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REGIONAL MAGNETIC REPEAT-STATION SURVEY IN KEMP LAND AND THE PRINCE CHARLES MOUNTAINS, 1989/1990

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Regional Magnetic Repeat-Station Survey in Kemp Land and the Prince Charles Mountains, Antarctica, 1989/1990

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Peter G Crosthwaite

Geomagnetism Section
Geophysical Observatories and Mapping Division

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Summary

This report presents the results of geomagnetic measurements made at two repeat stations off the coast of Kemp Land, Antarctica, in October 1989 and at nine repeat stations in the northern Prince Charles Mountains, Mac Robertson Land, Antarctica, in January and February 1990. From five to fifty sets of declination, inclination and total field observations (and sunshots to determine azimuth references) were made at each station. The repeat stations are within 500 km of the Mawson Geomagnetic Observatory.

The stations reoccupied in Kemp Land were Depot Island and Fold Island, both previously occupied and established during the 1975/76 ANARE Enderby Land Expedition (Hill, 1979). The Kemp Land occupations described in this report were made during an exceptionally magnetically disturbed period (K-index of up to 9).

New stations were established in the Prince Charles Mountains at Mt Woinarski, Blustery Cliffs (Fisher Massif), Jetty Peninsular, Else Platform, Mt Wishart, Mt Starlight, Corry Massif and Mt Jacklyn. The geomagnetic station marked by the BMR Moore Pyramid gravity station was reoccupied. Mt Forecast was visited and found to be unsuitable for use as a regional magnetic station because of extremely high magnetic gradients.

Previous occupations had been reported at undocumented stations at Mt Woinarski, Blustery Cliffs, Mt Forecast, Mt Wishart, Mt Jacklyn and Beaver Lake. Jetty Peninsular, Else Platform, Mt Starlight and Corry Massif had not previously been occupied.

The results of each magnetic field observation are listed, along with the corresponding value of the magnetic field at Mawson. The mean and median observed field values at the field stations and Mawson, and the mean and median difference between the field station and Mawson are listed. The average quiet-day monthly field value for the appropriate month at Mawson is also listed. The IGRF 1991 Revision-predicted value of the magnetic field and its secular variation are also listed for each field station at the time of observation. Station descriptions and references to other geophysical and surveying occupations are also given to facilitate reoccupation.

Introduction

The Geophysical Observatories and Mapping Division, Bureau of Mineral Resources, Geology and Geophysics (BMR), as part of the Australian National Antarctic Research Expeditions (ANARE), carries out a program of geomagnetic monitoring in Antarctica at permanent observatories, at repeat stations and opportunistically at other locations. Logistic support is provided by the Antarctic Division, Department of Arts, Sport, the Environment, Tourism and Territories.

The author operated the Mawson geophysical observatory from 23 December 1988 until relieved by Andrew Lewis on 3 January 1990. He reoccupied magnetic repeat stations established by Hill (1979) in Kemp Land during an absence of 26 days from Mawson; during this time the observatory remained fully operational. He joined the Prince Charles Mountains Expedition after being relieved from duty at the Mawson observatory and occupied 9 repeat stations throughout the northern Prince Charles Mountains. A summary of the field logs are given in Appendices A and B. Station locations are shown in Figures 1 and 2.

Kemp Land, October 1989.

After considerable preparation, the author was amongst a party of four who departed Mawson by two dog teams bound for Kloa Point on the 6 October 1989. The primary reason for the field trip was to reoccupy the magnetic stations at Depot Island (Edward VIII Gulf) and Fold Island (Stefansson Bay) in Kemp Land. The location of the stations provided an ideal opportunity to visit the emperor penguin rookeries at Fold Island and Kloa Point and take photographic records and penguin counts. Other biological observations were made along the way.

On the 13 October, two Hagglund vehicles with a party of five departed Mawson to rendezvous with the dog teams at Kloa Point. The dog teams arrived at Kloa Point on 15 October to make observations at the rookery and wait for the vehicles. The vehicles were hindered by very slow surface conditions and were unable to reach Kloa Point due to lack of fuel (the conditions reduced fuel efficiency to 3 l/km for two vehicles). On the 18 October the dog teams returned to Moonie Island on the southern side of Edward VIII Gulf to meet the vehicle party.

The sled party, including the author, then swapped with four of the vehicle party and proceeded to Depot Island on the 19 October to make the magnetic measurements. The station was located and very preliminary sunshots and field measurements were made to establish the equipment functionality. It was extremely unfortunate that a very large magnetic storm (peaking at K9 levels) commenced at about that same moment and persisted until the end of the observations at both Depot and Fold Islands. The storm caused the additional logistic problem of a Polar Cap Absorption event and almost total loss of communication with Mawson until the near the end of the field trip. The vehicle party remained at Depot Island performing sea ice measurements and magnetic field measurements while waiting for the abatement of the storm, and finally departed on 23 October with less than ideal results.

The vehicles arrived at Fold Island and the magnetic station was located on 24 October. Observations began on the 25th, including sunshots which were of poor quality as the most recent radio time check had been on the 19th. Altitude observations of the sun were made to try and determine time corrections. Magnetic observations continued until 26 October, and on the 27 October the dog team and vehicle parties again rendezvoused near Fold Island.

At that point, delays due to the slow surface conditions and magnetic storm made it necessary for two of the dog team party members to change over with two of the vehicle party members, one the author, and return to Mawson with haste. The author, aboard the dog teams, finally returned to Mawson on 1 November. On his return, the observatory was functioning perfectly; no data had been lost.

Northern Prince Charles Mountains, January/February 1990.

After being relieved of the responsibility for the Mawson Observatory on the 3 January 1990, the author remained at Mawson until the 11 January awaiting favourable flying conditions for departure to Dovers summer retreat to begin a field program of geomagnetic observations in the Prince Charles Mountains.

Professor Harold Heatwole, of New England University, who was investigating terrestrial biotic communities, was the author's field partner for the duration of the expedition. The field party was despatched to the first station at Mt Woinarski on 12 January and was transported via helicopter to numerous stations throughout the northern Prince Charles Mountains before returning to Dovers on the 12 February. Occupations at Mt Jacklyn were then made during a few breaks in poor weather using Honda quikes (all terrain 4 wheeled cycles). The final occupation was made on 15 February. The author returned to Mawson on 16 February 1990.

The total time away from Mawson was 36 days, during which 9 successful magnetic occupations and brief F surveys at Mt Forecast were made. 12 sites (with an average of 4 habitats per site) were sampled for biological studies.

Figure 1 Kemp Land

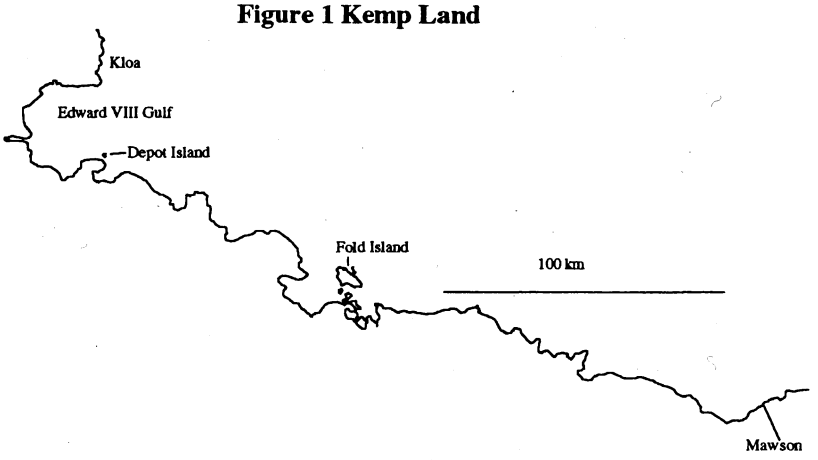
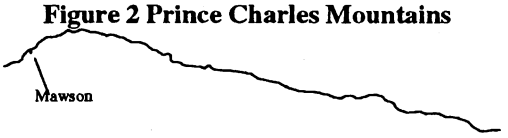
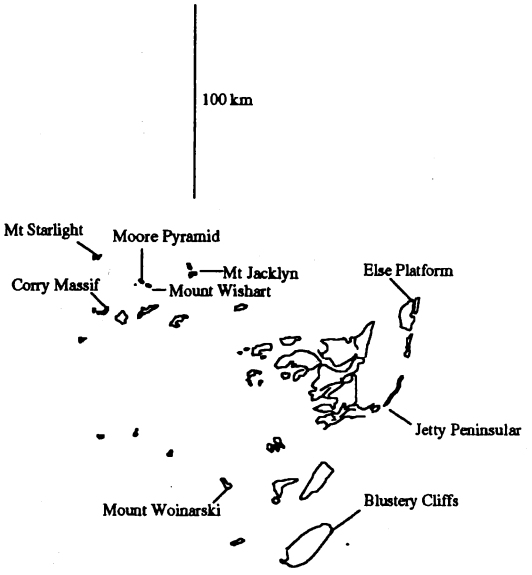


Figure 2 Prince Charles Mountains





Chapter 1. Kemp Land Magnetic Occupations

Many stations in the region between Mawson and Molodezhnaya have been occupied since the 1950s. Two stations established during the 1975/76 ANARE Enderby Land Expedition (Hill, 1979) were reoccupied by the author:

- 66°56'24"S 57°19'37"E elevation 35m Depot Island
- 67°15'52"S 59°20'55"E elevation 89m Fold Island

The stations are described clearly by Hill. Some additional information on the stations is included here to further assist future reoccupations.

At both stations, all D, I and F observations and sun shots, were performed from a tripod located at the primary pier site, called M, interchanging instruments during each observation. There is therefore no pier correction to be made to the results.

1.1 Station Occupation Details

Depot Island

Station Tags :	"BMR89" & "DEPOT ISLAND"/"MAG SITE".
Adopted coordinates :	66°56'24"S 57°19'37"E elevation 35 m (Hill,1979)
Dates occupied:	19-23 October, 1989.
Number of observations:	20th: 3 full obs; 21st: 3 full obs; 22nd: 10 full obs; 23rd: 8 full obs.
Magnetic gradients:	about 3 nT/m.
Pier difference:	0 nT (D, I and F observations were performed on the same pier).

Station:
The station of observation was 1.5 m from the cairn (the cairn was 8 m from the highest point of the island), in line with the cairn and the declination mark NMS70, at a height of 1.6 m. The equipment had to be rope-hauled up a steep snow bank to the top of the island. The station is a little precarious with a steep drop off to the south. There was a second cairn in a low saddle of the island of no significance. The original tag left by Hill in 1975 was nearly unreadable and was replaced with a pair of similar light aluminium tags whose longevity is questionable. They should be replaced with new sturdier tags at the next reoccupation. A small pile of rocks was left at the actual observation sight.

Azimuth reference:
The mark used by Hill was reused.

- NMS70 on Alphard Island. Note that the Russian oil drum that Hill noticed near the mark is no longer visible. A prominent pointy rock slightly to the left of the centre of the cairn was used as the mark. The cairn is 3 to 4 km from the observation station, subtends 0.6' of arc and is at an elevation of 1°07.3'. A 1 m position error at that distance is equivalent to 1' of error in declination.

A rough set of sunshots on arrival at the station confirmed Hill's azimuth of the mark to within a few minutes. The loss of radio communication and thus of radio time checks prevented further worthwhile sunshots to completely verify the azimuth.

Declinations in this report assume an azimuth of 117°11.4' from M to "NMS70" (Hill, 1979).

Weather conditions:
Pleasant enough between 8am and 8pm Mawson Time.

Notes:
There was K5 to K7 magnetic activity at Mawson during all observations. The station and mark descriptions by Hill (1979) are perfectly adequate to locate and use this station. If the opportunity arises in the future, the azimuth of the mark on Alphard Island should be confirmed.

Fold Island

Station Tags :	"BMR89" & "FOLD ISLAND"/"MAG SITE" (new tags).
Adopted coordinates :	67°15'52"S 59°20'55"E elevation 89 m (Hill, 1979). The station is 3 m south of NMS190, and so these coordinates could be refined according to the WGS84 coordinates of the survey station below.
Dates occupied:	24-27 October, 1989.
Number of observations:	25th: 8 full obs; 26th: 6 full obs.
Magnetic gradients:	indeterminate due to high magnetic activity during occupation.
Pier difference:	0 nT (D, I and F observations were performed on the same pier).

Nearest reference:
Survey Station NMS190 67°15'53.6881"S 59°20'53.6960"E (WGS84) elevation (see AUSLIG).

Station: (See Figure 3.)
The cairn marking survey station NMS190 and the nearby magnetic station is most obvious when approached along the sea ice from the east. The channel separating Fold Island from Cape Wilkins Island is most obvious and safest via that approach. A campsite was established in a valley to the east of the cairn. It was a long haul to the observation station. A small cairn was found 3 m south of the survey cairn and was accepted as the magnetic station. Observations were made at a height of 1.6 m. The station is comfortable on flat rock, but is somewhat exposed and windy.
The original tag left by Hill in 1975 was missing although a piece of wire was found. A new pair of tags similar to the original was left at the observation station. Their longevity is questionable. They should be replaced with new sturdier tags at the next reoccupation.

Azimuth reference:
• The primary reference mark was the survey cairn NMS69 on Havstein Island 28.207km away. Its location is 67°06'37.4892"S 58°49'56.2378"E (elevation 119.2m). AUSLIG derived the azimuth from NMS190 to NMS69 as 307°24'49.36". The correction to the azimuth for the magnetic station M is +17" yielding a corrected geodetic azimuth of 307°25'06".
Numerous sunshots were made to determine the azimuth of NMS69, but without a definite time reference. Altitude sunshots were used to correct the time piece by selecting the time correction which reduced the altitude errors of the sun to an average zero value. In all 9 sunshots were made. The observed astronomical azimuth was 307°25.0'±0.5'.

Two other features were included in rounds of angles for future use when the Havstein Island survey cairn is not visible.
• Havstein-L is a near vertical face on the left side of Havstein Island (primarily useful for locating NMS69)..
• Tooth is a "V" in the top of the shark tooth shaped island north of the magnetic station and just east of Cape Wilkin's Island. It is rather too close to be a good reference mark and should be used only if necessary.

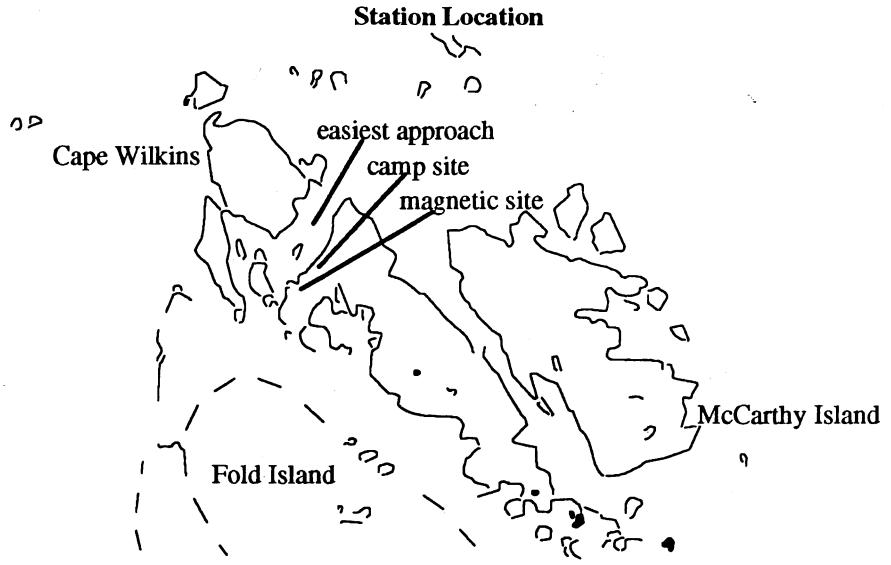
Rounds of angles: .
NMS69 to "Havstein-L" at M is 357°49.0'
NMS69 to "Tooth" at M is 56°33.9'

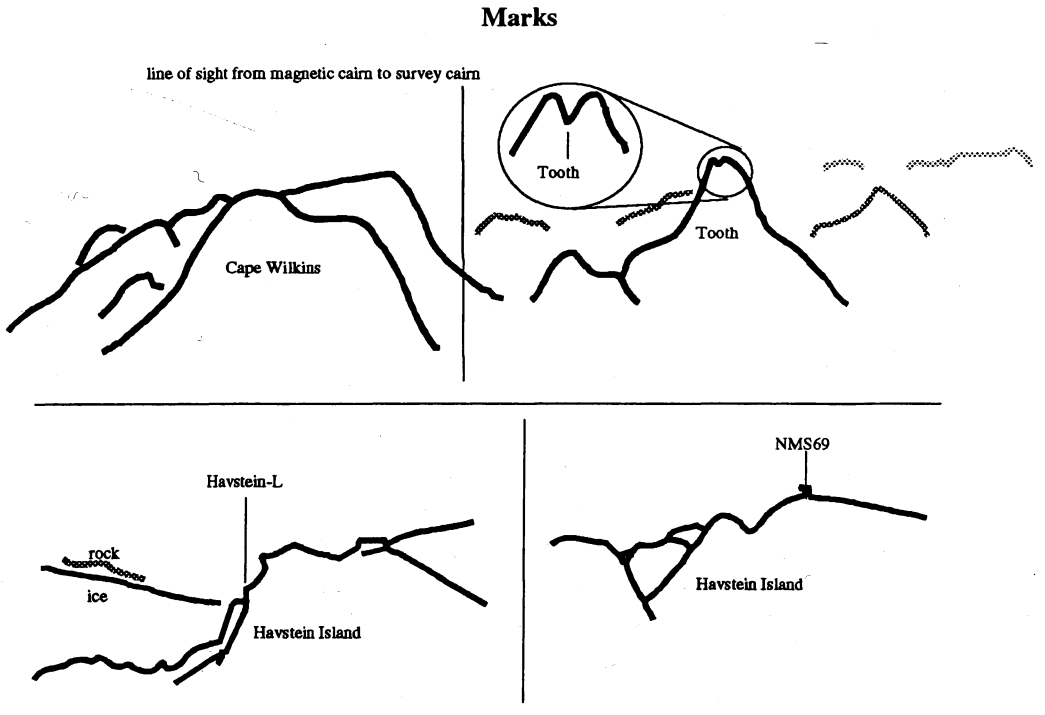
Declinations in this report assume an azimuth of 307°25'00" from M to NMS69.

Weather conditions:
Pleasant enough between 8am and 8pm Mawson Time.

Notes:
There was K3 to K7 magnetic activity at Mawson during all observations. It was assumed that the timing error for all observations was 8.9 seconds - this was determined by altitude shots of the sun assuming the location of the observation station. The following map taken with Hill's description (1979) may make it easier to locate the station. No marks are described by Hill, who used a compass theodolite at this station.

Figure 3 Fold Island





1.2 Magnetic Measurements

The following tables list the results of geomagnetic observations in Kemp Land.

The information in the tables is grouped into five sets of columns:
- the time (UTC) of the start of the observation of each magnetic field element (D, I and F)
- the instrumentally observed value of the field elements at the field station
- the average value of the field elements at Mawson during the observation of the same field elements at the field station (as measured by the Mawson variometer using adopted baseline values (Crosthwaite, 1991))
- the difference between the instrumental field observation and the Mawson variometer data
- the K-index at Mawson at the time of the observation

A summary of the information includes the mean, standard deviation, median and number of observations for each of the columns of magnetic data.

