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

RECORDS 1952 No. 71

INTERIM REPORT

GEOPHYSICAL INVESTIGATION OF THE COPPER-NICKEL DEPOSITS, NORTH DUNDAS FIELD, NEAR ZEEHAN, TASMANIA

by

O. KEUNECKE

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C O N T E N T S

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ILLUSTRATIONS

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INTERIM REPORT

GEOPHYSICAL INVESTIGATIONS OF THE COPPER-NICKEL DEPOSITS, NORTH DUNDAS FIELD, NEAR ZEEHAN, TASMANIA.

I. INTRODUCTION.

The Bureau of Mineral Resources has commenced a geophysical investigation of the copper-nickel deposits in the Five-Mile district near Zeehan at the request of the Tasmanian Department of Mines, Hobart.

The copper-nickel field is situated about five miles to the north-east of Zeehan and is reached by branching off the road from Zeehan to Renison Bell (Plate 1).

Prospecting and mining have been carried out in this area at intervals during the past sixty years. This has shown that high-grade copper-nickel ore occurs in an area about 1½ miles long by approximately 1,000 feet wide.

Geophysical work was carried out in the northern part of the area by the Imperial Geophysical Experimental Survey in 1929-30. The results were reported by Edge and Laby (1931). The survey obtained indications and some of these were subsequently proved by drilling to be caused by rich copper-nickel ore.

The Department of Mines, Tasmania, in its Summary Report (1952) has indicated the possibility that further ore-bodies of economic value exist in the area. Therefore, the Bureau was asked to carry out a geophysical investigation of the whole area. The Department of Mines laid out the lines including cutting and pegging the traverses. The area is mainly flat and swampy. The portion south of the Vaudeau shaft is fairly open and only partly covered with bush but the area north of it is covered with thick bush. The work of laying out the traverses through this thick bush was very greatly helped by the use of a bulldozer supplied by Eagle Metal & Industrial Products Pty. Ltd.

The geophysical survey was begun in May, 1952, with a programme including self-potential, magnetic and electro-magnetic measurements. The members of the field party were Dr. O. Keunecke and Mr. P. B. Tenni. Surveying commenced near the old Vaudeau shaft in the southern portion of the area.

Because of bad weather it was necessary to discontinue the survey in June, 1952. Up to that time, self-potential measurements had been made along 22 traverses, covering 2,100 feet along the baseline and magnetic measurements along 15 traverses. No electro-magnetic measurements had been made. The survey is, therefore, as yet incomplete even over the southern portion of the area covered so far.

However, it is expected that mining exploration will be taken up again soon in the copper-nickel district. Therefore, this interim report has been prepared to present the geophysical results obtained to date and to discuss their significance. The interpretation of the results is necessarily restricted by the lack of electro-magnetic measurements. Such measurements have been found by experience to give the best indications in the case of sulphide mineralization of the type believed to exist in the copper-nickel district.

2. GEOLOGY

The area consists of a series of Cambrian slates and breccias of purple, grey, green and black types. These rocks are intruded by four or more basic dykes striking north. These dykes consist of pyroxenite, norite and gabbro and have a width ranging from approximately 10 feet to 50 feet. At the surface the dykes dip fairly steeply to the east but at a depth of about 100 feet the dip is found to have decreased to about 45°.

Copper-nickel mineralization is known to be closely associated with one of these basic dykes. The ore, which has been mined at several places extending over a length of more than 1½ miles, was found either on the footwall of the dyke or within it.

The ore is massive and consists of pyrite, pyrrhotite, pentlandite and chalcopyrite. It has been oxidised at the surface to limonite and nickel and copper carbonates. It is stated in the Report (1952) of the Tasmanian Mines Department, that the ore at a depth of about 100 feet has been replaced by cellular quartz. The very limited extent of the old workings in the area shows that the copper-nickel ore occurs only intermittently along the strike, that it does not persist to any great depth and that the copper-nickel orebodies found so far have been small. Although the ore appears to occur only in small pockets its average metal content is reported to have been 5-6% copper and 9-12% nickel. Besides the copper-nickel ore, there is galena mineralization of minor importance associated with quartz veins in the slates.

3. GEOPHYSICAL METHODS

The baseline was first laid out along the western boundary of the area to be surveyed. Its bearing is 172° magnetic. The traverses, which lie at right angles to the baseline, are each 1,000 feet long and are at intervals of 100 feet. Three short traverses, HCA, HDA and HEA were added subsequently in order to give a better delineation of an anomaly in the south-west corner. Observation points were spaced 25 feet apart on all traverses.

The survey was started using both self-potential and magnetic measurements. The self-potential method reveals anomalies where sulphide mineralization is present extending to ground-water level, thus giving rise to chemical reactions. As a result of these reactions, electrical currents are set up producing potential differences which can be measured. These measurements may show a negative centre of as much as several hundred millivolts over an oxidised sulphide body. However, since pyritized fault and shear zones, graphitic slates, etc., can cause anomalies of the same order, the interpretation of self-potential anomalies has to be made very carefully particularly where no other type of electrical measurements has been carried out.

