

1902.

WESTERN AUSTRALIA.

A N N U A L

PROGRESS REPORT

OF THE

GEOLOGICAL SURVEY

FOR THE YEAR

1901.

(WITH ONE PLATE AND THREE FIGURES.)

Presented to both Houses of Parliament by His Excellency's Command.

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*Annual Progress Report of the Geological Survey for the
Year 1901.*

The Hon. Henry Gregory, M.L.A., Minister for Mines.

Geological Survey Office,
Perth, 1st June, 1902.

SIR,

I have the honour to submit, for your information, the Report of the Geological Survey for the calendar year 1901.

During 1901 the work of the Department proceeded practically on the lines of previous years. The arrangement of the different matters dealt with is somewhat similar to that followed in former reports. A map and sections, in explanation of the work of the Survey, is attached.

THE STAFF.

During the year the work of the Department has been carried out by ten officers. There have been no changes in the *personnel* of the staff. Owing to the numerical strength of the staff proving inadequate to meet the requirements of the day, it was found necessary to temporarily enlist the services of Mr. H. P. Woodward and Mr. Göczel. It is hoped that whenever the exigencies of the Treasury will admit, adequate provision will be made for an additional Assistant Geologist, and that such a salary be offered as will enable the Department to secure and retain the services of a highly qualified officer.

FIELD WORK.

The field work of the year has been, as in previous years, distributed over various portions of the State so far as the exigencies of the Department permitted.

A. GIBB MAITLAND.—The months of January and February found me engaged in an examination of the valleys of the Minilya and the Lyons, with the view of collecting any geological evidence bearing upon occurrence of artesian water, and the probable extent and nature of the Carboniferous Rocks. During the period between the months of May and December, I was engaged in geological explorations in the Kimberley Division.

W. D. CAMPBELL.—During the greater part of the field season Mr. W. D. Campbell was employed in the Kalgoorlie District, where the inspection of the underground works was carried on as the mapping of the rocks proceeded. The field work was finally completed in the month of December. Nine visits were paid to Kanowna for the purpose of inspecting the Government boring operations in progress. Five visits were also made by him to Coolgardie in connection with the boring operations which were being carried out. Bulong was also examined in respect to an application for a Government subsidy. A flying visit was also paid to Boorara for the purpose of reporting upon a new find which had been made. Mr. Campbell also inspected Waverley (Siberia) for the purpose of selecting sites for boring for alluvial deposits; Northampton in connection with proposals to test the lodes of lead and copper by means of the diamond drill, and the Canning River for the purpose of advising on the geological conditions prevailing at the site of the foundations of the proposed dam.

C. C. GIBSON.—The Junior Assistant Geologist, Mr. Gibson, accompanied me to Kimberley, and was continuously engaged for the whole of that period in field work.

LABORATORY WORK.

During the year 1900 the work in the laboratory was carried out as usual under the more immediate supervision of Mr. E. S. Simpson, the Mineralogist and Assayer. The routine work has been heavy, considering the numerical strength of the staff, and had it not been for occasional assistance from the field officers, and the almost continuous employment of the messenger in the laboratory, it would have been impossible to cope successfully with the work.

The establishment of public batteries, and the consequent increase of work thrown upon the laboratory staff, renders the addition of a well-trained scientific assistant imperative. The appointment of such an officer would also take some of the routine work off the shoulders of the Mineralogist and Assayer, and enable him to devote more attention than has hitherto been possible to the numerous important subjects of research which present themselves from time to time.

Reporting on the duties performed in the laboratory during the past year, Mr. E. S. Simpson informs me that, in the ordinary course of the routine work, 1,029 assays, analyses, and other determinations were made. The following table shows a detailed statement of the laboratory work carried out during the year:—

Table showing Details of Assays, etc., made in the Departmental Laboratory during 1901.

Classification.	Public.		Official.		Totals.
	Pay.	Free.	Geological Survey.	Other Departments.	
Total samples dealt with	65	167	149	442	823
Determinations	1	28	4	90	123
Assays for Gold	48	110	59	277	494
" Silver	6	68	16	24	114
" Mercury	1	6	...	1	8
" Copper	6	26	6	18	56
" Tin	4	12	...	3	19
" Lead	2	3	1	4	10
" Iron ... ..	...	1	5	...	6
" Antimony ... ..	...	2	...	...	2
" Bismuth ... ..	...	...	...	2	2
Chemical Analyses, complete	3	...	19	7	29
" proximate	2	9	...	...	11
" partial ... ..	...	1	57	...	58
Sections ... ..	...	...	9	...	9
Micro-photographs ... ..	...	...	17	...	17
Valuations ... ..	...	...	...	9	9
Miscellaneous	5	11	...	46	62
Total of Assays, etc.	78	277	193	481	1,029

It will be noticed that the amount of work done for other Government Departments (chiefly for the Public Batteries) has increased by 30 per cent., whilst that done for the general public has decreased considerably. Very few rock sections were cut during the year, but some time was devoted to preparing micro-photographs of some of those already sliced.

Plans for a new laboratory having now been finally approved, it is hoped that the present unsatisfactory state of affairs with regard to accommodation will soon be remedied.* The lack of necessary facilities in the past has frequently been the cause of delay, and the expenditure, unnecessarily, of valuable time and much labour in the accomplishment of the work.

The granting of a special vote for laboratory expenses (hitherto included under the head of "Incidentals") and a regular system of stocktaking now enables an exact statement of the cost and upkeep of the laboratory to be prepared at any time.

* The new laboratory in Museum Street is now in occupation.—A.G.M., 4th October, 1902.

One other point in the conduct of the laboratory demands immediate attention, and that is the necessity for ensuring a supply of chemically pure agents, manufactured by some standard firm whose chemicals can be absolutely relied upon to be of the quality set out on the labels. In doing analytical work of the highest order, such as alone should be permissible in a Government Laboratory (frequently called upon to check the work of others), it is absolutely indispensable that the materials used should be perfectly pure. It is obviously absurd, for example, in attempting to detect small quantities of arsenic in any material, to have to use acids or other chemicals which contain notable quantities of the substance sought for. An arrangement should be made, now that our stock of pure chemicals is giving out, for either the Government Storekeeper or else some local firm to indent these supplies from an approved manufacturer.

Experience having shown that the Assay Regulations, first drawn up in 1897, required slight alterations in places, a modified set has been drawn up. The principal features of the amendments are as follow:—The general regulations, and those for free assays, have been combined in one set, and the language simplified and made clearer. A new section has been introduced affirming the necessity for the prepayment of fees, or, in the case of Free Assays, of a clear statement of the reasons for such being made at the expense of the State. The fees prescribed are the same as before, with the following exceptions:—The fee for a dry assay for lead, silver, and gold is reduced from 25s. to 21s. The higher fee has been justly complained of, since the work involved is but little more than that of a gold assay. The fee for a complete analysis has been altered from a fixed sum, viz., £2 12s. 6d., to a variable amount ranging from £2 12s. 6d. to £5 5s., according to the work involved. The time spent on an analysis varies from about two to twelve days, so that it is unfair to charge a fixed sum for a variable amount of work. The sum of £2 12s. 6d. is far too small for work which occupies the Mineralogist's undivided attention for nearly a fortnight.

MINERAL COLLECTION.

The Departmental Museum received a large share of attention, the collection being re-arranged and re-labelled in a more useful style. 1,089 new specimens were added to the collection during the year; the examination, naming, and registration of which occupied a considerable amount of time. By far the greater part of these specimens was collected by officers of the Department, but for many we are indebted to the courtesy of others interested in the formation of a Geological Museum in Perth.

Of minerals new to this State noted during the year, the most important was *Bauxite*, a hydrated oxide of aluminium, which nowadays forms the chief source of this useful metal. The ore was found to be largely distributed through the deposits of laterite so abundant on the cappings of the hills throughout the State. The occurrence, however, appears to be very irregular, and it is as yet not known whether deposits occur of sufficient size and uniformity to constitute commercial ores of the metal.

Other new minerals noted were:—

Electrum (alloy of gold and silver), in quartz from Donnybrook.

Fluorite (fluoride of calcium), in greenstone schists from Boulder.

Enargite (sulpharsenate of copper), from Boulder.

Goldschmidite (telluride of gold and silver), in lodestuff (chlorite schist) from Boulder.

Coolgardite (telluride of gold, silver, and mercury), an entirely new mineral species discovered in lodestuff from Boulder by Mons. A. Carnot.

In view of the growing demand for salts of lithium for adding to aerated waters, it is worthy of note that the lithia mica which occurs so abundantly at Londonderry has been found to assay 5.97 per cent. of lithia. The spodumene occurring in large crystals in granite at Ravensthorpe assays 7.02 per cent. of lithia.

SCHOOL OF MINES.

