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GEOPHYSICAL WORK AT MACQUARIE ISLAND 1958.

by

A. TURPIE.

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ABSTRACT.

This record describes the work done in operating the seismic and magnetic observatories at Macquarie Island during the year 1958.

The scientific results are published in separate reports.

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1. INTRODUCTION.

The writer was geophysicist in charge of the seismic and magnetic observatories on Macquarie Island (54° 30'S, 158° 57' E, Magnetic Latitude 61° S) from December 1957 to December 1958, as a member of the 1958 Australian National Antarctic Research Expedition. The seismological observatory has been in operation since 1950 and the magnetic observatory since 1951.

The writer continued the work of previous observers, whose work has already been reported. Details of observatory installations and routines may be found in previous records, namely:-

Report on work at Macquarie Island 1951-1952, W.H. Oldham, (Records 1953, No. 30).

Geophysical work at Macquarie Island, April 1952-April 1953, P.M. McGregor, (Records 1954, No. 32).

Geophysical Work at Macquarie Island, April 1953-December 1953, P.B. Tenni, (Records 1954, No. 33).

Geophysical work at Macquarie Island 1954, C.S. Robertson, (Records 1957, No. 86).

Geophysical work at Macquarie Island, 1955, P.E. Mann, (In preparation).

Geophysical work at Macquarie Island, December 1955 - December 1956, B.G. Cook, (Records 1957, No. 105).

Geophysical work at Macquarie Island, 1957, J.R. Cleary, (In preparation).

2. GENERAL MAINTENANCE.

2.1 Introduction

It will be noted from previous records that, because of the frequent rain and high winds, all observers have had trouble with weatherproofing and corrosion. Strong winds, whipping up sand, cause sandblasting of the magnetic huts.

2.2 Caulking

A considerable number of leaks existed in all buildings. The sources of many of these leaks were not immediately apparent. Such leakage seemed to be due to a general seepage, abetted by the wind, along joints considerably distant from where the water appeared inside the buildings.

Previous caulking with pitch and PC 49 had become loose due to weathering. PC 49, in particular, seems to have poor weathering properties.

Caulking compound, containing castor and linseed oils, was provided by ANARE. A considerable programme of caulking all joints, seams and holes was carried out using this material, which was later covered with paint or tar. It therefore should remain moist and retain its adhesion.

All leaks were stopped except one just inside the door of the seismic vault. This leak may be impossible to stop. The roof is constructed of concrete with a corrugated iron base. The northern edge of this roof is buried in the hillside and water may be running from the hill, along the corrugated iron, under the concrete.

A considerable draught used to pass through the seismic vault in a high wind and was apparent on the seismograms. There was very little draught after all joints and holes had been filled.

2.3 Flashing etc.

Galvanised iron flashing along the east and west sides of the seismic vault roof, which had completely rusted away, was replaced.

The joint between the lean-to roof of the store hut and the side of the seismic vault was open. Previous attempts to patch this with cement and PC 49 had been unsuccessful. During this term the joint was covered with galvanised iron flashing.

Quad timber was screwed to the bottom of the variometer house and office doors to prevent water running down the doors on to the floors.

In the absolute hut, revolving plywood covers were fixed over the holes used for viewing the azimuth marks.

Plywood covers were also fixed over tripod holes in the floor of the absolute hut to prevent sand entering during high winds.

2.4 Tarring

In previous years, the roof of the office had been tarred, and considerable quantities of tar had been applied at the junction of the office and the seismic vault, with good results. These surfaces were given a fresh coating of tar.

The store roof was caulked, coated with red lead and then tarred.

Joints in the walls and roof of the seismic vault were caulked and then tarred.

The weather side of the roof of the variometer house was tarred, early in the year. This was later found to be a mistake, as explained in section 2.5 below.

The "tar", provided by ANARE, is a type of roofing compound. It must be applied thickly, as it is removed rapidly by weather. Paint should be used in preference to tar wherever possible.

2.5 Painting

It has already been stressed in previous reports that maintenance of paint work is difficult in the climate at Macquarie. The wood underneath much of the paint was saturated with water. Because of this it was possible to peel off great sheets of paint. On the windward sides of the magnetic huts, where sand blasting occurs, much of the wood was bare by September. On days when there was no rain, painting had to be stopped about five o'clock, as condensation began about that time and the surface became quite wet.

The year's supply of turpentine was exhausted very quickly because of its use for washing hands and brushes; consequently, kerosene had to be used for thinning the paint. This is not satisfactory, as paint thinned with kerosene takes too long to dry. When rain or condensation follows, blisters and streaks are caused, and in some cases the paint is completely washed off.

The weather side of the roof of the variometer house had been tarred in January. By September, this tar was weathered off, except for patches where it had been applied more thickly. The leaks, which had been stopped, had reappeared. It was decided that paint was preferable to tar, and this roof was now painted. When applying the second coat, the first coat was sliding where tar remained underneath the paint. It is advisable to paint this roof without standing on it. This may be done by painting the lower half from a ladder and the upper half from the ridge.

During painting of the variometer house, the variometers were subject to large deflections, caused by the steel reinforcing of the ladder. As no ladders in the camp were free of steel, the carpenter constructed a non-magnetic ladder, which is now stored in the absolute house.

Before repainting, all loose paint was removed with a wire brush and scraper. About half of the paint on the magnetic huts was scraped off down to the wood. All bare wood was painted with undercoat. Ironwork which had rusted was scaled, cleaned with a wire brush and coated with red lead. A top coat of battleship grey was applied overall. A second coat of battleship grey was applied to the weather sides of the magnetic huts.

Although the bared wood was allowed to dry as much as possible before repainting, it would still be wet beneath the surface and this water would later find its way to the surface under the paint, loosening it from the wood once more.

The post to the south of the absolute hut, used as an azimuth mark for declination, was painted with one undercoat and two top coats of white paint.

2.6 Tools

The tools which were stored in the dark room were in good condition, but those which were in the store room were in poor condition. All rust was removed from the tools and they were placed in a bath containing diesoline with some oil added. All files and a steel rule were useless and were written off. Cutting tools were sharpened. The steel body of one of the Scope soldering irons had rusted, causing an open circuit between body and tip. This could be a recurring fault.

2.7 Locks, etc.

Two locks were defective at the beginning of the year, and a further failure occurred during the year. The failures were due to corrosion of the steel springs. One lock was repaired, but no material was available to repair the other two. Phosphor bronze strip (3/8" x 18 gauge), from which replacement springs could be made, was ordered.

The door of the absolute house must sometimes be left open for short periods, whilst equipment is carried in and out. This door opens outwards and had been fractured by being blown back against the roof rafters.

To secure the door when open, a 2 ft. brass hook and eye with 3" x $\frac{1}{4}$" Whit. brass fixing bolts will be supplied next year.

2.8 Water Supply for Dark Room

The water for the dark room is supplied from a rain water tank, which collects the water from the roofs of the office, seismic vault and store room. This tank was very rusty and had several inches of sludge in it. Using this water for processing caused some records to be stained. The rust was most noticeable in the glycerine, where it seemed to coagulate. The tank was cleaned out and refilled, but the water was dirty afterwards. Water was therefore carried from the camp during the last two months. It is recommended that this tank be replaced.

At the beginning of the year, the supply of rainwater was not sufficient for dark room use. A drainpipe was installed to connect the previously unconnected guttering on the seismic vault roof to the water tank.

A stoppage which occurred in the hose between dark room and tank was cleared. The tap, which had been dripping at the gland since the beginning of the year, was reground, and the gland was repacked.

The drain from the dark room sink, previously draining on to the path to the store, was extended.

Water had to be carried to the dark room, during several periods, when the hose between the tank and the dark room was frozen.

2.9 Dark Room Floor

A steel sheet, which was used to cover the plywood floor of the dark room in front of and underneath the sink, had rusted through, and water was trapped underneath it. The steel sheet was removed, and the dark room floor was tarred and covered with rubber flooring.

2.10 Repairs to Power Cables

During the changeover, at the beginning of the year, the seismic power cable was cut, where the foundations for the new living quarters were being dug. Consequently, the power was cut off for several short periods during the changeover. Later, the seismic power cable was connected to the switch-board in the boiler house.

The magnetic power cable was cut by the bulldozer during excavation at the meteorological radar site. Junction boxes, mounted on posts and covered with 44 gallon drums, were installed at the end of the meteorology building and beside the road beyond the radar, and a new section of cable was installed between them.

The seismic power cable was cut again by the bulldozer during the construction of a sewage drain. A new junction box was installed at the foot of the steps leading to the seismic observatory, and a new section of cable was installed between there and the junction box beside the henhouse.

A taped joint in the magnetic power cable beside the battery box was replaced by a junction box. This box was mounted on a leg of the battery box and was covered with canvas.

2.11 Aerial

The aerial, used for receiving WWV time signals, broke twice and was repaired. According to previous reports, this occurs repeatedly. The wire used was 3/16" single strand copper and contained many joints. Telephone wire was used for a new aerial. It was installed in such a way that there were two end-fed aerials without joints. One of the aerials was tuned to a half wavelength at 10 mc/sec.. This aerial broke again and was replaced with the main span supported by steel fencing wire. This aerial remained unbroken for the rest of the year.

2.12 Heater in the Seismic Vault

A fault was discovered in the heater circuit in the seismic vault. It was found that the return lead of this heater was connected to the earthwire and that this wire was not properly earthed, due to corrosion. This earth connection was cleaned, and the wiring was connected correctly. This current drawn by the heater increased from 1.7 to 2.9 amps. A 400-watt heater would probably suffice for the vault instead of the present 750 watt heater.

2.13 Erosion around Magnetic Huts

Considerable erosion is taking place around the magnetic huts.

The power cable from the battery box to the absolute house was uncovered, and stones had to be piled over the cable where it was exposed.

The sleepers supporting the NW corner of the absolute house were undermined and had to be blocked up. It is suggested that stones be piled a few feet from the west wall of this house, as has been done for the variometer house. This would also decrease wind vibration of the absolute piers, which made measurements with the H.T.M. difficult.

2.14 Power Points in Magnetic Huts

A power point was installed in the variometer house, and an earth lead was connected to the power point in the absolute house.

2.15 Batteries

Early in the year both magnetic and seismic batteries were using a lot of water and required frequent topping up. It was the practice to add water to just above the plates. However, later in the year they were filled right to the top and topping up was required far less frequently, and less water was used. About three gallons of distilled water were used during the year.

During the winter months the lamp in the battery box was left on.

The top of the seismic battery was cracked, and it lost its charge rather rapidly, when the charging current was switched off.

The lead from the positive terminal of the magnetic battery was corroded and fractured. Fortunately, the lead still made contact, and no trace was lost. The lead was resoldered, and the joint was varnished.

