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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORDS 1957, No. 98

THE RESULTS OF DIAMOND DRILLING OF THE COPPER-NICKEL DEPOSITS AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA

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CONTENTS

ILLUSTRATIONS

ABSTRACT

The results of drill holes put down in the Copper Nickel area, North Dundas, Western Tasmania on the recommendation of the Bureau of Mineral Resources, as a result of a geophysical survey, are described.

Four of the holes (EM1 to EM4) were drilled by Eagle Metal and Industrial Products Pty.Ltd. in 1953, when that company had an option on the Cuni leases. The company relinquished its option after the completion of drill holes EM1 to EM4. In 1955, Montana Silver Lead N.L., the leaseholders, decided, on the recommendation of the Bureau, to start drilling with a diamond drilling plant provided by the Tasmanian Mines Department. Eighteen drill holes (M6 to M23) have been drilled by Montana Silver Lead N.L., and the results of that drilling are described in this report.

Fairly extensive mineralisation has been proved by the drill holes. Very high grade compact nickel ore was found on the footwall of the basic dyke with which the ore is invariably associated. Probably even more important is the more extensive disseminated mineralisation in the dyke. This is a new discovery which improves the prospects for the field; with the inclusion of the disseminated ore, greater ore reserves can be expected than have been won from the small shoots of rich compact ore in the past. Comparison of drilling results with geophysical results appears to indicate that the distinct self-potential anomalies are caused by the compact ore on the footwall of the dyke, while the disseminated ore gives only very weak self-potential indications. Geophysical work appears to be of only little assistance if drilling targets have to be selected for the investigation of the extent of the disseminated ore.

Geochemical assays of soil samples have proved helpful in differentiating between indications caused by copper-nickel ore, lead-zinc ore and graphitic and pyritic schists and slates.

Nickel sulphides associated with magnetite in serpentine were found by drilling on a magnetic anomaly in the main mass of basic eruptives east of the dyke. The orebody found is of only very low grade but seems to be of greater dimensions than the deposits associated with the meta-dolerite dyke. The discovery of this new type of nickel-magnetite ore in serpentine opens up prospects for more deposits in the main basic eruptive mass.

I. SUMMARY OF EXPLORATION ACTIVITIES

1. GEOPHYSICAL AND GEOCHEMICAL OPERATIONS.

Geophysical surveys have been made by the Bureau of Mineral Resources, Geology and Geophysics in the North Dundas Copper-Nickel field near Zeehan at various times since 1952 (see Plate 1). Previously, in 1928, a geophysical survey of the northern part of the field was made by the Imperial Geophysical Experimental Survey mainly with the object of testing the usefulness of various geophysical methods on suitable exploration targets. In that survey, three electrical methods (the equipotential line method, the A.C. potential ratio method and a high frequency electromagnetic method), and the magnetic method were used over selected areas.

During May and June, 1952, an area 2,200 feet by 1,000 feet, in the southern part of the field, was surveyed with the self-potential and magnetic methods and the results have been described by Keunecke (1952). Several strong self-potential anomalies were observed and recommendations were made for testing them by trenching. The magnetic survey gave no useful results.

Geophysical work was resumed in the area in December, 1952, and continued to March, 1953. During this period, self-potential surveys were extended northward from the previous area covered, for a distance of 5,600 feet; traverses were 1,000 feet long. The self-potential method was used over the whole of the area and several anomalies were found. The electromagnetic method was used over the northernmost 1,700 feet of the area surveyed and over a further 600 feet in the Cuni South area. The results have been described by Keunecke (1953). Anomalies ranging in intensity from strong to weak were observed at a number of places in good agreement with self-potential indications. The results of the survey were encouraging in the Cuni North area and testing by drilling was recommended and subsequently carried out.

Further geophysical surveys were made by the Bureau in October,1956, and from March to May, 1957, in areas to the south and east of those previously investigated. The self-potential and magnetic methods were used. The results have been described by Horvath and O'Connor (1958). Several self-potential anomalies were disclosed and two of the largest were tested by trenching. Two intense magnetic anomalies were found on the margin of the serpentine which adjoins to the east the sediments in which the known copper-nickel deposits occur (Plate 12).

A considerable amount of testing has been done on the geophysical anomalies by drilling and trenching.

Several hundred soil samples were taken with an earth auger, at a depth of about 2 feet, on observation points of the geophysical grid in areas of geophysical anomalies. The soil samples were to be assayed for copper and nickel and in many cases also for lead. It has been possible to assay only a portion of the soil samples for the presence of these metals using the very sensitive colorimetric methods developed by the U.S. Geological Survey, Washington.

A small weighed quantity of sieved soil is either fused or dissolved in acid. The solution of the fused or acid-dissolved soil sample is treated with dithizone when testing for copper, lead or zinc and with dimethylglyoxim when testing for nickel. The change of colour of the solution is an indication of the amount of metal present in the soil and the metal content can be estimated for each point from which a sample was taken by comparing the colour with that of standard solutions of different metal content.

Because of the shortage of personnel and facilities, many of the samples still await assay, but the assays carried out so far have been very useful in the selection of exploration targets which might be due to copper-nickel mineralisation. Geochemical methods were used only in the last period of the survey (1956-1957), but they appear to be giving good results and were used in the selection of borehole M23 and in the testing of the Deveraux and Nickel Reward prospects.

It is suggested that the assaying of soil samples taken over much larger parts of the area should be carried out as a means of discerning whether geophysical indications are likely to be due to copper or nickel mineralisation.

The purpose of this report is to review the results of the testing work done to date, especially in relation to the geophysical results, and to suggest avenues for further prospecting work including geological and geophysical work, geochemical testing, trenching, diamond drilling and underground exploration.

2. RESULTS OF THE GEOPHYSICAL SURVEYS.

The self-potential method was used to survey the whole area investigated. It is rapid, and proved successful, as the subsequent testing work showed, but it is not certain that the method is applicable over all the area, as the relative level of the ground water table is fairly critical for the application of this method.

The method generally accepted as the most suitable for prospecting for sulphide bodies is the electromagnetic, but it is more expensive than the self-potential method to apply. During the 1953 survey, the use of the electromagnetic method was confined to the northernmost area and to some traverses around the Cuni South shaft. In the 1957 survey, no electromagnetic work was done because suitable equipment was not available at the time. The magnetic method was used only over selected areas as the method proved unsuccessful over most of the area.

A composite plan of the self-potential results of all surveys except that on the Deveraux Prospect is attached as Plate 2.

The main results of the geophysical surveys carried out by the Bureau of Mineral Resources from 1952 to 1957 on the copper-nickel deposits of the North Dundas field, near Zeehan, were :

(i) Strong electromagnetic and self-potential indications, which subsequent testing showed were due to copper-nickel mineralisation in association with basic dykes, were found mainly in the northernmost part of the surveyed area.

The main indications extend between traverses BF and BO (Plates 2 and 3), in what is referred to below as the Cuni North area. South of Traverse BM, the indications strike approximately north and north of traverse BM the strike is north-easterly.

The indications are distinct, but not sufficiently continuous or strong to be due to a large continuous body of compact ore extending over the whole length.

(ii) A distinct but local anomaly was found at the Cuni South shaft.

(iii) A small S.P. indication with a different direction of strike was recommended for testing by drilling at the Nickel Reward Prospect.

Some small narrow anomalies, striking south-easterly, line up with this S.P. indication at the Nickel Reward but their direction changes to north-south. These indications may be associated with a continuation of the mineralisation found on the Nickel Reward Prospect.

(iv) Some small indications within the dyke area, especially around the Vandeau shaft, might be due to very small ore-bodies; the weaker, but more extensive ones might be caused by disseminated mineralisation.

(v) Irregularly distributed S.P. anomalies east of the dyke which were shown by subsequent trenching to be caused by pyritic or graphitic slates or lead-zinc mineralisation. Very intense self-potential anomalies were found on the eastern extension of some traverses surveyed in 1957 near the abandoned McKimmie mine. Most of these anomalies strike roughly north and are situated in the Dundas sediments.

(vi) A large, well-defined and extensive anomaly striking approximately north was found in the south-western portion of the area surveyed in 1957, but was indicative more of a geological feature than of mineralisation.

This was confirmed by two trenches which revealed graphitic slate.

(vii) The relatively weak and limited S.P. indications on the Deveraux Prospect which possibly are due to sparse mineralisation. The direction of strike is south-easterly, similar to that of the indications on the Nickel Reward Prospect, but different from the north-south strike found mainly in the dykes on the Cuni line of lode.

(viii) Two roughly parallel magnetic anomalies were found near the south-eastern boundary of the area surveyed in 1957.

The anomalies are strong, strike about north-north-east and are close together. No S.P. anomalies were found in the area of the magnetic anomalies, but high nickel values were found in soil samples taken in that area.

The Imperial Geophysical Experimental Survey obtained good electrical indications using the equipotential line method, the A.C. potential ratio method and the high-frequency electromagnetic method, mainly in the Cuni North and Cuni South areas. The survey was made over smaller areas, as the main object was the testing of various geophysical instruments and methods. Even from the test results obtained, however, it was possible to point to the Cuni North area as the most promising one, and trenching and drilling on five targets were recommended to the Director of Mines, Tasmania. This recommended exploration work was carried out, and is discussed in the report prepared by the I.G.E.S. (Edge and Laby, 1931).

3. RESULTS OF TESTING OPERATIONS.

The testing of exploration targets recommended as a result of the geophysical surveys was carried out in three different periods. The first testing was done in 1930, by the Mines Department, Tasmania, on the recommendations of officers of the Imperial Geophysical Experimental Survey. Five trenches were dug, some in the Cuni South and some in the Cuni North area. The results of the costeaning were inconclusive because of weathering of the material near the surface and because of water in the costeans. However, two diamond drill holes in the Cuni North area intersected good nickel ore. These results are discussed in detail later in this report.

The testing of results of the geophysical surveys made by the Bureau of Mineral Resources in 1952/1953 and in 1956/1957 was done in two periods. In 1953, Eagle Metal and Industrial Products drilled 4 bore holes, EM1 to EM4, but abandoned its option over the Cuni leases after completion of these holes, and the area reverted to its owners Montana Silver Lead N.L. In 1955, Montana Silver Lead N.L. decided, on the recommendation of the Bureau of Mineral Resources, to start drilling with a diamond drilling plant provided by the Tasmanian Mines Department. Eighteen drill holes (M6 to M23) were drilled by Montana Silver Lead N.L., between the end of 1955 and August, 1957.

Also, a large number of soil samples was taken during this period and several costeans were dug to test indications on the surface. As in earlier tests, the trenches mostly gave inconclusive evidence regarding the quality of the mineralisation because of weathering of sulphide minerals, but it was possible to eliminate several indications as being without economic interest, the cause of the geophysical indications in such cases being graphitic slates. In some places, as for instance near McKimmie's Mine and in the south-western part of the surveyed area, the S.P. indications were large, well defined and extensive. Test trenches on traverses 700S and 1100S on one of these indications revealed only graphitic slate. The indications are therefore believed to be caused by extensive areas of graphitic slates.

Assaying of soil samples taken at 25-foot intervals along the geophysical traverses proved to be of great assistance in discerning whether an indication was associated with graphitic or pyritic shales or with useful mineralisation, because in the former case there is no significant increase in metal values - copper, nickel, lead - in the area of the indication; the geochemical assay also helps in distinguishing between those indications which are associated respectively with copper-nickel or lead-zinc mineralisation.

Although only a few of the soil samples have been assayed, the results obtained agree fairly well with the results obtained by trenching and drilling. The impression has been gained that sampling and assaying of soil could largely replace costeaning and probably gives more significant results; this was found to be so in several cases, as discussed later.

The drill holes revealed several ore bodies of limited size containing copper and nickel sulphides. The most important results arising out of the recent drilling are :-

1. Appreciable widths of disseminated copper and nickel mineralisation of low but possibly workable grade occur adjacent to the massive and high-grade copper-nickel ore and may add considerably to the known ore reserves.

2. Extensive low-grade nickel mineralisation was discovered in association with magnetite in the serpentine belt. This discovery is regarded as important because this type of mineralisation was not known previously and the large area of the serpentine belt offers scope for prospecting for large ore bodies; the geophysical survey covered only a small part of the serpentine belt. The combined use of the magnetic method and of soil assays for nickel established a clear drilling target (drill hole M23) and suggest a rapid and economical means of further exploration in the copper-nickel field.

The exploration of the Cuni area has been confined to shallow depth. The mines working the rich compact ore at Vandeau, Cuni South and Cuni North terminated at shallow depth with the compact ore giving out. Very little exploration work was carried out from these shafts to investigate whether disseminated ore existed in the dyke.

In some of the recent drill holes appreciable widths of disseminated ore have been disclosed within the dyke at shallow depths. In the Cuni North area, only one borehole (M9) was examined for disseminated ore at a depth exceeding 200 feet. Only low-grade mineralisation (0.18% Ni) was found, but this investigation is not conclusive as it is not certain that the borehole has penetrated the full width of the dyke. Testing for occurrences of disseminated mineralisation at greater depth would appear to be warranted.

For convenience in detailed description of the testing results, the area has been divided into :-

1. The Cuni North Area.
2. The Deveraux Prospect.
3. The Nickel Reward Prospect.
4. The Serpentine Belt.

Each of these prospects is described separately in the following sections of the report.

II. THE EXPLORATION OF THE VARIOUS PROSPECTS

1. THE CUNI NORTH AREA

A. Diamond Drilling

(i) Drill Holes EM1 to EM4.

Five drilling targets were selected in the northern part of the area, based on the geophysical results, and information regarding these was conveyed to the interested company, Eagle Metals and Industrial Products Pty.Ltd. (Keunecke, 1953).

The positions of the five targets were :-

Traverse BM, point 200 E

Traverse BL, point 190 E

Traverse BH, point 130 E

Traverse BF, point 160 E

Traverse BE, point 175 E

Four holes (EM1 to EM4) were drilled between July and September, 1953, by a drilling contractor. Positions of these holes are shown on Plate 3. The fifth hole was started but was not completed.

Drilling results were not as conclusive as could be wished. Owing to poor core recovery, both core and sludge assays had to be used in the assessment of the drilling results. It is well known that assays of sludge samples are not as reliable as those of core samples and are sometimes very misleading. Also, sludge samples of these bore holes were taken in a routine manner over a width of 10 feet instead of over a width determined by changes in rock formation or in the character of the mineralisation.

It is not known whether the bore sludge was returned to surface with enough pressure to keep the heavier sulphide particles suspended. Nor is it known whether the holes were thoroughly washed after a run was completed. From a comparison of core and sludge assays, it appears that this precaution was not taken and that nickel and copper values in the lower part of the hole are salted by remnants of sludge from higher up in the lode.

On the other hand, it may be assumed that ore at a depth of between 50 and 100 feet is in the stage of oxidation and therefore soft and friable. It can therefore be inferred that core recovery is poorer in ore than in country rock.

It is reasonable to assume from the above that the true copper-nickel values are higher than those given by core assays, but lower than those given by sludge assays. Furthermore, the width of ore is probably not as great as indicated by the sludge samples.

As the basic sills and the copper-nickel ore dip to the east, and as it was intended to reach the ore at a depth of less than 100 feet, the drill holes were sited only a short distance east of the targets. In order to save time for transport and erection of drilling plant, drill holes EM1 and EM2 were drilled from the same location but in different directions.

The holes were drilled at an angle of depression of 45°; as the lode dips to the east at about 60°, the thickness of the lode traversed by the bore hole can be assumed to be approximately the true thickness.

The results of drill holes EM1 and EM4 are shown on Plate 4 in the form of cross-sections. The sections show the rock types encountered and the nickel and copper values from sludge and core samples. All drill holes first encountered tuffs and argillites, then passed through 10 to 30 feet of basic dyke, after which they entered tuffs and argillites again. Drilling was stopped after the holes had passed through about 30 feet of sediments on the footwall side of the dyke.

