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MAWSON GEOPHYSICAL OBSERVATORY, ANNUAL REPORT 1976

by

P.J. Wolter

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ABSTRACT

The work described in this Record was a BMR contribution to the program of the Australian National Antarctic Research Expeditions. Magnetic and seismological recording was continued at Mawson, Antarctica, during 1976 by means of two La Cour magnetographs and a three-component Benioff seismograph. Twenty-two third-order magnetic stations in Enderby Land and one station at Gaussberg on the West Ice Shelf off Wilhelm II Land were occupied during the 1976-77 summer expedition.

1. INTRODUCTION

Mawson geophysical observatory was established by the Bureau of Mineral Resources, Geology & Geophysics (BMR) in 1955 when a La Cour magnetograph was installed (Oldham, 1957). A history of changes to the instrumentation since than is given in Appendix 1.

During 1976 the magnetic observatory equipment consisted of a NORMAL and a SENSITIVE La Cour magnetograph; and three QHMs, one PPM, one declinometer, and one BMZ for 'absolute' observations. The seismological observatory was equipped with a three-component short-period Benioff seismograph. Table 1 gives station co-ordinates.

The author arrived at Mawson on 25 December 1975 to relieve Peter Hill, who then flew to Enderby Land for regional magnetic and gravity surveys. The author sailed for Enderby Land in December 1976 to make a regional magnetic survey after being relieved by Kevin Wake-Dyster.

All BMR activities in Antarctica are part of the Australian National Antarctic Research Expeditions (ANARE), and logistic support was provided by the Antarctic Division, Department of Science and the Environment.

2. MAGNETIC OBSERVATORY

Magnetic recording was maintained almost continuously throughout 1976; record losses totalled 3½ days on the NORMAL magnetograph and 2 days on the SENSITIVE.

Recorders

On 29 December 1975 the original 15 mm/hr SENSITIVE recorder was replaced by a BMR 20 mm/hr recorder to meet IAGA recommendations. Twice during January 1976, the NORMAL recording drum stuck, but filing of the paper clamp eliminated the problem.

Power for the drums was supplied by the mains till 26 October, when powerhouse alterations caused a long blackout. After that, two spare cores of the magnetic timing cable were used to supply power from the EMI clock. Although having high and low voltages in the same cable is undesirable, this arrangement worked successfully for the rest of the year.

Baseline value determinations

Absolute values were determined five or six times a month using QHM Nos. 300, 301, and 302, declinometer 332, and PPM 339: NORMAL scale-values were determined weekly, and SENSITIVE scale-values, BMZ 62 inter-comparisons, and pier-difference determinations were done once a month. The magnetometers were intercompared with travelling standards QHM 492, HTM 704, DEC 812, and PPM 424 in January 1976, but the fibre of QHM 492 was broken before re-calibration at Toolangi. Intercomparisons were again made, in January 1977, using QHM 172, HTM 704, DEC 812, and PPM 424. The observed instrumental differences are given in Table 11.

On 8 and 13 October 1976 optical adjustments were made to the Z NORMAL variometer to place the trace near the centre of the recording range. As the D NORMAL mis-orientation exceeded the tolerance of 1°, adjustments were made on 16 and 17 November 1976 causing an increase in baseline value of $8.5'$. Baseline jumps occurred on 28 January; 13 and 18 February; 13, 22, and 24 July; the cause was eventually found to be movements of a highly magnetic moving-coil ammeter in the cold porch of the variometer hut. As the ammeter was no longer used, it was removed from the variometer hut. Adopted scale-values are given in Table 2a and baseline values in Table 3.

Current source MCOIB was used to supply current to the Helmholtz scale-value coils. Current was monitored using a high-precision digital multimeter. The currents differed from the nominal currents by no more than 0.25%. The digital readings were taken to be correct (see Table 2b).

Temperature control

The variometer room temperature control worked reliably; however, the diurnal temperature variation was between 1^{o} and 2^{o} on most days. This might be improved by lowering the thermistor from the ceiling to the same level as the variometers.

The temperature was monitored using the Z NORMAL temperature trace and daily thermometer readings. Table 5 gives the thermograph parameters.

Preliminary data

Each month K-indices, preliminary baseline values, scale-values, and monthly geomagnetic means were sent to the Toolangi Observatory Group, Melbourne. Table 6 lists these values.

Preliminary mean annual geomagnetic values from 1966 to 1976 are given in Table 7.

Orientation tests

Orientation tests were made on 8, 10, 14 October 1976, and the results were consistent with 1975 observations (Hill, 1978). Results are given in Table 4. The moment of the deflector magnet was found by mounting it a set distance from a QHM and doing H readings. As previously mentioned, the orientation of the D NORMAL magnet was altered on 17 November.

3. SEISMOLOGICAL OBSERVATORY

The seismograph consists of three Benioff seismometers and a triple-drum photographic Benioff recorder. The north and east component seismometers and the triple-drum recorder are in the seismic building, and the vertical seismometer is in the 15 metre deep Cosray vault, where wind noise is almost eliminated.

Weight-lift tests and motor-constant determinations were made in February, April, September, and November. Being in a stable environment, the vertical seismometer kept constant magnification and damping ratio; in contrast the horizontals varied in magnification, free period, and damping ratio owing to large temperature variations. On 7 March the vertical damping ratio was altered from about 45:1 to 17:1, and magnifications on the same dB setting decreased by about 10%. Further tests confirmed that increasing the damping ratio increased the magnification on the vertical seismometer, contrary to theory. Table 8 gives the seismograph parameters.

Frequency response tests were carried out in June, using a vertical attenuation of 16 dB and a horizontal attenuation of 8 dB. Peak magnification was at about 0.45s period (see Plates 1 and 2). Weight-lift tests were done at the attenuator settings shown in Table 9. Magnifications obtained were used to determine the frequency response at those attenuator settings. Table 10 gives corresponding attenuator dB settings.

The Benioff recorder was inspected on 30 March. The worm drive was adjusted to improve the drive, which had been rather uneven.

P arrival-times were transmitted to the National Earthquake Information Service (US Geological Survey) via Melbourne three times per week. Seismic data were also sent to Sanae, Molodezhnaya, and Syowa Antarctic stations.

On 21 October the vertical seismic signal leads were accidentally reversed during cable repairs. This meant upwards trace movement corresponded to a downwards ground motion for the remainder of the year.

4. CONTROL EQUIPMENT

Power and timing equipment was described by Robertson (1972); no major changes were made during 1976.

