

This lead will take a considerable time to work out, as there are many patches that have not yet been touched.

Many other rich leads are certain to be found in the hills; but, to find them, considerable prospecting will be necessary.

The two main difficulties on this field arise from the want of water, or from too much water, as on the hillsides there is no water except during winter, when the workings are either flooded or become unsafe; the wash is therefore raised during the summer, and washed during the winter months; and in the large sandy and swampy flats, where the deep ground is situated, there is so much water that it is impossible to sink without pumping machinery at any time, whilst the surface is so flat that great difficulty would be experienced in getting rid of the water unless operations were started near one of the main drainage creeks, into which deep drains might be cut; but such work requires capital, as the ground would have to be first tested by boring.

As to the future of the field, until the rich lode deposits, which must exist, are discovered and worked, it will probably go along in its present quiet way for many years to come, as there is nothing to give it an impetus, unless large rich areas are found in the wet ground and worked on a large scale by a company.

That a rich belt of tin-bearing country does exist is proved, and it should be easily tested, particularly in such places as Williams', where the rock outcrops at the surface, and where an extensive and rich patch of stream tin is still being worked, the particles of tin being so sharp as to prove conclusively that they have never travelled, and therefore that the tin-bearing veins must cross this area. That they do exist a little to the Northward we do know; but as the surface deposits were not so rich here, it would be better to test below, where more stream tin has been found.

Again, near the Court House, upon this same line (but in a most unlikely place) bunches of ore were discovered in a lode formation, whilst in places along the Greenbushes lead and near Hester's Troughs the size and angular shape of the tin preclude the possibility of its having travelled; these patches of large tin must, therefore, have been found almost upon the lode, which should, therefore, be easily discovered and tested, as its position is known within a few yards.

It is highly probable that some rich patches of lode tin have already been worked as alluvium, as from its decomposed condition it would be almost impossible to distinguish it from the wash, and if this is the case it will account for some of the confusion which has occurred in following the leads.

The only methods by which the Government could assist this field would be by leasing portions which the working miners are unable to work, strictly enforcing the labour conditions; to prospect for the lode in the deep ground, either by boring or by sinking shafts, and driving or cutting trenches; and lastly, to cheapen the carriage from the field to Bunbury, which now costs about £2 10s. per ton, which, added to the shipping and other charges, does not leave much margin for profit at the present low price of tin, 70 per cent. being worth £42 per ton, 60 per cent. £32 5s., 50 per cent. £23 15s., 40 per cent. £16 10s., 30 per cent. £10 10s.

HARRY P. WOODWARD,
Government Geologist.

20-6-94.

Appendix III.

A Report on the Country between Broomehill and the Dundas Hills, and the Mines in that neighbourhood,

By the Government Geologist.—December, 1893.

Broomehill, on the Great Southern Railway, is situated on a high plateau at the head of the Gordon, Blackwood, and Pallinup Rivers. The surface of the country is comparatively flat, the soil consisting of red and light sandy loams, lightly timbered. The water-courses are not deeply cut, and do not run except after heavy rains or summer thunder showers, as the rainfall is light, as a rule, and has been particularly so during the last few years. This land is well adapted to agriculture, as areas of considerable extent of good land may be obtained here in one block, without any rocky outcrops to hinder the ploughing.

The water question of late years has caused great trouble, and the rainfall has been lighter than usual, and, owing to its elevated position wells have, as a rule, to be sunk a considerable depth into the solid rock to assure a permanent supply of water. Many tanks have been excavated, but as the gullies have not run the last few years, these have not been filled. In the bed of the Pallinup River, between Woodearup, Pallinup, and Nigalup Springs, there are several nice pools, with bars of schistose and granitic rock, very similar to those met with on the tinfield. Gold may probably exist here in small quantities, and, if found, will be associated with iron pyrites in the lode, but it is, more strictly speaking, a tin country. Down the river, towards Kybelup, the country changes, becoming more sandy, and the good land patchy, whilst the larger pools in the river are salt. From Kybelup to the Southward, towards the Stirling Range, and Westward towards the Gordon River, stretches a great open sand plain, upon which, particularly to the Westward end, there are a large number of fresh water lakes and swamps, whilst to the North-Eastward it extends, forming the great sandy table-land of the interior. At Magitup there is a nice patch of country of some extent, but as the water in the river between the granite bars is salt, tanks have had to be made in branch gullies.

