

the river at a distance of 14 miles to its S. To the N. it extends across the Ashburton and Hardy Rivers to Mount Wall and Mount de Courcey, *i.e.*, a distance in a Northerly direction from the river of 20 to 30 miles, which gives an auriferous area of about 10,000 square miles.

The rocks are identical with those of the auriferous areas of the other Colonies, and entirely different from anything in this Colony to the South of this district. The river follows the strike of the rocks, which dip mostly to the N.E. They consist of clay and chloritic slates, sandstones, and quartzites (the slates being often of the cleavable kind used for roofing purposes); they are intersected by numerous quartz and ferruginous lodes, which have often highly altered the slates in their immediate vicinity, and these whitish and highly mineralised portions of the country should be prospected. There is a most promising tract of this class between the Dead Finish and Gregory's Deep Creek, and two or three more on the road down the river.

The general features are high slate ranges to the S., backed up in the distance by flat-topped limestone ranges, large alluvial plains following the river chiefly on the N. side, with here and there low isolated slate hills rising up through the plain, and some miles away to the N. rough slate ranges again recur.

Up to the present very little prospecting has been done, as only the rich patches in the shallow ground are considered worth troubling about.

In the large plains of the Ashburton there are sure to be some very rich deposits of gold found, but as the prospecting will be most expensive work, no one will undertake it, unless he be granted a protection area, until the course of the leads has been ascertained.

Taken as a whole this is a most promising tract of country, and will, without doubt, prove a rich and lasting goldfield, but it is highly probable that before this is proved that everyone may leave the field under the impression that all the gold is worked out when they have scratched all they can from the slate bars of the small gullies in the ranges, but there will still remain that which will yield the best returns, *viz.* : the deep ground as yet untouched.

This field, as far as it has been worked, has produced the most gold in the shortest time of any field in the Colony, for about 15,000 ounces have been raised in about six months.

## THE PILBARRA GOLDFIELD.

*Proclaimed area, 32,000 Square Miles.*

The Pilbarra Goldfield is situated in that portion of this Colony known as the North-West, that is, the district lying between the coast on the North, the Fortescue River on the South, and the De Grey River and Warburton's Great Sandy Table-land on the East. It is one of the most promising mineral areas in this Colony, its general features being a large low alluvial plain which follows the coast, broken here and there by rocky hills, whilst to the South and East rises a high table-land.

Several large rivers have there sources on the Northern edge of this plateau, and cutting deep gorges through the upper horizontally bedded rocks expose the underlying crystalline rocks across the strike of which they have cut their channels. These water-courses trend towards the N. and N.W. in deep gorges cut through the limestone and quartzite rocks, then through flats bounded by rough sandstone ranges, and on by deep ravines through rough broken hills of schists, slates, sandstones, quartzites, conglomerates, and amygdaloids, containing trap dykes, into large alluvial plains, from which here and there bold massive hills of amygdaloid and small peaks of quartz, granite and ironstone, around which soft calcareous slates often rise to the surface but never form hills much above the level of the

plain. These plains extend to the sea coast, where they are fringed by mangrove swamps, except where trap rocks extrude and form a bold rocky coast. The amygdaloids in many places split up into rough blocks, which become red or black on the surface, and then present the appearance of a huge heap of stones; without a trace of soil or vegetation. They contain vast numbers of agates, calcite crystals, and other enclosures; so that it would be advisable to prospect the streams running through them for precious stones.

#### MALLINA.

In 1888 some very rich stone was found at Mallina, 70 miles East of Roebourne, and about 20 miles South of the sea; the reef is situated on the large low alluvial plain which extends along this North-west coast between the low ranges to the South and the sea to the North.

On the Mallina claim there are two outcrops of quartz; the first, a large white, barren-looking reef, rising out of the alluvial plain, and forming a hill running East and West, almost the length of the claim. The second, a small reef on the South side of the hill, from 9in. to 2ft. in width, following the contour of the hill, and apparently dipping slightly towards the larger reef. Both contain a certain amount of antimony.