Magnetic measurements, using the vertical magnetometer, are used in the search for magnetic ore such as magnetite, pyrrhotite, ilmenite, etc. Also, the method may be used to investigate the general distribution of rock types in an area particularly if igneous rocks are present. These rocks are often more magnetic than sediments and within the igneous group the more basic types usually have a greater magnetic effect than the more acid ones. Therefore, a magnetic survey can give very useful information.

4. RESULTS AND INTERPRETATION

(a) Self-potential Results.

The results of the self-potential survey have been plotted and are shown as profiles on Plate 2. These results have been combined to produce the contour map of Plate 3 showing contour lines of equal potential. Each profile shows the change of potential from point to point along a given traverse and some of these indicate disturbances. The contours show the extent and strike of each anomaly.

The contour map reveals several anomalies with negative centres ranging from 100 to 200 millivolts. The anomalies in the southern portion of the area occur mainly in the west, whereas further north they occur mainly in the eastern portion of the area.

The anomalies are not uniform in strike or shape. It can be presumed, therefore, that they are produced by different geological features. In the self-potential profiles two main types of indication can be noticed. One has quite a strong and distinct character and the other is rather weak. From such geological evidence as is available, it would seem that the strong anomalies may be associated with sulphide mineralization or pyritized fault or shear zones whereas the weak anomalies seem to be associated with copper-nickel mineralization.

As previously mentioned, self-potential anomalies are obtained if sulphide mineralization reaches the ground-water level and oxidation has taken place. The fact that no distinct anomalies appear near the known old workings does not necessarily mean that no further copper-nickel mineralization exists there. It indicates only that there is no oxidised ore present. All the oxidised ore originally present may have been removed by mining. Also, it is possible that the ground-water level was temporarily lowered in the old workings during mining operations. The level would then have risen again after mining ceased and would have covered the remaining ore thus preventing further oxidation. In this case no anomaly would be expected.

This all means that the results of the self-potential measurements alone, taken in conjunction with the known geology, are indeterminate. In order to determine more conclusively whether or not further copper-nickel ore exists, it will be necessary also to make electro-magnetic observations as originally planned.

The copper-nickel ore is associated with one of the basic dykes in the area as is shown in the old workings and in the Vaudeau shaft. However, nothing is known regarding the possible continuation of the dyke to the north and south of the mine workings. This is important because a well defined self-potential anomaly with a northerly strike is found on traverses F, G and H on a line which is approximately a southerly extension from the Vaudeau shaft. It seems possible that the basic dyke extends this far south and that the anomaly is therefore due to copper-nickel mineralization. The fairly uniform shape and very steep potential gradient of this indication shows that it is of local character and lies close to the surface. Also, the uniform shape indicates that the body producing the anomaly has a nearly vertical attitude. This does not correspond with the general tendency of the copper-nickel bodies in the area to have an easterly dip. Therefore it is not certain that this anomaly is caused by copper-nickel ore. Trenching along traverse G should help to determine its cause.

Another anomaly of local extent, showing a steep potential gradient, traverses the south-western part of the area. It has been observed on traverses HC to HF. Its most noticeable feature is that it has a north-westerly strike, whereas the known copper-nickel mineralization in the area is associated only with dykes having a northerly strike. This anomaly might therefore be due to quite a different cause. It seems probable that there exists a fault system with a north-westerly strike and that this has become pyritized, thereby giving rise to the anomaly. The area in which the anomaly has been found has so far received little attention from prospectors and there is, therefore, little surface exposure of the geology which might assist in the interpretation of the geophysical result. However, since the potential gradients are steep, the body giving rise to the anomaly is probably shallow. It should therefore be possible by trenching to determine the cause.

The largest zone of self-potential disturbance is in the eastern portion of the area surveyed. This zone shows first on traverse F and continues northward over a distance of more than 1,000 feet to traverse Q which is the northern limit of the present survey. The zone shows several separate small minima most of which have steep potential gradients (see Plate 2). Here again, it would appear that the mineralization giving rise to the anomalies is at shallow depth. However, it is not possible to give a clear indication of the nature of the mineralization. The anomalous zone does not appear to have any relation to the known copper-nickel mineralization. The old workings include some trenching between H.800 and N.800 but this does not throw any light on the structure. It seems possible that there is another basic dyke, not previously detected, that traverses the eastern portion of the area and that mineralization is associated with it. However, as previously mentioned, the known copper-nickel mineralization shows up only very weakly on the self-potential results. Therefore, it seems unlikely that the distinct anomalies of this extended zone are caused by copper-nickel deposits but rather that they may be due to some other mineralization such as a pyritized shear zone. The fact that the anomaly consists of several separate small minima of different strike makes it more likely that these are due to a pyritized shear zone in the country rock. Some trenching is recommended to determine the cause of the anomalies and this should be done on traverses E, K or Q.

(b) Magnetic Results.

A satisfactory interpretation of the magnetic results is not possible. A few sample magnetic profiles are shown in Plate 4. From these it can be seen that there are no magnetic anomalies of any significance. It is often possible to locate basic dykes by a magnetic survey because many dykes show magnetic effects. However, the results indicate that in the copper-nickel district this is not the case. Measurements carried out by the I.G.E.S. in 1929 (Edge and Laby, 1931) in the northern part of this area also showed that the basic dykes there showed no magnetic effect.

