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MAWSON GEOPHYSICAL OBSERVATORY

ANNUAL REPORT, 1985

BY

P. J. KELSEY

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SUMMARY

The work described in this report was part of the Bureau of Mineral Resources contribution to the 1985 Australian National Antarctic Research Expeditions. This contribution consisted of continuous recording of global seismic activity and the geomagnetic field at Mawson.

The geomagnetic field was recorded using a normal La Cour magnetograph (recording H, D and Z components photographically) until 12 December 1985; and after that by Photo-Electronic Magnetometers (X, Y and Z components) connected to an Edas digital recorder (magnetic cassette tapes) and a visual multichannel recorder.

Seismic activity was recorded using a Benioff short-period vertical seismograph, two Benioff short-period horizontal seismographs and a Press-Ewing long-period vertical seismograph.

Preliminary magnetic data were forwarded monthly to BMR, Australia. Preliminary seismic data were forwarded bi-weekly to the National Earthquake Information Service (NEIS) of the USGS at Denver, Colarado, via the Bureau of Meteorology's Global Telecommunication System (GTS) and to all other Antarctic geophysical stations.

CHAPTER 1: INTRODUCTION

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

The geomagnetic observatory commenced operation in 1955 using the absolute and magnetic variometer huts and a three-component La Cour magnetograph from Heard Island (Oldham, 1957). Since then numerous instrument changes have taken place (see Appendix A). During the summer of 1984/85 the Department of Housing and Construction built a new magnetic variometer building for the observatory. This was completed in May 1985 and during the latter part of the year Photo-Electronic Magnetometers were installed in the building. These finally replaced the La Cour magnetograph on 12 December 1985.

Seismological observatory history of instrumentation is also included in Appendix A. In February 1985, the Benioff short-period horizontal seismometers were installed in the Cosray vault, where the Benioff short-period vertical and the Press-Ewing long-period vertical seismometers were already operating (Figure 8). This completed the conversion from photographic to visual recording of the seismic system.

The author arrived at Mawson on 06 February 1985 on the Icebird to replace Peter Crosthwaite who departed after an extended changeover on 05 March 1985 on the Icebird. The replacement geophysicist Rodney Hutchinson arrived on the Nella Dan on 29 January 1986 and after another extended changeover the author departed Mawson on 14 March 1986 on the Nella Dan.

Absolute instrument comparisons were done at Davis in February 1985, during a stop-over visit on the way to Mawson.

CHAPTER 2: MAWSON GEOMAGNETIC OBSERVATORY

During 1985 a new magnetic variometer system was installed at Mawson. It consisted of X, Y and Z component Photo-electronic Magnetometers (PEMs) and a Proton Precession Magnetometer (PPM) with a noise-cancelling sensor. These instruments were installed in the new magnetic variometer building. The X and Y PEMs used were those previously installed in the old variometer hut. The Z PEM and the noise-cancelling sensor (to be used with an MNS2 PPM) were brought from BMR, Canberra. The magnetic field data were recorded digitally on magnetic cassettes by an Edas data logger, as well as visually on a W+W chart recorder. The new variometer system commenced recording on 12 December 1985.

Previous to this a La Cour magnetograph was used to record photographically the H, D and Z components of the geomagnetic field. It operated in the old variometer hut. Table 2 outlines the operating periods and locations of the different variometers used at Mawson during 1985.

All published magnetic data from Mawson were derived from the La Cour variometer until 12 December 1985. Subsequently they were derived from the PEM system.

2.1 Absolute Instruments

The instruments used were QHM 300 (with thermometers 2143 and 1650), QHM 301 (thermometer 1416), QHM 302 (thermometer 1401), Askania Declinometer 630332, Askania circle 611665, BMZ 62 (thermometer 2501) and Geometrics PPM G816/1024. The QHMs were all used with the Askania circle 611665.

The QHMs gave few problems. However the QHM 300 thermometer 2143 was difficult to read so it was replaced by thermometer 1650 on 19 March. Coincident to this, the residual torsion of QHM 300 also changed (Table 3). For QHM 300 observations up until 19 March the mean residual torsion was -3.7 minutes of arc; from 19 March onwards the mean residual torsion was 12.4 minutes of arc. Since residual torsion was not allowed for in the QHM calculations (see Appendix B) this increase in residual torsion should have caused an instrument correction change of +0.4 nT to QHM 300. This was not the case, an instrument correction change of -4.3 nT was actually observed.

If this change in instrument correction of -4.3 nT for QHM 300 is in fact real, it should be apparent in the QHM instument differences calculated through baseline value determinations during the year. And also in the yearly instrument comparisons done between QHM 300 and the travelling standards.

The instrument differences between QHMs 300 and 301 and QHMs 300 and 302 are given in Table 4 for 1985 with and without the inclusion of the instrument correction change for QHM 300. Also the QHM instrument differences for the previous three years are included (Crosthwaite, 1986; Cechet, 1984; Silberstein, 1984). The 1985 values that allow for the QHM 300 instrument correction change are more consistent and compare better to the values from previous years, than the values that do not include this change.

Table 5 summarizes the yearly QHM instrument comparisions done over the past 3 years. In 1983, 1985 and 1986 the travelling standards for QHM comparison were HTM 570704 and QHM 172, while in 1984 they were HTM 570704 and QHM 174. The HTM

570704/QHM 300 comparisons confirm a possible instrument correction change to QHM 300 of -4.3 nT while the data from QHM 172/QHM 300 comparisons do not.

The change in QHM 300 instrument correction is primarily due to the change of thermometer. It would seem that either or both of the thermometers 2143 and 1650 do not have accurate calibrations. It was noted by Cechet and Crosthwaite (Cechet, 1984; Crosthwaite, 1986) that thermometer 1416 (QHM 301) was inconsistent with the other QHM thermometers. As the calibrations of most BMR QHM thermometers are very dated, it is expected that instrument correction discontinuities will occur should any of them be replaced.

All data derived from QHM 300 observations from 19 March 1985 onwards are adjusted to allow for the change in its instrument correction.

The QHM 301 clamping mechanism is sticky and introduces nuisance vibrations at the beginning of an observation.

Declinometer 630332 and BMZ 62 worked satisfactorily all year.

PPM G816/1024 proved not to be a reliable instrument in Antarctic conditions. The connections to the sensor were replaced a couple of times and the dry cell batteries were an inadequate power source. However, it was used fairly successfully for total field observations until 15 November when it died completely. Its repair was inhibited by lack of documentation.

2.2 La Cour Magnetograph

The La Cour Magnetograph was used to photographically record the H, D and Z components of the geomagnetic field from 01 February to 12 December 1985 (Table 2). On 29 November 1985 the Z magnet of the La Cour was removed as it was to be installed in the new Z PEM. Thus for this period, 29 November to 12 December only the H and D components of the field were recorded. Otherwise the La Cour operated continuously except for the following periods of record loss:

1985	February	23	0600UT	-	25	0600UT
	April	24	1900UT	-	25	0250UT
		28	0550UT	-	29	0620UT
	July	05	1420UT	-	08	0850UT
	October	15	1140UT	-	15	1220UT

This was a total of 147.5 hours or 1.9% of the total recording period.

The primary reasons for data loss and the degradation of data quality were:

1. failure of station power supply
2. loose/intermittent connections in the power supply and timing circuits (PPT-1 and TMU-1)
3. overfixation of photographic records

The D timemark trace and the D reserve trace were missing from the La Cour magnetograms all year. The Z reserve trace was apparent but very faint. No attempts were made to restore or improve these traces as previous geophysicists had had no success when tackling this problem (Crosthwaite, 1986). Also very little data were lost during magnetic storms. All other traces were considered to be acceptable so no adjustments were required.

Blasting at the rock quarry site adjacent to the old variometer hut ceased at the end of February 1985. The rock crusher and other plant were not removed. No blasting was done in the '85/'86 summer.

Orientation tests were not done on the La Cour as 1985 was its last year of operation.

The labelling of Mawson La Cour magnetograms is misleading. Generally the H, D, Z and T stamps on a magnetogram have an arrow which indicates the direction of increasing field or temperature. On Mawson La Cour magnetograms the arrows indicate directions of increasing magnitude of geomagnetic field components. However the stamps do not indicate that magnitudes are being considered. Thus the D and Z labelling is incorrect as D and Z are both negative at Mawson.

2.2.1 Parallax Tests

Parallax tests were performed shortly before or after each set of absolute observations for baseline value determination. This was done to allow the event marks for the observations to be accurately transferred to the data traces using a parallel rule.

There is a very small parallax between both the H and Z traces and their respective timemark traces. In both cases the data trace is 0.1 mm or 0.3 minutes of time to the left of the corresponding timemark (i.e. the parallax corrections are +0.3 minutes). As previously mentioned there is no D timemark trace. Any other set of timemarks on the magnetogram could be used. The D trace is not more than 1 mm or 3.0 minutes to the right of the corresponding H timemark and not more than 1.7 mm or 5.0 minutes to the right of the corresponding Z timemark (i.e. the parallax corrections for the D trace are -3.0 minutes using H timemarks and -5.0 minutes using Z timemarks). These measurements are difficult to do accurately as the H and Z timemark traces are a long way from the D data trace on the magnetogram.

2.2.2 Baseline Value Control

La Cour scale value observations were done approximately four times per month. The constants for the scale value coils for the H, D and Z variometers are listed in Table 6. During every scale value observation the calibration current was monitored using a Fluke digital multimeter. The nominal calibration currents used were 60 mA for H, 40 mA for D and 70 mA for Z. The adopted scale values are listed in Table 7.

The H and D scale values compare well with those of 1984 (Crosthwaite, 1986). However there is a significant change in the Z scale value from 22.65 +/- 0.08 nT/mm in 1984 to 23.33 +/- 0.07 nT/mm in 1985. In January 1985 a blast in the rock quarry adjacent to the old variometer hut dislodged the Z magnet from its agate. The magnet and agate were thoroughly cleaned before the magnet was replaced. The Z scale value change is attributed to this event. Note that the Z temperature coefficient also changed (Table 7).

Absolute observations were performed about seven times per month. As the geomagnetic field at Mawson is very active absolute observations were done during periods of little magnetic activity and reasonable weather conditions. This meant that observations were not spread evenly throughout the month.

The observing schedule was:

PPM G816/1024, DEC 630332, QHM 300, DEC 630332, PPM G816/1024

La Cour baseline values are given in Table 8.

QHM calculations do not take into account residual torsion (see Appendix B). QHM observations were corrected for declination variation using data from the X and Y component PEMs until 24 June 1985. After that the declination corrections were measured from La Cour magnetograms.

The H baseline value change on 19 March 1985 for baseline values derived from QHM 300 data is a result of an instrument correction change to QHM 300. Some drift was seen in all of the H, D and Z La Cour baseline values derived during 1985. This is depicted as discrete baseline value changes on 13 May for H and D and on 01 July for Z.

QHM 301 and 302 observations were included once per month. Even though the La Cour H baseline values (Table 8) derived for each of the QHMs were fairly consistent, it is recommended that in the future QHM 301/302 observations are done as frequently as QHM 300 observations, as has been the practice in the past.

The BMZ 62 was the back-up absolute instrument for the PPM G816/1024 and was used only once per month. As there is a large scatter in Z baseline values (Table 8) derived from BMZ observations (a range of 30 nT in 1985), it may be advisable that BMZ observations are done more often than once per month in the future.

When the Z magnet was removed from the La Cour variometer on 29 November 1985 for installation in the new PEM system, the H and D baseline values changed. These baseline value changes were observed on the 29 November magnetogram. However during the period 29 November to 12 December no absolute observations were made as all effort was being used to complete the PEM installations as quickly as possible. Before the La Cour was dismantled and RTA'd in February 1986, several sets of absolute observations were done in order to calculate the H and D baseline values for this period.

The temperatures of the H and Z variometers were read every chart change and before and after each set of absolute observations. These measurements were related to scalings on the magnetograms and least squares analyses were used to determine the temperature scale values. The adopted H and Z temperature scale values were then used to determine the baseline values. See Tables 7 and 8.

2.3 New Magnetic Variometer Building

During the 1984/85 summer the Department of Housing and Contruction (DHC) commenced building the new magnetic variometer building in East Bay (see Figure 1). The building was satisfactorily completed by 04 May 1985, allowing the installation of the PEM system to commence.

However the official handover of the building from DHC to the Antarctic Division did not occur until 30 January 1986. This caused some data losses in December 1985 and January 1986 (see Table 9), as the PEMs were operational by this time. The data losses occurred when DHC built the external stairs (concrete pouring can only be done during summer) and undertook remedial work inside the building; and during the inspections required by DHC and the Antarctic Division.

The new magnetic variometer building consists of a cold porch, a control room and two instrument rooms (Figure 2). The construction of the building is quite elaborate. The building consists of two independent, non-connecting shells. The outer shell is built from panels which are a sandwich of polystyrene between two layers of marine plywood and oregon studs. The panels of the inner shell are similar except that the polystryrene is omitted. The panels are nailed together using bronze nails. In the construction of both shells the panels were connected using non-magnetic grade stainless-steel (316) bolts, and each shell was anchored to the concrete slab using similar grade hold-down bolts. The concrete slab has non-magnetic grade stainless-steel reinforcing. The slab is insulated from the ground except where it is keyed into the rock via 4 keyways each 200mm square by 600mm deep. The building is finished with fibreglass capping and all external bolt heads are insulated.

A few points should be noted:

1. The escape hatch over the door is useless and unnecessary.

2. The electrical circuit board is grossly over-designed and complicated and contributes to magnetic interference.

3. The electrical cabling goes underneath the floor of the southern most instrument room from where it enters the building to the electrical circuit board (Figure 2).

4. An external socket was in the original plans to accomodate an external generator to supply 240VAC to the building if mains power to the building became unreliable or non-viable. As the probability of this happening was negligible and an external power supply close to the building would cause magnetic interference it was recommended that this socket not be installed.

The magnetic variometer building is nominally non-magnetic. However, ferrous materials are included in many components of the electrical circuit board, eg. the transformer (iron core), circuit breakers (bi-metallic, including ferrous strips and springs), and the main switch (steel structure); and also in the door latches (parts of the internal mechanism). In addition, some magnet interference originates from the transformer and relays in the electrical circuit board. The purpose of these was for load shedding from the main power house should station power consumption become critical. As the power consumption of the new magnetic variometer building is quite small these relays and the transformer were bypassed but not removed. Thus the transformer merely supplies additional ferrous interference instead of a fluctuating magnetic interference.

Station power to the new magnetic variometer building arrives via Ring Main Unit No. 4 (RMU-4). The data cable from Wombat follows the existing cable tray to a point near RMU-4. A separate fire alarm cable was installed. All three cables leave the cable tray near RMU-4 and are laid along the ground to the new magnetic variometer building (see Figure 1). This route requires one road crossing, which was installed by DHC, and skirts the rock quarry adjacent to the old variometer hut. At the time of inception the route was very safe from any interference likely to cause damage to the cables.

Apart from its electrical design, the new magnetic variometer building is an excellent building and should provide more than adequate housing for any variometers BMR requires to operate at their Mawson Observatory. The level of ferrous interference mentioned previously is quite acceptable in a variometer building. However, when the Mawson Absolute Hut is replaced a building of simpler design should be considered. A pre-fabricated, insulated fibreglass shell bolted to a concrete slab would be very adequate. Besides greatly reducing cost this would decrease possible sources of ferrous interference.

2.4 New Magnetic Variometer System

Following the completion of the new magnetic variometer building, the northern instrument room was prepared for the three-component (X, Y and Z) PEM system and an MNS2 PPM. The X and Y PEMs were relocated from the old variometer hut (see Table 2), the Z PEM was a new instrument from BMR, Canberra, and the PPM was to be either the MNS2/1 or the MNS2/2, used with a new noise-cancelling sensor built by BMR. A doric temperature monitor (346904) was installed to monitor the temperature of the instrument room.

