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MACQUARIE ISLAND GEOPHYSICAL OBSERVATORY WORK 1962

by

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CONTENTS

SUMMARY

Operations of the Macquarie Island seismological and magnetic observatories are described. A brief outline is given of other geophysical programmes in which the author gave some assistance.

Scientific results are not included, but will be published later as separate reports.

1. INTRODUCTION

The seismological observatory at Macquarie Island has been in operation since 1950 and the magnetic observatory since 1951. Instruments operating in 1962 consisted of two La Cour normal-run magnetographs, of storm and normal sensitivities, and a three-component short-period Benioff seismograph.

Milne (1962) has described the 1961 operations. R.J.S. Cooke was in charge of the observatories from 10th December 1961 until 10th December 1962, and was succeeded by P. J. Gregson.

Earlier Records, such as those of van Erkelens (1961), Hollingsworth (1960) and Turpie (1959), include descriptions of observatory buildings, routines, and the installation of equipment.

2. GENERAL

The variometer and absolute-magnetic buildings and the office - darkroom were painted externally during October and November, 1962. Roofs and walls were scraped and caulked where necessary before painting commenced. The condition of the magnetic buildings, which are in exposed positions, was not very good. Many patches of rot, some quite extensive, were discovered. Outside beams on both magnetic buildings required complete replacement. Older layers of paint peeled off in large sections on some parts of the exteriors, and the plywood panels beneath such areas were quite damp. A window of the absolute house was broken during repairs. The space was boarded up pending arrival of a new pane on the relief ship. Most of the tie-down ropes originally attached to both buildings were broken and the remainder were rotten. All were removed and not replaced. With winds up to 96 m.p.h. recorded on the camp anemometer in 1962, no movement of the buildings could be detected, although the records would almost certainly have been affected if the variometer house had moved. The present magnetic buildings appear to have limited lives because of their condition, although there is no immediate likelihood of gross deterioration.

The office and seismic vault were in good condition. Occasional leaks occurred at the junction and these were caulked as necessary. The store building was not as good. In particular the roof, being unlined galvanised iron, was in poor condition. It is understood that the building will be repaired in 1963.

Because of severe power restrictions during the year, electric radiators and strip heaters were banned except where vital. Thus the office heater and the thermostat-controlled vault heater could not be used at all. One permanent strip heater was kept in use in the vault, and seemed sufficient for keeping the instruments dry, but the office and darkroom interiors were always slightly damp owing to the continual use of water in the darkroom. In particular, the darkroom floor was never dry. This caused difficulty in drying records completely, and changes in the shrinkage of records were noted over long periods. Some sort of heating for the office-darkroom is necessary, but the space is too small for a kerosene heater to be used comfortably. With the completion of a new power station in 1963, electrical heating may possibly be restored.

Occasional freezing of the water supply did not seriously affect darkroom operations. Several times during the year, complete blockages occured in the darkroom-sink outlet pipe, but these were cleared fairly easily with caustic soda.

On one occasion, the office radio aerial was blown down in a heavy storm, owing to severe corrosion at the anchor. The anchor section was modified and the aerial restored.

3. MAGNETIC OBSERVATORY

Programme and instruments

The magnetographs were of the La Cour type. In 1962 both operated at normal recording speeds of 15 mm/hr with sensitivities as follows:

	H (γ/mm)	D (min/mm)	Z (γ/mm)
Normal sensitivity	12.6	0.92	14.2
Low sensitivity	63.1	2.36	59.5

Temperature coefficients were low for the normal instrument, but rather large for the low-sensitivity instrument, being about 17γ/$^{\circ}$C for the Z variometer of the latter. Recording with the low-sensitivity and the normal-sensitivity magnetographs was discontinued on the 5th and 6th December 1962 respectively. The normal-sensitivity instrument was replaced by a La Cour-type rapid-run magnetograph (180 mm/hr); the low-sensitivity instrument, whose H and Z sensitivities were too low to be generally useful, was modified to operate at sensitivities intermediate between those of the original variographs. The Record of the 1963 work will include details of the re-installation.

Baseline control was achieved by nominally-weekly semi-absolute observations and scale-value determinations. Actual days of observation depended on the disturbance level as seen from the previous day's trace. In particular the scale-value determinations had to be done on the quietest days to obtain reasonable accuracy. Helmholtz-Gaugain coils were used for scale-value measurements. Absolute observations were done with two of a set of three QHM (No. 178,179), a BMZ (No. 64), and a DCK Kew-pattern declinometer (No. 158). These instruments are compared annually with a QHM or HTM, a long-range BMZ, and an Askania declinometer brought from Toolangi; one of the three QHM (No. 177 in 1962) is returned annually to Melbourne in cyclic order for this purpose. During the intercomparison series in December 1962, a proton-precession magnetometer was used for total-field observations.

