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Lennonville, Mount Magnet, and Boogardie, MURCHISON GOLDFIELD,

BY

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Issued under the authority of the Hon. H. Gregory, M.L.A., Minister for Mines.

WITH A MAP.

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PREFATORY NOTE.

DURING the year 1902, a short visit was paid by myself to Lennonville with the object of investigating its mineral resources. It was found that the auriferous deposits were of two distinct types, viz., white quartz reefs, and laminated quartz and jasper veins, approaching very closely the hematite-bearing quartzites which form such a conspicuous feature in some portions of the Murchison and elsewhere in the goldfields of the State.

The two types of deposit bidding fair to become of economic importance, it seemed that assistance could be rendered to private enterprise in the direction of mapping and otherwise investigating these formations in the hope of furnishing a reliable guide for the conduct of the operations of the prospector and the mining engineer. A map embodying the results of the work at Lennonville was issued to the public in the month of September last. It was deemed desirable that the extension of these deposits in the direction of Mount Magnet and Boogardie should be mapped and reported upon. This work was intrusted to the Assistant Geologist, Mr. Gibson. The area embraced by his labours extended over about 36 square miles. Upon the map by which the report is accompanied, all shafts, alluvial workings, existing leases, the strike and underlie of the reefs and ore bodies, in addition to the geological boundaries so far as they can be followed, have been shown, thus rendering the map of general utility.

The main auriferous series of Lennonville, Mount Magnet, and Boogardie is enclosed in a belt of more or less highly altered rocks, for which the term greenstone has been provisionally adopted. Under this head are included diorite, diabase, pyroxenite, together with hornblende and chlorite schist, which may merely represent the crushed or plated out variety of the former, induced by shearing, and possibly modified by chemical action. The greenstones are traversed by belts of laminated quartzites, which rise up from the surrounding country in the form of low, often serrated, ridges. These quartzites are intersected by numerous faults, the mapping of which is of considerable importance from a mining point of view, in that it is along these lines that the rich chutes of gold, for which the district is noted, occur. The bulk of the gold has been found to occur in chutes where the faults intersect the quartzites. Wherever visible, these faults cross the strike of the

quartzites approximately at right angles, and as the latter are generally only from 30 to 60 feet in width, it necessarily follows that the width of the chutes is small. The quartz reefs occur plentifully in both the granite and the greenstone area, though, as a rule, it is only in those occurring in the latter which have proved to be auriferous to any extent. The quartz reefs often form the continuation of the fault lines by which the laminated quartzites are crossed.

It is highly desirable, in the interests of the State, in view of the light conferred by the recent work in the Mount Magnet district, that when opportunity offers the northern extension of this auriferous belt should be geologically examined with the view of showing its relation to the deposits of Nannine, Meekatharra, and other localities in the North Murchison district.

The report and accompanying maps, on being submitted to the Hon. the Minister for Mines, were ordered to be printed for public information.

A. GIBB MAITLAND,

Government Geologist.

Geological Survey Office,

Perth, 6th June, 1903.

Lennonville, Mount Magnet, and Boogardie.

Murchison Goldfield.

The Murchison Goldfield, as originally constituted, was first proclaimed on 24th September, 1891. Its boundaries were modified on 15th February, 1895, so as to embrace an area of about 21,000 square miles. As defined by the authorities, the goldfield at present is:—

> "Bounded by lines starting from the summit of Mount Murchison and extending north-eastward to the summit of Mount Hale; thence east-south-eastward to the summit of Mount Russell; thence south-westward to the north-west corner of the Yilgarn Goldfield; thence west-north-westward to the summit of Wyemando Hill, and onwards to the trig. station K. 6 on Goonamondey Peak; thence north-westward to the summit of Mount Farmer; and onwards to the summit of Mount Luke, and onwards to the summit of Mount Murchison."

Extent of the Map.—The map of Lennonville embraces a tract of country extending about one and a-half miles north, three and a-half miles south, two and a-half miles west, and one mile east from the Lennonville Post Office; that of Mount Magnet-Boogardie, a tract extending about two and three-quarter miles north (coterminous with the Lennonville map), two and three-quarter miles south, four miles west, and two and a-half miles east from the Mount Magnet Post Office. On these maps are indicated all shafts, alluvial workings, the positions of existing leases, the strike and underlie of all reefs and ore bodies, and, in addition, all geological boundaries so far as they can be followed. These latter are, in places, only approximate, owing to their being hidden by considerable areas of recent superficial deposits derived from the residual weathering of the older rocks. The thickness of the cover of superficial deposits varies from a few inches up to a maximum of about 20ft. Its extent is not shown on the maps owing to the fact that its boundaries are very ill-defined, and also that in most cases its thickness does not exceed a few inches, thus rendering it not worthy of consideration.

History of the Field.—Very little has been written about the early history of the Murchison Goldfield; the following brief account, however, has been taken from Kimberley's "History of Western Australia," published by subscription in the year 1897:—

"The first place at which gold was discovered on the Murchison was at Yuin—a place long since abandoned—but the first find of any real importance took place at Nannine. . . . The field was first proclaimed in 1891. . . In 1893 the gold returns of the Murchison fell short of those of 1892 owing to the fact that a large number of miners were leaving for the Coolgardie field. . . . Quartz claims were opened up at several places, a long distance apart, on the Murchison, and a number of gold mining companies were floated. Alluvial still yielded the largest percentage of the output, and rich finds were made at Mount Magnet, Austin's Lake, Nannine, and Cue. The two chief centres at this time were Nannine and Cue. The former township was laid out, declared and excepted from occupation for mining purposes on 20th April, 1893, and the latter on 10th August of the same year. E. P. Dowley became Warden, the Warden's office was removed from Nannine to Cue, and the goldfield was proclaimed a magisterial district. Crushing operations were begun this year (1893); stampers were erected on the Star of the East, near Nannine, and also at Mount Magnet and Cue. Good supplies of fresh water for battery purposes were obtained at various places on the field, notably at the Star of the East, the Day Dawn (Cue), and the New Chum (Mount Magnet). The Government sank wells at Day Dawn, Cue, and on the road from Nannine to Abbotts. In each case good water was secured. Eighty-one gold mining leases were applied for on the Murchison in 1893, and 40 business licenses were issued. In January, 1893, the Government offered a bonus to any company or person who would sink a shaft below a depth of 100 feet in any proclaimed goldfield; £2 10s. per foot from 100 to 200 feet, and £5 per foot below 200 feet. During the year the sum of £1,734 was paid to 11 claimants—six at Yilgarn, one at Coolgardie (Bayleys, 180 feet), and four on the Murchison. The Blackbourne (267 feet), had the deepest shaft on the Yilgarn field, and the Black Iguana (174 feet) the deepest on the Murchison.

"Developments on the fields in 1894 far exceeded those of 1893. No phenomenal finds were made as on the Eastern Fields, but a considerable amount of machinery was erected on the mines. A Warden's Court was opened at Yalgoo in August, and the Court at Lake Austin was closed. The average of the stone crushed was very encouraging, and the alluvial also yielded some fair returns in 1894. The total output for the field was 52,946·30ozs., valued at £201,196.

"In 1895 the Murchison Goldfield became so active that the southern portion was separated from the northern, and called the Yalgoo Field. The mining population of this district was about 750. There were 17 batteries at work round Cue, nine round Nannine, and two at Mount Magnet. At Kalgoorlie the best

returns were being obtained, while at Cue and Day Dawn the best machinery was engaged. The towns of Austin and Mount Magnet were proclaimed in 1895, the former on 31st May, the latter on 18th January. The number of miners engaged on the Murchison in 1895 was 2,200."

Previous Observations on the Geology of the Murchison Goldfield.—In his Mining Handbook* Mr. H. P. Woodward, late Government Geologist, refers the rocks forming the greater portion of Western Australia to the Archean age. According to his account these Archean rocks are usually crystalline, and are found outcropping throughout the State, and being overlaid only in isolated places by much newer formations: these latter rarely of any great thickness. The Archean rocks he divided into three sections, the granites, the gneisses, and the schists, which, as a rule, run in parallel belts north and south, with a slight trend to the north-west. These belts are six in number.

"The fourth, or first auriferous belt, is situated immediately to the eastward of the granite belt, and is about 20 miles in width. It starts from the south coast, at the Phillips River, extending northward in a narrow belt by the Ravensthorpe Range, Parker's Range, Southern Cross, Golden Valley, Mount Jackson, Mount Kenneth, Mount Magnet, Austin's Lake, to Cue; thence it takes a slight bend to the north-east to Nannine and the Star of the East, where it strikes more to the north, and, skirting round the heads of the Murchison and Gascoyne Rivers, it turns north-west and follows down the Ashburton Valley to its junction with the Henry, finally disappearing beneath the palæozoic formations.

"The rocks of this belt consist mostly of hornblende, mica, or talc schists, of which the hornblende schist so closely resembles diorite that it is impossible to distinguish it in a broken specimen. . . . . The rocks of this belt are a good deal broken and faulted by granite and diorite dykes and quartz lodes containing gold, iron, and copper. There are also some large magnesia lode masses, rich in fine gold, which will probably prove to be serpentine at a depth. Many of the lodes also contain large quantities of chlorite."

