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SOME IRON DEPOSITS IN THE VICINITY OF BURNIE

INTRODUCTION -

Investigations were made of the iron deposits of the north-western district in order to determine if sufficient quantity of a suitable grade was available to justify the establishment of a charcoal pig iron industry near Burnie.

While it was understood that no single deposit of iron ore was of such magnitude as to provide sufficient high grade ore there was a possibility that, collectively, several deposits could provide sufficient ore reserves for many years.

A detailed survey was made of the deposit at Natone where exploratory work by Ferrico Proprietary Limited was being undertaken, and their programme of prospecting operations could be directed to the best advantage.

Surveys were also made at other deposits where such were considered necessary and where no previous plans were available, e.g., The Penguin Creek and Highclere deposits. Plans of these surveys are attached to this report.

GENERAL DISTRIBUTION -

The localisation of the various deposits is shown in the accompanying plan.

The Natone and Blythe deposits are apparently in a broad zone which trends east of north for about 6 miles. The covering of basalt on the ridges prevents all attempts at proving whether they form one continous line or separate belts with a general parallel direction.

The Penguin Creek deposits are 2 miles south-west of Penguin and are apparently parallel to the previous line, but this relationship may be more apparent than real, as the deposits are exposed along the Penguin Creek which has cut its valley through the overlying basalt, exposing the old rocks with their contained iron deposits.

The Highclere deposits are near the Pet River and apparently are an isolated occurrence of similar type.

The occurrences towards the south end of the Dial Range about 15 miles south-east of Burnie are totally different in nature from the above and their distribution is directly related to that of the conglomerates.

The Hampshire iron deposits differ from all the above not only by being composed largely of magnetite but also by their development in intrusive dykes in the granite. They are thus younger than the granite and not older as is the case of the other types mentioned above.

GEOLOGY -

Most of these districts are covered by numerous flows of Tertiary basalt, through which the rivers have dissected valleys in which the older rocks are exposed.

The oldest rocks, mainly lithological similarity, are considered to be of Cambro-Ordovician age. These consist of sandstones, mudstones, conglomerates, and breccia conglomerates which are sometimes closely and sharply folded and faulted. The folds become overfolds, giving an approach to imbricate structure in places, but in others, the folding is of a more open nature. The iron deposits, as a rule, are found in the Cambro-Ordovician rocks.

Overlying these with a marked unconformity is the Dial Conglomerate, which is identical with the West Coast Range Conglomerate. These conglomerates pass upwards into Tubicolar Sandstones, which are not very widespread in the area examined as they occur only on the western side of the Dial Range. This is the normal succession of this series as proved elsewhere in the State, and places beyond any doubt the correlation of the Dial Conglomerate with the West Coast Range Conglomerate which is at least of Upper Silurian and may even be of Lower Devonian age.

These beds strike in a general northerly direction and dip west on the eastern flank of the mountain, but show a general synclinal structure on the western side of the range. The western extension of the beds is sharply cut off and probably indicates a north and south fault of some magnitude, but until the area has been regionally mapped in detail, the geology of the district and the effects of these faults cannot be understood.

On the Eastern side of the Dial Range are the porphyries which are comparable structurally with similar rocks in parts of the West Coast, These, as far as known, do not come into contact with the granites. The chief feature of interest of the latter to the present investigation is the occurrence of the magnetite-haematite ore deposits of the Hampshire district, which occur as lenses in carbonated and silicified dykes.

The Tertiary basalts which are so widespread in this part of the State were extravasated from numerous points of eruption and beyond doubt the flows filled wide valleys and, in places, the intervening ridges. The present drainage system is partly consequent and was developed on a general north sloping surface but the actual river channels were initially determined by the hollows between the various lava flows. The rivers have carved deep gorges in the basalt due to uplift and in these valleys the older rocks are exposed.

ECONOMIC GEOLOGY -

Genetically there are three distinct types of iron ore deposits in this area :-

1. The haematite-limonite replacement lodes.
2. The derived iron ores of the conglomerates.
3. The Hampshire magnetite deposits.

THE HAEMATITE LIMONITE REPLACEMENT LODES

These occur at Natone, Highclere, Penguin Creek and Blythe River, and are characterised by their development along zones of faulting, with massive isolated bodies of ore varying grade, usually associated with brecciated iron ore, pointing to later earth movements of the lines of weakness along which the iron-silica solutions were introduced. Another feature shown by these deposits is the passage from siliceous to purer ore and the universal evidence of the replacement of the host rock by these deposits.

Selective replacement by the iron solutions is the underlying principle governing the original distribution of these ore bodies, which has been complicated by the later faulting increasing the isolation of the blocks and accounting for the brecciation associated with most of them.

