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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORDS 1960 No. 115

MAWSON GEOPHYSICAL OBSERVATORY WORK, ANTARCTICA 1959

by

M. Kirton

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ABSTRACT

The author was geophysicist in charge of the geomagnetic and seismic observatories at Mawson, Antarctica during 1959. This report describes the operation and maintenance of those observatories during that year.

1. INTRODUCTION

Descriptions of Mawson Station and the installation of the equipment have been given by Oldham (1957) and Pinn (in preparation). The author was resident geophysicist at the station during 1959. He took over the operation of the magnetic and seismic observatories from J.D. Pinn.

2. LOSS OF STATION POWER-HOUSE

On 3rd April 1959 a fire started in the station's only power-house, and all efforts to extinguish it were unsuccessful. The building containing the diesel generators, workshop, and garage was completely destroyed. Fortunately, there remained one new Petter-Maclaurin generator which had not been installed at the time of the fire. A hut was constructed from odd timber, and this generator was put into operation. However, because it had to carry the whole station load, it gave considerable trouble and stopped on the average once per day.

This interfered seriously with the year's programme; the effects on the various instruments are described below.

3. MAGNETIC OBSERVATORY

Absolute Instruments

Q.H.M. Nos. 300 and 301 were used for horizontal intensity determinations and gave a satisfactory performance during the year. Comparisons with instruments brought from Toolangi on the relief ship agreed well with previous similar comparisons.

Q.H.M. 300 was used also for declination measurements, and gave satisfactory results. The values calculated for residual torsion (alpha) from the year's horizontal-intensity determinations agreed well with previous years' values.

B.M.Z. 62 gave consistent baseline values of vertical intensity throughout the year, but comparisons with B.M.Z. 121, which was brought from Toolangi on the relief ship, for this purpose, were not completely satisfactory. This was due to a change of the constants of B.M.Z. 121 at some point on one of the journeys between Melbourne and Mawson.

Absolute observations were made at approximately weekly intervals; but owing to the high level of magnetic disturbance, the weather, and power failures, it was not possible to do these observations on the same day every week.

A number of sun observations were made to check the azimuth of the north mark. However, the accuracy was considerably less than that of the results obtained by the surveyor of the 1958 party, using star observations; consequently the latter value was adopted.

La Cour Magnetograph

(1) Variometers

These operated satisfactorily throughout the year. The only apparent baseline change was in the horizontal component variometer, and happened during a blizzard. The only criticism of the installation is that winds above 70 knots caused a blurring of up to several millimetres on the horizontal-component and declination traces. Winds above 100 knots caused these two variometers to vibrate to such an extent that the records were useless. This effect had been observed in previous years but to a much lesser degree. The cause was not found. The vertical component was not affected.

Scale values of the horizontal and vertical instruments were determined weekly by the Helmholtz-Gaugain coil method.

During prolonged power failures the variometers were operated from spare batteries which had been charged when power was available.

(2) Recorder

Stoppage of the clockwork drive caused the loss of about two days' record. The fault was found to be dirt in the drum bearings.

(3) Clock

During April the La Cour clock ceased to function. Various attempts to repair it were of no avail. The clock had been in continuous operation for several years, and it was concluded that the trouble was due to a worn bearing.

As there was no spare pendulum clock, an alternative time-mark system had to be arranged. A twin-core cable was laid from the cosmic ray hut to the variometer hut and connected to the time-mark circuit in place of the clock contacts. The other end was connected to a pair of contacts on the cosmic ray timing equipment. These contacts closed at every hour, thus giving hourly time marks on the magnetograms.

However, during power failures the cosmic ray equipment ceased recording. If this seemed likely to last for more than a few hours, the following alternative time-mark system was put in operation. The hour contacts on the Mercer chronometer, normally used for the seismograph time-mark circuit, were used to operate a battery-driven 12-volt relay. The heavy duty contacts on this relay closed the magnetograph time-mark circuit whenever the relay was energised.

Huts

Considerable trouble was experienced early in the year when power lines to the huts broke during high winds. These cables were strung from poles at a height of about four feet. They flapped a great deal during blizzards, causing fraying and breakage.

During the year the power cables were replaced by the new 'Pyrotenax' copper-covered cable, which was laid on the bare rock and held down with large stones. The low-tension cable from the battery box to the variometer hut was replaced by heavy-duty rubber-covered cable which was also laid on the rock. The battery-box, which had deteriorated badly, was replaced by a smaller box resting on the rock and held in place by many large boulders. This new system should give trouble-free service for many years.

In addition, routine maintenance and painting were carried out.

Bar Fluxmeter Magnetograph

This was operated whenever power was available. Power failures ranging from a few minutes up to several weeks occurred frequently, and were responsible for the loss of about one fifth of the year's record.

In addition, about three weeks' record was lost owing to the jamming of the paper in the take-up spool. This trouble first appeared in July. The paper presumably became a little stiffer and so would not feed through the slit on to the take-up spool. Instead it would buckle, and catch in the drive rollers and wrap itself tightly around them. Various modifications to the take-up chamber were ineffective. Finally a slit was cut in the back of the take-up chamber, and the paper was fed through this slit and allowed to fall into a light-tight box behind the camera. This arrangement proved fairly satisfactory, but the paper still jammed occasionally.

Around the fluxmeter bars a shelter was built early in the year to stop wind vibrations. This shelter was not complete when the first blizzard occurred, and sufficient snow accumulated inside it to cover the bars. The combination of snow and hut effectively prevented any further wind vobrations, even though some panels were torn off the hut during the winter blizzards. In December 1959 the shelter was rebuilt and strengthened.

4. LEET-BLUMBERG SEISMOGRAPH

The seismological programme suffered greatly from the shortage of power. About four complete months' record was lost, and on a considerable number of the remaining records the traces had drifted off-centre. A short power failure would allow the hut to cool down; when power was restored, the slow warming up caused differential expansion and mis-levelling of the pier, with resultant instability of the seismometers. In addition, the intermittent operation caused many components of both amplifier and power-supply units to break down.

5. COMMENTS

In the opinion of the writer, the geophysical results would be appreciably better if more time could have been devoted to geophysical work. This applies particularly to the seismograph, which was capable of giving a good performance if closely supervised. However, much time was required for station work in addition to the usual domestic duties; for example, the construction of three power houses and the installation of power cables.

On visits to Kerguelen and Mirny it was observed that the French party includes two geophysicists and the Russian party four, to conduct a roughly similar geophysical programme. In addition, these two stations have separate personnel for domestic and maintenance work.

6. ACKNOWLEDGMENTS

The writer is grateful for assistance from several members of the expedition; in particular, the cosmic ray physicist R. Dunlop for providing a time-mark service for the variometers and for operating the equipment during the writer's absence from camp.

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