COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORDS 1953 No. 30

REPORT ON WORK AT MACQUARIE ISLAND

1951 --- 1952

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A B S T R A C T

This report covers the work carried out by the author who was the geophysicist in charge of seismic and magnetic work conducted on Macquarie Island during 1951-52. It deals mainly with the preparation of and repairs to huts, the continuation of the seismic recording programme and the installation of a magnetic recorder.

Although scientific achievement was not outstanding, the way has been prepared for a successful observing programme in the future.

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REPORT ON WORK AT MACQUARIE ISLAND 1951-1952

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W. H. OLDHAM.

I. INTRODUCTION

Macquarie Island, situated 850 miles south-south-east of Tasmania, has been occupied by Australian National Antarctic Research Expedition parties since 1948. Lying in a vast expanse of open ocean, the island provides a unique opportunity to study the meteorological, biological, seismic, cosmic ray, auroral and ionospheric phenomena of this interesting region.

It has been the practice for a party of about seventeen men to occupy the island for a term of twelve months. They are then relieved by a new party and the relieving ship usually stays for a week or so to unload stores and to give the retiring party time to instruct the newcomers in local conditions and working procedure. Normally no other ship calls at the island during the twelve-month period. This isolation, and the extremely inhospitable climate, introduce special problems.

The writer was responsible for seismic recording and magnetic determinations from May 1951 to April 1952, the work being a continuation of that begun the previous year by Mr. W. R. Flower.

II. REVIEW OF EXISTING ESTABLISHMENT

(1) Instrumental

A two-component short-period seismograph of the Wood-Anderson type was recording continuously. It was running fairly satisfactorily and Mr. Flower had been sending earthquake reports to Melbourne for some time.

Absolute magnetic values were being determined with a Kew-pattern magnetometer and Dover dip circle. The magnetometer was in fair condition but the dip circle was badly corroded as a result of water dripping from numerous leaks in the roof of the hut.

A Watts H-variometer was being used to make continuous photograph records of the horizontal component of the earth's magnetic field. The equipment was not working very satisfactorily and, as a set of La Cour magnetographs was to be installed, the H-variometer was dismantled and returned to Melbourne.

(2) Condition of seismic hut

The seismic hut was in fair condition and one of the rooms was neatly fitted out as an office. Some shelves had been erected to carry stores, but they were not sufficient for the amount of equipment in the hut. Much water leaked through the roof at the junction between concrete and wooden rooms, but this is a failure inherent in the design of the building.

There was evidence of erosion around the outer wooden part of the hut. The slope on which the hut is built is steep, and the main track up Wireless Hill from which access to the hut is made runs immediately below the hut. Soil was rapidly being kicked away from this path due to the heavy traffic. There were no steps leading up to the hut, with the result that the journey to and from the hut was rather hazardous, particularly when the track was covered with ice.

(3) Condition of magnetic huts

The leaky roof of the Absolute magnetic hut has been mentioned already. Otherwise this hut was in good condition, though lacking in shelf space.

In the magnetograph hut some preparations had been made for installing the La Cour magnetographs. The floor had been partly cut away and four earthenware pipes in concrete foundations were ready to support the magnetographs. These piers were too short and extended only a few inches above floor level. Further, the floor needed attention, having been weakened by the removal of some of the bearers. The hut was in poor condition and leaked very badly as a result of unsuitable design, bad construction work, mixing up of parts from different huts, and accidental loss of the copper tacks which were to have secured waterproofing strips along the joints. Some stores were kept in the hut and there was a great quantity of equipment including much highly magnetic material lying about.

During the change-over Mr. P.G. Law directed that both huts be firmly tied down to prevent them from shifting during heavy wind.

(4) General

The Geophysicist's office as described in the Operations Manual did not exist, and geophysical stores were kept at many places in the camp, wherever space could be found.

The official darkroom was poorly equipped and facilities were inadequate for the satisfactory processing of geophysical records. As the darkroom was available to everyone, it was thought unwise to leave records there unattended.

III. PLAN OF CAMPAIGN

The change-over period was much too brief for geophysical work to be carried on uninterrupted. For a time after the ship departed all hands were largely occupied with building new huts, cleaning up the camp and settling into their new quarters. Gradually, however, it was possible to form a general picture of what had to be done. At that time it was believed that the seismic and magnetic programmes were of equal importance.

