

A very coarse grained greenstone, forming fairly conspicuous outcrops, is believed to be intrusive into the other rocks of the Greenstone Complex, but no evidence has yet been obtained to indicate whether it occurs as sills or is transgressively intrusive.

Because of the general paucity of outcrops it is very unlikely that it will be possible to sub-divide the Greenstone Complex on the maps. Distinctive varieties of greenstone are, however, being indicated.

It is proposed to continue field work in this area during the 1939 field season.

REPORTS ON SOME MINING GROUPS IN THE YILGARN GOLDFIELD.

(North of the Great Eastern Railway.)

(R. S. Matheson, B.Sc.)

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PILOT GROUP.

YILGARN GOLDFIELD.

(By R. S. Matheson, B.Sc.)

GENERAL INFORMATION.

The Pilot Group is situated on the western side of the Southern Cross-Bullfinch railway, approximately $6\frac{1}{4}$ miles from Southern Cross, and is $1\frac{1}{4}$ miles W.S.W. from the 6-mile peg on the main road between these two centres.

At the time of inspection (May-June, 1938), there were two existing leases, "Pilot" G.M.L. 3414 and "Exonia" G.M.L. 3483 both under the control of T. J. White and W. J. Heydon, and prospecting was being done in the old workings on the late "Colleen Bawn" G.M.L. 2544.

The present lessees of the "Pilot" G.M.L. 3414, first pegged the ground in December, 1932, but official records show that gold was discovered in this vicinity in the year 1909.

A 5-head battery and cyanidation plant is in operation on the "Pilot" mine, but only on rare occasions it is available for public crushings.

Water for domestic and mining purposes is obtained from the Southern Cross-Bullfinch water supply pipeline, which passes through the group.

There are adequate supplies of morrel, gimlet and salmon gum in the vicinity, which are suitable for mining purposes.

It is impossible to determine accurately the total production from this group, as some production may be included under "sundry claims" in the Hope's Hill official grouping, but a study of the official figures shows that 12,075.20 tons of ore have been treated yielding 6,739.86 fine ozs. of gold, and specimens total 17.81 fine ozs.

GENERAL GEOLOGY.

The group is situated in an area of highly metamorphosed interbedded, greenstones, jaspilites and erosion sediments, which are presumably of Pre-

Cambrian age and the country grades eastwards into replacement gneiss of granitic origin. The rocks are sheared and contorted, but have a general north-west strike and steep dips varying from 70° N.E. to 70° S.W.

A geological subsurface map of the area, on a scale of 5 chains to 1 inch, has been compiled, and it will be included in a later publication dealing with all the mining groups in the northern portion of the Yilgarn Goldfield.

Greenstones.—Metamorphosed basic lavas and tuffs constitute the major portion of the greenstones. The lavas are dark greenish in colour, and dense to medium-grained varieties occur. They are often amygdaloidal, and exhibit only a rude schistosity.

The tuffaceous rocks are distinguished from the lavas by their greyish-green colour and their greater schistosity.

Anthophyllite Schist.—A band of this rock 15 chains wide, occurs 45 chains south-west of the leases. It is believed to be a pre-folding, ultra-basic sill. It is yellowish to grey in colour, and is everywhere associated with chromite-bearing ironstone and cellular quartz, which are believed to be its decomposition products. The anthophyllite schist is regarded as a component of the greenstones, and it would probably be green in colour, if it could be seen in a fresh state.

Irregular masses of intrusive, coarse-grained, greenstone are associated with the anthophyllite schist in a few places.

Jaspilites.—Two main beds of jaspilite, approximately 16 chains apart, are present in the area, and there is some suggestion that these may be the same bed repeated by folding on a north-west-south-east axis.

The western bed occurs fairly continuously throughout the group forming a sinuous outcrop line. In places along its strike, two or more outcrop lines appear, and this is thought to be due to the presence of dragfolds.

The eastern bed is poorly represented, and can be best seen in the vicinity of the "Pilot" workings. To the north-west it is obscured by a thick overburden, while to the south-east it becomes almost completely granitised.

Erosion Sediments.—A band of metamorphosed erosion sediments, 10-15 chains wide, and consisting of quartzites and grey garnetiferous phyllites, occurs $\frac{1}{4}$ mile south-west of the workings. Numerous flows of amygdaloidal basic lava are interbedded with the erosion sediments, and are of necessity mapped with them.

At the time of inspection it was impossible to be certain whether these erosion sediments were a syndinal remnant of the Whitestone Series, or only a sedimentary band in the Greenstone Series. It is hoped that this point will be elucidated by future fieldwork.

Gneiss.—The gneiss is granitic in composition, and in the area mapped, is believed to have been formed by the replacement of greenstones. Owing to the mode of origin of the gneiss, its boundary with the greenstone is not sharp. A zone of intermediate rocks occurs between the greenstone proper and gneiss proper.

Structure.—The group is on the northern extension of the Southern Cross belt of country, which has been determined from previous mapping, to be situated on the western limb of a large anticline folded on a north-west-south-east axis. The eastern limb of this anticline embraces the Koolyanobbing belt of country.

From a study of the dragfolds in the jaspilites, it will be seen that they pitch 55° S. in the vicinity of the main workings, while north-westerly pitches prevail at the north-west and south-east ends of the area. This reversal in pitch was brought about by another system of folding with an approximately east-west axis, and is generally referred to as cross-folding. Gold deposition appears to have occurred close to the axis of this crossfold.

Normal faulting, with a displacement of approximately 5 chains, has taken place at the south end of the area, and milky-white quartz reefs occur along the line of the fault. The faulting appears to be post-gneiss in age because of the displacement of the greenstone-gneiss boundary, but this interpretation is open to question. Granitisation frequently ceases at a definite horizon, and it is probable that pre-gneiss faulting would not materially affect the process.

THE MINES.

"Pilot" G.M.L. 3414 and "Exonia" G.M.L. 3483.

At the time of inspection (May-June, 1938), mining activity was confined to the "Pilot" lease.

The ore body consists of greenstone lode material with quartz veins and stringers, which has been mined sporadically over a length of 225 feet and a width of 70 feet, between the surface and the 70 feet V.D. level. Payable values occur erratically through this block of country, and the limits of the ore shoots are ill-defined. The actual mined portions of the lode formation can be seen on the accompanying plans. (Plate V.).

The available ore has practically been stoped out between the surface and the 45 ft. V.D. level, and at the time of inspection overhand stoping was in progress in the south-east workings at the 70 ft. level. The jaspilite has also been mined in places, where ore shoots occurred.

The workable ore is limited in depth by the sulphide zone, which begins at approximately 70 feet V.D. from the surface. Values are said to occur in the sulphide zone, but there are no facilities for the treatment of such ore at the mine, and a loss is incurred if the sulphide ore is sent to Kalgoorlie for treatment. Specimens of the sulphide-bearing ore were submitted to the Government Chemical Laboratory for mineral determination and the sulphide present proved to be marcasite.

