

## II.—Report of Torrington Blatchford, B.A., F.G.S., Assistant Geologist.

### BORING FOR WATER AT MULGARRIE.

#### LOCATION.

The townsite of Mulgarrie is situated in the North-East Coolgardie Goldfield, at a distance of 20 miles North by East from Kanowna, and 12 miles due East of Broad Arrow (Kurawa). To both of these centres Mulgarrie is connected by surveyed roads which have been cleared, and are at present in excellent order for vehicular traffic.

#### GENERAL DESCRIPTION OF THE MULGARRIE AND SURROUNDING DISTRICT.

For a radius of many miles round Mulgarrie the surface of the country is flat and unbroken, except by low isolated ridges and an occasional higher point, such as Mount Jewel, which latter lies at a distance of some four miles to the North of the townsite. Lying between the ridges are extensive alluvial "flats," covered with mulga or salt bush, with occasional clumps of salmon gum. The general slope of the "flats" is to the South towards the lower portions of the district, which are occupied by a chain of dry salt lakes. These lakes are crossed by the road from Kanowna to Mulgarrie, and lie at a distance of some eight miles from the former locality. It is into these shallow depressions that the surface water flows during the periodic rains, and, though water is seldom seen at the surface, an abundant supply of salt water can be obtained by sinking in the sandy basins of these so-called lakes. Thin layers of mixed salts, which are invariably covered with the dust and sand blown about by the winds, mark where the water level has once been; and in one instance these saline deposits may be found at an elevation of at least 50 feet above the present bed of the lakes. There is no evidence at present for determining what is the exact composition of the salt beds, though it is apparent that the major portion consists of gypsum and common salt, while there is a fair proportion of magnesium salts present.

#### GEOLOGICAL CHARACTER OF MULGARRIE.

Geologically, the Mulgarrie District may be described as consisting of hornblende rocks intersected by small felsite dykes, and overlain in most places by recent superficial deposits.

*Alluvial Deposits.*—These recent surface deposits cover the greater portion of the field, varying from a few inches to many feet (over 100 in places) in thickness. In composition they usually consist of loose red alluvial, intermixed with ironstone gravel and quartz pebbles, which overlie more compact quartz and ironstone wash, the latter being frequently intermixed with, or overlying, beds of kaolin, commonly known as "pug." In appearance these beds closely resemble some of the alluvial deposits worked at Kanowna, their origin being very similar; but, unfortunately, up to the present payable wash has not been met with in the Mulgarrie beds. As far as could be ascertained, the maximum thickness of the deposits under notice is in excess of 100 feet, as that level was reached in some workings near Hayes' Consols (G.M.L. 657x), when further operations were stopped by an inflow of water. Scattered surface alluvial workings are to be seen in several parts of the field, and testify to the finding of surface gold, though in what quantities there is no available evidence. The prospecting in this respect, and also for "deep leads," has so far been carried on to a very limited extent.

*Hornblende Rocks.*—The hornblende rocks, which form the higher grounds to the North and South of the townsite, are usually in a more or less highly decomposed state. There are isolated cases, however, in which pieces of rock are found sufficiently unaltered to enable the principal rock-forming minerals to be detected in hand specimens. When such occasions offer, crystals of hornblende and felspar are seen to form the major portion of the rock; the proportion of hornblende exceeding the decomposed products are alone available for inspection, and as such, the prevailing colours of which are either yellow or brown. Specimens of very fine-grained compact rock are also to be found, but in such cases the constituent minerals are too minute to be distinguished with the naked eye. From their general appearance and habit, also their strong resemblance to certain rocks in the Coolgardie Goldfield, I have little hesitation in classifying these latter as diorites.

*Acid Rocks.*—Passing through the hornblende rocks, the outcrop of narrow dykes of acid rocks may be seen, trending usually North-West and South-East, with a prevailing dip to the East at a high angle. The thickness of these dykes does not usually exceed a few feet, though in isolated cases they widen out to at least to three or four chains. They are apparently of a later age than the diorites. Hand specimens of the dyke rock show that the base is felsitic, and contains small blebs of felspar, invariably in a decomposed state, and minute grains of quartz. When weathered the outcrops exhibit an apparent cleavage, which runs parallel to the strike of the rock.

*Granite.*—On the Double Birthday Gift (G.M.L. 768x) is an outcrop of granite which extends over the greater portion of that lease, and is entirely different in general characteristics from the acid dyke rocks. In hand specimens of the granite, well formed crystals of hornblende, mica, and felspar may be

clearly seen, intermixed with larger blebs of quartz. The mica of this rock is mostly of special notice, as it possesses the pink tint similar to the lepidolite mica found on the Coolgardie and Murchison Goldfields. I was unable to discover at Mulgarrie any other outcrop of granite than the one above-mentioned.

