THE BLYTHE RIVER IRON ORE DEPOSIT.

(Extract from Mineral Resources. No. 6).

(1) INTRODUCTION:

This is on a property held under mining lease from the Tasmanian Government by the Blythe River Iron Mines Limited.

It was visited by the writer first in June 1900; again in January 1901; and finally in 1918. Reports on it which have been issued are the following:-

Report on a Deposit of Iron Ore at the Blythe River, by A. Montgomery, M.A., 5th March, 1894.

Report on the Blythe River Iron Mines, by Mr. John H. Darby, M.I.C.E., 7th December, 1900.

Report on the Blythe River Iron Ore Deposit, by W.H. Twelvetrees, 30th January, 1901.

The leases at present held by the company are:- Nos. 1061/91M, 40 acres: 1009/91M, 73 acres: 851/91M, 78 acres: 4185/93M, 20 acres; 4066/93M, 40 acres; 7999/M, 91 acres; 8007/M, 50 acres; 8001/M, 184 acres; 1985/W, 2 acres; 7812/M, 40 acres; 7996/M, 40 acres; 7998/M, 12 acres; 7997/M, 68 acres; besides some freehold property and mining rights on C. O'Keefe's land, 50 acres.

In a report made for the owners of the property by the late Mr. J.H. Darby in 1900, he recommended work on a scale which would involve an ore output of upwards of 6000 tons weekly.

On his advice two test adits were driven into the lode below the outcrop on the northern side of the river, in order to obtain information as to the continuity and uniform quality of the ore. One was driven into the outcrop near the bridge over the Blythe River (since destroyed), and the other nearly 80 feet below one of the northern outcrops on the 40 acre section, - No. 1061/91M. These adits are at points about 50 chains distant from one another along the strike, and the vertical difference between them is about 600 feet.

In possession of the results of these drives and of the information gained by his personal examinations, Mr. Darby arrived at conclusions which can be summarised as follow:-

1. There are overwhelming indications at many points over a mile of country of an immense deposit of hematite, probably sufficient for the manufacture of 3000 tons of finished steel weekly for many years to come.

2. The ore can easily be reduced to pig iron. Its quality is excellent, and rarely surpassed by any in Europe or America.

3. A sample of ore taken over the whole deposit (63 per cent. iron, 0.024 per cent. sulphur, and 0.036 per cent. phosphorus) showed it to be capable of producing, with good coke and limestone, very superior hematite pig iron suitable for the manufacture of high-class steel.

(2) SITUATION:

The River Blythe, a non-navigable stream, rising in the Surrey Hills, has at between 6 and 7 miles from its mouth at Heybridge intersected this large lode of hematite ore, excavating its channel and exposing the intersected lode down to over 600 feet below the general level of the tableland. Its bearing is north 27 degrees east and south 27 degrees west for an observed distance of fully 1 mile, and signs of its continuation are visible for a further distance.

North of the river it extends through part of Section 851, 78 acres, through Section 1009, 73 acres, C. O'Keefe's purchased 50 acres, into Section 1061, 40 acres, and indications of its existence further north are to be seen on the east boundary of O. Allen's 100 acres.

South of the river it passes through Section 851, 78 acres, and Section 4185, 20 acres, into W.H. Atkinson's 186 acres, where it disappears beneath a covering of basalt of Tertiary age.

(3) DESCRIPTION OF THE LODE:

The outcrop dips at a high angle to the south-east and the lode appears to be conformable both in strike and dip with the enclosing sedimentary strata, which are of Silurian age. The surface strike is slightly sinuous, following the direction of the edges of the encassing beds. These beds are fissile sandstones and slates. On O. Allen's 100 acres east of the iron lode, the country rock, iron-bearing in places, is evidently the conglomerate of the West Coast Range and the Dial, and the hardened sandstone beds in immediate contact with the lode on

its eastern side belong in all probability to the same series.

