COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1959-7

PRELIMINARY REPORT ON A GEOPHYSICAL INVESTIGATION OF UNDERGROUND WATER AT YUENDUMU, NORTHERN TERRITOTY

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W.A. WIERENGA, R.J. Goodchild, and B.J. Bamber

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CONTENTS.

ILLUSTRATIONS.

ABSTRACT.

A geophysical survey to assist in the location of drilling sites for water supply has been completed at Yuendumu Native Settlement. This report briefly describes the nature of the survey and indicates zones selected as favourable drilling targets.

1. INTRODUCTION.

The Yuendumu native settlement is located about 175 miles west-north-west of Alice Springs. The approximate position of the settlement referred to in army co-ordinates is 222,500 yards north, and 492,500 yards east. It is situated about 1,500 feet above mean sea-level (see Mt. Doreen 4 mile sheet F52/12).

The yearly water consumption of about 6 million gallons comes from two bores north of the settlement, but it is desired to further supplement this supply. A water drilling programme combined with a geological investigation did not locate adequate supplies so that the Bureau of Mineral Resources, Geology and Geophysics was asked to make a geophysical survey preparatory to further drilling.

A geophysical party consisting of R. J. Goodchild, party leader, B. Bamber, geophysicist, and six assistants carried out the geophysical field work from 24th. September to 12th. November, 1958.

Geologically, the area consists of a thin layer of alluvial and windblown deposits on a bedrock of Pre-Cambrian metamorphic and igneous rocks. The problem was to find sub-surface river beds and drainage channels which may provide aquifers from which adequate water supplies could be drawn.

The methods used were electrical resistivity traversing (200 ft. electrode spacing), magnetic traversing, and electrical depth probing. Electrical depth probes were made at localities selected from the results of the resistivity survey.

2. RESULTS.

The resistivity of bore water from the existing bores, is 5.83 ± 0.17 ohm meters at 20°C. Assuming that the porosity of formations containing aquifers may vary between 35 per cent and 10 per cent, and that the pore solutions are of similar composition to bore water, the corresponding resistivities for the formations may range from 5 to 33 ohm meters. Hence, formations containing aquifers may be expected in the zones of comparatively low resistivity as indicated by the resistivity contour plan (Plate 1).

The correlation co-efficient between depth of bedrock from Wenner depth probes, and the apparent resistivity from the resistivity contour plan is 0.61 ± 0.13. Therefore, it is believed that the resistivity contour plan will approximately indicate the deepest places in the bedrock, and therefore the most likely places for the accumulation of alluvial material.

The resistivity contour plan (Plate 1) shows two zones of low resistivity within the 100 ohm meter contour lines. These have been outlined by cross hachuring and called the northern and southern low resistivity zones. There is a reasonable chance that these zones correspond to depressions or old drainage channels in the bedrock containing alluvial deposits and as such seem to offer the best prospects of finding underground water. Plate 3 shows sections based on electrical depth probing and Plate 2 the variations in vertical magnetic intensity (magnetic anomalies).

The northern low resistivity zone is sinuous in form and passes through Stations P3, P8, P11, P14, P18, and P20. Bores Nos. 2 and 7 are within the zone and Bores Nos. 1, 3 and 3A lie immediately north of it. Bores Nos. 4, 5 and 6 which lie still further north have entered bedrock at a relatively shallow depth and yielded no water. They coincide with relatively high resistivity values (200-300 ohm meters) which are consistent with the drilling evidence. Of the other bores only Nos. 1 and 2 yielded appreciable quantities of water and it is not evident from the resistivity results why these sites would be more favourable than those of Bores Nos. 3, 3A and 7. One explanation could be that bores Nos. 1 and 2 are on a narrow alluvial field channel which is a tributary of a main channel represented by the northern resistivity zone. A channel, narrow relative to the electrode spacing used, would not affect the resistivity values appreciably. It is also possible that at Bores Nos. 3, 3A and 7 the alluvium and/or weathered bedrock are too impermeable to yield appreciable quantities of water although they may be saturated.

The southern zone passing through P22 seems the more promising drilling target (between the 60 ohm meter contours, along P22) because:

(a) the overall resistivity to a depth of about 74 feet is close to what may be expected for alluvial material,

(b) the magnetic anomalies in this zone may indicate the presence of gravels containing magnetite, and so provide an aquifer.