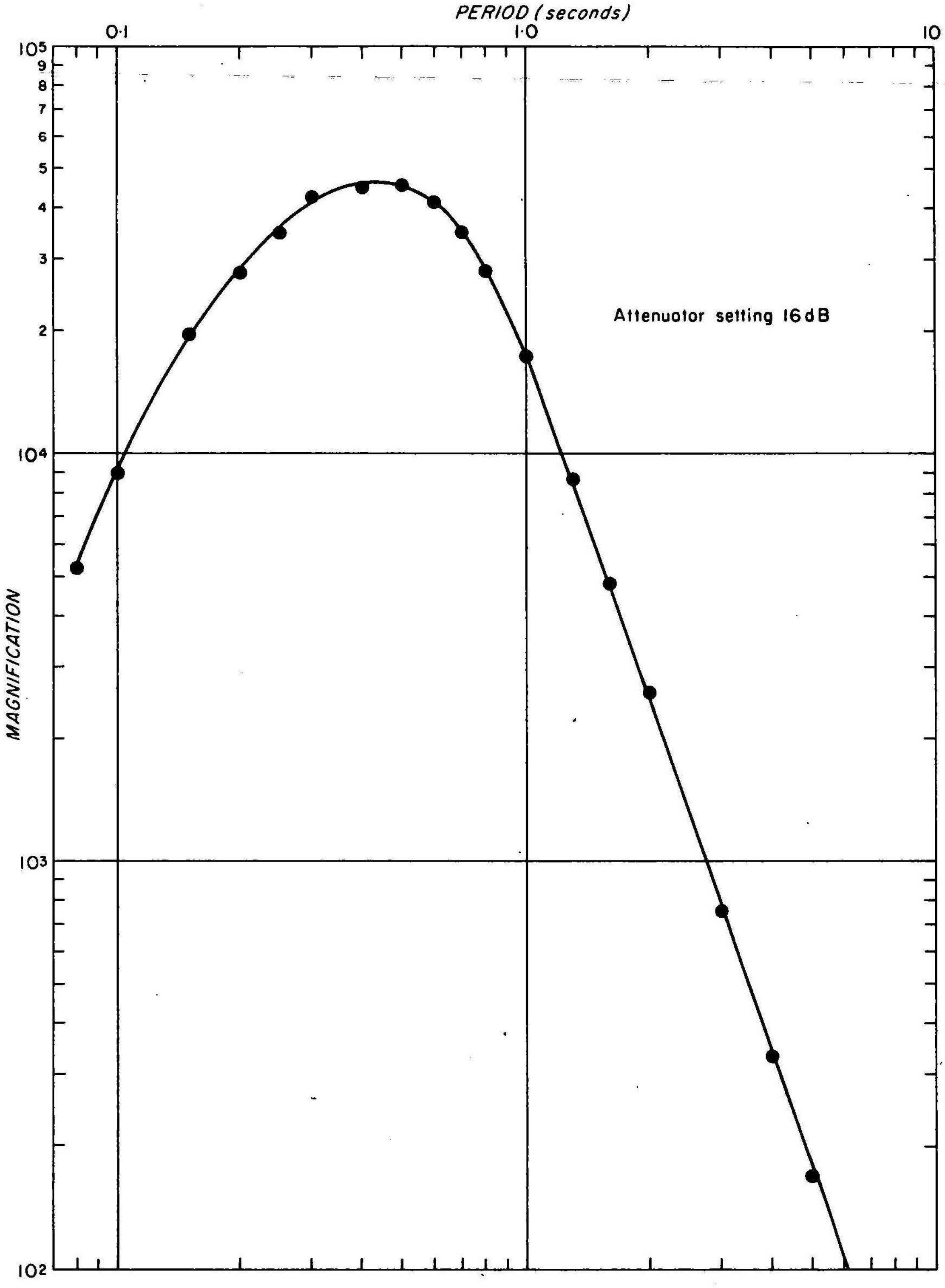

Fig. 1 Magnification curve for the SP-Z seismograph 1976

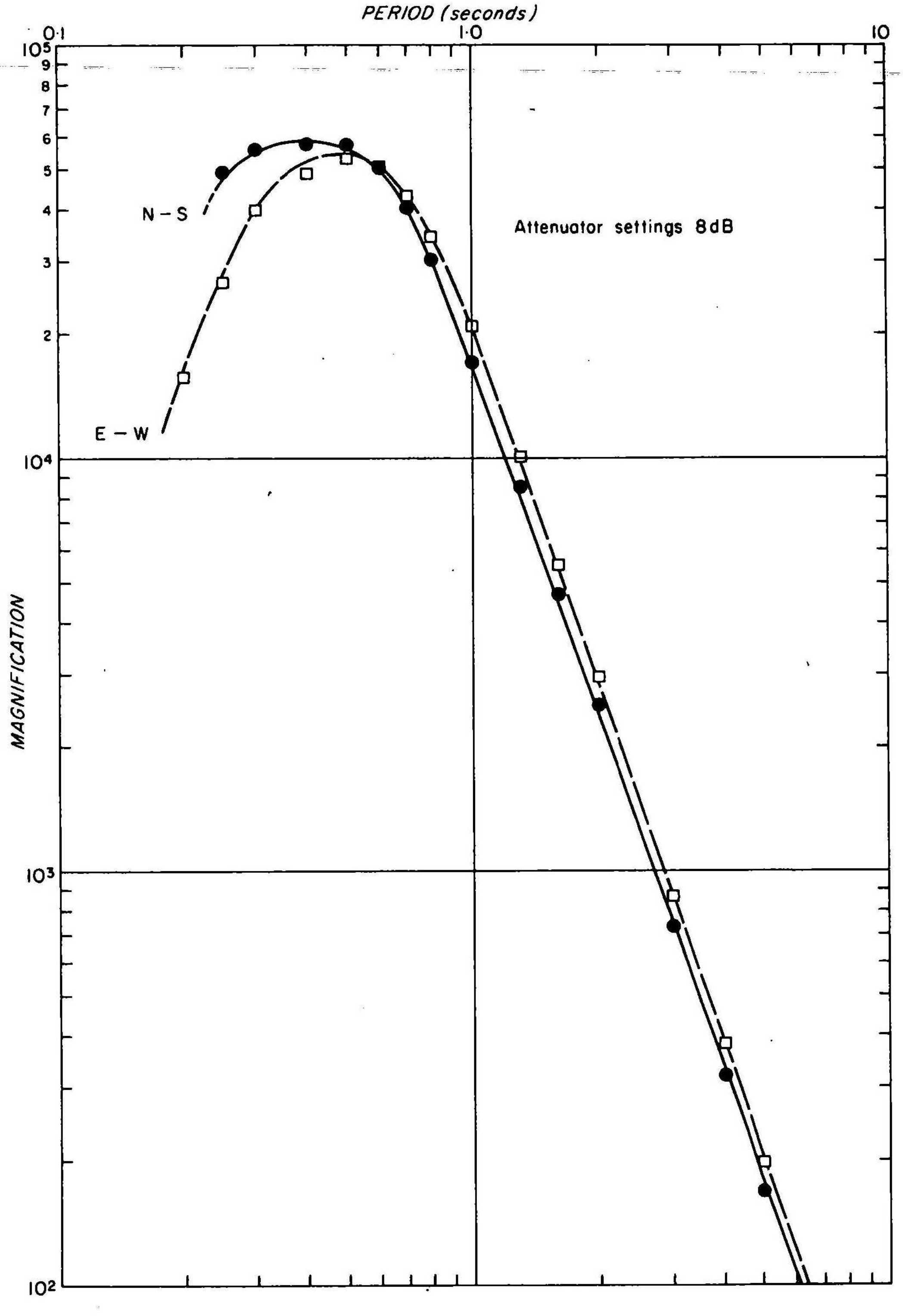

Fig. 2 Magnification curves for the SP – NS and SP – EW seismographs 1976

Time mark unit (TMU)

