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# RIO AUSTRALIAN EXPLORATION PTY. LIMITED

MELBOURNE, AUSTRALIA

**PROJECT:—** PRP/7/100

**REPORT No.:—** 5/1957

## THE IRON DEPOSITS

## OF THE SAVAGE RIVER AREA,

## NORTHWEST TASMANIA

by

R.S. MATHESON and H.E. JENSEN

Iron Deposits of the Savage R. Area (Rio Aust Expl Pty Ltd) by R.S Matheson & H.E. Jensen 20/5/57.

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# THE IRON DEPOSITS OF THE SAVAGE RIVER AREA NORTHWEST TASMANIA

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## CONTENTS



## PLANS AND SECTIONS

## INTRODUCTION

During the period 29th April to 9th May 1957, R.S. Matheson and H.E. Jensen visited the Savage River area for the purpose of making a preliminary geological examination of the iron deposits in the Rio Tinto Government Reservation and in the R.T.A.E. magnetic anomalous area, and to lay down an initial programme for test drilling. An examination of the Rocky River iron deposits, which are also embraced in a Government Reservation was not intended or undertaken during this visit.

The area of investigation is situated in deeply dissected, heavily forested country, about 22 miles west southwest of Waratah (Plate 1). Access to the Rio Tinto deposits is the more difficult, and they are reached by walking on a pack track for 4½ miles. Geological work can be more readily carried out at the Rio Tinto deposits than at the R.T.A.E. anomaly, however, as traverse lines have been cut through the dense undergrowth for ground geophysical work, whereas the R.T.A.E. anomaly is in virgin country covered by timber and thick bowera scrub.

The investigations were carried out under very arduous conditions, and, with a view to improving accessibility to the Rio Tinto area in the future, three helicopter landing points have been selected and the clearing of them is in hand. Better access to the R.T.A.E. area in the future can be readily obtained by prior use of a bulldozer.

The examination of the Rio Tinto deposits was carried out in conjunction with Geologist T. Hughes and party of the Tasmanian Geological Survey and we have collaborated with them in laying out the drilling programme for the area. The Tasmanian Geological Survey have kindly made available to us all their available information on the area, including preliminary results of the ground magnetometer surveys carried out on their behalf by the Bureau of Mineral Resources.

Details of the investigations which have been carried out are given in the following pages.

## THE DEPOSITS

### RIO TINTO DEPOSITS

These iron deposits, which have been known for many years, extend as scattered lenses in a north-south direction over a distance of about 2½ miles. They follow the crest of a sharp ridge, which crosses the Savage River, and rises to a height of about 800 feet above river level.

By reference to the Appendix it will be seen that the iron deposits, which consist chiefly of magnetite, are regarded by the Tasmanian Geological Survey as magmatic segregations in a belt of basic intrusive rocks consisting of gabbro-amphibolite and the schistose derivatives therefrom. These derivatives consist of talcose schists, chloritic schists, and amphibolite schists. These basic rocks intrude a sequence of Pre-Cambrian slates and quartzites and are tentatively regarded as also of Pre-Cambrian age. The sulphide mineralisation, and also the dolomite which occurs in the area, are considered to be associated with the basic magma.

The present investigations have been restricted to that portion of the Rio Tinto belt, extending northwards from a point about ½ mile south of the Savage River. In this area broad geological mapping of the iron deposits has been carried out on the lines which were previously cut for the ground magnetometer survey by the Bureau of Mineral Resources (Plate 2). From this mapping sufficient information has been obtained to make a rough estimate of possible reserves in the main north and main south iron deposits, and plan a preliminary test drilling programme.

Outcrop conditions in the area are poor, and only in a few places were clear cut boundaries seen, most geological boundaries being covered by soil and scree. The iron deposits themselves form the strongest outcrops along the main ridge, but even these are only sporadic.

The iron deposits are lenticular in character, and they strike in a northerly direction and dip steeply, probably steeply east as is mentioned in the earlier more detailed reports. The distribution of the lenses of iron ore appears to be parallel to the boundaries of the basic intrusives and they follow schistose zones therein, which may represent pre-mineralisation shear zones. In places in the iron deposits, and particularly near their boundaries they become impure and show an admixture with host rock minerals. It is possible that some of these impure bands occur within the boundaries of the main deposits. Hematite is associated with the magnetite in some places and this is considered to be due to surface weathering. The powdery friable magnetite occurring in the adit situated 250 feet south of a point 2300 feet west on traverse line A, may have also resulted from weathering processes. There is fairly widespread evidence that sulphide mineralisation occurs in association with the iron deposits, and the sulphides are regarded as post-magnetite. Pyrite, and possibly some pyrrhotite, have been noted, but no chalcopyrite was seen although its presence has been mentioned in earlier reports. The absence of any widespread copper staining indicates that the chalcopyrite is probably confined to small local areas. There is evidence of silicification of both the country rock and the iron deposit in places in the area.

A search for the marked gossan outcrop indicated west of the iron deposits on the plan in the Appendix proved disappointing. The best indications were on traverse line C29 where gossan and sulphides occurred over a width of 2 feet. As soil cover is present in the area the gossan could possibly be somewhat wider but certainly by no means as extensive as indicated on the plan mentioned above. The best gossan outcrop noted was the cellular quartz gossan on traverse line FOO.

It is considered a more careful search for gossans and a more detailed study of the geology can best be undertaken when drilling commences, and a good base camp is set up in the area.

It is of interest to note that thin flatly distributed remnants of a previously much more extensive, Tertiary basalt flow are present in the area.

The results from the levelling which has been done along the traverse lines was not available to us at the time of investigation, so that rough levelling was carried out by Abney level and Aneroid barometer to enable us to draw profiles and plan the diamond drilling programme. It will be possible to draw better profiles when the results of levelling come to hand from the Tasmanian Mines Department.

The final results of the ground magnetometer surveys are also awaited, but the magnetic highs in the vicinity of the main north and main south iron deposits, as indicated from preliminary results, are shown on plate 2.

## R.T.A.E. ANOMALY

This magnetic anomaly, which was located during airborne surveys carried out by Adastra-Hunting Geophysics on behalf of R.T.A.E., is situated about 6 miles south of the Rio Tinto deposits, in an area where the presence of iron deposits has not been previously recorded.

The plus 6000 gamma section of the anomaly trends in a north-north-westerly direction, is about 2½ miles long and ½ mile wide. At its peak the anomaly reaches 8000 gammas which is only about half the strength of the peaks at the Rio Tinto deposits.

A search for this anomaly on the ground indicated that it co-incided roughly with a north-north-westerly trending ridge, which however was heavily timbered and covered with a dense undergrowth of bowera and ti-tree scrub. Access to the ridge could only be obtained by cutting lines, and a longitudinal line extending for about ¾ mile from the south end of the anomaly was completed in 3 days. In addition a line was cut east for ¼ mile from the end of this traverse. An examination of these lines showed that the ridge was covered with peat and soil and no evidence of the existence of an iron deposit was found. In fact, the only rock fragments found were on the eastern traverse line, and these consisted of fragments of quartz schist and slates and were definitely not the host rocks for iron ore as found to occur in the Rio Tinto area.

It has now been decided to extend the line cutting for the full length of the ridge and cut cross lines therefrom at ¼ mile intervals for ¼ mile both east and west in search of evidence for the existence of an iron deposit. If outcrop conditions do not improve we will have to resort to ground geophysics to localise the zone responsible for the airborne magnetic anomaly.

The above work may occupy several weeks and nothing further can be done in the area until it is completed. A programme of diamond drilling for this area can only be laid down if and when an important iron deposit is located.

## GEOPHYSICAL WORK

The Rio Tinto area has been entirely covered by two airborne magnetometer surveys, and partly covered by a ground magnetometer survey. One of the airborne surveys and the ground survey were carried out by the Bureau of Mineral Resources on behalf of the Tasmanian Mines Department and the results are only now being made available to R.T.A.E. The final results for the ground surveys are still awaited. The second airborne survey was that carried out by Adastra-Hunting Geophysics during their regional surveys in northwest Tasmania on behalf of R.T.A.E. It is interesting to note that the results from the two separate airborne surveys are comparable, but there is a slight difference in the positioning of the anomalies. The anomaly located during the B.M.R. survey coincides more closely with the actual ground position of the iron deposits, while the anomaly located during the Adastra survey is displaced to the west.

The R.T.A.E. anomaly has been located by the Adastra survey, and its positioning with regard to the ground occurrence of iron deposits is yet to be determined. Ground magnetometer surveys may be required in this area.

## ESTIMATE OF POSSIBLE ORE RESERVES AND GRADE

A study of the geological plan of the Rio Tinto area (Plate 2) will show that the main north and main south deposits are very extensive, but as they occur near the crests of sharp ridges it is thought their dimensions are considerably exaggerated by scree. The paucity of outcrops also makes the dimensions of the deposits uncertain. It is considered wise for the purposes of this report to make a conservative estimate of possible reserves, and in doing so we have accepted the widths shown for the ground magnetometer anomalies as those corresponding to the iron deposits. The accepted length for the two main deposits is that over which iron is known to occur. A factor of 7.5 cubic feet to 1 long ton has been adopted for the estimates, and the tons per vertical foot has been calculated for both the north and south main deposits. A figure for total possible reserves has been calculated to a reduced level of 1100 feet in the case of the main north deposit and to a reduced level of 900 feet in the case of the main south deposit. These levels are approximately 500 feet below the highest surface level of the longitudinal axes of the two main deposits. Details are given in the table below and it will be seen that the total possible reserves greatly exceed previous estimates of reserves in the area, which however were only calculated to a vertical depth of 300 feet. Additional reserves are available from "scree" material and probably from greater depths in the two main deposits, and other deposits in the area will probably be found to contain large possible reserves when properly mapped and assessed.

Previous scattered sampling in the area has indicated that the iron is probably of high grade (in the vicinity of 65 per cent iron), and low in impurities ( titanic oxide trace; silica 0.38 to 2.40 per cent; alumina 0.02 to 0.22 per cent; phosphoric acid nil to 0.38 per cent; and sulphur 0.01 to 3.66 per cent). These values are tentatively accepted, but it should be borne in mind that the true average quality of the iron ore will only be established after drilling operations.