In his report on the Murchison Goldfield,† the same writer says:—"The principal auriferous belt is situated at the eastern side of this area" (*i.e.*, the proclaimed goldfield area), "about 200 miles from the coast; it runs in a north and south direction from West Mount Magnet to Austin's Lake, then in a north-easterly direction to Lake Anneen and Yagahong. Other rich patches and belts exist further east, and a few patches have also been discovered near the coast. . . . . The geographical features of the portion of the field on which gold has been discovered are not very

* "Mining Handbook to the Colony of Western Australia" by H. P. Woodward, F.G.S., Government Geologist, Perth. By authority: Richard Pether, Government Printer, 1895.

† Report on the Murchison Goldfield, by H. P. Woodward, F.G.S., Government Geologist, Perth. By Authority, 1898.

striking, being only the ruined remains of a vast, high, sandy tableland presenting to-day a broken surface consisting of salt marshes or lakes fringed by salt, sand, clay, and gypsum flats, from which rise low rough ridges of metamorphic rocks or white cliffs, on the top of which are sandy plains—the remains of the ancient tableland. There are no well-defined rivers, but the few creeks discharge themselves into the salt flats, where the water evaporates, except after very heavy rains, when they overflow into the rivers which run towards the coast. The hills are mostly small and low, consisting for the most part of ridges of hard metamorphic rocks, near which the rich finds of gold have been made. These are often capped by the same horizontally bedded formation exposed in the cliffs on the edges of the broken tablelands, which are generally covered by dense thickets of low scrub.

"The metamorphic rocks outcrop, rising as low ridges, wherever the overlying desert sandstone tableland has been removed; they are mostly hard large quartz reefs, often forming the axes of the ridges, but more generally beds of highly altered ferruginous quartzite, nearly approaching a mineral vein in character, at their intersection with which the quartz reefs are always the richest.

"Along the principal belt of auriferous country, the rocks for the most part strike a little to the west of north, and underlie to the westward, consisting largely of talcose and granitic rocks, although hornblendic and micaceous slates are also met with. Where there are patches of limestone, the surface is covered by travertin deposits, and the veins are mostly of a ferruginous calcite, in some of which gold has also been found.

"The rocks at the north end of the field take a sudden turn to the north-east and east. Dykes are met with in many places; these are generally either granite or diorite, the latter being of great variety, while the former generally contain crystals of foliated talc in cavities.

"The mineral veins consist mostly of quartz, but ferruginous lodes and veins of calcite and dolomite also exist. The quartz is of great variety, from pure white with talc in the white granite country, to white, blue, and highly mineralised in other places; whilst the calcites and dolomites are mostly ferruginous.

"Where the reefs have been opened up to water level, many of them contain galena as well as iron pyrites, and the veins seem for the most part, as far as one can judge at present, to be true fissure veins, most of them probably continuing in depth; but they will vary greatly in size, direction, and thickness, and many will have to be traced by a mere line or face for a considerable distance.

"The veins rarely follow the strike or dip of the other rocks, but cut across them in all directions; and when they are lost at the ends they generally seem to turn and strike along the line of bedding of the rocks as a mere thread for sometimes a considerable distance, making again into a large body of stone, when they strike off again more or less on their old course. The reefs are found to

be very rich in chutes, the gold being mostly met with at the intersection of certain beds, whilst at other places either large bodies of stone or pinches are accountable to the same cause. The question as to which are the true veins cannot be decided until a more systematic survey of the field has been made; but in most cases where there is a large main line of reef parallel lines are met with which it is quite impossible to trace for any distance; these latter are in all probability not true veins, but only infilled lateral fissures, which, although often very rich, will not extend for any distance either along the surface or in depth.

"The main lines of reef seem to follow a more or less north and south course, but there are some very rich ones which strike east and west; these also vary greatly, some being small cross-courses, extremely rich at their intersection with the main north and south reefs."

Continuing, the same writer says:—"The Mount Magnet diggings are situated a few miles to the south and west of West Mount Magnet, which hill is principally composed of metamorphic rocks, capped by a flat top of desert sandstone.

"The rocks strike mostly a little west of north, and dip to the westward. They are slate, dolomite, talcose schist, and ferruginous jaspery quartzite, all of which are very decomposed.

"The reefs follow much the same strike as the rocks, and dip also to the westward. They are small but well defined, and in some places appear to carry gold pretty well through the stone. The quartz is mostly white, and rather greasy, with ferruginous stains and yellow clay partings; but nothing very rich has been found in the reefing line on this part of the field, except the Monarch Mullocky Leader, which is not a true reef, but a mass of decomposed talcose schists, through which there are a number of small ferruginous quartz veins. The whole mass carries fine gold, but up to the present only the soft part has been worked, and has proved very rich in gold. On the surface here a small but very rich patch of alluvium was worked along the side of a large ferruginous quartzite bar.

"All the alluvial work here has been surfacing, the patches being worked by dryblowing places where a mixture of quartz and ironstone are found scattered over the surface.

"A good deal of gold will probably be found around here, but most of the men are away on the rich finds further north."

Geology of the Field.—The following is a description, based on personal observation, of the geological and cognate features of that portion of the Murchison Goldfield embraced within the boundaries of the accompanying maps.

GENERAL TOPOGRAPHY.—Taking West Mount Magnet as a starting point, the country from east through south to south-west consists of a level plain covered with a shallow deposit of recent beds,

the plain being sparsely timbered with stunted mulga. This plain, which extends south and south-east for 20 or 30 miles, is bounded on the east at a distance of some two or three miles south-east from Mount Magnet by a ridge of granite hills, which, at a point about due east of the mount, merges into a tableland which runs northerly for a distance of some six miles, when it turns away easterly and continues on this bearing for some miles. This tableland is covered with a shallow deposit of sandy soil, derived from the denudation *in situ* of the granitic rocks of which it is composed. It presents on its western and northern edge a more or less vertical cliff face of some 40 or 50 feet (which may mark a line of fault), rising abruptly out of the surrounding plain.

About six miles south-west from Mount Magnet is a low ridge of rough quartzite hills, rising some hundred feet above the surrounding flats and trending from south-west to west some three or four miles, at which point it joins the range of hills coming in from the west of Boogardie.

The country to the north is more broken than to the south, and consists of a series of low, rough quartzite ridges, running slightly west of north, and of isolated greenstone hills, which latter often rise to a height of 150 feet, and are generally capped by a considerable thickness of ironstone conglomerate; they are often flat topped with vertical faces for some 20 feet from the top. The country between these hills and ridges consists of flats covered with red soil derived from the weathering of the older greenstone rocks.

To the west of the Mount, and in the neighbourhood of Boogardie, the country is rough and hilly, consisting of numerous quartzite ridges running for the most part in a general north-westerly direction. These ridges attain their greatest elevation some two or three miles west of Boogardie, where they rise to a height of 150 to 200 feet.

West Mount Magnet itself, the highest point in the district, is a rough round-topped hill 250 feet high, forming the south-western end of a long quartzite ridge.

General Geological Features.—A belt of more or less highly altered greenstones comprises the main auriferous series which extends in a general northerly direction from West Mount Magnet, past Moyagee, as far north as Lake Austin and the town of Cue. This belt, at a point two or three miles south from Mount Magnet townsite, attains a maximum width of some 15 miles, narrowing rapidly as it runs north, till at a point about half-way between Mount Magnet and Lennonville it is only some five miles across. From this point it widens again to 10 or 12 miles, and continues northerly at this width beyond the limits of the map.

This belt of rocks, to which the general term of "greenstone" has been given, comprises diorite, pyroxenite, altered pyroxenite, together with hornblende and chlorite schists. Owing to the paucity of natural sections, it has been found impossible to distinguish on the

map the relative area occupied by each, and mining operations have not been carried sufficiently far to afford much assistance in this direction.

The rocks naturally vary considerably both in colour and texture, the diorites being the more coarse grained. These are found principally at the southern end of the field, while the rocks at the northern end consist mainly of pyroxenites, a section of which (G.S.M. 3963), seen under the microscope, shows it to consist entirely of a colourless to pale-brown augite, passing in places into a pale green fibrous hornblende. Both the diorite and the pyroxenite occur only over small areas, the greater mass consisting of a considerably foliated rock which appears to be a highly altered form of the latter.

These greenstones are intersected by numerous faults, and they are also traversed by belts of banded quartzites, which rise up from the surrounding country in the form of low, rough ridges, having a general north to north-west trend. These quartzites are especially abundant in the neighbourhood of Boogardie and along the western boundary of the greenstones occurring to the south from this place; they also occur largely on the extreme south-eastern edge of the greenstone belt. The central portion of the district south from Mount Magnet is very free from them, except at the "Six-mile," where a belt of quartzite, forming a bold outcrop, strikes south-west. All these quartzites, occurring to the south of an east and west line passing through Magnet Hill, are highly impregnated with oxide of iron, and in places are distinctly magnetic. North of this line they are practically non-ferruginous. After extending for about six miles northerly, in the form of low parallel ridges, they die out completely, reappearing again some 15 miles further north, where they are once more of the iron-bearing variety.*

It is within this greenstone belt that the gold-bearing reefs and lodes occur. These vary greatly both in size and in the direction of their strike. The largest and richest lines of reef, however, generally run in north and south directions.