The battery charger used for the seismic battery was not working properly. The current shown on the meter bore little relation to the current drawn and was subject to fluctuation. There were no fuses in the battery output circuit. Towards the end of the year the charger was replaced and fuses were connected in the circuit. The battery clips were removed and the leads were soldered to the battery. The joints were then varnished. The equilibrium battery voltage was adjusted to 6.75 volts by inserting a 0.45 ohm dropping resistor.

It is suggested that some manufacturers literature on batteries be obtained for Macquarie Island.

2.16 Absolute Time Mark Circuit

This circuit had been working intermittently. It is used to p... time marks on the variometer trace during absolute observations and, at all other times, causes a 200-watt bulb in the absolute house to be lit by the time marking contact of the La Cour clock, so that a time check may be made from the seismic observatory.

In repairing the circuit :-

(a) All unsoldered joints were soldered.

(b) Three dry joints, on the ends of the cable running between the absolute and variometer houses, were remade.

(c) The socket for the six-volt indicator bulb in the absolute house was removed, and the bulb was soldered into circuit.

(d) A cable fixing screw in the switch on the east pier had become loose and was tightened. (This seems to be a common fault with these bakelite switches and becomes more pronounced with a low voltage and a corrosive atmosphere).

The lead sheath of the cable between the magnetic huts was broken by seal pups at the floor of the absolute house. This was repaired, and stones were piled around it to prevent further damage.

2.17 La Cour Clock

Considerable trouble was experienced with the La Cour Clock early in the year. It could not be wound fully, because it stopped when the weight was right up. It also stopped occasionally at other times.

During the previous year the clock had been stopping, because the hour hand moved forward on its spindle and jammed against the five minute contact. To prevent this happening, the clock had been tilted backwards. It was returned to its proper level, and part of the 5 minute contact was cut away and moved slightly, so that the hour hand could clear it when fully forward. The tick became stronger and more regular, and the clock could now be wound fully, so that it had only to be wound every seven days. The rate improved also.

Considerable difficulty was experienced with intermittent contacts for the time spots, which varied in intensity and were sometimes missing. The current, during a time mark, varied and sometimes dropped to zero. The five and one minute contacts on the clock had to be cleaned every few weeks. Poor contact would recur whenever the minute hand was moved to reset the clock. A relay was inserted in the circuit so that the clock contacts operated the relay, and the time mark current went through the relay contacts. After this modification the time mark current became steady and no further trouble was experienced with dirty contacts. It should be noted that the voltage across the clock contacts was now 7 volts instead of 2 volts. The relay had a 100-ohm coil and was mounted vertically on the variometer control panel. The variometers were not deflected by the relay.

Trouble was also experienced with moisture condensing and collecting on the one-minute contact. When this happened, the contacts would stick together; the lower contact being lifted by the surface tension, and giving very intense time marks. The trouble was eventually overcome by unbending the wire attached to the lower contact sufficiently so that the lower contact was held down against the stop. The contacts can be dried in position.

After inserting the relay a spark occured at the minute contacts on break. This was overcome by inserting a 0.1 uF condenser in series with a 100-ohm resistor across the contacts.

The tick of the clock was not even, and it was found that the escapement lever had been considerably bent. This was partially straightened to make the tick even.

The rate of the clock varied rather erratically during the year. The rate is not easily adjusted, because the pendulum bob will not move downwards of its own accord but must be pulled down, and fine adjustment can only be obtained by screwing up. An attempt was made to improve the rate by soldering the joint in the pendulum, but this did not have any effect. The clock was oiled once during the year. Eventually the clock settled down and only had to be reset once a month.

It was found that the clock sometimes lost one or two ticks during winding. A stop watch was therefore used to check any loss during this process.

2.18 <u>Magnetic Variometer Scale Value Circuit</u>

From previous reports it appears that trouble has always been experienced with the scale value circuit due to corrosion of the switch contacts and potentiometer tracks. An attempt was made to get a steady current by cleaning these contacts and tracks before every measurement.

The scale value circuit was modified, early in the year, using the existing components. It gave a fine control and reduced the effect of corroded tracks. With this new circuit, the current could be reduced to zero before reversal. This circuit proved very successful and is shown in Fig. 1.

The modifications, and the reasons for them, were as follows :-

(a) The commutator switch was using only one gang of a two gang wafer switch. The two gangs were put in parallel.

(b) The 270-ohm potentiometer, previously used as a series variable resistor, was connected as a potentiometer. This allowed the current through the deflecting coils to be reduced to zero before reversal. It also meant that a fine control was obtained, because the 270-ohm potentiometer was in parallel with the 9-ohms resistance of the meter. The circuit was so designed that, in use, the moving arm of this potentiometer would be turned fully clockwise and would therefore rest on the brass end strip of the track. Particular attention was therefore paid to the cleaning of this end strip.

(c) A 500-ohm and a 5000-ohm resistor were placed in parallel with the series variable resistor of 5000 ohms. These resistors were so selected that, with the two potentiometers fully up, the coil current was about 1% below the required 15 ma. The 5000-ohm potentiometer could then be adjusted to give the required 15 ma, giving a very fine control. Further, only about 10% of the total current would flow through the 5000-ohm potentiometer and any current fluctuation due to poor contact on this track would be reduced by a factor of 10.

(d) The coil current changed suddenly when switching on the recording lamp, due to the change in load on the battery supplying both currents. To obviate this a 40-ohm fixed resistor in parallel with a 1000-ohm variable resistor was placed across the "off" position of the lamp switch. A meter was placed in series with the lamp circuit. This meter was already mounted on the board and had been used for scale value readings previously. The current in the "off" position could now be adjusted to be equal to the current in the "on" position.

(e) A switch was put in series with the clock contacts.

2.19 Prevention of Corrosion on Magnetic Variometer Control Panel.

As stated in 2.18, considerable corrosion occurred in components of the variometer control circuit and scale value circuit.

To prevent this, a box was fixed around the control panel, with gaps closed by felt. A 15-watt red pilot lamp was fixed in the bottom of the box to keep the controls dry.

This arrangement proved very successful, and no corrosion occurred from then on. This saved considerable time and trouble during scale value measurements.

2.20 Cleaning La Cour Recorder Drives

The failure of the recorder drives has been a main source of trouble with La Cour variometers.

The drives held at Macquarie Island during the year were Nos.131, 135 and 110.

No. 131 was a spare at the end of 1957 and had been overhauled by J.R. Cleary. This drive was returned to Melbourne at the end of 1958.

No. 110 was the drive in use at the end of 1957.

No. 135 was a new drive supplied in December 1957.

A reconditioned drive was supplied in December 1958.

The recorder stopped, on 15th April, 1958, and it was at first thought that the drive had failed. No. 110 was therefore replaced by No. 135. However, it was found on further examination that the bar holding the paper on the recorder drum had not been pushed fully home and had fouled the case.

On 12th July, 1958, drive No. 135 failed, and No. 110 was reinstalled.

Advice was sought from Melbourne as to the best method of cleaning these drives and the following method was advised :-

Remove the escapement.

Place the drive on its side with the ratchet wheel uppermost.

Undo four screws holding the sides with the ratchet wheel and lift the side off.

Clean out the bearing holes with a matchstick sharpened to a point.

Clean all parts with shellite or carbon tetrachloride.

Apply watch oil sparingly.

Re-assemble in reverse order.

It is suggested that lubricating with graphite might be better, as oil will collect dust and becomes viscous at low temperatures. Aquadag might be supplied for the purpose.

The driving weights in use at Macquarie Island are as follows :-

Escapement End	-	$2\frac{1}{4}$ lbs. with a counterweight of $1\frac{3}{8}$ lbs.
Other End	-	$2\frac{1}{2}$ lbs. with a counterweight of $\frac{1}{2}$ lb.

The counterweights were added by P.B. Tenni as a safeguard to prevent drive failures. The couple driving the recorder will therefore be less than the original.

Drive No. 135 was cleaned, lubricated and tested successfully with a driving weight of $\frac{3}{4}$ lb.

2.21 <u>Rewinding of H Scale Value Coil</u>

When replacing this coil after D and H orientation tests, one of the leads broke, and the coil was rewound.

2.22 <u>Return to use of Southern Azimuth Mark</u>

During the changeover in December, 1955, the QHM's 177, 178 and 179 were replaced by the DCK 158 for control of declination. The [illegible] of DCK 158 is considerably higher than that of the QHM. Consequently, it was impossible to use the Post Mark and South Mark, and the North Mark was also partly obscured. Both mark viewing holes were increased in height, and the Post Mark and South Mark were restored to use. It will be noted in section 3.11 that the Post Mark has moved one half minute since it was last used.

2.23 <u>Seismic Lamp Circuits</u>

Some fluctuation in trace intensity on the seismograms occured during the first half of the year. Two causes were eventually located and corrected.

When the hour mark contact closes a variable resistor is shorted out. This resistor was underrated and the cardboard former had burnt away. This fault was corrected by putting a $3\frac{1}{2}$ ohm manganin resistor in parallel with the variable resistor, so that it draws less current. Also, the wiper arm was transferred to a new point on the track. A replacement was ordered.

A loose banana plug on the Grenet light source was tightened up.

It is suggested that a reel of 24SWG DCC manganin wire be supplied.

2.24 <u>Seismic Time Mark Circuit</u>

The seismic chronometer has a built-in minute contact and an hour contact which is operated by the minute hand touching an insulated contact fixed to the dial at 12 o'clock. The minute contact operates relays, to which are attached deflecting mirrors at the three light sources, from 0 to the 4th. second of each minute. The hour contact intensifies the trace for about 15 seconds, between 0 and the 1st. minute of each hour. Several faults developed during the year.

Because the hour contact was poor, a relay was inserted in the circuit, so that the current through the hour contact was reduced from 900 ma to 60 ma, and the intensification of the trace was more definite.

A 0.1 uF condenser in series with a 100-ohm resistor was placed across each contact which operated a relay in the seismic control circuit to prevent damage of the contact by arcing.

The hour contact had been connected to an insulated lead underneath the dial. This lead had been fractured at some time and had been replaced by a lead on top of the dial. The wire of this lead was thicker than the dial contact, and the hour hand therefore made contact with the wire instead of the contact. This wire became blackened and made poor contact. The insulation on the lead, where it passed under the dial cover, became fractured.

The hour hand occasionally touched the dial contact giving an extra intensification at about 2400 hrs.

The moving part of the minute contact is held by one screw. This became loose and the contact swivelled so that it made continuous contact with the clock housing. This fault was temporarily corrected by pulling the contact up into its proper position with a pair of tweezers.

To correct all of these faults, the minute, hour and second hands and the dial were removed from the chronometer. The lead under the dial to the hour contact was replaced. The minute contacts were removed, cleaned and replaced. Unfortunately the contacts were not washed before replacing and they occasionally stuck together for one minute at a time after replacement. As this only happened occasionally, nothing was done about it, and this fault still exists.