Back-up DC power was installed for the MNS2 and the Magnetic Controller (MCC-1) of the PEM system.

The data were logged in the Science Building (Wombat) by a digital recorder (an Edas unit utilizing a magnetic cassette drive) and a visual multichannel chart recorder (W+W).

2.4.1 Preparation of Instrument Room

Layout of the Instrument Piers:

Tests were undertaken to determine the minimum permissible separation between the PPM noise-cancelling sensor and the PEMs. These tests were carried out on the X and Y PEMs while they were operating in the old variometer hut. The PPM noise-cancelling sensor affected the X PEM when the distance between the PPM sensor and the helmholtz coils of the PEM was less than 790mm. The PPM affected the Y PEM when this distance was less than 960mm. The closest spacing allowable between adjacent PEM helmholtz coils is deemed to be 1000mm. The PEMs should be arranged in a manner such that there is no light interference between them. PPMs have stronger signal strengths if the sensor head is of the order of 2000mm above the ground (Wienert, 1970).

All the above points were considered in the internal design of the northern instrument room of the new magnetic variometer building which was to house the X, Y and Z PEMs and the noise-cancelling sensor of the MNS2 PPM. No heights or sizes were specified for the PEM piers so these were made to accomodate the slate pier tops available at Mawson, to be reasonably stable and to be of a reasonable height to work at during the PEM installations.

The final layout of the instrument piers allows the maximum possible spacing between the instruments (see Figure 3). The closest distance between any of the sensors is about 1340 mm between the X and Z PEMs. The separation of the PPM sensor from the sensors of the X, Y and Z PEMs is approximately 1800mm, 3900mm and 1680mm respectively.

The X and Y piers are both 300mm x 600mm. Their pier tops are 915mm x 380mm x 49mm and 1115mm x 459mm x 49mm respectively. The heights of the X and Y piers with their tops in place are both 845mm. The Z pier is 300mm x 450mm and its pier top is 610mm x 458mm x 55mm. The height of the Z pier with its pier top in place is 848mm. The three pier tops are pieces of slate previously used in the old variometer hut or the old seismic hut. The F pier (for the PPM sensor) is 300mm x 300mm. The pier top is made from compressed cement (AC) sheet and is 347mm x 350mm x 17mm. The height of the F pier with the pier top in place is 1397mm.

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The piers are made of poured concrete with non-magnetic grade stainless steel (316) re-inforcing.

In January 1986, whilst working on the PEM Z during a blizzard, noise coinciding with wind gusts was observed on the output of the PEM. This noise did not appear to be of sufficient magnitude to affect the Edas recording. Nevertheless future installations of this nature should consider using piers of more solid and stable construction.

Orientation Marks for PEM alignment:

Two lengths of timber 70 mm x 30 mm were installed along each of the long walls of the northern (PEM) instrument room to accomodate orientation marks for the PEM alignment. The lengths of timber were mounted 52 mm to 58 mm off the walls. Three pairs of orientation marks were installed (see Figure 4). Brass nails were used as the marks.

The marks were derived from marks N1 and R1 which define an azimuth of 131° 49.2' (Crosthwaite, 1986) and are embedded into the concrete floor of the building (see Figure 2). The line defined by the marks labelled 1 (see Figure 4) is due north-south and has an error estimated to be +/- 0.05°. The line defined by the marks labelled 2 is also due north-south and has an error estimated to be +/- 0.06°. The line defined by the marks labelled 3 is 64° West.

However, since this is a new building and some shrinkage was already evident between 04 May 1985 when it was completed and January 1986, these marks will not retain this accuracy as the building moves. These marks should be checked from marks N1 and R1 before they are used to check the PEM orientations.

2.4.2 Installation of PEMs, PPM and the Doric Temperature Monitor

The X, Y and Z PEMs and the noise-cancelling sensor of the PPM were installed on their respective piers in the northern-most instrument room of the magnetic variometer building. The Doric temperature sensor was installed adjacent to the Y PEM sensor and at about the same height as the magnet of the QHM 291 in the Y PEM. The MCC-1, MNS2 and the Doric temperature monitor were installed in the control room (see Figure 2).

The outputs of the MCC-1, MNS2 and Doric are fed into a crushing terminal box which terminates the data cable from Wombat. A similar crushing terminal box is used in Wombat to terminate the other end of the cable. Figure 5 shows the cabling from the MCC-1, MNS2 and Doric in the variometer building to the Edas data logger and the W+W chart recorder in Wombat.

Setting up of PEMs:

The physical alignment of the PEMs was carried out using the orientation marks previously described. The total error in the alignment of the helmholtz coils of the X and Y PEMs is estimated to be +/- 0.18°. This is well within the acceptable +/- 0.25°.

The line defined by the orientation marks labelled 3 (64° West) was used to align the Z PEM. The total alignment error of the Z PEM Helmholtz coils to this line was not estimated. The Z PEM is required to be aligned to within 10° of magnetic North. As the annual mean declination for Mawson for 1985 was 63° 40.3' west and has been changing at a rate of about 7' west per year for the past 10 years, this Z PEM alignment is quite adequate. The critical aspect of the Z PEM alignment is that the feedback coils be horizontal.

Once the physical alignment of the PEMs was completed, the setting up procedure in the Photo-electronic Magnetometer manual (Seers and Black, 1984) was followed.

There were errors in the manual relating to polarities of the magnetic field components and to the directions of reflected light spot movement when scale value, set gain or orientation currents are applied to the helmholtz coils. This caused some confusion when the PEM set up procedure was first followed. There were also a few ambiguous sections in the manual and one of the crucial diagrams was missing.

Hardware faults in the system included some mild steel nuts and bolts being used in the Z PEM. The output pins of the circuit board of the Z PEM were connected in reverse at the plug J1 on the PEM casing. The three-component MCC-1 supplied only 1 minute scale value pulses instead of 2 minute pulses.

Despite these setbacks the PEMs were finally installed satisfactorily.

Setting up of the PPM Noise-cancelling Head:

The PPM was orientated on the F pier such that the axes of the detection coils are roughly perpendicular to the geomagnetic field vector. Note that the axes of the detection coils are perpendicular to the long axis of the cylindrical case.

Temperature Control:

It was decided to use 10°C as the standard temperature of the new variometer system. The building is heated in both instrument rooms by non-magnetic heaters mounted on the walls about 200 mm from the floor. The heaters both have thermostats. However a temperature controller built by BMR was used to control the heater in the PEM instrument room and maintain the room at 10°C.

2.4.3 DC Back-Up Power Supply

A 24 Volt DC power supply utilizing two lead acid batteries was installed in the magnetic variometer building to supply back-up power to the MCC-1 and the MNS2; see Figure 6. The MNS2 Hewlett-Packard (HP) power supply was used to charge the batteries.

When the back-up power system was installed it caused a lot of noise on the MNS2 outputs. Diodes were included in the circuit to isolate the HP power supply, MNS2 and the batteries. This solved the problem.

As the ventilation in the new magnetic variometer building is extremely poor two completely sealed Exide Safeguard 30 Amphour 12V batteries were used in preference to normal lead-acid batteries.

2.4.4 Data Acquisition System

The data acquisition system was located in Wombat and consisted of an Edas digital recorder utilizing magnetic cassette drive and also a W+W visual multichannel chart recorder.

The data were transmitted to the Edas and the W+W via an attenuation box which allowed attenuation settings of ÷1 or ÷10. The W+W and attenuation box settings, and the Edas settings and input module types and ranges are included in

Table 10.

2.4.5 Noise on the Data Signal Lines from the Variometer Building

Once the new variometer system was installed and operating the noise on the data lines was examined and an optimal earthing arrangement considered. Due to the lack of moisture in the soil good earths are a rarity at Mawson. The main switch board in the new variometer building is earthed back to the main power house (the Blue Box). An earth was taken from the main switch board in the variometer building to the crushing terminal box which terminates the data cable from Wombat. This was used to earth the shields of the data cable from Wombat and the cables from the MCC-1. Figure 7 depicts the layout of the variometer system and the earthing of the various data cables. The shield of the data cable between Wombat and the variometer building is not earthed at Wombat.

Taking an earth from the main switch board in the variometer building was actually unnecessary. The MCC-1 circuit board earth is connected to its chassis and mains earth via its mains power cable. The shields of all MCC-1 cables are connected to circuit board earth. Thus an earth could have been obtained at the crushing terminal box via the shield of the output data cable from the MCC-1. However, the earth from the main switch board was used because it was considered to be better than an earth via the MCC-1.

The noise on the Doric signal was unaffected by either the MNS2 or the PEMs and was seen to be about 0.2 V peak-to-peak.

The PEM signals were unaffected by the operation of the MNS2. At the termination box in the magnetic variometer hut the PEM signals displayed high frequency noise of about 0.08 V peak-to-peak. The Z PEM also exhibited 0.4 V peak-to-peak spikes at the chopper frequency of the LED superimposed on this. The Z PEM was using a new temperature compensating circuit board while the X and Y PEMs were using the older style circuit boards. This chopper frequency interference on the PEM output signal is a characteristic of the new circuit boards.

The PEM signals at the Wombat termination box exhibited a similar level of high frequency noise but with a 0.3 V peak-to-peak 50 Hz signal superimposed upon this.

The MNS2 (F100's and F10's) signals at the variometer building termination box displayed high frequency noise of about 0.1 V peak-to-peak whether the PEMs were off or on. At the Wombat termination box the MNS2 signals exhibited high frequency noise of about the same magnitude when the PEMs were off but 50 Hz 0.3 V peak-to-peak noise was superimposed upon this when the PEMs were operating. This made the MNS2 signal very similar to the PEM signals.

These noise levels were reported to H.Q. and the reply received indicated that they were quite acceptable. The PEMs have an output sensitivity of 10mV/nT and a resolution of better than 0.04 nT under ideal conditions (Seers and Black, 1984). In view of this, it is suggested that the noise on the data lines from the new variometer building be examined and hopefully decreased.

2.4.6 MNS2 Proton Precession Magnetometers

The MNS2/2 was installed in the new variometer hut in August and was operating while the PEMs were being installed. The MNS2 electronics were situated in the control room. The noise-cancelling head was installed on the F pier in the instrument room. The cycling rate was altered to 15 seconds per cycle. The temperature of the head was monitored by attaching the spare Doric (346901) sensor to the head. The temperature of the head was about 20° C when the room was kept at about 10°C. Although no calibrations were done the MNS2/2 appeared to be working well, giving the expected output on the W+W chart recorder until 23 November when it started giving spurious field values.

The PEM installations were completed and the new observatory operational before the problem with the MNS2/2 was considered. The IPS electronic engineer bench tested both the MNS2/1 and the MNS2/2. The MNS2/2 bench tested OK. The MNS2/1 had a track open circuit on the "most significant bit DV1" board. Once this was repaired the MNS2/1 was also OK. The two PPMs were both tried with cycling rates of 15 seconds per cycle and 60 seconds per cycle but spurious field values were still apparent. This problem was left with the incoming geophysicist.

During PEM installations the PPM MNS2/2 was operating. During the set up of the X PEM some interference was seen on the X PEM voltage output at the PEM circiut board. However this was not evident when all the instruments were operating and the output voltage lines were checked at the termination box in the control room of the variometer building.

2.5 Data from the New Magnetic Variometer System

The three-component PEM system was used to monitor the X, Y and Z components of the geomagnetic field from 12 December 1985 onwards. PEM data up to the end of February 1986 were analysed for this report. Several data losses were incurred during this period (Table 9).

2.5.1 X, Y and Z Baseline Value Control

Absolute observations were carried out with the same frequency and observing schedule as was used for the La Cour baseline value control. Scale value tests were made following each set of absolute observations. The constants for the scale value coils of the X, Y and Z variometers are listed in Table 6. The scale value calibration currents were checked once per month (Table 11). Preliminary and adopted scale values for the X, Y and Z PEMs are given in Table 12. Baseline values for the X, Y and Z PEMs are given in Table 13.

The scatter in the Z PEM baseline values was quite low when first operating (standard deviation was 3.6 nT). However on 08 January 1986, the light in the PEM room was inadverently turned on while the PEMs were operating. This did not affect the X and Y PEMs but caused the Z PEM to start oscillating on its agates. The Z PEM magnet vibrated itself to one side of its support. It had to be re-centered manually. This caused a Z baseline value shift as was expected, but also the scatter in the Z baseline values increased (the standard deviation increased to 13 nT). See Table 13.

On 30 January 1986, one of the new temperature compensating boards was installed in the PEM Z by the incoming geophysicist, Rodney Hutchinson. It was installed to measure -Z instead of +Z. This was corrected on 24 February 1986. For absolute observations done during this period the values of the Z ordinate from the Edas data were reflected about the zero values of the Edas (approximately 5000 counts). The Z PEM baseline values thus derived were very scattered (standard deviation = 23 nT).

Temperature coefficients for the X, Y and Z PEMs were determined by a least squares analysis of baseline value vs temperature data. See Table 12.

2.5.2 Temperature baseline and scale values

The temperature of the PEMs was monitored using a Doric temperature monitor. The sensor was mounted adjacent to the Y PEM. Before and after absolute observations the temperature of the Doric display was read. A least squares analysis of these observed temperatures vs the corresponding Edas counts was used to determine the temperature scale and baseline values. See Tables 12 and 13.

2.6 Preliminary Data

K-indices, preliminary baseline values, scale values and preliminary monthly mean values were transmitted monthly to BMR geomagnetism section, Canberra.

These data were derived from the La Cour variometer data until 12 December 1985, after that from the PEM data. K-indices were calculated from H and D indices from the La Cour data and X and Y indices from the PEM data.

Adopted scale values and observed baseline values are shown in Tables 7, 8, 12 and 13. Preliminary monthly mean geomagnetic field values and annual mean values are listed in Tables 14 and 15. Preliminary instrument corrections applied to these data are listed in Table 16. K-indices are listed in Table 14.

2.7 Instrument Comparisons

In January/February 1986 the QHM 300 was compared to the travelling standards QHM 172 and HTM 570704 and the Dec 630332 was compared to the travelling standard Dec 640505. The Askania circle 611665 was used with all instruments.

During the comparisons the Edas sampled at 10 second intervals (usually a 1 minute sampling interval). Six sets of each of the H and D comparisons were done. These results are tabulated in Table 17.

2.8 Rounds of Angles

Rounds of angles from Pier A in the Absolute Hut were carried out on 15 and 18 January, and 08 March 1986. The Askania circle 611665 was used to observe the relative azimuths of the three marks: 'BMR 1985/2', 'SOH' and 'Short Peg' (ref Crosthwaite, 1986).

The average angle between 'BMR 1985/2' and 'SOH' was 33° 11.1' which agrees with Peter Crosthwaite's azimuths. The average angle between 'SOH' and 'Short Peg' was 84° 20.1' (and the average angle between 'Short Peg' and 'BMR 1985/2' was 242° 28.8').

As these three marks are all so close to Pier A it is recommended that a mark be established on one of the islands in East Bay for future use.

CHAPTER 3: SEISMOLOGICAL OBSERVATORY

The Mawson seismic observatory consists of a four component seismograph system, (see Table 1 for details of seismograph locations):

Vertical seismometers

a Press-Ewing long-period seismometer
a Benioff short-period seismometer

Horizontal seismometers

two Benioff short-period seismometers

During the February 1985 changeover the two horizontal seismometers were installed in the Cosray vault where the two vertical seismometers were already operating. The data were collected on Geotech hot-pen helicorders located in the Science Building (Wombat).

See Table 18 for the seismograph parameters.

