BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

RECORD 1981/8

MAWSON GEOPHYSICAL OBSERVATORY
ANNUAL REPORT, 1977

by

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ABSTRACT

Geomagnetic and seismological recordings were continued at the Mawson Geophysical Observatory, Antarctica, during 1977. Instruments included two La Cour magnetographs and a three-component Benioff seismograph. Preliminary data were forwarded on a regular basis to Australia. The geophysics office, including power and timing equipment, was transferred to a new location in the Science Block, which had been constructed during 1976. Eleven third-order magnetic stations in Enderby and Kemp Lands were occupied during the 1977-78 summer field season.

1. INTRODUCTION

Mawson Geophysical Observatory was established in 1955 by the Bureau of Mineral Resources, Geology and Geophysics (BMR) at Mawson Base, Australian Antarctic Territory (see Oldham, 1957; Appendix III). During 1977 a magnetic observatory and seismic observatory were operated.

The author arrived at Mawson on 26 December 1976 and relieved Phil Wolter, who flew to M.V. Nella Dan to join the 1976-77 Enderby Land expedition for regional magnetic field survey work.

In late December 1977 the author sailed for Enderby Land for regional magnetic field survey work. From late December 1977 through to mid-February 1978 a geophysicist was not available for observatory operations, and essential observatory duties were carried out by stand-in operators David Barrett and Michael Hinchey. Full observatory duties were resumed by relieving geophysicist Josko Petkovic as from mid-February 1978.

Activities of BMR in the Antarctic are a part of the Australian National Antarctic Research Expedition (ANARE), with logistic support supplied by Antarctic Division, Dept of Science and the Environment.

2. MAGNETIC OBSERVATORY

Variation of the geomagnetic field components H, D, and Z, were recorded by a NORMAL and a SENSITIVE La Cour Magnetograph. Control observations were made with two QHMs and a declinometer, PPM and BMZ.

Continuous recording was maintained during 1977 with a total loss of 5½ days' NORMAL record and 1½ days' SENSITIVE record. This included a 3-hour simultaneous loss on both NORMAL and SENSITIVE recorders while orientation coil alignments were checked and modifications to the lamp power supply were attempted.

Recorders

Minor problems with the NORMAL magnetograph recorder, involving a sticking drum and jammed drive gears, persisted for one to two weeks during March and caused most of the record loss. The problem was due to the recorder lid being placed in an incorrect position during record changes, and careful lid alignment was needed throughout the year to limit record loss. The SENSITIVE recorder operated successfully although the drive gears were not properly engaged on some days when stand-in operators were used. Standard 50-Hz,240V AC from the EMI clock was supplied to the synchronous drive recorder motors throughout 1977. Occasionally station power was used when repairs to the EMI clock were needed. An unsuccessful attempt was made to construct a modified PMZ-1 power supply for the magnetograph recording lamps, to supersede the existing arrangement, which requires updating.

Baseline value control

Absolute observations and scale-value measurements were performed six to seven times per month to monitor baseline values of H, D, and Z on the NORMAL magnetograms. Instruments used for absolute observations included QHMs 300 and 302, Declinometer 332, and PPM 339. Measurements of BMZ 62 correction, pier difference, and SENSITIVE magnetograph scale values were done once a month.

During January 1977 intercomparison measurements were made between Mawson absolute instruments and instruments from Australia; results are described by Wolter (in prep.).

Further intercomparison measurements were made by Josko Petkovic and the author in February 1978 using QHM 172, HTM 704, and Geometrics PPM 816. Adopted instrument corrections are listed in Table 11. Magnetograph calibrator MCO1 B was used as a current source for Helmholtz coils for scale-value determinations, and applied coil currents were monitored with a Data Precision digital multimeter. Measured currents differed by no more than 0.1 mA from the specified currents of the MCO1. Measured currents were used as the final adopted scale-value coil currents and are listed in Table 3.

During March 1977 it was found that the D NORMAL baseline value was drifting, and measurements of the baselines on the NORMAL magnetogram proved this to be the case. The cause was traced to modifications made to the D NORMAL variometer baseline mirror in November 1976 when the variometer baseline mirror was removed and accidentally broken.

The largest piece of the mirror has been replaced, with a paper chock behind it, to give a baseline trace. The paper chock caused the baseline movement and on 13 May the baseline mirror was removed and remounted without the paper chock, and adjusted to give a baseline trace. Further adjustments of prisms and lenses, which were required during the year to improve the quality of the D NORMAL baseline trace, caused numerous baseline value jumps. The variometer head on the H NORMAL variometer was rotated on 8 and 9 September to decrease the H ordinate value. This resulted in a baseline value jump of +241 nT.

Table 4 lists adopted baseline values for the NORMAL magnetograph.

After movement caused by blasting on 24 August, the H SENSITIVE variometer head was rotated on 8 and 9 September to restore the trace to near its former ordinate value. The blast also caused the plaster to crack around the H SENSITIVE Helmholtz coils, requiring re-alignment nd re-plastering of the coils. The Z SENSITIVE variometer became enveloped in a coating of drift snow on 29 May as a result of a crack which developed in the variometer hut during a blizzard. The snow was carefully removed and no movement in the baseline trace was apparent.

Temperature control

The thermistor heator control units (PZC-1) in the absolute and variometer huts worked very reliably throughout the year. The temperature remained near $0^{\circ}C$ in the variometer hut with a daily variation of 1 or $2^{\circ}C$, and the absolute hut remained at about $10^{\circ}C$. The bar heater elements in the variometer hut required frequent replacement because of current surges in the station power supply. It was found that of the four heaters in the variometer hut only two were required to maintain the temperature at $0^{\circ}C$.

The thermometers of the H and Z NORMAL variometers were read daily and results are listed in Table 8. H and Z SENSITIVE variometer temperatures were read weekly.

Parallax tests

Negligible parallax existed between the NORMAL magnetogram traces and time marks, and zero parallax was adopted for all analysis of magnetograms.

Preliminary data

K-indices, preliminary baseline values, scale values, and preliminary monthly mean values were transmitted monthly to Toolangi Observatory Group, Melbourne. From November 1977, with the disbandonment of the Toolangi Observatory Group, all data were forwarded to Canberra. Preliminary monthly mean geomagnetic values and K-index values for 1977 are listed in Table 9. Values of the geomagnetic annual means from 1967 to 1977 are tabulated in Table 10.

Orientation tests

Orientation tests on H and D variometers for both NORMAL and SENSITIVE magnetographs were carried out on 30 August. Tests on the Z variometers were performed on 7 September. Following torsion-head adjustments on both H variometers, orientation tests were re-done on 9 September and also both Z orientation tests were rechecked owing to discrepancies with previous years' results. The results are listed in Table 6. Before commencing orientation tests, variometer wall mark (Fig. 7) positions were checked, and variometer coil alignments were checked by suspending plumb bobs from a string connecting the wall marks. The coil alignments were in the direction N64^{o}W (i.e. 296^{o}TN). The magnetic moment of the Z variometer deflector magnet was measured using a QHM (Wolter, in prep.). The value obtained, 491.4 nT m^{-3}, was consistent with ageing of the magnet since 1969. Z orientation tests were carried out using Hill's (1975) method. This uses a U tube arrangement for locating the deflector magnet at the same height as the variometer magnet, and an adjustable platform with levelbubble for positioning the deflector magnet accurately. Z orientation test results were not consistent with measurements by Hill in 1975 and Wolter in 1976, but no errors could be found in the setting-up procedure or calculations. All H and D orientation test results are consistent with previous measurements in other years. Currents were applied to the H and D orientation coils; the values used, and magnetic field directions produced by different switch settings, are listed in Table 7.

Pier difference

Absolute F observations were measured at Mawson with the PPM sensor head located on an external pier, designated E pier, with the electronic hardware unit located in the absolute hut. To correct F readings to the pier in the absolute hut (N pier), pier difference readings were done monthly using the Z baseline value.

The measured pier difference agreed with the value adopted in 1976: N pier - E pier = +3 nT (in terms of F).

3. SEISMOLOGICAL OBSERVATORY

Seismic activity was monitored by the use of a three-component Benioff seismograph system throughout 1977. The two horizontal component seismometers were on the surface in the seismic hut and the vertical component seismometer was located in the seismic vault at the bottom of the cosmic ray shaft. The three-component photographic drum recorder remained in use and the overall system has remained unchanged since the installation of the vertical seismometer in the cosray shaft in 1973. A new Pyrotenax cable was laid from the Science Block to the Seismic Hut to carry 110 V AC Standard 50 Hz power and time-mark pulses, with a spare conductor pair remaining in the cable for future use.

Maintenance

The seismograph recorder drive gears were inspected, cleaned, and regreased in June as part of a yearly service.

Lubrication oil was also applied to the main screw shaft, but this later caused the drum friction brakes to become coated in oil, causing difficulty in resetting the recorder drums. The NS recording drum was dismantled and cleaned and all excess oil was removed. It is suggested that in future lubrication services only the main drive gears be cleaned and regreased.

Radio frequency (RF) interference, which produced DC offsets of traces, was a continuing problem. Different arrangements of shield connections to earth were attempted, and signal cables were thoroughly examined for contact between signal lead and shield. The cause was finally traced to dirty attenuator potentiometers located in the galvanometer control boxes, allowing RF interference to be picked up. Regular application of CRC 2-26 to the potentiometers virtually eliminated the DC trace offsets.

