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Record No. 1971/87

Macquarie Island Geophysical Observatory, Annual Report, 1968

by

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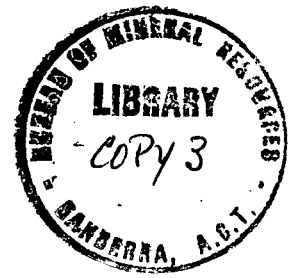
MACQUARIE ISLAND GEOPHYSICAL OBSERVATORY, ANNUAL REPORT 1968



by

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CONTENTS

TABLES

ILLUSTRATIONS

SUMMARY

This Record is an operational report on the Macquarie Island Geophysical Observatory for the year 1968. Scientific results from the observatory are published separately.

Both magnetic and seismological instruments were operated at the Observatory. The magnetographs comprised H, D, and Z variometers of medium sensitivity and H, D, and Z rapid-run variometers of high sensitivity coupled to normal-run recorders. The seismograph comprised a Mark I Willmore vertical seismometer and a BMR recorder. During the year eight locations were tested in an attempt to find a site where the noise level was appreciably lower than at the present vault; none was found.

A complete new geophysics office was erected and occupied during the year.

1. INTRODUCTION

Geophysical observatory work (comprising the operation of magnetic and seismological observatories) was continued at Macquarie Island in 1968. It was part of the Bureau of Mineral Resources' program and was made possible by the Antarctic Division, Department of Supply, which provides all logistic support for Australian National Antarctic Research Expeditions (ANARE).

The seismological observatory at Macquarie Island has been in operation since 1950 and the magnetic observatory since 1951 (Oldham, 1953).

The seismic observatory instruments originally consisted of two horizontal Wood-Anderson seismometers. A vertical Grenet seismometer was added in February 1956. These were replaced in 1961 by a three-component set of Benioff seismometers. In 1962 the horizontal Benioffs were withdrawn and in 1967 the vertical seismometer was replaced by a Willmore Mark I because the station was considered too noisy to warrant retaining the Benioffs.

The magnetic observatory variation equipment originally consisted of a medium-sensitivity normal-run magnetograph; this was supplemented in 1959 with a very insensitive normal-run instrument. In 1963 both were replaced by the present instruments, which consist of a normal-run magnetograph with a sensitivity between those of the two previous instruments, and a rapid-run high-sensitivity magnetograph (Gregson, 1965).

The author was responsible for the BMR program in 1968 and succeeded J.A. Major in December 1967; he was relieved in December 1968 by K.F. McCue. In addition to this program he continued the search for an improved seismograph site in the vicinity of the ANARE station, established a new geophysics office, and maintained recorders for other institutions.

2. GEOMAGNETISM

Both the normal- and rapid-run control panels were rewired into one panel before being moved to the new building. This was considered advisable as the old panels had been added to over the years and no complete wiring diagram was available. A time mark unit (TMU2) was installed to provide time marks for the magnetic records. It was driven from the 12-V magnetograph power supply, and was connected to the Mercer chronometer which gave a closure every minute. From this input the TMU2 produced one closure every five minutes and three on the hour. A twelve-core cable was laid in a trench from the variometer hut to the office to connect the control panel to the variometers. Plate 1 shows the path of the cable between the variometer house and the new office.

Magnetograph data are contained in Table 1.

Normal magnetograph

D variometer. The D baseline value drifted erratically during February and March. The drifting ceased about 25 March but no definite cause could be found for it. In an attempt to rectify the fault the screws holding the torsion head were tightened, but this made no difference. The fibre was replaced on 26 February. Again this made no difference to the erratic baseline values. The drifting could have been due to the Elsec proton magnetometer being left too close to the absolute hut during D absolute observations.

H variometer. The H baseline values drifted erratically after the variometer was jogged when the D fibre was replaced on 26 February. On 9 March the fibre was replaced and waxed into its mounts. This resulted in the drift normally associated with a new fibre being superimposed on the scatter. It was found later that the adoption of a temperature coefficient of -5 gammas/^{o}C (compared with the old value of +2 gammas/^{o}C) reduced the scatter and enabled reasonable baselines to be computed for the year. This coefficient was adopted from 26 February when the variometer was jogged.

Z variometer. The Z variometer functioned normally except for some unexplained baseline value jumps early in the year, which could have been due to the Elsec proton magnetometer being too near the absolute hut during Z absolute observations.