Seismic work could be kept in full operation. Magnetic work, on the other hand, was not highly developed and the continuity of recording would have been broken for at least several weeks while the new magnetographs were being installed. Existing absolute magnetic equipment could have been used to make periodic determinations, but this was not considered worthwhile because it was anticipated that the new absolute equipment would shortly be in operation.

As a general plan it was decided to continue and develop the seismic programme at the expense of the magnetic programme, which was to be fitted in as time permitted after seismic work was thoroughly organised and familiarity was gained in the interpretation of earthquake records. Also the opinion was held that the geophysical programme was, and always would be too big for one man to handle satisfactorily. Therefore everything possible must be done to make routine work easier, and all future construction work must be of a permanent nature to minimise maintenance.

After the plan outlined above had been followed for some time advice was received from Melbourne that magnetic work was of prime importance and must be begun without delay. All analysis of seismograms was then stopped, and for the remainder of the year

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seismic work was confined to developing records and maintaining and improving the seismograph setup.

IV. WORK DONE DURING THE YEAR

(1) Seismic instruments

The seismographs worked continuously during the year with only occasional minor loss of record due to power failure, electrical faults, adjustments, re-wiring circuits, etc. In addition two days' record were fogged through a visitor inspecting the instrument room.

Adjustment was made for focus of the E-W instrument, and a brass lens mount made to replace the existing temporary arrangement. Both instruments were adjusted once or twice to correct gradual drifting of the light spots.

Irregular rotation of the recorder-drum was traced to lack of balance in the drum which caused it to move round suddenly through a small angle as its centre of gravity passed over the axis of rotation. The fault was overcome by employing a friction brake consisting of a short length of string connected to the recorder frame and hanging over one drive roller, with a small weight attached to the end.

The lamp and time-mark circuits gave occasional trouble and after several such occurrences they were completely re-wired. A small perspex control panel was made and hinged to the wall so that the hour-mark relay could be watched in action and cleaned when necessary.

Minor maintenance work was done on the A.W.A. Receiver, and a new antenna was erected which greatly improved the signal strength from W.W.V.H.

(2) Absolute magnetic instruments

On the assumption that the La Cour QHM and BMZ instruments would shortly be in operation, the old magnetometer and dip-circle were greased and packed away to prevent further corrosion. However, several unforeseen difficulties arose and held up absolute determinations. A typewritten sheet of information on the QHM and BMZ was incomplete, lacking all the Greek symbols. Some time was spent in trying to decipher its meaning but in the end the corrections had to be sent from Melbourne. For several reasons it was decided to use Mr. Flower's absolute station (now known as station "C") but this was on the side of the hut from which skylights had been omitted. The QHM particularly, requires illumination from directly above, so a system of mirrors was tried. This was most unsatisfactory and after an unsuccessful search for non-magnetic torch bulbs, it was decided to run a 230-volt A.C. power line to the hut. A careful check was made to ensure that no undesirable magnetic effects had been introduced and then absolute values were determined more or less regularly for the rest of the year. The observed values are tabulated at the end of this report.

The BMZ instrument was set up and operated without difficulty but some difficulties were encountered with the QHM. Even with a 60-watt bulb and reflector directly above the centre of the instrument, illumination of the scale was not good, so a small cylindrical lens was mounted on the eyepiece, one edge of it acting as a prism to direct light vertically into the eyepiece.

The telescope is very awkward to focus, and to avoid continually adjusting the focus it must be set in the best compromise position to satisfy all three suspension tubes. There is no satisfactory provision for tilting the telescope, and the verticality of the crosshair, essential for declination readings, must be checked against some distant known vertical. The vertical axis bearings were not good, introducing erratic differences between vernier readings.

The azimuth reference point for previous declination determinations had been a rock out at sea. This was so frequently obscured by fog, swell and spray that a wooden post with a target was erected near the "Seal Wallow", approximately 250 feet south of the absolute hut, and an earth mound five feet high was built up round the post to prevent it from being moved by seals. The bearing of this target was transferred from the old reference point and after some time it was discovered that the original azimuth figure was incorrect. There was no theodolite for sun observations and the only reliable known azimuths related to Station "A" a few hundred yards south of the hut. This station could not be found readily and had to be re-located by precise surveying using the Kew-pattern magnetometer for angular measurements. True azimuths were then transferred to station "C" (main absolute station) and to an auxiliary station which was placed about 25 feet east of station "C". The latter station was marked by a short brass rod set in concrete flush with the ground.

