

With reference to artesian water, there is no single condition in favour of its occurrence, and, in my opinion, it would be useless to attempt boring with such an object in view. If boring be attempted I would recommend that the site be chosen on the flats lying to the South of the townsite, as a considerable amount of the drainage from the higher grounds pass over this portion of the field, though I feel convinced that after the oxidised zone be passed through, hard compact impervious rock will be met with, at a depth not exceeding 250 feet, and that such a condition will continue to an indefinite depth.\*

## THE GEOLOGY OF THE BARDOC DISTRICT.

### LOCATION.

The Bardoc Mining District embraces the most Northern of the four groups of mines in the Broad Arrow Goldfield, and lies in the neighbourhood of the township of Bardoc. Direct railway communication connects Bardoc with Fremantle, from which it is distant about 419 miles.

### HISTORY.

Unfortunately little if anything is recorded directly about the early history of the Bardoc Mining District. In the History of Western Australia,† brief reference is made to a "rush" to Broad Arrow (Kurawa) and Black Flag in the early part of the year 1894, and I have reason to believe, from verbal information, that shortly afterwards prospectors discovered gold in the vicinity of the townsite of Bardoc. No direct reference, however, is made to the exact locality in which the discovery took place.

### GENERAL DESCRIPTION.

The district which has been mapped in detail, and depicted on a plan (Plate IV.), embraces an area of about 40 square miles. The topographical features displayed over this area are exactly similar in nature to such mining centres as Hayes' New Find, Hayes' Find (Mulgarrie), etc., and consist of low lying sparsely timbered country, the monotony of which is broken only by occasional isolated knolls and ridges.

### GENERAL GEOLOGICAL FEATURES.

The general geological features resemble closely those of the Coolgardie goldfield, underlying a superficial covering of red superficial deposits, the *débris* of the country rock disintegrated *in situ*, occur massive hornblende rocks intersected with acid eruptive dykes, which in all probability emanate from the massive granite found outcropping at the Eastern and North-Eastern boundaries of the field. Running parallel to these dykes, which have a prevailing North and South strike, persistent lines of quartz reefs occur. These reefs can easily be classified into two varieties, viz., those consisting of almost pure white quartz, and those the quartz of which is often more or less regularly banded with oxides of iron. The latter variety resembles very much at times the banded quartzites found in the Murchison and East Murchison goldfields.‡ Overlying parts of the field are the nodular ironstone beds which form a prevailing surface feature of such a large portion of the Colony of Western Australia.

*Superficial Deposits.*—The superficial deposits of the field consist of two distinct formations, viz., the loose incoherent material and the nodular ironstone beds. Shallow superficial deposits of partially classified *débris* of the surrounding rocks cover the greater portion of the field. These deposits consist for the main part of ironstone pebbles, the denuded fragments of the nodular ironstone beds intermixed and cemented together with the kaolinised decomposition products of the hornblende rocks and granites. For a few feet from the surface such deposits are usually soft, but become much harder at a greater depth, the infiltrating iron cementing the whole mass into a more or less compact conglomerate. Several attempts have been made in the way of prospecting for gold at the lower levels of these deposits, but up to the present these have proved futile, though there is no reason why gold should not be found in payable quantities. The great disadvantage, however, in prospecting beds of this class is the difficulty in finding any indication at the surface of the contour of the bed rock, a fact which necessitates prospecting being carried on at a great expense and in a haphazard way. Dating back to the discovery of the field alluvial gold was sought for and won in considerable quantities, more especially in the immediate vicinity of the "Bardoc Hill." The amount of gold gained from this source cannot be ascertained, as records of it have not been kept officially, and the original prospectors have long since left the locality. All the gold obtained from this source was won either by "specking," i.e., picking out the larger pieces as they were seen in the loose *débris*, or by the process of gold recovery known as "dry blowing."§

*Nodular Ironstone Beds.*—In the Bardoc District these deposits are usually to be found covering the higher ground for which they form protecting caps, which resist the power of denuding agencies. In many instances it is impossible, with the present mining developments, to investigate the nature of these deposits. There is, however, one place in particular where one of the ironstone cappings has been apparently prospected in mistake for an ironstone lode. On Gold Mining Lease 512E two adits have been driven in the side of the hill at a depth from the surface where the ironstone is gradually merging into the underlying basic rock. It is evident in this section that the iron oxides from the basic rock-forming minerals, are in process of segregation and are gradually replacing the less basic constituents. That such a process is the cause of some of the ironstone deposits is further borne out in such sections as may sometimes be seen in the railway cuttings, e.g., Coates Siding,|| where the percentage of oxide of iron is much higher at the surface than at a greater depth of but a few inches. The evidence of the section at

\* Water may be carried far below this depth by means of fissures, to search for such, however, is practically useless. A.G.M., G.G.  
†History of Western Australia. W.P. Kimberley.

‡Annual Progress Report of the Geological Survey for 1897. Perth: By Authority, p. 20.

§ Vide Annual Progress Report of the Geological Survey of Western Australia for the year 1897. Perth: By authority, 1898. Report on the Coolgardie Goldfield, p. 56.

|| Coates Siding is a small railway platform on the railway line crossing the Darling Range.

Bardoc further emphasises the fact that this segregation takes place *in situ* in igneous rocks. On the other hand there is every reason to believe that similar deposits are formed in the highly ferruginous materials which have been removed and collected by the agencies of wind and water, and yet again from the disintegrated particles of older ironstone deposits themselves; in which latter case they are of detrital origin.