2.25 Wiring of Seismic Vault

It would be desirable to rewire the seismic vault completely. It is at present a mass of loosely hanging leads. A single control panel could be constructed at the same time, to replace the present seven separate panels on the office wall.

2.26 Wood Anderson Recorder Drive

This drive failed to start after changing the trace on 12th April. From then on, the checking of this drive, before leaving the vault became part of the routine. One further failure to start occurred later.

2.27 Miscellaneous

A considerable number of minor items of maintenance, not worthy of separate listing, required attention during the year.

3. CALIBRATION AND ADJUSTMENT OF INSTRUMENTS

3.1 Adjustment of La Cour Prisms

All rays, except that from the prism being adjusted, were cut off with tissues. A tissue with a hole in it was placed around the variometer lens aperture and light from the prism was then adjusted centrally on the aperture.

The first positive reserve spot on D is weak and could not be improved.

A list of the order of the prisms on the rack is given in Fig. 10 for reference.

Adjustments to prisms were made as follows :-

21 Dec. 1957	Replacement of D 1st and 2nd reserve +ve prisms. 1st and 2nd reserve -ve prisms. Z Main Spot.
12 Apr. 1958	Replacement of all remaining prisms and adjustment of all prisms.
14 July 1958	Adjustment of H 1st, 2nd & 3rd reserve +ve prisms.
30 Aug. 1958	Adjustment of D 1st & 3rd reserve +ve prisms.
8 Sept. 1958	Adjustment of D 1st reserve +ve prism.

From these dates new values must be taken for the reserve spot distances of the respective prisms (See Table 1).

Whether the various spots are of approximately the same intensity can be checked by looking into the lens aperture of the variometers.

Canada balsam was used for remounting the prisms. It appeared as though pitch may have been used previously. Pitch may be preferable in that it was very easy to re ove the prisms for replacement.

3.2 Intensity of La Cour Traces

The intensity of the La Cour variometer traces varies considerably with humidity. When the temperature was below zero, the lamp current was set as low as 120 ma. When the temperature and humidity were high and the trace was disturbed, the lamp current was sometimes set as high as 145 ma.

3.3 Orientation Tests on D and H Variometers

(a) Setting of Deflection Coil

A sketch of the variometer hut is shown in Fig. 11 and of the deflecting coil in Fig. 12.

The distance between the bars from which the lining-up cord is suspended is 347.9 mm.. Therefore one minute of arc is equivalent to a distance along one bar, relative to a point on the other, of 1.012 mms..

The azimuth between the holes in the north and south walls of the variometer hut has been established by P.E. Mann and checked by J.R. Cleary as $24^\circ\ 05'.9$.

The azimuth of the magnetic meridian was taken as $25^\circ\ 20'$. Therefore the cord must be further east from the hole in the north wall than from the hole in the south wall by 74.5 mm..

In the following table distances are given measured east along the bars on north and south walls from the respective holes.

<u>H Orientation Test</u> -

Cord above centre of H variometer	N	711.5 mm.
	S	637.0 "
Cord touching side of coil frame positioned centrally	N	775.5 "
	S	701.0 "

<u>D Orientation Test</u> -

Cord above centre of D variometer	N	879.5 "
	S	805.0 "
Cord touching edge of coil positioned centrally	N	999.5 "
	S	925.0 "

<u>H Scale Value Position</u> -

Cord touching edge of coil positioned centrally	N	832.5 "
	S	758.0 "

(b) Deflection expected for Allowed Misorientation

The deflection on the trace will be

$$d = \frac{F \sin \theta}{S}$$

where F = applied field = $7.49 \times I$ gammas

I = current in ma.

θ = angle which variometer needle makes with direction of F

S = scale value = 12.5 gammas/mm. for H
and 3.52 gammas/mm. for D

Putting I = 150 m.a., θ = 1 degree

for D d = 5.6 mms.

for H d = 1.6 mms.

(c) Modification of Scale Value Circuit to give necessary current

The new scale value circuit, shown in Fig. 1, may be very easily modified to give the necessary current. A 45-ohm resistor with pee-wee clips attached is placed in parallel with the 5000-ohm variable resistor, and a current of 160 ma. may then be obtained with the 270-ohm potentiometer. The 5000-ohm variable resistor is a low current potentiometer and should not be used to increase the current by more than a few milliamps.

(d) Procedure adopted during measurement

The deflection is expected to be small and the current is increased slowly. The magnet will require only a short time to come to rest. The recorder lamp was switched off for two minutes between readings and on for three minutes at normal intensity. Two sets were done for both H and D, and the coil was realigned for each set. The current used in both cases was 150 ma.

3.4 Parallax Test on La Cour Variometers

One parallax test was carried out during the year.

3.5 La Cour Variometer Scale Value Measurements

Two main reasons seem to exist for scatter in scale value measurements. These are :-

(a) Variation of the current flowing in the deflecting coils, while the lamp is switched on; and -

(b) Disturbance of the trace during the measurement. The measures adopted to reduce (a) have already been described in sections 2.18 and 2.19 and scatter caused by this is now negligible. Only a very small amount of disturbance is necessary to spoil a scale value measurement; close examination of the trace, before computation, will usually enable one to predict whether the scale value measured is likely to be above or below the mean value. It is therefore useless to try to measure the scale value except on very quiet days. The practice adopted was to carry out a scale value measurement soon after the record was developed, when it was seen that the trace was very quiet. The scatter of scale value measurements was reduced to about ± 1% during the last six months of the year. The deflecting current used is 15 ma., but could probably be increased to 30 ma. with advantage.

The spare sub-standard meter (VML 14260) for scale value measurements was checked against the meter in use (VML 11386).

Previously each scale value measurement had consisted of two deflections, one positive and one negative. This was changed to three deflections in the order positive - negative - positive at equal time intervals apart. Any error due to gradual change in the magnetic elements would thereby be eliminated.

3.6 Adjustment of H Variometer

A sketch of the optical system of the H variometer is shown in Fig. 9.

Prism A is supported by a bimetallic strip and moves as the temperature varies, giving a temperature trace and compensating the H trace for variation in moment of the suspended magnet with temperature. Advice was received from Melbourne at the beginning of April that the temperature compensation was not working properly. On examination, it was found that one corner of prism A was hard up against its support plate. Clearance all round was adjusted to 0.015" This is the approximate effective length of the bimetallic strip.

Prism A is adjusted by spring loaded capstan screws "b". Prism B is adjusted by another three screws on the front of the variometer body. The base line mirror is adjusted by three similar screws on the rear of the variometer body.

The base line mirror, which was half obscured by an irregular deposit of black substance, was removed and cleaned.

The positions of trace and temperature spots are varied by tilting the plates supporting prisms A and B; B moves both spots together; A moves the two spots at different rates. The intensity of the spots may be varied by cutting off parts of the vertical line images of the lamp filament on the stop at the bottom of the cylindrical lens. To vary the relative intensity of trace and temperature spots, the spots can be moved with the centre screw of prism A and brought back with the centre screw of prism B. To increase the separation of trace and temperature spots, the spots can be moved towards D with the two outside screws of prism A and brought back with the two outside screws of prism B.

The base line spot may be varied in position and intensity separately.

The initial adjustment of the H variometer was carried out on 12th April, 1958. A gradual movement of the prism caused about three millimetres movement of the trace during the next three months. When the temperature increased later in the year, it was necessary to increase the separation of trace and temperature spots. This adjustment was carried out on 8th September, 1958.

3.7 Temperature Cycling of Variometer

A temperature cycle was carried out on the H variometer on 25th April, 1958, soon after the adjustment of the bimetallic strip, described in Section 3.6.

The variometer room was heated by a kerosene heater to 16°C, whereupon the heater was removed and measurements of H were made during the decrease in temperature to the equilibrium value of 4°C prevailing at the time.

It was found that -

(a) The presence of the heater caused a deflection of some 15 gammas on the H trace.

(b) The Z variometer temperature lagged behind the H variometer temperature.

(c) During the temperature cycle the H variometer prism A moved independently of temperature by a small amount, as it did at other times during the three or four months following the resetting.

However, good estimates of the temperature coefficient of the H variometer and the sensitivity of the temperature trace were obtained.

It is suggested that a temperature cycle of the Z variometer be carried out, as the value for the temperature coefficient of the Z variometer obtained by analysis of baselines is subject to inaccuracies caused by the rather large drift in the Z baseline. It should be noted that such a temperature cycle might cause a movement of prism A, as in (c) above, with a consequent change in H baseline.

3.8 Remeasurement of Azimuths of Declination Marks

During the changeover in December 1958, a party of surveyors, under J. Lines of National Mapping, established an azimuth between the two auroral stations at either end of the island. Sunshots were taken on the parallactic camera pier in the auroral bay at Buckles Bay. This pier can be seen directly from the east pier in the absolute house. The glass window in the absolute house was removed and the azimuth was transferred directly to this pier. The azimuths of the declination marks were then measured. The results of these measurements together with previous determinations are tabled below :-

Year	Observer	Anchor Rock	Landward Nugget	Post Mark
1952	P.M. McGregor	353° 41.4'	177° 13.1'	176° 59.6'
1953	P.B. Tenni	353° 41.1'		176° 59.7'
1954	C.S. Robertson	353° 39.5'		176° 57.8'
1957	J.R. Cleary	353° 40.0'		
1958	J. Lines and M. Nicholas	353° 40.4'	177° 12.1'	176° 59.2'

Measurements in 1953 and 1954 were obtained from sun observations. Neither of the observers regarded his results as conclusive. Measurements in 1952 were obtained by transference from Station A via Station B. The transference from Station B was repeated in 1957 using the azimuths established at this station in 1952.

C.S. Robertson used the original value obtained by P.M. McGregor for the purpose of consistency. However, in his final report, McGregor adopted a slightly different value. Since there has not been consistency in the values adopted so far, it would appear that a final value based on the 1958 measurements should be adopted retrospectively. The values adopted and the corrections requiring to be made in the reports published to date are :-

Report No.	Date	Azimuth used for Anchor Rock	Correction
27, (P.M. McGregor)	7/ 4/52 to 31/12/52	353° 41.4'	-1.0'
31, (P.B. Tenni)	1/ 1/53 to 31/ 3/53	353° 41.4'	-1.0'
	1/ 4/53 to 30/11/53	353° 41.1'	-0.7'
	1/12/53 to 31/12/53	353° 40.9'	-0.5'
35, (C.S. Robertson)	1/ 1/54 to 31/12/54	353° 40.9'	-0.5'

An erratum to these reports will be published in the report for 1958.

3.9 Intercomparison of Instruments

QHM 288, Askania Declinometer 509320 (Circle 508813) and long range BMZ 121 were used as intercomparison instruments in December 1957.