The greenstones are bounded on either side by belts of intrusive granite, intermediate between the two being a narrow belt of highly foliated and contorted hornblende and chlorite schists, which pass imperceptibly into, and appear to be merely a localised alteration of, the former. This belt of schists has an average width of some 20 chains. The junction of the granite with the schists on the western side runs in a comparatively straight line on a general north to north-north-west bearing. It is, however, somewhat uneven, small tongues of granite, approaching aplite in composition, running out from the main body into the schists. The junction line on the eastern side is more irregular, varying from almost east and west, at a point due east from Mount Magnet, to north and south a little further north. It has, however, on the whole a general north and south trend. A long tongue of granite runs out

* These quartzites will be found more fully described under "Reefs and Lodes."

from the main body, at a point some two miles east of Mount Magnet, southerly into the greenstones. This tongue, at the point where it leaves the main body, is about a mile across, and runs south for some five or six miles, gradually dying out below the alluvium of the plains. There are, also, numerous dykes of intrusive granite in the greenstones, especially in the southern end of the district. These dykes are finer in texture than the main granite bodies, and in places approach closely to a felsite in general appearance. The main body of granite is a coarse-grained biotite variety (G.S.M. 3960), a section of it seen under the microscope showing it to consist of quartz, felspar, principally plagioclase, together with a little microcline, biotite, and little magnetite; the biotite being very abundant, and occurring in large tabular crystals. It appears to be undoubtedly of intrusive origin, the greenstones being highly foliated and contorted near their junction with it, the schists usually dipping away from the granite. Patches of greenstone schists are also found caught up in mass of the granite itself. A large mass of undoubtedly intrusive granite occurs near Moyagee; this is some ten miles long and several miles across, and is entirely within the greenstones, which have their usual contorted appearance near the junction.

The greater part of the country to the south and south-west of Mount Magnet is covered by shallow recent accumulations, consisting of red sandy soil, resulting from the gradual denudation of the older greenstone and granitic rocks *in situ*. This deposit is of very limited thickness, and rarely exceeds 15 to 20 feet.

There is another class of recent formations found in the district; these are the ironstone gravel deposits (laterite); they occur only over very small areas, generally as the cappings of hills, and consist of nodules of siliceous limonite and hematite cemented together with ferruginous silica and clay. They are probably formed by the gradual concentration of ferric oxide, resulting from the local decomposition of rocks rich in iron. The majority of them are of poor quality, and their actual iron contents low.

There are, however, two small deposits of this class, which are considerably above the average in their iron contents; they occur in the neighbourhood of Boogardie; one on the east side of the Eclipse Hill and the other on the north-east side of the Havelock Hill, and are very limited in extent, having only an area of a few square chains. An analysis made in the Geological laboratory of a sample of the former of these (G.S.M. 4372), taken from G.M.L. 635M, gave results as follows:—

Metallic iron	51·67 per cent.
Silica	11·46 „
Sulphur	·084 „
Phosphorus...	·023 „
Combined water	2·67 „
Moisture	·19 „

When the ironstone gravels occur as the cappings of hills, they generally have vertical cliff faces for a height of 20 to 30 feet; these faces are broken by numerous small caves, in which an impure

natural bitumen is often found. This bitumen, which is taken by many of the prospectors to be an indication of the presence of mineral oil in the surrounding rocks, is probably, from its mode of occurrence and general appearance, merely a decomposition product of the excrement of wallabies and kangaroos, by which these caves have been largely used.

Reefs and Lodes.

Banded Quartzites. — These are of two varieties, the "hematite bearing" and the "non-hematite bearing." The former is the more prevalent type, and occurs principally in the neighbourhood of Boogardie. They will during the remainder of this report be spoken of as the "Boogardie" type. The "non-hematite bearing," or "Lennonville" type, as they will be called, occur only within the Lennonville district, and in small areas at the Morning Star, Paris, and Hector Hill G.M.Ls. in the Mount Magnet district; they are much more limited in extent than the "Boogardie" type. They occur as low, rough ridges of hard compact black and white, or brown and white, quartz, outcropping in belts, generally from two to four chains in width, and with a vertical dip. On breaking through the hard upper surface of these belts they are found to alter greatly in appearance, changing in a few feet from hard compact quartz to alternating thin bands of hard white to grey quartz and soft kaolin. These quartzites invariably carry gold, but not always in payable quantities; there are, however, in them numerous rich chutes, which are being worked with satisfactory results, the gold being found both in the quartz and the kaolin.

The "Boogardie" quartzites differ from the preceding, in that they are more compact at a depth, and are highly impregnated with oxide of iron, usually hematite, but often also with magnetite as well, when they are naturally highly magnetic and render it utterly impossible to use a compass with any degree of accuracy in their vicinity. They also usually carry a considerable amount of pyrites at a depth.

These quartzites are of two varieties: one in which the quartz and iron oxides are in well-defined alternate thin layers, the iron being the predominating mineral; and the other in which the quartz predominates, and the lamination is not so pronounced, a broken specimen having almost the appearance of a highly ferruginous compact quartz. This latter variety, the so-called "jasper" of the local miners, is especially abundant about Boogardie, where the beds run in a series of north-north-west and south-south-east ridges. They differ from the "Lennonville" quartzites in their mode of occurrence, in that they run in a series of narrow parallel bands from one-half to one chain in width, as many as 12 of these bands outcropping along the top of a single ridge, whereas those of Lennonville run in single wide bands, often five to ten chains across. They further preserve their compactness as far as any depth yet reached; none of the kaolin, which is characteristic of the latter

type, being present. They are traversed by numerous faults, the displacement in almost every case being to the right. It is only along these faults that the rich chutes of gold, for which this district is noted, occur.

The following are three partial analyses of samples of these hematite-bearing quartzites made in the Geological laboratory:—

G.S.M.	4377	4384	4376
Metallic iron ...	50·55	32·83	26·63
Silica	24·26	52·50	61·13
Sulphur	·029	·017	·019
Phosphorus ...	·042	·072	·028
Combined water ...	2·94	1·33	·66
Moisture	·41	·08	·07

The numbers (G.S.M. 4377, etc.) refer to the Geological Survey Museum Register. G.S.M. 4376 is a sample taken from the top of West Mount Magnet; G.S.M. 4384 is from a dump on the Havelock G.M.L.; G.S.M. 4377 is from a spot half a mile north-west from the Trig. Station, K. 5.

The manner in which the gold is found in these two types of quartzites differs considerably. In the Lennonville district the gold is obtained in the main body of the quartzites themselves, generally occurring in chutes, some of which are of considerable extent. In the Boogardie district, on the other hand, the quartzites carry but a very slight trace of gold, and it is only in one or two places at the northern end that they are rich enough to pay for working. The bulk of the gold is obtained in rich chutes, occurring in the faults crossing the quartzite bars. These faults cross the bars almost at right angles, and as the latter are generally only from half to one chain in width, the chutes are of necessity short, as they are never found to continue into the country rock, being invariably restricted to the limits of the quartzite bar. The fissures produced by these faults are invariably filled with brecciated quartzite, cemented together with chalcedonic quartz, and traversed by small irregular quartz veins. It is in this quartz that the majority of the gold occurs. The fissures vary considerably in size, but usually range in width from three to six feet. The walls are sharp and well defined, consisting of hard compact quartzite, and usually, like the main body of the bars, carry only a slight trace of gold. These fault fissures are very numerous round about Boogardie, occurring every few chains along the main lines of quartzites; they invariably carry gold, some being extraordinarily rich in places, whilst others again contain only a trace.

The main bands of quartzites appear to have been old fault lines or joints, along which the original greenstones have been highly foliated parallel to the line of faulting or jointing, and thus formed zones of weakness, along which thermal solutions containing silica, iron, etc., have forced their way to the surface, and gradually converted the original foliated greenstones into their present form. This appears to be borne out by the fact that they almost invariably run with the general strike of the country, viz.,

about north-north-west and south-south-east, and also that in several places they can be seen to tail out and insensibly pass into foliated greenstone.

In his report* on the Island Lake Austin, Mr. Woodward, late Government Geologist, writing of the quartzites in that locality, remarks :—"The banded quartz reefs are the main feature of this district, being met with both at Mount Magnet and Nannine, as well as at the Island. They generally rise above the surface as rough rock ridges, which rarely extend half-a-mile in length; they do not follow one main fissure line, but lie a little to the east or west, as the case may be. At the surface they appear to consist mostly of banded ironstone with jasper veins, but when cut below water line they prove to be banded blue and white quartz, containing considerable quantities of pyrites in places. These lodes, although poor, always contain a small quantity of gold, and invariably exercise considerable influence upon the richness of the quartz reefs of the district, which rarely contain gold except when in proximity to them."

It will be thus seen that these Lake Austin quartzites differ slightly from those of Boogardie which preserve their hard compact ferruginous character as far as tested in depth (about 130ft. below water level).

Quartz Reefs.—Quartz reefs occur plentifully both in the granite and in the greenstones, and are found to vary considerably both in size as well as in the direction of their strike. Generally speaking, it is only the reefs in the greenstones which have proved to be auriferous; they are for the most part small and usually trend a little to the west of north, and the east of south, and can rarely ever be followed for any great distance. There are a few east and west reefs, but these are generally found to be much poorer in their gold contents than those trending north and south. There are several very large white quartz reefs following the junction line of the granite on both sides of the greenstone belt. These, however, as far as tested, have proved to carry no trace of gold. In the auriferous reefs the gold is very often found to occur in chutes, which, although generally short, are frequently very rich.