*Hornblende Rocks.*—Underlying the alluvium and more recent deposits, massive hornblende rocks occur. These, for the most part, are too decomposed even at the greatest depth to which they are exposed in the mines to be accurately described, though in individual cases they are to be found in a sufficiently unaltered state to be examined microscopically to advantage. In most of the underground workings where sections are visible, these hornblende rocks are seen to have weathered to a more or less soft ferruginous kaolin rock, through which pass irregular cracks forming the passages for the infiltrating surface water. On G.M.L. 422E the weathering of the hornblende rock is decidedly spheroidal, and at this spot the remnants of well-developed felspar crystals may be seen forming a large percentage of the composition of the rock. In most instances, however, the hornblende rocks are a much finer grain, and the individual crystals of rock-forming minerals are not visible even with the aid of a powerful pocket lens. The exact relation of these hornblende rocks to one another is not to be seen in any of the sections exposed on the field. Like similar rocks in the Coolgardie district there seems to be a tendency for one class of rock to merge imperceptibly into another.

*Granites.*—Bounding the hornblende rocks on the West and North-West occurs massive granite. This rock only outcrops in isolated cases, the denuded remains, principally sand, covering up most of the underlying rock. When outcropping at the surface the granite is seen to be a coarse-grained micaceous variety, hornblende being absent as far as could be seen by microscopic examination. The rock is too much weathered to allow of satisfactory microscopic examination. Narrow dykes of a closely allied rock, intersecting the field in many places, outcrops of which can be traced for considerable distances across the country. These dykes form an important factor in the formation of gold deposits, as they have probably been the cause of lines of weakness in the hornblende rocks into which subsequent deposits of auriferous quartz have made their appearance. That such is the case will be noticeable in the description of the mines in the following pages of this report, for in almost every instance the presence of the dykes can be noticed in the vicinity of the quartz reefs which are being worked on the field at the present time. In two instances, the Wycheproof (G.M.L. 324w) and the Wycheproof South (G.M.L. 1846E), the dyke rock itself is being mined and profitably treated. This is partly due to the presence of free quartz in the dyke rock, forming a class of stockwork as in several of the mines in the Coolgardie goldfield.\* The prevailing strike of the acid dykes, as can be seen on the accompanying map (Plate IV.), is a little to the West of North with a variable underlie either to the East or West, the dykes running more or less parallel. That these dykes are of a granitic nature is proved by analyses of samples taken from the two following localities:—Wycheproof Gold Mine 324w, here the percentage of silica was 68, and from the dyke lying immediately to the West of Gold Mining Lease 627E, where the percentage of silica was 51.1. In the latter case the rock is much weathered, which would easily account for the lower return. In this last-mentioned dyke the rock is impregnated with numerous elliptical steam holes, partially filled with oxides of iron. Though it is the exception, rather than the rule, for steam holes to be found in dyke rock, the regularity of these holes along certain lines and cracks, and their uniform shape, point strongly to their being of an eruptive nature. There is, however, no very conclusive evidence to this effect, the surface being so much covered over with recent deposits as to veil much of the evidence necessary before this question can be definitely decided. The rock at the surface is a pale grey or yellow colour, has an apparent banded structure and imperfect cleavage, which are prevailing characteristics of the outcrop of these rocks throughout the field, and is much weathered.

## DESCRIPTION OF REEFS AND LODES.

### OCCURRENCE OF GOLD.

The gold won on this field has been derived from three sources, viz., alluvial deposits, lodes or formations, and quartz reefs.

### ALLUVIAL GOLD.

The occurrence of gold in alluvial deposits has already been dealt with in this report, under the heading "Superficial Deposits."

### LODES OR FORMATIONS.

Few examples of auriferous lodes are met with in the Bardoc Mining District. As such they occur in intimate connection with quartz reefs, and are usually found associated with numerous quartz leaders. In appearance the lodes are usually banded, and distinguishable from the country rock only by their colour and auriferous nature. As prospecting had not been carried on, with one exception, at a greater depth than 150 feet on any of these deposits, their nature in undecomposed rock still remains unknown. In the Nerrin Nerrin mine a sulphide lode was struck in a crosscut at the 160ft. level in unweathered rock but has not been exploited at this level or at any greater depth.

### QUARTZ REEFS.

The quartz reefs that have been worked to any extent all occur in the vicinity of the acid eruptive dykes, and are found persistently following the latter, both as regards strike and underlie. There are two distinct varieties of quartz reefs. Of these the prevailing type is white, opaque, sometimes glassy, a

\* Bulletin No. 3.—The Geology of the Coolgardie Goldfield. Perth: By Authority, 1899, pp. 49 and 62.

kind which is found usually in lenticular patches, and may be seen outcropping in many parts of the field.\* From the main masses of quartz, small quartz leaders are often seen to branch off, and it is in the latter that the richer gold is found. There are, however, several examples on the field of veins of quartz of a more persistent type, and though it is very doubtful whether such can be classed as true fissure veins, they are much more extensive and of higher grade than the prevailing lenticular type. The second variety of quartz reef is entirely different in appearance to that previously alluded to, and consists generally of alternate bands of crypto-crystalline quartz and oxides of iron (usually hematite). In many cases the iron does not assume the banded form, but is disseminated throughout the quartz, giving it a brown or bluish brown appearance. These rocks are locally known as quartzites, although the evidence against their being an altered sedimentary rock is almost conclusive. They occur in close association with the acid dykes, and usually follow the strike and underlie of the latter, though at times they may be seen to penetrate the dyke rock itself, and would therefore seem to have been produced by the infiltration of siliceous waters.† So far as prospecting has proved, there is no example on the field of one of these quartz reefs of the second class proving payable as a gold producer, though it is found by experience that where an intersection of the two varieties of quartz reefs is met with, there is usually a rich chute of gold.