Sludge and core assays are shown on Plate 4; the width shown is that over which samples were assayed.

In general, higher assay values were obtained from sludge samples than from core samples in the lower part of the holes and vice versa in the upper part. This is especially noticeable in drill hole EM3.

The results and main characteristics of drill holes EM1 to EM4 are tabulated below :-

DRILL HOLE EM1

Angle of Depression :	45°
Bearing :	330° magnetic
Length of Hole :	120 feet
Position :	60 feet south of traverse BM at point 230 E
Drilled :	July, 1953
Geology :	Argillite and tuff 0 - 59 feet
	Basic dyke 59 - 79 feet
	Argillite and tuff 79 - 120feet

Assay Results

CORE				SLUDGE				
Depth	Feet	Ni(%)	Cu(%)	Depth	Feet	Ni(%)	Cu(%)	
70-79	9	1.72	0.10	60-68	8	0.44		
				70-80	10	4.10	1.90	
				80-90	10	1.80	1.0	
70-79	9	1.72	0.10	70-90	20	2.95	1.45	Average.

Core was lost in the footwall portion of the dyke which is the most mineralised. The core assay is therefore probably too low. The sludge sample from 80 to 90 feet is from a portion in the footwall sediments. The nickel and copper values from this sludge sample must be due to contamination from above and should be disregarded. Sludge samples taken from 60 to 68 feet show 0.44% Ni, which is probably too low as the nickel from this interval was probably recovered lower down. No core assays were made from 59 to 70 feet. Taking into account the above considerations, a width of 12 feet of ore with 2.0% Ni and 0.8% Cu is estimated.

DRILL HOLE EM2

Angle of Depression :	50°
Bearing :	270° magnetic
Length of Hole :	120 feet
Position :	60 feet south of traverse BM at point 230E

Drilled: July and August, 1953.

Geology: Argillite and tuff 0 - 44 feet

Basic dyke with quartz siderite and disseminated ore 44 - 81 feet

Argillite and tuff 81 - 120feet

Assay Results

CORE					SLUDGE			
Depth	Feet	Core Recovery	Ni(%)	Cu(%)	Depth	Feet	Ni(%)	Cu(%)
					50-60	10	0.1	trace
66-70	4	½	0.5	0.7	60-70	10	0.4	0.3
					70-78	8	0.3	
79-81	2	1	1.0	0.7				
	6	1½	0.7	0.7				

Core recovery in this hole was very poor and core assays were made only over some sections. Also, sludge sampling was incomplete. Core assays between 70 and 79 feet are missing although mineralisation is reported from that section. The results from this hole cannot be regarded as conclusive. The thickness of ore might be any value between 6 feet and 21 feet. The grade of ore is certainly low, but is probably between 0.5% and 1.0% Ni and about 0.7% Cu.

DRILL HOLE EM3

Angle of Depression : 45°

Bearing : 270° magnetic

Length of Hole : 120 feet

Position : 20 feet north of traverse BH at point 200 E

Geology : Argillite and tuff 0 - 57 feet

Basic dyke 57 - 88 feet

Argillite 88 - 109 feet

Shear zone of silicified argillite and slate with a few inches of lead-zinc lode 109 - 120 feet.

Assay Results

CORE					SLUDGE			
Depth	Feet	Core Recv.	Ni(%)	Cu(%)	Depth	Feet	Ni(%)	Cu(%)
70-76	6	5	2.1	trace	70-78	8	0.3	0.5
76-78	2	$1\frac{1}{2}$	0.9	1.7				
78-80	2	$1\frac{1}{4}$	0.8	1.1				
80-82	2	$\frac{3}{4}$	0.8	3.3	80-90	10	3.1	3.8
82-85	3	2	1.5	3.4				
85-90	5	$2\frac{1}{2}$	0.3	trace				
70-85	15	$10\frac{1}{2}$	1.5	1.5	70-90	18	1.85	2.33

Core recovery was much better in EM3 than in EM1 and EM2. The width of the nickel ore is estimated at about 15 feet with 1.5% Ni and 1.5% Cu, taking into account the core assays only.

DRILL HOLE EM4

Angle of Depression :	45°
Bearing :	270° magnetic
Length of Hole :	140 feet
Position :	On Traverse BF at point 275 E.
Drilled :	September, 1953
Geology :	Argillite and tuff 0 - 109 feet.
	Basic dyke with quartz veins 109 - 123 feet
	Argillite and tuff 123 - 140 feet

Assay Results

CORE					SLUDGE			
Depth	Feet	Core Recv.	Ni(%)	Cu(%)	Depth	Feet	Ni(%)	Cu(%)
118-120	2	2	0.4	0.1	110-120	10	0.4	trace
120-121	1	1	0.9	0.7	120-130	10	0.6	trace
Average	3	3	0.57	0.3		20	0.5	trace

Only three feet of ore were assayed and these showed ore of marginal grade. The evidence is incomplete as only small portions of the dyke material were assayed. The results appear to indicate that the mineralisation is of too low a grade to be classified as ore.

After completion of the four drill holes EM1 to EM4, Eagle Metal and Industrial Products Pty.Ltd. decided not to continue with drill hole EM5 and abandoned the option on the leases in the Cuni area held by Montana Silver Lead N.L. The drilling results were not very satisfactory and were somewhat inconclusive, due largely to poor core recovery. The decision seemed premature however, and was influenced by the fact that the drill holes revealed no compact ore of about 10% nickel, as was produced from the Cuni shafts during earlier mining.

(ii) Drill Holes M6 to M9.

When the ore reserves in the Montana lead mine had reached a low figure, the efficient concentrating plant at that mine was expected to close down and the company began to look for a suitable source of ore for its mill. The geophysical survey made by the Bureau in an attempt to find lead ores in the area surrounding the Montana mine did not reveal any promising targets. It was suggested that, in view of the favourable geophysical results obtained by the Bureau in the copper-nickel area, the company should continue exploration in that area. Tests carried out by the Metallurgical Laboratory of the Mines Department in Launceston suggested that the mill at the Montana mine could, with only minor modifications, be used for the treatment of the nickel ore. The directors of the company agreed and made arrangements with the Tasmanian Mines Department for that Department to provide a diamond drilling plant and a drill foreman. New drilling targets were selected in the northern area (north of traverse BM) where previous drilling had produced encouraging results, and drilling was recommenced in December, 1955. It was hoped that with better core recovery and more complete sampling and assaying, a more reliable assessment of the value of the deposit could be made. It was also considered advisable that the holes be drilled to greater depths. The position of, and the results from, these drill holes (M6 to M9) are shown on Plates 3, 5 and 6. All core cases of the bore holes drilled by Montana Silver Lead N.L. , were sent to the Launceston or Hobart offices of the Tasmanian Mines Department. All the assays referred to in this report were made in the laboratory of the Mines Department, Launceston under the direction of the Chief Chemist, W. St. C. Manson.

DRILL HOLE M6.

Angle of Depression :	45°	
Bearing :	317° magnetic	
Length of Hole :	157 feet	
Position :	On traverse BM at 427 E	
Drilled :	December, 1955 and January, 1956.	
Geology :	Tuff, volcanic ash	0 - 115 feet
	Basic Dyke	115 - 136 feet
	Compact ore	136 - 139 feet
	Tuff and argillite	139 - 157 feet

Assay Results (from cores only)

Depth	Feet	Ni(%)	Cu(%)	
123 - 125	2	1.46	2.58	)
125 - 126.8	1.8	0.37	0.33	)
126.8- 128.4	1.6	0.79	1.42	)
128.4- 130	1.6	0.83	1.76	) Disseminated ore.
130 - 132	2	0.39	0.33	)
132 - 134	2	0.61	0.53	)
134 - 136	2	-	-	Barren.
123 - 130	7	0.89	1.55	Average
136 - 137	1	10.0	5.46	) Compact ore
137 - 138	1	11.2	4.3	) on footwall
138 - 139	1	8.1	3.0	) of dyke
	3	9.7	4.3	Average

The good core recovery in this hole permits more accurate assessment of the metal values. The nickel content of the disseminated ore in the basic dyke varies considerably. The amount of sulphides present is rather low. Very little pyrrhotite and pyrite are found with the sulphides. Compact and disseminated ore together give 10 feet of ore with 3.5% nickel and 2.4% copper. A more detailed description of the mineral composition of the ore deposit is given in later chapters.

DRILL HOLE M7

Angle of Depression : Vertical

Length of Hole : 315 feet

Position : Same as M6

Drilled : January and February, 1956.

Geology : Tuffs, volcanic ash and slates 0 - 315 feet.

Drill hole M7 was drilled to investigate the deposit at greater depth, and was expected to reach the basic dyke at a depth of about 200 feet. The drill, however, did not encounter the basic dyke with which the nickel ore is associated and no ore was found. Drill hole M9 was put down to investigate the reasons why the dyke was not encountered in M7.

DRILL HOLE M9

Angle of Depression : 55^{o}

Bearing : 318^{o} 30' magnetic

Length of hole : 285 feet

Position : 57.8 feet from drill hole M7 on a bearing of 137° magnetic

Drilled : August and September, 1956.

Geology :

Tuff, volcanic ash, argillite	0 - 259 feet
Basic dyke	259 - 285 feet
Argillite	285 feet

The drill hole should have reached the dyke at about 180 feet if the dyke had continued downward from borehole M6, as assumed. The dyke was not encountered however, until the hole had reached 259 feet and it is doubtful if the footwall of the dyke has really been reached. The dyke showed no mineralisation between 259 and 270 feet and the assays over this interval give no nickel values. An assay between 270.5 and 274 feet gave 0.18% nickel and traces of copper. The part between 274 and 285 feet has not been assayed, but shows only slight mineralisation.

DRILL HOLE M8

Angle of Depression : 50°

Bearing : 311° 30' magnetic

Length of Hole : 118 feet

Position : 66 feet from drill hole M7 on a bearing of 1½° magnetic

Drilled : March and April, 1956.

Geology :

Tuff and argillite	0 - 68 feet
Basic dyke	68 - 105 feet
Argillite	105 - 118 feet

Assay Results (from cores only)

	Depth	Feet	Core Recovery Ft.	%	Ni(%)	Cu(%)
	80 - 87.5	7.5	5.0	67	trace	trace
	87.5 - 89	1.5	0.5	33	.37	.47
	89 - 92	3	2	67	1.31	1.88
	92 - 94	2	2	100	.81	.62
	94 - 96	2	2	100	.45	.39
	96 - 98	2	1.5	75	trace	trace
	98 -100	2	1.2	60	.18	trace
Average	89 - 94	5	4	80	1.11	1.38
Average	89 - 96	7	6	86	.92	.95

The hole was drilled near the northern end of the geophysical indication and shows disseminated but no compact ore.

Of the eight holes drilled in the Cuni North area in recent years, seven penetrated the basic dyke. Of these, one (M6) intersected compact ore of high value and four (EM1, EM3, M6 and M8) intersected disseminated ore assaying about 1% nickel. Two boreholes (EM2 and EM4) encountered disseminated mineralisation of about 0.5% Ni only. The nickel to copper ratio varies but averages between 1:1 and 2:1.

(iii) Earlier drill holes.

To obtain a better assessment of the extent and grade of ore, the available old drill hole records were studied. The holes were drilled at different times; the best recorded results are those for DH2 and DH4, which were put down in 1930 to check the geophysical indications obtained by the Imperial Geophysical Experimental Survey (Edge and Laby, 1931). The position of, and results from, these earlier drill holes are also shown on Plate 3.

The drill hole data given below were taken from records of the Tasmanian Mines Department. Positions are approximate and available information is incomplete. Positions and bearings are taken mainly from a geological sketch map by J.C. Ferguson of the I.G.E.S.

DRILL HOLE NO. 2

Angle of Depression :	45°
Bearing :	314° magnetic (approx.)
Length of hole :	100 feet.
Position :	Approximate only. About 40 feet north of traverse BM, at point 370E.
Drilled :	June, 1930
Geology :	0 - 40 feet tuff and argillite
	40 - 72 feet basic dyke
	72 - 75 feet compact ore
	75 - 100 feet ?

Only one assay value is recorded, namely 6.0% Ni, 2.6% Cu over the interval from 72 feet to 75 feet. Only the compact ore was assayed. As borehole M6 showed good disseminated ore, such can also be expected to exist in DH2, but the basic dyke material was not sampled or assayed.

DRILL HOLE No. 3 (I.G.E.S. No. 1).

Angle of Depression :	45°
Bearing :	315° magnetic(approx.)
Length of hole :	107 feet
Position :	Approximate only. About 40 feet north of traverse BN at point 485E.
Drilled :	July, 1930

Geology : 0 - 56 feet argillite

56 - 103 feet basic dyke

103 - 107 feet argillite

This hole was drilled on the recommendation of the I.G.E.S. to investigate an electromagnetic indication. The following extract is taken from Edge and Laby (1931, p.90) -

"This ore-body has now been intersected by a diamond drill hole. The drill proved several feet of sulphide ore at this point, at a depth of 75 feet below the surface. On assay, samples of the core gave nickel 3% to 6% and copper 2.5% to 3.5%." No confirmation of the assay was found in the records of the Department of Mines.

DRILL HOLE NO. 4 (I.G.E.S. No. 2)

Angle of Depression : 45°

Bearing : 314° magnetic

Length of Hole : 156 feet.

Position : Approximate only. About 40 feet north of traverse BM at point 465E.

Drilled : July, 1930.

Geology : Information meagre.

The drill hole passed through 3.5 feet of compact ore between 140.5 feet and 144 feet. The assay of the 3.5 feet of ore gave values of 10.1% Ni and 5.5% Cu. No assays were taken from the dyke and the disseminated ore found in borehole M6 probably exists also in DH4, but its presence was apparently not expected and not investigated.

DRILL HOLE NO. 9

Angle of Depression : 65°

Bearing : 348° 35' magnetic

Length of Hole : 346 feet

Position : Approximate only. About 30 feet south of traverse BL at point 550E.

Drilled : August, 1939.

Geology : 0 - 195 feet Tuff, argillite.

195 - 198 feet dyke

198 - 210 feet tuff

210 - 241 feet dyke

241 - 346 feet slate

No mineralisation was reported and no assays were made.

It is probable that the dyke encountered in this borehole is not the mineralised dyke.

DRILL HOLE NO. 10.

Angle of depression : Vertical

Length of Hole : 180 feet

Position : Approximate only. About 40 feet south of traverse BK at point 320E.

Drilled : September, 1939

Geology :
0 - 155 feet tuff and slate
159 - 167 feet dyke and mineralised quartz
167 - 180 feet slate

It is improbable that the borehole intersected the dyke in which the nickel lode occurs.

SUMMARY OF RESULTS FROM ALL DRILL HOLES IN NORTH CUNI AREA

Drill hole	Feet of ore	Ni (%)	Cu (%)	Remarks	Geophysical Indication	
					E.M.	S.P(mV)
EM1	12	2.0	0.8	Poor core recovery. Values approximate.	strong	136
EM2	10	0.7	0.7	Poor core recovery. Values approximate.	strong	120
EM3	15	1.5	1.5		strong to medium	360
EM4	>3	0.57	0.3		strong	-
M6	3 7	9.7 0.89	4.3 1.55	Compact ore. Disseminated ore.	)strong)	480
M7	Did not intersect dyke				-	-
M8	5	1.11	1.38		)strong to weak	150
M9	3.5	0.18	-	Doubtful if the drill hole intersected the dyke completely.		
DH2	3	6.0	2.6		strong	480
DH3	2	4.5	3.0	Information uncertain	weak	-
DH4	3.5	10.1	5.5	Only compact ore. No assay for disseminated ore.	strong	150
DH9	-	-	-	Probably did not intersect nickel-bearing dyke.	-	
DH10	-	-	-	" " " "	-	

Average 2.6 1.7 (Of drill holes EM1,EM2,EM3,M6,M8,DH2,DH3 and DH4).

