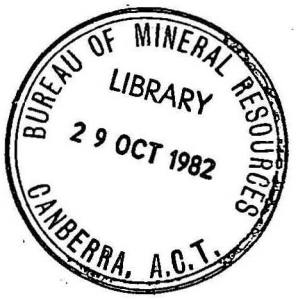

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

RECORD 1982/36

MACQUARIE ISLAND GEOPHYSICAL OBSERVATORY

OCTOBER 1981 - JANUARY 1982

by

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CONTENTS

SUMMARY

The Macquarie Island Geophysical Observatory continued operations throughout the summer of 1981/82 with no major interruption to service.

Preliminary seismological and geomagnetic data were forwarded to Australia weekly and monthly respectively.

1. INTRODUCTION

The Macquarie Island Geophysical Observatory is operated by a geophysicist from the Observatory Group, Bureau of Mineral Resources, Geology and Geophysics (BMR), Department of National Development and Energy; its program comprises geomagnetic and seismological observations. The observatory is run as part of the operations of the Australian National Antarctic Research Expeditions (ANARE) with logistic support supplied by Antarctic Division, Department of Science and Technology. Observatory data are given in Table 1, and a brief history in the Appendix.

Owing to problems in recruiting an observer for 1982 it was necessary for a temporary observer from HQ to operate the observatory for the 1981/82 summer; the author took over the Observatory as observer-in-charge from Warwick Williams on 23 October 1981 and was relieved by Ian Ferguson on 20 January 1982.

The magnetograph comprised three La Cour variometers and a normal-run BMR recorder. The resulting photographic record was processed daily. Twice weekly absolute magnetic observations were made comprising two PPM readings, two declinometer readings, and three QHM readings. A telex was forwarded to BMR Canberra at the end of each month containing the following magnetic data: H, D and K-indices and preliminary baseline and monthly mean values for H, D and Z (Table 2). The preliminary corrections applied to these data are listed in Table 3. Table 4 lists the geomagnetic annual mean values from 1971 to 1981.

The seismograph comprised a short-period vertical component (SP-Z) Willmore seismometer and photographic paper recorder. The seismograph photographic recording was upgraded to visual recording during December. Preliminary phase data were telexed at the beginning of each week to BMR Canberra via the Antarctic Division.

2. GEOMAGNETIC OBSERVATORY

La Cour magnetograph (20 mm/hour)

The La Cour magnetograph functioned satisfactorily throughout the summer. Only occasional maintenance was necessary, such as adjustment of the horizontal slit in front of the recording drum and removal of cobwebs from the trace and time-mark lamps.

The vertical intensity (Z), horizontal intensity (H) and declination (D) baselines remained constant throughout the summer. Baseline values are listed in Table 5.

H, D and Z scale values were constant.

The temperature coefficients were redetermined and agree with those used during 1981. They were zero for D and Z, and 3.0 nT/^{o}C for H. The scale values and temperature coefficients are listed in Table 6.

Parallax corrections were taken as zero for all traces for the summer.

Orientation tests. No orientation tests were made during the summer.

Magnetometers

Absolute instruments used during the summer were:

H = QHMs 177 (standard) 178, 179

D = Askania declinometer 640505 and circle 640620

F = PPM MNS2/2

Observations for H and D were carried out on Pier E, and the detecting head for the MNS2 was set on Pier W. The mark azimuths for D are listed in Table 7. As in previous years the total intensity pier difference was taken as zero (Davies, 1981). The vertical intensity (Zp) and Z-baseline values were calculated from the PPM F readings and H based on the previous month's H-baseline value.

The operation of the MNS2-2 was satisfactory, except for the failure of the bottle in the sensor head which burst when the PPM was left on for an extended period. A replacement bottle of suitable capacity was acquired from the Biology Laboratory.

Results from declinometer 640505 were not as consistent as required. Occasionally D-baseline values were scattered by about two minutes. Similar occurrences have been mentioned in earlier reports (e.g. Davies, 1981, 1982; Williams, 1982) but no significance has been attached to it. The problem appears to arise in the declinometer and not from the variometer (see Davies, 1981). The declinometer and circle were interchanged with declinometer 640506 and circle 640616 by R. Smith during his supervisory visit at changeover in January. Tests on declinometer 640505 and circle 640620 are continuing in Canberra (Smith, in prep.). The three QHM's gave no trouble.