Note on Elsec. During absolute observations the Elsec proton magnetometer was left close to the door of the absolute hut until 9 March when it was discovered that at this distance it had an effect of roughly 8 gammas on the vertical field at the Z pier. The effect at the H & D pier would have been more. If the proximity of the Elsec magnetometer was causing the baseline drifting, one would expect all three variometers to be affected. However, for much of the period prior to 9 March the H, D, and Z baseline values were undisturbed, and during the rest the D and Z

baseline values were disturbed while the H baseline value remained steady until the variometer was accidentally jogged.

Rapid-run magnetograph

No trouble was experienced with the rapid-run variometers. A gap was cut in the Z scale-value coil former to allow more light to reach the mirrors. The synchronous motor on the recorder was replaced with a BMR type on 10 February.

Orientation tests

Orientation tests were performed on all variometers during July. The results are given in Table 2.

Reconciliation of orientation tests. Secular changes of the three components at Macquarie Island at 1968 were:

H : 30 gammas/year decreasing numerically; D : 9 mins/year increasing easterly; Z : 30 gammas/year decreasing numerically.

Therefore the effects of secular variation should cause the variometer magnets to move as follows:

D : follow the meridian easterly

H : normal-run - North pole to move N

rapid-run - North pole to move S

Z : North pole to dip downwards.

The H magnets will be most affected by secular variation, because the effects of H and D changes are additive.

Table 2 includes the results of the last orientation tests made, adjusted where possible to the epoch of the 1968 tests. They show that both sets were compatible within $\pm 0.2^{\circ}$, which is about the accuracy to which the testing coils can be aligned.

Absolute instruments

Absolute instruments used during the year were QHMs 177, 178, 179; Declinometer 505; BMZ 236; and Elsec Magnetometer PPM 339.

PPM readings were taken until June, when they were discontinued. The author considered that they would be of little use in deriving Z baseline values, as the H baseline values which were required for the determination appeared at the time to be unreliable.

QHM 179 had a thermometer which was unreadable. A new one was provided in March and until then the thermometer from 178 was used in both 178 and 179. The free turn knob on the BMZ had a tendency to come loose so that the turn magnet could not be rotated.

Pier comparisons

Pier comparisons between the external proton magnetometer pier and the pier in the absolute hut were done once a month. The results are given in Table 3. On three of these occasions the comparison took the form of a survey on a one-yard grid over an area including both piers.

Intercomparisons

Intercomparisons were performed at the end of the year between QHM 177 and HTM 154 and between declinometers 505 and 812. No Z comparisons were performed as Headquarters in Canberra had anticipated that these would be obtained from a Z baseline derived from proton magnetometer readings. However, proton magnetometer readings had been terminated in June, as explained above.

3. SEISMOLOGY

A Willmore Mark I seismometer coupled to a Benioff short-period galvanometer and a BMR recorder was in operation during the year. For approximately nine months, testing for quiet sites was carried out. This involved operating the seismometer at eight sites on the isthmus and Wireless Hill. Coaxial cable linked the seismometer with the recorder in the vault. Quieter sites were found, but not quiet enough to warrant building a new vault.

During the year, 397 earthquakes were recorded. Of the total, 128 (32%) were teleseisms and 269 (68%) locals, 34 of the teleseisms and 13 of the locals were identified from the USCGS preliminary determination of epicentre sheets.

Arrival times of phases from all events which could be identified were punched onto cards and sent to ISC in Edinburgh.

Two of the local quakes were large enough to be felt on the Island. One on 24/06/68 at 0523 GMT was felt by most people in the main station, and one on 30/10/68 at 1241 GMT was felt at the station and at Bauer Bay. Other large locals were felt, but only by one or two people.

The results of seismograph system tests are given in Table 4.

Modifications to seismic system

3/01/68 New 'Labtronics' time-signal receiver installed in seismic office.

4/01/68 Galvanometer mounting adjusted. The galvanometer was formerly tilted by mounting it on a sloping surface. The sloping surface was removed and the galvonometer tilted using its own swivel mounts.

2/09/68 Control panel rewired. The new circuit was essentially the same as the old, but was mounted on matrix board instead of hanging loose. Wiring and switches from obsolete circuits were removed.