All the known ore shoots are either in, or stratigraphically above the jaspilite, and they bear a close relation to its structure.

The structural control is best understood by taking the lode formation as a whole, rather than the individual ore shoots. By referring to Plate V., it will be seen that the jaspilite has been folded into west, anticlinal limb, dragfolds, which pitch 55° S.S.E., and the lode formation is confined to the synclinal trough of the north-western of these two dragfolds. Because of this, the ore shoots in the mine are expected to have a south south-east pitch, although it

was impossible to observe the pitch of the shoots in the workings. Greenstone occurs stratigraphically above the jaspilite, and mica schist, believed to be an intermediate stage in the granitisation of the greenstone, predominates below it.

The production figures given below have been taken from the official records and are complete to 31st July, 1938.

Ore Treated.	Gold Therefrom.
11,665 tons.	2,004.06 fine ozs.
Sands.	2,819.73 fine ozs.
Total 11,665 tons.	4,823.79 fine ozs.

Some of the production from the sands shown above, may possibly be from public crushings carted from elsewhere, but it is reported that a large percentage of the gold in the "Pilot" ore is recovered by cyanidation.

RECOMMENDATIONS AND CONCLUSIONS.

1. The workings have not yet penetrated ground water level, and this fact along with the erratic distribution of the values, suggests a secondary origin for the majority of the lode material. It is not intended to imply that lode material will be entirely absent below ground water level, but there will be a marked decrease in lode material due to the disappearance of the secondary enriched portion, and any that remains will be in the proximity of the auriferous quartz veins and stringers.

2. Because of the poor extraction obtained from the treatment of sulphide ore at the mine, there is obviously a close association between the gold and the sulphides.

3. Diamond drilling to test the downward continuation of the lode formation, has been done by the Western Mining Corporation, who at one time held an option over this property. Two bores were drilled on the same site (see plan), and all the available information concerning these bores is tabulated below.

Bore No.	Angle of Depression.	True Bearing.	Bore Depth.	Remarks.
1	71° 31'	70°	235' V.D.	6ft. lode at 140ft. Recovery value, 4.1 dwts. gold per ton.
2	81°	70°	428' 5" V.D.	7ft. lode at 330ft. Recovery value, 3.8 dwts. gold per ton.

From a study of the section accompanying this report (Plate V.), it will be seen that diamond drilling has not been done to the best advantage. The bores do not intersect the main lode formation, which has pitched away to the south above them, and the values that were intersected probably occur in the downward continuation of the western leg of the dragfolded jaspilite. Owing to this error in the selection of the bores, the nature of the lode formation at depth is still unknown.

4. The southern dragfold shown on the plan has been inferred from fragmentary evidence. The displacement of the outcrop line, and the absence of

