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MACQUARIE ISLAND GEOPHYSICAL OBSERVATORY, ANNUAL REPORT 1971

by

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CONTENTS

SUMMARY

Geomagnetic and seismological recordings were continued at the ANARE station, Macquarie Island, in 1971. Results were sent to Melbourne at regular intervals. During the year a UED seismograph recorder was installed to replace the BMR drum recorder. The new observatory control panel was slightly modified and all its functions were brought into full operation. A twelve-core cable was laid from the Geophysics Office to the magnetic recording hut to carry the extra control panel functions. Routine maintenance and various station duties were performed during the year.

1. INTRODUCTION

Programs of seismological and geomagnetic recording have been carried out at Macquarie Island since 1950 and 1951 respectively, by the Bureau of Mineral Resources (BMR). The programs are part of the work of the Australian National Antarctic Research Expeditions (ANARE), for which the Antarctic Division, Department of Science, provides accommodation and logistic support.

The geophysical observatory work was done by the author during the interval 1 December 1970 (when he succeeded J.R. Meath) to 27 November 1971 (when he was succeeded by M. McMullan).

Information concerning the previous operation of the observatory can be obtained in BMR publications (e.g. McCue, 1971; Meath, 1971).

2. GEOMAGNETISM

The geomagnetic recording instruments in operation on Macquarie Island during the period under review were:

1. La Cour normal-run (15 mm/h) three-component magnetograph.
2. La Cour rapid-run (180 mm/h) three-component magnetograph.

The relevant parameters for the instruments are listed in Table 3.

Baseline values were calculated from control observations made about 4 times a month. The absolute instruments used in 1971 were: QHMs 172, 177, 178; Askania declinometer 640505; BMZ236; Elsec proton precession magnetometer (PPM) 339 to the beginning of March and Elsec PPM 434 from March to the end of May.

The replacement of PPM 339 became necessary when one of its readout meters ceased to function. Some trouble was experienced in obtaining correct Z baseline values with the PPM because of a change in procedure. Previously the magnetometer sensor had been placed on two thick blocks of wood standing end-on-end, which were themselves resting on a concrete pier. With this set-up the sensor was about 50 cm above the concrete pier and everything worked satisfactorily. However, the length of cable attached to the replacement sensor was short and only allowed the blocks of wood to be laid on their sides, which meant the sensor was only about 12 cm above the concrete pier. At the time, this change was not considered sufficient to alter the results, but the Z baseline values obtained in March, April and May, as calculated from PPM readings, were too high.

This was attributed at the time to a fault in the PPM and consequently PPM readings were stopped in May and subsequent Z baseline values were calculated solely from BMZ readings. It was realised on return to Canberra that the high baseline values were caused by the sensor picking up magnetic interference from the pier. The PPM readings for March, April, and May were corrected to make the Z baselines as consistent as possible with previous values. The corrections were determined from a series of pier comparison tests performed by M. McMullan in January 1972.

The BMZ suffered a minor mishap in December 1970 when the knife edges fell off the agate bearings after a bump. The instrument was subsequently repaired, but its correction was changed.

Normal-run magnetograph

The normal-run La Cour operated throughout the year. Record loss was caused by (a) the slit slipping out of position, (b) the drive motor gears not engaging properly, (c) optical adjustments to traces, and (d) the drum jamming. A number of records have no Z temperature trace and for these the H temperature trace was used for baseline calculations. Table 4 contains details of the normal-run thermographs. Some records have an intermittent trace which was caused by the stop-start motion of the recording drum. This problem was overcome by attaching a brake to the drive shaft of the drum. The time marks on the D trace disappeared in January 1971 and were not returned until December 1971.

The Z trace was difficult to keep in focus and often when the other traces were sharply focussed it was slightly blurred.

Early in March all magnetic recording was stopped for 10 days when the new control panel was modified and installed. At the same time a new 12-core cable was laid between the recording hut and the Geophysics Office to accommodate the extra functions of the new control panel. Before March some of the magnetograph functions had been operated from a separate panel.

