415	33094	0311	46850		
	0439	3 34.3	0427	33096	0443	46857		
	0803	3 31.3	0811	33071	0749	46846		
	0826	3 31.6	0818	33075	0828	46844		
	1018	3 31.0	1025	33064	1007	46844		
	1043	3 31.8	1035	33062	1047	46843		
					2323	46839		
7 Jun 79	0005	3 31.7	0016	33076	0039	46842	6	
	0035	3 32.1	0025	33079				
COCOS I. A								
6 Jun 79	0641	3 31.1	0654	33085	0630	46852		
	0712	3 30.7	0702	33084	0717	46849		
	0852	3 28.4	0900	33071	0842	46845		
	0915	3 29.5	0908	33071	0918	46845		
7 Jun 79	0502	3 32.7	0628	33050	0452	46844		
	0522	3 32.2	0636	33049	0643	46830		
CONDOBOLIN C				QHM 290				
18 Mar 78	0537	10 03.9E	0555	25175	0517	57990	1	1
19 Mar 78	0529	10 02.2			0507	57987		
20 Mar 79	0231	10 03.1	0245	25164	0211	57976		
	0309	10 04.0	0255	25167	0317	57983		
	0540	10 04.5	0558	25176	0517	57990		
	0731	10 03.2	0612	25176	0523	57990		
	0628	10 04.1	0705	25171	0742	57994		
	0642	10 03.4	0718	25171	0746	57991		
	2353	9 55.5			2326	57986		
					2336	57984		
21 Mar 78	0035	9 57.1	0007	25162	0746	57990		
	0234	10 03.4	0020	25146	2356	57986		
	0804	10 03.0	0054	25135				
			0224	25152				

Value of magnetic elements

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
22 Mar 78	0042	9 59.4E	0055	25172	0023	57983		
	0112	10 00.6	0103	25173	0218	57980		
	0145	10 01.6	0154	25176				
	0212	10 02.5	0202	25178				
15 Mar 79							6	6
CONDOBOLIN B								
21 Mar 78	0519	10 06.3	0524	25130	0457	58047		
	0555	10 05.3	0543	25135	0606	58054		
COOKTOWN C				QHM 173				
29 May 78	0643	6 41.2E	0652	34304	0635	47242	3	
	0723	6 40.6	0714	34304	0734	47243		
	2152	6 40.5	0730	34307	2145	47266		
	2213	6 40.0	2158	34332	2216	47268		
			2206	34330				
30 May 78	0016	6 36.9	0026	34323	0008	47264		3
	0547	6 41.6	0555	34252	0538	47202		
	0735	6 40.3	0742	34243	0730	47198		
	2146	6 39.2	2154	34294	2137	47238		
	2208	6 39.1	2202	34286	2114	47240		
COOKTOWN A								
30 May 78	0230	6 42.7	0237	34245	0220	47165		
CROYDON B				QHM 173				
1 Jun 78	0703	6 22.8E	0711	33205	0657	49375	3	
	0726	6 22.2	0718	33206	0730	49381		
	2234	6 19.7	2241	33245	2224	49414		
	2302	6 20.0	2254	33250	2306	49410		
2 Jun 78	0009	6 18.5	0017	33244	0002	49409		3
	0311	6 22.0	0319	33234	0305	49401		
	0550	6 23.3	0558	33221	0456	49392		
	0626	6 23.3	0619	33218	0541	49387		
					0630	49388		
CROYDON A								
2 Jun 78	0158	6 18.8	0206	33244	0147	49392		
DALY WATERS B				QHM 173				
6 Jul	0535	4 26.2E	0546	34064	0418	48942	3	2
	0627	4 26.7	0555	34056	0632	48950		
	0720	4 25.1	0619	34063	0708	48950		
	0747	4 24.5	0731	34045	0751	48936		
	2325	4 24.3	0738	34045	2315	48974		
			2332	34096				
7 Jul 78								
	0010	4 22.4	0004	34097	0013	48979	3	3
	0116	4 19.5	0124	34087	0109	48967		
	0144	4 19.2	0136	34080	0148	48962		
	0424	4 21.0	0433	34089	0417	48952		
	0518	4 23.8	0510	34090	0524	48952		
	0641	4 24.0	0649	34075	0634	48949		
	0738	4 24.0	0729	34071	0746	48942		
					0710	48932		
8 Jul 78	0226	4 20.7	0233	34052	0142	48932		
	0658	4 25.8	0649	34051	0203	48931		
					2340	48956		
9 Jul 78			0007	34070	0037	48956		
			0016	34071				
DARWIN E				QHM 173				
23 Jun 78	0850	3 32.0E	0856	35215	0844	46235		
24 Jun 78	0114	3 29.9	0123	35220	0057	46250	3	3
	0145	3 28.8	0137	35213	0151	46237		
	0257	3 29.6	0306	35229	0250	46242		
	0425	3 30.4	0420	35240	0430	46244		
	0519	3 31.4	0528	35222	0510	46232		
	0745	3 31.9	0739	35199	0738	46219		
	0816	3 31.6	0808	35193				
25 Jun 78	0117	3 29.2	0125	35242	0630	46235		
	0212	3 29.2	0205	35248	2222	46270		
	0247	3 29.9	0257	35246	2257	46279		
	0442	3 31.2	0432	35249	2349	46282		
	0639	3 32.2	0647	35226				
	0732	3 32.1	0725	35219				
	2232	3 33.5	2241	35258				
	2255	3 33.1	2248	35255				
	2357	3 31.9						
26 Jun 78			0005	35256				
DERBY B				QHM 173				
24 Jul 78	0800	3 00.1E	0813	33132	0848	50068		3
	0832	3 02.9	0830	33137				
25 Jul 78	0131	3 00.1	0140	33148	0123	50078	3	3
	0200	3 04.3	0151	33143	0207	50077		
	0247	2 24.8	0258	33150	0239	50072		
	0317	2 25.3	0306	33146	0325	50063		
	0532	2 29.1	0542	33170	0520	50053		
	0559	2 31.3	0550	33170	0604	50061		
	0658	2 32.2	0714	33163	0650	50066		
	0722	2 28.8	0705	33163	0726	50070		
26 Jul 78	0145	2 26.9	0153	33152	0136	50084	3	
	0207	2 23.5	0200	33148	0111	50075		
EMU B				QHM 293				
22 Nov							3	4
23 Nov 78	0234	4 36.4E	0245	26815	0223	56529	3	
	0303	4 32.2	0252	26818	0306	56535		
	0414	4 40.7	0533	26811	0500	56545		
	0559	4 39.2	0544	26805	0604	56550		
	0745	4 38.6	0756	26817	0732	56557		
	0819	4 37.3	0808	26819	0823	56559		
	0835	4 37.3	0844	26808	0828	56558		
	0900	4 37.4	0853	26804	0906	56558		
	2305	4 31.2	2318	26806				
24 Nov 78	0025	4 28.8	0014	26810	0030	56537		3
	0051	4 28.3	0101	26807	0036	56534		
	0132	4 30.1	0121	26810	0039	56537		
	0303	4 34.2	0312	26829	0138	56531		
	0332	4 35.7	0324	26824	0243	56531		
	2326	4 33.3	2341	26795				
			2355	26799	2305	56532		
25 Nov 78	0007	4 32.8			0012	56519		
EMU A								
24 Nov 78	0932	4 34.6*	0954	26840	0959	56538		
ESPERANCE C				QHM 293				
11 Nov 78	0738	0 18.1W	0758	22818	0717	60026		
	0826	0 18.8	0812	22817	0830	60037		
	0841	0 18.2	0849	22815	0833	60037		
	0911	0 19.2	0901	22818	0915	60039		
12 Nov 78	0304	0 20.4	0320	22864	0242	60006		
	0345	0 19.1	0335	22863	0300	60011		
	0432	0 15.7	0445	22862	0424	60015		
	0507	0 13.8	0457	22856	0512	60030		
	0804	0 10.2	0823	22817	0748	60065		
	0843	0 13.8	0832	22801	0848	60054		
14 Nov 78	0303	0 22.3	0313	22768	0242	60019	3	4
	0332	0 20.6	0323	22796	0338	60014		
	0436	0 17.4	0447	22808	0418	60017		
	0507	0 16.7	0457	22811	0514	60030		
	0620	0 16.1	0644	22823	0517	60029		
	0705	0 15.8	0655	22824	0610	60041		
					0714	60054		
ETADUNNA A				QHM 293				
17 Dec 78	0701	6 56.2E	0716	27363	0700	56349		
	0746	6 55.6	0728	27358				
	0811	6 54.7	0824	27352	0752	56340		
	0847	6 52.8	0836	27357	0856	56342		
18 Dec 78	0828	6 51.8	0842	27363	0820	56347	4	4
	0902	6 52.0	0851	27366	0908	56343		
11 Jan 79	2238	6 44.2	2253	27373	2208	56343		
	2326	6 45.0	2314	27366	2332	56331		
9 Mar 79	0913	6 52.7	0756	27361	0745	56333		
	2239	6 46.4	2247	27345	2232	56333		
	2305	6 44.7	2257	27340	2312	56330		
10 Mar 79	0130	6 46.2	0138	27321	0121	56299		
	0207	6 49.5	0159	27312	0212	56285		
	0648	6 55.6	0655	27331	0640	56320		
	0725	6 53.8	0718	27328	0728	56320		
	0851	6 51.9	0859	27326	0841	56327		
	2215	6 50.1	2222	27301	2209	56308		
	2237	6 49.2	2230	27298	2241	56288		
EUCLA C				QHM 293				
16 Nov 78	0816	3 54.2E	0833	23889	0740	58539		
			0848	23881				
17 Nov 78	0316	3 55.4	0325	23882	0359	58511	3	3
	0648	3 59.5	0656	23900	0637	58526		
	0713	3 58.2	0705	23902	0716	58535		
	0742	3 57.0	0750	23903	0737	58538		
	0808	3 55.9	0759	23905	0812	58544		
	0830	3 55.5	0839	23898	0824	58545		
	0907	3 54.9	0859	23895	0911	58543		