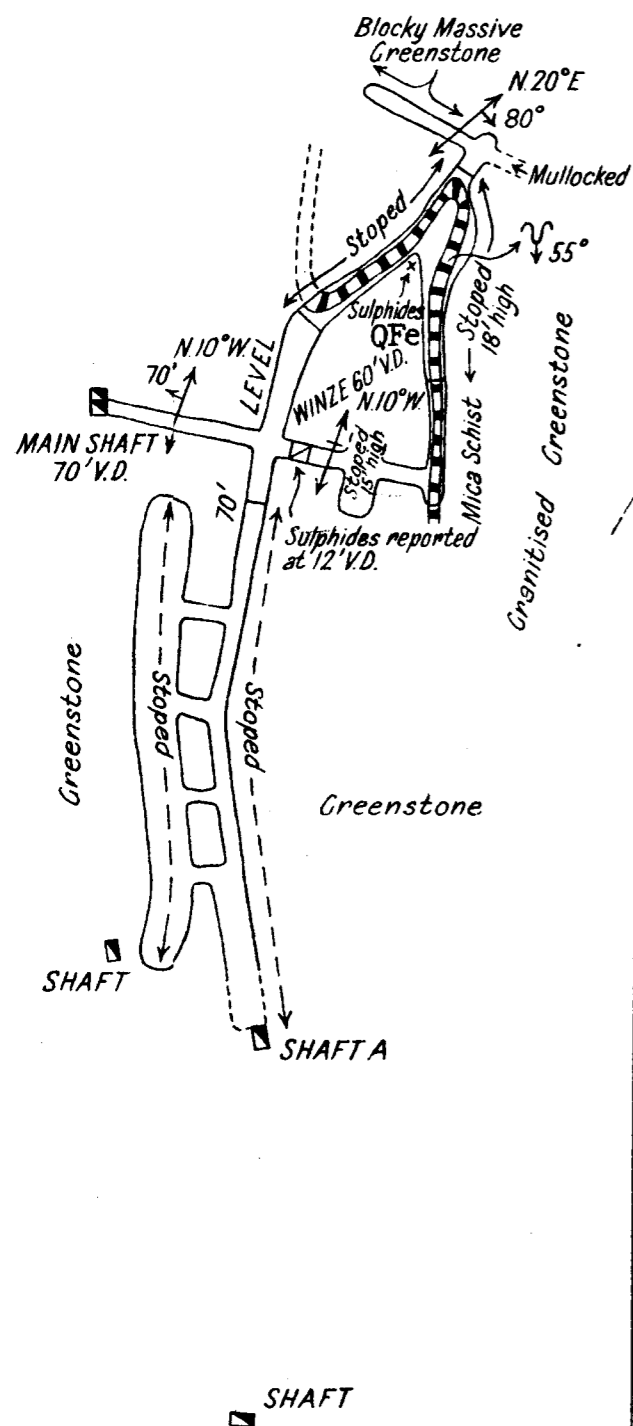
PLAN OF WORKINGS PILOT G.M.—G.M.L. 3414

YILGARN GOLDFIELD

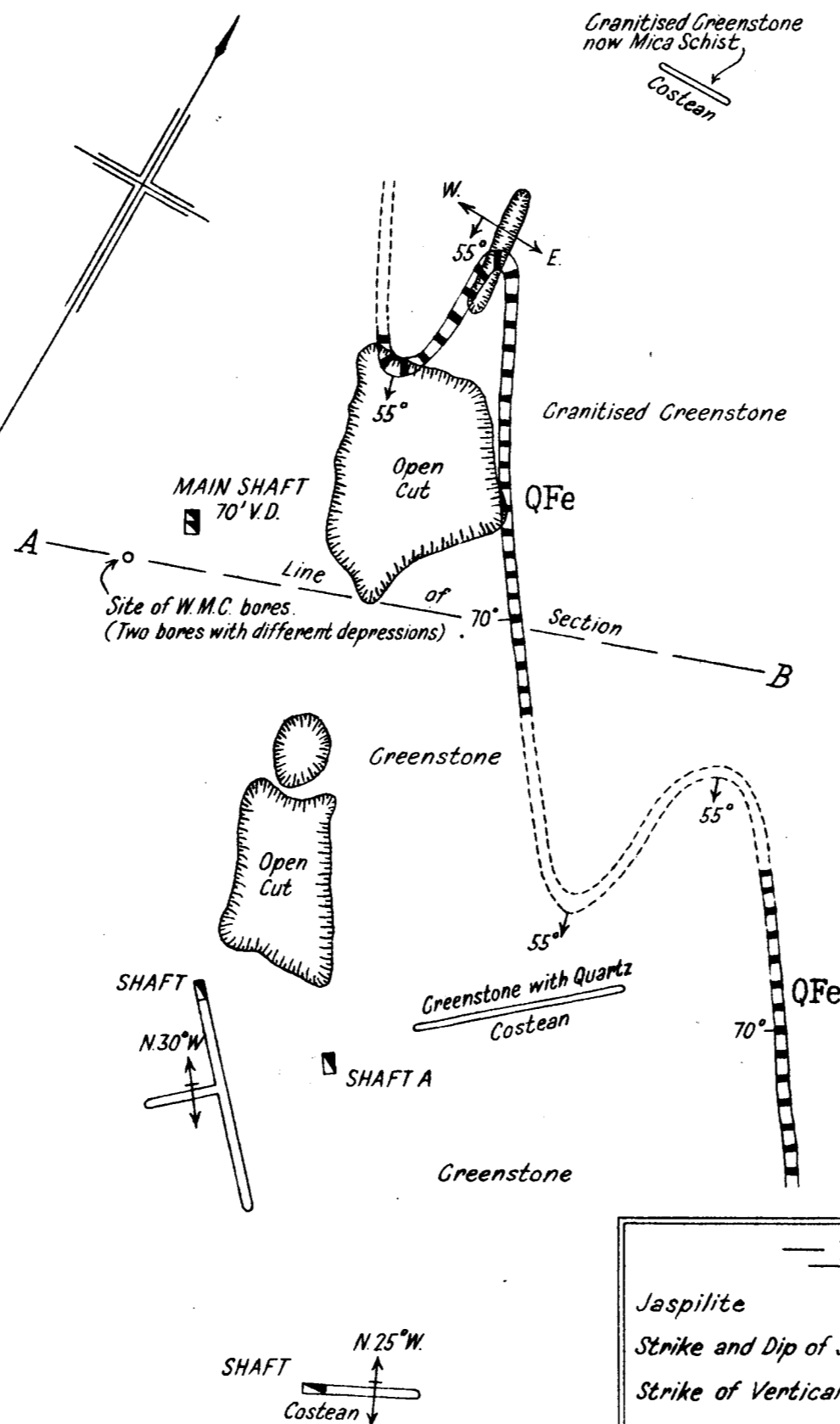
Scale 50 ft. to an inch

50 0 50 100

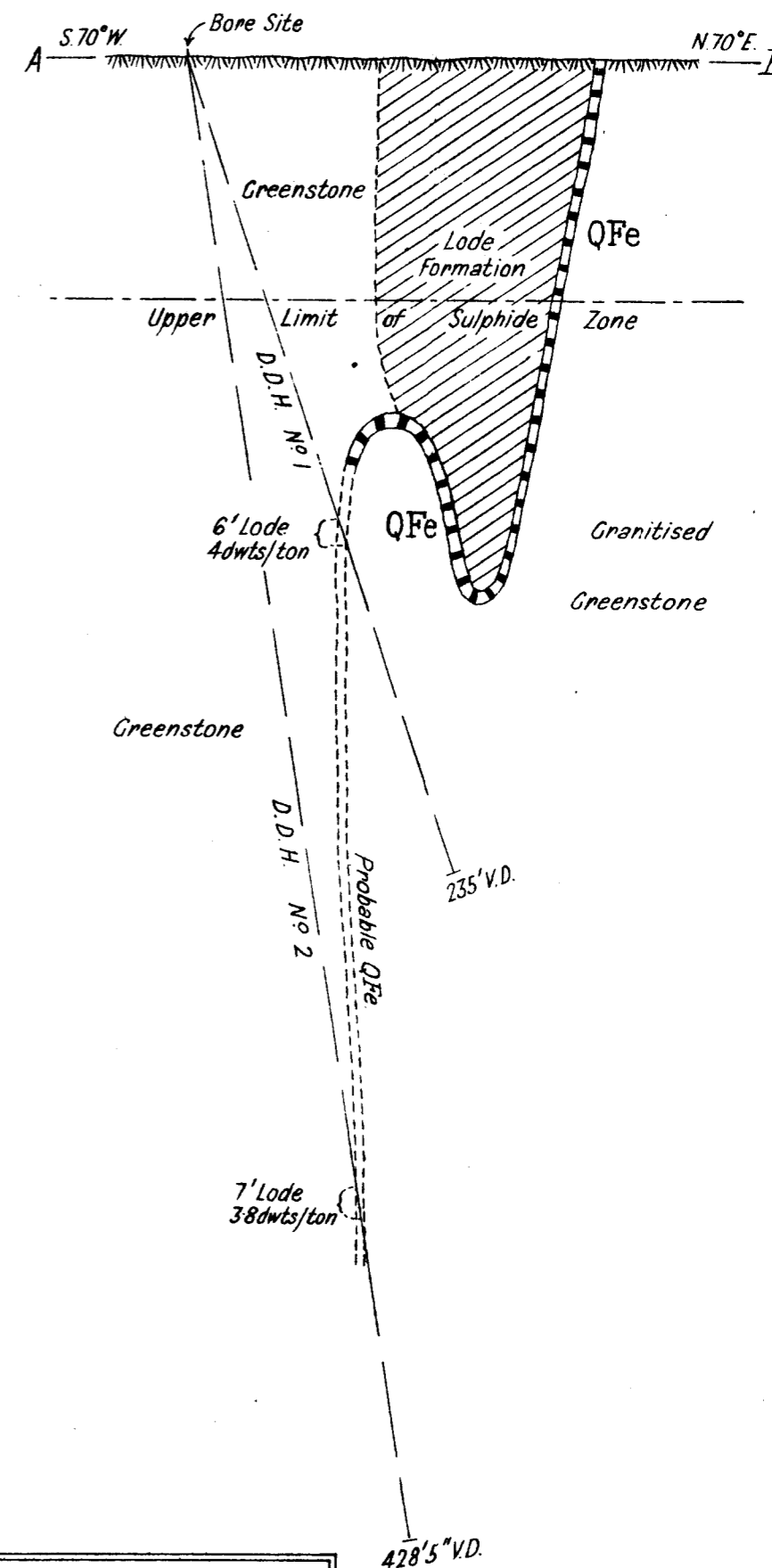
PLAN OF 70FT LEVEL



SURFACE PLAN



TRANSVERSE SECTION



REFERENCE

Jaspilite QFe
 Strike and Dip of Schistosity $N.10^{\circ}W. 70^{\circ}$
 Strike of Vertical Schistosity $N.10^{\circ}W.$
 Dragfold showing direction and angle of pitch $\searrow 60^{\circ}$

faulting in the mine workings, makes this inference fairly conclusive however. It is feasible therefore, to expect other ore shoots in the synclinal trough of this dragfold, and prospecting for them is strongly recommended.