Mr. G.A. Waller, a former geological officer, adduced reasons for considering the West Coast Range conglomerate as the basal formation of the Silurian system in Tasmania. Owing to the accumulation of evidence, this view has lately been adopted by the Geological Survey, and the conglomerate removed from its provisional place in the Cambro-Ordovician to the Silurian.

A great deal has been said locally at one time or another about the possibility of the outcrop covering copper ore deposits. Of course, this question does not in the slightest degree affect the future of the Blythe Iron Mine as an iron ore property, for the huge outcrop continues to be non-cupriferous hematite-bearing material down to river level. The absence of other lode minerals and the small proportion of limonite in the lode rather contra-indicate the existence of a copper lode in depth; a large number of analyses have been made without disclosing the presence of copper sulphides or any other ore. At the same time, there appears to have been a deposition of copper along parallel lines, and wherever the iron development is strong the parallel copper deposition is also pronounced. At the northern end of the iron lode the hard siliceous contact-rock is sparsely impregnated with specularite, iron, and copper pyrites. This strengthens a supposition that the deposition of both iron and copper ores formed part of one and the same physical process.

The lode at the Blythe has no doubt genetic associations with the granite which comes in at the southern boundary of Rutherford's land further south, or, more strictly speaking, with the acid magma, of which the granite is the manifestation and outcome. The relations, however, are not those of contact metamorphism. The ore is not magnetic, and there are no characteristic minerals of a contact aureole. The deposition, it may be conjectured, has been by way of precipitation from solutions. Without speculating specifically on the successive stages of deposition, the process may be regarded as having been metasomatic.

The lode is prominently shown on each side of the river by a series of huge crags projecting from the slopes of the hill as they descend to the stream. The upper crag on the north side appears to be east of the main outcrop line, and may possibly be part of a parallel lens which has been trenched upon lower down, and also crosses the river east of the main line of outcrop. This eastern lens seems to be of a decidedly siliceous nature. Its continuation northerly is obscure. The main lode runs north from the river for about three-quarters of a mile, 26 chains of which are below a capping of olivine basalt of Tertiary age. This sheet of lava is between 100 and 150 feet in

thickness. The lode emerges from below the northern edge of the lava and continues halfway through Section 1061.

The width of the lode north of theriver and at different horizons varies a good deal. A the river itself it is not more than 30 feet wide, while higher up and some chains north of the river the width of outcrop is 50 feet, and north of O'Keefe's quarry the solid ore at surface at different points measures from 80 to 100 feet across, widest at the northern end.

The lode-width at the point where the river flows across the formation has been taken by the Commonwealth engineers (8) as an indication that the lode is thinning out in depth along its entire course, but it is doubtful whether this assumption is sound. The explanation suggests itself that the river may mark the thin end of a lens, which was chosen by the stream as a path of least resistence.

On the south side of the river the lode occurs as lenses showing in the form of large crags, not always on the same line, and separated by areas of intervening country-rock. The base of the lowest crag is between 140 and 150 feet wide. A the top of the crag a trench exposes the ore and ore-ground for 4 chains.

Higher up is what is known as the "Purple Crag," a mass of dense lumpy iron ore, projecting in a striking way from the hillside. The crag is over 100 feet in width, siliceous ore extending further west, concealed below the overburden of soil. In the crag itself is excellent ore. Still greater widths have been ascribed to the ore-deposit on this side of the river, but these probably include intervening bands of iron-stained country between parallel iron formations, of which there are some signs. Further, there is a siliceous upper crag to the east -- possibly a parallel lens.

The origin of the Purple Crag is not quite clear. The view advanced that it is merely a surface formation deserves examination, although appearing somewhat improbable. Those familiar with the features of the Tasmanian conglomerates and breccias of this age will recall similar occurrences of brecciated ore without adopting for them a recent origin. Such may alternate with other beds in which the replacement has been imperfect. Naturally, the view adopted in the present case will inevitably affect the tonnage-estimate considerably. Samples which the writer took from the Purple Crag in 1900 yielded on assay by the Government Analyst 68.6 per cent iron, 1.8 per cent silica, 0.09 per cent phosphorus, and traces only of sulphur. The sampling carried out by the Commonwealth engineers in 5 feet sections shows results

ranging from 57.96 per cent iron and 12.92 per cent silica to 66.56 per cent iron and 2.26 per cent silica.

