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SUMMARY

The author was Observer-in-Charge of the geophysical observatory at Mawson, Antarctica, from February 1967 to February 1968. During this time the magnetic and seismic observatories were maintained in accordance with standard practice.

The difficulties experienced with instruments and the minor modifications carried out during the year are described. At the end of the year, operation of the bar fluxmeter was discontinued and the instrument was returned to Australia.

On the return voyage magnetic observations were carried out at Mackenzie Bay on the western side of the Amery Ice Shelf, and at Wilkes Base.

1. INTRODUCTION

Geophysical observatory work at Mawson was commenced in 1955 by Oldham (1957) who installed a 3-component normal-run La Cour magnetograph. Since then the observatory has been expanded to include a 3-component Benioff seismograph, an insensitive La Cour magnetograph, and a bar fluxmeter. Operation of the bar fluxmeter ceased in January 1968.

The purpose of this report is to describe the operation and maintenance of these instruments between 21 February 1967 and 20 February 1968, when the author was in charge of the observatory. The work was part of the programme of the Australian National Antarctic Research Expeditions; the Antarctic Division, Department of Supply, provided logistic support and accommodation, while the Bureau of Mineral Resources, Geology & Geophysics (BMR) provided the observer and equipment.

2. MAGNETIC OBSERVATORY

The variometer instruments comprised normal-run and insensitive La Cour magnetographs which functioned continuously throughout the year, with only minor record loss due mainly to stoppages of the clockwork drives of the recorders. During the year, many adjustments were made to the magnetographs in attempts to improve the quality of the traces. The Table gives the magnetograph constants and the preliminary monthly mean values of the magnetic elements.

Control observations

Absolute observations were done twice weekly, and more frequently during very quiet periods. The instruments used consisted of BMZ 62; QHMs 300 and 302; and declinometer ASK 332. Quiet periods were very rare during autumn and summer, and consequently it can be expected that the baseline values during these two seasons will show greater scatter. The insensitive pen-recording magnetometer at the auroral hut was of invaluable assistance in determining suitable observation periods. At the changeover in February 1968, intercomparisons were carried out using QHM 174, ELSEC PPM 340 and ASK 333.

The thermometer of QHM 302 was broken on 16 June, and after that the thermometer originally with QHM 300 was used for both instruments.

A scale-value unit, capable of delivering a constant current of any value between 10 mA and 220 mA was built by the auroral engineer, Mr Chris Thomas.

In December, D scale values were attempted using the Helmholtz coils. About six sets of measurements were made during the course of several weeks, but on no occasion were magnetic conditions really suitable for the observation of scale values. The best set gave a value of 0.85 min/mm. The value calculated from the geometry of the layout was 0.86 min/mm, and it was decided to retain this value because of the possible error in the experimental scale value. The Table shows the adopted scale values and the standard deviations of the baselines.

Temperature control

At the time the author took over the observatory, the thermostat in the variometer hut was only partially working. It could turn the radiators on, but not off. This problem was rectified in June, and after that time the variometer hut temperature was very stable, being kept at 3°C ± 1°C for most of the time. The only significant variations were during summer, when the inside temperature at times reached 5°C by the action of the sun's direct radiation combined with a higher outside temperature.

Orientation tests

Orientation tests were made on the H and D variometers of the normal-run magnetograph (N/R) and on the D variometer of the insensitive magnetograph. Difficulty was found in precisely aligning the Helmholtz coils, and it was not possible to independently check how close they were to the correct azimuth. The magnetographs were kept recording during these operations, so that any untoward effect on the variometers would be observed.

H orientation tests were first attempted on 16 March 1967. The maximum current available from the scale value unit at the time was only 40 mA, which could be expected to produce only a very small deflection. No measurable deflection was observed, and so on 17 March the coils were returned to the scale value position. The following day it was found that a major trace jump had occurred during this operation, and it was now the upper H reserve trace which was recording.

An orientation test was made again. This time a measurable deflection resulted. The variometer was determined to be approximately two degrees out of orientation, and it was calculated that the position of the trace before the jump indicated that the magnet had been within one degree of the correct orientation. The position for exact orientation was calculated, and on 24 March the torsion head of the variometer was adjusted to bring the trace to this position. A following orientation test did not produce any deflection, and the variometer was then considered to be orientated correctly.

D orientation was tested on 26 April and again on 4 and 5 May. No deflection was observed, and it was assumed that the D variometer was orientated correctly.

H orientation was again tested several times between 8 and 13 May. Again, no measurable deflection was observed, and this seemed to verify the results of the previous tests.

During October and November, several adjustments to the position of the insensitive D variometer were made, in order to recover the use of reserves and to optimize the position of the trace on the record. The variometer was tested for orientation in December, and by the resultant deflection it was seen that it was badly out of orientation. This was corrected for by successive adjustments to the torsion head, followed by orientation tests. When no further deflection was observed it was concluded that the insensitive variometer was orientated correctly for the accuracy expected of it.