Data reported monthly during the course of the year comprised K indices and preliminary monthly mean values of the three elements based on ten selected quiet days. Special effects, sudden commencements, storms etc., are reported annually.

Orientation tests

At the beginning of December 1962, the orientation of both H variometer magnets was checked using Helmholtz-Gaugain coils. The magnetic meridian adopted for the period was 26°01.7'E. This was laid out in the variometer hut relative to the known azimuth by direct measurement.

H-exorientation angles were 14 min and 8 min for the normal and low-sensitivity instruments respectively, the north end of the recording magnets being north of the prime vertical in each case. This is quite satisfactory as the current secular variation of declination is expected to reduce these discrepancies.

Absolute observations

No trouble was experienced with the two QHM.

Very early in the year BMZ 64 was moved while unclamped, with the result that the balance magnet was displaced from the agate flat. The magnet was checked and seemed to be undamaged. After careful relocation of the magnet, it was found that a change of about 30 γ in the instrument's correction had occurred.

The plane of movements of the BMZ turn magnet was about 10 degrees or more out of the magnetic meridian and had apparently been this way for some years. This was corrected in December 1962 by P.M. McGregor, who visited the Island to take part in alterations and new installations at the magnetic observatory. The disc correction for the instrument was checked early in the year, and the figure already in use was verified. In June 1962, in response to a request from Head Office, the magnetic moment of the BMZ field magnet was determined using a QHM (end-on position). This was necessary to calculate the magnetic effect at the Z pier when the BMZ was stored in the cupboard of the absolute building.

As in other years trouble was experienced with breakages of the DCK declinometer fibre, because there is no way of clamping the instrument while removing or inverting the magnet. At one stage during the year, the rack and pinion for raising and lowering the fibre was slipping during the course of an observation. This necessitated the dismantling and repair of the mechanism, which was successfully done. The scale value of the declinometer magnet graticule was checked by direct observation with the instrument during a disturbed period; this check verified the figure already in use. D baseline scatter was relatively large during the year and it seems likely that more-reliable data would be obtained if an instrument of the Askania type were permanently employed at the Island. This would also be easier to apply because of the awkwardness of the present instrument, the length of time required for a set of observations, and the poor quality of the telescope.

The usual azimuth mark for D observations was Anchor Rock, a rockstack off the coast, but when there was mist or fog, a subsidiary post was used for a mark. However, it was discovered towards the end of the year that this post had slightly moved, its azimuth changing by 3.8 min. This movement was attributed to the cattle, which had been observed scratching themselves against other posts and buildings and which roamed in the area of the magnetic observatory.

Magnetograph operation

Total losses of record for the year amounted to 28 hr for the normal-sensitivity instrument and 79 hr for the low-sensitivity instrument. In general, traces were fair, although some could have been much better, especially the normal-sensitivity Z during the last weeks of the year, and the low-sensitivity H. The low-sensitivity D baseline faded so much that it recorded only occasionally for some months of the year. This was apparently a climatic effect, and it was recording again towards the end of the year. Occasionally, fading or spreading of some traces was observed. This was usually due to cobwebs or fogging, and once to water leaking on to the prism rack.

Examples of faults causing loss were clockwork-drive failure, burning out of trace lamps, blowing of battery fuses, partial blackening of records because of accidental exposure to light, and once, carelessness with a paper shade. At one stage during the year, time marks were missed several times owing to shorting out by water leaking on to the switchboard terminals; caulking eventually stopped this leak.

At the end of March, one cell of the magnetic observatory accumulator failed, and a new battery was installed. The trickle changer used here gave no trouble at all during the year.

The La Cour pendulum clock operated well. As is usual, its daily rate was rather variable, but it gave no operational trouble.

The operation of changing the drying agent, phosphorous pentoxide (P_2O_5), invariably caused quite severe mechanical upsetting of the variometer magnets, in particular for the H variometer. However, it did not cause any baseline changes. Early in the year it was found that unless the glass containers were dried, considerable heat was released after refilling with powder. This caused a temporary change of the variometer temperature.

Towards the middle of the year, it became increasingly hard to make scale-value measurements owing to fluctuations in the currents. The dry cells used as the power source and the two helipots in the circuit were replaced by new ones. These changes improved the performance considerably, but not to the required degree. The remaining trouble was eventually traced to a dirty joint. After cleaning this no more trouble was experienced.

Bulldozer operations on the isthmus early in June cut and buried the power cable to the magnetic observatory. Repairs were difficult owing to lack of any plans and diagrams of the disposition of power cables and junction boxes in the camp. Eventually a complete new segment of line was laid. On a second occasion, a nick in the same cable, caused by digging operations, resulted in loss of A.C. power until the cable damage was discovered and repaired. A.C. power was lost temporarily on a number of other occasions owing to over-loading and blowing of fuses. The magnetic observatory line was of only temporary standard for most of the year. It was run through part of the meteorological section lines, and most blowing of fuses occurred here. On all such occasions there was a drop in trace intensity but not sufficient to cause loss of records. However, when relatively long repairs were being made to cables, the insensitive recorder was usually switched off to conserve battery power in case of unexpected difficulty in restoring the supply. In the work programme for 1963, redistribution of power for the whole camp is planned, so that the standard of supply should improve and the cables should be easier to locate.

