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RECORD No. 1965/74

UNION REEFS GEOPHYSICAL SURVEY
NEAR PINE CREEK,
NORTHERN TERRITORY 1963

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FOREWORD

In connexion with the Special Mineral Survey programme in the Northern Territory, a geophysical survey was made over the Union Reefs goldfield, near Pine Creek, between June and August 1963. The survey was made under contract to the Bureau of Mineral Resources (BMR) by J.J. Masur & Co. Ltd, local agents for Aktiebolaget Elektrisk Malmletning (ABEM), Stockholm, which provided the technical services.

At the conclusion of the survey, a report was prepared by ABEM. The report is reproduced herewith, with the following modifications:

(a) The section on "Field Operations" has been omitted.

(b) Of the 22 plates accompanying the report, only five are reproduced. Two of these are plans of the surveyed area showing axes of the geophysical anomalies. The other three give examples of the detailed presentation of the geophysical data.

(c) An appendix has been added listing details for recommended drill holes.

(d) The report has been edited to conform to BMR practices.

The full text of the report and all plans are held in the Geophysical Branch of the BMR.

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ILLUSTRATIONS

SUMMARY

At the request of the Geophysical Branch of the Bureau of Mineral Resources (BMR), Aktiebolaget Electrisk Malmetning made a geophysical survey, between 19th June and 16th August 1963, on the Union Reefs goldfield, about nine miles north of Pine Creek. The area surveyed measured 2200 ft, by 13,000 ft; a few reconnaissance traverses were also surveyed.

The problem was the location of auriferous quartz veins and sulphide depositions within the goldfield and its surroundings. It was considered that the Turam and Turam Transformer methods would be the most suitable, the former for the location of good conductors and the latter for poor conductors.

Many anomalies were obtained by both methods and, although some may be due to sulphide deposits, it is most likely that the irregular content of saline water has caused most of them. Several sites for drill holes are recommended in order to test the anomalies.

1. INTRODUCTION

In the eighties and nineties of the last century the Union Reefs goldfield was worked intensively and was one of the richest in the Northern Territory. Since then, activities have been sporadic. In 1934, the Union shaft was bored out by North Australia Mines (N.L.), and during 1935 some development work was carried out in the Lady Alice tunnel, but gold values appear to have been unsatisfactory as operations were abandoned.

Throughout the field, open cuts and shafts are numerous, but the workings are shallow and few of them reach 100 ft. Little, if any, work appears to have been done below water level.

As it is not unlikely that payable quartz reefs occur also at greater depth, the Bureau of Mineral Resources (BMR) decided to use geophysical prospecting methods as a means to locate them. The Turam electromagnetic method and the Turam Transformer (TT) electrical potential method were considered most suitable. The BMR decided to have the geophysical work done on a contract basis, and with J.J. Masur & Co. Pty Ltd, Melbourne, as main contractor, and Aktiebolaget Elektrisk Malmletning (ABEM) as subcontractor, geophysical field work was done during the dry season in 1963, between 19th June and 16th August.

The geophysical work was done by two ABEM geophysicists and the land surveying by J.J. Masur & Co. Pty Ltd..

2. GEOLOGY

The geology of the Union Reefs area has been described by Hossfeld (1936). The area forms part of the Pine Creek 1:250,000 geological series, Sheet D/52-8. Briefly, the geological features of the Union Reefs goldfield area are as follows:

The gold-bearing reefs occur near Pine Creek in two roughly parallel zones trending north-north-west and known as the Union and the Lady Alice lines of reefs. For a distance of about a mile to the west, small quartz reefs and a few larger ones are widely distributed. To the east, the auriferous formations are limited in extent by the outcrop of a granite batholith and its surrounding metamorphic aureole.

The rocks of the Union Reefs goldfield are of sedimentary origin and consist mainly of shales or slates and of greywacke and silicified greywacke folded tightly so as to produce vertical or nearly vertical dips. The folding movements were so severe that fracturing took place in the anticlines, and the resultant shearing movements were almost parallel to the strike of the rocks. These shears occur mainly in the two zones known as the Union and the Lady Alice lines of reefs. The shears in these zones are numerous and discontinuous. The shear zones and shears have a strike of about twenty degrees west of north and are vertical or nearly vertical. The movement set up strains that produced a subsidiary set of faults. These were filled by quartz reefs that strike easterly and westerly and dip gently to the north-north-west at right angles to the direction of the shearing movements.

The whole of these movements are believed to have taken place before the intrusion of the granite batholith by magmatic stoping. Subsequent to this intrusion the mineralisation of the area was effected, and the previous shears, fault fissures, and fractures acted as channels for the mineral-bearing solutions, from which the quartz and sulphides were deposited.

3. THE PROBLEM AND THE GEOPHYSICAL METHODS USED

The problem was the location of auriferous quartz reefs and depositions of sulphides, such as galena and arsenopyrite, which are believed to contain gold in payable proportions. Although the bedrock crops out in numerous places, the larger part of its surface is covered. Appropriate geophysical methods had to be adopted for these conditions and for the exploration of the deeper parts of the whole of the area.

Electrical methods that depend on the conductivity difference between sulphides and sedimentary rocks and between sedimentary rocks and quartz were applied.

Most sulphides, including arsenopyrite and galena, are comparatively good conductors, whereas shales are poor conductors, unless they are carbonaceous. Greywacke is also a poor conductor. For the location of sulphide depositions, the Turam electromagnetic method is convenient and was selected by the BMR for the geophysical survey of Union Reefs goldfield area.