H-intercomparisons

No comparison observations were made during changeover. However the instrument difference between QHM 177, QHM 178 and between QHM 177 and QHM 179 were derived from the year's observed H-baseline values (Table 8). The values of baseline differences obtained by the previous observer during 1981 are also listed.

3. SEISMOLOGICAL OBSERVATORY

The seismograph consisted of a short-period vertical (SP-Z) Willmore Mark II seismometer (free period 1.0s), a galvanometer control box, a galvanometer (free period 0.2s) and a photodrum recorder rotating at 60 mm/min. Time marks are supplied via cable from a digital EMI clock situated in the instrument room in the Science Block. There is also a Mercer back-up chronometer. Comparison radio time marks were placed on the seismogram every evening when radio reception from VNG was generally satisfactory. The EMI clock tended to stay well within the prescribed error rate of 50 ms per day. The seismograph parameters are listed in Table 9.

The photographic records were changed at 00 UTC and processed daily. Preliminary arrival times were telexed weekly to BMR Canberra. Macquarie Island is a low-gain station and the small number of events detected does not warrant telexing of data more frequently.

On 23 December visual recording was commenced using an AS320 preamplifier and seismometer control panel (Silic, 1979) in the vault, an AR311 amplifier and a BMR-modified Geotech R10 recorder in the office. See Figure 1 for a block diagram of the present seismograph arrangement. The new visual seismograph was calibrated by Ron Smith and Ian Ferguson on 20 and 22 January 1982 (Smith, in prep.).

Relative calibrations were carried out daily at the beginning and end of each seismogram, using the electronic calibrator unit. A current of 5 mA gave a deflection of 28.8 mm at a 12 dB setting on the galvanometer control box. The damping ratio was kept at about 17:1 for the summer. The calibration curve for the seismometer (Williams, 1982) is shown in Figure 3.

The galvanometer control box was left set at 12 dB from 23 October 1981.

4. CONTROL EQUIPMENT

The power and timing equipment is located in an instrument room off one end of the Geolab in the Science Block. From here underground cables carry signals to and from the variometer hut and the seismograph vault. The AS320 preamplifier is run from two 12v wet cells, which require charging once a month. A separate battery room in the Science Block is connected by cabling to the instrument room. The battery room is also shared by the Upper Atmospheric Physics Group.

Power for the AR311 amplifier and recorder in the office is provided by an inverter power supply.

Open circuit of the R8 1Ω resistor on the 4.75V supply board 4 caused the EMI digital clock to fail on 28 December. The clock was returned to service when this was replaced.

Batteries in the magnetic calibrator unit were recharged once during the summer period. Stand-by batteries were either on continuous charge or charged and maintained monthly.

All other equipment operated satisfactorily with no major faults.

5. BUILDING MAINTENANCE

No major building maintenance was undertaken during the summer. Assistance was given with the recladding of some of the Nissen Huts.

The leak in the south wall of the Geolab is still not repaired, but was not troublesome because the summer was unusually dry and warm.

The remote buildings (seismograph hut, magnetograph hut and absolute hut) are all in reasonable conditon and will, with constant attention, last for some time to come.

6. OTHER DUTIES

The standard additonal station duties were carried out over the summer. These included a week on slushie duties, occasional extra cooking while the cook was absent, and council jobs such as garbage runs.

7. ACKNOWLEDGEMENTS

Thanks go to all the members of the 1982 expedition for their support and good company over the summer. In particular the Electrical Engineer, Mark Femeri, for changing records while I was on trips down the Island, and Carpenter Rick Besso for building a bench to accommodate the new siemograph recorder in the Geolab.

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APPENDIX

1. Geophysical Observatory History

Macquarie Island

Buildings

1948 - Start of ANARE station on Macquarie Island.

1949 - Seismograph Hut constructed - included geophysics office.

1950 - Magnetic Variometer Hut erected.

- Magnetic Absolute Hut erected.