The necessity for the establishment of a School of Mines having been brought under the notice of the Government, I was appointed, in the month of April, Chairman of a Committee selected for the purpose of inquiring into the best method of giving facilities for scientific instruction in mining and cognate subjects on the Goldfields. The meetings of the Committee were held in the offices of the Chamber of Mines at Kalgoorlie. The deliberations of the Committee resulted in a unanimous recommendation that a scheme for scientific instruction in mining should embrace one central and fully equipped Mining School, which should work any of its outside branches by corresponding additions to the teaching staff. It was recommended that there should be two distinct sides to the school, viz. :—(a) the Metallurgical, and (b) the Mining, and that the teaching staff should be arranged accordingly, necessitating one very highly skilled man on each side of the school, together with an adequate staff of assistants. It was further recommended that the following subjects be taught in the school, viz. :—Chemistry, Assaying, and Metallurgy, Geology and Mineralogy, Mine Surveying and Mechanical Drawing, Mining Engineering, together with Mathematics and Elementary Physics.

PRINCIPAL RESULTS OF THE YEAR'S FIELD OPERATIONS.

KIMBERLEY.—There being good ground for believing that a portion of the lesser known area of the Kimberley Division included within its boundaries country which might prove to be mineral bearing, advantage was taken of the despatch of an exploration party to attach a geological unit thereto. Colour seemed to be lent to the assumption that the district would prove to be metalliferous from the fact that "Mineral Country" was shown on the official map 10A issued by the Department of Lands, as occurring on the Drysdale River between the 15th and 16th parallels of latitude, a statement which gained additional confirmation from the Geological Sketch Map of Western Australia, issued in 1884, in that a considerable tract of country to the North and West of King Leopold Range was shown as consisting of crystalline schists and granite, the matrices of the metalliferous minerals.

The following extract from a paper, which appeared in the year 1886, would seem to indicate the source from which the information embodied in the first mentioned map was derived:—

Monday, 3rd May, 1886.—Lat. 15deg. 31min. 38sec.; long. 126 deg. 45min. 20sec. Left camp on McKee River at 8 a.m.; course S.W. by W.; 240 deg. Then steered due W. 270 deg. Struck river flowing from S.S.E. 155 deg. and traversed river up this course to a point three miles up stream, then S.W. 225 deg. . . . At three and a-half miles up river came upon a black's grave. . . . At four and a-half miles had to head a small gully flowing into the Lorimer. Steered W.S.W. for half a mile and came back on the opposite side at four and a-half miles. Crossed river (Lorimer) here at a very good crossing, and travelled due West through fine, undulating, timbered country, gradually rising from the time we left the river. At nine miles came upon a fine line of lagoons, where we camped at 12 noon for lunch. . . . At 11 miles came on a fine chain of waterholes flowing North. . . . At 18 miles came upon the top of a tableland, and beheld, I think, the finest view I ever saw in my life. Cliffs on all sides, with a range of mountains in the distance. Below is a magnificent valley, in extent, as far as I can see here, about 100 square miles. Succeeded in getting down with some difficulty, and at 18½ miles got to bottom. Struck bed of river at foot, which I named the Carson, after Mr. David Carson, of Melbourne, and also the valley, which I named the Valley of the Carson. This river, I should say, was the head of a river flowing into the sea about due North from this point. Followed river down two miles, where we camped on the right bank in the best and thickest grasses I ever beheld—blue, Mitchell, and Kangaroo grasses. *Every indication of gold. Here quartz abounds, and I think eventually this valley will be a massive goldfield.* . . . Soil very dark chocolate, the darkest I have ever seen. . . . I have named the ridge we have just crossed, in the above latitude and longitude, the Ashton Range, after a friend of mine in Melbourne. Although a very heavy range owing to the tableland on the East side, it is only visible on the West, or I might say from the S.W. to North, and then from the Valley of the Carson in all its splendour. . . . Distance, 20 miles.*

The staple formation in the country traversed is made up of a series of quartzites, sandstones, fine conglomerates, and shales, disposed in a series of broad anticlinal folds. These beds extend as one continuous formation from Wyndham to Mount Hart, a pro-

* "The Kimberley Country:—A Page from an Explorer's Diary." *The Victorian Naturalist*, Vol. III., No. 8, pages 106-107. Melbourne, 1886.

minent summit on the King Leopold Range. No fossils were met with in any of the sedimentary rocks, so their position in the geological scale can only be approximately determined. The quartzites of the King Leopold and Mueller Ranges were shown on the map accompanying Mr. Hardman's Reports as being of Lower Silurian or Cambrian Age; no geological work having been carried out since the date of that gentleman's examination, no apparent reason can be found to alter them from the position to which he assigned them.

Associated with the quartzites, etc., are a series of bedded and intrusive igneous rocks, the prevailing types being andesite, dolerite, and diabase. The individual characters of the different beds naturally present a large amount of variation. The rocks are sometimes amygdaloidal, and contain nodules of zeolites and agates. Beds of volcanic ash and breccia are common in certain localities. In certain isolated portions of the district excellent sections are exposed, showing the intrusive nature of some of the igneous rocks. The sandstones are sometimes altered into hard compact quartzite, portions of which have been caught up in the body of the igneous rock.

Other sections indicate quite clearly that the igneous rocks have, in some cases, found an easy passage along the bedding planes of the sedimentary beds, and evidently occur in the form of sills. The lavas are traversed by almost vertical dykes of epidosite, which are traceable across country for long distances.

These igneous rocks are of considerable economic importance, in that they form excellent pastoral country wherever they are exposed at the surface. Careful attention was paid to the structural relations of the volcanic plateau and other cognate points. The igneous rocks rest upon quartzites, etc., of a type identical with those by which they are covered.

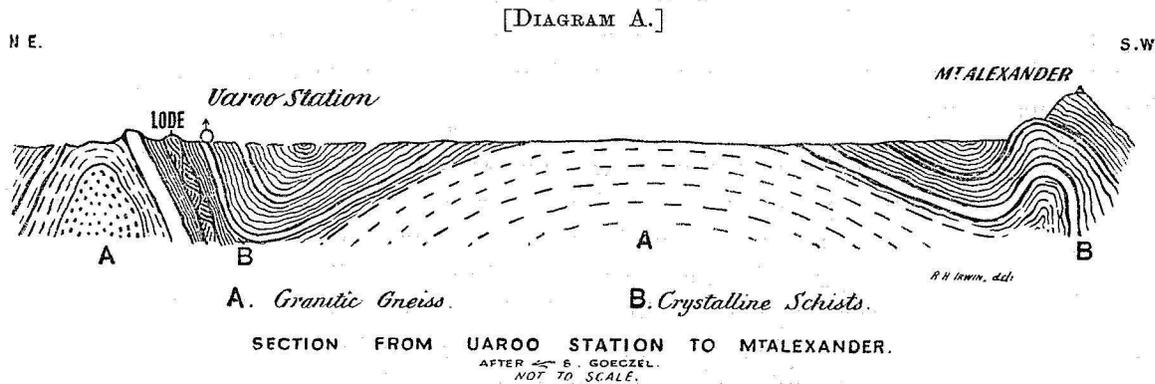
Both the sedimentary and the igneous rocks are intersected by numerous segregation veins of quartz, some of considerable size and horizontal extent; they are, however, from an economic point of view, of no commercial importance whatever.

Having in view the fact that the researches of the late Mr. E. T. Hardman showed an extensive area of crystalline schists—the matrices of the metalliferous minerals—trending in such a direction as should carry them into the South-Western corner of the country examined, attention was directed towards ascertaining whether any mineral country existed thereabouts. As a result of our investigations it was evident that the quartzite formation—which unconformably overlies the crystalline schists—has not been cut down to its base by any of the rivers to the North of the King Leopold Range, hence any mineral country is entirely concealed from view, and any extension thereof will have to be searched for on the South side of the Range, among the crystalline schists and allied rocks.

A full report on the district is in course of preparation, and will be duly submitted; but as the bulk of this can only be prepared outside the usual official hours, some little time must necessarily elapse before the work is completed and ready for the printer.

UAROO FIND, ASHBURTON RIVER.—Mr. S. Göczel was commissioned to report upon the copper deposits of Uaroo, on the Ashburton River; from this gentleman's researches it appears that the staple formation consists of crystalline schists associated with granitic gneiss. The beds form a belt of about 50 miles in width, which has been traced for a distance of about 150 miles in a North and South direction. The granitic gneiss apparently rises to the surface along the crests of anticlinal folds, along the flanks of which lie very much contorted crystalline schists. The schists often occupy

basin-like depressions, in the gneiss, and are apparently unconformable to the latter. The mutual relations of these beds are well illustrated in the cross section, which illustrates the structure of the country between Uaroo and Mount Alexander.



The junction of the crystalline schists with the gneiss appears to coincide with a line of ore deposits. The crystalline schists appear to consist of two series: a lower, principally made up of mica schists, together with minor bands of siliceous schists and thin quartzite beds, and an upper made up mainly of mica schist, quartzites, ironbearing schists, hornblende, and calcareous schists.