In this smaller reef gold was first discovered, and it proved so rich that it was decided to sink a shaft on the large reef, to cut the junction, as these intersections of auriferous reefs have generally proved of great richness. A shaft was therefore sunk 27ft. on the South side (footwall) by the cap of the large reef, but without success, as down to that point no stone was struck. A drive was therefore put in to the North on this level, to test the main reef, which here proved to be slightly over 10ft. wide and of so greatly improved a character that the work of testing it was carried on in a Westerly direction by a series of steepes or stopes. The reef improves in this direction, carrying a little gold in the solid stone, the richest stone being on the footwall.

This claim and the adjoining ones have now been abandoned, but will probably be re-opened when other mines in the neighborhood prove payable.

#### ALFRED ARGLES GOLD MINING Co.

This is on a reef running parallel to, and the shaft being a little to the N.E. of, the Mallina claim.

Gold was first found by Mr. Martin about half a mile to the Eastward in a small outcrop of quartz, which appeared above the clay plains. On opening it up, the reef proved to be about ten feet wide, and dipping, as the other did, to the North, but differing from it, as the reef seems to comprise two veins joined together; the small one, from eighteen inches to two feet wide on the hanging wall, being very rich in gold, whilst the larger mass of the stone is at present of a more hungry-looking character, but as this has only been opened up to about ten feet, it is rather early to form an opinion. The reefs on this ground are very promising in character, as their walls are well defined and they can be traced for a considerable distance; although they appear to be cut out, or to be thrown on one side by a fault, as on a small hill on the direct line of the reef, about one mile to the Eastward, there is no sign of quartz, and the rocks are rather different in character from those near the reef.

This area embraces both Martin's and Lady Carrington claims. On the former no work has been done during the past two years, but on the latter machinery has been erected, and two or three very satisfactory trial crushings effected. The battery is one of Bennett & Speechley's, and seems to work splendidly, notwithstanding the refractory character of the ore owing to the presence of so much antimony. The engine is a 5-horse portable Tangye, but is not powerful enough to work battery, pumps and saw. Its chief defect is

the smallness of the fire box, necessitating much labor in cutting up the wood, and making it very difficult to keep up a good head of steam. There was too much water in the mine to allow of an inspection being made, but from its proximity to Martin's shaft on the same lode, it will probably be very similar to that described above. Although these trial crushings have all proved very rich, sufficient ore has not yet been treated to prove the mine. There is abundance of fuel in the immediate neighborhood, and the water from the mine is very good.

A large quantity of the stone crushed was almost pure sulphide of antimony (stibnite), rich in gold, which first-named metal is entirely lost by this process. The question is whether it would not pay better to concentrate the pulverised ore and send it away to be treated, by which process not only the antimony would be saved but more gold, as the antimony must carry away gold into the tailings.

#### PEEAWAH.

About five miles to the East, at Peeawah, another find has been made by Messrs. Wells & Co. It consists of a small reef from two to three feet in width, dipping to the South. The stone in places shows gold freely, but is very different from that at Mallina, and contains a great deal of antimony; so much so, in fact, that I should be inclined to call it an auriferous antimony lode. Samples assayed yielded 10oz. 3dwt. 19grs., 7oz. 10dwt. 6grs., and 16dwt. of gold to the ton, respectively. A shaft has been sunk, passing through the reef near the surface, to a depth of 47 feet (water level).

Several other areas were taken up here, but they have all now been abandoned owing to the superior attraction of the recent discovery of alluvial gold.

#### EGINA.

This field is situated on the E. side of Peeawah, about 40 miles from the coast, and 5 miles S.W. of Mt. Langenbeck.

It was on this field, in 1888, that the first discovery of alluvial gold was made in this part of the Colony. The field consists of a compact patch of shallow diggings, amongst clay slate hills containing very little quartz. This patch of country extends a few miles S. and also to the Westward in the direction of Croydon, but owing to the scarcity of water in the latter direction very little prospecting has been done there. New and rich discoveries took the men away from this field, but as these get worked out, they will gradually return, as there is still a good extent of country that has not yet been touched.

This patch of country is very similar to the Ashburton, and, as on that field, no mineral vein carrying gold has yet been found.