On 19 January the seismic power cable shorted, causing the TMU to pulse almost continuously when connected to the EMI clock. The problem was believed to be a faulty transistor in the input monostable. The relevant circuit board was replaced by a spare on 3 March, and the unit operated without problems for the rest of the year. The input monostable components were replaced on the original board, but it was not tested.

EMI clock

The EMI clock gave almost trouble-free service. The output transistor BFY 50 blew in February and was replaced by an AY 8140; this caused the clock to draw about 1A less current. During the year the clock temperature-dependence was monitored by plotting average office air temperature against daily clock correction. In May the temperature effect was about 19 ms/^{o} C, but had risen to about 40 ms/^{o} C by July, so a replacement EMI clock was ordered for 1977.

Time signals

Time-signals from radio station VNG were received adequately most days, so ensuring negligible EMI clock timing errors. The V antenna was overhauled to prevent one arm from damaging the meteorological anemometers during blizzards.

Cables

On 3 January 1976 the magnetic timing cable shorted when cut by an over-enthusiastic drift-snow digger. Within a few hours after repair an open circuit developed at a T joint near the variometer hut. A few days later the seismic power cable shorted during a wet blizzard. This was replaced by a new 4-core Pyrotenax cable on 19 February. No more cable problems occurred until October. A fracture in the 2-core Pyrotenax cable carrying the vertical seismic signal had caused a gradual deterioration of the signal. The faulty section running over the radio office was replaced and re-routed through foundation pipes under the radio office on 19 and 20 October. The cable gave no more problems for the rest of the year.

5. REGIONAL MAGNETIC OBSERVATIONS

Third-order stations were established at 22 places in Enderby and Kemp Lands to the west of Mawson, and at Gaussberg on the coast of Wilhelm II Land between Davis and Mirny. Five of these stations were re-occupations of previous stations.

The emphasis during the 1976-77 summer was on geology, but owing to good weather and a high degree of co-operation between the four BMR geologists and the other geophysicist, a successful summer operation was carried out in geology, gravity, and regional magnetics.

Thirteen of the magnetic stations were surveyors' trig points and therefore had declination azimuths provided. At the other stations a compass theodolite was used both to obtain azimuths and to find declination directly by sunshots.

QHM 301, long-range BMZ 121A and Wild TO compass theodolite 104407 were used. Near the end of the season QHM 301 was broken, and QHM 302 was flown from Mawson to complete the program. Intercomparison of field instruments were carried out on return to Mawson. Table 11 gives instrument differences obtained and preliminary corrections to the observatory instruments. The resulting corrections were applied to the field results.

Wind above about 3 m/s (5 knots) greatly decreased the QHM's performance for D and H; and direct sun on the instruments decreased the accuracy of the QHM and the BMZ. The QHM circle and telescope proved awkward to use, especially for D observations. A slightly adapted Askania circle would considerably improve accuracy and ease of readings.

A number of stations were read on two or three different spots. The differences in readings indicate that most rock exposures visited were highly anomalous. More stations on the ice would give a better representation of the main field, but would be of little value for determining secular change.

Antarctic Division set up a fluxgate magnetic recorder at Mount King base, but no records were obtained. As only Mawson magnetograms were available at the time of writing, attempts were made to use them for reducing field data to a mean value. However, as Mawson is near the edge of the auroral oval, and field stations were 300 to 600 km west of Mawson, on some days the scatter in readings was not greatly reduced.

Table 12 gives 1976-77 summer results. A total of 41 stations have been visited since 1954 plus six D and three Z observations during traverses of 1975 and 1976 throughout the Enderby-Kemp Land region. Further details will be given in separate reports (e.g. Hill, 1979).

6. BUILDING MAINTENANCE

The gap between the seismometer pier and floor was resealed using canvas and non-drying putty. An attempt was made to tighten all screws and bolts in the variometer hut, and to plug small holes in the walls which let in drift. Guy wires on seismic and magnetic buildings were tightened or replaced in the hope of reducing wind effect during blizzards.

The new science building, containing the new geophysics office, was completed in late 1976. Transfer to the new office began with the arrival of the relieving geophysicist.

7. OTHER DUTIES

Usual station tasks were necessary during the year. The author was most involved with water resupply, and with exterior painting during December.

8. ACKNOWLEDGEMENTS

The author wishes to thank the 1976 Mawson party and the Enderby Land summer party for their co-operation.

Special thanks are due to Pete Davies for record changing while the author was absent; and to John Tibbits, Neil McDonald, and Graeme Ackerman for advice or assistance with electronic problems.

9. REFERENCES

ALMOND, R., 1975 - Mawson Geophysical Observatory, annual report 1973. Bur. Miner. Resour. Aust. Rec. 1975/140 (unpubl.).

BLACK, I.E., 1965 - Mawson geophysical observatory work, Antarctica 1963. Ibid. 1965/185 (unpubl.).

DENT, V.R., 1971 - Mawson Geophysical Observatory, annual report, 1967. Ibid. 1971/9 (unpubl.).

HILL, P.J., 1978 - Mawson Geophysical Observatory, annual report, 1975. Ibid. 1978/59 (unpubl.).

HILL, P.J., 1979 - Mawson-Molodezhnaya regional geomagnetic and gravity survey, Antarctica 1975-76. Bur. Miner. Resour. Aust. Rec. 1979/6.

MERRICK, R.W., 1961 - Mawson geophysical observatory work, Antarctica 1960. Bur. Miner. Resour. Aust. Rec. 1961/118 (unpubl.).

OLDHAM, W.H., 1957 - Magnetic work at Mawson, Antarctica, 1955-56. Ibid. 1957/79 (unpubl.).

PINN, J.D., 1961 - Mawson geophysical observatory work, Antarctica 1957. Ibid. 1961/27 (unpubl.).

ROBERTSON, M.J.M., 1972 - Mawson Geophysical Observatory, annual report 1970. Ibid. 1972/44 (unpubl.).

SMITH, R.S., 1971 - Mawson Geophysical Observatory, annual report 1968. Ibid. 1971/10 (unpubl.).