4. NEW OFFICE BUILDING

The new geophysics building was erected and occupied. The outer walls, roof, and some partitions of the new office were erected by the carpenter with help from 'working bees'. The remainder of the work on the building partitions, painting, internal fittings, linoleum laying, and skirting were done by the author with help from the O.I.C. for the linoleum laying. A plan of the new office is given in Plate 2.

The magnetograph control panel together with the Mercer chronometer and the TMU2 were installed in the new building. The system was driven from a 12-V battery continuously charged by a battery charger in parallel with it.

5. MISCELLANEOUS

Magnetic micropulsations recorders (Geophysical Institute, University of Alaska)

The charts on the micropulsation recorder were changed daily until July, when the chart speed was reduced, and the records were then changed every few days. Maintenance of the recorders was the responsibility of the auroral physicist.

Tide Gauge (Horace Lamb Centre for Oceanographic Research, Flinders University)

The author was responsible for maintenance and changing the records of the tide gauge. Records were changed once every three days. The syphon failed once owing to leakage round the tap in the line. It was restored using the fire pump; the engineer assisted in this operation. The tap had in fact the wrong fittings for the pipe, and new fittings were ordered from Flinders University.

The difference in level between Blake's bench mark put in in 1911, and the tide gauge was determined using the theodolite.

Sunshine recorder (J. Jenkin, Botany Department, University of Melbourne)

The sunshine recorder was read daily and the silica gel was changed when necessary.

Sea temperature (R. Simpson, Mawson Institute, University of Adelaide)

The sea temperature was taken daily.

Other Duties

Two and a half weeks 'slushy' duty were done, and for this period only the essential routine observatory work was performed. 'Working bees' on Wednesday and Saturday afternoons were attended and assistance was given with painting buildings during the latter half of the year.

6. ACKNOWLEDGEMENTS

The author is grateful for general co-operation by all members of the 1968 party during 'working bees' on the new office, and for particular assistance from Mr H. Thelander for carrying out the routine work during the author's absences. Messrs P. Cutler, H. Simpson, and J. Hasick gave valuable assistance with the new office block, and W. Goodall helped in restoring the syphon to the tide gauge.

7. REFERENCES

GREGSON, P.J., 1965 - Macquarie Island Geophysical Observatory Work 1963. Bur. Min. Resour. Aust. Rec. 1965/23.

OLDHAM, W.H., 1953 - Report on work at Macquarie Island 1951-1952. Bur. Min. Resour. Aust. Rec. 1953/30.

TABLE 1

MAGNETOGRAPH DATA

Instrument		Nominal Scale value	Standard deviation		Remarks
			Scale value	Baseline value	
Normal-run	H	24.7	±0.11	2.0	Before 26th Feb.
	H	23.7	±0.12	6.2	After 26th Feb.
	D	2.35	-	0.2	Before 15th Feb.
	D	2.35	-	0.25	After 15th Feb.
	Z	20.7	0.08	2.2	
Rapid-run	H	5.36	0.03		
	D	1.00	0.001		
	Z	6.20	0.07		

D values in minutes and minutes/mm

H, Z values in gammas and gammas/mm.

TABLE 2

VARIOMETER MAGNET EX-ORIENTATION ANGLES

Component	Magnet N pole		Remarks
	1968	previous*	
Normal-run			
D	Jul 22 N 0.1° E	*(a)	Fibre replaced 1968
H	Jul 22 E 0.6° S	(a)	Fibre replaced 1968
Z	Jul 26 N 0.1° D	N 0.1° D (1)	
Rapid-run			
D	Jul 29 N 0.8° E	N 0.5° E (2)	
H	Jul 29 W 1.0° S	W 0.7° S (2)	Before adjustment
	Jul 31 W 0.6° N		After adjustment
Z	Jul 29 S 0.1° U	S 0.1° D (3)	

* Previous tests adjusted to 1968

(1) Test of 1966 Jul 20

(2) Test of 1966 Jul 15

(3) Test of 1965 Oct 4

TABLE 3

TOTAL INTENSITY DIFFERENCES BETWEEN THE PROTON PIER (PM), THE EAST PIER (E), AND THE WEST PIER (W)