1968 - Geophysics Office constructed.

1979 - Science Builidng constructed - included geophysics office, upper atmospheric physics laboratory and office for the Officer in Charge.

Seismological Observatory

1950 - Two-component, short-period, Wood-Anderson Seismograph (East-West and North-South) installed.

December 1953 - Replacement two component, short period Wood-Anderson seismographs installed.

February 1956 - Short-period Grenet vertical seismograph installed in addition to Wood-Anderson seismograph.

January 1961 - Benioff three-component short-period seismograph installed to replace existing Grenet and Wood-Anderson seismographs.

November 1962 - Benioff vertical seismograph retained; the two horizontal component seismographs returned to Australia.

December 1967 - Willmore Mark I vertical seismometer used to test sites near seismoc hut for seismic noise the Wilmore then replaced the Benioff, which was returned to Australia.

December 1969 - Willmore Mk I seismometer was replaced by a Willmore Mk II vertical seismometer. The Mk I seismometer was retained to enable sites on the plateau to be tested for microseismic noise.

1972 - Two Willmore Mk II seismometers used concurrently during part of the year; one situated on the plateau and one in the seismic hut.

January 1973 - Willmore Mk II in seismic hut was returned to Australia and was replaced by a Willmore Mk I. Willmore Mk II remained in use on plateau.

1974 - Plateau system failed early 1974.

1975 - Willmore Mk I continued to operate in seismic hut. Willmore Mk II used to test sites on Wireless Hill for Seismic noise.

1976 - Willmore Mk II used in seismic hut in vertical position as previously. Willmore Mk I used to set up horizontal (North-South) seismograph in seismic hut.

1979 - Early in year, horizontal component recording was discontinued.

October 1980 - Willmore Mk I returned to Australia, leaving Willmore Mk II vertical seismograph in seismic hut.

23 December 1981 - Seismic recording system was changed from photographic to visual.

Magnetic Observatory (Variometer Hut)

August 1950 - Watts horizontal intensity variometer No. 61911 was installed. Scale value was 8.5 nT/mm

1951 - Watts H-variometer returned to Australia. 3-component normal La Cour magnetograph installed. Scale values: H, 12 nT/mm; D, 0.9/mm; Z, 13 nT/mm.

April 1960 - 3-component insentive La Cour magnetograph installed to supplement the existing sensitive magnetograph. Scale values: H, 63 nT/mm; D, 2.25'mm; Z, 59 nT/mm.

December 1962 - Normal La Cour magnetograph was replaced by a La Cour rapid run magnetograph (180 mm/hr). The insensitive La Cour magnetograph was modified to increase the sensitivity of the H and Z variometers by changing the H-fibre replacing the Z-magnet. Scale values are shown below.

	Before Normal	After Rapid-run	Before Insensitive	After Normal
H9nT/mm)	12.6	5.4	63	24.6
D'/mm	0.92	1.03	2.35	2.35
Z(nT/mm)	14.2	5.3	59	20.6

26 Feb 1968 - On 26 Feb, the D fibre was replaced in an attempt to

reduce erratic drift. 9 March 1968, H fibre was replaced - scatter and drift continued. The H scale value was reduced to 23.7 nT/mm

1 Feb 1970 - H variometer fibre was replaced in the normal magnetograph. This reduced the H scale value to 19.3 nT/mm, and eliminated steep drift.

15 Feb 1978 - Recording ceased on the rapid run magnetograph.

Table 1

Station Data for Macquarie Island

	Magnetic Absolute Hut	Seismograph Station (MCQ)
Geographic latitude	54°30.0'S	54°29.9'S
longitude	158°57.0'E	158°57.4'E
Geomagnetic latitude	-61.1°	
longitude	243.1°	
Elevation (m)	8	14
Foundation	Basalt	Basalt