Value of magnetic elements

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
KIDSON A			QHM 173					
26 Aug 78	0702	2 34.9E	0711	30405	0652	53467		3
	0728	2 34.5	0721	30404	0731	53471	3	
	0808	2 34.8	0816	30402	0801	53471		
	0835	2 35.2	0822	30407	0846	53476		
27 Aug 78	0139	2 32.2	0147	30427	0132	53484	3	3
	0202	2 31.9	0155	30426	0205	53483		
	0322	2 32.4	0328	30449	0315	53486		
	0342	2 33.3	0334	30446	0345	53482		
	0744	2 37.6	0750	30412	0625	53469		
	0802	2 37.4	0756	30411	0736	53465		
	0819	2 37.4	0825	30420	0805	53472		
	0837	2 37.8	0831	30418	0812	53473		
	2303	2 34.4	2312	30400	0842	53473		
	2334	2 34.7	2324	30391	2253	53488		
					2341	53485		
28 Aug 78							3	
LAVERTON D			QHM 290					
17 Sep 78	0404	1 39.8E	0419	26159	0347	56913	3	3
	0440	1 39.9	0430	26152	0445	56899		
	0758	1 43.9	0815	26120	0742	56919		
	0841	1 41.6	0827	26127	0846	56927		
	0906	1 42.2	0921	26137	0858	56929		
	0942	1 40.9	0931	26137	0946	56935		
18 Sep 78	0207	1 33.5	0219	26164	0200	56950	3	3
	0242	1 33.2	0230	26164	0247	56948		
	0401	1 36.3	0412	26158	0352	56927		
	0433	1 37.4	0422	26158	0439	56920		
	0838	1 40.4	0852	26149	0823	56931		
	0915	1 40.7	0903	26151	0920	56934		
19 Sep 78								3
20 Sep 78	0610	1 41.9	0647	26130	0551	56915		
	0620	1 42.5	0657	26139	0725	56921		
	0720	1 42.2	0708	26142	0859	56916		
	0815	1 40.2	0855	26139	0936	56923		
	0830	1 39.1	0905	26139				
	0928	1 39.1	0916	26141				
LORD HOWE I. C			QHM 173					
31 Jan 79	0620	15 07.3E	0606	27208	0600	55686		
	0724	15 05.8	0707	27201	0732	55686		
	2225	14 46.8	2245	27142	2200	55682		
1 Feb 79	0051	15 06.4	0032	27153	0100	55628		1
	0557	15 08.4	0616	27200	0542	55671		
	0722	15 05.8	0708	27196	0731	55690		
2 Feb 79	0017	15 00.8	0038	27170	0650	55677	4	4
	0724	15 05.3	0608	27194	2356	55640		
3 Feb 79	0203	15 09.5	0315	27185	0233	55631		
MACKAY B			QHM 173					
22 May 78	0657	8 41.9E	0705	31940	0643	50692		
	0718	8 40.8	0711	31940	0722	50702		
	2317	3 38.2	2326	31955	2311	50709		
	2343	8 38.1	2334	31955	2346	50702		
23 May 78	0130	8 38.5	0139	31940	0121	50690	3	3
	0322	8 40.0	0329	31915	0316	50670		
	0630	8 42.5	0638	31908	0623	50676		
	2113	8 42.6	2124	31980	2104	50722		
	2305	8 39.8	2313	31977	2258	50727		
MARYBOROUGH C			QHM 173					
18 May 78	0145	10 44.9E	0152	29832	0128	52817		
	0423	10 48.4	0429	29806	0415	52798		
19 May 78	0021	10 42.4	0028	29843	0011	52821	3	3
	0411	10 46.9	0421	29835	0355	52816		
	0633	10 47.0	0643	29835	0623	52843		
	2317	10 42.1	2310	29844	2300	52822		
20 May 78	0021	10 42.8	0028	29844	0013	52821		3
	0208	10 45.3	0215	29848	0201	52818		
	0513	10 49.0	0523	29842	0506	52830		
	0645	10 47.0	0652	29845	0635	52832		
	2241	10 43.8	2251	29853	2239	52832		
MEEKATHARRA B								
14 Oct 78			QHM 290					3
15 Oct 78	0357	1 01.8E	0412	26960	0345	56119	3	3
	0448	1 03.8	0436	26963	0455	56102	3	3
	0835	1 07.5	0850	26955	0929	56127		
	0923	1 06.3	0908	26951	0825	56120		
	0941	1 06.8	0951	26955	0934	56128		
	1012	1 05.9	1004	26948	1015	56128		
16 Oct 78	0256	0 57.7	0308	26944	0242	56107	3	
	0338	0 59.6	0328	26944	0343	56077		
	0359	1 01.4	0412	26940	0352	56075		
	0442	1 03.9	0430	26949	0447	56071		
	0638	1 08.4	0649	26967	0630	56092		
	0717	1 08.7	0707	26968	0722	56103		
	0937	1 06.7	0947	26950	0921	56119		
	1010	1 05.7	1002	26948	1015	56123		
17 Oct 78	0032	0 58.9	0043	26908	0022	56143		
	0110	0 58.1	0059	26970	0117	56143		
MILDURA C			QHM 290					
15 Mar 73	0521	8 51.6E	0536	24034	0458	59174	1	1
	0604	8 50.5	0551	24028	0609	59167	2	2
	0704	8 49.0	0721	24031	0651	59171		
	0746	8 47.9	0732	24035	0757	59176		
	2348	8 41.1			2325	59169		
16 Mar 78	0039	8 43.6	0008	24016	0050	59158		
	0539	8 50.4	0024	24011	0519	59162		
	0626	8 50.3	0556	24039	0736	59167		
			0611	24029				
17 Mar 78	0106	8 44.1	0120	24010	0049	59170		
	0146	8 44.3	0131	24011	0154	59165		
MOREE E								
4 Apr 78					0800	55758		
					2346	55726		
5 Apr 78					0023	55733		
					0133	55743		
					0720	55746		
6 Apr 78					0621	55757		
7 Apr 78							4	4
8 Apr 78	0722	10 23.4E			0705	55764	2	2
			QHM 290					
10 Apr 78	0639	10 24.2	0654	27301	0622	55765		
	0721	10 23.6	0000	27303	0732	55764		
	2351	10 18.5			2335	55731		
11 Apr 78	0033	10 25.7	0008	27268	0040	55741		
	0542	10 30.1	0019	27258	0527	55748		
	0624	10 31.3	0558	27225	0632	55745		
			0610	27233				
12 Apr 78	0028	10 20.0	0043	27213	0012	55724		
	0211	10 24.4	0056	27205	0221	55735		
MOREE D								
11 Apr 78	0708	10 27.9	0725	27264	0648	55713		
	0746	10 23.6	0734	27270	0751	55711		
MT. ISA A			QHM 173					
6 Jun 78	2318	5 52.8E	2325	32000	2310	51188		
	2345	5 53.0	2337	32000	2348	51184		
7 Jun 78	0128	5 51.7	0136	32005	0118	51180		
	0204	5 52.2	0509	31985	0541	51158		
	0460	5 53.2	0530	31977	0450	51169		
	0537	5 53.9	0637	31968	0655	51166		
	0630	5 53.9	0645	31973	0621	51153		
	0652	5 54.6	2254	32030	2317	51183		
	2247	5 58.9	2306	31998				
	2313	5 52.2						
8 Jun 78	0111	5 50.7	0120	32007	0229	51168	1	3
	0222	5 50.6	0215	31993	0103	51182		
	0507	5 53.2	0515	31965	0600	51161		
	0557	5 54.2	0550	31969	0458	51154		
	0647	5 54.1	0754	31983	0638	51167		
	2343	5 49.6	2349	31996	2330	51179		
			2360	31995				
9 Jun 78	0006	5 50.2	0055	31996	0008	51175	3	
	0048	5 50.2			0042	51173		
			QHM 290					
7 Jun 78			0148	31998				