POSSIBLE ORE RESERVES

| Block | Block Length Feet | Av.Cross Sectional Area Sq. feet | Depth to a reduced level Feet. | Tonnage (long tons) |
|---|---|---|---|---|
| D 24 to D 27 | 480 | 61,975 | 1100 | 3,966,400 |
| D 27 to E 00 | 880 | 140,825 | 1100 | 16,523,466 |
| E 00 to F 00 | 1100 | 156,987 | 1100 | 23,024,760 |
| F 00 to F 4 | 400 | 55,937 | 1100 | 2,983,307 |
| Total - Main North Deposit | 2860 | | 1100 | 46,497,933<br>(say) 46,500,000 |
| A+500'S to A | 500 | 299,925 | 900 | 19,995,000 |
| A to B | 500 | 285,250 | 900 | 19,016,666 |
| B to B 8 | 720 | 217,575 | 900 | 20,887,200 |
| B 8 to C | 690 | 149,612 | 900 | 13,764,304 |
| C to C12+100'N. | 1030 | 67,325 | 900 | 9,245,966 |
| Total - Main South Deposit | 3440 | | | 82,909,136<br>(say) 83,000,000 |
| Grand Total - Main North and Main South Deposits | | | | 129,500,000 (long tons) |

Note :- The widths taken in calculating the average cross-sectional areas were based on those of ground magnetic anomalies (Preliminary results from B.M.R. survey).

A factor of 7.5 cubic feet per long ton was used for tonnage calculation.

TABLE SHOWING LENGTH, AVERAGE WIDTH AND POSSIBLE TONS PER VERTICAL FOOT

| Deposit | Length Feet | Av. Width Feet | Long tons per vert. foot |
|---|---|---|---|
| Main North | 2,860 | 260 | 99,146 |
| Main South | 3,440 | 350 | 160,533 |

DIAMOND DRILLING PROGRAMME

Although it is desirable that R.T.A.E. commence drilling operations on their own iron deposits before drilling on the Government Reservation, it is only possible at this juncture to plan the diamond drilling programme for the Rio Tinto area. Details are given in the table below and reference should also be made to plates 2, 3 and 4. It is considered that this drilling is required to adequately test the quantity and quality of the iron ore in the main north and main south deposits to a depth of 500 feet. Further drilling would be required to assess reserves to a greater depth, to test and assess other iron deposits in the area, and to test gossan zones. The preliminary drilling should however be sufficient to decide whether or not mining operations are warranted in the area, and even this programme could possibly be curtailed if the quality of the iron ore does not live up to expectations.

It is anticipated that the drilling and camp equipment would be transported to the area by helicopter, and arrangements are at present in hand for three convenient landing points to be cleared (Plate 2). Adequate water supplies for drilling purposes can be obtained from the Savage River or its tributaries.

PROPOSED DIAMOND DRILLING RIO TINTO DEPOSITS

| Iron Deposit | Traverse Line | Site | Position Site | Hole No. | Depression | Bore Depth |
|---|---|---|---|---|---|---|
| Main North | E 00 | A | 275' E | 1 | 40° W | 1250 ft. |
| " " | E 00 | B | 480' E | 2 | 40° W | 1500 ft. |
| " " | F 00 | C | 215' E | 3 | 50° W | 1000 ft. |
| " " | D 27 | D | 260' E | 4 | 50° W | 600 ft. |
| Main South | B 8 | E | 740' W | 5 | 50° W | 500 ft. |
| " " | B 8 | F | 370' W | 6 | 50° W | 950 ft. |
| " " | A | G | 1490' W | 7 | 45° W | 950 ft. |
| " " | A | G | 1490' W | 8 | 60° W | 1300 ft. |
| " " | C | H | 365' W | 9 | 50° W | 800 ft. |
| | | | Totals :- | 9 | - | 8850 ft. |

Allowing for contingencies total drilling = 9000 ft. (Say)

All holes are to be drilled westwards on the bearing of their respective traverse lines, and with two machines it is estimated the work would take about 1 year.

An estimate of the costs involved in testing the area are as follows -

| | |
|---|---|
| Diamond drilling @ £5 per foot say | = £45,000 |
| Assay work, core boxes, freight on samples etc. | = £5,000 |
| Helicopter hire @ say £250 per month | = £3,000 |
| Additional geological work, technical supervision and clearing costs. | = £2,000 |
| Total : | £A55,000 + |

In the above estimate, no allowance has been made for the provision of access tracks for the drills, a water supply (involv-

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# ASSAY RESULTS OF SAMPLES OBTAINED FROM SAVAGE RIVER AREA - NORTHWEST TASMANIA

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| Sample No. | Gold | Insol. % | Iron % | Sulphur % | Manganese % | $P_2O_5$ | $TiO_2$ |
|---|---|---|---|---|---|---|---|
| 175 | Nil | - | - | - | - | - | - |
| 176 | Nil | 7.5 | 65.4 | 4.9 | - | - | - |
| 177 | - | 2.5 | 65.6 | 0.15 | 0.05 | 0.07 | 1.9 |
| 180 | - | 7.1 | 62.4 | 1.9 | 0.08 | 0,32 | 0.32 |
| 181 | Nil | 13.7 | 50.7 | 4.9 | - | - | - |
| 183 | Nil | 25.5 | 51.6 | 3.9 | - | - | - |
| 184 | Nil | - | - | - | - | - | - |
| 185 | Nil | - | - | - | - | - | - |

NOTE: 175 Gossan-cellular quartz assayed for gold only
184 Country with sulphides " " " "
185 Gossan " " " "

COMMENTS:

The assay results confirm that the iron content of the samples taken closely approximate those of the previous scattered sampling. Impurities are much higher however, and if these samples indicate representative percentages of sulphur and phosphorus pentoxide, the massive iron ore deposit could not produce a marketable product.

Sulphur in excess of 0.03% is undesirable, and over 0.25% the iron ore has little value. Phosphorus content should be less than 0.045%, ores containing more and up to 0.18% will sell at lower prices.

The titanium oxide content is also much higher than previous sampling has indicated.

These results confirm our contention that the quality of the iron ore is questionable, and it will not be properly appreciated until the deposits have been tested over a good cross section in the primary zone. Poor outcrop conditions indicate that this testing can best be done by diamond drilling.

R. S. Matheson and H. E. Jensen
12th June, 1957.

ing pumps, tanks and piping) and a good base camp, and these items could possibly involve an additional £5,000.

Although no drilling can yet be planned for the R.T.A.E. anomaly, if an interesting iron deposit is located in the area, the general idea would be to test it to about 500 feet with two holes on each of three separate section lines. About 4500 feet of drilling could possibly be involved.

## CHECK WORK

By reference to the Appendix it will be seen that samples previously collected from the Rio Tinto deposits have indicated that the iron ore is of good quality and low in impurities, but these analyses are not necessarily truly representative of the average grade of the reserves in the main iron deposits. The writers have suspicions that sulphides may be more abundant in the iron deposits than has been previously appreciated and this would detract from the value of the iron ore, but the association of gold, copper, nickel, cobalt or other valuable minerals with the sulphides would be a compensating factor. There is also a strong possibility that seams of amphibolite schist or magnetite amphibolite schist, which cannot be detected at the surface due to the paucity of outcrops, may occur within the iron deposits and lower its overall high quality. Silicification, which may also be deleterious, has also been noted in places in the iron deposits.

The following list of samples to provide some information in this regard, have been submitted to the South Australian Mines Department for assay and the results will be distributed when to hand. A true appreciation of the quality and extent of the iron deposits will however only be obtained by careful geological logging and sampling and assaying of the cores obtained from the proposed diamond drilling operations.

| Sample No. | Locality | Field Description | Work required |
|---|---|---|---|
| 175 | From outcrop 500' W. of F00 | Cellular quartz gossan | Assay for gold |
| 176 | From adit dump approx. 350 ft. west of F21 | Iron ore with sulphides | Determination iron, sulphur & gold content. Determination sulphide minerals. |
| 177 | Vicinity D23 | Iron ore, with hematite and silica | Assay Fe, $SiO_2$, $Al_2O_3$, $P_2O_5$, S, $TiO_2$, $MnO_2$. |
| 180 | From adit 250' S. of point 2300' W. on Traverse A. | Friable iron ore Sample over 55 ft. | As for 177 |
| 181 | From adit 500' S. of point 650' W. on Traverse D. | Iron ore with sulphides | As for 176 |
| 183 | S. side of river at approx. 1200' W. of C.12 | Sulphide being gossan | As for 176 |
| 184 | From trench 100 ft. N. at 970' W. on Traverse C29 | Country with sulphides | Assay for gold |
| 185 | As above | Gossan | Qualitative test for gold. |

Some powdery friable magnetite ore was found on one of the old adits, and although the extent of such ore is not known, and it may be restricted to the oxidised zone, it is well to bear its presence in mind in connection with drilling operations and possible later mining operations.

CONCLUSIONS

The investigations which have been carried out have confirmed the presence of possible large reserves of high quality iron ore in the Rio Tinto area. A conservative estimate of possible reserves in the two main deposits to an average level of about 1,000 feet amounts to 129,500,000 long tons of ore, which it is hoped is of high quality and low in impurities. A programme of 9,000 feet of diamond drilling has been laid down to confirm these reserves and determine more accurately the average quality of the ore. It is probable that at least an equal quantity of reserves is present in other deposits in the area, and these can be assessed later if the quality of the ore in the main deposits lives up to expectations.

Sulphide mineralisation is present in the area and a check will be made to see if valuable minerals such as gold, copper, nickel or cobalt occur in economic quantities in association with it.

The examination of the R.T.A.E. anomalous area indicated that extensive line cutting and possibly ground geophysics will be needed to locate the deposit responsible for the airborne magnetic anomaly. A programme of test drilling will be laid down when the anomaly has been located and geologically mapped.