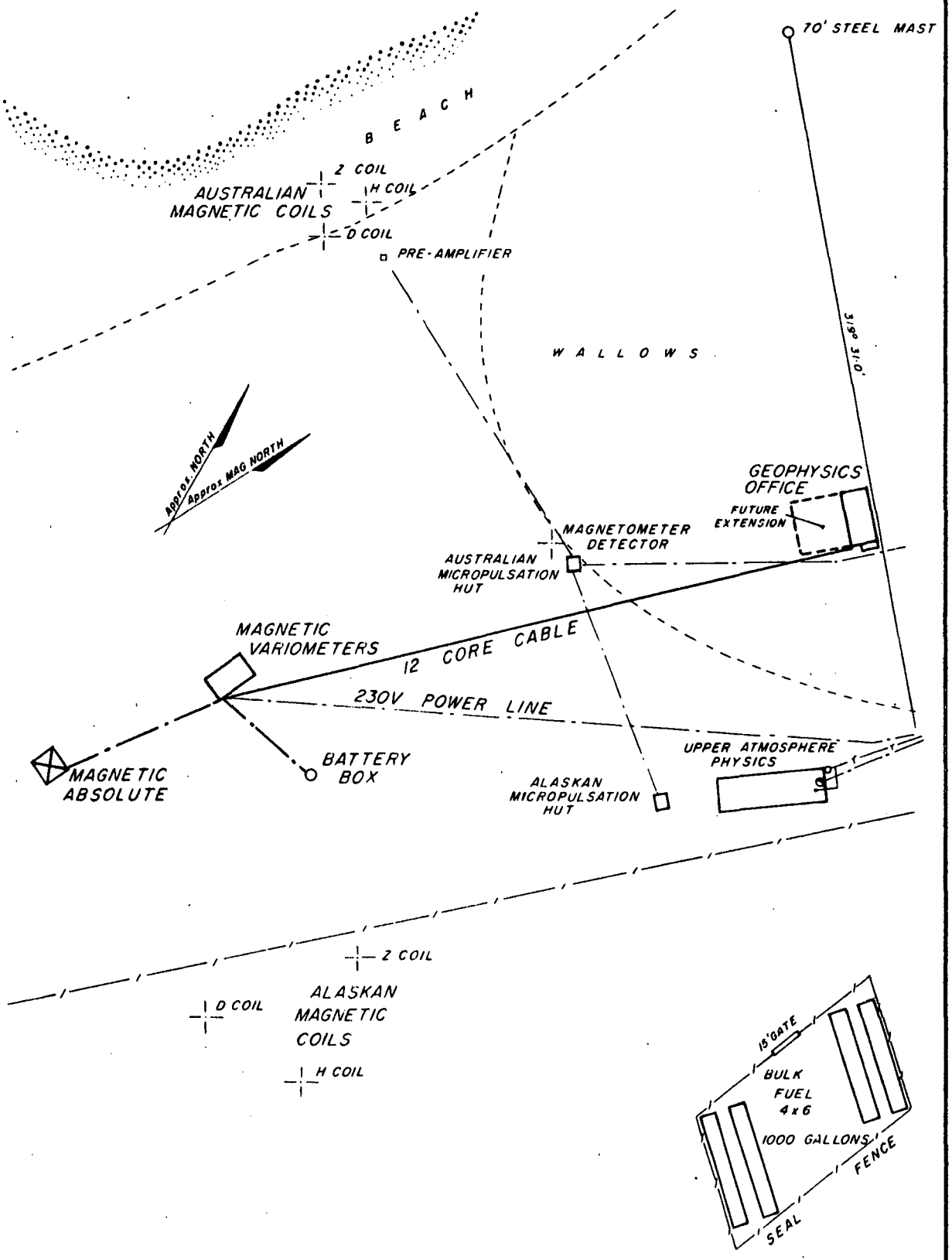
Date	PM-W gammas	PM-E gammas	Remarks
09/02/68	+ 7	+ 10	
13/02/68	+ 9	+ 6	
17/02/68	+ 7	+ 7	
23/02/68	+ 8	+ 6	
07/03/68	+ 9	+ 9	
04/04/68	0	- 9	Disturbed day (not used in mean)
17/05/68	+ 9	+ 12	
29/06/68	+ 10	+ 10	
13/07/68	+ 11	+ 11	
30/08/68	+ 10	+ 10	
22/07/68	0	0	incomplete survey) not used
19/10/68	+ 3	+ 3	survey) in mean
/11/68	+ 4	- 1	survey)
Mean	+ 9	+ 9	
Median	9	10	