To the Southward of this the bold peaks of the Stirling Range rise abruptly from the plain, attaining an elevation of from 2,000 to 3,000 feet above it. The rocks which compose this range strike East and West, and appear to belong to the newer palæozoic series, consisting of ripple-marked flags and shaley beds. This series of rocks, although covering a considerable area, are plicated in such a manner that two or three beds form the entire range, rising abruptly from beneath the plain to the Northward, and dipping under it again to the Southward. Although much folded, these beds are not highly altered or faulted, do not show any indications of mineral veins, and no fossils have yet been discovered by which their correct age may be determined. This range is of no interest, so far, beyond the bold feature it presents that we have here an outcrop of rock apparently intermediate in age between the very old crystalline series and the more modern formations of the plains, which leads us to the hope that the carboniferous formation, with its coal measures, may also exist here.

To the North-East of Magitup the country consists of an elevated sandstone table-land, cut here and there by the water-courses which drain into the Pallinup River, with here and there small patches of good land, but unfortunately the pools in the gullies formed by natural dams of granite are salt most of the year. This class of country also extends Southward across the Pallinup River to the South coast, and East and West from the mouth of the Gairdner to the Kalgan River.

On the road between Magitup and Jerramungup is a celebrated natural curiosity, called the "Night Well," in reality a fissure in the granite rock in the bed of the creek—which, during the summer months, is dry during the day, and full of water (often to overflowing) during the night; whilst during the winter it is always full, but is mostly covered by the water of the gully. The intermittent nature of this spring is evidently due entirely to the changes of temperature, for after very hot days it either is not filled at all, or not until nearly morning, whilst, as a rule, the water rises at from 10 to 12 p.m., disappearing again suddenly in the morning, as soon as the day begins to get hot. The immediate cause of the water rising is due either to the expansion and contraction of the rock with the rise and fall of temperature, which would cause the fissure to open or close, or, upon the other hand, as the water is probably derived from the drainage of the high sandplain to the northward, the supply might be affected greatly by the changes of temperature, the water being sucked up by the heated upper sand beds and plant roots, particularly if these beds are not of any great thickness above the water-bearing beds.

At Jerramungup, on the Gairdner River, a belt of very good land is met with, following the river valley, in which granitic rocks outcrop, and there are several good springs. Between Jerramungup and Cocanarup, at the head of the Phillips River, the country consists of a high sandy tableland, broken here and there by the branches of the Fitzgerald River, upon one of which, called Jacup, there is a pretty fair patch of country. This tableland extends South, where it is cut by deep river valleys, upon either side of which are cliffs of horizontally bedded white and coloured sandstones, some of which contain casts of recent marine shells. In these valleys, which are often of considerable extent, are some good patches of alluvial country, whilst in other places slates and granite outcrop, with numerous quartz veins, some of which are of a highly auriferous appearance. A coal seam was supposed to exist in the bed of the Fitzgerald River, but it proved to be only a poor bed of a peaty substance, lying directly upon the upturned edges of the slates, often containing large quantities of quartz.

Along the coast, which runs in a North-Easterly direction, from the mouth of the Gairdner River to the Phillips, is a rough range of crystalline rocks, in which a few small deposits of copper have been found, but as the ore seems to consist almost entirely of sulphides they are of no great value. The rivers along this coast are generally salt, and discharge themselves into large estuaries called inlets, which are, as a rule, now divided from the sea by bars or sand dunes, which have not been broken for so many years that they have become quite solid, and all the flood water is now held back, and can only find its level by gradually soaking through the sand. This is becoming a source of danger, for should an exceptional flood take place, the whole country behind the sand hills would be flooded.

At Cocanarup, on the Phillips River, a sudden change in the country takes place, the granite which outcrops in all the valleys to the Westward giving place to metamorphic and schistose rocks with

quartz reefs and diorite dykes. This formation extends through the Ravensthorpe Range as far as Carlingup, on the Jerdacuttup River, and is very probably the Southern extension of the Yilgarn belt of auriferous country, which, however, is covered by the sandstone tableland between the two points. Gold in small quantities has been found here, with copper and iron pyrites; therefore this range should be thoroughly prospected, and, as there is a good patch of country here and several good springs, this might be done during the dry season.