Speaking generally, there is so much siliceous lode-material and iron-stained country-rock on the south side of the river that a good deal of work is necessary in order to ascertain the boundaries and actual average quality of the ore-bodies. The old estimates and the present Commonwealth estimates have, in the absence of this work, merely a partial and tentative value. But the apparent lenses in

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(8) In a recent examination on behalf of the Federal Government

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this cannot be excluded from the consideration of the Blythe River lode as a whole. The development of high grade hematite ore on Rutherford's property further south shows that the ore-belt is not restricted the north side of the river, but continues a considerable distance beyond the limits of the Company's leases.

The tunnels which have been driven into the lode on the north side of the river are three in number, viz.:- The old Central tunnel at between 500 and 600 feet from the river and 280 feet above the level of the water (aneroid measurement); Mr. Darby's lower tunnel at the river; and his upper tunnel below one of the northern outcrops.

The central tunnel, as was pointed out by the writer in a previous report, was driven in a badly-chosen spot, in a poor-looking part of the line between two large crags of ore which project from the surface on this side of the hill. It is a crosscut tunnel through the ore-bed, which is here 54 feet across. The tunnel is only 50 feet below the out-crop, which had nothing to recommend it, consisting of soft to stony material. The ore cut was of inferior grade, the impression left on the writer's mind being that perhaps 10 per cent might be good ore, the rest being earthy and siliceous. The best ore assayed 56.7 per cent iron and 18.8 per cent silica. Going southwards from here the out-crop increases in width, till at a point above 400 feet above the river it is about 80 feet wide.

The lower tunnel was driven opposite to the old bridge which used to cross the river at that spot, and was put into the hill 225 feet on the western or footwall side of the lodge, which latter has been tapped by seven crosscuts. The lode underlies to the south-east, passing beneath about 40 feet of soft slate country, which is succeeded by a jaspery ridge, and 80 feet of siliceous and brecciated iron ore, most of which is earthy and stony, though some of it looks of fair quality. This may be taken to be the eastern parallel lode.

Outside the entrance on the writer's previous visit was an old pile of ore broken from the outcrop, consisting of solid hematite free from visible silica. There were also piles of good ore from the crosscuts, especially from the 77 feet crosscut.

The first crosscut has been driven at 30 feet from the tunnel-mouth for a distance of 12 feet, the last six of which were in dense ore without visible silica.

The second crosscut, at 45 feet, was driven east 6 feet to the ore, and them stopped.

The third crosscut, at 66 feet, was driven 6 feet in ore of a jaspery and stony nature, the assay showing 46 per cent iron and 34.2 per cent silica.

The fourth crosscut, at 77 feet, was driven 17 feet in hard solid ore, assaying 65 per cent iron and 7 per cent silica.

The fifth crosscut, at 142 feet, cut into ore for 6 feet, assaying 67.2 per cent iron and 3.8 per cent silica.

The sixth crosscut, at 167 feet, was 25 feet in ore. Some good ore can be got from this crosscut, assaying 68.1 per cent iron and 2.4 per cent silica, but patchy. On the whole, the material is impure and lumpy, and in the face cherty with a hackly fracture.

At 189 feet the ore was merely cut into for a foot, and appeared good and solid.

At 199 feet good-looking ore was just exposed by a cut into the wall of level (assay 65.5 per cent iron and 2 per cent silica). Siliceous material showed on the western wall.

The seventh crosscut, at 225 feet, was driven in ore 13 feet. 'Some of this was good, assaying 68.7 per cent. iron and 1.6 per cent. silica, but most of it was lumpy and suspiciously hackly with a short fracture. Some of the lode-matter is rather fine, and would have to be cautiously mixed with other ores.

