BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

RECORD 1982/28

MAWSON GEOPHYSICAL OBSERVATORY
ANNUAL REPORT, 1981

by

S. Marks

RECORD 1982/28

MAWSON GEOPHYSICAL OBSERVATORY
ANNUAL REPORT, 1981

by

S. Marks

CONTENTS

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 Geophysical Observatory, Antarctica, during 1981. Instruments included two La Cour magnetographs and a three component Benioff seismograph, which was replaced by a two component Benioff seismograph and two Geotech RV301 helicorders. Preliminary data were forwarded regularly to Australia and all other Antarctic stations.

1. INTRODUCTION

Mawson Geophysical Observatory is operated by the Bureau of Mineral Resources, Geology and Geophysics (BMR) as part of Australian National Antarctic Research Expeditions (ANARE) at Mawson station, Australian Antarctic Territory, with logistic support provided by Antarctic Division, Department of Science and Technology. The station details are listed in Table 1.

The observatory commenced operation in 1955 with the installation of a three component La Cour magnetograph from Heard Island. Since then, numerous instrument changes and additions have occurred (see Appendix 1).

The author arrived at Mawson on 6 December 1980 and relieved Brian Gaull, who flew to the M.V. Nella Dan to join the 1980-81 Davis expedition for regional magnetic survey work. Magnetometer comparison measurements were carried out by the author early in 1981 and again in 1982 (Table 2).

On 24 January 1982 the relieving geophysicist, Richie Silberstein arrived. Familiarization and developmental work were completed before the author's departure for Australia on 2 March 1982.

2. MAGNETIC OBSERVATORY

The elements H, D and Z were recorded during 1981 with a total loss of 6.5 days of NORMAL record. Simultaneous loss of both NORMAL and SENSITIVE records was negligible. Minor adjustments to variometer optics and routine equipment maintenance were carrried out as required.

Maintenance

Upon arrival at Mawson the author replaced the time-mark cable between the absolute and variometer huts by 6-core shielded cable. The only other building maintenance needed was the use of caulking compound to keep out drift snow.

Installations

The main installation for 1981 was that of an MNS2/1 proton precession magnetometer and enclosure. The hardware enclosure was located next to the existing BMZ enclosure and the head of the magnetometer was located in the absolute hut (see Plate 1a). The kerosene in the head was replaced with S.A.B. (special Antarctic blend) as the original fluid became solid at low temperatures. The system proved trouble free.

Later in the year the existing PMZ1 observatory power supply in the old micropulsation hut did not function when the station's power failed. This supply was replaced by that shown in Plate 2a, which proved reliable.

While the magnetograph lighting power supply was being modified, the opportunity was taken to change the street lighting between the science building and the variometer hut.

Late in 1981 all redundant wiring was removed.

Recorders

Occasionally the NORMAL recorder drum stopped when the two drive gears were not meshed correctly. This was caused by bad alignment and the roughness of the motor positioning bed.

The SENSITIVE magnetograph recorder operated successfully during 1981. Intermittently,reserve traces were superimposed on the main trace and obliterated it, but the cause was not known.

The only other problem was the loss of the D time-mark trace on the NORMAL record late in the year. This was not resolved before the author's departure.

Baseline value control

Absolute observations and scale value observations were performed on average five times a month to determine the baseline values of H, D and Z on the NORMAL magnetograms. Instruments used for absolute observations were QHM's 300, 301 and 302, declinometer 580332 and circle 640665. BMZ 62 was replaced by PPM MNS2/1 for routine absolute observations from 31 March. Observed mean baseline values are listed in Table 3 and scale values in Table 4.

SENSITIVE magnetograph scale values were measured once a month.

During February 1981 intercomparison measurements were made between Mawson absolute instruments and the travelling standards (Table 2) from Australia. Results were sent to Australia on M.V. Nanok S.

Further intercomparison measurements were made in February 1982 using QHM 172, HTM 570704, declinometer 580333, and circle 508810 Elsec P P M 595/144 (Table 2). Intercomparison results for declinometers on both occasions were unsatisfactory. This was caused by residual torsion in the fibre of the travelling standard declinometer 580333.

Temperature control

The PZC-1 thermistor heater-control unit located in the variometer hut worked reliably throughout the year, the only failure being a blown fuse. The temperature remained near zero in the variometer hut, with a daily variation of less than 1°C for most of the year. Slightly larger variations were noted in the summer. A few heater bar elements were replaced during the year.

The absolute hut was heated adequately by a two-bar radiator, switched on from Science via a relay at the MNS2 enclosure (see: Fig 1a) the day before absolutes were performed. The temperatures of the H and Z variometers were read daily. Temperature coefficients are included in Table 4.

Parallax tests

The parallax error between the normal magnetogram traces and time-marks was measured and found to be negligible.