Between the Jerdacuttup and the Oldfield Rivers is a high sandy tableland, but along the last-mentioned valley the country improves, and there are good patches of feeding country. Along the coast, between the Steere and Young Rivers, there are high dunes of blown sand, with swampy flats behind them. Into Stokes Inlet, at Fanny's Cove, the Young and Lort Rivers discharge themselves, which, during the floods of 1893, raised the level of the water in the inlet 11 feet above the sea; all the crossings, therefore, for a considerable distance inland were rendered impassable.

The Lort River as shown upon the map is a very small stream, but as a matter of fact it extends far into the interior, draining the salt lakes at the Dundas Hills. The rocks which outcrop along its course are mostly granitic, but here and there for a short distance there are outcrops of schistose rocks, whilst on either bank overlying them are the recent sandstones. The country up the Lort rises rapidly from the coast, attaining an elevation of about 600ft. at 30 miles inland, but after this the rise is very gradual into the interior, being only about 150ft. in the next 100 miles. Northward of the bend of the Lort, where that river turns to the Westward, the country is of a calcareous loamy nature, being covered with mallock (mallee) thickets and small fairly open flats around the granite outcrops. The ground is covered in many places with small nodules of limestone, and would make excellent wheat land if cleared; and, if worked on an extensive scale, as in South Australia, by rolling down the mallee, draining it, and ploughing with a stump-jumper, it should pay well. Judging from the quantity and class of vegetation, there must be about 15 inches of rain. This would have to be conserved, as by sinking salt water is almost invariably obtained. The conservation of water here is rendered simple, as there are a large number of outcrops of bare granite rock, which throw every drop of water like a house roof, so that tanks would have to be constructed round them of sufficient size to hold water for the year's consumption.

To the Westward, at the head of the Lort, are two striking hills, called the Fitzgerald Peaks. The northern one, which is conical, is called Peak Charles, and the southern one, which is more of a bluff-shaped hill, is called Peak Eleanora. These hills, from a distance, bear a striking resemblance to the Stirling Range, and from the description of the rocks given by persons who have visited them, they appear to be very similar, and are not worth prospecting. These peaks rise abruptly from the plain, which is about 700ft. above the sea, to an elevation of from 2,000 to 3,000 feet, and are visible for a distance of about 50 miles. Peak Charles is said to be so steep that it is impossible to climb to the top, but part of the way up the side there is a good soak or spring, whilst six miles further South, near Peak Eleanora, there is also another good spring. The country to the North and Eastward of these peaks is a light loamy tableland, timbered with gum and mallee, with here and there large patches of salt bush and well grassed country. It is broken here and there by granite outcrops, and large chains of salt-flats called lakes, from which the rivers which discharge themselves take their rise. There is excellent feeding country around these lakes and rocks, of which latter there are a great number; in fact it may be safely stated that if water were conserved at each of them, sheep would never have to travel more than five miles to water. When we consider the enormous expanse to which graziers have gone in the Eastern Colonies in procuring good stock water by deep wells and bores, it can safely be predicted that before many years this fine country will be stocked, particularly as it is comparatively free from poison plants.

About 50 miles in a North-East direction from the Fitzgerald Peaks, in a lake valley, is a low range of schistose rocks called the Dundas Hills. This range was sketched in from the Fitzgerald Peak by Surveyor-General Roe many years ago, and is shown on the old maps as an East and West range. This, as a matter of fact, is quite incorrect, as it runs North and South; but as all the Southern portion of the range is so low that it would not be noticed from the Peaks, it is highly probable that Mr. A. Forrest's Mt. Thirsty is Mr. Roe's Mt. Deans, and that the Mt. Deans of Mr. Brazier is the original Mt. Norcott, as Mr. Brazier's Mt. Deans and Mt. Norcott, seen from the Fitzgerald Peaks, appear to be much too close together. The Dundas Hills, except viewed from the lake on the East side, do not present a striking appearance, as they are situated in a hollow, the North end only rising very little above the tableland on the West side. The rocks strike North and South with the Range, and are mostly hornblendic and mica schists with granite, diorite, quartz and ironstone lodes, with well-defined lines of reefs carrying gold, which are now being tested. The belt of auriferous country is narrow, being from half to one mile in width, flanked on either side by granite, being probably the Southern extension of the Coolgardie line from which it can be traced through Wagemulla, being only lost for a short distance beneath an elevated sandplain.