Table 2

Preliminary Monthly Mean Geomagnetic Values and K-Indices, 1981

Month 1981	H (nT)	D ° '(E)	Z (nT)	F (nT)	K
Jan	12710	28 31.5	63746	65001	1.4
Feb	12705	28 35.9	63739	64993	2.0
Mar	12684	28 36.4	63747	64997	2.2
Apr	12687	28 36.7	63749	64999	2.5
May	12686	28 37.4	63752	65002	2.0
Jun	12695	28 38.3	63742	64994	1.1
Jul	12683	28 38.6	63748	64997	1.8
Aug	12681	28 39.6	63738	64987	1.7
Sep	12674	28 40.0	63726	64974	1.3
Oct	12671	28 40.7	63725	64973	2.8
Nov	12674	28 37.9	63716	64964	3.2
Dec	12688	28 37.3	63688	64940	2.9
MEAN	12687	28 37.6	63735	64985	2.1

Table 3

Preliminary magnetometer corrections, Macquarie Is. 1981

M'meter	QHM 179	QHM 179	QHM 179	Ask 505	MNS2/2
Corr'n	-13nT	-7 nT	-6 nT	+1.0'	0 nT
xH	-0.00102	-0.00055	-0.00047	-	-

Table 4

Geomagnetic Annual Mean Values, 1971-1981

YEAR	D o '(E)	I o '	H nT	X nT	Y nT	Z nT	F nT
1971	27 13.3	-78 33.3	12963	11527	5930	-64032	65331
1972	27 22.1	-78 34.4	12937	11489	5947	-64008	65302
1973	27 27.6	-78 35.8	12905	11451	5951	-63985	65273
1974	27 34.3	-78 37.6	12865	11404	5955	-63956	65237
1975	27 43.2	-78 38.2	12847	11373	5976	-63926	65204
1976	27 51.6	-78 39.1	12822	11336	5992	-63891	65165
1977	27 59.8	-78 39.9	12802	11304	6010	-63861	65132
1978	28 11.3	-78 41.1	12773	11258	6034	-63838	65103
1979	28 19.6	-78 42.3	12745	11219	6047	-63807	65067
1980	28 28.8	-78 43.0	12723	11183	6067	-63768	65025
1981	28 37.6	-78 44.6	12687	11136	6078	-63735	64985
Mean annual change							
1971-1981	8.43	-1.13	-27.6	-39.1	14.8	29.7	-34.6
1971-1976	7.66	-1.16	-28.2	-38.2	12.4	28.2	-33.2
1976-1981	9.20	-1.10	-27.0	-40.0	17.2	31.2	-36.0

Table 5

Observed Mean Baseline Values, 1981

Date 1981	UT h m	Baseline
Horizontal intensity		BHs nT
Oct 01 through Dec 31	00 00	12423
Declination		BD (E)
Oct 01 through Dec 31	00 00	26°53.5'
Vertical intensity		BZs * nT
Oct 01 through Dec 31	00 00 24 00	-63536
Temperature		BT °C
Oct 01 through Dec 31	00 00 24 00	-79.7

* Derived from H and F (MNS2/2)

Table 6

Magnetograph Parameters, 1981

Component	Scale Value	Calibration Current	Temperature Co-efficient
H	19.42 nT/mm	60.0 mA	3.0 nT/°C
D	2.36 min/mm	20.0 mA	0
Z Jan 01-May 31	20.68 nT/mm	40.0 mA	0
Jun 01-Dec 31	20.79 nT/mm		
T	1.42°C/mm	-	-

Table 7

Reference Mark Azimuths, 1981

Mark	Symbol	Azimuth from Pier E
North Mark *	NM	353°44.3'
Anchor Rock	ANC	353°40.4'

* The main mark used.

Table 8

QHM Comparisons, through routine Baseline values 1981

Date		(177)-(178)	(177)-(179)
Jan 01 - Jan 27		11	10
Jan 28 - Feb 08		9	9
Feb 09 - Apr 24		9	9
Apr 25 - Jun 27		8	9
Jun 28 - Aug 06		8	9
Aug 27 - Sep 30		7	11
Oct 01 - Dec 31		8	11
Mean	(nT)	9	10
	(xH)	0.00071	0.00079

Values are at standard temperature (5°C) with no instrument corrections applied.