Orientation tests

Orientation tests of NORMAL and SENSITIVE H, D and Z variometer magnets were carried out on 24 November 1981. Further tests on the H-SENSITIVE were done on 19 January 1982 because the orientation spots on the record were not clear during the previous tests. Orientation results are listed in Table 5.

Preliminary data

K-indices, preliminary baseline values, scale values and preliminary monthly mean values were transmitted monthly to BMR Canberra. These data were also passed to all other Antarctic stations.

Preliminary monthly mean geomagnetic values and K-index values for 1981 are listed in Table 6. Preliminary instrument corrections applied to the data are listed in Table 7, and geomagnetic annual mean values since 1971 are listed in Table 8.

3. SEISMOLOGICAL OBSERVATORY

Initially the seismograph comprised one Benioff horizontal component (SP-E) in the seismic hut and two vertical components (Benioff SP-Z and Press-Ewing LP-Z) in the Cosray vault.

This was changed during July to two components in the seismic hut (SP-E and SP-N) recording on the Benioff recorder, and the two vertical components in the Cosray vault recording on a Geotech helicorder (RV301) in the Science building (Plate 1b).

Maintenance

The Benioff gave very little trouble throughout the year. The problems encountered and actions taken are listed in Table 9. A second-order filter was included in the line between the TAM5 and amplifier AR311 (Plate 2b) and modifications were made to the input of the TAM5 (Plate 2c) to eliminate RF interference. DC off-sets on the trace were caused by rectification of the RF signal. This rectification was caused by dirty contacts, within the circuitry, acting as diodes. Hence, both HF oscillations and DC off-sets were eliminated by the initial elimination of RF in the circuit.

Once initial problems were corrected the Geotech helicorder gave no trouble. The LP-Z component was not usable because the pen drive motor was inoperative and a replacement motor was not available.

Calibrations

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

Weight lift and seismometer tests were carried out during September and November to check motor constants, damping ratios and seismometer free periods (Table 10).

Sinusoidal tests were applied to all components to check the frequency responses (Fig. 1 and 2).

Data

Preliminary P-phase arrival times were transmitted once a week to the Canberra Observatory Group and all Antarctic Stations.

On return to Australia, final seismic data analysis was done. It was found that the majority of earthquakes were recorded in the months September to November, this period having the maximum thickness of sea-ice. Attenuation settings are listed in Table 11.

4. CONTROL EQUIPMENT

During 1981 the observatory power and timing equipment required little modification and remained similar to previous years.

Timemark programming unit (TMU)

Throughout 1981 the TMU occasionally advanced itself. These advances appear to be generated either within the unit itself or via the power supply. All attempts to solve the problem were unsuccessful and from previous reports the same problem has existed since the installation of the TMU in 1968 (Smith 1971, Wake Dyster 1981, Gaull (in prep)).

EMI clock

The EMI clock provided timemark pulses and 240 V AC synchronous 50 Hz power and operated successfully except for minor malfunctions. Three BFY50 transistors failed early in the year which caused a record loss of 3 days. The clock rate was found to vary with room temperature. A replacement EMI clock was ordered for 1982, but was not supplied from Canberra.

Time signals

Radio signals from VNG, Lyndhurst, Victoria, Australia were received on most days to enable calibration of the EMI clock. On days when this signal was not clear the signal from WWV Hawaii and California was used. Propagation delay times provided by the Upper Atmosphere physicist and by the Ionospheric Prediction Service are:

VNG Lyndhurst	:	22 ms
WWV Hawaii	:	50 ms
WWV Calif.	:	60 ms

Cables

During the year the SP-Z and power cable to the seismic vault was cut by a vehicle. The power cable was replaced and set into the rock with resin to prevent a repetition of the accident. The SP-Z cable was diverted to the Science building for connection to the helicorder system.

No problems of moisture entry into the pyrotenax cable joints occurred during the summer. This usually causes shorting in the power and timing cables and in turn record losses.

5. OTHER DUTIES

Normal routine duties around the base were performed throughout the year, including kitchen duties, night watch, dog feeding, and Saturday afternoon projects. A helping hand was given to projects around the base which required large personnel effort.

6. ACKNOWLEDGEMENTS

The author wishes to express thanks to the 1980, 1981 and 1982 Mawson party for providing assistance and co-operation.

Special thanks are due to Lloyd Fletcher, Robert Petrini, Andrew Murray, Geoff Fulton, Derry Craig and Peter Longdon for changing records while the author was absent; and to Rowen Butler and Andrew Murray for assistance with electronic problems.

Thanks are also due to Henry Weiss for his re-wiring of the Geophysics huts.

REFERENCES

GAULL, B.A., (in prep.) - Mawson Geophysical Observatory Annual Report, 1980. Bureau of Mineral Resources, Australia Record

SMITH R.S. 1971 - Mawson Geophysical Observatory Annual Report, 1968.