In the northern low resistivity zone the most promising area for water drilling targets is found along P16, P11, P8 and P3 (see Plate 1, between the 100 ohm meter contours, north of the settlement). However water pumped from new bores in this area may seriously interfere with the water yield of the present bores 1 and 2 because these bores may draw from the same shallow basin.

The remaining area of the northern low resistivity zone along P14, P18 and P20, between the 100 ohm meter contours, south and south east of the settlement, is considered less favourable than the areas mentioned above because what may be the weathered bedrock, is at shallow depth. However, in some places partly or completely weathered bedrocks have yielded appreciable amounts of potable water. Hence, the area P14/P20 should considered for test drilling, starting at the P14 end.

3. CONCLUSIONS.

The places selected as favourable targets for water drilling within the surveyed area are in order of priority (see Plate 1).

1. The southern low resistivity zone, starting at P22 between the 60 ohm meter contours.

2. The area along P16, P11, P8 and P3 in the northern low resistivity zone within the 100 ohm meter contours north of the settlement, starting at the P3 end.

3. The area along P14, P18 and P20 in the northern low resistivity zone, within the 100 ohm meter contours south and south-east of the settlement, starting at the P14 end.

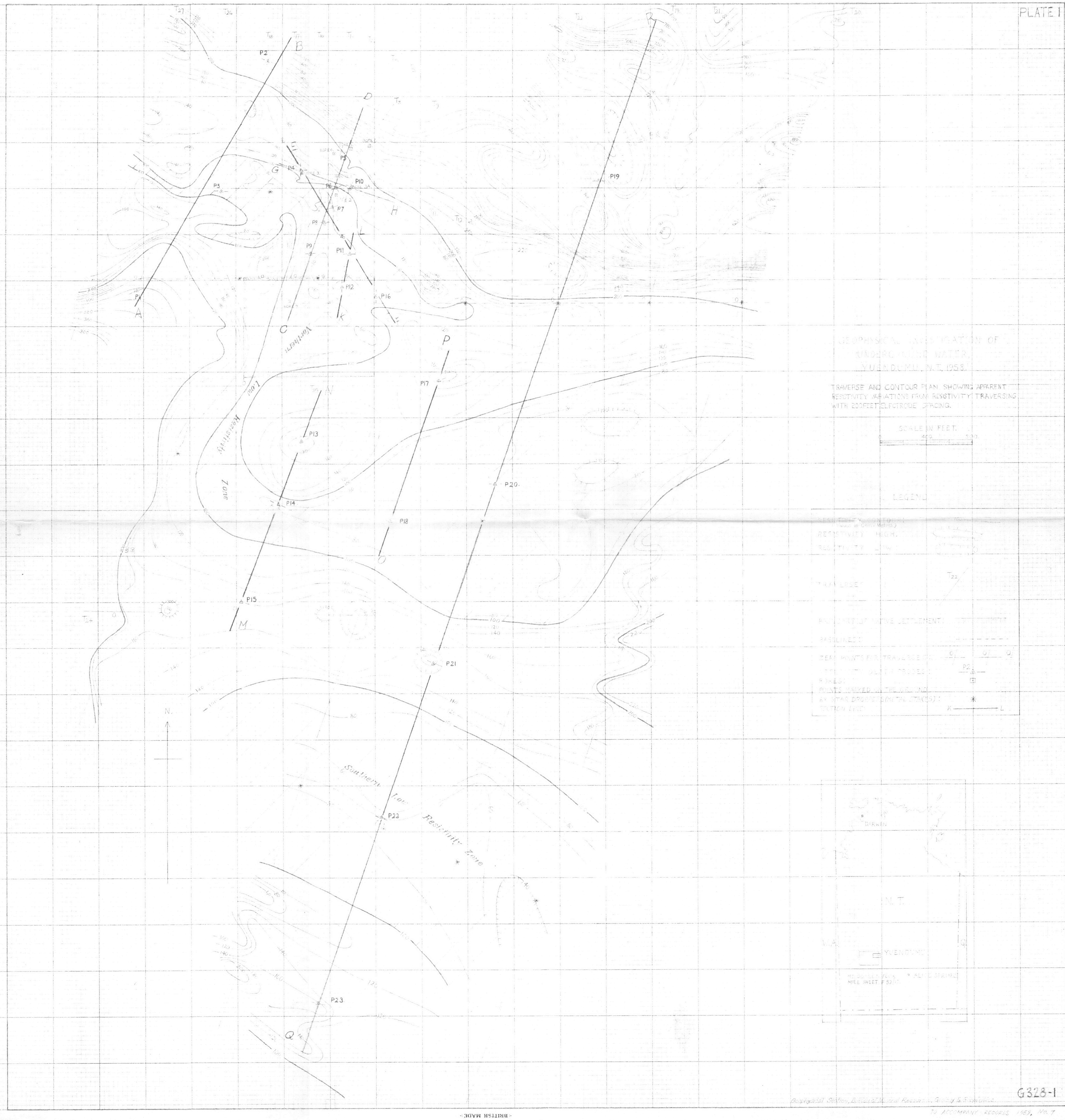
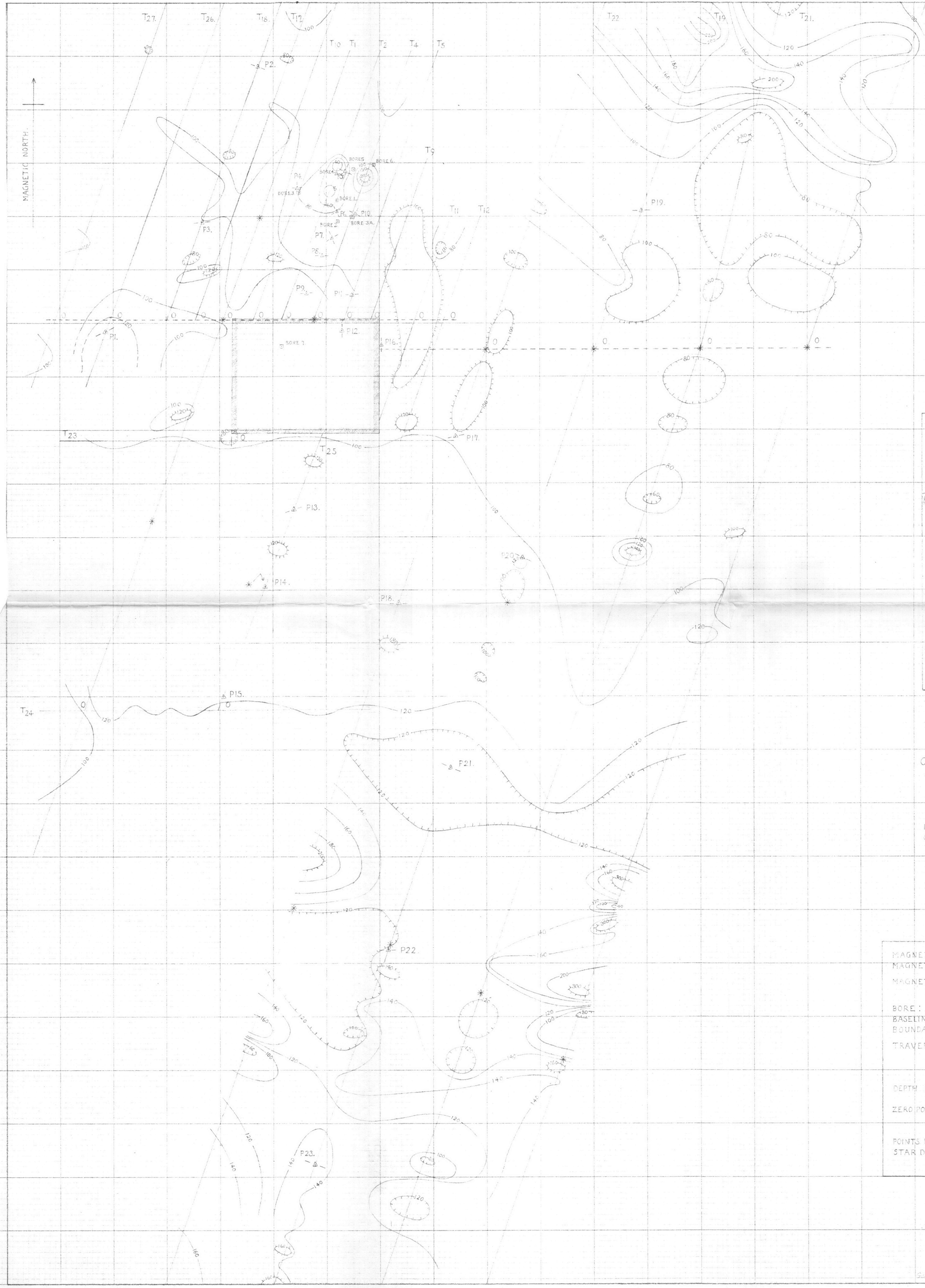
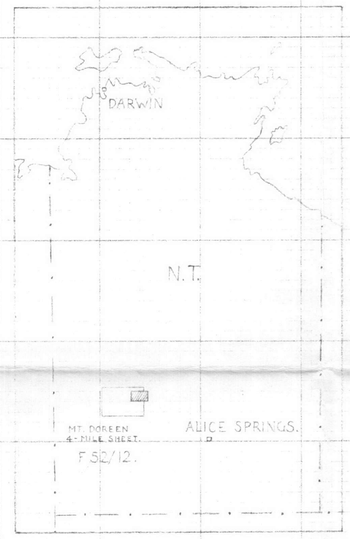