For the location of the quartz reefs the BMR chose the Turam Transformer (TT) method, an electrical potential method that is adequate for searching for very poor conductors or insulators such as quartz.

Turam electromagnetic survey

A description of the method is given in the report on the McArthur River survey (BMR, 1964).

The generator used had double windings, one for 220 c/s and one for 660 c/s. Traverses 6N and 8N were surveyed using both frequencies. A comparison between the plotted profiles of ratio and phase difference showed that there was almost no difference in the shape of the curves for the different frequencies. As it was much easier to obtain sharp readings with the higher frequency, the rest of the survey was performed with this. For control, readings were taken with both frequencies at single stations or at a series of stations.

The complete list of stations surveyed with both 660 c/s and 220 c/s is as follows:

6N: 2.25 W - 21.75 W, 18.75 E, 20.25 E

8N: 2.25 W - 21.75 W

10N: 10.75 W, 11.25 W

12N: 11.75 W

14N: 6.75 W, 10.25 W, 10.75 W, 15.25 W

16N: 8.75 W - 11.25 W

22N: 7.75 E - 20.75 E

24N: 2.25 E - 20.75 E

56N: 19.75 W

66N: 14.25 W

70N: 19.25 W

94N: 10.25 W, 13.25 W, 21.25 W

96N: 9.75 W, 10.25 W, 13.25 W, 16.25 W, 17.75 W, 20.25 W, 20.75 W

The readings were taken at 50-ft intervals on all traverses except 6N (west) and 8N, where the distance between the observation points was 25 ft. The distance between the coils was normally 50 ft, but the distance had to be reduced to 25 ft when the portion 17.5 E - 18.5 E of Traverse 120N was surveyed, because the strength of the anomaly was beyond the capability of the Turam ratiometer. Before these readings were plotted, they were transformed so as to be valid for a 50-ft coil-separation.

The primary cable, which was about 7500 ft long, was placed along the baseline with the grounded ends at least 2200 ft beyond the ends of the traverses to be surveyed. Four cable layouts were needed altogether. From the first layout, Traverses 0 - 28N were surveyed; from the second, Traverses 28N - 62N; from the third, Traverses 62N - 100N; and from the fourth, Traverses 100N - 130N. For control, the last traverse of each layout was resurveyed.

In order to tie the surveys of the different traverses together, a line (3W) was surveyed parallel to the baseline.

TT electric potential survey

In the Turam Transformer method, alternating current is fed into the ground by means of two current electrodes, and the potential distribution is measured by means of three more electrodes, which are equally spaced along part of the traverse and connected to a double transformer. The central electrode is connected to the mid-point of the primary windings. The secondary windings of the transformer are connected to the Turam ratiometer in place of the coils that are used for the Turam survey. Thus the ratio of the potential drops across the two spaces between the three potential electrodes will be obtained. As in the Turam survey, the phase difference can also be determined.

In the Union Reefs survey, both current electrodes were placed in line with the traverse to be surveyed, one at a distance of at least 1500 ft from the nearest potential electrode and the other 300 ft from the nearest potential electrode. As the survey proceeded, all electrodes other than the remote current electrode were moved, the distances from the potential electrodes to the near current electrode being kept constant. The spacing of the potential electrodes was 50 ft and the distances from the near current electrode to the three potential electrodes were 300, 350, and 400 ft respectively. For traverse 6N (west), the corresponding distances were 250, 300, and 350 ft.

The measured ratios were corrected for the distance from the near current electrode. As the normal ratio (ratio valid for homogeneous medium) is 300/400 = 0.75 for distances 300, 350, and 400 ft, the measured ratios have been divided by 0.75. For traverse 6N the corresponding correction factor is 250/350.

The influence of the remote current electrode is only a fraction of that of the near one and the correction for it would be about 1.5% at the beginning of a traverse and 0.3% at the end.

Before plotting the results, the reduced ratios were successively multiplied to express the electric field strength, the logarithm of which has been taken as ordinate.

A special correction was applied to compensate for a gradual increase of the electric field in the direction of survey advance (for the western traverses westwards, for the eastern eastwards). Traverse 6N (west) was resurveyed from east to west to find out if this increase was due to the topographical and geological conditions. The resurvey showed that the discrepancy was methodical. Obviously it depends on an increase in conductivity with depth. A small change in the normal ratio (from 0.75 to about 0.83) was usually sufficient to remove the discrepancies.

The TT traverses west of the baseline and south of Traverse 98N, except for the resurvey of Traverse 6N (west), were surveyed at 25-ft intervals, the rest at 50-ft intervals.

4. DISCUSSION OF RESULTS

The Geological Branch of the BMR had drawn up geological maps of the Union Reefs area at a scale of one inch to 100 ft and it was decided to draw the geophysical maps to the same scale. As the length of the map at a scale of one inch to 100 ft would be about eleven feet, it has been divided into five parts. In the area east of the baseline, only a few selected traverses have been surveyed. As this area has not been geologically surveyed, it was convenient to present the geophysical results on the one plate. The plates for the western parts of the surveyed area have been numbered from 2 to 6 (from south to north) and the plate of the eastern part has been denoted by number 7.

For each division, the profiles of Turam normalised ratio and phase difference have been plotted on a plate denoted by the letter 'A', the contours of Turam ratio on a separate plate marked 'B', and the contours of phase difference on a third plate marked 'C'. The TT survey results are shown in Plates 8 and 9.