Associated Minerals.—Pyrites occurs in more or less quantity in most of the quartz reefs throughout the district, and also in considerable quantities in the ferruginous quartzites round Boogardie, being generally found at or below water level. It is almost invariably found to carry gold.

Stibnite is found in small quantities in the ore bodies at the lower levels of the Morning Star G.M., Mount Magnet.

Pyrolusite is also found in small quantities in the lode stuff in the lower levels of the Hesperian G.M., Boogardie.

* The Island Lake Austin. Annual Progress Report of the Geological Survey for the year 1901. Perth: By Authority: 1902, p. 12.

An alloy of gold and mercury is reported to have been met with in the Havelock G.M., Boogardie.

Water.—The field as a whole is well watered, and as a rule abundance of good fresh water can be obtained at a depth of from 80 to 130 feet. There are, however, one or two exceptions, notably the Long Reef G.M. at Lennonville, and the Morning Star G.M. at Mount Magnet, where the supply is somewhat salt. It is, however, suitable for battery practice, for which purpose it is being used on both mines.

Timber.—Timber for mining purposes and for fuel is rapidly becoming a very serious item on the field. There is nothing but mulga in the district, and this has now to be brought in considerable distances, principally by means of camels.

The Mines.

The following is a brief description of the principal mines working in the district at the time of my visit (November, 1902). There are probably a few mines whose names do not appear on this list; this is because I was at the time unable to examine them owing to the fact that many were either abandoned, under exemption, or otherwise inaccessible.

MT. MAGNET DISTRICT.

MORNING STAR G.M.Ls. 314M, 317M, 320M.—This property, which is at present the most important in the Mt. Magnet district, has its workings down to a vertical depth of about 350 feet. Two lines of reef are being worked. The main one, known as the "Star" lode, consists of a large irregular quartz reef running about north and south; this reef is as much as 12 feet in width, but is not at all uniform either in size or in its gold values. The second lode, known as the "Easter" lode, is some 10 chains to the east of the main reef, and consists of a belt of very broken banded quartzites some 30 feet in thickness and also running north and south. Some very rich stone was obtained from this lode near the surface. The main shaft has been sunk on the "Star" lode to a depth of about 350 feet, and levels and crosscuts put in at 100, 200, 250, and 300 feet, and a large amount of stoping done, principally on this line of reef. A plentiful supply of water was struck at about 110 feet; it is, however, somewhat salt, this being one of the very few mines in the district in which fresh water was not obtained. The total stone crushed to the end of 1902 is 69,968·00 tons for 44,767·96ozs., an average of ·64oz. per ton.

IGUANA G.M.L. 457M.—On this lease two vertical shafts have been sunk, about 150ft. apart, on a small north and south quartz reef. A connecting drive has been put in at the 90 ft. level, and the reef stoped out to the surface. The reef is about 12 inches wide at its outcrop, widening to two feet at the bottom of the workings, and dips about 53° to the east. The country is soft decomposed greenstone, and carries a small amount of gold for

about 12 inches on each side of the reef. Water was struck at about 75 feet, the supply being brackish. At present a new vertical shaft is being sunk on the hanging wall side of the reef to cut it at about 200 feet. The average yield for the last two crushings was 1oz. 3dwts. per ton. The total stone crushed from this mine to date is 348·00 tons for 427·20ozs., giving an average of 1·22ozs. per ton.

Britannia G.M.L. 545M.—This property is situated near the "Six Mile," some five miles south-west from Mount Magnet. On it a main shaft has been sunk to a vertical depth of 90 feet on a lode formation, consisting of a soft decomposed schist highly impregnated with quartz. This lode is about 15 feet wide and runs east and west. A drive has been put in for a distance of some hundred feet at the 50-ft. level, and a considerable quantity of stone raised. A good supply of fresh water has been struck at 50 feet, and most of the stone raised is now being put through a horse puddler with satisfactory results. A crushing of 25 tons put through the Boogardie public battery lately gave an average return of about 1½ozs. per ton. A large quartz reef runs north and south through the property near the eastern boundary, dipping about 60° to the west. This reef is some 12 feet wide, and an underlie shaft has been sunk on it to a depth of about 40 feet. No further work has been done on it as the gold contents are low. Crushings to end of 1902, 176 tons for 168·77ozs., giving an average of ·96oz. per ton.

Comet G.M.L. 489.—Several small ferruginous quartzite bars run through this lease in a north-west and south-easterly direction. On one of these a vertical shaft has been sunk to a depth of 60 feet, and on a second a shaft and open cut have been put down some 30 feet. This bar is from two to three feet wide, and dips to the north-east at an angle of about 75°. The gold in these bars is very patchy, but some very rich specimens have been taken out. The total stone crushed to the end of 1902 is 65 tons for 54·47oz., including 3ozs. dollied; an average of ·83ozs. per ton.

Cushie Doo G.M.L. 490.—Three shafts are down on this property, all to a depth of about 65 feet; of these two are vertical and one underlay. A crosscut has been put in at the 65 feet level easterly between the underlay shaft and one of the vertical ones, a distance of about 50 feet, and also westerly for about 30 feet. The country consists of soft kaolinised greenstone, and is traversed by numerous north and south faults. Small bunches of mixed kaolin and quartz occur on the faces of these faults, and carry considerable quantities of gold. It is these bunches that are being principally worked at present, though work is also being done on a fair-sized north and south body of banded quartzites. This, however, is of low grade, and not of much value as far as prospected. The stone crushed from this mine to the end of 1902 was 104 tons for 285·15ozs., including 87·80ozs. dollied and specimens, giving an average of 2·74ozs. per ton.

PARIS G.M.L. 476.—There is a large banded quartzite lode, similar to the Lennonville quartzites, on this lease, the width of which has been proved to be not less than 60 feet. There are two old shafts on this lode, the most southerly of which is down to a depth of 130 feet. Short east and west drives were put in from this shaft at 30, 60, and 10 feet. It was then abandoned and is now full of water to 105 feet. The stone taken out of this shaft averaged from 4 to 8dwts. per ton. From a second shaft further north on the same lode some 200 tons of stone were taken out between the surface and 50 feet, and crushed for an average yield of 25dwts. of gold per ton. The lode is now being worked from a shaft sunk to a vertical depth of 50 feet on the eastern side near the centre of the lease. The stone from this shaft is expected to average from 4 to 10dwts. per ton. The total stone crushed from this mine to date is 662·00 tons for 370·61ozs., an average of ·56oz. per ton.

MONARCH G.M.L. 523.—This property was abandoned at the time of my visit, but Mr. H. P. Woodward, late Government Geologist, in his report on the Murchison Goldfield, thus describes it:—"On this area a mass of decomposed talcose schist, with small ferruginous quartz leaders, often jaspery, is being worked. The gold is mostly very fine, but it is plainly visible on the faces of the schistose rocks and all through the quartz, many specimens being extremely rich. There is a large mass of this gold-bearing material, but the full extent is not at present known. The country strikes a little west of north, and dips to the westward at a high angle. . . A very great deal of gold has been got from this claim by simply puddling and washing the decomposed rock, whilst the stone has been reserved for crushing." . . . Total crushings, 365 tons for 202·15ozs., being an average of ·55oz. per ton.

BOOGARDIE DISTRICT.

BOOMER G.M.L. 522M.—There are three shafts on this property, a main vertical shaft, down 105 feet, and two underlay shafts, 70 feet—all working on a large ferruginous quartzite bar, running about north-west and south-east, and dipping to the north-east at an angle of 75°. This bar is from 30 to 40 feet wide, and on the eastern side is soft, and broken for a thickness of some six feet. This portion carries the best gold, and averages about 8dwts. for the whole width, the richest stone being got on the extreme eastern edge. The remainder of the bar carries but a slight trace of gold. The gold-bearing portion of the lode has been stoped out for about 50 feet at the northern underlay shaft, small patches of it being very rich. The main vertical shaft has been sunk on the hanging wall side of the lode, and a short drive put in to cut the bar at 105ft. The country consists of soft decomposed greenstone. Good water was struck at 105ft. Total stone crushed, 209 tons for 39·87ozs.; an average of ·19oz. per ton.

GOLDEN STREAM G.M.L. 548M. — Four parallel vertical quartzite bars run through this lease in a north-westerly and south-easterly direction. On the most easterly of these, three shafts have been sunk to a depth of 65ft. From the middle one of these two sets of levels have been driven along the eastern side of the bar; the upper, at 50ft., has been driven some 75ft. northerly, while the lower, at 65ft., runs for some 400ft. northerly and about 150ft. southerly. The ore body consists of a mixture of quartz and honey-combed quartzite attached to the eastern side of the quartzite bar. It varies in thickness from a few inches to as much as 4ft. Its gold contents are patchy, ranging from a few dwts. to several ounces, the average being 8dwts. to 10dwts. The quartzite bar itself, as usual, carries only a very small amount of gold. Several lines of fault cross the bars in an east and west direction, and generally throw them to the right; the throw, as a rule, being only a few feet. A small granite dyke runs parallel to the bar some 20ft. to the east. The country is soft decomposed greenstone. A plentiful supply of fresh water was struck at 65ft. The total stone crushed from this lease, to the end of 1902, is 683·50 tons for 355·54ozs., being at the rate of ·52oz. per ton.