*Quartz Reefs.*—At the date of my visit to Mulgarrie there was but one reef being worked on the whole field, viz., the Hidden Treasure (G.M.L. 1056E). In consequence I was unable to see any of the underground workings, or to gather any information as to the nature of the reefs, etc., beneath the surface. On the accompanying plan Plate II., the outcrops of the various lines of quartz reefs have been carefully drawn, from which it will be seen that the prevailing strike of the reefs is to the West of North, with an underlie either to the West or East. In general appearance most of the quartz is of a barren white appearance, and generally free from iron. There are exceptions, however, to this rule, and in addition to oxides of iron, oxides of manganese is sometimes present in considerable quantities. Closely associated with the quartz veins is a highly siliceous rock, banded with oxides of iron and resembling in nature the quartzites of the Murchison districts. There is little doubt that this banded rock has formed in the fissures of the diorite at a subsequent geological age to the quartz, as leaders of the latter are often found branching off from the main mass of quartz and penetrating into the quartzite (?). This mode of occurrence is clearly seen in the Hit or Miss Mine (G.M.L. 343E).

It is noticeable on the Mulgarrie Field that the quartz reefs, quartzites, and acid dykes are usually closely connected, and it is to be regretted that their exact relations to one another are not determinable owing to the limited amount of mining, and the fact that most of the outcrops are overlain with a mantle of alluvium.

From an economic point of view the quartz veins, though extensive, have so far been proved to be of an unpayable nature. In the Hit or Miss Mine (G.M.L. 343E) one rich patch of gold was struck in the large quartz reef passing through that property, but the reef taken as a whole, as far as it was opened out, proved to be of too low a grade to treat profitably. The same may be said of the "Black Reef," passing through G.M.Ls. 729E and 725E. Crossing this latter, however, small leaders are sometimes found (striking East and West), which carry payable gold, the richest portions of the leaders being at their junction with the main line of reef. Since my inspection of the field further attempts are being made to prospect the reefs at a greater depth, and to try and make the large low-grade ore bodies pay by treating them on a larger scale than was done formerly.

WATER SUPPLY.

As far as could be discovered, water had been struck in the separate localities in the Mulgarrie district, which are as follows:—

No. of G.M.L.	Name of Mine.	Water Level: Depth from Surface in feet.	Output in gallons for 24 hours.
875E	Golden Lead... ..	85	(?)
725E	Hit or Miss South ... ..	83	30,000 to 40,000
760E	Hit or Miss Extended ... ..	98	(?)
	Government Well ... ..	72	(?)
	Water Reserve 84 ... ..	84	(?)

In each case the water which was obtained from the aforementioned sources was salt. The following is an analysis of a sample of water taken from the Hit or Miss South (G.M.L. 725E), which was made by Mr. Simpson in the Official Laboratory:—

	Percentage.
Sodium Bromide, NaBr ... ..	·0031
Potassium Chloride, KCl ... ..	·0700
Sodium Chloride, Common Salt, NaCl ... ..	2·7174
Magnesium Chloride, MgCl <sub>2</sub> ... ..	·3234
Magnesium Sulphate, MgSO <sub>4</sub> ... ..	·4397
Calcium Sulphate, CaSO <sub>4</sub> ... ..	·0979
Calcium Carbonate, CaCO <sub>3</sub> ... ..	·0503
Ferrous Carbonate, FeCO <sub>3</sub> ... ..	Trace
Sodium Nitrate, NaNO <sub>3</sub> ... ..	Trace
Silica, SiO <sub>2</sub> ... ..	·0014
Alumina, Al <sub>2</sub> O <sub>3</sub> ... ..	·0004
Total ... ..	3·7036

The specific gravity of the sample was 1·0286, taken at 4° C.

In comparison with sea water, the density and percentage of salts in this sample very closely agree, as in sea water the amount of saline matter varies from a minimum of 3·3 per cent. to a maximum of 3·7, while the maximum density is 1·0278.

With the exception of the Hit or Miss South (G.M.L. 725E), I was unable to obtain even the approximate output of the mines and wells above-mentioned.

As the supply of water evidently depends on the surface soakage, which will again be determined by the porosity of the underlying rocks, the best supplies of water would naturally be looked for where the country is broken and disturbed, i.e., in the vicinity of the dykes or lines of reefs. That such has been

the case in other mining centres is clearly proved in the Coolgardie Goldfield, *e.g.*, the outputs of the Great Hanover and Rose Hill Gold Mines, which are both situated at or near felsitic dykes,\* and from which plentiful supplies of water are obtained.

#### THE MINES.

As stated in a previous part of this Report, I was unable to make any personal observations of the workings (underground) of the mines, owing to the leases having been abandoned, or work being suspended pending exemption. The notes which have been made of the surface workings are practically useless; it is therefore unnecessary to include them in this place.