Plates 1 and 1a are plans of the whole area (scale 1 inch = 1000 ft) showing the geophysical grid, principal topographic features, and positions of axes of good conductors located by the Turam survey and poor conductors located by the TT survey.

Turam survey

Many Turam anomalies were obtained. In the whole area there is scarcely an undisturbed spot. The depth to the current concentrations has been calculated for some of the indications and is of the order of 50 - 100 ft.

As the thickness of the overburden is mostly small, it is assumed that the anomalies are produced by sections of good conductivity in the rock. Sulphide depositions of such frequent occurrence are unlikely, and carbonaceous shale cannot be expected in this area. It is most likely that the varying content of saline water has caused most of the anomalies. The base of the weathering, which, for instance, was encountered at a depth of about 160 ft below the surface in BMR drillhole No. 6, indicates the lowest water table reached during an extremely dry year. At the time of the survey, the ground water in a few places was almost at surface level. In other places the position of the water table was several tens of feet below the surface, as far as could be observed from the old mine shafts. The heterogeneous composition of the weathered layer, combined with the varying depth to the ground water table, is likely to have contributed to produce anomalies.

There is still a possibility that some of the indications originate from sulphide deposits. The most conspicuous anomalies are listed in Appendix A. The strongest anomalies have been numbered from 1 to 30. They include all ratios greater than 1.16 and phase differences stronger than -10 degrees. They also include all of the conductors that are recommended to be checked by drill holes in order to verify Turam anomalies (see Appendix D).

The proportion between the ratio and the phase difference is often used as a measure of the conductivity of the conductor. It is realised that the size and the shape of the conductor and the depth to it also have an effect on the relation between ratio and phase difference.

The normal curve of Turam ratio above a vertical conductor has a positive maximum nearly straight above the current concentration and a weak negative minimum (shoulder) on either side. The curve of the phase difference is roughly the inverse of the ratio curve. At some places, e.g. 0N/19.75W, 2N/19.3W, 6N/12.0W, 8N/13.2W, 26N/21.25W, 22N/17.9E, and 122N/20.6E, pronounced, inverted ratio and phase difference curves were obtained. They cannot be explained as inverted parts of regular anomalies. Instead, it is assumed that, owing to the underground conditions, the galvanic current in certain portions of the conducting material has a reverse direction.

Plates 2B to 7B show the contours of the Turam ratios, and Plates 2C to 7C the contours of the phase differences. From the contours, the axes of the conductors have been located and plotted on Plate 1. A distinction has been made between stronger and weaker indications. The former correspond to normalised ratios greater than 1.10 and phase differences stronger than -5 degrees, or both, and are drawn in full lines; the weaker indications are drawn in dotted lines.

Strong indication courses of considerable length are to be found in the following places:

1. 16W, from 0N to 14N
2. 9W, from 2N to 10N
3. 6.5W, from 4N to 14N
4. 11W, from 6N to 12N
5. 21W, from 48N to 56N
6. 7W, from 58N to 64N
7. 20W, from 60N to 66N
8. 13W, from 94N to 102N

The first indication course listed above follows a mountain ridge; the second one passes an old shaft of Millar's workings. In the northerly continuation of the third one there are two old shafts.

In the area east of the baseline, indications were also obtained. Particularly interesting are the anomalies on Traverse 120N at 18.25E and on Traverse 122N at 17.4E. They are by far the strongest anomalies of the whole survey. The Turam ratios are 1.37 and 1.44 and the phase differences $-25^{\circ}.5$ and $-13^{\circ}.5$, respectively. Apparently, the relatively strong anomalies at the eastern-most ends of Traverses 94N and 96N belong to the same indication course. Obviously the traverses have reached the contact between the sedimentary rocks in the west and the granite and its metamorphic aureole in the east.

Turam Transformer survey

As with the Turam results, a distinction has been made between clear and vague anomalies. The former have been listed in Appendix B.

Only a part of the area west of the baseline has been systematically surveyed by TT (94N-120N). The rest, including the area east of the baseline, has been partially surveyed by a few widespread traverses or pairs of traverses.

Because the shears and fractures acted as channels for the mineral-bearing solutions and deposits of both sulphides and quartz, the comparative importance of the TT anomalies can be founded on their nearness to Turam anomalies. From this point of view, the following is a list of promising TT anomalies:

6N/18.6W	74N/18.9W	94N/16.6W	102N/8.9W
6N/12.0W	76N/19.0W	94N/15.0W	104N/12.9W
8N/19.2W	76N/17.4E	96N/17.6W	106N/13.0W
8N/13.1W	94N/19.6W	96N/14.3W	120N/5.0W
22N/18.0E	94N/17.8W	100N/18.1W	

5. CONCLUSIONS AND RECOMMENDATIONS FOR TESTING

Owing to the heterogeneous geological conditions (quartz reefs, greywacke, and silicified greywacke interbedded in slate), varying depth to the ground water table, and irregular content of saline water, the conductivity of the ground in the Union Reefs area varies from place to place. Both the Turam and the TT surveys were influenced by these circumstances. Many anomalies were obtained.

The influence from possible larger orebodies at greater depth cannot be discerned. Some of the Turam anomalies possibly originate from small, shallow depositions of sulphides.

To verify the anomalies, twenty drill holes have been recommended (see Appendix D). The eight Turam anomalies listed above are additional drilling targets with reference to the Turam survey. As to the suggested TT drill holes, only two of them, No. 1 and No. 8, are applicable to checking TT anomalies near the eight Turam anomalies listed above.