R.S. Matheson and H.E. Jensen

20th May, 1957

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## APPENDIX

EXTRACT FROM "THE IRON ORE DEPOSITS OF TASMANIA"
GEOLOGICAL SURVEY OF TASMANIA, MINERAL RESOURCES No. 6,1919

(by A. McIntosh Reid)

### (2) LONG PLAIN IRON-ORE FIELD

The deposits of magnetite described in these pages, as well as many others smaller in extent occurring in this locality, have been known for many years. They were originally discovered by Surveyor-General Sprent on one of his early expeditions through the western districts. It was considered at the time that the huge outcrops were cappings of tinstone deposits, and when this anticipation was not realised, the prospects were abandoned. However, several years later prospecting was resumed on the associated pyritic ore-bodies, which were found to contain chalcopyrite, gold, and silver. Subsequently large exploratory works were undertaken by wealthy mining companies at Rio Tinto, Rocky River, and at intermediate points, but in no occurrence were the metals sought after sufficiently concentrated to be of economic value. These immense magnetic deposits have been repeatedly noted by the Geological Survey, but their possibilities as sources of iron have not been fully realised until recent time. This investigation has shown that the extent of high-grade magnetic iron is much larger, both in the Rio Tinto and Rocky River areas, than anyone had reason to anticipate.

The Rio Tinto portion of the iron field lies 25 miles by road south-westward from Waratah, and 20 miles from the port of Corinna, on the Pieman River. A fairly well-graded road has been constructed from Waratah over the Magnet Range to the edge of Long Plain, whence it is connected with the terminus of the road leading from Corinna by a 10-mile track.

The iron ore occurs in disconnected masses contained in a belt of metamorphosed gabbro-amphibolite, ½-mile wide by 25 miles long, running 8 degrees west of north and south of east. They lie for the most part on the eastern side of Savage River, but cross the valley at Rio Tinto, and extend northward to Specimen Reef gold field. Southward they continue on the western confines of Long Plain, cross the Whyte and Rocky Rivers near their confluence, and extend beyond Paradise River. The surface of this area is a tableland (Long Plain), 1100 to 1200 feet above sea-level, which is portion of an old Tertiary erosion channel. Much of the surface is gently undulating, with shallow serrated stream valleys, but in the vicinity of Savage River the effects of erosion are more pronounced.

### A. - PETROLOGY

Although the rocks which contain the magnetite deposits of the Long Plain and Zeehan districts differ in composition and in structure, as well as in age, yet in many respects they are remarkably similar. The former are described as hornblendic, serpentinous, quartzose, and talcose schists belonging to the Pre-Cambrian, while the latter are gabbro-amphibolites of Devonian age. Generally the metamorphosis of the Pre-Cambrian schists of Long Plain has been intense; but in certain parts the hornblendic rock occurs devoid of banding, foliation, or schistosity, having the macroscopic appearance of gabbro-amphibolite. These formations were examined by W.H. Twelvetrees, Government Geologist, who makes the following comments :- (ø)

ø Vide W.H. Twelvetrees : "Report on Mineral Fields between Waratah and Corinna" - Report of the Secretary for Mines, Tasmania. 1900-1901.

"The gneissose gabbro-amphibolite is enclosed in talc schists, into which it apparently passes. In places it is a pale banded gneiss; at other spots it is fissile and compact, passing into a hornblendic schist; or, again, it is coarse and gabbroid in texture. Its colours are green and grey in various shades. It consists of a fibrous green hornblende, with large gabbroid-like plates of plagioclastic felspar, apatite, quartz, and a good deal of epidote. Talc, hornblende (actinolite), asbestos, calcite, dolomite, and serpentine occur in its more decomposed portions. The hornblende is often in streaks or bands, giving the rock its gneissose character."

The associated secondary minerals enumerated are typical metamorphic products of the original components of basic igneous rocks.

The absolute age of these hornblendic, talcose, and quartzose schists has not been determined. They have been tentatively ascribed to the Pre-Cambrian, because - (1) their extreme metamorphism compared with the Devonian gabbros, pyroxenites, and peridotites occurring in the neighbourhood, suggests an extreme age; and (2), because of the conformity of the planes of schistosity with the cleavage planes of contiguous strata, which on lithological grounds are considered to belong to the Pre-Cambrian.

## B. - GEOLOGY

The oldest rock-formations in this area are the hornblendic, serpentinous, and talcose schists of igneous origin, and the adjacent metamorphosed slates and sandstones, which are tentatively ascribed to the Pre-Cambrian. It is noteworthy that the trend of the structural planes of the schists is a little east of north, whereas the strike of the schist zone is north-westerly. Further east, in the Heazlewood area, fossiliferous Silurian slates and and sandstones appear. These latter have been intruded by large masses of gabbro and peridotite rock, followed in this period (Devonian) by granites and syenites, which penetrated both slates and gabbros. The Devonian intrusives (gabbro and granite) outcrop 3 to 5 miles from the Rio Tinto ore-deposits.

All of the rock-formations occurring on Long Plain are more or less covered by unconsolidated and partly consolidated alluvial and detrital material. Near the goldfields occurs conglomerate, made up of angular to subangular and rounded quartz pebbles firmly cemented together. It has the appearance at first sight of an old consolidated rock, but it is evidently Tertiary.

Along the line of lode between Long Plain and Specimen Reef, patches of Tertiary basalt occupy the ridges. This eruptive rock is posterior to the Tertiary stream gravels and conglomerates.

## C. - ECONOMIC GEOLOGY

The solutions of the problems relating to the genesis of the magnetite deposits occurring in conformity with the hornblende schists in which they are contained appear difficult at first sight; but a closer investigation reveals the fact that, like those of the later occurrences in gabbro-amphibolite dyke rocks near Mt. Heemskirk, in the Zeehan district, they are largely the result of magmatic segregation. The conformity of the lenticular deposits with the planes of schistosity, and the banded structure exhibited by the magnetite ore, were formerly regarded as evidences of metasomatism. This evidence is inconclusive, for magnetite naturally assumes this banded form in conformity with the structural planes developed in the rock during the solidification of the basic magma; and, again, schistosity may have been developed in it during the transformation of the igneous rock. It has already been pointed out that the igneous schists of Long Plain and the gabbro-amphibolite rocks of the Zeehan district are widely separated in age, but they are, nevertheless, closely related types. In general, the old igneous schists have been subject to extreme metamorphosis, but in certain parts comparatively little alteration has taken place, and the rock exhibits the appearance of a normal gabbro-amphibolite. As the dyke rocks in both cases are identical, not only in regard to their composition, but also to the nature of their occurrence, so are the contained ore-bodies regarded as having been formed under essentially similar conditions.

It is well known that iron minerals, such as magnetite, pyrite, and pyrrhotite, are frequent and almost universal constituents of basic irruptive rocks. Again, nickel and cobalt are pronounced basic elements, and are almost without exception found genetically associated with rocks of the gabbro and peridotite types. Nickel minerals are often found mechanically contained in pyrrhotite, and chalcopyrite is one of their common associates. Minerals, such as magnetite, pyrite, pyrrhotite, and chalcopyrite, with accompanying nickel and cobalt compounds, being less soluble than other substances present in the magma, crystallise out first. During this crystallisation the particles of ferrous oxide (in the form of magnetite), of ferrous sulphide (in the form of pyrrhotite), and ferric pyrite were aggregated, in the order of the degree of their insolubility, in irregular bodies called lenses. Thus are found sulphide segregations associated with massive magnetite deposits. At the Long Plain the bulk of the ore was deposited as ferrous oxide rather than as sulphide, for perfectly crystallised magnetite in the form of rhombic dodecahedra has been frequently noted in the massive ore-bodies, and the alteration of pyrite to magnetite has not been observed. The segregation of magnetite in gabbro magmas is analogous to that of chromite in peridotite.

Evidence of their origin by magmatic differentiation is contained in the following particulars :-

(1) The deposits are invariably associated with basic irruptive rocks, usually gabbro.

(2) A feature of these ore-concentrations is their occurrence in enormous lenticular bodies, almost without exception along the peripheral margins of the irruptive masses.

(3) In all cases observed, the strikes and dips coincide with the direction of the line of contact of the intrusive with the sedimentary formations, and not necessarily in conformity with the structural planes of the latter.

(4) The ore-bodies are contained in igneous rocks.

(5) There is generally a gradual transition of ore to rock as the borders of the deposit are approached.

(6) Pneumatolytic minerals are not present.

(7) The ore-bodies sometimes enclose masses of igneous material.

(8) The associated dolomite is derived from basic igneous rocks, and does not contain an appreciable amount of magnetite.

(9) Limestone does not occur in the vicinity.

(10) Nickel and cobalt minerals are associated with the pyrite component.

Since the banded nature of the pyrite, hematite, and magnetite suggests a metasomatic replacement of the crystalline schists, it is probable, especially in the case of the pyrite component, that the deposits may in part be due to contact metamorphosis, or that they are older deposits which have undergone change subsequent to their original formation. This alternative is quite possible, as great masses of gabbro and granite occur in the neighbourhood. Limonite, hematite, and pyrite, replacing hornblende schists, have been commonly noted, and hematite containing cores of pyrite has been repeatedly observed, showing a possible derivation of hematite ore from pyrite. The mineralising solutions responsible for the later ore-deposits have been largely composed of carbonic and sulphurous acids.

Although the evidence relating to their origin is admittedly inconclusive, it is considered that the iron ore-bodies here to be described occur in the main as magmatic segregations.

## D. - THE MINES

### (1) - RIO TINTO DEPOSITS

#### (a) Preliminary Statement

The properties enclosing these deposits, between the Long Plain and Specimen Reef goldfields, are now held under lease by a Waratah syndicate, for which L. Vardy of that town is the secretary. The members of this syndicate, recognising that the enormous consumption and the increased cost of production of iron and steel in other countries during the last few years, would lead to the establishment of extensive works in Australia, have been energetically engaged upon exploratory work, with a view to the early exploitation of the Rio Tinto deposits.

#### (b) The Ore-bodies

This magnetite ore-field is the largest in Tasmania. It consists of a number of enormous disconnected lenticular masses, extending almost continuously for 3 miles, with other lenses at long intervals. The deposits are found in a zone of talcose, hornblendic, and quartzose schists, which strike N.N.W., and dip 60 to 80 degrees to the east.

These lenses occupy the summits of a series of high steep-walled ridges, trending in a general meridional direction, which stand out prominently above their surroundings in consequence of the greater power of resistance which the magnetite material affords to the denuding effect of erosive agencies. Erosion has, nevertheless, reduced the ore-deposits considerably, as shown by the deep and wide taluses of iron ore on the hill slopes.

