COMMONWEALTH OF AUSTRALIA
MINISTRY OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

RECORDS 1952 No. 11

MAGNETIC SURVEY OF TOOLANGI OBSERVATORY SITE

by

F.W. WOOD and P.M. McGREGOR

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C O N T E N T S

ILLUSTRATIONS

Plate

1. Plan of pegged stations with contours of declination departures.

2. Plan of pegged stations with contours of horizontal intensity departures.

3. Plan of pegged stations with contours of vertical intensity departures.

4. Profiles of departures in declination from Station "A".

5. Profiles of departures in horizontal intensity from Station "A".

6. Profiles of departures in vertical intensity from Station "A".

7. Profiles showing variation of magnetic intensities with height.

MAGNETIC SURVEY OF TOOLANGI OBSERVATORY SITE

1. INTRODUCTION.

An area surrounding the magnetic observatory at Toolangi was tested for uniformity of the magnetic field. The three elements measured and the instruments used were :-

Declination (D) - Cooke, Troughton & Sims theodolite No. V.012025 with compass attachment No.155. On test this gave a probable error for one observation of ±2'.

Horizontal Intensity (H) - Quartz horizontal-force magnetometer QHM No.189, with an accuracy of ±2 gammas.

Vertical Intensity (Z) - Watts vertical intensity variometer No.69138 with a scale value of 28.5 gammas per division and an accuracy of ±5 gammas.

The main tests were carried out over the period, 10th December to 21st December, 1951. Further determinations of H & Z at different heights above two of the stations were made on the 7th and 9th January, 1952.

2. PLAN OF SURVEY.

The station sites were laid out in a pattern similar to that to be used in proposed tests of R.A.A.F. compass-swinging sites. Six lines of pegs (A to F), about 40 feet apart, with seven stations at 30 feet intervals in each line, comprised the grid. The area thus covered was 200 feet x 180 feet. All lines had the same azimuth. The absolute and variation buildings of the observatory were fairly centrally situated between the lines C and D as indicated in the plans of Plates 1, 2 and 3.

3. METHODS OF OBSERVATION.

(a) Declination.

The pier (station "A") in the absolute hut was used as the reference point and an auxiliary peg "X" (see Plate 1) was used as the "mark" when reading from the pier. The line "A" - "X" was made to have the same azimuth as the lines of pegs. This served to give the true azimuth of the lines since the azimuth of a second "mark" from the pier is known. It also made it possible, by reference to the magnetogram, to determine the correction to the theodolite magnet to give true declination.

For declination observations, at each station the theodolite was sighted on the most distant peg in the line to give the mark reading. The difference between this and the reading obtained after the magnet setting was made was corrected for diurnal variation obtained by magnetogram scalings. The result plotted at each point in Plate 1 is the departure of this difference from that obtained at the reference point. On the same Plate are drawn contours of these departures obtained by cross-profiling and interpolation.

(b) Horizontal Intensity.

Observations with the QHM instrument yielded two independent values of horizontal intensity at each station. Readings were corrected for changes in declination by linear interpolation between the zero readings, and in most cases the two values, corrected for diurnal variation, were in very close agreement. Diurnal variation corrections were obtained from the

magnetogram. These were subtracted from the observed values, giving semi-absolute base-line values at each station. Departures of these base-line values from that obtained at the reference point are plotted in Plate 2, together with the contours obtained as for declination.

Also, a series of six sets of intercomparisons was carried out between observatory stations "A" and "C" to obtain the station difference. The difference obtained did not agree with the results of either of two previous intercomparisons. This, together with the general pattern of the departures, led to the later decision to make observations of H and Z at different heights.

(c) Vertical Intensity.

The vertical intensity corresponding to the central figure on the scale of the variometer was evaluated from the magnetogram for readings obtained at the reference point. Readings at all pegged stations were corrected for diurnal variation thus giving semi-absolute base-line values of vertical intensity at each station. Departures of these values from that obtained at the reference point are plotted in Plate 3, with the corresponding contours. A great deal of interpolation was necessary to produce these but they serve to indicate the nature of the vertical intensity anomalies over the region.

4. RESULTS.

The three plans (Plates 1, 2 and 3) show the lines of pegged stations in relation to the observatory, with contours and departures from the reference point (station "A" in the absolute hut) in gammas (H and Z) and minutes (D). Plates 4, 5 and 6 show profiles of these departures along the lines of pegs.

The range in D is 17' from +5' at station A.5 to -12' at E.4. In general there is a decrease from positive values on the north-east and east edges to large negative values on the central western part. Around both the variation building and the absolute hut the values are scattered with a range of 6 to 7 minutes.

H varies from +45 gammas at station C.1 to -23 gammas at E.1, a range of 68 gammas. The majority of the departures are positive. As in the case of declination, there are large departures in H around the two buildings.