The existing gold discoveries extend along the Hills for a distance of over eight miles, but more gold-bearing reefs will probably be found further North and North-East.

THE DUNDAS GOLDFIELD.

The Dundas Goldfield was proclaimed August, 1893, and consisted of an area of about 1,000 square miles. History:—This goldfield was discovered a few years ago, by Mr. Moir, of Fanny's Cove, who, whilst engaged in searching for country, found a few colours of gold in the alluvium. In 1892 he organised a party with Mr. Stennet, but they were not successful in finding gold in payable quantities, so left the field. About the same time, two or three other parties also started to prospect the hills, amongst which were Messrs. Mawson and Kirkpatrick, who were so fortunate as to discover the outcrop of a very rich reef, which they called the "May Bell." This discovery was quickly followed by that of Messrs. Bromley, Mason, and Dejarlais, who also found a rich outcrop, which they called the "Great Dundas," whilst Messrs. Brodie, Kirtley, and Devine also discovered the outcrop of two rich reefs, which they called the "Scotia." During the year 1893, these prospectors were engaged in opening up these reefs, but very little other prospecting has been done, as all the diggers who visited the field were naturally attracted away North to Coolgardie, where such a large quantity of alluvial gold was being found. Claims:—

THE MAY BELL.

(Mawson and Kirkpatrick.) This reef is about three miles North of the main camp at the Dundas Soak (Nookannia), and it was here that the first payable stone was found in 1892. The reef is well defined at its outcrop at the Southern end of the area running North up to the Hill, where it can still be traced at the surface, although smaller in size. It has been opened by two shafts and several small holes, from all of which good gold-bearing stone was obtained. The main shaft at the South end of the claim is 40ft. in depth, showing a wide defined reef 4ft. in width carrying gold all the way down. It underlies slightly to the West, and shows all the characters of a true fissure vein. Fine gold is carried all through the stone, besides which there are very rich patches, but in those also the gold is in the solid stone. A few chains North of this shaft is another, which is down about 10ft., in which there is a very solid body of stone about 5ft. in width, having, if anything, even a better definition than in the main shaft. There are also several spur veins or leaders striking off from the main lode, which also carry gold. This lode is a true fissure vein, and all the indications point to its continuing as rich or becoming richer in depth. The country is hornblend and mica schists, a good deal broken at the surface; but it will rapidly get solid in depth, when very little timber will be required. The water level will be about 200ft., and it will most probably be salt, but not so salt as near the lake; therefore, in erecting machinery, it will be better to sink a main working shaft on the mine itself, and raise the water by pumps, rather than cart the stone down to the lake; also the natural features near the mine offer great facilities for economic working. There are several well defined deep gullies in which dams could be made, and thus a considerable quantity of fresh water conserved. Although not so phenomenally rich like Bayley's, this mine is as promising as anything in the Colony; and, considering its position, being only 100 miles from the coast, the abundance of salt water, and large rainfall, and quantity of timber on the ground, it should be cheaply and successfully worked.

THE MAY BELL NORTH.

(Elliott, Gorman, and Henrickson.) This area is situated immediately to the North of the May Bell and upon the same line of reef. The reef is small at its outcrop when opened, but yields prospects of fine gold. The prospectors are engaged in driving a tunnel into the hill to cut the reef at a lower level, but have not yet driven far enough to cut it. This claim has the great advantage of being cheaply tested by adits, as the steep face of the hill approaches very close to the reef. Water can also be easily conserved here, as well as on the May Bell. This prospecting should be continued.

THE MAY BELL SOUTH.

(Challand, Hopper, Purches, and Binning.) This area is situated immediately to the South of the May Bell, and a shaft and several trenches have been put down, but the reef has not yet been struck; this is probably due to a break in the country, which has thrown the reef out of its course. A little further prospecting will be therefore needed, but as the reef is a true fissure and well defined close to the Southern boundary of the May Bell, it will be almost certain to be found in this claim.

THE GREAT DUNDAS.