Baseline value changes

D baseline values changed several times in the year without apparent reason. The H baseline value remained constant for the 12 months of 1971 although it underwent several changes in December 1970. Changes in observed baseline values and their causes are listed in Table 1; no corrections have been applied to the absolute instrument results in arriving at the observed values.

Rapid-run magnetograph

The rapid-run La Cour performed satisfactorily, but because of the poor quality of the mirrors the traces were thick and uneven. The only record losses occurred when the carriage failed to move across the recording drum and when the shroud was left up after scale value measurements had been carried out.

Scale values for the rapid-run variometers stayed constant throughout the year.

Orientation tests

Orientation tests were carried out on the three normal-run variometers in November. The orientation coils, which had been installed on the H and D variometers in 1970, made the testing easy. The orientation current was supplied by an MCO-3 source situated in the Geophysics Office. The Z orientation test was performed using a standard magnet whose magnetic moment was known. The results obtained, which are listed in Table 2, were consistent with those obtained in 1970 and no adjustments were necessary.

Auxiliary systems

Magnetograph calibrator. At the beginning of the year the calibrator system was situated in the anteroom of the magnetic hut, but when the new 12-core cable was laid to the magnetic recording hut the system was transferred to the Geophysics Office. The calibrator performed satisfactorily, but was susceptible to RF interference during radio schedules.

Observatory control Panel. Construction of the new control panel was begun in 1970 but all its components were not operative until its installation was completed in March 1971. The control panel, housed in a metal cabinet in the Geophysics Office, consisted of a PPT-1 power and timing control panel, a TMU 2 observatory timing unit, an E.M.I digital clock, and a magnetograph control panel.

The panel performed its functions in a very reliable manner. Occasionally the digital display on the TMU 2 unit would get ahead of the E.M.I. clock, probably because of spurious pulses in the line. The only other minor problem arose from fluctuations in the current for the magnetograph trace lamps. The cause of this was not determined.

A Stabilac voltage stabiliser was installed during the year to maintain a constant voltage for the control panel.

E.M.I. Clock. The digital clock performed well throughout the year. The only trouble it gave was when the reset mechanism for the digital display would not function properly.

3. SEISMOLOGY

During the first 9 months of the year the seismograph system consisted of a Willmore Mk II seismometer (free period 0.98 s), coupled to a Benioff short-period galvanometer (free period 0.2 s), and a BMR single-drum recorder which revolved at a chart speed of 30 mm/min. Time marks were provided every minute by a Mercer chronometer.

The trace lamp received its power from a pair of trickle-charged 6-volt batteries connected in parallel. The drive motor for the drum was driven by the 240V mains supply. The emergency power source for the drive motor was a d.c./a.c. inverter fitted with a relay that connected a bank of dry cell batteries in the event of a mains failure.

Because of a series of lamp failures in the BMR recorder a single-drum UED recorder was installed; it had a drum speed of 60 mm/min, and was used for subsequent seismic recording. Two days records were lost during the equipment changeover. The adjustment of the optics in the new system proved difficult, especially those related to the time-mark relay. It was found that the spring-mounting on the time-mark mirror was held too tightly, not allowing the mirror freedom to rotate. The optical system was adjusted, and it then recorded satisfactorily.

Records were changed daily, normally about 2300 UT (11 a.m. station time). Daily time checks were made on the Mercer chronometer using VNG time signals obtained from a Labtronics radio receiver. Seismograms were processed and the data cabled to Melbourne. About 300 earthquakes were finally reported to the International Seismological Centre at Edinburgh. At least 6 local earthquakes were felt on Macquarie Island. They were characterized by mild shaking of the huts. Two of these earthquakes were subsequently re-located using arrival times at other stations. The epicentres are listed in Table 5.

4. OTHER DUTIES

Apart from the general magnetic and seismic duties, the author was responsible for the operation of a tide gauge for the Horace Lamb Institute for Oceanographic Research (Flinders University). Records were changed every 3 or 4 days and time corrections noted daily. In January and February the tide gauge was out of action while repairs were made to the siphon system, which had disintegrated because of salt water corrosion.