No microscopic work appears to have been done on the basic dyke; no petrological report could be found and it seemed desirable to examine the mineral composition of the ore and dyke material and also the sediments of the Dundas formation.

Several core specimens from drill holes M6 to M16 were sent to the Petrological Laboratory of the Bureau of Mineral Resources in Canberra and investigated there by W.M.B. Roberts and J.K. Lovering. Their findings are summarised in an appendix at the end of this report.

The basic dyke material was identified as a metasomatised dolerite. Most of the original dyke minerals have been altered and replaced by secondary minerals.

The rocks of the Dundas Group consist largely of tuffs and volcanic ash, particularly near the basic dyke. Further away from the dyke they consist of shales, occasionally pyritic or carbonaceous.

The mineralogical composition of the nickel ore is interesting and unusual. The main nickel mineral in the compact ore is violarite, and in the disseminated ore it is millerite. Both minerals have a high nickel content and the nickel to sulphide ratio is also very high in this field. This is important, because ore of extraordinarily high grade has been won and may still be found and also because high-grade nickel concentrates may be produced from the disseminated ore. Therefore, even relatively low-grade disseminated ore may be of economic importance. On the other hand, the low sulphide content in the disseminated ore produces only very weak electrical indications and the disseminated ore may be overlooked in diamond drilling or other exploration.

The ore does not show any significant magnetic properties, although accessory magnetite and pyrrhotite are present; magnetic surveys have not, therefore, been of much value in the Cuni North area.

(B) Costeaning.

Recommendations for testing included costeaning as well as diamond drilling, and some costeans were dug following both the I.G.E.S. survey and the Bureau surveys.

The S.P. survey indicated mineralisation at fairly shallow depth in several locations and trenching was regarded as the cheapest and quickest method of testing. The testing work encountered difficulties however, due to influx of water in the water-logged ground. Gossanous lode formation was encountered in nearly every trench, below 1 to 2 feet of surface soil, but country rock and lode formations were so decomposed that results were not conclusive. In the trenches cut on the I.G.E.S. recommendations, pits were sunk 8 to 10 feet deeper, and sulphides were encountered, distributed through the gossan, on I.G.E.S. profiles 49N, 53N and 54N; reliable information about the dip, thickness and quality of the ore was obtained by drilling.

As no pits were sunk from the costeans which were made after the Bureau's survey, the information from these costeans is even less conclusive; however, the costean at 225E on traverse BR indicated some lode capping of lead mineralisation associated with weak self-potential indications. Another costean at 25W on traverse BD, dug to test a geochemical indication, also revealed minor lead mineralisation. High copper and lead assays were obtained from soil samples taken about 150 feet west-south-west of the Cuni

North shaft. The results of the trenches and these soil samples suggest the possibility of the existence of a lead-copper lode situated about 150 feet west of the copper-nickel deposit. A second dyke, west of the nickel-bearing dyke, has been observed at some points under the alluvial cover. Further exploration of this mineralisation would appear to be warranted. The geophysical survey was made only on a few traverses extended far enough west to reach this zone of lead mineralisation; these failed to show significant anomalies however, and the indication on traverse BR is quite local. It seems that the mineralisation occurs only sporadically.

The results obtained in these and other costeans mentioned later indicate that no really conclusive evidence is likely to be gained by cutting trenches to about 5 feet. Sinking of pits to larger depths, however, will often encounter difficulties from water; trenching can, therefore, be regarded only as a first guide in exploration.

From 1956, the information gained by taking and assaying soil samples seemed more conclusive and since then, exploration activity has been concentrated more on the geochemical method and less on costeaning.

(C) Recommendations for Underground Exploration

The testing of electromagnetic and self-potential indications revealed extensive mineralisation between traverses BF and BP. Neither method gave evidence of a continuous compact ore body, but indicated mineralisation of varying intensity, in some parts interrupted by a more or less barren portion. The testing is, however, incomplete and to test the indications over the whole distance between traverses BF and BP, additional boreholes would be required, e.g. between drill holes EM3 and EM2 and between EM1 and DH2.

A more satisfactory method of completing the testing of the mineralisation giving rise to the indications might be to drive along the foot wall of the dyke, roughly parallel to the line of electrical indications starting from the Cuni North shaft. Short crosscuts into the dyke at intervals of 30 to 50 feet along the drive would give information regarding the width and grade of the disseminated ore in the dyke. This drive would disclose the extent and grade of the mineralisation along its whole length and not only at a few points as is the case with drill holes; it would also allow a more reliable correlation to be made with the geophysical results. Also, the strike, dip and throw of faults suggested by the geophysical results could be determined from this drive. To reach the location of bore holes M6 and M8, the drive would need to be about 800 feet long.

(D) Conclusions and Prospects

The geophysical survey made by the Bureau of Mineral Resources over an area measuring 8000 feet by 1200 feet revealed that the indications north of the Cuni North shaft were the most favourable in the whole area surveyed.

Several diamond drill holes were put down in the Cuni North area, some in 1930, shortly after the I.G.E.S. survey, but most of them after the survey by the Bureau. Most of the drill holes intersected sulphide mineralisation within 100 feet of the surface. Four holes (M7, M9, DH9 and DH10), drilled to test the ore body at depth, failed to intersect ore. One of these holes (M7) failed to intersect any basic dyke and whether the others passed through the dyke which is mineralised nearer the surface is still uncertain. Two of the holes (M7 and M9) shown on the cross section on Plate 6 would have intersected the orebody had it continued downwards with the same dip as indicated in drill holes DH2 and M6. The other two holes DH9 and DH10, are probably too shallow to have tested any possible downward continuation of the orebody. The evidence from drill holes M7 and M9 cannot be considered as conclusive with regard to the behaviour of the orebody at depth, particularly as they tested the possible downward continuation on one cross-section only.

Records of the earlier bore holes are incomplete and not very accurate. Poor core recovery has contributed to the fact that conclusions regarding the drilling results, the assessment of the value of the deposit and the quantity and grade of ore are not as reliable as could be wished. The latest drilling, assaying of which included large portions of the basic dyke, has revealed the important fact that, besides small shoots of very rich compact ore on the footwall of the dyke, large portions of the dyke contain disseminated sulphides. These sulphides are mostly in small grains and the amount of sulphides in the mineralised dyke is rather low, but a very large portion of the sulphides are high-grade nickel minerals such as millerite, pentlandite and violarite-pyrrhotite is largely absent. The small amount of finely distributed sulphides is probably the main reason why no attention was paid to this type of ore in the earlier days. As disseminated ore has been found in nearly all the most recent drill holes, a wider occurrence of such ore seems likely. Assays taken over short sections show a wide range of nickel values, but usually there is a gradual decrease in the metal content towards the hanging wall of the dyke. The nickel values in the disseminated ore range between traces and about 4.0%, but if 0.5% nickel content is regarded as the limit of payability, the average of the disseminated nickel ore can be estimated at roughly 1.0% and the copper at about 1.6%.

The drill holes are still too few and too far apart for a reliable estimate to be made of the grade and quantity of the ore reserves. However, drill holes EM1, EM2, EM3, EM4, M6, M8, DH2 and DH4 indicate that the dyke is mineralised to a depth of 100 feet or more over a considerable portion of its length. The relatively strong self-potential anomaly on traverses BJ and BK and the accompanying electromagnetic indication remain to be tested either by drill holes or, preferably, by a drive from the Cuni North shaft, to ascertain the length of the ore shoots.

Additional holes to test the downward continuation of the ore and especially the extent of the disseminated ore below 100 feet would be warranted over those parts where the testing at shallow depth has shown positive results.

More attention should be paid to the exploration of a possible lead-copper lode about 200 feet west of the nickel deposit, particularly with regard to the economic prospects of the lode capping in the trench at BR/225E and the lead mineralisation at BD/25W. South of traverse BD, the lode would be situated west of the surveyed area.

2. THE DEVERAUX PROSPECT

The Deveraux Prospect, situated south of the Emu Bay Railway and about half a mile west of the Cuni lode (Plates 1 and 12), was not included in the area of the geophysical survey of 1952/1953.

A sample taken from the old Deveraux shaft showed high nickel and copper values and for this reason the company decided to extend the exploration to the Deveraux Prospect.

A hole (M10) was drilled to investigate the mineralisation but the results were inconclusive and it was considered that a geophysical investigation should be made as a guide for further testing.

(A) Geophysical and Geochemical Results

While drilling was in progress, a short self-potential survey was made by the author. This revealed only a very weak self-potential anomaly (58mV), but indicated that the direction of the strike of the lode is to the south-east as compared with the usual southerly direction in other parts of the field. The results of the survey are shown on Plate 7. The strike indicated by the geophysical survey coincides with that of the Silurian sediments which crop out only a few hundred feet south of the Deveraux Prospect. These sediments are the north-eastern limb of the Ordovician - Silurian basin of Zeehan. The S.P. survey was made over an area of about 800 feet by 600 feet around the Deveraux Prospect. The strongest indication (-58mV) was near the shaft; most of the other indications were of small extent and less than 40 mV.

Soil samples were taken wherever a slight S.P. anomaly was found. The soil samples were assayed for copper but did not give any metal values high enough to expect payable mineralisation further away from the Deveraux Prospect.

(B) Results from Drill holes M10 to M12

Three holes (M10, M11 and M12) were drilled near the Deveraux shaft. A sketch map showing the position of the drill holes is given on Plate 7.

The core recovery was not good and left some doubt regarding the value of the results. The main data regarding the holes are given below.

DRILL HOLE M10

Direction : 224° 30' magnetic

Angle of depression : 50°

Length of hole : 132 feet

Drilled : September - October, 1956.

Geology : 0 - 95 feet Tuff and argillite

95 - 122 feet Basic dyke

122 - 132 feet Red tuff

Assay Results

Depth	Ni(%)	Cu(%)
97' - 105'	0.14	0.23
105' - 112'	0.30	0.23
112' - 115'	0.91	0.27

DRILL HOLE M11

Direction : 256° magnetic

Angle of depression : 45°

Length of hole : 143 feet

Position of hole : Same as M10

Drilled : October and November, 1956.

Geology :

0 - 105 feet Argillite and tuff

105 - 109 feet Ore

109 - 117 feet Basic dyke

117 - 119 feet Red tuff with veins of siderite

119 - 143 feet Basic dyke

Assay Results

Depth	Feet	Core recovered (ft)	Ni(%)	Cu(%)
105' - 109'	4	1	2.45	0.37
109' - 110'	1	½	0.36	0.18
115'6" - 135'6"	20		0.15	0.05

DRILL HOLE M12

Direction of Hole : 40° magnetic

Angle of Depression : 45°

Length of hole : 118 feet

Drilled : November, 1956

Geology :

0 - 61 feet Argillite and tuff

61 - 75 feet Basic dyke

75 - 118 feet Tuff

Assay Results

Depth	Feet	Ni(%)	Cu(%)
62 - 67	5	0.16	0.12
67 - 74	7	0.39	0.22
74 - 75	1	2.02	1.15

(C) Conclusions and Prospects

Assays of samples from the dump of the shallow Deveraux shaft gave more than 10.0 per cent nickel and 5.0 per cent copper. The solid ore in the shaft is of high quality, but is narrow and appears to have only a very limited extent in depth as boreholes M10 to M12 revealed ore of only about 1.0 to 2.5 per cent nickel and 0.3 to 1.0 per cent copper in the footwall portion of the dyke.

Drilling, S.P. and geochemical results indicate that the ore occurrence must be regarded as one of very limited dimensions and not of economic interest. No further prospecting appears to be warranted in the Deveraux area.

3. THE NICKEL REWARD PROSPECT

(A) Geophysical Results

During the 1952 geophysical survey (Keunecke, 1953) a well-defined S.P. anomaly of -125mV was found near the old Nickel Reward shaft. This shaft is only about 20 feet deep and only a few small parcels of ore were obtained from it (McIntosh Reid, 1925).

The geophysical indication showed, however, a north-westerly direction of strike, as compared with the normal northerly direction of the dyke. Later, a short S.P. survey was made by the author to obtain more information on the extent of the mineralization. Four parallel traverses were surveyed, 50 feet apart. For comparison, the geophysical results and the results of drill holes M13 and M15 are shown on Plate 8 as profiles. The self-potential contours, combining the results of the 1952 survey and of the four traverses surveyed in 1957, are shown on Plate 9.

The S.P. results indicate two orebodies of limited dimensions fairly close together, but separated by a barren or only weakly mineralised zone. The total length of mineralisation can be expected to be about 120 feet.

No electromagnetic survey was made in this area and the S.P. survey was not sufficient to provide information on the exact shape and dip of the ore body. This information had to be obtained by diamond drilling.

When the first diamond drill holes (M13 and M15) intersected high-grade nickel ore, the company asked the Bureau for an extension of the geophysical survey to the south, as it was believed that additional ore bodies might be found. The request was agreed to and the survey was made in 1957 over an area of about 2000 feet x 2000 feet. The results are given in a report by Horvath and O'Connor (1958). Two S.P. anomalies were found in the continuation of the Nickel Reward indication, the first one of -150mV, is recorded mainly on a single traverse about 500 feet south-east of the Reward ore body. The second, centered a further 150 feet to the south, exceeds -150mV and extends as an anomaly of over -100mV for a length of approximately 150 feet. Both indications like that on the Reward prospect, are of limited extent and are of similar intensity to the Reward anomaly. They can probably be attributed to small ore bodies, as they are on the continuation of the Nickel Reward ore body and also because assays for copper on soil samples taken in that area showed higher metal contents near the S.P. indications than elsewhere. No testing has yet been done on these indications, but limited testing, perhaps by one drill hole on each anomaly, may be warranted especially if the Nickel Reward ore body is to be exploited.

Further south, on traverses 300S to 400S, is a relatively strong self-potential anomaly which strikes east-west and extends over a length of approximately 800 feet. The intensity is variable along this length and ranges up to -580 millivolts. Its strike is different from any of the known geological features. Soil samples have been taken over this anomaly but have not yet been assayed. Recommendations for testing will await the receipt of these assay results.

(B) Costeaning

Following the 1952 survey, a trench was dug along traverse HCA to ascertain the cause of the S.P. anomaly. The S.P. indication has a very steep gradient and indicates a body at fairly shallow depth. It was therefore considered advisable to test the indication by a trench. The trench, dug in 1953, showed only a few pieces of galena and pyrite in a shear zone and gave no definite signs of a nickel ore body; only later deepening and extension of trenching operations in 1957 revealed a compact nickel ore body. About half a ton of ore was taken from it. A quartered sample was sent to the Mines Department Laboratory in Launceston for assaying and flotation tests. The assay of the sample, dated 6th June, 1957, gave the following results :-

Copper :	5.26 per cent
Nickel :	7.23 per cent
Iron :	34.6 per cent
Sulphur	43.9 per cent
Acid, insoluble :	5.72 per cent

Mineragraphic examinations of this ore by Williams and Edwards (1958) showed that the ore consists of intergrown millerite and chalcopyrite, both of these minerals enclosing corroded residuals of pyrite and resembling the disseminated ore in the Cuni North area.

No other trenching was carried out on the Nickel Reward Prospect or its southern continuation.

The failure of the shallow trench to reveal the cause of the self-potential anomaly, subsequently disclosed by the diamond drilling and later deepening of the trench, emphasises the limitations of shallow trenching as a method of testing. Not only did the shallow trench fail to reveal any copper-nickel mineralisation but the minor galena and pyrite revealed in a sheared zone was misinterpreted as the cause of the anomaly.

(C) Results from Drill Holes M13 to M22

The first drilling sites were selected so that the holes would intersect the ore at right angles to the direction of the strike of the S.P. anomaly. The drill holes disclosed high-grade nickel ore at shallow depth. After completion of the first holes, it was decided to drill several more holes to ascertain whether the ore body could be mined by open-cut methods and to determine its size and shape. The position of, and sections through, these drill holes are shown on Plates 8 to 10.

