

The hydrostatic pressure of the body of water in the inland portion of the strata has a tendency to force the water outwards and thus cause a permanent flow seawards. This water flows with a velocity due to the difference of level between the intake and the level of discharge, less the frictional resistance of the rock through which it penetrates, which is such as to make the water rise considerably above sea-level in any borehole which may be put down.

Sufficient data have now been obtained by the two deep bores to enable an approximate estimate to be made of the depth at which the subartesian water will be met with along the surveyed route of the Transcontinental Railway Line.

A very voluminous report upon the Mineral Wealth of the State was prepared for the International Conference on the Conservation of Natural Resources. As this has appeared *in extenso* in the pages of the *Australian Mining and Engineering Review*, Vol. 3, Nos. 25 and 26, it has hardly been deemed necessary to reprint it, more especially as it is about to be issued in a more amplified form in the forthcoming volume on the geological and economic resources of the State, which I have at present in preparation.

(2.) *The Geology of the Country between Sandstone and Lawlers, East Murchison Goldfield, from the point of view of Railway Communication.*

In October, 1909, a deputation from the northern districts, urging the construction of a railway from Sandstone to Lawlers, waited upon the Premier: after some discussion it was intimated that the Government Geologist or the State Mining Engineer would be instructed to make a report upon the country lying between the two localities.

It was not, however, until the 12th of October, 1910, that instructions were issued to me to send an officer over this route: there being no other member of the staff available, I decided under the circumstance to make the inspection in person, in company with Mr. H. W. B. Talbot.

A petition was presented to Parliament in 1909 advocating the construction of a railway from Sandstone to Lawlers in lieu of one from Leonora to Lawlers. One of the statements (4) in the petition was to the effect that "from the point of view of opening up new auriferous country the route via Leonora presents no advantages over the route via Sandstone."

It was therefore to the investigation of the question as to whether there was any auriferous country between the two localities that my attention was solely directed.

On the 12th of December, 1910, I was instructed by telegraph that my report on this work need only be brief and of a preliminary nature.

Leaving Sandstone on the 21st of November, nineteen days were devoted to work in the field, during which period an examination was made of the country within about twenty miles on either side of the road which connects Sandstone with Lawlers.

The results of the field work, coupled with the detailed information contained in the reports of Mr. C. G. Gibson, Assistant Geologist, and Mr. Montgomery, the State Mining Engineer, indicate quite clearly that the geological formation containing auriferous deposits occupies only a restricted area in the tract of country lying between Sandstone and Lawlers. The position of this is more or less accurately delineated upon the geological sketch map with which this report is accompanied.\*

The auriferous area in which Sandstone lies has a length of about 25, and a width of about 20 miles. The eastern margin of this area is in the vicinity of the township of Maninga Marley, where active mining operations are at present being carried on. Full descriptions of the various mines will be found given *in extenso* in the latter of the two reports to which reference has just been made, and need not be repeated. The auriferous formation consists of a series of metamorphic sedimentary rocks, associated with vesicular greenstones which doubtless represent ancient lava flows.

The series is intersected by intrusive granite, occasionally in the form of dykes. A little to the north of Maninga Marley is a small though conspicuous ridge showing the intrusive nature of the granite: the strata forming the ridge consist of vertical beds of quartzite, mica schist, intersected along the bedding planes by veins of granite.

A traverse due north of Maninga Marley for about 10 miles showed the country to consist entirely of granite, which evidently occupied an extensive area in this part of the East Murchison Goldfield. To the southward the granite was followed for a distance of 14 or 15 miles down Everett Creek as far as the Lake Country, and from a commanding hill near the edge of the lake it could readily be seen that it extended as far southward as the eye could reach.

A very small patch of metamorphic rocks (quartzite, etc.), which represent a portion caught up by the granite outcrops on the main Lawlers road between Survey Stations J.H.R. 173 and 174: it does not, however, appear to have any great longitudinal extent.

