D.M. 422/55

DEPARTMENT OF MINES

SOUTH AUSTRALIA

THE ADASTRA-HUNTING AIRBORNE MAGNETOMETER EQUIPMENT AND THE REDUCTION OF RESULTS

by

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Geophysical Report No. 17/55

G.S. 410

Report Book No. 41/130

5th December, 1955.

SUMMARY

An airborne magnetometer complete with aircraft and crew was retained under contract to conduct surveys over selected areas within the state.

A description is given of the equipment layout and of the procedure of reducing the results obtained.

INTRODUCTION

This report is intended to be an introduction to the operation of the surveys and the reduction of the results. Individual surveys will be treated in separate reports.

A contract was entered into by the Department with Adastra-Hunting Geophysics Ltd. covering 400 hours flying conducting airborne magnetic surveys in selected areas of South Australia.

Huntings were to supply the magnetometer and all auxiliary equipment installed in a Percival Prince aircraft together with pilot, navigator, engineer and one or two operators. A ground magnetometer was to be operated if required. The Department was to supply chart paper, log sheets, 35 mm. film and all photomosaics and plans required. Relief operators were also to be made available on request.

The magnetometer operates on the flux-gate principal described in an article by R.D. Wyckoff in Geophysics, Vol. XIII, No. 2 and records the magnitude of the earth's total field continuously. The initial surveys over Eyre and Yorke Peninsulas were carried out at a height of 1000 and 1500 ft. above sea level respectively using the barometric altimeter as a guide (known as a constant barometric survey) but surveys can also be flown at constant ground clearance using a radio altimeter which records continuously the ground clearance.

Visual navigation is used with the aid of one inch to the mile photomosaics prepared either by the Lands Department or by the Mines Geological drafting section. Unfortunately the mosaics are not controlled and so the scale of the contour maps prepared from them is only approximately one inch to the mile.

ACKNOWLEDGEMENTS

Appreciation must be expressed to all members of the staff of Adastra-Hunting Geophysics Ltd. for their assistance in the reduction of the records obtained from the surveys. Especial thanks must be given to Messrs. Weyzbun and King who have visited Adelaide on several occasions to discuss the surveys and advise on the presentation of the results.

EQUIPMENT & LAYOUT

The magnetometer is installed in a Percival Prince high wing twin engine monoplane. This plane normally carries 7 passengers besides pilot and navigator.

The layout is shown diagrammatically in Drawing No. S 1177 Four seats have been removed to accommodate the equipment racks. The magnetometer head is installed in the tail assembly away from the extraneous fields of the cabin and equipment. The fields are further reduced by replacing all steel fittings and cables in the tail assembly with non-magnetic ones. This has enabled the heading effect to be reduced after compensation to 9 gammas. The heading effects on Yorke and Eyre Peninsulas were 35 and 12 gammas respectively. A typical heading test curve obtained by flying in a circle over a magnetically quiet area is shown in drawing No. S 1167.

The control and amplifier console is mounted on top of a tubular steel frame on the left hand side of the cabin immediately in front of the operator's seat. Below the console is the Leeds-Northrupp straight line recorder on which is recorded the magnetic record at either 500 or 2000 gammas full scale and underneath the frame are the generators necessary to supply power to the equipment.

The Vinten 35 mm. camera is installed on a F 24 type mount over the camera bay immediately behind the magnetometer operator. A sheet of glass protects the camera when the bay

doors are open. The intervallometer is mounted on the camera and will control the spacing of photos. down to a frame every second. Each frame is numbered by a counter in the camera and this number is also shown on counters in front of the operator and assistant operator. Every tenth and eleventh frame produce fiducial marks on the right hand side of the magnetometer record and are numbered by the operator. When the camera is switched off its operation continues until the next tenth frame is reached so that the numbering for a run always begins with a number ending in one and finishes on a number ending in zero.

The radioaltimeter recorder and camera control units are mounted on a frame in front of the second operator on the right hand side of the cabin. This rack also contains the recorder and console for the scintillometer, the head being at the rear of the cabin. The scintillometer is not in use on the present surveys.

A ground magnetometer which is similar to the airborne instrument but without direction control is set up at the base station if required to check for large variations in the earth's magnetic field. It has not been found necessary to operate this instrument to date; possibly because 1955 is near a minima on the sunspot cycle curve where large magnetic storms are unlikely to occur.

REDUCTION OF DATA

The reduction of data is divided into two sections, the plotting of the plane's path of flight and the scaling and correction of the records.

1. Plotting of flight paths

The path of the aircraft is recorded by the Vinton survey camera on 35 mm. film. The interval between frames is controlled by an intervallometer and can be varied to suit the conditions. An interval of two seconds has been used to date but this should be reduced to one second on areas involving long

flight lines which can be flown at high speed.

The plane is navigated by using a one mile per inch mosaic of the area. The flight and tie lines are shown on this mosaic and act as a guide to the navigator who marks his position on the mosaic when reliable land marks are crossed to assist in the plotting of the actual paths flown.