DRILL HOLE M13

Angle of Depression : 45°

Bearing :	232^{o}	
Length of hole :	142 ft.	
Position :	See Plate 9	
Drilled :	December 1956 and January 1957	
Geology :	0 - 11 feet	Overburden
	11 - 28 feet	Dyke material with disseminated sulphides and some quartz.
	28 - 45 feet	Massive ore.
	45 - 54 feet	Dyke material with disseminated sulphides and some parts of massive ore, leached.
	54 - 60 feet	Brecciated siliceous shale with some pyrite in places.
	60 - 110 feet	Mainly fine-grained tuff.
	110 - 142 feet	Banded grey shale.

The core recovery was poor and, also, the core case was damaged during transport to the laboratory, with the result that cores were disturbed and could not be properly re-arranged. Core recovery is not shown in the table below, and because of the poor recovery and the damaged core case the results cannot be regarded as reliable. Sludge samples were taken at intervals of 2 to 5 feet and assay results of both core and sludge samples are shown below. (Certificate of Department of Mines Laboratory, Launceston, 30th January, 1957).

CORE				SLUDGE	
Depth	Feet	Ni(%)	Cu(%)	Ni(%)	Cu(%)
11' - 28'	17	1.0	2.0		
28' - 40'	12	7.9	5.0		
40' - 42'	2	)Core		2.89	3.20
42' - 46'	4	)lost		14.23	0.35
46' - 49'	3	)in		3.01	2.13
49' - 54'	5	)Trans-)port.		18.84	0.40
54' - 66'	12	)		0.35	0.07
11' - 40'	29'	3.86	3.24		
40' - 54'	14'			11.87	1.16
11' - 54'	43'	6.47	2.56		

Although the core lost in transport and the combined use of core and sludge samples makes the results unreliable, the assays agree and are confirmed by those of samples from drill hole M15.

The large width of ore encountered is not the true width, as drill hole M13 penetrated the ore body from the footwall side and cut the deposit at an acute angle. But even if the quantitative results regarding width and grade cannot be fully relied upon, it appears certain that drill hole M13 showed a fairly wide ore body of good grade. To investigate the dip and behaviour of the lode at greater depth, the next drill hole (M14) was sited 40 feet north-east of borehole M13.

DRILL HOLE M14

Angle of Depression :	45°
Bearing :	232°
Length of Hole :	132ft
Position :	See Plate 9
Drilled :	February and March, 1957
Geology :	0 - 45 feet Grey and black shale
	45 - 50 feet Tuff
	50 - 80 feet Fault, very little core - consists mainly of pieces of quartz and clay
	80 - 81 feet Coarse grey tuff
	81 - 110 feet Shale
	110 - 115 feet Tuff
	115 - 120 feet Shale
	120 - 132 feet Tuff, with small veins of pyrite.

No basic dyke material was met in this hole. Extensive evidence of faulting was found, and some pieces of sulphides were found in the fault zone. As no nickel minerals were detected in this drill hole, the evidence suggests that the lode dips to the south. Also, as the log of M13 was not very satisfactory due to the damaged core case, it was decided to drill another bore-hole (M15) in the opposite direction from the other side of the anomaly.

DRILL HOLE M15

Angle of Depression :	45°
Bearing :	52°
Length of Hole :	132 feet
Position :	See Plate 9
Drilled :	April, 1957
Geology :	0 - 30 feet Light and dark grey, medium and coarse-grained tuff
	30 - 55 feet Basic dyke

30 -	33 feet	Disseminated ore
33 -	43 feet	Compact ore
43 -	45 feet	Heavily mineralised disseminated ore
45 -	47 feet	Slightly mineralised disseminated ore
55 -	62 feet	Light grey shale
62 -	67 feet	Fine-grained tuff
67 -	69 feet	Coarse-grained tuff
69 -	93 feet	Fine-grained tuff
93 -	103 feet	Medium-grained grey tuff with a little pyrite
103 -	109 feet	Medium and coarse-grained tuff, somewhat cavernous, carbonates
109 -	132 feet	Fine and coarse-grained tuff, cavernous.

Department of Mines Laboratory, Launceston, Certificate of 10th May, 1957.

Core Assays

Depth	Feet	Core recovered		Ni(%)	Cu(%)
		Inches	%		
30-32	2	7	29	0.65	0.71
32-34	2	7.7	32	6.57	0.96
34-36	2	7.7	32	13.72	2.80
36-38	2	7.7	32	12.66	1.97
38-40	2	7.7	32	10.53	1.77
40-42	2	7.7	32	9.77	4.44
42-43	1	11	92	6.73	6.77
43-44	1	11	92	2.02	3.03
44-45	1	9	75	0.95	0.91
45-46	1	12	100	0.69	0.62
46-47	1	11	92	0.27	2.12
30-34	4	14.7	31	3.61	0.84)
34-42	8	30.8	32	11.67	2.75)
42-47	5	44	75	2.13	2.69)

17' of ore with 6.97%Ni and 2.28% Cu.

The section on Plate 10 shows the results of drill holes M13, M14 and M15. The relative height of the drill holes has to be taken into consideration as M13 is situated somewhat higher than M14 and M15.

This section shows that the orebody is about 15 feet thick, has a flat southerly dip, and is situated relatively near the surface. The hanging wall is soft and broken. The self-potential anomaly coincides closely with the orebody at shallow depth. The fact that the trench on traverse HCA failed to reveal evidence of the massive sulphides clearly indicates the limitations of this type of testing.

The good quality of the ore found in the outcrop and in bore holes M13 and M15 and, on the other hand, the expected small size made it advisable to obtain more detailed information about the shape and extent of the body and the metal content of the ore. For this purpose, several additional short holes were drilled. The position of, and results from, these holes are shown on Plate 9 and details are given below.

DRILL HOLE M16

Angle of Depression :	55°
Bearing :	52°
Length of Hole :	65 feet
Position :	See Plate 9
Drilled :	1st to 10th May, 1957
Geology :	0 - 42 feet Weathered tuffs and slates
	42 - 46 feet Basic dyke
	46 - 65 feet Tuffs and slates

Core recovery was poor. Core and sludge samples were assayed in 1-foot sections between 42 and 46 feet. The sludge samples taken from 42 feet showed 0.1% nickel and those from 44 feet showed 0.16% nickel. All other assays showed only traces of nickel and copper. Bore hole M16 was offset about 20 feet to the west of the section through M15 and M13. The results from this hole indicate that the ore shoot terminates a little to the west of the section through M15 and M13. This is in accordance with the geophysical results, which indicated a sulphide body of small dimensions.

DRILL HOLE M17

Angle of Depression :	45°
Bearing :	52°
Length of Hole :	105 feet
Position :	20 feet south of Nickel Reward Shaft No. 2 (see Plate 9).
Drilled :	17th - 31st May, 1957.

Geology : 0 - 58 feet Tuffs and shales

58 - 70 feet Basic dyke, mineralised, with quartz and sulphides, (pyrite, galena, nickel ore?)

70 - 105 feet Tuffs and shales

The core recovery in this borehole was extremely low. An assay of only one sludge sample, taken between 58 and 66 feet, is given; this sample gave 0.36% Ni and 0.28% Cu. The assay of one sludge sample is of little value, and because of the very poor core recovery no reliable core assays could be done. The drill hole investigated the depth extension of the ore found in the trench, but the results from this hole must be interpreted as rather negative.

DRILL HOLE M18

Angle of Depression : 45°

Bearing : 10° east of north

Length of Hole : 87 feet

Position : Same as M17

Drilled : 31st May to 7th June, 1957

Geology : 0 - 53 feet Tuffs and shales

53 - 64 feet Mineralised basic dyke

64 - 87 feet Shales

Core Assays

Depth	Inches	Core Recovered		Ni(%)	Cu(%)
		Inches	%		
53' - 55'6"	30"	20	67	2.00	2.11
55'6"- 56'10"	16"	15	94	1.65	1.80
56'10"-58'	14"	12	86	1.69	1.82
58' - 60'	24"	9	38	1.75	2.20
60' - 62'	24"	9	38	1.05	1.72
62' - 64'	24"	9	38	0.51	0.56
53' - 62'	9ft.	5½ft.	56	1.65	1.96

DRILL HOLE M19

Angle of Depression : 65°

Bearing : 10° east of north

Position : Same as M17 and M18 (see Plate 9)

Length of Hole : 85 feet

Drilled : 10th to 14th June, 1957

Geology : 0 - 45 feet Tuffs and shales

45 - 59 feet Mineralised basic dyke

59 - 85 feet Tuffs and shales

Core assayed in Mines Department Laboratory, Launceston - Certificate 10th July, 1957.

Core Assays

Depth	Inches	Core Recovered		Ni(%)	Cu(%)
		Inches	%		
48' - 50'	24	7	29	1.00	0.86
50' - 52'9"	33	20	60	2.14	4.14
52'9"- 53'5"	8	5½	69	4.58	6.26
53'5"- 54'	7	4	57	2.04	1.46
54' - 56'	24	19	79	1.74	2.32
56' - 58'	24	19	79	1.62	1.69
48' - 58'	10ft.	6¼ft.	62	2.25	3.14

Drill holes M18 and M19 were drilled from the same site to determine the dip, thickness and quality of the ore body at slightly greater depth.

The results show disseminated ore about 10 feet thick in both holes, the nickel content being about 2.0 percent and the copper content 2.0 to 3.0 percent. The holes indicate also a rather flat dip of about 20°; this had already been suspected from bore holes M13 and M15. However, the sections through holes M18, M19 and M15 do not correlate very well and a fault with a throw of about 6 to 8 feet must be assumed between M15 and M18. The very high grade ore found in M15 was not found in M18, and it must therefore be rather limited in extent.

DRILL HOLE M20

Angle of Depression : 45°

Bearing : 10°

Length of Hole : 105 feet

Position of Hole : Approximately as shown on Plate 9, but somewhat uncertain.

Drilled : 18th June to 1st July, 1957.

Geology : Core case sent to Mines Department, Hobart without geological examination.

Core recovery poor.

Core Assays: Certificate of Mines Dept. Lab., Launceston, 18th July, 1957.

Depth	Feet	Core Recovered		Ni(%)	Cu(%)
		Inches	%		
9 - 11	2	4	17	0.22	0.31
11 - 13	2	6	25	0.49	0.47
13 - 15	2	6	25	0.49	0.38
15 - 17	2	6	25	0.50	0.40
65 - 67½	2½	16¼	54	trace	-
67½ - 70	2½	16¼	54	0.84	0.64
11 - 17	6	18	25	0.49	0.42
67½ - 70	2½	16¼	54	0.84	0.64

The drill hole seems to have struck only disseminated ore in two dykes. The results of this hole are unreliable as a result of bad drill reports and poor core recovery.

DRILL HOLE M21

Abandoned at 9 feet because an obstruction was met; drillhole M22 was drilled instead.

DRILL HOLE M22

Angle of Depression : 65°

Bearing : 10°

Length of Hole : 30 feet (abandoned, as timber of shaft No. 1 was encountered).

Drilled : July, 1957.

No core recovery was reported. As shaft timber was encountered in this hole, No. 1 shaft must have been somewhat deeper than recorded (15 feet).

(D) Conclusions and Prospects

The ore outcrops revealed in the new trenches and the results obtained in the drill holes indicate the existence of an orebody with approximately easterly strike and a relatively flat southerly dip. The body is irregular in shape but is probably lens-shaped and cut by faults. The length of the body is uncertain but is probably less than 100 feet; the thickness is over 10 feet in the centre. Its depth extent is unknown at present, but in drill hole M19 the ore was found to be about the same thickness and grade as further up in drill hole M18. The ore body is small, as is shown by the negative results of drill holes M14, M16, and M17.

4. OTHER PROSPECTS IN THE CUNI AREA

(A) Geophysical and Geochemical Results.

Several self-potential anomalies mentioned in the reports by Keunecke (1952 and 1953) and Horvath and O'Connor (1958) have either not been tested, or tested only by shallow trenching. As has been found in the Cuni North and in the Nickel Reward areas, shallow testing by trenching is not very satisfactory. On most of the anomalies, testing was either not recommended or was soon abandoned because the geological conditions for the occurrence of copper-nickel deposits were regarded as unfavourable, mainly because of the absence of basic dykes in the localities of the self-potential anomalies.

Further, testing was directed initially to finding compact ore which gives rise to relatively strong self-potential anomalies; the existence of the disseminated ore was unknown. As this type of ore may be important and gives rise to only weak geophysical anomalies, testing of some of the weaker self-potential anomalies, especially those on the strike of the dyke system may be warranted. The disseminated ore appears to be closely associated with the more compact ore and strong self-potential anomalies, even of very limited areal extent may be significant in that they may be due to small bodies of compact ore associated with substantially larger bodies of disseminated ore.

Some self-potential anomalies are still untested in the zone of the basic dyke. Of these, the strong anomaly on traverse AB near the Cuni South shaft, must be mentioned. More attention was not paid to the testing of this anomaly, because it is of small extent. The strong indication is derived probably from the compact ore, but this has largely been stoped and it is not known if any disseminated ore exists in the dyke itself. Investigation of this possibility should be worthwhile, because the compact ore was very rich. Mineragraphic investigations by the C.S.I.R.O. have shown that the ore types of Cuni North and Cuni South are very similar and the possibility of the existence of disseminated ore here should not be disregarded.

Several self-potential anomalies were recorded near the Vaudeau shaft, some to the north of it near the Blowfly and the Mosquito shafts. None of these anomalies has been tested, as such weak anomalies could be caused by various geological features. However, the position of the anomalies over the basic dyke suggests the possibility that they may be due to the occurrence of disseminated ore. Taking and assaying of soil samples in this vicinity is recommended as a first step before deciding on any drilling.

A strong self-potential anomaly with a northerly direction of strike was found on traverse G. The indication is about 500 feet south of the Vaudeau shaft and lies in the general direction of the basic dyke zone. The anomaly has been only superficially tested by a bull-dozed trench. The results are reported in the next section.

Several fairly intense anomalies were found in the area east of the basic dyke. Most of these show a northerly direction of strike and are situated in the Dundas formation, consisting here largely of brown, grey and black shales. Because of their unfavourable geological position, testing was confined to a few trenches. In the 1957 survey, several traverses were extended further east, approximately to the serpentine boundary. Several silver-lead mines, such as the Lead Blocks and McKimmie mines, were worked in the area to the east of the copper-nickel deposits in the past.

Some very strong self-potential anomalies were obtained in this area during the 1957 survey, but as the lead mineralisation occurs in black graphitic shales it is believed that the electrical indications are caused mainly by the graphitic shales, especially if they contain also finely distributed pyrite. The known lead ore occurs mostly in short shoots in the graphitic and weakly mineralised zones at widely separated places along the strike. The ore shoots might become more important if it is found that they are associated with basic dykes (McIntosh Reid, 1925), but it is difficult to recognise the ore shoots within the large graphitic and pyritic zones by geophysical means. Geochemical assays of soil samples might be helpful in the North Dundas field for the discovery of new lead deposits; at several places the lead deposits were found to be quite rich but seldom large. Economically, the lead mineralisation must be regarded as less important than the copper-nickel mineralisation.

A few indications were also found in the southern area surveyed in 1957. They were not tested, as it is considered that geochemical work should precede any further exploration there.

(B) Results of Testing

The anomaly on traverse G seemed to be in such a favourable position that a costean was bull-dozed in 1953 to see whether it is due to copper-nickel ore on the southern continuation of the basic dyke. The costean failed to reveal any dyke material, however, and showed only some pyrite and galena. Soil samples taken along the traverse in 1957 showed no higher copper values near the indication, but some showed high lead content. The results of these tests are not conclusive, as trenching in other parts has shown. Even if a drill hole is suggested as a final test, the prospects for finding a nickel ore body are not good. It seems that the dyke swings further to the west and that the indication is more like the type encountered elsewhere east of the dyke.