The ore consists chiefly of magnetite, and subordinately of hematite. Associated with some of the deposits are small quantities of pyrite, pyrrhotite, chalcopyrite, and ores of nickel and cobalt, with also a little gold and silver. No trace of sulphidic minerals, however, has been observed at the outcrops, and they do not appear to become prominent within 200 feet of the surface. Moreover, they do not occur intimately admixed with the magnetite in the main ore-bodies, but are found usually in separate bands adjacent thereto.

The ore, as a rule, is fairly coarse-grained, very compact, and hard. In the massive portions of the ore-bodies magnetite commonly occurs in perfectly-formed rhombic dodecahedra, and, more rarely, in octahedra. Towards the centre of the deposits the ore presents an extremely dense crystalline appearance. At many points in the outcrops, however, alteration to hematite and limonite has taken place.

The deposits are in great part steeply inclined, and are conformable to the schists; while the ore, especially the hematite and limonite components thereof, exhibits the structure of the enclosing rock. In some lenses hematite is the dominant mineral, and magnetite is in unimportant amount; but, generally, the ore almost exclusively consists of magnetite. Sulphidic minerals increase with depth, and effect the schistose appearance of the country-rock.

The length of the largest lens is 2000 feet, and the width about 100 feet. Others extend along the strike 1500 feet, for over 400 feet along the dip, and are from 40 to 60 feet thick.

No. 1 ore-body is a lenticular mass of magnetite outcropping on Section 4502-M in conspicuous crags overlooking Magnetite Creek. It courses a little east of north, parallel to and about 300 feet west of the track leading to Specimen Reef goldfield. Beyond Magnetite Creek it has not been traced southward, but it continues along the ridge in the opposite direction for 800 feet. As seen in the massive outcrop it is 50 feet wide, and is composed of very dense, clean magnetite and hematite. Samples 7, 8, and 9 were taken from this ore-body.

The main lens of No. 2 group is a very large massive body of ore extending almost unbroken through Section 4090-M, and through the north-west corner of Section 4092-M, a distance of fully 2000 feet. It is 450 feet above sea-level in Savage River valley, whence it rises up the steep ridge southward to an elevation of 1100 feet, showing clean magnetite and hematite all the way. The width of this ore-body varies from point to point, being greatest on the ridge near the centre of the lens, and tapering gradually towards the ends. Float or detrital ore broken from the capping covers the hill slopes on both sides for 200 feet; but the actual width, which is very difficult to determine, appears to be from 40 to 60 feet. In the centre the ore is very dense and massive; on the sides hematitic and limonitic replacements of the schists, and the associated dolomite, are conspicuously in evidence. Analyses of samples 1 to 6, and 12, 14, and 15, convey an idea of the nature of this ore.

On the west side of this ore-body, near its southern extremity, occurs another lens, much smaller in extent, and separated from the larger ore-body by a band of schist 250 feet wide.

The analysis of sample 13 shows the ore to be similar to that contained in the other lodes. The extent of this lens has not been determined.

South of Webster Creek, on the east side of the northern extremity of the main ore-body, are two parallel lenses of very clean magnetite-hematite ore. Their actual dimensions are impossible of determination until developmental works have laid bare the unbroken lodes. A great quantity of float ore is strewn over the surface in this locality, completely obliterating the outlines of the ore-bodies. Pyritic ores have not been detected in any of the deposits already described.

Across a parallel formation, composed largely of semi-oxidised pyrite contained in graphitic-looking serpentinous schist, a tunnel has been driven eastward from the bank for 200 feet. A little gold has been detected in the pyritic ore, and also in quartz which occurs as irregular veinlets in the schists.

On the north bank of the river, 30 chains westwards from the bridge, two parallel tunnels 30 feet apart have been driven northerly on the course of an immense formation of hematite and magnetite, containing siderite, pyrite, pyrrhotite, and a little chalcopyrite, associated with asbestos, tremolite, serpentine, and dolomite. As seen in the bank of the river, the lode is fully 100 feet wide, and extends up the hillside 700 feet higher. The magnetite usually occurs in distinct bands 10 to 20 feet thick, but in parts it is seamed with veinlets of pyrite and other sulphidic ores. Here hematite blocks were found with cores of fine-grained pyrite; the magnetite, however, is primary and anterior to the pyrite. Later cross-fractures, dipping south-easterly at 45 degrees, in the sulphidic ore-body, are filled with dense pyrite. Sample 10, from this ore-body, consists of pyrite and hematite, and 11 is of fairly clean hematite.

On the other side of the river No. 3 tunnel was driven southward 178 feet through similar material. No. 4, ½-mile above the confluence of Savage River and Hall's Creek, was driven from the east bank of the latter 172 feet in a south-easterly direction. Ore is cut at 147 feet, and a few feet farther ahead is a band of chalcopyrite. From this point the tunnel passes through actinolite schist containing magnetite and pyrites. No. 2 lode lies east of No. 1, and has an outcrop of hematite and magnetite. A tunnel driven 386 feet along its course shows the lode 17 feet wide, composed of gossan, with native copper and cuprite and much siderite.

Between these two pyritic ore-bodies, 12 chains north of the bridge, another lens (No. 3) of clean magnetite is exposed on the ridge of the steep hill leading towards Specimen Reef. The surface outlines are obscured by clayey material and vegetation, so that its size could not be ascertained.

Ore-bodies Nos. 4 and 5, which follow, are the most extensive and richest of them all. No. 4 commences at ¾-mile north of the bridge in Section 4649-M, at an elevation of 1000 feet above sea-level, and continues through Section 4648-M along the ridge of a steep hill in a general meridional course for 2000 feet. It is fully 100 feet wide, and consists of clean magnetite of an extremely dense texture. No impurities of any kind could be detected by eye in this ore, and its quality is shown by analysis No. 17.

No. 5 ore-body is of equal quality, and is perhaps even greater than its predecessor, from which it is separated by a band of schist 200 feet wide. It lies a little eastward of No. 4, following the ridge northward for 1500 feet and southward into Savage River valley. The western fall of the hill to Hall's Creek slopes at a very high angle, exposing a very long face of massive magnetite. In some cases the ore occurs in aggregates of almost perfect octahedra, in others rhombic dodecahedra are common. A remarkable feature of this outcrop is the quantity of float ore strewn over the surface, in pieces about 4 inches in diameter, of extraordinary regularity. Sample No. 16 was taken from this ore-body.

North of this outcrop basalt occupies the surface, but 30 chains farther on still another occurrence is found. This is a dome-shaped mass of considerable extent, essentially similar in composition and nature to those already described.

Several other deposits are known in this locality, but they are not of any considerable extent and were not examined.

(c) Analyses

The composition of the ore may be gathered from the following analyses made by Mr. W.D. Reid, Government Assayer, in the Geological Survey Laboratory :-

| No. | Kind of Ore | Iron | Manganese Dioxide | Titanic Oxide | Silica | Alumina | Phosphoric Acid | Sulphur |
|---|---|---|---|---|---|---|---|---|
| | | % | % | % | % | % | % | % |
| 1 | Magnetite | 67.0 | 2.37 | Trace | 1.50 | 0.12 | 0.02 | 0.05 |
| 2 | Magnetite | 68.5 | - | - | 1.68 | 0.18 | 0.02 | 0.07 |
| 3 | Magnetite | 69.2 | - | - | 0.86 | 0.07 | 0.03 | 0.06 |
| 4 | Magnetite | 68.1 | - | - | 2.40 | 0.22 | 0.04 | 0.13 |
| 5 | Magnetite | 69.25 | - | - | 0.94 | 0.03 | 0.01 | 0.02 |
| 6 | Magnetite | 69.5 | - | - | 0.63 | 0.02 | Nil | 0.01 |
| 7 | Hematite | 63.1 | - | - | 0.50 | - | 0.38 | 0.03 |
| 8 | Hematite | 64.3 | - | - | 0.46 | - | 0.29 | 0.02 |
| 9 | Hematite | 63.4 | - | - | 0.52 | - | 0.16 | 0.02 |
| 10 | Magnetite & pyrite | 64.00 | - | - | 1.73 | - | 0.04 | 3.66 |
| 11 | Magnetite & Hematite | 68.30 | - | - | 0.84 | - | 0.06 | - |
| 12 | Magnetite | 69.20 | - | - | 0.50 | - | 0.02 | - |
| 13 | Magnetite | 69.13 | - | - | 0.52 | - | Trace | - |
| 14 | Magnetite | 68.80 | - | - | 0.83 | - | 0.09 | - |
| 15 | Magnetite | 68.68 | - | - | 0.91 | - | 0.08 | - |
| 16 | Hematite | 63.4 | - | - | 0.40 | - | 0.04 | - |
| 17 | Magnetite | 69.31 | - | - | 0.38 | - | Trace | - |

Under working conditions it is considered that the average grade will not exceed 65 per cent. iron.