The Z departures are mostly negative, the range being 170 gammas from -141 gammas at station E.3 to +29 gammas at D.4. The only portion of the area in which Z is greater than at the reference point is the north-east. Departures around the two buildings are up to 30 gammas or more.

Because of the irregular nature of the magnetic disturbances revealed by the profiles of Plates 4, 5 and 6, and because of the inconsistent results obtained for the difference between stations "A" and "C" from three sets of intercomparison observations, it was considered probable that the cause of the disturbances is located near the surface of the ground. In order to test this possibility, vertical traverses in H and Z were made over stations A.2 and D.3. Readings were taken at heights of 2½, 4, 10 and 11 feet. The resulting profiles are shown in Plate 7.

Near station A.2 the value of H increases fairly uniformly with increasing height and Z decreases, rapidly at first, to an essentially constant value above about ten feet. At station D.3,

which is near the mound covering the variation building, the changes with height are quite different. The value of H decreases rapidly up to a height of four feet and thereafter is essentially constant. Z increases up to a height of four feet and then decreases again. The significant feature of the profiles of Plate 7 is that both the intensities exhibit changes of more than 40 gammas in a vertical distance of 1½ to 5 feet and these changes may be either positive or negative.

5. CONCLUSIONS.

There is apparently some magnetised material within the surface rocks on the site of the Toolangi Observatory. The existence of the magnetised material is confirmed by tests made by Mr. R. E. Ervin on some fragments of a partly metamorphosed sandstone picked up on the site near the variation building. These fragments show magnetic polarity.

The difference observed between the absolute building and the variation building area are probably not serious enough to affect the Toolangi Observatory as a variation station, though this point could be determined only by taking absolute measurements inside the variation building.

The results of this survey do show, however, that the site is unsatisfactory for absolute magnetic observations and more particularly for instrumental intercomparisons.

It is also evident that in any future survey for a magnetic observatory site it will not be sufficient merely to test for uniformity of observed declination along one or more lines as was, no doubt, done at Toolangi in the 1920's.

For a completely satisfactory investigation, it appears essential to make a variometer survey of the area for all three magnetic elements controlled, if possible, by a portable recording magnetograph.

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1st April, 1952.

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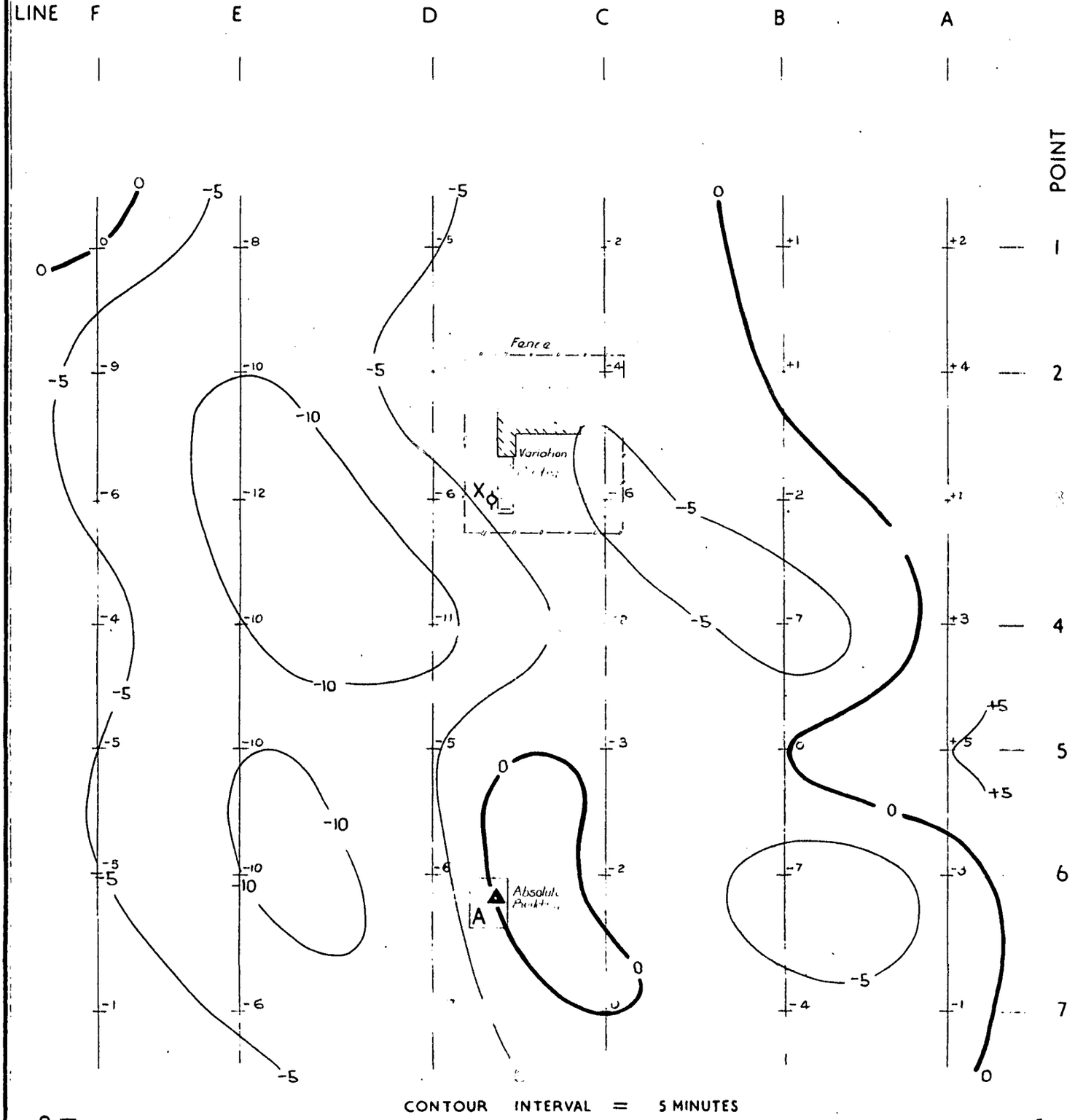
PLATE 1.