CALEDONIA G.M.L. 607M.—This property adjoins the Golden Stream on the north, and is on slightly higher ground. A vertical shaft has been sunk to water level (85ft.) on the eastern side of the same quartzite bar as the Golden Stream workings are on, and two drives have been put in some 20 or 30 feet northerly along the bar at 60 and 85 feet. The ore body, which is small, is the same as in the Golden Stream. Crushed 15 tons for 2·35ozs., being at the rate of ·16oz. per ton.

HAVELOCK G.M.L.—There are six shafts down on this lease, working on a series of parallel quartzite bars running in a north-westerly and south-easterly direction. The deepest of these is down about 135ft. to water level, the others being all from 100ft. to 110ft. in depth. Altogether three separate bars are being worked; these average from 20ft. to 30ft. in width, and are some 60ft. to 80ft. apart. They carry gold for their full width, having an average value of about 6dwts. Crosscuts have been put in east and west to connect several of the shafts at 100ft., and at this depth levels have also been driven some 100ft. or so along the bars both northerly and southerly. The bars are of the compact ferruginous type common to this district, and as usual are frequently broken by faults, rich chutes of gold being generally obtained at the spots where these breaks occur. Good water was struck at 135ft. The total stone crushed from this lease to date is 1,007 tons for 844·35ozs., including 55ozs. dollied and specimens; giving an average of ·83oz. per ton.

HESPERIAN AND LADY BUNBURY G.M.Ls. 361M, 379M.—These two leases are at present being worked in conjunction; a main pumping and hauling shaft has been sunk to a depth of 200ft. on the Lady Bunbury lease, near the northern boundary; a large quantity of water is being pumped out of this shaft, thus draining

both this property and the adjoining one (the Hesperian). On this latter lease a vertical shaft has been sunk to a depth of 100ft. near the southern boundary, for the purpose of working a rich body of ore occurring in a break in a large quartzite bar which runs north-westerly and south-easterly through the middle of the two properties. This ore body is some 30 feet in length (being entirely confined within the limits of the quartzite bar), and varies in thickness from about 12 feet to almost nothing; it consists of brecciated quartzite cemented together with chalcedonic quartz and small quartz veins. It has no well-defined walls, passing in places gradually into the hard compact quartzite of the bar, which, as usual, carries only a slight trace of gold. It dips at an angle of about 80 degrees to the south-east, and at about the 150-feet level passes into the Lady Bunbury lease. From the Hesperian shaft a short drive has been put in at the 100-feet level, and a winze sunk to 150 feet. The whole ore body has then been stoped out to the surface. From the 150-feet level a second winze has been put down another 50 feet, and connected by a short drive with the Lady Bunbury shaft, and stoping is now (November, 1902) being carried up from this level, where the average width of the ore body is from one to two feet. The gold contents of the stone raised vary considerably; some of the richest ore was got from the 150-feet level, where some parcels of stone were got averaging about 30ozs. Samples from the 125-feet level, Hesperian G.M., assayed in the departmental laboratory gave results ranging from 2ozs. to 11½ozs. per ton. A large number of parallel quartzite bars run through these two properties, and shafts have been sunk on several of them, but without satisfactory results. The country is soft decomposed greenstone, passing into hard settled rock at about 180 feet. Like most of the mines in this district, the water is fresh, and was first met with at 150 feet. The crushings from these two properties to the end of 1902 were as follows:—

—	Stone crushed.	Gold therefrom.	Average oz. per ton.
	tons.	ozs.	
Hesperian	1,597·00	2,134·50	1·33
Lady Bunbury ...	512·65	166·84	0·32

ECLIPSE EXTENDED G.M.L. 264M.—On this lease a vertical shaft has been sunk to a depth of about 110 feet on an ore body exactly similar in character and mode of occurrence to that on the Hesperian lease. This ore body extends only the width of the quartzite bar in which it is found, about 30 feet, and varies in thickness from three to 20 feet. It has been stoped out for its full width from 110 feet to the surface, but no further work has been done on it. Total stone crushed, 914·75 tons for 1,830·59ozs., being at the rate of 2·00ozs. per ton.

HESPERUS DAWN G.M.L. 463.—An ore body similar in all respects to the two foregoing has been worked out on this property to a depth of 150 feet (water level). At the time of my visit no work was being done, owing to the property being under exemption. From this lease, 521·98 tons of stone have been crushed for a yield of 1,860·95ozs., being at the rate of 3·56ozs. per ton.

GOLDEN BELLE G.M.L. 648.—There are several small shafts on this property working on small bodies of ore in the breaks of the quartzite bars similar to those worked in the three previous properties. There have been no crushings from this property to date.

JUPITER G.M.L. 190.—Four small quartzite bars run through this lease, in a north-westerly and south-easterly direction. On the most easterly of these a main shaft has been sunk to a depth of 175 feet, and levels driven along the bar at 100 and 175 feet; that at 100 feet has been driven some 100 feet northerly and 200 feet southerly, and that at 175 feet about 50 feet northerly and 170 feet southerly. At present the lower workings are flooded, and the mine full of water to 105 feet. A small party are now working the property on tribute, and are engaged in taking out stone from the 100-feet level. The bar as opened up here is from 4 to 6 feet wide, and carries gold right through in amounts varying from several dwts. to as much as 2ozs. For the most part it consists of hard compact ferruginous quartzite, but some parts are considerably softer and less compact than others. It is in these softer portions that the best gold is found. Several faults cross the bars in an east and west direction, and rich chutes of stone are generally found along the breaks. Below water level the stone carries a large amount of pyrites, which is invariably found to carry gold. Several smaller shafts have been sunk on the main bar, and also on a second small bar further westward, but very little work has been done from them. A small felsite dyke runs across the lease in an east and west direction, about 150 feet south of the main shafts, and cuts through the bars, without, however, displacing them at all. The country to water level consists of soft decomposed greenstone, becoming harder and more settled at about 150 to 180 feet. Salt water was struck at 110 feet, and was very abundant at the lower levels. This is the only mine in the Boogardie district in which salt water has been met with. From this lease 1,630·15 tons of stone have been crushed, for a total yield of 1,252·08ozs., giving an average of ·77oz. per ton.

SIRDAR G.M.L. 571.—There are two vertical shafts down on this lease, one, the main working shaft, down 90 feet, and the other 55 feet. The main shaft has been sunk on the west side of a large north-west and south-east quartzite bar, and at 75 feet a crosscut has been driven easterly into the bar for a distance of about 60 feet. The bar for the whole of this distance carries gold, and averages from 6 to 12dwts. No stoping has been done, and no drives put in at the lower level. From the second shaft two crosscuts have been put in, one at the 40 feet level for about 20 feet easterly, and one at the 55 feet for some 45 feet westerly. This latter crosscut

cuts through three small vertical quartzite bars, running north-west and south-east, the first two of which are about three feet wide, and the third almost westerly about 20 feet. These bars have been sampled for their full width, their average gold contents being about 8dwts. per ton. In all 529 tons of stone have been crushed from this mine for a yield of 244·30ozs., being at the rate of ·46oz. per ton.

NEPTUNE G.M.L. 445.—The main working shaft on this property has been sunk vertically to a depth of 210 feet on the eastern side of a large quartzite bar running through the middle of the lease in the prevailing north-west and south-east direction. Two drives have been put in south-westerly from it, one at 109 feet and the other at 200 feet, both of which are about 70 feet in length. The ore body consists of quartzite and brecciated quartzite, and is some three or four feet wide; it runs vertically across the main quartzite bar in a south-westerly direction, and is apparently an old fault line along which the quartz has been deposited. The length of the ore body has not yet been proved. The gold contents, as is usual with this class of ore body in this district, vary considerably, ranging from 1oz. to 13ozs., being richest where the quartz is most abundant. The main body of quartzite also carries a considerable amount of gold, but not sufficient to pay for working. The country on each side of the quartzite bar consists of greenstone, very decomposed and softened near the surface, but becoming hard and compact at the 200-feet level. Several small shafts have been put down at different places along the main bar of quartzite, but without result, and have since been abandoned. A good supply of fresh water was struck in the main shaft at about 110 feet. The total crushings to date from this mine are 452 tons for 1,161·15ozs., including 557·76ozs. dollied and specimens, being an average of 2·57ozs. per ton.

MARSITE G.M.L. 220 (late O.K. North).—On this property a quartz reef running north-east and south-west has been worked by means of three shafts, two vertical and one underlay, down to depths varying from 50 to 80 feet. At present two of these shafts have been abandoned, and the reef is being worked from a main vertical shaft, sunk on it to a depth of 80ft. At this level drives have been put in both ways along the reef for a total distance of about 200 feet, and a winze sunk a further depth of 35 feet to water level. No stoping has been done. The reef consists of white quartz considerably laminated at the northern end, and is about four feet wide. It runs vertically, and has sharp, well-defined walls on both sides, the country being soft, decomposed greenstone. The average gold contents of the reef are about 6dwts. per ton. A fourth shaft has been sunk on a small quartzite bar near the southern boundary of the property, but without any satisfactory results, and it has since been abandoned. The returns from this mine to date are 24 tons of stone crushed for a yield of 5·50ozs., being at the rate of ·23oz. per ton.