Two trenches tested the extensive S.P. anomaly between 300S and 1,300S. The position of the two trenches (one on traverse 700S/150W to 250W and one on 1100S/50W to 150W) is shown on Plate 2. The type of S.P. indication was not favourable for mineralisation and only graphitic shale was exposed in the trenches. No concentrations of copper or lead were found in the soil samples.

The very strong S.P. anomalies on the eastern extension have so far been tested only on traverse N, between 1800E and 1900E, and only graphitic and pyritic shale was unearthed.

Soil samples have been taken over the area but most have not yet been analysed. Only samples from traverse O have been assayed and these showed promising, high lead values over the western branch of the S.P. anomaly between 1700E and 1800E, with the maximum at 1725E. The combined use of S.P. and geochemical methods may lead to the discovery of more extensive lead mineralisation in the eastern extension of the geophysical grid between Lead Blocks and McKimmie's Mines.

5. NICKEL PROSPECTS IN THE SERPENTINE BELT.

(A) Geophysical and Geochemical Results.

Although the magnetic results in the Cuni area were rather disappointing, several traverses in the southern extension were read with a magnetometer during the 1957 survey. It was hoped to find the contact between the Dundas sediments and the serpentine, but the results were not encouraging from this aspect.

A well-defined magnetic anomaly was obtained on traverse 1200S at 1850E and on adjacent traverses. Soil samples were taken where indications were obtained with one or both of the geophysical methods, and these samples were assayed for copper and nickel.

Soil samples showed a maximum nickel content between 1700E and 1850E on traverse 1200S and a trench was dug at 1850E, the position of the magnetic anomaly. The trench revealed limonitic and siliceous material in strongly weathered serpentine; a sample of the limonitic material sent to the Mines Department Laboratory in Launceston gave, on analysis, a nickel content of 0.35%.

An easterly dip was indicated by the geophysical results and a drill site was therefore selected at 1200S/1900E, the hole to be drilled westerly in the direction of the traverse at a depression of 45°. The results from this drill hole (M23) are shown on Plate 11. The core was assayed in sections of 10 feet and 20 feet and the nickel values are plotted over the sections of the hole. The hole was in serpentine and bronzitite over its whole length, but core recovery, especially in the first 70 feet, was poor. The nickel values reach a maximum of 0.36 percent between 31 and 51 feet and decrease gradually from the maximum in both directions; values above 0.1 percent are spread over a bore hole length of about 100 feet.

(B) Drill Hole M23.

Angle of Depression :	45°
Bearing :	262° magnetic
Length of Hole :	170 feet
Position :	1200S/1900E on the 1957 geophysical grid.
Drilled :	11th July to 2nd August, 1957.
Geology :	In serpentine and pyroxenite throughout.

Assay results from core sections.

Depth	Feet	Core Recovered	Nickel (%)	Sulphur (%)	Copper (%)	Cr_2O_3 (%)
0 - 10	10	23"	0.06		trace	
10 - 31	21	5"	0.16			
31 - 51	20	6"	0.36	0.10		
51 - 61	10	22"	0.27	0.13		
61 - 71	10	26"	0.14	<0.1		
71 - 81	10	76"	0.11			
81 - 91	10	78"	0.20	0.06		0.84
91 -101	10	77"	0.19	0.13		0.47
101 -106	5	44"	0.14			
106 -119	13	67"	0.08			
119 -129	10	109"	0.04			
129 -139	10	115"	0.03			
139 -170	In sections of 10'	119" for each section	trace	< 0.1		

No copper or cobalt is associated with the nickel and only low sulphur values were found in the sections containing nickel. The serpentine, especially in the sections coinciding with the magnetic anomaly, contains a high proportion of magnetite; the sections from 81 to 91 feet and from 91 to 101 feet were assayed also for chromite. The section from 81 to 91 feet showed 0.84 percent Cr_2O_3 and 0.20 percent Ni, and the section from 91 to 101 feet showed 0.47 percent Cr_2O_3 and 0.19 percent Ni. Assays of the magnetic fractions of the crushed material showed a slight increase in nickel content.

A communication from the Director of Mines, Tasmania, dated 28th January, 1958, gives the following important information regarding some slides of samples from drill hole M23.

"A polished specimen of core from D.D.H. M23, 31ft. to 51ft., consists of altered, sheared serpentine, the rock being very magnetic. Magnetite - ilmenite occurs as irregular masses up to 0.3 mm across, surrounded by limonitic staining. Associated with the magnetite, and also occurring separately as minute disseminations about 0.1 mm across, is a deep violet mineral identified as violarite. Some pyrrhotite occurs with it in the larger masses. In a sample from 51 ft. to 61 ft., the magnetite is partly replaced by pentlandite and pyrrhotite largely altered to violarite."

The following facts became evident after the first hole had been drilled in the serpentine and some additional trenching and sampling had been done in the serpentine belt :-

(i) Nickel is found also in the ultrabasic main belt of serpentine and pyroxenite east of the dyke.

(ii) The nickel appears to be associated with the magnetite.

(iii) The magnetite occurs in well-defined zones, limited in length and width.

(iv) Little sulphur was found in drill hole M23, but the nickel does occur as sulphide in the form of violarite and pentlandite as replacement of magnetite.

(v) The nickel is not accompanied by copper or cobalt, but some chromite is present.

(vi) The nickel in drill hole M23 is not of economic grade, but is distributed over a large width.

(vii) The nickel values decrease gradually from a maximum.

(viii) The different type of ore probably needs a different type of treatment for concentration and recovery of nickel.

(ix) No appreciable difference appears to exist between the nickel values in the trench and those in the drill hole.

(C) Other Prospecting Activities in the Serpentine Belt.

After drill hole M23 established that the nickel follows higher magnetite concentrations in the serpentine, attention was paid to other similar limonitic outcrops in the serpentine belt and samples were taken in several places.

The samples were assayed in the Mines Department Laboratory, Launceston, and revealed fairly wide-spread nickel mineralisation in the serpentine. Nickel values ranging between 0.10 percent and 0.40 percent were found in considerable quantities at the localities shown in the table below :-

Locality	Description	Nickel (%)
Emu Bay Railway	Railway cutting	
"	0 - 6'	0.17
"	6'- 12'	0.21
"	12'- 18'	0.12
"	18'- 24'	0.19
"	24'- 30'	0.30
"	30'- 36'	0.38
"	36'- 42'	0.23
"	42'- 48'	0.16
"	48'- 54'	0.23
"	54'- 60'	0.26
Tunnel Hill	Summit cutting	
"	0 - 6'	0.40
"	6'- 12'	0.10

Locality	Description	Nickel (%)
Tunnel Hill	Summit cutting	
"	12' - 18'	0.15
Grand Price	Prospect tunnel	0.14
"	" "	0.24
"	" "	0.05

(D) Recommendations for Further Exploration in the Serpentine Belt.

An exploration programme of geological mapping, geophysical and geochemical surveys, trenching and drilling is required in the serpentine belt to determine whether ore bodies of payable grade and quantity can be found.

It has always been considered that the basic dyke and also the nickel deposits in it are only off shoots of the main magma consisting of serpentine, which originally was a pyroxenite. However, no nickel had been found in the mass of serpentine of Stichtite Hill. The serpentine mass is fairly extensive. It is found between the Argent tunnel and the Lead Blocks mine and must continue southwards in a fairly wide belt on both sides of the Emu Bay Railway. It was not known that this belt continued as far south as Nevada Creek, as is indicated by drill hole M23. The drill hole must be situated near the western and southern boundaries of the serpentine (Plate 12).

The serpentine weathers easily to a light grey-green, soft rock and is therefore found in the more denuded valleys and flats surrounded by a more blocky, waxy, dark green variety of serpentine which is found on Stichtite Hill and other ridges, mainly to the east of the Emu Bay Railway. The serpentine is closely associated with pyroxenites and is only an alteration product of these. The pyroxenite is hard and dense and is dark brown in colour where it crops out. It is more resistant to weathering than serpentine and stands out as hills above the softer serpentine. Although the serpentine appears in general to be free of magnetite, there are concentrations of magnetite such as the ore found in drill hole M23. The geophysical survey was made over only the margin of the serpentine belt and only a small area of ultrabasic material has been investigated by geophysical methods.

In the geological mapping, special attention should be paid to the presence of olivine minerals (peridotite and dunite) in the eruptive and of sulphides, as nickel has a close affinity for magnesium and sulphur.

The ultrabasic eruptives are shown on Plate 12 as one unit. Insufficient mapping has been done to differentiate between the various rock types such as serpentine, pyroxenite and bronzitite, gabbro and norite. A detailed investigation to map the distribution of these various rock types is necessary. Mapping in the thickly timbered country will be difficult and manual labor will be required to aid the geologist in obtaining exposures.

The boundaries of nickel values might be due to petrological variations in the host rock and might therefore be irregular in shape and poorly defined.

Better conditions for the persistence of the ore at depth can be expected within the main mass of the magma because temperature and pressure during the metallogenetic period will not have changed as quickly there as in the much smaller dyke.

If the nickel assays should reach payable values, much larger quantities of nickel ore might exist within the serpentine massif than in conjunction with the basic dyke.

III. ACKNOWLEDGMENTS

The valuable and ready co-operation of the Tasmanian Mines Department, particularly the Chief Chemist and Metallurgist (W.St.C. Manson) and staff of the Metallurgical Laboratory, Launceston, is gratefully acknowledged.

Thanks are also due to the Chairman of Directors (Mr. Sizer) and the Mine Manager (Mr. Clarke) of Montana Silver Lead N.L. for the co-operation and assistance given during the geophysical surveys and the diamond drilling campaign.

The assistance given by W.M.B. Roberts and J.K. Lovering of the Geological Section of the Bureau, in the mineralogical and petrological investigations of drill cores is also gratefully acknowledged.

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APPENDIX

MINERALOGICAL AND PETROLOGICAL INVESTIGATIONS OF DRILL CORES

Several drill core specimens were sent to Canberra for mineralogical and petrological determination of ore and rock types. The investigations were made in the petrological laboratory of the Bureau of Mineral Resources by W.M.B. Roberts and J.K. Lovering.

Mineragraphic determinations of ore minerals present were made on compact and disseminated ore from drill hole M6 in the North Cuni area.

The compact ore (M6, 138 feet) consists of the nickel iron sulphide violarite (Ni_2FeS_4) with the theoretical composition of 38.9 percent nickel, 18.5 percent iron, 42.5 percent sulphur. The mineral forms large irregular areas and is pseudomorphous after pentlandite. There is also some residual pentlandite (FeNi)S, which was the earliest sulphide mineral. The violarite is cut by very fine hair-like veins of pyrite. Pyrite is the second important sulphide; it fills the interstices between the violarite crystals and occurs also as groups of anhedral crystals. Chalcopyrite ($CuFeS_2$) forms irregular granular areas which mould anhedral pyrite crystals and which contain residuals of violarite. The variations in the nickel to copper ratio are due to the varying amounts of violarite and chalcopyrite, as the minerals tend to occur in bands. Pyrrhotite is found only as a very minor constituent. In most nickel ores, pyrrhotite is the main sulphide mineral and is usually closely intergrown with the pentlandite. These two minerals are usually hard to separate even with fine grinding, and with such ores the concentrates cannot be enriched to a high nickel content. With the relatively simple mineral combination in the compact Cuni ore no difficulties should be experienced in a flotation plant separating only the sulphides from the gangue and the country rock. The gangue material is mainly a fine-grained carbonate, either siderite or dolomite. The carbonate fills the cleavages in the violarite and contains angular fragments of residual sphalerite. Grains of quartz appear in the gangue. The carbonate gangue has been introduced subsequent to the sulphides in which it forms veins and large irregular areas.

The mineral sequence is sphalerite, violarite, pyrite, chalcopyrite, carbonate.

In the disseminated ore, the main nickel mineral is millerite (NiS) and a very minor amount of bravoite $(FeNi)S_2$ is present; chalcopyrite is the sole copper mineral. The sulphides occur in patches consisting of intimate intergrowths of the sulphide minerals with each other and with some of the gangue minerals. Siderite and quartz are the main gangue minerals; they often occur as veins. Pyrite and sphalerite are more prevalent as sulphide minerals than in the compact ore and the occurrence of ilmenite and hematite is reported.

Thin slides were made of several core specimens of dyke material and of the sediments of the Dundas group. Dyke material from drill holes M6, M8, M9, M10, M11 and M12 was examined and the dyke was found to be an extensively metasomatised dolerite. The meta-dolerite is a fine-grained to medium-grained, greenish grey rock consisting of feldspar pseudomorphs, remnants of pyroxene and hornblende. The feldspar is replaced by epidote and sericite. Most of the rock is made up of secondary actinolite, chlorite and penninite. Veins of carbonates - mainly siderate - and quartz cut the dyke where it is mineralised. The rock was regionally metamorphosed after invasion by the vein material. The metamorphism is so strong that its original character became almost obliterated but its basic and partly ultra basic composition can still be recognised.

Core specimens of the sediments of the Dundas group were also investigated, particular attention being paid to those from drill holes M7 and M9, as in these holes the dyke was not encountered at the expected depth. Most of the Dundas formation drilled through consists of tuff and volcanic ash. The tuff is fine-grained to medium-grained and is mainly red or green. The red ferruginous tuff is composed of quartz, tourmaline and chlorite fragments in a red matrix of hematite and chlorite. The matrix of the green and grey tuff consists of fragments of chlorite, plagioclase and limonite. Large parts of the formation are distinctly banded, the bands consisting of alternating fine-grained and medium-grained tuff. The bands were brecciated some time after their deposition, and infiltrated by solutions which filled the spaces with angular quartz, penninite, calcite and pyrite.

Volcanic ash of extremely fine grain size often occurs in conjunction with the tuff. The only minerals large enough for determination are quartz (in angular fragments) and sericite. The parallel arrangement of sericite flakes gives the rock a schistose appearance. Small grains of pyrite are distributed through the volcanic ash. Carbonate and chlorite have been introduced fairly widely.

Some fine-grained to medium-grained laminated rocks were encountered mainly in the area of the Nickel Reward Lease; the fine-grained were determined as argillite, the medium-grained as greywacke. The greywacke consists of fragments of quartz, chlorite, altered ferromagnesian minerals, limonite and patches of carbonate. The fragments are arranged in sub-parallel layers, giving a fine lamination.

