1968/13

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BUREAU OF MINERAL RESOURCES
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WILKES GEOPHYSICAL OBSERVATORY
ANNUAL REPORT, 1965

by

P.J. BROWNE-COOPER

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1968/13

1. INTRODUCTION

This report describes the work done at the Wilkes Geophysical Observatory during 1965. The author took charge of the observatory on 9th February 1965, relieving G.R. Small, and was relieved by F.J. Taylor on 3rd February 1966. Operation of the observatory prior to 1965 is described by Underwood (1960 & 1963), Jones (1961), Burch (1962), Whitworth (in preparation), and Small (1968).

Geomagnetic results from the observatory are published separately by the Bureau of Mineral Resources. Seismic results will be published by the International Seismological Research Centre.

2. BUILDINGS AND MAINTENANCE

During 1964 a new seismic hut was built (Small, 1968) on a site about 200 ft south-west of the small hut housing the Grenet seismograph. In February 1965 the hut was wired for power and lighting. Three power outlets were installed (two 200-volt and one 110-volt) and three red safe-lights were fitted above the recorder bench. Lights were also installed in each ante-room, and in the seismometer room. The safe-lights are controlled by a two-position switch such that when they are turned on the ante-room light is turned off. This reduces the risk of leaving the ante-room light on when the recorder room door is opened for record changing.

A small amount of structural work was also carried out on the hut; the slate slabs were positioned on the galvanometer pier, foam plastic sealing strips were inserted in the gaps between piers and floor and a set of steps was constructed up to the hut door. Later in the year, cover strips were attached over the joints in the wall panels. A six-core shielded cable was run from the office to the seismic hut (Plate 1) to supply separate power for the recorder motors and timing pulses for the seismographs.

In July the power cable from the office to the geomagnetic hut failed, necessitating the use of a spare cable until August when a six-core shielded cable was installed between the office and the carpenters shop junction box (Plate 1) to carry both power and time pulses, leaving the two old cables as spares for future emergencies.

Melt-water accumulation under the geomagnetic huts was kept to a minimum by almost continuous pumping from mid-December until late January, when freezing of the water over-night confined pumping to a few hours during the day.

Some repair work was done on the canvas covering of the geomagnetic hut corridors, and parts of the corridors were lined with heavy paper to keep out drift snow.

3. MAGNETIC

Absolute instruments

At the 1964-65 change-over an Askania declinometer (No. 506) was brought to Wilkes as a replacement for the D.T.M.C.I.W. instrument which had been used up till that time. The Askania instrument appeared to operate well, although intercomparisons with the D.T.M.C.I.W. instrument and another Askania instrument during the 1965-66 change-over indicate a correction of minus 5 minutes should be applied to Askania 506. This correction is very large for such an instrument, but further intercomparisons will either confirm the value of the correction or provide a new one.

The BMZ 236 operated well throughout the year. There is some evidence that a drift in the neutral division, over a period of time, causes a corresponding drift in the results obtained with the BMZ. It can be seen from Plate 2 that this effect is of the order of 3 gammas for a change of 0.1 in the neutral division. Whitworth suggests a modified eyepiece to enable the neutral division to be determined more accurately, and the effect is being investigated more thoroughly (Whitworth, in preparation).

During the 1965-1966 change-over, all absolute instruments used at Wilkes during the year were compared with instruments from Toolangi Observatory. Simultaneous intercomparisons between BMZ 236 and a proton precession magnetometer (P.P.M.) proved worthless because a pier difference could not be established owing to the scatter of the proton magnetometer readings at the absolute hut pier.

QHMs 494 and 492 were used throughout the year and gave satisfactory results. QHM 494 developed a faulty clamp and was exchanged for QHM 493 at the 1965-66 change-over.

Standard magnetograph

The sensitivity and stability of both magnetographs are indicated by the parameters in Appendix A.

The standard magnetograph operated successfully throughout the year, the only breakdown being the failure of the clockwork recorder drive early in February 1965. This was replaced by a spare drive unit, which continued in operation for the remainder of the year. The fault in the original drive unit was found to be a hair in the balance wheel spring, and after removal of the hair the unit ran successfully on the bench for several days and has been kept as a spare.

The optics of the Z variometer, installed by Small in 1964 (Small, 1968) were adjusted several times during the year in attempts to obtain a darker and finer trace. Three jumps in the Z trace were noted during November when ice under the geomagnetic hut would be melting and re-freezing. One of these jumps was correlated with an audible crack heard whilst working the hut. This lends strength to the cause of jumps suggested by previous observers (Underwood, 1963; Whitworth, in prep.; Small, 1968).

The H and D variometers were levelled as the need arose and the connections to scale value coils were inspected and tightened. The adjustment screws for the light source were tightened after some traces had been lost when the light source moved during record change.

Rapid-run magnetograph

In November the rapid-run recorder developed trouble in the traverse motor switch system. This was repaired by very careful adjustment of the cam-operated cycle-switch, which is very critical in its operation. An attempt was made to remove the cam operating the switch to enlarge the flat section of the cam but its removal proved to be a larger undertaking than was thought advisable.

The Z variometer level was checked each day and adjusted when necessary. The H and D variometer levels were adjusted when indicated necessary by faintness of the base-line traces.

Level adjustments were necessary more frequently during the summer when water from melting snow on the hut roof leaked through on to the instrument piers. The hut roofs were kept free of snow as much as possible by sweeping.