### THE MINES.

The following are brief descriptions of those mines which were being worked at the time the district was visited, and which were open to inspection. They are placed in geographical order in the following list (starting from the South) in order to facilitate referring to their position on the accompanying plan, Plate IV.

#### THE SURBITON GOLD MINING LEASE 6909E.

There are three shafts on this property which have been sunk to prospect a reef which strikes East and West across the lease, and underlies to the South. Of these the main working shaft lies to the West, and connects with the levels at 80 and 160 feet from the surface. The vertical depth of this main shaft is 240 feet. Below the 160 feet, however, neither driving nor crosscutting has been carried out.

*Eighty Feet Level.*—The crosscut North to the drives on this level is 32 feet in length. The drives extend 182 feet East, and 24 feet West. In the Eastern drive the reef pinches out at a distance of 132 feet from the main shaft, and behaves in a similar manner to the immediate West of the main shaft. Seventy feet from the main shaft the underlay shaft connects to the 80ft. level. The thickness of the reef in the 80ft. level varies considerably, the average being about 10 inches taken the whole length of the drive.

*One Hundred and Sixty Feet Level.*—At this level a crosscut to the North, 20 feet in length, connects the main shaft to drives extending 280 feet East, and 70 feet West. In the Eastern drive the reef averages 15 inches in thickness for a distance of 220 feet, but breaks off when it reaches a crosscut connecting to the Eastern vertical shaft. Past this point the drive has been continued for a distance of 35 feet. In the Western drive the reef continues from the main shaft for some 30 feet, when a winze sunk to the 240ft. level is passed. Beyond this winze the reef does not occur. The average thickness of the reef in the winze is about 12 inches.

I was unable to examine the other workings on this mine owing to a temporary suspension of work. Throughout the workings I visited, all the country rock is so much oxidised, as to prevent a proper determination of its nature. There is little doubt, however, that most of the rocks in the vicinity are hornblende and basic in character. Up to the present water has not been encountered even at the lowest level.

Official Records show that 10 tons of ore have been treated and have yielded 18ozs. of gold, or at the rate of 1oz. 16dwts. per ton.

#### AUSTRALASIAN GOLD MINE (HALF-MILE REEFS, G.M.L. 696E).

The reefs which are being worked on this lease do not appear at the surface in a defined outcrop, though they have been followed for considerable distances in the underground workings. In the Southern end of the lease, however, loose masses of quartz may be still seen at the surface, and these no doubt led to the discovery of the reefs lying but a few feet beneath the surface. Up to the present time, practically all the underground workings are connected to one main shaft, which has been sunk through more or less decomposed hornblende rock in the Northern end of the lease to a vertical depth of 360 feet. From this shaft levels have been opened out along the lode at vertical depths of 120, 170, and 250 feet. In addition, crosscuts have been made to the East and West at the 285 and 360ft. levels.

*One Hundred and Twenty Feet Level.*—A crosscut from the main shaft at this level has been put in 32 feet to the West to intersect the main reef. From this 150 feet to the North, and 100 feet to the South. The country rock in the crosscut is altered hornblende rock. The end of the North drive connects to the North underlay shaft. Most of the ore has been stoped out from this drive to the surface, the thickness of the reef varying from 18 inches to six feet. In the South drive the quartz body is very erratic in behaviour, and with the exception of one patch little or no quartz can be seen in this drive.

*One Hundred and Seventy Feet Level.*—As the reef passes through the shaft at the 225ft. level the crosscut to the lode at the 170ft. level is to the West, and is some 16 feet in length. Drives extend from the end of this crosscut 174 feet to the North, and 370 feet to the South. In the North drive the

\* Vide accompanying photographs, Nos. 1 and 2, taken of a quartz outcrop on the John Bull Gold Mine, G.M. Lease 858 W.

† Vide accompanying photograph, No. 3, taken of one of these reefs outcropping on the Blue Peter Gold Mine, G.M. Lease 1052.



reef is followed for a distance of 108 feet to a crosscut connecting the main drive to a vertical shaft used as an air shaft. The crosscut to this shaft is a Westerly one, and is 70 feet in length. The average thickness of the reef, from the main shaft to the above crosscut, a distance of 108 feet, is two feet, and the quartz for the most part has been stoped out in this part of the mine to the 120ft. level. To the North of the 70ft. crosscut, for an interval of several feet, the reef cannot be seen, but for the last 60 feet of the drive its average thickness is several inches, and some 12 inches of ore can be seen in the North face. The quartz reef at this level is fairly free from impurities, with the exception of a little oxide of iron. Passing along the South drive the ore body is seen constantly varying in thickness from a few inches to several feet, the greatest dimensions being reached at a spot 325 feet from the main shaft where for 50 feet the quartz has an average width of three feet. In the South face the thickness of the quartz body is 12 inches.