Before results from the first drill holes, drilled to verify geophysical anomalies, have been obtained, it is impossible to give preference to anomalies of any particular type. To check the strong Turam anomalies on Traverses 120 and 122, a costean is recommended.

6. ACKNOWLEDGEMENTS

It is desired to express appreciation to the staff of the Bureau of Mineral Resources for providing the maps and reports used as a basis for the present report, and in particular to Mr. J. Horvath, who also advised on the performance of the field work.

It is also a pleasure to thank Mr. J.J. Masur, Managing Director of J.J. Masur & Co. Pty Ltd, and the surveyor, Mr. J. Jackson, for their willing collaboration and attention to the needs of the party.

Stockholm, 11th March, 1964.

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7. REFERENCES

BMR	1964	McArthur River electromagnetic survey, Northern Territory 1963. *Bur. Min. Resour. Aust. Rec.* 1964/159 (unpubl.).
HOSSFELD, P.S.	1936	The Union Reefs goldfield. *Aer. Surv. N. Aust., NT Rep.* 2

APPENDIX A

A list of stronger Turam anomalies

Plate	Traverse	Co-ordinate	Ratio	Phase difference	Magnitude sequence
2 A	0 N	11.1 W	1.10	-7.0	
		13.25W	1.11	-5.1	
		15.4 W	1.12	-8.5	
		19.75W	0.92	+6.5	
	2 N	7.25W	1.16	-8.3	28
		9.1 W	1.13	-8.1	
		10.8 W	1.17	-10.4	13
		15.3 W	1.09	-5.7	
		17.7 W	1.08	-7.2	
		19.3 W	0.89	+7.2	
	4 N	6.3 W	1.14	-7.4	
		7.75W	1.16	-8.3	29
		8.75W	1.11	-6.1	
		11.1 W	1.16	-12.2	9
		16.25W	1.09	-6.5	
	6 N	6.1 W	1.12	-6.1	
		7.75W	1.13	-6.4	
		8.9 W	1.14	-7.8	
		10.5 W	1.15	-8.6	30
		12.0 W	0.89	+13.3	16
		16.2 W	1.14	-10.2	21
	8 N	6.2 W	1.12	-6.0	
		8.8 W	1.14	-7.8	
		10.8 W	1.16	-12.2	8
		13.2 W	0.95	+5.3	
		15.9 W	1.17	-10.5	12
	10 N	3.7 W	1.07	-6.9	
		6.3 W	1.11	-7.8	
		9.0 W	1.11	-7.0	
		11.0 W	1.28	-17.7	3
		16.3 W	1.09	-6.8	
	12 N	6.5 W	1.09	-5.0	
		11.7 W	1.09	-7.9	
		15.75W	1.09	-6.5	
		18.3 W	1.05	-5.7	
	14 N	6.7 W	1.10	-7.2	
		10.4 W	1.14	-10.8	18
		15.25W	1.14	-10.2	20
		18.1 W	1.04	-5.7	
	16 N	10.75W	1.18	-12.5	4
	18 N	7.25W	1.10	- 6.8	
		9.25W	1.14	-8.7	
		10.75W	1.10	-8.2	
	20 N	6.1 W	1.10	-7.5	
		7.25W	1.10	-7.9	
		15.25W	1.05	-5.3	
	22 N	2.75W	1.05	-5.4	
		6.0 W	1.08	-5.3	
		8.75W	1.09	-5.9	
	24 N	9.75W	1.09	-5.5	
3 A	26 N	6.2 W	1.10	-5.3	
		7.25W	1.11	-5.8	
		21.25W	0.94	+5.7	
	30 N	2.75W	1.04	-5.7	
		6.1 W	1.07	-6.0	
		8.4 W	1.06	-6.0	
	32 N	2.75W	1.07	-6.0	
		13.5 W	1.12	-4.2	
	34 N	7.25W	1.10	-4.8	
	38 N	8.75W	1.10	-6.1	

Plate	Traverse	Co-ordinate	Ratio	Phase difference	Magnitude sequence
3 A	40 N	3.75W	1.05	-5.2	
		8.75W	1.11	-6.8	
	42 N	4.25W	1.05	-5.7	
	46 N	3.75W	1.07	-5.6	
		9.25W	1.14	-7.9	
	48 N	9.25W	1.12	-8.0	
		20.8 W	1.09	-5.4	
		21.75W	1.19	-10.2	10
	50 N	5.2 W	1.15	-9.2	25
		8.25W	1.10	-5.3	
		19.8 W	1.10	-5.3	
		21.25W	1.17	-9.2	19
4 A	52 N	19.25W	1.13	-7.3	
		20.4 W	1.14	-8.7	
	54 N	5.7 W	1.09	-5.3	
		20.2 W	1.21	-8.2	17
	56 N	19.7 W	1.21	-10.2	7
		21.25W	1.11	-5.4	
	58 N	6.75W	1.15	-4.6	
		15.7 W	1.10	-3.5	
	60 N	7.1 W	1.13	-5.6	
		15.5 W	1.11	-5.5	
		20.75W	1.20	-8.8	15
	62 N	7.4 W	1.10	-5.0	
		15.75W	1.16	-8.9	23
		20.2 W	1.16	-10.8	14
	64 N	4.75W	1.04	-9.6	
		7.1 W	1.06	-8.2	
		14.7 W	1.10	-7.5	
		18.75W	1.08	-6.4	
		19.8 W	1.08	-7.5	
	66 N	4.75W	1.10	-8.2	
		14.25W	1.07	-5.7	
		20.25W	1.08	-5.7	
	68 N	4.75W	1.07	-8.0	
		15.7 W	1.13	-7.8	
		19.25W	1.18	-10.6	11
	70 N	15.25W	1.07	-5.2	
		19.25W	1.14	-9.9	24
		21.2 W	1.07	-6.9	
	74 N	11.2 W	1.07	-5.7	
		19.25W	1.07	-6.5	
	76 N	10.75W	1.06	-5.8	
		19.2 W	1.07	-5.7	
5 A	78 N	17.25W	1.08	-5.8	
		19.75W	1.09	-6.1	
	80 N	4.6 W	1.04	-5.0	
		20.75W	1.10	-5.2	
	86 N	19.0 W	1.10	-4.0	
	92 N	20.3 W	1.12	-5.9	
	94 N	10.2 W	1.10	-5.8	
		13.25W	1.17	-8.0	26
		21.25W	1.13	-6.6	
	96 N	10.1 W	1.08	-4.8	
		13.25W	1.13	-6.2	
		16.25W	1.12	-5.4	
		17.75W	1.12	-5.6	
		20.25W	1.18	-7.3	27
	98 N	9.5 W	1.12	-5.7	
		13.25W	1.12	-6.0	

