COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORDS 1960 No.133

WOOMERA RANGE-HEAD MAGNETIC SURVEY, S.A. 1957

by

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ABSTRACT

Weapons Research Establishment requested information on the earth's magnetic field over Woomera to a height of about 40 km. In response to this request an aeromagnetic survey and some absolute magnetic observations were carried out by the Bureau of Mineral Resources. This Record describes the work done, and presents some comments on estimates of the variation of the field with height.

1. INTRODUCTION

A request was received from Weapons Research Establishment (W.R.E.) to measure the magnetic field at Zero Point of Range E at Woomera, so that estimates of the field up to an altitude of 40 km could be made. This was to be done in three stages: first an aeromagnetic survey of an area about 20 miles square centred on Zero Point; then a determination of the absolute value of the magnetic field at Zero Point; and finally an extensive ground survey of magnetic vertical force, which could be used to continue the field upward analytically. The Bureau of Mineral Resources undertook the task, but when the first two stages had been carried out, the Chief Geophysicist was advised by W.R.E. that the third stage was unnecessary.

This Record contains results of the absolute determination of the magnetic field, and some comments about upward continuation of the field. The aeromagnetic survey was done on 5th August 1957 (see below), and absolute observations on the ground were made by the author between 19th and 22nd August 1957.

2. AEROMAGNETIC SURVEY

The purpose of the aeromagnetic survey was to show the size and extent of magnetic disturbance in the vicinity of the range-head. If the area had been magnetically disturbed, the aeromagnetic survey results would have been used in the selection of ground absolute stations, for which undisturbed conditions are desirable. However, the aeromagnetic survey showed that the area is magnetically not very disturbed.

The survey was done on 5th August 1957 by a party led by A.G. Spence. The aircraft used was a DC.3 (VH-BUR) fitted with a modified fluxgate magnetometer type AN/ASQ-8. For security reasons some of the recorded data were processed by W.R.E., and it is not considered necessary to include the aeromagnetic results in this Record.

3. ABSOLUTE MAGNETIC OBSERVATIONS ON THE GROUND

It was obviously impossible to observe exactly at Zero Point because of ferrous structures used for rocket launching. Therefore five magnetic stations were read at such locations that their centroid was within a mile of Zero Point.

The elements measured were declination, inclination, and horizontal intensity. The magnetic meridian and horizontal intensity were determined with an Askania HTM magnetometer, the true north meridian was determined by solar observations with a declinometer base and chronometer, and the inclination was determined with an Askania earth inductor and galvanometer. Declination is the difference between the magnetic and true meridians.

PARKINSON, W.D., CUREDALE, R.G., and VAN DER LINDEN, J. - Isomagnetic maps of Australia for the epoch 1957.5; Part 2 - Central and Western Australia. Bur. Min. Resour. Aust. Rep. (in preparation).

VESTINE, E.H., LAPORTE, L., LANGE, I., COOPER, C. and HENDRIX, W.C. 1948 Description of the earth's main magnetic field and its secular change 1905 - 1945. Publ. Carneg. Instn. 578.

Table 1 gives the positions of the stations, both relative to Zero Point and as map references, and values of the observed (D, H, and I) and computed (Z and F) elements. The values have been corrected for diurnal variation using standard tables for average conditions (Vestine et al., 1948). Magnetic conditions were quiet when the observations were made, so no further time corrections are considered necessary.

TABLE 1.

Station	Map ref.*	Hundreds of yards from Zero Point	Corrected magnetic elements				
			D	I	H	Z	F
1	533713	12 W, 9 N	5°57.1	62°58.9	26424	51820	58167
2	425721	120 W, 17 N	5°45.2	63°00.0	26442	51882	58242
3	617726	72 E, 22 N	6°01.4	63°00.0	26412	51836	58177
4	553651	8 E, 53 S	5°59.9	63°03.2	26322	51779	58086
5	637641	92 E, 63 S	6°04.5	62°59.0	26398	51771	58114
Mean		6 E, 14 S	5°57.6	63°00.2	26400	51818	58157

* "The Knoll" 1-mile Special, Third Edition

The positions of the stations are shown on Plate 1.

4. ESTIMATING THE FIELD AT ROCKET HEIGHTS

The variation of the intensity and direction of the field with height depends on the extent of local and regional anomalies in the area. If the field is essentially that of a centred dipole the direction is independent of height and the intensity decreases as the cube of the distance from the centre of the earth.

Isomagnetic maps of Australia for the epoch 1957.5 (Parkinson, Curedale, and van der Linden; in preparation) indicate that the tabulated values for Woomera are typical of this part of South Australia, and that there is no significant anomaly present. Therefore treating the field as that of a centred dipole should give a reasonable approximation to the variation with height.

