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MACQUARIE ISLAND

GEOPHYSICAL OBSERVATORY

ANNUAL REPORT, 1980

by

P.M. DAVIES

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SUMMARY

Geomagnetic and seismological recordings were continued at the Macquarie Island Geophysical Observatory throughout 1980.

Operations were transferred from the old geophysics building into the geophysical office in the newly constructed Science Building on 5 January 1980. Prior to this a trench had been dug from the science building to the magnetic variometer hut, and conduit laid. New cables for the magnetic power and timing were laid in the conduit. With both magnetic and seismic cables in conduit, no cable breakages occurred.

The old geophysical office was used to house the emergency transmitter, and also for housing BMR and Upper Atmospheric Physics stores.

Eighteen felt earthquakes were listed during the year. The biggest of these, which occurred on 7 February 1980 and was felt at an intensity between MMVI and VII, disturbed the three magnetic variometers and caused minor damage in the ANARE station.

1. INTRODUCTION

This report describes the operation of the Geophysical Observatory at Macquarie Island from 29 October 1979 until 30 October 1980. The observatory is the responsibility of the Bureau of Mineral Resources, Geology and Geophysics, which maintains continuous geomagnetic and seismological recordings as part of the program of the Australian National Antarctic Research Expeditions (ANARE). Station details are given in Table 1. Facilities and logistics are provided by the Antarctic Division, Department of Science and Environment.

The author took over from Kevin Wake-Dyster in October 1979, and was succeeded by Warwick Williams in October 1980.

2. GEOMAGNETISM

One three-component magnetograph was in continuous operation at Macquarie Island. This was a La Cour NORMAL run (20 mm/hr) magnetograph and it was calibrated eight times each month to determine the scale and baseline values for each of the components (Tables 2 and 3). The temperature trace was calibrated by noting the temperature on the vertical intensity (Z) variometer thermometer each day at record change (Table 4).

Magnetic K-indices, preliminary monthly mean values, baseline values and scale values were telexed at the end of each month to BMR Canberra. Table 5 shows the monthly mean magnetic values for 1980. These values were calculated using the adopted baselines shown in Table 3 and the mean ordinates on the five quietest days in the month. The annual mean values from 1952 to 1980 and values derived from absolute observations in 1911 (Webb, 1925), 1930 (Farr, 1944), 1948 (Chamberlain, 1952), 1950 (Jacka, 1953), and 1951 (Oldham, 1953), are shown in Table 6.

The elements observed by Webb in 1911, Kennedy in 1930, and Chamberlain in 1948 were the horizontal intensity H, the declination D and the inclination I, using Station A set up by Webb in 1911. The standard station for Macquarie Island since 1951 has been Station E inside the Absolute Hut. Station differences measured by Ervin, Oldham and McGregor in 1952 (Ervin, 1952) in the sense Station A - Station E were as follows:

Horizontal intensity	:	+57 nT
Declination	:	+27.0'
Vertical intensity (Z)	:	-51 nT

These differences were applied to the original magnetic observations, so that all values in Table 6 refer to Station E. Flowers in 1950 and Oldham in 1951 (Oldham, 1953) used a temporary tripod arrangement for Station E, and it was made permanent by McGregor in 1952 (McGregor, 1954) by setting a 9-inch diameter wooden spar in concrete. Starting with Oldham in 1951, the elements measured were Z, D and H, instead of I, D and H, as previously. Figures 1, 2, 3 and 4 show preliminary annual mean values of the elements H, F, D and Z respectively from 1951 until 1980.

La Cour magnetograph

The magnetograph functioned well with only minor record losses, which were due mainly to the local earthquakes felt during the year (Table 13). The H variometer was the most sensitive to earthquakes and large displacements of the H trace occurred on four occasions. The D variometer was badly affected by only the large local earthquake on 7 February. Other local earthquakes during the year caused the D variometer magnet to oscillate slightly, but did not affect the D baseline value. The Z magnet was moved slightly askew by the earthquake of 7 February, but the trace remained on the record. The magnet was cleaned and adjusted in