Heating

The thermostats controlling the heaters in the rapid-run and standard magnetograph rooms were replaced by a single thermistor unit in January 1966. This unit is more positive in its action and creates none of the radio interference that was becoming a problem with the old thermostats.

4. SEISMIC

Grenet short-period seismograph

Until March 1965, the Grenet seismograph was housed in a small hut 5 yards west of the recreation room (Underwood, 1963). The Grenet seismograph was moved into the newly completed seismic hut on 2nd March 1965. The seismometer was set up on the north end of the instrument pier, and the Sefram galvanometer on the west end of the galvanometer pier (Plate 5). The seismometer period was adjusted to 1.60 seconds.

The Sefram galvanometer gave continual trouble by jamming, which could not be rectified even after repeated attempts at levelling. It was finally replaced by a Kipp galvanometer of similar period. This galvanometer has proved very reliable since installation.

The light source for the Grenet seismograph was found to give a rather broad trace since an enlarged image of the lamp filament is produced on the photographic paper by the optics of the system. During the year a complete new light source was built and installed in mid-September. The window of the galvanometer was replaced by a vertical cylindrical lens of 50-cm focal length so that a sharp, unmagnified line-image of the filament is focused on the photographic paper 100 cm from the lens. This image is reduced to a spot by the horizontal cylindrical lens on the recorder.

The light source (Plate 3) employs a small relay movement to move the time marking mirror, the relay being mounted on one end of the light-source tube. The end of the tube is rotatable to allow the inclination of the output light beam to be adjusted. The straight filament lamp is mounted on the other rotatable end of the tube allowing for the filament to be adjusted to the vertical. The tube ends can be removed for adjustment by removing their locking screw, rotating the end until the two indicator marks are in line, and carefully withdrawing the end. The complete tube assembly is mounted on a height-adjustable pillar.

Lehner & Griffith long-period seismograph

The three-element, long-period, Lehner and Griffith seismograph was installed in 1957 in a small building a few yards west of the sleeping blocks. All three seismometers were anchored by bolts welded to a single piece of 1-inch steel plate covering half the area of the concrete pier. The other half of the pier supported the galvanometers and recorder. Flooding and lack of room made this site most unsuitable and the seismograph was moved to the new hut during the period 6th to 9th May.

It was considered impracticable to use the original steel base-plate at the new site since the single piece would not fit on the new pier and would have been extremely difficult to move. The possiblity of cutting the plate into three pieces was also discounted by the engineering personnel. It was decided therefore, to fabricate three separate base plates from half-inch steel plate. These base plates were fitted with three foot-screws so that levelling could be achieved simply and without removal of the seismometer covers. Previously levelling was achieved by use of the bolts securing the seismometer pillar to the base plate (Plate4).

Prior to re-installing the seismometers, several hinges and suspension wires were found to be in poor condition and were replaced. When re-assembling the vertical seismometer the coil former was broken, breaking several turns of the coil wire. An attempt was made to repair the coil but it was finally found necessary to repair the former and to wind a new coil. No information as to the number of turns on the original coil could be found at the time but a figure of 5,000 turns was deduced from the dimensions of the former. This figure was later confirmed by the instrument specifications. Using the workshop lathe a new coil was wound of 38 gauge enamelled copper wire. When installed in the seismometer, it was found to operate successfully. Trace amplitudes of microseisms indicate, however, that the gain of the seismograph is slightly lower than previously.

The galvanometers and recorder were installed on the eastern end of the galvanometer pier and recorder table respectively. The lay-out of all seismometers, galvanometers, and recorders is shown in Plate 6. The seismometers are shown in Plates 4, 5, and 6.

The periods of all three seismometers were kept as close to 15 seconds as possible by regular checks and adjustments. Galvanometer free periods were not adjusted and remained within 10 seconds of the nominal 90 seconds.

Temperature control and instrument drift

Considerable trouble was experienced with trace drift owing to temperature variations. This problem appears to have been present in previous years (Underwood, 1960; Burch, 1962). Even though the temperatures of the recorder and seismometer rooms were kept stable to within 1°C throughout the winter, the drifting of the east-west component was so bad as to render it virtually useless for most of the year.

Some of the drifting effect, in particular the small "bays", originates from the seismometers. However, this is only a small part of the problem and can be largely eliminated by insulation of the instruments. A few blankets draped over the seismometer covers will suffice if the vault temperature is fairly stable.

The major cause of trace drift stems from the long period ($\approx$ 90 second) galvanometers, which are apparently extremely sensitive to temperature changes. It has since been found that a less regulated, slowly changing temperature such as that obtained with a permanent heater, tends to reduce the galvanometer drift. The problem is then one of maintaining the seismometers at a constant temperature, as this is necessary to avoid their drifting or jamming on stops.

In the summer months it was found that the heating effect of the sun on the grey metal walls and roof of the seismic hut raised the temperature inside the hut from 60°F to as high as 80°F on occasions. This large diurnal change in temperature was overcome by painting the roof and north wall of the hut white, to increase the reflection from the sunlit surfaces.

5. TIMING AND CONTROL EQUIPMENT

Power and wiring

During August a cabinet was built to house all timing and power distribution equipment. This was necessary to provide office space for the glaciologist in the geophysics office. All the wiring for the system was completed first so that each unit could be moved to the new rack with the least possible break in their operation. The transfer of the equipment was thus managed with no more than one minute of record loss and three hours of somewhat confused time-marks on the magnetic records.