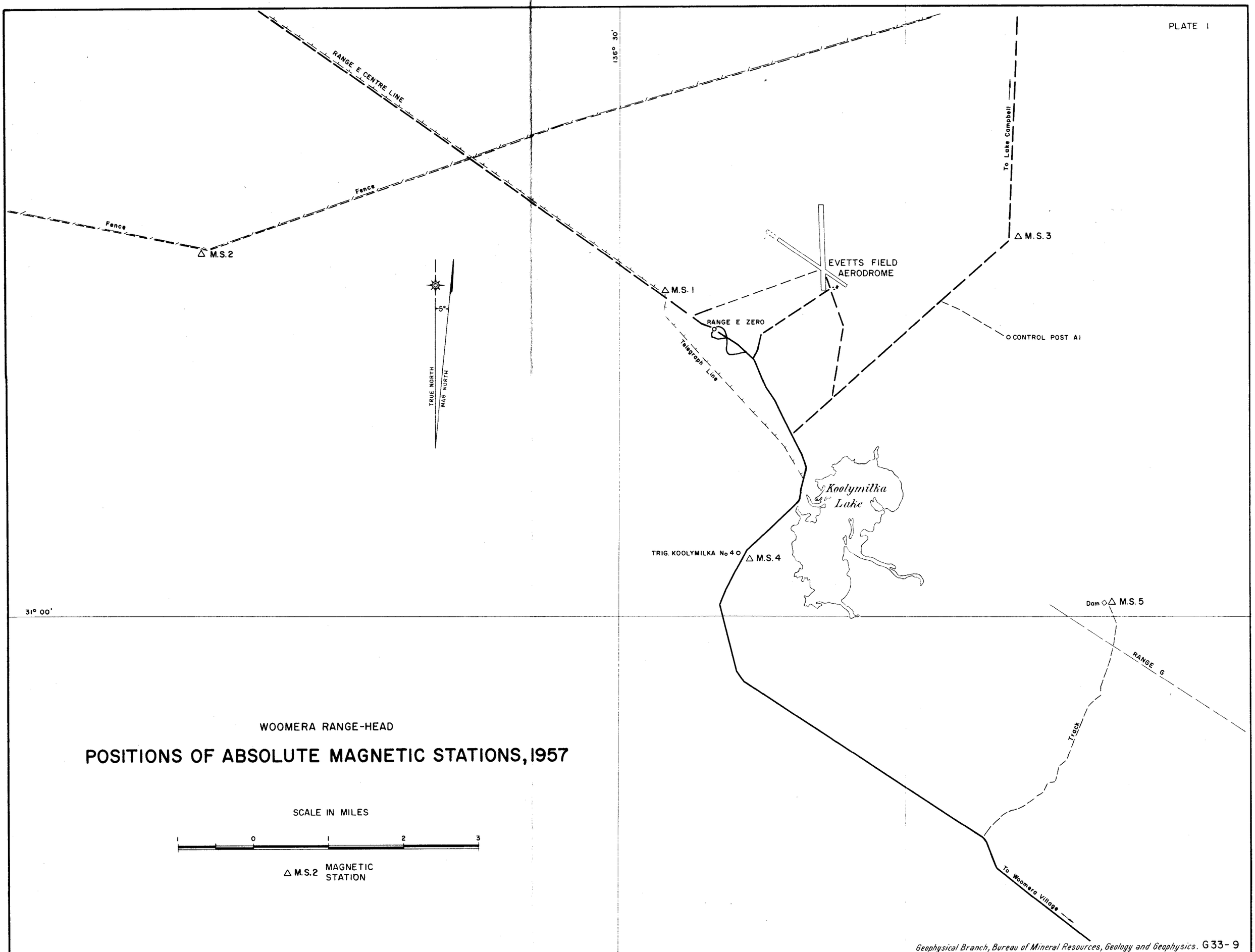
A better approximation can be obtained by using the eccentric dipole representation of the main field (Parkinson and Cleary, 1958). In this case the direction of the field does not change along radial lines from the magnetic centre of the earth, the direction being measured relative to those radial lines. The intensity decreases as the cube of the distance from the magnetic centre. According to the analysis of Finch and Leaton (1957) for the epoch 1955, the magnetic centre is 0.0685 earth radii from the geographic centre in the direction 15.6°N, 150.9°E.

5. REFERENCES

FINCH, H.F. and LEATON, B.R., 1957 — The earth's main magnetic field-epoch 1955.0. Mon. Not. R. astr. Soc. geophys. Suppl. 7 (6), 314.

PARKINSON, W.D. and CLEARY, J.R., 1958 — The eccentric geomagnetic dipole. Geophys. J. roy. astr. Soc. 1 (14), 346.

PLATE I



WOOMERA RANGE-HEAD

POSITIONS OF ABSOLUTE MAGNETIC STATIONS, 1957

SCALE IN MILES

1 0 1 2 3

△ M.S.2 MAGNETIC STATION

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G33-9

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