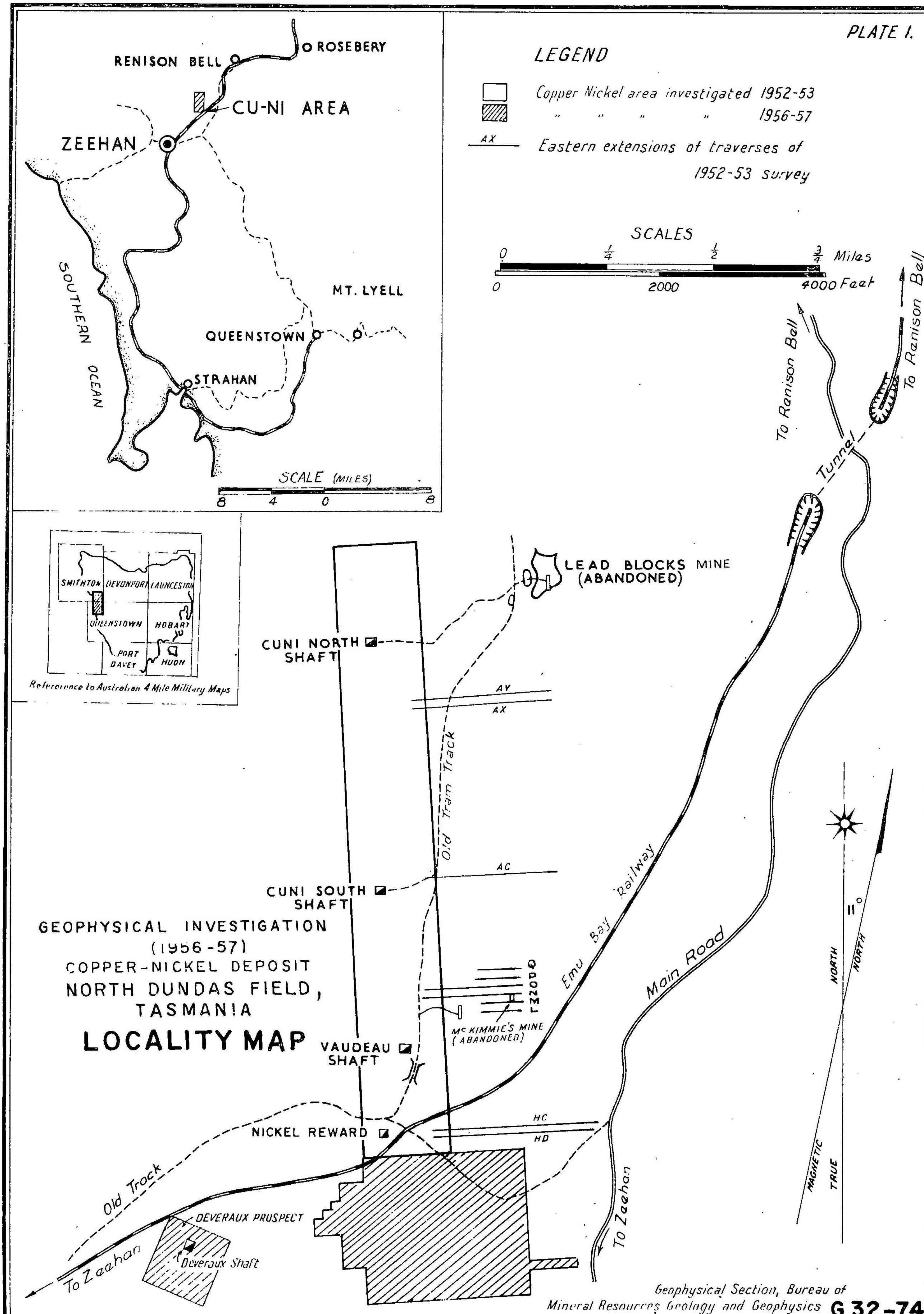
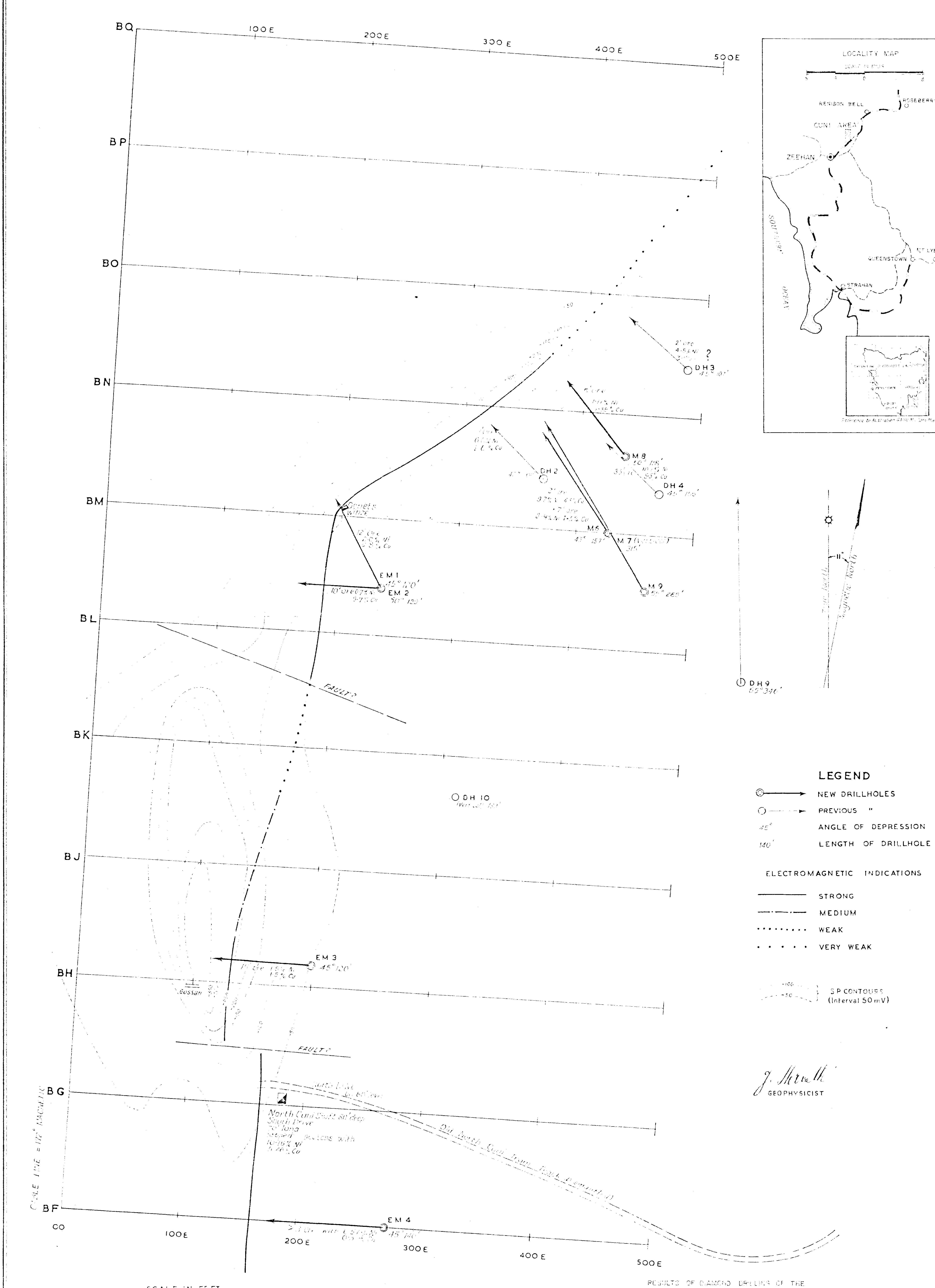


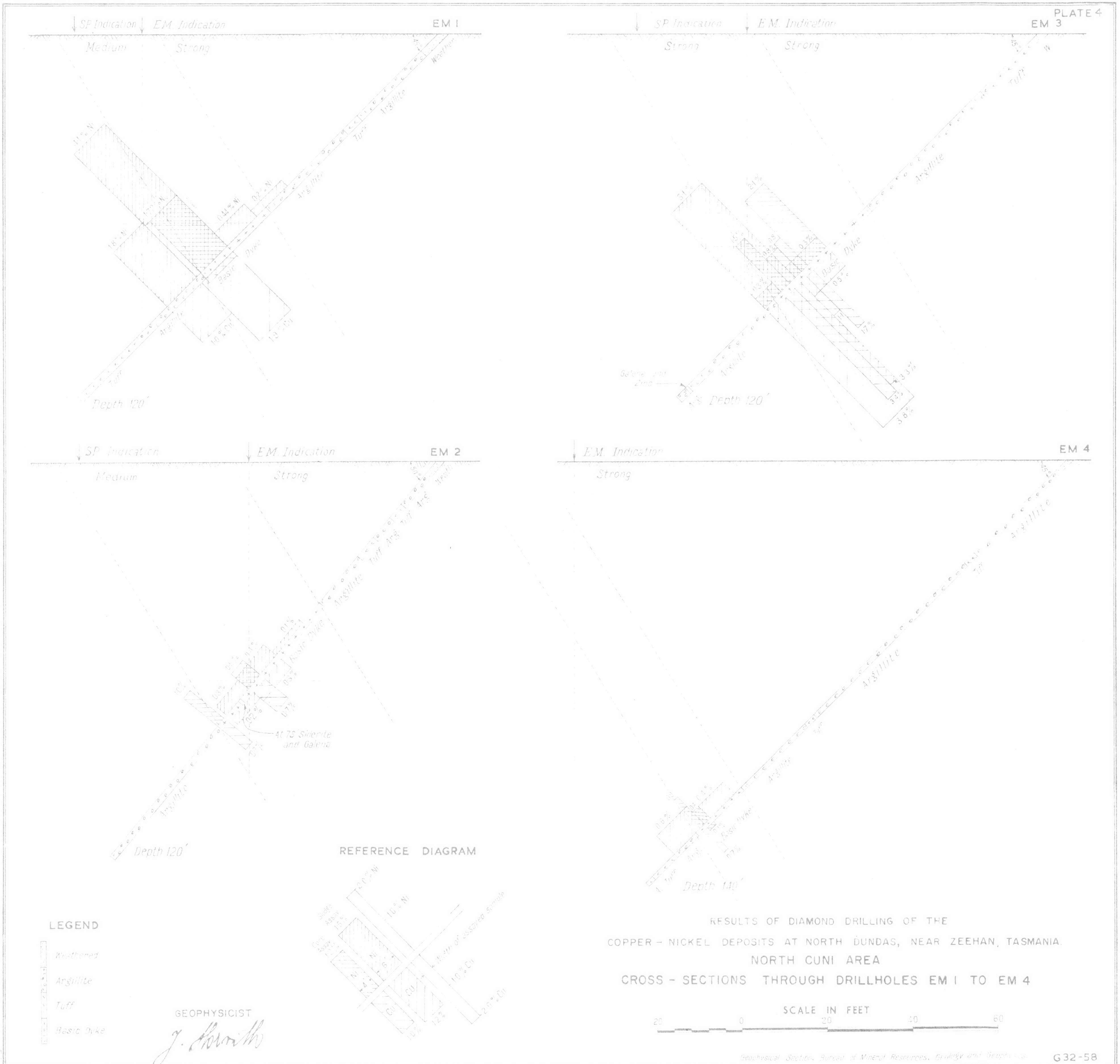
PLATE I.
LEGEND
Copper Nickel area investigated 1952-53
" " " " 1956-57
AX
Eastern extensions of traverses of 1952-53 survey
SCALES
0 1/4 1/2 3/4 Miles
0 2000 4000 Feet
ROSEBERY
RENISON BELL
CU-NI AREA
ZEEHAN
SOUTHERN OCEAN
MT. LYELL
QUEENSTOWN
STRAHAN
SCALE (MILES)
8 4 0 8
SMITHTON
DEVONPORT
LAUNCESTON
QUEENSTOWN
HOBART
PORT DAVEY
HUON
Reference to Australian 4 Mile Military Maps
LEAD BLOCKS MINE (ABANDONED)
CUNI NORTH SHAFT
AY
AX
Old Tram Track
AC
CUNI SOUTH SHAFT
To Ranison Bell
To Ranison Bell
Tunnel
Emu Bay Railway
Main Road
McKIMMIE'S MINE (ABANDONED)
VAUDEAU SHAFT
NICKEL REWARD
HC
HD
Old Track
DEVERAUX PROSPECT
Deveraux Shaft
To Zeehan
To Zeehan
NORTH
NORTH
11°
MAGNETIC
TRUE
GEOPHYSICAL INVESTIGATION (1956-57)
COPPER-NICKEL DEPOSIT
NORTH DUNDAS FIELD, TASMANIA
LOCALITY MAP
Geophysical Section, Bureau of Mineral Resources Geology and Geophysics
G 32-74

PLATE 3



RESULTS OF DIAMOND DRILLING OF THE
COPPER-NICKEL DEPOSITS AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA
NORTH CUNI AREA
POSITION OF DRILL HOLES AND RESULTS OBTAINED

G32-67



RESULTS OF DIAMOND DRILLING OF THE
COPPER - NICKEL DEPOSITS AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA
NORTH CUNI AREA
CROSS - SECTIONS THROUGH DRILLHOLES EM I TO EM 4


PLATE 2
RESULTS OF DIAMOND DRILLING OF THE COPPER-NICKEL DEPOSITS
AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA
SELF-POTENTIAL CONTOURS
SCALE IN FEET
200 0 200 400 600 800
CONTOUR INTERVAL 50 MILLIVOLTS
GRID, GEOLOGY, SHAFTS, OLD BORE HOLES, ETC., AFTER THE GEOLOGICAL REPORT OF THE TASMANIAN DEPARTMENT OF MINES, ZEEHAN BRANCH 1952, AND THE I.G.E.S. (IMPERIAL GEOPHYSICAL EXPERIMENTAL SURVEY) REPORT, 1931.
J. Horvath
GEOPHYSICIST
LEGEND
SELF-POTENTIAL CONTOURS
BASIC DYKE
TRENCH
MINE SHAFT (ABANDONED)
D.H.7 OLD BORE HOLE
M 23 NEW " "
RAILWAY
TRACK
TRAVERSE
See Plate 5
BASE LINE MAGNETIC BEARING 172°
BS
BR
BQ
BP
BO
BN
BM
BL
BK
BJ
BH
BG
BF
BE
BD
BC
BB
BA
AZ
AY
AX
AW
AV
AU
AT
AS
AR
AQ
AP
AO
AN
AM
AL
AK
AJ
AH
AG
AF
AE
AD
AC
AB
AA
Z
Y
X
W
V
U
T
S
R
Q
P
O
N
M
L
K
J
A
B
C
D
E
F
G
H
HA
HB
HC
HCA
HD
HDA
HE
HEA
HF
HG
HH
00
100 S
200 S
300 S
400 S
500 S
600 S
700 S
800 S
900 S
1000 S
1100 S
1200 S
1300 S
1400 S
1500 S
1600 S
1700 S
1800 S
600 W
400 W
200 W
00
200 E
400 E
600 E
800 E
1000 E
1200 E
1400 E
1600 E
1800 E
2000 E
2200 E
2400 E
2600 E
2800 E
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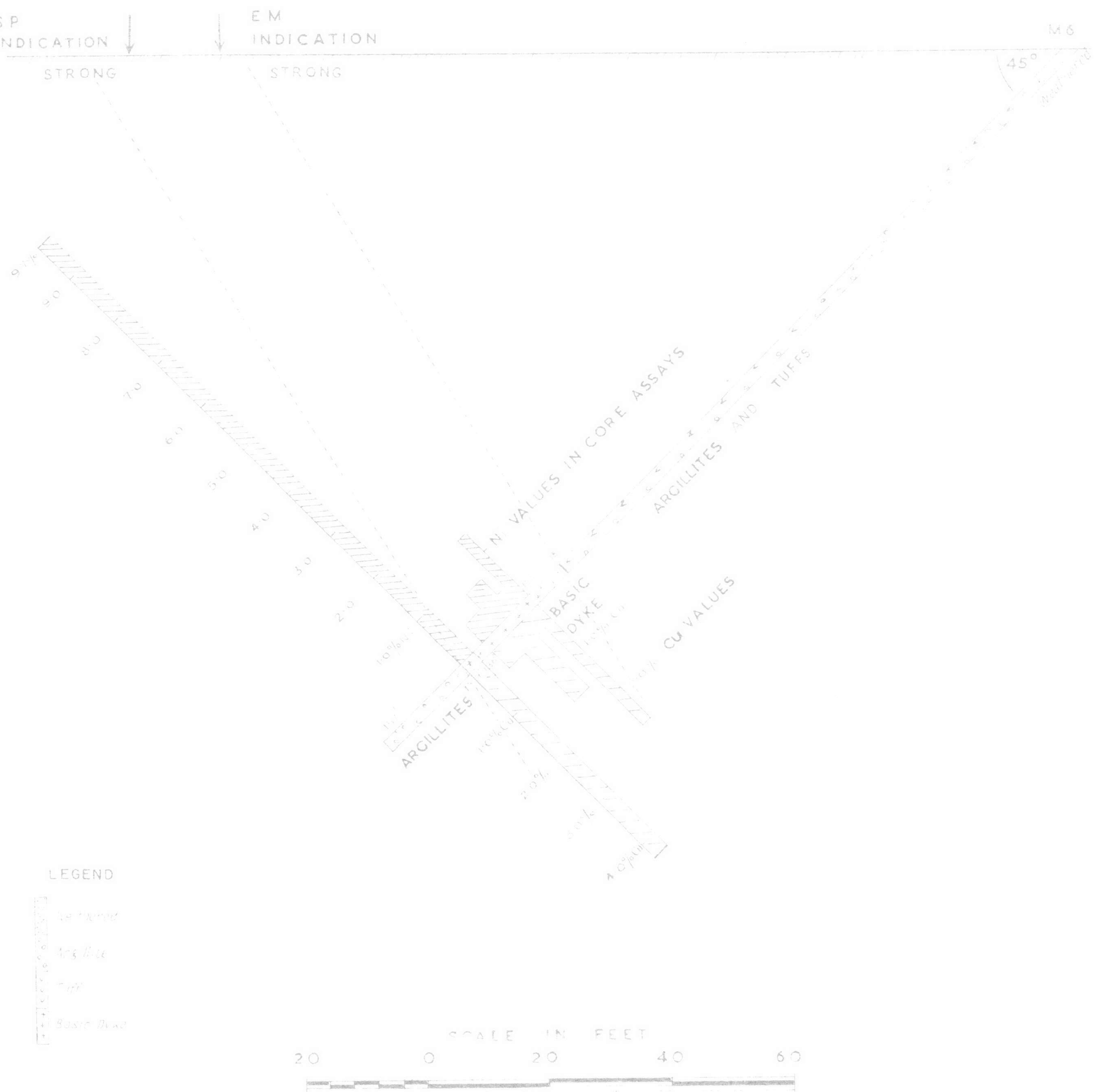