Composition of Ores -

Graphs were constructed of all the available analyses of the ores.

The remarkable result is that the analyses show a straight-line relationship and thus clearly demonstrate that the mineralising solutions were composed essentially of iron and silica. The concentration of the iron means a corresponding reduction of the silica content, and this is rigid within limits of plus or minus two per cent. The other constituents are in such minor proportions that the above generalisation is not affected and their presence is of metallurgical rather than mineralogical importance. Phosphorus ranges from 0.03% to 0.11% Sulphur from a trace to 0.2%. The field observations on the replacement of the silica by the iron, are thus supported by the chemical evidence.

The Penguin Creek and Rutherford analyses also fall into the same category. In the iron deposits of the Dial Range, where replacement of the iron has proceeded far, the customary agreement is reached, but where this replacement is not so advanced the analyses do not fit into the normal scheme.

The Iron Cliff analyses show that the deposit is not the quartz-haematite type and as Twelvetrees points out, this deposit is probably a gossan.

Age of the Iron Deposits -

The ore bodies at Penguin, Blythe River, Natone and Highclere are clearly formed by the partial replacement of rocks of Cambro-Ordovician age, and were generally considered as being formed during the Epi-Devonian metallogenetic epoch. The present investigations reveal that the picture is not quite as simple as first thought. Pebbles of haematite are abundant in the younger Conglomerates of the Dial Range, indicating that the iron ore bodies were in existence previous to the formation of these conglomerates. These ore bodies are thus younger than Cambro-Ordovician and older than the West Coast Range Conglomerate. This is the first evidence in Tasmania definitly proving metallogenesis older than the major one of Epi-Devonian age.

Later movements along the lines of fracture which govern the distribution of the iron ores continued to afford passage to the iron silica solutions, as, in places the conglomerates themselves have been replaced by haematite. The various stages of this replacement can be observed particularly in that area where the rounded pebbles of haematite are most abundant. Most likely, the brecciation of the iron deposits is due to continued movement along the older fracture lines.

NATONE IRON DEPOSITS

Location and Access -

These deposits are on the western side of the Upper Natone road and one half mile south-south-west of Natone Post Office which is about 8 miles to the south of Burnie.

The land is held by Ferrico Proprietary Limited under mineral lease No. 304P/M of 57 acres.

History -

The first attempt at mining was made by the owner of the property, T.S. Rutherford. The first official record of this work is in Mineral Resources of Tasmania No. 6, 1919, pp. 64-66, where it is stated that a shaft 40-50 feet deep had been sunk without exposing any solid ore.

Another old shaft, is situated near the top of the knob. It was reported that the results from this shaft also were not satisfactory.

In 1938, J. Linell Cook (Holdings Pty. Ltd.) further prospected the area by shaft sinking and trenching and two diamond drill holes were bored. The position of these sites is indicated on the accompanying plan.

A geophysical survey was carried out by a commercial geophysical organisation and this was reported to indicate that large tonnages were available. Details of this investigation are not available.

Bore No. 1 is 67 feet deep and is mainly mudstone with broken pieces of haematite. Only one foot of bore core was recovered.

Bore No. 2 was 68 feet deep through similar material with a core recovery of 8'6" from one 20 foot band of mudstone.

In 1939, Dr. W.G. Woolnough, Commonwealth Geological Adviser, included this occurrence in his "Report on Examination of Iron Ore Deposits in Tasmania", and came to the conclusion "that the existence of a major deposit of iron ore at this point is definitely disproved."

Ferrico Proprietary Limited, in recent times, has continued prospecting operations, with financial assistance from the Government. This work was directed to determine the amount of available ore.

Distribution of Ore and Prospecting Work.

Main Cut - The Main Cut is of two benches. The lower and shorter one exposes decomposed basalt resting on an uneven surface of bedrock on which a haematite gravel a few inches thick marks the junction, while the main bench, which is approximately 135 feet long with a maximum height of 15 feet exposes a section that clearly shows the relationship of the various ore occurrences to eath other and to the bedrock.

Near the toe of the cut, brown coloured mudstones dip west and are succeeded by a belt of brecciated ironstone about 20 feet wide from which they are separated by a fault dipping north-west at about 45 degrees. Farther west, the brecciated ore gives place to massive haematite, 22 feet wide. A thin zone of brecciated ironstone flanks the massive ore on the western side, and, in the northern face, there is a rapid tranistion to brown mudstone which, however, contains large isolated boulders of haematite.

Another important feature demonstrated by this cut is that some of the surface exposures of the ore are exceedingly shallow compared with their lateral extent. The ore exposed along the top of the cut is 45 feet long but only from two to four feet thick. The No. 3 shaft in this cut, sunk to prove the downward extent of the ore, is discussed later.