Field measurements are corrected for:
- pier differences when more than one observing pier was used (only one pier was used at Depot and Fold Islands)
- instrumental differences between the field instruments and Mawson standard instruments
- preliminary estimates of the instrumental differences between the Mawson standard instruments and the international geomagnetic standards (Lewis, 1991)

The IGRF 1991 Revision predicted field and secular variation at Mawson and the field station at the time of the observation are also listed (at the table entry "IGRF90 evaluated at ...").

In order to estimate the reliability of the field observations as an estimate of the "undisturbed" field value at the stations, the average field at Mawson during the same minutes the field observations were made are compared to the Mawson "Quiet-Day Mean Field Value" for the month. However, note that the 1992 January and February Mawson "Quiet Day Mean Field" differ by 1.9', 0.4' and 15 nT in D, I and F. The IGRF-predicted secular variation in D, I and F at Mawson is 0.7', 0.2' and 4.9 nT per month. Clearly the Quiet-Day Mean Field for the month is not a reliable baseline.

Field measurements during previous occupations

Hill (1979) measured the field at Depot and Fold Islands in 1975/76.

Depot Island	01 February 1976:	D -59°47.8'	I -68°36.4'	F 49699nT
Fold Island	30 December 1975:	D -60°03.7'	I -68°10.6'	F 50029nT.

The 1975 annual mean field at Mawson (Hill, 1979) was:

	D -62°31.4'	I -68°44.0'	F 50723nT.

The difference between the 1975 mean field at Mawson and these measured values are therefore:

Depot Island	D +2°43.6' (2.727°)	I +07.6' (0.127°)	F -1024nT
Fold Island	D +2°27.7' (2.462°)	I +33.4' (0.557°)	F -694nT.

Field measurements during the current occupation

From the following tables, the average measured value of the field at Depot and Fold Islands in 1989 are:

Depot Island	22 October 1989:	D -61°48.7'	I -68°07.7'	F 48606nT
Fold Island	25 October 1989:	D -61°52.3'	I -67°41.8'	F 48990nT,

and the differences between those values and the value at Mawson at the same time are:

Depot Island	D +2°44.0'(2.734°)	I +06.4'(0.107°)	F -1127nT
Fold Island	D +2°34.6'(2.571°)	I +30.8'(0.513°)	F -698nT.

Although the 1975 and 1989 observations are compared to different baselines, the difference between the field stations and Mawson are not markedly different.

Depot Island

Time			Depot Island			Mawson			Depot Island - Mawson			
D	I	F	D	I	F	D	I	F	D	I	F	K-index
20 October 1989												
0411	0426	0351	297.988	-68.247	48514	295.086	-68.304	49798	2.901	0.057	-1284	6
0451	0440	0526	297.776	-68.285	48379	294.789	-68.547	49579	2.987	0.262	-1200	6
0755	0805	0724	297.994	-68.113	48425	294.644	-68.117	49581	3.350	0.005	-1156	7
0821	0814	0841	298.052	-68.078	48658	295.308	-68.336	49722	2.744	0.258	-1064	7
1206	1214	1150	298.090	-67.653	48461	295.151	-68.153	49519	2.939	0.501	-1057	7
1225	1219	1240	297.748	-67.682	48036	295.771	-67.976	49145	1.976	0.293	-1109	7
21 October 1989												
0345	0354	0319	298.100	-68.675	48564	295.270	-68.277	49785	2.830	-0.398	-1221	7
0410	0403	0422	297.135	-68.874	48689	295.164	-68.995	49607	1.971	0.121	-918	7
0909	0918	0833	296.971	-68.053	48409	294.015	-68.067	49549	2.956	0.013	-1140	7
0930	0923	0939	297.251	-67.913	48620	295.818	-68.150	49546	1.433	0.237	-926	6
1141	1149	1117	297.595	-68.120	48366	294.760	-68.116	49504	2.835	-0.004	-1138	6
1160	1153	1215	297.391	-68.127	47939	295.747	-68.302	49361	1.644	0.175	-1422	6
22 October 1989												
0206	0214	0146	298.893	-68.485	48850	296.202	-68.184	50022	2.691	-0.301	-1172	6
0227	0221	0238	298.386	-68.495	49044	295.818	-68.501	50059	2.567	0.006	-1015	6
0507	0516	0452	297.471	-68.735	48894	295.086	-68.360	50115	2.385	-0.376	-1221	6
0528	0521	0536	297.860	-68.750	48892	295.082	-68.547	50088	2.778	-0.203	-1196	6
0728	0736	0718	298.038	-68.189	48926	295.472	-68.333	50072	2.565	0.144	-1146	6
0748	0741	0755	297.934	-68.156	48793	294.961	-68.040	49902	2.973	-0.116	-1110	6
0810	0816	0759	298.206	-68.052	48769	295.381	-68.053	49910	2.826	0.001	-1141	6
0828	0823	0838	298.244	-68.066	48633	295.398	-68.037	49759	2.847	-0.029	-1126	6
0945	0950	0934	298.490	-67.950	48787	295.649	-68.044	49808	2.841	0.094	-1021	5
0959	0954	1006	298.454	-67.939	48693	295.812	-67.934	49817	2.642	-0.004	-1124	5
1017	1022	1009	298.395	-67.809	48731	295.602	-68.066	49780	2.793	0.257	-1050	5
1032	1027	1039	298.371	-67.691	48780	295.750	-67.894	49684	2.621	0.204	-904	5
1054	1102	1044	298.487	-67.808	48693	295.624	-68.099	49696	2.863	0.291	-1003	5
1110	1105	1117	298.362	-67.802	48603	295.828	-67.845	49719	2.534	0.043	-1117	5
1207	1213	1120	298.677	-67.795	48607	295.793	-68.154	49733	2.884	0.359	-1126	6
1223	1218	1235	298.680	-67.795	48559	295.777	-67.930	49573	2.903	0.136	-1014	6
1249	1255	1238	298.641	-67.677	48565	295.709	-68.079	49556	2.932	0.402	-991	6
1305	1259	1313	298.681	-67.652	48466	295.824	-67.907	49477	2.857	0.255	-1010	6
1326	1332	1316	298.710	-67.718	48418	295.750	-68.062	49471	2.959	0.345	-1053	6
1342	1336	1349	298.678	-67.729	48358	295.827	-67.988	49471	2.851	0.259	-1113	6
23 October 1989												
0203	0209	0150	298.682	-68.054	48747	295.885	-68.188	49830	2.797	0.134	-1084	4
0220	0215	0227	298.742	-68.065	48646	295.859	-68.181	49779	2.883	0.116	-1133	4
0245	0252	0233	298.650	-68.269	48739	295.782	-68.225	49763	2.868	-0.044	-1024	4
0301	0257	0311	298.573	-68.278	48774	295.887	-68.256	49860	2.686	-0.022	-1085	7
0329	0334	0317	298.210	-68.153	48666	295.469	-68.261	49823	2.741	0.108	-1157	7
0342	0338	0351	298.292	-68.172	48709	295.716	-68.265	49799	2.576	0.094	-1090	7
0501	0508	0451	297.694	-68.460	48522	294.991	-68.459	49909	2.703	-0.001	-1388	7
0518	0512	0526	297.988	-68.368	48736	295.302	-68.387	49959	2.686	0.020	-1223	7
0544	0552	0534	298.084	-68.704	48569	294.823	-69.114	49851	3.261	0.409	-1282	7
0601	0556	0609	297.970	-68.643	48259	294.712	-69.045	49544	3.258	0.402	-1285	7
0625	0630	0616	298.025	-68.469	48402	294.757	-68.550	49647	3.268	0.081	-1245	7
0640	0636	0648	297.961	-68.482	48616	295.132	-68.490	49958	2.829	0.008	-1343	7
0830	0835	0821	298.380	-67.865	48673	295.406	-67.998	49761	2.974	0.132	-1088	7
0844	0839	0856	298.575	-67.874	48652	295.651	-68.006	49801	2.924	0.132	-1149	7
0908	0912	0859	298.591	-67.915	48612	295.720	-68.046	49728	2.871	0.131	-1116	7
0919	0915	0926	298.607	-67.918	48612	295.763	-68.051	49729	2.843	0.133	-1117	3
average			298.183	-68.121	48605	295.432	-68.227	49732	2.751	0.107	-1127	6.1
standard deviation			0.458	0.334	209	0.445	0.283	200	0.362	0.191	112	1.0
median			298.227	-68.072	48627	295.613	-68.154	49760	2.838	0.119	-1121	6.0
number of observations			48	48	48	48	48	48	48	48	48	
pier correction			0.000	0.000	0				0.000	0.000	0	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			298.171	-68.128	48606	295.437	-68.234	49732	2.734	0.107	-1127	
IGRF90 evaluated at 22 October 1989:												
field			300.251	-66.839	47764	295.624	-68.213	49775	4.627	1.374	-2010	
secular variation			-0.134	0.040	-63	-0.134	0.036	-62	0.000	0.004	-2	
Mawson Quiet Day Average for October 1989:						295.738	-68.145	49639				
Sampling Bias in results in the Mawson data:						-0.302	-0.089	93				

Fold Island

Time D	Time I	Time F	Fold Island D	Fold Island I	Fold Island F	Mawson D	Mawson I	Mawson F	Fold Island - Mawson D	Fold Island - Mawson I	Fold Island - Mawson F	K-index
25 October 1989												
0620	0627	0602	297.319	-68.108	49187	294.531	-68.758	49925	2.788	0.650	-738	7
0635	0630	0644	296.824	-68.076	48848	294.002	-68.755	49584	2.823	0.678	-736	7
0703	0707	0652	297.282	-67.921	48796	294.540	-68.521	49574	2.742	0.600	-778	7
0716	0711	0723	297.345	-67.924	48823	294.579	-68.512	49559	2.766	0.588	-736	7
0918	0925	0906	298.099	-67.644	49007	295.469	-68.098	49633	2.630	0.454	-626	5
0932	0928	0942	298.188	-67.660	49061	295.575	-68.109	49759	2.613	0.449	-698	5
0953	0959	0944	298.361	-67.705	49062	295.809	-68.210	49795	2.552	0.505	-733	5
1007	1003	1013	298.348	-67.728	49035	295.760	-68.228	49742	2.587	0.501	-707	5
1030	1034	1015	298.437	-67.661	49030	295.880	-68.164	49736	2.557	0.503	-706	5
1041	1038	1113	298.409	-67.662	49022	295.871	-68.166	49690	2.539	0.504	-668	5
1129	1140	1117	298.400	-67.633	49008	295.886	-68.113	49676	2.514	0.480	-668	5
1148	1144	1157	298.392	-67.634	49007	295.850	-68.111	49696	2.542	0.478	-689	5
1210	1215	1202	298.343	-67.596	49010	295.775	-68.101	49677	2.568	0.505	-667	3
1222	1218	1228	298.318	-67.598	48977	295.798	-68.100	49662	2.520	0.502	-686	3
1237	1242	1230	298.337	-67.608	48983	295.787	-68.113	49665	2.550	0.505	-682	3
1248	1245	1318	298.332	-67.609	48992	295.812	-68.114	49698	2.520	0.505	-706	3
26 October 1989												
0828	0832	0811	298.214	-67.651	48959	295.676	-68.162	49674	2.539	0.511	-715	5
0838	0835	0916	298.198	-67.665	48953	295.638	-68.180	49669	2.560	0.515	-716	5
0937	0943	0925	298.138	-67.684	48930	295.556	-68.184	49635	2.582	0.500	-705	4
0950	0946	0957	298.184	-67.683	48991	295.614	-68.176	49687	2.570	0.493	-696	4
1012	1016	1001	298.221	-67.650	49005	295.641	-68.138	49703	2.580	0.487	-698	4
1023	1019	1029	298.267	-67.638	49019	295.700	-68.125	49709	2.566	0.486	-690	4
1043	1047	1031	298.285	-67.621	49020	295.730	-68.096	49706	2.555	0.475	-685	4
1054	1050	1100	298.382	-67.612	49020	295.853	-68.105	49696	2.529	0.493	-676	4
1110	1115	1102	298.340	-67.583	49043	295.810	-68.080	49720	2.530	0.496	-677	4
1122	1118	1129	298.348	-67.582	48997	295.811	-68.075	49681	2.537	0.493	-684	4
1140	1144	1131	298.296	-67.592	48991	295.745	-68.094	49681	2.551	0.502	-690	4
1150	1146	1206	298.298	-67.597	48948	295.761	-68.099	49649	2.537	0.502	-700	4
average			298.139	-67.690	48990	295.552	-68.203	49689	2.587	0.513	-698	4.6
standard deviation			0.411	0.141	76	0.493	0.190	69	0.085	0.053	29	1.2
median			298.297	-67.647	49006	295.753	-68.120	49684	2.556	0.502	-697	4.5
number of observations			28	28	28	28	28	28	28	28	28	
pier correction			0.000	0.000	0				0.000	0.000	0	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			298.128	-67.697	48990	295.557	-68.210	49689	2.571	0.513	-698	
IGRF90 evaluated at 25 October 1989:												
field			298.526	-67.352	48530	295.623	-68.213	49774	2.903	0.861	-1245	
secular variation			-0.134	0.039	-63	-0.134	0.036	-62	0.000	0.003	-1	
Mawson Quiet Day Average for October 1989:						295.738	-68.145	49639				
Sampling Bias in results in the Mawson data:						-0.181	-0.065	50				

Chapter 2. Northern Prince Charles Mountains Magnetic Occupations

Many stations in the Northern Prince Charles Mountains had been previously occupied, but no documentation other than the name of the principal geographic feature and geographic coordinates to the nearest minute of latitude and longitude was available. The only geographic coordinates which could be checked were those of Moore Pyramid gravity station: in that case it was clear from altitude sunshots, comparison with the accepted coordinates of nearby Mt Wishart and the inconsistency of azimuth sunshots that the coordinates were incorrect. It was therefore impossible to locate old stations with any accuracy (except for Moore Pyramid, where reoccupation was most likely within 5 metres).

Previous occupations had been reported at:

• 71°14'S 66°30'E	Mt Woinarski	02/02/71, Z (Robertson, 1972)
• 71°20'S 67°56'E	Blustery Cliffs (Fisher Massif)	13/01/71, DHZF (Robertson, 1972)
• 70°18'S 65°15'E	Moore Pyramid	11/01/71, DHZF (Robertson, 1972)
•	Mt Forecast	(Robertson, 1972)
• 70°19'S 65°12'E	Mt Wishart	02/02/70, DHZF (Major, 1971)
• 70°16'S 65°53'E	Mt Jacklyn	28/11/56, HZ
• 70°48'S 68°23'E	Beaver Lake	01/11/58, DHZ

No station descriptions or magnetic data for these stations have been located by the author.

Marked magnetic repeat stations were established as close as practical to survey stations located on previously occupied geographic features and other features for the following reasons:
- It was the only way of obtaining accurate geographic locations for use in sunshot reductions and for magnetic mapping.
- The survey stations are well known and well marked on maps and usually have established cairns marking their location. They are also documented in surveying reports and are therefore easy to relocate.
- It was presumed that previous occupations were also in the vicinity of survey stations for the above reasons and because magnetic surveys were sometimes performed with surveyors (Robertson, 1972).

The constraints on the proximity to the survey stations were:
- artificial magnetic anomalies in the vicinity of the survey stations;
- natural local magnetic anomalies;
- terrain constraints;
- availability of a nearby campsite.

Unfortunately, almost all old survey stations are located on the peaks of mountains in difficult places to access and with inhospitable weather. There was considerable time when no work was possible at several of the stations. (Modern survey stations using satellite survey techniques are more conveniently located.) The stations where magnetic observations were made were Mount Woinarski, Blustery Cliffs, Jetty Peninsular, Else Platform, Mount Wishart, Moore Pyramid, Mount Starlight, Corry Massif and Mount Jacklyn. Mount Forecast was visited, but a preliminary F survey indicated enormous local anomalies, up to 1000 nT/m, making the area unsuitable for use in a regional survey. A site on Beaver Lake shores near the entrance to Pagodroma Gorge was examined but not occupied, and sites in Pagodroma Gorge were not occupied (even though several days were spent in the area collecting biological samples) because of the lack of accurate geographic locaters. In 1990/91 a new satellite survey station was established on Beaver Lake near the entrance to Pagodroma Gorge. This station may provide a good site for a new magnetic station. For logistic reasons, sites such as Corry Rocks, Trost Rocks and Depot Peak which would have greatly extended the surveyed region were not occupied.

All stations occupied consisted of two separate piers: an M pier which was the primary magnetic reference point used for D, I and sunshot observations using a declination-inclination fluxgate-theodolite magnetometer and an F pier which was used for F observations using a proton precession magnetometer. The M pier was marked with a small cairn amongst which was placed a 90x20x1.5 mm aluminium tag tied to one of the rocks with wire and stamped

"BMR MAG", "PCM x" where x is a capital letter starting at "A" for Mount Woinarski through to "I" for Mount Jacklyn[1]. The F pier was not tagged, but often marked with a low cairn.

The magnetic conditions during the entire survey were acceptable (the K-index at Mawson was averaged from 3 to 5 at all field stations during the occupations) and the results are a good representation of the undisturbed field at the locations occupied.

For future reoccupations of the stations occupied in 1989/90 summer, the following priorities are suggested:
- Jetty Peninsular (good weather, very low field gradients, easy access)
- Blustery Cliffs (reasonable weather, SE extreme of the area, easy access)
- Corry Massif (acceptable weather, near NW extreme of the area, reasonable access; local anomalies)
- Else Platform (good weather, NE extreme of the area, easy access; small local anomalies)
- Mt Jacklyn (moderate weather, close to Dovers, easy access by ground transport)
- Moore Pyramid (moderate weather, easy access)
- Mt Starlight (at the NW extreme of the area; not very good weather conditions, not easy access)
- Mt Wishart (poor weather, difficult access, long way to campsite)
- Mt Woinarski (notorious for bad weather, difficult access and camping).

[1]In early 1992, the following sites were reoccupied: Jetty Peninsular, Blustery Cliffs, Corry Massif, Else Platform, Mt Jacklyn, Moore Pyramid, Mount Starlight (de Deuge, 1992). During the reoccupations the M pier was marked with a brass peg and tagged "BMR MAG" "PCM x" and at all of these stations except Jetty Peninsular the former M pier tag was relocated to mark the F pier.

2.1 Station Occupation Details

Pagodroma Gorge

The gorge was visited to collect biological samples. There are countless excellent campsites with running water or lake frontage. Due to the absence of suitable geographic locaters in the gorge, no station was established. A new survey station was established on Beaver Lake near the entrance of Pagodroma Gorge in 1990/91 - this would be an excellent site for a magnetic repeat station. The survey station is AUS037 located at 70°48'28.053"S 68°09'37.910"E (WGS84) elevation 6.369 m (MSL).

Mount Forecast

It was expected that previous observations at Mt Forecast would most likely have been at the gravity station - a search for the gravity station failed - apparently it was not marked. A subsequent F survey of the area indicated very large magnetic gradients (up to 1000 nT/m); small errors in position could cause very large errors in measured field - it was therefore considered unsuitable as a repeat station.

Beaver Lake

A previous occupation had been reported at 70°48'S 68°23'E Beaver Lake 01/11/58, DHZ

There is an old "astro station" on Beaver Lake east of the entrance of Pagodroma Gorge (hand-scaled coordinates from an old map 70°50'S 68°13'E). It is unlikely that this was the station used given the large difference in longitude. The coordinates place the station about 6 km west of Jetty Peninsular ("PCM C"). With no more accurate information to go by, the Jetty Peninsular station was established in preference to using "Beaver Lake".