3.1 Operation

In June 1984 the Benioff short-period horizontal seismometers (SPE and SPN) were removed from the Old Seismic Vault (where they had been operating and recording on a Benioff three-drum photographic recorder) to the Cosray vault. The Press-Ewing long-period vertical (LPZ) and the Benioff short-period vertical (SPZ) seismometers were already operating in the Cosray vault. The vertical seismometer outputs were being recorded on Geotech hot-pen helicorders located in Wombat. During the February 1985 changeover the outgoing geophysicist, Peter Crosthwaite, and the author installed the horizontal seismometers in the Cosray vault (see Crosthwaite, 1986). To do this the SPZ seismometer was moved and the two horizontal seismometers were installed adjacent to the LPZ seismometer on the seismic platform, see Figure 8. Due to an oversight the spacings between the seismometers are somewhat less than the stated acceptable requirements (Press-Ewing manual). No interference was evident during 1985 but it is recommended that tests be done on the system to verify this.

The existing two Geotech helicorders in Wombat were converted to dual pen operation. The SPZ and SPE were recorded on one helicorder with a recording speed of 60 mm/min while the SPN and LPZ were recorded on the other helicorder with a recording speed of 30 mm/min. The nominal record duration was 12 hours. However one of the helicorders lasted less than 12 hours initially and just over 12 hours after its microswitch had been shifted. The lack of grace in these record changes caused some small record losses during 1985.

Thus on 02 September the helicorders were converted back to single pen operation (24 hour record duration) and only the SPZ and the LPZ data were recorded. This situation persisted until February 1986 when the incoming geophysicist Rodney Hutchinson, installed a third helicorder and all four components were again recorded.

Besides the shifting of the SPZ seismometer, few changes were made to the vertical seismograph system. The LPZ TAM-5 amplifier was left non-rackmounted as previous attemps to rackmount it adjacent to the SPZ TAM-5 amplifier had caused "cross-talk" between the SPZ and LPZ signals (see Crosthwaite, 1986). The active

50 Hz filter which was on the SPZ TAM-5 output was removed at the beginning of the year. No evidence of 50 Hz was seen on the SPZ signal during the year.

There was also a filter on the SPZ input signal to the AR320. This was removed (on 23 April) as it initially was not connected correctly and when connected correctly it did not improve the problems of radio frequency interference that were occuring. The frequency response of the filter was determined (see Figure 9) in case it should be required in the future.

During the worst blizzard of the year (21 June) the LPZ seismometer exhibited an extremely unstable output. The LPZ signal was disconnected from the AR320 input to stop the helicorder pen from self-destructing. After the blizzard had abated the signal was reconnected and the LPZ system behaved as normal. This was the only time such an event occured during the year. The reason for this is unknown but a bad connection or some other electrical problem seems the most probable cause.

Many modifications were made to the Wombat end of the seismic system to help reduce radio frequency interference. These will be described later. Also with the advent of the 1986 geophysicist the Wombat end of the seismic system was tidied up. New cable teminations were installed and the equipment in the rack was re-shuffled.

However the remote end of the seismic system (Cosray vault) is very messy. The rack containing the SPZ TAM-5 amplifier is inadequately documented. The non-rackmounted LPZ TAM-5 amplifier has no back-up power in case of mains power failure. The SP horizontals and the LPZ do not have calibration pulses. The cabling around the room is extremely messy. The short-period horizontal TAM-5 amplifiers are in a temporary rack built by Peter Crosthwaite (Crosthwaite, 1986). Thus it is recommended that the remote end of the seismic system be completely upgraded: the layout of the seismometers should be assessed, the pre-amplifiers should be adequately rackmounted, back-up power should be made reliable, calibration pulses should be available on all seismometers and the cabling should be tidied up and adequately shielded to inhibit any interference.

3.2 <u>Radio Frequency Interference</u>

Radio frequency interference was evident on the Mawson seismic records during 1985. Many simple modifications were done to the seismic system to overcome this problem. Interference from routine radio transmissions from VLV (Mawson Radio) was apparent, but the problem was greatly accentuated by the ham operators.

The following modifications were made to the seismic system in Wombat (refer to Figure 10):

1. Data inputs to AR320s: These were twisted pairs from the termination box of the data cable from Cosray to the inputs of the AR320s (pins 1 and 2). These were replaced by shielded two core cable. The shields of these cables were connected to the shield of the data cable from Cosray, to the pin 9's (commons) of the AR320 amplifier boards via a 0.01 microF capacitor and to the chassis of the AR320s.

2. Time mark inputs to AR320s from the relay driver: The twisted pairs were replaced by shielded two core cables. The shields were connected to the pin 9's (commons) of the AR320 amplifier boards via a 0.01 microF capacitor and

to the chassis. A 0.1 microF capacitor was put across all time mark outputs in the Relay Driver box. Cable shields were not connected at the Relay Driver box. However, the circuit board earth of the Relay Driver circuit is connected to the chassis of the Relay Driver box. This is connected to mains earth via the CRO.

3. A 0.1 microF capacitor was put across the 0V, 12V supply in the time mark Relay Driver.

4. A 1.0 microF capacitor was put between the 0V and the chassis of the clock currently in use (ref. no. N-1). There is a 0.1 microF capacitor between the 0V and 24V input to the clock in the original clock wiring.

5. 0.1 microF capacitors were put across the 0V, -12V and the 0V, +12V back-up power inputs to the AR320s, ie. across pins 4 and 5 and pins 3 and 4 of the power supply board of the AR320s. Internally there is a 4.7 microF capacitor between the 0V (circuit board earth or common) and the AR320 chassis.

6. A 0.1 microF capacitor was put across the output from the ac power changeover relay box which supplies 240Vac from the inverter or the mains to the helicorder.

The outputs from the AR320s to the helicorders are shielded two core cable; the shields were not connected at the AR320s or the helicorders.

The modifications to the system were completed in early July and removed almost all the interference from the seismographs.

3.3 Calibrations

The LPZ seismometer was calibrated in November 1985, see Table 19 and Figure 11. The seismometer mass used in the calibrations was 6.9 Kg (Press-Ewing manual). Since the weight lift point for the test masses does not correspond to the center-of-gravity of the mass/boom system of the seismometer, the distance of the center-of-gravity of the mass/boom system to the pivot and the distance of the weight lift point to the pivot must be known for accurate determination of the calibration coil motor constant, G. It is possible to make a rough measurement of the distance from the weight lift point to the pivot, but the distance of the center-of-gravity of the mass/boom system to the pivot is not accurately known. A value of 308 mm was used (Silberstein, 1984; Crosthwaite, 1986). This value is not mentioned in the Press-Ewing manual and is the value used for the long-period vertical seismometers in the Worldwide Standard Seismograph Network.

To obtain accurate LPZ calibrations an accurate determination of G needs to be made either by determining accurately the two distances mentioned above or by some other method.

The SPZ seismometer was calibrated in January 1986, see Table 20 and Figure 12.

The short-period horizontal seismometers were not calibrated during 1985.

3.4 Data

Seismological data were reported bi-weekly to the National Earthquake Information Service (NEIS) of the USGS at Denver, Colarado, via the Bureau of Meteorology's Global Telecommunication System (GTS) and to all other Antarctic geophysical stations.

CHAPTER 4: CONTROL EQUIPMENT

In 1985 the Time Mark Unit (TMU), the Power and Timing Unit (PPT-1) and the Timing Board were removed from operation. The Time Mark Relay Driver was installed. An Invertech (Serial No. 1781) inverter and a new voltage stalilizer were installed to supply frequency and voltage stabilized power to the helicorders. A changeover relay allows switching to mains power if the inverter fails. The dc power system was re-organised and a dc distribution board installed. Back-up dc power was supplied to the AR320 amplifiers.

4.1 Power Supplies

Station mains (240V ac) and two lead-acid battery systems supply power to the seismic system. The AR320 amplifiers are powered by station mains with -12V, 0, +12V dc back-up power. The helicorders run off an Invertech inverter (240V ac) with switching to station mains if the inverter fails. The inverter is powered by the -12V, 0, +12V battery system. The radio and SPZ calibrator are also powered by this -12V, 0, +12V battery system. The primary power to the GED clock is from station mains with the 0, 24V battery system supplying dc back-up power. The Time Mark Relay Driver which supplies time-marks from the clock to the AR320 amplifiers and the W+W chart recorder is powered from the clock (0, +12V). This was initially designed with a 0, 12V external power supply but was modfied to be powered from the clock (Figure 13).

Figure 10 illustrates the seismic system and the power supplies. If all the instruments were "floating" (circuit board earth not connected to mains earth) only one dc battery system would be required to supply the 0, 24V and -12V, 0, +12V power to the system. The inverter, AR320 amplifiers, clock and radio are all "floating". However in order to do time comparison between the clock and radio pips the respective time signals are displayed on the CRO via the Time Mark Relay Driver. This connects the 0V (circuit board earth) of the Time Mark Relay Driver to mains earth via the CRO; hence the 0V of the 0, +24V battery system to mains earth. As demonstrated by the incoming 1986 geophysicist it is easy to inadvertently earth the AR320 amplifiers (or any other component of the system). If only one dc battery system was in operation this would cause one of the 12V lead-acid batteries to be shorted out.

The seismometers in the cosray vault use station mains and a 12V dc power system.

The W+W chart recorder uses station mains. The Edas uses station mains as its primary power source and an internal battery on mains failure. However when this battery back-up system was checked in January 1986 it was found to be faulty, so was repaired and new batteries were installed.

The new variometer system (PEMs and MNS2) utilizes station mains power and a 24V dc back-up power system (see Section 2.4.3) located in the new magnetic variometer building.

4.2 Timing Control

4.2.1 Time Signals

A new Labtronics radio was installed at the beginning of 1985. The Ionospheric Prediction Service (IPS) supplied BMR with an antenna, initially from an aerial just north of Wombat and later from a "V" antenna located on IPS aerials to the east of the station.

Generally VNG (Lyndhurst, Victoria) was used to provide accurate time signals for comparison with the GED crystal oven clock. See Crosthwaite, 1986, Table 21 for available stations, frequency and propagation delays to Mawson.

4.2.2 GED Digital Crystal Oven Clock

A GED clock was used to provide time marks to the seismic and magnetic systems.

Two new GED clocks were brought from Canberra at the beginning of 1985. Both of these were installed and kept operating. This was to facilitate the introduction of the second clock to the system should the clock in use malfunction. Both clocks ran satisfactorily all year. The clock used to supply the time marks was kept to within the required accuracy of 50 ms.

Time comparison between the clock and radio pips was done by displaying both signals on a dual channel CRO (Crosthwaite, 1986).

The Time Mark Relay Driver (Figure 13) supplied a further amplifier stage to the GED clock time mark output and supplied time signals from the clock to the seismic system, the W+W chart recorder and the La Cour variometer.

4.3 Cables

With the advent of the new magnetic variometer system the cabling has become much simpler. The cables currently in use are:

1. A 10 twisted pair shielded cable from the new Magnetic Variometer Building to Wombat carrying magnetic information and control signals. The cable route is discussed in Section 2.3. This cable was laid in 1985 and has one join near the old Variometer Hut as it was laid in two pieces.

2. A 10 twisted pair shielded cable from the Cosray vault to Wombat carrying seismic information and control signals. This cable was laid in 1984 and has joins near the Pump House as it was damaged in 1984 and 1985.

3. The cable carrying 12V from the Cosrologist's office to the Cosray vault.

All the cable joins done in 1985 were soldered. This is much neater and more reliable than Scotchlock crimping connectors. Aluminium foil bound with wire was used to reconnect the cable shield. The completed joins were encased in two layers of heavy duty heat shrink tubing. Because of the low temperatures, it was necessary that all joins be done in a parially enclosed space - cold porch of Variometer Hut, ute cab or tent.

CHAPTER 5: BUILDINGS AND BUILDING MAINTENANCE

The buildings used in the operation of the BMR observatories are:

1) Magnetic Absolute Hut
2) Old Magnetic Variometer Hut
3) New Magnetic Variometer Building
4) Micropulsations Building (or Variometer Power Supply Building)
5) Old Seismic Vault
6) Cosray Building
7) Wombat (Science Building)

Only minimal maintenance was done to the buildings in 1985. The Old Variometer Hut is in poor condition and should be removed. The Absolute Hut is in fair condition considering its age (ex- Heard Island), and given the correct maintenance would last for several more years. The new Magnetic Variometer Building is excellent.

In 1985 a short-circuit in the station mains power cable between the Variometer Power Supply Building and the Old Variometer Hut became apparent. When the station electrician repaired the cable he bypassed the Variometer Power Supply Building so this building is of no further importance to BMR.

The Old Seismic Hut continued in its role as general store room and is very useful, providing a place for the storage of RTA crates and other bulky items which would be a nuisance in Wombat. It will require painting in the near furture.

The Cosray building houses all of the seismometers and a preamplifier/calibration rack deep in its mine shaft, and a 12V power supply in the office. Despite requests to the Antarctic Division carpentar a ceiling was not installed in the seismic vault in 1985 but would still be a good idea in the furture. A pump is also required to empty the sump in the shaft during the melt.

The Science Building or Wombat is externally in good condition. However, the interior could be re-painted and some of the furniture upgraded to make it a more comfortable working enviroment. Wombat was still not connected to site-services at the end of 1985.

CHAPTER 6: OTHER DUTIES

The author was sea-ice observer for 1985. This involved taking measurements of the depth of the sea-ice either weekly or monthly at various sample points in the Mawson area, and noting the formation and decay pattern of the ice. It also involved at times, reconnaissance of the sea-ice to judge its safety regarding travel and recreation.

The usual station duties were performed. This included one night per month nightwatch, a couple of weeks of full time kitchen duties and Saturday afternoon council duties (garbage disposal etc.). Volunteer cooking was also done to enable the full time cook to go on field trips.

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REFERENCES

Oldham, W.H., 1957 - Magnetic Work at Mawson Antarctica 1955/56.
Bureau of Mineral Resources, Australia, Record 1957/79.

Crosthwaite, Peter, 1986 - Mawson Geophysical Observatory Annual Report, 1984.
Bureau of Mineral Resources, Australia, Record 1986/12.

Cechet R.P., 1984 - Mawson Geophysical Observatory Annual Report, 1983.
Bureau of Mineral Resources, Australia, Record 1984/36.

Silberstein, R.P., 1984 - Mawson Geophysical Observatory Annual Report, 1982.
Bureau of Mineral Resources, Australia, Record 1984/35.

Wienert, K.A., 1970 - Notes on geomagnetic observatory and survey practice.
UNESCO 1970.

Seers, K.J. and Black G.W., 1984 - Handbooks for MPE-1 Photo-electronic Magnetometer (Horizontal), MPE-2 Photo-electronic Magnetometer (Vertical) and MCC-1 Magnetic Controller (2nd Edition).
Bureau of Mineral Resources, Australia, Record (not published).

Instrument Manual for the Model SV-282 Press-Ewing Vertical Seismometer.
United ElectroDynamics, Inc.

QHM The Quartz Horizontal-Force Magnetometer. User's Manual.
Danish Meteorological Institute, DK-2100 Copenhagen February 1978.

McGregor, P.M., 1967 - Notes on the Use of the QHM Magnetometer in the Measurement of Horizontal Intensity and Declination.
Bureau of Mineral Resources, Australia, Record 1967/140.

APPENDIX A: HISTORY OF INSTRUMENTATION UP TO 1985

A brief summary of the developement of Mawson Geophysical Observatory in terms of instrumentation until 1985 is presented below.

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.
Aug 1982	:	La Cour sensitive magnetograph removed (Silberstein, 1984).
Jul 1983	:	Photo-electronic magnetometer (PEM) X and Y components installed (Cechet, 1984).
Jul 1983	:	MNS2/1 proton precession magnetometer ceased operation (Cechet, 1984).
May 1984	:	Digital recording of PEM X and Y component data began (Crosthwaite, 1986).
Mar 1985	:	QHM 300 thermometer 2143 replaced by thermometer 1650. Residual torsion of QHM 300 also changed. Total instrument correction change to QHM 300 was -4.3 nT (Kelsey, in prep.).
Dec 1985	:	La Cour normal magnetograph ceased operation. X, Y and Z PEMs commenced operation (Kelsey, in prep.).