#### PILBARRA.

This narrow belt of auriferous country is situated about 12 miles to the South-East of Egina, and about 8 miles West of the Yule River. It is about 2 miles in width, running in a North-Easterly and South-Westerly direction, and is bounded Easterly by a mass of intrusive granite, and Westerly by a razor-back range, which is a great dyke of ferruginous quartz. The gold on this field is not the least waterworn, and occurs in rich but very limited patches almost on the surface, where it has been left when the quartz from the rich leaders was washed away. These patches extend in a South-Westerly direction for about 6 miles, but nothing in the shape of a lead has yet been discovered, although down the creek, at the end near the Warden Camp, there is a very promising-looking flat, which has not as yet been prospected. The Broken Reef is the most important feature of this field; several claims were taken up on it. On one of these a Huntingdon Mill was erected, and although this was one of the best machines yet imported into the Colony, and was well managed, the stone did not

prove rich enough to pay. It is a great pity that the investors from the other Colonies and elsewhere do not insist upon getting reliable reports from independent sources on such areas as may be offered to them before going to the expense of erecting machinery. If they would only apply to the Government here, they would be informed as to the best manner of obtaining thoroughly trustworthy information. The gold in the reefs of this district is too patchy to be promising, but in some cases there is not the least doubt that very rich bunches of stone will be found, though not of sufficient extent to make this a reefing field, but it will probably last out for some time as an alluvial ground, as rich patches are continually being found.

There are no true veins on this field, the reef masses being lenticular segregations, often of very great size, but it is not at all probable that they will extend in depth any more than they do at the surface. Although these latter, as at the Broken Reef, appear to extend for a considerable distance, it will be found, on closer examination, that it is not one reef but a series of these lenticular masses, one lapping on to another.

These splits and fissures owe their origin to the great mass of intruded granite immediately to the Eastward and the close proximity to it. This in itself would be sufficient to preclude any hope of these reefs living down for any great depth.

#### NULLAGINE.

This field is situated on a creek of this name, which is a branch of the DeGrey River. By road it is about 300 miles to the Eastward of Roebourne, but in a direct line only about 200 miles, and about 130 from the coast.

Alluvial workings of three classes occur: 1st, the alluvium of existing creeks. 2nd, the alluvium of older creek beds, but in conjunction with the present streams. 3rd, old alluvium deposits or deep leads bearing no relation to existing streams or configuration of the country. The most recent deposits are easily worked, for nature is at work here to-day ground sluicing debris from the older formations; therefore no sinking is required, and the dirt is so free that it can easily be dry-blown. The older alluvial deposits are found in the river flats, where the auriferous gutters are crossed and recrossed by the present streams. The sinking here is about 10ft., and very hard work owing to the fact that the deposits that overlay the dirt are cemented masses of quartz and boulders of other hard rocks. The dirt from these is screened on the spot and carted to the creek, there to be sluiced by water raised from pools or shallow wells by Californian pumps. The deep leads are cut across by the present valleys, and can be traced from hill to hill. Here the sinking is very variable in depth, the whole gutter in some places appearing on the side of a cliff where the work merely consists in driving, while in other places shafts up to 60ft. or 70ft. have to be sunk to work the same lead. Up to the present only one of these leads has been discovered, but there cannot be the least doubt that more will be found when the small hills between the conglomerate range and the creek are thoroughly prospected.

All three of these deposits are very rich, but no one can estimate the quantity of gold with any degree of accuracy, as so much leaves the Colony without ever being reported; but there is no doubt that more has been taken from this field than from any other in the Colony.

To the West of this field are hills of nearly horizontally bedded conglomerate rocks, probably of Devonian age, in which reef gold occurs in small veins of quartz and ironstone which follow, and indeed fill in all interstices between the larger boulders. They are very rich in places, in fact so rich that it pays to "dolly," and the gold in the flat close by is evidently derived from these veins. This deposit is of very great interest, as nothing like it has before been found; for the gold although occurring in an alluvial deposit is reef

gold and not alluvial, for it has been deposited subsequently to the formation of these boulder beds.

Four miles to the Eastward is a very nice patch of auriferous country, where a great deal of gold has been obtained absolutely on the surface. The rocks of this belt are kaolinized slates with numerous quartz reefs and leaders, some of which have been worked as long as the stone was rich enough to "dolly," but since then they have been abandoned, as reefs at present are rather a drug in the market, but when there is more capital in the Colony this will prove a very rich reefing area.

The country to the Eastward for 50 miles, and for a considerable distance to the North, is of an auriferous character, and as soon as the rain sets in will be thoroughly tested.