TABLE 1. STATION DATA MAWSON (CODE: MAW)

	Magnetic	Seismological
Lat. geographic	67°36'S	Z 67°36.4'S H 67°36.2'S
geomagnetic	-73.1°	
Long. geographic	62°53'E	Z 62°52.3'E H 62°52.5'E
geomagnetic	102.9°	
Elevation	10	Z 15 H 8
Foundation	Precambrian granite	Precambrian granite

TABLE 2a. MAGNETOGRAPH PARAMETERS

Component	Observed	Scale value adopted	Standard deviation Scale value	Standard deviation Baseline	Temp. coeff. nT/°C
NORMAL					
H	21.41 nT/mm	21.4 nT/mm	.06 nT	2.0 nT	0
D	2.44 min/mm	2.44 min/mm	.02 min	0.5 min	0
Z	22.66 nT/mm	22.7 nT/mm	.07 nT	5.0 nT	2
SENSITIVE					
H	9.5 nT/mm	9.5 nT/mm	.2 nT	-	-
D	0.87 min/mm	0.87 min/mm	.2 min	-	-
Z	10.3 nT/mm	10.3 nT/mm	.1 nT	-	-

TABLE 2b. SCALE-VALUE CURRENTS

Component	MC01 current	DVM current
NORMAL	(mA)	(mA)
H	60	59.9
D	40	39.9
Z	70	69.95
SENSITIVE		
H	30	30.0
D	10	10.0
Z	30	30.0

TABLE 3. ADOPTED BASELINE VALUES (UNCORRECTED), NORMAL MAGNETOGRAPH 1976

Date		UT h	UT m	Baseline value	Remarks
Declination					
Jan	01	00	00	61°19.3	
Jan	28	02	50	20.5	Moving-coil ammeter moved
Feb	13	08	47	18.1	" " " "
Feb	18	07	20	19.0	" " " "
May	01	00	00	18.8	Drift
Jun	01	00	00	18.6	"
Jul	13	11	10	16.0	Ammeter rotated
Jul	22	03	05	20.3	" "
Jul	24	08	45	18.6	Removed ammeter
Nov	14	05	35	60°37.6	Bumped variometer
Nov	16	17	55	61°56.2	Adjusted variometer
Nov	17	06	00	61°29.0	" "
	18	00	00	28.8	Baseline trace
	20	00	00	28.6	Drifting by about 0.1'/day
	24	00	00	28.2	
	26	00	00	28.0	
	28	00	00	27.8	
	30	00	00	27.6	
Dec	02	00	00	27.4	
	04	00	00	27.2	
	06	00	00	27.0	
	08	00	00	26.8	
	10	00	00	26.6	
	12	00	00	26.4	
	16	00	00	26.2	
Horizontal intensity					
Jan	01	00	00	17122	
Feb	01	00	00	17124	Change of QHMs
Jul	13	11	10	17135	Ammeter rotated
Jul	22	03	05	17124	Ammeter rotated back
Jul	24	08	45	17135	Ammeter removed

TABLE 3 (cont) ADOPTED BASELINE VALUES (UNCORRECTED), NORMAL MAGNETOGRAPH 1976

Date		UT h	UT m	Baseline value	Remarks
Vertical intensity					
Jan	01	00	00	47085	
Feb	01	00	00	47084	Adopted H base changed
Jul	13	11	10	47078	Ammeter rotated
Jul	22	03	05	47090	Ammeter rotated back
Jul	24	08	45	47084	Removed ammeter
Oct	08	09	10	46463	Variometer adjusted
Oct	13	06	20	46401	" "

TABLE 4. ORIENTATION OF VARIOMETER MAGNETS

Date	Component	Orientation Ref. Field	Magnet N Pole	Orientation
3/10/75	Z Norm	47242	N	0.0^{o}N
8/10/76	Z Norm	47130	N	0.0^{o}
23/06/75	H Norm	18392	E	0.2^{o}N
10/10/76	H Norm	18421	E	0.4^{o}N
23/06/75	D Norm	62.53^{o}W	N	1.7^{o}E
10/10/76	D Norm	62.65^{o}W	N	1.4^{o}E
18/11/76	D Norm	62.65^{o}W	N	0.3^{o}W Adjusted
3/10/75	Z Sens	47242	N	0.6^{o}N Pole Down
14/10/76	Z Sens	47130	N	1.3^{o}N Pole Down
23/06/75	H Sens	18392	E	1.3^{o}S
10/10/76	H Sens	18421	E	1.1^{o}S
23/06/75	D Sens	62.53^{o}W	N	0.4^{o}W
10/10/76	D Sens	62.65^{o}W	N	0.5^{o}W

TABLE 5. Z NORMAL THERMOGRAPH PARAMETERS 1976

From	To	Observed St ^{o}C/mm	Adopted St ^{o}C/mm	Bt ^{o}C
1/01/76	31/03/76	1.78	1.78	-104.6
1/04/76	31/07/76			-104.8
1/08/76	8/10/76			-105.0
8/10/76	12/10/76			- 86.0
13/10/76	31/10/76			- 90.7
1/11/76	30/11/76			- 90.4
1/12/76	31/12/76			- 90.1

TABLE 6. PRELIMINARY MONTHLY MEAN GEOMAGNETIC VALUES AND K-INDEX 1976

Month	D (west)	H, nT	Z, nT	F, nT	K
January	62°34.0	18412	47205	50669	3.8
February	34.2	407	199	661	4.2
March	35.8	416	197	663	4.2
April	36.2	415	187	653	3.7
May	37.2	418	175	643	3.5
June	37.2	420	164	634	3.2
July	37.6	419	153	623	3.4
August	38.6	419	143	613	3.1
September	38.4	421	139	611	3.7
October	39.2	423	128	601	3.4
November	39.0	423	116	590	3.3
December	39.9	427	111	587	3.3
Mean	62°37.3	18418	47160	50629	3.6

TABLE 7. GEOMAGNETIC ANNUAL MEAN VALUES 1966-1976

Year	D	I	H nT	X nT	Y nT	Z nT	F nT
1966	-61°24.0'	-69°09.6'	18362	8790	-16121	-48235	51612
1967	-61°34.4	-69°07.2	18374	8747	-16158	-48168	51553
1968	-61°43.8	-69°05.2	18365	8698	-16174	-48060	51449
1969	-61°53.0	-69°03.4	18353	8649	-16186	-47954	51346
1970	-62°00.5	-69°00.4	18358	8616	-16209	-47840	51241
1971	-62°05.3	-68°56.4	18375	8602	-16236	-47719	51135
1972	-62°11.4	-68°53.1	18381	8575	-16257	-47600	51026
1973	-62°17.6	-68°49.7	18391	8551	-16281	-47486	50923
1974	-62°24.9	-68°49.7	18392	8516	-16298	-47380	50824
1975	-62°31.4	-68°44.0	18397	8488	-16321	-47269	50723
1976	-62°37.3	-68°40.0	18418	8470	-16355	-47160	50629
Mean Annual Change	- 7.33'	+ 2.96'	+ 5.6	- 32.0	- 23.4	+ 107.5	- 98.3