Table 9

Seismograph Parameters 1981

Willmore Mark II Seismometer		
Free Period	1.0 s	
Galvanometer Free Period	2.0 s	
Calibration Current	5.0 mA	
Calibration Deflection	29 mm	
Damping Ratio	17:1	
Attenuator Setting (12 Dec 1980 - 24 Dec 1981	12 dB	
Magnification at 1 s (12 dB)	2700 (see Fig. 3)	
Polarity: 28 Jun - 24 Dec 1981	Trace up	Ground motion up

Fig 1 BLOCK DIAGRAM OF MACQUARIE ISLAND SEISMOGRAPH SYSTEM

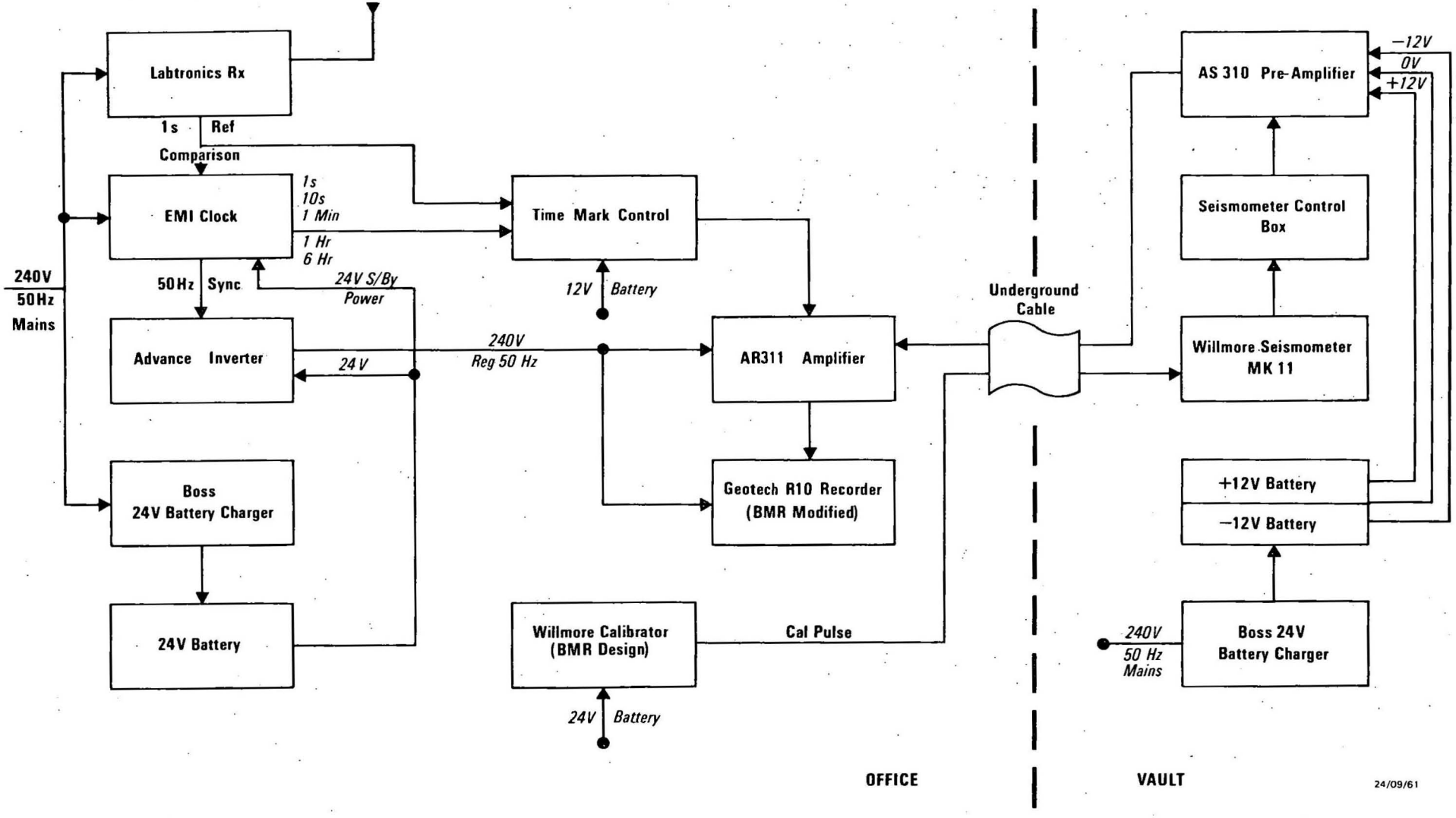
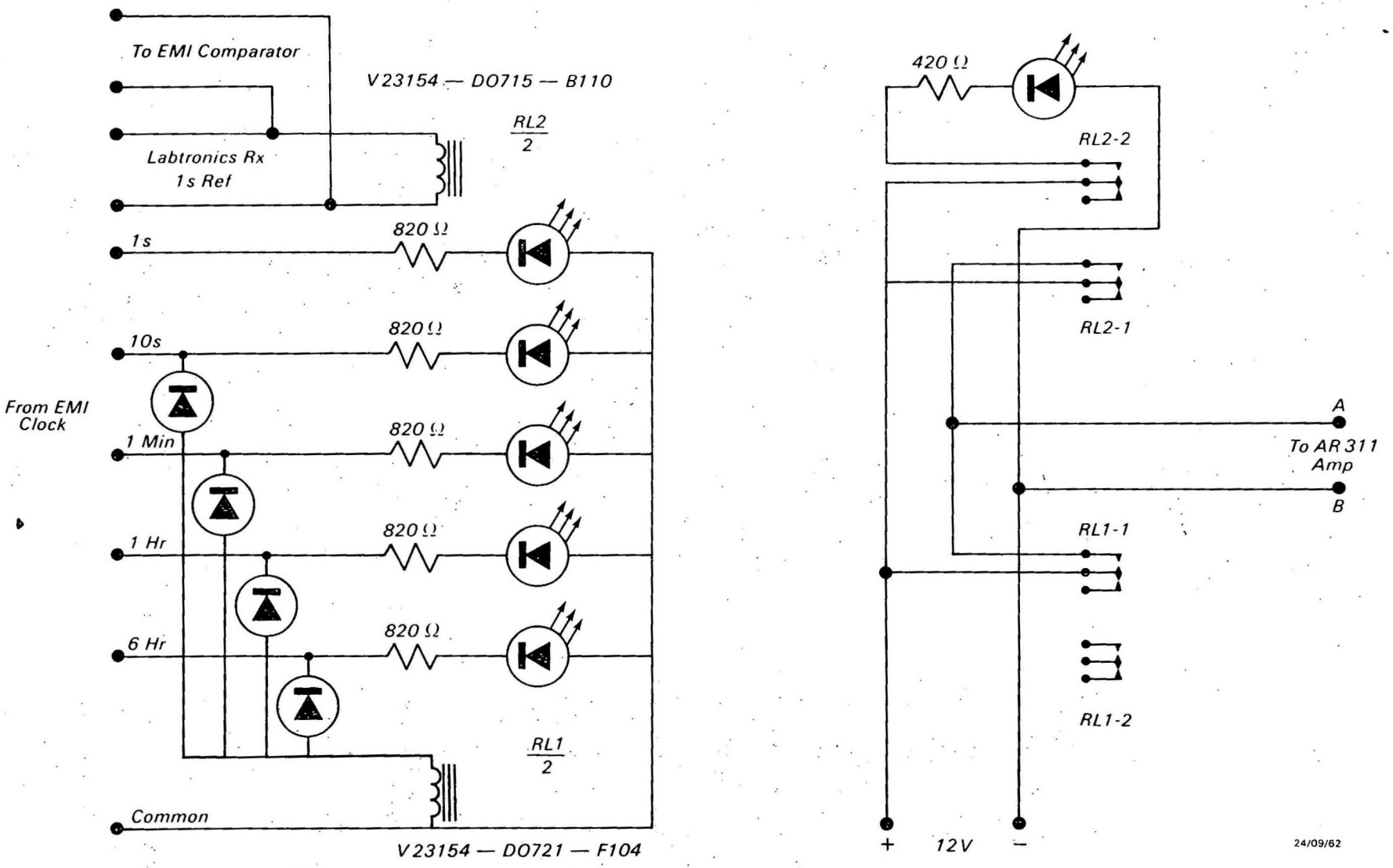