Other shoots of ore may also exist in similar structures, north-west or south-east along the strike of the jaspilite.

Late "*Colleen Bawn*" G.M.L. 2544.

These old workings were being prospected in June, 1938, but owing to their dangerous state they were not examined by the writer.

From information received, the ore body appears to have been a series of rich quartz reefs, parallel with the enclosing greenstone country, which were lenticular both horizontally and vertically. The reefs have been stoped out to ground water level, reported to be 90 feet V.D. from the surface. The ore shoots pitch to the south-east, and their lensing out coincides with a change in strike or dip, which suggests the presence of gentle folding. Shearing is more intense near the ore channel, and the greenstone is represented by tale schist.

This line of workings is approximately 16 chains south-east of the "*Pilot*" workings, and the official production figures show that to July, 1938, 410.20 tons of ore had been treated yielding 1,916.07 fine ozs. of gold, and specimens totalled 17.81 fine ozs.

KOOLYANOBING GROUP.

YILGARN GOLDFIELD.

(By R. S. Matheson, B.Sc.)

GENERAL INFORMATION.

Koolyanobbing is situated on the north-western side of Lake Seabrook, approximately 30 miles north-east of Southern Cross. The distance by road between these two centres is slightly greater however, being about 40 miles.

The Koolyanobbing belt of country extends north-west from Lake Seabrook for a distance of 22 miles, but mining activity is confined to the country in the immediate vicinity of Trig. M.Y. 1. At the time of inspection (July-August 1938), mining was in progress on "*Chadwick's Reward*" G.M.L. 3514 and the late "*Golden Wishbone*" G.M.L. 3581, and prospecting was being done on the late "*Rainbow*" leases.

Gold was discovered in this locality in 1904, by a Mr. Chadwick of Southern Cross, but the area has never attained importance as a gold mining centre.

Iron, copper and gypsum also occur in the district.

The main Koolyanobbing range contains some high grade lenses of iron ore,* which show promise of being of economic importance.

Copper carbonates are reported in several places, but no deposits of economic value have been disclosed.

Gypsum deposits are being worked on the south-eastern shore of Lake Seabrook, immediately opposite the Koolyanobbing Range. The gypsum is

crystalline, and has been built up into dunes by the action of wind blowing across the surface of the lake.

A two-head battery, with no cyanidation plant, is in operation on G.M.L. 3514, and it crushes all the ore mined at Koolyanobbing.

Water for domestic purposes is obtained from an excavated tank, 36 chains west of the late "*Rainbow*" leases, which has a capacity of 50,000 gallons. After rain, domestic water can also be obtained from rock holes at Condenser Rocks and Flat Rocks, but the supply is small. Water for mining purposes is obtained from the underground workings on G.M.L. 3514, ground water level being 138 feet V.D. from the surface.

A thick forest of morrel, salmon gum and gimlet, which are suitable for mining purposes, covers the area.

The official production returns show that to the 31st December, 1937, 1,958.05 tons of ore were treated, yielding 1,022.64 fine ounces of gold, and alluvial gold totalled 0.26 fine ozs.

GENERAL GEOLOGY.

A geological map, on a scale of 40 chains to 1 inch, embracing 13 miles of the main range, and an area of 150 square miles, has been compiled, and is available for inspection at the Geological Survey Office.

The area is composed of rocks of the Greenstone Series, consisting of interbedded basic lavas, agglomerates, tuffs and jaspilites, which are intruded by biotite granite, and quartz porphyry dykes. The greenstone belt has a maximum width of 5 miles, and grades eastward and westward into granitic gneiss of replacement origin. All the rocks are presumably of Pre-Cambrian Age.

The general strike of the country is N. 40° W. and the dip varies from 50° N.E. to vertical. The country has been highly folded and the dragfolds have a general pitch 50°-80° N.W., but a temporary reversal in the direction of pitch occurs near the north-west end of the area mapped. An interpretation of the folds shows that Koolyanobbing is on the east limb of an antiform.

The main range is composed of contorted jaspilite and is very conspicuous, attaining a height of 400 feet above the general level of the country in some places. Another prominent line of hills occurs along the western gneiss-greenstone boundary, and granitic quartz forms the backbone to these hills.

Koolyanobbing is believed to be the northern extension of the Mt. Palmer† belt of greenstone.

THE MINES.

"*Chadwick's Reward*" G.M.L. 3514.

This lease is situated 2¾ miles south-east of Trig. M.Y. 1.

A plan‡ of the accessible underground workings on a scale of 50 feet to 1 inch has been compiled.

According to the official production returns, to the 30th April, 1938, 990.05 tons of ore were mined from this lease for the recovery of 497.24 fine ozs. of gold.

* A detailed survey of the iron deposits at Koolyanobbing, by the Geological Survey of Western Australia, has just been completed. (November, 1938.)

† Ellis, H. A., G.S.W.A. Bull. No. 97.

‡ Plan not published.

Two parallel quartz reefs, striking N. 30° W. and dipping 65-75° N.E. with the schistosity of the enclosing greenstone country, have been mined on this lease. The western reef has been the main ore body.

Main Reef.—The reef is very lenticular in nature, and is reported to have had an average width of 1 foot. The average length of the ore shoot is 130 feet, and it has been practically stoped out between the surface and ground water level, 146 feet V.D. from the top of the dump. The workings were only partially accessible, and for this reason the details of the workings are meagre. The pitch of the ore body is not definite, but appears to be to the north-west. This is probably correct, however, since the regional pitch in this vicinity is to the north-west.

Eastern Reef.—The reef is very lenticular in nature and is reported to have had an average width of 6 inches. The only work on this reef is at the 117ft. level, where it has been driven on for 136 feet and overhand stoped for 50 feet. Overhead and underfoot the reef was apparently an unpayable proposition.

Structure.—The country rocks are gently folded on an axis pitching 70° N.W. and the structure appears to have had some control over quartz deposition. The quartz lenses occur in the synclines (or downfolded portions), and the quartz pinches to a stringer over the anticlines. This control is noticeable at the 117ft. and 143ft. levels. The lessees should not overlook the fact that this control may also occur vertically. Owing to a large portion of the workings being inaccessible, an investigation along these lines was impossible at the time of inspection (July, 1938).

Recommendations and Conclusions.

1. There is reported to be a 200ft. level on the main reef, but it was under water at the time of inspection, and could not be examined. Owing to an increase in mining costs due to pumping water, and a slight decrease in the values, the reef cannot be worked profitably at this level. This information was supplied by the lessees. The mine therefore has no prospects at depth.

2. The lessees have overlooked the possibility of the ore shoot having a north-west pitch, and a north-west drive at the 143ft. level is recommended. This is the only prospecting warranted on the known ore bodies.