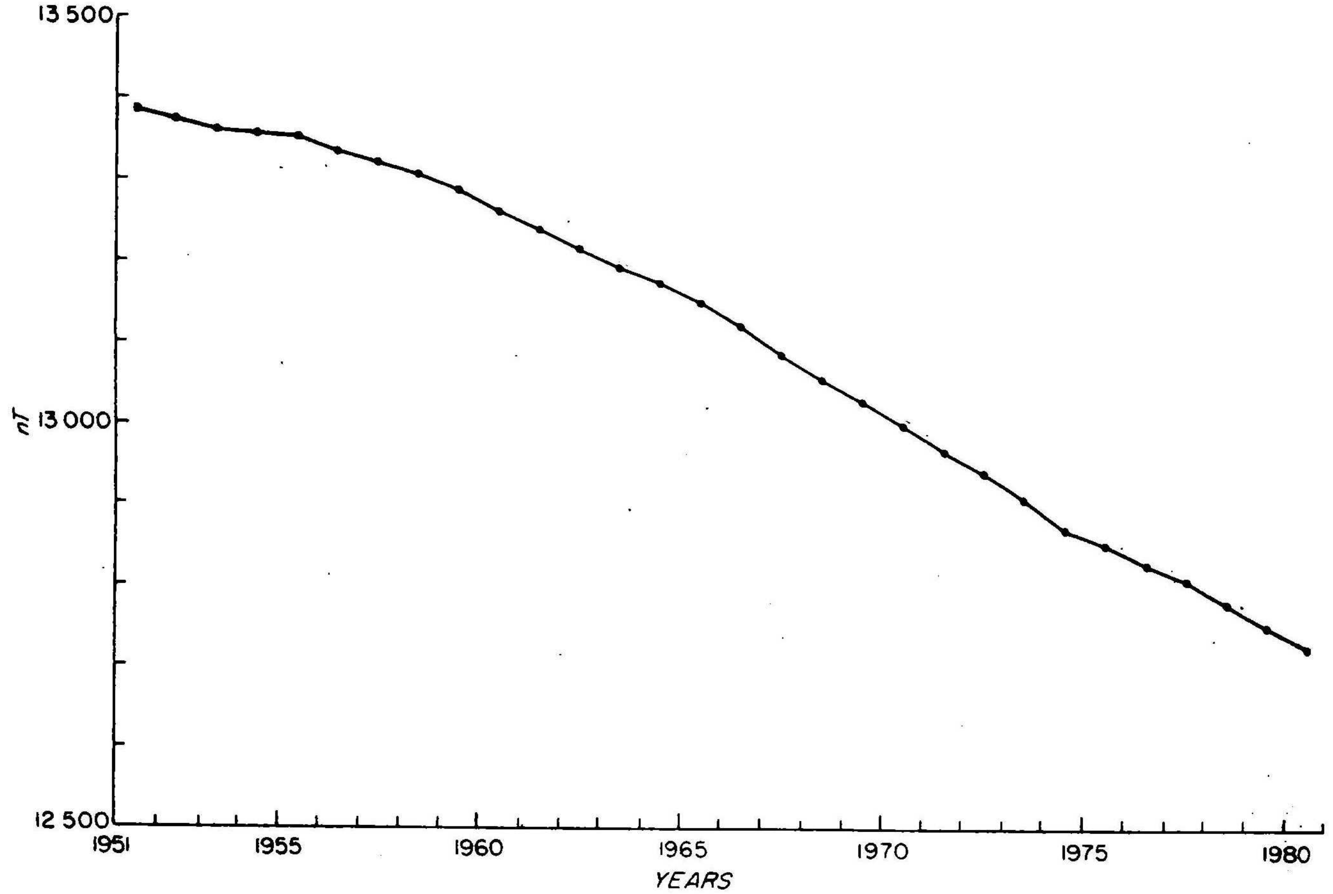


Fig. 1 Annual mean values of horizontal intensity, H

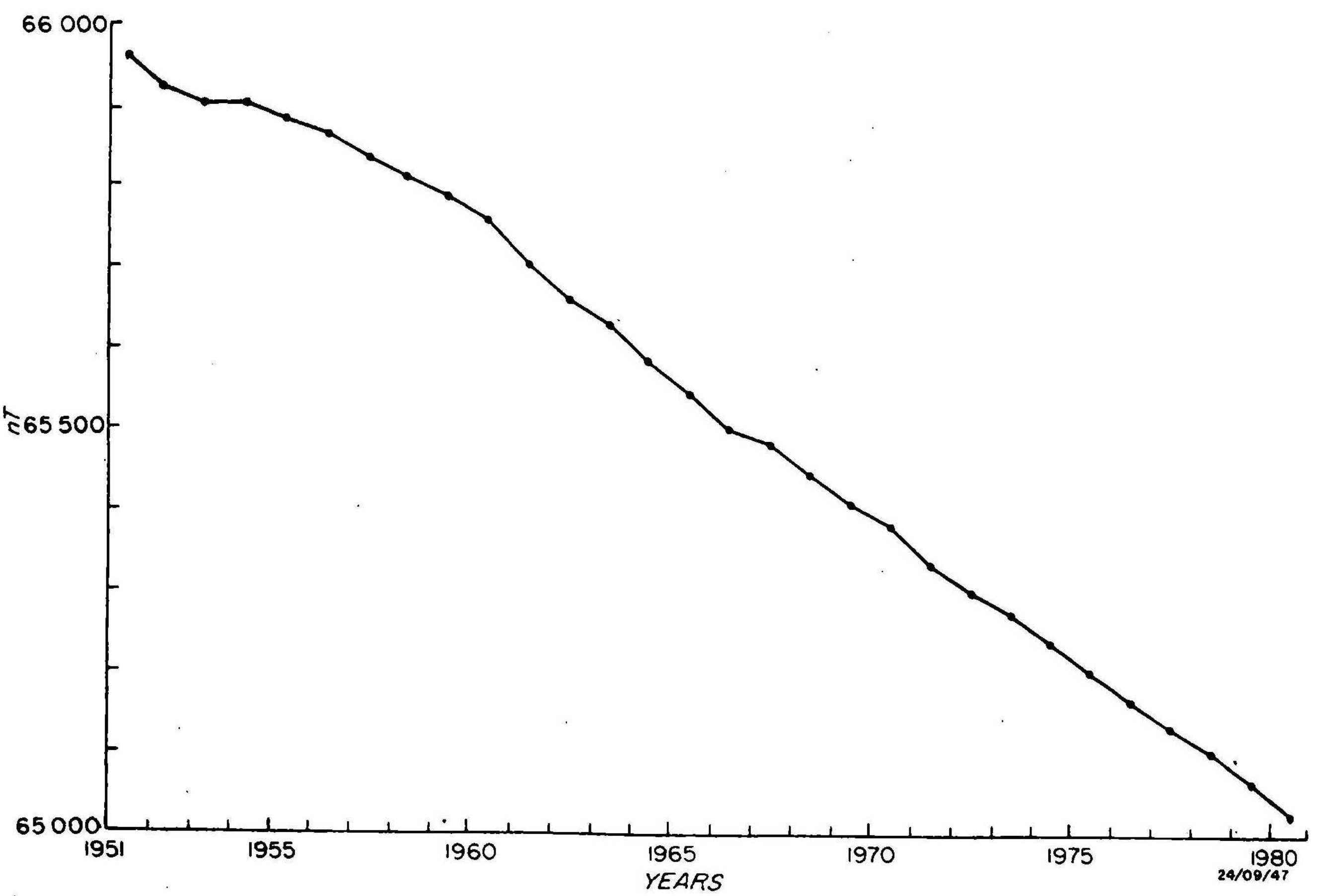


Fig. 2 Annual mean values of total intensity, F

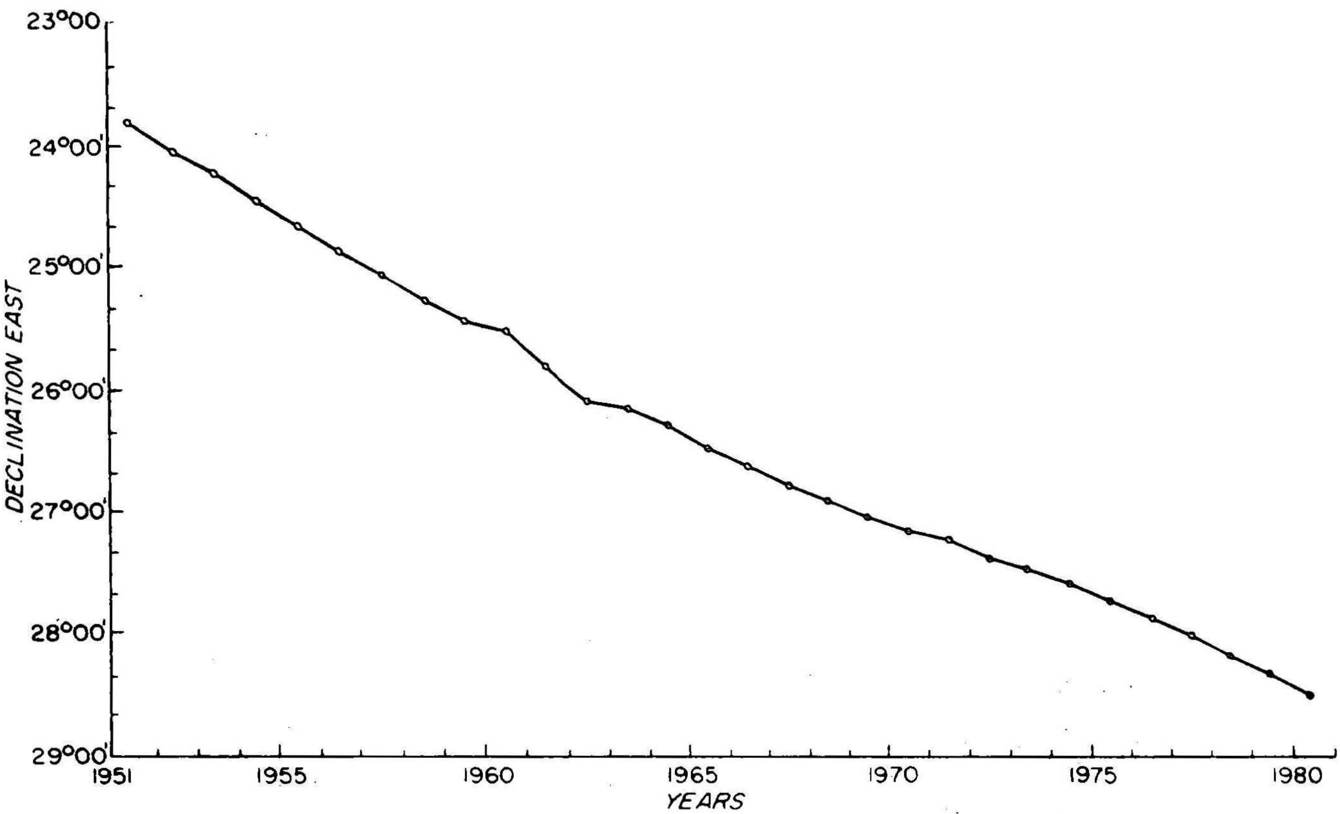


Fig. 3 Annual mean values of declination, D

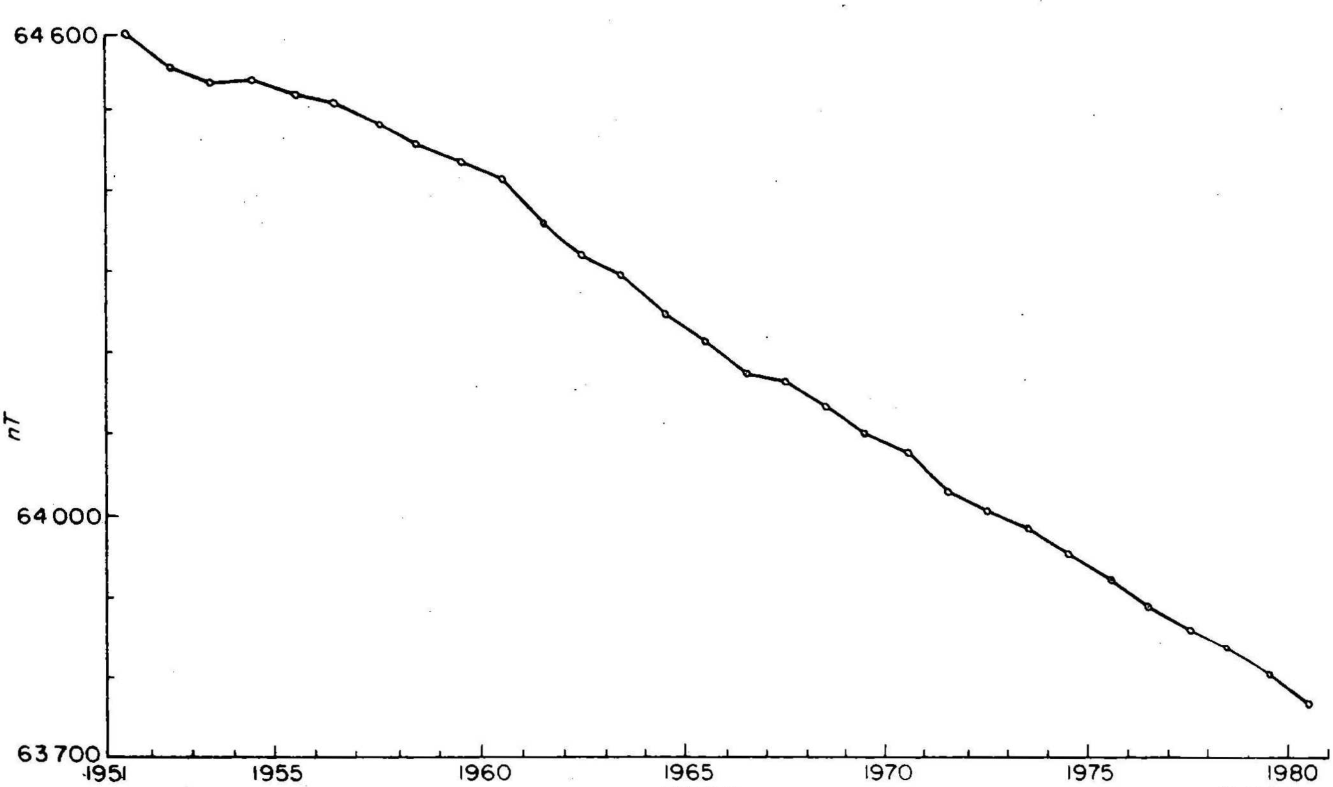


Fig. 4 Annual mean values of vertical intensity, Z

March and April to get the best position of the magnet on its agate support. The magnet was also disturbed slightly by the local earthquake on 13 July, which caused a minor change in the baseline value.

Thermograph and temperature coefficients. The thermograph in the Z variometer was calibrated from daily thermometer readings; the results are given in Table 4, for use in reducing baseline values to standard temperature. A temperature coefficient of 3.0 $\pm$ 0.3 nT/°C was determined for the H ordinate by a least squares fit of the baseline and temperature data. This value is slightly different from the adopted value of 3.2 nT/°C used during 1980. The temperature coefficient of the Z ordinate was taken to be zero, as in past years.

Orientation tests. On 7 February 1980 the H and D traces moved off the record because of a strong local earthquake (see Table 13). To reposition traces the H torsion head was rotated through about 180°, and the D torsion head was rotated through about 1400°, i.e. 4 complete rotations.

Orientation tests were performed on the H and D variometers to determine any change in orientation. The results are shown in Table 9, together with the orientations determined by Wake-Dyster (1981) in September 1979. The H-magnet orientation in 1979 and 1980 is about the same whereas the D-magnet orientation changed from 1.1°E in September 1979 to 0.7°W in February 1980 as a result of adjustments required after the earthquake on 7 February.