#### BORING FOR WATER AT HAYES' NEW FIND.

Accompanying this report are a geological map (Plate III.) and section, which I have made in order to illustrate, approximately, the general geological features and boundaries of that part of the Hayes' New Find district, under special notice, and to show the exact location of the two Government bores, and all underground workings, which have been carried to a depth below the water level. In addition, the surface plan shows the location of typical rock specimens and samples of water, which have been collected. In the section, the relation of the different rocks to one another, their approximate thickness and dip may be seen.

#### LOCATION OF HAYES' NEW FIND.

Hayes' New Find lies in the North-East Coolgardie Goldfield, at a distance of 24 miles North by East from Kanowna, and about 30 miles due East from Bardoc.

#### GENERAL DESCRIPTION OF THE HAYES' NEW FIND AND SURROUNDING DISTRICTS.

The contour of the country lying within a radius of 30 miles of Hayes' New Find townsite, is extremely flat, broken only by small isolated ridges, and an occasional higher point, such as Mount Jewel, which lies four miles to the North of Mulgarrie. From these slightly elevated portions, the drainage of the country, in times of rain, falls into the shallow depressions, known either as lakes or clay pans, according to their size. When such depressions are filled with water, they do not remain long in that condition, as the evaporation is very high, and the amount of water usually limited. In consequence, most of these natural reservoirs are covered with a coating of mixed salts, principally sodium and magnesium, which salts are usually in sufficient quantity to render the water salt or brackish, even immediately after a rainfall. The country immediately surrounding Hayes' New Find forms the centre of a watershed for several of these so-called lakes, which lie more particularly to the South, South-East, and North, and at a distance of several miles. Within the radius above-mentioned the geological features are almost monotonous, and unvaried as the topographical. With the exception of occasional outcrops on the higher portions, the whole of this country is covered over with a recent superficial deposit, usually of a red colour, and more or less sandy. This deposit is evidently the detritus of the basic rocks, the sand grains being derived from the intruding porphyry dykes.

#### GEOLOGY OF HAYES' NEW FIND.

As in the surrounding districts, much of this field is covered with the mantle of red alluvium, though to the North, North-West, and West of the townsite, several extensive outcrops of the underlying rocks may be seen. Such outcrops are found to consist chiefly of belts of quartz porphyry, intruding (?) schists, which are much weathered at the surface. Intruding the porphyry itself, several smaller dykes of rock of a more basic character may be seen; and though the outcrops of these basic dykes are too much altered to enable one to definitely classify them, there is sufficient evidence to show that they are of a different age and nature to the rocks enclosing them. The porphyry is found on examination to consist of a felsitic base, impregnated with crystals of quartz and felspar. Usually, only the decomposed products of this rock are found at the surface, and as such, the whole of the felspar and felsitic base are found decomposed into kaolin, in which are the blebs of quartz. Fragments of the unaltered rock are, however, sometimes met with at the surface, and show the true nature of the rock.

In the weathered portions of the porphyry an apparent cleavage is often visible, this structure arising, no doubt, from lateral pressure and subsequent weathering. The strike of this cleavage is identical with that of the surrounding rocks, viz., North 15 degrees to 20 degrees West, and South 15 degrees to 20 degrees East.

In describing the schists little can be said at present with any degree of accuracy, as in only two cases which came under my notice had the undecomposed zone been pierced. On the Bulletin Gold Mine (G.M.L. 624x) and the Golden Puzzle Gold Mine (G.M.L. 2940x) as far as could be ascertained from inquiry and examination of the rock on the dumps of the shafts, serpentine schists was passed through, and these had gradually become harder and more compact till at length a rock devoid of schistose structure was encountered. This alteration was complete at the 200ft. level (approximately). I have little doubt, therefore, that similar conditions prevail on this field with reference to these rocks, as in the Coolgardie Goldfield, *i.e.*, that the schistose structure is due only to the weathering of the surface of basic rocks such as diorites, etc., and that there is no probability of the schists being of sedimentary origin. The prevailing strike of the schists is North 15 degrees to 20 degrees West. Capping the higher portions of the schists and porphyry are the remnants of former sedimentary beds of sandstone and ironstone gravels. Of the sandstones there are two classes, a hard compact variety changed to quartzite, and resembling the quartzites capping the higher grounds on the Murchison Goldfield; a soft sandy variety known locally as cement, resembling the cements of Kanowna. Both of these deposits are non-auriferous and very limited in extent.

\* *Vide* Annual Progress Report of the Geological Survey for the year 1897. Perth: By Authority, 1898, also Bulletin No. 3. The Geology of the Coolgardie Goldfield, by T. Blatchford. Page 44.