No. 1 Open Cut - This cut is 60 feet long gradually increasing in height to 15 feet. At the entrance, some ironstone rubble is separated from flattish broadly folded black mudstone to the north by a fault dipping north at about 40 degrees. In the face, which is of brecciated ironstone, a fault dips 60 to 65 degrees north and steeps to nearly vertical towards the surface.

Shaft No. 4 is in the floor of this cut.

No. 2 Open Cut - No. 2 open cut is 63 feet long, The surface concentration of iron rubble along the upper part of the cut is seen and for the first fifteen feet the cut is probably in this material.

The next 25 feet is soft mudstone with isolated pebbles and boulders of haematite. This is succeeded by a solid mass of ironstone 5 feet in width which again passes into pebbly brown mudstone. The south side of the massive haematite is bounded by a nearly vertical fault. Near the face thin bands of haematite and brecciated haematite dip to the north at 50 degrees.

There is a shallow shaft in the floor of this cut, but there has been no driving from this.

There are two other trench-like cuts. One almost midway between No. 1 and No. 2 cuts is mainly in decomposed basalt. The other, 240 feet north of the Main Cut, is mostly in surface detritus and does not expose ore.

Shafts - An old shaft not accessible at present and stated to have been one of Rutherford's shafts is 100 feet east of the Main Cut.

An inclined heading along a fault dipping to the north at 45 degrees is near the crest of the hill. This fault is at the junction of the iron ore and mudstones and probably forms the footwall of this lens of iron. Bore Hole No. 1, situated 40 feet south-west is undoubtedly in the bedrock beneath this footwall fault.

On the ridge about 550 feet south-west of the Main Cut, there is a shaft supposedly one of Rutherford's early works. This is stated to be 17 feet deep and is in the western brecciated margin of the big surface exposure. Details of this shaft are not available. Another shallow shaft, 25 feet to the north-west has been filled in.

The only other shaft worthy of mention, belonging to the earlier period of prospecting, is 450 feet north of the Main Cut on the opposite side of the creek. This is only shallow and discloses some iron ore breccia.

Ferrico Proprietary Limited sank four shafts.

Shaft No. 1, 40 feet deep is 35 feet north-west of the Main Cut, but no driving has been carried o t from this shaft which is in ironstone breccia.

No. 2 shaft-is 95 feet north-west of No. 1 shaft. It is 40 feet deep with curved drives to the west and south. The westerly drive is 53 feet long. There is a gradual passage from blackish brown mudstone, into more siliceous whitish clays with nodules of haematite, into massive haematite in the face. As in the case with all underground workings, on this lease, the driving ceased when massive iron was reached, due to the extreme difficulty of boring by hand steel in the hard ore. The underground work thus gives no indication of the dimensions of the lenses of massive iron ore but gives information as to their boundaries, and probable underground extension. The work has rather accentuated the proportion of barren bed rock between the lenses of iron ore. The ore in the face of this westerly drive is probably the downward extension of that ore exposed in "C" trench.

The south drive has a total length of 53 feet. It is mostly in siliceous brown mudstones containing an occasional pebble of haematite near the end. This drive would have to be extended at least 30 feet to the south to prove any vertical downward extension of the ore exposed in "A" trench.

No. 3 Shaft - This shaft is in the Main Cut and is 24 feet deep with a sump 2'6" deep. The drive to the south-east was extended for a length of 27 feet with a little iron ore in the toe of the face, thus indicating that what appears to be a massive lens of ore in the face has a very limited downward extension. The ore in the face is probably developed on the fault between the brecciated iron ore and the brown mudstone. The north drive is stated to be about 23 feet, but disclosed no solid ore, only boulders of haematite.

No. 4 Shaft - This is in No. 1 Open Cut and is 24 feet deep. In the shaft, there is a gradual downward passage from brecciated ironstone into siliceous black and brown mudstone. The south drive which is 17 feet 6 inches long is in this siliceous mudstone.

The north drive is 65 feet long with crosscuts east and west. At 24 feet, the western crosscut has a bearing of 297 degrees for 29 feet. At 11 feet the mudstones flatten and become very siliceous. The face is in solid ironstone which is on the western side of a fulat dipping west at 50°, and striking north 20° west. Twelve inches of rubbly quartz is present on this fault. At 36 feet on the main drive, an eastern crosscut is 12 feet long mainly in mudstone.

The underground workings are mainly in soft black and brown mudstones which are much faulted and slickensided and dip north at small angles. The faults are generally parallel to the main drive and dip east, although there are several dipping west. The displacement on these faults is apparently of small dimensions.

