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MAWSON GEOPHYSICAL OBSERVATORY WORK, ANTARCTICA 1961

by

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CONTENTS

SUMMARY

The author was observer in charge of the geophysical observatory at Mawson during 1961. This Record describes the operation of the magnetic and seismic observatories; the scientific results will be published in separate reports.

1. INTRODUCTION

The magnetic observatory at Mawson was established during 1955 with a three-component normal-sensitivity La Cour magnetograph, and has since been expanded to include a bar fluxmeter and an insensitive magnetograph. A seismic station using a three-component Benioff seismograph is operated in conjunction with the magnetic observatory.

A description of the station and details of the observatory installations and routines may be found in previous Records (e.g. Oldham, 1957; Pinn, 1961; Merrick, 1961).

2. VOYAGE TO MAWSON

The Thala Dan left Melbourne on 5th January 1961 to relieve the wintering parties at Davis and Mawson.

After calling at Mirny, the ship arrived at Davis on 21st January, and during the changeover operations several sets of absolute magnetic observations were completed. Unfortunately the results were slightly marred by the disturbed magnetic conditions prevailing at the time.

The ship left Davis on 26th January and arrived at Mawson on 28th January; shortly after this date the author relieved R.W. Merrick as O.I.C. of the observatory. He operated the observatory until 30th January 1962 when he, in turn, was relieved by J.C. Branson.

Intercomparison observations were carried out during the changeovers by the incoming and outgoing geophysicists. An intensive unloading and building programme occupied a considerable amount of the changeover time.

3. MAINTENANCE AND BUILDINGS

Installation of Coleman stove

In previous years the geophysics office had been heated by a stove that burnt brown coal briquettes. This system was generally dirty to operate, and office equipment and records became covered with fine yellow ash. Early in 1961 a Coleman oil-burning stove with thermostatic control was installed. With an Elcon circulating fan mounted beside it, this stove proved adequate to keep the office at approximately 68°F for the whole year, and was much cleaner and easier to operate than the briquette stove. It was found, however, that the draught meter setting was critical for correct operation, and it was necessary to use aviation turbine kerosene (ATK) as fuel during the cold months when diesel oil becomes too thick to flow properly through the feeding line and control valve. A fuel tank was erected on the pipe rack on the wall outside the office.

Office improvements

A set of bookshelves was built on the back edge of the main office desk to hold reference books, tables, cahiers, etc., thus giving more cupboard space for spares. The Eddystone radio receiver was built into one end of the bookshelf with an extension lead for a speaker near the chronometer bench. The sink bench was extended and shelves were put in on one side; a set of metal shelves was constructed under the work bench, for storing materials and spares. The exterior walls of the office were scraped down and painted, and a broken panel in the rear wall of the building was replaced.

Darkroom improvements

Wooden racks were constructed for drying the traces, and both benches were sheathed in aluminium to reduce the corrosive action of the photographic solutions. The walls above the benches were lined with lino tiles, and the interior walls were painted.

Radio receiver

Several defective valves were replaced during the year, and the set was checked by the senior technician. A new and longer aerial erected in September gave improved reception. Time signals were received reasonably clearly for most of the year on ten megacycles from WWV and WWVH, except when interrupted by magnetic disturbances or drift static. During the winter months a South African station ZUO gave very clear reception on five megacycles.

Magnetograph batteries

The accumulator supplying 6 volts D.C. for the magnetograph circuits was replaced in August when it was found that it would not hold its charge. The replacement was also defective so a third battery was used. This proved satisfactory. A variable balancing resistor was placed in the charging circuit to prevent a sharp drop in current when the charger was cut off.

4. MAGNETIC OBSERVATORY

Normal-sensitivity La Cour magnetograph

A small amount of record loss was caused by drive failure on several occasions but these periods were covered by the insensitive instrument. During the year, the optical system was adjusted to improve the focusing of the recording spots and to bring the traces to a more central position in their section of the paper. The Z cylindrical lens was found to have slipped out of level, causing the trace to be cut off by the edge of the slit. This was rectified.

Wind noise on normal magnetograph

Excessive wind noise appeared on the normal magnetograph during a severe blizzard in February, causing even the baseline spots to jump badly. On examination it was discovered that the floor of the hut was resting against one of the piers that support the variometers. A section of the floor was chiselled away and the hessian bags covering the floor opening were replaced with rubbing strip. After this no more wind noise was recorded even in the severest blizzard.

Orientation tests

Orientation tests were carried out on the normal magnetograph during November. The original azimuth line had been taken through the south wall of the variometer hut, but with the insensitive instrument in place it was not possible to use this line. A new azimuth was transferred from the absolute hut with the theodolite and taken through a hole in the east wall of the variometer hut. Two aluminium and brass brackets were mounted inside on the east and west walls to hold the aligning string, which was set up by the method used by Oldham in 1955 (Oldham, 1957). The initial tests indicated that the H-variometer was exoriented by 1° 50' and the D-variometer by 1° 20'. Both variometer heads were adjusted to align the magnets as close as possible with respect to the azimuth 61°W. Final tests gave the exorientation angles as 0° 19' for D and 0° 21' for H, which were considered to be small enough.

Insensitive La Cour variograph

The insensitive variograph was installed by Merrick in January 1961 (Merrick, 1961) and gave virtually no trouble apart from minor record losses caused by drive stoppages. During the year the D recording spot was adjusted to bring the trace to a more central position, and the Z baseline mirror was masked to remove a spurious baseline spot.

