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WESTERN AUSTRALIA.

R E P O R T

OF THE

DEPARTMENT OF MINES

FOR THE YEAR

1896,

WITH SUPPLEMENTARY NOTES ON PART OF 1897.

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

[SECOND SESSION OF THIRD PARLIAMENT.]

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Annual Progress Report of the Geological Survey for the Year 1896.

Report of A. Gibb Maitland, Government Geologist.

APPOINTMENT.

I accepted the appointment of Government Geologist on the 18th of July, and after completing for the Queensland Department of Mines the report and map on the work upon which I had been engaged in the Gulf of Carpentaria, I left Brisbane on the 20th of October, arriving in Perth on the 9th of the succeeding month. I reported myself to the Honourable the Minister for Mines on the following day.

OFFICE WORK.

About three weeks were devoted to making the necessary arrangements with reference to the furnishing of the offices placed at my disposal, as well as attending to other official details.

THE ORGANISATION OF A GEOLOGICAL SURVEY.

At the request of the Minister for Mines I drew up a report upon this subject, and showed that the principal object of a geological survey is to prepare geological reports and maps, such as can be used by the Government and the public in dealing with all general questions which may arise in connection with mining, water supply, agriculture, and other industrial pursuits. In a country which depends so much upon its mineral wealth, the survey must, of course, devote itself to those problems in economic geology which it is essential should be solved—if that be possible—without, however, neglecting purely scientific questions; for the economic and scientific aspects cannot be entirely separated.

It is highly essential that the Goldfields of the Colony should be systematically investigated, and geological maps, accompanied by descriptive memoirs, prepared and made readily accessible to the public.

At the present time there is no official map which shows even the simplest data, namely, the direction in which the reefs and lodes trend, as well as the amount and direction of their underlie. The geological examination of the fields would afford opportunities for this state of things being remedied.

The head-quarters of the survey should be in Perth. According to the Estimates, as passed by the Members of the Legislative Assembly on the 19th October, 1896, and ordered to be printed, it appeared that provision had been made for two assistant geologists, one of whom was to have his head-quarters at Coolgardie, and the other at the Murchison. The control of the scientific staff should be vested in the head of the Geological Survey, and such cannot be exercised if the geologists are to be stationed at either of the places mentioned. Scientific officers cannot work together unless they have access to the work of their colleagues, such as can only be obtained in the head office in Perth.

The preparation of geological maps and reports can only be effectively carried out at head-quarters under the supervision of the geologist responsible for the field work. To have the head-quarters anywhere but at the office of the Geological Survey is to condemn the travelling officers to fall behind the times in a manner which will seriously impair their efficiency. If there are to be two branch offices as suggested, a considerable sum will have to be incurred in providing each member of the staff with an office and laboratory; for a geologist without the means of testing and examining his specimens is like a ship without a rudder.

Attached to the office of the survey should be a Museum of Practical Geology, of which the Government Geologist would be, *ex officio*, the Curator. Such a Museum should contain maps of the districts visited and reported upon by various members of the staff, the minerals, rocks, and fossils collected, as well as the cores and drillings from all the bores in the Colony. The collection would consist almost entirely of Western Australian exhibits, and thus form an illustration of the mineral resources of the Colony. A typical collection of minerals, arranged scientifically, should be purchased and placed on view for the purpose of comparison. To the Museum should be attached a well appointed Library, containing works on Geology, Mining, and other cognate subjects, for the use of the scientific staff. The Library would be increased by the exchange of publications with kindred institutions throughout the world.

The position of a geological surveyor requires special qualifications and training, for which the salary voted by the Legislative Assembly is insufficient to secure men of the requisite stamp. With the view of increasing the efficiency of the Department, so as to meet the requirements of the present day, it is essential that the remuneration voted for the salaries of the geologists be increased to an amount which will enable the Department to secure and retain the services of properly trained officers.

Topographical maps being absolutely essential to satisfactory geological work, and map making in a country like this having come to consume an ever increasing share of the geologist's time, the services of a topographical surveyor are essential to prepare the field maps in advance of geologists.

During the course of the field work a great deal of material accumulates, of which it is essential that analyses and assays be made either for the purpose of being embodied in the reports, or for the information of the Mines Department. It is essential that this work should be done under the direct supervision of the Head of the Survey; and such can only be the case by the appointment of a Chemist and Assayer, whose laboratory and work-room are under the same roof as the offices of the Government Geologist.