Minor adjustments to the recorder optics and time-mark relay units were required to restore trace quality on several occasions.

The vertical seismometer signal cable from the Cosray building to the Seismic hut proved very reliable, with no problems of moisture entering Pyrotenax cable joins during the summer thaw. A new cable join located in the old Geophysics hut was made when the office was transferred to the new Science block. The cable was Megger tested several times to ensure insulation of signal leads from the Pyrotenax cable shield. During May, weight-lift tests showed that the vertical seismometer signal leads were connected in reverse, and had been since late 1976. The signal leads were reconnected on 30 May to give correct ground movements on the vertical seismogram.

<u>Calibrations</u> (Figs. 1, 2)

Calibration pulses were applied daily to check any changes in the magnification of the three components of the seismograph system.

Weight-lift seismograph system tests were carried out during the year to check seismograph parameters such as motor constants, damping ratios, and seismometer free periods.

Frequency-response tests were applied to all three components to check any changes in the frequency response characteristics of the seismograph system. The plotted frequency-response curves for both vertical and horizontal seismograph systems agree very closely with measurements in other years.

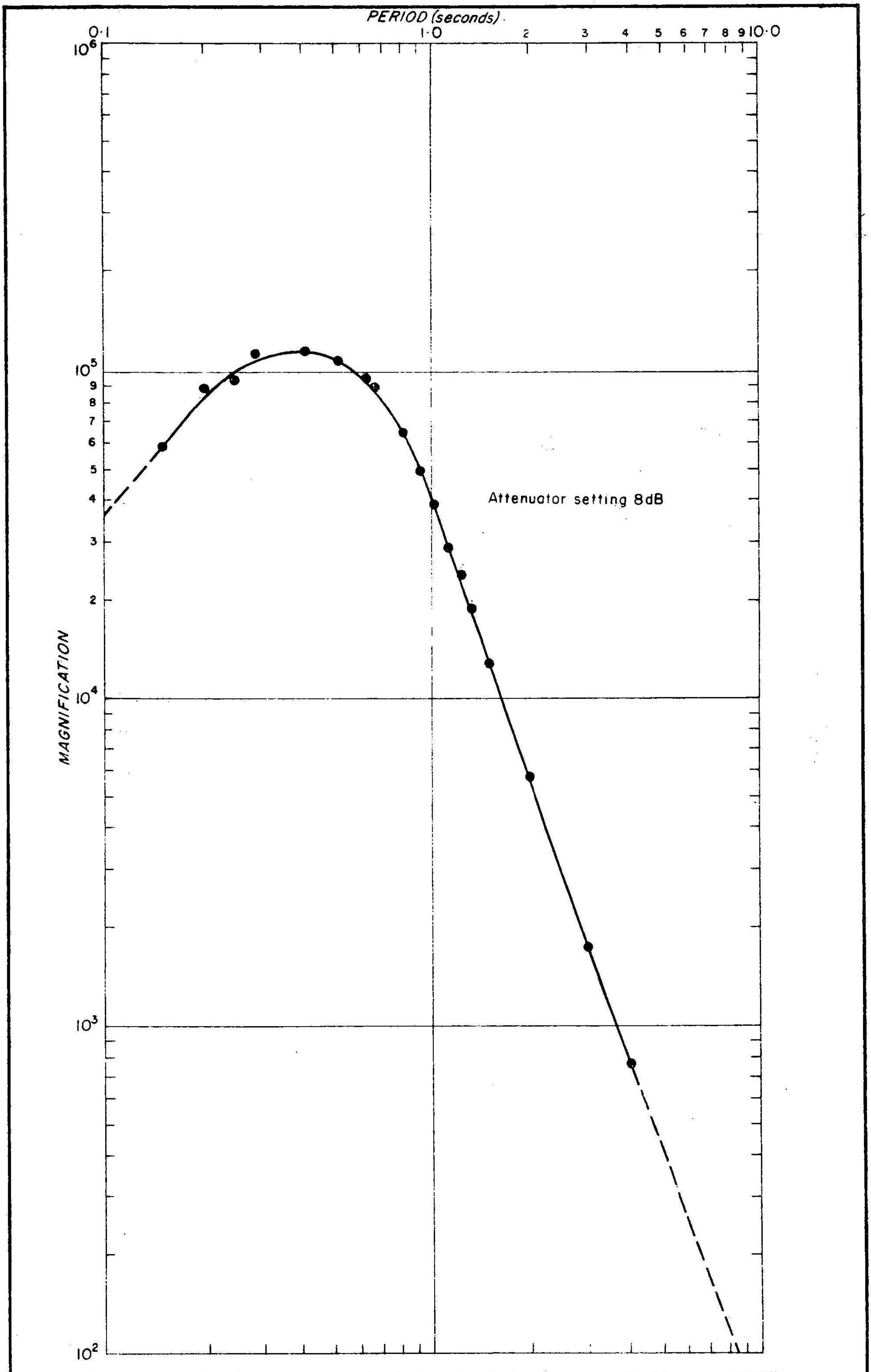

Fig. 1 Magnification curve: vertical short period seismograph, Mawson, 1977

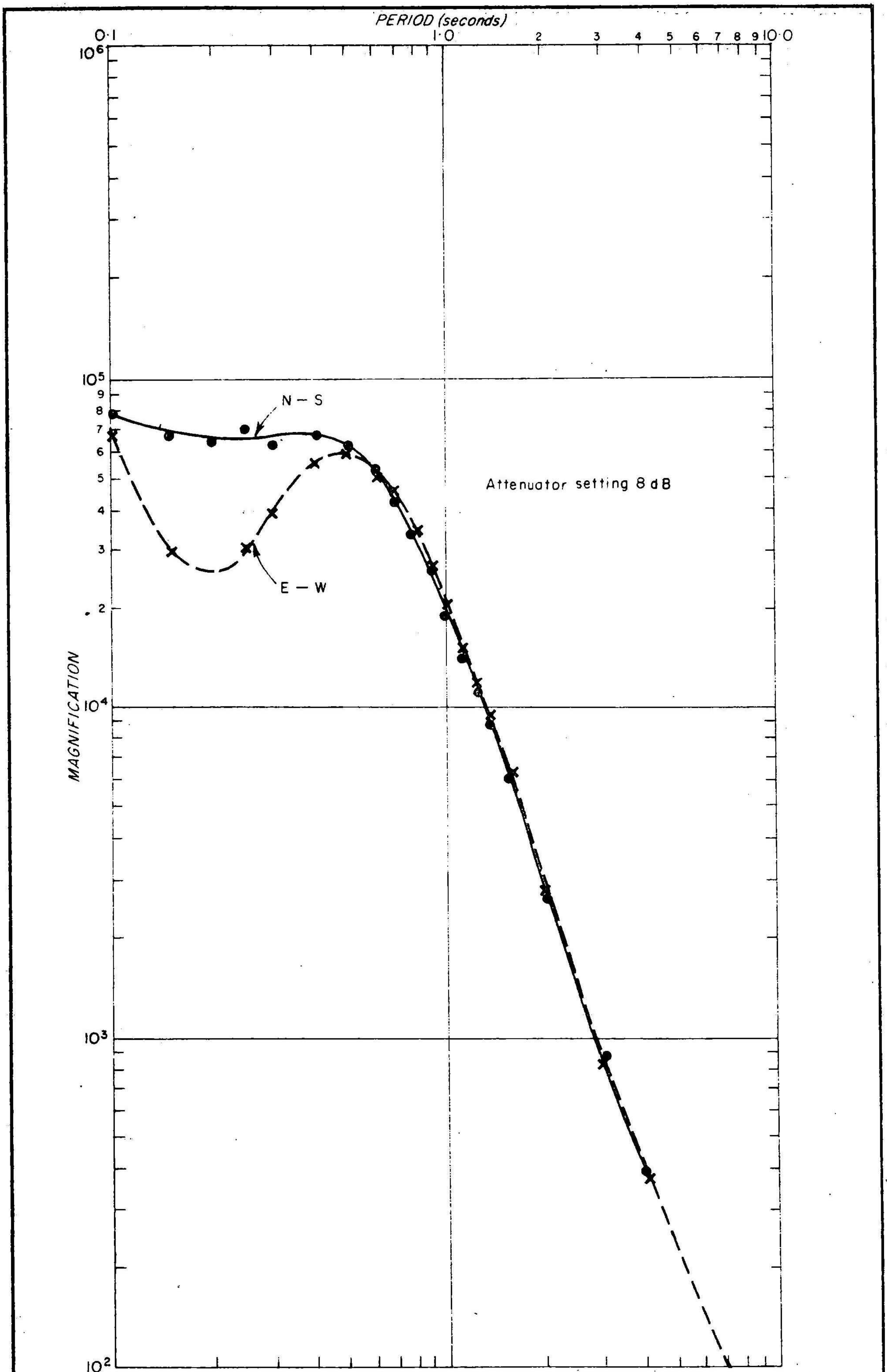

Fig.2 Magnification curves: horizontal seismograph, Mawson, 1977

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Magnification values calculated for different attenuation settings at 1 Hz during the year were in error by up to 20% of the correct values due to a misused magnification formula. The corrected values are listed in Table 14.