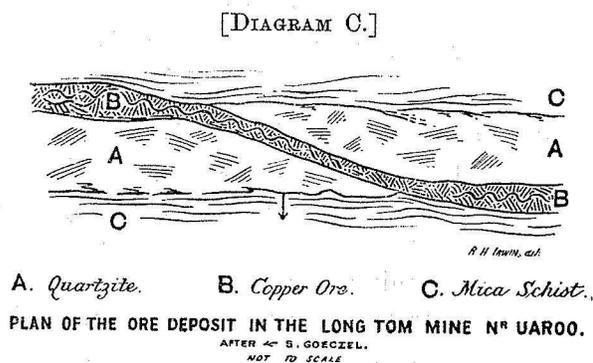
The ore deposits of Uaroo occur in the crystalline schists, which have a North-Westerly strike and a steep dip to the East. The ore consists of carbonate and red oxides of copper, associated with argentiferous lead ores.

At the date of Mr. Göczel's visit, mining operations had only been commenced on the Rainbow Reward Lease.



The deposit consists of a copper bearing quartzite (?) which has been faulted, and along the line of which argentiferous lead ores have been introduced. About 70 tons of high grade ore were at grass at the date of Mr. Göczel's inspection.

In the "Long Tom" Lease the copper lode is evidently a contact deposit at the junction of a quartzite mica schist bed, as can be seen by the section:—



The lodes, so far as may be judged by their outcrop, vary from a few inches to from two to three feet in thickness. Similar ore deposits are known to exist in many places in the district, and there appear to be good grounds for believing there are others as yet unopened.

GASCOYNE.—Reference has been made in a previous report* to the Carboniferous Rocks of the Gascoyne and the Minilya Rivers. The Minilya River, from Booracoorilya to a few miles above the junction with the North and South branches of the river, drains country underlain by beds of carboniferous age. The beds consist of sandstones, shales, limestones, and conglomerates. Near the base of the series, the boulder bed, with glaciated pebbles, alluded to in the previous report, occurs in great force in the vicinity of L 64, on the South branch of the Minilya, and can readily be followed across country for many miles. The boulder bed contains a heterogeneous collection of all varieties of crystalline rocks and very large boulders of granite. One exceptionally large flat-sided granite boulder exhibited glacial striæ in an excellent state of preservation; the boulder was too large for transport, and our attempts to reduce it to a more portable size proved unavailing. The carboniferous rocks of the Minilya, although arranged in a series of gentle folds, have a prevailing dip to the West. The Eastern boundary of the formation on the Minilya is marked by a powerful fault trending generally North and South, which throws the sedimentary beds against the crystalline rocks. The limestones and other rocks are standing on their edges in close proximity to the fault. The fossils collected during my examination of the country have been submitted to Mr. Robt. Etheridge, Curator of the Australian Museum, Sydney, who has supplied the following interim list:—

WANDAGEE STATION, MINILYA RIVER:

Fucoid.

Chonetes Pratti, Davidson?

Ptychomphalina, sp. nov. (*P. Maitlandi*, Eth. fil., M.S.)

Aviculopecten, sp. md. (portions only).

COOLKILYA POOL, WANDAGEE STATION, MINILYA RIVER:

Track caused probably by a burrowing organism.

Strophalosia Clarkei, Foord (nov. Etheridge).

HILLS ON WESTERN BOUNDARY OF WILLIAMBURY STATION, MINILYA RIVER:

Athyris Macleayana, Eth. fil.

WILLIAMBURY STATION, MINILYA RIVER:

Crinoid, Stems (in the "swollen" condition.)

Ampletus pustulosus, Hudleston.

Pleurophyllum Australe, Hinde.

Athyris Macleayana, Eth. fil.

Productus semireticulatus, Martin.

TRIG. STATION K37, GASCOYNE RIVER:

(Specimens with an ironstone glaze.)

Spirifera (partial internal cast of a large ventral valve).

Productus or *Strophalosia* (internal cast).

Athyris? (internal cast).

GASCOYNE RIVER:

Crinoid stems (fragments).

Athyris Macleayana Eth. fil.

Spirifera Musakheylensis, Davidson.

* Annual Progress Report of the Geological Survey for the year 1900. Perth: By Authority, 1901, pp. 27-28.

BARRACOODA POOL, ARTHUR RIVER :

- Evactinopora crucialis*, Hudleston.
Rhombopora tenuis, Hinde.
Athyris Macleayana, Eth. fil., var.
Productus semireticulatus, Martin?
Aulosteges, sp. nov.
Dielasma, sp. md.

WYNDHAM RIVER, LYONS DISTRICT, BOULDER BED :

- Fragments of a *Spirifera* and a *Pecten*.
Polyzoa, small fragments.

FOSSIL HILL, WYNDHAM RIVER :

- Hexagonella dendroidea*, Hudleston, sp.
Pleurophyllum Australe, Hinde.
 Crinoid stems (portions).
Polyzoa, fragments.
Spirifera Musakheylensis, Davidson.
Spirifera Hardmani, Foord?
Spirifera lata, McCoy.
Reticularia lineata, Martin, sp.
Athyris Macleayana, Eth. fil.
Chonetes Pratti, Davidson.
Productus (cf. *P. tenuistratus*), Foord.

THE ISLAND, LAKE AUSTIN.—Mr. H. P. Woodward, who visited this district in connection with an application for assistance towards testing the ore deposits at a depth, has furnished the following notes on the general aspects of the district:—

The Island is a ridge of about three miles long, which rises abruptly from the salt flat called Lake Austin. The rocks, which strike a little East of North, are schistose with diorite dykes, lenticular banded ferruginous quartz reefs and white irregular quartz reefs—all of which underlie to the Westward, whilst the ore chutes dip to the North at a slight angle. These rocks have been considerably broken by the diorite intrusions, for, although few of these outcrop, they are met with in the crosscuts below ground.

The banded quartz reefs are the main features of this district, being met with at both Mt. Magnet and Nannine, as well as 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 overlap one another and 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 the 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 this district, which rarely contain gold except when in proximity to them.

The white quartz reefs are very irregular in their course, and are included in fissures of a more recent date than the last-mentioned, which they intersect. These reefs have in parts at the surface proved to be phenomenally rich, but these patches were never of great extent, nor did any go down. The chutes of rich stone in these reefs dip to the North, but are, as before stated, influenced by the presence of the so-called ironstone lodes; they are very flat and are never of great thickness, but the stone contained is good. The reefs at a depth contain a considerable quantity of hornblende and chloritic schist, with pyrites, and assume a banded appearance something similar to the main lodes.

MOUNT IDA.—The mining centre of Mount Ida, situated in the Ularring District of the North Coolgardie Goldfield, 66 miles North-West of Menzies, was examined by Mr. H. P. Woodward, who reported that in its physical configuration, the district consisted of—

A series of low ranges running a little West of North, between which are wide stony flats. Some of these ranges are flat-topped, being apparently the isolated remains of the sandstone tableland which once covered the entire district. The geological features, from a mining point of view, are decidedly of interest, but, owing to the broken nature of the country, form a complicated puzzle to unravel until a detailed geological map of the district has been compiled. Roughly speaking, however, they may be described as a main anticlinal fold, the axis of which lies a little West of North and East of South. Of this anticlinal the arched beds have been denuded, exposing the granite core (which was evidently the cause of this contortion), upon each side of which there is a belt of crystalline rocks about three-quarters of a mile in width, which dip at a high angle upon the E. to the E. and upon the W. to the W., and it is in these zones that the auriferous veins are met with. These belts are greatly broken by a series of cross courses and faults which prove a considerable trouble to miners, since they either throw or cut out the lodes or cause the formation of secondary veins, which are sometimes rich, but which are never continuous.

To the Westward and Eastward of these belts is a belt of large ferruginous veins, some of which are said to carry gold, whilst beyond them are plains strewn with stones, with here and there large quartz blows or flat-topped ridges of the desert sandstone.

The rocks of the auriferous belt, like those of most of the goldfields, consist principally of the hornblende and chlorite series, whilst the dykes are feldspar porphyry, feldstone, quartz, hornblende, and fibrous talc veins. The rocks of the two belts are identical even to their relative positions to the lodes, for on both sides of the anticlinal we find the main lode is of the class called "contact," and lies between hornblende schists and feldspar porphyry, locally called "spotted rock."

The lodes are, for the most part, small, although they open out in places to bodies of considerable size; but, to counterbalance this, they may pinch to a mere thread of quartz or indicator for a considerable distance. The stone of the reefs carries gold throughout the so-called chutes, being that portion of the lode which is large enough to work at a profit. These vary in size, but are sometimes of considerable length. The stone in the upper levels is oxidised, but below the water level it is heavily charged with sulphides of iron and copper, the latter metal being generally associated with gold in this district.

The water supply of this district is not as a rule good, the water shaft used by the Government yielding about the best supply, whilst that at the Mt. Ida Consols is so small that, in spite of the most economical treatment, it will only supply the battery 12 hours. The water difficulty does not promise to improve with depth, since, when the old sulphide zone is entered, it is found to be hard and impervious. However, when the workings are extended in the water-bearing zone to the point of intersection of the lode with a cross course, it is highly probable an abundant supply will be struck.