Absolute observations

Absolute magnetic observations were made approximately four times per month, during fairly quiet periods if possible. The instruments used were QHMs 300 and 301 for H, QHM 300 for D, and BMZ 62 for Z. QHM 302 was returned to Melbourne in February 1961 for serviceing and intercomparison with the Toolangi instruments. A slight adjustment to the time-mark relay was necessary to record the time marks during absolute observations on the insensitive trace.

Scale values

Scale value determinations for the H and Z variometers of both magnetographs were made several times a month, during quiet periods when possible, using the Helmholtz-Gaugain coil method. It was found that attempts during even slightly disturbed conditions gave spurious or widely scattered results, so determinations could not be made at very regular intervals. Actually it was often more satisfactory to do two sets of scale values on each of two quiet days in a month rather than to try to pick four quiet days and do a single set on each. During the orientation tests four determinations of the D-variometer gamma scale value were made using a Helmholtz-Gaugain coil.

Bar fluxmeter magnetograph

Record loss from the bar fluxmeter was very small. A tendency for the camera to jump out of gear was rectified by tying the gear lever. The paper feed rollers, which had become stiff, were taken apart and cleaned and oiled. It was also necessary to repair the spring drive to the take-up spool. During the year excessive wind noise appeared on the record, particularly on the vertical component. This was found to be due to ice accumulating on the detector coils and effectively cementing them to the ground and the sides of the cover. Several days were spent digging away the huge accumulation of snow and chipping the ice from the coils. Unless the cover can be made drift proof, the job will probably have to be done every year. The levels of the Kipp galvanometers were checked and adjusted.

Heating variometer hut

Temperature variations at Mawson are large at times, changes of up to 10°C in one day being recorded on several occasions. It was recommended that thermostatically controlled heaters be installed in the variometer hut to reduce this range. This would result in steadier operations of the instruments and easier baseline adoption procedures. Also temperature compensation adjustments would not be so critical. Non-magnetic heaters were ordered from Melbourne for 1962.

5. SEISMIC OBSERVATORY

Instruments

The seismograph consisted of two Benioff 1-sec horizontal seismometers connected to two 70-sec galvanometers, and one vertical seismometer connected to a 0.2-sec galvanometer. During winter, when the ocean freezes, the microseismic background is very low and a high magnification can be used, particularly on the vertical component. Over 1000 teleseisms were recorded during 1961, most of them between May and November.

Installation of new fibres

New gold ribbon fibres were installed in the long-period galvanometers by Merrick and the author in February 1961. During instrumental adjustments later in the year, one of these was broken but was successfully replaced with spare ribbon.

Control panels

Two Benioff control panels for the horizontal components and one for the vertical were connected. A new stand for the short-period galvanometer was also fitted.

Wiring

In an effort to reduce erratic sudden deflections of the galvanometer and slight drift, particularly on the horizontal instruments, the original unshielded wiring between the seismometers and galvanometers was replaced by shielded coaxial cable. The frames of all components were connected to the cable shielding and earthed.

Adjustments to instruments

Some time was spent adjusting the coil configurations in the horizontal seismometers to obtain optimum conditions of matching and damping. Slight modifications were made to the horizontal control panels to obtain some measure of damping control; these proved successful for the east-west component but only partly so for the north-south where it was not possible to damp the galvanometer critically. Correct adjustment of the vertical component was achieved with the new control box. The air gaps on all seismometers were checked and equalised. The collimators for the horizontal components were adjusted to provide better focusing of recording spots.

Heating recording room

An attempt to heat the seismic recording room thermostatically was abandoned, as the switching off and on of the heaters interfered with the galvanometers and spot intensities. A 500-watt heater was operated constantly during the winter months to keep the temperature around $0^{\circ}C$, as very low temperatures affect the free running of the recorder motors. No great drift in the galvanometers due to temperature fluctuations was noticed.

Long-period microseisms

Much of the record from the long-period instruments was confused by microseisms of period about 40 to 70 sec. These usually occurred between about midnight and 9 a.m. local time and were most severe when the temperature dropped sharply during the night. During blizzard conditions, when the temperature has a tendency to rise, they were usually absent or fairly small. Sutton (1962) cites a similar case in Palisades and suggests that the movements are due to the thermal instability of the air inside the seismometer case, occurring when the temperature at the top of the case is lower or falls faster than that at the bottom. In the instance cited the microseisms were removed by enclosing the seismometer in a styrofoam case heated at the top by an electric lamp. This method will be tried at Mawson during 1963.

6. TIME MARKING SYSTEM

La Cour clock

A new La Cour clock sent down at the beginning of the year was installed in the geophysics office and connected to the magnetograph by means of a time-line running to the variometer hut. This system proved much more satisfactory than the previous arrangement of placing the clock in the variometer hut. Not only was it simpler to carry out time checks, but the clock had a much steadier rate under the controlled conditions in the office where it is not subject to violent temperature changes. This was demonstrated during the year when the rate remained less than one second per day for most of the time, and the instrument gave no trouble apart from one stoppage that was apparently due to the office being shaken by high winds.

Mercer chronometer

The chronometer for the seismic instruments was removed from the recording hut and installed in the office, connection being made to the recorder by means of a time-line. As with the La Cour clock, this resulted in a steadier rate and simpler and more accurate time checks. The one disadvantage of this system is the possibility of the time-line being broken by high winds, which happened several times during the year. However, this will be obviated this year by the installation of a heavy multi-channel cable throughout the station.

7. PHOTOGRAPHIC ROUTINES

On several occasions when in the final rinse or glycerine solutions the records became rather slimy and commenced to lose the trace. This was found to be due to lack of hardening agent in the fixer and could be corrected by the addition of a few drops of acetic acid to the fixer or first rinse solutions.

8. ACKNOWLEDGEMENTS

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