The Chemist and Assayer should be paid a fixed salary, and be allowed to perform assays for the public, without unduly interfering with his official work, at fees in excess of those charged by professional men engaged in similar work in a private capacity. The fees derived from this source could be devoted towards increasing the efficiency of the office, by the purchase of additions to the laboratory, the library, or the museum.

As perhaps no branch of the service will have more occasion to avail itself of the statistics and underground plans accumulated by the Mining Record Office, it might be advisable to place this under the control of the Government Geologist. Such a transference would not entail any increased expenditure, as the machinery necessary for the collection and utilisation of the Records already exists, and the salary of the clerk in charge has been provided for in the Estimates. Clerical assistance in the office of the Geological Survey is necessary. Without interfering with his present duties, the officer in charge of the Mining Records could perform the work of confidential clerk to the Government Geologist and thus save the expense of an additional appointment.

The services of a lithographic draftsman are absolutely essential for the preparation of maps for publication, as well as to complete the plans required for out-door work, and to perform all the other drafting which the exigencies of the office demand. Provision for a draftsman having been made in the Mining Record Branch, its transference to the Geological Survey would not necessitate a fresh appointment, but as the officer would require qualifications over and above those of an ordinary draftsman, the salary will have to be increased accordingly.

To assist in performing some of the routine work in the office, helping in the laboratory and the field when required, the services of a cadet would be advantageous.

The means of transport, forage, field equipment, wages of camp assistants, and other incidentals, form such a considerable item in the expenditure of a Department the officers of which must travel so extensively in various parts of the Colony, that in order to meet all possible contingencies, an adequate sum will have to be set apart for this purpose; and all whose duties entail periodical absence from headquarters be paid actual travelling and incidental expenses incurred.

If geological work of the nature above set forth is to be of any service to the country, the officers of the Survey should not be sent on every wild goose chase suggested, or examine every claim in the country; but an attempt should rather be made to carry out the operations as an organised whole. Should any important discovery be made, or a point arise upon which the Government requires information, a Geologist could always be instructed to report.

The Geological Survey and its officers should be under the immediate and direct control of the Government Geologist, who alone should have the direction of matters appertaining to the Department, subject only to the authority of that member of the Government entrusted with the administration of the Department of Mines.

FIELD WORK.

My field work during the year was mainly directed to the question of artesian water. In this connection I reported upon Coolgardie and Kalgoorlie, Menzies, and Northampton.

ARTESIAN WATER.

COOLGARDIE AND KALGOORLIE.

The success which has attended the sinking of artesian wells in the sister colonies has suggested the possibility of ameliorating, by similar means, some of the conditions of life upon the Goldfields of the Eastern interior of this country.

A prevailing notion in certain circles is that if a well is only carried deep enough, an abundant supply of artesian water is assured. As Mr. H. P. Woodward, the ex-Government Geologist, has gone so fully into the structure of artesian areas,* and the conditions under which water is found therein, it is not necessary for me to re-discuss the question.

COOLGARDIE.

The country in the vicinity of Coolgardie consists of granitic rocks on the West, succeeded by schists, which are intersected by dykes of greenstone † on the East.

These rocks are affected by weathering to such an extent as to allow of the percolation and transmission of water to a depth, depending, amongst other causes, upon the nature of the individual rocks.

From the official records of the three town wells in Coolgardie, furnished by the Goldfields Water Supply Department, it appears that the zone of decomposition extends to the depth of at least 160ft. A fair supply of water has been obtained from these wells.

At the corner of Wilkie and Parkes Streets, on Reserve 3096, is the site of what is known as Number 1 Bore, put down by the Goldfields Water Supply Department. The well has been sunk to a depth of 165 feet.

* Mining Handbook to the Colony of Western Australia. H. P. Woodward, 2nd Edition. Perth: By Authority: 1895, pp. 39-42.

† I use this term as being convenient, pending further examination.—A.G.M.