During the visit of the Thala Dan on 11 March 1980, Andrew McEwin from BMR, Canberra, performed torsion tests on the D variometer. The results of these are summarised in Appendix 2, and show there was negligible torsion in the D fibre.

McEwin also checked the reference azimuth and the position of the scale value/orientation coils which surround the D and H variometers.

The reference azimuth was checked independently and the results are shown in Table 10 with McEwin's and previous determinations. The value of 24° 14.3' gave the azimuth of the reference meridian as 28.9°, which does not differ significantly from the adopted azimuth (29.0°).

An orientation test was performed on the D variometer several days after the torsion tests; a negligible change in orientation was found.

Further orientation tests were made in October. The values of Z and H orientation are the same as the previous determinations in February 1980, and September 1979. The D magnet had the same orientation as in February and March 1980.

Parallax. The parallax of the magnetogram traces was checked approximately once each month. The parallax correction for the H, Z and T traces was approximately zero for the whole period of observation. The D trace correction was zero until the parallax observations on 30 June when the measured correction changed to -0.5 min. The measured correction had changed to -1.0 min when the parallax was checked on 2 August, and remained at this value for succeeding observations.

Magnetometers

Absolute and semi-absolute magnetometers used during the year were:

H	:	QHM's 177, 178, 179
D	:	Askania declinometer 640505 and circle 640620
Z	:	BMZ 236
F	:	Elsec PPM 271

The PPM head was placed on Pier W and gave readings of F; Zp was derived using these F values and values of H derived from QHM observations on Pier E, the standard pier. Inter-pier F observations, which were made monthly, indicated a pier difference of approximately 0 $\pm$ 1 nT. The pier difference in F was taken as zero.

BMZ observations were also made on Pier W. Comparison of the BMZ values with Zp gave the following mean difference and standard deviation:

Zp = BMZ 236 - 95 $\pm$ 6 nT

No trouble was experienced with the three QHMs during 1980. As was noted in the author's 1978 report (Davies, 1981), the QHM thermometers need recalibrating.

The D baseline values became more scattered from the end of August until the end of the period covered by this report i.e. 31 December 1980. The standard deviation increased from its previous value of 0.2 to about 0.4 during the period 13 August to 31 October. During November and December the standard deviation increased to about 1.0.

The PPM also behaved erratically at times during the year, giving readings widely at variance with the expected magnetic field value. However, enough good readings were obtained to enable reasonably good baseline values to be obtained each month. At changeover in October, the PPM 271 was exchanged with MNS2/2.

Intercomparisons and corrections. At Macquarie Island in October 1980 intercomparisons were made between the following instruments: (a) QHM 172, QHM 177, HTM 704; (b) declinometer 640505 with circle 640602 and declinometer 333 with circle 813; (c) PPM 271, MNS2/1. Table 7 summarises the results obtained from intercomparisons (a) and (b) and the differences between QHMs 177, 178 and 179 obtained from the observed baseline values determined throughout the year.

The comparison of PPM 271 with the MNS2 gave no clear result as the field at the time of observation was very active; the readings given by the two instruments were approximately the same.

The preliminary corrections used at Macquarie Island during 1980 were:

QHM 177 -11nT; QHM 178 -3nT; QHM 179 -2nT

Ask. 505 +0.5; Elsec 271 0nT

<u>Effect of humidity on QHM observations</u>. Bobrov and Pavlovich (1967) reported that the relative humidity at the time of observations affects the QHM observation.

To test this supposition on Macquarie Island, wet and dry bulb thermometers were mounted in the corner of the Absolute Hut. The position of these thermometers was not in accordance with Meteorological Bureau specifications, viz. to be mounted in a Stevenson Screen with an airflow over the bulbs, but the Meteorological Officer in Charge gave his opinion that the results would be adequate.

For twelve sets of QHM observations, a measurement of the relative humidity in the absolute hut was taken at the time of the observations. The results are shown in Table 8 together with the calculated QHM baseline values. QHMs 177 and 178 showed an increase of 1.0 nT and 1.4 nT respectively per one percent increase in relative humidity, whereas QHM 179 showed a decrease of 4.0 nT per one percent increase in relative humidity. However, the correlation coefficients for the QHM 177, 178 and 179 observations were 0.36, 0.45 and 0.14 respectively, which indicates little dependence of baseline values on relative humidity over the small range observed; any effect of relative humidity is masked by the various errors inherent in determining QHM baselines values.

3. SEISMOLOGY

The seismograph

One seismograph was operated at Macquarie Island during 1980; it comprised a Willmore Mark II short-period vertical seismometer, a Geotech telemetry amplifier, a discriminator, a 60 mm/min recorder, a galvanometer and galvanometer control box. On 11 March the telemetry amplifier and discriminator were removed and the seismometer output was connected directly to the galvanometer through the control box. The high-impedance seismometer coil was replaced by a low-impedance coil to accommodate this change.

The 380-ohm seismometer coil was originally tapped to give a seismometer resistance of 130 ohm, and the free period of the seismometer was set at 1.5 s as advised by H.Q. This did not give sufficient damping, and the increased free period of the seismometer compared to the previous free period of 1 s, meant a greater disturbance of the record by micro-seisms.

The minimum external resistance obtainable was 180 ohm giving a damping factor of 0.36 critical, much lower than the recommended damping factor of between 0.6 and 0.7 critical. The coil was finally tapped to give an internal resistance of 250 ohm. The seismometer free period was reduced to 1 s to improve the appearance of the record, and these two changes gave the recommended theoretical damping of 0.67 critical (see

Table A in the Willmore seismometer handbook). The damping determined from the seismogram was 0.65 critical.

Figures 5 and 6 show calibration curves of the seismograph before and after the change. The magnification at 1 Hz was about 50% lower after the change with the attenuator at its normal setting. This was 32 dB before the change and 12 dB after it. This reduction in magnification was necessary because the telemetry system included a filter to reduce microseismic noise, which is mainly concentrated in periods greater than 1.5 s. An unsuccessful attempt was made to construct an active filter.

Although the seismograph was normally run at an attenuation of 12 dB, this could be varied in 2 dB steps depending on the prevailing weather conditions. Table 11 shows how the seismograph magnification is affected by the different attenuation settings.

The free period for the vertical seismometer was measured 4 times during the year. The results before and after the change on 11 March are shown in Table 12, together with the magnification at 1 Hz.

Seismic data were telexed to BMR, Canberra, and thence to the United States Geological Survey (USGS) for the preliminary determination of epicentres.

Local seismicity

Table 13 lists earthquakes felt on Macquarie Island during 1980. Four of them disturbed one or more of the variometers. The large earthquake on 7 February had a magnitude MB of 6.4 and was felt at the Macquarie Island Station with an intensity (MM) VI+. It was preceded by 11.2s by an earthquake with MB 4.8 and followed about 10 min later by an MB 5.8 earthquake. During the next 12 days about 350 aftershocks