*Two Hundred and Fifty Feet Level.*—A short crosscut to the East connects this level to the main shaft. From the end of this crosscut drives extend to the North and South for distances of 160 and 155 feet respectively. The reef varies considerably in its dimensions, as it is followed along the South drive, and in one place, 120 feet to the South of the main shaft, it vanishes altogether. A short distance further on to the South, however, the reef is again seen, and in the face of the drive had opened out to a thickness of at least two feet six inches. Followed to the North the quartz body varies in thickness from a few inches to 14 feet, and for a short distance has a reversed underlie, though an Easterly underlie is again assumed in the Northern end of the drive. In the North face of the drive the thickness of the quartz is about two feet.

*Two Hundred and Eighty Feet Level.*—The only workings at this level are two crosscuts, one 40 feet to the East of the main lode, the second 50 feet to the West, to what is known as the Western or No. 2 lode. At the point where the Eastern crosscut intersects the main lode, the ore body attains a thickness of 10 inches. The Western lode has not been broken, though sufficient work has been done to show that the lode is heavily charged with pyrites. The country rock in the crosscuts is unoxidised hornblende rock, which has been much crushed and broken, and in places is altered in the direction of serpentine.

*Three Hundred and Sixty Feet Level.*—Owing to the fact that water had not been raised from the lower workings for a considerable time, I found the mine flooded to the 290ft. level, and in consequence was unable to descend below the 25ft. level. A large quartz body was cut in an East and West crosscut which connects the two Southern shafts at a depth of 70 feet from the surface. This quartz body corresponds in strike and underlie with the one found in the main workings, but whether they are the same has not been proved.

The output of water from the main workings, which is salt, is 1,500 gallons per diem; most of the water comes into the shaft at about the 340ft. level.

Up to date the Official Records show that 4,749 tons 18cwt. of ore have been treated, and have yielded 2,946ozs. 12dwts. 13grs. of gold, or at the rate of 12dwts. 9grs. per ton.

The milling plant consists of a 10-head stamp battery.

#### BLUE PETER GOLD MINE (G.M.L. 1502w).

Mining operations have been carried on in this property on two small quartz leaders, striking approximately East and West and underlying to the South. On the more Northern of these two a shaft has been sunk to a vertical depth of 40 feet, and a small quantity of the quartz stoped out and crushed. Two underlay shafts have been sunk to vertical depths of 40 and 90 feet respectively on the Southern reef, but with the exception of a small amount of stoping near these shafts, no other work has been done. The nature of the quartz is clear and vitreous, containing little or no foreign minerals. The thickness of the reefs in both cases varies from a few inches to one foot. Whether these reefs have any direct connection with the line of banded quartz reef running in a North and South direction through the Western edge of the lease, has not been proved conclusively, though it is almost certain that one at least, viz., the Northern one, does not extend past the banded type, as it is not found occurring in some old workings made to prospect the latter. The country rock hereabouts is so very much altered as to make accurate classification very difficult. In all probability, however, the rock will be found, I think, to be of a basic character when the undecomposed zone is reached.

Official Records to date show that from the two quartz reefs on this property 119 tons 10cwt. of ore have been mined and treated for a return of 213ozs. 0dwts. 8grs. of gold, or at the rate of 1oz. 15dwts. 15grs. per ton.

#### THE NERRIN NERRIN GOLD MINING LEASE 310E.

With the exception of three small prospecting shafts, there is only one working shaft on this lease. This shaft is supplied with the usual hauling gear, and has been sunk to a vertical depth of 310 feet. Levels at depths of 30, 38, 70, 160, and 236 feet have been opened out and connected to the main shaft.

*Thirty Feet Level.*—This level and the shafts connected with the same are the old prospectors' workings, from which most of the ore has been stoped. The old workings are connected with the main workings by means of a winze which joins them at the 38ft. level at a point 96 feet to the South of the main shaft.



*Thirty-eight Feet Level.*—The main shaft at this level lies to the West of the drive, to which it is connected by a 10ft. crosscut. These drives extend 48 feet North and 100 feet South along the reef, which tapers out in both faces, though it averages from 12 to 15 inches in thickness for the 148 feet of driving. In the South drive all the ore has been stoped out to the surface.

*Seventy Feet Level.*—At this level the lode passes through the shaft. Drives along the lode extend for distances of 60 feet South and 88 feet North. The reef for this distance averages about 12 inches in thickness. Forty-eight feet to the North of the main shaft a winze connects the 38ft. level with that of the 70ft. level. The quartz in this winze has a thickness of four feet. Fifty tons of ore have been stoped from the 70ft. level, and have averaged by battery treatment about 10dwts. to the ton.

*One Hundred and Sixty Feet Level.*—The crosscut from the main shaft to this level is 40 feet in length. One drive has been put in to the North from this crosscut along the lode, and has proved the latter to have an average thickness of two feet for a distance of slightly over 100 feet. Where the crosscut intersects the reef the latter has a thickness of 10 feet.

Official Records show that 918 tons of ore treated have yielded 447ozs. 6dwts. of gold, or at the rate of 9dwts. 17grs. per ton.

#### THE BANK OF ENGLAND GOLD MINE (G.M.L. 1076w).

Four underlay shafts have been sunk on a quartz reef which passes through the centre of the lease in a North by West direction. The vertical depths of these shafts, taken in order from the North, are 145, 301, 207, and 66 feet. Unfortunately, owing to a blockage in the mine, no examination below the 50ft. level was possible.

*Fifty Feet Level.*—At this level a drive extends from Number 4 shaft North to Number 1, and 12 feet beyond the latter. For this distance the reef is continuous, and averages at least two feet in thickness. The quartz, however, is seen to taper considerably near the ends of the drive, and in the faces is scarcely visible. Free gold can be seen in some of the ore, which consists of white quartz slightly impregnated with iron oxides. Between Number 2 and Number 3 shafts a winze has been sunk, and a parcel of 108 tons taken out, which yielded, on treatment, 115ozs. of gold. The country rock, in as far as could be seen in the workings, consists of a much altered basic rock.