Mount Woinarski

Station Tag :	"BMR MAG" / "PCM A".
Adopted coordinates :	71°13'08.3"S 66°26'39.3" E, elevation 1617m.
Dates occupied:	12-19 January, 1990.
Number of observations:	13th: 2 full obs; 14th: 4 full obs.
Magnetic gradients:	indeterminate because of field activity, probably no more than a few nT/m.
Pier difference:	M-F = less than 10 nT, assumed to be 0 nT.

Nearest reference:
Survey Station NMS107 71°13'08.5636"S 66°26'40.0639"E (WGS84) elevation 1617.000 m (MSL). Established February 1970, ANARE. A station summary is available through AUSLIG . (Station Mark: 8" steel tent peg driven into rock. Beacon: Rock cairn 1.7 m diameter and 0.6 m high. Eccentric: Nil.)

Station: (See Figure 4.)
The M pier is on a rocky surface and is 12.2 m at approximately 320° (down along the ridgeline) from the survey beacon cairn NMS107. It was set up over a small existing cairn which was thought may have been Robertson's magnetic station marker. Later investigation revealed a steel tent peg under the cairn (whose magnetic effect was thought to be less than 1 nT) - it apparently was an eccentric survey station although no eccentric is documented in the AUSLIG station summary. The F pier was set up at the survey beacon cairn (there was no expectation of magnetic material being in the cairn; except for the steel peg at the base, this was most likely true). D and I observations at pier M were at a height of 1.6 m; F observations at pier F were at a height of 2.4 m. The survey beacon cairn was measured as 1.5 m in height and diameter. The previous campsite (from 20 years ago) had obviously been departed from in some haste, and the remaining tent pegs from which the tent had been cut proved of value to the author's party who established a slightly more sheltered campsite further down the hill and also departed from it in as much haste in 60 knot winds. The area has notoriously bad weather and provides few opportunities to make useful observations.

Azimuth reference:
Two reference marks were used.
• The primary reference mark "Distant" was a notch in a nearby mountain to the west.
The measured astronomical azimuth from M to "Distant" was 293°17'34"±15" (3 sunshots with reasonable timing control; DUT1=+0.3s applied). Unfortunately the altitude to mark was not measured.
• The secondary reference mark "Local" was a nearby pebble of no significance. This mark was used under poor visibility conditions.
The derived astronomical azimuth from M to "Local" was 335°31'22".

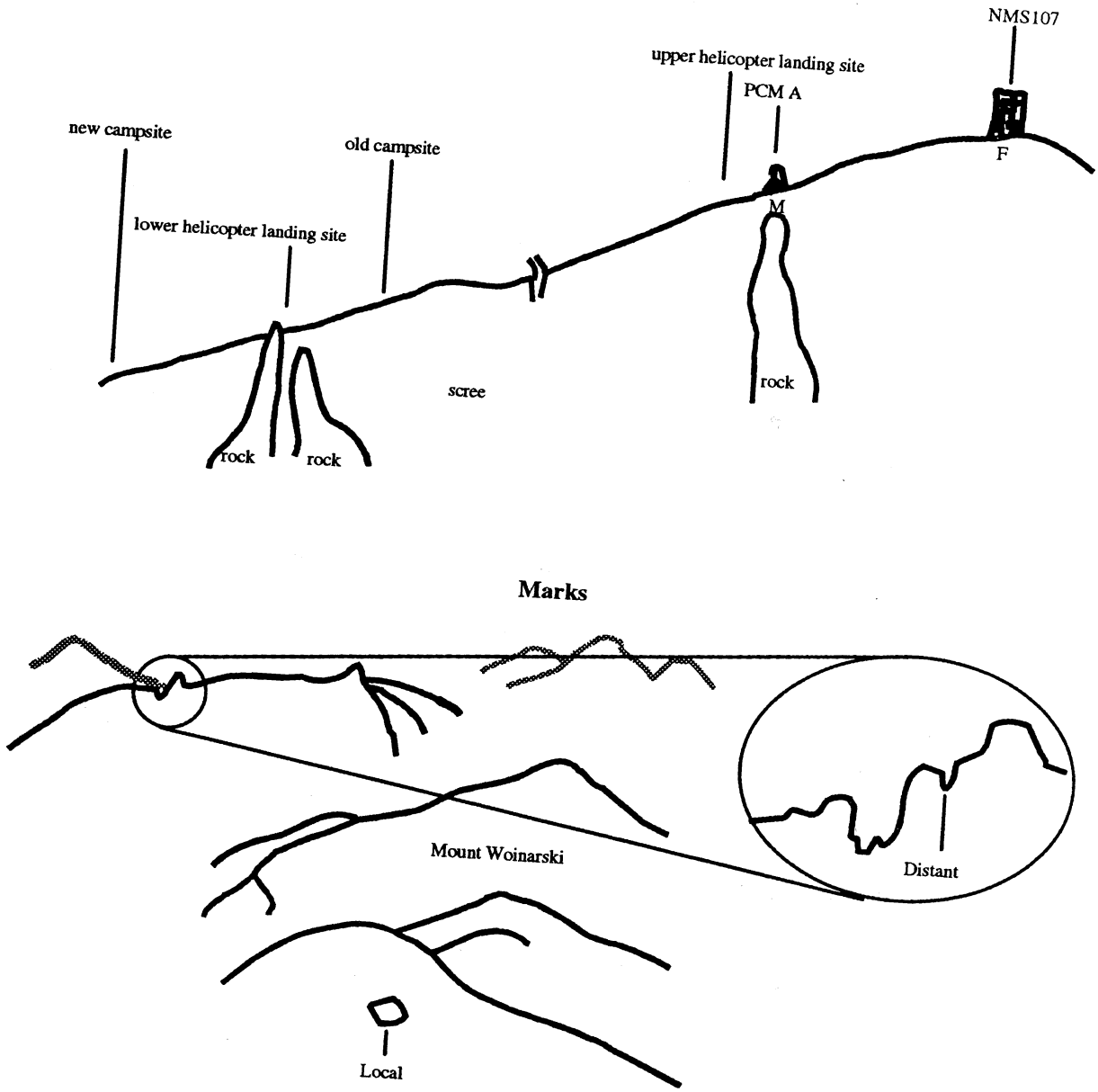
Rounds of angles: "Distant" to "Local" at M is 42°13'48".

Declinations in this report assume an azimuth of 293°17'34" from M to "Distant".

Weather conditions:
During 7 days at the site, significant magnetic work was only possible on 2 days due to very high winds, low visibility and generally unpleasant conditions. Temperatures -10 to -15 °C.

Notes:
A limited sequence of observations was obtained. Reoccupation priority is recommended as low.

Figure 4. Mt Woinarski



Blustery Cliffs

Station Tag :	"BMR MAG" / "PCM B".
Adopted coordinates :	71°25'20.6"S 67°52'52.5" E, elevation 1110m.
Dates occupied:	19-22 January, 1990.
Number of observations:	20th: 8 full and 1 half obs; 21st: 2 full and 2 half obs; 22nd: 3 full obs.
Magnetic gradients:	The field was moderately active and accurate gradients were impossible to measure. It appeared that gradients were of the order of 3 to 5 nT/m. The survey cairn was magnetic.
Pier difference:	Impossible to determine accurately. Apparently M-F = -15 nT. Adopted -14.5 nT from 1992 occupation details (de Deuge, 1992).

Nearest reference:
Survey Station NMS147 71°25'20.8026"S 67°52'52.4446"E (WGS84) elevation 1109.070 m (MSL). Established January 1969, ANARE. A station summary is available through AUSLIG (Station Mark: HF6 Meat Bar. Cairn: Ten foot rock cairn over station. Reference Mark: rock piton in small cairn 7.65 ft from station towards NMS148 Fox Ridge. Eccentric: Bamboo cane on snow dune.)

Station: (See Figure 5.)
Easy access by helicopter; good campsites within a few hundred metres. The station is on a slightly sloping flat area covered with small boulders very near the survey cairn close to the cliff edge. The M pier was 6.1 m at 2°24' from the survey beacon cairn (in the direction of the reference mark). The F pier is 5.6 m at 245°40' from M. D and I observations at pier M were at a height of 1.6 m; F observations at pier F were at a height of 1.8 m. The survey cairn was measured as 2 m high, 1.1 m diameter. There were large artificial anomalies near the survey cairn.

Azimuth reference:
• natural feature, "V"; a V in a ridge line of Fisher Massif across a valley a few kilometres away. "V" is almost on the sky line, but just backed by a distant rock feature. This mark was always visible.
The measured astronomical azimuth from M to "V" was 203°09'32"±13". (7 sunshots with good timing control; DUT1=+0.3s applied.) The measured altitude was -0°23.4'.
• Mt Woinarski survey cairn NMS107. This mark was only visible on a few occasions due to heat haze and drift on Mt Woinarski. The computed geodetic azimuth from NMS147 to NMS107 (WGS84) is 293°09'01"; distance 56 km. The derived geodetic azimuth from PCM B to NMS107 is 293°08'40".
The derived astronomical azimuth from PCM B to NMS107 cairn from rounds of angles was 293°09'14". The altitude was not measured. This indicates some problem of the order of tens of seconds of arc in azimuth.

Rounds of angles: "V" to NMS107 cairn at M is 89°59'42".

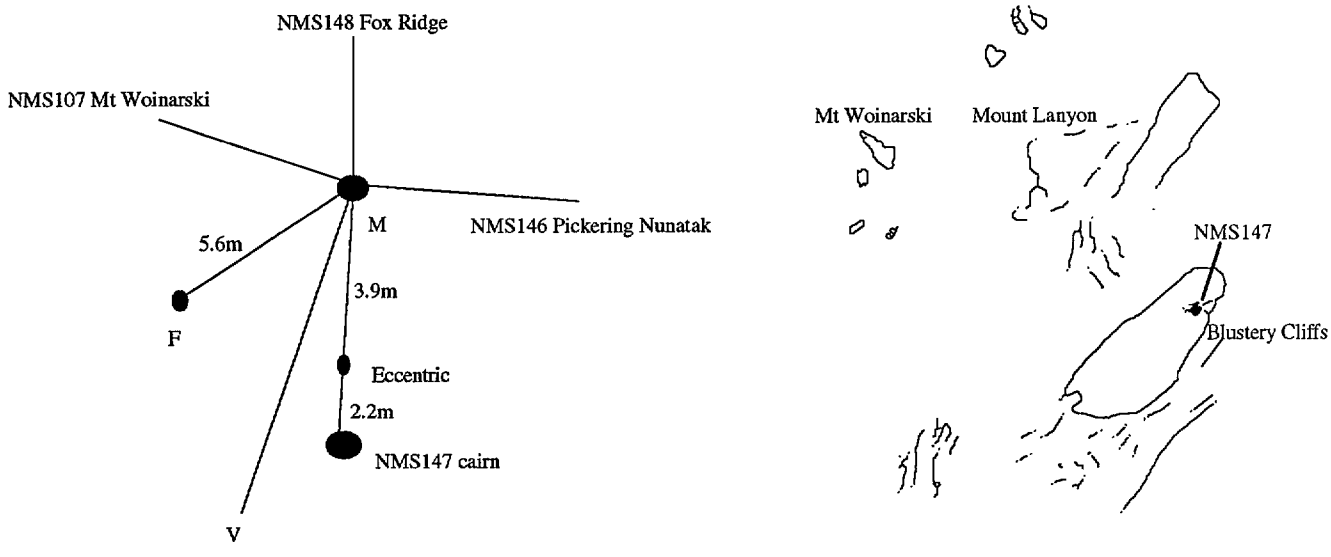
Declinations in this report assume an azimuth of 203°09'32" from M to "V".

Weather conditions:
Usually light winds and moderate temperatures even when nearby Mt Woinarski was suffering high winds.

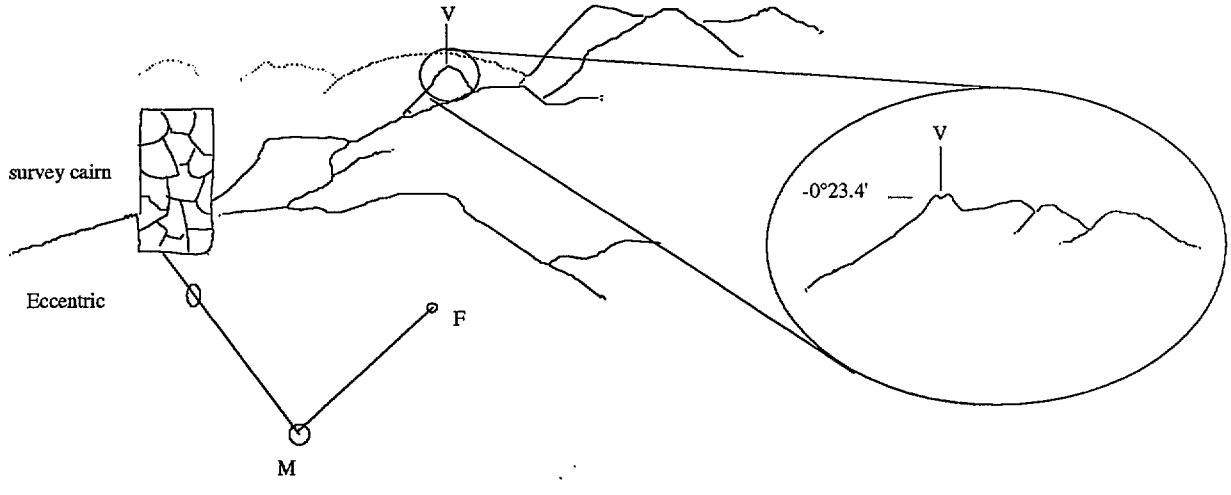
Notes:
This is a good station with moderate weather conditions at the south east corner of the northern area of the Prince Charles Mountains. A good sequence of observations was obtained. Reoccupation is recommended. The field gradients and pier differences should be confirmed during reoccupation.

Figure 5. Blustery Cliffs

Station Location



Marks



Jetty Peninsular

Station Tag :	"BMR MAG" / "PCM C".
Adopted coordinates :	70°48'48.7"S 68°32'45.5"E, elevation 201m.
Dates occupied:	25-28 January, 1990.
Number of observations:	25th: 6 full and 6 half obs; 26th: 6 half obs.
Magnetic gradients:	A quiet field on arrival enabled a quick F survey of the area to be made. The area has very low gradients (very nearly 0 nT over tens of meters); the only anomalies found were artificial ones in the vicinity of the survey beacon and fuel dumps for helicopter operations.
Pier difference:	Apparently M-F = 0 nT. Adopted 0 nT from 1992 occupation details (de Deuge, 1992).

Nearest reference:
Survey Station AUSV23 70°48'48.5"S 68°32'41.5"E (WGS84) elevation 201.898 m (MSL). Established 1968, M.J.Corry. A station summary is available through AUSLIG (AUSV23 consists of an old rock piton which is located on a low moraine and permafrost outcrop at the southernmost extremity of Jetty Peninsular. An old rock cairn and a collapsed flour drum mark the station. A new reference rock piton, surmounted by a small rock cairn, was placed on the western side of the old cairn in 1988/89.)

Station: (See Figure 6.)
Easy access by helicopter; good campsites on the ice/rock boundary very close to the observation station. The M pier is on a rocky surface downhill from the survey beacon and is 42 m at 99° from the survey peg AUSV23. The F pier is 19 m at 226° from the M pier. D and I observations at pier M were at a height of 1.5 m; F observations at pier F were at a height of 1.7 m.

Azimuth reference:
• The survey beacon Fox Ridge NMS148 on McLeod Massif (24.687 km from AUSV23) was used as a reference when possible.
The derived geodetic azimuth from AUSV23 to NMS148 is 278°44'00.9". There is no correction for the azimuth from pier M as the M, AUSV23 and NMS148 are collinear.
The measured astronomical azimuth from PCM C to NMS148 was 278°43'59"±16". (6 sunshots with good timing; DUT1=+0.3s applied.)
• A nondescript "Rock" 600 m distant was used as the reference when visibility was low.
The derived astronomical azimuth from PCM C to Rock was 12°43'20". The measured altitude was -0°43'45".

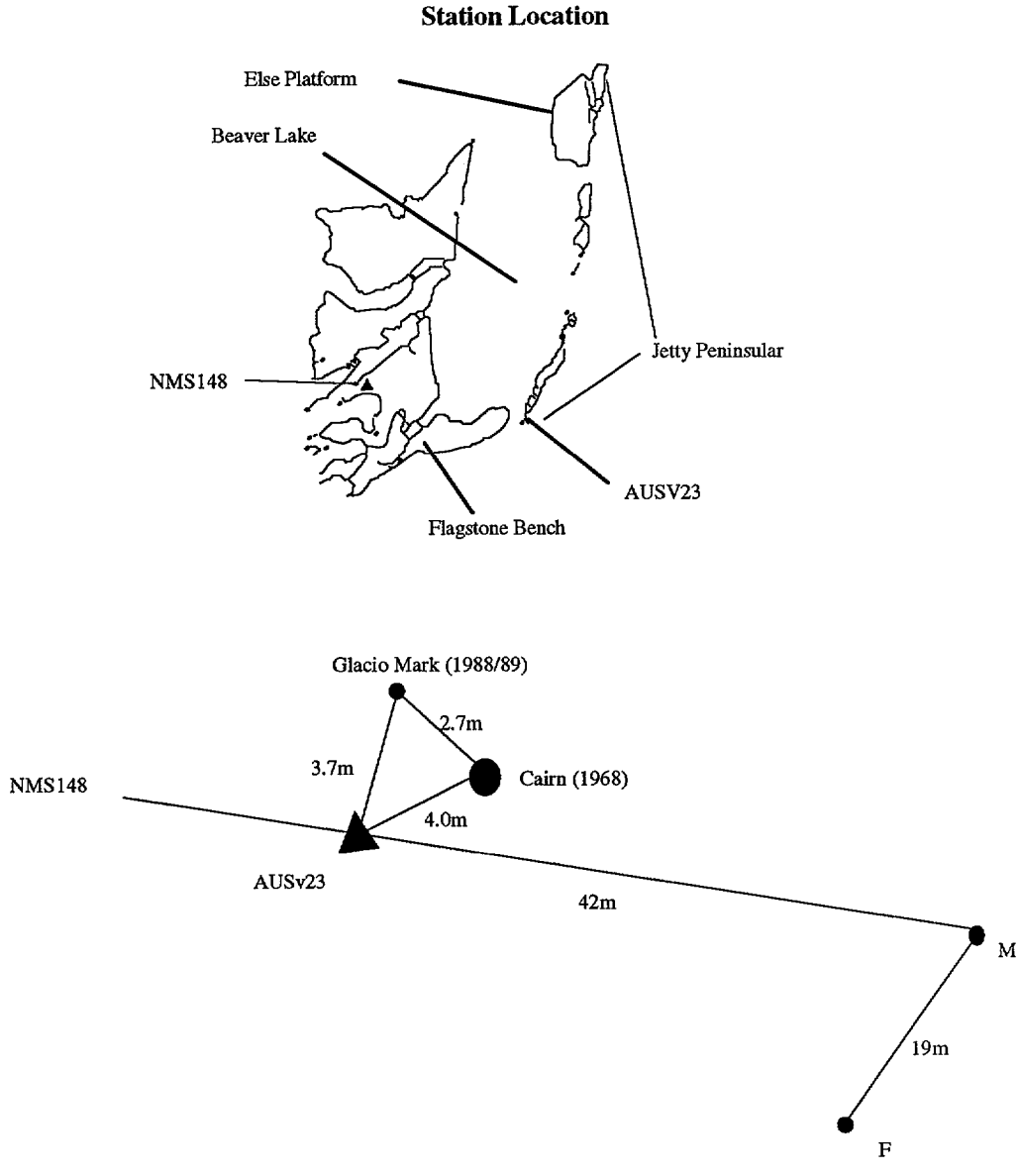
Rounds of angles: NMS148 to Rock at M is 93°59'21".