It will be noticed that in no instance has a crosscut been driven right through the lode; the latter has sometimes been tapped for a few feet only, or even merely exposed by a cut. The object appears to have been to obtain assurance that the lode was descending from surface in strength. Some good payable ore has been disclosed, but associated with siliceous material. The assays of samples taken by the Commonwealth experts across the lode at entrance to the tunnel yielded 54

per cent. iron and 31 per cent. silica. Such results are possible from a given section of the lode if in a cherty zone.

The upper tunnel is situate in the northern part of the lode, about 600 feet above the lower one. It has cut the lode at about 80 feet below the outcrop, and has traversed the ore-body for 84 feet without passing through it. A few yards more driving would probably have taken it through the lode. The ore is solid, and has the appearance of being good, though the writer's samples did not yield the best results, giving 59.8 per cent. iron and 14.4 per cent. silica. Soft siliceous and earthy patches occur, and one of these has been entered at the end of tunnel. This tunnel also shows that the surface outcrop is not an encrusting capping, but that the lode descends with the enclosing strata. The trenches north of the tunnel show dense ore associated with silica. The Commonwealth experts formed the opinion that the ore in this tunnel is very cherty and siliceous throughout, though they say some of the ore looked fairly good, and some nice clean ore is showing in one or two places on the surface immediately over the tunnel. The results, they say, go a long way towards proving the irregularity and non-continuity of the better grade of ore exposed on the surface. Their complete sampling showed 54.3 per cent iron and 25 per cent silica.

A small quarry in the northern part of O'Keefe's 50 acres shows some very good-looking hard hematite, from which the writer got samples assaying as much as 68.4 per cent iron, with only 2.2 per cent silica. The thousand tons of ore which were sent away by the company are said to have been broken from this quarry. As usual, there is some mottled siliceous ore with the higher grade hematite, and the samples taken by the Commonwealth experts averaged 56.4 per cent iron and 19.11 per cent silica.

If the fine outcrops are worth anything as an indication, they encourage the hope that actual work will show that all along the line adequate quantities of payable ore will be found available for many years to come. It is true that the trench work and close sampling carried out by the visiting experts in certain parts of the lode seem to justify the opinion that the average silica contents are unduly high, so far as those samples and trenches are concerned, but the real question is what proportions obtain in the lode as a whole. This must remain a matter of opinion until the lode is thoroughly tested and opened up in the course of working. It will then be possible also to determine how far it is practicable to reject excessively siliceous and waste stuff without going to too great expense. Mr. Darby's opinion was that there may be half a ton of

refuse in 1 ton of ore, or equal bulk of each.

Mr. Darby gives the results of analysis of an average surface sample taken from the whole deposit, and these may be placed by the side of an analysis given by the Commonwealth experts of a composite sample from proportional parts of 23 samples of fairly good ore from different parts of the lode as follow:-

	Mr. Darby Per cent.		Commonwealth Experts Per cent.	
Ferric oxide Ferrous oxide	86.954 3.074	= iron 63.259%	89.68 1.2	= iron 63.71%
Silica	7.312		7.76	
Alumina	1.756		0.620	
Lime	0.068		0.165	
Magnesia	0.071		Trace	
Sulphur trioxide	0.060	= sulphur 0.024%	0.135	= sulphur 0.054%
Phosphorus pentoxide	0.083	= phosphorus 0.036%	0.119	= phosphorus 0.052%
Titanic acid	0.03		Nil	
Copper	Trace		Trace	
Arsenic	Trace		-	
Manganese	Trace		0.078	manganous oxide
Chromium	Absent		Nil	
Combined water	0.324		0.54	
Moisture	0.160		0.13	

These analyses of the good ore at the Blythe do not differ essentially from each other. The crucial question after all is one of tonnage.

The writer, on his recent visit, took samples of good hematite exposed at and near the quarry on O'Keefe's section in the northern part of the lode, and from the southern end of the outcrop. These were assayed by Mr. W.D. Reid, Government Assayer, with the following results:-

	Northern Samples.	South of River.	River Bank, South side.
	Per cent.	Per cent.	Per cent.
Iron	66.10	69.00	64.36
Silica	5.20	1.20	6.20
Sulphur	0.063	0.057	0.07
Phosphorus.. ..	0.002	0.02	0.002
Moisture at 110°C.	1.12	1.14	0.08

Some of the more siliceous ore on the south side of the river was taken for assay, and yielded the following result:-

	Per Cent.
Iron	44.63
Silica ..	32.80
Sulphur ..	0.04
Phosphorus	0.001
Moisture at 110°C.	0.16

Such stone is too impure for treatment in the furnace.