TOOLANGI OBSERVATORY

PLAN SHOWING PEGGED STATIONS WITH OBSERVED VALUES AND CONTOURS OF DECLINATION (DEPARTURES FROM STATION "A")

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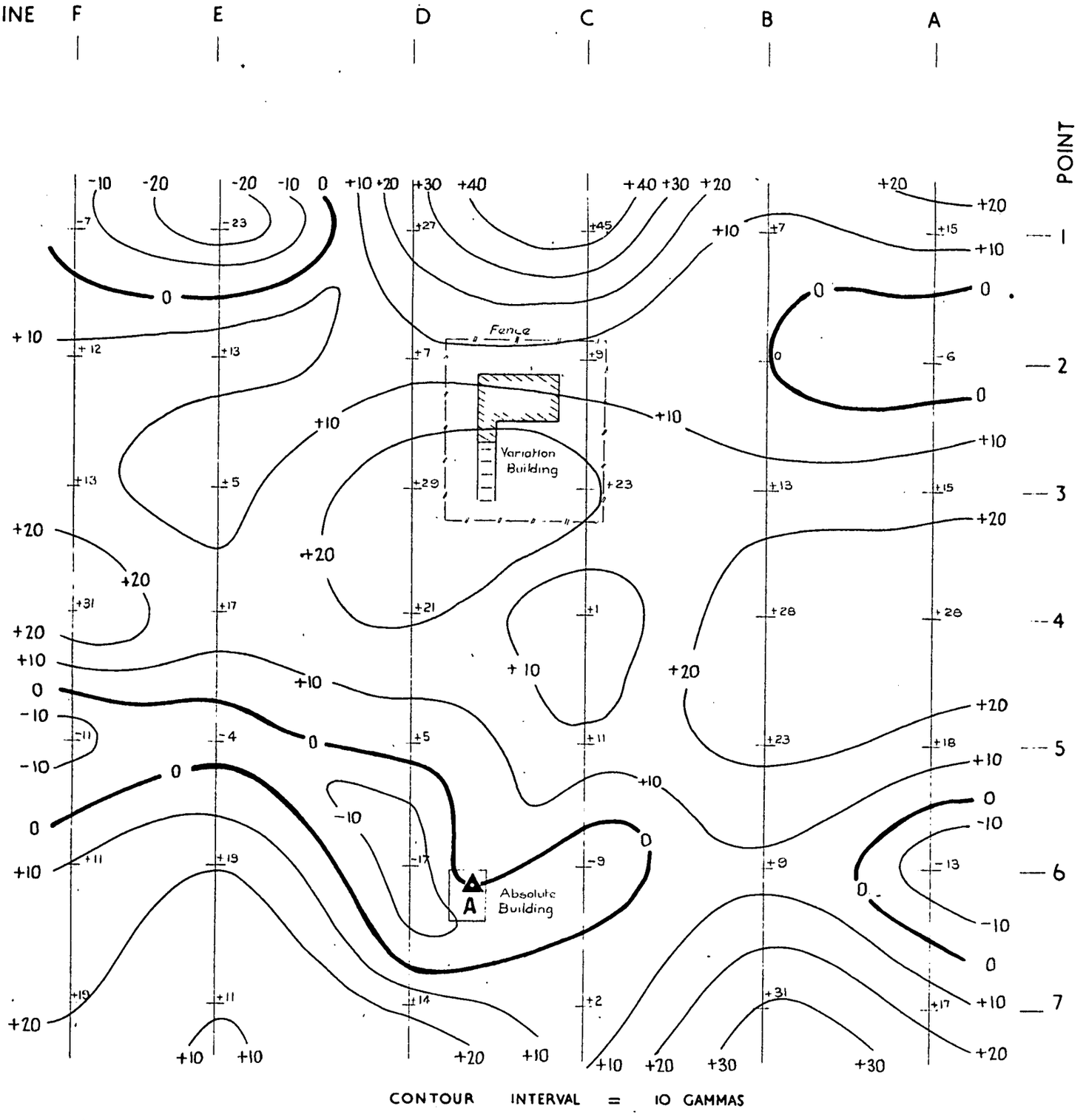
GEOPHYSICIST