The bore results given in the Summary Report (1952) show that at least four easterly-dipping dykes traverse the area being surveyed. These run more or less parallel with a northerly strike. Small magnetic anomalies, at least, might have been expected where the dykes crop out. Since no magnetic anomalies have been observed it follows that the dykes are of a non-magnetic character or else that they have lost their magnetization through the decomposition that is observed to have taken place to some considerable depth. In one of the old workings it was noted that the dyke had been completely decomposed to a depth of 70 feet.

5. SUMMARY

A start has been made on a geophysical investigation of the copper-nickel district of North Dundas situated 5 miles north-east of Zeehan, Tasmania. Only part of the self-potential and magnetic measurements had been completed when the survey had to be discontinued because of unsuitable weather.

The self-potential measurements indicate several anomalies. These anomalies differ in extent and strike but all show steep potential gradients indicating that the cause of the disturbance lies close to the surface.

It is not possible, on the basis of the self-potential results alone, to say whether or not the anomalies are due to the presence of copper-nickel deposits. Since those portions of the area in which copper-nickel ore is known to occur, in association with a basic dyke, show up only as very weak anomalies, it is probable that the definite anomalies obtained are due to some other cause than copper-nickel mineralization.

The exact nature of the bodies causing the observed anomalies may possibly be determined by trenching. The question of whether or not there are further unknown deposits of copper-nickel ore in the area can most probably be settled by electro-magnetic measurements.

Magnetic measurements made over portion of the area did not yield any results that could be used to determine the position of basic dykes.

6. RECOMMENDATIONS

Additional geophysical work in the area, particularly to the north of the present survey, should be carried out. This should consist principally of electro-magnetic measurements which offer the best chance of locating copper-nickel mineralization. This work could not profitably be attempted until after the end of the rainy season.

In the meantime, trenching could be carried out to determine the type of mineralization causing the main anomalies revealed by the self-potential survey. This type of work is not expensive and it would be particularly helpful to have it done before the electro-magnetic work is begun.

The principal anomalies could be tested by trenching carried out along the following traverse lines :-

Traverse	HC_A	between	pegs	100	and	250
"	G	"	"	400	"	500
"	E	"	"	700	"	800
"	K	"	"	925	"	975
"	O	"	"	850	"	950
"	Q	"	"	850	"	950

7. REFERENCES

D.M.T. (1952) - Summary Report on the Copper-Nickel Deposits of the Five-Mile District, Zeehan. Unpublished Report, Department of Mines, Tasmania.

Edge, A. B., and Laby, T. H. (1931) - The Principles and Practice of Geophysical Prospecting, Imperial Geophysical Experimental Survey, Camb. Univ. Press, London, pp. 84-90.

(O. Keumecke)
Geophysicist.

Melbourne,
September, 1952.

Distribution :

Original - Library (File 50T/4B).
1st copy - Chief Geologist.
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6th " - " "