Data

Preliminary earthquake data consisting of P-phase arrival times were transmitted 2 to 3 times a week to the National Earthquake Information Service (U.S. Geological Survey) via Melbourne and later via Canberra after the disbandment of the Toolangi Observatory Group.

On return to Australia, final seismic data analysis was done for transmission to the International Seismological Centre in Newbury, U.K.

The majority of earthquakes were recorded during the later half of 1977 when the sea-ice was at its maximum thickness, so allowing higher magnification settings of the vertical seismograph and the detection of weaker movement (see Hill, 1978).

Table 16 lists underground nuclear explosions at Southern Nevada Test Site, U.S., from which PKP phases were recorded at Mawson. Mawson appears to be ideally located for the detection of nuclear explosions at the Nevada Test Site with a characteristic style of PKP waveforms.

The epicental distance (Δ) from Nevada Test Site to Mawson is 149.4^{o} and the order of PKP branch arrivals is DF (or DEF), GH, BC, and AB. Plotting of travel times (Δt) of the different phase arrivals against epicental distance on travel time curves indicates that only the DF and BC branches are measurable. Major (1970), in his list of nuclear explosions at Nevada recorded at Mawson, designates certain PKP phase types to phase arrival times; however, the majority of the designated phase types are in error with corresponding arrival times.

4. CONTROL EQUIPMENT

During 1977 the observatory power and timing equipment was transferred from the Geophysics office to the newly constructed Science block. Minor changes were made in the equipment layout, but no major modifications were made. The installation of a new inverter into the system to replace the use of the EMI clock inverter proved unsuccessful, and standard 240 VAC 50-Hz power was supplied from the EMI clock throughout the year. Figure 4 shows the layout of the Science block.

Power and timing equipment relocation (Fig. 5)

Power and timing control equipment was transferred to the new Geophysics office in the Science block on the 22 April. Before moving the power and timing equipment new seven-core Pyrotenax cables were laid and installed between the Seismic hut and Science block, and Variometer hut and Science block. During the equipment transfer the seismograph and magnetograph recorder motors were switched over to station mains power. A loss of several minutes' timing control was allowed for while the Mercer chronometer and Time-mark Programming Unit (TMU) were transferred to the Science block to provide secondary timing while the EMI clock was shifted and installed. On moving the equipment the TMU, EMI clock, and Power and Timing Control panel all failed to operate satisfactorily and 9 hours' timing was lost during attempts to repair faults. A temporary timing arrangement using NTO-1 relay units with Mercer chronometers was used until a short on the input cable to the TMU was repaired, allowing a correct sequence of time marks to be made. After several days of replacing components in the EMI clock it mysteriously resumed operation although a display reset fault remained. Power and timing equipment was placed in a new instrument rack to be used for visual display helicorders in future years. Within a week all equipment was operating satisfactorily, with the EMI clock supplying primary power and timing, secondary power supplied from the station mains, and secondary timing provided by a Mercer chronometer.

Time-mark programming unit (TMU)

Throughout 1977 the TMU occasionally advanced itself owing to spurious pulses on the input timing cable to the TMU. The cause of the