Timber for mining purposes is getting scarce in the vicinity of the mines, but at present there is abundance of excellent firewood close at hand.

About five miles South of the township, upon what may be probably the Southern extension of the same belt, a patch of surfacing was discovered some time ago, the deposit dry-blown, with the result that some rich parcels of gold were found. This led to the prospecting of the reefs in the vicinity, which consist for the most part of large quartz blows, all of which proved to be barren, however. Two or three smaller parallel reefs were worked, which yielded rich stone in patches, but never in sufficient quantities to pay.

Public Batteries and Cyanide Plant.—This is a very complete 10-head stamp battery with cyanide plant upon this field, which has been a great boon to the prospector, who, without it, could not have worked their claims. During the time this has been running, a considerable quantity of stone has been crushed and yielded very good results, whilst the tailings still remained to be treated; however, since these contain a considerable quantity of copper, the extraction from the sands, although rich in gold, will be low. The stone treated at this battery amounts to 9,832 tons, which yielded 10,795ozs. 1dwt. 6grs. of gold, giving an average per ton of 1oz. 1dwt. 23grs., the total value of the gold won being £41,021.

The district generally is in a quiet condition owing to the fact that the miners have worked out most of the payable stone exposed in the workings left by the previous prospecting companies, and therefore require capital to proceed with dead work. Many of the properties undoubtedly warrant the expenditure of capital, and when it is borne in mind that a public battery, etc., exists in such a central position, there would be no need for a company to erect its own plant until such time as it felt warranted in doing so.

With regard to boring to test lodes at a depth, this cannot be recommended anyhow until a detailed geological survey has been made of the locality, owing to the fact that the lodes are so broken by dykes and cross courses, besides which the reefs themselves are so irregular in dip and size, which might lead to most unsatisfactory or erroneous conclusions, therefore by far the most satisfactory method to be adopted for the assistance of the district would be the subsidising of sinking below the water level.

Everything considered, this district may be said to be rich in auriferous quartz veins, which present all the appearance of true fissure veins, the ore bodies, although small upon the average, contain chutes of considerable extent of workable sizes, whilst the value of the ore has been so high that it has paid working miners to raise and cart to a public battery without taking into consideration the value of the tailings.

YARDARINO BORE.—Having in view the delimitation of the Western margin of the Irwin River coal measures, a bore was put down by the Government at Dongarra in the year.

The bore attained a depth of 2,111 feet 7 inches, when operations were stopped owing to the capabilities of the bore's plant being exhausted, without having proved the presence of the Irwin River Coal Beds.*

The Government having decided upon boring operations at Yardarino, one mile to the Eastward, there was then no necessity for deepening the bore originally put down at Dongara.

Boring operations were eventually started at Yardarino, and when the bore hole attained a depth of 1,607 feet, the boring tools were lost in the hole, and it then became impossible for the contractor to continue further operations.

* The Mineral Wealth of Western Australia. A. Gibb Maitland. Bulletin No. 4. Perth: By Authority: 1900, pp. 105-106.

The following is a section of the strata pierced:—

YARDARINO BORE.

Nature of Strata.	Thickness.		Depth.	
	ft.	in.	ft.	in.
Clay and sand	53	7	0	0
Quartz gravel	76	5	53	7
Yellow sand and ironstone bands	16	0	130	0
Quartz gravel	6	0	146	0
Micaceous shale	48	0	152	0
Fine white sandstone	10	0	200	0
Grit	11	0	210	0
Sandstone and shale	29	0	221	0
Micaceous sandstone	5	0	250	0
Shaley sandstone	30	0	255	0
Lignite	0	6	285	0
Shaley sandstone	59	6	285	6
Shaley sandstone (and coal?)	3	6	345	0
Shale... ..	16	11	348	6
Sandstone and shale	15	11	365	5
Sandstone, shale, and iron pyrites	74	8	381	4
Shaley sandstone	4	0	456	0
Shale and sandstone	22	0	460	0
Grit, sandstone, and shale	64	7	482	0
Grit, sandstone, and shale cemented in places with pyrites	126	6½	546	7
Shaley sandstone	75	6	673	1½
Shale	45	9½	748	7½
Grit and sandstone	30	11	794	5
Sandstone and grit cemented in places with iron pyrites	52	8	825	4
Sandstone with occasional pyrites	40	6	878	0
Shale and sandstone with pyrites	63	2	918	6
Shale	23	0	981	8
Sandstone with occasional pyrites	93	6	1,004	8
Sandstone	11	0	1,098	2
Sandstone with occasional pyrites	152	1	1,109	2
Sandstone	42	10	1,261	3
Shale	9	11	1,304	1
Grit	87	0	1,314	0
Shale	40	0	1,401	0
Sandstone and grit with occasional pyrites	166	0	1,441	0
Total	1,607	0	1,607	0

When boring ceased, the water stood at 25 feet below the surface, and at this depth 2,000 gallons per hour could be pumped without lowering the level of the water. The temperature of the water was 87° Fahr.

Two samples of the water were submitted to the Government Analyst, Mr. E. A. Mann, at whose hands the following results in grains per gallon were obtained:—

	I.	II.
Silica	·62	1·64
Iron and Alumina	·46	·28
Carbonate of Lime	4·86	2·58
„ Magnesia	3·50	6·96
Sulphate of Lime	6·60	11·36
„ Magnesia	6·72	4·96
Chloride of Magnesia	5·38	7·54
„ Sodium	67·76	128·36
	95·90	163·68

It is of interest to note that an assay at the hands of Mr. E. S. Simpson, of the pyritous sandstone, from 913 feet yielded a trace of gold to the ton.

Neither the Dongara nor the Yardarino bores having entered the Coal Measures, and the main object of the operations being yet unaccomplished, the necessity for definitely ascertaining the seaward extent of the Irwin River beds may be held to justify the expenditure necessary to put down another bore hole to the East, where it may be expected these strata would be met with at a relatively shallow depth, provided boring in such a locality would advance the general interests of the State, and not those of a private corporation.

THE DUNDAS GOLDFIELD.—This goldfield was examined by Mr. Woodward, who furnished the following report thereon:—

Although the area proclaimed as a goldfield is of considerable extent, the actual portion over which gold has been discovered is small, and seems to be confined to the Dundas Range and its Northern extension, or, in other words, the belt of land that lies between Lake Cowan and Lake Dundas.

Gold was first discovered in the year 1892, at the Southern end of the Dundas Range; but as the reefs did not prove to be very rich, little mining is being carried on at that locality at the present time. The gold produce of the district from its discovery until September of this year has been 173,799oz.

The rocks of the gold bearing belt are similar to those of the Coolgardie district, and, like that locality, the richest lodes are situated in the contact zone, upon the Eastern side of the granite. The belt is dislocated and considerably disturbed in places by the intrusion of large diorite dykes which rise as rough, reddish, black hills here and there, running in an almost East and West direction.

There are about three distinct main lines of auriferous lodes, most of which dip at an angle of about 45° and vary considerably in size and richness. A very considerable amount of development work has been done upon them, and it is difficult to understand why some of them, which are undoubtedly payable propositions, should have been abandoned, whilst in some instances it is strange to find that so much money should have been expended upon such valueless lodes.

There are several small scattered groups of mines to the North and East, but the main Northern group is called the Royal, after the Princess Royal mine, which is the principal one now at work upon the field.

The lode worked in this mine has an Easterly dip, an 80 feet vertical, giving 100 feet of backs. In the upper levels the lode is not continuous between the two underlay shafts, a cross dislocation having apparently taken place, which has also slightly altered the course of the lode. In this upper portion it is very often accompanied by that, and termed "Consort" lodes, *i.e.*, lodes which follow it lying parallel in either foot or hanging wall; these sometimes are of greater size and richness than the main lode, and are thereupon worked in conjunction with it. In this mine water was struck at 60 feet from the surface; it is very salt and in considerable volume. The lode varies in width from a few inches to 10 feet, the stone being oxidised down to the 260 feet level where pyrites makes its appearance. The main vertical shaft has been sunk to a total depth of 367 feet, passing through the reef at a point where it was very small, and consisted of only one ore channel. This will lead one to the belief that as depth is attained all the consort reefs and leaders will probably make into one body.

The two adjoining properties—the Princess Royal North and the Princess Royal South—have not yet cut the lode, but it is expected that it will be shortly. The "Desirable" is about one mile West of "Princess Royal," the lode being very similar, *i.e.* broken in the middle. The dip is, however, not so steep, in fact it sometimes lies horizontally, and varies from a few inches to four feet in width. It has been opened by two underlay shafts to a depth of 160 feet, or 80 feet vertical, which is the water level. A considerable amount of work has been done upon this mine, which, at one time, had 20-head of stampers that crushed 4,605 tons of stone for 3,925ozs. of gold, or nearly one ounce to the ton, without cyaniding the tailings. It is generally stated that the battery was a very bad gold saver, and that the stone crushed assayed about two ounces. It is difficult to understand why this property should have been abandoned, since even the results obtained should be payable.