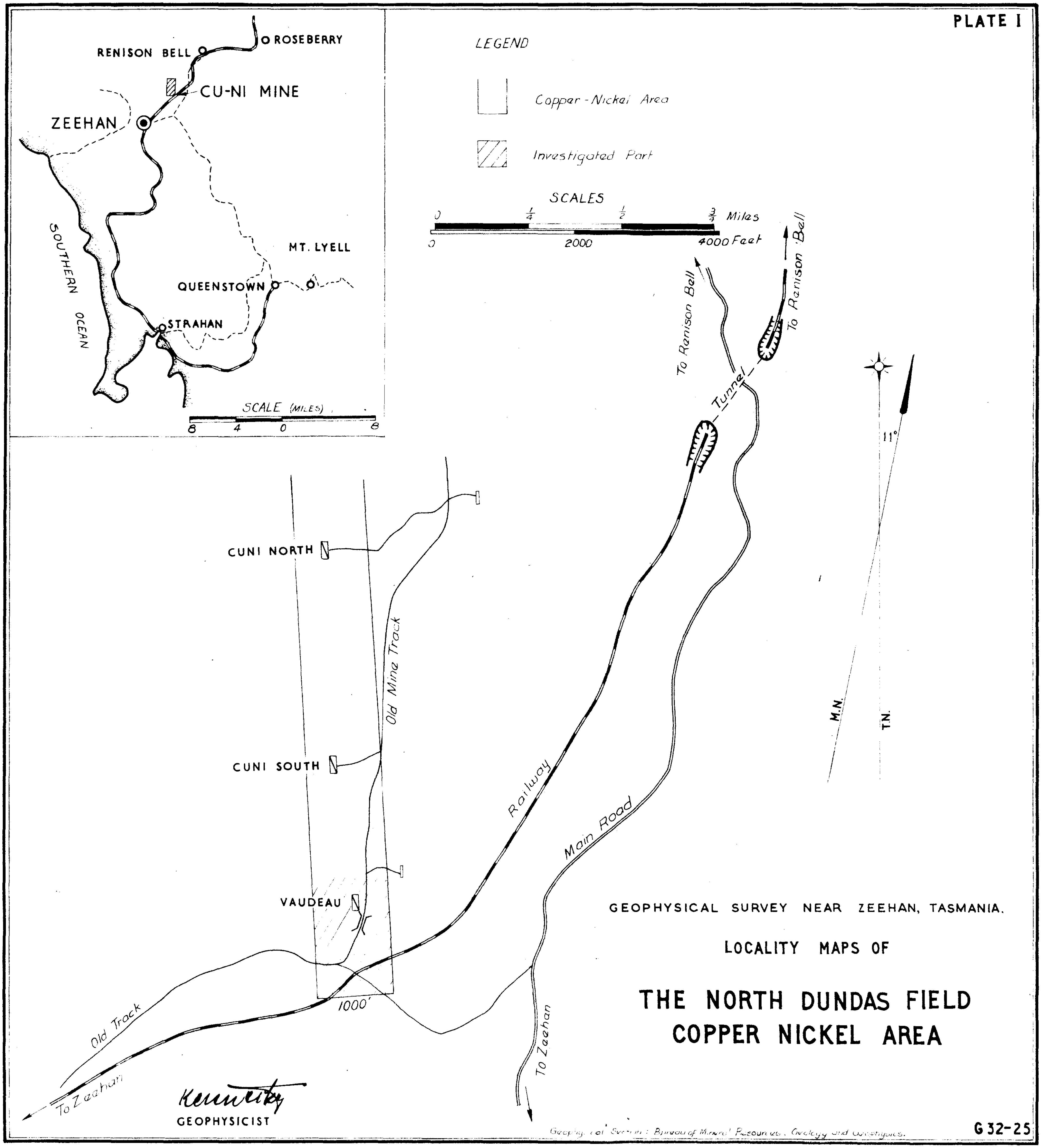
PLATE I
RENISON BELL
ROSEBERRY
CU-NI MINE
ZEEHAN
SOUTHERN OCEAN
MT. LYELL
QUEENSTOWN
STRAHAN
SCALE (MILES)
8 4 0 8
LEGEND
Copper-Nickel Area
Investigated Part
SCALES
0 1/4 1/2 3/4 Miles
0 2000 4000 Feet
To Renison Bell
To Renison Bell
Tunnel
11°
M.N.
T.N.
CUNI NORTH
CUNI SOUTH
VAUDEAU
Old Mine Track
Railway
Main Road
Old Track
To Zeehan
To Zeehan
1000'
GEOPHYSICAL SURVEY NEAR ZEEHAN, TASMANIA.
LOCALITY MAPS OF
THE NORTH DUNDAS FIELD
COPPER NICKEL AREA
GEOPHYSICIST
Geophysical Section: Bureau of Mineral Resources, Geology and Geophysics.
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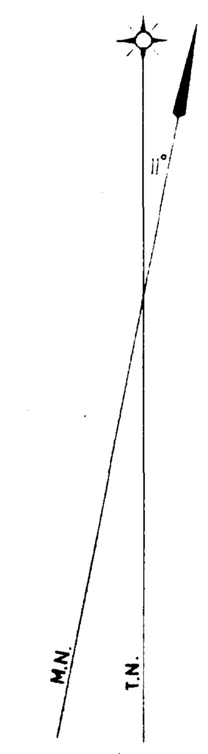


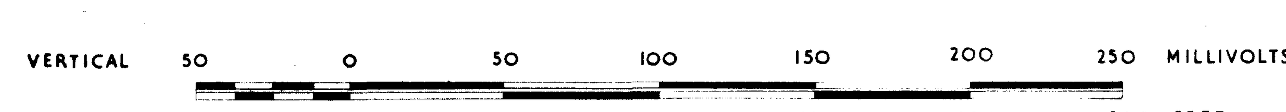
GEOPHYSICAL SURVEY NEAR ZEEHAN, TASMANIA.

THE NORTH DUNDAS FIELD COPPER - NICKEL AREA

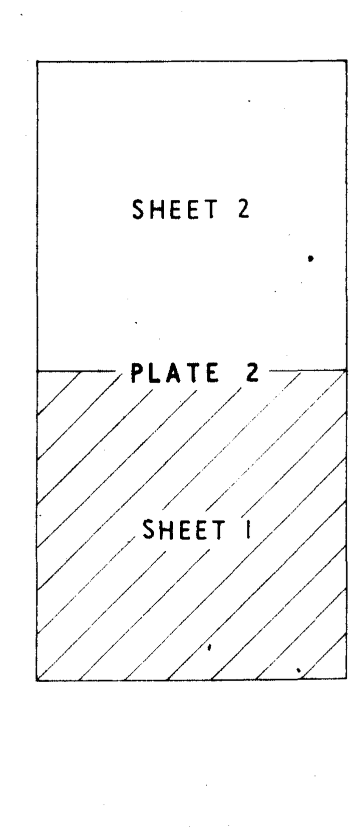
SELF POTENTIAL PROFILES

Kennedy
GEOPHYSICIST

SCALES



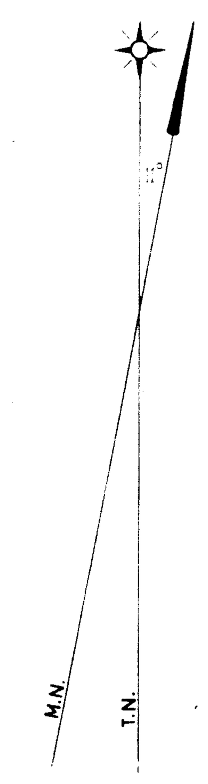
TRAVERSE SEPARATION SCALE 50 FEET TO 1 INCH



INDEX TO SHEETS

Geophysical Section: Bureau of Mineral Resources, Geology and Geophysics.