The film is developed at Weapons Research Establishment at Salisbury and a positive transparency made. The actual flight and tie lines are then plotted on the mosaic endeavouring to locate points not more than two miles apart, however on bad areas it is sometimes not possible to definitely locate points at distances less than ten miles.

The intersections of flight and tie lines are located to one quarter of a frame by comparison of the film strips ensuring that an accurate tie is obtained. This is necessary to reduce misclosures and is more important than the plotting of the intersection on the mosaic.

All plotting is checked by a second computer. The plotted lines are traced on to astralon sheet and dylines obtained on which are plotted the contours values.

2. Scaling and Reduction of Magnetic Chart Data

The profile of total magnetic intensity as recorded on the recorder is without a baseline, which must be provided so that all records are related. This is achieved by the use of tie lines flown across the normal flight lines.

A tie system is set out before the survey commences consisting of tie lines flown across the flight lines at right angles at regular intervals of 10 to 15 miles. Control lines are then chosen from the flight lines at similar intervals so that the area is divided into a network of squares.

The charts for the tie and control lines are scaled at the intersection points using an arbitrary baseline (e.g. the left right hand side of the chart) and the value entered on a control

plan. Misclosures around each square and changes along the sides of the squares are computed and the misclosures are distributed by a least squares method* and the changes along the sides of the squares adjusted accordingly. The changes along the square sides are now further adjusted for normal regional changes as determined from Carnegie tables.

The system is now ready for "tying in". An arbitrary value is chosen for a key intersection and by applying the increases and decreases along the sides of the squares the corresponding values at all other intersections are obtained. Baselines can now be drawn on the charts for all the control and tie lines. The crossover points for the remaining flight lines are marked on the tie line charts and the values scaled thus permitting baselines to be determined for these lines. The base-lines will all have a slope which is determined mainly by the regional correction.

The final operation is to measure the charts for contour intervals using a straight edge and an adjustable set square which has been drilled along one side at the contour interval required. The positions of the contour values are plotted on the flight line plan and contours drawn.

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Associated Drawings

S 1167 Heading Test Adelaide, February 15, 1955.
S 1177 Airborne Magnetometer Layout of equipment in Percival Prince Plane.

