

handled at the start. I do not say that they will remain the best things on the field, for it is highly probable that still finer reefs will be discovered when the flats and the lake beds are prospected, and indeed some of the claims that are not now highly estimated may come to the front, whilst others, now so showy, may sink into oblivion.

It is almost certain that large alluvial patches will be found to exist in the deep ground of the lakes, as with so many rich reefs around them it is most improbable that such a deposit as was found below the Central's is a solitary occurrence. Up to the present there have been so few alluvial diggers of experience on the fields that no prospecting worthy of mention has been done in this direction.

Not the slightest doubt exists in my mind of the richness and permanence, and of the ultimate success of these fields, for they have been proved to extend over an area of eighty miles in length; and they will in all probability be found to continue to the South coast. But I consider that it is essential that a railway should be constructed connecting the fields with the settled districts, for no real progress can be made until there is a cheap and rapid mode of transit established, not only for machinery and stores, but also to give visitors an easy access to the mines, for possessors of capital are not likely to undertake the journey by road. I cannot see that the proposed telegraph line will be of any real assistance, while the railway would not only be so, but would form the first section of the great transcontinental line.

The water question has always been, and will always be, a most serious one, but it will, I believe, be from too great an underground supply that the mines will suffer most. Artesian water will never be obtained in the goldfield area, and boring for it is only a waste of money. Large reservoirs should be constructed in the beds of those lakes that are fresh, or nearly so, in which large quantities of water might be stored, and should this become salt towards the end of the season, that remaining could easily be pumped out before the rain commenced.

The water in the mines will, I believe, become fresher after heavy pumping, so that there need be no fear of the future of the field being imperilled on account of the scarcity of water.

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## EXAMINATION OF THE COUNTRY TO THE NORTH OF PERTH CONTINUED, WITH ESPECIAL REFERENCE TO THE GREAT CARBONIFEROUS FORMATION.

*Report issued December, 1889.*

As I have twice already in my Reports described the country between Perth and the Irwin River, I do not propose to say any more about it now, although I had again to cross it on my way to the Irwin coal seam.

**THE IRWIN COALFIELD.**—On revisiting the field I found, that although a good deal of money had been spent in one way and another, very little work of any importance had been done.

Poor shaley seams, similar to those discovered by Messrs. Bell & Elliot which out-cropped in the cliff, on the North branch just outside the Coalfield Reserve, have also been found on the Reserve and for a considerable distance up the branch on which Gregory was supposed to have made his discovery; but up to the present no work of any consequence has been carried on, owing to the immense body of salt water encountered.

Some tons of this coal have been sent for trial on the coasting steamers and trains, and at the time of my visit it was used on a trial trip from Geraldton to Fremantle, but as it was found to be rather inferior in every way to the New South Wales coal it certainly will not be worth working, especially as the amount of coal consumed in this Colony is so small that it would never pay to work a mine for our own consumption, and the quality is so inferior that it would not find any market abroad.

The suggestion that I made on my first visit that a shaft should be sunk to test this field, was, it seems, misunderstood by those at work (who were lead and copper miners) and taken to mean that they should follow the seam or bed down its dip, which they accordingly did for 150 feet; but finding so little improvement in quality, they abandoned this first and uppermost seam and set to work on another, some distance down the river, which is certainly of a better quality but still not sufficiently good to be worth working.

I was able to trace the outcrop of these seams in the branches of this river for a distance, from North to South, of forty miles, but in no instance could I find any indication of a good coal, which has caused me to rather lose faith in this field, for, the formation having a considerable dip, a perfect succession of the beds is seen in each of the branches running East and West, and all over this area the beds are all of this same poor quality, although associated with the same shales and sandstones in which true carboniferous fossils occur. If there were superior beds underlying these, they would outcrop in the beds of the streams further to the West, but nothing of the kind appears, but, instead, a flaggy sandstone and a large series of clay-slates and clay-stone beds, containing impressions of carboniferous plants, occupy their place.

This question will soon be set at rest, for the companies have combined to carry on boring operations to test the Carboniferous series in depth.

The quantity of salt water met with in these rocks, and the extent of sandy country that has to be crossed to reach the nearest port, are great drawbacks to the development of this field.

The coal itself occurs in thin seams mixed with coaly shale; it is dirty to the touch, and contains so much water that it falls to pieces on exposure to the atmosphere.

Two assays made in London gave the following results: No. 1 was by Mr. Harland, and No. 2 by Mr. Wingham.

|                        | No. 1. | No. 2.         |
|------------------------|--------|----------------|
| Water ... ..           | 17·04  | 12·4           |
| Volatile matter ... .. | 28·61  | 32·2           |
| Fixed Carbon ... ..    | 41·29  | 43·5           |
| Ash ... ..             | 13·06  | 11·9           |
|                        | 100    | 100            |
| Sulphur ... ..         | ...    | 0·83 per cent. |

The large amount of ash may in part be due to extraneous earthy matter. The coal cannot be utilised for gas making, as it does not cake, and the coke formed, being in powder, is valueless; but, as before mentioned, the coal can be used for steam boilers and household purposes, and for those metallurgical operations in which a particularly high temperature is not required.