The new distribution panel incorporated the automatic power change-over described by Small (1968). Fuses were placed in the 110-volt lines to the geomagnetic and seismic huts to avoid the loss of power to both huts if a fault occured in one line. This had happened once earlier in the year when a short-circuit occurred across the 110-volt line to the geomagnetic hut during a blizzard.

Other additions to the system were indicator lights to show whether power is being drawn from the power-house or the garage supply, and an indicator light for each time-mark circuit.

Some trouble was experienced with interference from the ionosonde transmitter causing extra time-marks on the magnetic records. This was largely overcome by placing diodes and small capacitors across all the time-mark lines and properly earthing the shield of the cables to the huts.

Times chronometer

The Times tuning-fork chronometer maintained a very low rate throughout the year. The chronometer stopped several times in the first half of the year during voltage drops on the mains power. In August, after these failures had occured several times in one day, the chronometer was removed from service and examined on the bench. The fault was a shorted capacitor in the motor drive amplifier and on replacing this component the chronometer ran much more smoothly and silently. The motor then had sufficient power to drive the digital clock face, which had been previously disconnected (Underwood, 1963).

The chronometer was completely overhauled and all outputs wired to the output plug and brought to a terminal block behind the distribution panel through a shielded cable. Two spare wires were used to install a stroboscope lamp behind the 1 rev/sec dial of the chronometer, the original dial having been replaced by one of perspex. This lamp was wired through a switch to the WWV stroboflash unit (Small, 1968) to a VNG stroboflash unit constructed in the BMR workshops, and also to a relay operated by the chronometer contacts. It was thus possible to obtain accurate time corrections and to check that the chronometer contacts were closing at the correct time.

Time-mark unit

The time-mark unit was installed in 1964 (Small, 1968) to replace the Simplex programme unit. The time indicator microammeters were replaced during the 1964-65 change-over period and operated successfully.

The unit gave trouble during the year by gaining pulses now and then, thus advancing the timing by integral minutes. The trouble occurred more when the office temperature rose to about 80°F (this occured frequently enough to be a nuisance), owing to an increase in leakage of the transistors in the circuitry. The trouble was almost eliminated by the installation of a fan to circulate air behind the time-mark unit. The office temperature then had to rise to over 90°F to affect the unit. This occurred very infrequently and was not considered a nuisance.

One interesting point emerged during efforts to locate the fault in the unit. Four Raytheon 2N404 transistors in the "divide by 6" section of the unit (see handbook for time-mark programming unit, T.M.U. 1) were found to have lower gain than the new Philco transistors supplied as spares. However, on replacing the Raytheon by the Philco transistors the unit would not operate at all. The only explanation appears to be that the leakage of the Philco transistors, which is higher than that of the Raytheon transistors, is above the level that can be tolerated by the circuit.

6. LOCAL SEISMICITY

During 1963 and 1964, numerous low-magnitude events not reported by other stations were detected, and some of these events bore considerable similarity to local earthquakes. Unfortunately local noise made reliable interpretation difficult. In 1965, however, the seismographs were moved to the new seismic hut described by Small (1968) and an improvement in signal-to-noise ratio was obtained sufficient to distinguish the events from local noise.

Details of the three main types of disturbance are given by Browne-Cooper, Small, and Whitworth (1967).

In view of the large number of local-type events recorded at Wilkes, it is strongly recommended that at least one short-period horizontal seismograph be installed and that a vertical short-period seismograph be set up at S-2 (87 km south-east of Wilkes) at least for some weeks. This would enable the direction of the source of these disturbances to be roughly determined.

7. ACKNOWLEDGEMENTS

The author wishes to acknowledge the assistance given by Dr. K. Hicks in carrying out the observatory routines in his absence, and for his advice and assistance throughout the year. The assistance is also acknowledged of all members of the 1965-66 Wilkes party, who were always willing to help or advise the author when called upon.