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 galvanomters replaced by short-period (0.2 s) galvanometers (Robertson, 1972).
Dec 1973	:	Z seismometer transferred to vault beneath Cosray building (Almond, 1975).
Apr 1977	:	Transfer of Geophysics office, including power and timing to Wombat (Science Building).
1978	:	Recording of SP-N Benioff seismometer discontinued (Petkovic, not published).
Jul 1981	:	Helicorder hot-pen recorder installed for SP-Z and LP-Z; and SP-N Benioff restored.
Aug 1983	:	Four Teledyne-Geotech seismic amplifiers (AR320) installed for connection to twin hot pen recorders (Cechet, 1984).
May 1984	:	Horizontal seismometers and the Benioff photographic recorder disconnected (Crosthwaite, 1986).
Feb 1985	:	Horizontal seismometers installed in Cosray vault; output to visual hot pen recorders in Wombat (Crosthwaite, 1986; Kelsey, in prep.).

APPENDIX B: QHM CALCULATIONS

All QHM observations (preliminary and final) done with the La Cour variometer operational (01 February - 12 December 1985) were calculated using the following formula (QHM User's Manual). Residual torsion corrections were not included (McGregor, 1967; Crosthwaite, 1986 (Appendix D)). Residual torsion corrections for QHMs used at Mawson in 1985 are listed in Table 3.

$$\log H = C + \log n - \log \sin(phi) + c1.t - c2.H.\cos(phi)$$

where H = horizontal field strength
C = main QHM constant
n = number of whole turns of the QHM from the zero position
phi = mean deflection angle
c1 = temperature coefficient
t = mean value of temperature in the two deflected positions
c2 = induction coefficient

Preliminary calculations of the routine QHM observations done in conjunction with the PEMs and the H instrument comparisons done in January/February 1986 were calculated on a HP15C desk calculator using the following formula which includes the residual torsion correction:

$$\log H = C + \log n - \log \sin(phi) + c1.t - c2.H.\cos(phi) - \log \cos(b)$$

where b = a + (phi+ - phi-)/2
a = deviation due to residual torsion
phi+ = deflection angle when n positive
phi- = deflection angle when n negative

All these routine QHM calculations (12 December onwards) were later recalculated on BMR's HP1000 computer using the formula (which includes the residual torsion correction):

$$H = K.n / (1-k1.t).(1+k2.H.\cos(phi)).\sin(phi).\cos(b)$$

where K = main QHM constant
k1 = temperature coefficient
k2 = induction coefficient

The QHM coefficients are given below :

	C	c1(x10E-5)	c2(x10E-10)
QHM 300	4.19467	17.1	30
QHM 301	4.21644	17.4	40
QHM 302	4.18696	18.4	40
QHM 172	4.20077	17.0	20
HTM 704	4.081045	11.3	

	K	k1(x10E-4)	k2(x10E-9)
QHM 300	15655.61	3.94	6.91

APPENDIX C: DAVIS ABSOLUTE INSTRUMENT COMPARISONS

During a stop-over visit at Davis in February 1985 instrument comparisons were done between the QHM 492, used to measure H and D and the travelling standards. A BMZ tripod was used as a temporary pier south of the absolute hut and simultaneous observations were made with the help of Pelham Williams.

One set of simultaneous H comparisons was done. The QHM 492 (circle 73) was compared with QHM 172 (circle 508813). The observing schedule was:

Set	Absolute hut pier	BMZ tripod
H1	QHM 172	QHM 492
	QHM 492	QHM 172

This gave an instrument difference, QHM 172 - QHM 492 of 23 nT (0.00138H). The station difference (Pier - Tripod) was -29 nT (0.00174H) (see Table 21). The QHM calculations were done using a HP 15C calculator and include the correction for residual torsion. Residual torsion corrections for all the QHM 492 H and D observations are listed in Table 22.

Two sets of simultaneous D observations were done. QHM 492 (circle 73) was compared with Dec 640505 (circle 508813). The observing schedule was:

Set	Absolute hut pier	BMZ tripod
D1	Dec 505	QHM 492
	QHM 492	Dec 505
D2	QHM 492	Dec 505
	Dec 505	QHM 492

The calculations of the QHM declination observations allowed for the residual torsion of the QHM fibre and the collimation angle of the magnet/mirror assembly (McGregor, 1967). Thus complete QHM 492 observations were made in order to measure the residual torsion (Table 22). The collimation angle was taken to be -8'.

The two sets of D observations did not produce consistent results. Since the QHM 492 exhibited a residual torsion of 1° 15.9' (equivalent to a correction of 5.2 nT to observed H value) in the first set of D comparisons, the instrument and pier differences were calculated from the second set only. The instrument difference, Dec 505 - QHM 492 was 1.1' East; and the station difference, Pier - Tripod was 13.0' East (Table 21).

The QHM observations took approximately 20 minutes as it was difficult to get sufficient light into the QHMs when operating them on the BMZ tripod outside.

Comparisons of the Davis BMZ 115 with QHM 172 and Geometrics 1024 PPM were also made. However, the PPM gave incorrect F readings (probably tuned to the wrong setting) so these observations were unusable.

1 STATION DATA FOR MAWSON 1985

Magnetic Absolute Hut - Pier A (instrument level)

Geographic co-ordinates	67°36'14.2"S	62°52'45.4"E
Geomagnetic co-ordinates	73.34°S	105.89°E (from DGRF 1980.0)
Elevation (m)	12	
Foundation	Precambrian Granite	

Magnetic Variometer Building - NEW, Mark N1

Geographic co-ordinates	67°36'11.4"S	62°52'38.5"E
Elevation (m)	09	
Foundation	Precambrian Granite	

Magnetic Variometer Building - OLD

Geographic co-ordinates	67°36'13.0"S	62°52'38.5"E
Foundation	Precambrian Granite	

Cosray Building, Seismometer platform

Geographic co-ordinates	67°36'16.6"S	62°52'16.6"E
Elevation (m)	17	
Foundation	Precambrian Granite	

The co-ordinates of Pier A, Mark N1 and the Cosray building seismometer platform were measured by Crosthwaite in 1984 using ISTS 51 as a reference location. This reference is a satellite trig station positioned by the road near the Old Seismic Vault and the Bureau of Meteorology buildings. Its location is 67°36'04.95"S 62°52'23.66"E, its height above mean sea level is 9.79m, and its spheroidal height is 39.37m.

The co-ordinates of all buildings were measured by Australian Survey Office surveyors, and the WGS 72 co-ordinates provided by ASO agree within 0.2" of latitude and longitude with the instrument pier co-ordinates measured by Crosthwaite.

Elevations quoted are Height Above Mean Sea Level. The elevations of Pier A, Mark N1 and the top of the Cosray shaft were measured relative to ISTS 51. The quoted elevation of the seismometer platform assumes the shaft to be 13m deep.

2 MAGNETIC VARIOMETERS USED AT MAWSON DURING 1985

Magnetometer Component	Location	Dates Operated	Comments
La Cour			
H	old hut	Feb 01 0000UT - Dec 12 0600UT	De-commissioned and RTA'd
D	old hut	Feb 01 0000UT - Dec 12 0600UT	De-commissioned and RTA'd
Z	old hut	Feb 01 0000UT - Nov 29 0400UT	Z magnet removed for installation in the 3 component PEM system
PEM (2 Component)			
X	old hut	Feb 01 0000UT - Jun 24 1417UT	Removed for re-installation in the new hut
Y	old hut	Feb 01 0000UT - Jun 24 1417UT	Removed for re-installation in the new hut
PEM (3 Component)			
X	new hut	Dec 12 0500UT onwards	
Y	new hut	Dec 12 0500UT onwards	
Z	new hut	Dec 12 0500UT onwards	

3 QHM RESIDUAL TORSION CORRECTIONS AT MAWSON, 1985

Instrument	phi (°)	phi (') difference	derived (') alpha	residual torsion (nT) correction	
QHM 300					
until Mar 19	58.44	- 6.6	- 3.7	0.0	
Mar 19 onward	58.36	22.5	12.4	0.4	
QHM 301	63.53	-42.4	-17.0	1.1	significant
QHM 302	56.69	-12.4	- 7.5	0.1	
QHM 172	59.62	14.1	7.2	0.2	
HTM 704	40.92	0.1	0.1	0.0	

4 QHM INSTRUMENT DIFFERENCES

1. QHM instrument differences assuming no change in QHM 300 instrument correction:

Date	QHM 300 - QHM 301 (nT)	QHM 300 - QHM 302 (nT)	No of observations QHM 300	301,302
1985				
Feb 01 - Feb 10	0.1	-5.1	6	1
Feb 10 - Mar 18	1.0	-3.4	5	1
Mar 19 - May 12	0.4	-4.8	12	1
May 13 Nov 29	5.8	1.2	42	8
WEIGHTED MEAN:	4.4	-0.3		
RANGE:	5.7	6.3		

2. QHM instrument differences assuming a QHM 300 instrument correction change of -4.3 nT on 19 March 1985:

Date	QHM 300 - QHM 301 (nT)	QHM 300 - QHM 302 (nT)	No of observations QHM 300	301,302
1985				
Feb 01 - Feb 10	0.1	-5.1	6	1
Feb 10 - May 12	-1.4	-6.3	17	2
May 13 - Nov 29	1.5	-3.1	42	8
WEIGHTED MEAN:	0.8	-3.9		
RANGE:	2.9	3.2		

3. QHM differences from 1984, 1983 and 1982:

Year	QHM 300 - QHM 301 (nT)	QHM 300 - QHM 302 (nT)	Comments
1984	1.7 +/- 0.6	-5.4 +/- 0.5	From La Cour data
	1.7 +/- 1.6	-4.7 +/- 1.8	From PEM data
1983	1.6	-5.4	
1982	2.5	-2.7	

5 SUMMARY OF QHM COMPARISONS FOR 1983 - 1986

Date	Observer	HTM 704 - QHM 300 (nT)	QHM 172 - QHM 300 (nT)
Feb/Mar 1983	Silberstein	-5	43
Feb 1984	Crosthwaite	-6.2	
Feb 1985	Crosthwaite	-3.9	40.9
Feb 1986	Kelsey	-9.4	41.0

6 SCALE VALUE AND ORIENTATION COIL CONSTANTS, 1985

Component	Scale Value Constant nT/mA	Orientation Constant nT/mA
La Cour Magnetometers		
H	8.07	8.07
D	8.07	8.07
Z	7.49	-
Photo-Electronic Magnetometers		
X	8.03	8.03
Y	8.03	8.03
Z	8.03	8.03

7 LA COUR MAGNETOGRAPH PARAMETERS, 1985

Component	Preliminary Scale Value	Preliminary Temperature Coefficient	Adopted Scale Value	Adopted Temperature Coefficient
H	21.3 nT/mm	+0.8 nT/°C	21.03 +/-0.26 nT/mm	+0.6 nT/°C
D	2.44 '/mm	-	2.42 +/-0.02 '/mm	-
Z	22.8 nT/mm	-1.0 nT/°C	23.33 +/-0.07 nT/mm	0.0 nT/°C
Tz	1.73 °C/mm	-	1.76 °C/mm	-
Th	2.48 °C/mm	-	2.46 °C/mm	

8 OBSERVED BASELINE VALUES FOR LA COUR MAGNETOGRAPH, 1985

Date	Baseline Values (BLV)		No of absolute observations used to determine BLV	Remarks
Horizontal Intensity (nT)				
1985				
Feb 01 00UT - Feb 10 03UT				
	17406	+/- 2	6	QHM 300
	17406		1	QHM 301
	17411		1	QHM 302
Feb 10 03UT - Mar 19 00UT				new observer
	17417	+/- 4	5	QHM 300
Mar 19 00UT - May 13 00UT				*
	17421	+/- 3	12	QHM 300
Feb 10 03UT - May 13 00UT				new observer
	17418	+/- 4	2	QHM 301
	17423	+/- 4	2	QHM 302
May 13 00UT - Nov 29 04UT				drift
	17426	+/- 2	42	QHM 300
	17420	+/- 3	8	QHM 301
	17424	+/- 5	8	QHM 302
Nov 29 04UT - Dec 12 06UT				Z magnet removed
	17406	+/- 2	22	QHM 300
Declination				
1985				
Feb 01 00UT - May 13 00UT	-61° 40.4'	+/-0.6'	48	**
May 13 00UT - Nov 29 04UT	-61° 39.9'	+/-0.6'	102	drift
Nov 29 04UT - Dec 12 06UT	-61° 40.7'	+/-0.4'	19	Z magnet removed
Vertical Intensity from PPM G816/1024 Observations (nT)				
1985				
Feb 01 00UT - Jul 01 00UT	-46182	+/- 5	55	new PPM
Jul 01 00UT - Nov 29 04UT	-46186	+/- 4	37	drift
Vertical Intensity from BMZ 62 Observations (nT)				
1985				
Feb 01 00UT - Nov 29 04UT	-46161	+/- 10	22	

Temperature - Vertical Thermograph (°C)

1985			
Feb 01 00UT - Feb 25 00UT	-103.5 +/- 0.2	24	
Feb 25 00UT - Apr 30 00UT	-103.7 +/- 0.2	64	drift
Apr 30 00UT - Jun 07 00UT	-104.0 +/- 0.2	38	drift
Jun 07 00UT - Nov 29 04UT	-103.6 +/- 0.2	175	drift

Temperature - Horizontal Thermograph (°C)

1985			
Feb 01 00UT - Oct 28 00UT	- 37.39 +/-0.04	269	
Oct 28 00UT - Dec 12 06UT	- 36.91 +/-0.06	46	drift

* The H BLV determined from QHM 300 observations changed on 19 March 1985 due to an instrument correction change to QHM 300. This change was estimated to be -4.3 nT from this BLV shift.

** Even though there was a new observer doing the absolute observations from 10 February 1985, the D BLVs matched exactly once Peter Crosthwaite's were corrected by +1.2' West (see Crosthwaite, 1986).

9 DATA LOSSES FOR PEMS DURING DECEMBER 1985, JANUARY AND FEBRUARY 1986

PEMs commenced operating on 12 December 1985 0500UT.

Period of Data Loss	Reason
1985	
Dec 22 1020 UT - 1444 UT	Fixing MCC-1
Dec 24 0900 UT - 1000 UT	Working in new magnetic variometer building control room - ferrous interference
1985 1986	
Dec 28 0200 UT - Jan 03 1200 UT	DHC installing steps outside magnetic variometer building - ferrous interference
1985	
Dec 30 0330 UT - Dec 31 0500 UT	DHC inspecting interior of building
1986 1986	
Jan 06 0427 UT - Jan 08 1413 UT	DHC doing remedial work to the magnetic variometer building
Jan 30 0219 UT - 1058 UT	Installation of new PEM Z circuit board and official handover of magnetic variometer building
Feb 04 2019 UT - Feb 05 1129 UT	Drive spring in Edas broken
Feb 11 0332 UT - 1703 UT	Rod re-arranging instrument racks in Wombat
Feb 24 0358 UT - Feb 24 0614 UT	Corrected polarity of PEM Z

10 EDAS, W+W AND ATTENUATION BOX SETTINGS

December 1985, January and February 1986

Edas and W+W Channel	Component	Sensor	Attenuation Box Setting	W+W Settings	Edas Input Module Type	Edas Input Module Range
1	X	PEM	÷10	2 VFS	2	+/-10V
2	Y	PEM	÷10	2 VFS	2	+/-10V
3	Z	PEM	÷10	2 VFS	2	+/-10V
4	F(0-990)	MNS2	÷10 *	2 VFS	1	0-20V
5	F(0-99)	MNS2	÷10 *	2 VFS	1	0-20V
6	T	Doric	÷1	2,10 VFS **	2	+/-10V

* This was 1 on some records.
** W+W setting was changed from 2 VFS to 10 VFS on 31 January 1986 0805UT.