PLATE 2
SHEET 2



GEOPHYSICAL SURVEY NEAR ZEEHAN TASMANIA

THE NORTH DUNDAS FIELD COPPER-NICKEL AREA

SELF – POTENTIAL PROFILES

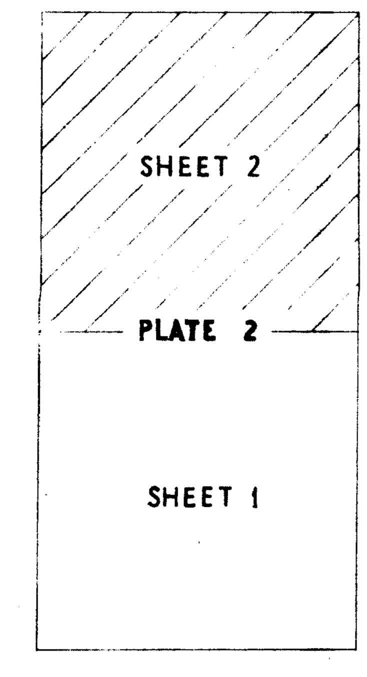
GEOPHYSICIST

SCALE

VERTICAL	50	0	50	100	150	200	250 MILLIVOLTS
HORIZONTAL	100	0	100	200	300	400	500 FEET

TRAVERSE SEPARATION SCALE 50 FEET TO 1 INCH

INDEX TO SHEETS

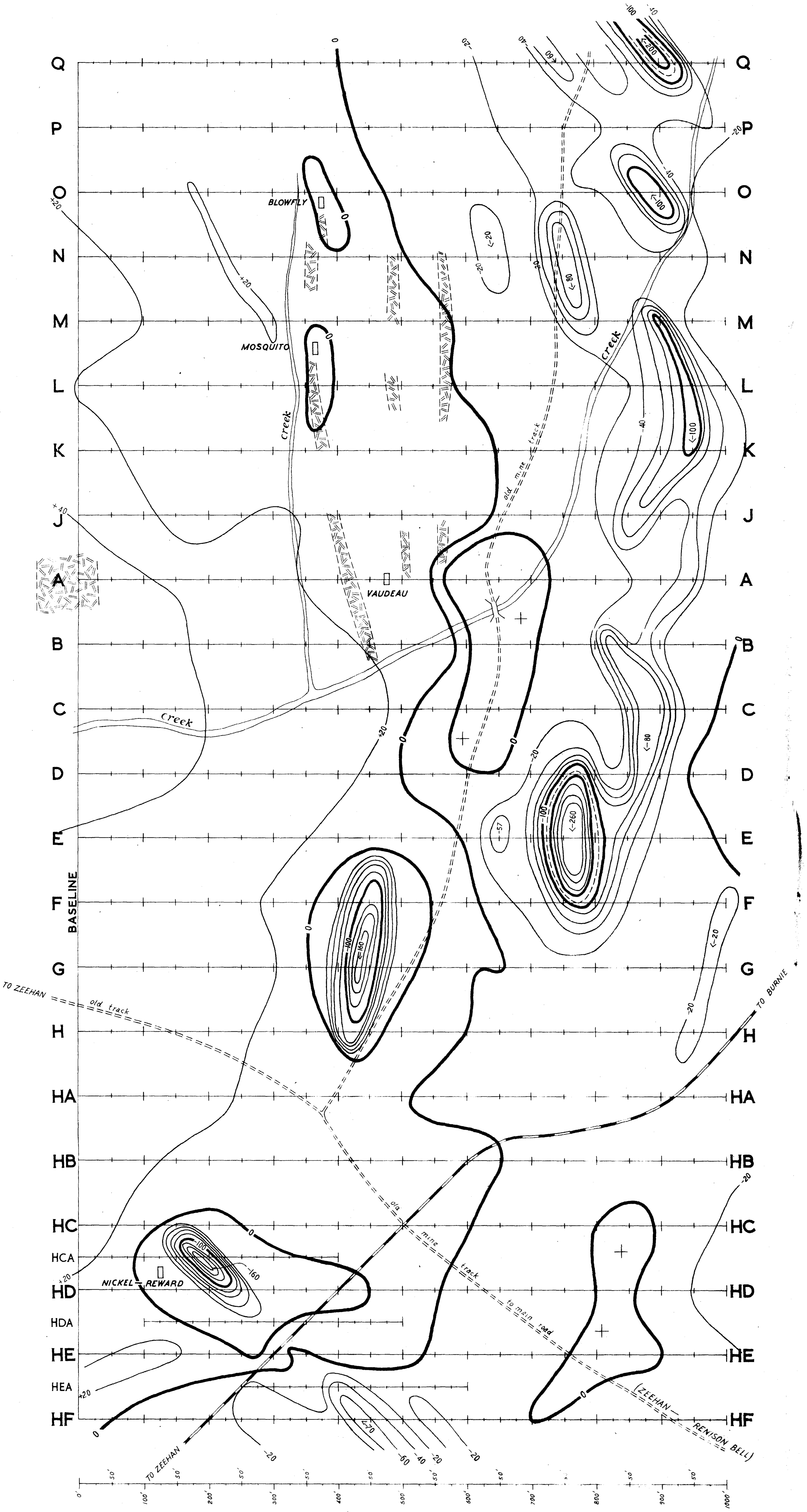


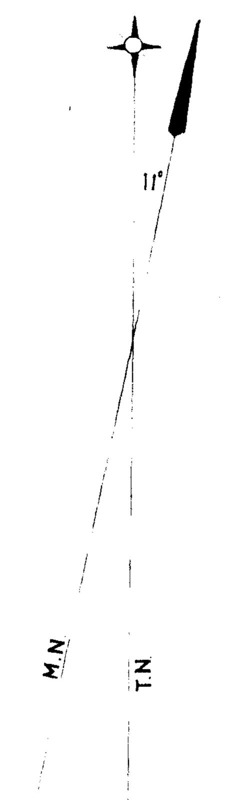
GEOPHYSICAL SURVEY NEAR ZEEHAN TASMANIA

THE NORTH DUNDAS FIELD COPPER NICKEL AREA

SELF POTENTIAL CONTOURS

IN MILLIVOLTS





GEOPHYSICYST: Kruneta.