Running to the East and parallel to the line of reef is an outcrop of acid eruptive rock. Though the exact association of the reef with the dyke is not yet revealed in the upper level it should be seen at a greater depth in the mine as the dip of the dyke rock is much greater than that of the reef.

Official Records show that 282 tons of ore taken from this mine have yielded 217ozs. 16dwts. 12grs. of gold, or at the rate of 15dwts. 10grs. per ton.

#### ZOROASTRIAN GOLD MINE (G.M.L. 39w).

The main shaft, which is situated in about the centre of the lease, has been sunk to a vertical depth of 314 feet. From the main shaft the principal workings have been opened out from the 100, 200, and 300ft. levels. A limited amount of prospecting was carried on at the 50ft. level by the original holders, but these workings are not being used at the present.

*One Hundred Feet Level.*—The reef which underlies to the West passes through the shaft at the 100ft. level. A drive follows the course of the reef to the South for a distance of 273 feet. No drive has been put into the North, as there is no appearance of the lode continuing in that direction. The average thickness of the reef along the South drive is about two feet. In the South face the quartz body has a width of four feet. At a distance of 113 feet to the South of the main shaft, a crosscut East connects the 100ft. level to No. 2 shaft.

*Two Hundred Feet Level.*—At this level the reef has been cut in a crosscut for a distance of 105 feet from the main shaft towards the West, and from this point of intersection drives have been put in for distances of 69 feet North and 137 feet to the South along the course of the reef. A crosscut East extends for a distance of 160 feet from the main shaft. At a distance of 10 feet to the South of the main crosscut a rise has been made for 67 feet from the South drive, and immediately below the rise a winze has been sunk a vertical depth of 75 feet. From the end of the South drive a crosscut extends East for a distance of 27 feet. The average thickness of the reef in this level is about 21 inches. In the winze the thickness attained is about 15 inches. A small quantity of quartz has been stoped from near the intersection of the main crosscut and main drive. The amount of stoping, however, is not extensive, as about 200 tons only of ore were taken out.

*Three Hundred Feet Level.*—At this level a crosscut has been put in to the West for a distance of 110 feet, but as the reef underlies West, at an angle of under 60 degrees, the reef has not been struck in this crosscut up to the present.

In the lower levels the country rock becomes less decomposed, and is seen to be of a basic character, though it is difficult to determine its true nature. In the Eastern crosscut, at the 200ft. level, a thin dark band was passed through in the vicinity of the main shaft. This same band was cut in the West crosscut at the 300ft. level. There is fairly strong evidence that the rock to the immediate East of this dark band is of an acid eruptive nature, and will probably be found to be part of one of the felsite dykes seen outcropping, both to the North and South, with a strike trending towards the main shaft.

The output of water is about 6,000 gallons per diem. The water is salt, but not of very great salinity. Official Records show that 112 tons of ore from this mine have been treated for a return of 164ozs., or at the rate of 1oz. 9dwts. 6grs. of gold per ton. Official records show that 312 tons of ore taken from this mine have yielded 388ozs. 16dwts. 18grs. of gold, or at the rate of 1oz. 4dwts. 22grs. per ton.

#### EXCELSIOR GOLD MINE (G.M.L. 359E).

This lease is situated on a line of country extending for a considerable distance to the North and South. The workings consist of three vertical and two underlay shafts. Of these the most Southern, known as the "Old Water Shaft," has been sunk to a vertical depth of 200 feet. Crosscuts have been made to the West at the 100 and 200ft. levels.

*One Hundred Feet Level.*—The crosscut to the West at this level extends for a distance of 92ft.; when drives were made North and South along the course of a quartz leader averaging about 18 inches in thickness. The total length of the drives is 63 feet. In the Southern drive a rise has been made up to an Eastern crosscut which connects with a shaft which has a vertical depth of 90 feet. This 90 feet crosscut is 12 feet in length. Immediately below the rise a winze has been sunk on the quartz leader to a vertical depth of 20 feet. The average thickness of the quartz in the winze is 20 inches.

*Two Hundred Feet Level.*—At the 200ft. level a crosscut extends for a distance of 50 feet. A winze, with a vertical depth of 40 feet, has been sunk at the end of the crosscut. These lower workings were made in pursuit of water, and though a small quantity of the latter was obtained the supply gradually diminished till at last the workings became quite dry. In the vertical shaft lying to the West of the Old Water Shaft, to which it is connected at the 90ft. level, a reef carrying gold was followed to a vertical depth of 40 feet and then underlied to the West. The continuation of this reef is probably that vein found in the drives at the end of the West crosscut at the 100ft. level of the Old Water Shaft.

*Main Shaft.*—This shaft has been sunk to a vertical depth of 310 feet to prospect two reefs which outcrop at the surface in an unbroken line for a considerable distance. The shaft has been opened out at the 50, 100, and 300ft. levels.

