COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

RECORDS
1959 NO.134

GEOPHYSICAL WORK AT MACQUARIE ISLAND

DECEMBER 1954 - DECEMBER 1955

by

P.E. MANN

RECORDS 1959 NO.134

GEOPHYSICAL WORK AT MACQUARIE ISLAND
DECEMBER 1954 - DECEMBER 1955

by

P.E. MANN

C O N T E N T S

P L A T E

A B S T R A C T

The geophysical programme in geomagnetism and seismology of previous years was continued at Macquarie Island in 1955. A general account of the observations, routine work and the performance of the equipment is outlined. A description is given of the preliminary work required for orientation tests on the H & D variometers and the reoccupation of the Caroline Cove Field Station. The results of orientation tests and intercomparison observations made during the year are given. The full scientific results are not included as they will be presented in separate reports.

1. INTRODUCTION

The establishment of a scientific station at Macquarie Island latitude 54°30'S and longitude 158°57'E by the Australian National Antarctic Research Expedition in 1947 lead to the founding of magnetic and seismological observatories as part of the scientific programme. The Bureau of Mineral Resources, Geology and Geophysics is responsible for equipping and staffing these observatories. The writer, an officer of the Bureau, was geophysicist at the island from December 1954 to December 1955, in charge of the magnetic and seismological observatories.

A description of the two observatories and their operation is contained in previous reports by Oldham (1953), McGregor (1954), Tenni (1954) and Robertson (1957).

2. MAGNETIC OBSERVATORY

(i) Housing

The magnetic instruments are housed in two huts built on a grass flat about 400 yards from the main camp area. A broad sand and shingle beach gradually slopes up to the western sides of the huts. Sand whipped up by strong western winds soon removes paint from the exposed walls of the huts. Both huts which had been painted in 1954 were in good condition on the writer's arrival, but required painting again after the winter. The remaining paint was stripped from the western walls after which they were left for a while to dry before repainting. A thick coating of red-lead was applied to the western side before applying the final coat of paint to both huts.

A few minor repairs were made to the absolute hut door because it would not close securely. The panels of this hut were quite moist and the wood had expanded considerably. After a few shavings were taken off the door it could be closed properly. Later in the year the plywood backing of the door lifted because the copper nails would not hold in the moist wood, and the door remained slightly ajar. A wooden prop was then used to keep the door closed.

The bench on the southern wall of the variometer room was moved to a position on the west wall behind the La Cour recorder, so that the magnetic meridian required in orientation tests on the H and D variometers could be established through each variometer.

The small wooden structure used to house the battery required occasional attention after sea elephants had weakened its supports.

(ii) Magnetic Recording Equipment

The magnetic recording equipment at the island consists of a set of three low sensitivity La Cour variometers and a 15mm per hour La Cour recorder. Continuous recording of the magnetic elements was not achieved in 1955 because the clockwork recorder drive jammed on a number of occasions. A total of 80 hours magnetograph record is missing. The failure of the drive has been a common occurrence at Macquarie Island and in most cases can be attributed to dust or corrosion in the drive mechanism. The drive which had been in operation throughout 1954 performed satisfactorily until it stopped in June 1955. This drive was dismantled and found to be very dirty in spite of the dust cover fitted to the escapement platform. The drive was cleaned and a loose escapement jewel fixed with shellac in its mounting. The drive held as a spare did not perform reliably and was replaced as soon as the original one had been tested after its overhaul. The spare drive was dismantled and cleaned. One bearing jewel and the balance wheel staff pin were found to be chipped so this drive was not used again. Later in the year the drive jammed but no obvious fault was detected when it was again dismantled and cleaned. The balance wheel staff pin was broken when the drive was being assembled. A new balance staff was made on the workshop lathe and fitted in the balance wheel assembly. This unit with the "home-made" balance staff operated successfully from November 8th until December 12th when it was replaced by a clockwork drive brought down by the relieving geophysicist. The two drives were returned to Australia for repairs.

The La Cour pendulum clock performed erratically throughout the year and it was difficult to maintain its correction to within half a minute of GMT. During July the clock was dismantled cleaned and a new eccentric cam made for the minute contact. While the clock was out of service, hour marks were placed on the magnetogram manually several times a day by comparison with a chronometer whose correction to GMT was accurately known.