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	PM
PORTLAND A								
8 Mar 78	0227	9 16.5	0241	21056	0206	61354		
	0301	9 18.0	0248	21056	0312	61362		
PORTLAND B				QHM 290				
6 Mar 78	0634	8 56.3E	0702	21261	0344	61364		
	0741	8 54.3	0716	21263	0756	61376		
	2319	8 47.1	0002	21229	2251	61378		
7 Mar 78	0029	8 48.2	0016	21225	0035	61366	1	1
	0529	8 58.7	0551	21265	0513	61360		
	0636	8 57.5	0618	21277	0642	61376		
	2256	8 45.2	2317	21243	2238	61375		
	2350	8 46.3	2333	21238	2358	61373		
8 Mar 78	0548	8 57.8	0608	21265	0325	61357	1	1
	0631	8 56.8	0619	21266	0639	61370		
	2317	8 45.8	2334	21195	2258	61369		
9 Mar 78	0008	8 47.4	2349	21193	0020	61355		
PORT LINCOLN C				QHM 293				
1 Dec 78	2302	5 03.2	2317	23373	2242	60346		
	2348	5 02.8	2337	23369	2352	60330		
2 Dec 78	0353	5 17.4	0405	23382	0343	60308		
	0446	5 18.2	0434	23392	0515	60326		
3 Dec 78	0704	5 15.7	0713	23400	0646	60344		
	0731	5 14.6	0722	23405	0736	60352		
	0758	5 13.2	0807	23403	0751	60355		
	0823	5 12.3	0814	23405	0826	60357		
4 Dec 78	0039	5 05.5	0051	23416	0012	60333		
	0111	5 06.5	0102	23415	0122	60323		
	0522	5 16.6	0531	23406	0512	60329		
	0547	5 15.9	0539	23413	0550	60335		
	0628	5 14.6	0636	23416	0618	60339		
	0655	5 15.3	0647	23419	0659	60337		
	2312	5 01.1	2325	23392	2256	60360		
	2345	5 02.5	2334	23390	2349	60340		
10 Jan 79							6	6
QUILPIE A				QHM 173				
24 Apr 78	0711	8 01.8E	0729	28836			4	4
	0756	8 00.2	0742	28440				
25 Apr 78	0202	7 58.7	0317	28835	0741	54549		
	0345	8 00.3	0330	28842				
	0624	8 02.9	0642	28849				
	0710	8 01.4	0654	28852				
	2353	7 54.9			2323	54556		
26 Apr 78	0033	7 55.6	0010	28868	0052	54548		
	0441	8 03.2	0021	28808	0408	54537		
27 Apr 78	0707	8 00.6	0455	28854	0731	54544		
	2249	7 56.9	0505	28851				
	2338	7 55.6	0638	28829	2200	54558		
			0652	28829	2356	54556		
			2305	28870				
			2321	28866				
			QHM 290					
			0524	28838				
			0536	28838				
			QHM 306					
			0604	28837				
			0615	28834				
ROMA D								
13 Apr 78					0819	54008		
14 Apr 78					0405	53965	2	2
					0707	53995		
					2311	53997		
15 Apr 78					0435	53995	4	4
					0729	53998		
17 Apr 78					0627	54008		
				QHM 290				
18 Apr 78	0754	9 17.1E	0809	29225	0840	54012		
	0834	9 16.7	0820	29224				
19 Apr 78	0611	9 18.7	0625	29204	0557	54014		
	0651	9 19.2	0636	29200	0659	54006		
	2335	9 11.3	2311	29243	2239	54012		
	2255	9 12.0	2321	29244	2344	53999		
20 Apr 78					0235	53988		
	0253	9 16.6	0308	29201	0353	54001		
	0342	9 16.9	0323	29205	0619	54012		
	0635	9 17.2	0653	29213	0721	54008		
	2163	9 13.9	0731	29213				
	2337	9 12.3	2202	29225				
			2216	29231				
			2309	29236				
			2321	29232				
			QHM 173					
			0713	29224				
			2237	29236				
			2251	29239				
21 Apr 78					0042	54017		
ROMA A								
20 Apr 78	05C3	9 09.2*			0428	54077		
					0512	54053		
ROMA C				QHM 290				
20 Apr 78	0041	9 15.0	0058	29192	0020	53995		
	0127	9 15.0	0109	29186	0135	53989		
SOUTHERN CROSS B								3
26 Sep 78				QHM 290				
27 Sep 78	0303	0 32.2W	0315	24389	0248	58500		3
	0338	0 30.3	0325	24391	0343	58491		
	0403	0 28.4	0413	24370	0353	58488		
	0435	0 26.9	0424	24360	0441	58478		
	0805	0 24.9	0817	24358	0723	58497		
	0844	0 24.9	0830	24362	0849	58508		
	0901	0 24.2	0912	24357	0853	58505		
	0936	0 27.1	0924	24360	0943	58513		
28 Sep 78	0760	0 24.4	0816	24347	0748	58505	3	
	0839	0 24.2	0828	24347	0843	58507		
	0856	0 24.0	0907	24316	0848	58508		
	0930	0 27.2	0918	24331	0940	58525		
29 Sep 78	0226	0 30.9	0237	24367	0212	58498	3	
	0257	0 30.8	0247	24368	0250	58485		
	0329	0 28.8	0312	24365	0304	58499		
					0315	58499		
	0401	0 28.5	0327	24374	0335	58477		
30 Sep 78			0339	24360				
			0349	24342				
			0957	24332	0931	58510		
			0944	24335	1006	58510		
1 Oct 78			0052	24359	0039	58520		
			0104	24362	0112	58512		
2 Oct 78	0351	0 31.9			0337	58492		
	0401	0 31.2			0415	58486		
	0408	0 30.4						
SOUTHERN CROSS A								
29 Sep 78			0158	24127	0140	58368		
			0209	24124				
			0220	24126	0230	58355		
2 Oct 78	0506	1 04.9W			0455	58343	2	
	0515	1 04.5			0526	58340		
	0522	1 04.0						
TELFER A				QHM 173				
15 Aug 78	0213	1 34.8E	0223	30634	0200	52734		
	0248	1 35.3	0238	30631	0254	52733		
	0322	1 35.5	0332	30631	0307	52731		
	0358	1 35.3	0348	30628	0352	52725		
	0608	1 39.5	0616	30614	0600	52710		
	0634	1 39.3	0621	30615	0638	52707		
	0717	1 40.4	0724	30608	0710	52706		
	0745	1 40.6	0736	30609	0749	52705		
					2352	52742		
16 Aug 78	0004	1 37.9	0013	30650	0036	52744	3	
	0032	1 37.1	0023	30650	0157	52741		
	0207	1 34.9	0215	30652	0245	52740		
	0241	1 35.4	0230	30658	0534	52725		
	0540	1 37.8	0558	30641	0620	52718		
	0617	1 38.3	0609	30640	0725	52714		
	0730	1 39.5	0737	30624	0823	52715		
	0757	1 39.3	0751	30622				
17 Aug 78	0122	1 34.3	0130	30636	0109	52736	3	6
	0245	1 36.1	0239	30633	0248	52723		
			2348	30638	2333	52732		
18 Aug 78			0001	30640	0006	52738		