(3) Magnetographs

Before setting up magnetographs it is essential to have a magnetic north bearing marked in the magnetograph hut. This bearing should properly be the magnetic meridian at the absolute hut rather than at the magnetograph piers. If a short-focussing theodolite had been available this bearing could easily have been carried into the magnetograph room, but with the instruments on hand it would have been necessary to remove a wall of the hut. Rather than do this, a compass bearing was taken in the hut.

Although there was plenty of literature dealing with adjustment of La Cour magnetographs it was found that most of the problems encountered had to be treated from a commonsense approach.

Fixing focal distances, suspending the magnets and adjusting their directions presented no difficulties. Broadness of the light spots focussed on the drum was traced to non-verticality of the straight-filament lamps. The lamp filament must be vertical and both the slit and cylindrical lenses must be exactly horizontal. Parallelism between slit and cylindrical lenses can most easily be obtained by viewing the enlarged image of the slit through the lens and making it parallel to the edges of the lens. The straight-filament lamps have badly made glass envelopes, more or less polygonal instead of circular in cross-section, so that the apparent filament thickness varies when the lamp is viewed from different directions. Great care must be exercised in correctly orienting the lamp.

The greatest difficulty arose from vertical parallax. Several light spots have to pass through any one section of the slit, and these spots have been focussed down from beams of light reflected from mirrors at different heights. Therefore, the spots are also at different heights. Each spot, even at best focus, is very obviously of finite size, and so the height of the cylindrical lens must be adjusted to a compromise position whereby the fractions of the various spots which can be made to pass through the slit will give correct intensity of light for each trace on the record. Intensities of individual light spots may be adjusted by altering the inclination of their mirrors so that only part of the light passes through the cylindrical lens. This adjustment alters the vertical parallax and may necessitate a further adjustment of the cylindrical lens.

Parallax of the reserve spots resulted from incorrect inclination of some of the prisms. By softening the holding wax these prisms were adjusted so that all reserve spots fell within the slit. Parallax between recorder-lamp and time-lamp was brought to the best compromise by fitting a thin brass spacing ring under the recorder-lamp cup.

Relative intensities of the declinometer trace and baseline may be altered by raising or lowering the supended mirror. The ground glass screen was used throughout for all these adjustments; the viewing device mounted between slit and cylindrical lenses was found to be of very little use and was eventually removed as an unnecessary encumbrance. This permitted the placing of small screens between the cylindrical lenses, confining the trace of each instrument to its own section of the record.

Faulty clock contacts were a frequent source of trouble. The minute contacts, particularly, were very erratic, and a small spiral of fine copper wire was soldered between each strip and its mounting screw. This, together with increased contact pressure provided by a brass mass soldered to the upper strip, remedied the trouble.

Design of the recorder drum is such that it will only just accommodate a full day's record without overlap. A device was fitted which enables the drum to be set so that the record begins as near as possible to one edge of the paper.

The Z-variometer was originally set up with the north pole of the magnet pointing north, giving a scale value of about 13 gammas per millimetre. Later the magnet was reversed, but the resulting increased sensitivity proved too great for proper recording of the large disturbances in this region, so it was replaced in its original direction. When this magnet is reversed it is necessary also to adjust the other variometers. Scale value for the H-variometer was approximately 12 gammas per millimetme and for the declinometer about 0.9 minutes per millimetre.

Magnetic fluctuations on Macquarie Island are larger and more frequent than had been expected, and much time was spent in striving for a degree of recording perfection apparently unattainable with these instruments under such disturbed conditions.

(4) Seismic hut

In the outer wooden room a bench was erected, with a vyce and storage space for the comprehensive toolkit. A number of shelves and a bench were built and fitted with a sink and drainpipe for processing records. Outside the hut a 44 gallon drum was mounted on a wooden stand and a hose run in to the tap over the sink. Gutters and spouting were arranged to collect rainwater but the supply unfortunately proved to be inadequate, so the possibility of finding surface water was investigated. There is good permanent water 120 yards from the hut and higher up Wireless Hill, but as insufficient hose was available to pipe it to the hut, water had to be carried occasionally.