The section disclosed the following:—

	Thickness.		Depth.	
	ft.	in.	ft.	in.
Sand	7	0	7	0
Cement and Conglomerate	47	0	54	0
Decomposed Granite	111	0	165	0

This well yields a pumping supply of about 6,000 gallons of salt water per diem. The water is said to be the most suitable for condensing purposes of any in the district. From observations which have been made, I am informed that there has been a gradual decline in the yield of this well, from about 7,000 gallons per diem to its present amount. The site of the Number 1 diamond drill bore at Coolgardie is on Reserve 3647, distant about two miles South-West from the Railway Station.

At the date of my visit, 4th December, the drill had reached a depth of 500 feet. The core was drawn in the presence of Mr. Hector and myself, and was found to consist of a very hard micaceous granite. From the surface the first five feet of the bore penetrated a conglomerate, which gave place to a very decomposed granite. This zone of decomposition extended to a depth of about 35 feet from the mouth of the bore.

From this depth the rock gradually increased in hardness until 500 feet had been reached. If the granite is not intrusive, but older than the schists, it is not at all likely, if boring is continued, that any change will be disclosed, unless, perhaps, in the direction of increased hardness, or the piercing of a greenstone dyke. Should the granite be intrusive, it is within the bounds of possibility that it may give place to schists, but no favourable change in the hardness or compactness of the rocks could, under these conditions, be expected.

None of the rocks of the Coolgardie Goldfield being below the level of the weathered zone, are sufficiently porous to allow of the absorption and transmission of water; and even at greater depths are likely to be more compact owing to pressure. No hope of obtaining a supply from this source exists.

Fissures, either joints, faults, or bedding planes may allow the water to be carried below either the weathered zone or the level of permanent saturation. The chances of striking such a fissure, even on the doubtful assumption that such would yield a supply of water sufficient to meet even moderate demands, are so infinitesimally small, that I cannot recommend any further expenditure being incurred in this direction. In certain portions of the field, both the granite and schistose rocks are covered with a variable thickness of their own weathered *débris* and other superficial deposits.

These beds are permeable, and allow water to penetrate to depths which depend as much upon the porosity as on the thickness of the strata. Such deposits cover a fairly wide area in some portions of the field, and have been shown to be capable of yielding a copious supply of salt or brackish water.

About eight miles from Coolgardie, at Hampton Plains, No. 2 Bore, a supply of condensing water has been obtained from beds of this nature. The water rose to some distance above the height at which it was first struck.

The following is a section of the beds pierced:—

	Thickness.		Depth.	
	ft.	in.	ft.	in.
Clay, with Ironstone Gravel	27	0	27	0
Fine Sand	30	0	57	0
Coarse Yellow (water-bearing) Sand	43	0	100	0
Clay	4	0	104	0
Sand Wash	11	0	115	0
Kaolin (?)	8	0	123	0
Bed Rock (nature undetermined)	39	0	162	0

No attempt having been made to map out the area which these beds occupy, an estimate of their superficial extent cannot be formed. As deposits of this nature fill up old valleys and other inequalities of an ancient land surface, it by no means follows that the section above described represents the maximum thickness of the strata. The economic importance of these beds, from a hydro-geological point of view, warrants some attention being paid to them in the future, in the direction of approximately mapping out their area.

KALGOORLIE.

The Kalgoorlie Goldfield consists chiefly of schists, intersected by dykes and masses of igneous rocks the exact nature of which has not yet been determined. As far as the hydro-geological features are concerned, the field is identical with that of the Eastern portion of Coolgardie, and no greater hope of obtaining a supply of water from artesian sources exists in this neighbourhood.

GENERAL CONCLUSIONS.

It has been shown that there are only two possible sources of obtaining underground water on either of the two fields. First, from the drifts and other superficial deposits; as has been experimentally proved by the No. 2 Bore at Hampton Plains. Second, from those portions of the rocks which have been subjected to the influence of weathering; for the numerous wells throughout the district have shown that salt or brackish water can be obtained fairly readily. This water being merely percolation from rainfall, it is quite evident, seeing that these rocks become much more compact below the zone of decomposition, and are quite incapable of absorbing and transmitting water, that what has disappeared from the surface in this direction is still to be found.

Failing any more feasible method of obtaining water, both Coolgardie and Kalgoorlie will have to depend upon comparatively shallow wells for their supplies.

From official records it appears that up to February, 1895, the sum of about £6,500 has been expended in the district on machine boring in rocks of the nature above described without any useful

result. To this amount must now be added the cost of the Coolgardie bore. The requisite and qualifying conditions for obtaining a deep-seated supply of water being entirely wanting, I cannot advise the Government to incur any further expenditure on boring for artesian water at either Coolgardie or Kalgoorlie.