Bureau of Mineral Resources, Australia Record 1971/10.

WAKE-DYSTER, K.D., 1981 - Mawson Geophysical Observatory Annual Report, 1977. Bureau of Mineral Resources, Australia, Record 1981/8.

APPENDIX 1

History of Instrumentation up to 1982

A brief summary of the development of Mawson Geophysical Observatory in terms of instrumentation until 1982 is presented below.

(a) GEOMAGNETIC

May 1955	:	Absolute instruments used for regular observations of H, D & Z (Oldham, 1957).
Jul 1955	:	Continuous recording commenced by three-component normal La Cour magnetograph (Oldham, 1957).
1957	:	Bar-fluxmeter magnetograph installed (Pinn, 1961).
Jan 1961	:	Three-component insensitive La Cour magnetograph installed and recording commenced (Merrick, 1961).
Dec 1967	:	Bar-fluxmeter magnetograph withdrawn (Dent, 1971).
Sep 1968	:	Insensitive La Cour magnetograph converted to medium sensitivity and renamed normal magnetograph. The normal La Cour magnetograph was renamed sensitive magnetograph (Smith, 1971).
Feb 1975	:	15 mm/hr normal recorder replaced by 20 mm/hr recorder (Hill, 1978).
Dec 1975	:	15 mm/hr sensitive recorder replaced by 20 mm/hr recorder.
Mar 1981	:	MNS2 proton precession magnetometer installed for absolute measurements.

(b) SEISMOLOGICAL

Jul 1956	:	Three-component Leet-Blumberg seismograph (Pen-and-ink recorder) installed.
1960	:	Three component seismograph installed consisting of Benioff seismometers (free period 1.0 s) and three-channel BMR single drum recorder. Z galvanometer 0.2 s free period, horizontal galvanometers free period 70 s (Merrick, 1961).
Feb 1963	:	BMR recorder replaced by Benioff 60 mm/min three-channel recorder. 14 s free period horizontal galvanometers installed (Black, 1965).
Sep 1970	:	14 s free period horizontal galvanometers replaced by short period (0.2 s) galvanometers (Robertson, 1972).

Dec 1973	:	Z seismometer transferred to vault benearh Cosray building (Almond, 1975).
Apr 1977	:	Transfer of Geophysics office, including power and timing of Wombat (Science Block).
1978	:	Recording of SP-N Benioff seismometer discontinued (Petkovic in prep.)
Jul 1981	:	Helicorder hot-pen recorder installed for SP-Z and LP-Z; and SP-N Benioff restored.

Table 1

Station Data for Mawson 1981

		Magnetic Absolute Hut	Seismometers	
			(Z)	(N,E)
Geographic	latitude	67°36.0'S	67°36.4'S	67°36.2'S
	longitude	62°52.0'E	62°52.3'E	62°52.5'E
Geomagnetic	latitude	-73.1°		
	longitude	102.9°		
Elevation (m)		10	15	8
Foundation		Precambrian Granite	Precambrian Granite	

Table 2

Magnetometer Comparisons, 1980, 1981, 1982

Date	Inst A	Inst B	Difference (A-B) at H=17400nT	
26 Feb 1981	QHM 172	QHM 300	36 nT	0.00207H
26 Feb 1981	HTM 570704	QHM 300	- 3 nT	-0.00017H
28 Jan 1981	Ask 580333	Ask 580332	*-10.5'	
28 Feb 1982	QHM 172	QHM 300	37 nT	0.00213H
28 Feb 1982	HTM 570704	QHM 300	-16 nT	-0.00092H
27 Feb 1982	Ask 580333	Ask 580332	* 53.9'	
27 Feb 1982	Elsec 595/144	MNS2/1	-3.8 nT	
Through routine baselines 6 Dec 1980 - 10 Dec 1981				
	QHM 300	QHM 301	2 nT	0.00011H
	QHM 300	QHM 302	- 7 nT	-0.00040H

Values are at standard temperature ($0^{o}C$) with no instrument corrections applied.

* These results are unsatisfactory and reflect residual torsion in the fibre of the travelling standard declinometer 580333.

Table 3

Observed Mean Baseline Values, 1981

Date	UT h m		Baseline	Remarks
Horizontal intensity			BHs nT	
6 Dec 1980	00	00	17409	
Declination			BD(W)	
6 Dec 1980	00	00	61°42.5'	
Vertical intensity			BZs	
6 Dec 1980	00	00	46418	BMZ 62
31 Mar 1981	00	00	46423	Derived from H and F (MNS2/1)
31 Nov 1981	00	00	46430	Cause unknown
Temperature			BT °C	
6 Dec 1980			-89.1	

Table 4.

Magnetograph Parameters, 1981.