HTM 5010154, Askania Declinometer 509320 and long range BMZ 211 were used for this purpose in December 1958.

The instruments used at Macquarie Island during the year were QHM's 177 and 178, DCK 158 and BMZ 64.

QHM's 177 and 179 were interchanged at both changeovers, 179 and 177 being returned to Toolangi at the beginning and end of the year respectively for intercomparison.

A considerable programme of intercomparing declinometers was undertaken in conjunction with J.R. Cleary in December 1957.

Corrections to all instruments were computed by taking the means of corrections measured from 1956 onwards. The corrections to the QHMs for measurements of H were consistent but the corrections to the declinometers and the BMZ's showed some scatter also.

3.10 Rearrangement of order of Absolutes

The order in which absolute measurements were made previously was

D, D, Z, H, H, Z.

As the order is not important when measuring against a variometer baseline, this order was changed to

D, D, Z, Z, H, H.

Each instrument was clamped and re-levelled between sets to ensure their independence.

3.11 Adjustment of Grenet Vertical Seismograph

During December 1957 and January 1958, the record from the Grenet Seismograph occasionally became completely smooth. It was found that the boom was resting on the toroidal magnet. An operational diagram of the seismometer is shown in Fig. 2.

The boom is supported by the crossed springs at O and the spiral spring S, at D. The boom is free to oscillate in a vertical plane about O. The centre of gravity of the boom may be raised or lowered by the eccentric weights W, which can be rotated when the nuts on the outside of the weights are loosened. These nuts are only finger tight. The period of oscillation of the boom is controlled by moving the point of suspension Y of the spring horizontally. This period may be measured visually with a stop watch, after open circuiting the coil C.

In order that the seismograph should respond to only the vertical component of earth movement, the centre of gravity of the boom must be in the same horizontal plane as the axis of rotation. When this is so, the couple about O will be a maximum and the extension of the spring will be greatest. The relative spring extension may be read off the pointer and scale H. The sensitivity to level varies as the square of the period. In adjusting the level of the boom, the period should be increased to about 3 seconds, using screws A and B in conjunction. Lower the boom by screwing in B; raise it again by screwing out A, and so on, alternately, until the period is as required. The maximum period is obtained when A is fully out.

The platform levelling screws are therefore adjusted until the extension of the spring is a maximum. In order that this maximum be within the range of the levelling screws, the point of support of the spring must be raised or lowered as necessary. The adjustment of the eccentric weights, W, must be such that the centre of the coil, C, is about level with the top of the field magnet, M, when the boom is level.

Once the reading of H, for the boom to be level, is known at the longer period, the period is adjusted to 1.4 seconds and the reading on H is made the same, using screws A and B.

Two knife edges are provided in line with the crossed springs, presumably to determine the length of the equivalent simple pendulum.

A note was made of the reading obtained on H, during setting up on 11th Feb. 1958, but unfortunately this was lost. It is thought the reading was 12.7, and on 27th Nov. 1958 was 11.6. If the first of these values is correct, the spring must again be relaxing. It is therefore necessary to check this reading every few months.

A small bobbin is mounted on the base of the seismometer. A standard current passed through this bobbin should give a standard deflection. The constancy of performance of the instrument can be examined in this way. However, this circuit was not in use; it was wired up but, because it was not adjusted, no deflection was obtained. The resistance of the bobbin is about 15 ohms.

The external circuit of the seismometer is shown in Fig. 3 and the circuit of the control box in Fig. 4.

The value recommended by Melbourne for the resistance R_1 was 20 ohms. This value had been decreased to 10 ohms, by B.G. Cook, when installing the instrument, because of the greater microseismic activity at Macquarie Island.

The record for 27th Nov. 1958 includes sections for values of R_1 equal to 10, 20 and 30 ohms. The constants of the instrument have not been computed for the values of R_1 and R_2 in use.

It should be noted when using the air bulb to obtain deflections of both the Wood-Anderson and Grenet instruments, that the bulb should be held vertically, so that the gravity operated valve will work.

3.12 Focussing of Grenet Light Spot

The light spots of the Wood-Anderson and Grenet seismographs seem to have been obtained by trial and error, as no two seem to be focussed in the same way. After many attempts, both at Melbourne and at Macquarie Island, a systematic method of focussing the system was evolved. This gave a very good spot on the Grenet and could probably be used with the Wood-Anderson.

A diagram of the optical system is shown in Fig. 5. It is possible to move the lamp L in any direction. The 45° mirror M is mounted in the collimating tube, which can be moved up and down and rotated about a vertical axis.

In Fig. 6 are shown the types of beam obtainable from the collimator. The degree of parallelness of the beam may be judged by moving a sheet of white paper away from the collimator and looking for any change in height of the image. The lamp must be adjusted sideways and vertically so that the beam is central in the mirror M. The degree of parallelness of the beam may be controlled by moving the lamp L longitudinally with respect to the lens A. The bright bands at the edges of the beam are coloured and are probably due to imperfections in the optical system.

As the light source is neither a point nor a line source, two variables are needed to obtain a reasonable spot. These variables are the distances of the galvanometer and of the cylindrical lens from the recorder drum. A beam was obtained as in Fig. 6 (3). This beam was then adjusted to be incident on the galvanometer lens as shown in Fig. 7. The bright edges of the beam must be excluded from the lens. The distance of the galvanometer from the recorder drum was then adjusted to give a best horizontal focus and the cylindrical lens was adjusted to give a best vertical focus. The effect of including the bright edges of the beam is shown in Fig. 8.

Past practice seems to have been to use one of the bright edges of the beam to give the spot, but when both bright edges are incident on the galvanometer lens, a double spot very often results.

The deflection to the right was limited by one of the Wood-Anderson seismometers. The position of the photographic paper on the recorder drum was altered to overcome this difficulty.

Attempts were made to improve the focus of the Grenet spot on 9th July and 5th November. A good spot was finally obtained on 7th November.

3.13 Measurement of Constants of Wood-Anderson Horizontal Seismographs.

The two Wood-Anderson seismometers are in the same N-S line.

The N/S component is more northerly. The period screws of the N/S and E/W instruments are to the east and north respectively.

A sketch plan of the Wood-Anderson seismograph is shown in Fig. 13, together with some relevant dimensions.

(a) Measurement of Period

The cover of each instrument was removed in turn, and the damping magnet was swung back from the pendulum. The pendulum was set oscillating, and 50 to 100 swings were timed with a stop watch. Numbers of oscillations greater than 100 are not practical because of air damping of the pendulum.

The periods obtained were :-

N/S	1.00 secs.
E/W	1.02 secs.

Both instruments were examined to see that the drops of castor oil, which prevent violin string oscillations, were still present.

After all other measurements had been completed the periods of both instruments were reset to 1.0 secs.

(b) Measurement of Static Magnification

Apparently the static magnification, used until now, is the theoretical value, derived from the linear dimensions of the seismometer. It has been stated that it is impossible to measure this quantity, because of the equiangular spacing of the levelling screws. However, the period can be maintained constant by counter-rotating the two levelling screws, other than the period screw, by equal amounts. By moving only one screw, the change in period will affect the measurement by only a small amount, which can be calculated.

A simple cardboard scale (with divisions every 10 degrees), was made to fit under the two levelling screws. This scale was fixed to the base of the instrument with tape. It was known from McGregor's calculations that the approximate magnification was 2900. From this, it was calculated that a deflection of 533 cms. would be produced by turning both screws one full turn. It was therefore decided that a rotation of 10° on each screw would produce a satisfactory deflection.

This method should have an accuracy of the order of 10%. The scatter of measurements on a single instrument was somewhat less that 5%. A systematic error of 5 or 10% is easily possible. The easiest way of increasing the accuracy of the method would be to fabricate metal scales which could be fixed to the levelling screws of the instrument. An alternative would be to use an optical method of measuring the rotation. This latter method would involve considerably greater difficulty, and it is not really necessary to know the magnification to better than 10%.

The results obtained were -

N/S	V	=	2200
E/W	V	=	2260

which are considerably lower than the 2900 given by the theoretical calculation.

(c) Measurement of Damping Coefficient

The damping coefficient recommended for these instruments is 0.85. This requires that the first overswing of an impulsive displacement be 1/150th of the original displacement.

The method of giving one of the levelling screws a sudden rotation of about 30° was used firstly. In this method, it is assumed that the undisturbed trace is the original position of the spot. However, the spot first travelled in the opposite direction to that of the final deflection. The amplitude of the initial impulse was therefore indeterminate.

The method recommended by P.B. Tenni was tried next. In this method the spot intensity is increased to a maximum, and a blue filter is used to reduce the intensity in the region of the undisturbed trace. Deflections are produced using an air blast. Even here the deflection must not be too large or else the spot movement will be too great to be recorded. The maximum deflection recorded was about 10 cms..

Because the microseismic activity is fairly high, it is desirable to have an overswing of about 2 mm.. This requires an initial impulse of 30 cm..

Finally, several deflections, judged visually to be about 30 cms., were caused by air blasts at each setting of the damping magnet. The overswings were recorded at increased intensity on the trace. It is fairly easy to control the amplitude of the initial deflection to within 20%. Good and consistent results were obtained by this method.

It was noted visually that both seismometers were considerably overdamped and this was confirmed on the traces. The magnet could only be lowered 7 turns from the original position on the N/S instrument and 6 turns on the E/W instrument. The final settings were -

N/S	-	Fully down
E/W	-	$5\frac{1}{2}$ turns down from original position.

The damping is quite sensitive to the height of the magnet and changed in the E/W instrument from almost critical at 5.0 turns down to about 0.85 at $5\frac{1}{2}$ turns down.

It was noticed when adjusting the damping magnet that mass was deflected slightly, indicating that the mass may be slightly magnetic.

(d) Levelling of Instruments

The N/S instrument was level.

The E/W instrument was slightly off level, and, after levelling, the mirror had to be rotated about a vertical axis to bring the spot back on to the trace.

4. COMPUTATION OF RESULTS

4.1 Modification of Procedure for deriving Sq Curves

In the instructions to minor observatories for obtaining Sq curves, it is laid down that the five quietest days during the month, should be used, if possible, to give a good average regular daily variation. If, say, three out of five days are good, and the other two incorporate slight K variations, individual judgment should be used.

There are at least two interpretations of the last sentence,

either (a) discard the two days with K variation as has been done at Macquarie Island hitherto;

or (b) smooth out the K variation using the other quiet days, the Sq curve for the previous month, or the Sq curve of the same month of the previous year as a guide.

During the early months of 1958, it was found that there were no days without some K variation, but that there were always five days with only minor K variation. It was decided that the alternative, (b) above, was preferable to using the previous year's curves.