3. Lateral prospecting for the occurrence of parallel ore bodies may be done to advantage.

4. The tailings dump should be thoroughly sampled to see if the erection of a cyanidation plant is warranted.

Late "Golden Wishbone," G.M.L. 3581.

This lease is situated 3½ miles south-east of Trig. M.Y. 1.

The lease was forfeited in 1936, but was being worked as a prospecting area at the time of inspection (July 1938). To the time of forfeiture, 339 tons of ore were treated for the recovery of 203.89 fine ozs. of gold.

The ore body on this lease consists of a mass of small quartz lenses, which strike N. 30° W. and dip 50-60° N.E., with the enclosing kaolinised greenstone

country. The shoot has been mined on three levels, by means of an underlay shaft, to a vertical depth of 107 feet. The shaft underlies at 50 degrees to the 38ft. V.D. level, where the dip steepens to 65 degrees.

The shoot has an average length of 12 feet and an average width of 4 feet, and has been stoped out between the surface and the 78ft. V.D. level. The shoot was being mined between the 78ft. and 107ft. levels at the time of inspection. The ore body pinches to a stringer in both the north-west and south-east faces of the drives throughout the workings, but is 4 feet wide underfoot at the 107ft. V.D. level. The gold is reported to have had an erratic distribution throughout the quartz, indicating secondary enrichment. The pitch of the shoot is steep to the south-east.

The country rock is kaolinised throughout the workings, and is believed to be decomposed, partly granitised, sedimentary greenstone. Some barren quartz veinlets, transverse to the strike of the country, are present in the workings.

Recommendations.

1. The shoot should be stoped out to ground water level, as an enrichment may occur at that level. Ground water is expected to be encountered at approximately 140 feet V.D. from the surface.

2. Values are reported to have been best, where the flatter dip occurred, that is, between the surface and the 38ft. V.D. level. In the course of mining the shoot to ground water level the prospectors should watch for any flattening in dip as it may mean an increase in values.

3. A shoot of these dimensions will not be worth mining below ground water level, unless the gold content increases considerably.

4. Lateral prospecting for parallel ore bodies should not be overlooked.

Late "Rainbow" Leases.

These old leases are situated 3 miles north-east of Trig. M.Y. 1.

Prospecting was being carried out on these leases at the time of inspection, but the underground workings were inaccessible. Some of the workings have been described by Blatchford* in Bulletin No. 71. The ore bodies have been quartz reefs with lenticular habit, parallel to the schistosity of the enclosing country. The country has been extensively granitised, consisting of alternate bands of greenstone and gneiss.

HOPE'S HILL GROUP.

YILGARN GOLDFIELD.

(By R. S. Matheson, B.Sc.)

The main leases at this group are situated on a prominent ridge approximately 4½ miles north-west of Southern Cross.

* Blatchford, T. G.S.W.A. Bull. No. 71, p. 188.

No mining operations were in progress at this group at the time of inspection (May, 1938) and the underground workings were all inaccessible. The main Hope's Hill G.M., which closed down in July, 1905, has been reported on, however, by Gibson* and Montgomery. Montgomery states that—

The lode is a very large low-grade ore body, striking N.W. and S.E., which has been worked extensively on the surface by opencutting, and underground down to the 160 ft. level, below which it became unprofitable to work. There are four levels, the lowest being 300 or 350 feet below the surface. The ore body has been driven along for about 1,800 feet at the 160 ft. level, has been taken out in places as large as 30 feet in width, averaging probably between 15 and 20 feet wide.

The lode occurred on the footwall side of a large barren quartz reef, which is parallel with the enclosing country, striking N. 35° W. and dipping 70° S.W. The lode consisted of "Alternating seams of rubbly quartz, with much kaolinic material, pale-coloured tale schist, and brown chlorite schist," according to Saint Smith.†

From a study of a geological map of country in the vicinity of the workings, which was compiled by the writer, the lode is seen to occur between two parallel jaspilite bands, which are interbedded with greenstones. The jaspilites are contorted, and the shape of the dragfolds suggests the two beds are in reality one bed repeated by synclinal folding on a north-west, south-east axis. Also there are reversals in the direction of pitch of the dragfolds indicating the presence of crossfolding. At the north-west end of the main open cut the dragfolds pitch 30° S.E., and at the south-west end they pitch 65° N.W., so that ore deposition has occurred very close to the intersection of the axes of the two systems of folding. As a result of the broad geological mapping, the Hope's Hill mining centre is shown to be on the western limb of a major antiform with a north-west-south-east axis.

The country rocks grade eastwards into replacement gneiss of granitic origin. The granitisation process actually commences on the footwall of the large barren quartz reef, and the mica schists and quartzites, which occur between the greenstone proper and gneiss proper, are partly granitised greenstones and jaspilites respectively. All the rocks are presumed to be of Pre-Cambrian age.

The official production returns for this group, to the 31st December, 1937, are as follows:—

	Dolled and Specimens.	Ore Treated.	Gold Therefrom.
Alluvial.	Fine ozs.	tons.	Fine ozs.
5.04	107.13	125,435.07	35,649.23

and Westley's cyanidation plant recovered 106.93 fine ozs. of gold from the treatment of sands.

A fuller report will be written later, when the writer has time at his disposal to refer to all previous literature on this mining centre.

* Gibson, C. G. G.S.W.A. Bull. No. 17, p. 23.
Montgomery, A., Report on the Mines of the Yilgarn G.F., 1908, p. 26.
† Saint Smith, E. C. G.S.W.A. Bull. No. 49, p. 160.

COPPERHEAD SYNDICATE.
BULLFINCH.
YILGARN GOLDFIELD.
(By R. S. Matheson, B.Sc.)

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GENERAL INFORMATION.

The leases controlled by the Copperhead Syndicate are situated on a ridge approximately 1 mile north-east of the Bullfinch townsite, and they embrace the workings of the late Bullfinch Pty. (1919), Ltd. The following leases were being held by the syndicate at the time of inspection (April, 1938):—

"Copperhead" G.M.L. 3345, "Copperhead Deeps" G.M.L. 3378, "Copperhead Central" G.M.L. 3836, "Copperhead South" G.M.L. 3660, "Copperhead West" G.M.L. 3826, "Easter Gift" G.M.L. 3337, "Frances May" G.M.L. 3400, "Goldfinch" G.M.L. 3397, "Rising Sun" G.M.L. 3350, "Jupiter" G.M.L. 3458, "Aisla Joan" G.M.L. 3819 (3463 on the posts).

Gold was first reported from this locality by C. Jones, the working partner of a prospecting syndicate formed by D. L. Doolette, whose application for mining leases was lodged at the Warden's Court, Southern Cross, on 29th December, 1909. The early crushings were extremely rich in gold content and a phenomenal mining boom resulted. From the time of its discovery to 1920, the mine was a consistent producer, but since that time mining operations have been very spasmodic. At the time of inspection (April, 1938), underground work was being done mainly by tributary parties.