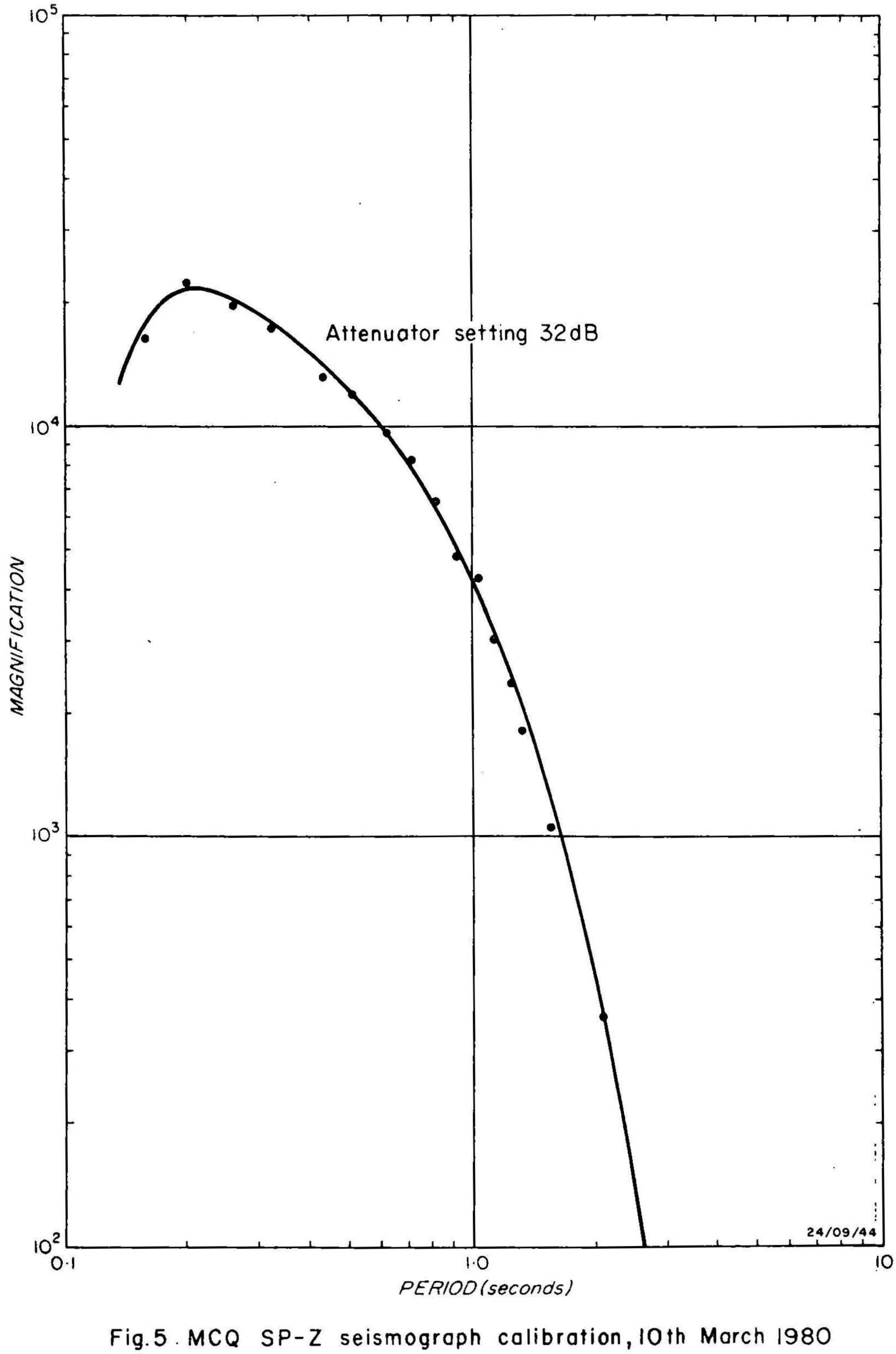


Fig.5. MCQ SP-Z seismograph calibration, 10th March 1980

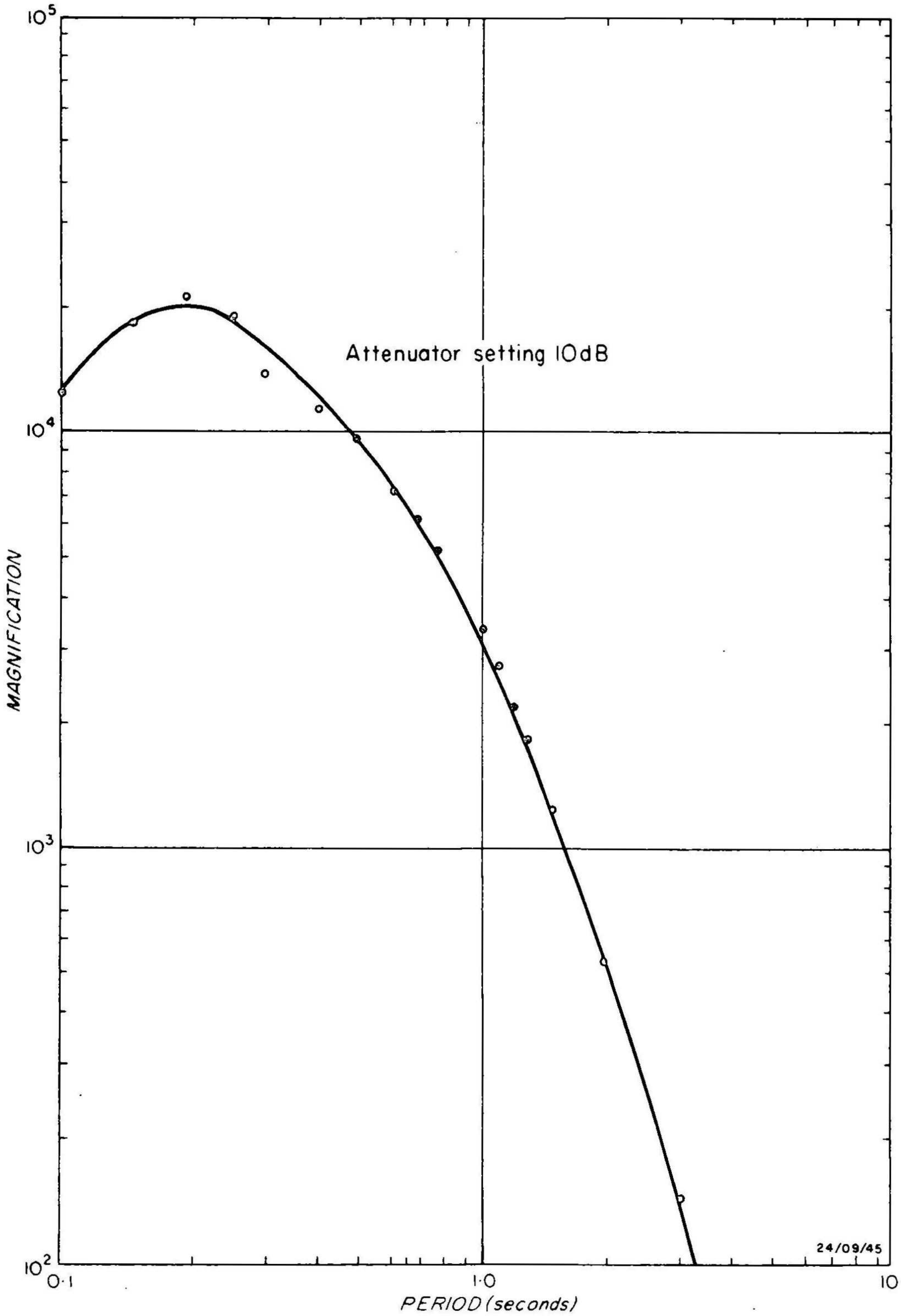


Fig.6 MCQ SP-Z seismograph calibration, 25th August 1980

were recorded; 6 of these were felt on Macquarie Island.

Among the local effects of the large earthquake on 7 February were the following: many books were hurled across the Mess; most of the photographs hanging on the Mess walls were thrown on to the floor; landslides occurred at various places, in particular a large boulder rolled down Wireless Hill and came to a stop about 20 metres from Hasselborough House; the concrete floor in the main store cracked along one of its seams.

The seismicity in the Macquarie Island region is illustrated in Figure 7, which shows all events recorded up to the end of 1980.

4. ANCILLARY EQUIPMENT

On arrival at Macquarie Island in October 1979, power and timing for both seismological and magnetic equipment were obtained from a central console in the old geophysics hut. In addition, the seismological observatory had a back-up power and timing supply which automatically came into operation if the cable from the geophysics hut was broken or the console equipment failed.

During December and January preparations were made to move the geophysics office to the newly constructed Science Building. Figure 8 shows a sketch plan of the new arrangements (not to scale as no building plan was available).

A new cable to the seismograph hut had previously been laid by Wake-Dyster. This cable lay in conduit in a deep trench to the main camp area, and for the last 50 m the cable lay on the ground in deep tussock grass. The cable was brought from under the Science Building into the instrument room through an opening in the floor, and terminated in the switchboard which consisted of 3 wooden boxes mounted on the pillar in the instrument room. All cables leading either into or out of the instrument room were through the opening in the floor and were terminated at the switchboard in sockets.

Another wooden box with sockets was mounted in the battery room, and cables were taken from this box, through a hole drilled in the floor, under the Science Building, and terminated at the switchboard in the Instrument Room.

Five new 12 V accumulators plus 6 V accumulator were placed on the battery tray in the battery room.

A trench was dug from the Science Building to the Variometer Hut, and 100 mm conduit laid in it. A hole was drilled in the wall of the Science Building and another through the floor of the variometer hut. Two 12-core cables, one 6-core cable, one 2-core pyro cable, one twin-flex electrical cable (for the mains 240 V supply), and a draw-wire were pulled through the conduit. These cables were taken through the hole in the Science Building wall and up into the Instrument room, to be terminated at the switchboard. At the other end the cables were pulled up into the variometer hut, and left unterminated.

On 12 December the darkroom sink was moved to the Science Building, and the seismic and magnetic records were processed there. On 7 January 1981 geophysics operations were transferred to the Science Building. The central console was moved to the instrument room, and connected to the switchboard. The cables leading into the variometer hut were terminated at the appropriate places, after removing the old cables. The inverter which provided the 240V 50 Hz power for the seismic and magnetic recorders was moved to the battery room and connected to the switchboard and batteries.