From various reports it can be gathered that some of the ore is of excellent quality. Mr. J.R.M. Roberston, of Sydney, reported in 1891 to Messrs Henry Law & Co.:-

> "I know of no deposit of iron ore so pure, and consequently so admirably fitted for producing the highest and best brands of iron and steel".

The "Australian Mining Standard" of July 20, 1891, contains an account of experiments made at Halliday's Engine Works, 20 Erskine Street, Sydney, with a 4 cwt. sample of Blythe River ore:-

> "Mr. Brazenhall informs us that he charged an ordinary foundry furnace with 3 cwt. of the Tasmanian iron ore and about 14 lb. of limestone, and ran the iron smelted into pigs, He afterwards made castings of various descriptions from the pigs thus produced, and had a cast mandrill put into the lathe to show that the iron was not too hard for machining. The iron proved of the very highest quality, of exceedingly fine and close grain, and very tough. In addition to the cast-iron, a small quantity of puddle bar-iron was secured, owing to the furnace not being entirely adapted for producing cast-iron, and wrought iron has been worked up with the most satisfactory results".

Mr. A. Montgomery, M.A., Government Geologist for Tasmania, in 1894 reported in that year as follows:-

> "As it was quite impossible for me in the undeveloped state of the mine to obtain a sample of the ore which would at all fairly represent its average bulk value, and as such a sample would indeed be of no particular use, inasmuch as in actual working a lot of lean ore would be necessarily rejected, I only

took a few samples of the best-looking boulders in the river for analysis. They may be looked upon as fairly representing the best ore, but from inspection I should judge that many thousands of tons of equally good stuff could be readily obtained. What the average yield of such first-class ore from the bulk of the deposit would be is, as already remarked, only to be ascertained after it has been opened out by trenches and cuttings.

"The samples taken were forwarded to Mr. W.F. Ward, Government Analyst, in Hobart, with instructions to have them carefully examined for all impurities likely to interfere with the quality of the iron to be made from the ore. He reports the analysis as follows:-

	Per cent.	
Iron peroxide	95.2%	= iron 66.4%
Silica	4.8%	
Phosphoric acid ..	Traces	

This ore is of excellent quality, being practically free from all impurities with the exception of the silica. It resembles the well-known Cumberland red hematite, so long used for the production of steel by the Bessemer process".

Mr. Montgomery goes on to say that, according to these analyses, the Blythe River hematite is one of the finest and purest in the world.

The estimates of quantity which have been made by various observers at different times must be regarded as subject to the limitations which inevitably attach to the consideration of imperfectly tested properties. They are as follow:-

1894, Mr. A. Montgomery, 30,000,000 tons gross.
1900, Mr. J.H. Darby, 24,500,000 tons net.
1901, Mr. W.H. Twelvetrees, from 17,000,000 to 23,000,000 tons net.

1919, Messrs Boyd, Gibson & Young, 9,000,000 tons, the bulk of which is regarded as being too siliceous for an iron ore at the present day.

The following will indicate the basis adopted for these estimates:-

Mr. Montgomery says:-

"The deposit must be one of the largest also, containing many millions of tons. The data for calculating its size are very insufficient, but taking them such as they are, a rough calculation may be made which will serve to give some idea of it. On the south side of the river, the ore is seen for a horizontal

distance of about 8½ chains, and rises to a height of 280 feet above the stream; on the north side it rises to 500 feet above the river in about 50 chains horizontal distance, and then falls a little, say to 400 feet, for another 16 chains. Taking the width of the ore-body at 66 yards, these measurements give the cubic contents of the deposit under the visible outcrop down to the level of the Blythe River as slightly over 10,000,000 cubic yards, or, at 3 tons to the cubic yard, 30,000,000 tons. It is not to be supposed that the ore terminates where the outcrop disappears under the superficial basalt, or that it only goes down to the level of the Blythe River". (ϕ)

A good deal of the bush has been cleared away since the above report, and the width of the lode has been ascertained to be less than was surmised.