Variometer scalings during periods of K variation, i.e. h_2, h_3, h_4, h_5 in Fig. 14, were discarded and replaced by corresponding values from the same month in 1957, with a correction for mean level. Referring to Fig. 14, this correction was made as follows :-

$$\underset{(1958)}{h_2} = \underset{(1957)}{h_2} + \underset{(1958)}{\frac{h_1 + h_6}{2}} - \underset{(1957)}{\frac{h_1 + h_6}{2}}$$

4.2 Results of Orientation Tests

With the H variometer, an increase in ordinate corresponds to an increase in H and the magnet is therefore aligned with its north pole towards the east. In measuring H scale value, a positive current gives an increase in ordinate, i.e. a northerly field in the coil. The coil was rotated 90° to the east for the orientation test and positive current would therefore give an easterly field.

During the orientation test positive current gave an increase in ordinate. The magnet is therefore slightly more than 90° east of magnetic north.

The deflections obtained were -

$$d_1 = 0.15 \text{ mms.}$$
$$d_2 = 0.25 \text{ mms.}$$

$$\therefore \quad \theta = 8'$$

and the magnet was suspended 115° 28' east of north.

The deflections obtained with the D variometer were -

$$d_1 = + 0.25 \text{ mms.}$$
$$d_2 = - 0.25 \text{ mms.}$$

$$\therefore \quad \theta = 0$$

The accuracy of the measurement depends mainly on -

(a) the alignment of the coil

(b) the disturbance level of the trace

The trace was quiet and the accuracy of measurement was probably determined by (a).

Some idea of the accuracy of setting the coil may be obtained from the D measurements, where the apparent accuracy is $\pm$ 3' .

4.3 Adoption of D Variometer Scale Value

A measurement of the D variometer scale value was made by the coil deflection method.

The scale value adopted was obtained by a least-squares analysis of the measurements of D throughout the year.

A summary of measurements of the D variometer scale value, since the commencement of observations, is given in Table 2.

4.4 Adoption of H and Z Variometer Scale Values

The scale value circuit for measurement of H and Z variometer scale values was modified, as already described in sections 2.18, 2.19 and 3.5.

Measurements were classified A, B or C according as to whether the trace were quiet, slightly disturbed or disturbed. Values classified A showed a scatter of less than ± 1% and these values only were used in obtaining the adopted value.

4.5 Adoption of D Baseline

The D baseline was consistent throughout the year. Two groups of greater scatter were noticeable in January and October. It is known that at these times the declinometer magnet was allowed to get stiff in its holder due to corrosion. Ignoring these two groups, the total scatter is ± 0'.7. Including these groups, the total scatter is ± 1'.2.

4.6 Adoption of Baseline and Scale Values for H Temperature Trace

(a) December 1957 to 11th April, 1958

During this period the temperature compensating prism was stuck, as already stated in Section 3.4; there was very little temperature compensation, and the temperature trace was very insensitive. Baseline and scale values were determined by least squares analysis.

(b) 12th April to 8th September

During this period the bimetallic strip was settling down. The temperature trace drifted by about a quarter of a millimetre per day for the first week. From then on the baseline and scale value of the temperature trace changed occasionally. The changes of baseline were always in the same direction. When a bimetallic strip is held in a vice, as it is in this case, there must be considerable forces set up when it tries to bend. It is not surprising that it takes some considerable time to settle down.

Separate scale values and baselines were computed by least-squares analysis for each of the periods after the first week. During the first week, a mean scale value was used, and the baseline was derived from a single measurement of temperature on each day.

(c) 8th September to December 1958

The bimetallic strip had almost settled down by this time. The baseline and scale value were determined by least-squares.

4.7 Determination of H baselines and Temperature Corrections

Because of the considerably greater sensitivity of the Z temperature trace, the temperature of the H variometer was obtained from the Z temperature trace, with a correction applied to take into account the difference between the thermometers on the H and Z variometers:-

(a) December 1957 to 11th April, 1958

The temperature coefficient of the H variometer was derived from the H baseline during this period by a least-squares analysis. This was found to be in good agreement with the temperature coefficient derived from the uncompensated temperature coefficient, as shown in section (b) below.

The mean baseline was computed in the normal way.

(b) 12th April to 8th September

Because of the drift of the compensating prism during this period, it was impossible to derive temperature coefficients and baselines in the normal way. The temperature trace was in the first instance used as a baseline and hence the uncompensated temperature coefficient corresponding to each change in the temperature trace could then be computed. The baseline corresponding to each change in the temperature trace could also be computed.

When using the temperature trace as a baseline, it was found that the measured values of H, when plotted against temperature, had a much smaller scatter than in (a) above, (b) below, or in the Toolangi Observatory results. It would appear from this that a large proportion of the scatter of baseline values, where a bimetallic strip is being used for temperature compensation of the variometer, is due to randomness in the position of the bimetallic strip. After the bimetallic strip has settled down, it may vary about a mean value, but, at any particular time, there must be a possible variation from the mean position. It follows that intercomparisons are better done against another instrument, rather than against baselines, where such a variometer is in use.

(c) 8th September to December 1958

Although the bimetallic strip had almost settled down, there was a considerable scatter in baseline values during this period. However, the temperature coefficient of the variometer derived by computing the compensated value from the uncompensated value was equal to that obtained by least-squares analysis of baseline values.

A separate baseline was taken for each month.

4.8 Adoption of Baseline and Scale Values for Z Temperature Trace

The baseline and scale-values for the Z temperature trace remained constant throughout the year.

On 21st December 1957, the prism for the main Z spot was replaced. A second trace appeared 0.25 mm. below the original temperature trace, having a parallax of 4 minutes.

The temperature base-line of the upper and original spot is 19.38° C. and of the lower and new spot 19.66° C.

The mean difference between thermometer readings on H and Z variometers is 0.16°C. To obtain the temperature of the H variometer from the Z temperature trace a baseline value of 19.55°C. is used with the upper spot.

4.9 Determination of Baselines and Temperature Corrections for the Z Variometer

There is a continuous drift in the value of the Z baseline. Because of this drift it was decided to compute the rate of drift and the temperature coefficient of the variometer simultaneously by least-squares analysis. The mean rate of drift was one gamma in ten days. The direction of the drift is consistent with either a decrease of magnetic moment of the variometer magnet or an increase in the gravitational couple. However, whereas it can be seen why a magnet at Macquarie Island is more liable to rust, it can not be seen why the magnet should be more likely to decrease in moment.

The amount of misorientation represented by this drift is about two or three minutes per year, which is negligible.

5. MISCELLANEOUS

5.1 Contacts with Watheroo

Several radio contacts were made with Mr. Allan Parkes of Watheroo Observatory during the year. These proved of considerable use.

5.2 Other Duties

The total time spent on other duties (including general camp duties) would amount to an average of a few hours per week.

The author was second-in-charge of the expedition and was in charge at Buckles Bay for about two months during the absence of the O.I.C. at Hurd Point.

Assistance was given to the auroral observer, by keeping watch at Buckles Bay to assist in the taking of parallactic pairs.

Assistance was given to several members of the expedition with electronic problems.

5.3 Acknowledgments

I should like to acknowledge the co-operation of other members of the expedition throughout the year, and, in particular, that of Mr. B.W. Webster who carried out the observatory routines during my absence from camp.

TABLE 1

Reserve Spot Separations

Date from which value to be adopted		1st Dec. 1957	21st Dec. 1957	12th Apr. 1958	14th Jul. 1958	30th Aug. 1958	8th Sep. 1958
Spot							
H	1st - ve	-94.2		-93.4			
	1st + ve	+97.7		+95.0	+95.0		
D	1st -ve		-92.2	-90.6			
	1st +ve		+93.2	+93.3		+94.9	+94.9
	2nd +ve					+87.9	
Z	1st -ve			-89.3			
	1st +ve			+98.2			

TABLE 2

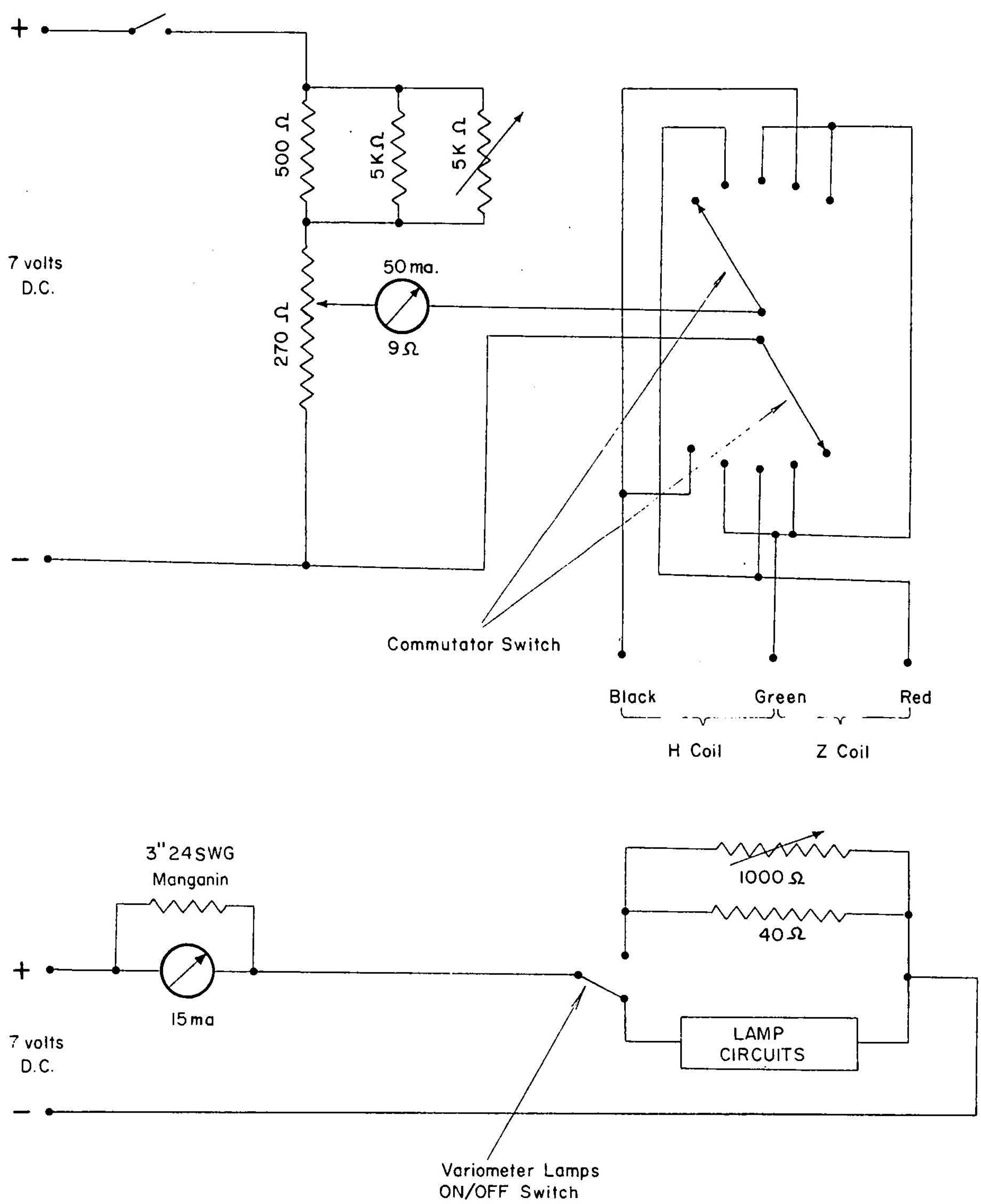
Summary of D Variometer Scale Values

Date	Observer	Scale Value	Method	Date	Observer	Scale Value	Method
1952				1957	J.R.Cleary	0.905	A
Apr. 21	P.M. McGregor	0.888	A			0.913	D
Jul 10		0.890	A				
		0.914	B	1958	A. Turpie	0.948	B
						0.919	D
1955	P.E. Mann	0.945	D				
1956	B.G. Cook	0.935 (±0.007)	C				

Note - The existing fibre was replaced by a heavier fibre prior to measurements on 21st. April, 1952.