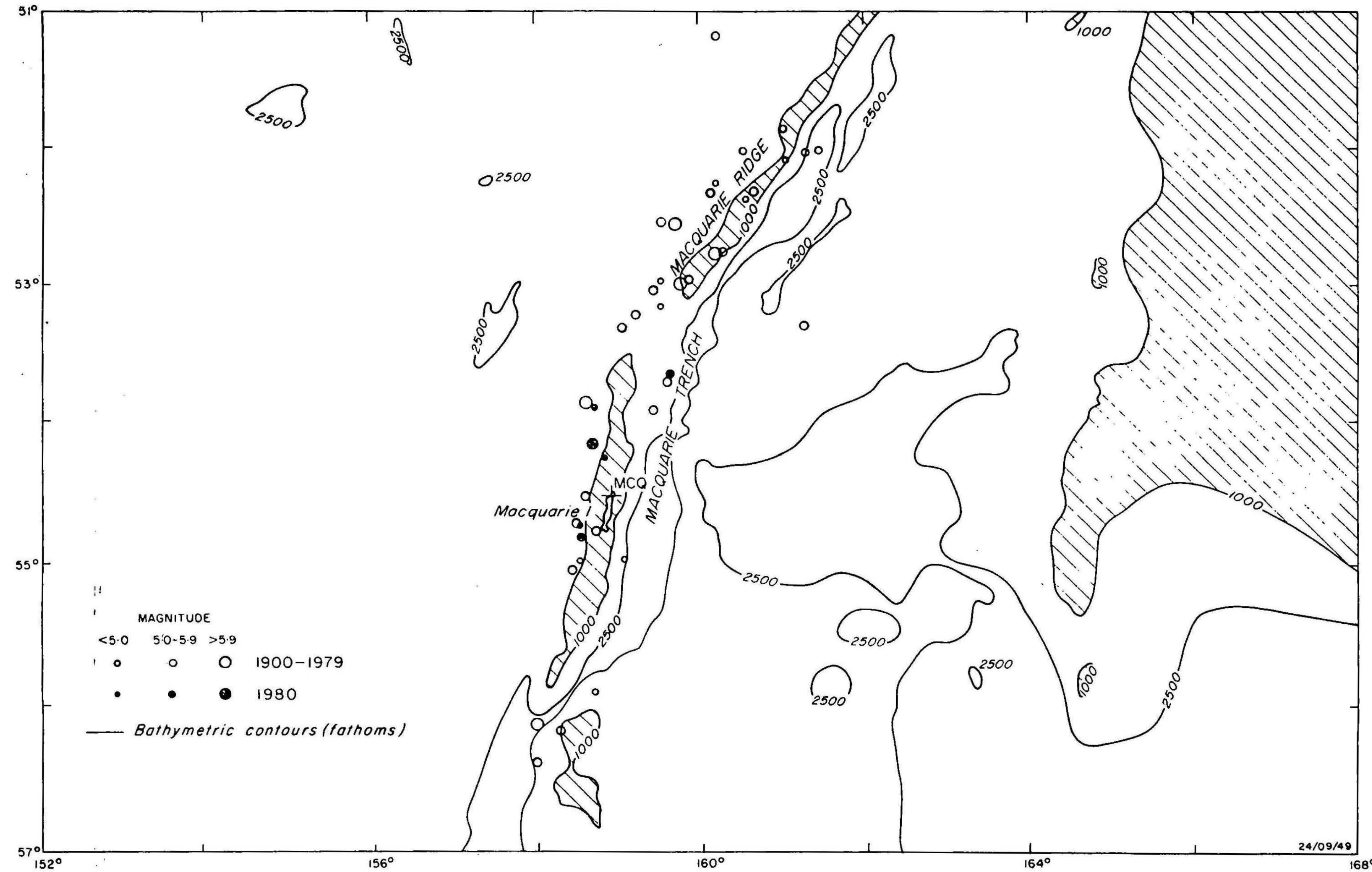


Fig.7 Seismicity in the Macquarie Island region

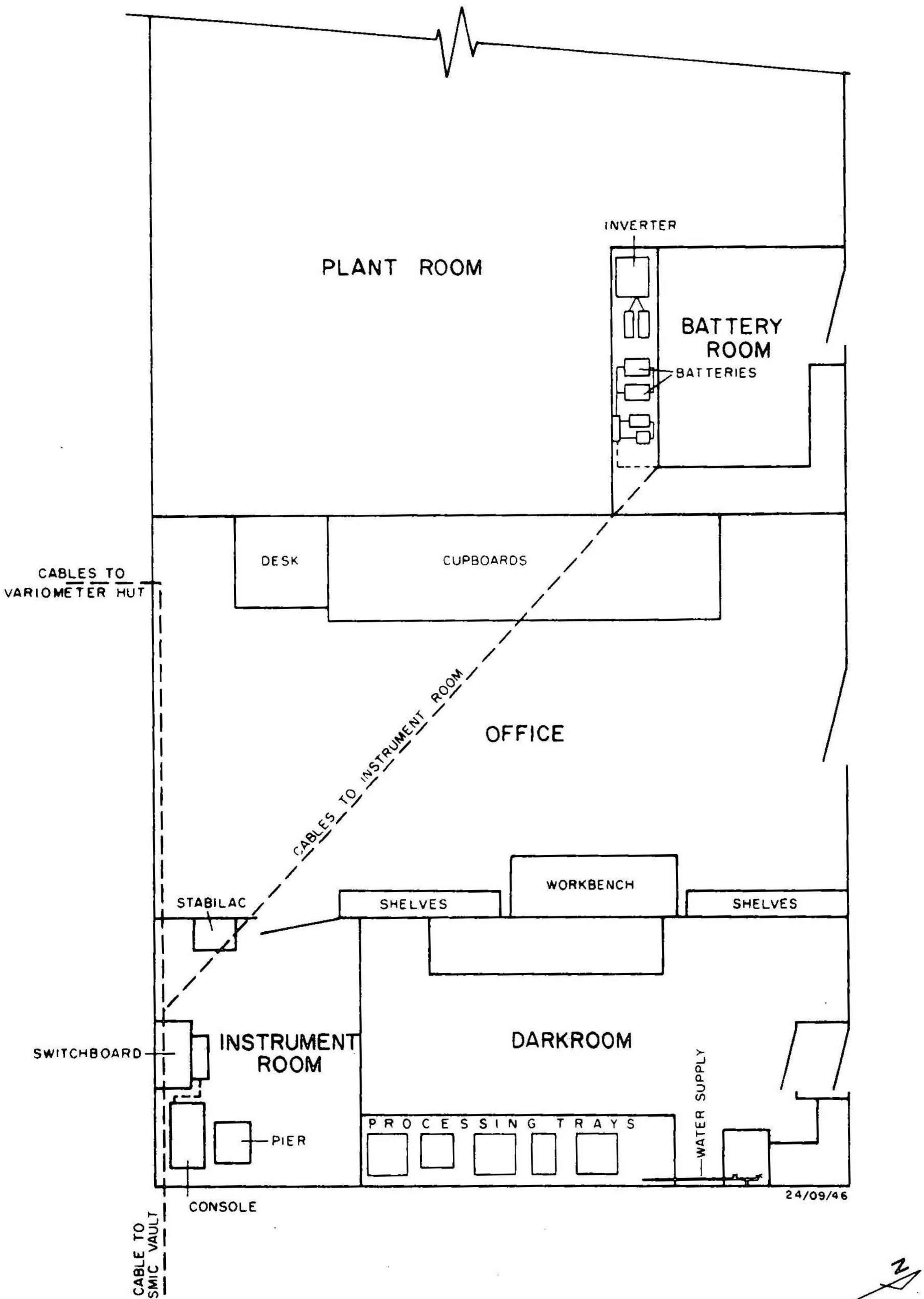


Fig. 8 Plan of Geophysics laboratory (not to scale)

The inverter was externally synchronised by an EMI clock on the central console to give an accurate 50 Hz supply. The secondary power supply, a 240V Stabilac had previously been mounted on a shelf in the instrument room and connected to the switchboard. The total down-time for the magnetic and seismic systems was about 4 hours.

Two small items of equipment were built during the year. A switch with indicator light was installed in the absolute hut, and connected to a relay mounted in the central console. This enabled the magnetograph time-marks to be switched back on from the absolute hut, instead of the geophysics office as before. Also an orientation test circuit was installed on the central console. Although orientation tests are normally done only once a year, this new arrangement enables an orientation test to be done quickly if the variometers are disturbed in any way.

5. ACKNOWLEDGEMENTS

The author thanks all members of the 1980 expedition; in particular the two physicists, G. Burns and D. Barrett, for looking after the observatory during the author's absence on field trips, and also the Meteorological Officer in Charge, K. Batt, for meteorological advice during the year.

6. REFERENCES

BOBROV, V.N., and PAVLOVICH, L.K., 1967 - Influence of Humidity on QHM readings. Geomagnetism and Aeronomy Vol VII, No. 4, p 618-620.

CHAMBERLAIN, N.G., 1952 - Observations of Terrestrial Magnetism at Heard, Kerguelen and Macquarie Island, 1947-48. Bureau of Mineral Resources, Australia - Report 5.

CLEARY, J.R., 1958 - Geophysical work at Macquarie Island December 1956 - December 1957. Bureau of Mineral Resources, Australia - Record 1958/66 (unpublished).

DAVIES, P.M., 1981 - Macquarie Island Geophysical Observatory Annual Report 1978. Bureau of Mineral Resources, Australia - Record 1981/18 (unpublished).

ERVIN, R.E., 1952 - Determination of differences in the magnetic elements between the absolute stations on the north end of Macquarie Island. Bureau of Mineral Resources, Australia - Record 1952/52 (unpublished).

FARR, C.C., 1944 - Terrestrial Magnetism, British and New Zealand Antarctic Research Expedition 1929-31 Reports Series A Vol. IV, Part 1.

GIDLEY, P.R., 1981 - Macquarie Island Geophysical Observatory Annual Report 1976. Bureau of Mineral Resources, Australia - Record 1981/26 (unpublished).

HILGER & WATTS LTD., 1964 - Instruction manual for the Willmore Seismometer Mk. II.

JACKA, F., 1953 - Magnetic Observations at Heard, Kerguelen and Macquarie Island 1947-51. Australian National Antarctic Research Expedition Reports Series C, Vol. 1.

McGREGOR, P.M., 1954 - Geophysical work at Macquarie Island 1952-53. Bureau of Mineral Resources, Australia - Record 1954/32 (unpublished).

MANN, P.E., 1959 - Geophysical work at Macquarie island December 1954 - December 1955. Bureau of Mineral Resources, Australia - Record 1959/134 (unpublished).

MEATH, J.P., 1971 - Macquarie Island Geophysical Observatory Annual Report 1970. Bureau of Mineral Resources, Australia - Record 1971/129 (unpublished).

OLDHAM, W.H., 1953 - Report on work at Macquarie Island 1951-52. Bureau of Mineral Resources, Australia - Record 1953/30 (unpublished).

RICHTER, C.F., 1958 - ELEMENTARY SEISMOLOGY. San Francisco, W.H. Freeman.

TURPIE, A., 1959 - Geophysical work at Macquarie Island 1958. Bureau of Mineral Resources, Australia - Record 1959/123 (unpublished).

WAKE-DYSTER, K.D., 1981 - Macquarie Island Geophysical Observatory Annual Report 1979. Bureau of Mineral Resources, Australia - Record 1981/19 (unpublished).

WEBB, E.N., 1925 - Terrestrial Magnetism. Australian Antarctic Expedition 1911-14, Scientific Reports Series B, Vol. 1, Part 1.

APPENDIX 1

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 and Absolute Huts erected.

1968 - Geophysics office constructed.

1979 - Science building 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.

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

1956 Feb - Short-period Grenet vertical seismograph installed.

1961 Jan - Benioff three-component short-period seismograph; Grenet and Wood-Anderson seismographs withdrawn.

1962 Nov - Benioff horizontal seismographs withdrawn.

1967 Dec - Willmore Mark I vertical seismometer used to test sites near Seismograph Hut for seismic noise; the Willmore replaced the Benioff SP-Z which was withdrawn.

1969 Dec - 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 Seismograph Hut.

1973 Jan - Willmore Mk II replaced the Willmore Mk I in Seismograph Hut. Willmore Mk II remained in use on plateau.

1974 - Plateau landline failed early 1974 and site abandoned.

1975 - 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.