LENNONVILLE.

GOLDEN GIANT WEST G.M.L. 567.—There is a main vertical shaft down some 150 feet on this lease. It is, however, at present (October, 1902) abandoned, and the only work done on the property is being carried on in a large open cut. The lode, as opened up in this cut, consists of banded quartzite intersected by numerous small quartz leaders. The full width of it has not yet been exposed. Some samples of stone taken from the face of the open cut and dollied, gave very good prospects.

BAXTER'S REWARD G.M.L. 604M.—On this property a main shaft has been sunk vertically to a depth of 135ft. in the centre of a large quartzite bar. At 75ft. a drive has been put in north and south along the strike of the quartzites with the object of working a small quartz reef running in that direction. This reef at the southern end of the drive is about 1ft. in width and about 2ft. 6in. at the northern end and dips at a high angle to the westward. Drives have also been put in both ways along the reef at 95ft. and 135ft. for about the same distance, the reef being of the same size as in the upper level; a crosscut has also been put in Easterly for a distance of some 20ft. at the 135ft. level in order to test the values of the quartzites, which always carry a certain amount of gold.

FAIR PLAY G.M.L. 333M.—On this lease two vertical shafts have been sunk (some 160ft. apart) on a small north and south quartz reef. Of these the main shaft has been sunk to a depth of 200ft. while the second, or more Northerly, is down 130ft. to water level. These shafts are connected at the 130-feet level by a drive which has also been continued some 60ft. south of the main shaft; at the 200-feet level about 90ft. of driving has been done from the main shaft some 70ft. north and 20ft. south; a winze has also been sunk from the 130-feet level to a further depth of 35ft. at a point some 30ft. south of the northern shaft. The reef consists of white quartz and is small, having a maximum thickness of some 10in. to 13in. The country is soft decomposed greenstone.

SIMMER AND JACK G.M.L. 586.—A small vertical North and South quartz reef is being worked on this property; several shafts have been sunk, the main one being down 105ft. vertical, and a fair amount of work done. The reef is very thin as a rule, but at one place there is a thickness of nearly five feet of clean quartz. Another vertical shaft further west is down about 100ft., and a crosscut has been put in Easterly for a distance of some 50ft. at the 40-feet level. The shaft has, however, been since abandoned. The country consists of a slightly decomposed foliated serpentinous rock, the lines of cleavage of which trend north and south, and run vertically.

SPLENDOUR G.M.L. 421M.—A fair sized North and South reef runs through the centre of this lease, dipping at a high angle to the

westward. A vertical shaft has been sunk to a depth of 80ft. on the footwall side, and short crosscuts have been put in to cut the reef at 50ft. and 80ft., and levels driven along it for some distance. The average width of the reef is about two feet six inches, but it is rather irregular, being as much as five feet in width in some places.

TARCOOLA G.M.L. 590M.—There are several shafts down on this property to depths varying from 40 to 70 feet; the main working shaft is down 70ft., on a fair sized quartz reef, trending north-west and south-east and dipping to the westward. This reef is from four to five feet wide, and a considerable amount of work has been done on it, but at present (October, 1902), the workings are inaccessible. Another working shaft, further to the north-east, is down some 70ft. on a small quartz reef, striking north-west and dipping to the westward. The width of this reef is about 18 inches.

GAMBIER 535M.—On this lease a main shaft has been sunk to a depth of 140ft. on the western side of a quartz reef, striking north-west and south-east, and at 60ft. a crosscut has been put in easterly to cut the reef, and a level driven along the line of the reef. This reef is some three feet wide, and is, apparently, the same one as is being worked on the adjoining lease (the Tarcoola). The lower workings on the property were inaccessible.

THE GIANT G.M.L.—This property adjoins the Canterbury on the south. Very little work has been done on it. At present there is a large open cut on a banded quartzite bar. A small quartz reef runs through the deposit in the direction of the strike of the quartzite (north and south). Samples taken from the open cut and dollied showed good prospects. 65·00 tons have been crushed from the lease for a yield of 18·53ozs., being at the rate of ·28oz. per ton.

BROOKLYN SOUTH G.M.L. 605.—Here a shaft has been sunk to a depth of about 80ft. on a vertical quartz reef running north and south. A drive has been put in 40ft. along the reef southerly at the 50-feet level, and a little stoping has been done.

UNION JACK G.M.L. 611.—A large banded quartzite bar runs north and south through the centre of this property. On the western side of this bar an underlay shaft has been sunk to a depth of about 30ft. The section in the shaft shows the lode to consist of banded grey and white quartz, with bands of kaolin, rendering the deposit very friable. No further work has been done, and the full width of the deposit is not yet determined. There have been no crushings to date.

GOLDEN HILL G.M.L. 511.—This property is also working on a large north and south body of banded quartzites. The main body of these is some three to four chains across, and runs through the middle of the property. On the western side of this body a shaft has been sunk to a vertical depth of 80ft., and a drive put in northerly for a distance of 35ft. at this level. The ore body is situated on the extreme western edge of the quartzite bar, and is from five to eight feet in width. It consists of a brecciated mass of quartzite cemented together with kaolin, and varies considerably in its gold contents. This property has crushed to the end of 1902 298·50 tons for 85·07ozs., giving an average of ·27oz. per ton.

THE FARM G.M.L., 582.—This property adjoins the Golden Gem on the south; on it a main shaft has been sunk about 50ft., and crosscuts put in north-west and south-east for a total distance of about 200ft., but so far without result. The country consists of very soft decomposed greenstone.

GALTEE MORE G.M.L. 343.—This property is situated some three miles south of Lennonville townsite. A large banded quartzite lode runs through the lease in a general north and south direction. This lode, the full width of which has not yet been determined, is being worked by means of four shafts, the deepest of which has been sunk to a vertical depth of 120 feet. On the north end of the lease a shaft has been sunk vertically for 100 feet, and a short level put in at 40 feet, and a somewhat longer one at 80 feet; this level has been driven about 40 feet north and the same distance south, and a crosscut has been put in westerly from it for a distance of about 90 feet; no stoping has been done. Of the three shafts at the southern end of the lease, the deepest is 120 feet and the other two 60 feet and 105 feet, respectively; from the latter of these, drives have been put in north and south at the 40, 60, 80, and 100 feet levels for about 100 to 120 feet each way, and a considerable amount of crosscutting and stoping has been done, the three shafts being connected at the lower levels.

The two largest gold producers in the Lennonville district are the Long Reef G.M. and the Wheel of Fortune North. These have respectively produced, to the end of 1902, 37,911·19ozs. from 54,766·25 tons, and 9,296·14ozs. from 3,123·00 tons.

The following tables, compiled from the latest official information, show the gold returns from the various leases in the district, other than those already mentioned, up to the end of 1902. It may be mentioned, however, that the majority of the leases named in

these lists have been abandoned for some years past, very little work having been done upon them :—

OUTPUT OF GOLD BY DISTRICTS.

Lennonville District.

Name of Lease.	No. of Lease.	Total Gold Yield to end of 1902.		
		Ore Milled.	Gold Yield.	Average ozs. per ton.
		tons.	ozs.	
Agnes	302M	13·00	4·15	·32
Ardpatrick	613M	322·00	265·50	·82
Bushman	644M	19·00	13·00	·69
British Exploration Co., Ltd.	78, 74M	110·00	144·65	1·31
Briton	602M	28·00	6·63	·24
Canterbury	519M	301·00	392·58	1·34
Canterbury Extended No. 1 ...	459M	12·00	1·10	·09
Colonial Consolidated Finance Corporation Co., Ltd. late Corsaire Consolidated G.M. Co.	80M, R.C., 2M 80M, 345M	4,934·00	3,013·02	·63
Federal	407M	10·00	·55	·05
Geraldton United	144M	51·00	13·13	·26
Golden Gem	201M	550·50	1,371·79	2·49
Golden Giant Leases	47M, 179M	147·00	71·40	·49
Grand Gorge	549M	456·50	982·30	2·13
Haeremai	628M	54·00	90·25	1·67
Helm	494M	20·00	16·85	·84
Josephine	453M	6·00	·91	·15
Kathleen	559M	5·00	6·50	1·30
Keep-it-dark	393M	49·90	103·10	2·07
Klondyke	348M	36·00	*142·91	3·94
Lady Brassey	379M	97·00	203·35	2·10
Last Chance United	556M	54·00	17·07	·31
Lady of the Lake	486M	14·00	8·10	·57
Long Reef Central	542M	190·00	83·29	·44
Matterhorn	632M	12·00	3·80	·31
Magnet Gem	322M	22·00	14·18	·64
Merriwee	606M	22·00	37·37	1·70
Mabel	578M	118·00	28·35	·24
Mount Blanc	539M	14·00	3·00	·21
Murchison Boulder	425M	26·00	7·47	·28
Queenslander	552M	395·50	210·69	·53
Queenslander South	393M	1,135·00	967·40	·85
Rock of Ages	517M	181·00	141·44	·77
Rosella	412M	13·00	14·00	1·08
Royal Surprise	278M	36·00	9·72	·27
Scottish and Colonial	449M	10·00	2·00	·20
St. Albans	359M	45·00	56·20	1·25
St. Albans South	384M	105·00	90·80	·86
Victoria	480M	39·00	11·75	·30
Vicquery Piedmont	80M	2,061 00	1,408·00	·68
Viking	431M	20·75	25·57	1·23

* Includes 29·65ozs. dollied and specimens.