11 PEM CALIBRATION CURRENTS

MCC-1 Setting	Positive Current	Negative Current
4 mA	4.1 mA	- 4.1 mA
8 mA	8.0 mA	- 8.0 mA
20 mA	19.8 mA	-19.7 mA
40 mA	39.8 mA	-39.6 mA
80 mA	79.6 mA	-77.8 mA

December 1985, January and February 1986

Component		Preliminary Scale Value		Preliminary Temperature Coefficient	
		Edas nT/count	W+W nT/mm	nT/°C	
	1985				
X	December	0.1968	8.88	3.1	
	1986				
	January	0.1986	8.74	3.1	
	February	0.1986	8.65	3.1	
	1985				
Y	December	0.2065	8.88	- 8.0	
	1986				
	January	0.1990	8.78	- 8.0	
	February	0.1990	8.71	- 8.0	
	1985				
Z	December	0.2	8.92	-14.05	
	1986				
	January	0.1950	8.72	-14.05	
	February	0.1950	8.67	- 5.54	*
		°C/count	°C/mm		
	1985				
T	December	-	0.0736	-	
	1986				
	January	0.0205	0.065 **	-	
	February	0.0205	0.3738	-	

Component	Adopted Scale value		Adopted Temperature Coefficient
	Edas nT/count	W+W nT/mm	nT/°C
X	0.198 +/-.003	8.68	2.45
Y	0.198 +/-.002	8.74	- 6.35
Z	0.194 +/-.003	8.70	-12.94 until Jan 30 0219UT - 7.17 after Jan 30 1058UT *
	°C/count	°C/mm	
T	0.0206	0.07 until Jan 31 0805UT	-
		0.37 after Jan 31 0805UT **	-

* New PEM Z circuit board installed on 30 January 1986.
** W+W temperature channel setting changed from 2 VFS to 10 VFS on 31 January 1986 0805UT.

13 OBSERVED BASELINE VALUES FOR PEMS AND DORIC THERMOGRAPH

December 1985, January and February 1986

Component Date	Baseline Value at 10 C		Number of Values	Remarks
X (True North)	nT			
1985 1986				
Dec 12 0500UT - Mar 01 0000UT	8187	+/- 3	29	
Y (True East)	nT			
1985 1986				
Dec 12 0500UT - Mar 01 0000UT	-16508	+/- 6	30	
Z (Down)	nT			
1985 1986				
Dec 12 0500UT - Jan 06 0427UT	-46357	+/- 4	7	
1986				
Jan 08 1413UT - Jan 30 0219UT	-46405	+/- 13	7	PEM disturbed
Jan 30 1058UT - Feb 24 0358UT	-46273	+/- 23	14	PEM circuit board replaced
Feb 24 0614UT - Mar 01 0000UT	-46273	+/- 23	*	Corrected polarity of circuit board
T	°C			
1985 1986				
Dec 12 0500UT - Mar 01 0000UT	-0.5	+/- 0.1		

* No absolute observations were done in this period, but as only the polarity of the Z PEM board was changed the baseline value should have remained the same.

14 PRELIMINARY MEAN MONTHLY AND K-INDEX VALUES 1985/6

	H nT	D ° '	Z nT	F nT	K-INDEX av.	median	max	
1985 (Crosthwaite)								
January	18466	-63 35.0	-46368	49910	3.8	3	7	
February	18452	-63 38.4	-46372	49908	3.8	4	7	
1985 (Kelsey)								
March	18456	-63 38.6	-46367	49905	3.2	3	7	
April	18450	-63 40.1	-46362	49898	3.8	3	8	
May	18439	-63 39.9	-46352	49885	3.0	3	8	
June	18457	-63 40.0	-46339	49879	3.3	3	8	
July	18457	-63 40.6	-46336	49877	3.9	4	8	
August	18447	-63 41.6	-46339	49875	3.7	4	8	
September	18460	-63 41.9	-46331	49873	3.5	3	7	
October	18461	-63 42.7	-46319	49862	3.7	4	8	
November	18466	-63 42.7	-46317	49863	3.7	4	7	
	X	Y	Z	F				
December	8188	-16562	-46312	49861	3.6	3	7	
1986								
January	8166	-16549	-46268	49812	3.5	3	7	*
February	8156	-16567	-46319	49864	4.1	4	9	*

H and D values derived from PEM X and Y values:

	H	D
1985		
December	18475	-63 41.6
1986		
January	18454	-63 44.2 *
February	18466	-63 47.3 *

	H	D	Z	F	K av.
Mean 1985 (Jan-Dec)	18457	-63 40.3	-46343	49883	3.6

Note:

1. A preliminary magnetometer correction of -5 nT has been applied to H. No corrections have been applied to Z even though this correction of -5 nT to H contributes to a correction of -2 nT to Z.

2. No corrections have been applied to the X, Y, Z and F data.

3. F is derived from the H and Z values (or the X, Y and Z values).

4. * Rodney Hutchinson's calculations.

15 PRELIMINARY GEOMAGNETIC ANNUAL MEAN VALUES, 1975 - 1985

YEAR		D °	'	I °	'	H nT	X nT	Y nT	Z nT	F nT
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
1982		-63	21.2	-68	25.5	18433	8267	-16475	-46616	50128
1983		-63	26.6	-68	22.3	18439	8245	-16493	-46503	50025
1984		-63	33.1	-68	19.2	18446	8216	-16515	-46398	49930
1985	**	-63	40.3	-68	17.1	18457	8186	-16542	-46345	49885

Mean annual changes

	D	I	H	X	Y	Z	F
1975-1985	-6.9	2.7	6.0	-30.2	-22.1	92.4	-83.8
1975-1980	-6.9	2.8	7.0	-29.6	-23.0	97.0	-87.8
1980-1985	-6.9	2.5	5.0	-30.8	-21.2	87.8	-79.8

** 1985 results have a Z correction of -2 nT applied to the annual average as the preliminary means did not apply a correction to Z. This correction is applied nowhere else in this record.

16 PRELIMINARY INSTRUMENT CORRECTIONS, 1985

Instrument	Correction at H = 18457 nT	Correction
QHM 300	- 5 nT	- 0.000271 H
Askania Dec 630332	0 min	-
BMZ 62	-	-
PPM G816/1024	0 nT	-

17 INTERCOMPARISONS OF MAGNETOMETERS, MAWSON 1985/6

31 January, 01, 04 and 05 February 1986

Instrument A	Instrument B	Difference (A-B) at H = 18500 nT
HTM 570704	QHM 300	-9 +/- 2 nT = -0.00051H
QHM 172	QHM 300	41 +/- 2 nT = -0.00222H
Dec 640506	Dec 630332)	0.3 +/- 0.2 ' East
Cir 611665	Cir 611665)	

Circle 611665 was used with all the instruments.

The QHM calculations include the residual torsion correction. The values of the residual torsion (alpha) for these observations were:

HTM 570704	0.1' +/- 1.2'	
QHM 172	7.2' +/- 4.3'	*
QHM 300	12.4' +/- 0.5'	

*These values decreased in a linear manner from 12.9' to 2.6' during the comparisons.

Values are given with no instrument corrections applied. PEM/Edas data were used to calculate delta-H and delta-D to reduce all H and D comparisons to a common time for each set. Six sets of H comparisons (HTM704, QHM172, QHM300, QHM300, QHM172, HTM704) and six sets of D comparisons (640505, 630332, 630332, 640505) were made.

Through routine baseline value determinations from March 19 1985 to November 29 1985 using reductions from La Cour magnetograms:

QHM 300 - QHM 301 = 4.6 nT
QHM 300 - QHM 301 = -0.1 nT

The above calculations do not include residual torsion corrections and the QHM 300 baseline value is not corrected by -4.3 nT (see Section 2.1)

As a quality check on observer performance, variometer sensitivity and absolute instrument reliability one may note the following observation scatters:

Instrument	Difference between observations in the SAME set	
	Average	Maximum
HTM 570704	2.5 nT	4.1 nT
QHM 172	1.0 nT	3.2 nT
QHM 300	0.5 nT	1.5 nT
Dec 640505	0.3 '	0.7 '
Dec 630332	0.2 '	0.2 '

Component	SP-Z	SP-NS	SP-EW	LP-Z
Seismometer				
Type	Benioff SN 55	Benioff SN 58	Benioff SN 61	Press-Ewing Model SV-282 SN 11
Free Period (s)	1.0	1.0	1.0	12.8
Mass (Kg)	107.5	107.5	107.5	6.9
Coil Resistance	1000 ohms	1000 ohms	1000 ohms	500 ohms ++
Damping Resistance	387 ohms	820 ohms	820 ohms	5120 ohms
Power Supply	PP2	PP2	PP2	ad hoc
Preamplifier				
Type	TAM5	TAM5	TAM5	TAM5
Gain/Attenuator settings	(gain - attenuation recorded on seismogram)			
Bandpass filter	.1-10 Hz	.1-10 Hz	.1-10 Hz	.01-20 Hz
Recorder Amplifier				
Type	Geotech	Geotech	Geotech	Geotech
Model	AR320	AR320	AR320	AR320
Attenuator setting	(recorded on seismograms)			
Recorder				
Type	Geotech	Geotech	Geotech	Geotech
Model	RV-301	RV-301	RV-301	RV-301
Chart rate	60 mm/min	30 mm/min	60 mm/min	30 mm/min
Calibrator				
Motor constant	1.38 N/A	not measured	not measured	0.17 N/A
Coil resistance	(247 ohm)	(249 ohm)	(258 ohm)	(3.3 ohm)
System				
Polarity	Up-Up	North-Up	East-Up	Up-Up

++ The coil values are nominal only. The actual values are slightly less than the nominal values.
Bracketted values are taken from previous reports.

19 LPZ SEISMOGRAPH CALIBRATION, NOVEMBER 1985

Period (secs)	Magnification
1.00	1630
2.00	1030
3.00	1040
4.00	776
5.00	622
5.78	469
6.00	454
7.00	420
8.00	406
9.00	387
10.0	396
11.0	322
12.0	248
13.0	190
14.0	145
15.0	119
16.0	93.6
17.0	76.4
18.0	65.9
19.0	53.8
20.0	42.9
25.0	20.8
30.0	10.1
40.0	4.77
50.0	2.21

Magnifications are given at TAM5 set to		72dB gain
		-24dB attenuation
		0.01-20Hz passband
	AR320	-30dB attenuation
Seismometer free period		12.8 secs
Damping resistor		5120 ohm

Sine wave tests		currents used: 3.7 - 3.9 mA (approx p-p value)
Weight lift tests	0.532 mm/mg	masses used : 31mg, 62mg
Current pulse tests	8.11 mm/mA	currents used: 4.3 - 4.5 mA
Motor constant, G	0.17 N/A	

The seismometer mass used in the calculations was 6.9 Kg. The distance of the center-of-gravity of the mass/boom system from the pivot was taken to be 308 mm (Silberstein 1984). The distance of the weight lift point to the pivot was measured to and was 357 mm.

See Cechet (1984) for Magnification Conversion Tables for TAM5 and AR320.

Period (sec)	Magnification
0.157	2.41 x 1000
0.209	5.85
0.260	10.2
0.308	15.6
0.407	27.4
0.526	37.9
0.613	44.8
0.722	49.0
0.824	47.4
0.947	40.1
1.02	33.9
1.13	25.5
1.22	20.5
1.33	15.7
1.54	9.95
1.96	4.57
2.07	3.98
3.04	1.20
4.12	0.479
5.16	0.244

Magnifications are given at TAM5 set to 96dB gain
-12dB attenuation
0.1-10Hz passband
AR320 -24dB
Seismometer free period 0.98 sec
Damping resistor 387 ohm
Sine wave tests currents used: 4.7 - 5.0 mA (approx p-p value)
Weight lift tests 0.031 mm/mg masses used : 100mg, 200mg, 500mg
Current pulse tests 4.40 mm/mA currents used: 5.3 mA, 5.6 mA
Motor constant, G 1.38 N/A

Magnification Conversion Tables :

TAM5

Attenuation	0 dB	-6 dB	-12 dB	-18 dB
0 dB	1	0.508	0.254	0.125
-6 dB	1.97	1	0.500	0.247
-12 dB	3.94	2.00	1	0.494
-18 dB	7.96	4.04	2.02	1

AR320

Attenuation	-6 dB	-12 dB	-18 dB	-24 dB	-30 dB	-36 dB
-6 dB	1	0.474	0.237	0.119	0.058	0.028
-12 dB	2.11	1	0.500	0.250	0.123	0.059
-18 dB	4.22	2.00	1	0.501	0.245	0.118
-24 dB	8.42	3.99	2.00	1	0.490	0.236
-30 dB	17.2	8.16	4.08	2.04	1	0.481
-36 dB	35.8	17.0	8.49	4.25	2.08	1

21 DAVIS INSTRUMENT COMPARISONS, FEBRUARY 1985

H COMPARISONS

QHM 492 (Circle 73) compared with QHM 172 (Circle 508813).

Set	Absolute hut pier Instrument	H	BMZ Tripod Instrument	H
H1	QHM 172	16645.8nT	QHM 492	16650.8nT
	QHM 492	16642.1nT	QHM 172	16694.5nT

Station difference : Pier - Tripod = -29nT (0.00174H)
Instrument difference : QHM 172 - QHM 492 = 23nT (0.00138H)

D COMPARISONS

QHM 492 (Circle 73) compared with Dec 640505 (Circle 508813).

Set	Absolute hut pier Instrument	D(West)	BMZ Tripod Instrument	D(West)
D1	Dec 505	76° 45.5’	QHM 492	75° 48.2’
	QHM 492	76° 40.9’	Dec 505	77° 02.0’
D2	QHM 492	76° 52.1’	Dec 505	77° 03.9’
	Dec 505	76° 49.9’	QHM 492	77° 04.0’

Station difference : Pier - Tripod = 13.0’ East
Instrument difference : Dec 505 - QHM 492 = 1.1’ East

22 QHM 492 RESIDUAL TORSION CORRECTIONS, DAVIS FEBRUARY 1985

Set	Date/ Time	phi(°)	phi (’) difference	derived (’) alpha	residual torsion correction (nT)
	02 Feb 1985				
H1	09 56.4	27.44	4.4	17.3	0.9
	10 35.5	27.50	-9.0	-35.3	1.1
	03 Feb 1985				
D1	02 18.5	27.52	-19.4	-75.9	5.2
	03 01.7	27.50	-2.0	-7.8	0.1
D2	03 25.5	27.51	-0.1	-0.5	0.0
	03 52.0	27.38	-0.6	-2.5	0.0