In the inner wooden room more shelves were built and a shutter made for the window so that the instruments could be inspected during daylight. A strip heater in this room ran continuously and in warm weather, or if the wind dropped, the hut temperature rose considerably, affecting the rate of the chronometer. The trouble was overcome by arranging a "Sunvic" thermostat in the heater circuit. A telephone was installed in this room. The electric power wiring was extended and a fuse fitted so that, during repairs, this wiring could be isolated without visiting the power-house. The lead-covered cable bringing power to the hut was entirely buried about one foot underground.

In the instrument room a red safelight was arranged near the recorder drum.

Just below the wooden section of the building a small retaining wall of sleepers was set up and held in place by a steel cable encircling the concrete room. The retaining wall was filled with stones to prevent erosion. A massive set of wooden stairs was erected up the steep slope to the hut. The hut roof was tarred (paint stocks being exhausted) and considerable improvement made in the air-and water-tightness of the junction between concrete and wooden rooms.

(5) Magnetic huts

First it was necessary to tie the huts down. At each corner of the two huts a railway sleeper was buried in the ground. Ropes were tied from the roof corner to a loop of heavy copper cable round the sleeper. The bulldozer was used to make a mound of earth near each hut on the windward side. It was hoped by this means to reduce wind effects but the attempt was not very successful. The earthmoving did, however, bring to light various articles of a magnetic nature and some parts of the huts lost in the sand. An extensive search was then begun to clear away all such material from around the huts.

Improvements began on the absolute hut. After tightening up the frame the outer surface was waterproofed. Almost every joint had to be sealed and the most effective method was to use rubber cement (P.C.49) applied like putty and forced into joints and window edges with a small knife. The larger gaps were first plugged with felt, small strips of wood, etc., and then treated with rubber cement. Later two coats of paint were applied. Some of this paint later peeled off because the wood was not absolutely dry when painted. Only on very rare occasions is the weather suitable for painting. Inside the absolute hut a large bench and two small shelves were erected and a shutter made to fit over one window at times when the light was too strong.

The magnetograph hut was a much bigger undertaking. Many of the frame bolts had either never been fitted or incorrect sizes had been used. When this was remedied the frame was eventually made rigid so that the outer cover could be waterproofed. The waterproofing was difficult because the hut had become warped, leaving big gaps at many of the joints. When the gaps were plugged and sealed the hut was painted. Both dividing walls were pulled out and refitted to make them airtight and part of the floor was removed so that a set of bearers could be placed. After replacing the floor linoleum was laid. A large bench was built in the clock room and a shelf was fitted in the instrument room. A comprehensive 230-volt A.C. lighting system was wired, with white lights in the porch and clock room and safelights in the clock room and instrument room. An elaborate control panel built just before leaving Melbourne, was hinged to the wall above the clock room bench, and wiring was arranged from control panel to magnetograph piers. The magnetograph piers were raised by adding earthenware pipes secured by a concrete plug at the joint. The pipes were filled with sand surmounted by a layer of concrete. After careful levelling, slate slabs were cemented with plaster on to the piers, and holes were drilled in one slab for the recorder chain-drive.

The holes in the floor through which the piers projected were much too large. By nailing down sheets of plywood sawn to shape, the gap between piers and floor was reduced to a narrow space round each pier. In this way the entry of light and air was reduced without allowing hut vibrations to be transmitted from the floor to the piers.

(6) Power line to magnetic huts

To check whether A.C. power would be satisfactory for illuminating the absolute hut, a temporary line was laid on the ground from the cosmic ray hut. The insulation soon burned out but, as results had been promising, a permanent line was begun from the radio hut. Supplies of lead-sheathed cable on hand stretched only about half way so this cable was buried in a shallow trench and an overhead line erected the rest of the way. Concentric two-conductor "Domestic Inlet" cable was used for the latter section. The underground part was soon broken by the bulldozer but fortunately, in the interim, a full reel of lead-sheathed cable had been found, and it was possible to replace the underground part with new cable buried at greater depth. Shortly after this operation was concluded the overhead cable gave trouble. Its insulation proved unequal to weather conditions and it had to be replaced by underground cable.