Declinations in this report assume an azimuth of 278°43'59" from PCM C to NMS148.

Weather conditions:
Usually light winds and moderate temperatures not far below 0 °C.

Notes:
The station has very low field gradients and is well documented as a survey station; it has ideal weather conditions and is near the north east corner of the northern area of the Prince Charles Mountains. A very good sequence of observations was obtained. Reoccupation is highly recommended.

Figure 6. Jetty Peninsular



Else Platform

Station Tag :	"BMR MAG" / "PCM D".
Adopted coordinates :	70°20'05.2"S 68°47'38.8"E, elevation 173m.
Dates occupied:	28-30 January, 1990.
Number of observations:	28th: 7 full and 2 half obs; 29th: 4 full and 1 half obs; 30th: 1 full obs.
Magnetic gradients:	A quiet field on arrival enabled a quick F survey of the area to be made. The area has fairly low gradients, although there are many bands of magnetic rock producing small scale low anomalies. The survey cairn knoll has a local F high value of 5-10 nT. The M pier has an F value typical of the area.
Pier difference:	Apparently M-F = 0 nT. Adopted -1.3 nT from 1992 occupation details (de Deuge, 1992).

Nearest reference:
Survey Station AUS072 70°20'04.6227"S 68°47'40.5952"E (WGS84) elevation 173.130 m (MSL). Established February 1969, ANARE. A station summary is available through AUSLIG (Previously known as NMS150 Manning Platform. Station Mark: 6" piton covered by 2 foot rock cairn. Eccentric: Nil placed.)

Station: (See Figure 7.)
Easy access by helicopter; good campsites on rock abound with the nearest melt lake a few hundred metres away. The survey beacon cairn is surrounded by 3 eye bolts and is very near the edge of the Platform. The M pier is on a sloping ramp below the knoll with the cairn and is 27.5 m at 224°13' from the survey cairn AUS072 on a sloping broken rock surface. The F pier is 8.0 m at 157°01' from the M pier. D and I observations at pier M were at a height of 1.6 m; F observations at pier F were at a height of 1.8 m. There are vast numbers of Russian built cairns and drums in the area. There is a band of magnetic rock quite close to the M and F piers.

Azimuth reference:
• A Russian cairn on the skyline which is 1°30' to the left of the F pier was used as the primary mark.
The measured astronomical azimuth from M to "Cairn" was 155°31'09"±10". The measured altitude to the base of the cairn was +1°40'. (7 sunshots with good timing control; DUT1=+0.3s applied.)
• A "V" in what was thought to be Sandilands Nunatak was used as a reference when visibility allowed.
The measured astronomical azimuth from M to "Sandilands" was 244°49'38"±2". (3 sunshots with good timing; DUT1=+0.3s applied.)

Rounds of angles: "Cairn" to "Sandilands" at M is 89°18'28".

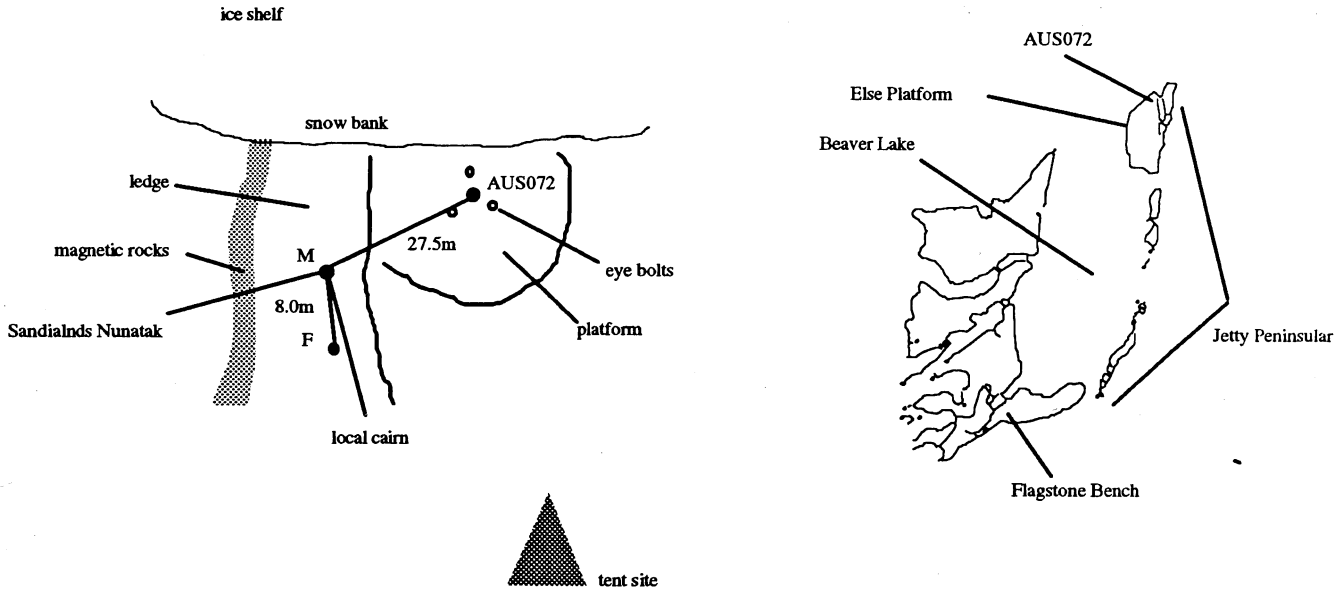
Declinations in this report assume an azimuth of 155°31'09" from M to Cairn.

Weather conditions:
Usually light winds and moderate temperatures not far below 0 °C.

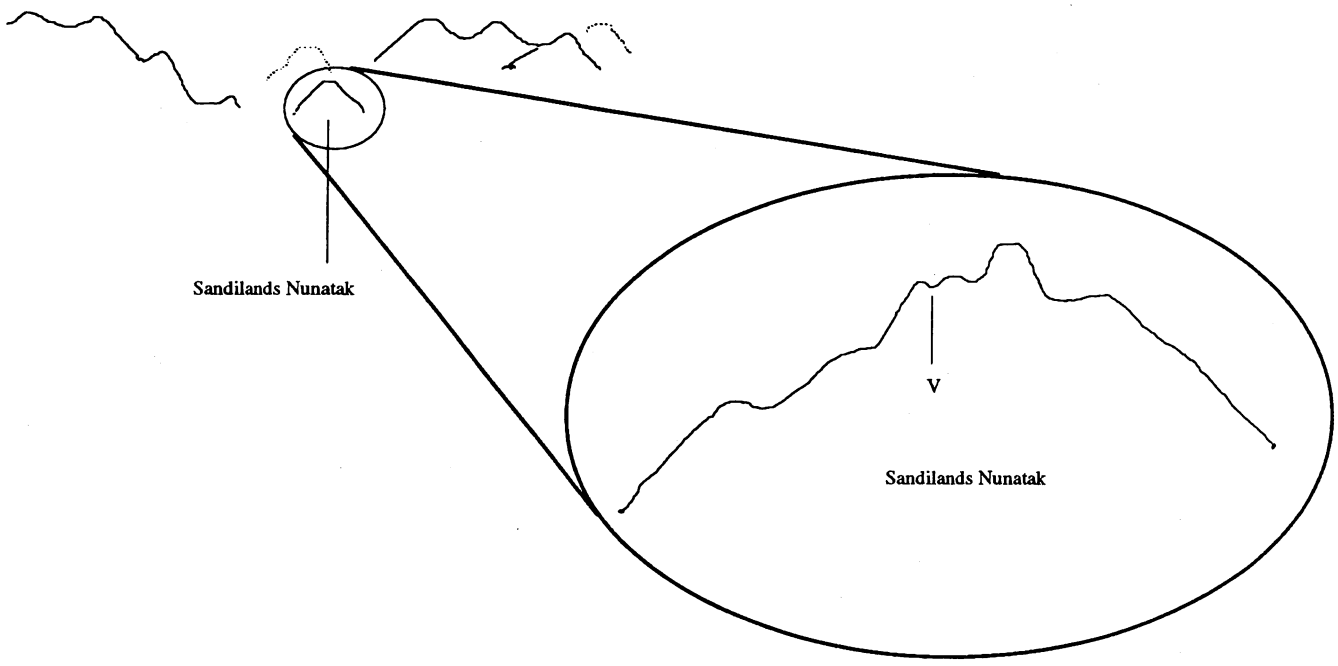
Notes:
The site has several areas of magnetic rock; it has moderate weather conditions and is at the north east corner of the northern area of the Prince Charles Mountains. A good sequence of observations was obtained. Reoccupation is recommended.

Figure 7. Else Platform

Station Location



Marks



Mount Wishart

Station Tag :	"BMR MAG" / "PCM E".
Adopted coordinates :	70°19'05.2"S 65°13'14.3"E, elevation 1640m.
Dates occupied:	30 January- 2 February, 1990.
Number of observations:	31st: 2 full obs; 1st: 3 full obs.
Magnetic gradients:	The area was difficult to survey because of the sharp dropoffs from the ridge, contamination from the survey beacon, windy conditions and moderately active field. The gradients did not appear to be too great.
Pier difference:	M-F = Apparently fairly small. Probably no more than 2 or 3 nT, assumed to be 0 nT.

Nearest reference:
Survey Station NMS120 70°19'06.2257"S 65°13'13.8147"E (WGS84) elevation 1642.210 m (MSL). Established November 1966, ANARE. A station summary is available through AUSLIG (Station Beacon: 10 foot pole with 3 foot diamond-shaped vanes, guyed. Eccentric Station: Rock piton with aluminium number tag.)

Station: (See Figure 8.)
It was impossible to land or sling load gear anywhere near the survey station. The station is on a narrow ridge with steep snow and rock slopes on both sides. It is exposed to severe wind gusts. There are very few locations useable as magnetic stations in the vicinity of the station. The only campsites are a considerable distance away; the one used was SE of the station on the snow at the base of the mountain - it was a long way to go to recover from cold hands and escape the discomfort of the high wind gusts. The M pier is on a ridge below the survey beacon and is 32 m at 9°49' from the beacon. The F pier is 9 m at 21°04' from the M pier. D and I observations at pier M were at a height of 1.6 m; F observations at pier F were at a height of 1.5 m. The PPM head was frequently blown over.

Azimuth reference:
• The primary reference mark was an apparent cairn "Moore" on Moore Pyramid.
The measured astronomical azimuth from M to "Moore" was 295°43'00"±7". The measured altitude to the base of the cairn was +4°18.1'. (7 sunshots with timing control good to a few tenths of a second; DUT1=+0.3s applied.)
• Another cairn "Leah" in the direction of Leah Ridge NMS134 was visible. The derived geodetic azimuth from NMS120 to NMS134 is 323°05'26"; distance 13.9 km. The corrected geodetic azimuth from M to "Leah" is 322°59'24". The astronomic azimuth of Leah derived from Moore sunshots and rounds of angles is 322°59'29". The measured altitude to "Leah" was +1°27.0'

Rounds of angles: "Moore" to "Leah" at M is 27°16'29".

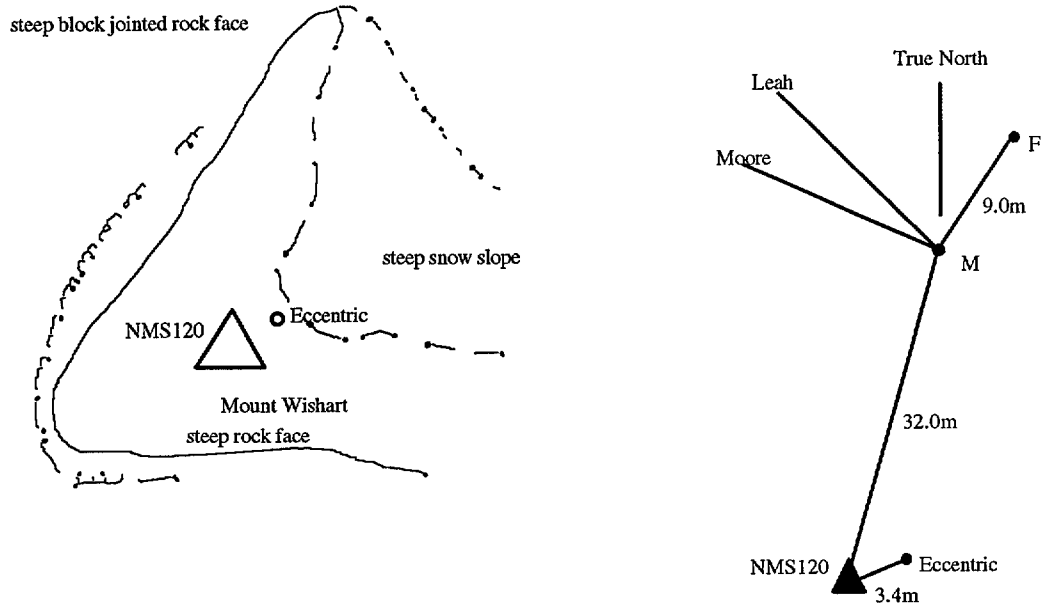
Declinations in this report assume an azimuth of 295°43'00" from M to "Moore".

Weather conditions:
Moderate temperatures of -10 to -15 °C with high wind gusts at the station and drift at the campsite lower down.

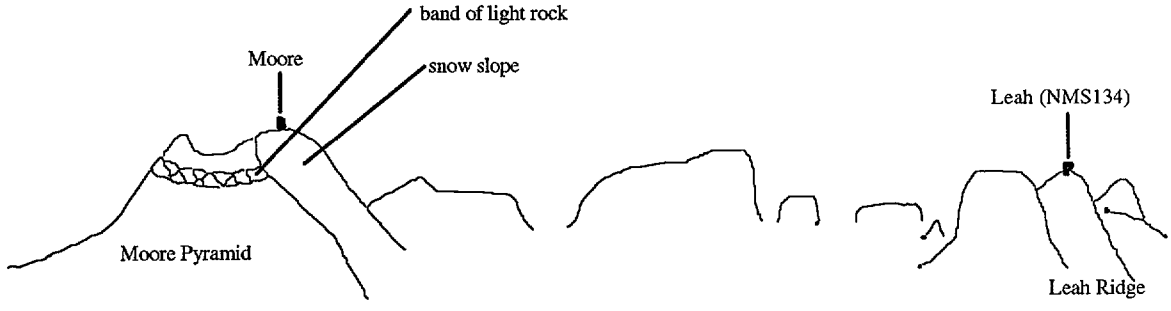
Notes:
This is a difficult station to use and is very close to the Moore Pyramid gravity and magnetic station. Sunshot timing was poor due to the distance and time taken to travel to and from the tent and radio time checks and the unpredictable rate of the watch in varying temperatures. The sequence of observations here was limited. Reoccupation is not recommended as a high priority.

Figure 8. Mt Wishart

Station Location



Marks



Moore Pyramid

Station Tag :	"BMR MAG" / "PCM F".
Adopted coordinates :	70°18'06"S 65°09'49"E, elevation nominally 1525m. (elevation derived from a relative elevation of -117m from NMS120, assuming a distance of 2827m and a measured altitude of 2°38'03".).
Dates occupied:	2-5 February, 1990.
Number of observations:	3rd: 2 full and 1 half obs; 4th: 1 full obs and 2 half obs.
Magnetic gradients:	about 1 nT/m in the local area.
Pier difference:	Apparently M-F = -5 nT. Adopted -10.2 nT from 1992 occupation details (de Deuge, 1992).

Nearest reference:
Gravity Station 7105.0020. The actual tag recorded was 7105.002, the final 0 is assumed from records. This station has been documented as 70°18.10'S 65°14.00'E (unknown elevation). Nearby 7015.0001 is recorded as 70°18.45'S 65°12.80'E, elevation 1468m. (Cooke, 1975). The documented longitude of this station is certainly incorrect. Digitising one of the original maps indicated that the location was 70°18'01"S 65°09'23"E. The location of the magnetic station was refined by taking sights on the Mt Wishart survey beacon NMS120 and constraining the results with altitude shots of the sun. The adopted location should be accurate to within a few hundred metres. Moore Pyramid NMS111 (a survey station whose position has only been determined from intersection methods) is documented as having location 70°18'20.9"S 65°08'18.7"E at 1930m, which when corrected to WGS84 is 70°18'13.4"S 65°08'13.1"E. The location of the summit (not necessarily the survey station) was digitised from the map as 70°18'10"S 65°08'07"E.

Station: (See Figure 9.)
Easy access by helicopter; good campsites on flat blue ice to the east of the observation station. The M pier is on moraine and is 4.7 m at 118°19' from the gravity station 7105.0020 (marked by a brass plate near a small cairn on top of a flat boulder on the moraine on the northern side of Moore Pyramid). The F pier is 9.5 m at 96°54' from the M pier. D and I observations at pier M were at a height of 1.6 m; F observations at pier F were at a height of 1.5 m.

Azimuth reference:
- The Mt Wishart survey beacon was the only reference.

The measured astronomical azimuth from M to "Wishart" was 131°03'38"±9". The measured altitude to the base of the beacon was +2°38.1'. (6 sunshots with good timing control; DUT1=+0.3s applied.)

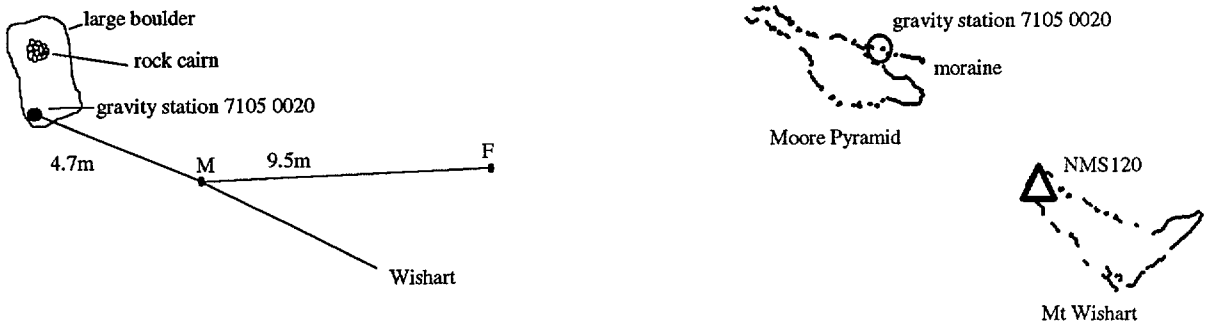
Declinations in this report assume an azimuth of 131°03'38" from M to "Wishart".

Weather conditions:
The observation station was disappointingly gusty compared to the nearby campsite a few hundred meters to the east. The area is in the lee of Moore Pyramid and subject to unpredictable 30 to 40 knot gusts from eddies. Temperatures were -15°C to -20°C. In general more pleasant than Mt Wishart a few kilometres away.