Lennonville District—*continued.*

Name of Lease.	No. of Lease.	Total Gold Yield to end of 1902.		
		Ore Milled.	Gold Yield.	Average ozs. per ton.
		Tons.	ozs.	
Wah Wah	420M	192·00	243·62	1·27
Waringee	341M	127·00	238·33*	1·87
Welcome News	395M	31·00	6·85	·22
Wheel of Fortune North ...	103M	3,123·00	9,296·14	2·91
Wheel of Fortune South Block	151M	926·65	3,401·25	3·64
Wheel of Fortune North, Extd.	109M	117·00	108·77	·92
Wrayfield	334M	114·75	133·00	1·16
Yuletide	198M	66·00	48·93	·74
Yuletide North	23M	334·00	205·44	·61

* Includes 3·35ozs. dollied and specimens.

Mount Magnet District.

Birthday	317M	184·50	30·92	·16
Black Diamond	304M	39·00	33·95	·87
Chums Consolidated, Ltd. ...	7M, 206M, 257M, 301M, 313M, 315/6M, 324M, 555/6M	11,984·00	28,503·15	2·38
Easter Gem	543M	33·00	20·73	·63
Evening Star	389M	30·00	5·25	·17
Gascoyne (Murchison) Goldfields Exploration Co., Ltd.	49M, 56M	19·25	4·37	·23
Gay Parisienne	417M	534·85	160·21	·29
Golden Age	301M	77·00	109·65	1·42
Hector Hill	257M	24·00	7·55	·31
Homeward Bound	401M	76·50	148·16	1·94
Kapai	562M	61·00	32·99	·54
La Perola	370M	41·00	36·85	·90
Mayflower G.M., Ltd.	9M	174·00	287·98	1·65
Mt. Magnet G.Ms., Ltd. ...	64M, 319M, 399M	2,759·00	2,261·68	·82
Murchison	448M (9M)	588·00	559·29	·95
New Chum South Extd. ...	26M	163·00	28·70	·11
New Moon	371M	286·00	187·20	·65
Old Jock	560M	12·00	12·85	1·07
Pearl of Ben Rose	45M	66·00	33·25	·50
Primrose	339M (32M)	135·00	88·95	·66
Pearl North	623M	13·00	20·00	1·54
Revenue	572M (565M)	182·00	65·00	·36
South Pearl	2M	11·00	12·45	1·13
Tarquin	63M	50·00	25·00	·50
Waikawa	565M	44·00	34·15	·77
Western Syndicate, Ltd. ...	120M, 339M	876·00	* 1,436·92	1·64
White Rose No. 1 North ...	29M	51·00	5·65	·11
L.C. 87	L.C. 87	28·00	13 25	·47

* Includes 6·04ozs. dollied and specimens.

Boogardie District.

Name of Lease.	No. of Lease.	Total Gold Yield to end of 1902.		
		Ore Milled.	Gold Yield.	Average ozs. per ton.
		tons.	ozs.	
Bobbie Burns	462M	19·00	6·25	·32
Bobs	594M	65·00	64·25	·99
Bonanza	184M	40·00	20·00	·50
Boogardie	351M	16·00	4·52	·28
Briars	553M	12·00	21·60	1·80
Bronzewing	507M		47·75ozs. dollied and specimens.	
Constellation	337M	20·00	6·50	·32
Deep Alluvial Claim	A.C. 1	2,392·00	959·84	·40
Eclipse	172M	400·00	*826·25	2·05
Eclipse North	411M	104·00	23·76	·22
Emily Bennett	530M	15·00	3·40	·22
Exchange Leases	185M, 281M	159·00	145·05	·91
Federal	520M	14·00	†7·65	·55
Federation	410M	12·50	‡113·65	9·09
General Roberts	500M	74·00	51·70	·70
Golden Crown	173M	121·00	232·90	1·92
Golden Point	224M		7·60ozs. dollied and specimens.	
Grosotto	438M	110·50	163·60	1·49
Havelock Extended	335M	93·00	47·35	·51
Havelock Proprietary	328M	42·00	§118·34	2·82
Hesperus...	491M	6·00	6·12	1·02
Jupiter West	504M	53·00	29·05	·54
Iron Dyke	635M	6·50	‖5·63	·87
Lone Hand	435M	25·00	5·20	·20
Lucknow...	226M	610·00	766·17	1·25
Magdala	518M	28·00	9·25	·33
Meteor	148M	51·00	51·70	1·01
Midlothian	182M	12·00	11·10	·92
Mystery	456M	66·50	26·13	·39
National	347M	11·00	5·15	·47
New Year's Gift	292M	20·00	20·60	1·03
Nil Desperandum	391M	57·00	40·60	·71
O.K.	160M	55·30	¶188·30	3·40
Pick-me-up	513M		8·62ozs. dollied and specimens.	
Planet	65M	247·00	149·25	·60
Rock of Cashel	307M	24·00	8·55	·35
Rose, Shamrock, and Thistle ...	426M	90·00	20·75	·23
Saturn	538M	98·00	37·85	·38
Star of the West	455M	238·00	380·70	1·60
Sun	555M	17·00	3·10	·18
Three Star	332M	106·50	**630·03	5·91
Venus	479M	279·00	1,527·48	5·48
Waverley	470M	200·00	83·85	·42
Wellington	353M	18·00	28·10	1·56
Western	469M	60·00	23·15	·38
Q.C. 77	Q.C. 77	43·00	2·12	·49

* Includes 4·80ozs. dollied and specimens. † Includes 2·70ozs. dollied and specimens.
‡ Includes 73·05ozs. dollied and specimens. § Includes 45·15ozs. dollied and specimens.
‖ Includes 2ozs. dollied. ¶ Includes 38ozs. dollied and specimens. ** Includes 61ozs. dollied and specimens.

OUTPUT OF GOLD BY LINES OF REEF.

Name of Lease.	No. of Lease.	Total Gold Yield to end of 1902.		
		Ore milled.	Gold Yield.	Average ozs. per ton.
Empress Reef.		tons.	ozs.	
Empress, Empress North, Empress South, Empress Extd. (Empress Leases)	465M, 583M, 503M, 544M	1,335·00	2,724·61	2·04
Total	...	**1,335·00**	**2,724·61**	**2·04**
Brooklyn Reef.				
Brooklyn	573M	80·00	201·25	2·51
Brooklyn North...	591M			
Brooklyn Block...	610M			
Brooklyn South...	605M			
Total	...	**80·00**	**201·25**	**2·51**
Galtee More Reef.				
Galtee More	343M	3,087·00	1,847·74	·59
Galtee More North	581M			
Galtee More South	505M			
Total	...	**3,087·00**	**1,847·74**	**·59**
Simmer and Jack Reef.				
Simmer and Jack	586M	150·00	64·89	·43
Day Spring	593M	41·50	45·35	1·09
Day Spring North	597M	...	...	...
Splendour	421M	518·25	499·32	·96
Mermaid	557M	187·50	229·58	1·22
Total	...	**897·25**	**839·14**	**·93**
Gambier Reef.				
Tarcoola	590M	54·00	38·15	·70
Gambier	535M	125·50	124·20	·99
Gambier Extd.	554M	...	...	....
Total	...	**179·50**	**162·35**	**·90**

Name of Lease.	No. of Lease.	Total Gold Yield to End of 1902.		
		Ore Milled.	Gold Yield.	Average ozs. per ton.
Long Reef Reef.				
		tons.	ozs.	
Long Reef	30M	54,766·25	37,911·19	·69
Long Reef North	31M	153·00	206·80	1·35
Long Reef South	433M	...	...	...
Total	...	**54,919·25**	**38,117·99**	**·69**
Burra Burra Line of Reef.				
Last Chance	541M	54·00	20·55	·38
Burra Burra	327M	1,133·50	3,468·95	3·06
Burra Burra Extended ...	346M			
Burra Burra South Extended	368M			
Total	...	**1,187·50**	**3,489·50**	**2·93**
Lennonville Line of Reef.				
Brilliant	48M	52·700	564·15	1·07
Lennonville	512M	395·00	824·80	2·09
Moonstone North	595M	10·00	3·50	·35
Moonstone South	601M			
Total	...	**932·00**	**1,392·45**	**1·49**
Welcome Reef.				
Golden Giant West	143M	80·00	68·85	·86
Sullivan's Dunlop	405M	609·00	584·65	·96
Welcome	57M	1,860·00	*6,259·19	3·36
Baxter's Reward	604M	139·00	26·55	·19
Total	...	**2,688·00**	**6,939·24**	**2·58**
Fair Play Reef.				
Occidental Extended	508M	57·50	100·65	1·75
Golden Treasure Leases, G.O.M.	41M, 508M, 52M	1,433·00	984·36	·69
Fair Play	333M	411·00	773·02	1·88
Speedwell	436M	21·00	35·65	1·70
Occidental Leases	66M	87·80	156·92	1·78
Total	...	**2,010·30**	**2,040·60**	**1·01**

* Includes 2,550·00ozs. dollied and specimens.