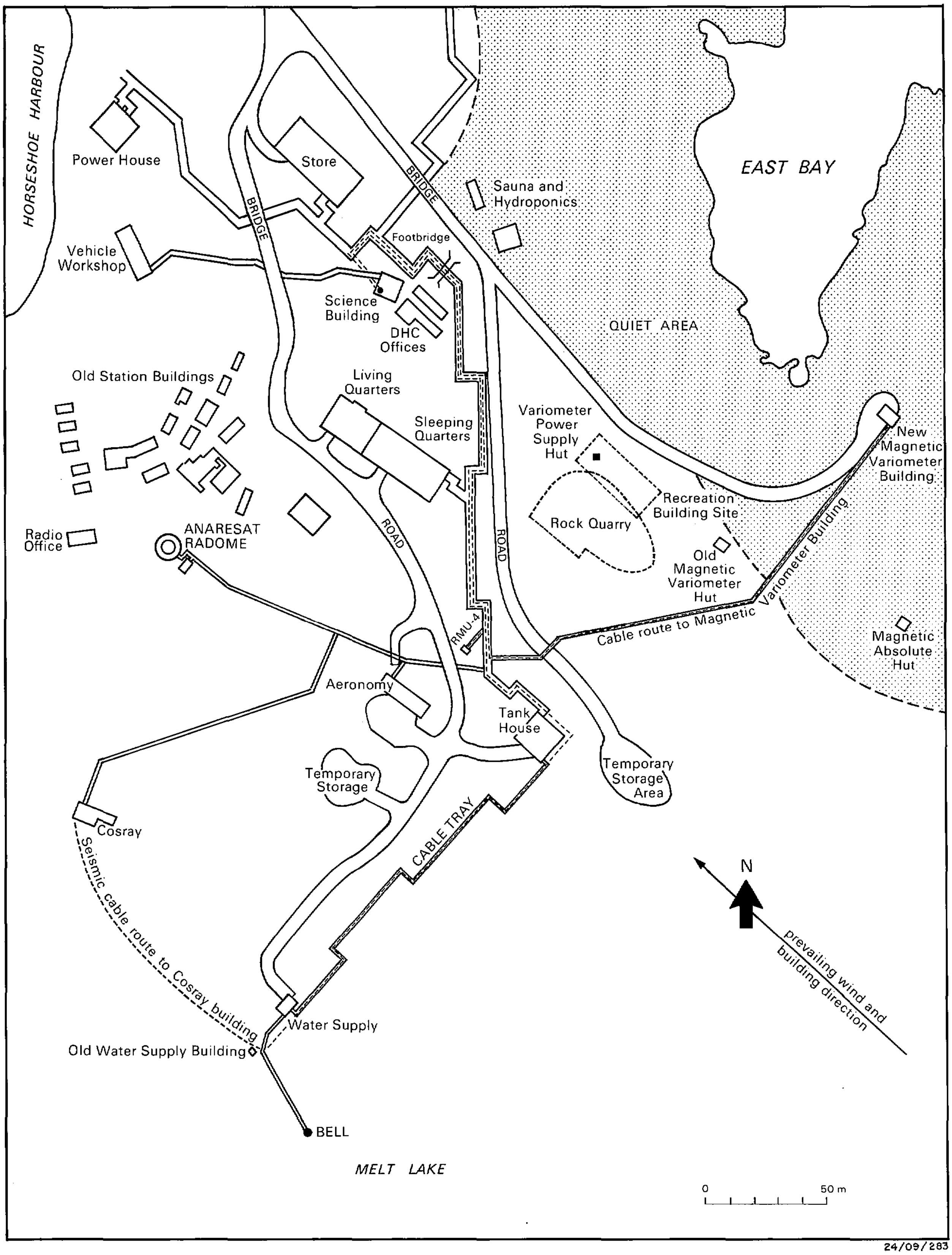

Fig. 1 Mawson

4C

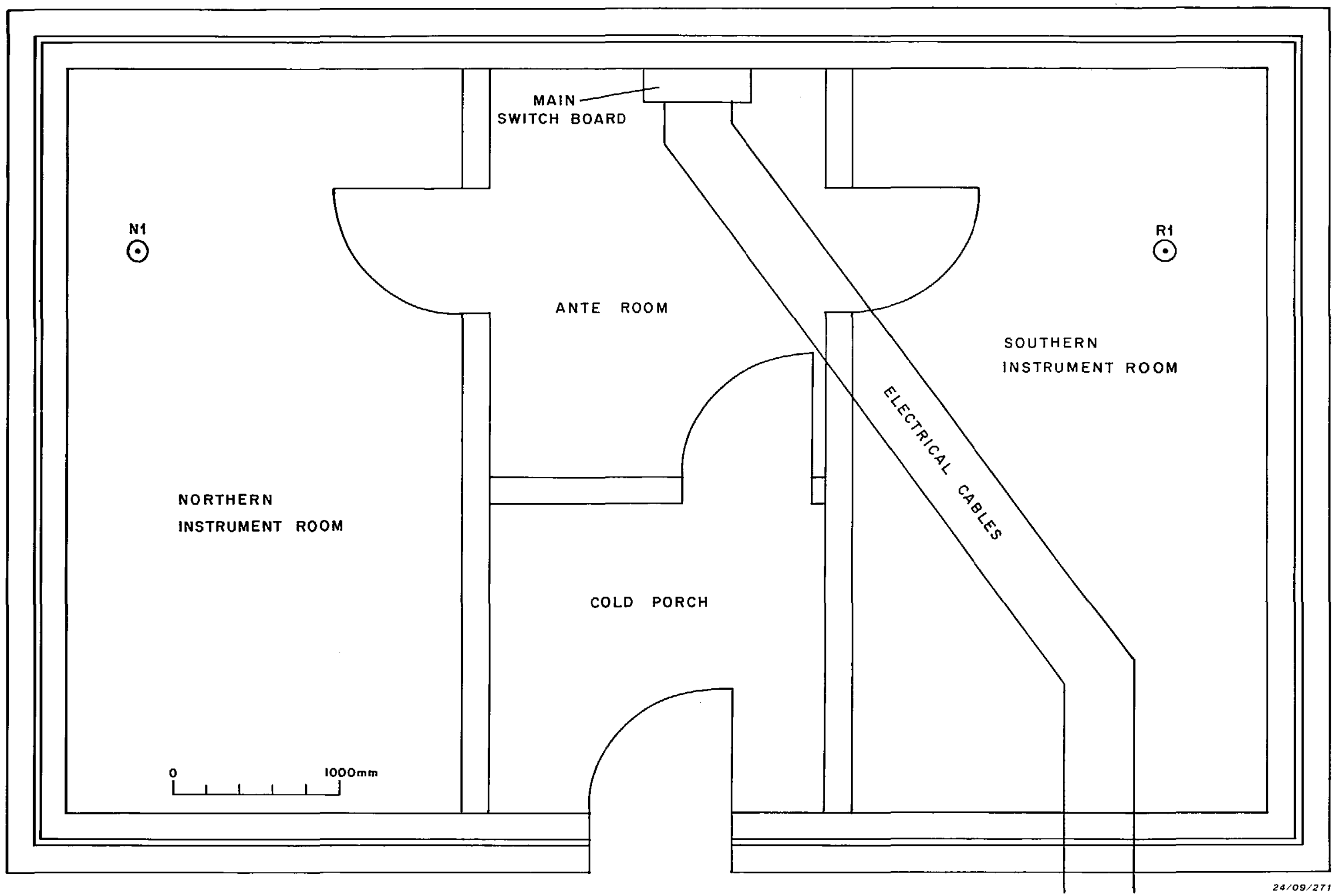

Fig. 2 New magnetic variometer building

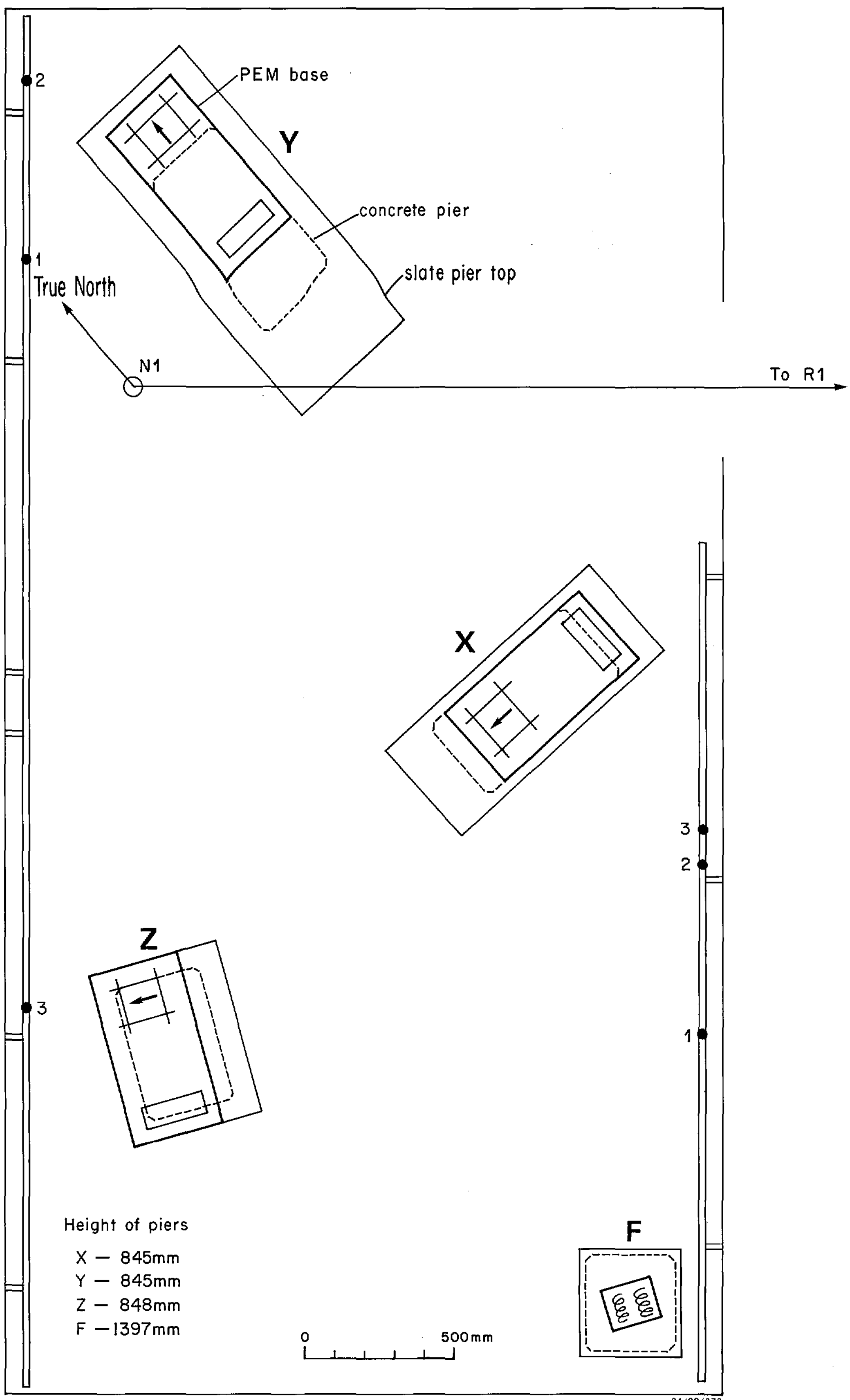

Fig. 3 Instrument room layout for the photo-electronic magnetograph system

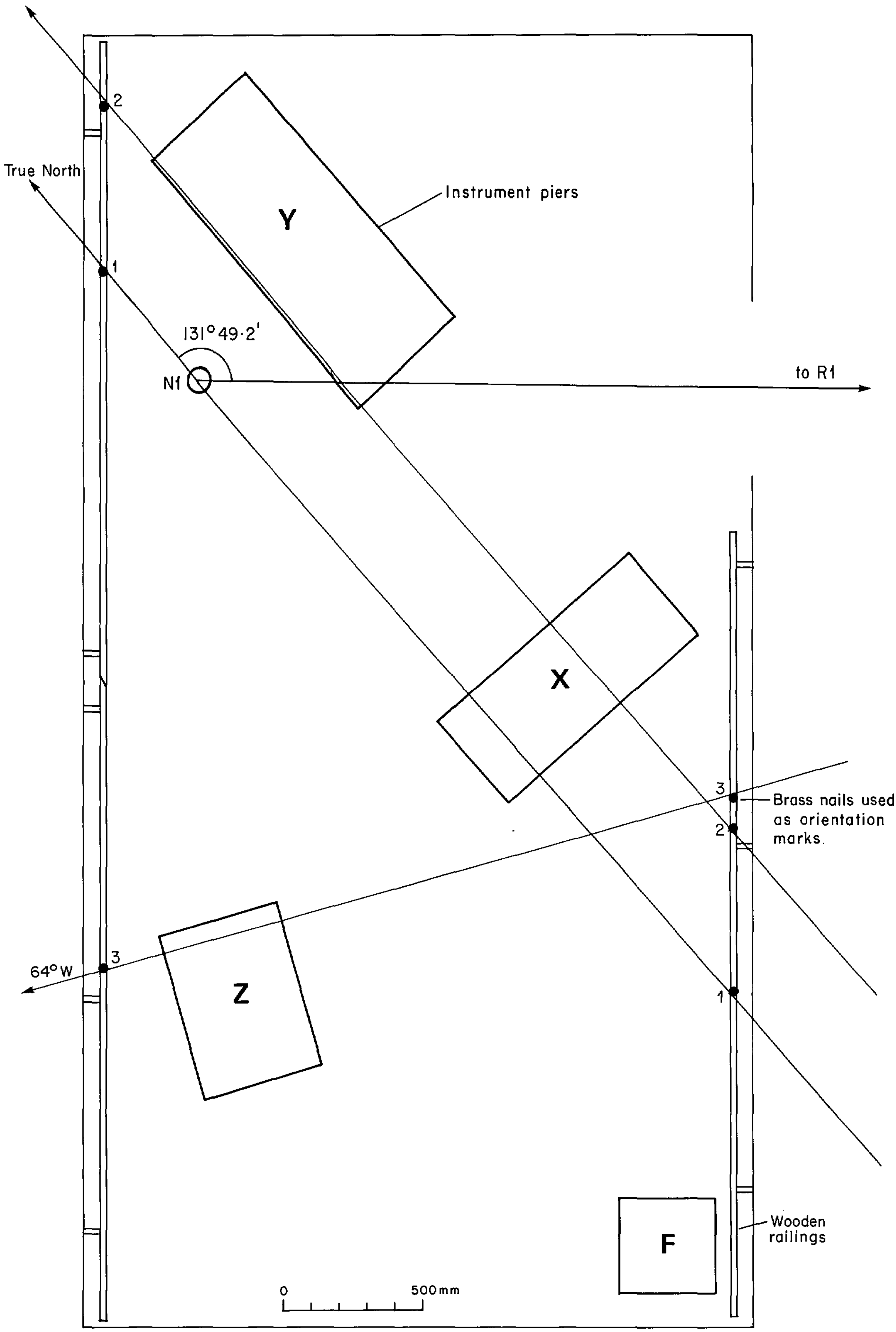

Fig. 4 Orientation marks in the northern instrument room

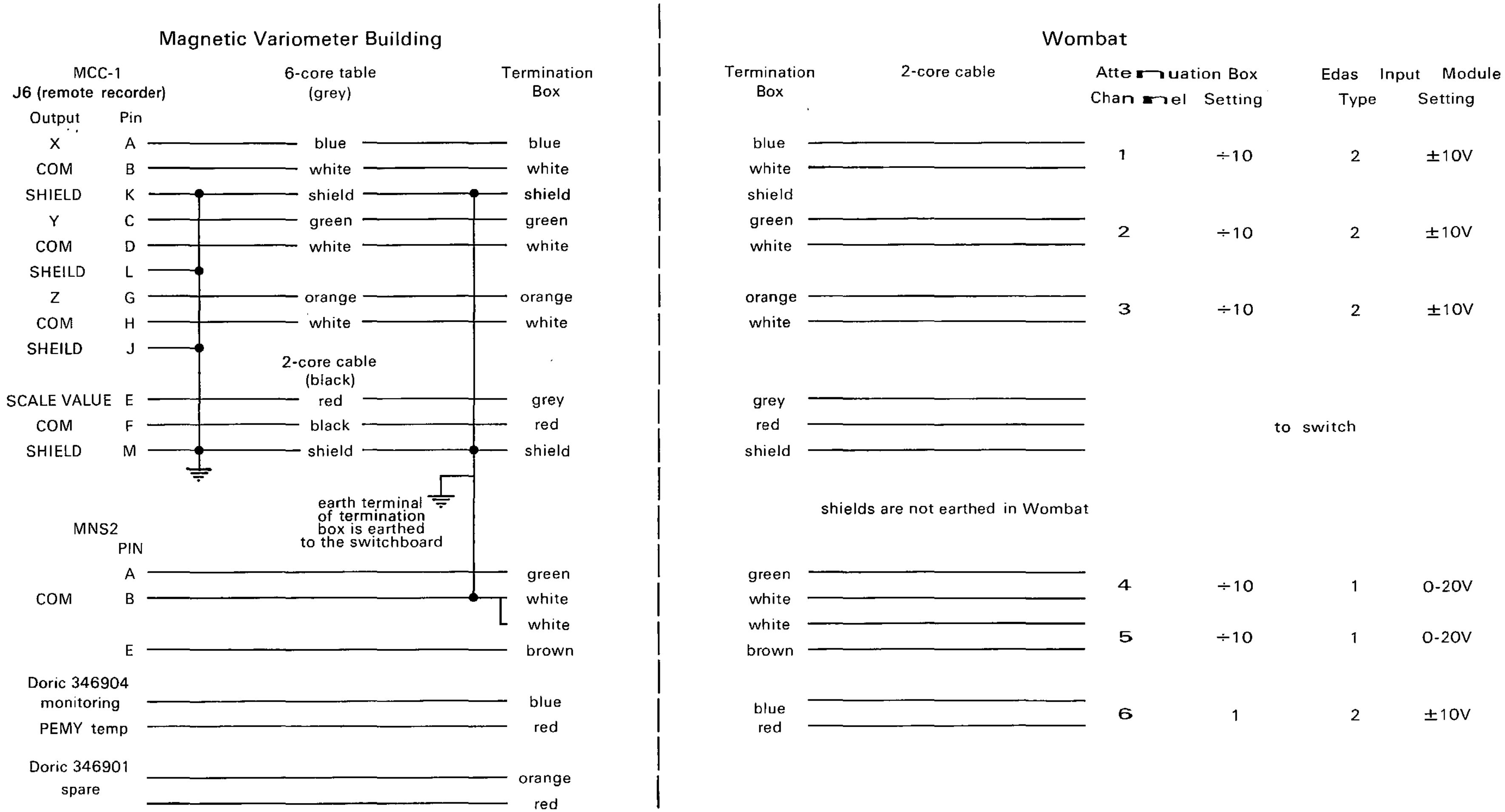