Magnetograph adjustments

At the time the author took control of the observatory, the normal-run Z variometer was not recording satisfactorily. The trouble was rectified on 16 March when it was discovered that the magnet had rotated slightly about the vertical axis and its movement was consequently impeded by its supports.

At the time of changeover the normal-run D and H baseline traces were very thick and faint respectively. This was rectified by adjusting the prisms and cylindrical lenses of the recorder, and the baselines were brought to a reasonable degree of focus and intensity.

Much experimentation was also done in attempts to recover missing reserve traces. It was not possible to get good recording of the D upper reserve, because the spot could not be positioned correctly on the recorder lens when the D spot was in position. Similarly, for optimum H intensity, it was necessary to permit the upper D reserve to record in the H channel of the magnetogram.

The normal-run Z reserves could not be recovered. Also the Z trace lost intensity whenever it neared the extremities of its channel. It was thought at the time that the variometer was tilted, but it probably resulted from non-horizontality of the cylindrical lens in front of the Z recording channel.

The positions of the recording traces of the magnetographs within their respective channels were all adjusted during the year so that reserve recording would be reduced to a minimum. The baselines were also adjusted so that they would not be too remote from the normal quiet day positions of the traces.

By these adjustments it was hoped to reduce errors due to incorrect scale values and uneven shrinkage.

Bar fluxmeter

The bar fluxmeter behaved unreliably throughout the year. Trouble was experienced with breaking and slipping of the spring drive. The self starter on the electric drive motor also failed, and a day's record was lost during its repair.

As mentioned by Haigh (1967) the galvanometer installed during the 1967 changeover began to drift in the summer months. The trace was brought back into position by adjustment of the torsion head when it reached its recording limit.

The bar fluxmeter was superfluous to some extent because of the auroral 3-component micropulsation unit; consequently its operation was discontinued from 1 January 1968, and it was dismantled and returned to Australia.

3. SEISMIC OBSERVATORY

The seismic observatory operated satisfactorily throughout the year, the only significant problems being two recorder drive-motor seizures and occasional losses of time marks. Over 500 confirmed earthquakes were recorded in the year.

At the 1967 changeover, the recorder motors were being driven by the station power supply, of non-constant frequency. When the power was being produced by the Ruston generators, the frequency varied significantly and erratically from the nominal 50 Hz. When the Dorman generator was in use the frequency stabilized considerably, though the output was still not exactly 50 Hz.

A 50-Hz amplifier built by Haigh (Haigh 1967) was repaired. The cable from the crystal controlled supply in the auroral hut to the seismic hut was also re-installed, and the recorder motors were put onto this precision 50-Hz supply on 19 April. This standard frequency proved to be of admirable quality, and if any time marks were missing, it was possible to interpolate quite accurately.

Some trouble was experienced with the precise 50-Hz power beating with the station supply of about 51 cycles. This caused an oscillation in the voltage output. Below 115 V output, the system would revert to the station supply. If the voltage oscillated about 115 V a chattering of the relay resulted.

The drive motor stopped on 29 April and because no spare was available it was dismantled. The bearings were practically worn out but it was made operational by reversing them. When the motor failed again on 21 May, Mr Mark Forecast overhauled it and cut new gears. It was re-installed on 29 May and ran until 9 January 1968. Another temporary repair allowed it to run satisfactorily from 12 January until it was replaced by a new motor at the annual changeover.

At the 1967 changeover, about 8 replacement globes for the three recorders were in hand. However, the lifetime of the globes was not very long, probably because of the frequent power surges. It was decided in November that since only one spare remained, it would be best to shut down one recorder to save globes for the important vertical recorder. Accordingly the E-W recording lamp was left off for about two weeks. After this period it seemed that the end of the year would be reached safely and the seismograph was returned to normal operation.

The trace intensity of the vertical seismic recorder gradually fell during the year. The light beam was not falling squarely on the galvanometer, and the prisms controlling the direction of the beam had reached the limit of their adjustment. It was finally decided that the only solution was to lower the galvanometer on its adjustable legs, even though it meant that the galvanometer would have to record in an off-level position. This was done in early January 1968, and after this, no more trouble was experienced.

In December, the E-W galvanometer jammed. One day's record was lost before it was freed by gently tapping the exterior of the instrument. Both the N-S and E-W galvanometers showed a tendency to drift, particularly in the winter months, but the traces always returned to their normal position.

4. POWER AND TIMING SYSTEMS

At changeover 1967, time-marks were provided as follows:

Magnetic: La Cour pendulum clock, 5-minute programme in geophysics office via camp telephone cable to the auroral office and landline to the variometer house.