Component	Scale Value	Calibration Current	Temperature Co-efficient
Normal			
H	21.0 nT/mm	60.0 mA	0.0
D	2.43 min/mm	40.0 mA	-
Z	22.7 nT/mm	70.0 mA	0.0
T	1.76 °C/mm	-	-
Sensitive			
H	9.5 nT/mm	30.0 mA	0.0
D	0.86 min/mm	10.0 mA	-
Z	10.5 nT/mm	30.0 mA	0.0

Table 5

Orientation Tests of La Cour Variometer Magnets, 24 November 1981

Component	Reference	Magnet N	Orientation	N-Pole
H normal	18455	E	1.63°	South
D normal	63°55.2'W	N	0.83°	West
Z normal	46676	N	0.96°	Down
*H sensitive	18465	E	1.02°	South
D sensitive	63°55.2'W	N	0.44°	East
Z sensitive	46676	N	2.44°	Down

*H sensitive was tested on 19 January 1982

Table 6

Preliminary Monthly Mean Geomagnetic Values and K-Indices, 1981.

Month 1981	H (nT)	D o	D '	Z (nT)	F (nT)	K
Jan	18450	-63	09.9	-46718	50229	3.6
Feb	18446	-63	09.0	-46726	50235	3.6
Mar	18434	-63	13.9	-46728	50233	3.7
Apr	18435	-63	14.8	-46724	50229	3.9
May	18448	-63	13.6	-46717	50228	3.6
Jun	18454	-63	15.5	-46700	50214	3.0
Jul	18444	-63	16.0	-46707	50217	3.6
Aug	18428	-63	17.5	-46706	50210	3.8
Sep	18439	-63	16.3	-46692	50201	3.3
Oct	18436	-63	17.9	-46706	50213	4.2
Nov	18455	-63	14.6	-46676	50192	3.9
Dec	18451	-63	16.2	-46662	50178	3.8
MEAN	18443	-63	14.6	-46705	50215	3.7

Table 7

Preliminary instrument corrections, Mawson 1981

Instrument	Correction at H = 17400	Correction
QHM 300	-5 nT	-0.00029H
QHM 301	0 nT	0
QHM 302	-6 nT	-0.00034H
Ask 332	0 min.	0
MN52/1	0 nT	

Table 8

Geomagnetic Annual Mean Values, 1971-1981

YEAR	D °	D '	I °	I '	H nT	X nT	Y nT	Z nT	F nT
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	24.8	-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
1978	-62	51.9	-68	35.5	18421	8402	-16392	-46986	50468
1979	-62	57.9	-68	32.9	18425	8375	-16411	-46890	50380
1980	-63	05.8	-68	29.8	18432	8340	-16436	-46784	50284
1981	-63	14.6	-68	27.1	18443	8303	-16467	-46705	50215

Mean annual changes

1971-1981		-6.9	2.9	6.8	-29.9	-23.1	101.4	- 92.0	
1971-1976		-6.4	+3.2	8.6	-26.4	-23.6	112.4	-101.8	
1976-1981		-7.5	2.6	5.0	-33.4	-22.6	90.4	- 82.2	

Table 9

Benioff Maintenance Table

FAULT	REMEDY
Record retaining bar on drum loose	Remove holding brackets, retension and replace
Trace bulb blown	Replace
Time mark relay oscillating	A. Bench test B. Replace
Trace intensity variable	A. Check intensity potentiometer B. Change supply tapping from transformer C. Check 6V back-up battery
RF interference on trace	Place RF ferrite beads on input lines in attenuator box (Plate 2c)

Table 10

Seismograph Parameters

Component	SP-Z	SP-N	SP-E	LP-Z
Seismometer				
Type	Benioff	Benioff	Benioff	Press Ewing
Free period(s)	1.0	1.0	1.0	10-35
Coil Rs (ohms)	146	420	420	520
Galvanometer				
Type		Geotech	Lehner-Griffith	
Free period(s)		0.2	0.2	
Amplifier				
Type	TAM5			TAM5
Attenuator				
Type	Geotech			Geotech
Model	AR/311			AR/311
Calibrator				
Motor Constant(N/A)	1.34	4.76	4.76	-
Recorder				
Type	Geotech RV/301	Benioff	Benioff	Geotech RV/301
Chart Rate	60 mm/min	60 mm/min	60 mm/min	60 mm/min
System				
Damping		17:1	17:1	
Attenuator setting(db)	12	8	8	-
Magnification at 1 Hz	164K	64K	51K	-
Peak Magnification/period(s)	207K/0.8	192K/0.4	107K/0.5	
Polarity	up-up	N-up	E-up	up-up