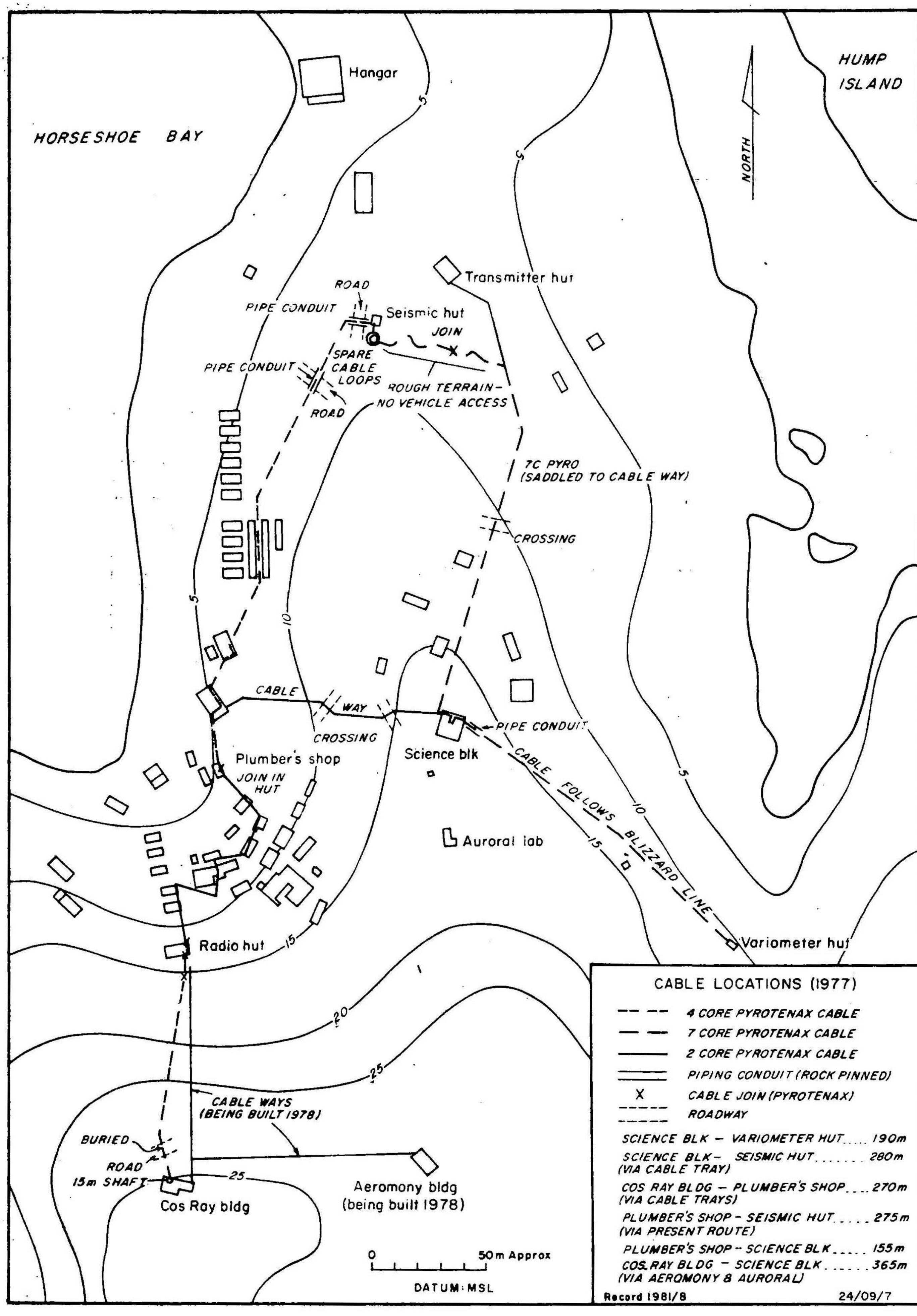

Fig. 3 Building and cable locations, Mawson, 1977

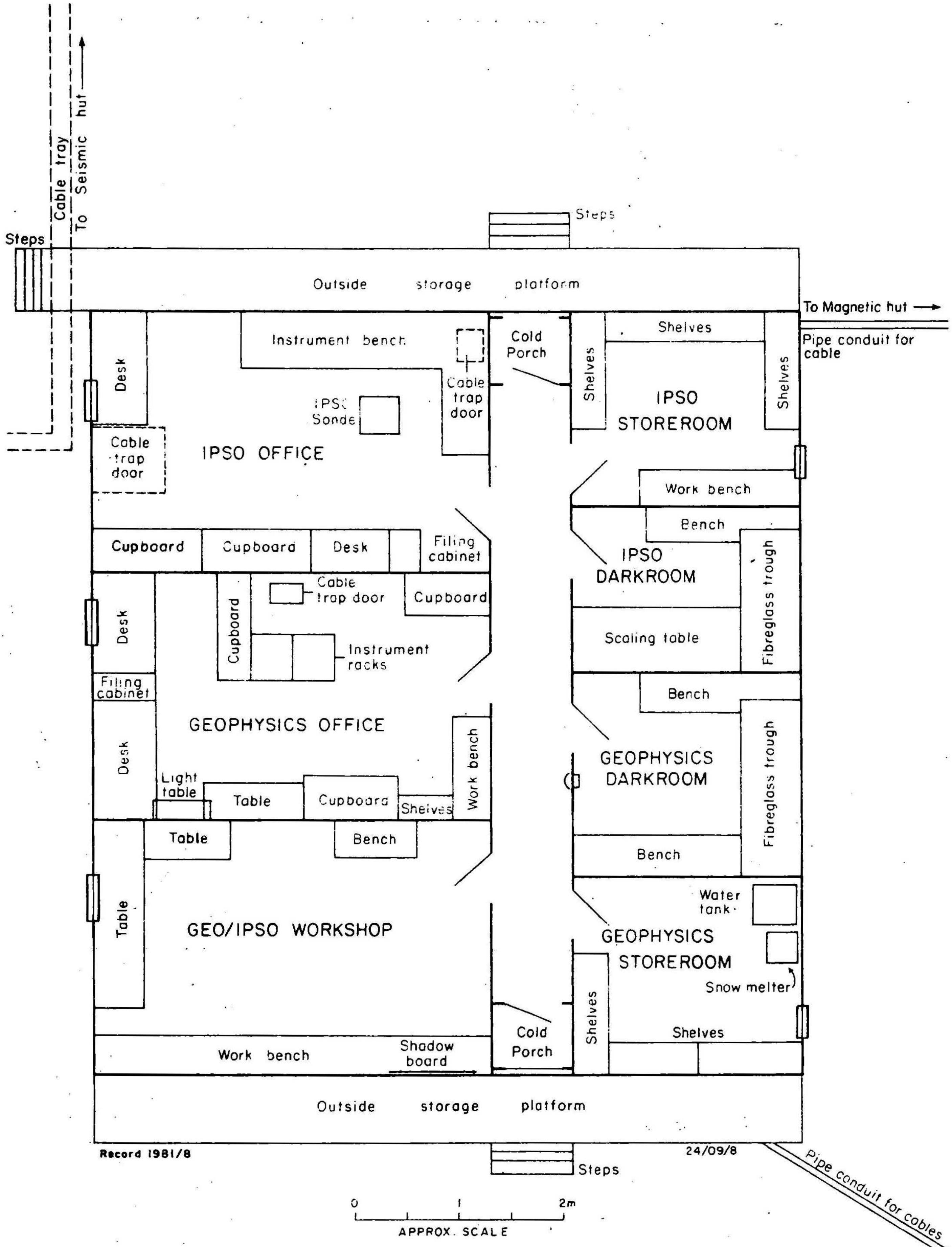

Fig. 4 Layout of science BLK, Mawson, 1977

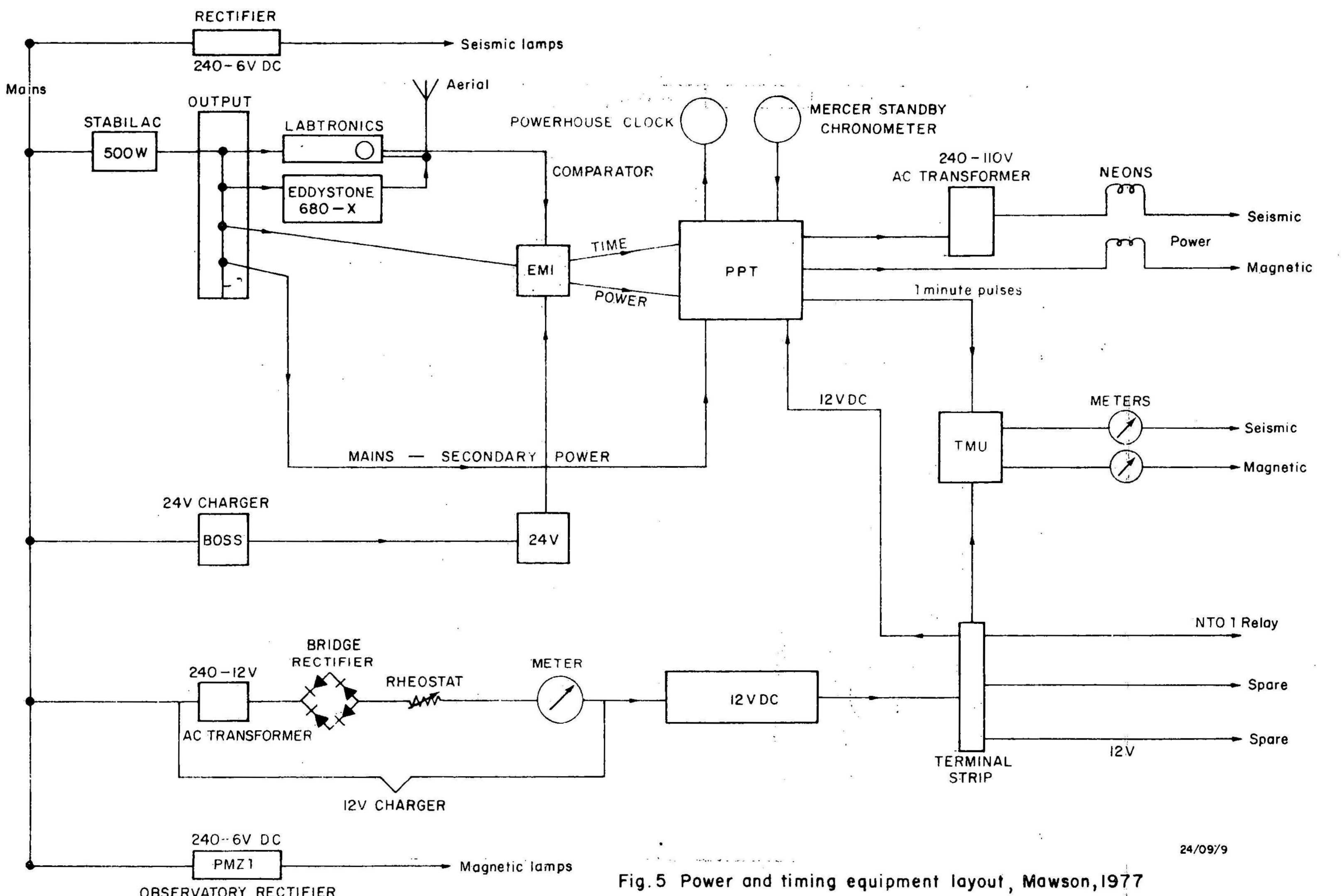

Fig. 5 Power and timing equipment layout, Mawson, 1977

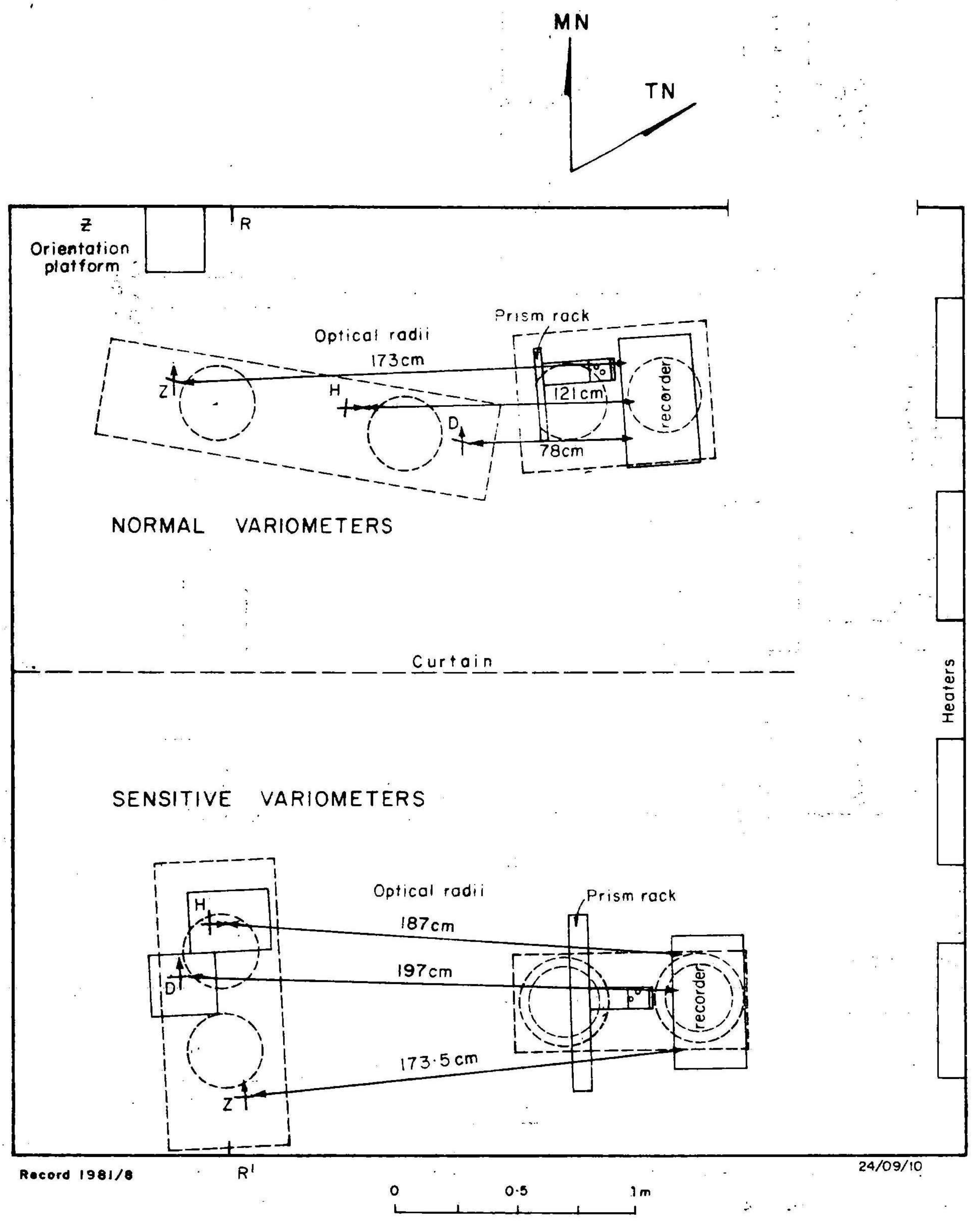

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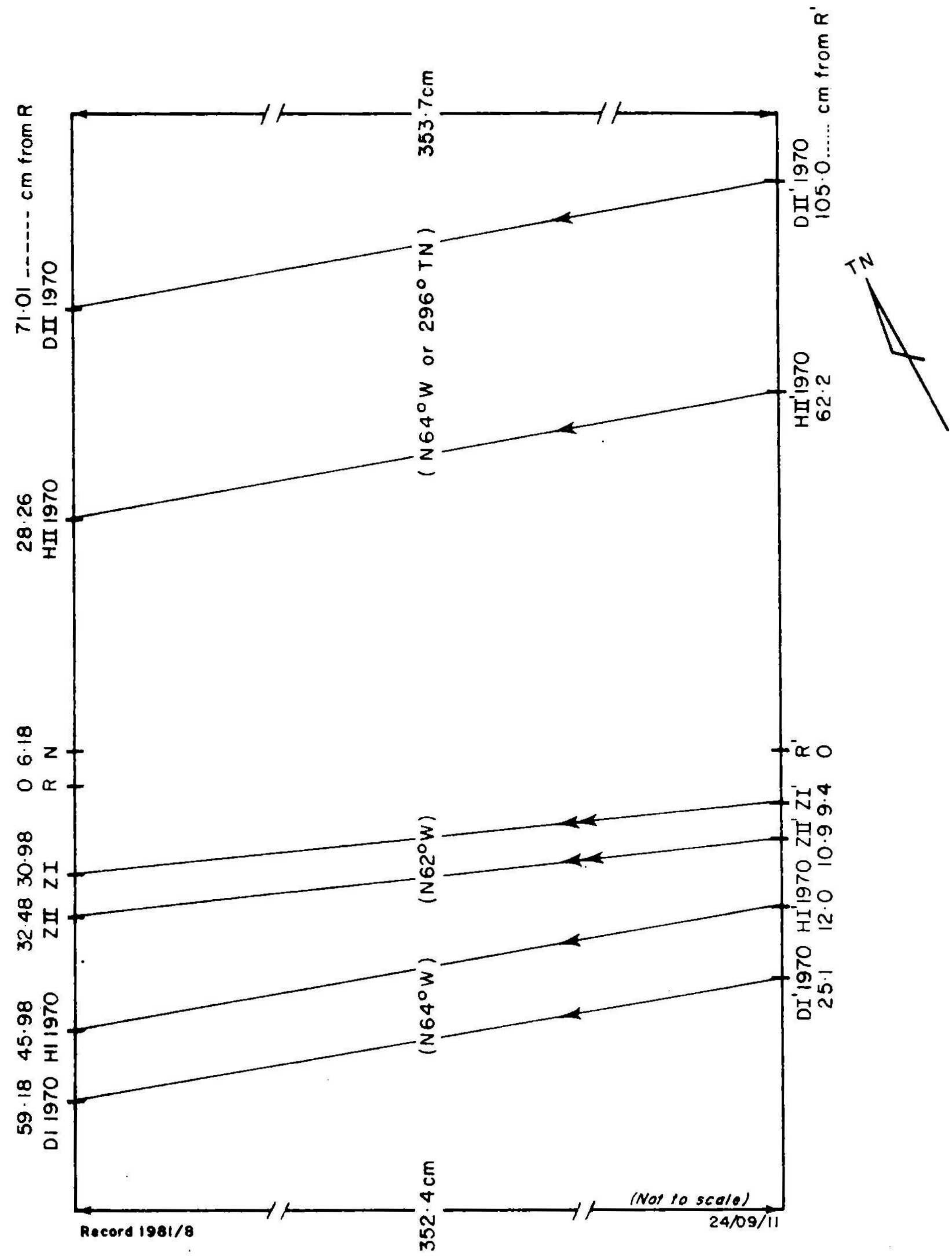
Fig. 6 Variometer room: variometer optical radii



Notes: *R' – R* : *Reference direction (wall apertures for survey line) – 301°29·1' TN*
R' – N : *Line normal to walls – 302°29·1' TN*
HI, DI, ZI : *Wall marks associated with SENSITIVE magnetograph*
HII, DII, ZII : *Wall marks associated with NORMAL magnetograph*

Fig. 7 Variometer hut, Mawson: wall mark locations pulses seemed to be connected in some way with the contact closures of the Mercer chronometer. All attempts to solve the problem were unsuccessful, and from previous reports of the Mawson Geophysical Observatory equipment the same problem has existed since the installation of the TMU in 1968.

EMI clock

The EMI clock provided time-mark pulses and 240 V AC Standard 50-Hz power and operated successfully except for malfunctions on two occasions totalling 14 days. The repair of the EMI clock involved a stop-start resetting display problem which persisted throughout the year and could not be repaired owing to the lack of spare parts. A replacement EMI clock was ordered for 1978 because of the above problem and also because the rate of the clock varied to a small degree with room temperature. During February 1978 the replacement EMI clock was installed and the faulty unit was returned to Australia for an overhaul.

Time signals

Radio time signals fron VNG, Lyndhurst, Victoria, Australia were received on most days to correct the EMI clock. A new dipole receiving aerial was erected near the Science block owing to difficulties in re-routing the existing antenna, and this proved satisfactory for time-signal reception. The Eddystone multi-waveband receiver was overhauled by the radio technician and operated successfully as a standby receiver to the Labtronics radio receiver.

Cables

New seven-core Pyrotenax cables were laid from the Science block to both the Seismic and Variometer buildings to provide power and timing facilities for recorders. Figure 3 outlines the location of cables laid and existing cables being used during 1977. The cable trays were used where possible and in other places the cable was protected by galvanised iron piping if vehicular traffic was to be driven over it. The abandoned Pyrotenax cables could not be recovered due to snow drift accumulations in some areas and these should be recovered during a summer period when the base is relatively drift free. No problems of moisture entry into

Pyrotenax cable joins occurred during the summer; this usually caused shorting in power and timing cables and consequent record losses.

5. REGIONAL MAGNETIC OBSERVATIONS

During the 1977-78 Summer expedition tc Enderby and Kemp Lands west of Mawson 11 third-order magnetic stations were visited. Of these, 3 stations were re-occupations.

Third-order magnetic observations were made at all glaciological JMR re-measurement (GE) stations located on the tractor train traverse route from Mount King to Mawson. The author and two glaciologists were members of the returning tractor-train from Mount King to Mawson, and measurements were made en route during the traverse.