Value of magnetic elements

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
18 Nov 78	0843	3 55.5	0852	23890	0830	58535		
	0907	3 55.8	0859	23891	0910	58537		
19 Nov 78	0258	3 54.7	0324	23898	0244	58514	3	3
	0349	3 57.5	0336	23901	0355	58514		
	0627	4 00.1	0644	23918	0715	58531		
	0708	3 58.8	0657	23912	0724	58532		
20 Nov 78	0233	3 54.4	0236	23904	0205	58524		
	0256	3 56.1	0245	23904	0300	58518		
EUCLA B								
18 Nov 78	0852	4 06.9*	0557	24587	0613	58368		
			0606	24698				
FLINDERS I. B								
			QHM 293					
18 Jan 79	0607	13 06.7E	0632	20620	0551	61388	3	1
	0658	13 07.3	0647	20619	0705	61387		
	2242	12 49.2	2305	20613	2222	61368		
19 Jan 79	0114	12 54.2	0059	20588	0123	61367	3	6
	0347	13 06.0	0402	20626	0412	61397		
	0532	13 08.4	0548	20629	0616	61395		
20 Jan 79	0002	12 56.8	0019	20585	0000	61362		
	0438	13 07.0	0420	20628	0445	61388		
	0633	13 04.5	0620	20630	0640	61387		
	2347	13 02.1			2330	61354		
21 Jan 79	0041	13 00.8	0003	20587	0049	61358		
			0024	20591				
GERALDTON C1			QHM 306					
26 Oct 78	0930	2 11.8W	0940	25356	0916	56913		
	1008	2 14.0	0952	25358	1015	56922		
	1022	2 13.4	1031	25363	1016	56919		
27 Oct 78	0851	2 10.2	0904	25269	0402	56876	6	6
	0941	2 14.4	0926	25274	0939	56915		
	1000	2 13.0	1020	25266	0945	56939		
	1047	2 14.8			0950	56943		
					1052	50922		
28 Oct 78	0413	2 19.1	0435	25318	0350	56885		
	0517	2 17.2	0502	25312	0520	56870		
	0648	2 12.0	0701	25314	0638	56875		
	0722	2 12.6	0914	25322	0727	56894		
	0813	2 11.8	1032	25332	0757	56901		
			1038	25332				
29 Oct 78	0129	2 19.4	0146	25347	0111	56936		
	0213	2 20.9	0201	25346	0219	56925		
	0246	2 21.3	0258	25342	0239	56919		
	0321	2 19.9	0310	25342	0327	56898		
GERALDTON B								
28 Oct 78	0914	2 9.8*	0943	38057	0934	56853		
GILES A			QHM 173					
2 Sep 78	0652	3 26.3E	0728	28774	0620	54703	3	3
	0754	3 24.3	0743	28792	0806	54718		
	0832	3 25.0	0846	28812	0817	54722		
	0911	3 23.9	0858	28817	0916	54725		
3 Sep 78	0228	3 19.4	0244	28812	0204	54709		
	0304	3 21.5	0252	28813	0310	54702		
	0449	3 27.3	0460	28821	0428	54696		
	0519	3 27.5	0508	28821	0524	54697		
	0708	3 27.5	0719	28810	0654	54707		
	0742	3 27.1	0730	28810	0744	54712		
	2342	3 19.5	2354	28834	2327	54740		
4 Sep 78	0016	3 17.6	0004	28833	0021	54733		
GOVE B								
			QHM 173					
26 Jun 78	0756	4 42.2E	0804	35189	0747	45870		
	0820	4 43.2	0814	35191	0822	45887		
					2351	45932		
27 Jun 78	0001	4 41.9	0009	35242	0027	45939	3	3
	0024	4 42.5	0017	35239	0132	45937		
	0141	4 42.5	0147	35244	0506	45917		
	0516	4 44.0	0523	35245				
	0548	4 45.4	0542	35241	0551	45923		
	0724	4 45.0	0731	35213	0718	45901		
	2350	4 42.7	2358	35270	2340	45965		
28 Jun 78	0042	4 42.0	0034	35271	0045	45961		
	0209	4 42.3	0218	35284	0203	45966		
	0446	4 43.0	0439	35283	0449	45950		
	0616	4 44.1	0623	35267	0610	45946		
	0741	4 44.8	0734	35262	0745	45945		
	2311	4 45.3	2317	35268	2304	45960		
	2331	4 45.4	2325	35278	2334	45962		
29 Jun 78	0022	4 45.1	0023	35288	0017	45969		
GOVE A								
27 Jun 78	0339	5 47.7*	0354	35681	0258	46207		
			0358	35677	0402	46214		
GRAFTON A			QHM 290					
30 Mar 78	0602	11 20.5E	0618	27504	2311	55243	3	3
	0645	11 20.0	0629	27499				
	2332	11 16.0	2349	27492				
31 Mar 78	0020	11 17.2	0003	27493	0031	55251		
	0111	11 19.2	0122	27515	0055	55254		
	0303	11 23.5	0137	27520	0313	55277		
	0719	11 20.0	0205	27522	0701	55273		
			0220	27523				
1 Apr 78	0049	11 21.2	0222	27492	0139	55257		
	0201	11 19.2	0233	27493	0301	55268		
HALLS CREEK D								
			QHM 173					
14 Jul 78	0458	3 06.8E	0506	32650	0450	50423		3
	0525	3 08.0	0517	32657	0528	50407		
	0628	3 07.2	0636	32642	0718	50400		
	0653	3 07.9	0644	32646	0653	50396		
15 Jul 78	0035	3 04.5	0044	32645	0023	50414	3	3
	0115	3 03.6	0108	32645	0118	50408		
	0226	3 03.0	0236	32639	0218	50396		
	0300	3 03.1	0250	32650	0306	50400		
	0546	3 06.6	0555	32667	0540	50413		
	0617	3 07.8	0610	32666	0620	50405		
	0653	3 08.1	0701	32651	0650	50402		
	0725	3 08.4	0717	32642	0729	50392		
16 Jul 78								3
HALLS CK C								
16 Jul 78			0251	32982				
	0319	1 38.8*	0257	32984				
HOBART F			QHM 306					
22 Jan 79	0148	13 56.0E	0211	18726	0122	62831	6	6
	0412	14 03.3	0356	18738	0419	62830		
			0707	18773				
23 Jan 79	0125	13 53.8	0105	18709	0132	62794		
	0313	14 05.4	0255	18718	0321	62823		
	0625	14 07.3	0609	18760	0630	62819		
	0646	14 02.1	0707	18768	0634	62822		
	0725	14 04.7			0731	62829		
24 Jan 79	0024	14 00.0	0006	18646	0039	62767		
	0214	14 03.2	0158	18678	0220	62795		
	0348	14 04.9	0526	18778	0554	62823		
	0657	14 02.5	0640	18761	0708	62816		
	2205	13 49.3	2201	18741	2152	62818		
INGHAM B								
			QHM 173					
26 May 78	0615	7 26.1E	0623	32910	0606	49367		3
	0639	7 26.3	0631	32913	0643	49373		
	2249	7 22.8	2259	32935	2240	49395		
	2310	7 22.0	2308	32934	2321	49397		
27 May 78	2304	7 21.6	0107	32929	0047	49389	3	
	2326	7 21.6	0333	32921	0320	49378		
	0056	7 21.1	0534	32919	0515	49373		
	0328	7 24.2	0709	32916	0655	49374		
	0525	7 25.5	2312	32950	2256	49402		
	0703	7 24.7	2320	32947	2331	49397		
INGHAM A								
27 May 78	0452	7 30.1	0500	32931	0444	49172		

