REPORT ON POSSIBILITIES OF OBTAINING UNDERGROUND WATER IN THE MARRAWAH DISTRICT.

INTRODUCTION.

The Marrawah district is one with a good basalt soil, and rises like an island above the surrounding country of poor sandy soil. Dairying is the principal industry, and for this industry adequate water supplies are essential. Surface water supplies are not common except for a few small pools. Shallow reservoirs have been constructed in a number of places and tend to relieve the position, but either become exhausted or low in the dry season. Numerous wells have been sunk and some of these have yielded satisfactory supplies while others have been dry or given only a small amount of water. The recent geological survey was carried out in order to determine the possibilities of obtaining supplies of underground water and to advise the local farmers accordingly.

TOPOGRAPHY.

The good land in the Marrawah district forms a low plateau rising to a height of 370 feet above sea-level. The plateau is some 7 miles long in an east-west direction and averages 1½ to 2 miles wide in a north-south direction.

The Welcome River rises on the south side of the plateau and flows east and then north along its eastern side. The remainder of the drainage is by short creeks flowing directly into the ocean (the largest of which is Doctors or Williams Creek), or entering the indeterminate drainage of the sandy country to the north.

Only the heads of these creeks extend onto the plateau and they are short and with small watersheds only and carry very little water.

The country to the north and south of the plateau is lowlying, being about 50 - 100 feet above the sea.

GEOLOGY.

Only a small number of rock formations exist in the Marrawah district, and these are described below, in their order of age from oldest to youngest.

Cambro-Ordovician. In the western portion of the district, white crystalline quartzites outcrop at a number of localities. The strike and dip could be measured in only a few places and was generally a north-south strike with an easterly dip, but strikes from N.W. to S.E. were also obtained. These quartzites form the bedrock of the western part of the district.

In the eastern portion, blue limestones with subordinate amounts of dolomite outcrop on the western side of the Welcome River flat. The strike is E. & W., the dip to the south at 60°.

The limestones and dolomites are similar to those at Smithton and are, therefore, considered as of Cambro-Ordovician age. The quartzites are probably of the same system but slightly older than the limestones, corresponding to the rocks between Irishtown and Sisters Hills.

Tertiary Sedimentary Rocks (sub-basaltic). No exposures of such rocks exist in the district, but it is highly probable that they occur below the basalt in some portions of the district. The few feet of clay reported in Loverock's well would form part of this formation.

Tertiary Basalt. This rock occupies the greater part of the surface of the settled country in the Marrawah district. It occurs from heights of about 90 feet to 370 above the sea and its maximum thickness is therefore 280 feet. It has been partly eroded in places and its thickness at such points is much less.

The rock is the typical olivine basalt of the north-western districts. Judging by the road metal, portions of the basalt are of a tachylytic nature with abundant zeolites and opaline quartz. There is no evidence as to whether there are one or more flows but it is possible that more than one occurred (in the adjacent Smithton district four flows occur and are separated by clays, sands &c)..

The basalt has been weathered to a great depth and fresh outcrops are few most of the exposures consisting of partly weathered basalt or basaltic clay.

Pleistocene (?) Limestones and Sands. Limestones of geologically recent age occur at two main localities, viz. between Marrawah and Green Point, and south-east of Redpa. The western occurrences are represented by three separate outcrops as shown on the attached map. The limestone is white to creamy in colour and is composed largely of small fossils and pieces of fossils. The lowest outcrop is 190 feet and the highest is 250 feet above the sea. The limestone occurs on the flanks of the basalt hills and appears to have been deposited in that position. It is, therefore, of later age than the basalt and this is borne out by the occurrence of basalt pebbles in the limestone.

The eastern occurrence is on the west side of the western side of the Welcome River flat to the S.S.E. of Redpa. It is also reported that limestone occurs north and north-west of Redpa. The limestone in this locality is somewhat different from that near Marrawah, being pinkish and much harder. It stands out in the curiously weathered crags &c. typical of limestone. The base of the limestone is visible and it overlies with a great unconformity the Cambro-Ordovician limestones and dolomites.

The base is at a height of 135 feet above the sea and its thickness is 50 to 100 feet or more. This limestone is also fossiliferous and generally resembles the western occurrences.

The basalt plateau is surrounded on all sides by sandy deposits. These deposits also extend onto the basalt plateau and represent infillings of former short valleys draining the plateau, as is evident from the geological map. These deposits are loosely compacted and when exposed in depth consist of reddish stained sand. At several places e.g. north and east of Marrawah Siding and south-west of Marrawah township, the sands are roughly stratified and contain small pieces of weathered basalt. In the deep gully at the east end of H.W. Wainwright's block, the sands are cemented by oxides of iron into compact sandstones. The sand has the appearance of marine sand, but the general absence of fossils may denote that wind has played a part in its distribution.