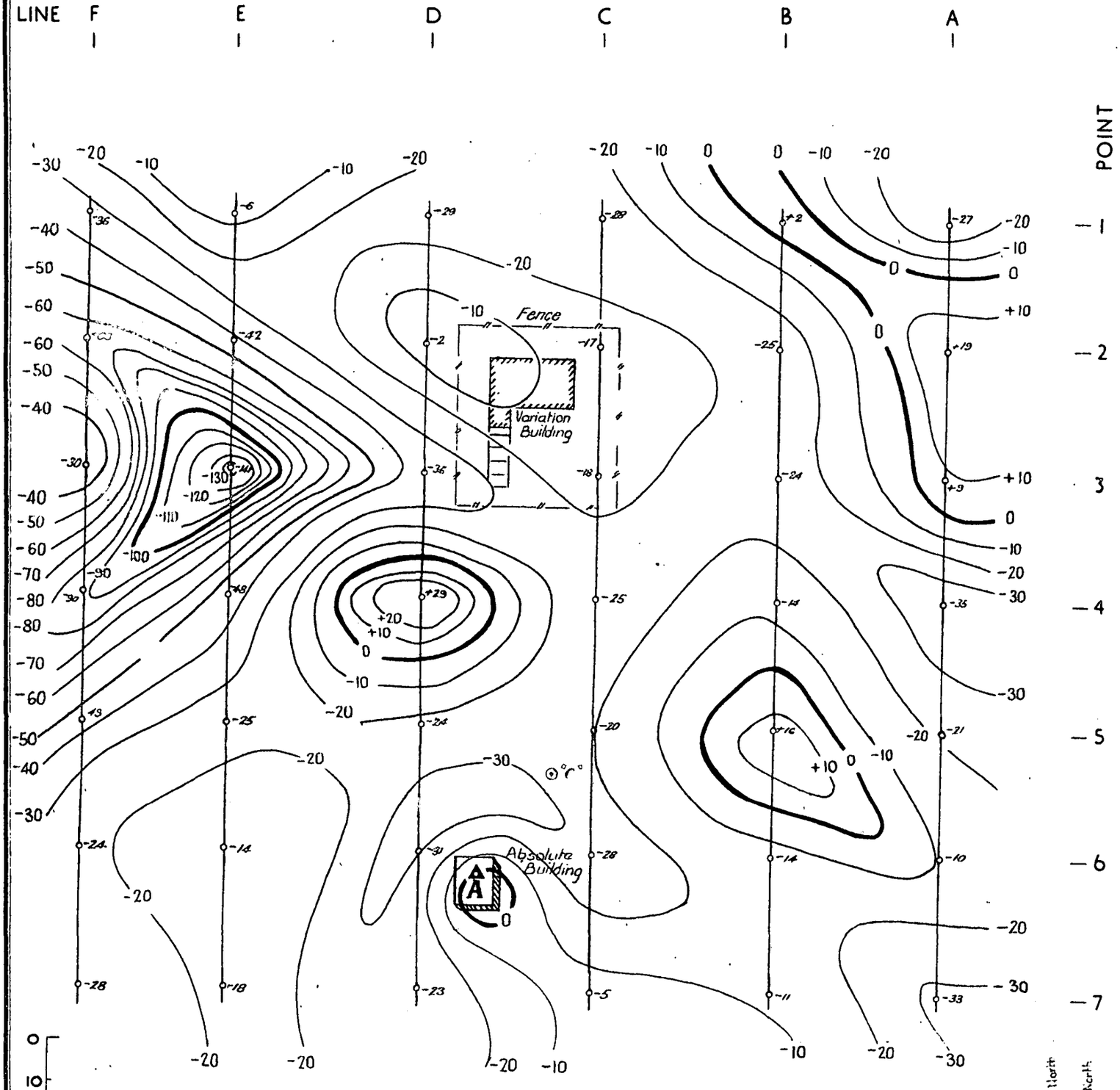
TOOLANGI OBSERVATORY

PLAN SHOWING PEGGED STATIONS WITH OBSERVED VALUES AND CONTOURS OF HORIZONTAL INTENSITY (DEPARTURES FROM STATION "A")

J.W. Wood
GEOPHYSICIST

Geophysical Section - Bureau of Mineral Resources Geology and Geophysics

PLATE 3.