Seismic: Mercer chronometer, 1-minute programme via camp telephone cable to the transmitter building and via landline to the seismic house.

Faults soon developed in the transmitter-seismic cable and so a new line was laid direct from the office to the seismic house. This was subject to breakages by traffic but these were gradually overcome by protecting the cable where necessary.

In April the office heater became unserviceable and the chronometer rate became high and erratic; therefore it was decided to make use of a crystal-controlled timing system based on the auroral clock. This meant using the telephone cable from the auroral hut to the Office previously used for the magnetic system, and so the pendulum clock was re-located in the meteorological office and a landline was laid from there to the variometer house.

On 19 April, the pendulum time-marks were replaced by crystal clock marks derived from a divide-by-five circuit constructed by the auroral engineer. This worked well except when interference pulses caused it to advance. However on 17 May the auroral chronometer failed and the original timing system was reverted to.

Late in November the pendulum clock stopped after an interval of erratic behaviour and could not be restarted. A mechanical divider driven by the chronometer was made, which provided magnetic timing for the remainder of the year.

About the same time the auroral crystal supply became available so seismic power and timing was again derived from this source.

In mid-December a new landline of armoured cable was laid from the electrician's hut (in the main station area) via the geophysics office to the hangar; a connexion was made from here to the seismic hut, and power and timing were transferred to this stronger and safer cable.

5. OBSERVATORY MAINTENANCE

Early in the year, the interior of the office hut was repainted, and new lino was laid. Trouble was then experienced with the oil heater. It was dismantled and cleaned, but it was some 4 weeks before it was made to work properly. During this time the developing solutions repeatedly froze, as did the snow melting urn. This in turn damaged the urn and severely reduced the supply of water from the hut.

In the summer months, the exteriors of the huts were repainted, using bitumastic aluminium paint as had been done in previous years.

Re-sealing of the piers in the variometer hut was done at intervals during the year when new cracks in the old sealing became evident.

The layout of the office hut was substantially altered, and several new shelves were constructed with the assistance of the carpenter. The position of the safelight in the darkroom was altered so that the observer was not working in his own shadow.

The windows of the absolute magnetic hut were blocked out with polythene foam brought down for that purpose. This was designed to help insulate the building. Having not had much previous experience in this hut, the author is not able to judge what effect this had.

Following a request from head office, a permanent proton magnetometer pier was constructed about 20 yards north of the absolute hut. This pier was to be free of any metallic material. Accordingly, a wooden tripod was constructed of 2" square pine, with the ends of the beams being fitted into holes made in appropriate positions in the rock by a 'cobra' drill. A detachable wooden platform was made for the top.

6. FIELD WORK

During the return voyage, one set of field observations was made at Mackenzie Bay, on the western side of the Amery Ice Shelf.

Geological observations were made at Landing Bluff (formerly known as Wharf Hill) in Sandefjord Bay, at the eastern end of the Amery Ice Shelf. A description of these observations has been prepared and will appear in a separate report.

During a brief visit to Wilkes Base, a site was chosen for a permanent magnetic station at the replacement station (Casey station), and simultaneous observations were made between this station and the old station at Wilkes, two miles away.

7. ACKNOWLEDGEMENTS

Without the assistance of several other people, the successful running of the observatory would have been impossible. The author would like to acknowledge the work done by Chris Simpson, electronics engineer, who constructed and maintained much of the electrical equipment in use. Thanks are due to Tony Jaques and Mark Forecast, who maintained the observatory during the author's absence on field trips. John Reilly, cosmic ray physicist, assisted the author in preparing the Wilkes Absolute Hut for re-occupation, and made the Wilkes half of the simultaneous magnetic observations.

8. REFERENCES

HAIGH, J.E., 1967 - Mawson Geophysical Observatory, annual report 1965. Bur. Min. Resour. Aust. Rec. 1967/28 (unpubl.).

OLDHAM, W.H., 1957 - Magnetic work at Mawson, Antartica, 1955-56. Bur. Min. Resour. Aust. Rec. 1957/79 (unpubl.).

TABLE

Preliminary monthly mean values, adopted scale values, and baseline.
standard deviations, Mawson 1967

Month	H, gammas	D, °W	Z, gammas
January	18362	61°31.9'	-48163
February	380	30.5	215
March	386	32.2	209
April	380	32.6	195
May	381	33.0	192
June	387	34.0	199
July	381	34.7	180
August	362	35.3	164
September	362	36.6	119
October	364	37.3	131
November	364	36.9	119
December	374	38.1	127
Annual means	18374	61°34.4'W	-48168

	H	D	Z
Adopted scale values	9.50± 0.09 gammas/mm	0.86* minutes/mm	10.41± 0.08 gammas/mm
Standard deviation of baselines	± 6.0 gammas	± 0.41 minutes	± 3.5 gammas

* based on only one determination