Value of magnetic elements

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
MT. VERNON A				QHM 290				
18 Oct 78	0717	0 29.4E	0732	28631	0735	54262		
	0818	0 28.6	0807	28632	0823	54277		
	0926	0 27.0	0937	28627	0916	54288		
	1010	0 27.8	1000	28616	1014	54284		
19 Oct 78	0346	0 22.1	0356	28620	0310	54282	6	6
	0856	0 23.6	0806	28621	0944	54294		
	0932	0 24.6	0923	28624	0847	54286		
	0951	0 24.1	1003	28630	0938	54283		
	1016	0 24.6	1008	28628	1019	54347		
20 Oct 78	0326	0 20.5	0337	28639	0304	54287		
	0402	0 21.3	0352	28646	0406	54282		
	0634	0 27.8	0645	28662	0715	54280		
	0711	0 27.4	0660	28662	0824	54292		
	0814	0 26.9			0809	54292		
	0821	0 27.2			0851	54299		
	0856	0 25.4			0907	54297		
	0904	0 25.9						
NEALE JUNCTION A				QHM 290				
10 Sep 78	0345	2 03.6E	0358	26742	0317	56605	3	1
	0420	2 04.5	0408	26742	0427	56603		
	0651	2 06.3	0702	26736	0634	56607		
	0728	2 07.4	0715	26735	0732	56611		
	0858	2 07.2	0907	26739	0835	56617		
	0924	2 07.5	0913	26736	0929	56613		
11 Sep 78	0228	2 04.3	0239	26748	0207	56615	3	3
	0260	2 04.1	0249	26747	0304	56613		
	0350	2 05.5	0403	26750	0339	56609		
	0429	2 06.1	0412	26748	0434	56601		
	0710	2 09.8	0723	26738	0655	56610		
	0745	2 09.1	0734	26737	0749	56613		
	0810	2 09.3	0823	26741	0800	56614		
	0852	2 07.6	0836	26739	0903	56622		
12 Sep 78	0234	2 03.3	0246	26736	0217	56606	3	3
	0313	2 05.0	0301	26735	0317	56604		
NEWCASTLE A				QHM 290				
23 Mar 78	0704	11 53.9	0718	25640	0639	57415		
24 Mar 78	0652	11 53.2	0707	25646				
			0718	25644				
25 Mar 78	0714	11 54.2	0729	25656				
	2346	11 46.8	0741	25657				
26 Mar 78	0009	11 48.0	0747	25628			3	3
	0733	11 52.6	0800	25630				
27 Mar 78	0529	11 55.7	0545	25563	0408	57395		
	0614	11 56.1	0558	25578	0510	57392		
	0651	11 54.6	0705	25557	0624	57404		
	0729	11 54.9	0715	25558	0739	57400		
28 Mar 78	0122	11 51.3	0138	25597	0036	57392		
	0324	11 54.2	0150	25602	0333	57403		
			0302	25586				
			0312	25588				
				QHM 173				
			0210	25599				
			0221	25600				
				QHM 306				
			0245	25588				
NORFOLK I. B				QHM 293				
19 Feb 79					2332	52352		
20 Feb 79	0646	15 04.7E	0251	28876	0304	52344	1	
	2231	14 58.3	0604	28895	0625	52362		
			2300	28885	2213	52362		
21 Feb 79	0556	15 11.4	0538	28908	0606	52350	2	3
	0717	15 05.6	0659	28865	0728	52347		
	2032	14 58.9	2052	28841	2017	52344		
22 Feb 79	0525	15 09.4	0606	28829	0621	52335		1
ONSLOW B				QHM 173				
9 Aug 78	0909	0 03.4E	0924	29792	0954	52978		3
	0944	0 03.5	0933	29793				
10 Aug 78	0105	0 01.4	0113	29812	0054	53003	3	3
	0132	0 01.0	0121	29813	0125	53003		
	0226	0 00.0	0244	29813	0304	53000		
	0300	0 00.5W	0252	29815	0227	53007		
	0559	0 01.6	0608	29810	0630	52960		
	0626	0 02.5	0616	29808	0706	52958		
	0717	0 03.6	0736	29813	0808	52963		
	0744	0 04.4	0726	29813				
11 Aug 78	0056	0 01.0	0105	29817	0047	53005	3	
	0120	0 00.5W	0112	29819	0125	53002		
OODNADATTA B				QHM 293				
13 Dec 78	0744	5 26.7E	0757	28032	0733	56103		
	0821	5 25.9	0809	28023	0828	56093		
	2258	5 15.1	2311	28017	2245	56095		
	2335	5 18.7	2324	28021	2342	56089		
14 Dec 78	0637	5 35.3	0654	27993	0630	56123	4	4
	0720	5 29.8	0705	27959	0725	56067		
	2346	5 18.9	2359	28000	2335	56089		
15 Dec 78	0019	5 17.3	0007	28004	0025	56034		
	0353	5 31.4	0407	27973	0342	56054		
	0432	5 34.1	0418	27962	0741	56085		
	0700	5 29.7	0713	27989	2244	56076		
	0735	5 29.4	0723	27990	2342	56073		
	2256	5 19.1	2310	27999				
	2335	5 20.9	2321	27996				
OODNADATTA C								
15 Dec 78					2233	56065	2	2
16 Dec 78	0025	5 24.1	0037	27994	0015	56065		
	0055	5 24.7	0046	27995	0101	56065		
PARAFIELD A				QHM 293				
6 Dec 78	0645	7 48.8E	0654	23250	0629	59903		
	0711	7 48.3	0703	23257	0715	59907		
	2318	7 38.2	2341	23233	2250	59906		
			2357	23235				
7 Dec 78	0012	7 37.7	0128	23230	0029	59891		
	0111	7 40.8	0142	23229	0058	59882		
	0156	7 43.2	0345	23230	0202	59875		
	0313	7 47.6	0359	23226	0304	59872		
	0414	7 50.2			0420	59877		
8 Dec 78	0821	7 47.5	0837	23240	2051	59911		
	0903	7 46.6	0849	23238	2220	59902		
	2110	7 40.5	2130	23248	2326	59892		
	2207	7 37.8	2147	23244				
9 Jan 79							6	6
PORT HEDLAND D				QHM 173				
28 Jul 78	0745	1 18.7E	0742	31177	0525	52072		
	0804	1 15.7	0752	31171	0810	52075		
29 Jul 78	0218	1 12.7	0228	31204	0200	52100	3	3
	0301	1 13.4	0246	31205	0307	52098		
	0335	1 12.8	0344	31211	0326	52099		
	0402	1 09.5	0353	31211	0410	52096		
	0714	1 56.5	0724	31183	0705	52078		
	0751	1 57.7	0739	31185	0756	52084		
	0826	1 37.8	0838	31183	0817	52087		
			0849	31182	0855	52092		
30 Jul 78					2355	52114		
31 Jul 78	0009	1 16.2	0021	31209	0103	52128		
	0059	1 14.7	0049	31212	0111	52129		
	0119	1 13.9	0130	31213	0225	52127		
	0219	1 12.5	0205	31209	0521	52073		
	0534	1 16.8	0543	31197	0644	52074		
	0639	1 18.7	0630	31196	0652	52077		
	0658	1 19.2	0712	31197	0755	52084		
	0750	1 18.4	0742	31210				
				QHM 290				
			0039	31221				
			0147	31216				
				QHM 306				
			0608	31200				
			0729	31193				