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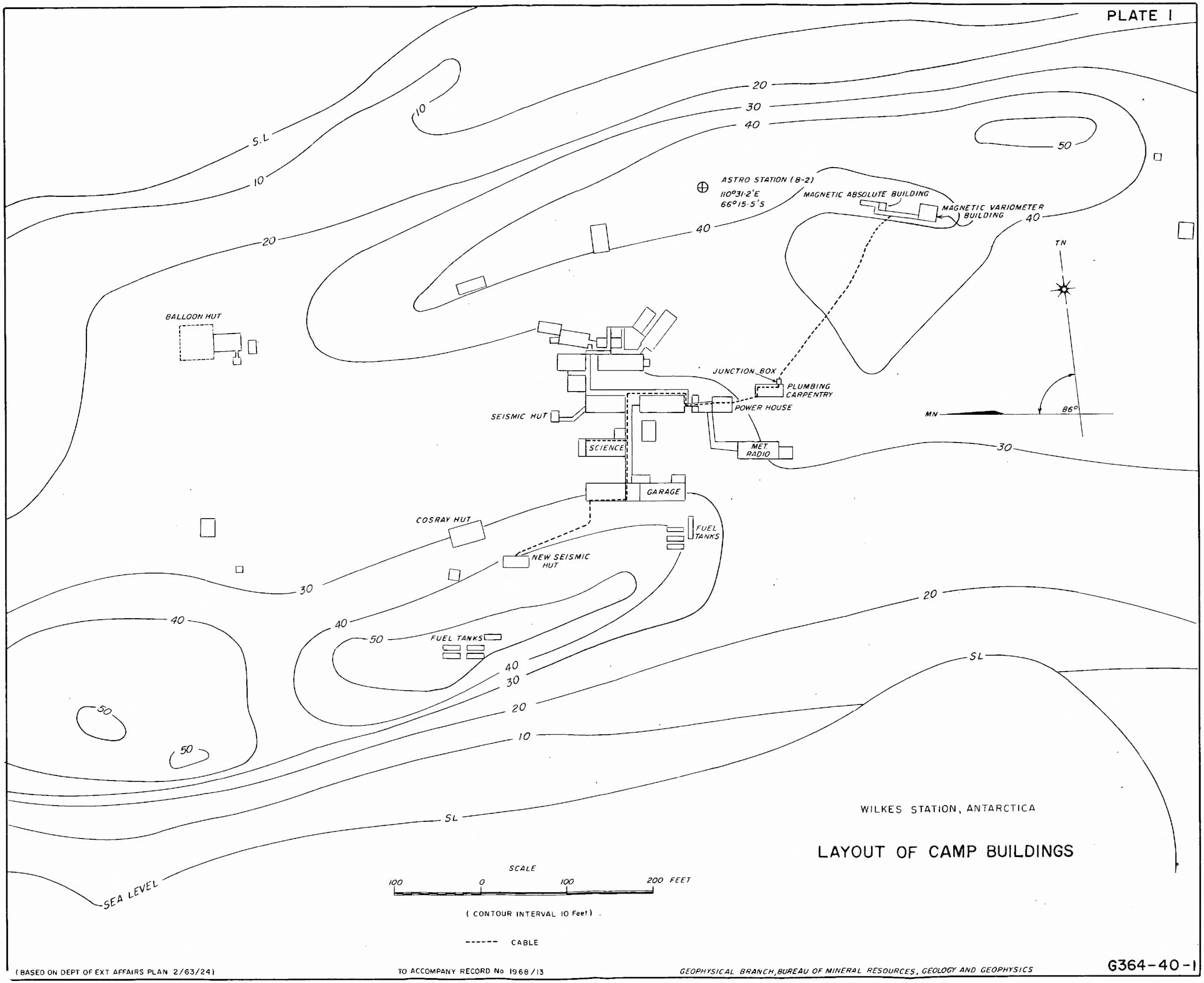
APPENDIX A

PARAMETERS OF MAGNETOGRAPHS

Magnetograph element		Scale value	Standard Deviation	
			Scale value	Baseline
Normal	D	10.05 min/mm	0.07 min/mm	3.08 min
	H	25.10 gammas/mm	0.14 gamma/mm	3.59 gammas
	Z	20.85 gammas/mm	0.14 gamma/mm	2.86 gammas
Rapid Run	D	1.18 min/mm	0.02 min/mm	-
	H	5.14 gammas/mm	0.06 gammas/mm	-
	Z	6.00 gammas/mm to 7.40 gammas/mm	0.16 gammas/mm	-



(BASED ON DEPT OF EXT AFFAIRS PLAN 2/63/24)