Mr. Darby reported that as he only saw the crosscut of the deposit made by the Blythe River and the solid ore blasted out in a few places, he was unable to state how many million tons are actually obtained, but could say that after thoroughly examining the surface, there are overwhelming indications at many points in over a mile of country of an immense deposit of hematite.

He proceeds:-

> "In estimating the probable quantity of ore, I have taken the river bed as the bottom, although it is nearly certain to extend down much further, and have measured the width of the deposit where the sides are well defined. The cubical content of the deposit, which I have thought it advisable to divide by two, at 3 tons per cubic yard, yields 24,500,000 tons of selected ore".

The estimate of 17,000,000 tons marketable ore made by the writer was based on a horizontal lode length of 90 chains, and average widths and height above river level for separate sections, deducting 50 per cent for waste rock. Taking the lode length as a mile, and the width as 100 feet, nearly the same result is obtained.

These three estimates, it will be observed, are rough and tentative, and assume the existence of concealed sections of the ore-body, besides involving personal opinions as to the average nature and quality of the ore. The estimate of Messrs Boyd, Gibson, and Young, however, belongs to a different category, being confined to segments of the lode, on which some prospecting, however imperfect, has been carried out, and making some pretension to the valuation of definite blocks of ore. Being a buyers' valuation,

all portions of the lode which cannot be demonstrated to contain sufficient usable ore are cut out, and, of course, potentialities and so on are not admissible. These necessary limitations, while meeting the requirements of an intending purchaser preclude the consideration of the general prospects and possibilities of the lode from the standpoint of its eventual contribution to the iron resources of the State. The additional trenches and excavations made under the direction of the Commonwealth experts have as far as they have gone, given results not altogether reassuring; that is to say, they have

ø Report of the Secretary for Mines, 1893-4 (p. xxii).

shown the existence of more siliceous ore than was expected, and they indicate the necessity for the lessees to exercise care in deciding where they will open out in starting production. The company's advising engineers will, no doubt, in the first instance, lay out a well-considered prospecting scheme, and then locate the sites for their quarries. It is possible that a quarter of the whole tonnage exists to the south of the river, but very little is really known of the ore-bodies on that side of the Blythe, and they suffer under the disadvantages of being less accessible than the northern part of the lode. The lessees will probably look ahead for 20 or 25 years, and, if aiming at a moderate metal production with the aid of the State hydro-electric current, say, perhaps, 100,000 tons annually, they will require to assure themselves of an ore-supply to the extent of 4,000,000 to 5,000,000 tons, or double that quantity if they desire to double the production. It is regrettable that so many years, have elapsed without opening up and practically establishing the value of the property.

The possibility of reducing the average silica content by selection and blending will have to be investigated. The mere presence of siliceous ores does not invalidate the claims of an iron property to serious attention. Some of the Lake Superior ores, as shipped, contain as much as 34 to 40 per cent. silica, but the proportion is brought down by mixing with the purer grades to an average of under 10 per cent. (ø)

The facilities for ore-raising are good. Points for open-cut workings can be easily selected in the solid crags and outcrops of ore standing out on the hill-sides, and the ore sent down at no unusual expense to river-level for despatch to works. If the smelters are erected at the mouth of the Blythe, the old tramway route from the mine (some 6½ miles) can be used for laying down rails and connecting with the Government line at the coast. There would be a further transport of the finished product over a distance of 5 miles to Burnie, where interstate vessels can load with ease.

ø "The Geology of the Lake Superior Region, by C.R.V. Hise and C.K. Leith. United States Menograph Volume III., 1911 (p. 273).

DEPARTMENT OF MINES

HOBART

4th November, 1919