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

Magnetic Observatory (Variometer Hut)

1950 Aug - 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.

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

1962 Dec - Normal La Cour magnetograph was replaced by a La Cour rapid run magnetograph (1980 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	After	Before	After
	Normal	Rapid-run	Insensitive	Normal
H(nT/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

1968 26 Feb - On 26 Feb, the D fibre was replaced in an attempt to reduce erratic drift. On 9 March 1968, H fibre was replaced - scatter and drift continued. The H scale value was reduced to 23.7 nT/mm.

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

1978 - Recording ceased on the rapid run magnetograph.

MAGNETIC OBSERVATORY (Absolute Instruments)

Date	Declination	Horizontal Intensity	Vertical Intensity	
	Instrument/Circle	QHM	ELSEC PPM	BMZ
1950	DCK 158	DCK 158		
1951	QHMs	QHMs 177,178,179		64
1952	QHMs	177,178		64
1953	QHMs	177,179		64
1954	QHMs	178,179		64
1955	QHMs	177,178		64
1956	DCK 158	177,179		64
1957	DCK 158	178,179		64
1958	DCK 158	177,178		64
1959	DCK 158	178,179		64
1960	(instrument numbers not specified)			
1961	DCK 158	177,178		64
1962	DCK 158	178,179		64
1963	DCK 158	177,179		64
1964	DCK 158	177,179		64
1965	640505/640620	177,178		64
1966	640505/640620	177,179		64
1967	640505/640620	178,179		64,236
1968	640505/640620	177,178,179	592/339	236
1969	640505/640620	177,178,179	592/339	236
1970	640505/640620	172,177,179	592/339	236
1971	640505/640620	172,177,178	592/339,434	236
1972	640505/640620	172,177,178,179	592/421	236
1973	640505/640620	177,178,179	592/421	236
1974	640505/640620	177,178,179	592/421	236
1975	640505/640620	172,177,178	592/421	236
1976	640505/640620	177,178,179	592/421	236
1977	640505/640620	177,178,179	592/421	236
1978	640505/640620	177,178,179	592/424	236
1979	640505/640620	177,178,179	592/271	236,221A
1980	640505/640620	177,178,179	592/271	236
1981	640505/640620	177,178,179	MNS2/2	236

MAGNETIC OBSERVATORY (Intercomparison Instruments)

Date	Declination	Horizontal Intensity	Vertical Intensity	
	ASKANIA/CIRCLE		PPM	BMZ
1955	508813	QHM 179		121
1956	508813	QHM 178		115
1957	509320/508813	QHM 177,288		121
1958	509320/508813	QHM 179, HTM 5010154		211
1959	instruments not specified			
1960	580339/	QHM 178, HTM 154		221A
1961	580339/	QHM 174, 179		221A
1962	instrument numbers not specified			
1963		QHM 178	MNZ-1/1	211
1964		QHM 177	MNZ-1/1	221
1965	640505/	QHM 177	MNZ-1/1	221
1966	640812	QHM 178, HTM 154	Elsec	
1967	640812	QHM 177, HTM 154	Elsec	
1968	640812	HTM 154		
1969	580333/	QHM 172, HTM 154		
1970	580333/	QHM 178, HTM 704	592/424	
1971		QHM 173, 179		
1972	580333/	QHM 174, HTM 704	592/339	
1973	509320/	QHM 172, HTM 704	595/339	
1974	640812/	QHM 172, HTM 704	592/271	
1975	640812/	QHM 179, HTM 704	592/271, 340	
1976	640812	QHM 172, HTM 704	592/424	
1977	640812/508810	QHM 172, HTM 704	592/424, 429 Geom. 816/1023	
1978	580333/508813	QHM 172, HTM 704	592/271, Geom. 816/1023	
1979	580333/508813	QHM 172, HTM 704	Geom. 816/1023	
1980	580333/508813	QHM 172, HTM 704	MNS2/2	
1981	580333/508810	QHM 172, HTM 704	595/144	

Notes

1. QHMs were used to measure declination between 1951 and 1956. To improve the accuracy of D observations, the Kew Magnetometer 158 was re-introduced in 1956.

2. Between 1951 and 1968, QHMs 177, 178, 179 were used; two at Macquarie Island and the other one being re-standardised in Australia. In 1968, QHM 172 was added to this list. From 1976 QHMs 177, 178, 179 were left permanently at Macquarie Island and standardised during intercomparison observations once a year.

3. From 1968 an Elsec PPM was used for F absolutes. Z baselines were derived from the F absolutes and the previous months H baseline.

APPENDIX 2

Report of Supervisory Visit by A. McEwin: 11, 12 March 1980

Proton precession magnetometer series 592/271

A type MNS2 replaced a type 271 which P. Davies had reported as giving inconsistent readings. The 271 was working satisfactorily when I arrived. The MNS2 was tested and found unserviceable after several hours checking. It was returned to Australia for further work by the Interim Engineering Services Branch (IES).

New spare cards for 271 were left at Macquarie and the accumulation of old spares were returned to Australia for checking by IES.

Seismology and telemetry

The high impedance coil in the Willmore seismometer was replaced by a low impedance coil. The telemetry gear was removed and together with any spares and the high impedance coil was returned to Australia. Owing to lack of time the seismometer was not critically damped. This was left to the observer (P. Davies).

Transfer of azimuth mark 12-3-80

Because of the earthquake in February (which may have moved the building), it was decided to check the azimuth of the transfer lines. It was last checked in 1976 (Gidley, 1981).

See Figure 9; a tripod and theodolite was set up outside the door of the absolute hut using a plumb bob to centre over the head of a copper nail sunk in a 100 mm square wooden block which protruded about 750 mm above ground level. (Presumably this was the station set by Mann (1959)). From the tripod the angle between the centre of the circle on

Pier E and the hole in the inner wall of the variometer hut could be measured.

When reading the bearing between the theodolite and Pier E the theodolite was focussed on the telescope of the Askania circle and vice-versa. A light source (a variometer lamp connected to the terminals of the rapid-run lamp) was used as a mark in the variometer hut. It was moved along the inner edge of the spacer bar on the northern side of the hut (opposite the hole in the southern wall) until it was judged to be at its brightest as observed at the theodolite. This point was found when the lamp was upside down with the flange of its base resting on the top of the spacer bar very close to points determined on previous occasions, the positions of which depend on the centering of the theodolite. In this case the mark was 7 mm to the right of the 1955 mark (Mann, 1959), 5 mm to the right of the 1970 Traverse mark (Meath, 1871) and coincident with a drill hole marker in the spacer bar (no reference to this drill hole is made in past reports).

<u>Results</u> (in variometer hut)

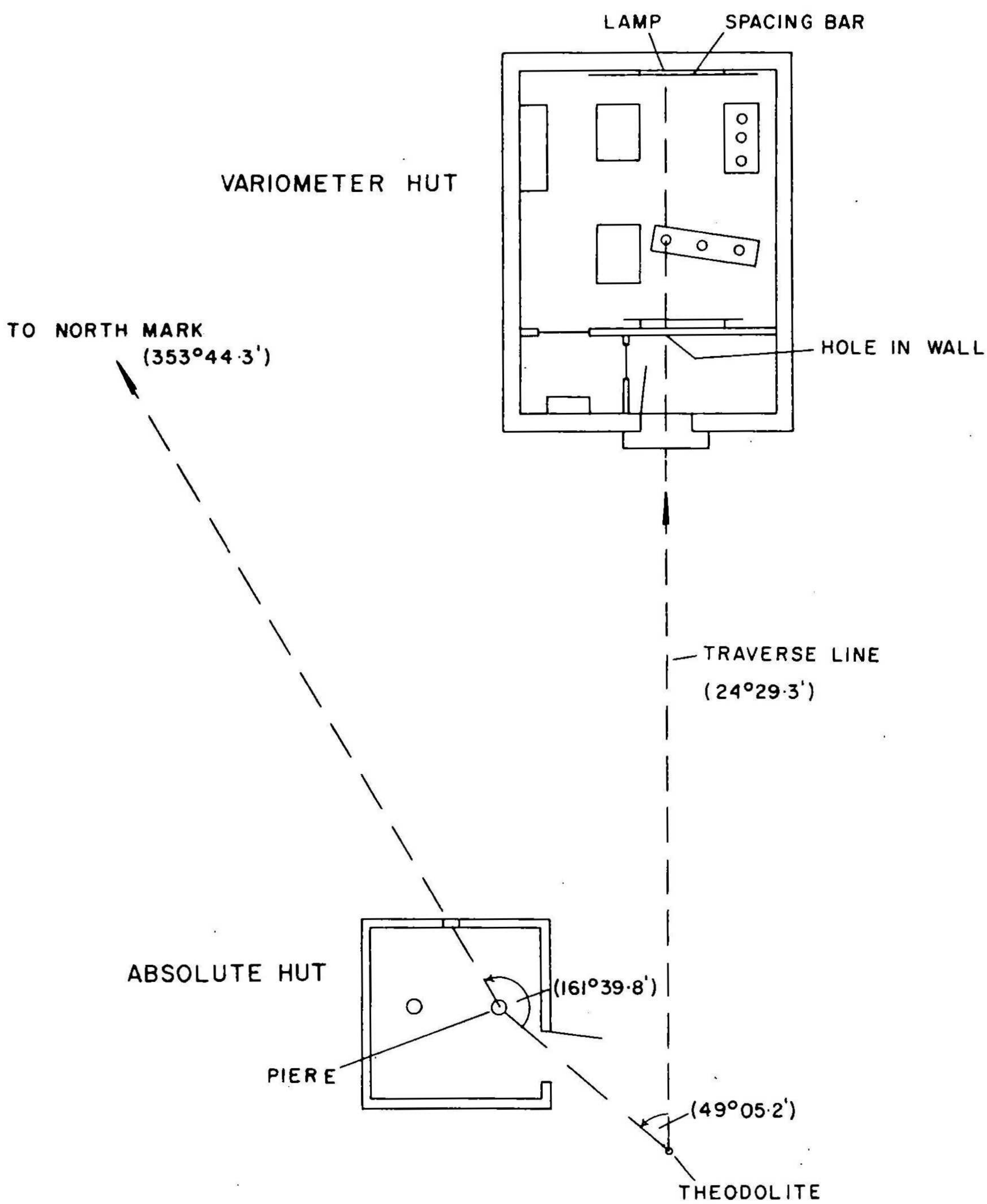
Theodolite to light	172° 59.6'	) 49° 05.2'
Theodolite to E pier	123° 54.5'	
E pier to Theodolite	302° 03.2'	) 161° 39.8'
E pier to Nth mark		
Azimuth of North Mark	353° 44.3'	
∴ Azimuth of Traverse line	24° 29.3'	