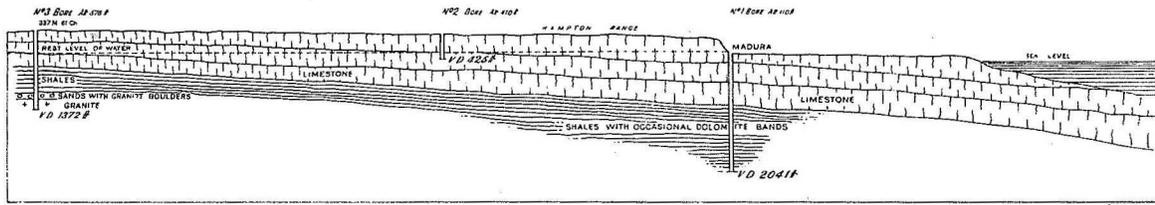
To the west of Hell's Gates, and to the east of No. 5 Well on the reserve at Rocky Creek is a narrow strip of country which might possibly form the matrix of a few small auriferous deposits, containing as it does irregular patches of hornblende schist and massive amphibolite. The belt, however, is not of any great width even at its widest part, the southernmost extremity, where it gradually falls into the Lake, about ten miles due south of No. 6 Well on Reserve 8295, consists of metamorphosed sedimentary rocks (quartzites, etc.).

In the vicinity of Hell's Gates the granite is traversed by several very large and extensive quartz reefs, which may possibly merely represent another phase of the pegmatite intrusions, which are a marked feature in many portions of this district.

Granite occupies the whole of the country between Hell's Gates and Mount Holmes (Wallaby Knob). Mount Holmes is a conspicuous hill which from its isolation forms a well-marked feature in the landscape, and upon it Survey Station J.H.R. 196 has been placed. The normal coarse-grained granite of which it is composed is traversed by a greenstone dyke.

To the north of Mt. Holmes lies what is shown on the maps as the Boobygoo Range, better known locally as the Dépôt Hills. Granite occupies the whole of the country until the base of the hills is reached, about 16 miles distant. Where an opportunity of examining these presented itself, they were found to be made up of iron-bearing quartzites, which dip westerly at an angle of 45 degrees. These metamorphic sediments are invaded by intrusive granite: so far as my own personal observations were carried, there were no auriferous deposits to be seen.

\* Not reproduced.



GEOLOGICAL SECTION FROM THE SEA COAST TO Nº3 BORE AT 337 M P. TRANSCONTINENTAL RAILWAY SURVEY

HORIZONTAL SCALE 10 M TO 1 INCH

VERTICAL SCALE 1000 F TO 1 INCH

The country between Hell's Gates and Gum Creek Well, Reserve 9591, is all granite of the usual type. The granitic rocks also continue much further eastward, to the vicinity of Lawlers.

I did not, however, deem it necessary to extend my investigations as far as the town of Lawlers itself, that district and its mines having been fully dealt with by Messrs. Gibson and Montgomery, in the reports to which allusion has already been made.

Summarising the results of my investigations, it appears that from its geological constitution it is improbable that the stretch of granite country about 60 miles in width lying between Maninga Marley and Lawlers contains any auriferous or other mineral deposits of such a value as to warrant the construction of a railway for their exploitation.

H. P. WOODWARD, Assistant Government Geologist.

(3.) *The Prospects of obtaining a Water Supply for Geraldton, either Artesian, Sub-artesian, Wells, or Catchment Areas.*

Geraldton (114deg. 32min. E. long. and 28deg. 47min. S. lats.) is situated upon a low sandy promontory terminating in Point Moore, which forms the southern side of Champion Bay, and protects the shipping from all southerly and south-westerly weather.

The town itself has been built upon a long narrow belt of sandy flat or beach only a few feet above high-water mark, bounded by sea upon the north-west and sand dunes upon the south-east, behind which latter a low sandy plain extends to the base of the hills a distance of some six miles.