Taking all things into consideration, there appears to be a splendid future for Nullagine, although this district generally is patchy, but these patches, when found, have always proved very rich.

At the present time there are a good many men at work on the Turner, a river a little to the East of Peewah. At the Coongan, where the largest nugget was found, there are still a few men, but owing to the scarcity of water they cannot do much; but there is no doubt that where those large nuggets were found more will be discovered, and that this belt of country will also probably extend across to the Turner. Gold will probably be found from the Coongan in a N.E. direction, starting round the Northern face of the table-land and so away round in a S.E. direction to the Nullagine, and also between Look's and the Coongan there is a very promising belt of country.

The country to the East of Nullagine is called the Forty Mile, but there seems to be no definite place to which this name applies; but if one may judge from the opinion of the diggers, who, as a rule, are not over sanguine, there must be some very fine country in this direction.

In a country of this description a more or less detailed geological survey would be of very great assistance to the diggers, but at present the smallness of the staff prevents work of this kind.

#### THE NICOL.

Early in 1890 gold was found on a small river called the Nicol, about ten miles West of Roebourne, by some men engaged by Mr. Sholl to sink post-holes for a fence. The gold occurred about the surface, and was at first easily and cheaply obtained, but later on, when the lead was traced down into the flat, more work had to be done to gain it. This small patch of gold-bearing country is so little above the sea level that no deep sinking has at present been possible, owing to the vast volume of water encountered; but it is highly probable that the deep ground carries gold. At the present time this field is nearly deserted, as the limited area over which gold has been found is worked out, and no reefs have as yet been discovered. The gold was probably derived from rich patches in the quartz veins, and leaders, which in this district are much broken and of very variable thickness, owing to the many intrusions of masses of granite and trap rocks.

Besides gold, this district is rich in many other minerals, the most important of which (and the only other which is at present being worked) is copper at the Balla Balla Creek, about 15 miles nearer Roebourne than Mallina, and about 15 miles from the coast. Here there are low rolling hills of clay-slate, with numerous quartz veins of a highly promising character for gold.

#### WHIM WELL COPPER MINE.

When it is stated that this mine was worked by about four men for a month or two last year, and that from the results of their work the syndicate were able to

pay all the working and preliminary expenses, some idea can be gained of the richness, size, and quality of this lode. It is hardly right to call it a mine, for no mining will be required for years, even if it be worked on a large scale, for there is a hill of copper ore that only requires quarrying. The lode is on the surface, forming the face of a low ridge running E. and W. for about half-a-mile, when it is lost at both ends. It dips gently to the North at an angle that allows it to be worked comfortably on the footwall, *i.e.*, with just sufficient pitch to allow masses to be rolled down, and yet not too steep for men to walk upon it. It is 12ft. in thickness where it has been opened, 6ft. of which can be dressed without the slightest trouble to 30 per cent., and with care even to 40 per cent., whilst the other 6ft. can be dressed to 20 per cent. with a little trouble, although if a proper dressing plant were erected better results could be obtained. The lode appears to be good in quality throughout its entire length, and is nowhere, as far as can be judged from the surface, less than 6ft. in thickness, and is mostly a good deal more. The ore consists of carbonate (chiefly green), but there is some blue also in the poorer parts of the lode, while in the rich some beautiful specimens of malachite have been obtained. Considering its proximity to the coast (15 miles) and comparatively shallow depth at which good water can be obtained, and the enormous mass of rich ore in sight, this should prove a very valuable property.

A few miles South of Roebourne some copper mines were worked a few years ago. They are situated at the base of some low slate and quartzite hills on the edge of a large flat formed by one of the branches of the Harding River. These lodes are chiefly oxides of iron and copper, in some of which gold is often visible. There are two sets of lodes, one running more or less North and South and dipping East, while the other runs East and West and dips North.

A good deal of work was formerly done here, but has been discontinued owing to the low price of copper, but as the ore at the surface is very fair, and the lodes are so large and so near a port that they could be worked cheaply, now that copper is realising a higher price, they ought certainly to be re-opened. In any case the one containing gold should be worked, as that metal can be now separated from copper so much more economically than it could twenty years ago.