Distance between inner faces of the spacer bar 3515 mm

Distance along northern spacer bar for 29° Azimuth

= 3515 tan (29° 29.3')

= 277.4 mm



(Based on ANT/B9-23A) 24/09/58

Fig.9 Transfer of true bearing to variometer room

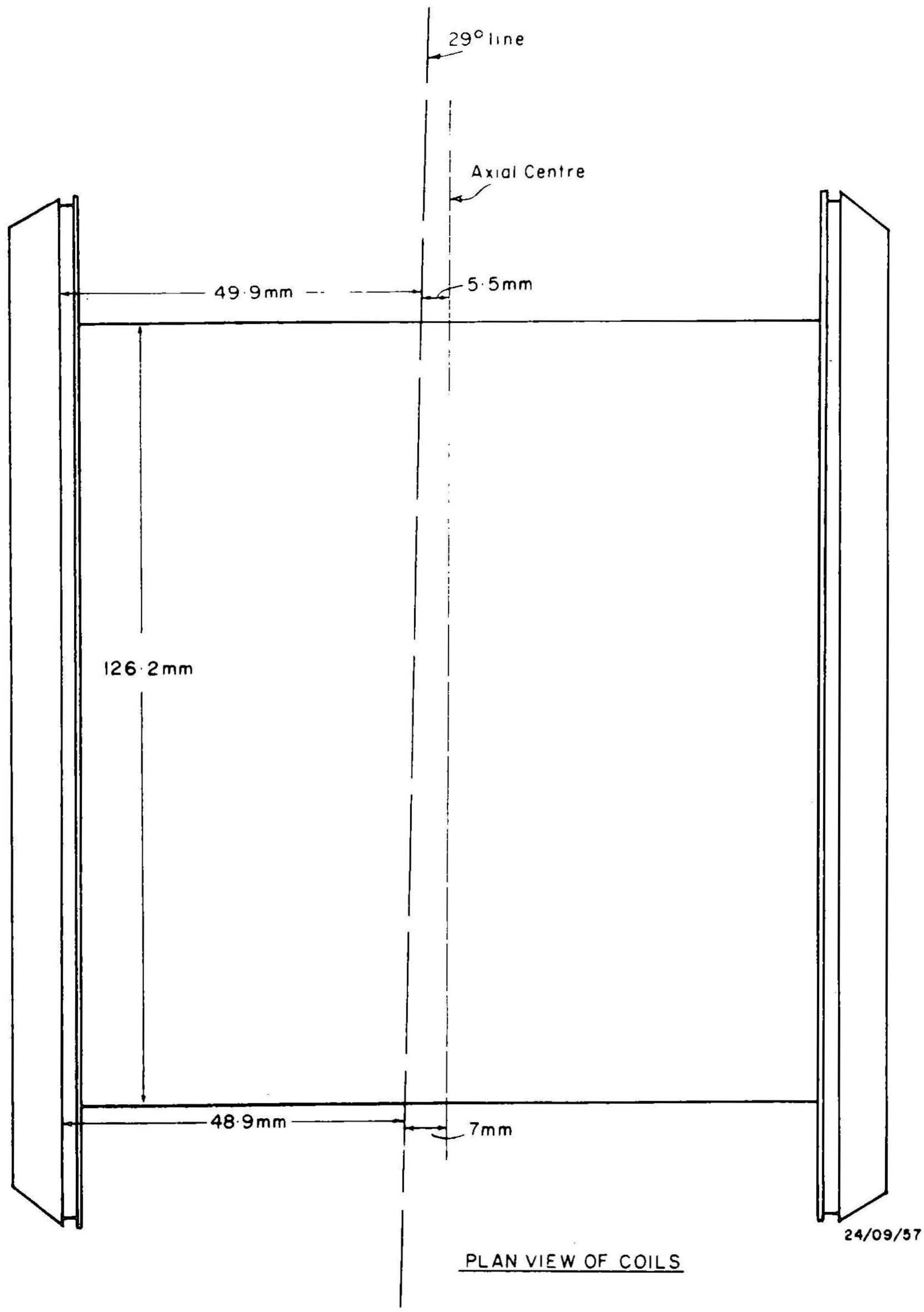


Fig.10 Ex-orientation coil plan

The above azimuth of the traverse line is 23.1' greater than Meath's result. Because of the rushed nature of the survey, it should be repeated by P. Davies paying particular care to the levelling of the instruments. No alteration was made to the current 29° reference line.

Checking orientation

Cotton strung between Meath's (Meath, 1971) 29° "V"s (weighted by brass screws) did not go over the centre of the D variometer coils but 5 to 7 mm to the west of it. Also, it was not parallel to the axial centre of the coils being 5 mm on one side and 7 mm on the other side of the coils (Fig. 10).

The following measurements were obtained -

a) a variation of 1.5 mm in the distance of the axial centre notches on opposite sides of the coil from the cotton;

b) a variation of -1.0 mm in the distance of the groove containing the coil wire (western coil) to the cotton 29° line in the opposite sense to a).

P. Davies has been using b) but has not adjusted the coils because of the disagreement by method a).

The alignment of the coils against the current 29° reference line is 1.5 mm out across the width of the coils by using the centre marks on the top of the coils. By using the edge of the coils the alignment error is 1 mm across width of the coils in the opposite sense.

No adjustment of the coils was made pending discussion in Canberra as to what part of the coils should be aligned. It seems that the coils are not symmetrical. (They are slightly damaged with wood chipped off in one place as if they have been dropped at some stage).

The error in orientation could be as much as

$$\arctan \frac{1.5}{126.2} = 0.7°$$

D. Variometer

After the earthquake of 7 February 1980, P. Davies rotated the D variometer head approximately 1400° (p. 3) to reposition the traces, there was some doubt whether residual torsion remained. The D trace and time mark trace were checked by blocking off in turn the various prisms and also the H and Z variometers. It was found that the main D trace and time trace were recording and that there was an upper and a lower reserve D trace. A torsion test was conducted to check for residual torsion by rotating the D variometer torsion head in 30° steps clockwise and then anticlockwise with a three minute wait at each position. The following results were obtained.

Torsion head	330	360	390	360	330	300	270	300	330
Time Begin		0202	0205	0208	0211	0214	0217	0220	0223
Ordinate (mm)	0	8.9	17.5	8.9	0	8.7	17.3	8.6	0
Ordinate change (mm)		8.9	8.6	8.6	8.9	8.7	8.6	8.7	8.6
Mean change (mm)		8.75 ± 0.17					8.65 ± 0.06		
Mean deflection for 30° (mm)				8.7 ± 0.1					

The difference between the clockwise and anticlockwise rotation (0.1 mm) indicates a torsion of 0.3°, which is negligible.

Optical scale value (ED) (McComb, 1952, Chapt. 7)

$$R = L - c/3 + bl$$

R the derived effective recording distance (mm)

L measured distance in mm from the front of the D lens to recording drum

c maximum thickness of cylindrical lens in mm

b 0 for plano-convex lens, plane side in

l maximum thickness of variometer lens in mm

$$b = 0, L = 746.5 \text{ mm}, \quad c = 3.6 \text{ mm}$$

$$\therefore R = 745.3 \text{ mm}$$

$$\therefore 2R = 1490.6 \text{ mm (optical Lever)}$$

$$ED = \cot 1' \, f/((f-h).\, 2R)$$

where $\tan 2h = d/R$

f angular turn torsion head (minutes of arc)

h angular turn of magnet corresponding to f

d deflection of D spot on recording paper due to angular turn in torsion head (f)

$$d = 8.7 \qquad \therefore h = 20.06'$$

Optical scale value of D $\quad ED = 2.33'/\text{mm}$

REFERENCE

McComb, H.E., 1952 - Magnetic Observatory Manual, US Department of Commerce, Special Publication 283, Washington, D.C.

TABLE 1

STATION DETAILS

	Magnetic observatory (MCQ)	Seismograph (MCQ)
Latitude		
Geographic	54° 30.0'S	54°29.9'S
Geomagnetic	-61.1°	
Longitude		
Geographic	158° 57.0'E	158° 57.4'E
Geomagnetic	243.1°	
Elevation	8 m	14 m
Foundation	Basalt	Basalt

TABLE 2

MAGNETOGRAPH PARAMETERS (NORMAL RUN)

Component	Scale Values		Standard Deviation		Temp Coeff.
	Observed	Adopted	Scale Value	Baseline	
H (JAN 01-DEC 31)	19.48	19.5	0.05	2.5 nT	3.0
D (JAN 01-MAY 31)	2.37	2.37	0.01	0.5 min	-
(JUN 01-DEC 31)	2.38	2.38	0.006	0.4 min	-
Z (JAN 01-FEB 07)	20.68	20.7	0.11	3.3 mT	-
(FEB 08 APR 30)	23.34	23.3	0.40	2.5 mT	-
(MAY 01-JUL 31)	20.72	20.7	0.08	3.2 nT	-
(AUG 01-DEC 31)	20.61	20.6	0.02	3.3 nT	-