(Bromley, Mason, Dejarlais, and Blake.) This reef is situated about $1\frac{1}{2}$ miles North-Eastward of the Dundas Soak, and about $1\frac{1}{2}$ miles South of the May Bell. It is a large lode mass on the West or hanging wall side of a large ironstone vein, which rises about 50ft. above the level of the lake. This lode runs North and South with the country, and can be traced for a considerable distance at the surface, but its size is not known yet, as it has not been cross-cut from wall to wall. The rocks to the Westward of the lode are hornblendic schists, whilst to the Eastward of the ironstone lode there are mica schists and granite, and some dykes of the latter cross the lode. A shaft has been sunk 45ft. on the lode mass, the stone being very rich in the shaft for the first 15ft., after which the shoot was lost, dipping to the South, but was again cut by a drive at the bottom of the shaft, from which some very good stone has been obtained. The cap has been opened in many places, from all of which good prospects have been obtained upon crushing. A large supply of salt water will be struck at a depth of about 60ft., below which the

rock will be found to be solid, requiring but little timber. The lode is a true fissure vein of great size, and will probably prove to carry gold all through it when tested. The great size of the lode, richness of the stone, and distance at the surface it has proved to carry gold, all point to this as a very rich property. There will be abundance of water in the mine for crushing, and there is plenty of timber on the spot; fresh water may also be conserved by constructing a large reservoir on the gully flat to the Westward, near the shaft.

THE NOS. 1 AND 2 GREAT SOUTH DUNDAS.

Two leases of 10 acres each have been applied for South of the Great Dundas, but the lode has not been struck upon either of them up to the present, as it has been thrown out of its course by a granite dyke. The ironstone lode to the Eastward of the lode was struck in a shaft, however, so it will take very little more prospecting to get the lode, as they now know where to sink. These areas are well worth prospecting, as the Great Dundas reef is rich where it sinks below the flat at the South end of the Great Dundas area, and all the shoots are dipping also in this direction.

THE FLORENCE ADA.

(Keyser). This area is North of the Great Dundas, but the lode has not yet been struck. However, a formation is forming in the shaft, which the prospectors intend to follow down, which it is certainly worth doing.

THE SCOTIA.

(Brodie, Kirtley, and Devine). This area is situated about six miles South of the main camp and three miles South of the Three-mile Rock, sometimes called Mount Deans. On it there are two parallel lines of reef, both of which carry fine gold all through the stone. There are two shafts and several holes on these reefs, from all of which good prospects can be obtained, although the gold is rarely visible to the naked eye. The reef to the Eastward has been tested by two shafts, one at the North and one at the South end of the area, to a depth of about 30ft. The reef is solid and well formed, consisting of solid stone from 254ft., and about 3ft. of rubble between good walls. In the Northern shaft it is cut by a granite dyke at a depth of 25ft., but the reef is not displaced or disturbed in any way by it. In the Southern shaft the lode mass from wall to wall is about 6ft. in width, and has much the same character as at the Northern end. The second reef has only been opened at the cap as yet, but to judge from the prospects obtained from it, it should be opened up.

These reefs are true fissure veins, the country being hornblende schist, rather heady near the surface, but will get solid in depth, and require little timber. Salt water will be struck at about 120ft., but will probably be much fresher than the water near the lakes. There is a very good site for a battery near the South-East corner of the area, and fresh water can easily be conserved by damming the deep gullies, and there is plenty of timber on the ground. Although the stone from these reefs is not so showy as that from the Northern reefs, it will probably be found to yield as good returns upon crushing.

No. 1 SOUTH SCOTIA.

(J. E. Angove). This area is situated on the South boundary of the last-mentioned, and both the reefs have been found upon it, presenting the same appearance, and yielding good prospects of fine gold. The reefs do not outcrop at the surface, so considerable time was spent in finding them, after which the prospector had to discontinue work, as he could not follow them down by himself any deeper, and no labour was to be obtained on the field. This is a very promising area, and is the only one, so far, upon which a line of reef has been traced beyond the prospector's area, and found to be rich in gold. Several other gold-bearing reefs have been discovered, but the gold was either lost in sinking, or they proved to be only gash veins, and pinched out. There are very few well defined outcrops of auriferous reefs on the field, and when they do come to the surface it is for a comparatively short distance, and can be, as a rule, taken into one area of 25 acres, outside which they dip below the surface. This necessarily makes prospecting difficult, and, as the prospectors who have visited this field and stayed a few days have been unable at once to find gold-bearing stone at the surface, they had left for the Northern fields. These reefs are true fissure veins, and will be found to carry gold both in length and depth; therefore they are well worth looking for outside the areas on which they outcrop, and, with a little perseverance, there is no reason why this search should not be rewarded as it was in the case of the prospector of the No. 1 South Scotia.