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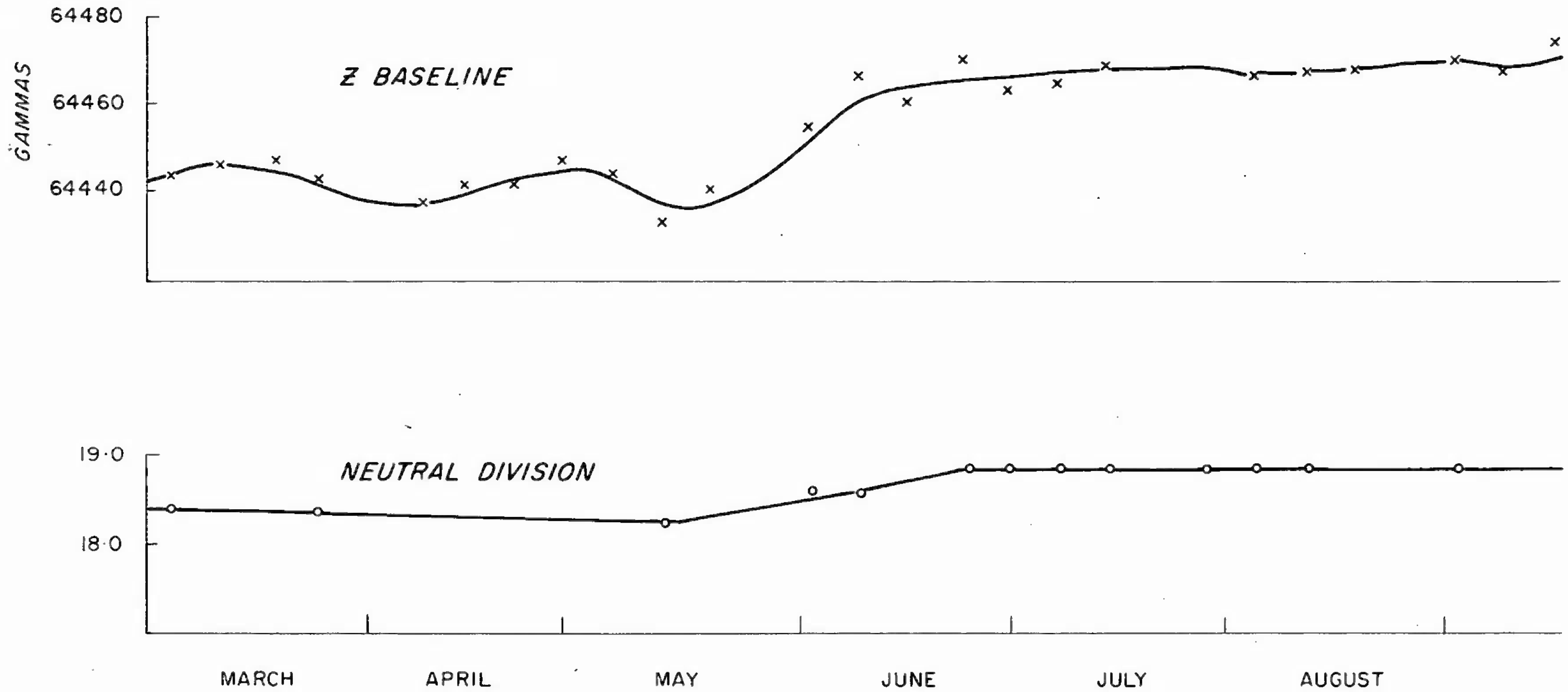
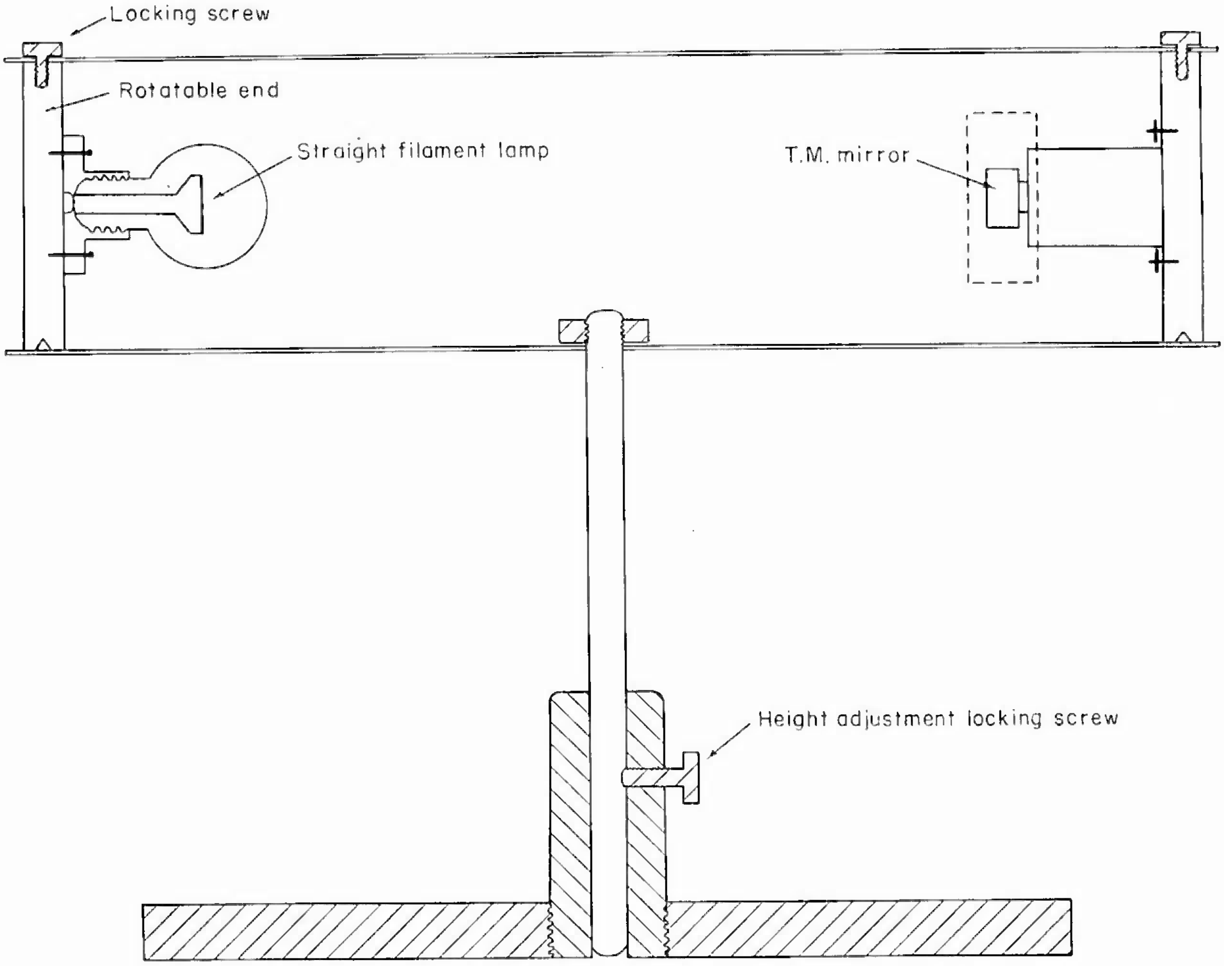
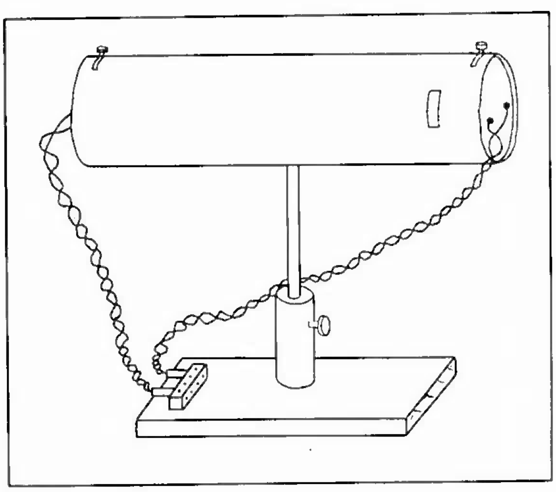
PLATE 2