TABLE 4

SEISMOGRAPH TESTS

Date	Seismometer free period (sec)	Seismometer damping ratio	Galvanometer damping ratio
02/02/68			20.0
06/03/68	0.91		20.0
13/03/68	0.92	5.0	
03/04/68	0.99	3.6	9.6
03/05/68	1.02	3.8	9.1
10/06/68	0.90	3.5	9.7

PLATE 1

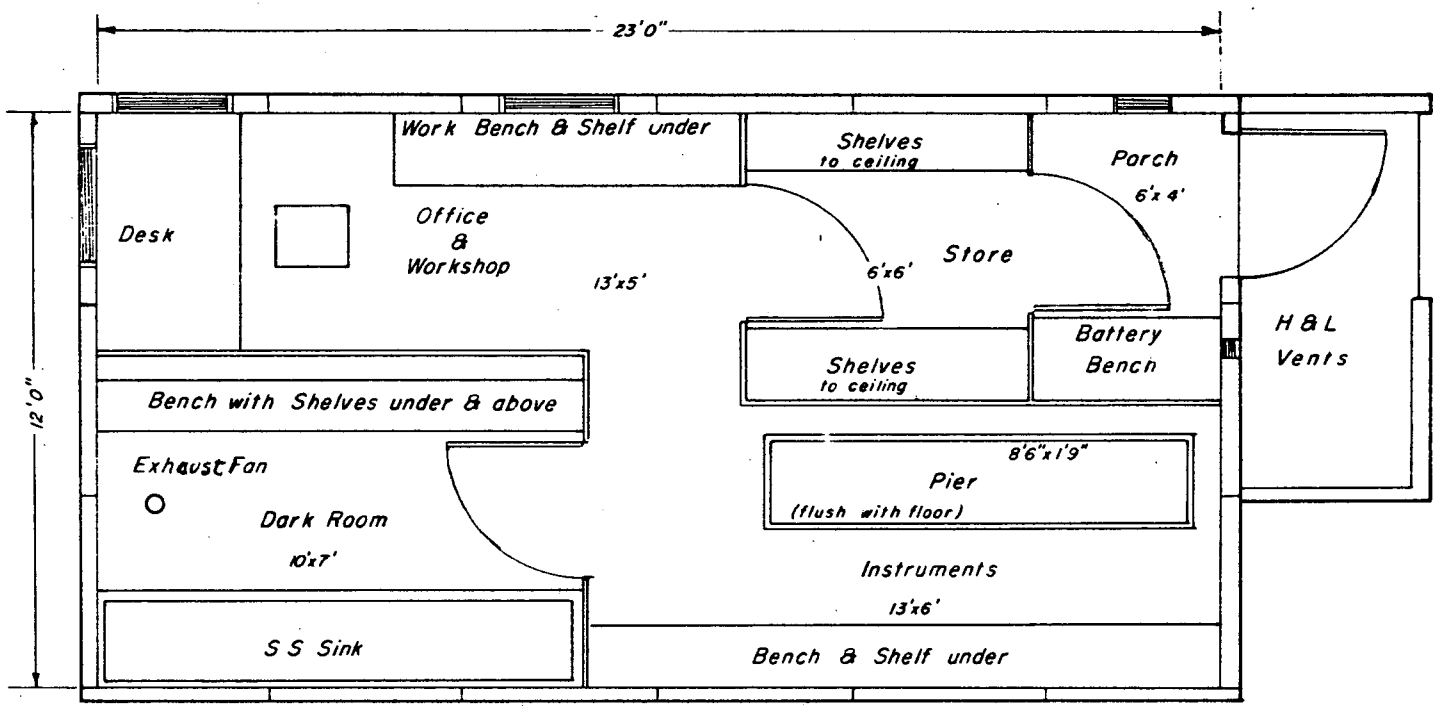


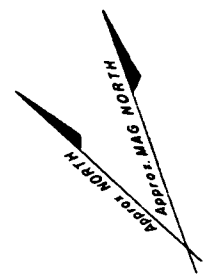
MACQUARIE ISLAND

GEOPHYSICS OFFICE

LOCATION

To accompany Record No.1971/87 ANT/B9-21A





Note: work bench & instrument bench not fixtures

Scale: 1" = 4'

MACQUARIE ISLAND

GEOPHYSICS LABORATORY

PLATE 2

To accompany Record No. 1971/87 ANT/B9-20A