No. 5 Shaft - in No. 2 Cut is 24 feet deep but no driving has been attempted as water proved troublesome, and at the time of inspection was well up the shaft.

Trenches and Ore Outcrops -

Previous to the prospecting operation by Ferrico Proprietary Limited, there had been much trenching which had partly outlined several lenses of ore.

Near No. 1 Bore, one lens has several trenches along the boundary as well as an approach 40 feet long to an inclined drive. This work revealed that the outcrop was roughly elliptical in shape, with axes 24 and 12 feet long. The inclined drive shows a footwall dipping north-east about 45 degrees. Bore Hole No. 1 tested the country beneath the fault and thus gives no information as to the downward continuation of this lens. Exploratory work would have to be situated north-east of the outcrop to prove any downward continuation.

North of No. 1 Cut, several trenches delimit a small outcrop fifteen feet long, and of irregular shape. Around No. 2 open cut, there are several other trenches. A line of small ones, showing brecciated ore, extends to the north-east and is probably along the fault line seen in the face of this cut. The ironstone outcrop west of this cut, is roughly crescentic in shape, being 30 feet in length with a maximum exposed width of ten feet. The depth of this ore is not known.

Near No. 2 Bore, a shallow trench 75 feet long trends to the north-west, and at right angles to this from the midpoint, another trench is 60 feet long, exposing the largest single outcrop of iron ore in this lease. The information from the Bore Hole and the shafts is insufficient to indicate its total depth. Spoil from the shaft shows good lumps of haematite and black mudstones. It is stated that solid ore extended for 17 feet in the shaft.

Ferrico Proprietary Limited continued the policy of trenching, cutting new trenches, extending old ones, and connecting others, so that the exposures of the lenses are now known in some detail.

The apparent lack of system in the design of the layout of the trenches is an indication of the inherent outcrops which show no defined directional trend.

Several of these extensions were completed after the survey and information regarding these was supplied by the Company. This information has been incorporated in the plan and is shown by hachuring.

"F" trench extending north-west from the main cut is about 400 feet long. Iron ore was cut for the first 80 feet from the cut. The greater portion, with the exceptions noted below, was in mudstone. Some brecciated iron ore extends from 160-196 feet and massive ore outcrops from 220-293 feet except for seven feet of mudstone from 240 feet. The only other ore of consequence occurs between 350 and 360 feet. Short trenches at right angles indicated that this lens is 23 feet long.

From a point 150 feet on "F" trench, another runs at right angles and connects with "C" and "D" trenches. Brecciated ore is exposed at the junction with "C" trench, indicating a lens 25 by 15 feet. Partly surrounding the lens is a belt of siliceous mudstone with boulders of haematite. "C" trench has been connected with "B" trench. At 40 feet from "C" another lens of massive ore has been exposed with dimensions of 30 feet by 13 feet.

There is another haematite lens in the western end of "B" trench, 18 feet by 13 feet.

In the trenches northerly from No. 1 open cut, several lenses mostly of brecciated ore are exposed and there are two other lenses near No. 2 cut. The dimensions are of the order of those already described, the largest of massive ore being 30 feet long.

There is a faint suggestion that the elongation of the lenses is a little to the east of north, agreeing with the general trend of the crush zone.

Further trenching in the paddock south-west of the timbered knob has defined the lateral limits of the ore lens which is rounded in outline with a length of 250 feet and a width of 200 feet. No. 2 bore is 30 feet outside the outcrop and thus gives no indication of the depth of this occurrence. Rutherford's old shaft is said to be in ore to a depth of 17 feet, but we could not verify whether the shaft continued in ore at this depth or had penetrated through the lens.

Four hundred feet south-west from No. 2 Bore, there is a small outcrop, A number of jumper holes were placed around this, but did not reveal any extension.

<u>Summary</u> -

The shallow prospecting has been sufficient to determine the amount of ore at the surface, and although we cannot speak with certainty as to the distribution in depth, the surface distribution does not offer much encouragement to formulate any prospecting scheme involving much expenditure in order to obtain this information.

The information obtained from the examination of these deposits can be usefully summarised as they provide more evidence of the nature and characteristics of these haematite ore bodies than any of the other known deposits.

1. The ore bodies have been formed along a zone of fractures which provided access to the iron-silica solutions.

2. The ore has been mainly formed by the replacement of the sediments by the mineralised solutions.

3. The ratio of iron to silica is constant within such narrow limits that the solutions must originally have been of a fixed composition.

4. Earth movements, later than the formation of the ore bodies, have displaced them and brecciated the margins of the iron ore.