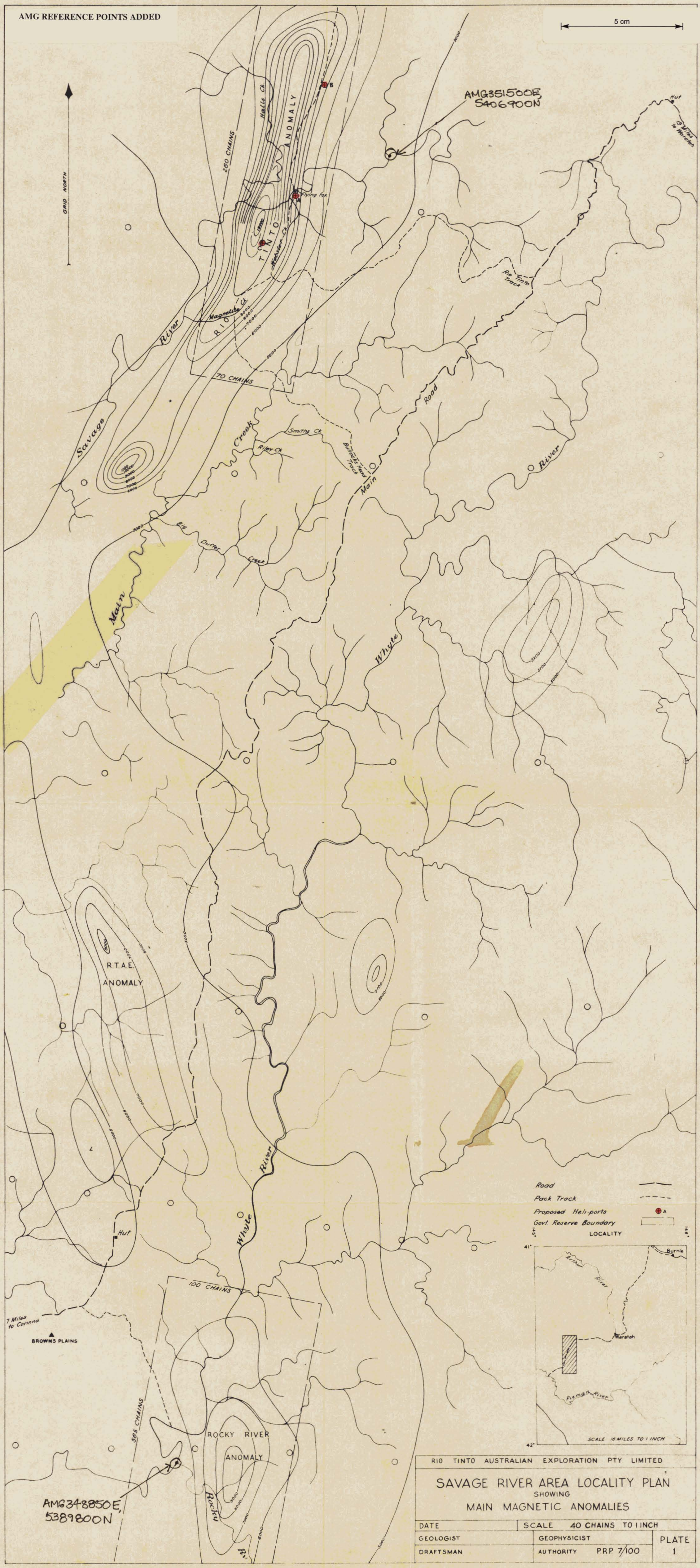
All these samples were taken from surface outcrops. There are no underground openings in the main magnetite ore-bodies, and consequently no means are available for ascertaining their extent and their nature at depth.

Very little silica and alumina, and traces only of magnesia and lime, are present in the body of the deposit. As the bounds of the lenses are approached the last impurities mentioned (magnesia and lime) increase in amounts until the ore becomes too poor to work. The manganese content is low, titanium occurs only in traces, and sulphur and phosphorus are in negligible quantities. The phosphorus is below the Bessemer limit; it is dependent upon the original apatite component of the igneous rock. It may be remarked that the increasing presence of magnesium and calcium silicates towards the walls is detrimental only in reducing the percentage of iron. The only impurities likely to cause anxiety are the sulphides - pyrite, pyrrhotite, and chalcopyrite - but these appear in large quantities only near the walls of the magnetite bodies at a considerable depth below the surface. If the Savage River valley be considered a trench, then the ore-bodies have been intersected to a depth of 700 feet below the outcrops on the ridges. The river has carved its channel through the soft schists between two lenses, but the ends of the magnetite bodies show on both sides of the valley.

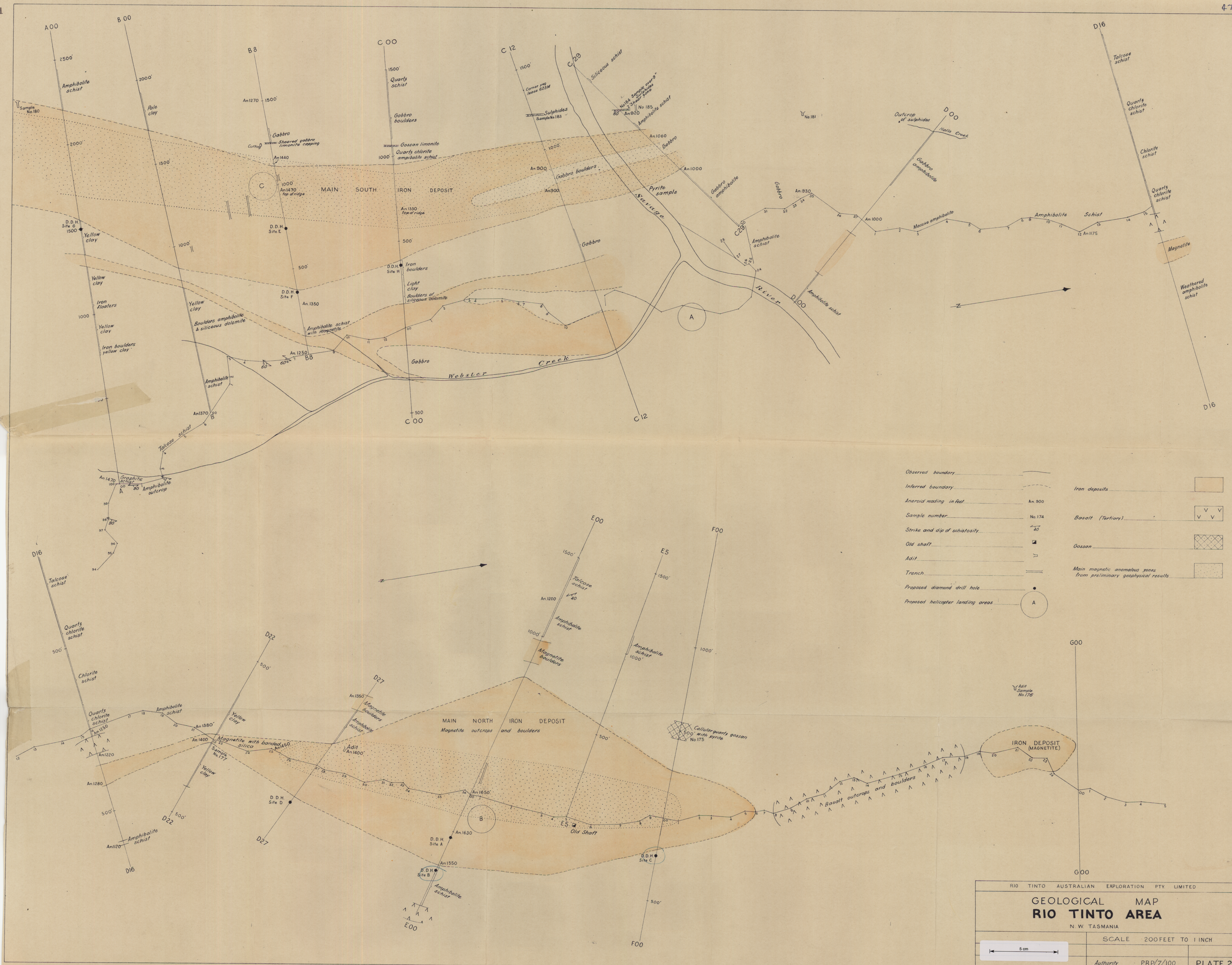
(d) Estimation of Quantities

Although a considerable amount of developmental work is necessary before precise estimates can be arrived at relating to the quantities of the higher grades of ores obtainable by open-cut methods of exploitation, there is nevertheless sufficient information available to serve as a basis for safe calculation. It is probable that the quantities given here are much too small, for the estimates are based on a vertical extent of only 300 feet, and care has been exercised in restricting the superficial dimensions to the outlines of the unbroken ore-bodies. The large quantity of float ore strewn over the surface, therefore has not been taken into the consideration of the available supplies. The determination of the actual sizes of the ore-bodies has been attended with considerable difficulty. In the first place, the width of the ore-bodies could not be defined with precision because of the deep taluses of magnetite ore extending on both sides of the outcrops. Furthermore, they have not been intersected at depth by tunnelling, save in those places where pyritic bodies were known to occur. Consequently, a true valuation is impossible, and an approximate estimate only has been attempted. In the following statement no account has been taken of the quantities available from those deposits containing pyritic ore-bodies. Under these conditions the probable high-grade ore amounts to :-

| | Tons |
|---|---|
| No. 1 ore-body | 1,100,000 |
| No. 2 ore-body | 4,000,000 |
| Associated ore-bodies | 1,500,000 |
| No. 3 ore-body | 400,000 |
| No. 4 ore-body | 6,500,000 |
| No. 5 ore-body | 7,000,000 |
| | 20,500,000 |



AMG REFERENCE POINTS ADDED
5 cm
GRID NORTH
AMG351500E,
5406900N
RIO TINTO ANOMALY
260 CHAINS
Hollis Ck
Flying Fox
Webster Ck
Magnetite Ck
70 CHAINS
Savage River
Creek
Smiths Ck
Riley Ck
Bullocks Head Track
Rio Tinto Track
Main Road
Main River
Big Duffer Creek
Main
Whyte
Hut
13 Miles to Waratah
R.T.A.E. ANOMALY
Whyte River
Hut
100 CHAINS
7 Miles to Corinna
BROWNS PLAINS
595 CHAINS
ROCKY RIVER ANOMALY
Rocky Ri
AMG348850E,
5389800N
Road
Pack Track
Proposed Heli-ports
Govt. Reserve Boundary
LOCALITY
Burnie
Arthur River
Waratah
Pieman River
SCALE 16 MILES TO 1 INCH
RIO TINTO AUSTRALIAN EXPLORATION PTY LIMITED
SAVAGE RIVER AREA LOCALITY PLAN
SHOWING
MAIN MAGNETIC ANOMALIES
DATE
SCALE 40 CHAINS TO 1 INCH
GEOLOGIST
GEOPHYSICIST
DRAFTSMAN
AUTHORITY PRP 7/100
PLATE 1