Source of Ore.	Total Yield to end of 1902.		
	Ore Milled.	Gold Yield.	Average ozs. per ton.

Miscellaneous Returns.

	tons.	ozs.	
Sundry claims at Boogardie	1,450·50	* 688·72	·47
Do. do. Mt. Magnet	1,944·60	†2,549·02	1·31
Do. do. Lennonville	593·25	‡ 472·22	·79

From district generally—	ozs.
Sundry parcels treated at Australian Gold Recovery Works	5,009·40
,, ,, ,, New Chum Works	1,382·75
,, ,, ,, State Battery, Lennonville ...	2,859·37
Alluvial	613·83

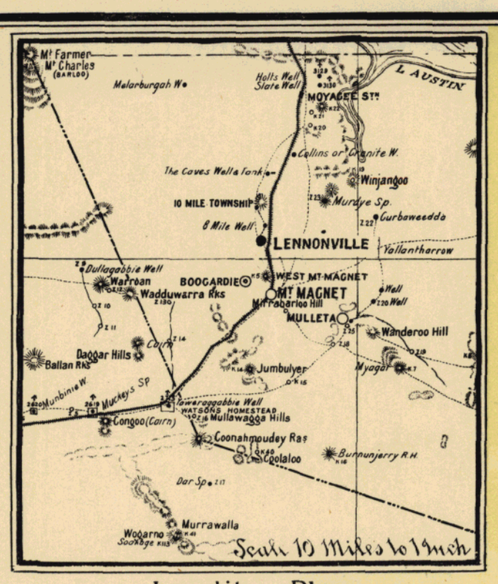
* Includes 5·86ozs. dollied and specimens.
† ,, 23·07ozs. ,, ,,
‡ ,, 13·50ozs. ,, ,,

Total gold yield from district embraced within the limits of the area referred to in this report up to end of 1902 is synoptically shown in the following table:—

	Alluvial.	Tons Crushed.	Gold Yield.	Average ozs. per ton.
	ozs.		ozs.	
Boogardie	...	15,800·83	* 18,536·50	1·17
Mt. Magnet	...	91,940·20	† 82,958·11	·90
Lennonville	...	84,079·10	‡ 80,811·80	·96
District generally ...	613·83	—	9,251·52	—
Total	**613·83**	**191,820·13**	**191,517·93**	**·99**

* Includes 1,052·13ozs. dollied and specimens.
† ,, 29·11ozs. ,, ,,
‡ ,, 2,642·48ozs. ,, ,,

By Authority: Wm. Alfred Watson, Government Printer, Perth.



Locality Plan.

THE HON: H. GREGORY M.L.A.
Minister of Mines

GEOLOGICAL SKETCH MAP

OF

LENNONVILLE

MURCHISON G. F.

BY

A. Gibb Maitland
GOVERNMENT GEOLOGIST

AND

C. G. Gibson
ASSISTANT GEOLOGIST

15 0 15 30 45

Scale 15 Chains to 1 Inch.

EXPLANATION OF COLOURS & SIGNS

BASIC ? ROCKS (*Undetermined*) ..... Di

GRANITE ..... Gn

ORE DEPOSITS { QUARTZ REEFS (*Arrow shewing direction of underlie*) ..... Q
BANDED QUARTZITES .....
HÆMATITE BEARING QUARTZITES ..... Qfe

LINES OF FOLIATION { HIGHLY INCLINED (*The longest line in the direction of Strike*)
VERTICAL *do* *do*

GEOLOGICAL BOUNDARIES ..... (*Uncertain*)

SHAFTS .....

MINING LEASES { NAME OF ..... LENNONVILLE
REGISTERED No OF 512M
POST NO OF 440M
BOUNDARIES OF .....

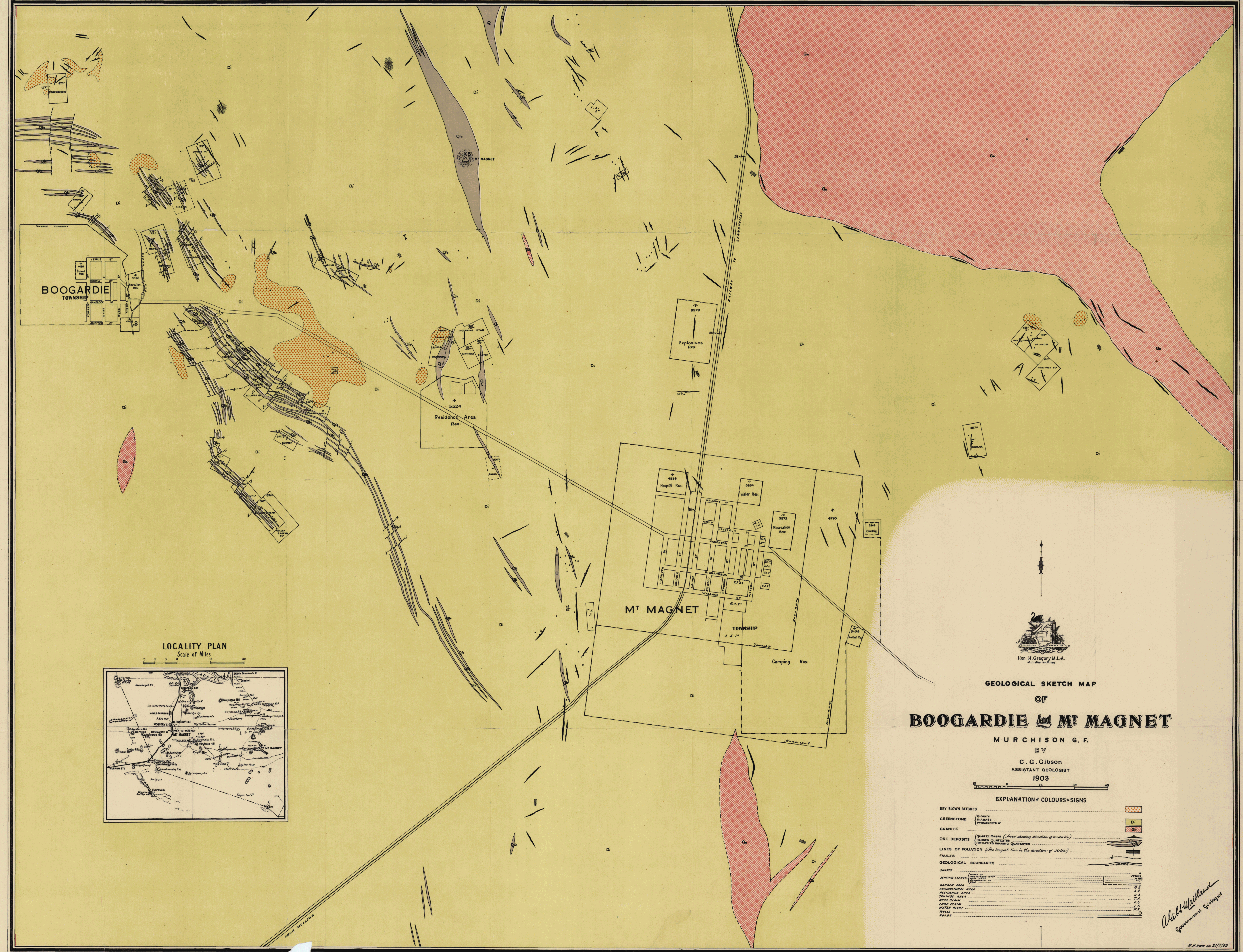
GARDEN AREA ..... G.A

WELLS .....

ROADS .....

H. J. Pether, Government Photolithographer, Perth, W. A.

R. H. Irwin del:
25/8/02.


BOOGARDIE
TOWNSHIP
Mt MAGNET
TOWNSHIP
Residence Area Res.
Explosives Res.
Hospital Res.
Camping Res.
LOCALITY PLAN
Scale of Miles
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
Hon: H. Gregory M.L.A.
Minister for Mines
GEOLOGICAL SKETCH MAP
OF
BOOGARDIE And Mt MAGNET
MURCHISON G. F.
BY
C. G. Gibson
ASSISTANT GEOLOGIST
1903
EXPLANATION of COLOURS & SIGNS
DRY BLOWN PATCHES
GREENSTONE DIORITE DIABASE PYROXENITE &c
Di
GRANITE
Gn
ORE DEPOSITS QUARTZ REEFS (Arrow shewing direction of underlie) BANDED QUARTZITES HÆMATITE BEARING QUARTZITES
LINES OF FOLIATION (The longest line in the direction of strike)
FAULTS
GEOLOGICAL BOUNDARIES
SHAFTS
MINING LEASES NAME OF REGISTERED No OF POST No OF BOUNDARIES OF VOID
VENUS
GARDEN AREA G.A.
AGRICULTURAL AREA A.A.
RESIDENCE AREA R.A.
TAILINGS AREA T.A.
REEF CLAIM R.C.
LODE CLAIM L.C.
WATER RIGHT W.R.
WELLS
ROADS
A. Gibb Maitland
Government Geologist