5. The ore bodies are of very limited areal extent and although not definitely proved, there is every justification for believing that their extension in depth would not greatly exceed what has been proved on the surface.

The proportion of massive iron ore in the most closely prospected portion of the lease is about 10 per cent of that area. This takes no cognisance of the grade and does not include the brecciated ore as the total iron in these is such variable factor. It also includes the ore exposed by the Company's prospecting since our survey.

It is thus evident that the reserves of iron ores in these deposits is strictly limited and the amount of rejected material in quarrying would be excessively high. The isolation of the individual blocks of ore indicates that these would have to be mined from several separate quarries.

BLYTHE RIVER IRON DEPOSITS -

The Blythe River Deposits are situated on the banks of the Blythe River some 7 miles south-south-east of Burnie. These deposits have been investigated on many occasions.

A list of this early literature is given in Mineral Resources of Tasmania No. 6, 1919. Since then, the following reports have been written.

1919 - Report of Experts, on Blythe River Iron Deposit, Burnie, Tasmania. Commonwealth Parliamentary Papers, 1917-19.

1937 - Report on Blythe River Iron Deposits by P.B. Nye, Government Geologist.

1939 - Report on Examination of Iron Ore Deposits of Tasmania. Dr. W.G. Woolnough, Commonwealth Geological Adviser.

These deposits outcrop prominertly on both banks of the Blythe River Gorge, which gives a vertical section on this type of ore occurrence up to 700 feet.

All previous investigators agree that there is one main fracture zone trending north-north-east, with a steep dip to the east. The Natone deposit most probably is the southerly continuation of this belt.

Increased knowledge of these deposits, as the result of continued prospecting operations and more detailed investigations, has led to a continued decrease in the estimates of quantity of available ore. This is shown by the following summary :-

1894 - A. Montgomery (before the commencement of exploratory work) (Sec. for Mines Report 1893-4 - Report on a Deposit of Iron Ore at Blythe River). 30,000,000 tons (assuming 3 tons of ore per cubic yard).

1901 - W.H. Twelvetrees. (Sec. for Mines Report 1901). Report on the Blythe River Iron Ore Deposit). 17,291,000 tons (allowing 50% for reject rock. 23,000,000 tons (allowing 33% for reject rock).

In 1919, (Mineral Resources of Tasmania No.6), the above estimates were repeated by Twelvetrees.

1919 - Boyd, Gibson and Young (Commonwealth Parliamentary Papers. House of Reps. No. 164). 8,834,000 tons (This estimate is subject to the proviso that "the bulk of this must be discarded as being far too siliceous to be of any value at the present time").

1937 - P.B. Nye (Typewritten Report. Geological Survey of Tasmania - January 1937).
Report on the Blythe River Iron Deposits.
Figures are generally similar to those of Boyd, Gibson and Young.
7,000,000 tons (plus any ore existing under the basalt on the north side of river).

1938 - W.G. Woolnough - Report on Examination of Iron Ore Deposits in Tasmania.
On page 10 of this report, it is stated - "We find no justification for the belief that a major iron-ore deposit exists in this locality... We are, however, so completely convinced of the economic worthlessness of the deposit that no such survey (i.e. detailed Geological Survey) should be undertaken."

The investigation which formed the basis of the above report, was undertaken to determine whether a major iron deposit of high grade was present, and formed part of the investigations being carried out at this time for the whole of Australia.

In the last ten years, the Australian Commonweath Carbide Company has been extracting ore from a quarry on the northern side of the river. The amount of silica in the ore was advantageous for the purpose required by this Company.

The ore has been mined for use in the manufacture of ferosilicon, in which process the high percentage of silica was desired.

Operations are, at present, temporarily suspended due to wartime conditions.

The following is the production from this quarry :-

Quarter ending	June, 1940	103tons	- £169
" "	December, 1940	309 "	- £572
" "	March, 1941	1084 "	-£2060
" "	June, 1941	1096 "	-£2086
		2592 "	£4887

The dense undergrowth and collapse of most mine openings effectively screened most of the deposits except for the above quarry and conditions for examination are worse now than was the case in previous examinations when the scrub had been cleared, and some adits cleaned out. No attempt could thus be made of estimating reserves, but the general similarity of type of the deposits to the ore at Rutherford is striking. The deep gorge of the Blythe River enables the formation to be studied to a depth of several hundred feet and the vertical discontinuity of the various lenses is very pronounced.

<u>PENGUIN CREEK IRON DEPOSITS</u> -

The following reports have been written on these deposits :-

1895 - A. Montgomery (Sec. for Mines Report on the Mineral Fields of the Gawler River, Penguin, Dial Range etc.).