RESULTS OF DIAMOND DRILLING OF THE

COPPER-NICKEL DEPOSITS AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA

NORTH CUNI AREA

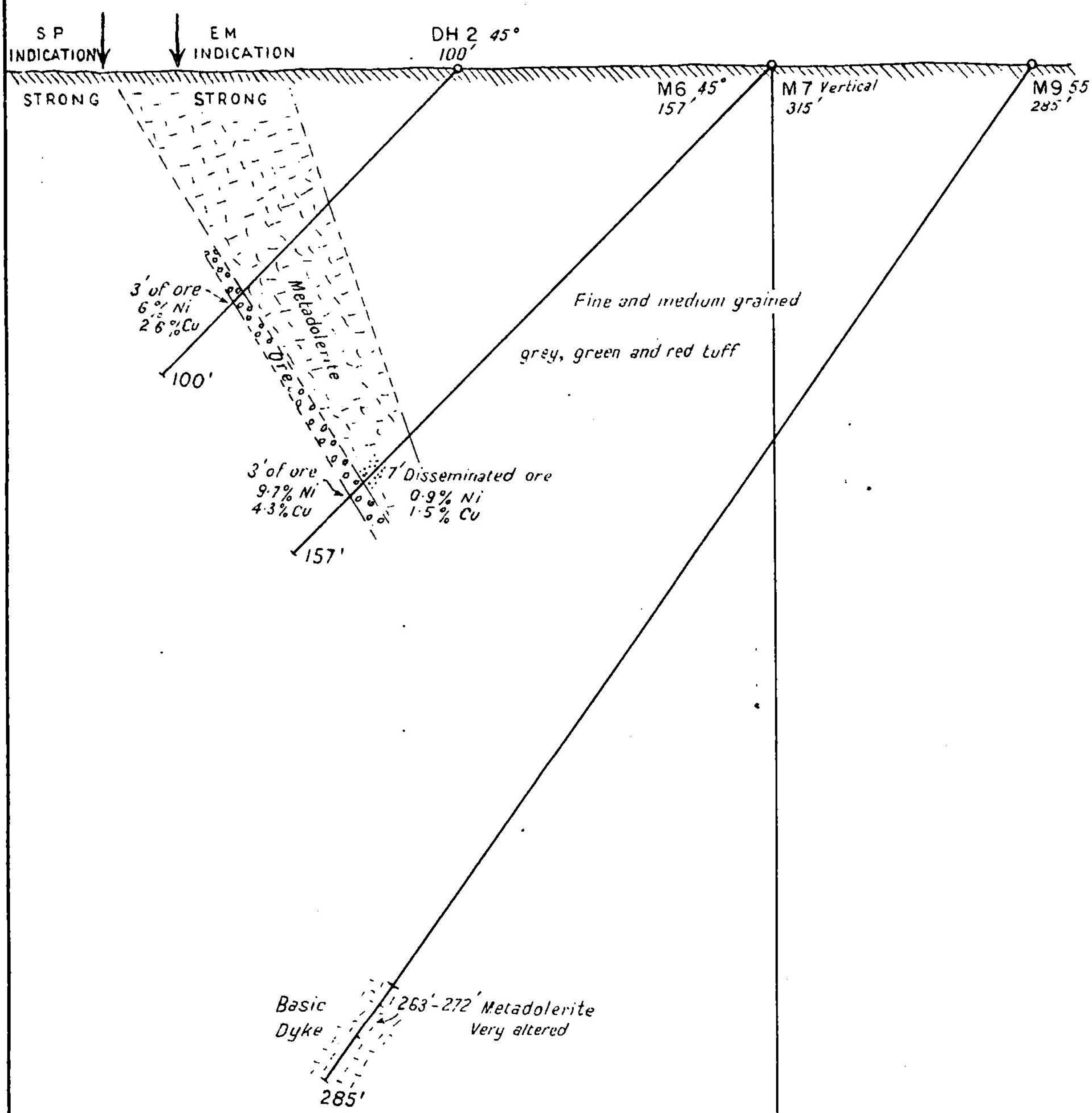
CROSS - SECTION THROUGH DRILLHOLE M6

J. Horvath

GEOPHYSICIST

G 32-61

PLATE 6



LEGEND

M9 55° 285' — DRILL HOLE, NUMBER, DEPRESSION AND LENGTH

J. Horvath
GEOPHYSICIST

RESULTS OF DIAMOND DRILLING OF THE

COPPER – NICKEL DEPOSITS AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA

NORTH CUNI AREA

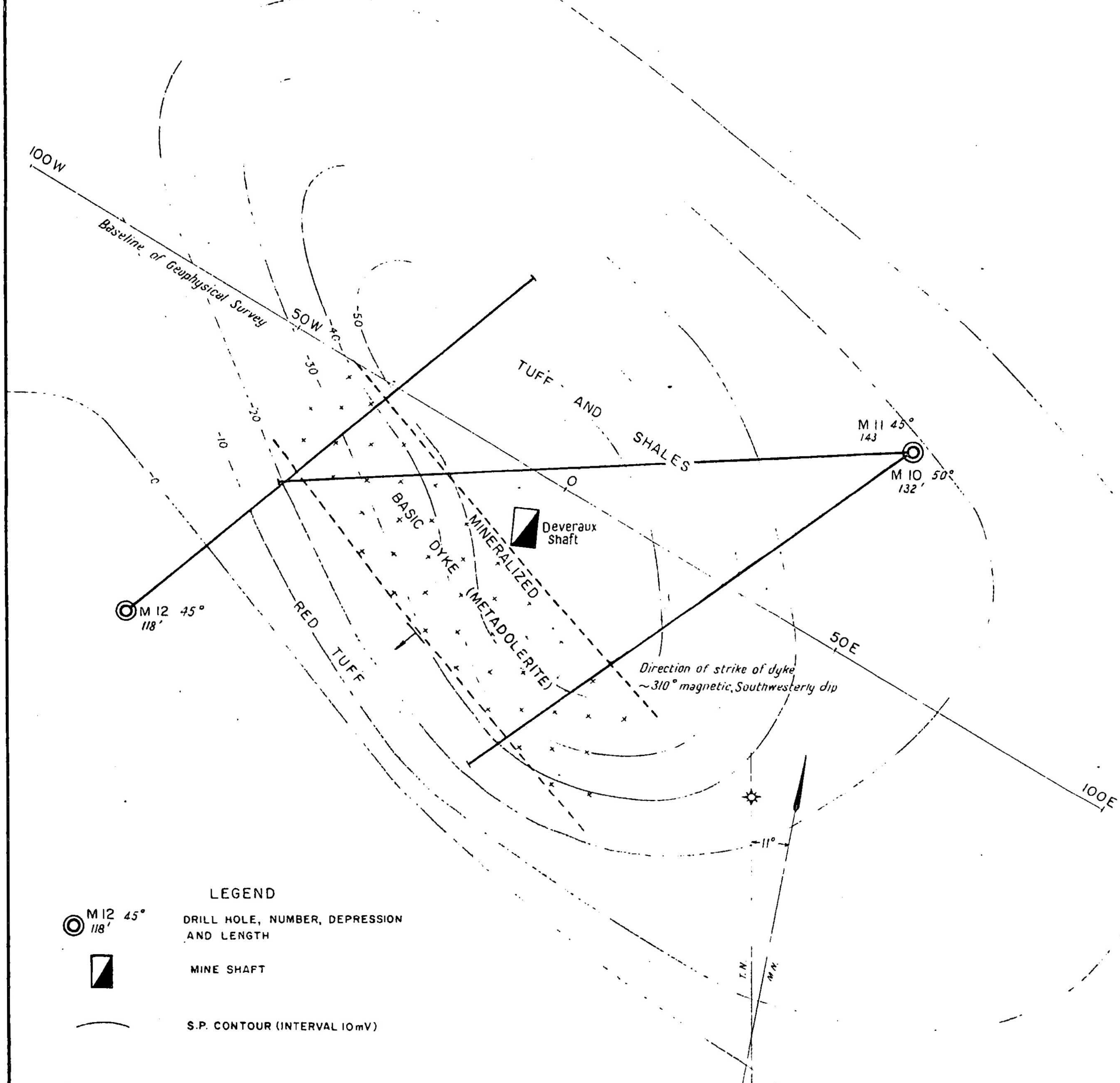
CROSS – SECTION THROUGH DRILLHOLES M6, M7, M9 AND DH2

SCALE IN FEET

40 0 40 80 120

G 32 – 70

PLATE 7



RESULTS OF DIAMOND DRILLING OF THE
COPPER - NICKEL DEPOSITS AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA.

DEVERAUX PROSPECT
PLAN OF DRILLHOLES M10, M11, M12 AND S.P. CONTOURS.

SCALE IN FEET

20 0 20 40 60

GEOPHYSICIST J. Horvath

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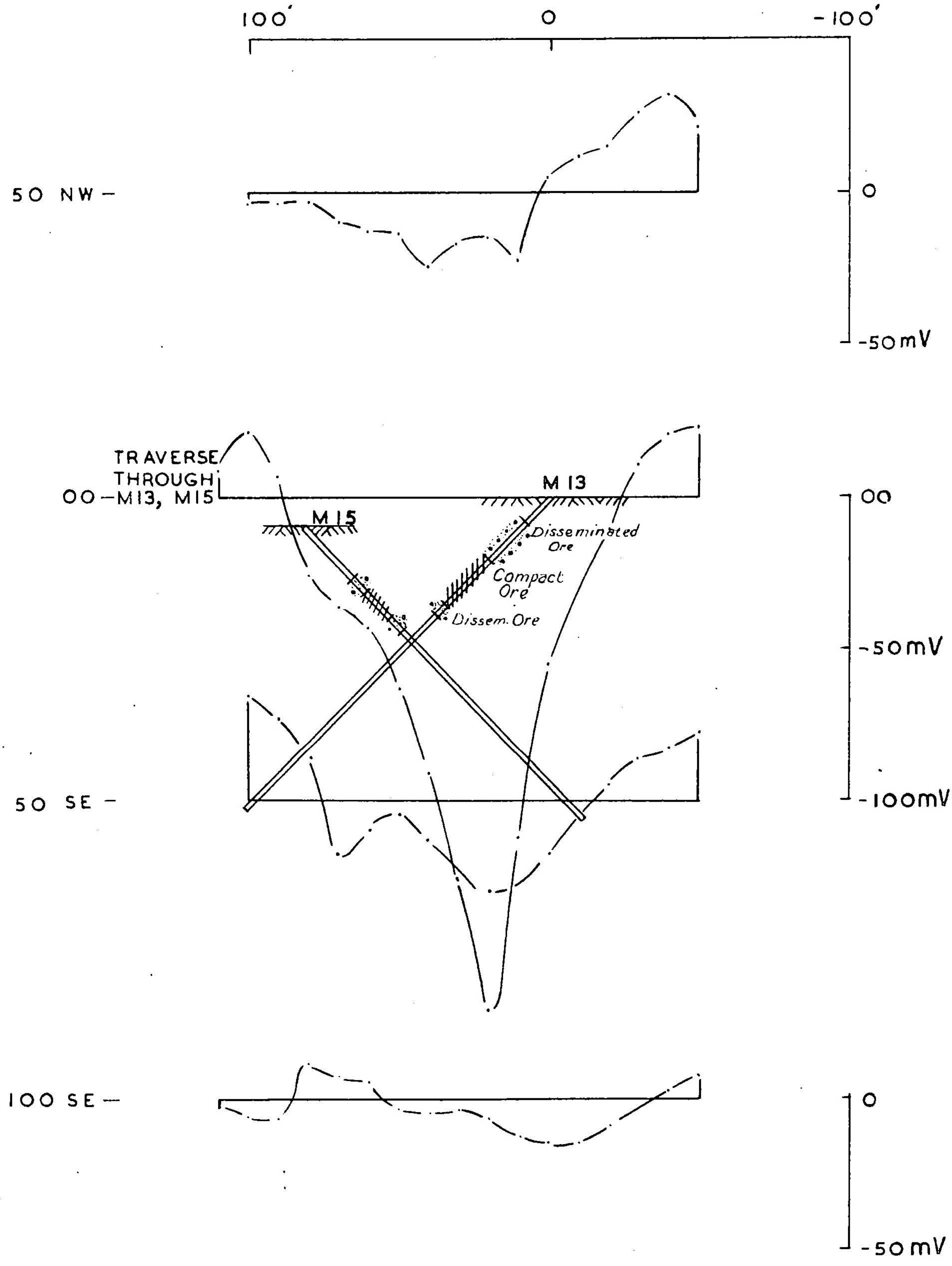
PLATE 8