TOOLANGI OBSERVATORY

PLAN SHOWING PEGGED STATIONS WITH OBSERVED VALUES AND CONTOURS OF VERTICAL INTENSITY (DEPARTURES FROM STATION "A".)

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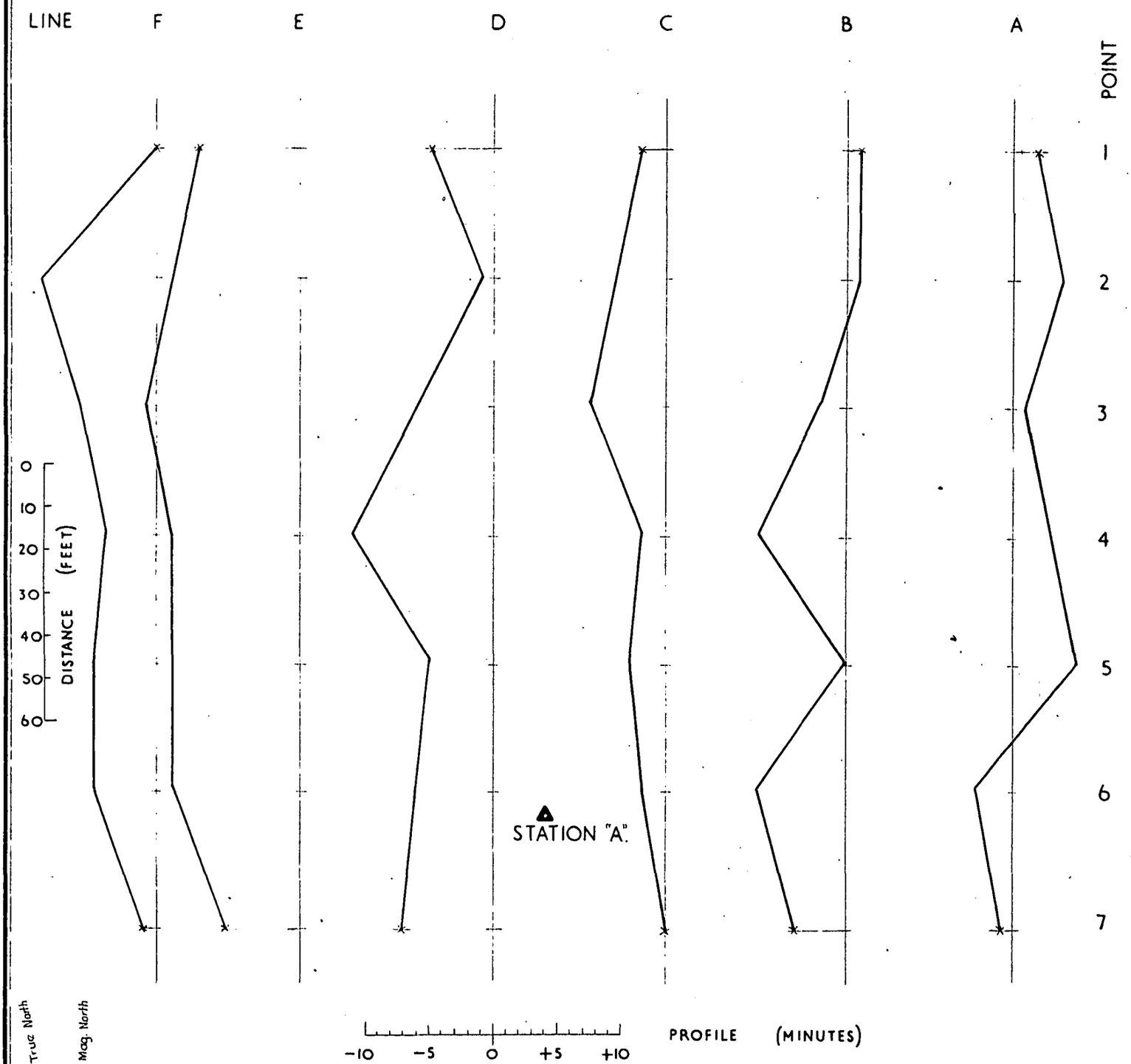
G.66-6



TOOLANGI OBSERVATORY

PROFILES SHOWING DEPARTURES IN DECLINATION FROM STATION 'A'