Value of magnetic elements

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
TENNANT CREEK C			QHM 173					
20 Jun 78	0550	4 32.4E	0557	32382	0544	50947		3
	0630	4 35.7	0623	32386	0633	50955		
	0716	4 33.0	0723	32382	0709	50958		
	0744	4 33.0	0727	32380	0747	50963		
	2348	4 29.8	2351	32426	2338	50992		
21 Jun 78	0010	4 29.3	0003	32422	0014	50993	6	3
	0102	4 28.2	0109	32419	0055	50993		
	0401	4 30.1	0407	32362	0354	50940		
	0446	4 30.5	0453	32345	0441	50930		
	0647	4 32.0	0655	32351	0700	50940		
	0721	4 33.3	0728	32348	0717	50941		
	2305	4 28.8	2311	32401	2258	50981		
	2330	4 28.8	2324	32399	2333	50974		
	2357	4 29.0			2350	50972		
22 Jun 78			0007	32378				
THE GRANITES C			QHM 173					
18 Jul 78	0543	3 34.8E	0554	31750	0522	52233	3	4
	0606	3 36.6	0602	31752	0611	52238		
	0755	3 35.6	0804	31742	0743	52251		
	0826	3 34.0	0817	31741	0832	52256		
					2353	52274		
19 Jul 78	0000	3 33.2	0009	31757	0031	52273	3	4
	0027	3 31.7	0020	31756	0158	52260		
	0205	3 30.4	0212	31748	0246	52251		
	0241	3 29.8	0230	31743	0516	52236		
	0523	3 32.9	0533	31765	0558	52241		
	0554	3 35.3	0546	31751	0719	52244		
	0729	3 35.7	0757	31730	0812	52247		
	0807	3 34.4	0739	31731	2344	52273		
	2352	3 32.3						
20 Jul 78	0016	3 31.6	0000	31752	0022	52275		
			0010	31761				
RABBIT FLAT A								
20 Jul 78	0321	2 26.1*	0338	31990	0327	51762		3
			0343	31990				
TIBOOBURRA A			QHM 293					
5 Mar 78	0632	8 11.3E	0639	27014	0623	56569		
	0707	8 12.6	0660	27026	0712	56578		
	2319	8 01.6	2327	27015	2310	56568		
			2356	26999				
6 Mar 78								
	0005	8 02.1	0152	26999	0008	56550	6	6
	0143	8 04.9	0347	27003	0125	56543		
	0340	8 12.2	0511	27038	0322	56541		
	0505	8 14.0	0652	27030	0458	56558		
	0645	8 13.7	0658	27027	0649	56560		
	0708	8 13.8	2333	26990	0709	56565		
	2326	8 02.8	2349	26987	2317	56561		
	2356	8 03.3			2359	56551		
WARRACKNABEAL C			QHM 290					
10 Mar 78	0640	9 39.3E	0701	22693	0620	60236	1	1
	0737	9 38.5	0715	22685	0748	60239		
					2342	60235		
11 Mar 78	0009	9 31.7	0030	22641	0040	60227		
	0608	9 38.1	0043	22641	0107	60224		
	0650	9 36.8	0624	22681	0546	60232	1	1
			0635	22683	0658	60237		
12 Mar 78	0247	9 35.7	0309	22661	0247	60228		
	0343	9 38.1	0325	22670	0353	60233		
	0845	9 36.9	0901	22678	0917	60233		
13 Mar 78	0102	9 34.3	0116	22683	0039	60225		
	0148	9 36.0	0130	22639	2321	60228		
	0352	9 39.4	0408	22709				
	0512	9 38.5	0528	22702				
	0557	9 38.9	0541	22711				
	1042	9 32.7	1110	22652				
	2344	9 29.7						
14 Mar 78	0038	9 30.1	0006	22677	0050	60226		
			0021	22677				

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
WEIPA B			QHM 173					
29 Jun 78	0704	5 34.0E	0711	35650	0655	46554		
	0723	5 33.5	0716	35646	0728	46553		
	2326	5 34.1	2333	35632	2319	46538		
	2357	5 33.0	2350	35642	2358	46540		
30 Jun 78	0059	5 30.9	0106	35634	0052	46548		3
	0213	5 31.4	0207	35632	0217	46539		
	0414	5 31.3	0422	35629	0407	46529		
	0449	5 32.5	0443	35631	0452	46531		
	0705	5 34.9	0713	35615	0656	46529		
	0732	5 35.6	0725	35602	0735	46526		
	2358	5 31.6			2338	46570		
1 Jul 78	0030	5 31.4	0004	35673	0129	46576		
	0109	5 31.7	0022	35680	0103	46579		
	0142	5 31.4	0116	35678	0147	46576		
	0419	5 32.1	0125	35682	0412	46565		
	0513	5 33.1	0421	35672	0518	46555		
	0628	5 34.0	0507	35670	0621	46547		
	0701	5 34.1	0635	35644	0706	46548		
	2251	5 32.2	0654	35646	2246	46571		
	2329	5 31.7	2303	35669	2333	46570		
	2347	5 31.3	2322	35669	2341	46570		
			2353	35668				
WILCANNIA D			QHM 293					
13 Mar 79	0808	8 57.0E	0816	25773	0800	57519		
	0828	8 54.4	0822	25768	0834	57517		
	2249	8 47.7	2251	25752	2240	57511		
	2312	8 48.5	2304	25750	2315	57508		
	2354	8 50.9			2347	57503		
14 Mar 78	0104	8 54.0	0003	25753	0058	57498	6	5
	0509	8 59.3	0113	25761	0504	57512		
	0708	8 55.9	0515	25784	0703	57521		
	0727	8 55.7	0714	25781	0731	57522		
	2216	8 48.4	0721	25784	2210	57523		
	2223	8 47.4	2222	25772	2226	57522		
			2227	25769				
WINTON B			QHM 173					
6 May 78	0710	7 15.3E	0723	31074	0657	51838		
	0745	7 14.1	0733	31076	0752	51843		
7 May 78	0451	7 16.2	0505	31065	0428	51822	1	1
	0533	7 17.4	0517	31066	0543	51823		
	0636	7 16.7	0703	31072				
	0718	7 15.2	0651	31068				
8 May 78							4	4
10 May 78	0536	7 15.8	0547	31060	2354	51839		
			0556	31059				
11 May 78	0009	7 08.4	0020	31072	0056	51836		
	0041	7 09.3	0029	31074	0418	51799		
	0431	7 15.9	0443	31036	0509	51818		
	0503	7 16.5	0451	31028	0718	51807		
	0729	7 16.8	0741	30982	0800	51809		
	0753	7 16.1	2246	31068	2217	51847		
	2230	7 11.1	2258	31068	2323	51842		
	2314	7 10.7						
WINTON A								
9 May 78							4	4
11 May 78	0137	7 10.4	0152	31059	0124	51864		
	0216	7 12.4	0201	31058	0219	51854		
	0619	7 14.3	0631	31003	0608	51841		
	0652	7 16.1	0638	31006	0659	51833		
WOOMERA A1			QHM 293					
10 Dec 78	0437	6 19.6E	0452	25639	0424	57817		
	0518	6 18.1	0502	25640	0525	57823		
	0605	6 17.6	0622	25621	0557	57824		
	0634	6 17.1	2322	25592	0640	57828		
	2309	6 05.9	2336	25593	2253	57829		
	2348	6 04.5			2354	57817		
11 Dec 78	0553	6 17.7	0612	25621	0540	57830	3	3
	0644	6 16.4	0627	25623	0650	57832		
	2315	6 04.3	2330	25582	2301	57825		
	2354	6 05.5	2342	25583				
12 Dec 78					0002	57821		

Value of magnetic elements

Date	UT	D	UT	H	UT	F	No. of Sunshots AM	No. of Sunshots PM
WYNDHAM C				QHM 173				
11 Jul 78	0358	2 56.0E	0407	34 156	0344	48765		3
	0422	2 56.1	0414	34 153	0422	48763		
	0734	3 00.7	0748	34 135	0724	48751		
	0809	3 00.8	0759	34 135	0812	48753		
	0823	2 59.9	0835	34 130	0817	48753		
	0851	2 59.9	0843	34 131	0857	48757		
12 Jul	0112	2 55.8	0121	34 160	0101	48787	3	3
	0245	2 55.2	0228	34 157	0249	48776		
	0732	3 00.0	0237	34 161	0724	48760		
	0754	2 59.4	0740	34 151	0757	48761		
	0809	2 59.5	0748	34 144	0800	48762		
	0835	2 59.4	0818	34 147	0840	48761		
			0827	34 145				
13 Jul 78	0218	2 55.1	0230	34183	0203	48784	3	
	0254	2 56.2	0241	34184	0259	48785		
ZANTHAS B								
22 Sep 78	0901	1 07.7E	0912	24711	0842	58230		3
	0932	1 06.9	0921	24714	0936	58233		
23 Sep 78	0341	1 02.2	0354	24699	0323	58221	3	3
	0415	1 04.7	0406	24697	0421	58209		
	0720	1 08.7	0735	24710	0708	58225		
	0760	1 08.8	0746	24717	0806	58232		
	0847	1 07.0	0902	24703	0830	58233		
	0924	1 06.9	0913	24702	0930	58231		
24 Sep 78	0555	1 07.9	0608	24698	0537	58213	3	
	0749	1 06.7	0620	24701	0813	58230		
	0824	1 06.0	0837	24707	0816	58230		
	0901	1 05.2	0931	24717	0910	58239		
	0921	1 05.0			0912	58239		
					2355	58242		
25 Sep 78	0044	0 59.2	0057	24727	0031	58248		
	0118	0 58.4	0108	24731				
ZANTHUS A								
25 Sep 78	0253	1 16.1						
	0305	1 00.6	0316	24711	0249	58253		
	0517	1 07.4	0328	24711	0509	58233		
	0643	1 10.6	0655	24710	0518	58233		
	0722	1 11.2	0707	24706	0627	58244		
					0727	58251		

* These values were obtained using the Wild Compass Theodolite to 104407. A correction of -36.9' has been applied to the observations.