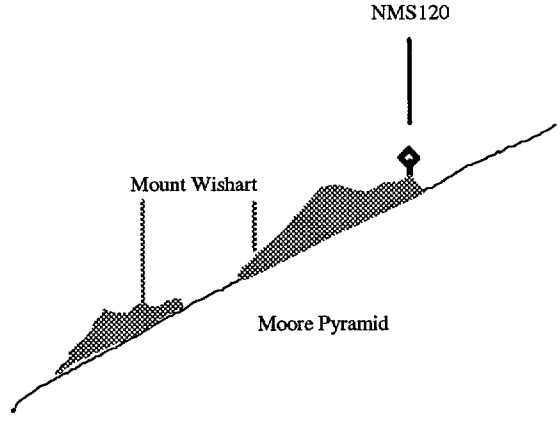
Notes:
A limited set of observations was obtained. Reoccupation is recommended in preference to the more difficult nearby station at Mt Wishart.

Figure 9. Moore Pyramid

Station Location



Marks



Mount Starlight

Station Tag :	"BMR MAG" / "PCM G".
Adopted coordinates :	70°12'17"S 64°29'23"E, elevation nominally 2145m. (elevation derived from a relative elevation of -5 m from NMS133, assuming a distance of 376 m and a measured altitude of 0°45'09". The distance from NMS133 is likely to be an underestimate).
Dates occupied:	5-8 February, 1990.
Number of observations:	6th: 2 full obs; 7th: 3 half obs.
Magnetic gradients:	appears to be low in the area.
Pier difference:	Apparently M-F = 0 nT. Adopted -2.5 nT from 1992 occupation details (de Deuge, 1992).

Nearest reference:
Survey station NMS133 70°12'17.8961"S 64°29'58.8360"E (WGS84) elevation 2150.000 m (MSL). Established November, December, 1966. A station summary is available through AUSLIG (Station Mark: 3 ft rock cairn on summit.). The surveyors description has notes about cairns on "No. 1" (the eastern) and "No. 2" (the western) peaks.
The location of the magnetic station was refined by taking sights on the known Mt Starlight NMS133 survey beacon and constraining the results with altitude shots of the sun and dubious rounds of angles to Moore Pyramid survey beacon NMS111 and Mt Bechervaise survey beacon NMS132. The adopted location should be accurate to within a few hundred metres.

Station: (See Figure 10.)
Reasonable access by helicopter to an acceptable but windy campsite on a snow platform to the west of and lower down than the observation station. Mt Starlight is blessed with two survey cairns, both on the edge of the south facing cliff line. From the helicopter the one with the closest reasonable campsite was chosen (the western cairn) which of course is not NMS133 (the eastern cairn). It is possible to traverse across a tricky slippery saddle to NMS133 from the campsite with safety ropes, but the effort is not warranted. A cairn "C" was built near the north facing cliffs overlooking a valley with distinctive moraine features to mark the magnetic station area. The M and F piers lie between and on the line joining cairn "C" and the cairn on the surveyors "No. 2" peak. The M pier is 5.4 m at 164° from "C". The F pier is 9 m at 164° from M. Both piers are on a rocky westward sloping surface. They are slightly protected from the wind but still subject to severe erratic gusts. D and I observations at pier M were at a height of 1.6 m; F observations at pier F were at a height of 1.8 m.

Azimuth reference:
• The survey cairn on "No. 1" peak "Trig" was used as the primary reference. In its 1990 manifestation, the cairn had a sharp rock on top to provide a good reference.
The measured astronomical azimuth from M to "Trig" was 94°17'09"±10".(3 sunshots with good timing control; DUT1=+0.3s applied.) The measured altitude to the base of the beacon was +0°45'09".
• The survey cairn on "No. 2" peak may be useful as a locater, although it is too broad for an azimuth reference. Its elevation was +2°53'. The derived astronomical azimuth from M to the cairn is 163°53'.
• A feature that may have been Mt Bechervaise NMS132 survey beacon was observed at an altitude of +0°18'18". The derived geodetic azimuth from NMS133 to NMS132 is 84 09'41.55"; distance 11.537 km. The derived astronomical azimuth from M to the feature is 84°35'33".
• A feature that may have been Moore Pyramid NMS111 survey beacon was observed at an altitude of -0°34'54". The derived geodetic azimuth from NMS133 to NMS111 is 114 55'11.95"; distance 26.442 km. The derived astronomical azimuth from M to the feature is 114°42'33".
• A natural feature apparently on Moore Pyramid was observed at an altitude of -0°37'12". The derived astronomical azimuth from M to the feature is 114°54'51".

Rounds of angles: The angle at pier M between Trig and:
• No. 2 cairn is 69°36'.
• NMS132? is -9°41'36".
• NMS111? is 20°25'24".
• Moore? feature 20°37'42".

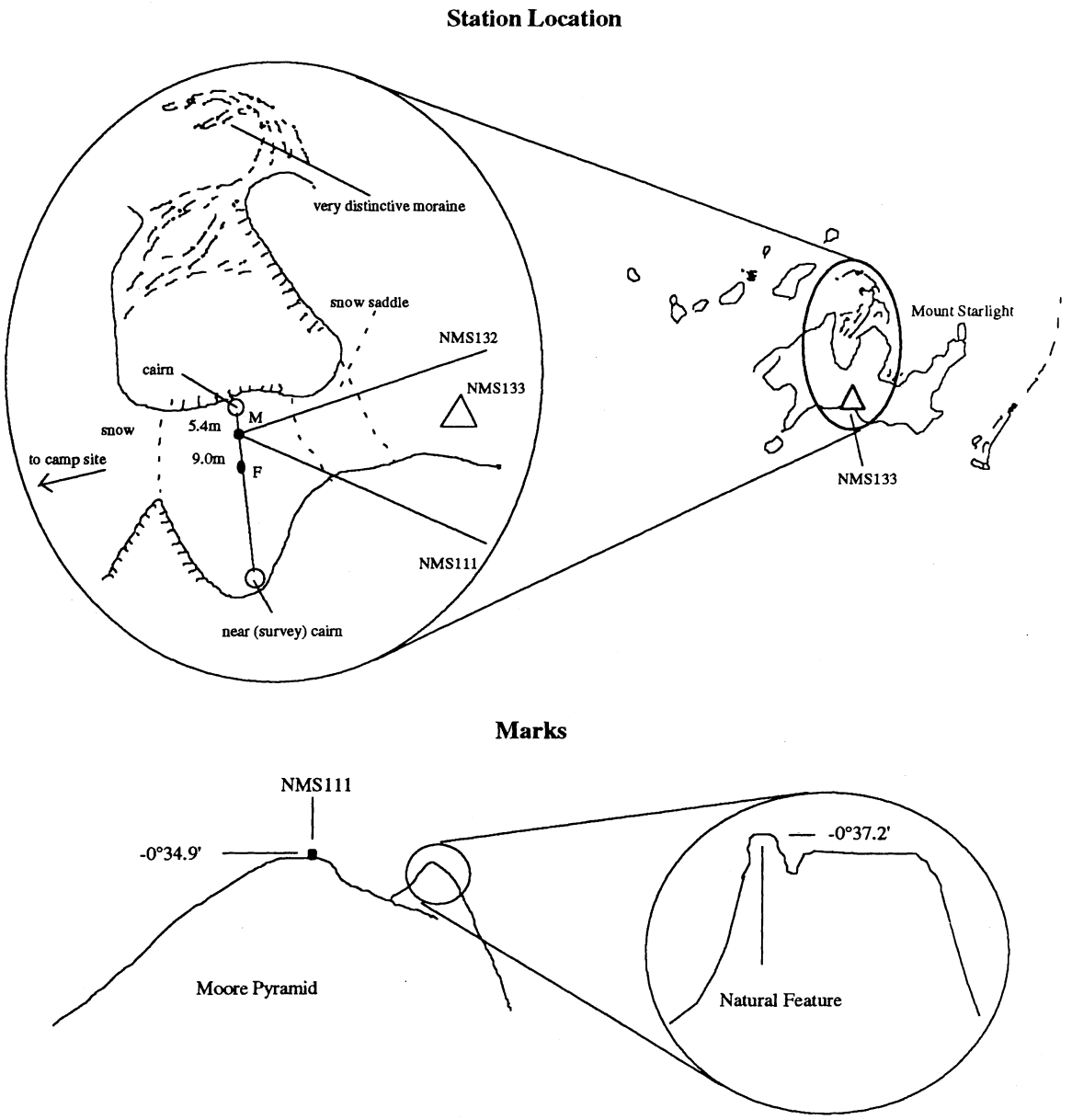
Declinations in this report assume an azimuth of 94°17'09" from M to "Trig".

Weather conditions:

Temperatures were about -20°C and winds gusting to 40 or 50 knots.

Notes:
A limited set of observations was obtained. Reoccupation is recommended as a low priority; nearby Corry Massif is an easier station to work.

Figure 10. Mount Starlight



Corry Massif

Station Tag :	"BMR MAG" / "PCM H".
Adopted coordinates :	70°26'57.5"S 64°39'26.0" E, elevation 2065m.
Dates occupied:	10-12 February, 1990.
Number of observations:	10th: 1 full obs; 11th: 3 full obs.
Magnetic gradients:	A quiet field on arrival enabled a quick F survey of the area to be made. The area has fairly low gradients on the whole, although there are many bands of magnetic rock producing anomalies of 100 to 150 nT. The M and F piers were situated in an area away from the anomalies in an unfortunately windy spot.
Pier difference:	M-F = apparently quite low, at most 2 nT. Adopted +2.5 nT from 1992 occupation details (de Deuge, 1992).

Nearest reference:
Survey Station NMS176 70°26'57.5513"S 64°39'29.6199"E (WGS84) elevation 2065.000 m (MSL). A station summary is available through AUSLIG (it consists of only a pair of aerial photographs). The survey beacon is a rock cairn built around two fuel drums. There is an eccentric station nearby.

Station: (See Figure 11.)
Easy access by helicopter; good campsites on rock or snow abound. The M pier is on a flat broken rock surface and is 37.5 m at 267°38' from the survey cairn NMS176. The F pier is 12.5 m at 87°38' from the M pier (back towards the survey cairn). D and I observations at pier M were at a height of 1.5 m; F observations at pier F were at a height of 1.8 m.

Azimuth reference:
• The primary reference mark "Hill" was a small scale near vertical section of rock near the top of the hill on Corry Massif some hundreds of metres west of the cairn.
The measured astronomical azimuth from M to "Hill" was 267°57'59"±3" (6 sunshots with good timing control of which 3 were rejected because of difficult observing conditions; DUT1=+0.3s applied.) The feature was at an elevation of -0°13' from M.
• A brief view of a nunatak between Mt Starlight and Mt Bechervaise provided an opportunity to provide a locater for the nondescript primary reference mark. The peak of the nunatak was used as a mark. From rounds of angles its derived azimuth is 3°26'53" and its altitude is -0°10.9'. Although no survey beacon was observed on the nunatak and NMS119 is located on Mt Lacey approximately 28 km away, it is likely that the nunatak is Mt Lacey as it is the only feature near that azimuth.[2]

Rounds of angles: "Hill" to "Nunatak" at M is 95°28'54". Hill to Mt Wishart at M is approximately 147°03.4'. Hill to NMS176 Cairn at M is approximately 179°40.2'. (The survey cairn, F, M and Hill are roughly collinear.)

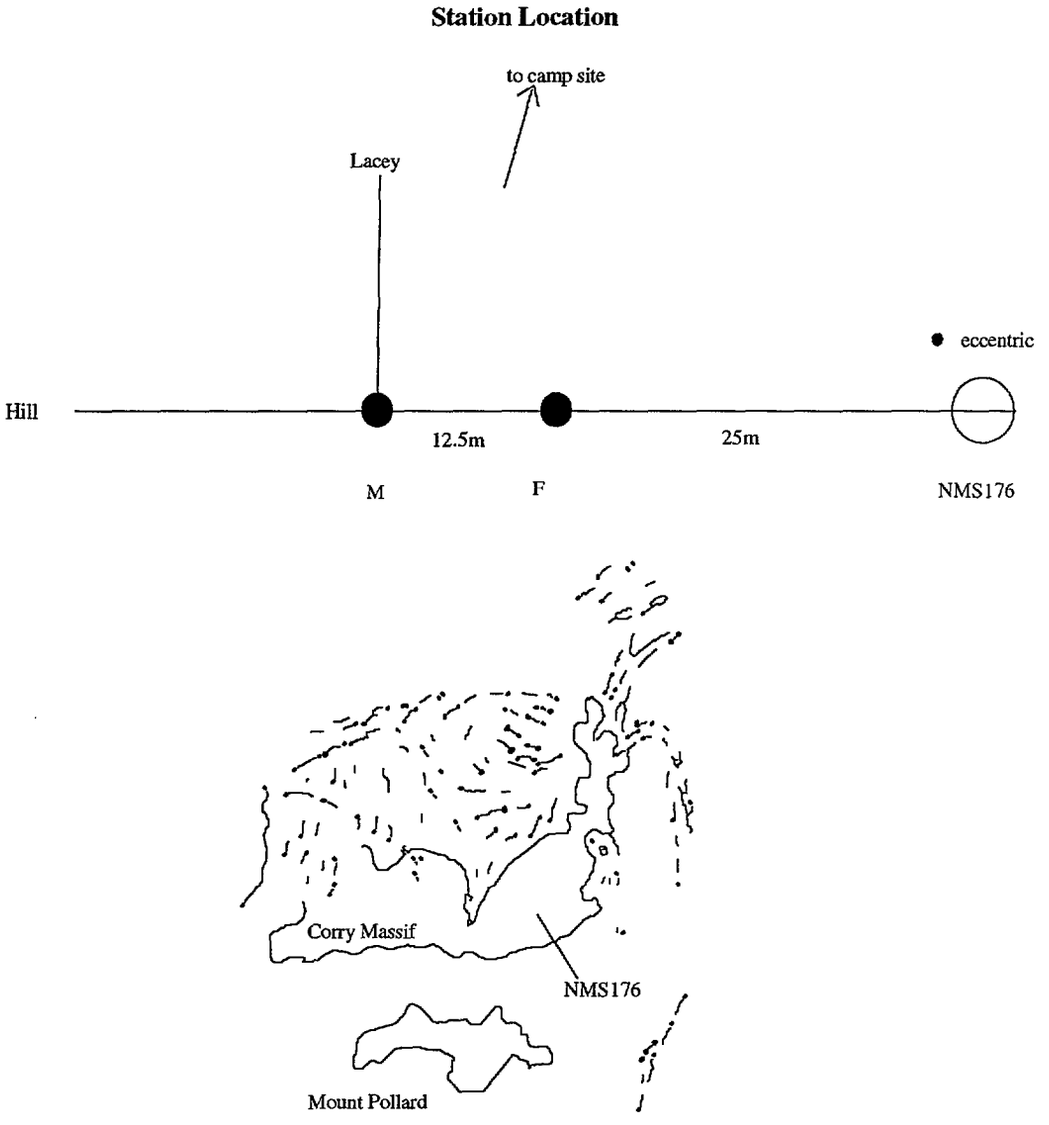
Declinations in this report assume an azimuth of 267°57'59" from M to "Hill".

Weather conditions:
Usually moderate winds when nearby mountains were experiencing high winds and temperatures of -15 to -20 °C.

Notes:
The station has several areas of magnetic rock; it has moderate weather conditions for the high altitude western region and is at the north west corner of the northern area of the Prince Charles Mountains. A limited sequence of observations was obtained. Reoccupation is recommended.

[2]This feature was confirmed to be Mt Lacey during the 1992 occupation. (de Deuge, 1992).

Figure 11. Corry Massif



Mount Jacklyn

Station Tag :	"BMR MAG" / "PCM I".
Adopted coordinates :	70°15'13.2" S 65°50'53.8" E, elevation 1109m.
Dates occupied:	13-15 February, 1990.
Number of observations:	13th: 3 full obs; 15th: 1 half obs.
Magnetic gradients:	low.
Pier difference:	M-F = Apparently 0 nT. Adopted -1.7 nT from 1992 occupation details (de Deuge, 1992).

Nearest reference:

• Survey Station AUS016 "Dovers" 70°15'12.5433"S 65°50'55.4088"E (WGS84) elevation 1109.600 m (WGS84). Established December 1988, AUSLIG. A station summary is available through AUSLIG . (Station Mark: Galvanised iron eye bolt set in rock surrounded by a ring of rocks. A rock cairn 1 m high has been built on a high rock boulder nearby to help locate the station mark. A small brass plate (0.025x0.075m) stamped with the station number is affixed to rock nearby. Beacon: Nil. Reference Marks: Nil. Access: The station is located on a large flat rock between several large boulders at the northern base of Mt Jacklyn East Peak. Access is a simple 2.7 km drive across the ice from Dovers Base Camp.

• Survey Station "Jacklyn" NMS158 70°16'14.8018"S 65°47'19.6772"E (WGS84) elevation 1557.000 m (MSL) was not used because of difficulty of access.

Station: (See Figure 12.)

Easy access by vehicle from Dovers base camp. The M pier is on a flat soil surface and is 25 m at 220°52' from the survey station AUS016. The F pier is 17 m at 76°12' from the M pier (about 15 m from AUS016). D and I observations at pier M were at a height of 1.6 m; F observations at pier F were at a height of 1.8 m. The survey station was difficult to locate without local knowledge. Unfortunately the AUSLIG map on the station summary is of little value and the station is not marked on most available maps (at 1990). The author's failing memory of Jacklyn is inadequate, but from Dovers it is necessary to go down a steepish ice slope to get to a rocky slope heading up towards Jacklyn East. The station is a considerable distance up the slope which eventually ends in a ridge overlooking a large hollow in Jacklyn. Back sightings on the Mt Farley mark may be useful (and even altitude sights) if locating the mark proves difficult.

Azimuth reference:

Two reference marks were used depending on visibility.

• The primary reference mark "Nunatak" was a vertical section of rock on the left a nunatak to the west.

The measured astronomical azimuth from M to "Nunatak" was 279°15'36"±10". (2 sunshots with reasonable timing control; DUT1=+0.3s applied.) The measured altitude to mark was +2°36'.

• The secondary reference mark "Farley" was a V in the rock to the left of Mt Farley peak.

The measured astronomical azimuth from M to "Farley" was 307°24'18".(1 sunshot with reasonable timing control; DUT1=+0.3s applied.) The measured altitude to mark was +5°21'.

Rounds of angles: Nunatak to Farley at M is 28°08'50".

Declinations in this report assume an azimuth of 279°15'36" from M to "Nunatak".