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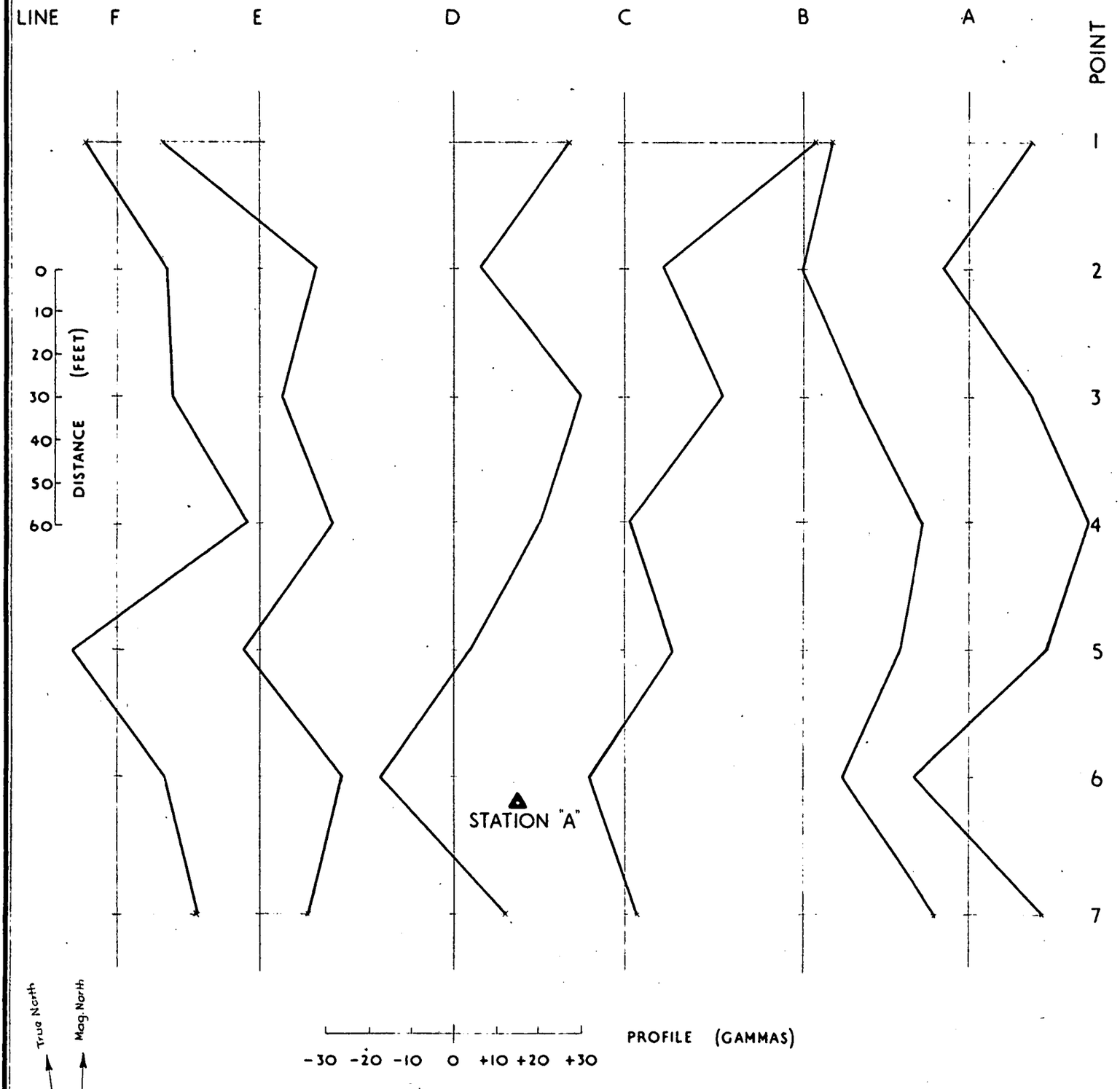
G.66-7



TOOLANGI OBSERVATORY

PROFILES SHOWING DEPARTURES IN HORIZONTAL INTENSITY FROM STATION 'A'