The pendulum clock five minute contacts were cleaned occasionally and no trouble was experienced in obtaining distinct time marks on the magnetograms. On several occasions when the pendulum clock had been stopped to advance the minute hand it was found difficult to synchronize all the five-minute contacts with the minute contact because the minute hand was very slack on its axle. Successive adjustments to the minute hand corrected this defect.

The clock case which was hung from a single copper nail driven into the wall rotated slightly whenever the drive weight was lifted to rewind the clock. Two right angled brass plates were fixed to the wall and the clock case mounted securely between them in the position where the clock worked satisfactorily.

The clock was returned to Australia for overhaul after it had been replaced by one brought down by the relieving geophysicist.

(iii) Drying agent for variometers

The practice of using phosphorus pentoxide to absorb moisture in the H, D and Z variometers was continued in 1955. The use of a drying agent in the H and D variometers would be more effective if the magnet chamber of each variometer was better sealed than it is at present. Some baseline jumps of the Z variometer have occurred at the times when the drying agent was changed. To reduce such baseline jumps use could be made of the method of sealing the Z magnet chamber (La Cour 1930). There appears to be no reason why this feature of the La Cour Z variometer should not be used.

(iv) Anti dimming compound on glass surfaces

All exposed glass surfaces of the magnetograph were occassionally coated with an anti-dimming compound to reduce fading of the magnetogram traces when condensation occurred on the lenses, but the result was not entirely satisfactory as fading still occurred on several days of the year.

(v) Scale value circuits

A faulty five way rotary switch in the scale value circuit was replaced early in the year. Some difficulty was experienced producing a smooth increase of current in the Helmholtz Gaugain coils during scale value tests. The potentiometers and switches were cleaned with methylated spirits and manipulated several times to remove any corrosion before scale value or orientation tests were made. Fluctuations in the coil currents were reduced but not entirely eliminated using this method.

(vi) Recording and time lamp circuits

The recording and time lamp circuits were satisfactory throughout 1955. Parallax tests were made twice during the year even though the recording and time lamps were not changed.

(vii) Time mark system for absolute observations

The manual time mark system installed by C.S. Robertson in 1954, to simplify and improve the accuracy of scaling the magnetograms for absolute computations worked efficiently throughout the year. The exposure times used for this timemark system when making absolute observations for the elements H, D and Z were :-

D	=	1 second
H	=	3 seconds
Z	=	5 seconds

(viii) La Cour clock comparison time signals

The time comparisons of the La Cour clock were made using the flash from a 240V globe produced by closing of the contacts of a 6V 100 ohm relay, which was actuated each time the five-minute and minute contacts on the pendulum clock closed (Robertson, 1956). This globe was mounted near the window of the absolute hut and could be seen from the geophysicists office. Thus direct comparisons with radio time signals could be made at any time. On a few occasions the relay contacts stuck but no other trouble was experienced. Time comparisons were possible in all types of weather and this simple system proved very effective in determining the corrections to the clock.

(ix) Semi absolute magnetic instruments

The instruments used in 1955 to determine the values of declination vertical and horizontal intensity were :-

Horizontal intensity	QHMs 177 & 178
Vertical intensity	BMZ 64
Declination	QHMs 177 & 178

Horizontal intensity was generally determined at weekly intervals, using QHMs177 and 178 alternately. Declination was also observed at weekly intervals using the same instruments alternately until the end of July. The D baseline values derived from each QHM had a large scatter and in an effort to reduce this scatter the number of observations made each absolute day was increased.

BMZ No.64 was used at weekly intervals for the determination of vertical intensity.

(x) Intercomparison observations

The three QHMs are interchanged annually so that two remain at the island while the third is returned to Australia for calibration at the Toolangi Magnetic Observatory. This system provides a check on any instrumental drift. Additional information is provided by comparing the two QHMs at the Island through the observatory baseline. In March and November QHMs177 and 178 were intercompared for the elements H and D.

(a) Horizontal intensity March 16th - 17th and November 17th -18th. Four sets of observations were made with each instrument. The results obtained were :-

March $H_{178} - H_{177} = -1$ gamma $= -0.00007H$

November $H_{178} - H_{177} = -2$ gamma $= -0.00015H$

(b) Declination March 16th -17th, November 17th-18th. Four observation sets were made with each instrument. The results obtained were :-

March $D_{178} - D_{177} = 10'.0$

November $D_{178} - D_{177} = 12'.1$

QHM177 was intercompared at Toolangi in July 1954 and QHM178 was returned to Melbourne in December 1955 for intercomparison at the Toolangi Observatory.