Fig. 2 TIME CONTROL UNIT FOR SEISMOGRAPH RECORDER, MACQUARIE ISLAND



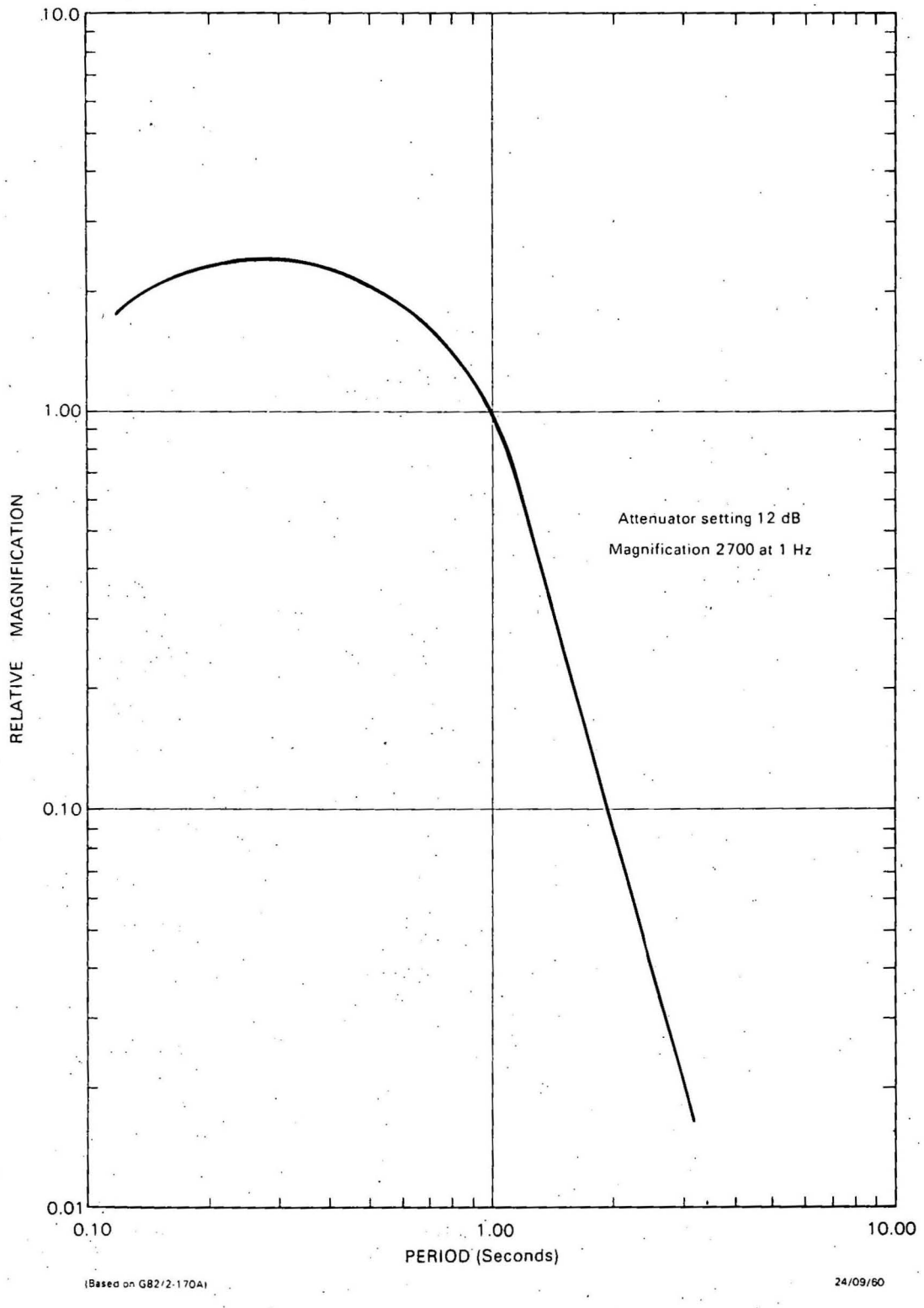


Fig. 3 Macquarie Island, SP-Z seismograph calibration curve