1898 - J. Harcourt Smith (Sec. for Mines Report) "Report on the Penguin and Dial Range Mineral Field".

1903 - W.H. Twelvetrees. "report on the Dial Range and some other Mineral Districts on the North West Coast of Tasmania."

1905 - W.H. Twelvetrees. (Sec. for Mines Report) "Report on North West Coast Mineral Deposit."

As no map was available showing the distribution of these workings, a map has been prepared on which they are marked.

It should be noted that Twelvetrees (1903, p.16-30) interpreted the deposits as "transmuted beds of the Dial Range formation." He argued that the iron deposits filled a hollow in the irregular and unconformable contact between the Cambro-Ordovician rocks and the Dial Conglomerate. He thus thought that they would not descend to any great depth and that the deposits would not go further west than the survivals of the original conglomerates.

While the above remarks may be true of the iron deposits further south on the Dial Range and which are discussed later, they certainly do not apply to those along Penguin Creek. These are identical in character to those of the Blythe, Natone and Highclere and are ores formed along fault zones, by selective replacement of the Cambro-Ordovician Rocks.

Along Penguin Creek these are interbedded slates, breccias and breccia conglomerates. The latter especially were susceptible to alteration but in no case are they lithologically similar to the West Coast Range Conglomerate and the evidence in the quarries themselves is definite that the host rock of the iron-deposits is not the heavy conglomerate which caps the Dial Range.

The haematite deposits outcrop along Penguin Creek about three miles from its mouth. The deposits were worked in the years 1897-1909, and the ore was transported by means of a horse-tram for a distance of 3½ miles down the Creek which it crossed at least 25 times. The ore was shipped from Penguin to Devonport by lighter and then transhipped to New South Wales.

In 1905, the effects of Australian competition was felt and led to the loss of markets and some time after, disagreements with landowners deprived the Company of their tramway facilities.

The ore that was exported was low in sulphur and phosphorus and silica, giving 68-69% Iron and up to 2.2% Silica.

Three quarries known as Hudson's No. 1,2 and 3 are on the west side of the Creek. These have a general north-westerly trend. No. 3 is the largest of the three and is 240 feet long, by 80 feet wide, and a maximum depth of about 40 feet.

Nowhere in the workings were continuous ore-bodies seen, as the ore consists of large rounded and angular masses of haematite and some limonite in a soft clayey matrix.

According to Twelvetrees (1919) about 40,000 tons of ore were mined. The mine workings have one feature in common - a long narrow crosscut approaches to wider openings along the deposits. The amount of dumped waste is appreciable on all the quarries so that the ratio of waste to high grade ore has always been high.

East of these and on the opposite side of the Creek is the most northerly of Ellis's workings. This is a narrow cut trending a little east of north. The approach from the west is 230 feet long and the quarry is about 100 feet long. Four hundred feet to the south-west is another quarry, a narrow cut trending west of north, 140 feet long with maximum height of nearly 50 feet.

Sixty feet south is another large quarry with a north-easterly trend. This quarry is 170 feet long with a maximum width of 70 feet. Both these quarries have a very steep wall on the eastern side, with very little ore showing.

About 1,100 feet to the south-west, is another group of three small quarries. The most northerly of these is now being held by K.O. Atkins and some ochre has been produced. This is obtained from weathered haematite and the limonitic clay associated with the brecciated ore.

The most southerly of the workings is in Good's Lot 12654.

A group of three cuts is 480 feet south-west of the north-east corner of the allotment and one other is 700 feet south of the above, but none of these is very extensive. The isolated outcrops on this spur may be gossans from lodes of the same type as the Iron Cliffs Lode which is about half a mile to the south.

In the quarries, the ore consiste of lumps of haematite and limonite, angular or rounded, set in clay-like matrix which represents the altered host rock. Boulders of haematite are very abundant in places but the waste heaps of each quarry is indicative of a low ratio of ore of suitable grade to waste.

HIGHCLERE -

Previous Literature -

The only Departmental report is by Q.J. Henderson (Typewritten Report, Mines Department, 1936, pp.55).

Location -

These deposits are in the vicinity of the Pet River on Subdivision lots 419,420 of the Van Dieman's Land Company's Emu Bay Block, and are in mineral lease 347P/M - 20 acres charted in the name of J.W. Barrett.

Access -

They are 1½ miles east of the Highclere Railway Station about 15 miles from Burnie. A branch road from the Burnie-Hampshire road runs to Cohen's homestead to within about a quarter of a mile.

General Geology -

The iron ore outcrops are found in the Lower Palaeozoic rocks. Overlying these to the south, is a thin capping of Tertiary Sands mostly of granitic origin, and these, in turn, are covered by extensive flows of basalt. Over most of the district, exposures are few as the mantle of basalt and basaltic soil prevents any close study of the structure and the mutual relationship of the ore bodies and the older rocks.