PLATE 1
YUENDUMU, N.T. 1958.
TRAVERSE AND CONTOUR PLAN SHOWING APPARENT RESISTIVITY VARIATIONS FROM RESISTIVITY TRAVERSING WITH 200FEET ELECTRODE SPACING.
SCALE IN FEET.
0
400
LEGEND
(Values in Ohm-Metres.)
RESISTIVITY HIGH.
TRAVERSE
BASELINES
POINTS MARKED ON THE GROUND
SECTION LINE
Northern
Resistivity
Zone
Southern
Low
Resistivity
Zone
N.
DARWIN
N.T.
YUENDUMU
G328-1
TO ACCOMPANY RECORDS 1959, No. 7

PLATE 2



LOCALITY MAP.



GEOPHYSICAL INVESTIGATION OF UNDERGROUND WATER, YUENDUMU, N.T., 1958.

CONTOUR PLAN SHOWING VARIATIONS IN VERTICAL MAGNETIC INTENSITY.
CONTOUR INTERVAL: 20 γ.

SCALE (FT.)
0. 400. 800.

LEGEND.

- MAGNETIC CONTOUR LINE (100 γ) : 100
- MAGNETIC HIGH :
- MAGNETIC LOW :
- BORE :
- BASELINES :
- BOUNDARY OF NATIVE SETTLEMEMENT :
- TRAVERSE : T22.
- DEPTH PROBE : P16. -Δ-
- ZERO POINT FOR TRAVERSES : 0 0
- POINTS MARKED ON THE GROUND BY STAR DROPPERS (METAL STAKES). *

G 328-4

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PLATE 3

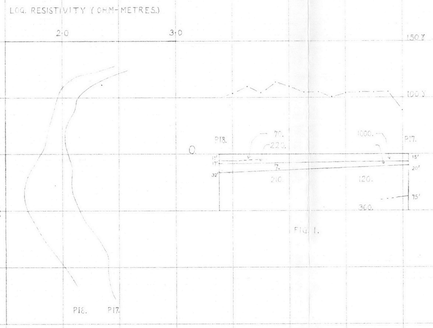

FIG. 1.

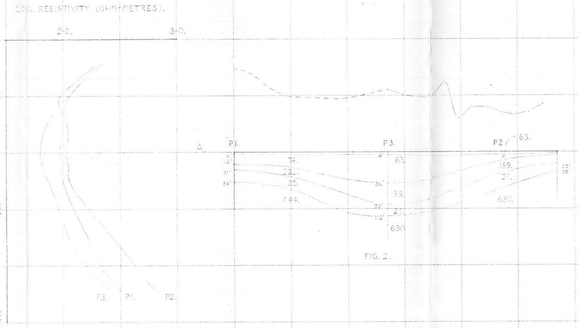

FIG. 2.