In December 1955 QHM177, 178 and 179 were compared for declination at Macquarie Island with Askania Magnetometer 508813 and BMZ64 was compared with long range BMZ121. Before this time the IMS correction to BMZ64 was not known because no suitable BMZ was available for intercomparisons at Macquarie Island. All intercomparisons were made through the observatory baselines. The observers were B.G. Cook, I.B. Everingham and the writer.

(a) Horizontal Intensity 12th, 13th and 14th December, 1955.
All three QHMs 177, 178, 179 were intercompared. Four observation sets were made with each instrument. Results obtained were :-

$H_{179} - H_{177} = 5$ gamma $= 0.00038H$

$H_{179} - H_{178} = 6$ gamma $= 0.00045H$

(b) Declination 11th - 15th December 1955. Intercomparison observations were made between Askania Magnetometer 508813 and QHMs177, 178, 179. Twelve sets of observations were made with each instrument. Results obtained were :-

$$D_{508813} - D_{177} = 3'.1$$
$$D_{508813} - D_{178} = -7'.9$$
$$D_{508813} - D_{179} = -4'.6$$

The original constants supplied by Rude Skov for QHMs 177, 178, 179 were used in computing these results.

(c) Vertical intensity 11th December 1955. Intercomparisons were made between the long range BMZ121 and BMZ64. Eight sets of observations were made with each instrument. The results obtained were :-

$$Z_{121} - Z_{64} = -64 \text{ gamma}$$

(xi) Orientation tests on the variometers

The variometers were installed in 1951 using a magnetic meridian established in the variometer room by a compass bearing (Oldham, 1953). The D and H magnets were aligned approximately in the meridian and prime vertical respectively.

In 1955 it was thought desirable to check the orientation angles of the magnets and determine how much error was present as the result of the initial alignment and the effect of secular variation. The preliminary work was carried out in July and August and the orientation tests in August and September.

The absolute and variometer huts at Macquarie Island are not in line and it is impossible to sight directly from the declination pier of the absolute hut into the variation room. If a line of known azimuth is established in the variometer room, the magnetic meridian can be quickly related to it. A station was selected outside the absolute hut in a place from which the declination pier was visible and such that a line through this point and parallel to the meridian would also pass through the variometer room. (Plate 1). A theodolite was mounted at this point with its telescope horizontal and directed at the north wall of the porch in the variometer hut (visible through the open variometer hut door) at such a height that the continuation of the line of sight would just be higher than the top of the H variometer. A $\frac{1}{4}$ inch hole was drilled through the wall. Two tongued boards each approximately 6' x $\frac{3}{4}$" x 4" were prepared. One board was mounted on the south wall of the variometer room two inches from this wall and in such a way that the tongue was just under the $\frac{1}{4}$" hole. The board was levelled and secured with three brass screws at each end to the framework of the hut. A spacing block was fixed about halfway along its length to keep the plank parallel to the wall and to prevent any sagging. The other board was mounted on the north wall as follows: the test light of an ophthalmoscope was moved slowly over the inside of the north wall until it was visible in the theodolite through the $\frac{1}{4}$" hole in the south wall. When centred as accurately as possible the position was marked and a $\frac{1}{4}$" hole drilled in the north wall. The two holes were clearly visible with the theodolite when a 200 watt globe as light source was placed behind the hole in the north wall to test their alignment. A 4" x 4" x 2' wooden block temporarily centred under the theodolite was fixed permanently in position as the reference peg. By using $\frac{1}{8}$" diaphragms over the $\frac{1}{4}$" holes it was possible to define the line through the variometer room accurately.

Fine pencil marks were then placed on the tongue of the spacing board corresponding to the line defined by the centres of the holes. Bearings were taken on the line and the declination pier. The holes used to define the line through the variometer room can be used later as a check on any movement of the building.

The distance between the centres of the spacing boards was determined at six points using copper wire drawn taut by 1.6 lb. plumb-bobs attached at each end. The lengths of wire were measured by a steel tape under the same load conditions. A distance of 351.5 cm was adopted as the mean distance between the spacing boards.