The "Three Colonies" lies upon the edge of the lake to the West of the last mentioned, and was one of the sensational proprieties in its prospecting stage. The lode is an irregular cross-country reef, from which about 350 tons of stone have been crushed for a little over half an ounce. Water is a serious matter here as it is struck quite close to the surface, and it is in such large quantities that a tank has to be kept going to keep it down at all. A shaft is now being sunk further up the hill to open a formation that was cut in a bore, which is probably the Eastern continuation of the lode in the main workings.

Between the "Princess Royal" and the "Desirable," a deep lead has been discovered flowing in a Northerly direction, and has been opened up for a distance of about half a mile, but as the lower portion of the lead contains a great deal of water, it has only been worked in the upper.

In the prospector's claim the gutter is 102 feet from the surface, the wash being from two to three feet in thickness, but only the bottom six inches is found to be worth raising. This wash is a mottled clay with ironstone nodules and rounded quartz pebbles, whilst the gold is often found in considerable sized pieces. The gutter is 90 feet in width, resting upon a decomposed schistose bottom, the Eastern bank of which rises abruptly and the Western gradually. This lead must be of considerable antiquity as the slides that have taken place in the bed rock are often continued through the wash itself.

At Norseman itself, things are at present very quiet owing to the cessation of work at the Norseman Gold Mines, Limited, which Company owned a very large property and employed a large number of men. This Company has a subsidy from the Government to sink to a depth of 700 feet, but at present this work has been discontinued, and the lower workings are full of water, whilst the upper are let to a party of tributers.

The No. 1 North Norseman is one of the mines upon which a considerable amount of money was spent and then abandoned. The reef, which varies from a few inches to four feet in width, dips at an angle of about 40 degrees, and opened to a depth of 300 feet by a large inclined shaft, and levels at the 100, 200 and 300 feet, having a total length of about 2,000 feet. The shaft and levels are well timbered, and tram line laid throughout, but the battery and winding engine have been removed. It is now being

worked by a party of three, who raise the stone, and have it treated at the Government battery, where it generally yields two ounces to the ton. The "North Star" is a very similar class of reef to the No. 1, but the stone is not so rich nor the workings so extensive, the main shaft being 200 feet in depth with a level North and South at 160 feet. The reef varies from two feet to four feet in width.

The "Lady Jean" is situated upon a line upon the Eastern side of the hills, and has been opened up by an underlay shaft to a depth of 85 feet, with a level at the bottom, and at the 45 feet. The auriferous chutes are short, and the reef itself varies from a few inches to 3 feet, but it is lost entirely at the Northern end of the workings.

The "Mararoa" is a large quartz body upon which a considerable quantity of work has been done. Two shafts have been sunk about 5 chains apart upon the lode, which dips at an angle of 45° to a depth of 120 feet; these are now being connected by a level, which is nearly through. In the South shaft the quartz reef is of great size, sometimes being as much as 20 feet in width; this is not very rich, but at the Northern shaft a very rich chute was worked quite up to the surface.

To the Southward of the Norseman group, upon some rough hills which break the North and South gold belt, are a group of mines in which the lodes are entirely different in character, strike, and dip. The first of these is the Mt. Benson, from which a considerable quantity of stone has been crushed, yielding nearly 1oz. This stone came mostly from an adit level, but now that this has been worked out, shafts are being sunk to test a series of cross and irregular reefs at a depth, but as yet sufficient progress has not been made to determine their courses.

The "Cumberland," another of this group, has been opened up to a vertical depth of 227 feet, and four levels totalling more than 1,000 feet in length. The reef is, as a rule, small, varying from a few inches to 2 feet in width, whilst only a limited quantity was worth stoping. At the 143 feet level a new development took place in the form of a series of cross reefs, of which there are five, all of which contain stone that crushes about 1oz. These cross reefs are 3 to 4 feet in width and short in length, but will probably increase in length with depth. At the 227 feet level, seven of these cross reefs were cut, thus proving that two more have made their appearance between the two levels.

A few miles South of this group is the "Lady Mary," upon which a considerable quantity of work has been done, and a fine plant erected. The reef now being worked is of the Norseman type in the upper portion, where it dips at an angle of 45° , but lower down it pitches away at an angle of 70° .

The underlay shaft is 360 feet in depth, with a level at the bottom 170 feet in length, in which there is a fine body of lode matter, the chute being 120 feet long. The stone at this level is mineralised, but also shows gold freely in places.

The "Alikazander," although close to the "Mary," is entirely different from anything else upon this field, it being a large ferruginous formation of low grade. A shaft has been sunk to a depth of 120 feet upon it, and at the bottom there is a level and crosscut, which latter proves the lode to be 30 feet in width. By battery treatment this stone yields from 12 to 15 dwts., but the sands and slimes contain a quantity of fine gold. A great deal of work has been done on this property in the way of tunnels, of which there are about three, each being of considerable length, and in which the large lode was crosscut.

It is rather distressing to see so many apparently payable properties upon which so much money has been expended, either abandoned or being worked by one or two working miners. However, when the railway system connects with Norseman, this field is bound to have a revival.

THE PHILLIPS RIVER GOLDFIELD.—In the year 1900, Mr. Blatchford, the then Assistant Geologist, reported upon this field in its earlier stages, and the following Report by Mr. H. P. Woodward, furnished during the year, serves to supplement the information already obtained:—

This, the most recently discovered goldfield in the State of Western Australia, is situated upon the Southern coast, about 150 miles to the Eastward of Albany, and immediately adjoins the Dundas Goldfield upon the West.

Its port is Mary Ann Harbour (the township being called Hopetoun) which is served by a weekly steamship service from Albany, whilst there is a telegraph station both here and at Ravensthorpe, the official centre 30 miles to the Northward.

The coast line in the vicinity of Hopetoun is low and sandy, along which numerous granite reefs are encountered even for a considerable distance out to sea.

Behind the town a semicircular sandy plain extends, measuring about 20 miles East and West, and 10 North, behind which the country gradually rises towards a low range which runs in a crescent shape from East Mt. Barren upon the West in a North-East direction, then East and then South-East to the coast. The whole of this basin is drained by the Steere River, which discharges itself into Culham Inlet, near the base of East Mt. Barren; but since this river has not run for a considerable time, the pools are quite salt, and the Inlet (large lake behind the coastal sand hills) contains only a few inches of water.

After crossing this range, the country is hilly and broken to the foot of the Ravensthorpe Range, which is a fairly defined range of hills that run from North to East, and then turn South-East, attaining its greatest elevation at Mt. Desmond, which is situated to the South of the gap, at which point the range takes its Southward turn.

This basin, which lies between the first-mentioned low range and the Ravensthorpe, is drained by the Phillips River, which discharges itself into the sea to the Westward of East Mt. Barren.

In the coastal section the soil is for the most part poor and sandy, although in some low swampy patches there is good black soil and limestone. Nothing but the ordinary sand plain vegetation and marlock (mallee) grow upon this belt.

In the next section, which embraces the gradual slope towards the low range and the range itself, the soil improves considerably, there being considerable areas that are covered with light loams and clays, but the large proportion consists of ironstone and rocky outcrop. This belt is mostly covered with marlock, with here and there small patches of yate.

In the Phillips basin a very marked improvement in the nature of the soil takes place, there being very considerable tracts of rich red clay and loam which often attain a thickness of nine or ten feet. This country is, as a rule, thickly timbered with marlock and salmon gum, but the latter rarely attains to considerable size. When, however, clear patches are met with, the ground is covered with fine crops of grass. This soil would make excellent agricultural land owing to the fact that it is a good strong soil and contains a certain quantity of gypsum, which causes it, when dry, to crumble, thus allowing the air to influence an oxidising action upon the minerals contained in it.

There are, of course, also poorer patches and belts in this basin, particularly near the base of the range where the granitic rocks outcrop; these belts are clearly marked by the class of vegetation, which is always of a stunted and scrubby nature.

Here, like all along the Southern coast, we find that a great disturbance has taken place in long bygone geological ages, by which the main strike of the metalliferous series has been thrown into a more or less Easterly and Westerly direction by a great granite intrusion, but unlike most of this coast, the mineral bearing series approach the coast more nearly, the granite only appearing as reefs upon the beach and out at sea, although they probably extend for about ten miles inland beneath the recent coastal sandstones and limestones to the Northward of Hopetoun.

A few miles to the Westward of Hopetoun a bold rock mass rises abruptly called "East Mount Barren"; this is the Eastern end of a range which runs along the coast for a distance of about 40 miles, the rocks of which consist of hard highly crystallised rocks and quartzes, being destitute of metalliferous mineral veins.

From the Eastern end of this range is a low semi-circular range of schistose rocks with large pink quartz reefs traversed by numerous porphyritic dykes having a well defined North-West and South-East course, whilst diorite dykes are of less frequent occurrence. These rocks, to judge from their weathered surface, are hornblende and mica-schists with veins of dolomitic limestone, the latter having probably furnished the magnesian limestone with which the fragments of the rocks are encrusted. This series, so far, has not proved to be metalliferous. In the Phillips River basin a marked change in the nature of the country is at once apparent, not so much from the rocks themselves, since they rarely outcrop, but from the soils which result from their decomposition. Upon sinking, these rocks prove to be hornblendic and mica-schists similar to those of the Northern goldfields with granite and feldspathic dykes, the latter of which are often garnetiferous, whilst diorite dykes are abundant, and are of considerable extent and size, having apparently exercised a direct influence upon the formation of the mineral veins which occur in this series.