Several weeks were spent on general station duties (which were shared by all members of the expedition) and in providing assistance to the biological program. Several weeks were spent as relief physicist.

Routine maintenance was carried out as required on the huts during the course of the year.

5. ACKNOWLEDGEMENTS

The author thanks all members of the 1971 expedition for their support. More specifically he would like to thank G. Colback, the OIC, who spent considerable time looking after the equipment in the author's absence; and John Major, the physicist, who provided invaluable advice and help on equipment matters, and spent many hours helping to rectify problems.

6. REFERENCES

McCUE, K.F., 1971 - Macquarie Island Geophysical Observatory, annual report 1969. Bur. Miner. Resour. Aust. Rec. 1971/13 (unpubl.).

MEATH, J.R., 1971 - Macquarie Island, Geophysical Observatory, annual report 1970. Ibid., 1971/29 (unpubl.).

TABLE 1. OBSERVED NORMAL-RUN MAGNETOGRAPH BASELINE VALUES

Date	Time	Before	After	Reason
H		nT	nT	
6-12-70	0016	12727	13686	Torsion head on variometer was bumped
10-12-70	0400	13686	12686	Baseline readjusted after previous bump
01-01-71	0000	12686	12636	Unknown
01-12-71	0000	12636	12628	Unknown
D		deg. min.	deg. min.	
16-01-71	0100	26 50.0	26 44.9	Unknown
21-03-71	0100	26 44.0	26 43.4	Unknown
13-05-71	0500	26 43.4	26 48.3	Unknown
Z		nT	nT	
13-05-71	0000	63766	63611	Changed from PPM to BMZ

TABLE 2. ORIENTATIONS OF VARIOMETER MAGNETS

Component	Reference field	Date	Orientation Magnet N Pole
Normal-run - H	13018 nT	20-11-71	E 0°.4 N
- D	27° 23.5'	20-11-71	N 1°.0 E
- Z	64056 nT	20-11-71	N 0°.3 down
Rapid-run - H			
- D	NO TESTS		
- Z			

TABLE 3. MAGNETOGRAPH PARAMETERS

Component		Scale Value	Standard Deviation		Temp. Coeff nT/°C
			Scale Value	Baseline	
Normal run	H	19.30	0.09	5	+3
	D	2.38	0.02	0.5	-
	Z	20.75	0.07	8	0
Rapid run	H	5.30	0.08	-	-
	D	1.00	0.01	-	-
	Z	6.30	0.06	-	-

D values are in minutes or minutes/mm;

H & Z values are in nT or nT/mm

TABLE 4. NORMAL-RUN THERMOGRAPH 1971

From	To	St	bt
Z THERMOGRAPH		°C/mm	°C
01-01-71	08-02-71	1.4	- 64.1
08-02-71	19-02-71	1.4	- 63.6
19-02-71	24-03-71	1.4	- 62.9
24-03-71	01-04-71	1.4	- 62.5
01-04-71	22-04-71	1.4	- 63.3
22-04-71	27-04-71	No Z Temp. Trace	
27-04-71	04-05-71	1.4	- 63.9
04-05-71	01-06-71	No Z Temp. Trace	
01-06-71	01-08-71	1.4	- 63.5
01-08-71	01-10-71	1.4	- 62.8
01-10-71	31-12-71	1.4	- 62.3
H THERMOGRAPH			
01-01-71	14-04-71	4.1	-225.4
14-04-71	01-05-71	4.1	-223.0
01-05-71	31-12-71	4.1	-234.0

On days when there was no Z temperature trace the, H temperature trace was used.

TABLE 5. EARTHQUAKES NEAR MACQUARIE ISLAND

Date	Origin Time UT	Lat. °S	Long. °E	Depth km
02 FEB 1971	19 06 17.7	54.34 S	159.43 E	H = O
04 FEB 1971	01 19 42.7	53.98 S	158.69 E	H = O