The magnetic meridian was transferred to the azimuth line by the following method. The theodolite was centred over the reference peg and the azimuth line established with the telescope. A fine cotton thread carrying a heavy plumb-bob was suspended from a copper nail above the door in the south wall of the variometer hut. The cotton thread was centered over the two azimuth holes with the telescope. A thin black line corresponding to a section of the vertical cord was then painted on the architrave. The north eastern window of the absolute hut was removed and readings were taken with QHM178 on the magnet "door mark" and Anchor Rock azimuth mark. It was possible to swing from one setting to another without any adjustment to the QHM telescope. When the angle ($\emptyset$) between the magnetic meridian and the azimuth line was known, the meridian could be established in the variometer room.

The offset distance of the meridian on the north spacing board is equal to the product of tan $\emptyset$ and the mean distance between the spacing boards. A cotton thread stretched taut between the spacing boards by small weights at each end represented the magnetic meridian in the variometer room. By moving the thread along the wall strips so that the two ends are equidistant from the points on the spacing boards defining the meridian, the meridian could be established through the centre of the variometers (centre of the recording magnets).

To test for misorientation of the variometer magnets a known field is applied to the recording magnet along the direction of its standard orientation. If the recording magnet is properly orientated it will not be deflected but if it is maladjusted the recording magnet will be deflected by a component of the field normal to the magnet.

For the H variometer, a Helmholtz Gaugain coil was aligned by a cotton thread parallel to the meridian to produce a field in the prime vertical. For the D variometer the coil was aligned to give a field directed along the meridian. The azimuth of the reference line is based on the value $353^{\circ}40'.9$ for the azimuth of Anchor Rock.

The following results were obtained :-

Bearing of declination pier E from reference station	= $334^{\circ}46'.0$
Angle between azimuth line and pier E	= $49^{\circ}19'.9$
Azimuth of established line of variometer room	= $24^{\circ}05'.9$

Value determined for meridian by QHM178	=	$24^{\circ}55'.1E$
Angle between azimuth line and established meridian	=	$00^{\circ}49'.2E$
Distance between spacing boards in variometer room	=	351.5 cm.
Meridian offset a distance d on north spacing board	=	351.5 tan 49'.2=50 mm

(xii) D variometer

A Helmholtz Gaugain coil was aligned using the thread representing the meridian to give a field directed along the azimuth $24^{\circ}55'$.

The exorientation angle is given by :-

Ex = artan $\frac{2u}{f}$ Sd where 2u is the deflection in mm for a total applied field of f gamma and Sd is D gamma scale value (/mm) (McComb 1952 p.135). The values obtained are given in Table 1.

TABLE 1

Date	Ammeter Reading	Ammeter Temperature	Current Applied	Total Current	Total Deflection	Ex	Remarks
Aug. 30th	+25	10.9	+24.54	49.09	76.6-76.0	19'	
	-25	12.0	-24.55				
	+50	11.0	+49.36	98.63	78.0-74.3	31'	
	-50	11.9	-49.27				
	+75	11.2	+74.64	149.30	79.0-73.2	61'	
	-75	11.9	-74.66				
	+100	11.2	+98.72	197.46	80.0-71.8	63'	
	-100	11.8	-98.74				

The ammeter used was VML11386 and the coil constant was 7.49 gamma per milliampere. A positive current in the coil produced a field that was directed from north to south and deflected the D trace in the direction of decreasing D. The north end of the magnet is therefore oriented west of north. The exorientation angle of the magnet with respect to the meridian $24^{\circ}55'$ is 62 minutes but with respect to the mean meridian for August September ($24^{\circ}46'$) the angle is 53 minutes with the north end west of north.

(xiii) H variometer

A Helmholtz Gaugain coil was aligned using the cotton thread representing the magnetic meridian to give a field applied at right angles to azimuth $24^{\circ}55'$.

The exorientation angle is given by :-

$$Ex = \text{artan} \frac{2u}{f} S_H$$

where 2u is the deflection in mm for a total applied field f and S_H is the scale value in gammas per mm. (McComb 1952, p.135).

The values obtained are given in Table 2.