Table 11

Seismograph Attenuator Settings 1980-82

All Attenuation Changes at 0300 UT

Month	Day	Attenuator LP-Z	SP-Z	SP-E	SP-N	Month	Day	Attenuator LP-Z	SP-Z	SP-E	SP-N
Dec 1980	01	8	4	3	-	Aug	01	12	18	7	10
	02	9	4	4	-		11	12	18	8	12
	13	9	6	6	-	Sep	20	12	18	8	10
	19	9	7	6	-		30	-	-	8	10
	31	9	8	6	-	Oct	24	-	-	9	14
Jan 1981	13	10	10	8	-		26	-	-	8	12
	15	9	8	6	-		27	-	-	8	10
	18	9	10	7	-	Nov	06	-	-	10	18
	23	10	12	8	-		08	-	-	9	12
	27	10	16	9	-		09	-	-	8	10
Feb	07	10	18	10	-		12	-	18	8	10
	25	9	18	10	-		18	-	12	8	10
Mar	06	10	18	10	-		20	-	18	8	10
	11	10	22	10	-		21	-	24	8	10
	13	10	20	10	-		22	-	18	8	10
	14	10	22	10	-		24	-	12	8	10
	25	9	22	10	-		25	-	18	8	10
	30	9	18	8	-		28	-	12	8	10
Apr	02	9	16	7	-		29	-	18	8	10
	03	9.5	16	7	-	Dec	04	-	24	8	10
	11	9.5	16	8	-		05	-	18	8	10
	19	9.5	-	8	-		10	-	12	8	10
May	09	10	-	8	-		18	-	18	8	10
Jul	06	10	-	8	16		28	-	20	8	10
	07	10	-	8	12	Jan 1982	02	-	24	8	10
	10	10	-	8	10		06	-	30	8	14
	20	10	-	8	8		13	-	24	9	14
	21	-	-	8	10		16	-	30	9	14
	28	12	18	8	10		20	-	24	9	14
							27	-	30	9	14