RIO TINTO AUSTRALIAN EXPLORATION PTY LIMITED

GEOLOGICAL MAP

**RIO TINTO AREA**

N.W. TASMANIA

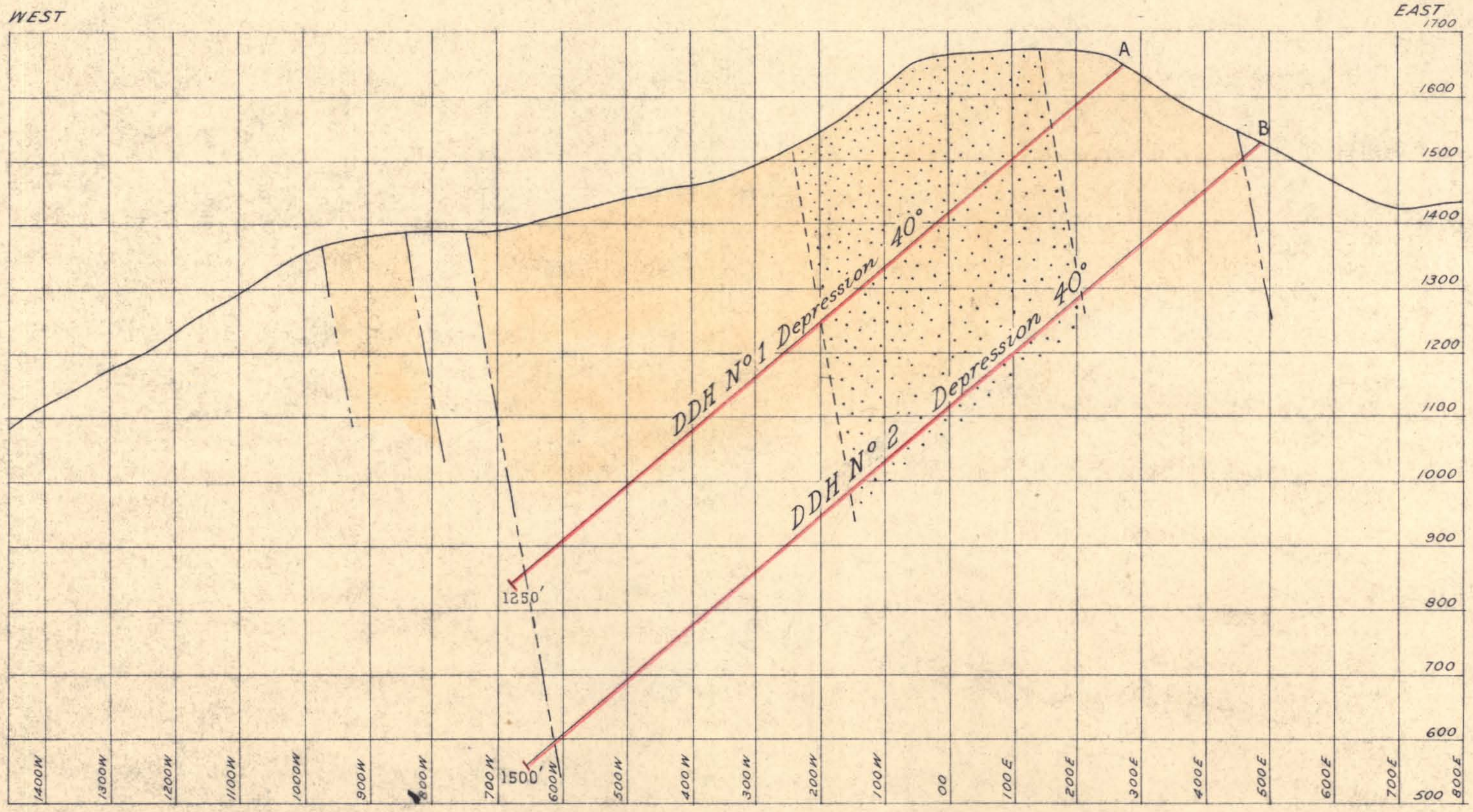
SCALE 200 FEET TO 1 INCH

Authority PRP/7/100

PLATE 2

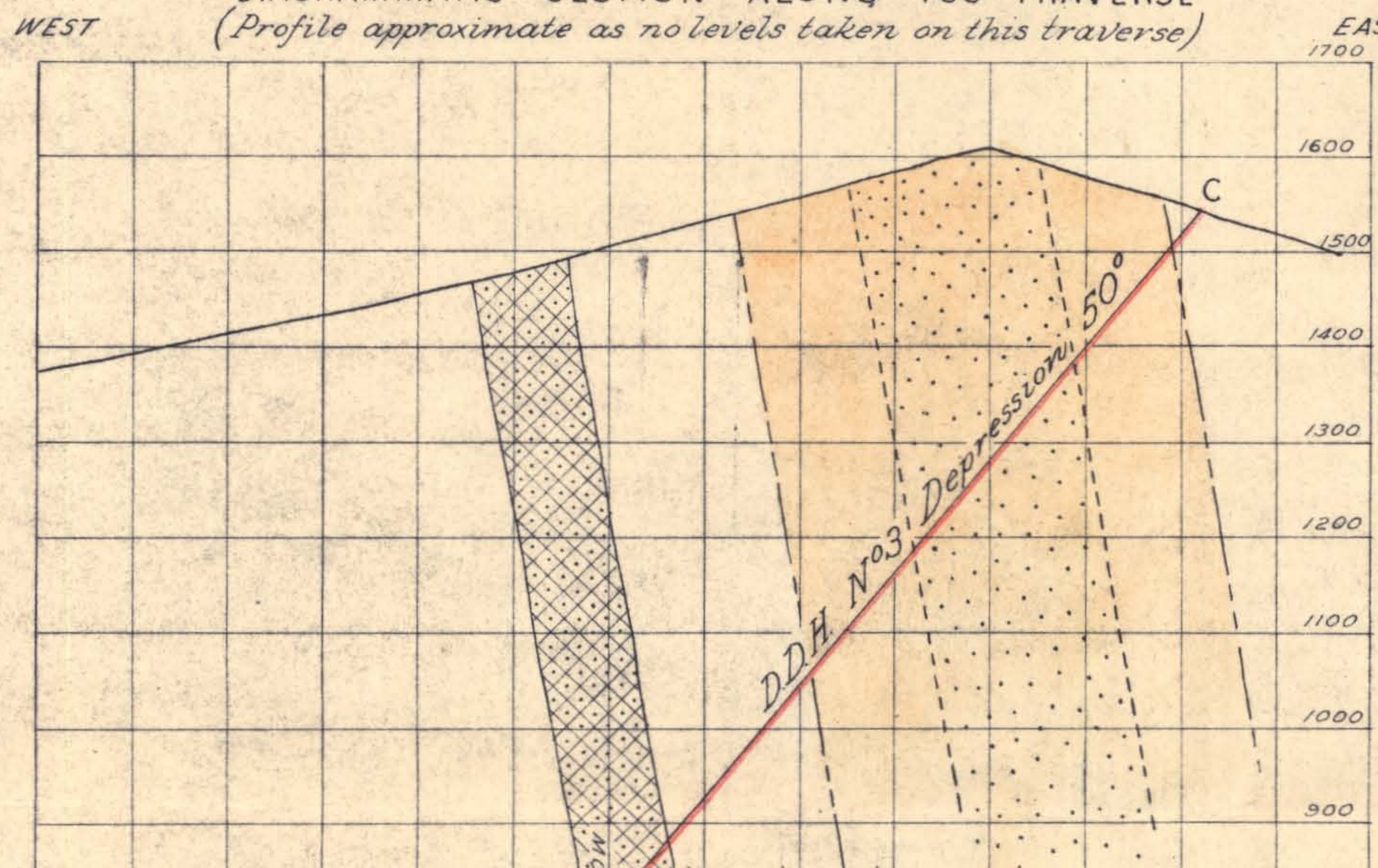
022

## SECTION ALONG "EOO" TRAVERSE
## MAIN NORTH IRON DEPOSIT

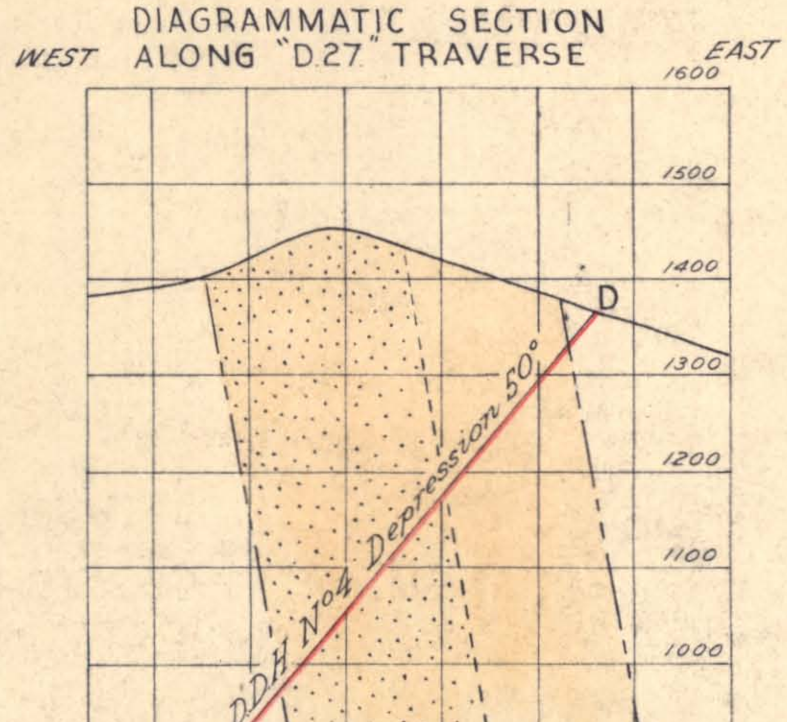



5 cm

## DIAGRAMMATIC SECTION ALONG "FOO" TRAVERSE
*(Profile approximate as no levels taken on this traverse)*




## DIAGRAMMATIC SECTION ALONG "D.27" TRAVERSE




REFERENCE

- *Iron deposits*
- *Main magnetic anomalous zones from preliminary geophysical results*
- *Gossan*
- 850' *Proposed diamond drill holes*

RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED

RIO TINTO AREA
PROFILES ON SELECTED TRAVERSE LINE
*Showing Proposed Diamond Drilling*
**MAIN NORTH IRON DEPOSIT**