Large ferruginous copper lodes occur all over the district, some of which carry from 30 to 40 per cent. of the metal, but the mass of the lode stuff is iron, and in some of the specimens gold is plainly visible, and, judging from the assays, would be well worth working. The galenas and cupriferos gossans of this district are well worth testing.

Tin has also been found in the alluvial workings at Pilbarra, but could not be worked as the Mining Regulations for working gold and tin clash, and no larger area than an alluvial digger's area can be granted on a goldfield. A very rich deposit of coarse stream tin occurs near Mr. G. & J. Withnell's station on the Shaw, which assayed 71 per cent. of metallic tin; the only drawback to the working here is its distance from the coast, but should a good lode be discovered, there is not the least reason why it should not be profitably worked.

Prospects are obtained in many places between Pilbarra and the Nullagine, all of which country is of a highly Metamorphic character, highly favorable for deposits of tin; and there is not the least doubt that before long some great discoveries will be made.

The North-West district, as a whole, is rich in minerals; wherever the slates occur gold is found, and wherever the granite outcrops prospects of tin may be obtained, and also mica of first class quality. In the trap country, veins of beautiful chalcedony and opal occur, although up to the present no precious opals have been found; its matrix and character are so similar to those of the Queensland specimens that they are worth prospecting. Associated with these also are beautiful banded agates, and there is no doubt but that other precious stones will be found. In the table-land to the south, coal shales exist, and

should any good coal seams be discovered here, they will be of immense value in the working and development of the mines. Copper occurs near Roebourne and at Whim Well, while galena has also been found near Roebourne, and antimony at Mallina and Peeawah. Enough has been said to show that mineral deposits of great richness do exist in this district, and that there is a brilliant future for its mining industries.

### CONCLUDING REMARKS.

The gold deposits which have up to the present been worked have only been the small rich patches, which were easily worked in a country where water is scarce; therefore all the old workings will pay well to work over from time to time, as large quantities of gold are left behind which will be re-sorted by the creeks when in flood.

There are some nice patches of country on the Murchison near the great bend, and also near Mr. Nairn's station.

The country from Austin's Lake to the head of the Murchison and across to the Gascoyne should also be prospected.

Through the N.W. a great deal more gold will be found, in fresh rich patches, as soon as rains enable prospectors to travel about.

The Ashburton is only in its infancy, and it is highly probable that some very large deposits will be met with in the deep ground when it comes to be tested, and that this belt of country will prove to be a *permanent goldfield*.

A belt of Carboniferous country, about 20 miles in width, extends from the Irwin River to the Northward, crossing the Greenough, the Murchison, the Wooramel, the Gascoyne, the Lyons and Minilya Rivers, then spreading out over the Henry, Ashburton, and Fortescue Rivers, and forming the great table-land which stretches away to Kimberley. It is true that up to the present only carbonaceous shales have been found, and the fossils at present described all belong to the Lower Carboniferous or Devonian series, but when the enormous area over which these rocks extend is taken into consideration, and as they are mostly covered by Mesozoic and more modern rocks, it is highly probable that true coal measures do exist here.

The tin in the N.W. would be worth prospecting, and so would the mica, but most of the other minerals are at present too low in price to be worth taking up.

### DESCRIPTION OF THE ROUTE TRAVERSED FROM GERALDTON TO THE NULLAGINE.

Immediately after crossing the sand dunes which follow the coast there is a large alluvial flat, the Northern extremity of the back flats of Greenough, and probably in former times the bed of the river of that name, which would then have discharged its waters into Champion Bay, somewhere about the mouth of the present Chapman River. To the Eastward of this flat, the land rises into a series of flat-topped hills of Secondary age, of a decidedly unprepossessing appearance at first sight, but the bad impression is soon dispelled on passing through the valleys with rich soil and springs which break out here and there from the sandstone beds which form the capping of the ranges.

The table-land on the top of these hills is a scrubby, sandy plain, about 800 feet above the sea-level, and extends inland for about 70 miles from the coast, only varied in patches by gum thickets, where the sandstone has been denuded, exposing the underlying clay beds (of Carboniferous age?), and by the deep gorge which is cut across it by the Greenough River, in the bed of which a fine series of sections of Mesozoic and Carboniferous rocks are exposed. At Mullewah the country entirely changes from the sand plain to the crystalline rocks, with