TABLE 2

Date	Ammeter Reading	Ammeter Temperature	Current Applied	Total Current	Total Deflection	Ex
Aug. 30th	-25	11.2	-24.54	49.09	26.7-26.1	70'
	+25	12.0	+24.55			
	-50	11.4	-49.26	98.54	27.2-25.8	81'
	+50	12.0	+49.28			
	-75	11.8	-74.66	49.32	27.9-25.3	100'
	+75	12.1	+74.66			
	-100	11.9	-98.75	197.50	28.2-24.9	96'
	+100	12.2	+98.75			
Sept. 11th	+75	10.0	+74.62	149.24	28.8-26.4	92'
	-75	10.0	-74.62			
	-75	10.1	-74.62	149.24	29.0-27.0	77'
	+75	10.2	+74.62			

The ammeter used was VML11386 and the coil constant 7.49 gamma per ma. A positive current in the coil produced a field that was directed from east to west and deflected the H trace in the direction of decreasing H. The north end of the magnet is therefore oriented south of east. The exorientation angle of the H magnet with respect to the meridian 24°55' is 86 minutes but with respect to the mean meridian for August September (24°46') the angle is 77 minutes with the north and south of east.

Further tests were made on the D variometer during September but no results were obtained because of the lack of intensity of the first positive reserve trace of D and current fluctuations in the coil.

The H variometer was bumped when the Helmholtz Gaugain coil was replaced after a D orientation test on the 21st September. The H trace ordinate was reduced by about 27 mm but the baseline and temperature trace ordinate remained unaltered. It is probable that the torsion head had been moved slightly by the jar the H variometer received.

No orientation tests were carried out on the Z variometer.

(xiv) Azimuth observations

The azimuth of the north mark (Anchor Rock) from the declination pier was obtained in 1952 by transference of azimuths from station A. (McGregor 1954). The result was not entirely satisfactory. Further work by P.B. Tenni in 1953 did not clarify the position. In 1954 C.S. Robertson carried out successful sun observations and the values he found were about 1'.5 lower than those previously adopted. The writer was unable to obtain a complete and consistent series of sun observations and the half sets obtained were not of much value. The value 353°40'.9 obtained in 1952 has been adopted for the azimuth of north mark and is consistent with values adopted for previous years. On a few occasions when there was a heavy fog the "post mark" was used as the reference. A check on the angle between the post mark and the north mark was made later and the azimuth of the former deduced. The azimuth of this mark remained fixed throughout the year but its use as a reference mark is not recommended because the QHM telescope has to be set at a compromise position to read the magnet and the mark.

(xv) Field observations

In 1911 Webb and Kennedy carried out absolute observations at Caroline Cove on the extreme south west point of the island. In 1952 P.M. McGregor carried out absolute observations at a new station marked by a concrete block within 15 feet of the original (McGregor, 1954). Observations were made for horizontal and vertical intensity but no value of declination could be calculated until the azimuth of the reference mark used by McGregor was obtained. In 1953, P.B. Tenni determined the azimuth of the reference mark but he was uncertain of the results obtained. In 1954 C.S. Robertson obtained a value of 343°02.'0 for the azimuth of the mark. The mark is a low dome shaped rock on the horizon, slightly to the right of the centre of the Cove. Robertson describes two points visible on the rock approximately equal in height and differing by 2.2 minutes of arc. McGregor describes only a single highest point which he used as reference point, but the two points could be distinguished with a QHM telescope and the southern point (to the right as seen in the telescope) was used as the reference point in 1955 when the station was reoccupied. An attempt to occupy the station was made in April. All the instruments were carried by pack from the main camp to Hurd Point. Twelve days were spent at this station but on only one of these was the weather sufficiently favourable for the arduous journey over the 1000 foot plateau to what was thought to be Caroline Cove. After a long search for the station it was concluded that this bay was not Caroline Cove. The weather deteriorated quickly and any further attempt to locate the magnetic station had to be abandoned.

A successful occupation of the station was made in October. On a warm calm and slightly overcast day the instruments were taken to Caroline Cove from Hurd Point and the station reoccupied. Four values of declination and horizontal intensity, and twelve values of vertical intensity were obtained. The station is located on a soft peaty platform which is very spongy underfoot. Levelling of the BMZ was difficult because any movement of the observer, produced a large movement in the levelling bubble. During H determinations, mechanical oscillations of the QHM magnet produced by the observer walking around the tripod had to be damped out by the clamping mechanism before a reading could be taken.