The Ravensthorpe Range itself consists more of the granitic series, being capped by ferruginous sandstones, and is untraversed by diorite dykes or mineral veins; the only dislocation being at the gap, where it takes its turn South-East at the apex of the diorite intrusion. Of the dykes, the granite (locally called "mica bars") are the most recent, for they often cut through the lodes, whilst probably the diorite are next, since the felstones, with their associated copper lodes, seem to have been dislocated at the same time as the range.

The lodes may be divided into two classes—those in which copper is of the greater intrinsic value, and those in which gold is. The first of these have been opened upon at three different parts of the field, viz., Ravensthorpe, Mt. Desmond, and Harbour View.

The Ravensthorpe belt of copper lodes strikes in an East-North-East and West-South-Westerly direction from the North-West corner of the township, and extends for a distance of 5 miles; it consists of two groups, the first or central lies to the North of the township, and extends continuously for a distance of 2 miles, after which there is a gap of $1\frac{1}{2}$ miles, and then the Eastern group of leases for a distance of $1\frac{1}{2}$ miles.

Three miles in a West-South-Westerly direction from the Westernmost lease of the central group are three large mineral leases, which may be called the Western group, upon which the earliest discoveries of mineral upon this field were made; these are possibly upon the same belt, but no definite statement can be made since lines of rock outcrop cannot be traced, owing to the thickness of the superficial deposits; prospecting is therefore rendered difficult, and the presence of reefs and lodes only determined by small fragments upon the surface. This, it may be remarked, is the general characteristic in the Ravensthorpe District of both gold and copper lodes, whilst further it is not at all exceptional to discover, after finding fragments of lode matter upon the surface, that some 4 to 6 feet of clay, destitute of stone, has to be passed through before the cap of the lode is encountered.

Although this belt has a general direction East-North-East and West-South-West, the individual lodes, as a rule, strike almost East and West, or a few degrees North of East and South of West with a general Northerly dip; the exception being in some few lodes which dip to the Southward.

The Central Group.—This group consists of eleven leases, the earliest discovered being the Mt. Cattlin, M.L. 15, upon which a large lode has been opened upon for a length of 6 chains, varying from 5 feet to 15 feet in width, and sunk upon by an underlay shaft to a depth of 72 feet, in which the lode has been cross-cut at the 30 feet level where it is 15 feet wide, and the 54 feet where it is 17 feet wide, below which the sulphides make their appearance; but water has not yet been struck. Five tons of ore have been shipped from this mine, which gave a return of 19 per cent. of copper and $\frac{1}{2}$ oz. gold per ton.

On the Marian Martin, M.L. 16, lodes have been opened at three points across the lease, but although these shafts are upon the general line of strike, there is nothing to prove that they are upon the one lode; in fact, everything points to the existence of two lodes, one striking East and West, and the other East-North-East and West-South-West. The Northern lode, which is 3 feet in width, has been opened upon to a depth of 15 feet near the Eastern boundary, and the ore taken out for a distance of 20 feet East, whilst in some trenches a little to the South-East a lode is exposed which cannot be the same, unless a throw of some 15 feet or 20 feet has taken place, and the course of the lode changed. Near the centre of this lease this last-mentioned lode has been opened upon by an underlay shaft for a depth of 35 feet, in which the sulphides were cut at 20 feet from the surface.

From the Westward of this shaft the ore has been removed to a depth of 10 feet, and for a distance of 30 feet, in which the lode was 4 feet 6 inches in width. Near the Eastern boundary another shaft has been sunk to a depth of 40 feet, in which the sulphides were cut at 30 feet from the surface. From this lease between 60 and 70 tons of ore have been shipped, which averaged 20 per cent. of copper, whilst a large quantity has been bagged for shipment.

The Zelandia, M.L. 46, has been opened by an underlay shaft at the North-East corner to a depth of 62 feet, down which a nice vein of ore from 2 feet to 3 feet in width was followed. At the 40 feet a level was driven for a considerable distance to the Eastward, in which the lode was thrown by a number of cross faults to the Northward, whilst in the Western level the reef behaves in a similar manner. A new shaft is now being sunk upon the lode to the Westward, from which some nice ore is being raised. A good many tons of ore have been shipped from this lease, and there are still a number of bags ready filled, which should go from 20 to 25 per cent.

The Grimsby, M.L. 110, has two lodes, 18 feet apart at the surface, which dip towards each other, and should junction at a depth of about 100 feet if the present dip continues. These lodes have been sunk upon to a depth of 40 feet, and prove to carry a good vein of ore from 6 to 12 inches in width, sulphides being met with at the bottom. A parcel has already been shipped, and more is now being bagged, which should yield from 10 to 15 per cent. of copper.

The lodes upon the other members of the group are many of them promising, but as yet very little development has taken place.

The Eastern Group.—The Eastern Group, which consists of the Kingston, Ravensthorpe, Mary, etc., have not been sufficiently developed yet to say much about, but upon the Mary, M.L. 7, the developments are promising.

The Western Group.—The Western group, consisting of the "Surprise" and "Jim's Wonder" are practically abandoned, but there is no doubt that these and the intermediate land between the various groups will be thoroughly prospected so soon as the facilities for the treatment of ore improve, since, at the present time the cost of £7 per ton (exclusive of cost of raising, bagging, etc.), practically handicaps working miners, and renders it impossible for them to ship anything but high grade ore.

The Mt. Desmond (Elverdton) group is situated near the hill of that name 6 miles South-West of Ravensthorpe township. The principal mine here is the "Elverston, M.L. 95," across which the lode runs in a North and South direction. It has been opened upon for a length of 200 feet by three shafts, the Northern of which is 25 feet, the middle 81ft., and South 45ft., whilst most of the lode has been stoped from the 25 feet and 45 feet levels to the surface. The lode varies from 2 feet to 8 feet 6 inches in width, but averages, as a whole, 6 feet in width, from which 400 tons, averaging 28 per cent. of copper and 6dwts. of gold, have been shipped, whilst about 50 tons more are bagged ready for shipment. There are also about 1,000 tons of seconds which are estimated at 10 per cent. of copper at grass. The ore exported, so far, after carriage and all charges were deducted, has given a return of £20 per ton, which must have yielded a very handsome profit over working costs. No water has yet been sunk, and the sulphides were not cut until the main shaft was down 70 feet from the surface. Portions of the lode carry very rich veins and bunches, from which all the ore shipped was won, since this needs no dressing but simply breaking small and bagging.

The "Elverston South" is the same lode, but here it needs more dressing; it consists of nodules of green carbonate in a kaolinised matrix which is washed away in an adjoining creek, after which the clean ore is bagged.

The lodes which lie to the Eastward of this line strike more to the East of North; some of them are large kaolin veins with bunches of green carbonates, whilst others are compact veins of ore from 6 to 12 inches, which is rich enough to ship without dressing.

The Harbour View Group.—The Harbour View group is situated about 6 miles to the South-East of the last-mentioned, and the mine which gives its name to the locality was the first to be discovered in this locality. The lode here, as at Mt. Desmond, strikes nearly North and South, with a Westerly underlay, it averages 4 feet in width, and has been opened upon an underlay shaft to a depth of 80 feet, from which levels have been driven North at the 35 feet for a distance of 20 feet, and at the 80 feet for a distance of 100 feet., in which latter there is a break in the lode about 50 feet North of the shaft. This, however, is only local, since the cap of a good strong lode body can be traced over the entire length of the lease. The ore body is solid and clean, 70 tons of which have been shipped, which yielded 23 per cent. of copper and 1½ ounces of gold per ton. A large quantity more is on its way to the smelters, whilst a large and continuous output can now be kept up since no stoping has yet been done.

The "Red, White, and Blue," M.L. 60, lies to the Eastward of the last mentioned, and in it the lode strikes in an East and West direction, with a dip to the South, which has been opened upon for a distance of 11 chains. In the vertical shaft, which has been sunk to a depth of 110 feet, the lode has passed through at a point where it measured 12 feet in width; but as a general rule when it is exposed it is smaller, and will probably average from 5 to 6 feet over its entire length. In some parts of this lode

the cap consists almost entirely of iron, with only a small percentage of copper, but, since as a rule at these points it is extra rich in gold, it will probably all pay to smelt when greater facilities offer. These latter remarks also apply to the Harbour View, which is by many persons supposed to be the continuation of the same lode, thrown by the great quartz intrusion to the Southward, which apparently cuts off the mineral bearing country.

Eleven tons of ore were sent from this mine, which yielded 29 per cent. of copper and 7 dwts. of gold; whilst a small supply, shipped when more iron was present, yielded 10 per cent. copper and $1\frac{1}{2}$ ozs. gold. There are eight other leases in this locality, which are still in the prospecting stage.