*Fifty Feet Level.*—Crosscuts from the main shaft at this level extend for distances of 70 feet West, and 45 feet East. In the Western crosscut the layer of the two reefs is met with almost at the shaft, and has a thickness of some six feet. This reef has been followed for a short distance to the North in a prospecting drive. At a distance of 35 feet from the shaft another reef was cut, and averages about 15 inches in thickness across the crosscut. The crosscut has been continued for a further distance of 35 feet. In the Eastern crosscut the smaller and richer of the two outcropping quartz reefs is cut at a distance of 12 feet from the shaft. This reef is at this point 18 inches in thickness, but apparently tapers towards the South, and it is not met with in the 100ft. level, but is found some distance further to the North. At the end of the Eastern crosscut a felsite dyke is passed through. This dyke is very much decomposed, but can easily be distinguished from the more basic encasing rock.

*One Hundred Feet Level.*—The crosscuts at this level extend for distances of 39 feet to the West and 40 feet to the East. At the end of the Western crosscut the same reef apparently as that found in the 50ft. level has been intersected. The reef at the 100ft. level is 10 inches in thickness. At the end of the Western crosscut a drive has been extended to the South for a distance of 26 feet to prospect several quartz leaders. In the Eastern crosscut the layer reef is cut at a short distance from the shaft, and has been opened out in drives extending 15 feet to the South and nine feet to the North. The reef in these drives is seen to have diminished very much in size, not averaging more than a few inches in thickness. At the end of the crosscut the felsite dyke is again cut.

*Three Hundred Feet Level.*—Crosscuts extend for distances of 62 feet West and 82 feet East at this level, but with the exception of the intersection of the felsite dyke at the end of the Eastern crosscut, there is nothing to note in these lower workings. The output of water is 2,000 gallons per diem.

*Underlay Shaft No. 1.*—This underlay shaft lies to the immediate North of the main shaft. The vertical depth of the shaft is 50 feet. At this level a crosscut has been extended to the East for a distance of 60 feet. At the bottom of the shaft drives extend North and South for distances of 24 and 21 feet respectively. The reef which has been followed in this shaft, and averaged in thickness about one foot, is seen to widen out considerably in the Southern face of the South drive, where it has attained a thickness of six feet. This reef is commonly believed to be the same as the Eastern reef in the main workings. In the Eastern crosscut, at a distance of 30 feet from the shaft, another reef having a thickness of from two to three feet is intersected. This reef has been opened out to the South for a distance of 42 feet. In the Southern face the thickness of the reef is about four feet. At the end of the crosscut probably the same felsite dyke as is seen in the main workings is intersected.

*Northern Underlay Shaft.*—This shaft is the most Northern on the lease, and has been sunk to a vertical depth of 50 feet. The shaft follows a line of reef averaging about 18 inches in thickness. Drives extend for distances of 48 feet to the North, and 50 feet to the South along the course of the reef. The reef has an average thickness of 18 inches. It is impossible to state with any degree of certainty if this quartz reef belongs to either of the above-mentioned lines of reef. The country rock in all the workings is highly altered basic rock, intersected with apparently more or less lenticular veins of quartz. The quartz varies in character in the different workings, but it is all more or less of a white and vitreous nature. The strike of the quartz reef is approximately North and South, with a variable underlie to the East at a high angle.

## EXCELSIOR EXTENDED G.M.L. 417E.

This property belongs to the same company as the Excelsior, and the two are worked in conjunction. The workings consist of one vertical shaft, which has just been commenced, and an underlay shaft, which has been sunk to a vertical depth of 100 feet. The underlay shaft, which follows a small quartz vein underlying to the East, has been opened out at the bottom by means of a drive, extending for a distance of 30 feet to the South. The quartz vein has an average thickness of about one foot in the shaft, but is two feet six inches across in the Southern face of the drive. The quartz is of the white and vitreous variety, and is slightly impregnated with oxides of iron. The official Returns for the Excelsior and Excelsior Extended show that 779 tons of ore have been treated for a return of 798ozs. 10dwts. 5grs., or at the rate of 1oz. 0dwts. 12grs. per ton.

## HOMEWARD BOUND G.M.L. 403W.

On this property two shafts have been put down on the outcrop of a reef which strikes North and South through the centre of the property. The most Southern of these shafts underlies slightly to the East, and follows the quartz reef to a vertical depth of 150 feet. At the 150ft. level, which is the bottom of the underlay shaft, drives extend for distances of 253 feet North and 69 feet South along the line of the reef. At the end of the Northern drive a crosscut from the main shaft is intersected at a distance of 20 feet to the East of the latter. The reef throughout the length of the 150ft. drive has an average thickness of 18 inches. For a distance of 90 feet from the South face of the drive black graphite schist forms the walls of the reef. The schist varies from a few inches to several feet in thickness. It is in places heavily charged with iron pyrites. In the Northern portion of the drive the schist is absent.

*Main Shaft.*—Owing to the influx of water to the 175ft. level, I was unable to descend below the 150ft. level, though the vertical depth of the shaft is 320 feet. It was also impossible for me to see the 50ft. workings, as no ladder-way was provided in the main shaft. I was, however, able to examine the crosscuts at the 150ft. level, as there is access to these workings from the underlay shaft.

*One Hundred and Fifty Feet Level.*—Crosscuts extend from the shaft for distances of 230 feet West and 170 feet East. In the Western crosscut at a distance of 90 feet from the main shaft a felsite dyke, probably not the same as is found in the Excelsior Gold Mine (G.M.L. 359E), is intersected, and has been proved to have a thickness of 30 feet. In the Eastern crosscut the main drive is met with at a distance of 20 feet from the shaft. Here quartz reef is seen to taper considerably. The crosscut is continued a further distance of 150 feet. The country rock throughout these workings consists of a variety of hornblende rock in too highly an altered state to be satisfactorily determined. No crushings would appear to have been taken from this mine.