J. Horvath
GEOPHYSICIST

RESULTS OF DIAMOND DRILLING OF THE

COPPER-NICKEL DEPOSITS AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA

NICKEL REWARD PROSPECT

S.P. PROFILES ALONG TRAVERSE THROUGH DRILL HOLES

M 13 AND M 15 AND PARALLEL TRAVERSES

SCALES

HORIZONTAL 50 0 50 100 150 FEET

S. P. 50 0 50 100 150 mV

G 32-64

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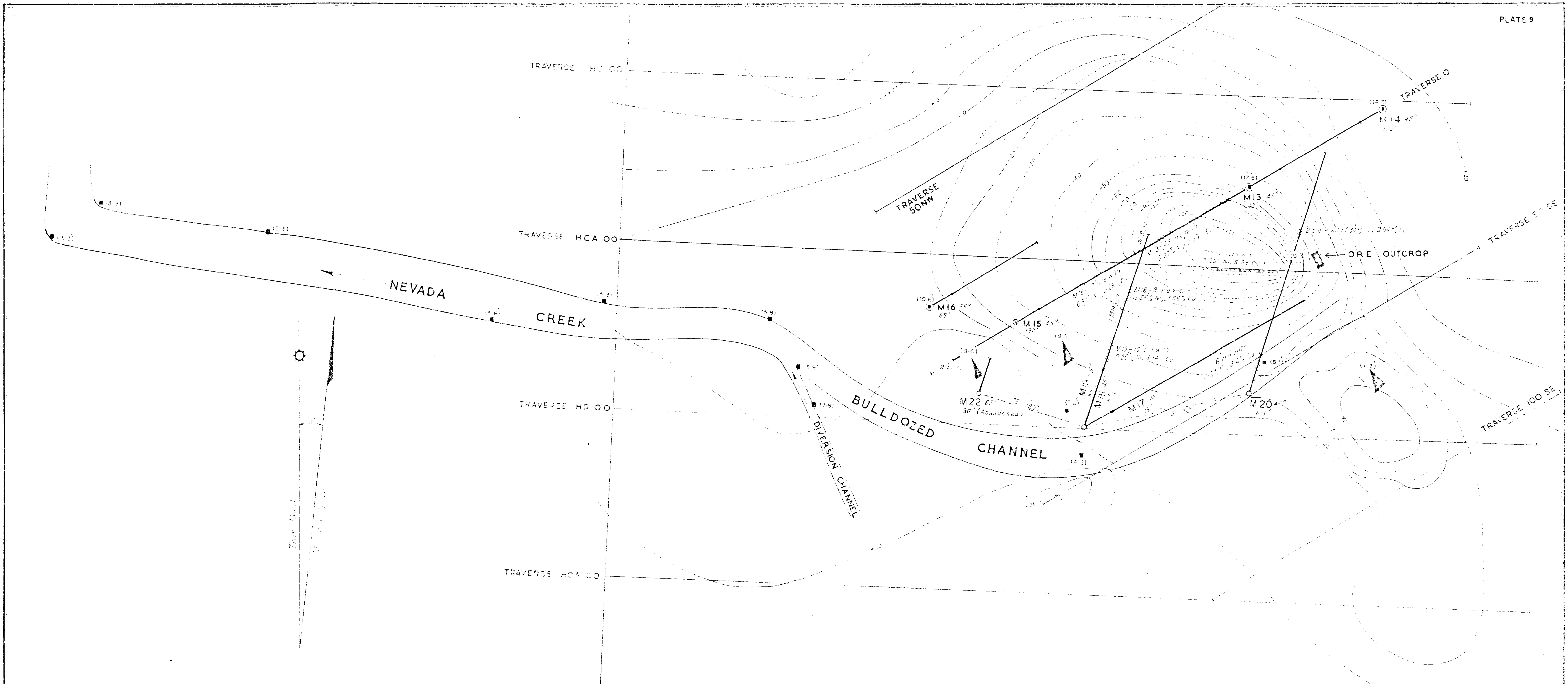


LEGEND

M20 45° 105' DRILL HOLE, NUMBER, DEPRESSION, LENGTH

MINE SHAFT (ABANDONED)

(3·3) SPOT LEVEL

THE POSITIONS OF DRILL HOLES M16 TO M22 ARE AS REPORTED BY THE MINE MANAGER.

RESULTS OF DIAMOND DRILLING OF THE

COPPER - NICKEL DEPOSITS AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA

NICKEL REWARD PROSPECT

POSITION OF DRILL HOLES M13 TO M22, DRILLING RESULTS OBTAINED AND SELF-POTENTIAL CONTOURS

SCALE IN FEET

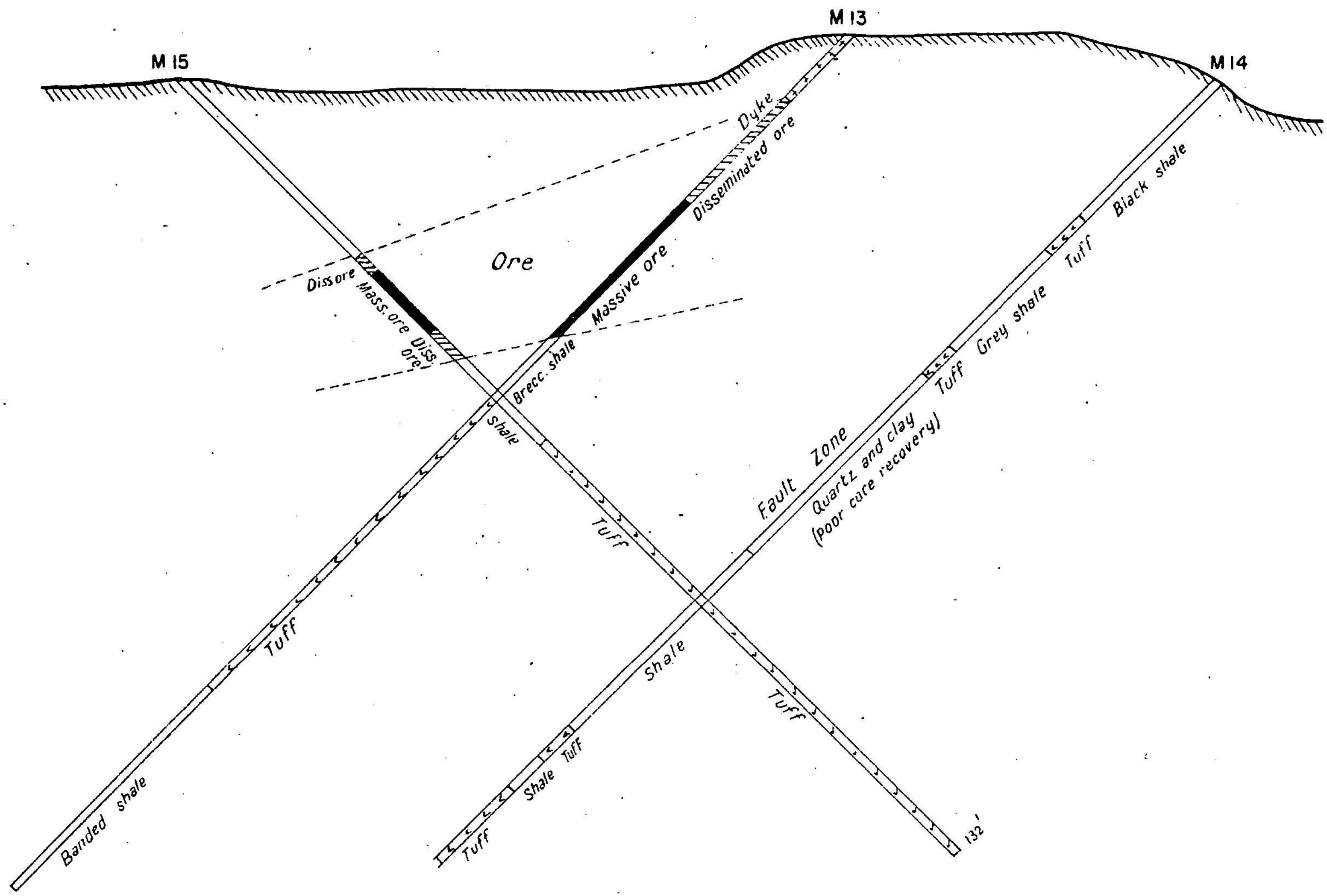
20 0 20 40 60

GEOPHYSICIST

J. Smith
GEOPHYSICIST

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics

G 32 - 63



RESULTS OF DIAMOND DRILLING OF THE

COPPER - NICKEL DEPOSITS AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA

NICKEL REWARD LEASE

CROSS - SECTION THROUGH DRILLHOLES M 13, M 14 AND M 15

SCALE IN FEET

20 0 20 40 60

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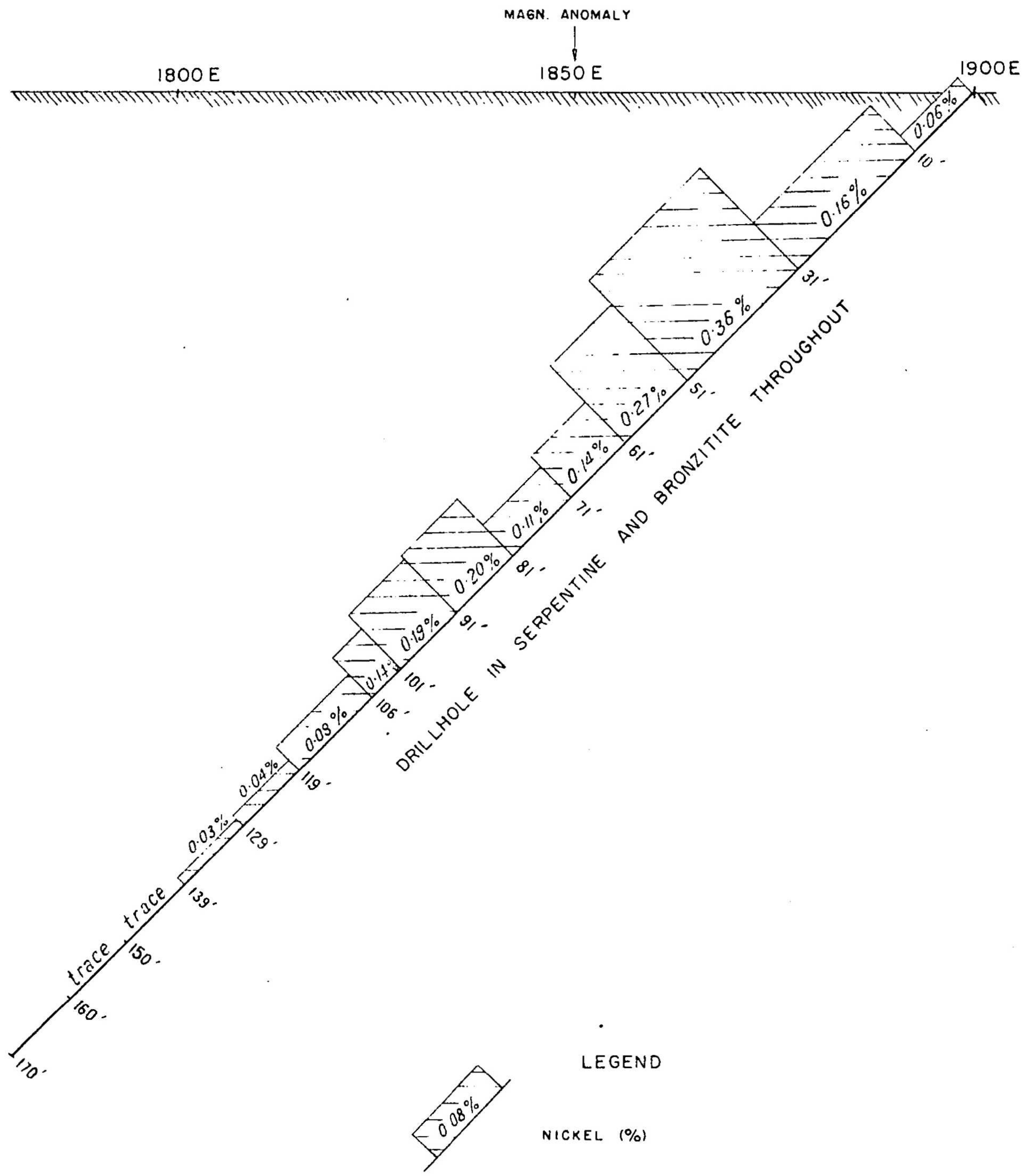

RESULTS OF DIAMOND DRILLING OF THE

COPPER – NICKEL DEPOSITS AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA

SERPENTINE BELT

CROSS – SECTION THROUGH DRILLHOLE M 23

SCALE IN FEET

0 50 100

J. Horvath

GEOPHYSICIST

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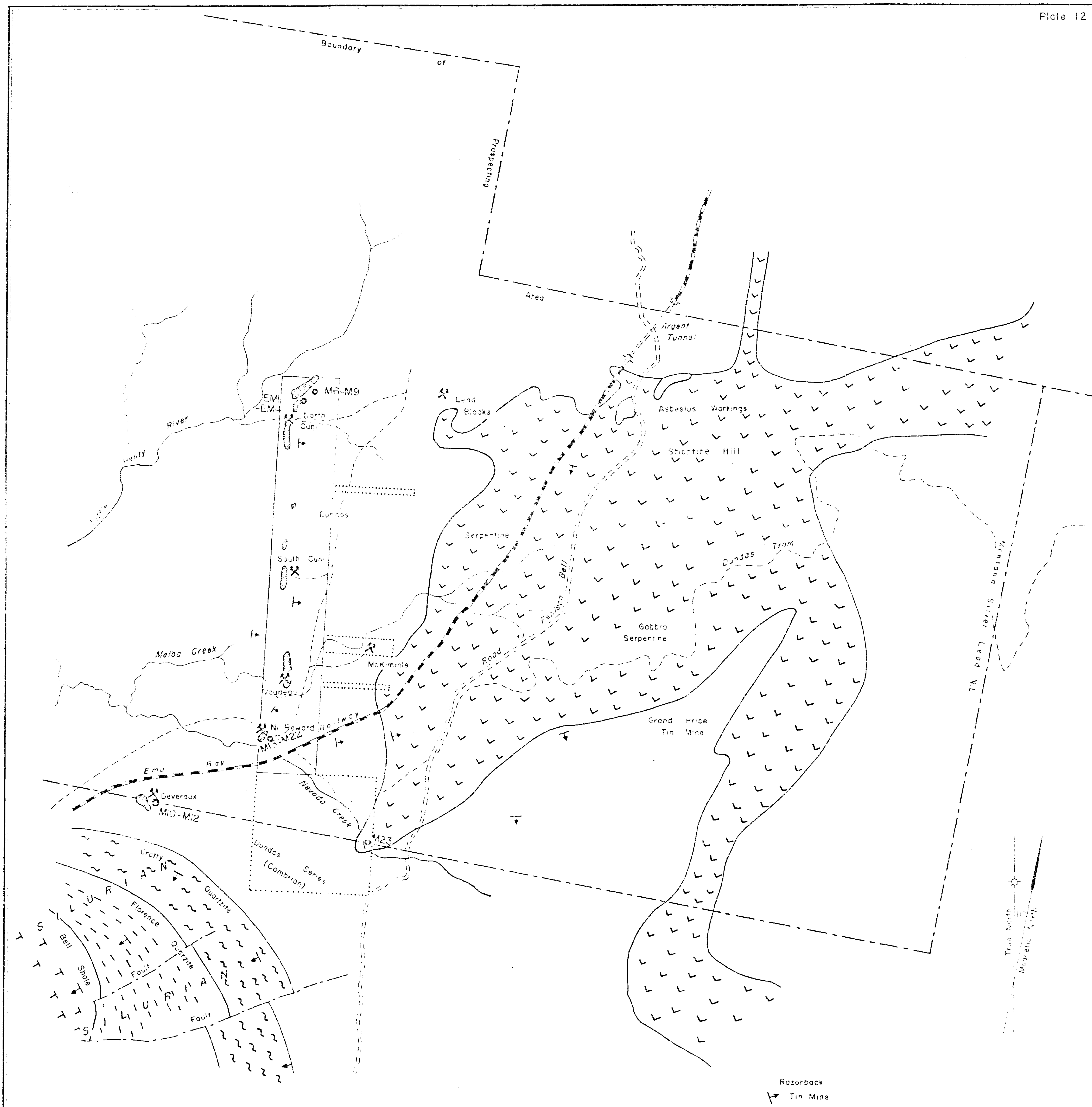

Legend

- Dundas Series
- Ultrabasic Rocks: Serpentine, Bronzitite Gabbro
- Metadolerite Sill
- Geophysical Survey 1952/1953
- Geophysical Survey 1957
- Road
- Old Tramtrack (Rails removed)
- Boundary of Prospecting Area of Montana Silver Lead Mine
- Old Abandoned Mines
- Drill Holes Completed EM1-EM4, M6-M9, M10-M12, M13-M22, M23

SCALE IN CHAINS

20 0 20 40 60 80

RESULTS OF DIAMOND DRILLING OF THE COPPER NICKEL DEPOSITS
AT NORTH DUNDAS, NEAR ZEEHAN, TASMANIA

REGIONAL GEOLOGICAL SKETCH MAP

(COMPILED MAINLY FROM TASMANIA GEOLOGICAL SURVEY BULLETINS)

GEOPHYSICIST

GEOPHYSICAL SECTION, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

G 32-77