Weather conditions:

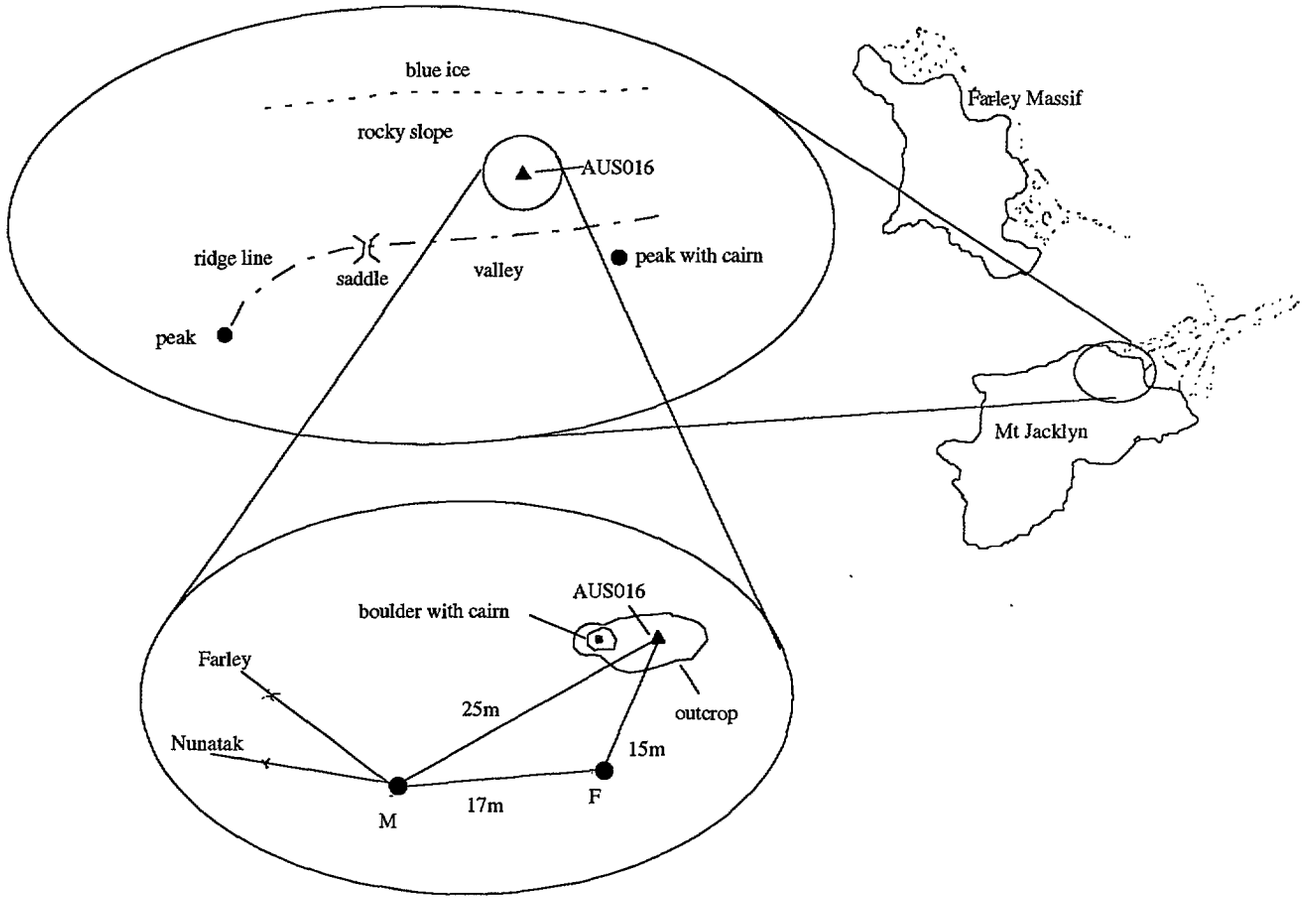
Better conditions than Dovers which was usually in drift. Temperatures -10 to -15 °C.

Notes:

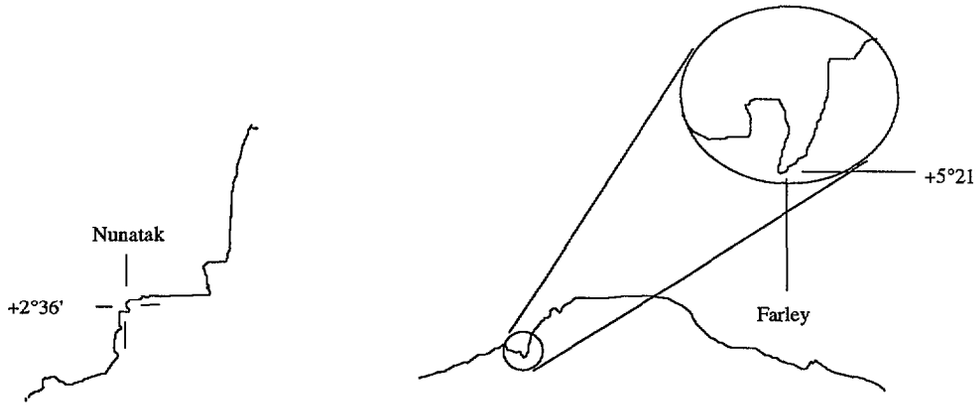
A limited sequence of observations was obtained. Reoccupation is recommended only because of ease of access.

Figure 12. Mount Jacklyn

Station Location



Marks



2.2 Magnetic Measurements

The following tables list the results of geomagnetic observations in the Prince Charles Mountains.

The information in the tables is grouped into five sets of columns:
- the time (UTC) of the start of the observation of each magnetic field element (D, I and F)
- the instrumentally observed value of the field elements at the field station
- the average value of the field elements at Mawson during the observation of the same field elements at the field station (as measured by the Mawson variometer using adopted baseline values (Lewis, 1991))
- the difference between the instrumental field observation and the Mawson variometer data
- the K-index at Mawson at the time of the observation

A summary of the information includes the mean, standard deviation, median and number of observations for each of the columns of magnetic data.

Field measurements are corrected for:
- pier differences when more than one observing pier was used;
- instrumental differences between the field instruments and Mawson standard instruments;
- preliminary estimates of the instrumental differences between the Mawson standard instruments and the international geomagnetic standards (Lewis, 1990).

The IGRF 1991 Revision predicted field and secular variation at Mawson and the field station at the time of the observation are also listed (at the table entry "IGRF90 evaluated at ...").

In order to estimate the reliability of the field observations as an estimate of the "undisturbed" field value at the stations, the average field at Mawson during the same minutes the field observations were made are compared to the Mawson "Quiet-Day Mean Field Value" for the month. However, note that the 1992 January and February Mawson "Quiet Day Mean Field" differ by 1.9', 0.4' and 15nT in D, I and F. The IGRF-predicted secular variation in D, I and F at Mawson is 0.7', 0.2' and 4.9 nT per month. Clearly the Quiet-Day Mean Field for the month is not a reliable baseline.

Mt Woinarski

Time			Mt Woinarski			Mawson			Mt Woinarski - Mawson			
D	I	F	D	I	F	D	I	F	D	I	F	K-index
13 January 1990												
0543	0553	0536	289.505	-69.672	51822	295.489	-68.097	49614	-5.983	-1.575	2208	4
0609	0601	0619	289.284	-69.661	51770	295.404	-68.097	49550	-6.120	-1.564	2220	4
1431	1442	1421	289.865	-69.567	51838	295.768	-68.091	49619	-5.903	-1.476	2219	3
1455	1448	1506	289.806	-69.555	51837	295.736	-68.091	49644	-5.930	-1.464	2193	3
14 January 1990												
0635	0643	0627	289.446	-69.590	51778	295.491	-68.079	49570	-6.045	-1.511	2208	3
0656	0649	0704	289.511	-69.588	51767	295.544	-68.083	49567	-6.033	-1.505	2200	3
0757	0803	0752	289.528	-69.608	51772	295.566	-68.109	49565	-6.037	-1.498	2207	3
0814	0808	0822	289.534	-69.619	51759	295.577	-68.110	49559	-6.043	-1.509	2200	3
1313	1320	1311	289.697	-69.453	51710	295.866	-67.965	49633	-6.169	-1.488	2077	4
1331	1325	1337	289.726	-69.488	51620	295.889	-67.958	49621	-6.163	-1.530	1999	4
1341	1347	1339	289.664	-69.522	51604	295.930	-67.881	49615	-6.266	-1.641	1989	4
1357	1351	1402	289.744	-69.492	51637	295.861	-67.893	49595	-6.117	-1.599	2043	4
average			289.609	-69.568	51743	295.677	-68.038	49596	-6.067	-1.530	2147	3.5
standard deviation			0.168	0.069	82	0.185	0.087	32	0.105	0.054	91	0.5
median			289.599	-69.578	51769	295.657	-68.087	49605	-6.044	-1.510	2200	3.5
number of observations			12	12	12	12	12	12	12	12	12	
pier correction			0.000	0.000	0				0.000	0.000	0	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			289.597	-69.575	51743	295.682	-68.045	49596	-6.084	-1.530	2147	
IGRF90 evaluated at 14 January 1990:												
field			290.069	-69.742	51891	295.593	-68.205	49761	-5.524	-1.537	2130	
secular variation			-0.116	0.036	-63	-0.134	0.031	-59	0.018	0.005	-4	
Mawson Quiet Day Average for January 1990:						295.731	-68.110	49634				
Sampling Bias in results in the Mawson data:						-0.050	0.065	-37				

Blustery Cliffs

Time			Blustery Cliffs			Mawson			Blustery Cliffs - Mawson			
D	I	F	D	I	F	D	I	F	D	I	F	K-index
20 January 1990												
0653	0660	0650	288.401	-70.453	52743	295.667	-68.065	49557	-7.266	-2.388	3186	5
0712	0705	0719	288.591	-70.484	52815	295.740	-68.075	49528	-7.150	-2.409	3287	5
0905	0911	0902	288.541	-70.553	52787	295.804	-68.146	49563	-7.263	-2.407	3224	3
0922	0916	0929	288.488	-70.555	52782	295.772	-68.144	49601	-7.284	-2.411	3181	3
1004	1010	0955	288.686	-70.529	52839	295.828	-68.149	49598	-7.143	-2.380	3242	3
1022	1015	1031	288.699	-70.515	52845	295.862	-68.146	49631	-7.164	-2.369	3214	3
1105	1111	1100	288.727	-70.413	52840	295.915	-68.129	49653	-7.188	-2.284	3188	3
1121	1116	1128	288.643	-70.422	52879	295.846	-68.115	49664	-7.203	-2.307	3215	3
1141	1146	1137	288.654	-70.436	52869	295.848	-68.140	49700	-7.194	-2.295	3169	3
1155	1150	1202	288.712	-70.446	52862	295.854	-68.139	49713	-7.142	-2.308	3149	3
1313	1318	1308	288.590	-70.364	52974	295.853	-68.059	49733	-7.263	-2.305	3241	5
1328	1323	1336	288.501	-70.284	52985	295.799	-68.058	49762	-7.298	-2.227	3222	5
1535	1539	1529	288.699	-70.291	52407	296.039	-67.713	49561	-7.340	-2.578	2846	6
1549	1544	1555	288.850	-70.300	52457	296.085	-67.742	49505	-7.234	-2.558	2952	6
1640	1646	1636	289.122	-70.468	52572	296.188	-67.999	49498	-7.066	-2.469	3073	6
1657	1651	1704	289.376	-70.533	52729	296.406	-68.084	49618	-7.030	-2.449	3111	6
1739	1745	1735	289.026	-70.673	52633	296.003	-68.108	49421	-6.977	-2.564	3212	6
21 January 1990												
0410	0415	0402	288.800	-70.455	52864	295.580	-68.174	49639	-6.780	-2.281	3224	4
0427	0420	0434	288.772	-70.442	52975	295.596	-68.188	49718	-6.824	-2.254	3256	4
0610	0615	0605	288.859	-70.280	52989	295.489	-68.265	49668	-6.630	-2.015	3321	5
0626	0620	0631	289.070	-70.264	53016	295.373	-68.362	49860	-6.303	-1.903	3157	5
1448	1453	1444	288.470	-70.236	52673	295.828	-67.789	49649	-7.358	-2.447	3024	4
1613	1617	1609	288.530	-70.340	52674	295.750	-67.972	49602	-7.220	-2.368	3073	5
22 January 1990												
0159	0204	0154	289.020	-70.286	52888	296.083	-68.050	49769	-7.063	-2.236	3119	5
0215	0209	0221	289.134	-70.282	52905	296.217	-68.045	49794	-7.083	-2.237	3112	5
0344	0349	0337	288.655	-70.273	52951	295.613	-68.098	49847	-6.958	-2.176	3104	6
0359	0353	0404	288.676	-70.263	52988	295.574	-68.092	49868	-6.897	-2.171	3120	6
0528	0532	0522	288.511	-70.214	52873	295.824	-67.921	49805	-7.313	-2.293	3068	6
0543	0538	0549	288.809	-70.247	52768	295.947	-67.954	49772	-7.137	-2.293	2996	6
average			288.745	-70.390	52813	295.841	-68.066	49665	-7.096	-2.324	3148	4.7
standard deviation			0.234	0.121	155	0.226	0.141	115	0.232	0.148	104	1.2
median			288.699	-70.413	52845	295.828	-68.092	49653	-7.150	-2.307	3169	5.0
number of observations			29	29	29	29	29	29	29	29	29	
pier correction			0.000	0.000	-15				0.000	0.000	-15	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			288.734	-70.396	52799	295.846	-68.073	49666	-7.112	-2.324	3133	
IGRF90 evaluated at 21 January 1990:												
field			288.699	-70.077	52345	295.591	-68.205	49760	-6.892	-1.872	2586	
secular variation			-0.116	0.036	-63	-0.134	0.031	-59	0.018	0.005	-4	

Mawson Quiet Day Average for January 1990: 295.731 -68.110 49634

Sampling Bias in results in the Mawson data: 0.114 0.037 32

Jetty Peninsular

Time D	Time I	Time F	Jetty Peninsular D	Jetty Peninsular I	Jetty Peninsular F	Mawson D	Mawson I	Mawson F	Jetty Peninsular - Mawson D	Jetty Peninsular - Mawson I	Jetty Peninsular - Mawson F	K-index
25 January 1990												
0908	0913	0901	288.390	-70.049	52448	295.392	-68.073	49620	-7.002	-1.976	2827	5
0924	0918	0930	288.817	-70.026	52474	295.683	-68.089	49684	-6.866	-1.937	2790	5
1008	1013	1001	288.913	-69.985	52368	295.750	-68.099	49630	-6.836	-1.885	2738	5
1021	1017	1029	288.916	-69.994	52338	295.729	-68.113	49610	-6.813	-1.881	2728	5
1106	1112	1101	288.777	-69.929	52349	295.704	-68.045	49662	-6.927	-1.884	2687	5
1122	1117	1128	288.883	-69.948	52268	295.855	-68.020	49667	-6.972	-1.928	2601	5
1206	1210	1201	288.613	-69.981	52144	295.548	-67.841	49530	-6.935	-2.140	2614	4
1219	1215	1225	288.535	-69.963	52231	295.444	-67.825	49503	-6.909	-2.138	2728	4
1304	1308	1301	288.809	-69.899	52254	295.742	-67.980	49635	-6.933	-1.918	2619	4
1317	1313	1322	288.898	-69.901	52304	295.742	-67.986	49601	-6.844	-1.916	2704	4
1404	1408	1401	288.988	-69.944	52346	295.792	-68.056	49623	-6.804	-1.887	2723	4
1418	1413	1423	289.074	-69.882	52223	295.910	-68.018	49689	-6.836	-1.864	2533	4
1519	1525	1516	289.052	-69.911	52114	295.852	-67.972	49550	-6.800	-1.939	2564	4
		1531			52227			49595			2632	4
1606	1610	1601	288.980	-69.952	52221	295.715	-67.959	49586	-6.735	-1.993	2635	4
		1616			52222			49593			2629	4
1704	1709	1701	289.054	-69.970	52333	295.777	-68.072	49618	-6.723	-1.898	2715	4
		1718			52350			49632			2717	4
1819	1824	1816	289.129	-70.061	52356	295.821	-68.068	49518	-6.692	-1.993	2838	4
		1831			52341			49564			2776	4
1953	1959	1949	288.996	-69.964	52343	295.739	-68.064	49620	-6.743	-1.900	2722	4
		2006			52351			49623			2728	4
2205	2209	2200	289.157	-69.964	52419	295.809	-68.196	49702	-6.652	-1.768	2717	4
		2217			52478			49736			2742	4
26 January 1990												
0041	0048	0035	289.416	-70.160	52442	295.932	-68.285	49610	-6.517	-1.875	2832	4
		0056			52469			49637			2832	4
0307	0313	0300	288.997	-69.959	52490	295.601	-68.168	49658	-6.604	-1.791	2832	6
		0321			52474			49665			2809	6
0436	0442	0430	289.086	-69.935	52483	295.495	-68.192	49760	-6.409	-1.743	2724	6
		0449			52508			49683			2825	6
		0542			52620			49603			3018	6
0611	0617	0606	288.405	-70.177	52565	295.205	-68.272	49534	-6.800	-1.905	3031	5
		0624			52571			49536			3035	5
		0718			52465			49565			2901	5
0745	0750	0738	288.669	-70.156	52550	295.587	-68.164	49566	-6.919	-1.991	2984	5
		0756			52437			49598			2839	5
		0840			52343			49604			2740	5
0905	0910	0902	288.947	-70.038	52358	295.770	-68.132	49631	-6.823	-1.906	2727	4
		0920			52365			49620			2745	4
average			288.896	-69.990	52375	295.691	-68.070	49617	-6.796	-1.919	2758	4.6
standard deviation			0.241	0.082	120	0.173	0.114	57	0.144	0.093	121	0.7
median			288.932	-69.964	52356	295.741	-68.070	49620	-6.818	-1.906	2728	4.0
number of observations			24	24	39	24	24	39	24	24	39	
pier correction			0.000	0.000	0				0.000	0.000	0	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			288.884	-69.996	52376	295.696	-68.077	49617	-6.812	-1.919	2758	
IGRF90 evaluated at 26 January 1990:												
field			288.661	-70.100	52391	295.589	-68.204	49759	-6.928	-1.896	2632	
secular variation			-0.120	0.035	-62	-0.134	0.031	-59	0.014	0.004	-3	
Mawson Quiet Day Average for January 1990:						295.731	-68.110	49634				
Sampling Bias in results in the Mawson data:						-0.035	0.033	-16				