Plate	Traverse	Co-ordinate	Ratio	Phase difference	Magnitude sequence
5 A	100 N	13.25W	1.08	-5.0	
	102 N	12.75W	1.07	-5.2	
6 A	124 N	19.25W	1.12	-4.1	
		20.25W	1.15	-5.1	
	126 N	18.25W	1.14	-5.5	
	130 N	21.25W	1.15	-7.0	
7 A	6 N	9.2 E	1.13	-7.1	
		13.75E	1.09	-6.1	
		18.75E	1.14	-10.0	22
	22 N	17.9 E	0.86	+6.9	
		20.0 E	1.15	-7.9	
	24 N	4.75E	1.08	-5.4	
		19.6 E	1.12	-6.3	
	94 N	~20 E	> 1.17	< -11.7	6
	96 N	19.2 E	1.19	-11.6	5
	120 N	18.25E	1.37	-25.5	1
	122 N	17.4 E	1.44	-13.5	2
		20.6 E	0.97	+5.9	

APPENDIX B

A list of stronger TT anomalies

Plate	Traverse	Co-ordinate	Plate	Traverse	Co-ordinate
8	6 N	9.3 W	9	108 N	6.2 W
		12.0 W			13.3 W
		17.2 W			16.2 W
		19.7 W			17.3 W
	8 N	12.1 W		110 N	13.3 W
		13.1 W			17.1 W
		17.2 W		112 N	12.3 W
		19.3 W			14.7 W
	22 N	10.9 W		114 N	11.2 W
		13.9 W			12.7 W
		15.8 W			15.8 W
	24 N	9.1 W		116 N	16.2 W
		15.7 W		118 N	5.8 W
		17.1 W			10.7 W
					12.3 W
	74 N	5.8 W			13.7 W
		8.8 W			19.3 W
		10.2 W		120 N	11.8 W
		17.6 W			14.2 W
	76 N	5.6 W			17.3 W
		9.8 W			19.7 W
		12.1 W			
		17.6 W	8	22 N	18.0 E
				24 N	4.2 E
9	94 N	8.0 W			18.5 E
		11.4 W		74 N	4.8 E
		14.8 W			9.2 E
		19.3 W			10.7 E
	96 N	11.5 W			12.8 E
		14.3 W			15.3 E
		15.7 W		76 N	13.7 E
		19.4 W		96 N	4.3 E
	98 W	6.7 W			6.7 E
		11.2 W			14.2 E
		13.9 W			16.7 E
		15.3 W			
		19.3 W			
	100 N	18.0 W			
		19.3 W			
	102 N	6.5 W			
		13.8 W			
		18.2 W			
	104 N	9.8 W			
		13.8 W			
		16.2 W			
	106 N	13.7 W			
		15.5 W			
		17.8 W			

APPENDIX C

A list of plates accompanying the ABEM report

Plate 1	Plan of Union Reefs area, Pine Creek, N.T. Axes of electrical conductors located by Turam Survey	(Drawing No.D52/B7-109)
1a	Plan of Union Reefs area, Pine Creek, N.T. Axes of poor electrical conductors located by TT Survey	(D52/B7-110)
2A	Profiles of Turam ratio and phase difference Traverses 0 - 24	(D52/B7-111)
2B	Contours of Turam ratio Traverses 0 - 24	(D52/B7-117)
2C	Contours of Turam phase difference Traverses 0 - 24	(D52/B7-123)
3A	Profiles of Turam ratio and phase difference Traverses 26 - 50	(D52/B7-112)
3B	Contours of Turam ratio Traverses 26 - 50	(D52/B7-118)
3C	Contours of Turam phase difference Traverses 26 - 50	(D52/B7-124)
4A	Profiles of Turam ratio and phase difference Traverses 52 - 76	(D52/B7-113)
4B	Contours of Turam ratio Traverses 52 - 76	(D52/B7-119)
4C	Contours of Turam phase difference Traverses 52 - 76	(D52/B7-125)
5A	Profiles of Turam ratio and phase difference Traverses 78 - 102	(D52/B7-114)
5B	Contours of Turam ratio Traverses 78 - 102	(D52/B7-120)
5C	Contours of Turam phase difference Traverses 78 - 102	(D52/B7-126)
6A	Profiles of Turam ratio and phase difference Traverses 104 - 130	(D52/B7-115)
6B	Contours of Turam ratio Traverses 104 - 130	(D52/B7-121)
6C	Contours of Turam phase difference Traverses 104 - 130	(D52/B7-127)