LEGEND

BASIC DYKE

(ABANDONED) MINE SHAFT

RAILWAY

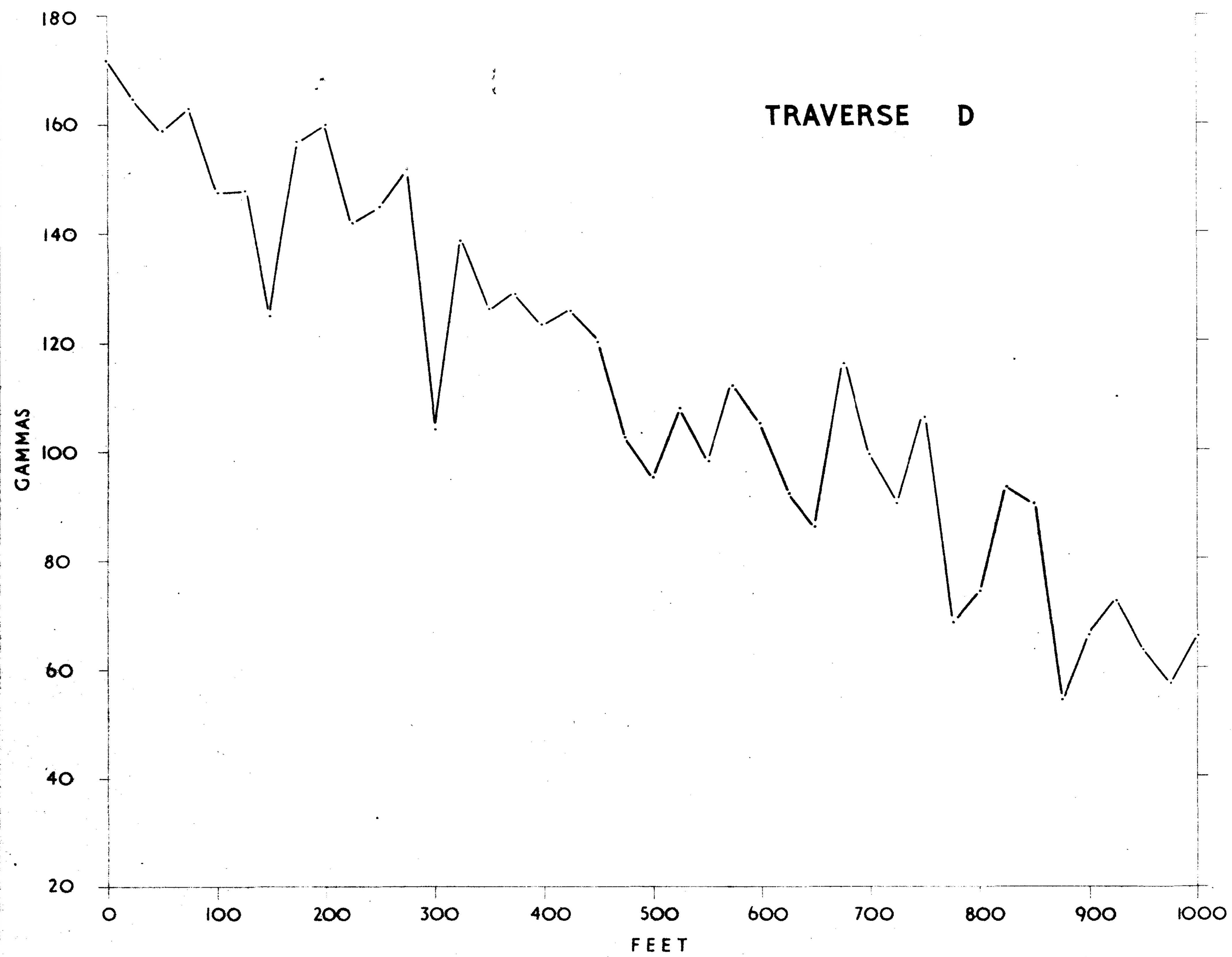
TRACK

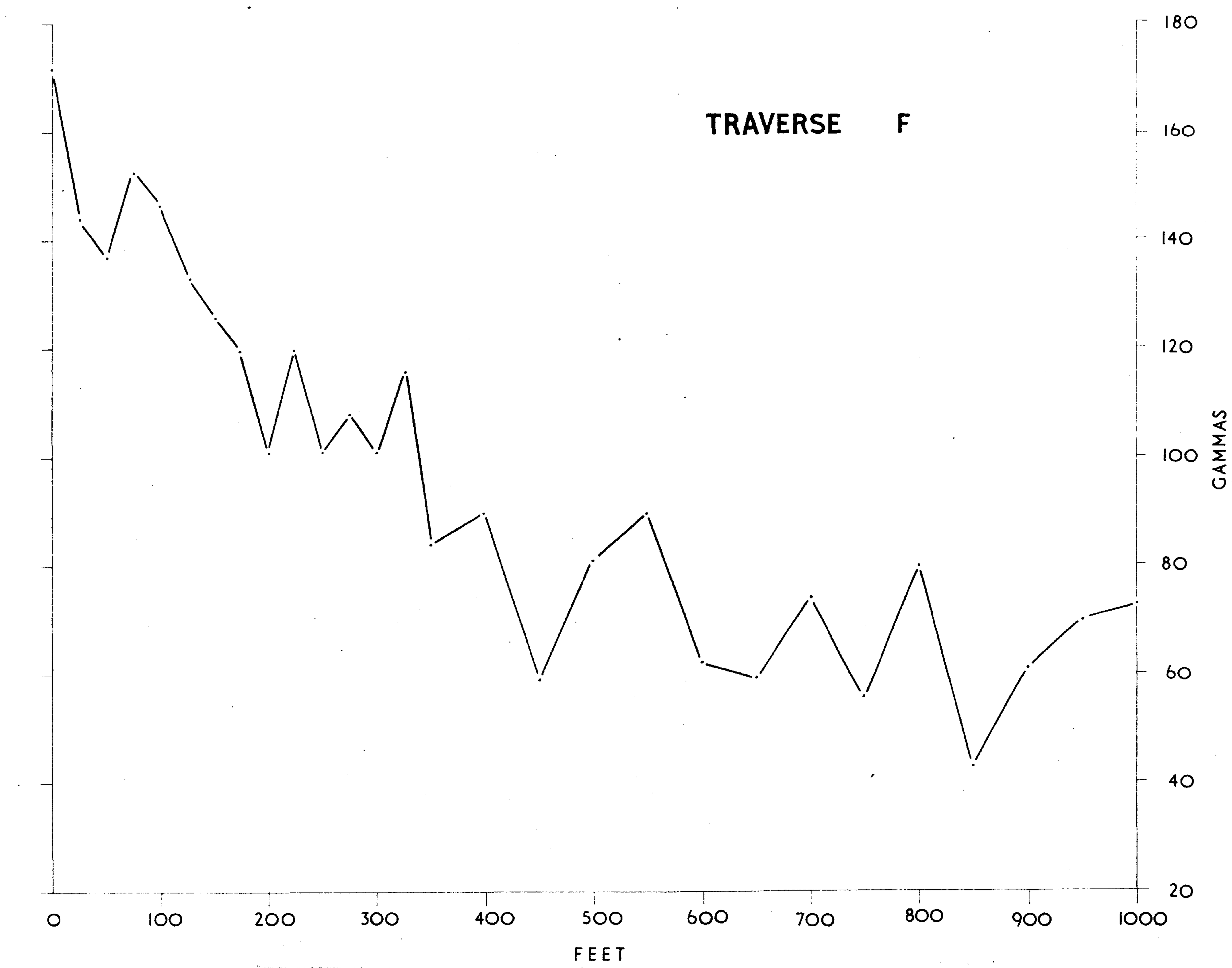
CONTOURS

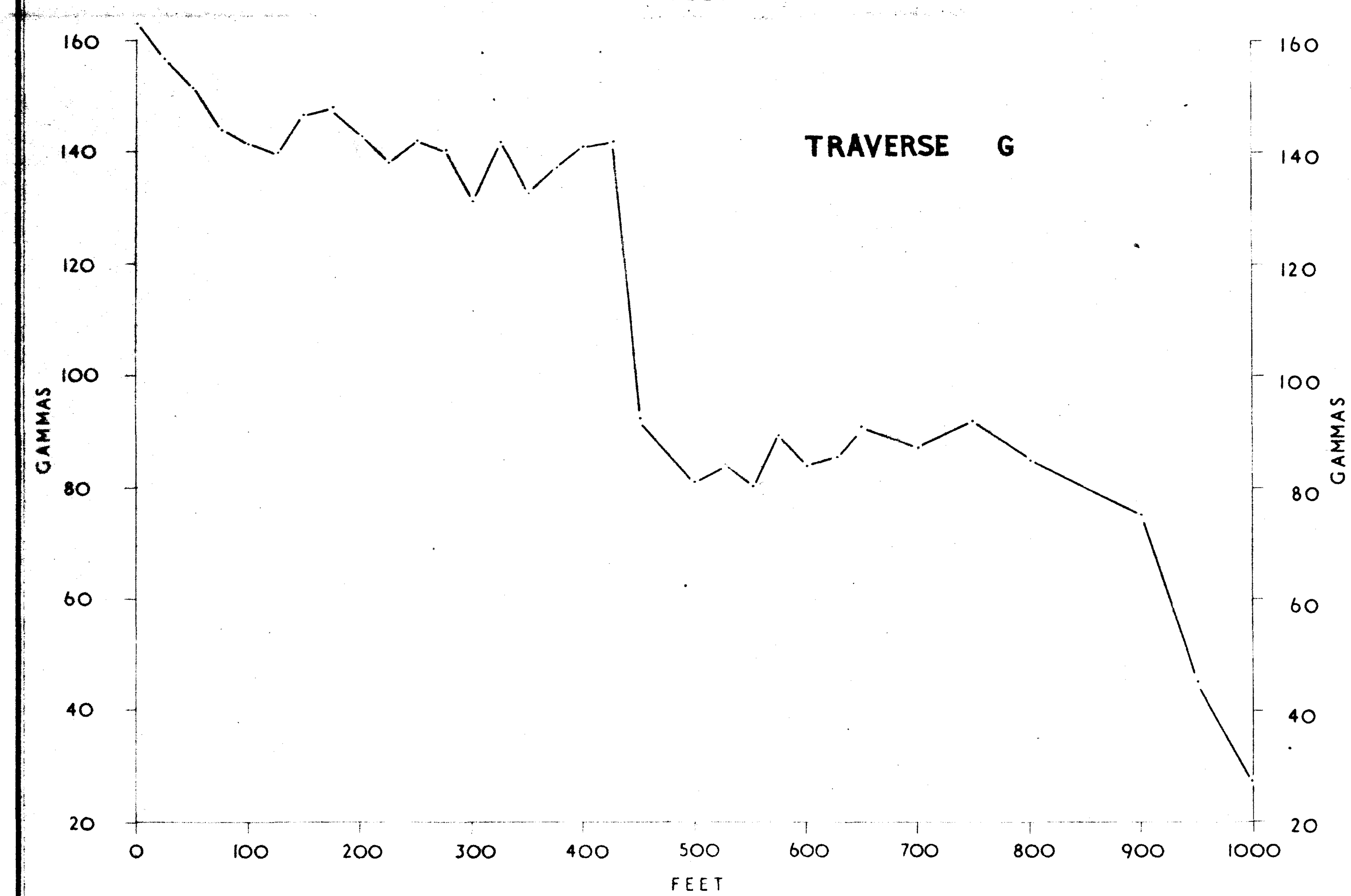