Miscellaneous

Some special events and other interesting occurrences noted on the records are worth mentioning.

The high-altitude nuclear explosion at Johnston Island on July 9 1962 caused considerable magnetic effects at Macquarie Island.

Pearl-type micropulsations (with periods of the order of 1 to 2 sec) were observed on a number of occasions. These were positively identified as such by correlation with records obtained from an induction loop during the early months of the year. This apparatus is briefly described in Section 5. These micropulsations could be seen mainly on the normal-sensitivity H trace, although occasionally more clearly on the D trace. The amplitudes in some cases were larger than expected, but they were apparently increased by resonance of the variometer magnet. The resonance peak appears to be quite narrow, because the correlation mentioned earlier showed that not all pearl events were recorded by the variometer. Thus the only data that may be usefully obtained from the normal-run records consist of the times of occurrence, and these only for some of the events. That they were recorded at all appears to be due to a coincidence of the micropulsation periods and the natural period of a variometer magnet being the same. The data however are sufficient to show that local midday is a distinctly preferred diurnal time of occurrence.

Macquarie Island is one of the few Southern-Hemisphere stations in the auroral zone, and in addition is conjugate to an Alaskan station, Kotzebue. Because of this favourable situation and the high frequency of micropulsations in the auroral zone, the author believes that the scientific value of the station could be greatly increased by installing a micropulsation recorder.

4. SEISMOLOGICAL OBSERVATORY

The instrument in use during the year was a three-component short-period Benioff seismograph consisting of 1-sec seismometers, 0.2-sec galvanometers, and a three-channel 60-mm/min photographic recorder. Timing was obtained from a chronometer, the rate of which could be kept within a few tenths of a second per day.

During the year it was decided in head office to withdraw the two horizontal seismometers, and on 25 November 1962, recording ceased temporarily in order to dismantle these. The horizontal seismometers and the recorder were packed for return to Melbourne. A single-drum recorder from Melbourne was to be installed to operate with the vertical component. The seismometer periods were checked in November and verified as correct within a few hundredths of a second.

There was little loss of records apart from some caused by power failure. Loss of time marks was rare except for a few days in July when the chronometer broke down during the author's absence from camp. The spare chronometer, without hour contacts, was installed and operations continued until the end of the year with minute marks but without hour marks. Only once did a recorder time-mark relay need adjustment.

Occasional minor loss of records resulted from unrolling of records from the drum owing to slackness of the clamp-bar retaining springs. These springs had to be adjusted regularly. Sometimes overlapping of trace occurred owing to a drum failing, for some unknown reason, to move along the axle. Battery voltage slightly lower than normal on some occasions was sufficient to prevent the operation of one of the main timing relays. No trouble was experienced with the accumulators or associated trickle charges.

During the year about 50 distant shocks were reported, data being sent twice weekly (when necessary) to head office, for forwarding to the United States Coast and Geodetic Survey. Usually only the first P phase was recorded, although in a few cases other P group phases were observed. On no occasion were the horizontal components useful for such shocks. About 250 shocks from the Macquarie Island region were recorded of which 10 were reported. Few of these were large enough to record at other stations, and again, the horizontal components were rarely of particular use. Four of the local ones were felt at the station. The largest had an estimated intensity V on the Modified Mercalli scale. Heavy microseismic disturbance was the cause of the low number of shocks reported, and the attenuations of the seismometer signals were altered occasionally to suit the prevailing microseismic level.

The T phase was positively identified for the first time at Macquarie Island during this year, and further details will be published elsewhere. Other minor projects, such as the plotting of observed Love-wave dispersion from regional shocks, were undertaken.

5. ADDITIONAL GEOPHYSICAL PROGRAMMES

During the year an all-sky auroral camera was operated by the Radio Supervisor as an ANARE programme.

Between the December 1961 changeover and early March 1962, a team of five physicists, four American and one Australian, carried out a series of experiments involving several related techniques for upper atmosphere investigations. The equipment used included a riometer (rio : relative ionospheric opacity) operating at 27.6 Mc/s, a low-frequency radio-noise recorder, an earth-current recorder, and an induction loop recorder for registration of micropulsations in three different frequency bands (the lowest period being about ½ sec). The main programme concerned high-altitude detection of X-rays and neutrons by means of a balloon-borne scintillometer and geiger counter, and associated transmission apparatus.

The author assisted in balloon launchings, and in correlating magnetic disturbance data with effects recorded by some or all of the other devices.

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