Method - A. Torsion Head Deflections.
B. Helmholtz Coil Deflections.
C. Direct Method, by measuring D during a period when D is changing continuously.
D. Least-squares analysis of measurements of D baseline throughout the year.

FIGURE I



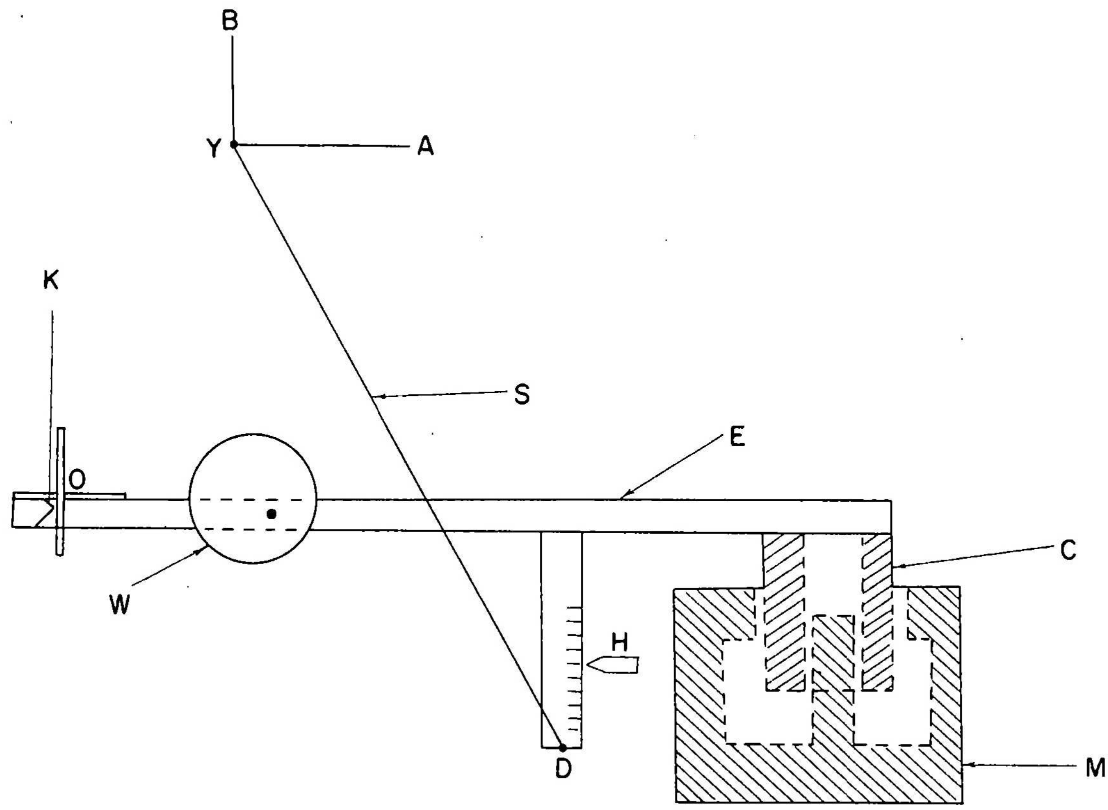
GEOPHYSICAL WORK AT MACQUARIE I. , 1958

SCALE VALUE CIRCUIT

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics. G54-26

TO ACCOMPANY RECORDS 1959, No 123

FIGURE 2



A - Lateral adjusting screw for head of spring.

B - Vertical " " " " " "

C - Coil

D - Point of support of boom by spring.