After the BMZ was returned to the main camp, an increase of 35 gammas was noted in its readings. This change probably occurred when the instrument was carried back from Caroline Cove to the main camp.

(xvi) Magnetic Programme, 1955

The magnetic routine previously established for the operation of the observatory, was continued. The routine includes :-

(a) Daily changing and photographic processing of the La Cour magnetograms.

(b) Scaling mean hourly values for the magnetic elements, horizontal intensity, vertical intensity and declination.

(c) Semi-absolute determinations of H, D and Z four times a month.

(d) Determination of H & Z scale values four times a month in conjunction with (c).

(e) Calculation of provisional monthly mean values of H, D & Z which were transmitted to Melbourne for publication a few days after the end of each month.

(f) Plotting of the Sq curve and the scaling of the K-index for each three-hourly period. These were also transmitted to Melbourne for publication a few days after the end of each month.

(g) Daily determination of chronometer rates and corrections to standard time.

(h) Daily inspection of magnetograph at different times after changing the record.

(j) Occasional parallax tests on the magnetograph.

(k) Abstracting K-index data and all monthly mean, absolute, baseline and scale-values to provide a complete record at the island when the originals were returned to Melbourne.

3. SEISMOLOGICAL OBSERVATORY

(i) Housing.

The seismological observatory is situated about 45' above sea level on the side of Wireless Hill overlooking the main camp. The seismograph hut is concrete, built into an excavation in the hillside. The instruments are mounted on a T-shaped concrete pier set on rock and isolated from the floor of the hut. Adjoining the concrete hut is a wooden hut used as office and darkroom and a small corrugated iron hut serving as workshop and store. In November the huts were painted, the roof of the wooden hut tarred and PC49 applied along the junction of the wooden and concrete sections. The office was connected to the camp telephone system, installed in September.

(ii) Seismic equipment

The seismological equipment comprised a two component short period Wood-Anderson type seismograph, set up to record north-south and east-west components installed by Robertson in 1954. Recording was on photographic paper mounted on a drum with a speed of 30 mm per minute. Minute and hour time marks were placed on the record from a Mercer chronometer checked daily against station WWV. Several times during the year the aerial for the reception of time signals needed repairing after it had been broken by high winds. The damping co-efficient and free period of the two seismometers were tested four times during the year and maintained at the values 0.85 and 1 second respectively. Several days records were lost during the year because of failure of the light sources, power lines to the observatory and loose contacts on the synchronous motor driving the recording drum. On several occasions the grub screw controlling the movement of the time mark relays worked loose and no time marks appeared on the seismogram.

(iii) Damping tests on seismometers

The free period To of the seismometers was determined by swinging aside the magnet system from around the cylindrical inertia weight and timing 100 oscillations of the inertia weight with a stop watch. The procedure was repeated several times and a mean taken.

The damping coefficient of 0.85 recommended for the Wood-Anderson seismometer requires a damping ratio of 150:1 for the initial deflection to the deflection on the other side of the zero position. To obtain a measureable second deflection the first deflection has to be quite large. An impulse is given to the inertia weight by a blow tube and the maximum light intensity is required to record the large initial swing but unfortunately the small overswing is lost because the trace in the zero position becomes very broad and it is hard to read the amplitude of the secondary swing accurately. To overcome this difficulty a filter was used to reduce the intensity in the zero position. It was possible to deflect the EW component by the blow tube so that the large initial deflection recorded satisfactorily through the NS cylindrical lens and the next swing recorded through the normal EW cylindrical lens covered by a screen. The initial deflection produced by the blow tube on the NS instrument moved off the recording drum. To overcome this difficulty the NS trace was moved to the position of the EW trace by altering the levelling screws on the seismometer by equal and opposite amounts so that the NS trace occupied the position of the EW component. Damping tests could then be carried out as before. Another method used on the NS component was to measure the initial deflection off the drum on a scale and record the other deflection in the normal manner. This method was difficult to perform and is inferior to the first method quoted.

The deflection tests were repeated several times for any determination of the damping ratio of a seismometer. Some trial tests to obtain the damping ratio were made using a gear that gave a drum speed of 60mm/minute but the results were not much improvement on those already obtained.

(iv) Seismological programme

The routine seismological programme carried out was :-

(a) Daily changing and processing of seismograms.

(b) Preliminary scaling and interpretation of all earthquakes recorded using Jeffreys and Bullen seismological tables.