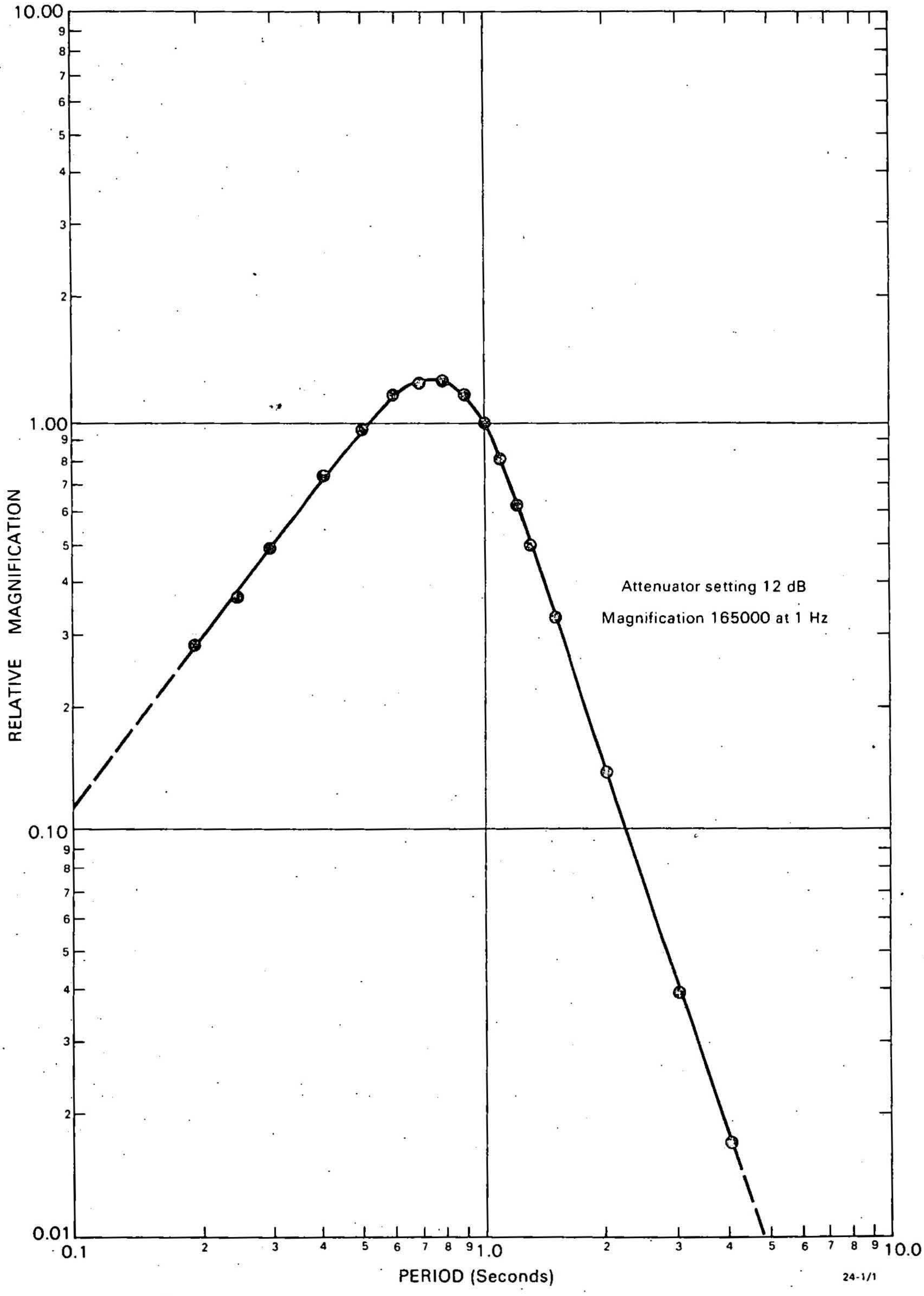


Fig. 1 Magnification curve: SP-Z seismograph, Mawson, 1981