Iron Ore Deposits -

Ironstone boulders are widely strewn on the surface of the older rocks, but only four outcrops of ore were found. These four surface indications consist mainly of haematite and some limonite. The amount of siliceous ore is apparently small. The following analyses of grab samples serve to indicate the grade of ore :-

	Lab. Reg. No. 1440	Lab.Reg.No. 1441	Lab.Reg.No. 1442
Iron	66.08	63.7	64.3
SiO_2	2. 6	5.6	3.7
Al_2O_3	0.6	0.5	1.7
MnO_2	0.1	0.1	0.1
P_2O_5	0.18	0.26	0.26
TiO_2	0.07	0.18	0.07
S	0.16	0.19	0.31

The most southerly of the outcrops is just outside the south-west corner of the lease and is 70 feet long and 30 feet wide. The two which are near the northern end of the flat ridge are the largest of the outcrops. The samller of these and the more southerly is roughly elliptical in shape and measures 80 feet by 50 feet. The other is more irreglar in shape and measures 150 feet long and 100 feet wide. The fourth is 350 feet north of the north boundary of the lease, and has an observed length of 10 feet, and is entirely surrounded by basaltic soil.

The outcrops are insufficient to determine the relationship of the ore bodies to each other and to the bedrock.

Prospecting is necessary before any estimates of quantities and reserves of ore can be made. Costeaning and the sinking of shallow shafts would yield much added information and would determine whether further prospecting is warranted.

2. THE DERIVED IRON ORES OF THE CONGLOMERATES

The iron deposits on the south end of the Dial Range differ from the previous type of iron deposits by being younger in age, and by the fact that a great deal of the iron is in the form of pebbles in the conglomerate. These pebbles are well-rounded and are undoubtedly derived from the erosion of the deposits of the previous types.

The literature of these deposits is as follows :-

1903 - W.H. Twelvetrees "report on the Dial Range etc." p.p. 17-20.

1919 - W.H. Twelvetrees and A. McIntosh Reid. Mineral Resources No. 6 - "Iron Resources of Tasmania".

No mining or prospecting has been carried out since the above reports were written and the growth of scrub makes extremely difficult the detailed examination of the whole of the deposits, or to form estimates of the grade and quantity that is available.

Twelvetrees maintained that the iron in the conglomerate was due to replacement of the pebbles. Undoubtedly most of the haematite pebbles are derived from deposits older than the conglomerate, but there is also evidence of replacement of portions of the conglomerate. These are easily distinguishable from those portions merely containing pebbles of ironstone, by the fact that the matrix, as well as the pebbles, show this alteration in its various stages of development. There is undoubtedly a thick bed in the conglomerate where haematite pebbles are more abundant than elsewhere, and the ironstone boulders are strewn along the outcrop of this band. Where the pebbles of haematite are abundant, there has been replacement of part of the silica by the iron from these contained pebbles. In places this alteration has progressed further and here it is difficult to determine whether iron solutions permeating along fault lines have been active. It is suggested that continued movement of iron solutions along pre-existing fault lines has added its quota of iron to these beds.

The nature of these deposits, which are mainly concentrations of pebbles of haematite in a siliceous conglomerate, with a secondary replacement along small defined belts, is not such that holds much promise of their utilisation as a source of iron ore.

Up to the present, no exhaustive atttempt has been made to determine the quantity of ore that is available and the information obtained is not such that holds much promise of their being a source of high grade iron ore, as would be required for the proposed charcoal pig iron industry. If ironstone with a certain percentage of silica were needed, these deposits should be regarded as a potential source of supply.

3. HAMPSHIRE MAGNETITE DEPOSITS

These deposits lie 4½ miles south-east of Hampshire Siding on the Emu Bay Railway which is about 16 miles south of Burnie. A branch road from Hampshire to Upper Natone runs south towards Holloway's House. Then, after about half a mile of bad road, a board road runs to Cumming's Mill which is half a mile beyond the iron deposits.

Geology -

The iron deposits are an isolated occurrence of altered, silicified and carbonated basic rocks totally enclosed by the granite. The basic rocks are probably dyke-like bodies intrusive into the granite.

The iron deposits differ from the ones previously discussed in that they are predominantly of magnetite with haematite and limonite as the secondary minerals.

Owing to the regrowth of dense scrub, it is difficult to locate the trenches described by A. McIntosh Reid, Typewritten Report, 1924 (first half year) p. 165 and in order to check the estimates of reserves, it would be necessary to scrub the area and cut trenches. Information obtained from this work would decide what further prospecting would be necessary to determine the potential reserves of these deposits.