To the northward and north-eastward the country rises more rapidly towards the Moresby's Flat Topped Ranges, the rocks of which are sandstones and clays, and belong to the Jurassic Series. To the eastward the plain rises more gradually towards the Jurassic capped granite ridges of Newmaracarra, whilst to the southward upon the other hand the country is mostly flat, consisting of coastal and low alluvial plains, the more elevated portions being sandplains.

The area to the northward is drained by the Chapman River, which, although subject to floods in its upper courses rarely discharges any great volume of water into the sea, whilst when pools are met with in its bed the water is usually brackish or salt except immediately after rains.

The country to the south and east is drained by the Greenough River, which takes its rise upon the Murchison Goldfield, and this, like the Chapman, rarely flows except after heavy rains, when large tracts of alluvial plains near the coast called the "Flats" are flooded.

There are four possible supplies, all of which have been considered, viz., 1st from shallow wells within the municipal area, 2nd from artesian bores, 3rd from springs in the hills, and 4th by building dams and conserving water.

This question of a water supply for Geraldton has been under consideration for the last 15 years, during which time the Government has not only expended very considerable sums of money upon it, but have also employed their officers from time to time to report upon the various schemes brought forward.

Recently, however, the condition of things became so bad that the Railway Department installed a condensing plant, from which the locomotives and steamers are supplied.

*Shallow wells within the Municipal Area.*—The ground upon which the town is built is composed of recent marine and beach deposits piled up by the sea, consisting of sea-weed, shells, and sand, from which the present water supply is obtained at a depth of about eight feet.

The supply is derived directly from the rainfall (18 inches average) impounded by the sand of the dunes, this in its gradual passage towards the sea must pass beneath the town.

It is all very hard but varies very considerably in quality according to the nature of the deposits through which it passes, thus in the beds of decomposed sea-weed it is extremely bad and often salt, in the beds of shell it contains a larger proportion of lime, whilst in the sand it may be very fair quality even close to the edge of the sea.

Although the main supply is derived from the sand hills, this is augmented by the rain which falls upon the town itself, since the surface of the ground is also sand, and there are no impervious beds between it and the water level.

There is no sewerage system in Geraldton with an estimated population of 3,000, therefore, all the waste water after employment for domestic purposes is thrown upon the ground, and has been so disposed of ever since the town was built.

It naturally follows that the rain falling upon this surface becomes contaminated, and that after carrying on this practice for a number of years, that the eight feet of sand filter bed has become impregnated to such an extent that it no longer acts as a purifier, and therefore the usual consequences may be expected at any time attendant upon the consumption of sewerage.

*Grimshaw's Valley.*—This is situated within the Municipal Area in a depression amongst the sand dunes to the southward of the main portion of the town.

This flat is little over 12 feet above the sea level, whilst the bottom of the pumping trench to be mentioned later on was one foot six inches below it.

The supply here is derived directly from the impounded rain which falls upon the sand dunes, and owing to the fact that these contain large quantities of shell matter as do also the water-bearing beds, it is of a very hard quality.

The Government Analyst reports it to be very pure but extremely hard, this, however, he points out could be reduced to under 10 degrees by treating it by the Archbutt-Deeley process.

The first tests in this locality were made upon a well, which is stated to have yielded from 8,000 to 10,000 gallons per diem; later on, however, the Council, with Government assistance and under the supervision of the Public Works Department carried out the following work.

Extract of report presented to the Municipal Council, dated 15th December, 1907:—"In May last we excavated a trench well  $3\frac{3}{4}$  chains long, by four feet wide, connecting the original Grimshaw's Well with a well where 9 feet 3 inches of water was previously obtained. In order to sink the trench below water level, it was necessary to provide an engine and pump to keep the water bailed out, with the result that about 1,000,000 gallons were pumped out of the trench during sinking operations. A line of pipes 650 feet long was then laid over the rise of the sand-hills to the neighbouring valley, and during the first eight days 300,000 gallons were pumped over the sand-