E - Boom

H - Scale on boom and pointer on chassis

K - Knife edges to determine centre of oscillation

M - Toroidal magnet

O - Axis of rotation of boom defined by crossed springs

S - Spring

W - Eccentric weights

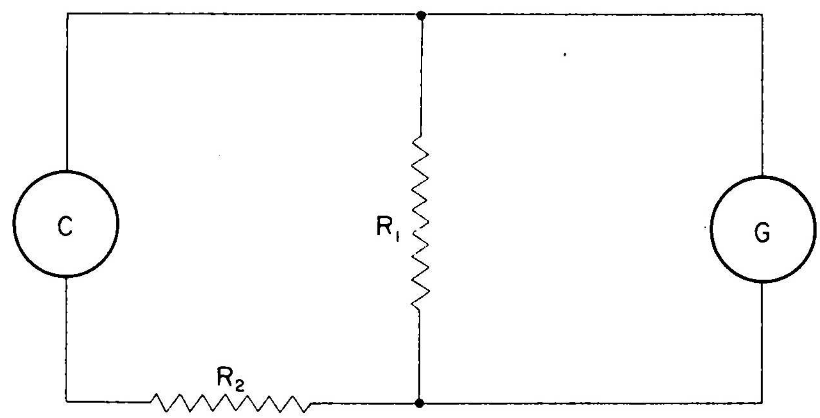
Y - Point of suspension of spring

GEOPHYSICAL WORK AT MACQUARIE I. ,1958

FUNCTIONAL DIAGRAM OF GRENET VERTICAL SEISMOGRAPH

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics. G54-27

TO ACCOMPANY RECORDS 1959, No. 123



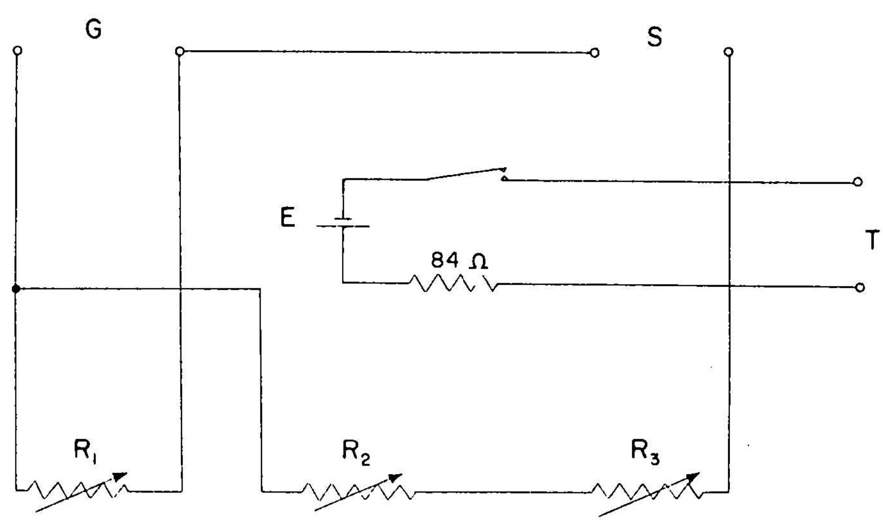
C - SEISMOMETER COIL

G - GALVANOMETER COIL

R_1 - 10 Ω

R_2 - 33 Ω

FIGURE 3



R_1 - POTENTIOMETER SWITCH IN STEPS OF 10 Ω

R_2 - " " " " " 10 Ω

R_3 - " " " " " 1 Ω

E - 1·5 VOLT CELL

G - GALVANOMETER TERMINALS

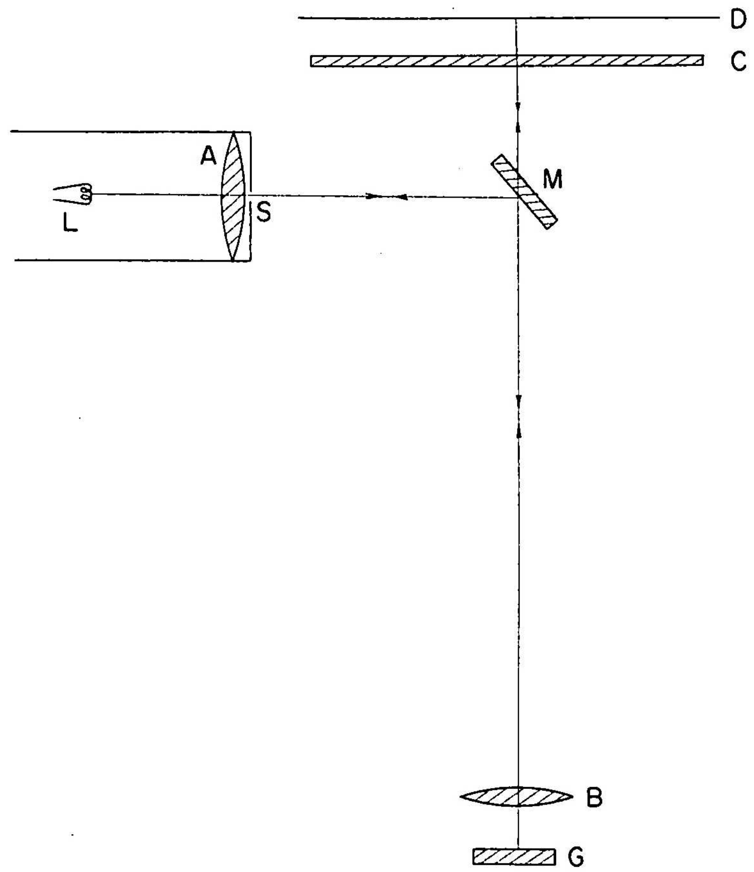
S - SEISMOMETER TERMINALS

T - BOBBIN TERMINALS

FIGURE 4

GEOPHYSICAL WORK AT MACQUARIE I. , 1958

FIGURE 5



A - COLLIMATING LENS

B - GALVANOMETER LENS

C - CYLINDRICAL LENS ON RECORDER

D - PHOTOGRAPHIC PAPER ON RECORDER DRUM

G - GALVANOMETER MIRROR

L - COILED FILAMENT 6 VOLT GLOBE

M - TIME MARK MIRROR SUPPORTED ON RELAY

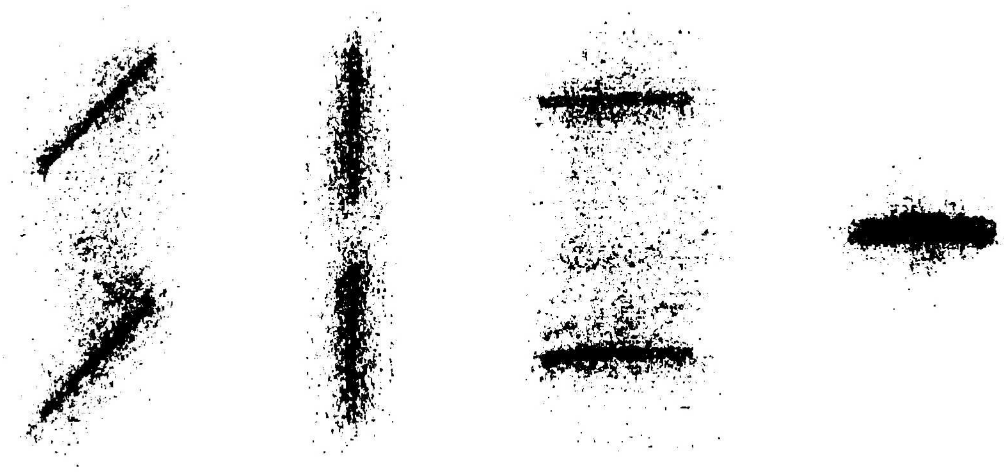
S - SLIT

GEOPHYSICAL WORK AT MACQUARIE I. ,1958

PLAN VIEW OF OPTICAL SYSTEM

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics. G54-29

TO ACCOMPANY RECORDS 1959, No.123



Position I. 2. 3. 4.

Fig. 6

Position 1. Filament at 45° to slit — Parallel Beam.
" 2. " parallel " " — " "
" 3. " normal " " — " "
" 4. " " " " — Convergent Beam. (Bright edges coincident)

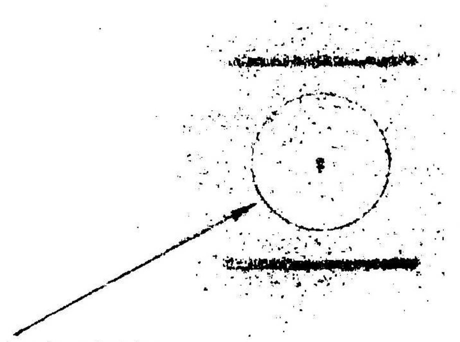
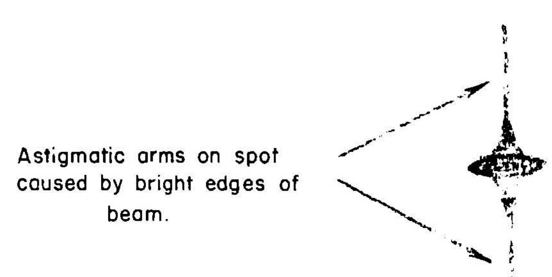


Fig. 7

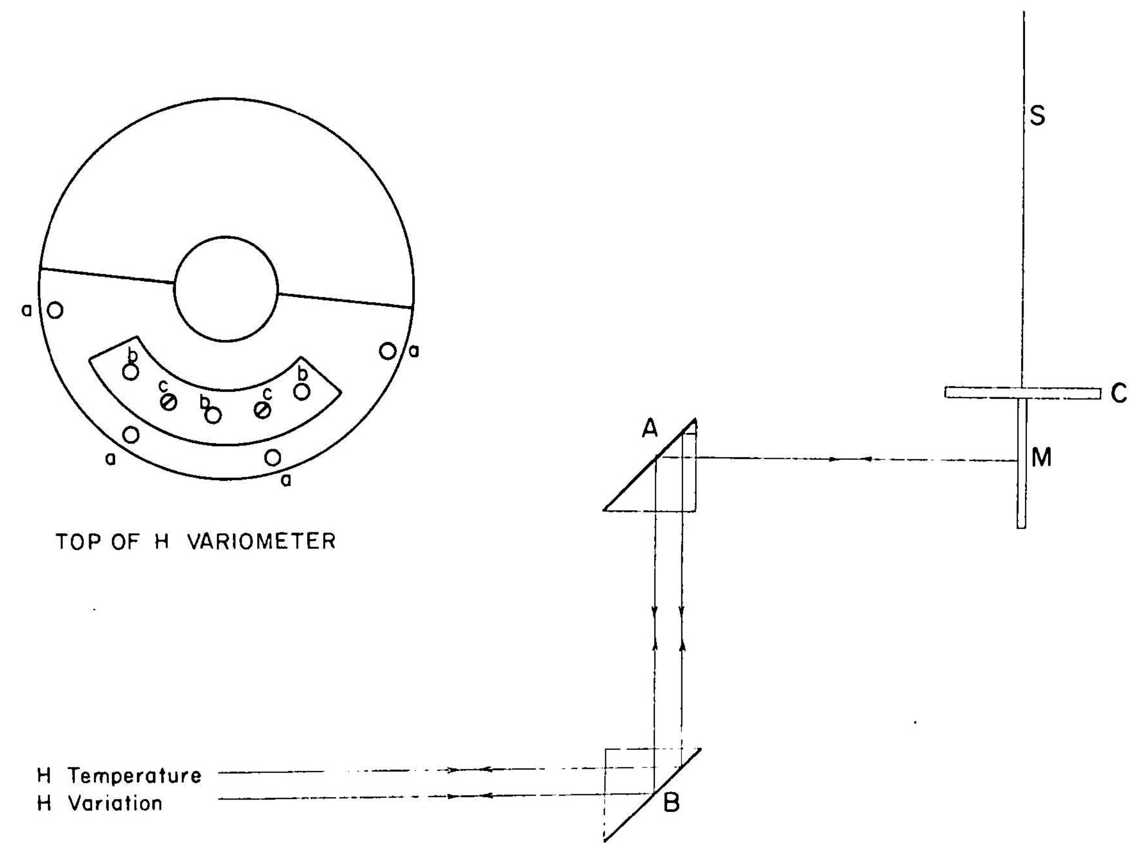


Magnified spot showing effect of including bright edges of beam.

Fig. 8

GEOPHYSICAL WORK AT MACQUARIE I. , 1958

FIGURE 9



A and B - 45° PRISM SILVERED WHERE OUTLINE IS DARK

C - MAGNET

S - QUARTZ SUSPENSION

M - MIRROR

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TO ACCOMPANY RECORDS 1959, No 123

▷ Z 2nd. − ve

▷ D 4th. − ve

▷ Z Ist. − ve

▷ D 3rd. − ve

▷ Z Main Spot

▷ Z Time Marks

▷ H 3rd. − ve

▷ D 2nd. − ve

▷ Z Ist. + ve

▷ H 2nd. − ve

▷ D Ist. − ve

▷ H Ist. − ve

Note.-
D prisms are highest
Z prisms are lowest

▷ D Ist. + ve

▷ H Ist. + ve

▷ D 2nd. + ve

▷ H 2nd. + ve

▷ D 3rd. + ve

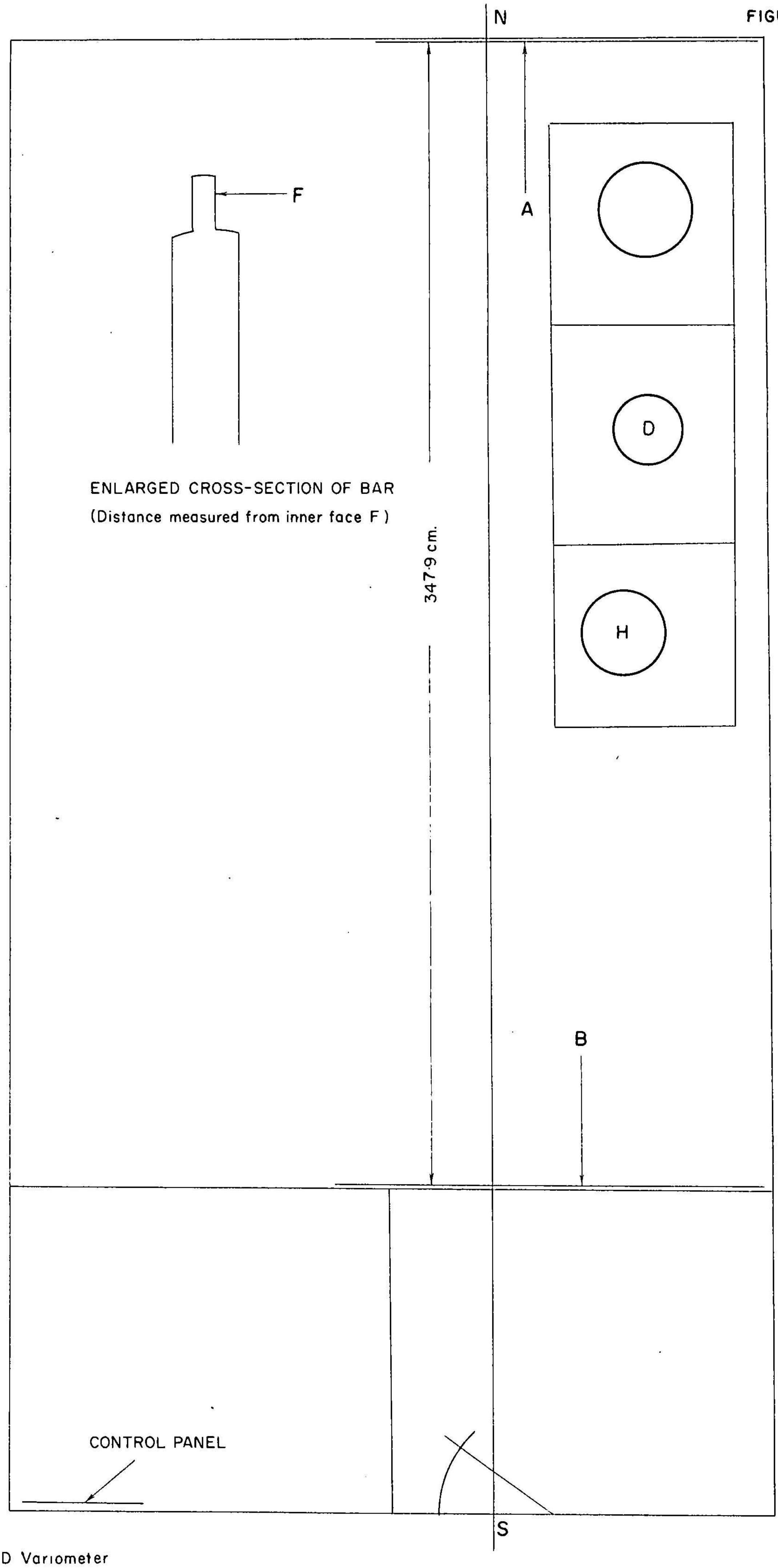
▷ H 3rd. + ve

▷ D 4th. + ve

GEOPHYSICAL WORK AT MACQUARIE I. ,1958

ORDER OF PRISMS ON RACK FOR LA COUR VARIOMETER

FIGURE II



D - D Variometer

H - H Variometer

A and B - Bars on N and S walls

NS - Meridian between holes on N and S walls.