BASELINE AND NEUTRAL DIVISION CHANGES FOR BMZ 236

G364-48





LIGHT SOURCE FOR GRENET SEISMOGRAPH

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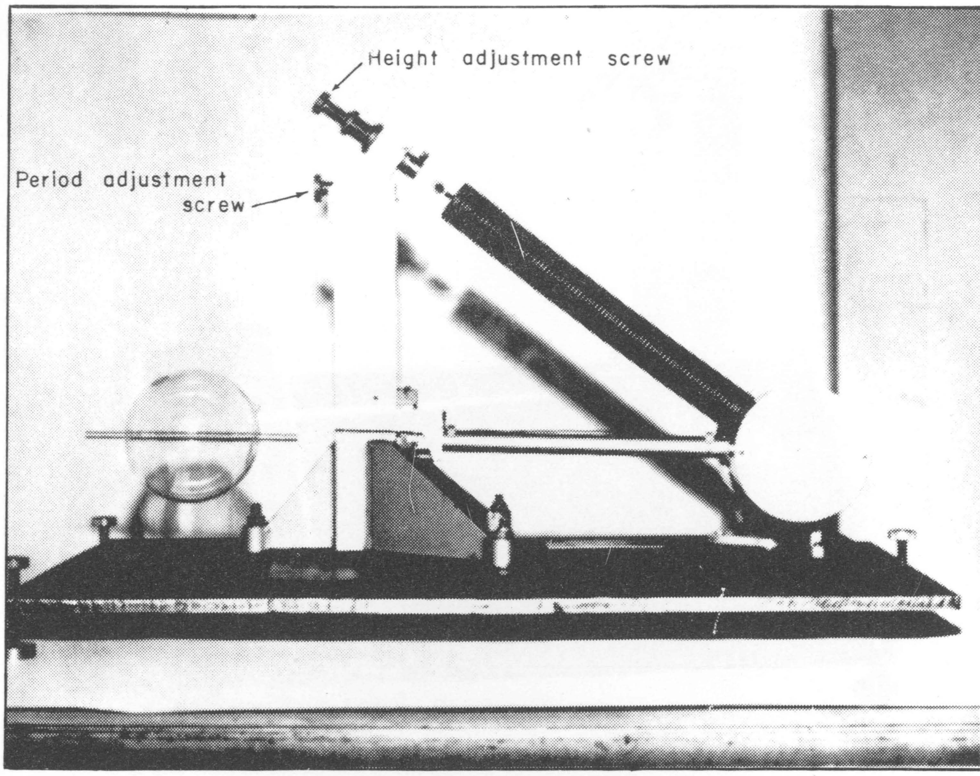
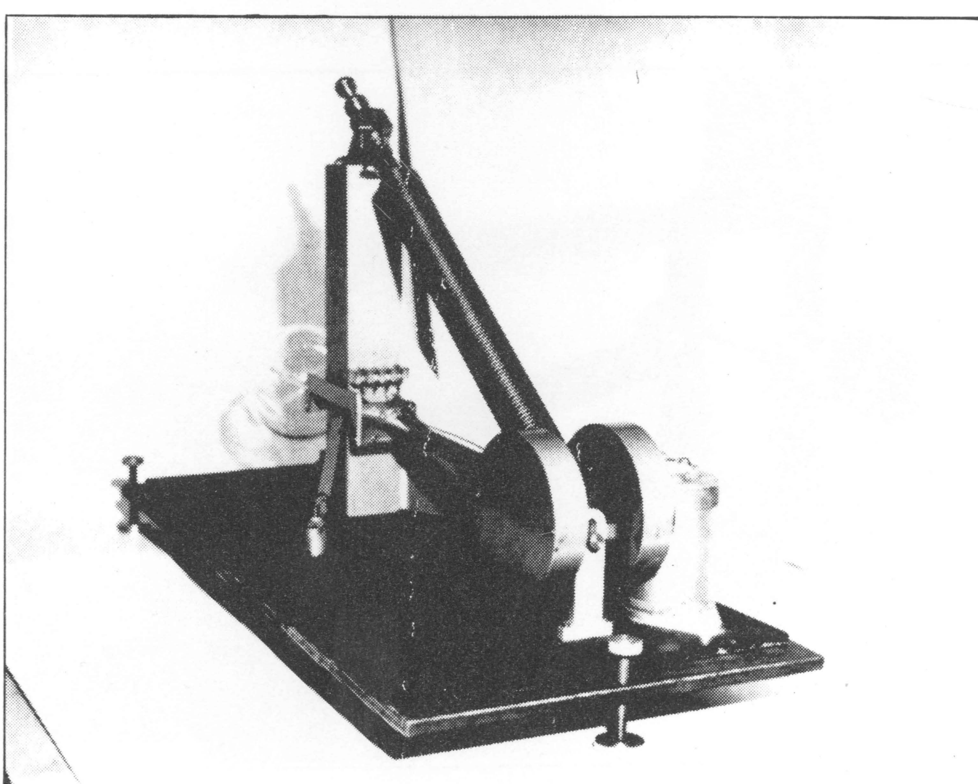
PLATE 4