Continuing my exploration of the North branch of the Irwin to Badgerer I found in the cliff sections shales, sandstones, and clays, but neither coal seams nor any signs of carboniferous fossils, but from the lithological similarity and conformity to the rocks of that age, I am inclined to class them in this series.

From this point, however, the country changes entirely, the old crystalline rocks, containing quartz veins, and ferruginous lodes stained with copper, outcrop and continue on the surface to the North, and to the head of the river, where they are capped by clays and gravels. Between the Irwin and the Greenough Rivers there is an elevated table-land covered by a sand plain, and extending from the coast to the Herschel Range. This low line of hills runs North from the head of the Irwin by Mullewah to the Greenough River; they consist of schistose rocks, and rise but very slightly above the table-land. In the deep gullies small quantities of gold have been found, and also very nice, though small, lodes of copper, but nothing up to the present rich enough to pay for working, and it would require something very rich to do that in this almost inaccessible position, there being thirty miles of heavy sand between it and the coast. Whenever a line of railway to the Murchison country is constructed this tract will be well worth prospecting.

In the valley of the Greenough, below Tallering Peak, the same non-fossiliferous beds, which I classed as Carboniferous in the Upper Irwin, again make their appearance, forming high and almost vertical cliffs, and in places flat-topped hills; but there are no sections to be seen in the river bed, at the level at which the coal seams should be; and so I cannot say whether the coal extends thus far, though it seems probable, for we find salt springs breaking out here like those occurring on the Irwin, where coal is found.

Between the Greenough and Murchison we again encounter the elevated sandy table-land, which here, however, is towards the coast, broken by numerous streams, in the beds of which sections of the old rocks are exposed. These contain the lodes of copper and lead that have so long been worked in the Northampton district.

This line of mineral bearing country extends in a Northerly direction from Geraldton as far as the Geraldine on the Murchison River, and it seems to form the Western side of the basin in which the Carboniferous rocks were deposited, for between this line and the coast nothing but Mesozoic rocks are found. Whether the coal measures may to any extent underlie them we cannot say; but, wherever the rivers have cut through the newer strata, only crystalline rocks are to be seen, even as far West as the coast.

On the Murchison River, just above this outcrop of mineral bearing country, the Carboniferous rocks again made their appearance, but here again, as on the Greenough, there are no good sections and no fossils, though the springs break out in the same manner as on that river and on the Irwin. This is evidently due to the fact that these nearly horizontally bedded Carboniferous rocks lie upon an impervious bed, which causes the water, percolating through the sandstones from the higher country to the Eastward, to come to the surface.

This formation continues up the Murchison as far as the great bend, where the country opens out into what may be called the characteristic Murchison country, namely, large alluvial plains with low ranges of schistose rocks, containing quartz reefs, the ranges being mostly flat-topped and capped with a ferruginous sandstone, and with here and there bold granite hills that are evidently a Northern continuation of the line of intrusive rocks that can be traced down to the South coast. In several places between this great bend and Milly Milly there are patches of very promising mineral country, that I consider should be prospected.

From Milly Milly on the Murchison, to Mount Clair on the Gascoyne, the country is rugged and hilly, the surface being strewn with quartz, and numerous reefs of this are visible. Similar country continues down the Gascoyne, to its junction with Darie Creek, where the carboniferous rocks again re-appear, and where there is a larger development of this series exposed than anywhere else in the Colony. The crystalline limestone, full of fossils, extends from the Woromoll

River to the Gascoyne, and on up the Lyons, forming the flat-topped Kennedy Range, but here it is so horizontally bedded that the under-lying beds are rarely exposed, and it is only in well sections that shales and sandstones can be seen. In some of these shales fish scales are found, and these were among some of the first fossils to be identified as Carboniferous.

No coal seams have as yet been discovered in this district, for only the limestones are visible, and no boring has been attempted, and so it is impossible to say whether or no they exist here.

The Carboniferous system has now been proved beyond a doubt to extend for a distance of three hundred miles to the north of the Irwin, so it will be very strange if some better seams of coal, than those found in its mouth, be not found when the district is properly tested; but there being little money in the Colony that can be spent on experimental bores just now, it must wait for better times, or for enterprise from outside.

The finding of a coal seam on the Gascoyne would be a good thing, as Sharks Bay, one of the few really good natural harbors of this country, is situated at its mouth.

From the Lyons River down to the mouth of the Gascoyne, sandy country, similar to that above classed as Mesozoic, is crossed. In some portions, however, plant remains have been found proving them to be of more recent origin.

Along the coast at Sharks Bay a large deposit of Tertiary limestone, containing fossils, occurs.