Measurements were made on snow surfaces near GE station snowpoles, which are reasonably permanent fixtures and should be re-locatable.

Sun shots using a compass theodolite were made at 10 stations in order to determine azimuth directions and declination measurements, as previously determined azimuth directions at stations were not known. Magnetometers used during the season included HTM 154, BMZ 221A, Geometrics PPM 816, and Wild TO compass theodolite 93794. DEC 333 was also sent from Australia, but it was found more convenient to use the compass theodolite for declination measurements in the cold and sometimes windy conditions. The Askania circle (No. 813) proved to be far superior to the previously used QHM circles and proved easier to operate while wearing field gloves. The Geometrics PPM proved to be a very reliable instrument for measuring the total magnetic field and required only minutes to set-up and take readings; it should be regarded in future surveys as an essential for the survey. The HTM was ideal in windy conditions with its built-in self-damping facilities. It was found that for temperatures below about minus 15°C it was very difficult to take readings owing to cold fingers, and more importantly the freezing of clamp and circle rotation movements of HTM and BMZ magnetometers.

The results indicate that magnetic field measurements on ice give better estimates of the Earth's regional magnetic field than the observations made on the majority of rock exposure stations in Enderby Land which were usually anomalous (c.f. Wolter, in prep).

On return to Australia measurements were reduced to mean station values with a reasonable degree of success using the magnetograms from Mawson.

Measured magnetic field values including H,D,Z, and F are listed in Table 17, and reduced values are tabulated in Table 18.

6. BUILDING MAINTENANCE

Continual maintenance on the Seismic, Variometer, and Absolute huts was necessary to eliminate snow drift from entering buildings and affecting equipment operations. Air gaps in buildings were sealed using a commercial sealant applied by a cartridge sealant gun. This eliminated the drift snow effectively in the seismometer room and variometer room. Guy wires to buildings remained secure throughout the year and required little maintenance.

The original Geophysics office was repainted on the outside on my arrival and before moving into the new Science building the interior of the new Geophysics office was painted. During the year the remainder of the inside of the new science building was painted; the exterior finish of the building was maintenance free. Sections of the exterior of the variometer hut were touched up with aluminous bitumen paint, especially on the windward wall and sections scarred by a broken guy wire during a blizzard. The Seismic hut exterior was also painted soon after my arrival.

The magnetic huts were in reasonable structural condition on my departure, but the windward panels appeared to be weakening after twenty years of buffeting by continual high winds; this seems to be having an increasing effect on the stability of the variometers from year to year.

7. OTHER DUTIES

Normal routine duties around the base were performed throughout the year, including kitchen duties, night watch, and Saturday afternoon projects. A helping hand was given in building projects around the base and other projects requiring a large personnel effort.