LONG PERIOD VERTICAL SEISMOMETER



LONG PERIOD VERTICAL SEISMOMETER

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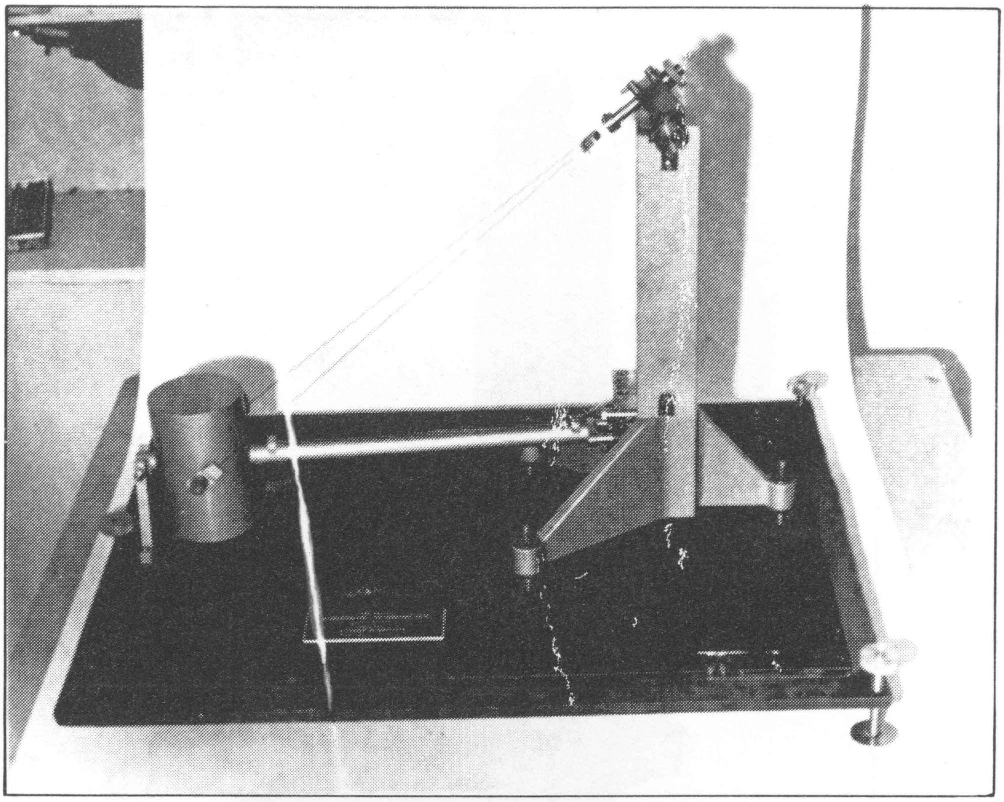
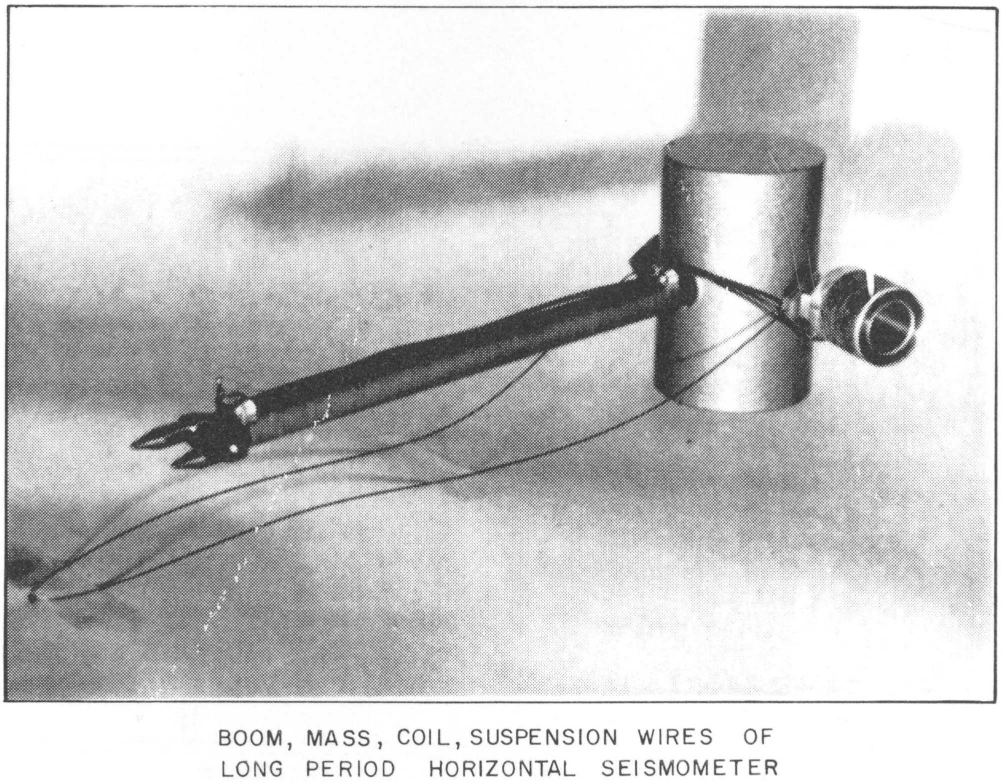
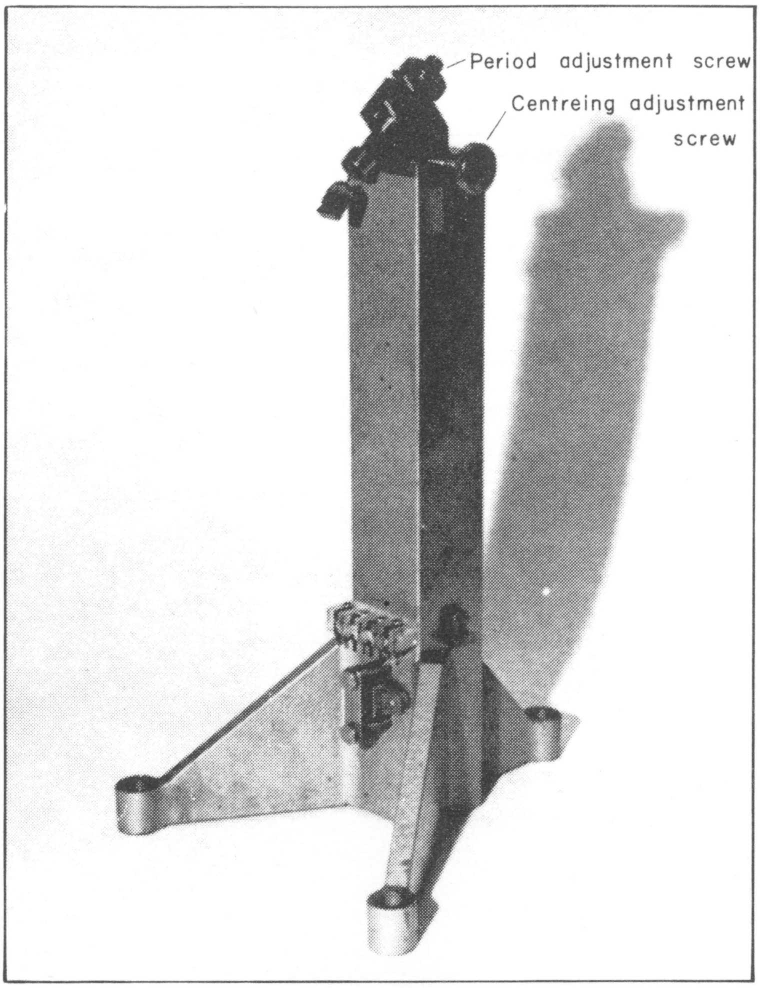
PLATE 5