TABLE 8. SEISMOGRAPH PARAMETERS (From 7 March 1976)

Component	Z	N	E
<u>Seismometer</u>			
Type	BENIOFF	BENIOFF	BENIOFF
Free period (s)	1.0	1.0	1.0
Coil Rs	146	420	420
<u>Galvanometer</u>			
Type	GEOTECH	GEOTECH	GEOTECH
Free period (s)	0.2	0.2	0.2
<u>Calibrator</u>			
Motor constant (N/A)	1.50	1.43	1.32
<u>Recorder</u>			
Type	BENIOFF	BENIOFF	BENIOFF
Chart rate	60 mm/min	60 mm/min	60 mm/min
<u>System</u>			
Damping	17:1	17:1	17:1
Mag/1s	39K	34K	40K
Mag peak/period	92K/0.45	92K/0.40	92K/0.50
Attenuator	10 dB	6 dB	6 dB
Polarity for gnd-mot. Up, N, E	Up (to Oct 21) down	Up	Up

TABLE 9. SEISMOMETER MAGNIFICATIONS AT 1 s PERIOD 1976 (K)

Month	Day	Time	Z	N-S	E-W	Month	Day	Time	Z	N-S	E-W
Jan	01	0300	42	34	38	Jun	18	0306	31	21	23
	09	0316	42	29	32		19	0304	39	34	40
	09	0835	34	14	15		23	0306	39	29	32
	12	0304	42	34	38		25	0310	39	34	40
	15	0841	26	34	38		29	0317	39	21	23
	16	0324	34	34	38	Jul	01	0304	39	34	40
	16	0719	22	29	32		02	0310	31	21	23
	17	0305	22	14	15		03	0306	39	29	32
	18	0320	17	8	7		04	0310	39	21	23
	20	0322	14	8	7		06	0319	39	29	32
	21	0311	14	14	15		07	0304	39	34	40
	22	0305	17	21	24		11	0306	39	21	23
	28	0305	22	29	32		12	0341	39	15	16
	29	0304	17	21	24		13	0304	39	29	32
Feb	06	0307	14	14	15		15	1004	39	34	40
	06	0519	14	8	7		25	0840	39	21	23
Mar	28	0309	22	21	24		28	0310	39	36	42
Apr	02	0331	17	8	7	Aug	13	0449	31	15	16
	03	0355	22	21	24		15	0307	39	32	34
	08	0315	31	29	32		21	0305	39	36	42
	09	0305	22	21	24		24	0321	39	15	16
	11	0309	31	29	32		25	0308	39	32	34
	13	0309	20	21	23		27	0322	39	36	42
	14	0308	31	29	32	Sep	01	0306	39	21	23
	20	0304	39	34	40		02	0303	39	36	42
	21		20	34	40		09	0304	39	22	25
	22	0304	39	34	40		10	0306	39	36	42
	23	0306	24	29	32		13	0303	31	22	25
	25	0305	39	34	40		14	0708	39	36	42
	27	0519	16	8	7		18	0304	39	22	25
	30	0343	20	21	23		19	0305	39	32	34
May	02	0307	24	29	32		20	0307	39	36	42
	04	0305	39	34	40		22	0305	39	22	25
	30	0312	24	21	23		23	0309	39	36	42
	31	0312	39	34	40		29	0304	39	22	25
Jun	06	0304	31	21	23		30	0303	39	36	42
	09	0319	39	34	40	Oct	02	0304	39	32	34
	17	0305	39	29	32		03	0306	39	36	42
							04	0305	39	32	34

TABLE 9 (cont)

onth	Day	Time	Z	N-S	E-W	Month	Day	Time	Z	N-S	E-W
Oct	05	0304	39	22	25	NOV	22	0314	31	13	14
	08	0315	39	36	42		23	0304	31	19	21
	11	0329	31	8	7		27	0505	24	19	21
	12	0307	31	22	25		28	0306	20	13	14
	13	0305	39	36	42	DEC	01	0319	24	19	21
	14	0305	39	32	34		02	0306	20	13	14
	16	0304	39	36	42		06	0529	31	19	21
	22	0308	39	22	25		07	0312	31	32	34
	26	0303	39	36	42		17	0733	24	13	14
	27	0305	39	22	25		19	0303	24	19	21
	28	0303	39	32	34		28	0336	20	13	14
	29	0306	39	36	42		30	0332	20	19	21
NOV	11	0329	31	19	21		31	0312	24	19	21
	12	0309	39	36	42						

TABLE 10. SEISMOMETER MAGNIFICATIONS AT 1 s PERIOD

Z		N-S		E-W
dB	Mag	dB	Mag	Mag
20	13	10	7	7
18	16	9	14	15
16	20	8	21	23
14	24	7	29	32
12	31	6	34	40
10	39			

(Magnifications determined by weight lift tests using formula Mag = $800 \frac{X}{Wt}$)
X = Pulse amplitued (mm)   Wt = Weight used (g)

TABLE 11. MAGNETOMETER DIFFERENCES

Instruments	Diff.	10^3nT/T
QHM300 - HTM702	+9.9 ± 0.6 nT (+538 ± 33)	10^3nT/T
QHM300 - QHM172	-32 ± 2 nT (-1739 ± 109)	"
*QHM300 - QHM301	-2 ± 1 nT (-109 ± 54)	"
*QHM300 - QHM302	-0.4 ± 0.6 nT (-22 ± 33)	"
DEC332 - DEC812	+0.4 ± 0.7 mins	
*DEC332 - QHM301	+1° 13.4 ± 0.2 mins	
*DEC332 - QHM302	-24.8 ± 0.1 mins	(before and during field use)
*DEC332 - QHM302	-36.0 ± 0.1 mins	(after field use)
PPM339 - PPM424	+9.5 ± 0.4 nT	(F difference)
*PPM339 - BMZ121A	+71 ± 2 nT	(Z difference)

* Field instrument intercomparisons

Preliminary corrections to standard instruments:

QHM300	-1 nT	H = 18400 nT
DEC332	0 min	
PPM339	0 nT	

TABLE 12. REGIONAL MAGNETIC OBSERVATIONS

RIPPON DEPOT

Lat. 66°40'06"S   Long. 56°28'41"E   Elev. 193 m

Date	UT	D	Date	UT	H	Date	UT	Z
				(Station 2)				
31/12/76	0440	58°45.5	31/12/76	0450	18069	31/12/76	0805	45468
	0500	45.5		0650	18189		0853	45467
	0642	28.3		0717	18164		0903	45474
	0657	33.8		0929	18164		1012	45486
	0710	36.3		0954	18157		1028	45478
	0723	36.7		1546	18134		1639	45491
	0922	33.5		1624	18126		1644	45493
	0935	32.0						
	0947	33.4						
	1001	31.3						
	1540	30.0						
	1552	30.9						
	1620	31.0						
	1629	30.1						
1/1/77	1010	58°23.7	1/1/77	1014	18157	1/1/77	1057	45470
	1019	24.9		1040	18166		1110	45480
	1035	29.8		1216	18154		1141	45470
	1044	31.7					1157	45480
	1210	32.8						
	1222	27.1						
3/1/77	0230	58°37.2	3/1/77	0236	18054	3/1/77	0426	45501
	0241	41.1		0321	17969		0437	45499
	0315	45.6		0613	18149		0503	45481
	0326	37.4		0656	18127			
	0607	36.7						
	0619	37.5						
	0651	38.1						
	0700	36.1						
				(Station 3)				
31/12/76	1057	59°06.1	31/12/76	1104	18163	31/12/76	1303	45412
	1111	06.4		1243	18218		1317	45411
	1236	03.3		1425	18188		1408	45406
	1249	04.3						
	1419	01.5						
	1430	03.7						

TABLE 12 (cont)

WARD ROCK (Station 1)

Lat. $67^{o}09.0S$ Long. $51^{o}22.3E$ Elev. 614 m

Date	UT	D	Date	UT	H	Date	UT	Z
4/1/77	1023	$55^{o}29.0$	4/1/77	1028	18333	4/1/77	1117	43076
	1033	34.2		1050	18329		1121	43076
	1045	34.2						
	1055	33.0						
8/1/77	0612	$55^{o}33.7$	8/1/77	0616	18358	8/1/77	0742	43038
	0621	33.1		0647	18351		0751	43039
	0641	32.7		0715	18348		0816	43027
	0652	31.7		0910	18337		0844	43032
	0709	32.8		0926	18328		0851	43031
	0721	32.5						
	0905	32.7						
	0915	33.1						
	0922	31.6						
	0930	32.9						

WARD ROCK (Station 2)

8/1/77	1134	$55^{o}06.5$
	1140	05.1

HOWARD HILLS

Lat. $67^{o}05.7S$ Long. $51^{o}06.0E$ Elev. 84 m

Date	UT	D
4/1/77	0707	56^{o} 8.5
	0714	8.2

TABLE 12 (cont)

OBSERVATION ISLAND

Lat. $67^{o}00'10''S$			Long. $50^{o}24'59''E$			Elev. 32 m		
Date	UT	D	Date	UT	H	Date	UT	Z
5/1/77	0725	$52^{o}11.2$	5/1/77	0730	18943	5/1/77	0848	42633
	0734	30.2		0755	18926		0852	42633
	0750	53.0		0824	18902		0913	42633
	0801	51.8		0931	18934		1048	42624
	0819	49.6		0952	18927		1053	42622
	0828	49.1		1025	18920		1126	42625
	0926	47.4					1131	42627
	0935	48.5					1139	42631
	0947	48.5						
	0956	47.4						
	1020	49.6						
	1030	28.5						

MOUNT DOUGLAS

Lat. $67^{o}39'18''S$			Long. $50^{o}4'12''E$			Elev. 1564 m		
Date	UT	D	Date	UT	H	Date	UT	Z
7/1/77	1001	$53^{o}28.3$	7/1/77	1006	18142			
	1012	27.5		1032	18140			
	1027	28.3						
	1036	28.2						
27/1/77	1254	$53^{o}22.7$	27/2/77	1258	18120	27/1/77	1221	43433
	1302	21.7		1342	18136		1226	43425
	1339	20.8					1242	43417
	1345	21.4						

TABLE 12 (cont)

MOUNT KING

Lat. 67°04'29"S Long. 52°52'59"E Elev. 1116 m

Date	UT	H	Date	UT	D(corr)	Date	UT	Z
7/1/77	1650	19221	7/1/77	1645	54°48.8	7/1/77	1741	43726
	1708	19230		1656	48.9		1746	43728
				1704	47.5			
				1712	49.5			
24/1/77	0927	19173	24/1/77	0919	54°45.2	24/1/77	0845	43712
	1015	19175		0934	45.1		0859	43710
	1113	19169		1010	44.7		0906	43705
				1019	45.7		1038	43687
				1109	46.0		1053	43690
				1117	46.4			
			31/1/77	0618	55° 0.0	31/1/77	0623	43679
				0634	0.8		0629	43654
				0652	54°57.1		0831	43821
				0813	48.3		0839	43810
				0847	36.7		1014	43822
				1008	41.4		1021	43843
				1026	37.0		1151	43961
				1159	36.8			
4/2/77	1508	19198	4/2/77	1503	54°44.4	4/2/77	1603	43709
	1532	19206		1513	43.1		1626	728
	1615	19205		1523	44.1			
				1529	42.1			
				1536	42.2			
				1540	43.5			
				1612	43.1			
				1619	41.9			
				1632	41.9			

TABLE 12 (cont.)

McLEOD NUNATAKS

Lat. 67°29.5'S   Long. 52°43.6E   Elev. 1337 m

Date	UT	D	Date	UT	H	Date	UT	Z
8/1/77	1640	54°21.9	8/1/77	1645	19547	9/1/77	0329	44182
	1651	22.5		1705	19543		0334	44174
	1658	22.2					0346	44182
	1712	21.9					0355	44177
9/1/77	0427	54°02.1					0403	44146

NYE MOUNTAINS NUNATAK 821 (Station 1)

Lat. 68°00.9'S   Long. 48°38.3E   Elev. 630 m

Date	UT	D	Date	UT	H	Date	UT	Z
9/1/77	0839	53°36.2	9/1/77	0844	18981	9/1/77	0942	43337
	0849	36.4		0903	18971		1002	43186
	0858	36.4		0921	18973		1017	43529
	0907	36.3		1226	18976		1023	43470
	0917	35.4		1333	18965		1033	43402
	0926	35.3		1345	18965		1036	43546
	1221	31.8					1042	43455
	1231	31.3					1044	43523
	1329	28.8					1404	43541
	1337	30.6					1407	43548
	1341	29.8					1413	43523
	1349							

NYE MOUNTAINS NUNATAK 821 (Station 2)

9/1/77	1143	52°38.5

TABLE 12 (cont)

DEBENHAM PEAK (Station 1)

Lat. 66°37'30"S Long. 53°42'56"E Elev. 1840 m

Date	UT	D	Date	UT	H	Date	UT	Z
12/1/77	0840		12/1/77	0845	18526	12/1/77	0808	43570
	0850			0904	18540		0812	43577
	0859						0919	43589
	0902						0926	43594

DEBENHAM PEAK (Station 2)

12/1/77	0732							

MOUNT BRECKENRIDGE (Station 2)