Lead-sheathed underground cable now connects the radio hut to a large box mounted on a stand near the magnetograph hut. The box is used for charging batteries and as a junction for all cables. Underground lines carry 230-volts A.C. to both huts, and 6-volts D.C. and 2-volts D.C. to the magnetograph hut. The 6-volt battery is being continuously charged by an STC battery charger fitted with a dropping resistor which limits charging rate to about 250 milliamps.

(7) Other work

Apart from geophysical work there were several duties requiring attention from time to time. It was the practice to become familiar with someone else's routine work, to cover emergencies and to allow him to leave camp occasionally for a day or so. Thus an arrangement was made with the radiophysicist to exchange routine work. This proved rather one-sided because the radiophysicist made several trips to Lusitania Bay for auroral observations, and his ionosphere recorder usually broke down during his absence. Some assistance was given to the engineer by acting as part-time bulldozer driver. The job of Cook's offsider, about once a fortnight, occupied most of a day's work.

A concrete block with a brass plate set in the top was carried down to Caroline Cove to mark the magnetic station there. The station could not be located so the block was left in the Cove on a large lead slab which had an inscription believed to include the word "Dovers" and apparently was related to early survey work.

V. CONCLUSIONS

During the 1950-51 year Mr. Flower had devoted his efforts almost exclusively to production of scientific results, and, considering the limited facilities at his disposal, his achievements were highly commendable. Reasons have already been given to explain why the same policy was not followed during the year's work described here. As a result of the change in policy very little scientific work was done but the buildings and equipment now provide a geophysical setup more conducive to serious scientific work in the future.

Seismic records for the year were brought back to Melbourne for analysis by Mr. H.A. Doyle. The results will be distributed when this analysis is completed.

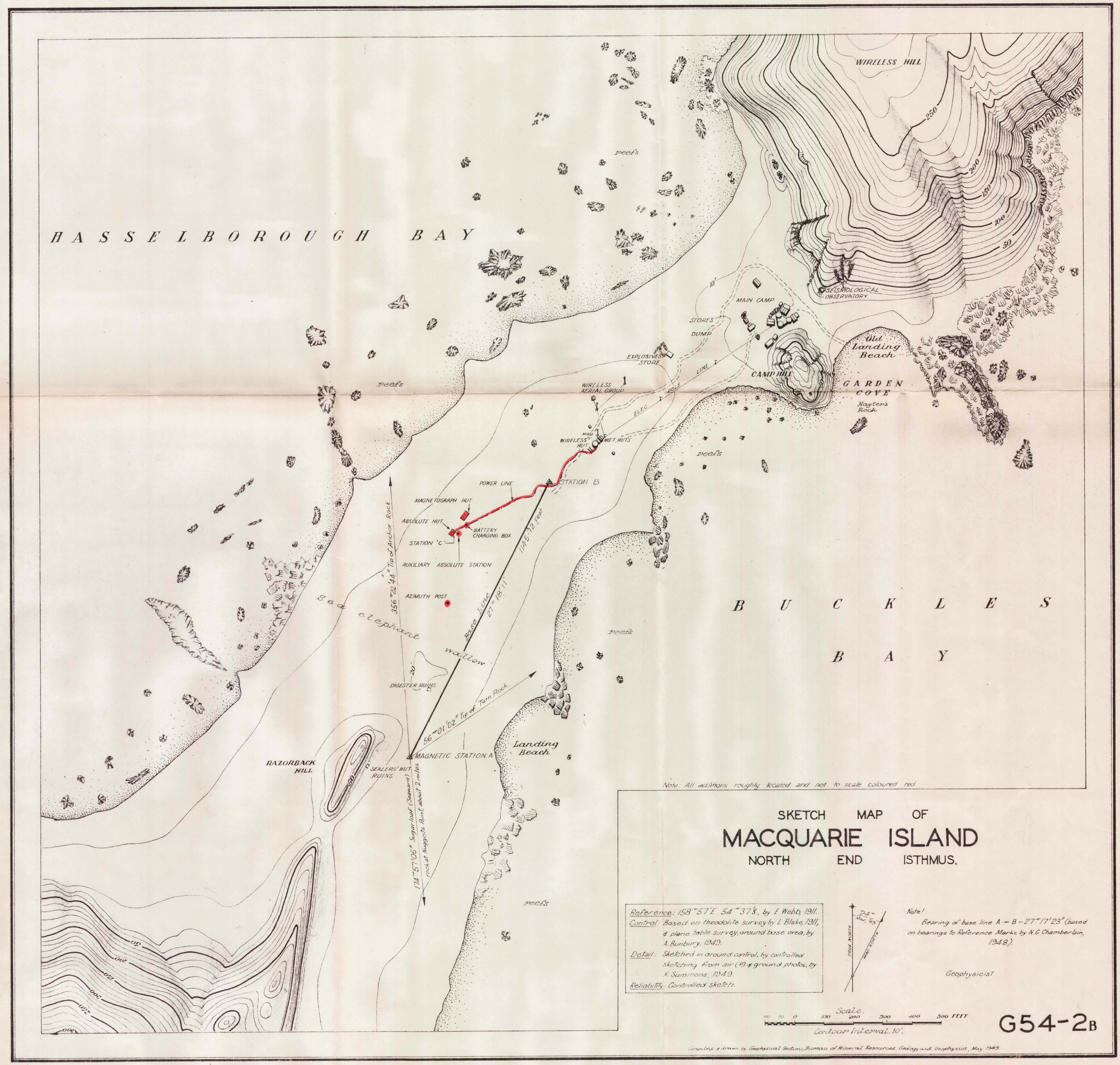
Melbourne,
29th. January 1953.