INSTRUMENTS

The instruments used throughout the survey were:

. Declinometer 509320
. Proton Precesion Magnetometer absolutes 595/120
. Proton Precession Magnetometer-recordings 595/131
. Askania Circle 508810
. Quartz Horizontal Magnetometers 173, 290, 293, 306.

Table 4

SURVEY INSTRUMENT CORRECTIONS

H standard = QHM 173 - 0.00147H (final)
H standard = QHM 290 - 0.00154H "
H standard = QHM 293 - 0.00030H "
H standard = QHM 306 - 0.00063H "

F standard = PPM 595/120 + OnT. (preliminary)
D standard = Ask 509320 + 0.0' (preliminary)

Table 5

1980.0 ADOPTED STATION VALUES

STATION		MAIN FIELD							SECULAR VARIATION						
		D	H	F	I	X	Y	Z	D	H	F	I	X	Y	Z
		degree	nT	nT	degree	nT	nT	nT	minute	nT	nT	minute	nT	nT	nT
ALBANY	ABY	-3.36	21697	60137	-68.85	21660	-1272	-56087	-1.2	-41.0	10.0	-2.8	-42.0	-5.0	-26.0
ALICE SPRINGS	ASP	4.76	30066	53770	-56.00	29962	2495	-44579	0.2	-41.7	7.0	-3.5	-41.0	-2.0	-36.0
ALPHA	ALP	8.40	30525	52538	-54.48	30198	4459	-42761	2.0	-36.5	0.0	-2.9	-39.0	12.0	-26.0
AUGUSTA	AUG	-4.34	21207	60437	-69.46	21146	-1605	-56594	-1.6	-41.2	14.0	-2.8	-42.0	-7.0	-31.0
AYERS ROCK	AYE	4.28	28833	55014	-58.39	28753	2152	-46853	0.0	-41.0	8.6	-3.4	-41.0	-3.0	-35.0
BIRDSVILLE	BIR	6.61	29190	54589	-57.67	28996	3360	-46129	1.0	-37.5	0.0	-2.8	-38.0	4.0	-24.0
BOULIA	BOL	6.65	30694	52442	-54.18	30487	3554	-42521	0.9	-42.3	2.0	-3.5	-42.0	4.0	-33.0
BOURKE	BUL	9.38	26780	56378	-61.64	26422	4365	-49612	2.4	-34.8	-5.0	-2.3	-38.0	12.0	-13.0
CARNARVON	CVN	-1.57	27218	54738	-59.58	27708	-759	-47201	-1.9	-27.3	23.0	-2.9	-28.0	-15.0	-43.0
CARNEGIE	CNE	1.70	28046	55381	-59.57	28034	832	-47754	-0.9	-33.6	12.3	-2.9	-34.0	-8.0	-34.0
CEDUNA	CED	4.99	24790	58712	-65.02	24696	2156	-53222	0.8	-39.8	2.0	-2.6	-40.0	2.0	-21.0
CHRISTMAS I	XMI	0.31	35051	46063	-40.45	35050	190	-29887	-3.1	21.0	37.0	-0.8	22.0	-32.0	-32.0
COCOS I	COC	-3.60	33062	46585	-45.12	32997	-2076	-33205	-3.9	4.0	31.0	-1.9	1.0	-41.0	-40.0
CONDOBOLIN	CDN	10.08	25137	57972	-64.30	24749	4400	-52239	2.9	-32.7	-14.5	-1.7	-36.0	15.0	1.0
COOKTOWN	CKT	6.70	34259	47264	-43.54	34025	3997	-32561	1.6	-35.5	11.5	-4.6	-37.0	12.0	-54.0
CROYDON	CRO	6.36	33177	49413	-47.82	32973	3675	-36619	1.1	-28.0	11.5	-3.4	-29.0	7.0	-41.0
DALY WATERS	DYW	4.36	34012	48986	-46.03	33914	2586	-35254	-0.2	-31.5	16.5	-4.2	-32.0	-5.0	-53.0
DARWIN	DAR	3.46	35177	46295	-40.55	35113	2123	-30097	-0.6	-17.5	26.0	-4.2	-17.0	-7.0	-60.0
DERBY	DER	2.39	33109	50122	-48.66	33080	1381	-37630	-1.3	-27.3	26.6	-4.1	-27.0	-14.0	-59.0
EMU	EMU	4.55	26809	56568	-61.71	26725	2127	-49812	0.4	-33.8	9.0	-2.6	-34.0	0.0	-28.0
ESPERANCE	ESP	-0.38	22788	60065	-67.70	22787	151	-55574	-0.7	-42.6	10.0	-2.9	-42.0	-5.0	-29.0
ETADUNNA	ETA	6.85	27333	56331	-60.97	27138	3260	-49255	1.2	-39.8	0.0	-2.8	-41.0	5.0	-22.0
EUCLA	EUC	3.85	23854	58547	-65.96	23800	1602	-53467	0.2	-41.1	6.5	-2.8	-41.0	-2.0	-26.0
FLINDERS I	FLI	13.05	20614	61374	-70.37	20082	4655	-57809	3.4	-29.5	-18.0	-1.4	-34.0	13.0	9.0
GERALDTON	GER	-2.33	25329	56949	-63.59	25308	-1030	-51006	-1.7	-33.0	19.6	-2.8	-33.0	-11.0	-42.0
GILES	GIL	3.34	28781	54748	-58.28	28732	1677	-46572	-0.3	-40.0	10.0	-3.3	-40.0	-5.0	-37.0
GOVE	GOV	4.72	35230	45990	-40.00	35111	2899	-29562	0.1	-28.8	18.0	-4.9	-29.0	-1.0	-63.0
GRAFTON	GFN	11.40	27496	55258	-60.16	26954	5435	-47931	3.2	-31.3	-12.4	-1.8	-36.0	18.9	-4.0
HALLS CREEK	HAL	3.06	32640	50451	-49.69	32593	1742	-38470	-0.8	-28.1	23.9	-3.9	-27.0	-8.0	-55.0
HOBART	HOB	13.96	18758	62811	-72.62	18204	4525	-59945	3.2	-28.1	-19.6	-1.3	-31.0	10.0	12.0
INGHAM	ING	7.41	32876	49397	-48.28	32601	4240	-36868	1.8	-35.2	2.0	-3.4	-37.0	13.0	-34.0
KIDSON	KID	2.54	30381	53507	-55.40	30351	1346	-44045	-0.9	-32.8	20.9	-3.5	-32.0	-9.0	-48.0
LAVERTON	LAV	1.60	26126	56956	-62.70	26116	729	-50610	-0.8	-38.0	13.2	-3.0	-38.0	-7.0	-35.0

Table 5(cont.)