There seems very little prospect of this field proving rich in alluvial gold, as comparatively little denudation has taken place of the auriferous reef crops, which so rarely rise above the surface; but there is every promise of it becoming both a rich and permanent reefing field.

THE BREMER RANGE.

About 60 miles to the Westward is a patch of schistose country called the Bremer Range, which is highly spoken of by prospectors who have visited it, but owing to the bad holding nature of the ground, water can only be found immediately after rain, so that no one has yet been able to stop there. Between this and the Fraser Range, which is about 50 miles in a North-Easterly direction, the country is mostly covered with thickets, with here and there fine large open patches of grass country, or fairly open patches around the granite rocks. The Fraser Range runs in a general North and South direction, consisting

mostly of massive hornblendic rocks with diorite dykes, a few quartz blows, and veins of magnetite and manganese. The country is open and well grassed, being timbered only with a few casuarina trees. The conservation of water has been a great expense, as on this elevated tract of country (about 2,000 feet) wells have to be sunk a great depth, and, therefore, it has been found better to make tanks and dams. Most of the country between Dundas and Esperance Bay is thickly covered with mallee, the soil being either sandy or a light calcareous loam, which makes it very heavy for wheel traffic, and as it is so thick with scrub there is very little feed. Mount Ridley is a fine granite outcrop about 50 miles from the coast, around which several nice springs break out. From the top of this hill a good view of the surrounding country, which appears to be extensive sandy plains with salt lakes, and here and there bold granite masses and ranges rising from it. All the bold headland hills at the back of Esperance Bay are granite, but all along the coast in the centre of the bay recent limestones are met with, but these are mostly covered with the blown sandhills. Abundance of fresh water can be obtained by sinking a few feet in this formation.

HARRY P. WOODWARD,
Government Geologist.

December, 1893.

Appendix IV.

Report on the Mines, Coolgardie District,

By S. Göczel.

To the Secretary for Mines.

90-Mile Camp,
July 6th, 1894.

SIR,—

In accordance with instructions I have inspected the most important places in the Coolgardie goldfield, and now I have the honour to send over my preliminary report.

GEOLOGICAL REMARKS.

The general descriptions given in my last year's report, under the title "The Central Goldfields of W.A.," apply fully to the Coolgardie goldfield in particular, and, in the places where prospecting and mining operations were carried out, my theoretical deductions have found practical proof. In some instances, therefore, I will have to refer, for more detailed explanation, to that paper.

The principal rocks of the field are the massive and banded greenstones of palæozoic age. Concerning those rocks, I have observed that, in proceeding from West towards East, the quartzose diorites are gradually replaced by diabases, rich in olivine. The latter mineral, on and near the surface, is mostly altered into a greenish grey serpentinous secondary substance. Magnetite and pyrites are common accessories in both rocks, and limonite, as a product of rock and mineral alteration, is present almost everywhere on the surface.

The ore or gold deposit occurs in rocky areas, rising above the surrounding flat loess and lacustrine country, like islands out of the sea; their average height is moderate; I should estimate it to be 1,200ft or 1,300ft. above sea level.

The general description of the ore deposits would involve repetition of matter already treated, therefore, I will confine myself more to the description of special occurrences, and, in concluding this chapter, I am pleased to say that the wealth of the gold deposits already discovered in the Coolgardie goldfields has surpassed my expectations.

GOLD MINING CENTRES.

Since my arrival on the field I have visited and inspected the following places, viz. :—Coolgardie, Calgoorlie, I.O.U., White Feather, Broad Arrow, the so-called 25-Mile, Siberia, and the 90-Mile; besides I have crossed, from East to West, the Dead Finish and Black Flag country.

COOLGARDIE

Is situated on a contact zone between archæan gneiss-granite, from the West, and diorites and amphibolites from the East. The contact metamorphism offers a study of interest. The gneiss below the houses of the township is altered into a white, friable, quartz-containing rock of kaoline-like appearance. In the Government Well the gneiss is reached at a depth of about 70ft. Here we meet it about a mile West