Fig. 5 Cabling of PEMs, MNS2 and Doric temperature monitors

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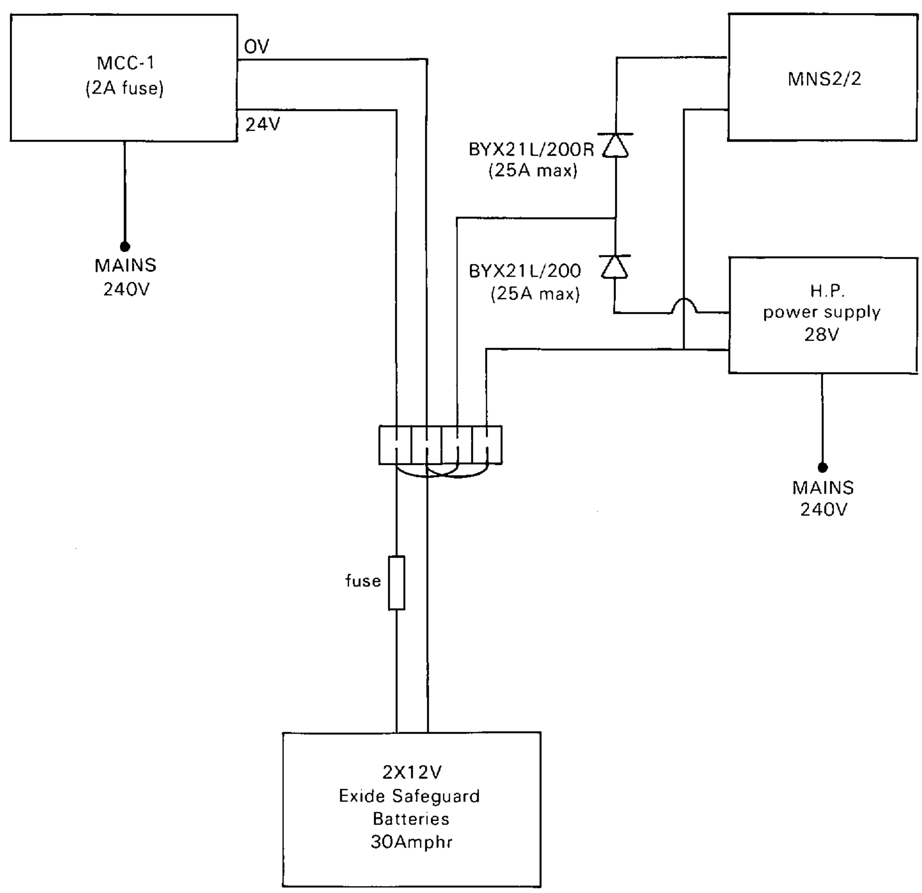

Fig. 6 Back up power for the MCC-1 and MNS2

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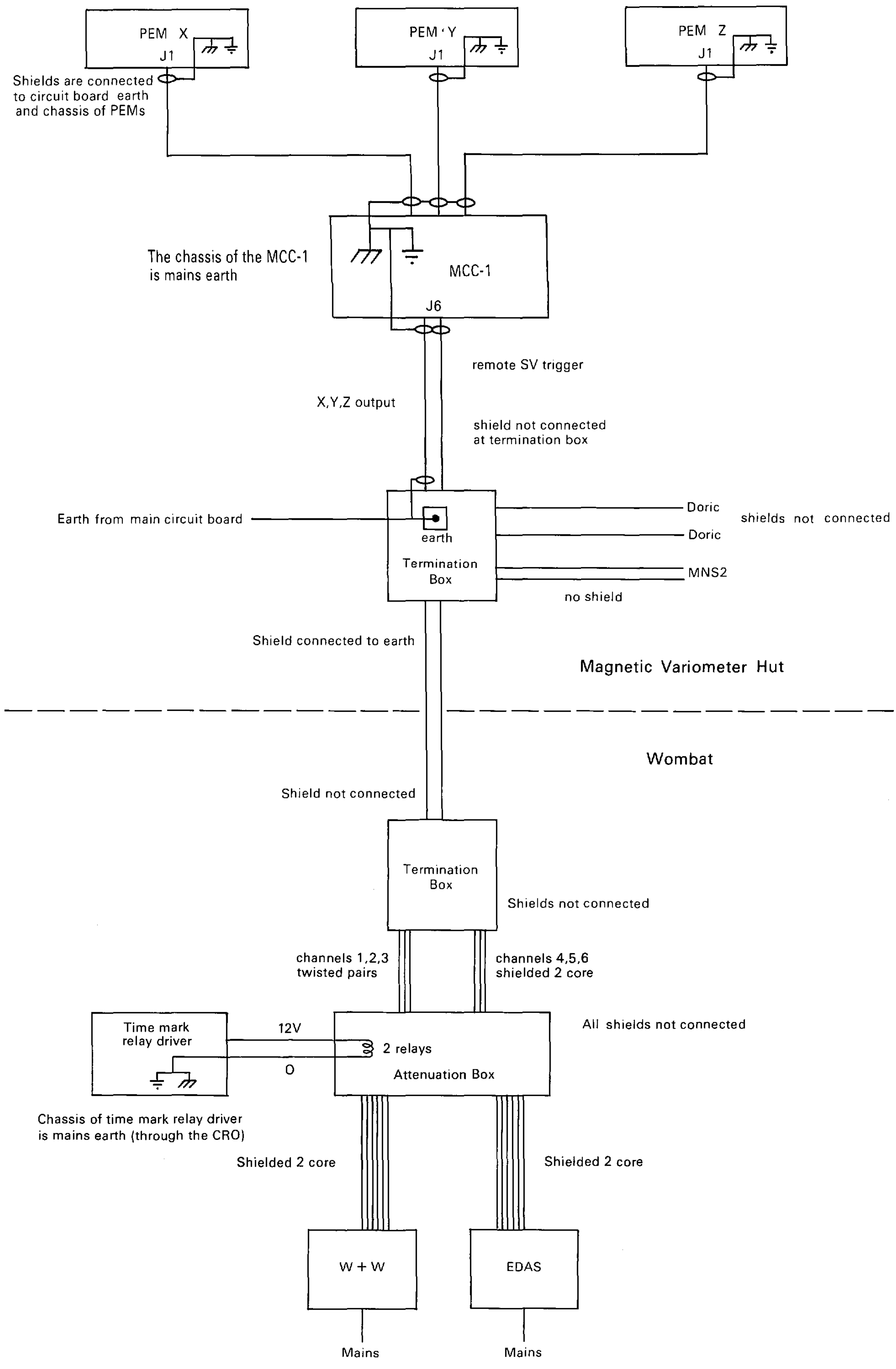

Fig. 7 Cabling of photo-electronic magnetograph system

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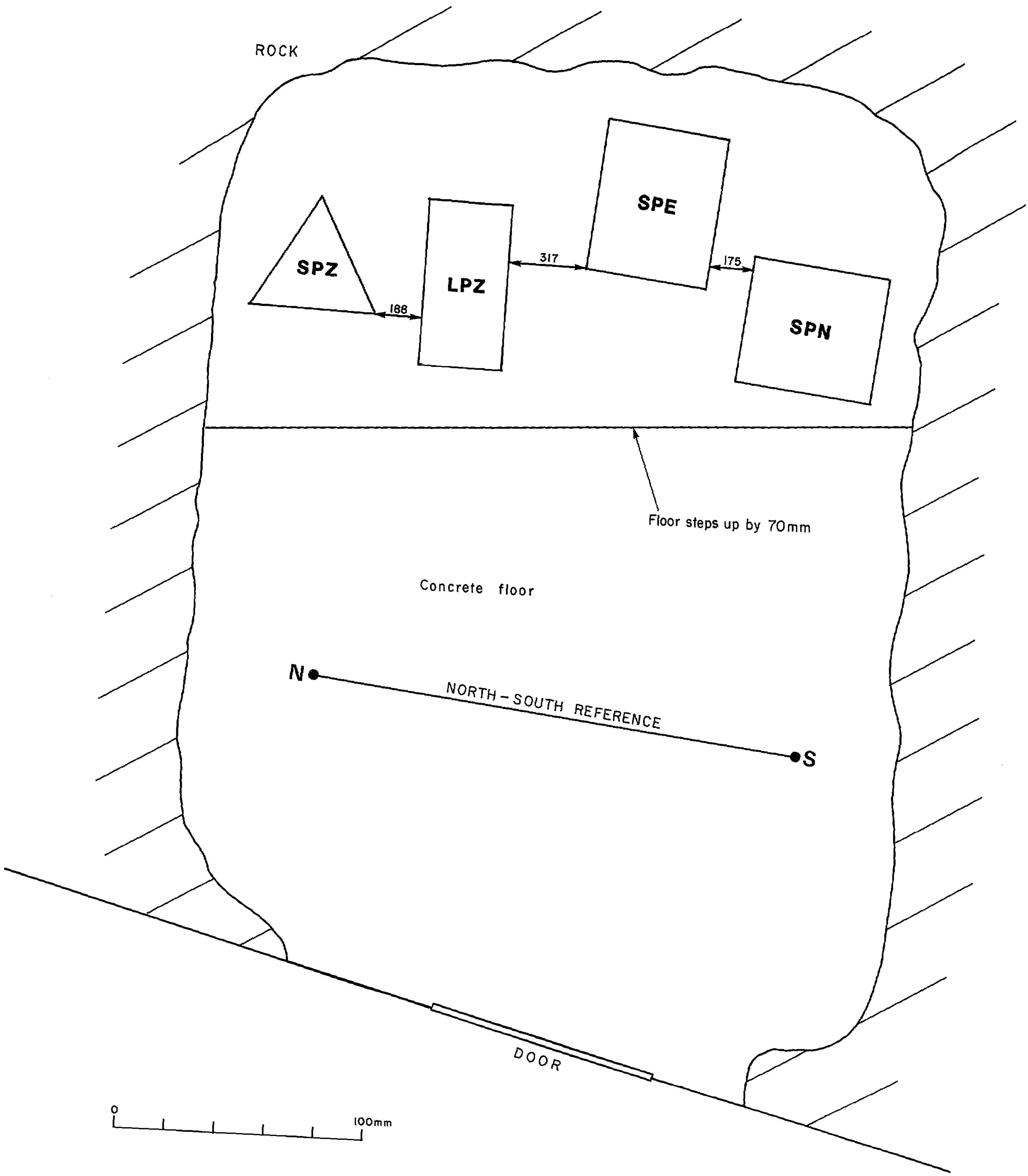