Plate 7A	Profiles of Turam ratio and phase difference Eastern traverses 6, 22, 24, 74, 76, 94, 96 120, 122	(D52/B7-116)
7B	Contours of Turam ratio Eastern traverses 6, 22, 24, 74, 76, 94, 96 120, 122	(D52/B7-122)
7C	Contours of Turam phase difference Eastern traverses 6, 22, 24, 74, 76, 94, 96 120, 122	(D52/B7-128)
8	TT survey. Profiles of potential gradient plotted on logarithmic scale and profiles of phase difference. Western traverses 6, 8, 22, 24, 74, 76, 94-120	(D52/B7-129)
9	TT survey. Profiles of potential gradient plotted on logarithmic scale and profiles of phase difference. Eastern traverses 22, 24, 74, 76, 96.	(D52/B7-130)

APPENDIX D

Details for recommended drill holes

In the lists below the co-ordinates indicates the approximate positions of the upper edge of expected sulphide bodies and quartz reefs respectively. The approximate depths for the conductors have also been listed.

A. Drill holes to check conductors indicated by Turam anomalies

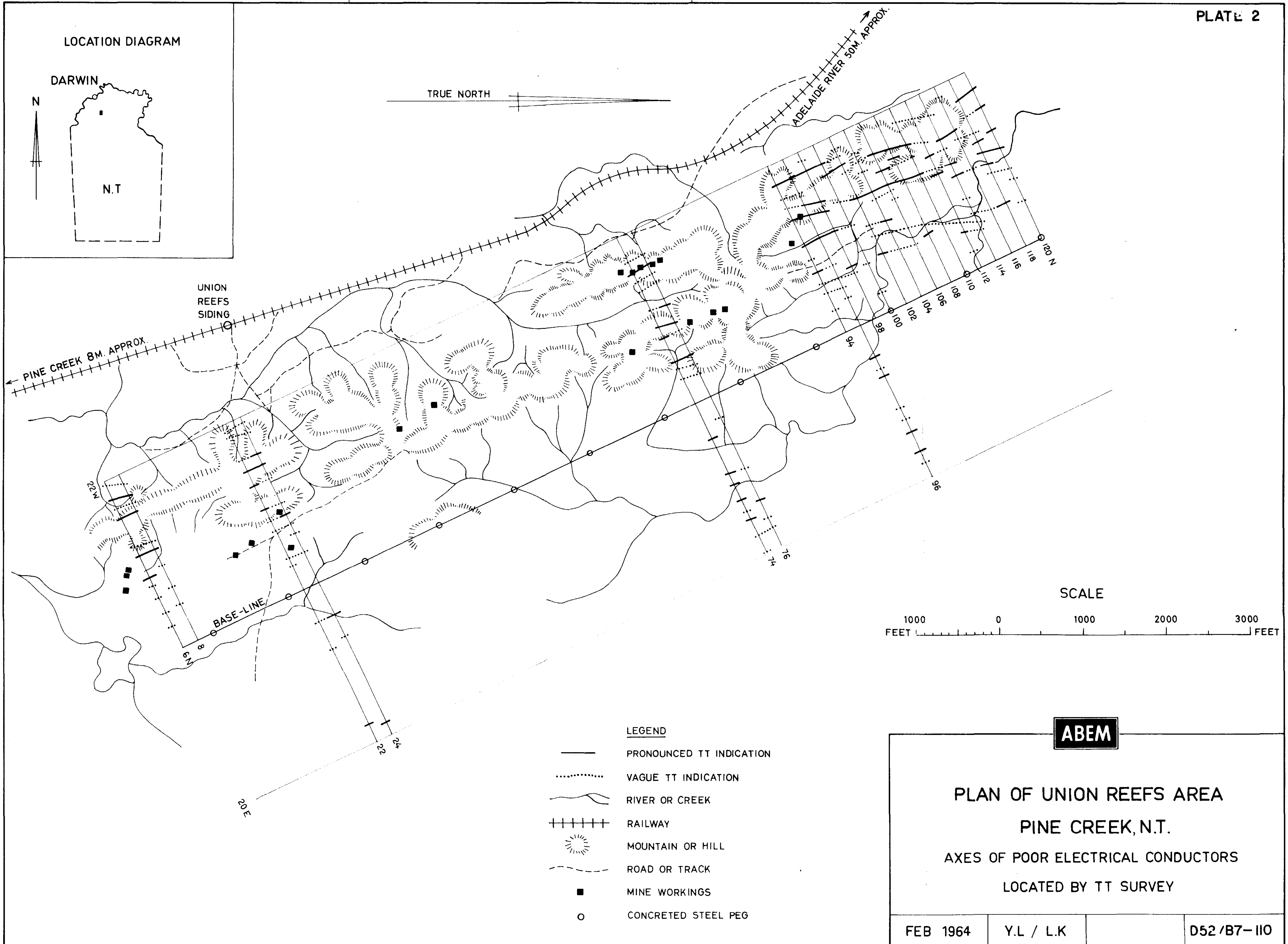
No.	Co-ordinates	Depth	No.	Co-ordinates	Depth
1.	3.0N/10.9W	90'	6.	55.5N/19.8W	70'
2.	7.5N/16.0W	80'	7.	61.0N/20.4W	80'
3.	10.0N/11.0W	100'	8.	62.0N/15.7W	60'
4.	18.0N/9.3W	50'	9.	68.0N/15.7W	110'
5.	50.0N/5.2W	70'	10.	69.0N/19.3W	70'