The track of country between the Harbour View and Mt. Desmond should be prospected, since there is every prospect that other rich lodes will be found in this belt. The copper prospects of this field are distinctly encouraging, for not only are the lodes large and rich, but they all contain an appreciable quantity of gold, which latter metal is in greater abundance as a rule in those portions of the lode in which there is less copper, and since the whole lode masses contain a sufficiently high percentage of copper to warrant it all being smelted, the whole gold contents will also be secured, which will add considerably to the value of the resulting matter.

About two chains North of the 70 feet shaft is one which has been sunk to a depth of 30 feet, in which the reef is 1 foot 6 inches in width. A little to the Eastward of the Northern shaft a small parallel reef 2 feet in width has been opened upon to a depth of 40 feet, the stone from which assayed from $1\frac{1}{2}$ to 2ozs. The strike of this lode is 25° East of North, with a Westerly dip; its outcrop has been opened at several points for a distance of about half a mile over the adjoining leases.

"The Grafter," G.L. 17, is the next property to the Westward, which has attracted considerable attention owing to the richness of the stone, but up to the present the main lode has not been opened upon, the rich stone being raised from two small spur veins, one of which has been sunk upon to a depth of 70 feet, the stone from which is said to average 3 ozs. What appears to be a main lode lies a little of the Eastward of these two shafts. It has a large ferruginous outcrop, and is said to prospect well. This is now being crosscut for from the bottom of the North shaft.

The next main line is the "Floater," M.L. 24, the outcrop of which has been traced for a distance of one mile for certain, whilst many prospectors claim for it double this distance, and they may be right. It has been opened upon to a depth of 200 feet by a large vertical shaft, which has been sunk entirely in the body of the lode, from which some 500 or 600 tons of stone, which assays rather over 2ozs., are at grass. A battery is in the course of erection upon this lease, but strange to say, although located in a valley, no water has yet been cut in the shaft.

At the North end of this line is the "Lady Bertram," which is clearly the same line of lode, the strike of which is 20° East of North, and dips to the North-West. The reef is three feet wide, and has been sunk upon to a depth of 80 feet, the sulphides being met with at the 50-foot level, whilst the stone assays from 2oz. to 3oz.

The North shaft has been sunk to a depth of 53 feet vertical, but only cut the reef at 50 feet from the surface. At the South end of this line is the "Albavale," M.L. 27, where a large lode has been opened upon for a length of four chains by four shafts—two to a depth of 60 feet and two to 30 feet. From the two 60-foot shafts levels have been driven North and South, and a large quantity of stone raised, in which the gold is very fine. Fifty tons of this are now being bagged and shipped for treatment in Victoria. The North shaft, which is 30 feet, did not cut the reef, on account of a throw, but it was picked up by a crosscut from the bottom of the Eastward.

The "James Henry," G.L. 26, line strikes North-East, dips North-West, and can be traced for a distance of about one mile, and has been sunk upon in this lease to a depth of 80 feet, with a level drive 50 feet North, in which the reef averages 2 feet in width, the stone from which is said to assay extremely well.

The oxidised portion of the lode does not extend far from the surface, below which sulphides occur in abundance to the water level at the bottom of the shaft.

On the "Cousins Glory" and the "Phillips River Proprietary" there are several shafts upon the same lode, which vary in depth from 20 to 60 feet, or water level; whilst upon the last-named, which is admirably situated, a battery is being erected.

The "Lady Annabel" line runs parallel, and only a little to the Westward of the last-named. It is very highly mineralised below the water level, but above this it consists often of a solid mass of oxide of iron. A shaft has been sunk upon Lease 21 to a depth of 50 feet, the water being struck at a depth of 30 feet from the surface, at which level a drive is being driven, which is now in 40 feet South-West. This stone is said to assay very well.

Although not continuously traced at the surface, a reef of very similar character has been opened up upon the "Annabel South," the "I.X.L.," and the "Monarch," covering a distance of about one mile, and which is very probably the same lode.

The next line is the last and most Western, which is called the "Diamond Jubilee," after Lease 16, upon which gold was first discovered. Upon this lease an underlay shaft has been sunk to a depth of 100 feet, in which the lode varies from a few inches to 4 feet in width, and is said to be very rich, especially where the reef makes in size. Whether the lode in the "Alpha" is a continuation of the same line or not it is impossible to say, but it is probable, and, if so, this lode will prove to be of the usual length of a mile, viz., from the "Jubilee South" to the "Alpha."

There are a few more leases to the Westward, but up to the present no well-defined lode has been discovered upon them. Between the various main lines mentioned above there are a series of small and large lodes, but these have not up to the present been sufficiently prospected to determine whether or not they are main fissures, and have any extent. Upon this field there is nothing very sensational, visible

gold being the exception, since it is as a rule fairly disseminated through the stone which, in the oxidised zone, generally carries a considerable quantity of oxide of iron and sometimes copper stains, whilst below this, which is never at a great distance from the surface, sulphides are principally met with, which point must not be lost sight of in the selection of plant for ore treatment.

Another feature of the field is that large reefs are the exception, and therefore it is necessary that they should be rather above the average in rich ores to make profitable mines.

Very little work has been done considering the length of time that these leases have been held, but this is only what is to be expected considering that the work of development has been left entirely to working miners or small syndicates without capital, whilst the cost of shipping and treating ore from the field, is too great to yield a return from even two-ounce stone, therefore the owners have had to exercise a waiting policy until a battery was erected upon the field. This may now be said to be almost an accomplished fact since two are in the course of erection, whilst foundations for the third is being prepared, and therefore in a short time it is expected that the true value of the various leases will be determined, when it is to be hoped that many of the promising ones will attract the attention of persons or companies that are in a position to work them properly for the benefit of themselves and the State.

This naturally brings us to the water question, which is going to be a difficult problem, since the rainfall is small and light, spread over many months, so that the creeks rarely run except after thunderstorms (in fact there is no appearance of this having taken place for many years); the ground is bad for holding, and the water level and underground supply very variable and very uncertain, whilst the water is generally salt. Up to the present neither of the companies that are erecting batteries have a drop of water, whilst the third—where the foundations are being prepared—has a water supply, but no battery. Timber will also be a serious item since the local marlock, etc., although good enough for prospecting, will be of little use in opening up mines, since both it and the salmon gum do not stand well in the ground, although making excellent firewood.

Carting too is a serious item, added to which the cost of shipping to the miserable little port where there are no facilities for landing timber or machinery, will render the preliminary working of this field extremely expensive. Taken as a whole the field is a very promising one, since there are a number of well defined fair and large-sized gold lodes which are of apparently paying value, whilst the copper lodes have been proved to be decidedly so, for in several cases, in spite of the large costs in connection with the treatment of the ore, they have not only paid all expense, but repaid the purchase money and something over.

What these mines need is a smelter on the ground, so that the ores could be matted up to a high percentage; such a smelter would be able to utilise some of the rich ironstone lode caps, and all the concentrates from the batteries, and should be an exceedingly profitable undertaking, since there is abundance of ore in sight to keep a 30-ton furnace going.

NORSEMAN GOLD MINES, LIMITED.—As alluded to in my report of last year,* financial assistance was rendered to this company, to enable them to explore the deep levels by sinking the Viking shaft from 450 feet to 700 feet. The following table gives the particulars of assays made in the Departmental Laboratory as the work proceeded:—

Lab. No.	Depth in feet.	Assays.
3020	460	Gold, 20 grs. per ton; silver, 2 dwts. 11 grs. per ton.
3021	470	Gold, trace; silver, 2dwts. 11grs per ton.
3022	480	Gold, trace; silver, <i>nil</i> .
3023	490	Gold, trace; silver, 2dwts. 11grs. per ton.
3024	500	Gold, 1oz. 16dwts. 18grs. per ton; silver, 3ozs. 19dwts. 5grs. per ton.
3025	510	Gold, 2dwts. 11grs. per ton; silver, 15dwts. 12grs. per ton.
3026	520	Gold, 20grs. per ton; silver, 1oz. 3dwts. 16grs. per ton.
3268	530	Gold, 20grs. per ton; silver, 20grs. per ton.
3269	540	Gold, 20grs. per ton; silver, trace.
3270	550	Gold, 3dwts. 6grs. per ton; silver, 4dwts. 22grs. per ton.
3271	560	Gold, trace; silver, <i>nil</i> .
3272	574	Gold, 20grs. per ton; silver, 20grs. per ton.