A 10-head battery and cyanidation plant is in operation on the mine, and it is available for public crushings.

Morrel, salmon gum and gimlet are abundant in the vicinity of Bullfinch, and are used for fuel and mining timber.

Water for domestic and mining purposes is obtained from the Southern Cross-Bullfinch pipeline, which is a branch line from the main Eastern Goldfields Water Supply Scheme. The ground water is very saline, and original ground water level in the main shaft, is reported to have been 268 feet V.D. from the surface.

According to the official production returns, the production from the ground now held by the Copperhead Syndicate to 31st July, 1938, is 195,292.67 fine ozs. of gold from the treatment of 521,642.35 tons of

ore, and specimens total 64 80 fine ozs. The Copperhead Cyanide Plant has produced 10,033.99 fine ozs. of gold from the treatment of sands, which is not included in the above figures, and some of the gold has undoubtedly come from this property, but it is impossible to determine the amount.

Retreatment of the old tailings was in progress at the mine at the time of inspection, and 1 dwt. gold per ton is reported to be recovered by cyanidation.

The geological investigations at the mine were considerably hampered, as the only accessible underground workings were portions of the Nos. 1, 2 and 3 levels. The mapping of the geology in the underground workings was done in collaboration with Mr. H. A. Ellis.

GENERAL GEOLOGY.

The leases are situated in an area of highly metamorphosed, interbedded, greenstones, jaspilites and erosion sediments, which are presumably of Pre-Cambrian age, and the country grades eastwards into replacement gneiss of granitic origin. The rocks are contorted, and have a general strike N.N.W. and a general dip 60° W.S.W. Outcrop conditions are good, except in the immediate vicinity of the workings, where drifted tailings cover the surface.

A geological subsurface map of the area, on a scale of 5 chains to 1 inch has been compiled, but it will be published at a later date.

Greenstones.—Metamorphosed, basic lavas, tuffs and probably greywackes constitute the greenstones.

The basic lavas have a fairly wide distribution, and there are two varieties, which show marked differences in hand specimen. The lavas occurring stratigraphically above the main jaspilite band, are hard, fine to medium grained rocks, which have a dark greenish colour and often a rude schistosity. This type of lava forms good outcrops, and can be seen underground at the No. 2 level, in the crosscut from the main shaft to the dolomite lode. Stratigraphically below the jaspilite, the lavas are soft, highly sheared rocks, which are from all appearances tale schists. The tale schist is greenish-grey in colour, and decomposes more readily than the other variety of lava, but is more resistant to weathering than the tuffaceous rocks. The weathered surface is often pitted, and this is thought to be due to the weathering out of amygdulæ.

The remainder of the greenstones is composed of highly sheared rocks, which are predominantly dark grey in colour, and which often have a noticeable banding. In contrast to the reddish brown decomposition product of the tale schist, these rocks weather to yellow and purplish schists. These rocks are believed to be of sedimentary origin, and to be tuffs and/or greywackes.

Jaspilites.—Between the surface and the No. 2 level the weathering of the country rocks has been extensive, and the jaspilite appears mainly as a rock composed of alternate bands of quartzite and iron oxides (hematite, limonite and magnetite). In some places in this zone however, owing to leaching by surface waters, the iron oxides are absent, and the jaspilite is represented by a white friable quartzite.

At the No. 2 level, where the action of weathering is diminishing, the jaspilite changes to a laminated rock, with alternate bands of quartzite and ferromagnesian (amphiboles and pyroxenes), which can only be distinguished with difficulty from the enclosing greenstones.

The jaspilite is believed to be a metamorphosed sediment.

Metamorphosed Erosion Sediments.—The metamorphosed erosion sediments do not have a wide distribution in the area mapped, and the only occurrence of them is in a costean approximately 24 chains south-easterly from the south peg of G.M.L. 3819. They consist of grey to purple phyllites, and are believed to be a thin band in the Greenstone Series.

Gneiss.—The gneiss has been formed by the replacement of greenstones by granitic material, during a period of granitic intrusion. The replacement origin for the gneiss is substantiated, by the occurrence of a marginal zone of rocks, which are intermediate in composition between greenstone and gneiss, and by the parallelism of the gneissosity and schistosity of the gneiss and greenstone respectively.

THE ORE BODIES.

Three types of ore bodies have been mined on this property: jaspilite lodes, yellow lodes and dolomite lodes.

Jaspilite Lodes.—The accompanying plan* (Plate VI.), shows the distribution of the jaspilite at the No. 2 level, and the structure outlined by the jaspilite on this level persists throughout the mine.

The ore bodies of this type are mainly confined to the southern band of jaspilite shown on the plan, and have been formed by the mineralisation of the jaspilite and the injection of auriferous quartz veins presumably emanating from a granitic magma. The quartz veins have penetrated the jaspilite where it was fractured, sheared and contorted during folding. The ore shoots occur mainly in the crests and troughs of the dragfolds, and are generally absent in the limbs. The best values are reported to occur in the vicinity of the quartz veins and stringers. The occurrence of paint gold in fractures in the lode is suggestive of secondary enrichment, and the ore bodies will probably diminish in size and decrease in values below ground water level (260ft. V.D.). Actually, mining of this type of ore body ceases at the No. 3 level. The lessees report that mining of this class of ore has been discontinued between the Nos. 3 and 5 levels, not because the values have become unpayable, but because the ore has become highly mineralised with sulphides, for which there are no facilities for treatment at the mine.

The sulphide zone commences at about the No. 2 level (210ft. V.D.) but the workings on the sulphide ore at this level could not be examined due to bad air. The Nos. 4 and 5 levels were still under water, and were also inaccessible. Blatchford† states however, that the sulphides are galena, and various sulphides of iron, chiefly pyrites, but probably some marcasite and pyrrhotite.

The ore bodies locally known as the "Discovery Lode" or "Southern Series," the "Main Lode" and the "Watershaft Lode" are all mixtures of jaspilite and yellow lode material.