Else Platform

Time D	Time I	Time F	Else Platform D	Else Platform I	Else Platform F	Mawson D	Mawson I	Mawson F	Else Platform - Mawson D	Else Platform - Mawson I	Else Platform - Mawson F	K-index
28 January 1990												
0058	0103	0052	288.838	-69.978	52295	295.735	-68.068	49637	-6.897	-1.910	2658	2
		0108			52279			49640			2639	2
0845	0850	0840	288.824	-70.043	52237	295.680	-68.120	49573	-6.856	-1.923	2664	3
		0856			52329			49568			2761	3
0904	0908	0901	288.839	-70.052	52233	295.701	-68.125	49574	-6.862	-1.928	2659	2
0917	0912	0922	288.865	-70.045	52233	295.723	-68.123	49573	-6.858	-1.923	2660	2
1005	1009	0957	288.886	-70.050	52235	295.740	-68.137	49582	-6.854	-1.913	2653	2
1016	1012	1021	288.899	-70.058	52239	295.747	-68.140	49582	-6.848	-1.918	2657	2
1043	1047	1038	288.920	-70.056	52245	295.765	-68.142	49590	-6.845	-1.914	2655	2
1055	1051	1101	288.967	-70.057	52254	295.779	-68.146	49600	-6.812	-1.911	2654	2
1204	1207	1200	288.960	-70.035	52267	295.764	-68.131	49609	-6.804	-1.904	2657	3
1214	1211	1219	288.950	-70.038	52262	295.762	-68.132	49611	-6.812	-1.906	2651	3
1302	1305	1259	288.968	-70.025	52265	295.783	-68.126	49617	-6.815	-1.899	2648	3
1313	1310	1318	288.971	-70.041	52273	295.798	-68.123	49620	-6.826	-1.918	2653	3
1504	1508	1501	288.936	-69.989	52277	295.744	-68.101	49619	-6.808	-1.889	2659	3
1516	1512	1520	288.938	-70.008	52280	295.743	-68.105	49624	-6.805	-1.903	2656	3
1701	1705	1658	288.945	-70.007	52257	295.752	-68.102	49614	-6.807	-1.906	2644	3
1713	1709	1718	288.948	-70.008	52253	295.759	-68.098	49600	-6.812	-1.910	2652	3
29 January 1990												
0311		0418	289.072		52455	295.657		49703	-6.585		2752	5
0445	0449	0441	289.243	-69.873	52466	295.387	-68.219	49756	-6.145	-1.654	2710	5
0457	0453	0501	289.406	-69.867	52462	295.530	-68.251	49850	-6.124	-1.616	2612	5
0639	0643	0636	287.922	-70.039	52633	294.667	-68.473	49856	-6.744	-1.566	2777	6
0652	0647	0657	288.068	-70.106	52565	294.752	-68.513	49812	-6.684	-1.593	2753	6
0828	0834	0821	288.814	-70.175	52286	295.714	-68.205	49597	-6.900	-1.970	2689	6
0851	0847	0857	288.693	-70.220	52305	295.711	-68.161	49617	-7.018	-2.059	2688	6
1202	1206	1200	288.655	-69.735	52359	295.714	-67.890	49736	-7.060	-1.845	2623	5
		1212			52258			49754			2504	5
30 January 1990												
0911	0915	0903	289.057	-70.052	52311	295.987	-68.120	49627	-6.930	-1.932	2684	3
0924	0919	0932	289.030	-70.095	52305	295.879	-68.128	49600	-6.850	-1.967	2705	3
average			288.870	-70.026	52314	295.653	-68.155	49646	-6.783	-1.871	2668	3.5
standard deviation			0.298	0.095	103	0.297	0.120	84	0.211	0.124	52	1.4
median			288.937	-70.041	52277	295.742	-68.128	49617	-6.821	-1.910	2657	3.0
number of observations			26	25	29	26	25	29	26	25	29	
pier correction			0.000	0.000	-1				0.000	0.000	-1	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			288.858	-70.033	52313	295.658	-68.162	49646	-6.800	-1.871	2667	
IGRF90 evaluated at 29 January 1990:												
field			288.862	-70.069	52341	295.588	-68.204	49758	-6.726	-1.865	2583	
secular variation			-0.123	0.034	-62	-0.134	0.031	-59	0.011	0.003	-3	

Mawson Quiet Day Average for January 1990: 295.731 -68.110 49634

Sampling Bias in results in the Mawson data: -0.074 -0.052 13

Mount Wishart

Time D	Time I	Time F	Mt Wishart D	Mt Wishart I	Mt Wishart F	Mawson D	Mawson I	Mawson F	Mt Wishart - Mawson D	Mt Wishart - Mawson I	Mt Wishart - Mawson F	K-index
31 January 1990												
1026	1032	1022	292.327	-69.217	51366	296.014	-68.114	49750	-3.687	-1.103	1617	5
1043	1036	1054	292.135	-69.173	51275	295.886	-68.070	49654	-3.752	-1.104	1621	5
1156	1201	1149	291.950	-69.132	51257	295.817	-68.047	49651	-3.867	-1.086	1606	5
1214	1207	1222	291.888	-69.169	51305	295.767	-68.053	49665	-3.880	-1.116	1640	5
01 February 1990												
0540	0547	0533	291.297	-69.238	51638	294.908	-68.326	49823	-3.612	-0.912	1815	6
0605	0554	0614	291.493	-69.287	51571	294.980	-68.404	49661	-3.487	-0.883	1910	6
0721	0726	0714	291.413	-69.373	51232	295.533	-68.138	49541	-4.120	-1.235	1691	5
0739	0732	0747	291.625	-69.345	51207	295.616	-68.132	49557	-3.990	-1.213	1650	5
0822	0828	0817	291.771	-69.257	51198	295.584	-68.120	49589	-3.813	-1.137	1609	5
0843	0836	0835	291.990	-69.259	51208	295.737	-68.128	49607	-3.748	-1.132	1601	5
average			291.789	-69.245	51326	295.584	-68.153	49650	-3.796	-1.092	1676	5.2
standard deviation			0.331	0.077	156	0.367	0.118	86	0.183	0.113	104	0.4
median			291.830	-69.248	51266	295.677	-68.124	49653	-3.783	-1.110	1631	5.0
number of observations			10	10	10	10	10	10	10	10	10	
pier correction			0.000	0.000	0				0.000	0.000	0	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			291.777	-69.252	51326	295.589	-68.160	49650	-3.812	-1.092	1676	
IGRF90 evaluated at 31January 1990:												
field			291.784	-69.299	51285	295.587	-68.204	49758	-3.803	-1.095	1527	
secular variation			-0.121	0.035	-63	-0.134	0.031	-59	0.013	0.004	-4	
Mawson Quiet Day Average for February 199(						295.700	-68.117	49618				
Sampling Bias in results in the Mawson data:						-0.111	-0.043	32				

Moore Pyramid

Time			Moore Pyramid			Mawson			Moore Pyramid - Mawson			
D	I	F	D	I	F	D	I	F	D	I	F	K-index
03 February 1990												
0642	0649	0634	292.443	-69.260	51341	295.579	-68.115	49595	-3.136	-1.144	1745	3
0709	0701	0719	292.438	-69.278	51346	295.587	-68.117	49578	-3.149	-1.161	1769	3
0841	0847	0834	292.360	-69.272	51301	295.595	-68.114	49584	-3.235	-1.158	1718	3
0858	0852	0906	292.464	-69.261	51314	295.636	-68.112	49575	-3.173	-1.149	1738	3
1128	1138	1122	292.607	-69.270	51352	295.736	-68.144	49619	-3.128	-1.126	1733	4
		1153			51349			49609			1740	4
04 February 1990												
0422	0432	0409	292.691	-69.100	51669	295.359	-68.086	49934	-2.668	-1.014	1735	5
		0441			51606			49890			1716	5
1223	1229	1219	292.647	-69.228	51372	295.795	-68.115	49625	-3.148	-1.112	1747	4
1243	1237	1250	292.561	-69.210	51377	295.798	-68.105	49674	-3.237	-1.105	1703	4
1317	1323	1315	292.597	-69.170	51376	295.789	-68.068	49644	-3.192	-1.102	1732	4
		1344			51365			49655			1710	4
average			292.534	-69.228	51397	295.653	-68.108	49665	-3.118	-1.119	1732	3.8
standard deviation			0.112	0.060	115	0.144	0.021	120	0.174	0.045	18	0.7
median			292.561	-69.260	51359	295.636	-68.114	49622	-3.149	-1.126	1734	4.0
number of observations			9	9	12	9	9	12	9	9	12	
pier correction			0.000	0.000	-10				0.000	0.000	-10	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			292.523	-69.234	51387	295.658	-68.115	49665	-3.135	-1.119	1722	
IGRF90 evaluated at 03 February 1990:												
field			291.842	-69.283	51266	295.586	-68.203	49757	-3.744	-1.080	1509	
secular variation			-0.121	0.035	-63	-0.134	0.031	-59	0.013	0.004	-4	
Mawson Quiet Day Average for February 199(						295.700	-68.117	49618				
Sampling Bias in results in the Mawson data:						-0.042	0.002	47				

Mount Starlight

Time D	Time I	Time F	Mt Starlight D	Mt Starlight I	Mt Starlight F	Mawson D	Mawson I	Mawson F	Mt Starlight - Mawson D	Mt Starlight - Mawson I	Mt Starlight - Mawson F	K-index
06 February 1990												
0910	0922	0902	292.483	-69.043	50948	295.682	-68.113	49590	-3.200	-0.930	1358	2
0942	0935	0950	292.428	-69.033	50934	295.684	-68.109	49590	-3.257	-0.924	1344	2
1228	1235	1222	292.516	-69.026	50977	295.703	-68.114	49625	-3.187	-0.912	1351	2
1252	1245	1258	292.508	-69.019	50979	295.698	-68.109	49624	-3.189	-0.910	1355	2
07 February 1990												
0635	0645	0622	291.710	-69.231	50811	295.394	-68.144	49447	-3.685	-1.087	1365	5
0713	0705	0729	291.565	-69.388	50947	295.179	-68.260	49421	-3.614	-1.128	1526	5
1310	1319	1307	292.291	-68.895	50732	295.625	-67.894	49447	-3.334	-1.001	1285	5
		1330			50760			49464			1297	5
average			292.214	-69.091	50886	295.566	-68.106	49526	-3.352	-0.985	1360	3.5
standard deviation			0.404	0.164	101	0.203	0.108	89	0.210	0.090	73	1.6
median			292.428	-69.033	50941	295.682	-68.113	49527	-3.257	-0.930	1353	3.5
number of observations			7	7	8	7	7	8	7	7	8	
pier correction			0.000	0.000	-3				0.000	0.000	-3	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			292.203	-69.097	50884	295.571	-68.113	49526	-3.369	-0.985	1358	
IGRF90 evaluated at 07 February 1990:												
field			292.463	-69.123	51031	295.585	-68.203	49757	-3.122	-0.920	1274	
secular variation			-0.121	0.035	-63	-0.134	0.031	-59	0.013	0.004	-4	
Mawson Quiet Day Average for February 199(						295.700	-68.117	49618				
Sampling Bias in results in the Mawson data:						-0.129	0.004	-92				

Corry Massif

Time			Corry Massif			Mawson			Corry Massif - Mawson			
D	I	F	D	I	F	D	I	F	D	I	F	K-index
10 February 1990												
1302	1312	1255	292.356	-69.155	51118	295.769	-68.100	49634	-3.414	-1.056	1484	4
1331	1323	1341	292.363	-69.155	51117	295.771	-68.101	49637	-3.409	-1.054	1480	4
11 February 1990												
0607	0617	0601	292.019	-69.213	51126	295.516	-68.088	49657	-3.497	-1.125	1469	4
0642	0634	0652	291.929	-69.215	51040	295.463	-68.079	49553	-3.534	-1.136	1487	4
0827	0834	0818	292.296	-69.172	51068	295.709	-68.101	49589	-3.413	-1.071	1479	4
0852	0844	0901	292.108	-69.175	51079	295.581	-68.095	49580	-3.473	-1.080	1499	4
1127	1133	1107	292.407	-69.174	51124	295.808	-68.119	49653	-3.401	-1.055	1470	3
1155	1148	1205	292.419	-69.190	51149	295.786	-68.135	49651	-3.367	-1.055	1498	3
average			292.237	-69.181	51103	295.675	-68.102	49619	-3.439	-1.079	1483	3.8
standard deviation			0.191	0.023	36	0.135	0.018	40	0.057	0.033	11	0.5
median			292.326	-69.175	51118	295.739	-68.101	49636	-3.414	-1.064	1482	4.0
number of observations			8	8	8	8	8	8	8	8	8	
pier correction			0.000	0.000	3				0.000	0.000	3	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			292.225	-69.188	51105	295.680	-68.109	49619	-3.455	-1.079	1486	
IGRF90 evaluated at 10 February 1990:												
field			292.139	-69.209	51155	295.583	-68.203	49756	-3.444	-1.006	1399	
secular variation			-0.119	0.036	-63	-0.134	0.031	-59	0.015	0.005	-4	
Mawson Quiet Day Average for February 199(						295.700	-68.117	49618				
Sampling Bias in results in the Mawson data:						-0.020	0.008	1				

Mount Jacklyn

Time D	Time I	Time F	Mt Jacklyn D	Mt Jacklyn I	Mt Jacklyn F	Mawson D	Mawson I	Mawson F	Mt Jacklyn - Mawson D	Mt Jacklyn - Mawson I	Mt Jacklyn - Mawson F	K-index
13 February 1990												
0757	0801	0739	291.311	-69.324	51359	295.650	-68.132	49567	-4.338	-1.192	1792	2
0809	0805	0815	291.292	-69.325	51356	295.653	-68.129	49575	-4.361	-1.196	1782	2
1019	1023	1013	291.387	-69.294	51386	295.739	-68.123	49601	-4.352	-1.171	1785	3
1033	1028	1041	291.369	-69.290	51392	295.735	-68.116	49606	-4.366	-1.175	1786	3
1130	1135	1122	291.440	-69.273	51409	295.787	-68.105	49625	-4.347	-1.168	1784	3
1147	1141	1155	291.449	-69.258	51417	295.794	-68.099	49623	-4.344	-1.159	1794	3
15 February 1990												
1248	1255	1242	291.534	-69.163	51382	295.852	-68.038	49608	-4.318	-1.126	1774	4
		1302			51286			49641			1645	4
average			291.397	-69.275	51373	295.744	-68.106	49606	-4.347	-1.170	1768	3.0
standard deviation			0.084	0.055	41	0.074	0.032	25	0.016	0.023	50	0.8
median			291.387	-69.290	51384	295.739	-68.116	49607	-4.347	-1.171	1785	3.0
number of observations			7	7	8	7	7	8	7	7	8	
pier correction			0.000	0.000	-2				0.000	0.000	-2	
field instrument cor'n			-0.017	0.000	0				-0.017	0.000	0	
Mawson preliminary instrument correction			0.005	-0.007	0	0.005	-0.007	0				
Adopted			291.386	-69.282	51372	295.749	-68.113	49606	-4.363	-1.170	1766	
IGRF90 evaluated at 14 February 1990:												
field			291.320	-69.416	51454	295.582	-68.203	49756	-4.262	-1.213	1698	
secular variation			-0.121	0.035	-62	-0.134	0.031	-59	0.013	0.004	-3	
Mawson Quiet Day Average for February 199(						295.700	-68.117	49618				
Sampling Bias in results in the Mawson data:						0.049	0.004	-12				

Chapter 3. Survey Equipment and Procedures

The following describes the equipment used by the author in Kemp Land and the northern Prince Charles Mountains.

3.1 Absolute Instruments

The instruments used for field measurements were:

- PPM Elsec 770/206 (used in the Bolts-Up orientation in Kemp Land and Bolts-Down orientation in Prince Charles Mountains) for **F** (a proton precession magnetometer);
- DIM Elsec 810/213, Theodolite 311542 for **D** and **I** (and surveying) (a Declination-Inclination fluxgate-theodolite magnetometer).

Comparisons of these instruments to the Mawson standards are given in the 1989 Mawson Observatory Report (Crosthwaite, 1991) and the 1990 Mawson Observatory Report (Lewis, 1991). As the field observations at field stations will be compared to the field at the corresponding time at Mawson in the tables in this report, the following instrument corrections have been applied to all observations quoted in this report:

• Corrected D	value	= DIM Elsec 810/213 observed value	-1.0'
• Corrected I	value	= DIM Elsec 810/213 observed value	+0.0'
• Corrected F	value	= PPM Elsec 770/206(bolts up) observed value	+0 nT
• Corrected F	value	= PPM Elsec 770/206(bolts down) observed value	+0 nT

There is some concern about these corrections. The Mawson F standard in 1989 was PPM 199(bolts up) and in 1990 was PPM 199(bolts down). Comparisons indicate a 3 or 4 nT difference in operating PPM 199 in these two modes. Comparisons in 1989 indicate that PPM 206 is unaffected by its orientation and that it gives the same results as PPM 199(bolts up). Comparisons in 1990 indicate that PPM 206(bolts down) gives the same results as PPM 199(bolts down). So this cast a 4 nT doubt on the accuracy of the F results, and consequently a 1.0' doubt on the accuracy of the I results.

When using the DIM to measure D, the vertical circle was set to 90 or 270 immediately prior to every horizontal circle reading even when a rotation from "Vertical Circle North" to "South" (for example) would not be expected to alter the vertical circle reading. This was done as the theodolites used with the DIMs are gimbaled devices, and the vertical circle reading may change during a rotation in the horizontal plane if the alidade is not level. The DIM observations were sometimes "full sheet" (a symmetric schedule measuring D, I, I and D) and sometimes "half sheet" (a schedule of only one D and one I measurement) observations. It was found that "half sheet" observations were more useful, particularly during stormy periods, and "full sheet" observations were processed as two "half sheet" observations.

The DIM was secured by the screw thread to a DIM tripod. The PPM was used on the PPM extendable pole at various heights, usually at nearly the same height as the DIM, supported either by the DIM tripod at the DIM observation station (Kemp Land) or by another wooden makeshift tripod at an auxiliary pier (Prince Charles Mountains).

3.2 Absolute Instrument Performance

Declination Inclination Magnetometer 213/Theodolite 311542

The instrument was left at the observation station during most occupations and was always used at ambient temperature. In general it performed very well, only presenting difficulties at temperatures below -20°C. At such temperatures it was sometimes necessary to warm the electronics and batteries in the tent before continuing. The most serious problem at such temperatures was the slow response of the Liquid Crystal Display - frequently a moderately active field would cause the units digit to have all elements on, thus displaying "8". It was important to **face the LCD towards the sun** to get direct heat absorption. It appeared that the instrument was at the limit of its capabilities at such temperatures. (The DIM used in the Lambert Glacier Basin traverse was used at temperatures down to -35°C, but in such cases was taken directly from a heated environment to the observation station and kept warm by body contact with an assistant to the observer). The DIM had a low power consumption and needed only a single set of batteries for the Prince

Charles Mountains work. The most serious fault with the DIM was the cable connecting the sensor on the theodolite to the electronics box. The connection at the sensor received an enormous amount of twisting and turning - as the cable was not designed for cold conditions it was near to breaking for the latter part of the field work (indeed it did break on return to Mawson and was unserviceable for the following 12 months). The cable was also too short for use in windy rocky sites in the field. **Future Antarctic DIMs should have long cold tolerant cables.** The second difficulty with the DIM was the poor battery retainer setup. It was discovered that certain brands of batteries would not fit easily into the instrument and that the retainer was barely capable of securing the batteries resulting in unreliable electrical contacts and instrument operation (and the need to use up valuable minutes of finger cold exposure to repairs rather than observations). Even considering these problems, the DIM was an excellent instrument for use in the field in cold and gusty conditions.

PPM 206

The instrument was left at the observation station during most occupations and was always used at ambient temperature. In general it performed very well, only presenting difficulties at temperatures below -20°C and occasionally in high winds where it gave erratic results. It was important to always **face the LCD towards the sun** to get direct heat absorption as for the DIM. The PPM was heavy on power consumption and needed three sets of batteries for the Prince Charles Mountains work. A minor fault with the PPM was the fragility of the cable connections to the sensor. The cable connections broke on several occasions (and, incidentally, the PPM continued to register a signal strength of 5 (good) even with no connection to the sensor head). **Future Antarctic PPMs should have long cold tolerant cables.** Another difficulty with the PPM was the poor battery retainer setup which was exactly the same as for the DIM.