(c) Determination of free periods and damping co-efficients of the Wood-Anderson seismometers several times during the year.

(d) Scaling of the period and amplitude of microseisms recorded by the two components at 0, 6, 12 and 18 hours GMT when time permitted.

4. GRAVITY OBSERVATIONS

In December 1954 gravity readings were taken at intervals for several days with a Worden gravimeter at the station previously established in the meteorological store hut. Results of these observations are included in a separate report (Williams, 1957).

5. GENERAL

In addition to the geophysical work there were several camp duties required of the writer. Every twelfth week the job of mess orderly occupied about 10 hours and that of cooks' assistant about 40 hours a week. The writer was engaged as duty cook on five whole days during the year. When on duty as cooks' assistant there was little time for anything other than routine work for that week. Other minor jobs occupied a few hours per week at odd occasions. Assistance was given in auroral observations while the writer was at the Hurd Point station.

6. RESULTS

Results of immediate value obtained during the year were radioed back to Melbourne and subsequently published by the Bureau of Mineral Resources in the monthly Observatory Report. Data in this category includes K-indices provisional monthly means of the magnetic elements H, D & Z. Preliminary analyses of earthquakes were published in a separate monthly bulletin.

A complete report of the years' investigations including final mean hourly values of H, D & Z, principal magnetic storms and lists of sudden commencements will be issued at a later date. The final analyses of earthquakes will be issued as a separate bulletin.

7. CONCLUSIONS AND RECOMMENDATIONS

(i) Magnetic

The routine observatory work was marred by several failures of the recording equipment with a consequent loss of record. The two clockwork drives at the island should be changed annually so that they can be checked by an instrument maker and retained in good condition. An exchange of the clockwork drive in use every three months may help to reduce loss of record. The La Cour clock is unreliable in its operation, and a few improvements would make it more reliable.

Orientation tests on the H & D variometers have shown that the magnets were not aligned correctly in the prime vertical and magnetic meridian respectively. These tests should be repeated and adjustments made to improve the orientation of the magnets.

These remarks apply particularly to the H variometer because of the shift in the position of the H trace. The ordinate of the D trace is too large and for some time declination has been largely recorded by the first positive reserve spot for a number of hours a day. This ordinate could be reduced to a convenient value when any adjustment to the orientation of the D magnet is made.

There appears to be no reason why the La Cour Z variometer should not be hermetically sealed as in the original design. The effect of humidity on the variometer would be reduced and the baseline jumps often detected after the drying agent is changed would be eliminated.

(ii) Seismological

The routine seismological programme was continued and preliminary analyses of records made but precedence was given to the magnetic programme.

A short-period vertical component seismograph would be of great assistance in the interpretation of both local shocks and teleseisms because of the greater certainty in identifying the P phase. Any study of local seismology would be aided by the location of a seismograph at the auroral station at Hurd Point in addition to that at the main camp. A recording speed of 60 mm per minute would be an advantage at both stations if such a project was envisaged.

(iii) General

The geophysical programme is a full one requiring a minimum of 56 hour week and only a thorough training in seismology and geomagnetism will aid the geophysicist in his term as observer in charge at the island to keep this working week.

It is considered that other members of the party should be made to realise the extent of the programme and be asked to assist wherever possible.

8. ACKNOWLEDGEMENTS

The writer wishes to thank Mr. C.A. van der Waal of the Observatory Section for the assistance in preparing for the year at the Island.

Thanks are also due to P. Ford and E. Field for their share in the arduous task of carrying the magnetic equipment from the main camp to Caroline Cove and back on the first and second trips respectively.

Special thanks are due to Dr. S. Csordas for his valuable assistance in observatory work while the writer was at the south end of the Island and engaged on a few short field trips.

9. REFERENCES

La Cour, D., 1930 -

La Balance de Gadhavn. Danish Met. Institute. Mag. Comms. No.8.

McComb, H., 1952 -

Magnetic Observatory Manual. U.S. Dept. of Commerce, Special Publication No.283.

McGregor, P.M., 1954 -

Geophysical work at Macquarie Island, April 1952 - April 1953. Bureau of Mineral Resources. Aust., Records 1954 No.32.

Oldham, W.H., 1953 -

Report on work at Macquarie Island 1951/52. Bureau of Mineral Resources, Aust., Records 1953 No.30.