B. Drill holes to check non-conductors indicated by TT anomalies

No.	Co-ordinates	No.	Co-ordinates
1.	6N/12W	6.	74N/17.6W
2.	6N/17.2W	7.	96N/11.5W
3.	22N/10.9W	8.	96N/14.3W
4.	24N/15.7W	9.	98N/19.3W
5.	74N/8.8W	10.	102N/13.8W

TO ACCOMPANY RECORD 1965/74

PLATE 2



ABEM

PLAN OF UNION REEFS AREA

PINE CREEK, N.T.

AXES OF POOR ELECTRICAL CONDUCTORS

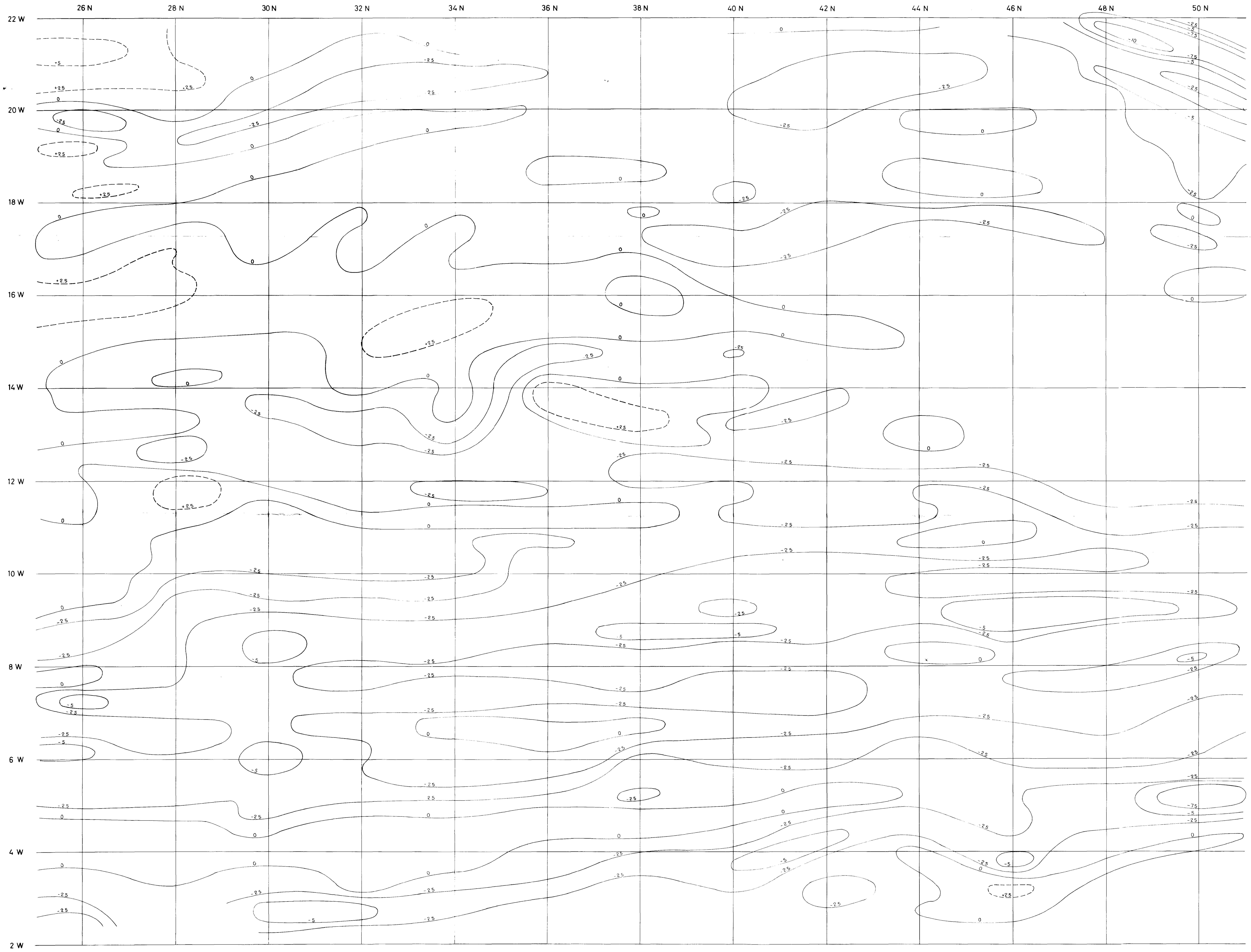
LOCATED BY TT SURVEY

FEB 1964	Y.L / L.K		D52/B7-110

TO ACCOMPANY RECORD No. 1965/74

PLATE 3

TO ACCOMPANY RECORD No. 1965/74



LEGEND:

CONTOURS OF TURAM PHASE DIFFERENCE -2°5, 0° AND +2°5

TRUE NORTH

SCALE

FEET 100 0 100 200 300 FEET

ABEM

UNION REEFS AREA

PINE CREEK, N.T.