Lat. 66°37'30"S Long. 53°42'56"E Elev. 1840 m

Date	UT	D	Date	UT	H	Date	UT	Z
14/1/77	0924	54°42.2	14.1.77	0929	19320	14/1/77	0835	44757
	0934	41.8		0950	19307		0839	44766
	0946	38.0		1118	19313		0853	44763
	0954	37.8		1156	19311		0907	44742
	1114	39.7		1232	19328		1011	44744
	1112	37.6		1406	19321		1032	44726
	1152	36.7					1057	44746
	1201	37.3					1102	44745
	1228	37.2					1246	44716
	1236	37.2					1347	44730
	1401	37.1					1422	44738
	1411	36.7						

MOUNT BRECKENRIDGE (Station 3)

14/1/77	1452	54°23.7
	1512	21.2
	1521	16.3

TABLE 12 (cont)

MOUNT CODRINGTON (Station 1)

Lat. 66°19'05"S Long. 52°52'48"E Elev. 1222 m

Date	UT	D	Date	UT	H	Date	UT	Z
15/1/77	0727	54°7.6	15/1/77	0732	18284	15/1/77	0659	43655
	0738	7.1		0804	18291		0706	43643
	0800	9.9		1023	18292		0824	43695
	0809	10.7		1049	18282		0830	43689
	1019	5.9		1254	18299		0956	43709
	1028	4.4		1309	18298		1003	43717
	1045	4.7					1106	43724
	1054	5.8					1128	43732
	1250	7.9					1238	43744
	1258	7.9					1324	43712
	1305	8.4						
	1313	8.0						

MOUNT CODRINGTON (Station 2)

15/1/77	1145	53°19.3
		21.8
	1223	22.7

LATHAM PEAK (Station 1)

Lat. 66°22'27.5"S Long. 51°47'02"E Elev. 1000 m

Date	UT	D	Date	UT	H	Date	UT	Z
18/1/77	0553	54°22.6	18/1/77	0600	18605	18/1/77	0502	43079
	0606	17.1		0639	18637		0517	43069
	0633	9.1		0731	18772		0525	43053
	0644	8.0		0755	18800		0702	43079
	0726	0.7		1033	18782		0717	43234
	0737	1.8		1105	18784		0809	43308
	0751	3.8					0822	43291
	0800	53°55.1						
	1028	54° 1.2						
	1037	53°58.8						
	1100	54° 0.4						
	1109	53°58.7						

TABLE 12 (cont)

LATHAM PEAK (Station 2)

Date	UT	D	Date	UT	H	Date	UT	Z
18/1/77	0625	54°06.6						
	0709	00.6						
	0746	53°56.4						
	0818	56.2						
	0847	50.3						
	0906	54.3						

MOUNT BISCOE

Lat. 66°13.9S | Long. 51°19.2 E | Elev. 300 m

Date	UT	D	Date	UT	H	Date	UT	Z
18/1/77	1414	54°17.9	18/1/77	1419	19150	18/1/77	1351	42253
	1423	17.2		1436	19160		1401	42225
	1432	15.9					1456	42262
	1440	15.8					1502	42246
	1528	11.3						
19/1/77	0441	54°22.7	19/1/77	0446	19191	19/1/77	0421	42253
	0451	23.2		0505	19189		0427	42253
	0501	20.1		0537	19179		0518	42223
	0510	21.7					0523	42222
	0533	24.0					0551	42216
	0541	22.1						
	0628	18.5						

TABLE 12 (cont)

SHEELAGH ISLAND (Station 1)

Lat. 66°32'40"S Long. 50°10'51"E Elev. 21.1 m

Date	UT	D	Date	UT	H	Date	UT	Z
19/1/77	0947	52°34.9	19/1/77	0955	18923	19/1/77	0911	44008
	1002	35.6		1042	18908		0917	44007
	1036	35.4		1152	18919		1116	44005
	1049	32.9		1226	18934		1133	44008
	1147	35.0					1242	44027
	1158	32.6						
	1222	32.6						
	1230	32.2						

SHEELAGH ISLAND (Station 2)

Date	UT	D
19.1.77	0935	52°21.4
	1101	17.5
	1101	17.9
	1410	29.8
	1432	29.3

FYFE HILLS (Station 1)

Lat. 67°23'33"S Long. 49°13'03"E Elev. 504 m

Date	UT	D	Date	UT	H	Date	UT	Z
25/1/77	0756	55°59.8	25/1/77	0800	17800	25/1/77	0740	44456
	0805	56°02.2						

FYFE HILLS (Station 2)

Date	UT	D	Date	UT	H	Date	UT	Z
27/1/77	0823	55°42.7	27/1/77	0828	17745	27/1/77	0917	44324
	0832	43.9		0855	17738		0923	44332
	0850	43.6		0947	17723		0935	44340
	0900	43.7		1020	17712		1000	44356
	0943	41.1		1054	17714		1008	44354
	0951	42.0					1033	44363
	1016	42.1					1042	44351
	1024	38.6						
	1051	40.0						
	1058	39.6						

TABLE 12 (cont)

SANDERCOCK NUNATAK

Lat. 68°33.3S   Long. 52°07.3'E   Elev. 2273 m

Date	UT	D	Date	UT	H	Date	UT	Z
26/1/77	1147	54°41.1	26/1/77	1239	18736	26/1/77	1157	44799
	1229	39.1		1306	18721		1212	44833
	1248	37.9		1358	18724		1337	44791
	1257	38.0						
	1315	39.7						
	1348	37.4						
	1410	33.2						

MOUNT MUELLER (Station 1)

Lat. 66°54'57"S   Long. 55°32'46"E   Elev. 1179 m

Date	UT	D	Date	UT	H	Date	UT	Z
28/1/77	0854	55°39.4	28/1/77	0858	18799	26/1/77	0938	44775
	0903	38.4		0925	18790		0942	44782
	0921	36.8		1026	18780		1010	44763
	0929	37.0		1111	18783		1044	44780
	1021	36.7					1055	44776
	1030	37.6					1129	44788
	1108	37.4						
	1115	37.7						

MOUNT MUELLER (Station 2)

Date	UT	D
28/1/77	1051	56°09.6
	1102	08.6
	1123	05.8
	1134	08.3

TABLE 12 (cont)

OBLACHNAYA NUNATAK (Station 1)

Lat. 67°40'45"S Long. 51°13'40"E Elev. 1600 m

Date	UT	D	Date	UT	H	Date	UT	Z
29/1/77	0804	53°57.6	29/1/77	0810	18965	29/1/77	0637	43184
	0816	59.4		0847	18988		0718	43190
	0842	57.5		1029	19014		0737	43155
	0851	57.9		1058	19051		0918	43211
	1024	59.4		1158	19059		0952	43228
	1033	54°00.7		1303	19007		1144	43219
	1054	53°58.0					1214	43231
	1102	54°00.9					1248	43213
	1154	53°59.7					1326	43217
	1203	54°01.0						
	1259	2.1						
	1307	3.4						