Yellow Lodes.—The main ore bodies of this type occur stratigraphically above, and in proximity to, the ore bodies in the southern band of jaspilite. There are a few exceptions to this however, for instance the yellow lode exposed in the workings off

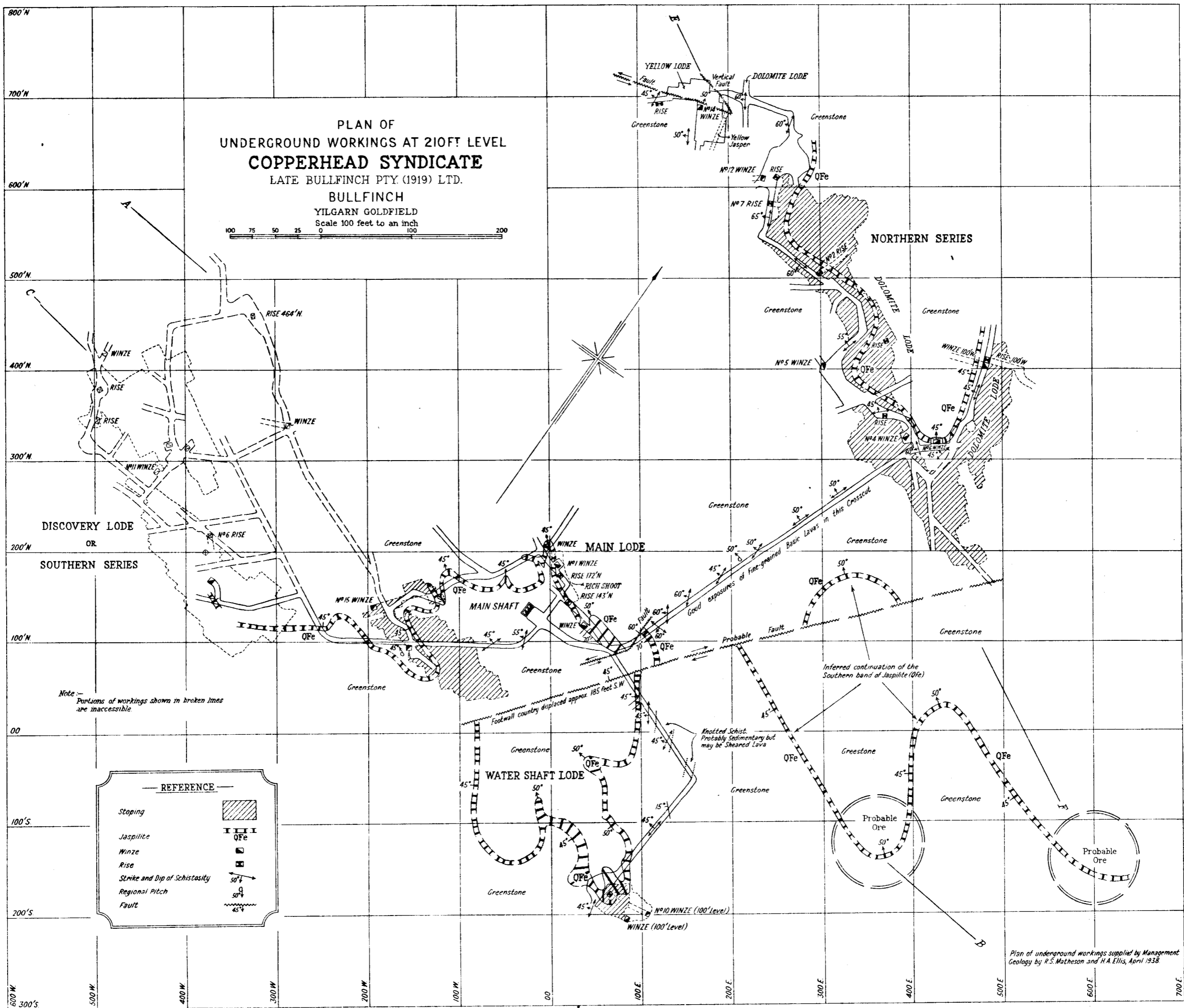
* A surface plan and a plan of the No. 1 level, have also been compiled, and are available at the Geological Survey Office.

† Blatchford, T. G.S.W.A. Bull. No. 71, p. 81.

PLAN OF
UNDERGROUND WORKINGS AT 210FT LEVEL
COPPERHEAD SYNDICATE
LATE BULLFINCH PTY (1919) LTD.

BULLFINCH
YILGARN GOLDFIELD

Scale 100 feet to an inch



the New Shaft at the north-west end of the dolomite lode, which appears to be in no way associated with jaspilite. The yellow lodes exist only above ground water level, and consist of secondary enriched decomposed greenstone schist, which is intersected with auriferous quartz veins and stringers. As is expected of a lode of secondary origin, the shape of the ore bodies is very irregular and the distribution of the values erratic. Yellow replacement jasper frequently occurs with the yellow lode material.

The auriferous quartz veins and stringers probably persist below ground water level, but have been too small to be worked profitably.

The yellow lodes owe their name to their appearance near the surface, but they gradually become green in colour as ground water level is approached.

Dolomite Lode.—This ore body consists of a mixture of granitic quartz and dolomite, which is associated with minor amounts of greenstone lode material. It occurs on the stratigraphic footwall of the northern band of jaspilite, and is locally known as the "Northern Series." The dolomite was not present in the lode in the oxidised zone, appearing first at approximately 120 feet V.D. from the surface, and this is due to leaching by surface waters. According to Blatchford* :—

"The lode from the 100ft. level upwards, and to a depth of 20 to 30 feet below the level, consists of a mixture of ferruginous clayey lode material partially cemented together, with irregular masses of jasper, the whole ore body being traversed by narrow quartz veins. These veins are comparatively flat with a general north-west-south-east strike and an underlie to the north-east."

The dolomite lode appears to have been the most consistent ore body in the mine, and has been worked from the surface to the bottom level, 510ft. V.D. From a study of the plans of the mine, it will be seen that the ore body diminishes in size below ground water level, indicating that secondary enrichment has played some part in the formation of the ore body in the upper levels.

The sulphide zone commences at about the 210ft. level, and as in the case of the jaspilite lodes, the sulphides have a close association with the gold.

An analysis† of a specimen of the dolomite lode from the 210ft. level gave the following result:—

G.S.M. 1/826.					G.S.L. 8886D.				
SiO ₂	..	..	..	..	15.83				
Al ₂ O ₃	..	..	..	..	0.29				
Fe ₂ O ₃	..	..	..	..	0.11				
FeO	..	..	..	..	4.86				
MnO	..	..	..	..	0.27				
MgO	..	..	..	..	17.21				
CaO	..	..	..	..	27.64				
Na ₂ O	..	..	..	..	0.18				
K ₂ O	..	..	..	..	0.06				
H ₂ O hyg.	..	..	..	..	0.06				
H ₂ O comb.	..	..	..	..	0.80				
TiO ₂	..	..	..	..	0.02				
Co ₂	..	..	..	..	31.99				
P ₂ O ₅	..	..	..	..	0.07				
Fe ₂ S ₃	..	..	..	..	0.48				
Cr ₂ O ₃	..	..	..	..	nil.				
V ₂ O ₅	..	..	..	..	0.04				
					99.91				

* Blatchford, T. G.S.W.A. Bull. No. 71, p. 80.

† Vide G.S.W.A. Bull. No. 71, p. 80.

Gold—15 grs. per ton. Sp. gr.—2.94. Analyst, H. Bowley.

The chief constituents are dolomite, about 55.2 per cent.; Calcite, about 14.3 per cent.; actinolite, about 25 per cent.; with smaller amounts of pyrrhotite and probably serpentine, albite and quartz.