8. ACKNOWLEDGEMENTS

The author wishes to express thanks to the 1977 Mawson party and Enderby Land summer party for providing assistance and cooperation.

Special thanks are due to Mick Hinchey for changing records while the author was absent and for assistance with electrical problems, and to John Best for patience and assistance with electronic problems and for changing records.

Thanks are also due to Dave Barrett for changing records and operating the observatory equipment during the 1977-78 Enderby Land summer expedition operations, of which the author was a participating member.

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Appendix : History of instrumentation up to 1978

A brief summary of the development of Mawson Geophysical Observatory in terms of instrumentation until 1978 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-an-ink recorder) installed (Pinn, 1961).
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 (free period 14 second.) (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).

(c) General

April 1977	:	Transfer of Geophysics Office, including Power and Timing equipment to Science block.

TABLE 1. STATION DATA.

	Magnetic	Seismological	
Name	Mawson	Mawson	
Code	MAW	MAW	
		(Z)	(H)
Latitude geographic	67° 36'S	67°36.4'S	67°36.2'S
geomagnetic	-73.1°		
Longitude geographic	62° 53'E	62°52.3'E	62°52.5'E
geomagnetic	102.9°		
Elevation (m)	10	15	8
Foundation	Precambrian granite	Precambrian granite	

TABLE 2. MAGNETOGRAPH PARAMETERS

Component	Scale Value Observed	Scale Value Adopted	Standard Deviation Scale Value	Standard Deviation Baseline	Temp Coeff nT/$^{\circ}$C
Normal					
H	21.39	21.40	0.10 nT	3.6 nT	1.0
D	2.43	2.44	0.02 min	0.5 min	-
Z	22.75	22.75	0.09 nT	3.3 nT	2.0
Sensitive					
H	9.54	9.50	0.07 nT	-	-
D	0.86	0.86	0.01 min	-	-
Z	10.49	10.50	0.07 nT	-	-

D scale values are in minutes/mm

H and Z scale values are in nT/mm

TABLE 3. SCALE VALUE CURRENTS

Component	MCO1 Current	DMV 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 4. ADOPTED BASELINE VALUES (CORRECTED), NORMAL MAGNETOGRAPH 1977

	Date	UT h	UT m	Baseline Value	Remarks
	Horizontal Intensity			BHs nT	
	Jan 01	00	00	17124	
	Sept 08	10	55	17588	Variometer head adjustment
	Sept 09	06	05	17365	" " "
	Declination			BD(w) o '	
	Jan 01	00	00	61 25.9	
	Jan 17	00	00	61 25.6	
	Feb 07	00	00	61 25.4	
	Feb 12	00	00	61 25.1	Drifting baseline value
	Feb 18	00	00	61 24.7	Due to variometer
	Feb 24	00	00	61 24.3	
	Mar 02	00	00	61 23.8	Baseline mirror movement.
	Mar 10	00	00	61 23.3	
	Mar 18	00	00	61 22.8	
	Mar 26	00	00	61 22.3	
	Apr 03	00	00	61 21.9	
	Apr 11	03	00	61 34.0	Prism adjustment
	Apr 15	00	00	61 34.2	Drifting baseline
	Apr 20	00	00	61 34.5	value (as above)
	Apr 24	00	00	61 34.8	
	May 13	11	30	61 54.6	Variometer baseline mirror repaired
	May 15	03	00	61 45.2	Variometer baseline mirror adjustment
	Jun 10	03	00	61 46.8	Prism adjustment
	Jul 01	03	00	61 09.5	" "
	Jul 02	04	46	61 46.4	" "
	Sep 09	08	30	61 47.3	Baseline mirror and trace adjustment
	Nov 14	03	00	61 46.4	Trace adjustment
1978	Jan 02	03	00	61 47.1	Converging lens bumped.

TABLE 4 (CONT). ADOPTED BASELINE VALUES (CORRECTED), NORMAL MAGNETOGRAPH 1977

Date	UT h	UT m	Baseline Value	Remarks
Vertical Intensity			BZs* nT	
Jan 01	00	00	-46404	
Feb 02	00	00	-46410	Cause unknown
Mar 01	00	00	-46404	Cause unknown
Apr 01	00	00	-46410	Cause unknown
May 01	00	00	-46412	Cause unknown

*Derived from H and F (PPM 339)

TABLE 5. MAGNETOGRAPH SCALE VALUE AND ORIENTATION COIL CONSTANTS

Component	Normal $nT.mA^{-1}$	Component	Sensitive $nT.mA^{-1}$
H S.V.	8.07	H S.V.	8.06
D S.V.	8.07	D S.V.	8.06
Z S.V.	7.49	Z S.V.	7.49
H OR.	8.07	H OR.	8.06
D OR.	8.07	D OR.	8.06
Z OR.	-	Z OR.	-

TABLE 6. ORIENTATIONS OF VARIOMETER MAGNETS

Date	Component	Reference field	Ex-orientation Magnet N pole			Remarks
30-8-77	H NORM	18429 nT	E	0.2°	N	
9-9-77	H NORM	18421 nT	E	0.2°	S	Adjusted
30-8-77	D NORM	62.76°W	N	0.1°	W	
7-9-77	Z NORM	47039 nT	N	1.3°	Down	
23-9-77	Z NORM	47039 nT	N	0.9°	Down	
30-8-77	H SENS	18429 nT	E	1.0°	S	
9-9-77	H SENS	18421 nT	E	1.1°	S	Adjusted
30-8-77	D SENS	62.76° W	N	0.5°	W	
7-9-77	Z SENS	47039 nT	N	2.1°	Down	
23-9-77	Z SENS	47039 nT	N	1.7°	Down	

TABLE 7. ORIENTATION TEST, APPLIED COIL CURRENTS

Component	Source	Current (mA)	Switch position	Field produced
H NORM	MANUAL	300	H2 +	E
D NORM	MANUAL	300	D2 +	N
H SENS	MCO1	99.8	MCO1 -	E
D SENS	MCO1	99.8	MCO1 -	N
Z NORM	Deflector magnet (M = 491.4 nTm^{-3}) (measured Sept 1977)			
Z SENS				

TABLE 8. THERMOGRAPH PARAMETERS 1977

Date From	Date To	Observed St °C/mm	Adopted St °C/mm	Bt °C
Z Normal Thermograph				
1- 1-77	31- 1-77	1.86	1.86	-94.0
1- 2-77	28- 2-77			-93.9
1- 3-77	30- 4-77			-94.1
1- 5-77	31- 7-77			-94.0
1- 8-77	31- 8-77			-93.9
1- 9-77	31-10-77			-94.0
1-11-77	30-11-77			-93.8
1-12-77	31-12-77			-93.9
H Normal Thermograph				
1- 1-77	31- 1-77	2.69	2.69	-41.3
1- 2-77	28- 2-77			-41.0
1- 3-77	31- 3-77			-41.5
1- 4-77	30- 4-77			-41.4
1- 5-77	31- 5-77			-41.0
1- 6-77	31- 7-77			-40.9
1- 8-77	31- 8-77			-41.0
1- 9-77	30- 9-77			-41.1
1-10-77	31-10-77			-40.9
1-11-77	31-12-77			-40.8

TABLE 9. PRELIMINARY MONTHLY MEAN GEOMAGNETIC VALUES AND K-INDEX 1977

Month	D (West)	H, nT	Z, nT	F, nT	K
January	62°39.1'	18431	-47094	50 572	3.5
February	40.7	422	085	561	3.7
March	42.4	422	077	553	3.4
April	43.4	424	077	554	3.8
May	44.0	424	059	537	3.4
June	44.2	425	056	535	3.2
July	45.5	429	044	525	3.9
August	45.3	421	039	517	3.8
September	45.6	424	029	509	3.5
October	46.6	424	028	508	3.2
November	45.0	427	018	500	3.2
December	45.2	427	010	493	3.1
MEAN	62°43.9'	18425	-47051	50 530	3.5

TABLE 10. GEOMAGNETIC ANNUAL MEAN VALUES 1967-1977

Year	D		I		H	X	Y	Z	F
	°	'	°	'	nT	nT	nT	nT	nT
1967	-61	34.4	-69	7.2	18374	8747	-16158	-48168	51553
1968	-61	43.8	-69	5.2	18365	8698	-16174	-48060	51449
1969	-61	53.0	-69	3.4	18353	8649	-16186	-47954	51346
1970	-62	.5	-69	.4	18358	8616	-16209	-47840	51241
1971	-62	5.3	-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	24.8	-68	47.2	18390	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	-16354	-47157	50626
1977	-62	43.9	-68	36.9	18425	8442	-16376	-47051	50530
Mean annual change	-6.95		+3.03		+5.1	-30.5	-21.8	+111.7	-102.3

TABLE 11. MAGNETOMETER CORRECTIONS 1977

Instrument		Corr.(at Mawson)	Corr. (nT)
(Mawson)	QHM 300	-5 nT (at 18425 nT)	-0.00027H
	QHM 302	-6 nT (at 18425 nT)	-0.00033H
	DEC 332	0 min	
	PPM 339	0 nT	
	QHM 300 (As DEC)	-27.4 min	
	QHM 302 (As DEC)	-35.7 min	
	BMZ 62	-18 nT (at -47051 nT)	+0.00038Z
(Field)	HTM 154	+ 9 nT (at 18425 nT)	+0.00049H
	CT 93794	-35.5 min	
	PPM 816	0 nT	
	BMZ 221A	+32 nT (at -47051 nT)	-0.00068Z
	HTM 154 (As DEC)	-6^{o} 31.5' min	

*Used to obtain values given in Table 9.