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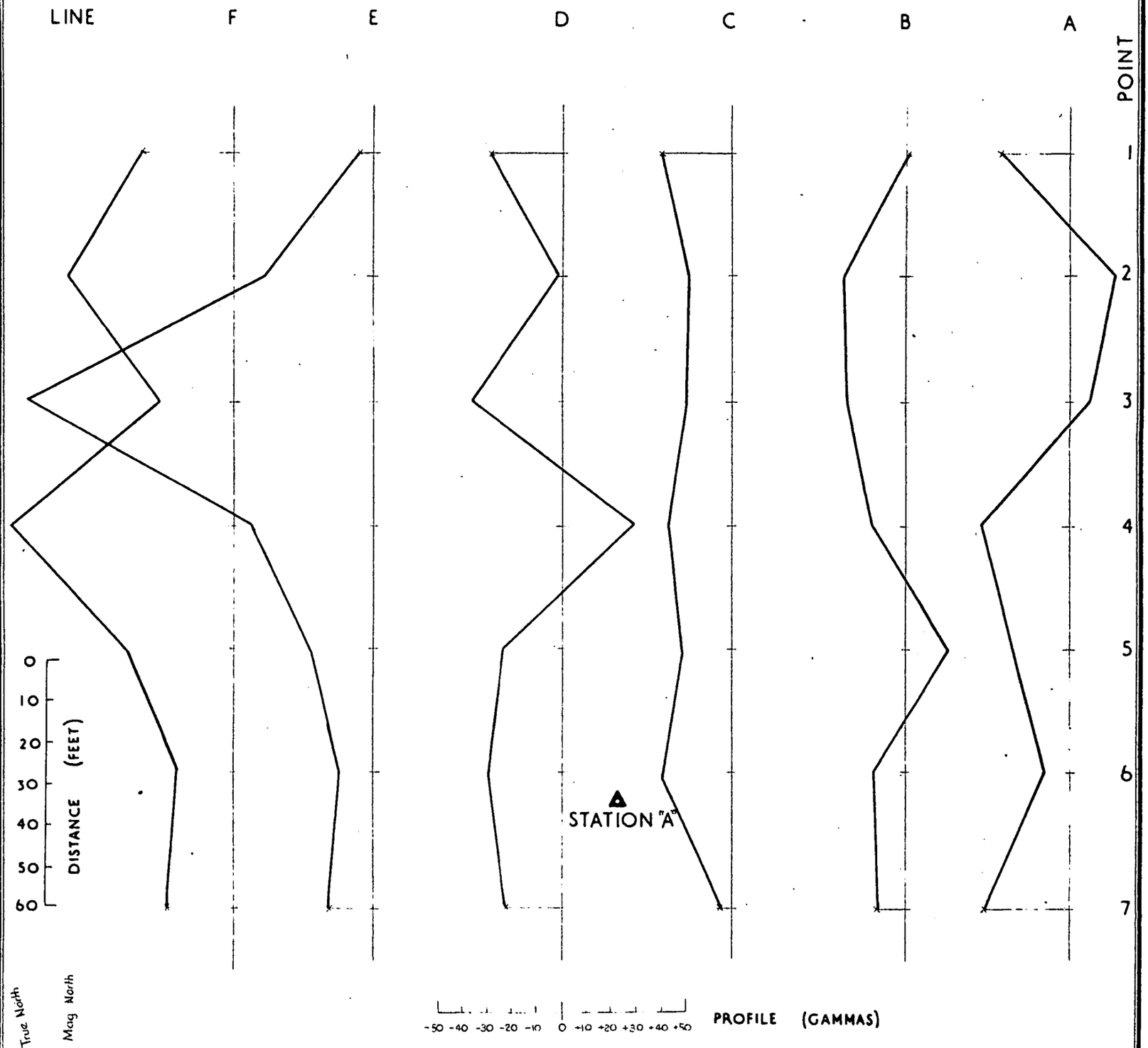
PLATE 6.



TOOLANGI OBSERVATORY

PROFILES SHOWING DEPARTURES IN VERTICAL INTENSITY FROM STATION "A"