OBLACHNAYA NUNATAK (Station 2)

Date	UT	D
29/1/77	0729	54°10.5
		6.4
	0945	53°58.8
		58.3
	1046	58.6
		54.4
	1242	54°10.5
	1333	13.3

TABLE 12 (cont)

NEWMAN NUNATAKS (Station 1)

Lat. 66°41.8"S			Long. 54°52.6"E			Elev. 2044 m		
Date	UT	D	Date	UT	H	Date	UT	Z
30/1/77	0950	55°26.9	30/1/77	0959	17210	30/1/77	0806	43683
	1007	28.2		1035	17206		0848	43783
	1029	27.2		1137	17290		0922	43816
	1040	26.7		1158	17371		1050	43815
	1130	25.0					1120	43820
	1144	30.3					1156	43794
	1153	38.0					1240	43740

NEWMAN NUNATAKS (Station 2)

30/1/77	0740	55°49.9
	0744	45.7
	0854	55°33.0
	1057	24.2
	1235	41.3

PINN ISLAND (Station 3)

Lat. 67°33'35"S			Long. 47°54'22"E			Elev. 112 m		
Date	UT	D	Date	UT	H	Date	UT	Z
1/2/77	0823	51°18.5	1/2/77	0827	18535	1/2/77	0755	43686
	0832	19.1		0856	18528		0805	43694
	0852	19.8		1000	18516		0909	43694
	0900	19.8		1058	18512		0946	43700
	0956	19.7		1200	18515		1013	43710
	1004	17.8		1233	18500		1044	43722
	1054	18.1					1112	43746
	1103	16.8					1147	43739
	1156	15.6					1211	43744
	1205	14.1					1210	43735
	1230	16.0						
	1237	13.7						

(contd)

TABLE 12 (cont)

PINN ISLAND (Station 4)

Date	UT	D	Date	UT	H	Date	UT	Z
1/2/77	0921	$50^{\circ}10.4$						
	0948	9.4						
	1018	7.6						
	1038	7.2						
	1116	7.8						
	1143	7.4						
	1216	7.0						

PROCLAMATION ISLAND (Station 3)

Lat. $65^{\circ}50'19''$S Long. $53^{\circ}41'09''$E Elev. 268 m

Date	UT	D	Date	UT	H	Date	UT	Z
2/2/77	0743	$52^{\circ}44.6$	2/2/77	0749	20260	2/2/77	0707	47985
	0754	40.6		0818	20274		0730	48190
	0814	42.2						
	0822	41.0						
PROCLAMATION ISLAND (Station 4)								
2/2/77	0903	$53^{\circ}45.7$	2/2/77	0909	20375	2/2/77	0835	48301
	0914	47.0		1021	20350		0852	48325
	1017	46.5		1116	20387		0921	48347
	1026	45.2					1009	48380
	1112	41.4					1033	48407
	1120	41.5					1103	48378
							1128	48345
PROCLAMATION ISLAND (Station 5)								
2/2/77	0722	$52^{\circ}17.1$						
	0848	11.4						
	0931	13.8						
	1005	14.3						
	1037	5.0						
	1059	3.0						
	1132	6.6						

TABLE 12 (cont)

KNUCKEY PEAKS

Lat. $67^{\circ}54'17''$S			Long. $53^{\circ}32'22''$E		Elev. 2156 m
Date	UT	D	Date	UT	Z
10/1/77	0835	$42^{\circ}49.4$	30/1/77	0519	49216
	0844	$42^{\circ}48.0$			
	0853	$42^{\circ}46.7$			
29/1/77	1833	$43^{\circ}36.1$			
	1843	$43^{\circ}36.2$			
	1851	$43^{\circ}24.3$			

GAUSSBERG

Lat. $66^{\circ}48.0''$ S			Long. $89^{\circ}11.5''$E			Elev. 1011 m		
Date	UT	D	Date	UT	H	Date	UT	Z
26/2/77	1050	$80^{\circ}51.7$	26/2/77	1209	14999	26/2/77	1123	57285
	1111	49.2		1237	14991		1135	57271
	1225	52.0					1255	57148
							1308	57145
							1320	57136

MOLODEZHNAYA MEAN MONTHLY VALUES 1976

Lat. $67^{\circ}40''$S	Long. $45^{\circ}52''$E		
Month	D	H	Z
Jan.	$50^{\circ}11.7$	18992	42099
Feb.	12.0	19003	42118
Mar.	12.2	18996	42116
Apr.	13.3	19005	42101
May	9.9	18987	42076
Jun.	11.3	19018	42073
Jul.	11.0	18994	42053
Aug.	11.9	19023	42055
Sep.	15.0	19022	42049
Oct.	16.5	19025	42035
Nov.	17.3	19063	42003
Dec.	13.5	19063	42003

APPENDIX 1: HISTORY OF INSTRUMENTATION BEFORE 1976

A brief outline of the development of Mawson Geophysical Observatory in terms of instrumentation until 1976 is presented below.

(a) Geomagnetic

May 1955	: Absolute instruments used for regular observations of H, D, and Z (Oldham, 1957).
July 1955	: Continuous recording commenced by three-component NORMAL La Cour magnetograph (Oldham, 1957).
1957	: Bar-fluxmeter magnetograph installed (Pinn, 1961).
January 1961	: Three-component INSENSITIVE La Cour magnetograph installed and recording commenced (Merrick, 1961).
December 1967	: Bar-fluxmeter magnetograph withdrawn (Dent, 1971).
September 1968	: INSENSITIVE La Cour magnetograph converted to medium sensitivity and renamed NORMAL magnetograph. The NORMAL La Cour magnetograph was renamed SENSITIVE magnetograph (Smith, 1971).
February 1975	: 15 mm/hr normal recorder replaced by 20 mm/hr recorder (Hill, 1978).
December 1975	: 15 mm/hr sensitive recorder replaced by 20 mm/hr recorder.

(b) Seismological

July 1956	: Three-component Leet-Blumberg seismograph (pen-and-ink recorder) installed (McGregor, personal communication).
1960	: Three-component seismograph installed consisting of Benioff seismometers (free period 1.0 second) and three-channel BMR single-drum recorder. Z galvanometer 0.2 second free period, horizontal galvanometers were long-period (14 second free period) (Merrick, 1961).
February 1963	: BMR recorder replaced by Benioff 60 mm/minute three-channel recorder, 14 second free period horizontal galvanometers installed (Black, 1965).

September 1970 : 14 second free period horizontal galvanometers replaced by short-period (0.2 second) galvanometers (Robertson, 1972).

December 1973 : Z seismometer transferred to underground vault beneath cosray building (Almond, 1975).