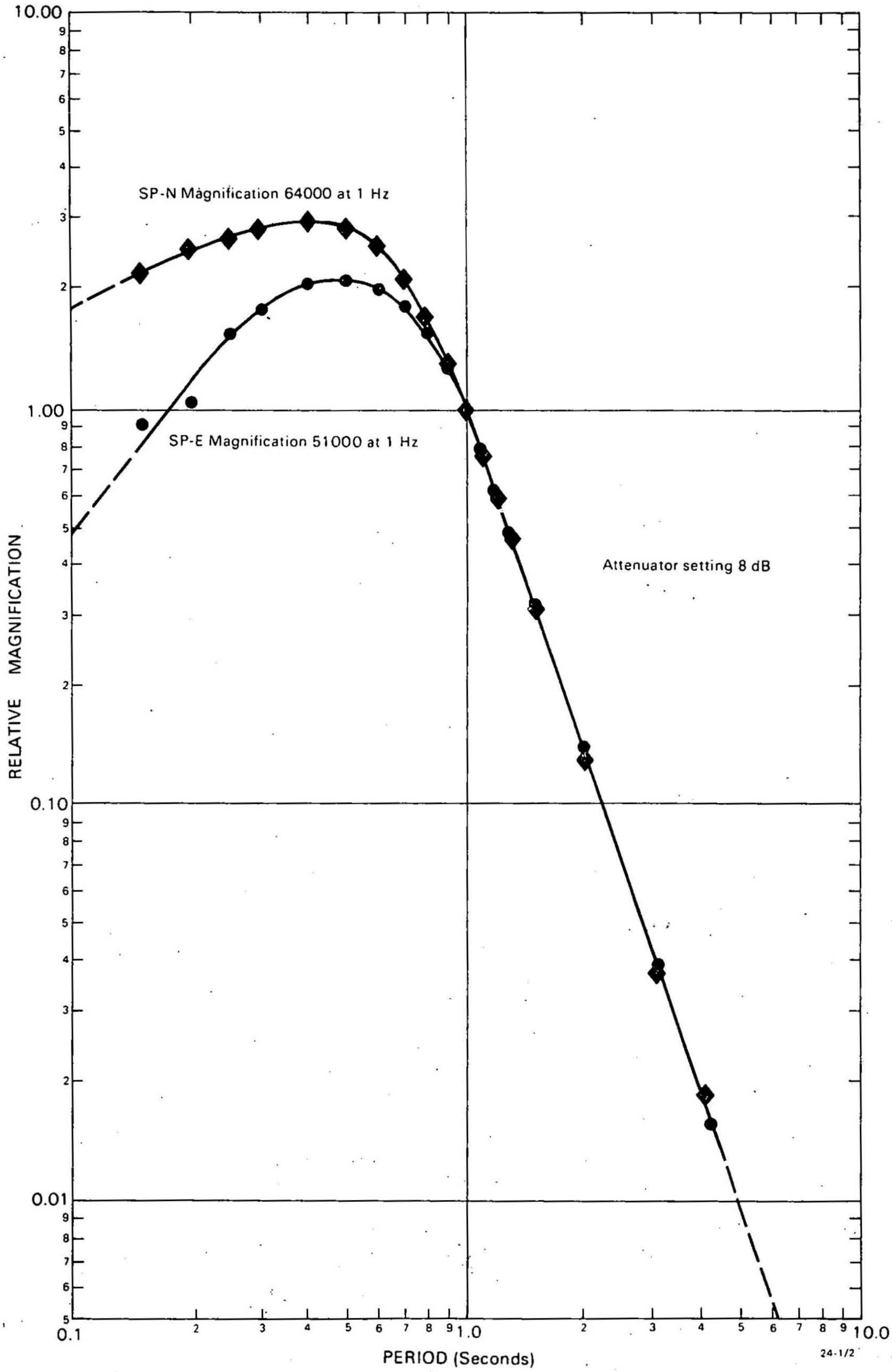
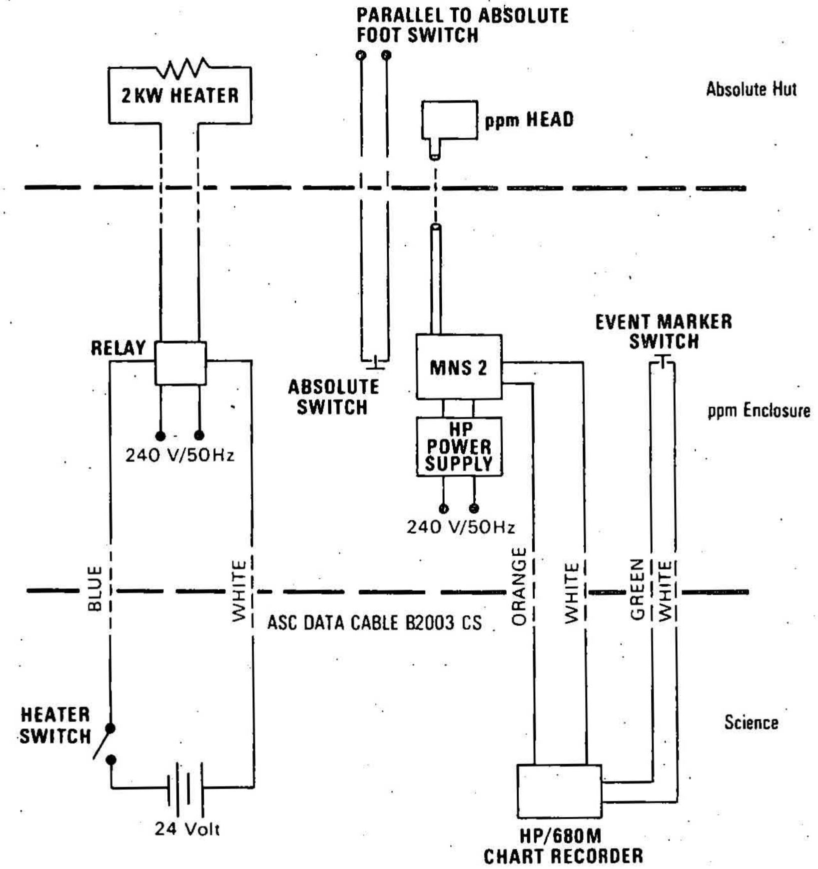
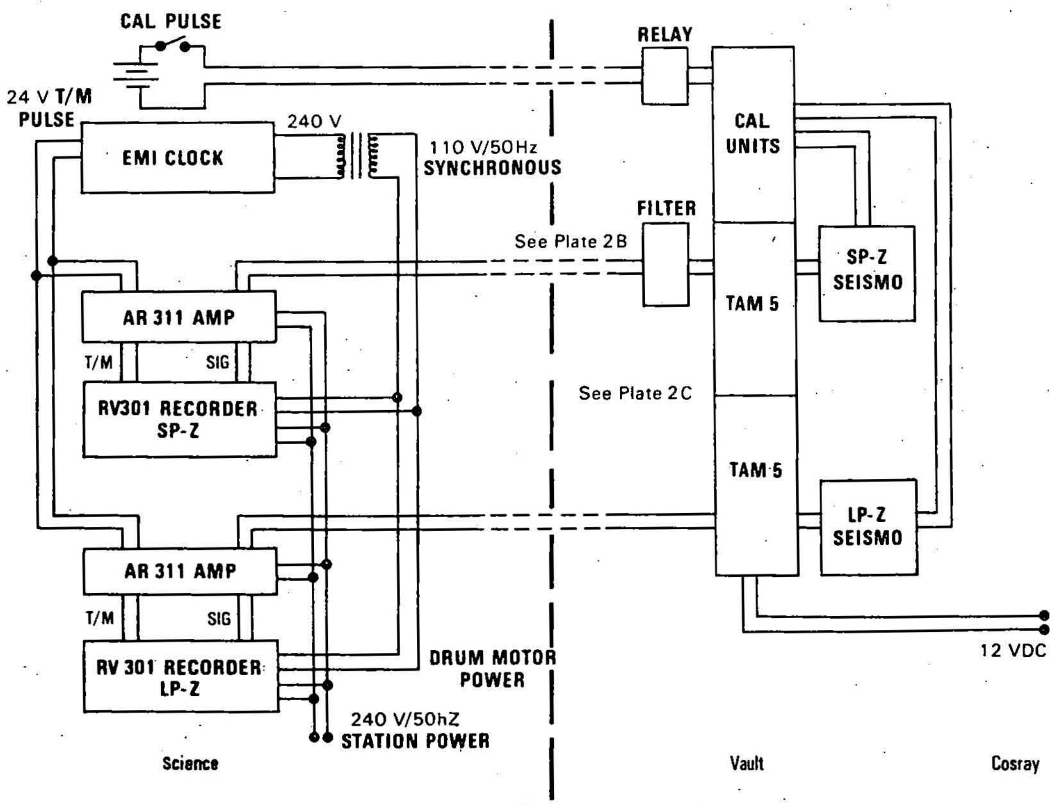