TABLE 12. SEISMOGRAPH PARAMETERS

Component	Z	N-S	E-W
Seismometer			
Type	Benioff	Benioff	Benioff
Free period(s)	1.00	1.00	1.00
Coil configuration	B	F	F
Coil Rs (ohms)	146	420	420
Galvanometer			
Type	Geotech	Lehner Griffith	Lehner Griffith
Model	4100-43	GS-250	GS-250
Free period(s)	0.2	0.2	0.2
Current sensitivity damped (amp/mm at 1 m)	2.8×10^{-8}	0.35×10^{-7}	0.35×10^{-7}
CDRX (ohms)	124	92	92
Coil Rg (ohms)	19	29	29
Calibrator			
Motor constant (N/A)	1.50	1.43	1.32
1- 1-77 to 31- 5-77	1.50	1.43	1.32
1- 6-77 to 31-12-77	1.50	1.26	1.33
22-12-77 onwards	1.44	1.39	1.32
Calibration coil resistances (ohms)	258	240	254
Calibration currents applied (mA o-p)	2.0	4.0	4.0
Recorder			
Type	Benioff	Benioff	Benioff
Chart rate	60 mm/min	60 mm/min	60 mm/min
System			
Damping	17:1	17:1	17:1
Attenuator Setting (dB)	8	8	8
Magnification at 1 Hz	42K	21K	21K
Peak magnification/period(s)	118K/0.36	66K/0.40	57K/0.50
Polarity	Reversed until 30 May	N-up	E-up

TABLE 13. SEISMOGRAPH ATTENUATOR SETTINGS 1977-78

Month	Day	Time (UT)	Attenuator Vertical	Attenuator Horizontal	Month	Day	Time (UT)	Attenuator Vertical	Attenuator Horizontal
Jan	01	0000	14	8	May	04	0311	10	8
	05	1030	12	7		05	0307	12	9
	06	0307	12	8		06	0328	10	8
	14	0311	14	8		10	0310	12	9
	15	0310	12	8		11	0359	10	8
	17	0311	14	9		15	0324	10	9
	20	1000	18	10		16	0318	10	8
	22	0320	12	8		19	0307	10	9
	23	0311	20	10		21	0510	10	10
	25	0312	16	9		23	0310	10	8
						25	0307	8	8
Feb	19	0310	20	10		27	0315	8	7
	26	0312	16	9		28	0316	8	9
						29	0403	8	10
Mar	04	0315	24	9		31	0325	8	8
	05	0308	22	9					
	08	0316	24	10	Jun	04	0330	8	10
	12	0310	22	10		07	0326	8	8
	13	0715	16	10		11	0319	8	9
	14	0312	18	10		12	0319	8	10
	15	0314	16	10		13	0317	8	9
	18	0308	16	9		15	0311	8	8
	20	0312	16	8		29	0313	6	8
	20	0408	14	7					
	23	0310	16	8	Jul	01	0352	6	7
	30	0311	16	9		05	0314	4	6
						12	0312	4	8
Apr	06	0314	14	9		14	0313	8	8
	07	0327	14	8		15	0314	6	8
	12	0315	12	9		16	0333	8	10
	14	0314	14	9		18	0312	6	7
	18	0308	16	10		21	0320	8	9
	19	0307	18	10		26	0307	6	7
	20	0314	16	10		28	0312	8	9
	21	0307	14	9		30	0312	6	7
	27	0315	12	8					
	28	0312	12	9					
	29	0312	12	8					
	30	0314	12	9					

TABLE 13 (cont) SEISMOGRAPH ATTENUATOR SETTINGS 1977-78

Month	Day	Time	Attenuator Vertical	Attenuator Horizontal	Month	Day	Time	Attenuator Vertical	Attenuator Horizontal
Aug	04	0323	6	8	Dec	06	0314	6	7
	06	0308	6	7		07	0310	4	6
	09	0312	6	8		10	0317	6	7
	11	0315	6	9		16	0320	12	8
	13	0314	6	7		19	0309	8	7
	15	0315	6	8		22	0320	10	8
	17	0308	6	7					
	19	0313	6	9	1978				
	20	0308	6	8	Jan	01	0316	12	9
	23	0312	6	7		07	0313	10	8
						15	0314	12	9
Sep	06	0311	8	9		21	0310	14	9
	07	0319	6	7					
	20	0312	4	6	Feb	03	0314	14	8
	22	0323	4	7		07	0314	16	9
						09	0316	18	9
Oct	08	0313	4	6					
	09	0312	4	7					
	17	0312	4	8					
	18	0308	4	7					
	19	0309	4	8					
	21	0308	4	7					
Nov	04	0314	4	8					
	05	0320	4	7					
	07	0312	4	8					
	12	0309	4	7					
	13	0314	6	8					
	14	0334	4	7					
	21	0310	4	8					
	23	0322	4	7					
	24	0313	6	8					
	26	0317	8	8					

TABLE 14. SEISMOGRAPH MAGNIFICATIONS AT 1 Hz

Z		N-S		E-W	
Attenuator setting (dB)	Mag ($X10^3$)	Attenuator setting	Mag ($x10^3$)	Attenuator setting	Mag ($X10^3$)
24	7	10	5	10	6
22	8	9	13	9	15
20	11	8	19	8	21
18	13	7	20	7	28
16	17	6	32	6	35
14	20				
12	26				
10	33				
8	40				
6	52				
4	65				

(NB Magnification values are a mean of 3 separate) determinations made throughout the year.

Magnifications determined by weight lift tests using formula ;

$$Mag(x10^3) = \frac{4\pi^2 M\ A_{p-p}\ A_W}{m\ g\ A_i T^2}$$

where M seismometer mass (107.5 kg)

m lift mass (mg)

A_{p-p} sine wave amplitude, peak to peak (mm)

A_i pulse test amplitude (mm)

A_w lift test amplitude (mm)

g gravitational acceleration (9.8 m/sec^2)

T sine wave period (sec)

For magnifications at 1 Hz the above formula can be reduced to ;

$$Mag(x10^3) = \frac{433\ A_{p-p}A_w}{m\ \ A_i}$$

(contd.)

TABLE 14 (CONTD)

For Z seismograph : Applying sinusoidal signal at 1 Hz ; A_{p-p} = 34.0 mm
and for the same applied current ; A_i = 22.0 mm

$$Mag(\times 10^3)(\text{at } 1\text{ Hz}) = 670\left(\frac{A_W}{m}\right)$$

For N-S seismograph : Applying sinusoidal signal at 1 Hz ; A_{p-p} = 22.1 mm
and for the same applied current ; A_i = 14.2 mm

$$Mag(\times 10^3)(\text{at } 1\text{ Hz}) = 670\left(\frac{A_W}{m}\right)$$

For E-W seismograph : Applying sinusoidal signal at 1 Hz ; A_{p-p} = 24.0 mm
and for the same applied current ; A_i = 15.0 mm

$$Mag(\times 10^3)(\text{at } 1\text{ Hz}) = 690\left(\frac{A_W}{m}\right)$$

TABLE 15. VERTICAL SHORT-PERIOD SEISMOGRAPH MODIFICATIONS (AT 8 dB)

Period(sec)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.5	2.0	3.0	4.0
Mag($\times 10^3$)	-	89	113	115	110	98	86	69	50	40	30	25	20	13	5.9	1.7	0.8

Magnifications at other attenuation settings can be calculated by multiplication of the above magnifications by a factor R, where R is defined by the relation :

$$dB = 20 \log R \qquad \log R = \frac{dB}{20}$$

dB setting	4	6	8	10	12	14	16	18	20	22	24	26	28
R	1.58	1.26	1	0.79	0.63	0.50	0.40	0.32	0.25	0.20	0.16	0.13	0.10

TABLE 16. NEVADA NUCLEAR EXPLOSIONS RECORDED AT MAWSON

Date	Origin time (UT)	Magnitude (MB ERL)	Dist.°	Phase	Arrival Time (UT)	t	O-C
	h m s				h m s	ms	
05 Apr 1977	15 00 00.2	5.5	149.46	1	15 19 46.0	19 45.8	+0.3
				2	15 19 50.2	19 50.0	
27 Apr 1977	15 00 00.1	5.4	149.43	1	15 19 45.5	19 45.4	0.0
				2	15 19 50.0	19 49.9	
25 May 1977	17 00 00.1	5.3	149.43	1	17 19 45.5	19 45.4	0.0
				2	17 19 50.0	19 49.9	
04 Aug 1977	16 40 00.1	5.1	149.43	2	16 59 50.0	19 50.0	
17 Aug 1977	17 55 00.1	5.5	149.45	1	18 14 46.0	19 45.9	+0.4
				2	18 14 50.0	19 49.9	
27 Sep 1977	14 00 00.2	4.8	149.44	2	14 19 50.4	19 50.2	
09 Nov 1977	22 00 00.1	5.7	149.41	1	22 19 45.5	19 45.4	0.0
				2	22 19 50.3	19 50.2	
14 Dec 1977	15 30 00.2	5.7	149.47	1	15 49 45.5	19 45.3	-0.2
				2	15 49 50.3	19 50.1	