3.3 Equipment Checklist

The following checklist may be of value for future field work:

- DIM electronics box, service and user manual.
- DIM theodolite and matching tripod (with securing bolt); theodolite tool kit (including brass screw driver for adjustment to the fluxgate sensor orientation) and sunfilters for sun observations.
- PPM electronics box, PPM head, extension poles, service and user manual.
- Extra wooden tripod for supporting the PPM.
- Ample supply of batteries for the DIM and PPM.
- Foam support boxes for the DIM and PPM electronics.
- DIF observations forms. Sunshot observation form.
- Thermometer and barometer (or hand help altimeter) for determining atmospheric corrections to altitude observations of the sun.
- HB pencils and pens which work in the cold and don't run when wet (eg Ball Pentel Black or Red). A non magnetic clip board with ample supply of elastic bands to retain observation forms in extremely windy conditions.
- Hand help magnetic compass.
- Programmable calculator and manual; a sun almanac program. Nautical almanac as backup.
- Field note books. Station and azimuth mark description proformas.
- Long tape measure for station descriptions.
- Non magnetic TAGS or other station markers for attaching to observation stations.
- Maps and previous station descriptions.
- Two multi function time pieces (time of day/stop watch). If the stop/reset buttons on the watches are too easily operated, then a they should be modified to accept a "securing pin" to prevent accidental operation. Most time pieces are unfortunately magnetic - non magnetic units would be far better.
- A radio, spare batteries, manual and long wire/dipole aerials for time signal reception. The Sony ICF-2001D AIR/FM/LW/MW/SW PLL synthesised receiver worked very well in the Prince Charles Mountains.
- Silk inner gloves, kidskin leather gloves, "fold back" woollen mittens that allow use of the fingers when necessary.
- Tape, string, stationary, torch, batteries, map reading items such as rulers, protractors etc.

No survey tent or shelter was used at any of the Kemp Land or Prince Charles Mountains stations; indeed, it would have been inconvenient and difficult to use such a tent at most locations. A non magnetic survey tent (with non magnetic pegs) was used in the Lambert Glacier Basin Traverse field work.

Only one PPM was used in the field work. The major problem with this was that, in most cases, it was impossible to determine accurate F pier differences between piers, or to determine accurate F gradients. This problem was circumvented in Kemp Land by performing all observations on the same pier. In the more adverse weather and poorer

visibility conditions in the Prince Charles Mountains, it was necessary to use two piers: to reduce the time taken to perform an observation; and so that the DIM could be left in situ while near marks were used during poor visibility without severe reduction in the accuracy of azimuth reference. To make observations on dual piers more accurate a second PPM would be highly desirable. A portable variometer to obtain results of first-order survey quality is also highly desirable.

3.4 Establishing New Stations

New magnetic observation stations were established near existing survey stations for the following reasons:
- It was the most accurate way of determining geographic coordinates of the station. (Accurate coordinates are essential for accurate reduction of sunshot observations.)
- Survey stations are marked on most published maps, are well documented and easy to locate.
- The drawback for using these locations is that non-satellite survey stations are often weather beaten stations difficult to work.

As the author had no experience in establishing magnetic stations and no description of how to go about it, he developed a sequence of operation as the Prince Charles Mountains survey progressed. This may be of use to future observers:

Once the locality of a new station had been chosen, a quick F survey of the area was carried out to determine local natural and artificial anomalies so that the most suitable site based on the following criteria could be made:
- low magnetic gradients, and a field value most typical of the general area.
- proximity to a survey station and campsite, ease of access and description.
- visibility of appropriate azimuth marks.
- lack of snow cover, ground stability, protection from weather if at all possible.

Then the M and F piers were setup and the tripod legs were securely buried with large rocks to prevent the instruments from being blown over. If F was unknown, the DIM was used to get an approximate value of the field by aligning the fluxgate sensor with the field and taking the μT reading. The F pier difference between the DIM and PPM tripods was determined whenever the field was quiet enough.

If visibility was suitable, then a selection of azimuth marks was made. It was found that three marks at least were needed at varying distances from the station as visibility was quite variable. (Distant marks are most accurate but only local marks (anything from 50 to several hundred metres) may be visible during poor conditions; sometimes a distant, intermediate and local mark were used.) In good conditions, particularly on cloudy days when heat haze was not a problem, survey beacons 30 km or more away were visible. Survey beacons were found to be useful as marks as the geodetic azimuths can be computed and used instead of or to verify astronomical azimuths observed using sunshots, and they are easily described. A record of the altitude of the mark helps locate the mark in future reoccupations. Rounds of angles using prominent features also help locate the marks. As soon as possible (ie. when visibility was suitable and once radio time signals had been received and the watches set - the rates of the watches in the variety of conditions they were subjected to were far from constant, and the watches were set immediately before sunshots and checked immediately after sunshots) sunshots were taken to determine the azimuth of the marks.

The magnetic observations were then made as often as conditions and logistics would permit. Between lapses in observations, the tripods were left setup; often the theodolite was returned to its case, but all equipment was left at or near the observation station, secured with large rocks to prevent it being blown away.

At any convenient time, the station was measured for a station description and to determine geographic offsets from the nearest known geographic marker (usually the survey station). If there was any doubt about the geographic coordinates of the station (or the accuracy of the watches, say if there was no radio time signal reception), then altitude sun observations were made noting both the local temperature and atmospheric pressure essential for refraction correction. This allowed either the astronomic latitude and longitude or the watch correction to be estimated.

3.5 Reoccupying Established Stations

Established stations were reoccupied in Kemp Land and at Moore Pyramid. The stations were identified by old tags or other markers left at the stations and from the station descriptions. The Kemp Land stations at Fold and Depot

Islands were established and very well documented by Hill (1979) and were reoccupied within centimetres. The tags left by Hill were thin aluminium foil tags and had nearly disintegrated. New tags of exactly the same type were added to the cairn markers, and could be expected to disintegrate as well. The station at Moore Pyramid was briefly documented by Robertson (1972) and was fortunately marked on field maps and was near a marked gravity station; reoccupation could only be made to within several metres.

The author feels that most of the procedures suggested for establishing a new station should be carried out also during reoccupations to verify location, mark azimuths, field gradients, pier differences and to improve station descriptions (it is very easy for a person reoccupying a station to see the shortcomings of a station description that may not be obvious to the person who established the station).

Conclusions

The tables in this report give a difference between the field at the field stations and at Mawson. The standard deviation of this difference is often greater than the expected annual variation in the field. It is clear that Mawson Observatory data cannot be used as an accurate baseline reference. de Deuge (1992) acquired continuous variometer data from several sites in the Prince Charles Mountains that show clearly that, although there are many qualitative similarities between the Mawson and Prince Charles Mountains variometer records, there are quantitative and some qualitative differences, thus confirming the existence of variability in field differences between Mawson and the field stations. Further analysis on that data may reveal a time of day when the difference between the magnetic field at the field stations and Mawson is least variable.

Crosthwaite (1992) suggests that the field at Mawson may be least disturbed between 9:00 and 21:00 UTC. It may therefore be better to select observations from that period of the day to calculate the "undisturbed" field at the field stations rather than average all observations at those stations where there are enough observations during that part of the day.

A reasonable way to assess the secular variation at the field stations in the vicinity of Mawson may be to derive the secular variation relative to the Mawson Observatory. This would remove the problem of determining a baseline reference at Mawson which is done by smoothing quiet-day monthly averages for a long interval before and after the field survey - making reporting the results very difficult.

The field equipment for Antarctic surveys needs to be modified to use cold-tolerant cables. Portable non magnetic heat packs would be desirable to keep the equipment well within its operating specifications. (Chemical based slow combustion heat packs were used without success.)

Acknowledgments

The author wishes to express his thanks to all fellow expeditioners of the Mawson 1989 wintering party . There is no doubt that every member of the station community made a significant contribution to the preparation and execution of the Kemp Land field work by preparing field depots, communications plans and backup, vehicles and field equipment, maintaining the Mawson geophysical observatory and covering for the station duties in the absence of the nine people who actually had the pleasure of taking part in the field work. It should be noted that during the four weeks of the field trip, the rest of the station was inconvenienced by the absence of two Hagglunds and both dog teams. Special thanks to Mike Dymond and Dave Grant for keeping the observatory going in the author's absence, to Kym Frost for his willing, cheerful and valuable assistance as scribe at Depot and Fold Islands at any hour of the day in any weather conditions, and to the other members of the field party - Bruce Alcorn, Diana Patterson, Mike Hennessy, John French, John Armistead, Bryan Hodge and Peter Newman. And of course to the lead dogs Pedro and Arne and their marvellous teams for hauling a tonne of equipment through the exhausting 700 km of heavy snow and one of the greatest experiences of my life.

Thanks to the all those who were at Mawson and the Prince Charles Mountains in the 89/90 summer for their assistance in carrying out the magnetic survey. Particularly to my field partner, Professor Harold Heatwole for his company and tales and toleration of the sometimes abysmal campsites I chose, to the Helicopter Resources pilots who cheerfully and skilfully carried us to the tops of many windy mountains and to the Dovers base station crew for the support they provided.

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Appendix A Summary of Survey Log/Kemp Land

Date/Time (UTC) 1989	GENERAL LOG
6 October	Dog teams departed Mawson in 30 knot winds and light snow. Those involved were Bruce Alcorn and Diana Patterson on one sled, and Kym Frost and Peter Crosthwaite on the other. Reached Low Tongue.
7 October	Hagglund arrived with to replace two dogs, Blackie and Cocoa, with Bundy and Mandy. Travelled in exhausting heat to reach Colbeck Hut.
8 October	Already a lay day. Another day of heat wave and brilliant weather.
9 October	Travelled to Tilley Bay on a cooler day.
10 October	On a much appreciated cooler day, travelled to Ledingham's Depot near Fold Island.
11 October	Travelled to Law Islands on a brilliant day with correspondingly painfully slow deep heavy snow.
12 October	Travelled over various snow surfaces to Island 75 in Bell Bay.
13 October	Took a long time to travel across very slow surface to Mule Point to depot food for us and dogs. Then heavy going (getting heavier and heavier as the warm weather continues) around Hoseason Glacier across large tide cracks. Camped near Crooked Island. Hagglunds left Mawson to reach Kloa at same time as dogs.
14 October	Travelled to Moonie Island on southern side of Edward VIII Gulf in great weather cool enough to have to wear a jumper most of the day.
15 October	Travelled to Kloa initially in 5/8 cloud and light wind. Later turned into another brilliant sunny warm day just right for getting a tan. Surface slow across the gulf, and broken and drifted amongst the bergs closer to Kloa - but the scenery and wildlife and interesting surfaces were a welcome change to the boredom of the gulf.
16 October	Lay day at Kloa; overcast, light wind, mild white out. Did a penguin estimate at the rookery - the counts were 12000 (Crosthwaite), 9000(Patterson) and 7000(Frost); quite a variation between counters. Vehicles decided not to cross the gulf because of low fuel reserve caused by heavy travelling surface.
17 October	Windy, snowy, no travel.
18 October	Departed Kloa and travelled back to Moonie Island to meet the Hagglund party. Big party for the dogs with butter and 'fresh' meat etc.
19 October	Poor weather. Left the Mike Hennessy, John French, Bryan Hodge and John Armistead with the dogs to return to Kloa and the rest of us (Bruce Alcorn, Diana Patterson, Kym Frost and Peter Newman and Peter Crosthwaite) went to Depot Island. Located station and performed preliminary obs to verify location, azimuths and equipment function.
20 October	Have been hit by a Polar Cap Absorption event and a big magnetic storm. Made some obs but field changing by as much as 70 nT/minute, and 400 nT during an obs. Enjoyed the spectacle of a fairy land sunset watching Enderby Land in spindrift and low light.
21 October	Cold, no cloud, no wind, no communications. Good observing weather, but the magnetic field still very active. Poor obs made. More beautiful scenes over Enderby Land/King Edward Plateau at sunrise and sunset, and mother of pearl clouds. Bruce and Peter did some sea ice measurements (1.5m snow over 1.6m ice).
22 October	No coms. Enderby Land again like castles in the sky. Field marginally quieter.
23 October	Finished obs by 09:00UTC. Passed by dogs at lunch time. Left behind a marker "BMR89/Depot Island/Mag Site". Arrived at East Stack 21:30MBT for the night.
24 October	Blizzard, poor weather. Left late and travelled to Fold Island. Had some difficulty locating the station as Hill's description did not give a large scale map. Still could not make ourselves heard by Mawson, although we received them ok.
25 October	Did many DIF and sunshot obs, although without time corrections (no time signals since Depot Island).
26 October	Blown away attempting obs early in the day so waited a while. Later on did several DIF and sun obs. No coms to Mawson. Dog sleds caught up to us again and camped nearby.
27 October	Bruce Alcorn and Peter Crosthwaite swapped with Bryan Hodge and John French on the dog sleds. Vehicles left for Mawson, and dog sleds followed. Travelled to south end of Fold Island. Bad weather and whiteout overnight.

28 October	Took photographs and counts at Fold rookery. Counts were 700(Crosthwaite), 500(Hennessy) and 200(Alcorn). Travelled over a good surface to Tilley Nunatak.
29 October	Coms with Mawson today. Travelled to Colbeck. Saw the first Adelie penguin of the season.
30 October	Good coms. Windy and overcast early on. Repaired sleds.
31 October	Late start due to bad weather, then pushed onwards. Obviously weren't going to get home in one go so camped on the only island left uninfested with Adelies (between Oldham and Island 45).
1 November	Travelled home weaving in and out of an amazing influx of Adelies coming from the sea to their island rookeries. An incredible experience to suddenly be amongst such a hustle and bustle of pushy brave little birds. Rolled one of the sleds 10m from the dog lines!

Appendix B Summary of Survey Log/Prince Charles Mountains

Date/Time (UTC) 1990	GENERAL LOG
11 January	Departed Mawson for Dovers base camp via Depot Peak after the evening meal.
12 January	Prepared field equipment at Dovers. Departed Dovers approx 02:30MBT, arrived at Mt Woinarski 03:00MBT. Established the camp, discovered inadequacies in tent equipment and stove. Used old pegs left at old camp site to anchor our tent and repaired stove. Wind constantly 50knots or greater. Took a look around the survey station and surrounds. No observations done.
13 January	Wind abated and temperature more pleasant, but visibility restricted. Observations hampered by snow, cloud, drift etc. Performed preliminary observations using a nondescript rock 30m away as an azimuth reference. Tried to measure F pier differences between M and F piers. Later managed one more DIF observation using a more distant natural feature as a mark and a sunshot in high winds with Vertical Circle readings accurate to only 1 or 2 minutes.
14 January	Expected news from choppers at 16:00MBT re pickup. Helped Hal with some sampling lower down the mountain. Did some DIF obs and sunshots in reasonable conditions. Had to interrupt good observing conditions for sked. Visibility dropped after sked so no more work. Visibility improved by 18:00MBT, but had another sked after which visibility dropped out again so no more obs for a while. Pickup cancelled due to weather conditions. Did a few more obs, but only using one glimpse of the mark - most of the work done in falling snow with no visibility.
15 January	No pickup due to snow, low cloud, low visibility. Tested a piton similar to the one marking the eccentric survey station under the small cairn. Maximum effect at the observation height is 1 nT. No other work done.
16 January	High winds until lunch, then whiteout all day. No obs or pickup possible.
17 January	No obs or pickup due to continuing poor weather.
18 January	Did some biological sampling early on, then more whiteout and bad weather.
19 January	Very windy but clear skies. Choppers arrived in 60 knot winds - we were blown away several times while packing up; noticed slight damage to tent pole assembly. Taken to Blustery Cliffs where the weather was still, warm and delightful. Established camp and tucked in.
20 January	Weather still very good. Ready to start obs at local noon; finished last obs around local midnight. Noticed large anomaly near the large cairn.
21 January	Obs made at 10 and 12 MBT; then left camp site for some biological sampling. Returned and with good visibility managed to see what may have been Mt Woinarski trig. Got some more obs done.
22 January	Obs at 8:00MBT and a few more early obs before breaking camp and waiting for the choppers in glorious weather; departed in choppers at 15:00MBT. Investigated Flagstone Bench astro station for an obs station; camp site very unappealing on loose earth with no rocks around near the edge of Beaver Lake. Looked for another campsite near Pagodroma Gorge for Hal's work. Final campsite in sector Q11, too far from the astro station to do any work there.
23 January	Sampled along Pagodroma Gorge to Beaver Lake. Saw nesting skuas and snow petrels.
24 January	Sampled upstream to Radok Lake and Glossopteris Gully.
25 January	Left Pagodroma Gorge for Jetty Peninsular at 10:00MBT. No sun, but started sequence of obs at 09:00 UTC.
26 January	Finished a long sequence of obs at 09:00. Wonderful weather.
27 January	Woke at 05:30 MBT for sked and 6:30 departure...7:00 ... 10:00 ... 15:00 ... flying cancelled finally due to bad weather at Dovers. No work done in the uncertainty of pickup.
28 January	Pickup at 03:00 MBT and travel to Else Platform . Did a few obs then got some sleep then did more obs until midnight.
29 January	Got some hazy sunshots done. Eventually good time check over WWV. Change PPM batteries. Then more obs and sunshots until wind stopped work. Packed up in preparation for 06:00MBT pickup which was later deferred.
30 January	Waited and waited for a pickup which eventually arrived at 21:00MBT. Briefly passed through Dovers for a cup of coffee and continued on to Mt Wishart. Disappointed to once again be in the cold windy western high country. Encamped by midnight.

31 January	After a late start following our late night, took quite some time to carry all of the equipment up the mountain to the trig station from the campsite on the southern side of the mountain. Frequent gusts blew the PPM tripod over several times. Some personal items blown over the edge also. Did a few sets of obs and sunshots under difficult gusty conditions. Campsite drifting up badly.
1 February	After only 5 obs in 2 days in this unpleasant spot, lugged the gear down from the mountain hoping for better at the next station. Peter Malcolm and Pip Turner arrived late at night to sling load surveying equipment to the top of Wishart, but the conditions were dangerously gusty and the exercise was abandoned.
2 February	Shifted at 14:45MBT to Moore Pyramid. Camped 200 m from a cairn which turned out to be the Gravity Station. A turbulent site with calm frequently interrupted by gusts.
3 February	Managed a few obs and sunshots only. Finally abandoned due to high winds.
4 February	A few obs and sunshots made. Again hampered by high winds. Made some altitude shots of the sun to try and confirm the questionable geographic data for the station. Eventually gave geomagnetism away to do some biological sampling on Moore Pyramid. The observation station must have been the windiest place in the area.
5 February	Pickup delayed and delayed eventually until 16:00MBT. Dropped at Mt Starlight - confused by two survey cairns - picked the wrong one to camp near, although there was really no possibility of camping near the real trig. It was too far and too dangerous to cross the gully to get the gear to the trig cairn, so a more reasonable place was chosen for the obs station.
6 February	Had trouble with the PPM. Eventually replaced the batteries. Very windy and cold. Only 2 obs done.
7 February	Warmed DIM and PPM up in the tent before starting obs. Various equipment malfunctions used up valuable minutes of bare finger tolerance. Gusty cold conditions. Did some obs but suffered some cold injuries in the process. Later on managed some more obs and built marker cairns.
8 February	Moved to Mt Forecast at 13:00MBT. Spent some time looking for a nonexistent gravity station marker. Did rough F survey to find a suitable site. Gradients of 50 nT/m common, persisting for total ranges of 1000 nT/25m.
9 February	Did some F traverses. Had to repair the PPM cable several times. One place the gradients were 1000 nT/m.
10 February	Moved from Mt Forecast to Corry Massif in deteriorating weather. Set up camp and did F survey to find suitable observation site. One DIF observation made.
11 February	Completed 3 sets of DIF observations, some sunshots and a round of angles.
12 February	Prepared for pickup, and eventually moved to Dovers - first shower for a month and the water was cold! Good food and a warm bed though.
13 February	Bad weather prevented any work being done from Dovers until ....
14 February	Drift prevented any work being done from Dovers all day.
15 February	Drift cleared just long enough for one set of observations and equipment recovery.
16 February	Returned to Mawson from Dovers.