Fig. 2 Magnification curves: horizontal seismograph, Mawson, 1981

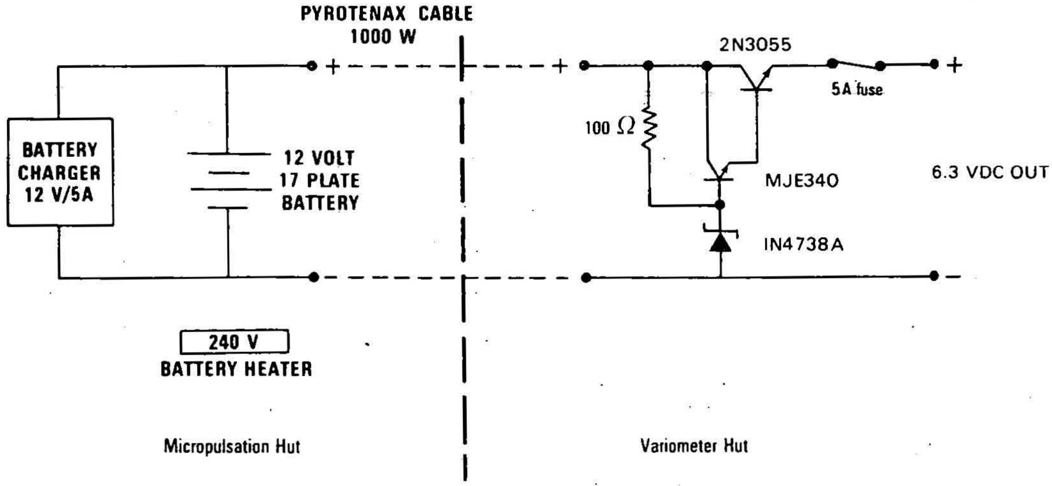


A Magnetic observatory wiring

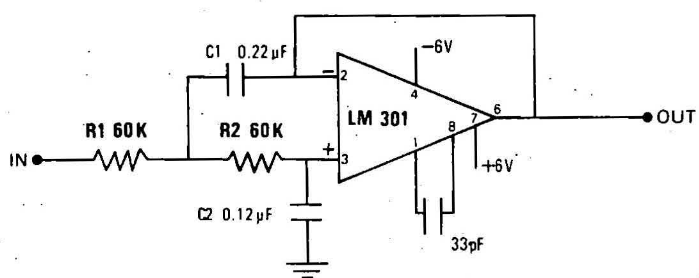


B Vertical Seismograph systems

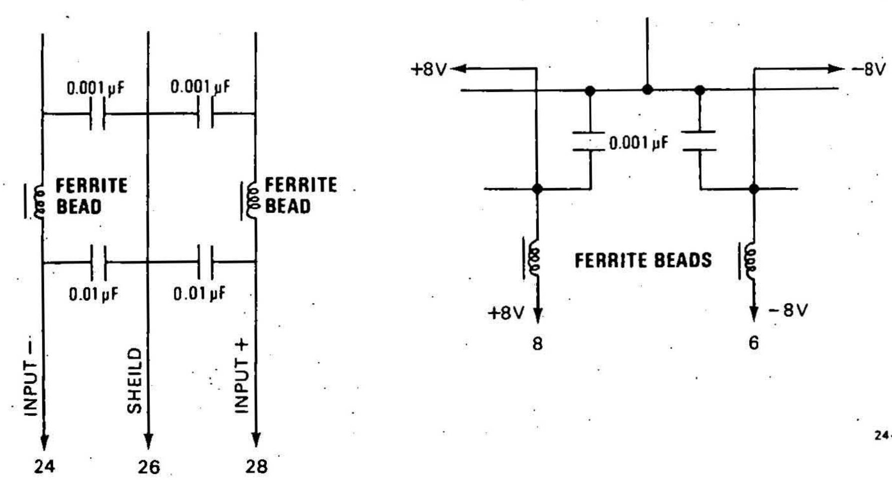
PLATE 2



A Variometer lamp supply



B Second order filter 12 db/octave roll-off
$f_c = 20\,Hz$



24-1/4

C Modifications to TAM 5 Seismograph Amplifier