JEW:ACK
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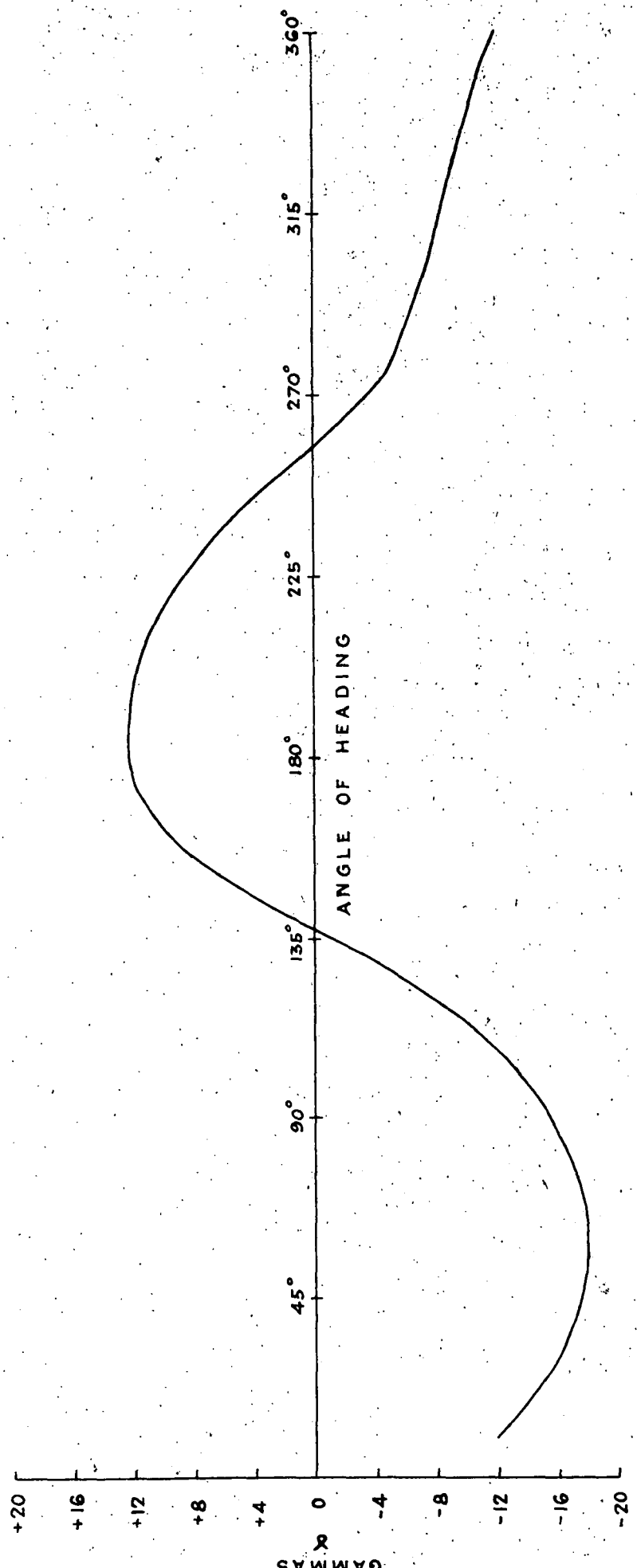
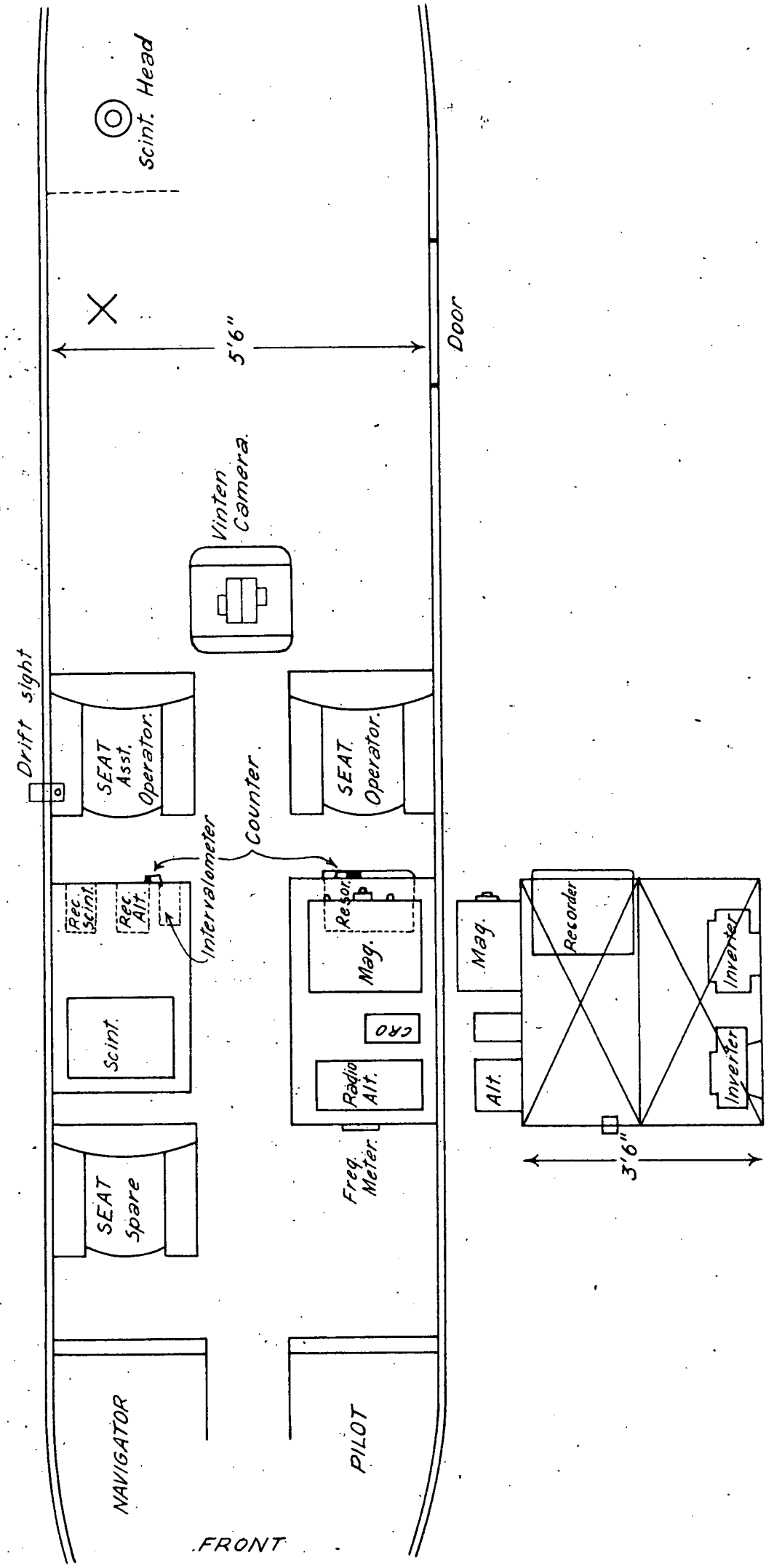
* A.E. Smith, Geophysics Vol. XVI No. 2.
Also notes supplied by Hunting Adastra.



To accompany report by J. Webb.

S.A. DEPARTMENT OF MINES					
Approved	Passed	Drn.	HEADING TEST HUNTING PRINCE AIRCRAFT G-AMLW ADELAIDE. FEB. 15TH 1955 COMMENCEMENT OF YORKE PENINSULA SURVEY	D.M.	Scale 1
		Tcd. R.R.		Req.	S 1167 Gh
		Ckd.			
Director		Exd.			Date 28-11-55



S.A. DEPARTMENT OF MINES					
Approved	Passed	Drn.	Airborne Magnetometer Layout of equipment in Percival Prince Plane	D.M.	Scale
		Tcd. C.J.K.		Req.	S 1177 MGI
		Ckd.			
Director		Exd.			Date 19·12·55