My instructions, however, are couched in the following terms:—"To report upon Number 1 diamond bore now in operation at Coolgardie. Such report to state whether in his [the Government Geologist's*] opinion it is desirable that boring should be continued: if not, in conjunction with Mr. Hector [Engineer in charge of Goldfields Water Supply], another site should be selected."

And "also to proceed to Kalgoorlie, and there select a site to enable the Government to commence boring operations in that locality, as promised."

I have shown that the chances of obtaining water in the diamond drill bore at Coolgardie are so infinitesimally small as to render it useless to proceed any further with the work. As to the selection of another site, there being no better chance of obtaining water than in the drill hole at Number 1 Bore, it appears to me that the best locality is one where artesian water, if obtained, would be of service.

In conjunction with Mr. Hector I have selected two areas, coloured red on the attached maps,† where this condition would be fulfilled. The exact spot at which the drill will work would, in each case, have to be determined by engineering considerations, upon which the officers in charge of the operations would be in a better position to offer advice.

The localities selected are:—

At *Coolgardie* the area to the West of the Railway line, to the North of the Gold Mining Leases 1,429 and 342, and South of 1,542.

At *Kalgoorlie*.—The area to the South of the Boulder townsite, bounded by the following Gold Mining Leases 1637E, 1318E, 2644E, 2366E, and 2438E.

If a supply of artesian water is obtained in either place, I shall be gratified but extremely surprised.

MENZIES.

From the information derived from an inspection of Mr. Göczel's Geological Sketch Map of the Interior Auriferous Region of Western Australia, it appears that the district of which Menzies forms the centre is geologically identical with Coolgardie and Kalgoorlie, and is formed of granite and schistose rocks intersected by diorite and diabases. These rocks are covered with superficial deposits, apparently of some considerable extent. In my report on proposed boring for water on Coolgardie and Kalgoorlie, I have dealt so fully with the hydro-geological features of similar country that it is unnecessary for me to traverse the same ground again, except to record the fact that I am afraid there is little chance of obtaining a supply of artesian water anywhere in the vicinity of Menzies.

That a very fair supply of water is to be found between the level of permanent saturation and the depth beyond which decomposition does not extend, may be considered to have been proved by the shallow wells already in existence.

The drifts or superficial deposits may also be expected to yield water which, in some cases, might rise to some distance above the depth at which it is first struck. Whether a supply of this nature would be adequate to meet the drain upon it, perhaps the officers of the Goldfields Water Supply Branch, who are thoroughly cognizant with the district, might be able to furnish more reliable information.

NORTHAMPTON.

I have no knowledge of the geology of this district, except such as is derived through the medium of official and other reports. From the information obtained by my predecessor, and shown on the Geological map of the Colony, it appears that the town of Northampton is situated on an area of granite and schistose rocks. As no artesian water can be expected from country of this nature, I cannot recommend the expenditure necessary to comply with the request of the residents of Northampton.

As pointing to the possibility of water being obtained from the beds outside the granitic area, I may mention that in the year 1870 Mr. Chas. Moore, in a paper read before the Geological Society of London, mentions the discovery of a series of strata in the Greenough River, which from the list of fossils appear to be the equivalents of the Rolling Downs Beds (artesian water carrying) of Queensland.

The granitic area of Northampton appears to rise as an island from the midst of these strata.

The Mesozoic Beds, as will be seen by an inspection of Mr. Woodward's map, extend Northwards to the Murchison, and as a belt of varying width up to Onslow. It is of the utmost importance that this area should some day be geologically mapped with the object of definitely ascertaining whether any sandy porous strata lie at the base of the mesozoic series, as is the case in the cretaceous areas of the Sister Colonies. If this should turn out to be the case, the hope may be reasonably indulged in that somewhere between the Greenough and the Murchison a supply of artesian water may be expected.

A. GIBB MAITLAND,
Government Geologist.

15th May, 1897.

* The words in brackets are mine. A.G.M.

† *Vide* Litho. 13, Mining Leases at Coolgardie. Perth: By Authority: 1-12-96.
Vide Litho. 15, Mining Leases at Kalgoorlie. Perth: By Authority: 28-10-96.