## EUREKA GOLD MINE (G.M.L. 993W).

At the date of my visit there were two working shafts on this property, the other workings, as marked on the accompanying map (Plate VI.), having for the time being been abandoned.

*Number One Underlay Shaft.*—This shaft has been sunk to a vertical depth of 30 feet on one of three series of auriferous quartz leaders. At the 18ft. level drives have been put in 30 feet to the South and 18 feet to the North along the line of reef. In the Southern face of the drive are two quartz leaders, each eight inches in width. In the North drive a winze has been sunk to a depth of 10 feet, in which the quartz body averages about 18 inches in thickness. In this winze some rich specimens were found, half-a-ton of stone producing 72ozs. of free gold.

*Main Shaft.*—The main vertical shaft has been sunk to a depth of 113 feet. I was unable to descend below the 30ft. level, owing to the fact that the lower levels were partially filled in.

*Thirty Feet Level.*—At the 30ft. level a crosscut has been made to the West, which connects with a drive from an underlay shaft lying 27 feet to the North of the main shaft. The crosscut to this drive is nine feet in length, and is continued a further distance of 30 feet towards the West. At a distance of 23 feet from the main shaft a band of lode stuff was cut in this crosscut, and from the point of intersection a drive was made to the South along the course of this lode for a distance of 30 feet. The lode averages two feet in thickness in this drive. Free gold is seen in much of the ore in this lode, and assumes the form of thin flakes. One crushing of 56 tons taken from the lode as mined out of the drive averaged 26dwts. per ton. In the drive from the underlay shaft to the Western crosscut a quartz body has been followed, and is seen to have an average thickness of about 18 inches. All the workings in the mine are, up to the present, in highly altered hornblende rock, which is intersected with numerous other small quartz leaders than those above-mentioned.

*One Hundred and Thirteen Feet Level.*—At this level a crosscut has been put in East for a distance of 114 feet. Drives have been put in from the crosscut at distances of 20, 35, and 60 feet from the main shaft to follow quartz leaders which were intersected at those distances along the crosscut. I was unable to inspect these workings, owing to a blockage in the mine, the shaft to these workings being for the present filled in with broken rock. The average strike of the leaders is North and South, with a prevailing Easterly underlay of some 45 to 50 degrees.

Official Records show that 156 tons 10cwt. of ore taken from this mine have yielded 223ozs. 0dwts. 16grs. of gold, or at the rate of 1oz. 8dwts. 12grs. per ton.



## THE THREE STAR GOLD MINE (G.M.L. 693E).

Seven shafts have been sunk on this lease on three distinct lines of reef. The vertical depths of the shafts, commencing with the most Northern one, are 50, 160, 35, 100, 50, 135, and 50 feet respectively.

*Number One.*—The most Northern of these, which is an underlay, has been sunk on a reef which underlies strongly to the West. The average thickness of the quartz body is about 20 inches.

*Number Two.*—This shaft which has a vertical depth of 160 feet, has been opened out from the 50ft. and 100ft. levels.

*Fifty Feet Level.*—A Western crosscut at the 50ft. level cuts a lode at a distance of 14 feet from the shaft, and then continues a further distance of 26 feet. Drives along the lode extending 150 feet to the North, and 100 feet to the South to No. 4 shaft, have been made along the lode. The lode, which consists of ferruginous lode-matter intermixed with quartz leaders, is of considerable width, and averages some 12 feet in thickness. At the end of the West crosscut another ferruginous lode has been discovered, but has not been opened up.

*One Hundred Feet Level.*—At the 100ft. level, a crosscut East passed through a quartz body at a distance of 16 feet from the shaft. This is probably the same reef as was discovered in the No. 1 underlay shaft. The reef in this crosscut is three feet six inches in thickness, and underlies to the West at an angle of about one in five. Salt water in some quantity has been encountered at the 160ft. level.

*Number Three.*—Little work has been done in this shaft. At the 35ft. level, *i.e.*, the bottom of the shaft, drives have been extended a few feet only to the North and South along the main lode, which maintains a similar character as in Number 2 shaft. I was unable to descend Numbers 4 and 5 shafts, as these workings were for the time being abandoned.

*Number Six Shaft.*—Drives have been made at the lowest level to the North and South about 40 feet; each was along the course of a reef averaging about 20 inches in thickness.

*Number Seven Shaft.*—Drives have been made from this shaft at the 50ft. level, 10 feet to the South, and 14 feet to the North. The quartz reef which averages several feet in thickness is almost vertical, and appears in the sides of the shaft. It is noticeable however, that, though the reef is continuous, it has a lenticular habit, and varies very much in thickness at different levels. The quartz is white and vitreous, and comparatively free from oxides of iron and other impurities. The country rock in all the workings on the above property are in a much altered rock, the exact nature of which it is impossible to determine at present.

Official Records of crushings made of ore taken from this mine, show that 60 tons of ore have been treated for a return of 14ozs. 15dwts., or at the rate of 4dwts. 22grs. per ton.