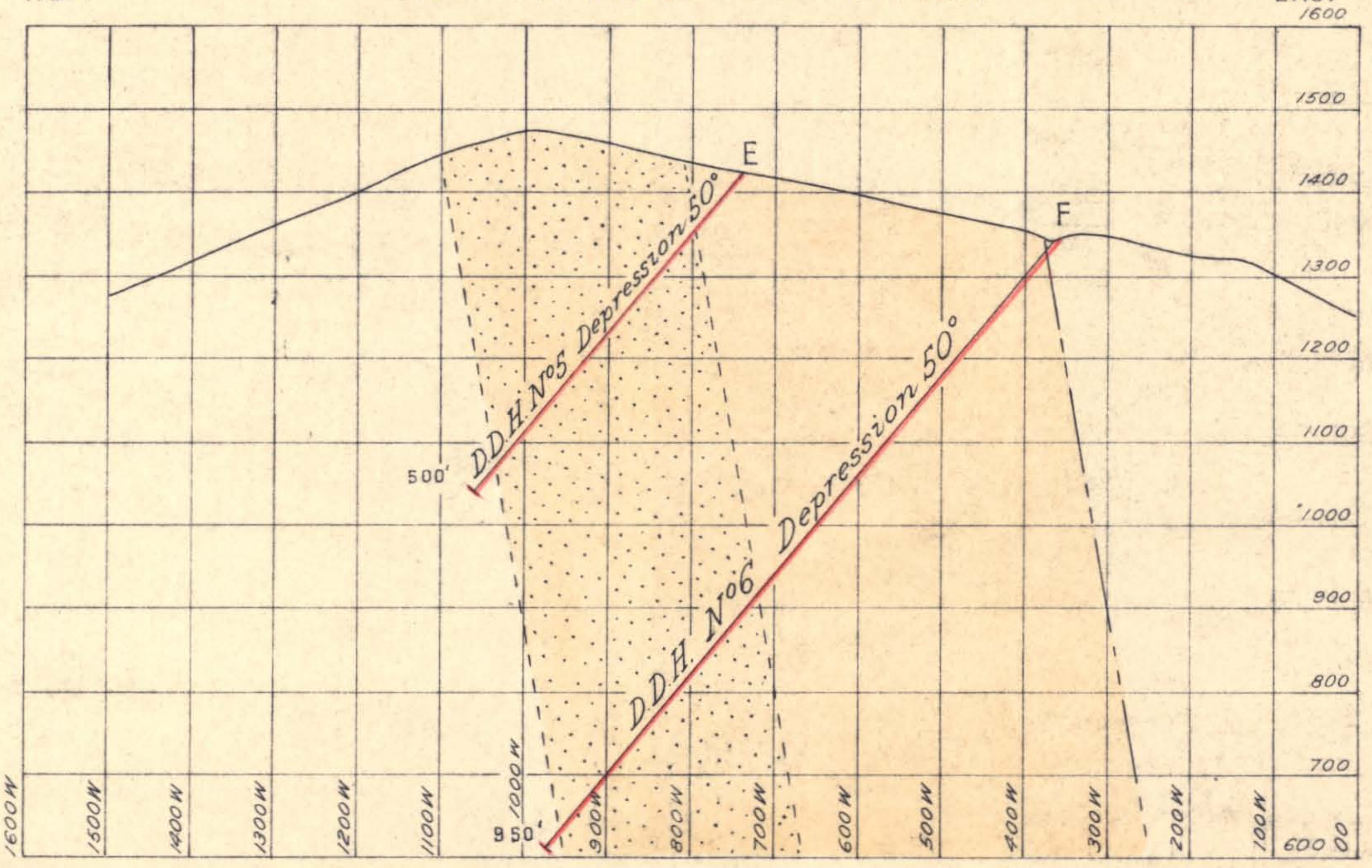
| | |
|---|---|
| Date May 1957 | Scale 200 feet to 1 inch |
| Geologist | Geophysicist |
| Draftsman A.T.N. | Authority PRP/7/100 |