The boundaries of the ore body in the underground workings are not sharp, as carbonation extends beyond it into the adjacent country.

The occurrence of isolated "horses" of greenstone within the lode, substantiates the belief that the lode has been formed by metasomatic replacement.

Owing to the attitude and size of the ore body, and the broken nature of the adjacent country, some difficulty was experienced in mining the lode, and square set stopping was resorted to.

STRUCTURE.

Broad Geological Structure.—Detailed mapping in the vicinity of Bullfinch has shown that the country has been folded into the form of a syncline, which pitches 45° N.W., and is overturned to the north-east at 70 degrees. The structure is clearly outlined by the southern jaspilite band. This syncline has been shown by areal mapping to be situated on the western limb of a large anticlinal fold, with a north-west-south-east axis.

No reversals in the pitch of folds were noted in the vicinity of the Bullfinch leases, the pitches being constantly to the north-west, so that the mine is not situated on a crossfold axis. At the Corinthian group of mines, approximately 10 miles south of Bullfinch, the regional pitch is to the south-east, so that there is at least one crossfold between the two centres, but it is impossible to determine with accuracy the position of its axis. This crossfold may have had some influence on ore deposition at Bullfinch.

Structural Control of Ore Deposition.—The rocks between, and including the two jaspilite bands, have been the most favourable for the deposition of gold. This is partly due to their composition, but mainly to their structure. From a study of the accompanying plan it will be seen that gold deposition has occurred in isolated places in the favourable host rocks, and these areas of mineralisation are related to the geological structure. Viewing the zone of mineralisation broadly, it will be seen to have taken place in the trough of the pitching syncline outlined by the southern jaspilite band. Numerous dragfolds are present in the trough of the syncline, and ore deposition is mainly confined to the crests and troughs of these minor folds. The ore bodies are everywhere fairly close to one or the other bed of jaspilite, and the jaspilites have probably acted as the means of access for the gold bearing solutions.

The dolomite lode occurs in the trough of a pre-existing synclinal dragfold, and has been formed by the metasomatic replacement of greenstone country on the stratigraphic footwall of the northern jaspilite band.

Faulting.—Three post-gold faults, which have caused considerable difficulties in mining, and prevented a previous understanding of the geological structure, were mapped in the workings.

Two of these faults are shown on the plan of the No. 2 level (Plate VI.), and they can be conveniently described together. The faults strike north-easterly and dip 45°-60° N.W. The footwall country of the

southern fault has been displaced approximately 185 feet south-west, and is clearly shown on the accompanying plan. In order to indicate the faulting more clearly, and show where further ore bodies may exist, the probable position of the jaspilite in unexplored country has been inferred. The northern fault has displaced the "rich shoot" at its southern end approximately 30 feet north-east, and work was in progress on this section of the lode between the two faults at the time of inspection.

The third fault is seen best in the workings off the New Shaft at the north-west end of the dolomite lode, but is also intersected in the workings at the No. 2 level. Yellow lode, associated with replacement jasper, has been mined on the footwall of this fault, and the difficulty of locating the continuation of this ore body on the hanging wall, has arisen from the fact that the fault is parallel to the schistosity of the country for a considerable amount of its exposed length. The fault strikes north-easterly and dips 50°-60° N.W. The ore body has been located on the hanging wall of the fault at the 100ft. and 210ft. levels, and prospecting for it should be done at the 150ft. level.

In the square setting at the 200ft. level a fault striking north-westerly appears to branch off the north-east striking fault, and although it was impossible to determine the displacement on this subsidiary fault, the writer is fairly certain that as a result of faulting the block of country between the two faults has been displaced to the south-west. The difficulty of interpretation is due to the presence of folding, as well as faulting, in this vicinity.

DIAMOND DRILLING.

Two underground diamond drill bores are indicated on the plan of the No. 3 level, but unfortunately no information concerning them was available.

1. Recommendations and Conclusions.

From the evidence available there is good reason to believe that the southern jaspilite band has an extension, which up to the present time (April, 1938) has not been prospected. This extension is shown on the plans* of the Nos. 1 and 2 levels, and also on the 5 chain to 1 inch geological subsurface map, where its boundaries are indicated by dotting.

Prospecting for further occurrences of jaspilite lode material and for yellow lode material is strongly recommended in this area, especially above ground water level (260ft. V.D.). This area is covered by the tailing dump, and diamond drilling, either from the surface or underground, would probably be the best method of prospecting. Several bores would be necessary to prospect the area thoroughly.

2. In the vicinity of the New Shaft, owing to faulting, folding and the highly oxidised condition of the country, it has been extremely difficult to follow the ore bodies. The true nature of the faulting is not properly understood, but, as mentioned above, it is very probable that as a result of faulting, the block of country between the two faults has been displaced to the south-west.

The yellow lode material, which has been mined at the 100ft. level and 210ft. level, should be encountered at the 150ft. level by crosscutting in a westerly direction from the north-west end of the workings.

* Only the plan of the No. 2 level accompanies this report.

The possibility of parallel ore bodies occurring on the hanging wall of the yellow lode should not be overlooked.

3. At the No. 2 level, prospecting north from the crosscut connecting the square setting to the north-west end of the main dolomite lode is warranted.

If the assumption that folding has occurred here is correct, a prospecting drive commenced 60 feet from the square setting should become a crosscut as the work proceeds. A dolomite lode may be encountered in this direction.

4. Between the two faults off the south-east end of the "rich shoot" at the No. 2 level, jaspilite lode material with quartz veins is being mined. Because of its position between the two faults the length of the ore body is limited, as will be proved by driving on the ore body. Provided that ore is still in the face when the southern fault is encountered, then the west leg of the water shaft jaspilite should be investigated, because it is the continuation of the ore body, and has been displaced by faulting.

5. At the No. 1 level, in the most western synclinal trough of the Water Shaft jaspilite, typical yellow lode has been mined, and this ore body may exist in the same structural position at the No. 2 level. If the values were good at the No. 1 level, the prospecting of this structure should be carried out.

6. A crosscut north, from the vicinity of the No. 2 rise in the workings on the dolomite lode at the No. 2 level (see Plate VI.) also has possibilities of locating other ore bodies. This cross-cut should be continued until it intersects the continuation of the eastern leg of the dolomite lode.

7. The ore bodies in the sulphide zone should be thoroughly tested, to see if the erection of a plant, for the treatment of such ore, is warranted.

8. Approximately ¾ mile north-west of this property, the jaspilite is contorted into another large fold, and it is the extension of the western leg of the southern jaspilite band. The synclinal trough of this fold warrants prospecting.

ERLISTOUN GOLD MINE.
COX'S FIND.
MT. MARGARET GOLDFIELD.
(By R. S. Matheson, B.Sc.)

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PLANS.

Opposite Page

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GENERAL INFORMATION.

The Erlistoun Gold Mine is situated on a low rise approximately 41 miles north of Laverton, but the distance by road is slightly greater. The Erlistoun