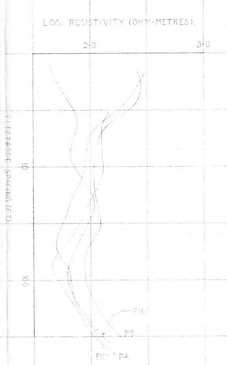

FIG. 3.

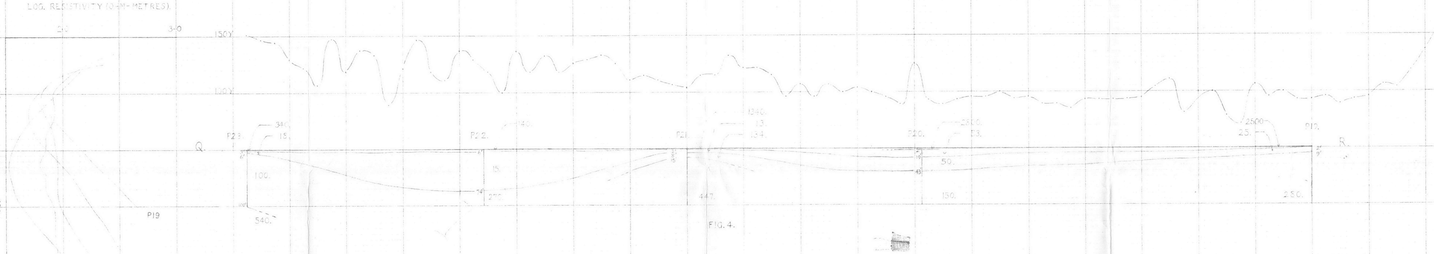

FIG. 4.

FIG. 5.

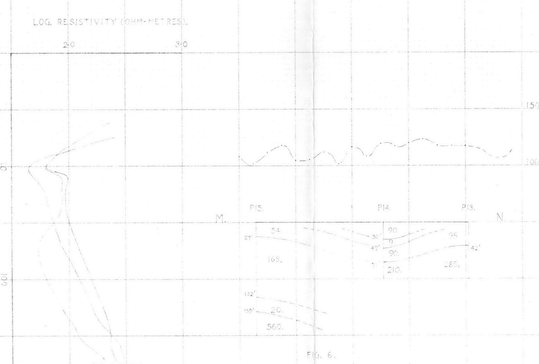

FIG. 6.

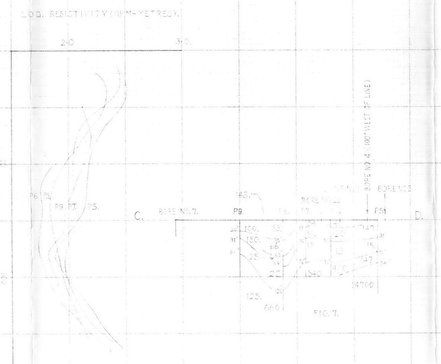

FIG. 7.

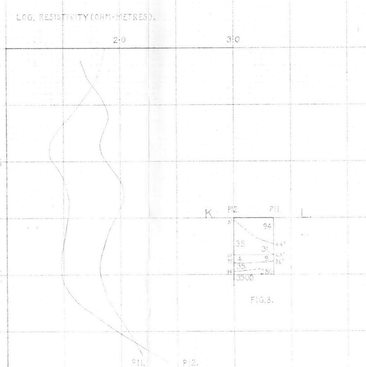

FIG. 8.

GEOPHYSICAL INVESTIGATION OF UNDERGROUND WATER YUENDUMU, N.T., 1958.

FIGURES SHOW SECTIONS DERIVED FROM ELECTRICAL DEPTH PROBES WITH CORRESPONDING PROBE DATA ON A LOGARITHMIC SCALE.

LEGEND.

VERTICAL MAGNETIC INTENSITY : ———

LOCATION OF DEPTH PROBES : P21.

LOCATION OF BORES : BORE NO. 3.

RESISTIVITY OF ROCK (OHM-METRES) : 380.

DEPTH OF ROCK LAYER DERIVED FROM PROBE : 15'.

G 328-3

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