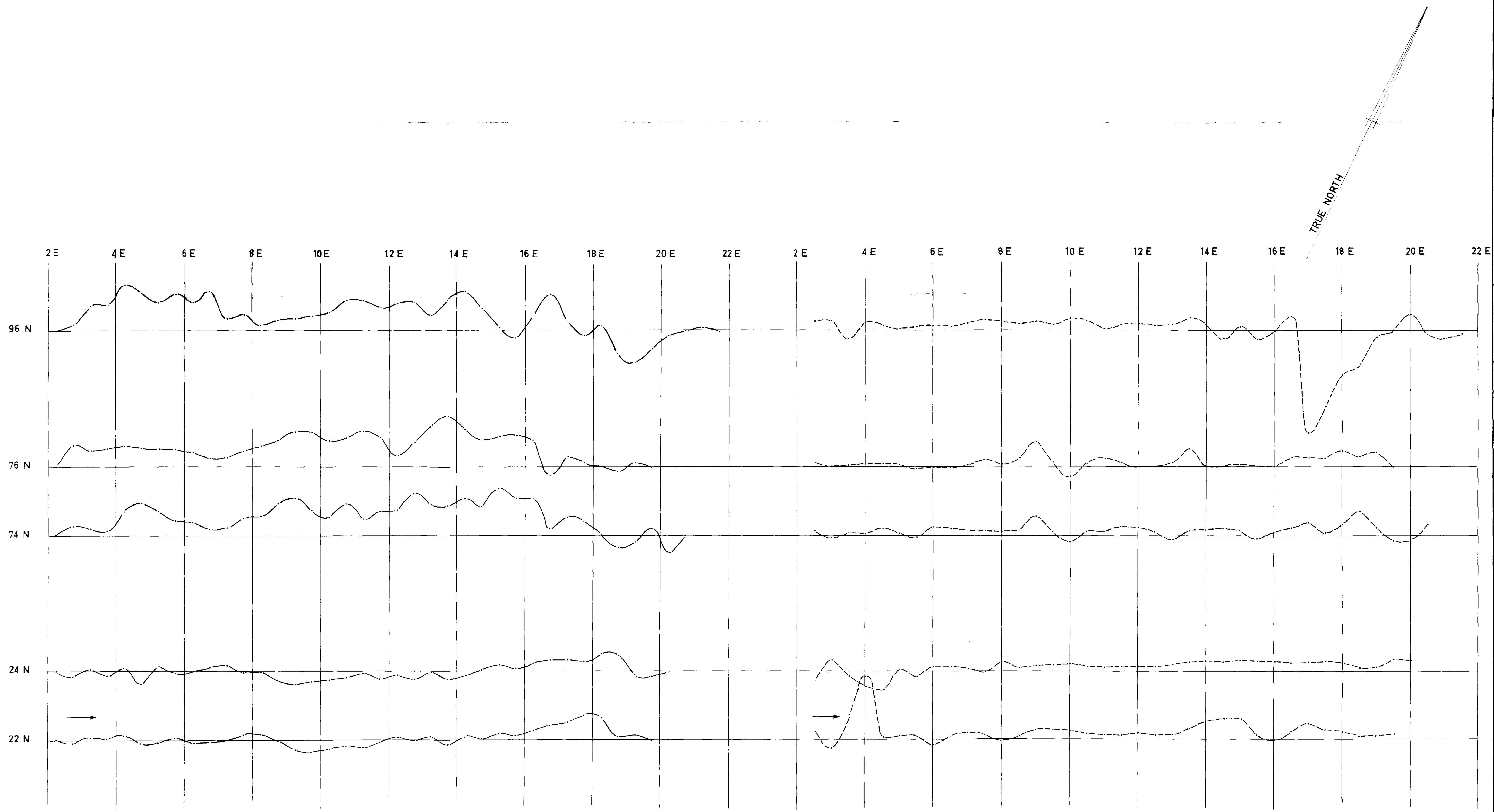
CONTOURS OF TURAM PHASE DIFFERENCE

TRAVERSES 26-50

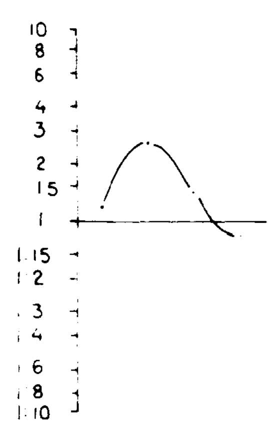
FEB 1964	Y.L / D.S L.K		D52/B7-124

TO ACCOMPANY RECORD No. 1965/74

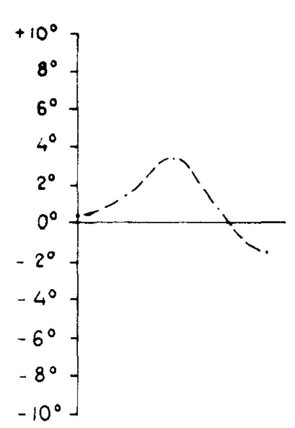
PLATE 5



LEGEND:



POTENTIAL GRADIENT PLOTTED ON LOGARITHMIC SCALE



PHASE DIFFERENCE AT 50FT. ELECTRODE SPACING SURVEYED AT 50FT. INTERVALS

→ DIRECTION OF SURVEY

SCALE

FEET 200 0 200 400 600 FEET

BEM

UNION REEFS AREA

PINE CREEK, N.T.

TT SURVEY. PROFILES OF POTENTIAL GRADIENT PLOTTED ON LOGARITHMIC SCALE AND PROFILES OF PHASE DIFFERENCE

EASTERN TRAVERSES 22, 24, 74, 76, 96

FEB 1964	Y.L / D.S L.K		D52/B7-130