APPENDIX

ABSOLUTE MAGNETIC OBSERVATIONS MADE AT MACQUARIE ISLAND DURING 1951 and 1952

Date	Declination (East) °	Declination (East) '	Horizontal Intensity	Vertical Intensity (-ve)
7 July 1951	23	53.1	13379	
3 Oct. "	24	02.7	13387	64588
23 Oct. "	24	06.6	13405	64605
12 Nov. "	24	08.2	13508	64643
27 Nov. "	24	12.9	13384	64573
14 Dec. "	24	14.7	13412	64577
22 Dec. "	23	57.6	13482	64620
4 Jan. 1952	24	09.7	13409	64570
15 Jan. "	23	51.4	13484	64660
21 Jan. "	23	59.7	13413	64597
4 Feb. "	24	05.1	13409	64589
17 Feb. "	24	06.0	13378	64565
24 Feb. "	24	11.9	13397	64557
3 Mar. "	24	12.8	13391	64567
20 Mar. "	24	07.1	13385	64587

NOTE:- These values are not corrected to I.M.S.



SKETCH MAP OF
MACQUARIE ISLAND
NORTH END ISTHMUS.
HASSELBOROUGH BAY
BUCKLES BAY
WIRELESS HILL
250
200
150
100
50
SEISMOLOGICAL OBSERVATORY
MAIN CAMP
STORES DUMP
EXPLOSIVES STORE
CAMP HILL
Old Landing Beach
GARDEN COVE
Hayter's Rock
WIRELESS AERIAL GROUP
ELEC. POLE LINE
WIRELESS HUT
MET. HUTS
STATION B
POWER LINE
MAGNETOGRAPH HUT
ABSOLUTE HUT
BATTERY CHARGING BOX
STATION "C"
AUXILIARY ABSOLUTE STATION
AZIMUTH POST
Sea elephant wallow
Base Line 27°18'11"
1145·72 Feet
356°22'44" Tip of Archer Rock
DIGESTER RUINS
56°01'02" Tip of Tern Rock
MAGNETIC STATION A
Landing Beach
RAZORBACK HILL
SEALERS' HUT RUINS
174°57'06" Sugar-loaf (Seaward) rock at Hoggets Point, about 2 miles
reefs
Note: All additions roughly located and not to scale coloured red.
Reference: 158°57'E 54°37'S, by E. Webb, 1911.
Control: Based on theodolite survey by L. Blake, 1911, & plane table survey, around base area, by A. Bunbury, 1949.
Detail: Sketched in around control, by controlled sketching from air (P) & ground photos, by K Summons, 1949.
Reliability: Controlled sketch.
24° Mar. '49
TRUE NORTH
MAG. NORTH
Note!
Bearing of base line A → B = 27°17'23" (based on bearings to Reference Marks by N.G. Chamberlain, 1948).
Geophysicist
Scale.
100 50 0 100 200 300 400 500 FEET
Contour Interval, 10'.
G54-2B
Compiled & drawn by Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics, May 1949.