GEOPHYSICAL WORK AT MACQUARIE I., 1958

SKETCH OF VARIOMETER HOUSE

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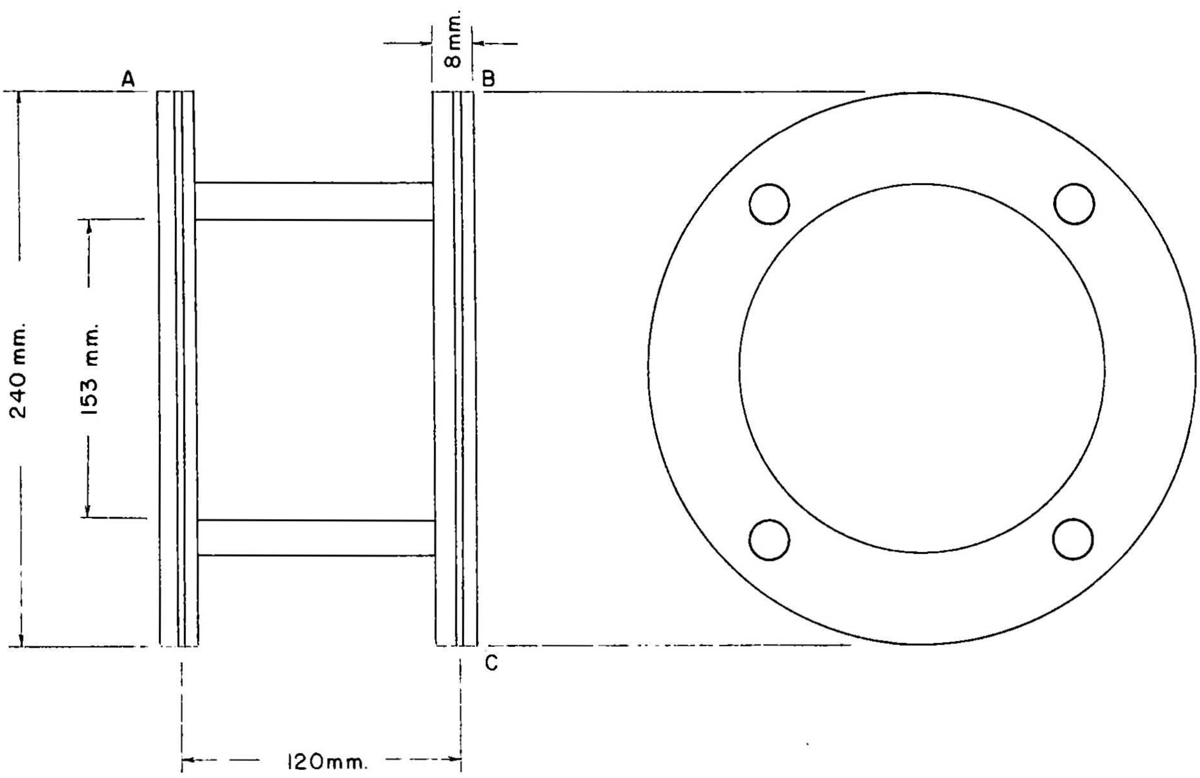
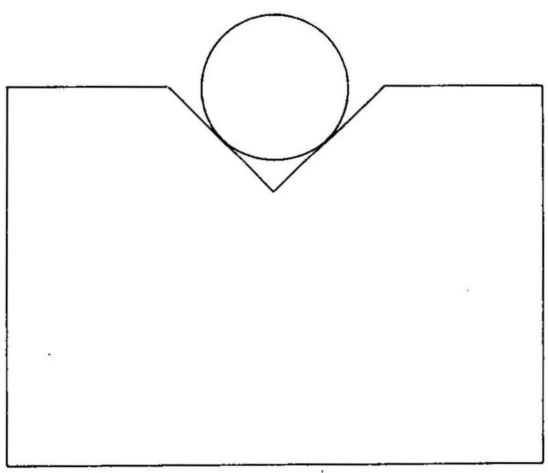
FIGURE 12



SKETCH OF DEFLECTING COIL.

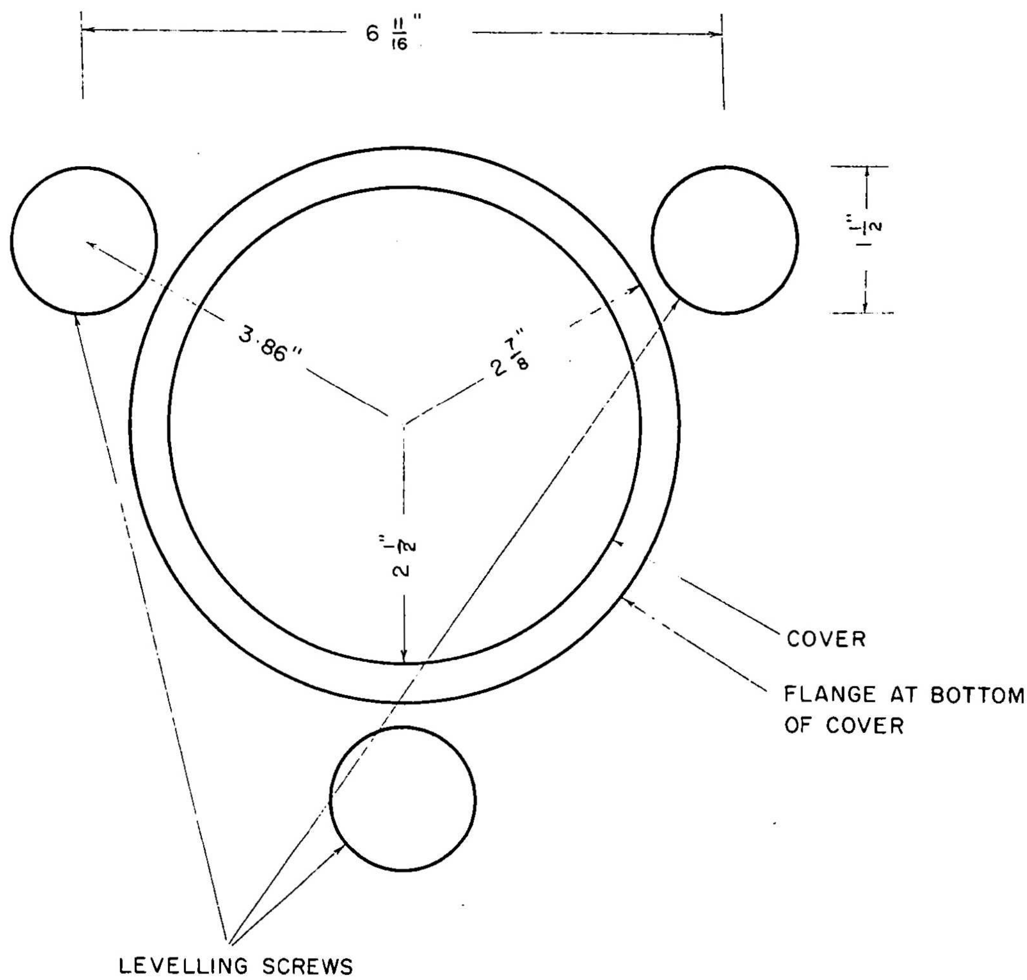


ENLARGED CROSS-SECTION OF WIRE IN GROOVE (Distance between wires measured from centres)

CORD ALONG AB FOR 'D' ORIENTATION TEST AND 'H' SCALE VALUE POSITIONS.
CORD ALONG BC FOR 'H' ORIENTATION TEST.

GEOPHYSICAL WORK AT MACQUARIE I. ,1958

FIGURE 13



LEVELLING SCREWS - 40 T.P.I.

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PLAN VIEW OF WOOD-ANDERSON SEISMOMETER BASE

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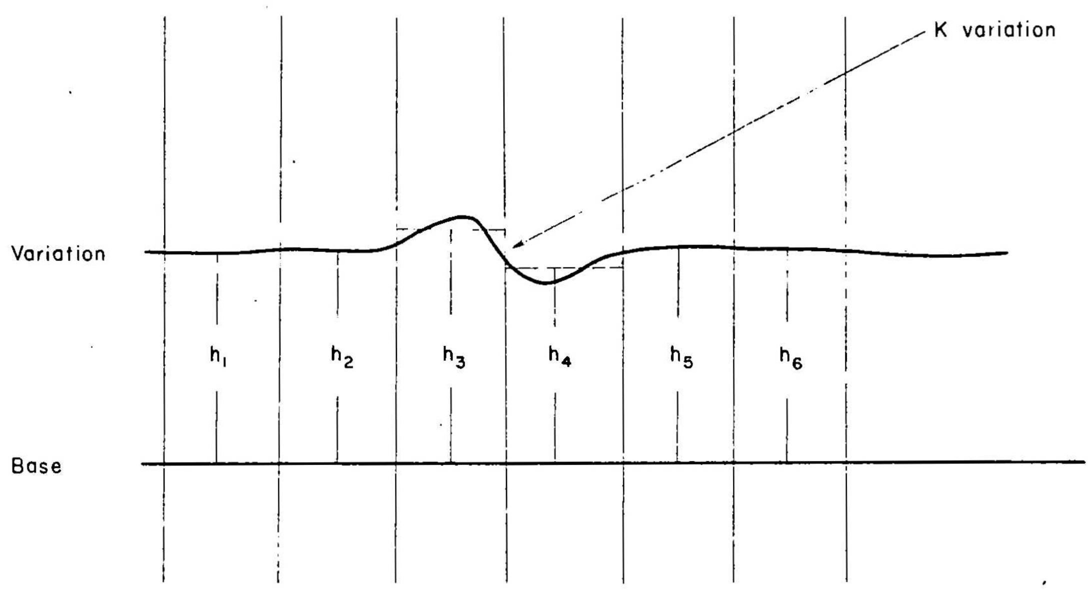

Vertical lines represent intervals of 1 hour

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