Definition of PKP Phases;

PKP Phase	PKP Branch Equivalent	°	t (To Mawson)
			m s
1 PKIKP	DF	149.4	19 45.4
2 PKP1	BC	149.4	19 50.0

TABLE 17. REGIONAL MAGNETIC OBSERVATIONS Mount King Base

Lat 67° 05'S Long 52° 52'E Elev 1116 m

Date	UT	H nT	Date	UT	D (W)	Date	UT	Z nT	Date	UT	F
			28/12/77	1030		28/12/77	0929	43670	28/12/77	0855	47733
										1103	47733
										1615	47782
										1654	47792
1/1/78	0802	19213	1/ 1/77	0802	54°49.6'				1/ 1/78	0630	47768
				1403	54°38.4				11/ 2/78	1742	47765

TABLE 17 (CONT). REGIONAL MAGNETIC FIELD RESULTS

MOUNT KING BASE

GE9

Lat 68° 15.9'S Long 53°31.6'E Elev 2199 m

Date	UT	H nT	Date	UT	D (W)	Date	UT	Z nT	Date	UT	F nT
4/1/78	1805	18184	4/1/78	1805	55°50.7'				4/ 1/78	0636	47675
										1556	47604
5/1/78	0928	18503	5/1/78	0928	56°21.2'	5/1/78	0855	44032	5/ 1/78	0829	47796
										1035	47834
7/1/78	0905	18533	7/1/78	0905	56°25.8'	7/1/78	0831	44052	7/ 1/78	0750	47789
				1110	56°22.5'		0945	44022		1012	47805

Cane E264 (Between GE9 and GE8)

Lat 68° 13'S Long 53° 41'E Elev 2150 m

Date	UT	F nT
7/ 1/78	1940	47748

GE8

Lat 68° 00.6'S Long 53° 52.1'E Elev 2133 m

Date	UT	H nT	Date	UT	D (W)	Date	UT	Z nT	Date	UT	F
8/1/78	1235	18128	8/1/78	1110	58°02.5'	8/1/78	1207	44371	8/ 1/78	1138	47939
				1235	58°06.3'		1310	44381		1325	47941

TABLE 17 (CONT). REGIONAL MAGNETIC FIELD RESULTS

GE7

Lat $68^{\circ}16.9'$S Long $55^{\circ}01.0'$E Elev 2004 m

Date	UT	H nT	Date	UT	D(W)	Date	UT	Z nT	Date	UT	F nT
			10/1/78	1642	$57^{\circ}28.1'$						
11/1/78	0931	18757	11/1/78	0931	$57^{\circ}37.0'$	11/1/78	0911	44498	11/1/78	0848	48302
							0955	44526		1009	48312
12/1/78	0939	18721	12/1/78	0939	$57^{\circ}35.1'$	12/1/78	0925	44523	12/1/78	0910	48303
							1004	44536		1022	48309

GE6

Lat $68^{\circ}23.8'$S Long $56^{\circ}29.9'$E Elev 2054 m

Date	UT	H nT	Date	UT	D(W)	Date	UT	Z nT	Date	UT	F nT
14/1/78	0935	18609	14/1/78	0808	$58^{\circ}32.7'$	14/1/78	0913	45156	14/1/78	0855	48831
				0935	$58^{\circ}49.7'$		1027	45159		1040	48849

GE5

Lat $68^{\circ}31.1'$S Long $57^{\circ}52.5'$E Elev 2203 m

Date	UT	H nT	Date	UT	D(W)	Date	UT	Z nT	Date	UT	F nT
			20/1/78	1125	$59^{\circ}55.5'$	20/1/78	1440	45817	20/1/78	0950	49417
										1458	49476

GE4

Lat $68^{\circ}36.5'$S Long $59^{\circ}21.6'$E Elev 1921 m

Date	UT	H nt	Date	UT	D(W)	Date	UT	Z nT	Date	UT	F nT
23/1/78	0940	18518	23/1/78	0810	$61^{\circ}11.4'$	23/1/78	0912	46227	23/1/78	0650	49803
				0940	$61^{\circ}06.1'$		1015	46240		1033	48914

GE3

Lat $68^{\circ}39.1'$S Long $60^{\circ}32.9'$E Elev 1878 m

Date	UT	H nT	Date	UT	D(W)	Date	UT	Z nT	Date	UT	F nT
24/1/78	1010	18461	24/1/78	1010	$61^{\circ}49.8'$	24/1/78	0933	46603	24/1/78	0858	50127
							1029	46614		1047	50147
25/1/78	1505	18734	25/1/78	1012	$61^{\circ}54.6'$	25/1/78	1456	46519	25/1/78	1055	50140
				1505	$61^{\circ}47.6'$		1534	46543		1439	50141
										1544	50111

TABLE 17 (CONT). REGIONAL MAGNETIC OBSERVATIONS

GE2

Lat 68°39.05'S Long 61°58.2'E Elev 1862 m

Date	UT	H nT	Date	UT	D(W)	Date	UT	Z nT	Date	UT	F nT
27/1/78	0915	18146	27/1/78	0730	63°41.1'	27/1/78	0850	47178	27/1/78	0800	50564
				0915	63°36.9'		0941	47178		0954	50582
29/1/78	0848	18061	29/1/78	0848	63°54.6'	29/1/78	0822	47169	29/1/78	0813	50513
							0908	47175		0918	50568

Turner's Turnoff

Lat 68°41'S Long 62°09'E Elev 1750 m

Date	UT	F nT
29/1/78	1150	50571

M117 Cane and Drum (Almost buried) (Between T.T. and Mt Twintop)

Lat 68°21'S Long 62°10'E Elev 1250 m

Date	UT	F nT
29/1/78	1845	50615

Mount Twintop Depot

Lat 68°05'S Long 62°22'E Elev 1250 m

Date	UT	F nT
30/1/78	0725	51334

Sheelagh Island

Lat 66°32.7'S Long 50°10.85'E Elev 21 m

Date	UT	H nT	Date	UT	D(W)	Date	UT	Z nT	Date	UT	F nT
			2/2/78	0832	54°10.2'	2/2/78	0854	44097	2/2/78	0400	48067
				0950	54°07.4'		0937	44107		0826	48058
										0956	48034
3/2/78	1000	18965	3/2/78	0937	54°16.2'	3/2/78	0951	44084	3/2/78	0928	48006
				1000	54°12.5'		1022	44087		1044	48027
				1036	54°13.3'						
			6/2/78	1508	54°02.0'	6/2/78	1520	44109	6/2/78	0727	48010
				1532	54°06.1'						

TABLE 17 (CONT). REGIONAL MAGNETIC OBSERVATIONS

Rippon Depot

Lat 66°40.1'S Long 56°28.7'E Elev 193 m

Date	UT	H (nT)	Date	UT	D(W)	Date	UT	Z (nT)	Date	UT	F (nT)
12/2/78	1630	18178	12/2/78	1520	58°35.1'	12/2/78	1602	46432	12/2/78	1505	49061
				1630	58°29.6'					1653	49080
13/2/78	0922	18141	13/2/78	07343	58°37.2	13/2/78	0805	45498	13/2/78	0735	49035
				0922	58°25.8'		0945	45494		1011	49028
				0958	58°35.7'						

TABLE 18. REDUCED* MEAN MAGNETIC FIELD MEASUREMENTS, ENDERBY LAND, SUMMER 1977-78

Station	Lat	Long	Time	H	D West	Z	F
Mt King Base	67°05'S	52°52'E	Jan 1978	19242	54°45.2'	43704	47774
GE9	68°15.9'S	53°31.6'E	Jan 1978	18580	56°23.0'	44016	47820
Cane E264	68°13'S	53°41'E	Jan 1978				47719
GE8	68°00.6'S	53°52.1'E	Jan 1978	18100	58°04.6'	44336	47900
GE7	68°16.9'S	55°01.0'E	Jan 1978	18754	57°33.8'	44515	48311
GE6	68°23.8'S	56°29.9'E	Jan 1978	18622	58°38.9'	45153	48832
GE5	68°31.1'S	57°52.5'E	Jan 1978	18616	59°56.1'	45790	49429
GE4	68°36.5'S	59°21.6'E	Jan 1978	18547	61°04.5'	46224	49813
GE3	68°39.1'S	60°32.9'E	Jan 1978	18421	61°54.8'	46592	50114
GE2	68°39.05'S	61°58.2'E	Jan 1978	18142	63°35.5'	47174	50566
Turner's Turnoff	68°41'S	62°09'E	Jan 1978				50476
Cane M117	68°21'S	62°10'E	Jan 1978				50689
Mt Twintop Dept	68°05'S	62°22'E	Jan 1978				51192
Sheelagh Is	66°32.7'S	50°10.85'E	Feb 1978	18987	54°12.8'	44118	48064
Rippon Depot	66°40.1'S	56°28.7'E	Feb 1978	18160	58°32.7'	45500	49051

*Corrected for difference between value of the relevant magnetic element at Mawson at the time of field observation and the Mawson monthly mean value.