1980.0 ADOPTED STATION VALUES

STATION		MAIN FIELD							SECULAR VARIATION						
		D	H	F	I	X	Y	Z	D	H	F	I	X	Y	Z
		degree	nT	nT	degree	nT	nT	nT	minute	nT	nT	minute	nT	nT	nT
LORD HOWE I	LHI	15.16	27138	55662	-60.82	26194	7097	-48598	3.7	-25.0	-19.7	-1.1	-32.0	22.0	8.0
MACKAY	MAK	8.73	31960	50723	-50.94	31590	4851	-39388	2.2	-32.5	0.0	-2.9	-36.0	15.0	-26.0
MARYBOROUGH	MYB	10.81	29793	52810	-55.66	29264	5588	-43604	2.8	-32.0	-9.0	-2.2	-36.0	18.0	-11.0
MEEKATHARRA	MEK	1.01	26929	56152	-61.34	26925	475	-49273	-1.3	-28.8	20.0	-2.7	-29.0	-11.0	-39.0
MILDURA	MIL	8.73	23981	59160	-66.09	23703	3640	-54082	2.2	-34.5	-12.0	-1.9	-36.0	10.0	-2.0
MOREE	MOR	10.48	27241	55751	-60.75	26787	4955	-48643	2.9	-34.0	-8.0	-2.2	-38.0	16.0	-10.0
MT.ISA	ISA	5.88	31973	51197	-51.35	31805	3275	-39986							
MT.VERNON	VER	0.34	28614	54330	-58.22	28613	170	-46184	-1.5	-32.4	22.4	-3.3	-32.0	-13.0	-47.0
NEALE JUNCTION	NLJ	2.06	26719	56635	-61.85	26702	960	-49936	-0.3	-36.3	9.0	-2.8	-37.0	-3.0	-30.0
NEWCASTLE	NEW	11.95	25596	57392	-63.51	25041	5300	-51368	3.3	-33.5	-13.5	-1.8	-38.0	17.0	-2.0
NORFOLK I	NIA	15.12	28899	52342	-56.49	27899	7538	-43641	3.8	-20.8	-22.5	-0.7	-29.0	25.0	13.0
ONSLOW	ONS	- 0.06	29781	53027	-55.83	29781	- 31	-43874	-1.9	-25.0	27.0	-3.2	-25.0	-17.0	-50.0
OODNADATTA	OOD	5.38	28008	56106	-60.05	27885	2626	-48615	0.7	-34.7	3.0	-2.6	-36.0	3.0	-24.0
PARAFIELD	PAF	7.77	23200	59899	-67.21	22987	3137	-55224	1.7	-35.7	0.0	-2.2	-37.0	6.0	-15.0
PORT HEDLAND	HED	1.21	31154	52141	-53.31	31147	658	-41810	-1.7	-24.7	30.0	-3.5	-24.0	-16.0	-56.0
PORT LINCOLN	LIN	5.17	23371	60348	-67.22	23276	2106	-55639	1.2	-40.4	0.0	-2.5	-41.0	5.0	-17.0
PORTLAND	POL	8.93	21207	61358	-69.78	20950	3292	-57577	2.4	-32.0	-12.0	-1.7	-35.0	9.0	1.0
QUILPIE	QUI	8.02	28823	54553	-58.11	28541	4021	-46317	1.8	-34.8	-7.5	-2.3	-37.0	10.0	-13.0
ROMA	ROM	9.31	29193	54005	-57.28	28808	4723	-45435	2.4	-37.7	-10.5	-2.5	-40.0	14.0	-11.0
SOUTHERN CROSS	SOX	-0.55	24349	58533	-65.42	24348	-234	-53228	-1.1	-39.1	10.0	-2.8	-39.0	-7.0	-29.0
TELFER	TEL	1.58	30594	52753	-54.55	30582	844	-42975	-1.2	-31.0	22.0	-3.5	-30.0	-12.0	-50.0
TENNANT CREEK	TCK	4.50	32383	51007	-50.59	32283	2541	-39409	0.1	-32.0	19.3	-3.9	-32.0	-2.0	-51.0
THE GRANITES	GRN	3.50	31716	52273	-52.65	31657	1936	-41552	-0.4	-29.1	10.0	-2.9	-29.0	-5.0	-35.0
TIBOOBURRA	TIB	8.16	27012	56576	-61.48	26739	3834	-49711	1.8	-36.6	-5.0	-2.4	-39.0	9.0	-14.0
WARRACKNABEAL	WAR	9.62	22639	60217	-67.92	22321	3783	-55799	2.4	-31.8	-12.5	-1.6	-34.0	11.0	0.0
WEIPA	WEI	5.55	35607	46595	-40.17	35440	3444	-30054	0.9	-33.2	15.8	-5.2	-34.0	6.0	-64.0
WILCANNIA	WCA	8.86	25753	57515	-63.40	25446	3966	-51427	2.2	-39.0	-6.3	-2.4	-41.0	11.0	-13.0
WINTON	WTN	7.24	31034	51857	-53.24	30787	3911	-41546	1.4	-35.1	1.5	-2.9	-37.0	8.0	-28.0
WOOMERA	WOO	6.17	25584	57830	-63.74	25436	2750	-51863	1.2	-36.5	0.8	-2.5	-37.0	5.0	-19.0
WYNDHAM	WYN	2.94	34113	48822	-45.68	34068	1750	-34927	-0.8	-25.8	26.4	-4.4	-25.0	-9.0	-62.0
ZANTHUS	ZAN	1.04	24691	58255	-64.92	24681	448	-52764	-0.5	-42.8	8.9	-3.0	-43.0	-4.0	-29.0

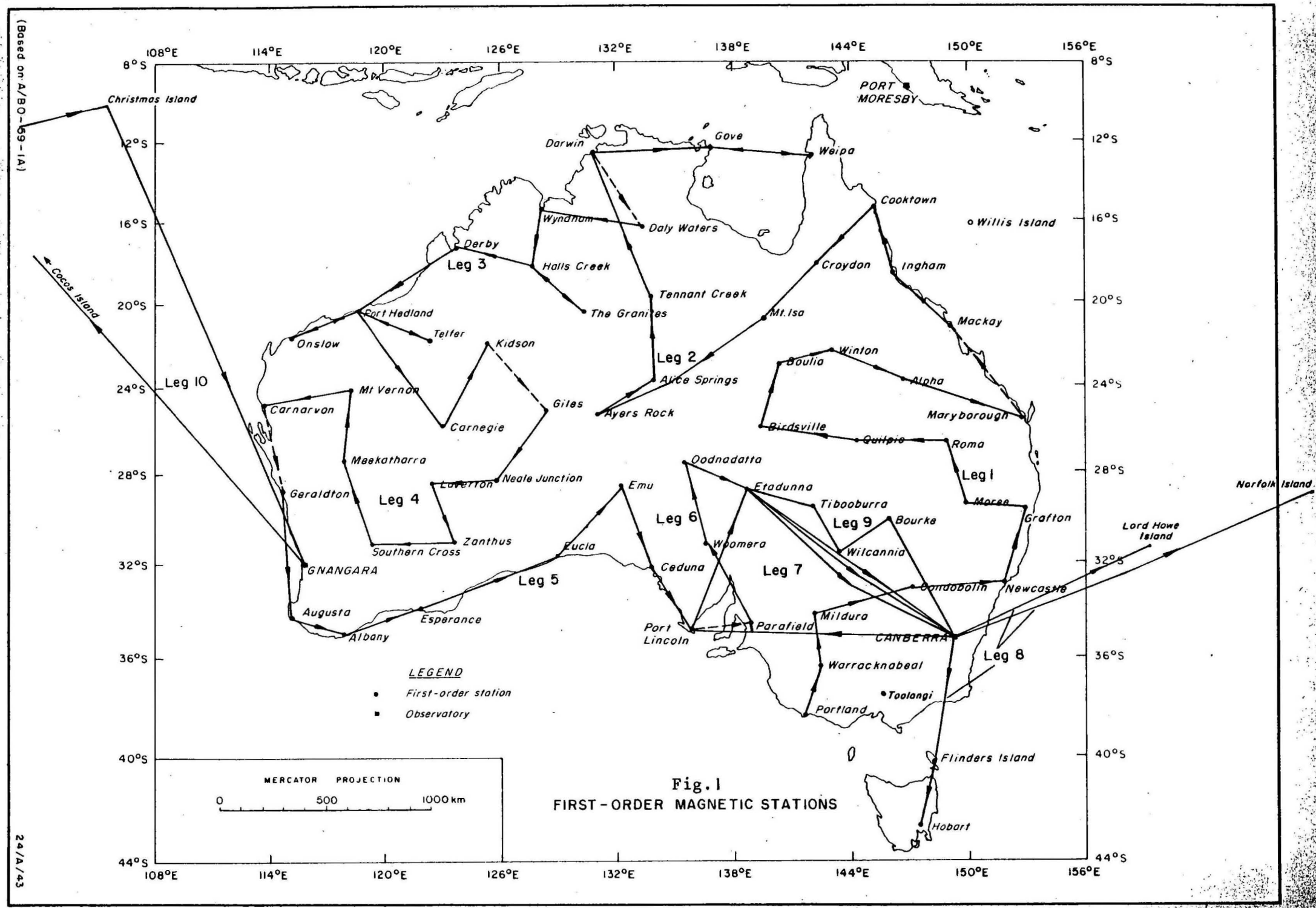

Fig. 1
FIRST-ORDER MAGNETIC STATIONS

24/A/43

Fig. 2.

Variograph