## WYCHEPROOF GOLD MINE (G.M.L., 324w).

One main vertical shaft has been sunk on this lease, and that to a vertical depth of 100 feet. From the bottom of the shaft a crosscut has been put in for a distance of 80 feet to the West. This crosscut passes through one of the numerous felsitic dykes, which are so often seen traversing the country in a more or less North and South direction. At a distance of 43 feet from the shaft in the crosscut, a winze has been sunk to a vertical depth of 60 feet in the felsite, and from the bottom of the winze a drive 40 feet in length to the South has further opened out the country. In this last-mentioned drive the foot wall of the dyke is being mined and treated for gold, the same eight or nine feet of this portion of the dyke containing sufficient gold to mine and treat profitably. The felsite dyke, which is close grained and of a light grey colour, is found to be impregnated with small crystals of iron pyrites, and contains numerous patches and veins of quartz, which are evidently the main source of the gold, though the latter is also visible in the felsite itself. At a distance of 73 feet along the crosscut at the 120ft. level a lode heavily charged with iron pyrites was discovered, but this lode has not been opened out, as the prospects were not as promising in this as in other parts of the mine.

In addition to the main shaft, two other shafts have been sunk on the lease. One to the North has been sunk to a vertical depth of 30 feet to exploit a small quartz reef about 18 inches in thickness. This reef strikes North 10 degrees West, and is parallel to the main lode. It underlies strongly to the West. The central shaft, which has been sunk on the same lode as the main shaft, has been abandoned, as that portion of the lode was of lower grade than that found in the main shaft.

Official Records show that 99 tons 18cwt. of ore have produced 76ozs. 16dwts. of gold, or at the rate of 15dwts. 3grs. of gold per ton.

## WYCHEPROOF SOUTH GOLD MINE (G.M.L. 1846E).

Two shafts have been sunk on this property, on the same felsite dyke as that being mined on the Wycheproof Gold Mine. With the exception of the shafts, which have a vertical depth of 80 and 40 feet taken respectively from the North, no underground workings have been carried on. The lode, as seen in the shafts, differs from that in the Wycheproof, in that the felsitic rock is much decomposed, and in consequence the quartz leaders are better defined. At present the centre of the dyke alone is being mined and is found to contain payable gold. There is no official record of ore having been taken and treated from this mine.

## RETURN SHOWING THE YIELD OF GOLD FROM BARDOC.

Number of Lease.	Name of Lease.	Date.	Quantity of Stone Crushed.	Yield of Gold.		Value of Gold.	
				Total Yield.	Rate per Ton.	Rate per Ounce.	
			Tons cwt. qrs.	ozs. dwts. grs.	ozs. dwts. grs.	£ s. d.	
1076w	Bank of England ...	1898	163 0 0	93 10 12	0 12 2		
		1899	119 0 0	124 6 0	1 0 21		
	Total ...	...	282 0 0	217 16 12	0 15 10		
1052w	Blue Peter ...	1898	58 10 0	105 4 20	1 15 21		
		1899	61 0 0	107 15 12	1 15 18		
	Total ...	...	119 10 0	213 0 8	1 15 15		
Q.C.6w	Blue Reef ...	1899	9 10 0	10 5 12	1 1 15	3 17 6	
25w	Excelsior ...	prev. to 1898	275 0 0	264 7 5	0 18 5	3 15 0	
		1898	157 0 0	266 9 0	1 13 22	3 15 0	
		1899	347 0 0	267 14 0	0 15 10	3 15 0	
	Total ...	...	779 0 0	798 10 5	1 0 12	3 15 0	
993w	Eureka ...	prev. to 1898	43 10 0	82 8 22	1 17 17		
		1898	7 0 0	5 17 6	0 16 18		
		1899	106 0 0	134 14 12	1 5 10	4 0 0	
	Total ...	...	156 10 0	223 0 16	1 8 12		
1004w	Eureka North ...	prev. to 1898	1 0 0	1 7 0	1 7 0		
107w	Australasian ... or Half-Mile Reefs...	prev. to 1898					
108w		1898	1412 0 0	1138 6 0	0 16 2		
109w		1898	614 0 0	276 6 7	0 9 0		
887w		1899	2723 18 0	1532 0 5	0 11 5		
956w	Total ...	...	4749 18 0	2946 12 12	0 12 9		
19w	Nerrin Nerrin ...	prev. to 1898	326 0 0	88 6 0	0 5 10		
		1898	592 0 0	359 0 0	0 12 3		
	Total ...	...	918 0 0	447 6 0	0 9 17		
1116w	Our Pride ...	1899	18 10 0	43 19 0	2 7 12		
176w	Rose and Swan ...	1899	195 0 0	75 13 8			
982w	Rose and Swan South ...	1899	25 0 0	31 5 0	1 5 0		
1043w	Struck Oil...	prev. to 1898	51 0 0	74 0 0	1 9 0		
		1898	36 0 0	17 1 0	0 8 23		
		1899	50 0 0	14 0 0	0 5 14		
	Total ...	...	137 0 0	105 1 0	0 15 8		
147w	Surbiton ...	prev. to 1898	10 0 0	18 0 0	1 16 0		
1100w	Three Star ...	1899	60 0 0	14 15 0	0 4 22	3 17 10½	
959w	Vetter's Find ...	1899	3631 0 0	2675 2 0	0 14 17	3 7 6	
325w	Wycheproof ...	1898	36 0 0	43 3 0	1 3 10		
		1899	63 18 0	32 13 0	0 10 5		
	Total ...	...	99 18 0	75 16 0	0 15 3		
39w	Zoroastrian ...	prev. to 1898	112 0 0	164 0 0	1 9 6		
		1898	200 0 0	224 16 18	1 2 11		
	Total ...	...	312 0 0	388 16 18	1 4 22		
GRAND TOTAL ...			11,710 16 0	8,424 2 19	0 14 9		