D scale values are in minutes/mm

H and Z scale values are in nT/mm

Temperature coefficient is in nT/°C

TABLE 3

ADOPTED BASELINE VALUES, NORMAL MAGNETOGRAPH

Date 1980	UT h	UT m	Baseline Value	Remarks
Horizontal Intensity			BHs (nT)	
Jan 01	00	00	12602	
Jan 10	08	52	12616	Earthquake
Feb 07	10	50	12496	Earthquake
May 02	18	00	12440	Earthquake
Jul 13	21	00	12458	Earthquake
Nov 01	00	00	12451	Recorder Adjusted
Declination			BD (East)	
Jan 01	000	000	26° 38.1'	
Feb 07	10	50	26° 57.4'	Earthquake
Mar 12	00	00	27° 02.0'	Torsion Tests
Mar 12	00	00	27° 12.8'	Re-adjustment
Jun 01	00	00	27° 11.0'	Adoption
Aug 12	00	00	27° 10.9'	Adoption
Nov 01	00	00	27° 06.7'	Recorder Adjusted
Vertical Intensity			BZs (nT)	
Jan 01	00	00	63559	
Feb 07	10	50	63637	Earthquake
Mar 12	00	00	63624	Adjustment
Apr 01	00	00	63526	Adjustment
Jul 13	21	00	63535	Earthquake

BHs is the H baseline value at standard temperature (5°C)

BZs is the Z baseline value at standard temperature (5°C)

BD is the D baseline value

Table 4

Z thermograph parameters 1980

Date 1980 Month day hr	Scale value °C/mm	Baseline value °C
Jan 01 00	1.49	-87.8
Feb 07 11	1.25	-69.1
Apr 01 00	1.46	-85.7
May 01 00	1.35	-78.3
Jun 13 21	1.42	-82.1
Jul 24 00	1.45	-83.4
Oct 24 00	1.41	-80.2

Table 5

Preliminary monthly mean magnetic values, 1980

Month	D(E)	H	Z	F	K
	o '	nT	nT	nT	
Jan	28 24.9	12 739	-63 776	65 036	2.09
Feb	25.8	731	778	036	1.90
Mar	26.3	727	773	031	1.20
Apr	28.3	718	775	031	1.65
May	29.2	718	774	030	1.32
Jun	29.4	718	776	032	1.71
Jul	30.0	722	765	022	1.19
Aug	29.9	720	765	021	1.33
Sep	29.5	720	764	020	1.55
Oct	30.3	700	757	010	2.42
Nov	31.7	727	755	013	1.90
Dec	30.3	731	753	012	1.58
Mean	28 28.8	12 723	-63 768	65 024	1.65

TABLE 6

GEOMAGNETIC ANNUAL MEAN VALUES 1952 - 1980 AND ABSOLUTE OBSERVATIONS FOR 1911, 1930, 1948, 1950, 1951

DATE	H nT	D (east) ° '	Z nT	F nT
1911 (Dec)	13929	18 06.8	-64922	66399
1930 (Dec)	13429	19 28.4	-65230	66598
1948 (Mar)	13395	22 59.7	-64712	66084
1950 (Apr)	13477	23 31.0	-64568	65939
1951 (a)	13383	23 50.8	-64589	65961
1952 (b)	13371	24 04.2	-64550	65920
1953	13360	24 14.6	-64533	65901
1954	13356	23 28.4	-64535	65903
1955	13350	24 42.0	-64520	65887
1956	13333	24 53.2	-64506	65870
1957	13319	25 05.7	-64482	65843
1958	13307	25 16.6	-64456	65815
1959	13288	25 26.3	-64436	65792
1960	13262	25 32.0	-64414	65765
1961	13240	25 50.5	-64359	65707
1962	13216	26 05.8	-64321	65665
1963	13193	26 08.5	-64294	65634
1964	13174	26 17.0	-64249	65586
1965	13152	26 28.6	-64214	65547
1966	13121	26 37.6	-64175	65503
1967	13084	26 46.5	-64166	65486
1968	13053	26 54.7	-64132	65447
1969	13026	27 02.3	-64099	65409
1970	12996	27 09.6	-64078	65383
1971	12963	27 13.3	-64032	65331
1972	12937	27 22.1	-64008	65302
1973	12905	27 27.6	-63985	65273
1974	12865	27 34.3	-63956	65237
1975	12847	27 43.2	-63926	65204
1976	12822	27 51.6	-63891	65165
1977	12802	27 59.8	-63861	65132
1978	12773	28 11.3	-63838	65103
1979	12745	28 19.6	-63807	65067
1980	12719	29 29.4	-63770	65026

Mean annual change

1970-1980 :	-27.7	7.98	26.2	-35.7
1970-1975 :	-29.8	6.72	21.2	-35.8
1975-1980 :	-25.6	9.24	31.2	-35.6

(a) Mean of 7 absolute observations July-December

(b) Absolute observations Jan-March; final MHV from April

TABLE 7

MAGNETOMETER DIFFERENCES 1980

(MACQUARIE IS, H=12 700nT)

Method	Magnetometer			
Routine BLV	QHM 177	QHM 178	6 ± 3.5nT	0.00047
Determinations	QHM 177	QHM 179	7 ± 4.0nT	0.00055
Intercomparisons	QHM 172	QHM 177	15.1 ± 2.3nT	0.00119
Oct 1980	HTM 704	QHM 177	-13.1 ± 2.4nT	-0.00103
	Ask. 333	Ask. 505	1.5 + 0.4 min	--

TABLE 8

H BASELINE AT VARIOUS VALUES OF RELATIVE HUMIDITY

Date	Dry Bulb °C	Wet Bulb °C	Relative Humidity%	H Baseline Values at 5°C		
				QHM 177 nT	QHM 178 nT	QHM 179 nT
14 Jul	2.4	1.2	78.5	12472.8	12462.9	12462.5
16 Jul	4.6	3.9	88.5	12471.3	12464.2	12462.8
21 Jul	3.9	2.9	84	12472.8	12465.6	12465.0
25 Jul	6.9	6.4	92	12473.3	12467.1	12462.1
30 Jul	7.7	7.2	92.5	12470.9	12467.0	12467.3
02 Aug	6.3	6.1	97	12476.5	12469.0	12459.5
05 Aug	6.9	6.2	90.5	12474.5	12462.6	12462.8
11 Aug	8.0	6.8	83	12472.4	12467.1	12464.1
13 Aug	2.6	1.5	80.5	12470.1	12465.4	12462.3
16 Aug	3.3	2.2	81.5	12470.8	12464.7	12464.8
21 Aug	7.5	6.9	91.5	12472.8	12465.3	12464.9
24 Aug	7.0	6.4	91	12468.5	12464.3	12464.2

TABLE 9

ORIENTATIONS OF VARIOMETER MAGNETS

Date	Component	Ref. field	Orientation of N pole
17 SEP 1979	H	12776 nT	E 0.2° N
	D	28° 20.4'	N 1.1° E
	Z	63804 nT	N 0.6° DOWN
9 FEB 1980	H	12678 nT	E 0.2° N
	D	28° 27.0'	N 0.7° W
16 MAR 1980	D	28° 20.4'	N 0.65° W
19 OCT 1980	H	12676 nT	E 0.2° N
	D	28° 17.3'	N 0.7° W
	Z	63762 nT	N 0.6° DOWN

TABLE 10

AZIMUTH OF TRAVERSE LINE

Date	Azimuth
1955 (MANN, 1959)	24^{o} 05.9'
1970 (MEATH, 1971)	24^{o} 06.2'
1976 (GIDLEY, 1981)	24^{o} 11.6'
1980 (McEWIN)	24^{o} 29.3'
1980 (DAVIES)	24^{o} 14.3'

TABLE 11

CHANGE IN SEISMOGRAPH MAGNIFICATION BETWEEN 2dB LEVELS

OF ATTENUATION

Attenuation dB	P-P Amplitude of 1 Hz Sinewave, mm	Amplitude Relative to 32dB Atten.	Ratio of Amplitudes
1) Jan 01 to Mar 10			
28	55.2	1.57	1.25
30	44.1	1.26	1.26
32	35.1	1	1.29
34	26.9	0.77	1.22
36	22.0	0.63	1.31
38	17.0	0.48	
		Mean ratio - 1.27 ± 0.03 (=2.08dB)	
2) Mar 11 to Dec 31			
8	73.0	1.54	1.23
10	58.8	1.25	1.25
12	47.1	1	1.27
14	37.0	0.79	1.23
16	20.3	0.64	
		Mean ratio - 1.25 ± 0.02 (=1.94dB)	

TABLE 12

SEISMOGRAPH PARAMETERS

Date	Seismometer Free Period	Galvanometer Free Period	Magnification at 1 Hz
Jan 01 to Mar 11	0.98	0.20	4200 (at 32dB)
Mar 12 to Dec 31	1.0	0.20	2700 (at 12dB)

TABLE 13

PARAMETERS OF LOCAL EARTHQUAKES DURING 1980

Date	Arrival time(UT) h m s	Origin time (UT) h m s	Epicentre		MB (GS)	Intensity (MM)	S-P (s)
			°S	°E			
JAN 10	130028.4		-	-		II	2.4
JAN 18	NO RECORD	215526.7	53.66	159.63	5.5	V	-
FEB 07	104916.3	104904.8	53.91	158.69	4.8	-	-
		104916.0	54.16	158.89	6.4	VI	-
	105915.0	105910.3	54.26	158.77	5.8	-	-
FEB 15	003423.2		-	-	-	II-III	1.5
MAR 30	035416.8		-	-	-	II-III	2.4
APR 15	124153.6		-	-	-	III-IV	2.0
MAY 02	174414.3	174406.5	54.81	158.53	5.1	IV-V	-
MAY 10	1021589		-	-	-	III	3.1
JUN 03	0606358	060627.3	54.73	158.54	-	II-III	12.9
JUL 08	084451.2		-	-	-	II	3.8
JUL 09	171354.0		-	-	-	II	13.0
JUL 13	215328.1		-	-	-	IV	-
AUG 06	205847.1		-	-	-	II	-
SEP 30	183922.0		-	-	-	III-IV	1.9
SEP 30	184559.3		-	-	-	III	1.7
OCT 13	015028.9		-	-	-	III	2.1