In the above report, A. McIntosh Reid states of these deposits:- "Their thickness and extent cannot be determined with any degree of exactitude owing to the difficulty in tracing their outlines. This is due to the covering of detritus and clay soil.......The trenches were confined to the bodies near the granite which were considered likely to contain ores of tin. The information they reveal is of no value in so fat as it concerns the investigation of the magnetite deposits. There are then no criteria upon which an estimate of quantity can be based. The reason for the difficulty in arriving at an estimate of quantity is experienced again in attempting a determination of the quality of the ore."

Since the above report was written, no active prospecting has been undertaken and there has been considerable regrowth of scrub which effectively prevents any detailed geological investigations.

The following is the average of five analyses of ore from the Hampshire Hills and is indicative of the grade of ore that is present :-

Metallic Iron	67.48
SiO_2	1.62
Al_2O_3	2.40
CaO	0.11
MgO	0.32
S	Trace
P_2O_5	"
TiO_2	"
MnO	0.60

The ore is of high quality and contains traces only of deleterious substances. The central part of the large lenses is mostly magnetite but this is fringed by oxidised ores consisting mainly of haematite and limonite, the latter representing the end product of alteration.

CONCLUSION

The iron deposits in the area south of Burnie can be considered as belonging to three distinct types. Those at the Blythe River, Penguin Creek, Natone and Highclere are replacement bodies developed along fracture zones. The Dial Range Iron Deposits have been largely derived from the erosion of deposits similar to the above. The Hampshire Hills iron deposits differ from the above by being replacements in dykes of basic rock intrusive into the granite, and differ from the above types by being mainly magnetite.

Of the above deposits only those at Natone and the Blythe River have been prospected sufficiently to indicate the quantities available and the variation in grade.

The Penguin Creek deposits are the only ones that have been mined to any appreciable extent, about 40,000 tons of ore having been exported to New South Wales. No signs of prospecting beyond the various open cuts can now be observed, and so no estimate of ore is possible. The deposits are similar in type to those at the Blythe and Natone and no doubt a large quantity of ore is present. The results from the more intensively prospected areas give indication of the amount of ore that can reasonably be expected to exist.

The Blythe River deposits have been quarried in recent years and 3,408 tons valued at £6,055, have been mined for the manufacture of ferrosilicon in which the silica content of the original iron ore was advantageous. The latest estimates by P.B. Nye (1937) of reserves of the Blythe River deposits is at least 7,000,000 tons to river level. There is no reason to doubt this estimate which, however, could not be checked owing to regrowth of scrub since those estimates were made.

At Highclere, no prospecting of any nature has been attempted.

The Hampshire Hills deposits are of different type but even when originally investigated, insufficient prospecting had been undertaken to form estimates of quantities. Since the, conditions for examination have so deteriorated that it would be necessary to prospect the area before attempting to assess the amount of magnetite that is present. There is no doubt that an appreciable amount of ore is present.

At Natone, much prospecting, which has clearly demonstrated the nature of this deposit, has recently been carried out by Ferrico Proprietary Limited. This work has been confined to an area of about three acres in a lease of 57 acres. The three acres cover the maximum concentration of surface exposures, which occupy only one tenth of this area. Calculating the tonnage of ore within this area above the level of the greatest depth of prospecting (equivalent to the 830 feet contour level) and assuming a tonnage factor of 8 cubic feet per ton of ore, the total estimated tonnage is 56,000 tons. The total tonnage of waste assuming an average specific gravity of 2.8, is 314,000 tons. This gives a ratio of ore to waste of 1 to 5.6 if all the material in this prospected area was quarried. This ratio would be much lower according to the degree of selective mining. Nearly half of the amount of ore is contained in the largest outcrop near No. 2 Bore, and the depth of this has not been established with any certainty.

One of the main factors that would control the mining of iron ore on this lease is the lack of continuity of the isolated outcrops thus necessitating the mining of a varying proportion of spoil. Selective mining would thus be necessary in the vicinity of even the largest outcrops.

The purity of the ore compares favourably with those haematite ores in other parts of the world and the amount of deleterious ingredients is very small. The dominating factor that would determine the production of iron ore from these deposits would be the cost of mining. The evidence is conclusive that the deposits persist in depth, and reserves of sufficient magnitude to warrant the establishment of an industry, could be proved by systematic prospecting. The whole project depends on the cost of extraction of the iron ore, and the occurrence of the ore in small lenses adds to the cost of production so that it is extremely doubtful whether at present market prices the mining could be performed at a sufficiently low cost to justify the establishment of the industry.

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