Plate 3

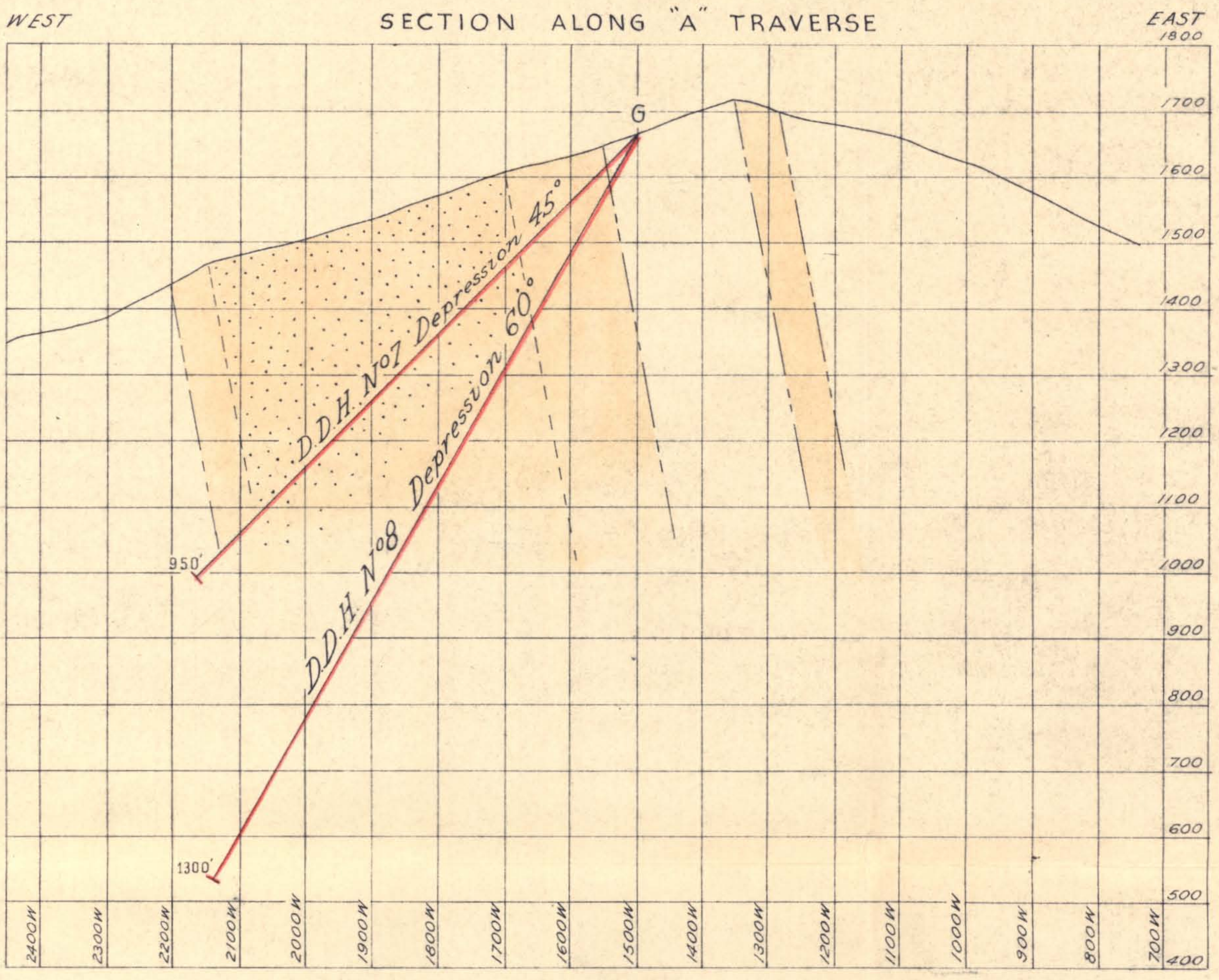
023

471023

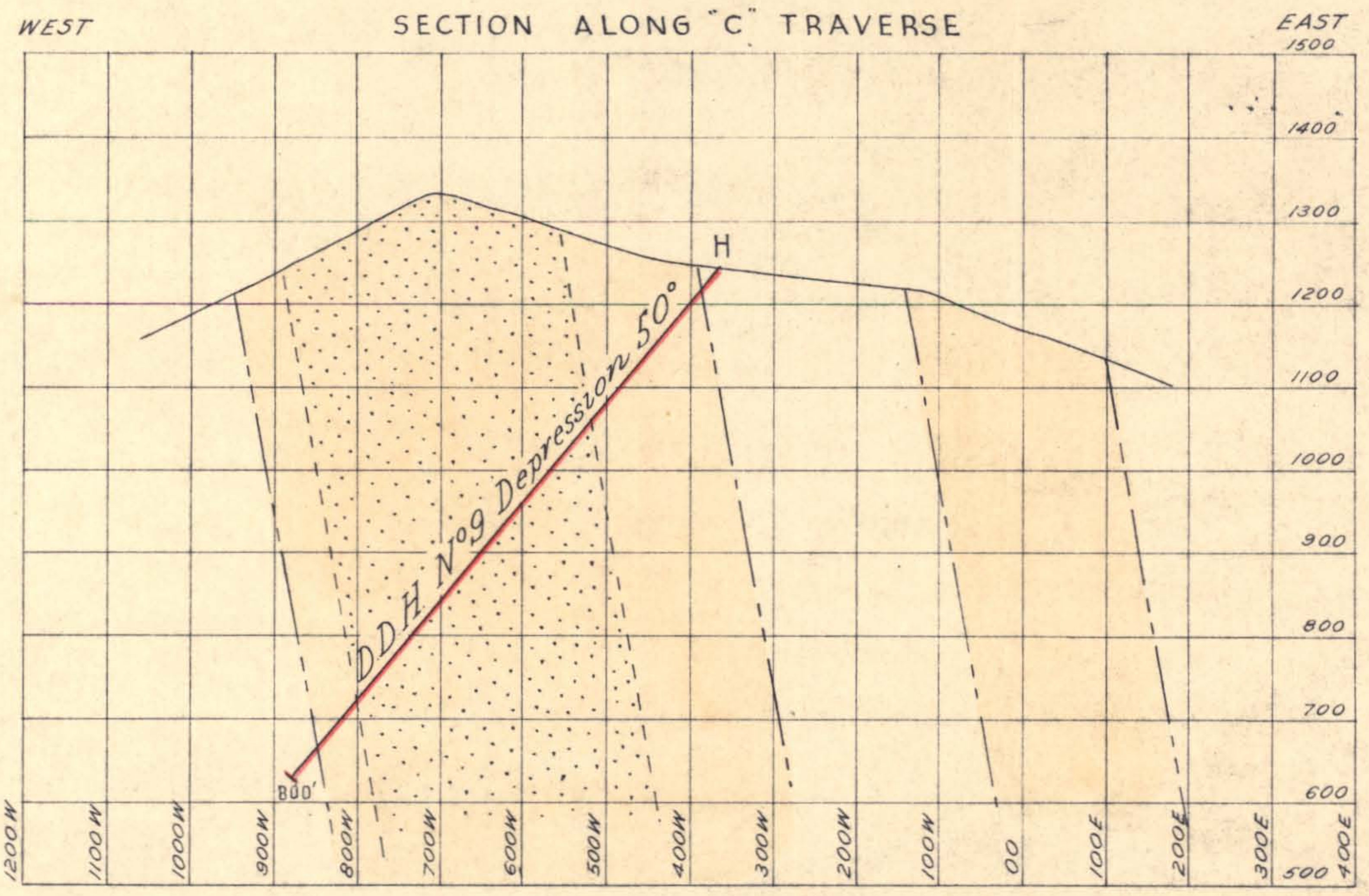
WEST — SECTION ALONG "B8" TRAVERSE — EAST




WEST — SECTION ALONG "A" TRAVERSE — EAST




WEST — SECTION ALONG "C" TRAVERSE — EAST




REFERENCE

- Iron deposits
- Main magnetic anomalous zones from preliminary geophysical results
- Proposed diamond drill holes (950')

| RIO TINTO AUSTRALIAN EXPLORATION PTY. LIMITED | | |
|---|---|---|
| RIO TINTO AREA<br>PROFILES ON SELECTED TRAVERSE LINE<br>*Showing Proposed Diamond Drilling*<br>MAIN SOUTH IRON DEPOSIT | | |
| Date May 1957 | Scale 200 feet to 1 inch | |
| Geologist | Geophysicist | Plate 4 |
| Draftsman A.T.N | Authority PRP/7/100 | |

5 cm

471023

018

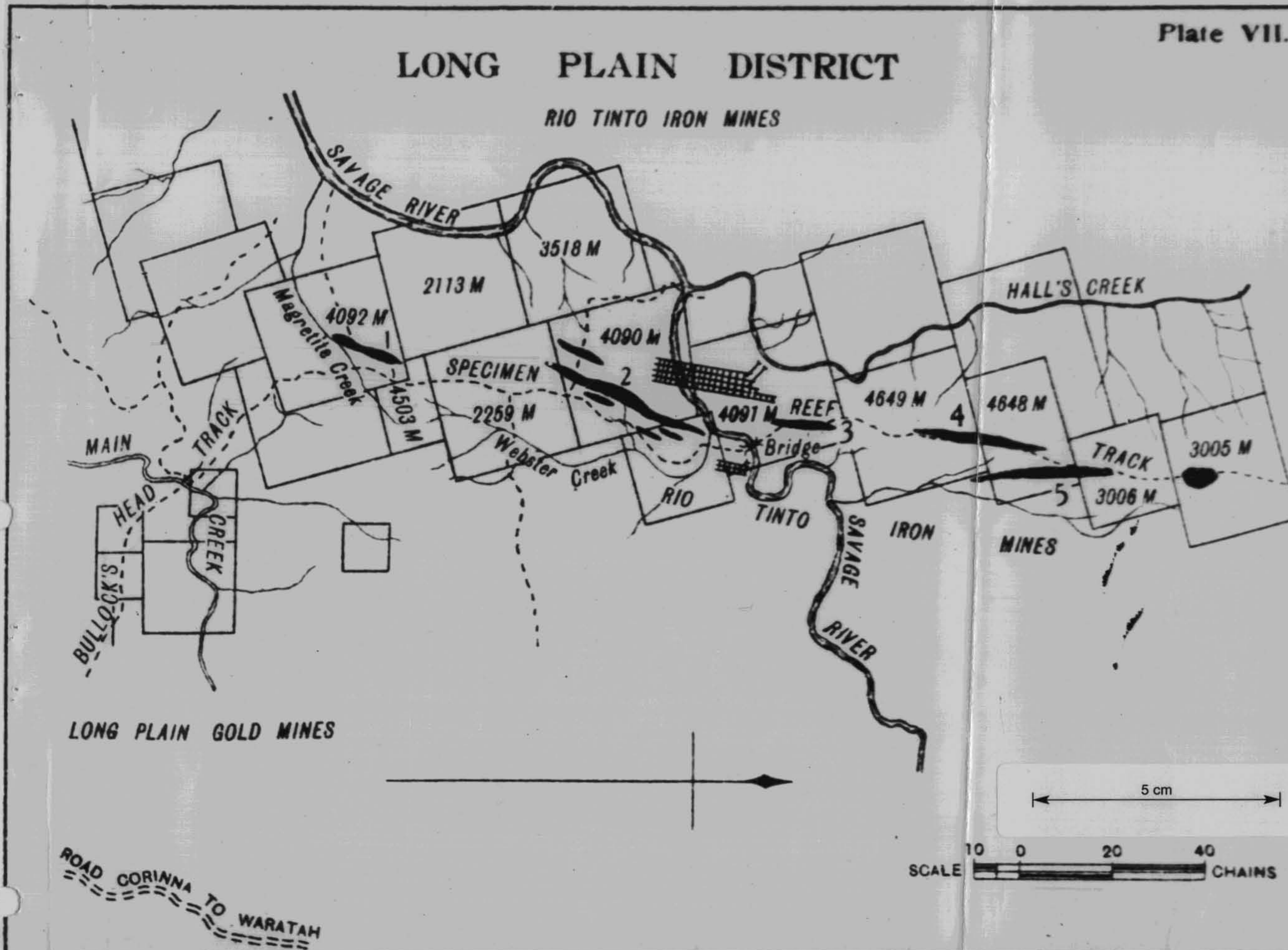
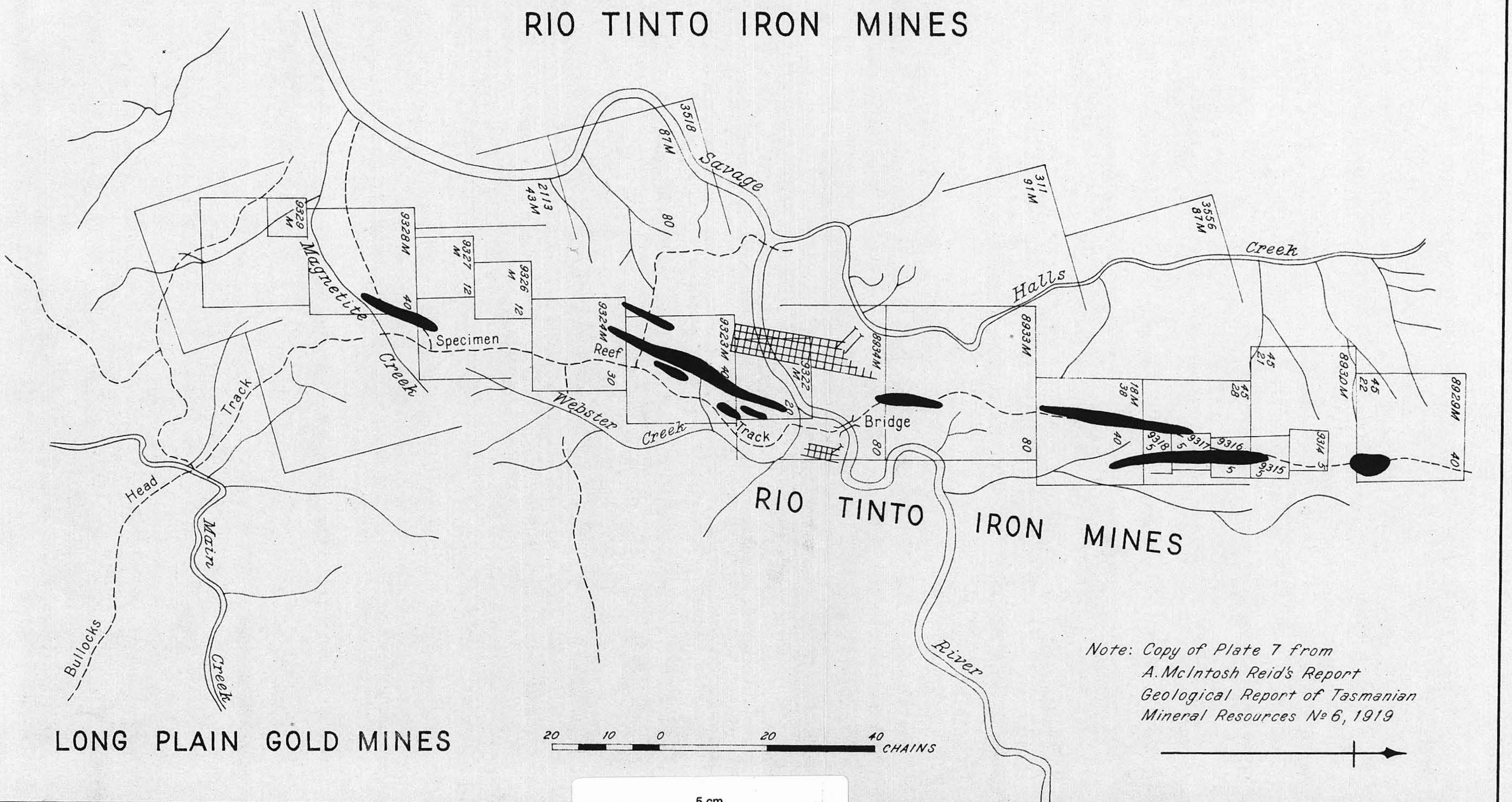



Photo Algraphed by John Vail Government Printer Hobart Tasmania.

This map is a later edition of that referred to in the Appendix of this report.



# LONG PLAIN DISTRICT
## RIO TINTO IRON MINES




Note: Copy of Plate 7 from
A. McIntosh Reid's Report
Geological Report of Tasmanian
Mineral Resources Nº 6, 1919

5 cm