Robertson, C.S., 1957 -

Geophysical work at Macquarie Island December 1953 - December 1954. Bureau of Mineral Resources, Aust., Records 1957 No.86.

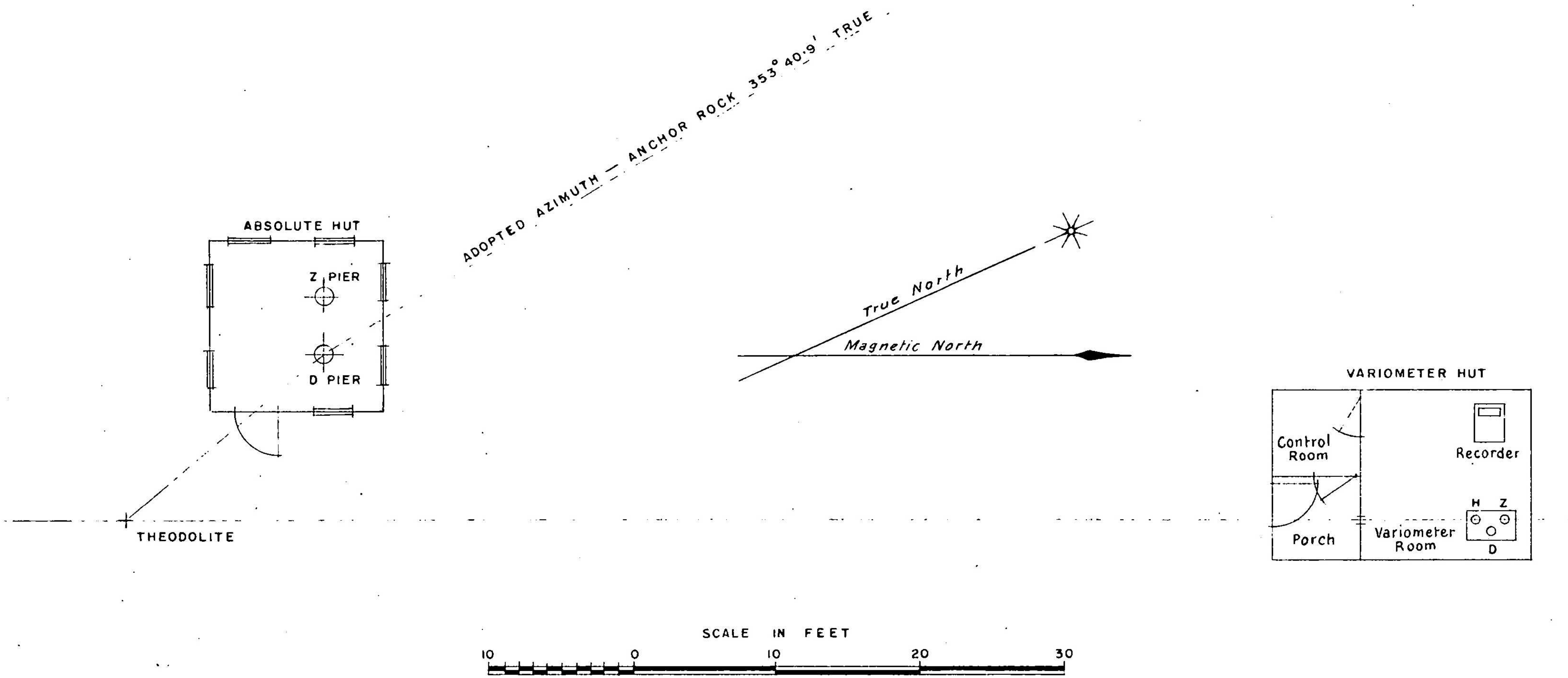
Tenni, P.B., 1954 -

Geophysical work at Macquarie Island, April 1953 - December 1953. Bureau of Mineral Resources, Aust., Records 1954 No.33.

Williams, L.W., 1957 -

Gravity Measurements in Antarctica 1953 - 1956. Bureau of Mineral Resources, Aust., Records 1957 No.87.

****



GEOPHYSICAL WORK AT MACQUARIE ISLAND, 1954-1955

LAYOUT OF INSTRUMENT HUTS

PLATE I

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G 54-47

To Accompany Records 1959, No 134