BASELINE BEARING 172° (MAGNETIC)

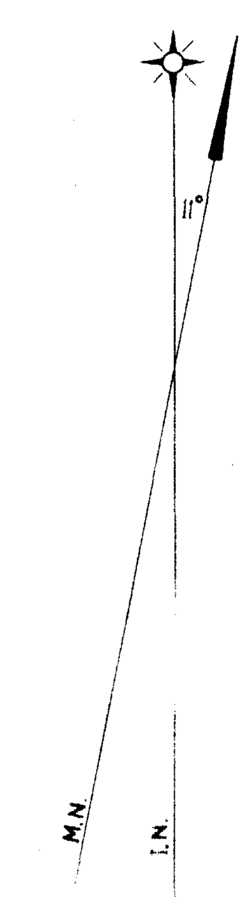
SCALE

FEET 100 0 100 200 300 400 FEET







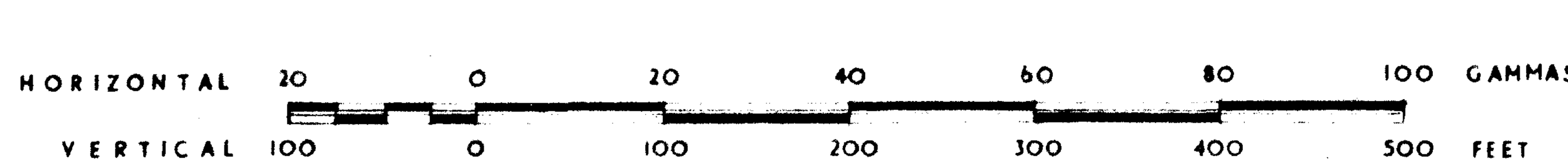


GEOPHYSICAL SURVEY NEAR ZEEHAN TASMANIA

THE NORTH DUNDAS FIELD COPPER-NICKEL AREA

MAGNETIC VERTICAL FORCE PROFILES

SCALES



GEOPHYSICIST

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