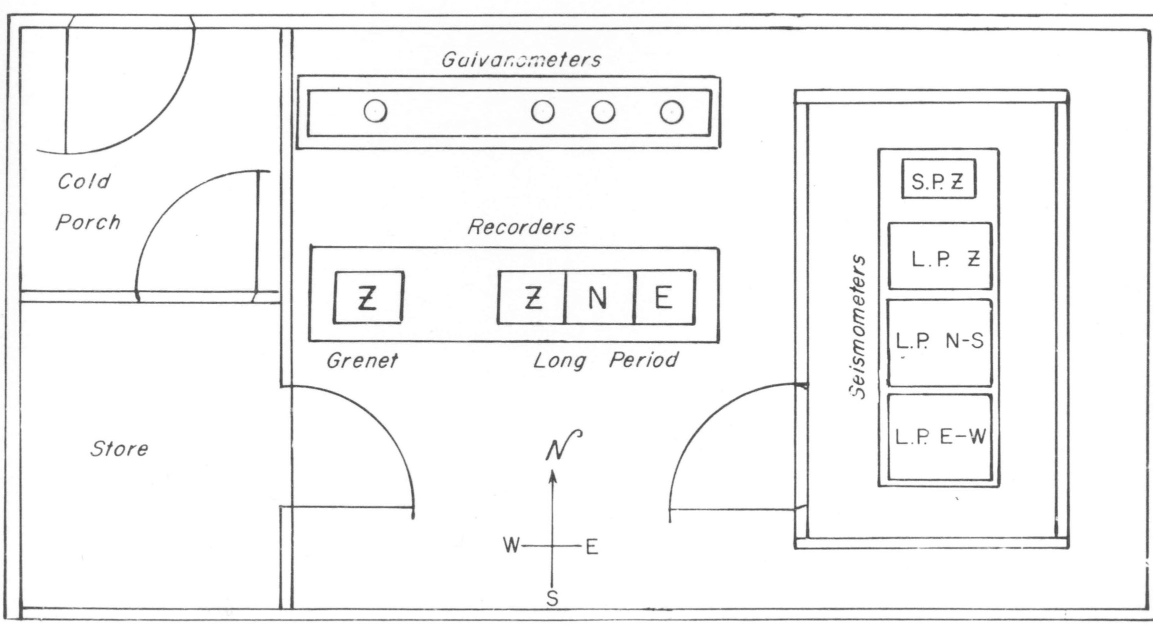
LONG PERIOD HORIZONTAL SEISMOMETER



BOOM, MASS, COIL, SUSPENSION WIRES OF
LONG PERIOD HORIZONTAL SEISMOMETER



PILLAR OF LONG PERIOD HORIZONTAL SEISMOMETER



Scale: 1" = 4'

WILKES, ANTARCTICA, SEISMOGRAPH LAYOUT

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