Fig. 8 Mawson seismic vault

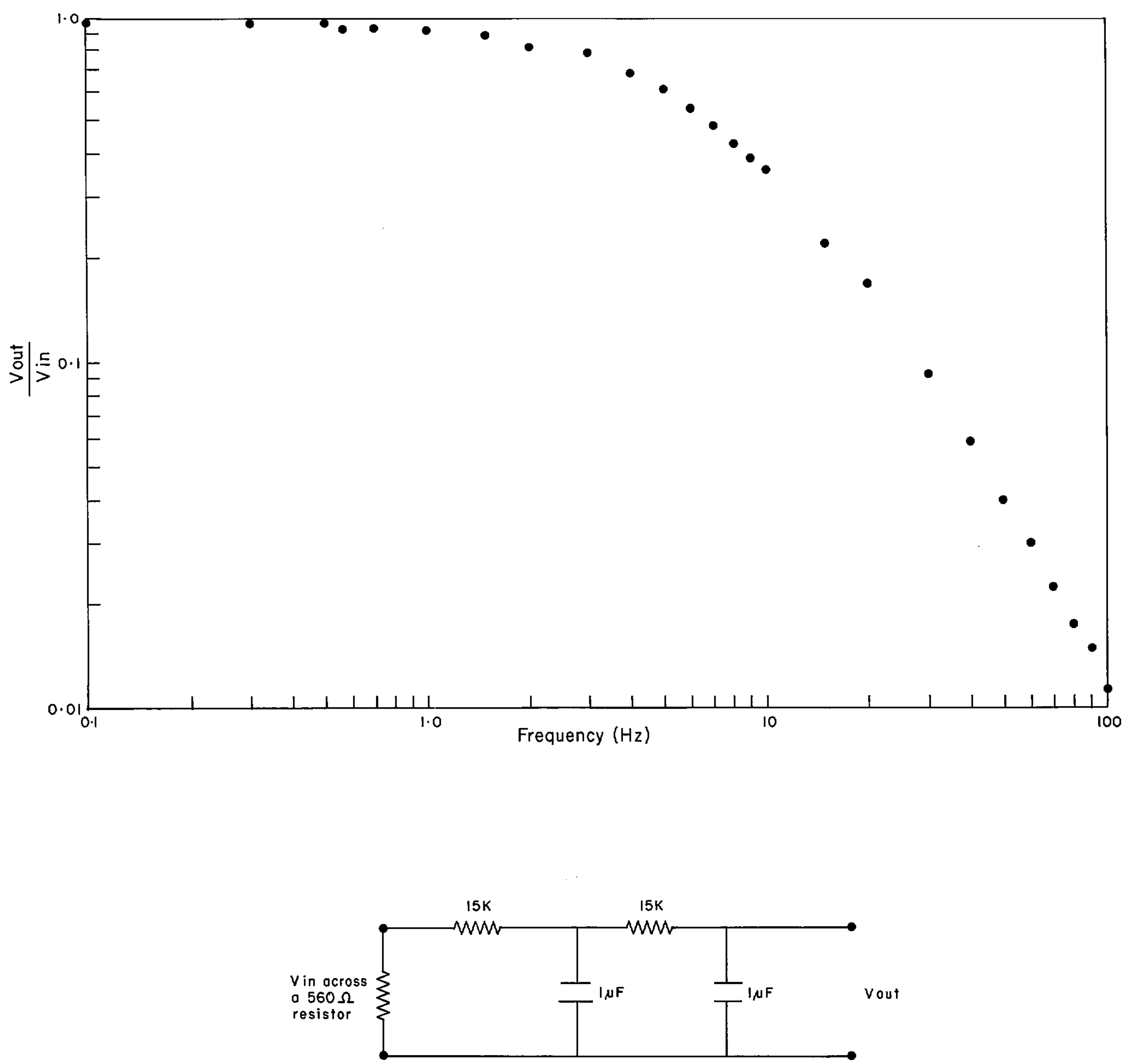

Fig. 9 Frequency response of filter from SPZ AR320 input, Mawson 1985

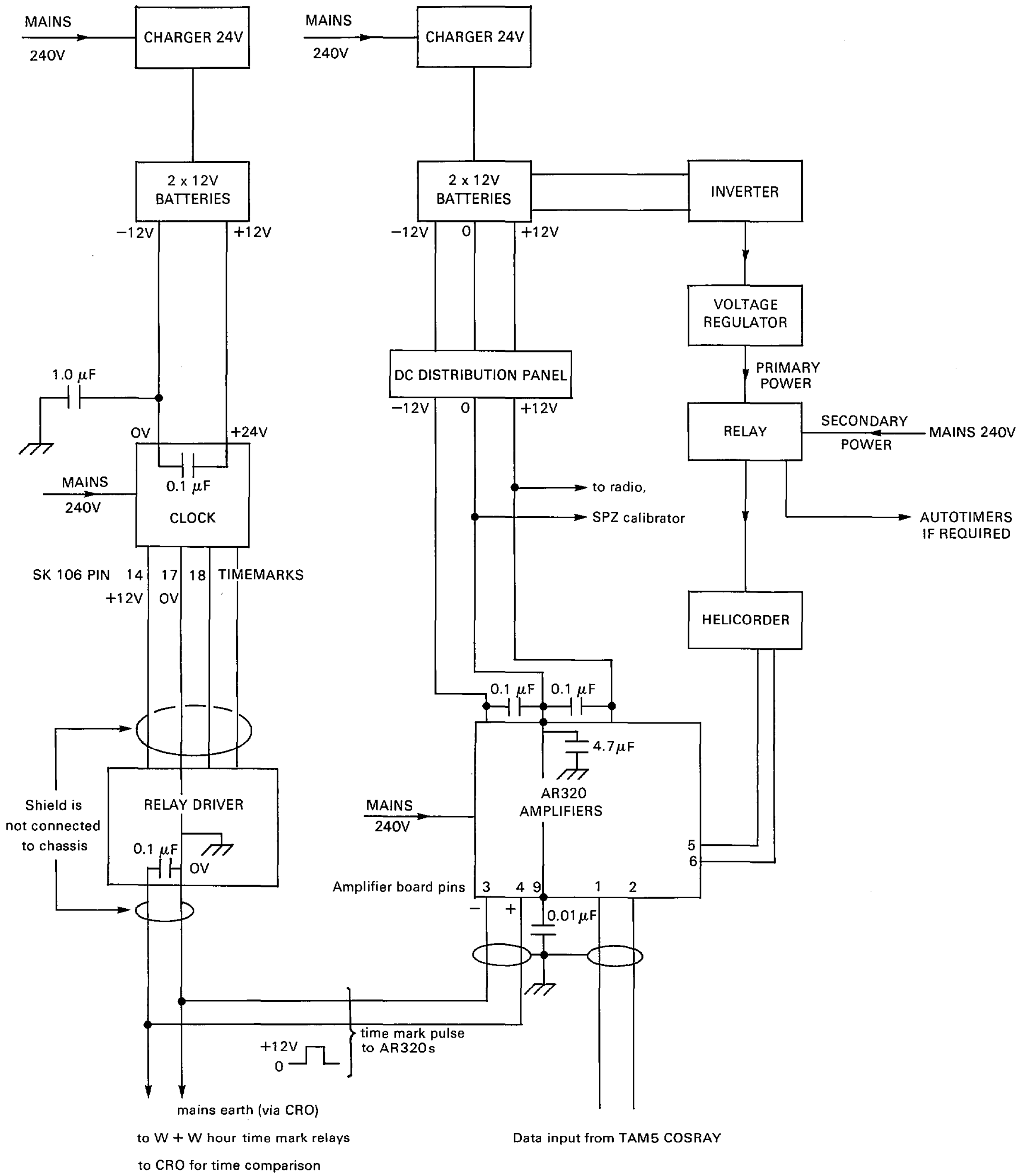

Fig. 10 Mawson seismic system

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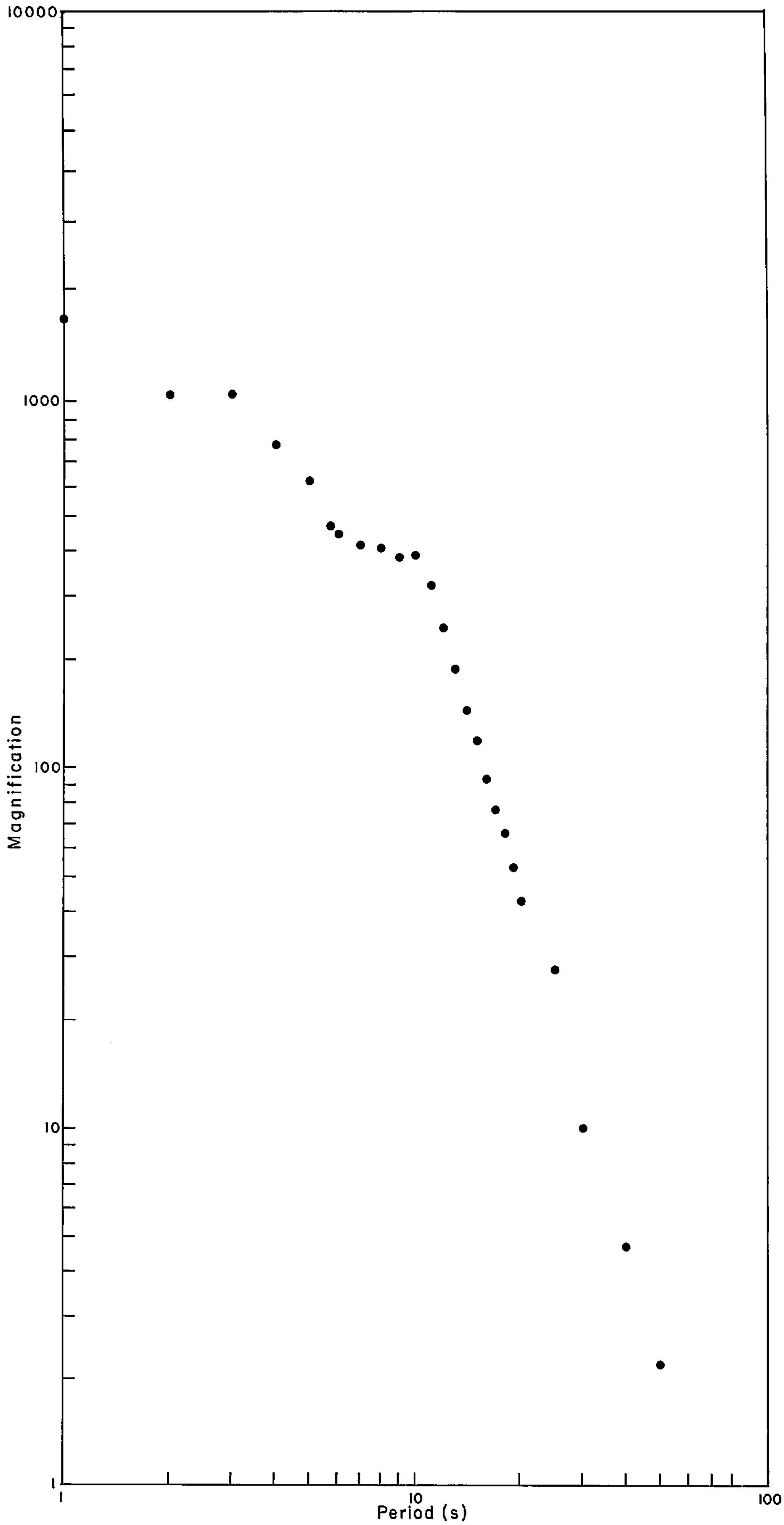

Fig. 11 LPZ Calibration curve, Mawson, November 1985
TAM5 gain 48dB AR320 attenuation -30dB

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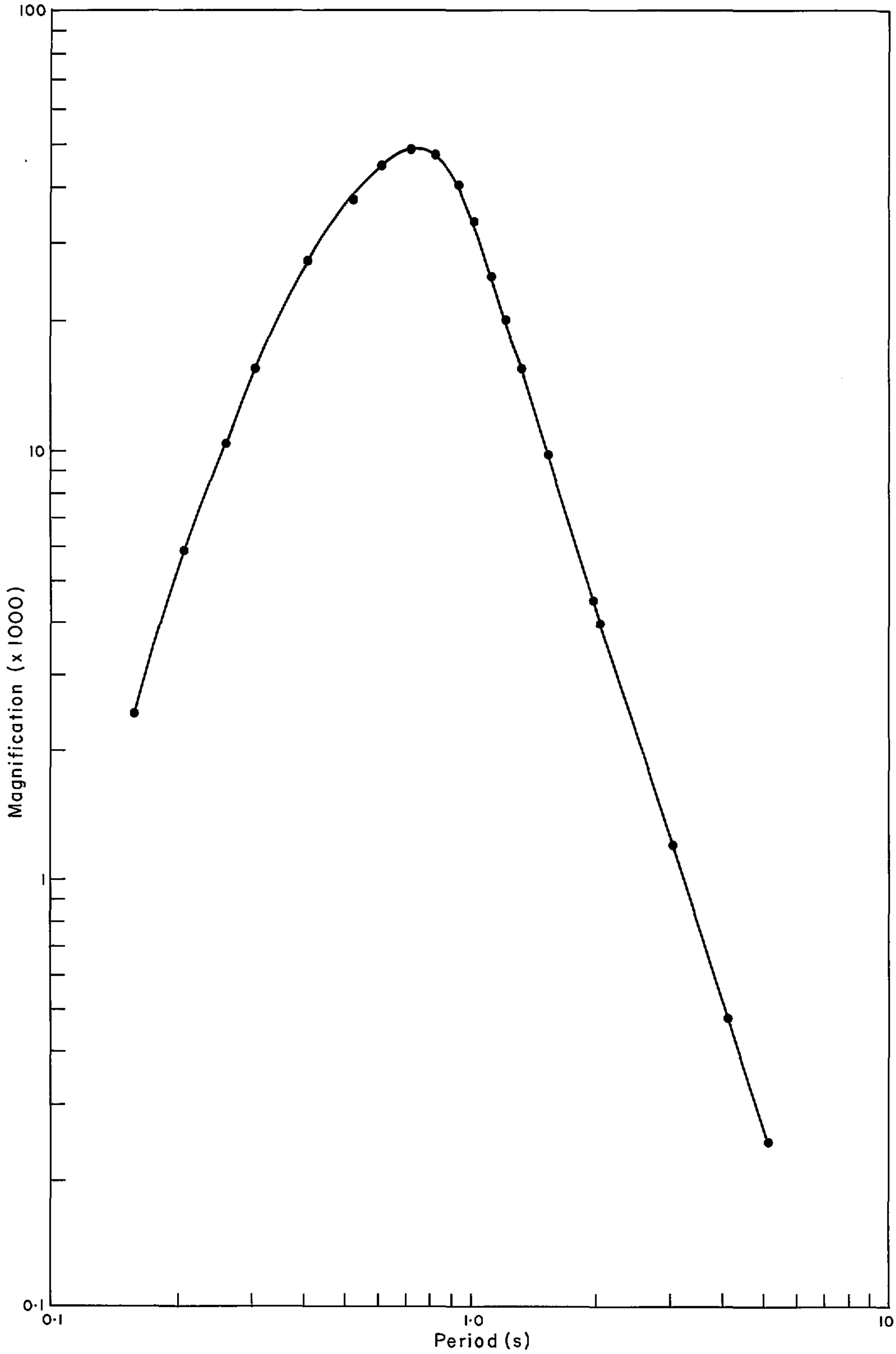

Fig.12 SPZ Calibration curve, Mawson, January 1986
TAM5 gain 84dB AR320 attenuation -24dB

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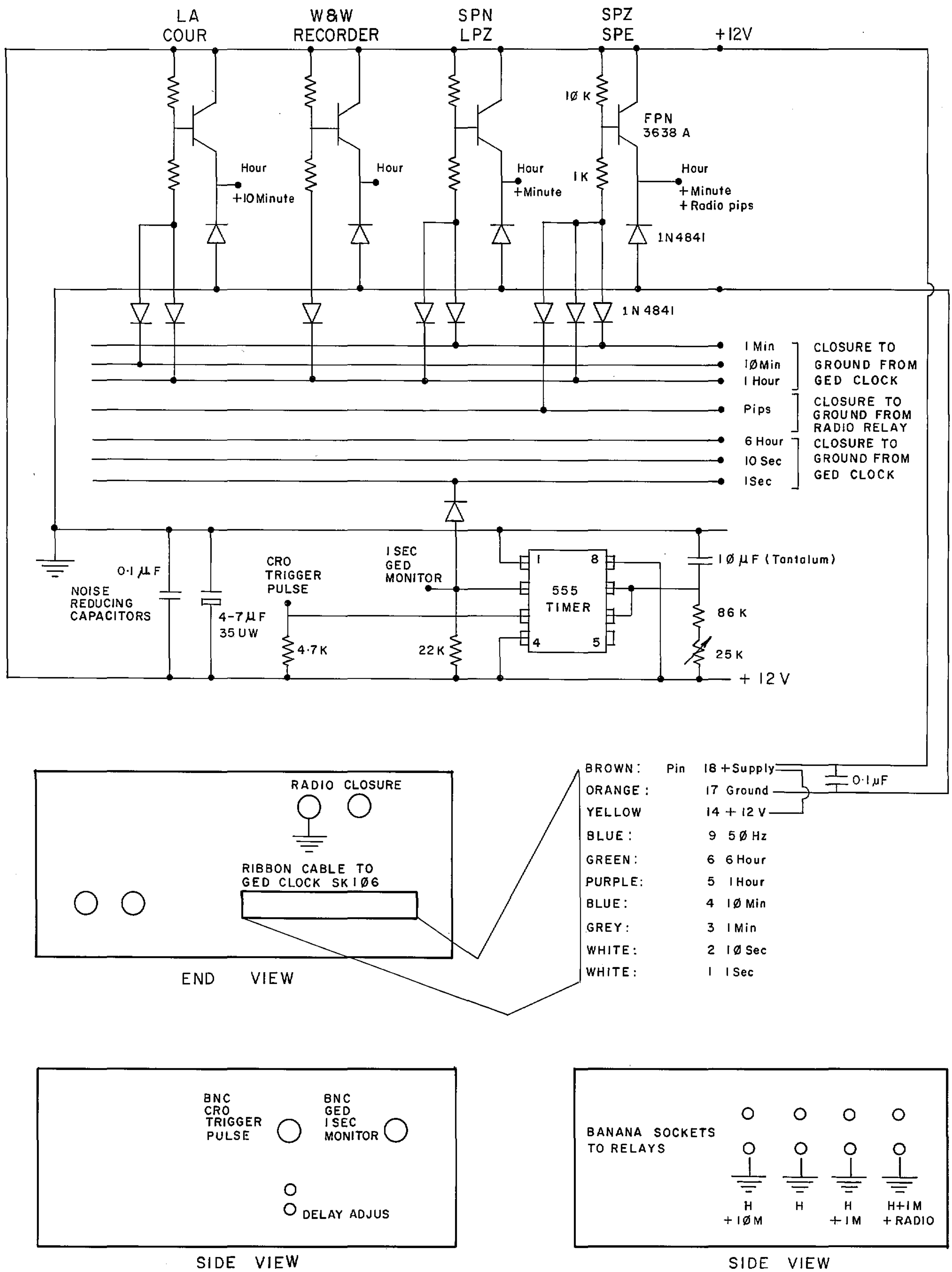

Fig. 13 Time-mark relay driver box circuit

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