ALLUVIAL DEPOSITS, SIBERIA.—In February, 1901, the Assistant Geologist, Mr. W. D. Campbell, in accordance with instructions, submitted the following report upon the occurrence of deep alluvial ground at Waverley (Siberia):—

For several years sinking for deep leads has been tried to a limited extent with poor results, the deepest shaft has been from 92 to 93 feet by Hornby's and Gregory's party. In September last, application was made by the Siberia Progress Committee, to the Hon. the Minister for Mines, for testing the ground by means of bores. Alluvial gold was found in November near the Majestic Gold Mine by means of prospecting shafts at a depth of 26 feet. This lead is about three-quarters of a mile due East of the hilly ground on which the Invincible and Camperdown Gold Mines are situated, where some rich lodes are being worked, from which this gold may have been derived. There have been also several patches of surface alluvial gold found adjacent to these lodes. Boring would materially facilitate operations, as there are no surface indications of the deep lead, it being across the toe of the hill slope. The yield of the workings so far has been about 8dwt. of gold per man per week; just sufficient to pay for food and encourage further prospecting. The area of the lead can only be of small extent. The material sunk through is a compact, dry, ferruginous sand, resting on a diorite bottom.

* Annual Progress Report of the Geological Survey for the year 1900. Perth: By Authority: 1901, pp. 25-26.

Another locality that is being tested for a deep lead is an extensive flat one mile on the Western side of the same lode, and North-East from another auriferous line of hills that embrace the main Siberia mine. Here a prospecting area is held by Jergo and party, who have found a fine wash at a depth of 80 feet below kaolinised material, but with only a trace of gold so far. There must be a great extent of deep ground here, judging by the very large size of the timber along the flat for a distance of several miles. My attention was also drawn to another flat, about one mile to the South of the same Invincible Gold Mine, that might probably yield some good results if it could be tested by boring. These flats receive the washings of a number of gullies which have been worked, yielding coarse gold and supporting a population of from 50 to 200 diggers. It is not possible to ascertain the yield, but it has evidently been very profitable to the persons engaged. . . . Mr. Campbell selected three areas for boring, all of which seem to offer reasonable prospect of success, and located 33 bore sites. In consequence of the estimated heavy expenditure involved in carrying out the operations originally outlined, the number of bores was reduced to 20. These were distributed between the three areas with the view of affording the same information, though in a slightly different form. Boring operations, upon the modified scheme, were carried out during the latter part of the year. Twenty-eight bores were sunk to depths varying from 26 to 117 feet.

A plan of the bore sites, and sections showing the information at present obtained, has been prepared and is attached (Plate I.)

No defined gutter has been located by the operations, and it is very doubtful, from the evidence so far adduced, whether any extensive area of deep alluvial ground exists in the vicinity of Siberia. Traces of gold have been found in the detritus passed through in several of the bore holes, but in no case in such quantities as would warrant the sinking of shafts.

GENERAL.

The Department is indebted to Mr. R. Etheridge, jun., Curator of the Australian Museum, Sydney, for important assistance rendered gratuitously in the determination of fossils which have been submitted to him from time to time.

The various members of the staff have, without exception, continued to discharge their respective duties with assiduity and efficiency, and have never hesitated to extend their labours far beyond official hours whenever the exigencies of the work demanded.

I have, etc.,

A. GIBB MAITLAND,

Government Geologist.



The Hon. H. GREGORY M.L.A.
Minister of Mines.

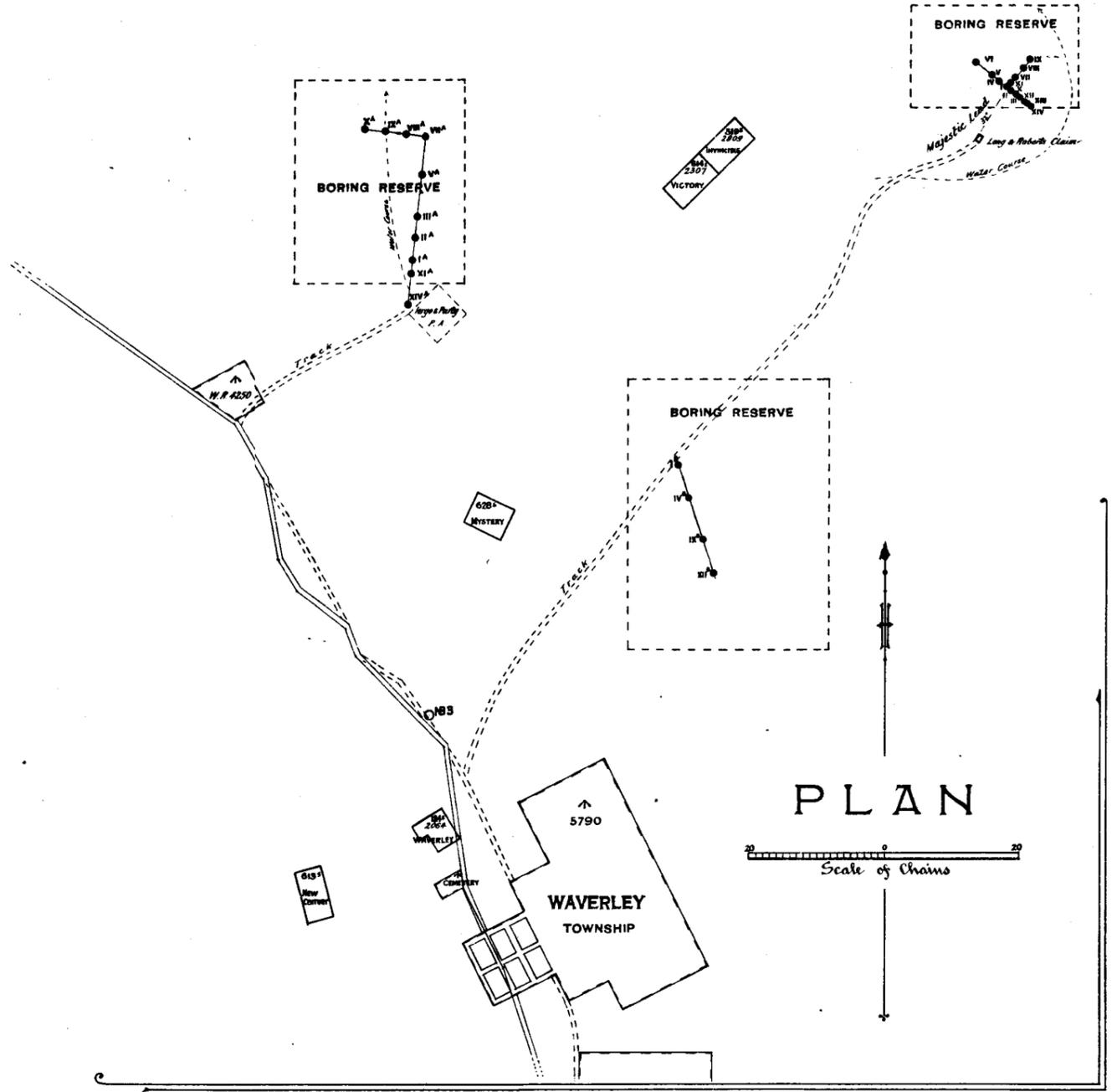
GENERAL PLAN AND SECTIONS Shewing results of Boring for Alluvial Leads at

WAVERLEY (SIBERIA)

COOLGARDIE G. F.

BY
W. D. Campbell A.M.I.C.E., F.G.S.,
ASSISTANT GEOLOGIST

To Accompany Annual Progress Report of the Geological Survey for
1901

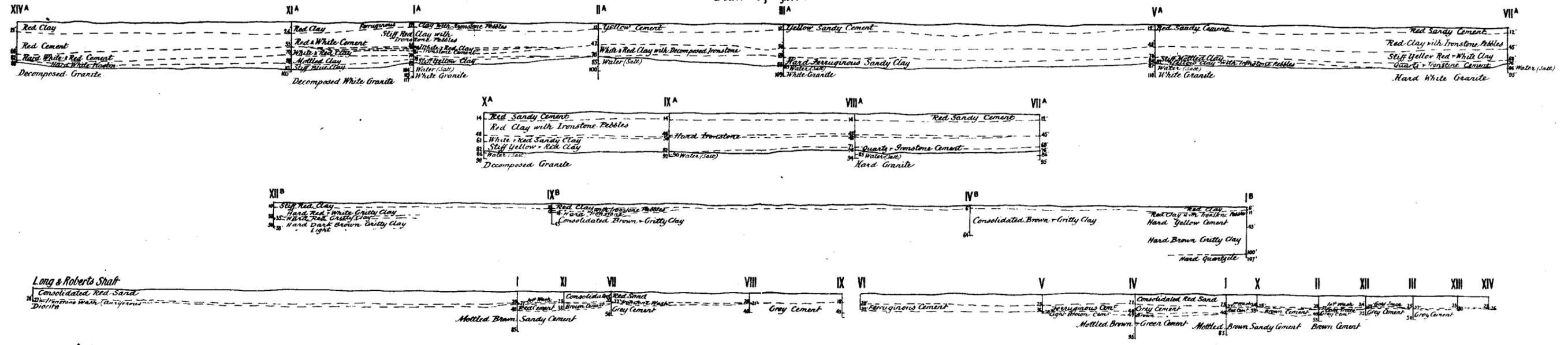


PLAN

Scale of Chains

SECTIONS

Scale of Feet



NOTE — NO WATER MET WITH EXCEPTING WHERE STATED IN SECTION.