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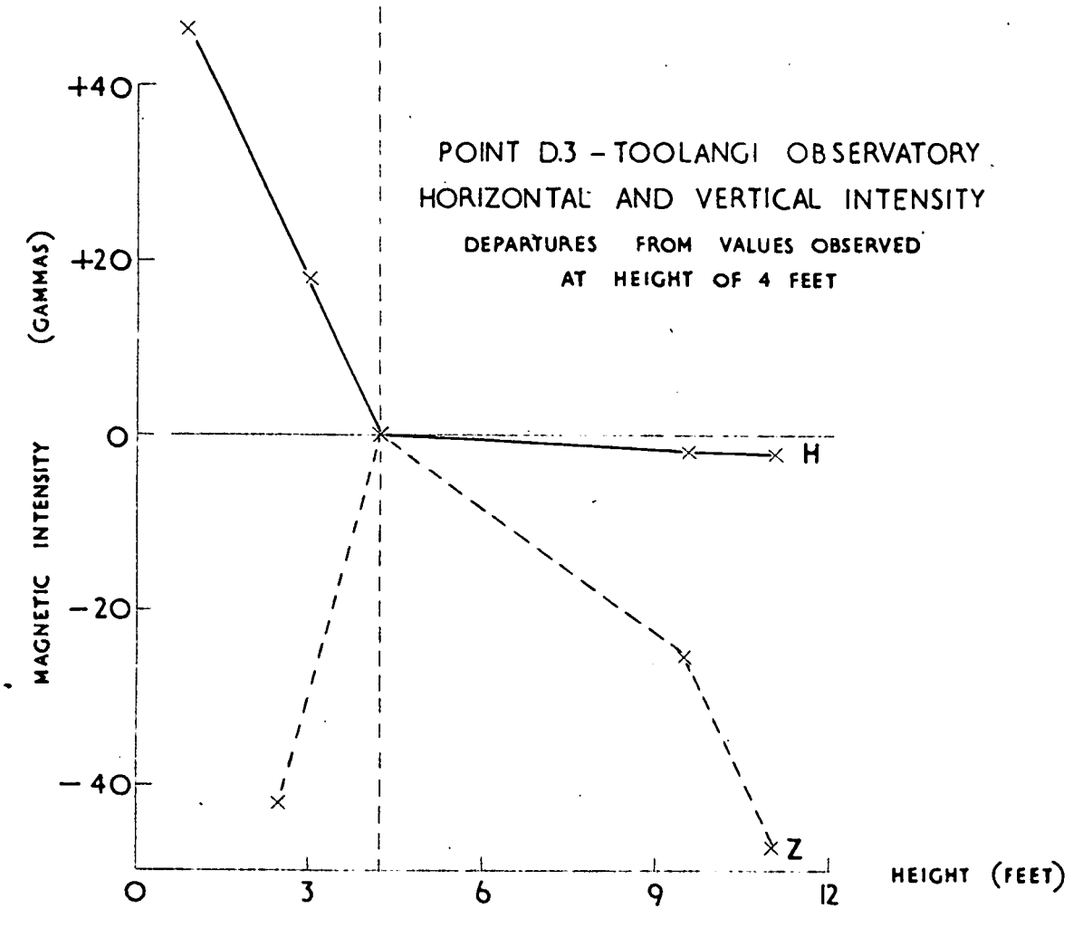

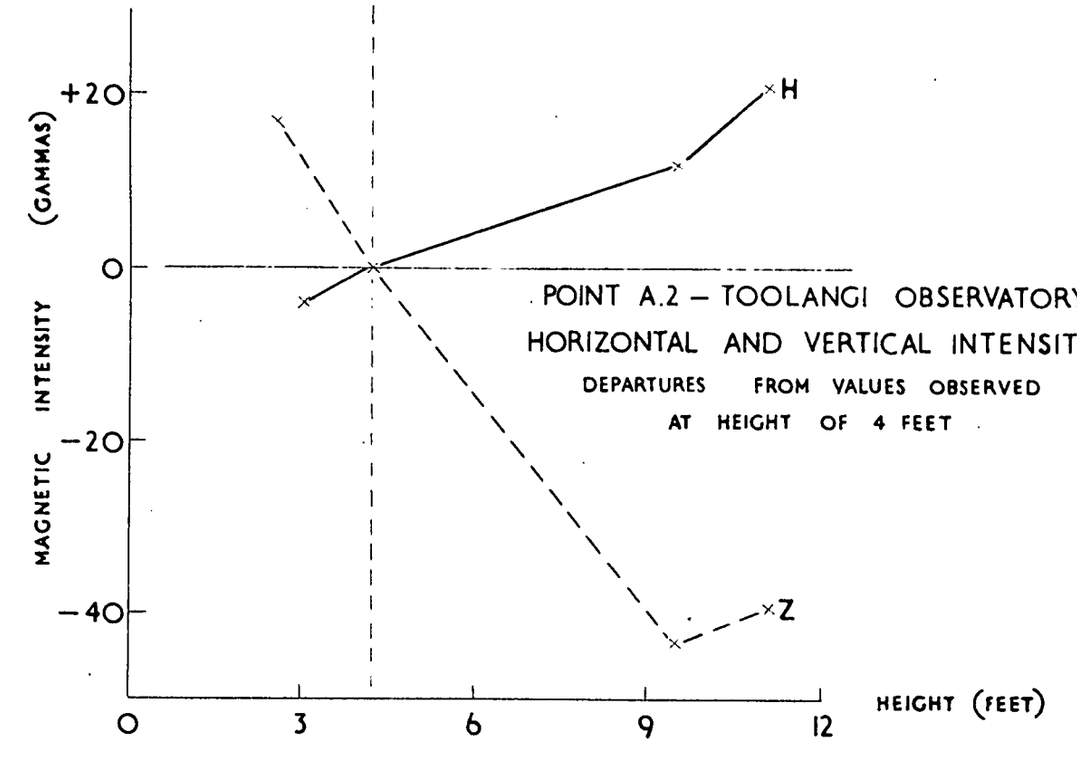

TOOLANGI OBSERVATORY

PROFILES SHOWING VARIATION OF MAGNETIC INTENSITIES WITH HEIGHT

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