The limestones and the sands have been formed around the basalt plateau which apparently stood out as an island in a former sea. The exact relation of the limestones and the sands is not clear, but generally they appear to be of much the same age. If there is any difference the limestones are probably the older.

The age of these beds is provisionally put down as not older than Pleistocene. The only evidence so far (the fossils not having been thoroughly examined) is that they are younger than the basalt which is presumed to be generally equivalent to the New Basalt of Victoria and of Pliocene age.

Recent. The sandy beds would at many parts merge into recent deposits found by their re-distribution some distance from the plateau and more particularly towards the coast.

Recent river alluvium occurs to only a slight extent within the district and is confined to the flat of the Welcome River.

UNDERGROUND WATER.

Underground water occurs in the rocks beneath the surface of the earth by virtue of its occupying spaces on these rocks. Such spaces may be - (1) the pores in porous rocks such as loose compacted sands, sandstones &c. (2) the cracks, joints &c. in rocks even non-porous ones, and irregular spaces such as solution cavities and channels in limestone.

The water is derived from the rainfall on the surface and represents that portion which percolates underground.

The problem of the occurrence of underground water is therefore intimately associated with the nature of the rocks. The nature of the rocks in the district will, therefore, be briefly considered in their relation to occurrence of underground waters.

Cambro-Ordovician. The quartzites are non-porous rocks and supplies of water are only likely to be obtained from any major joint and bedding planes in them. These planes cannot be readily determined and so sinking wells or bore holes would be more or less a matter of luck.

The limestones and dolomites are non-porous, and water would only be obtained from joint and bedding planes, and solution channels in them. As in case of the quartzites, the obtaining of water would be a matter of luck.

Basalt. As a general rule water can be readily obtained in basalt country. The basalt itself is practically non-porous, but the numerous joint planes generally yield a supply of water. The keeping open of the joint planes depends largely upon the freshness or unweathered nature of the rock. Unfortunately in the Marrawah district, the basalt has been largely weathered and now consists of partly weathered basalt and basaltic clay. These have not apparently preserved the open nature of the joint planes and so the possibility of obtaining water supplies is therefore considerably reduced and in places altogether eliminated.

Tertiary sediments. Tertiary sands, clays, gravels &c. are usually associated with basalt flows some underlying the basalt and others interbedded between different flows. Such sands and gravels are porous and provide good supplies of water. However the presence of such beds has not been detected in the Marrawah district. No interbedded sediments appear to be present, but is possible that they may be present below the basalt at some localities.

Pleistocene limestones. These rocks are of areal extent and therefore not of great importance to the district as possible water-yielding rocks. They are only slightly porous, but bedding and joint planes and particularly solution channels will yield good supplies of water. Such can be seen to be the case in Nichols well where an adequate supply flows from a solution channel, while on Saward's property to the south several wells have proved to be dry owing to failure to intersect planes or channels.

The situation of solution channels cannot be determined from the surface unless indicated by the presence of springs.

Pleistocene sands. Unconsolidated sands are among the most porous of rocks and yield large supplies of water. The Marrawah sands are no exception and the wells sunk in these have all given good supplies.

Recent alluvium. This is not common within the district, but on King's property on the west side of Welcome River flat, a good supply has been obtained from the alluvium.

POSSIBILITIES OF OBTAINING SUPPLIES ON VARIOUS PROPERTIES.

"Knoxford" (H.F. Hardy). This farm is occupied wholly by basalt which has been weathered to considerable depths. Surface water supplies are restricted to a gully at the western end of the farm. A dam has been constructed near the north boundary of the property and provides the only water supply on the farm. This however becomes low during the dry period in summer.

Several wells have been sunk in an endeavour to obtain underground water but with no success. Recently one was sunk to a depth of 126 feet from a point several chains south of the dam, weathered basalt being intersected until near the bottom where fresh dense fine grained basalt was cut. The only chance of success would be to continue until the basalt was passed through and any underlying gravels or the bedrock was reached. It is possible that a further maximum depth of 90 feet would be required to pass through the basalt. Two other unsuccessful wells have been sunk nearby, one being 1½ chains to the north and 60' deep and the other being 10 chains to the east. Yet another was sunk about the middle of the farm to a depth of 60 to 100'.

The only prospect of obtaining a supply near the homestead appears to be to continue the 126 foot well until bedrock is reached, but even then it cannot be stated that a supply will be obtained. As regards a supply on other parts of the farm, the best prospect appears to be to sink near the southern boundary as close to Gray's well as possible in the hope of encountering the same water-bearing bed as was met in the latter. Such a well would need to be sunk to at least 70 feet and its success would depend upon the continuation of the water bearing bed referred to above.

If the above fail, or in any case if a supply is needed near the south-eastern corner of the farm, it would be advisable to sink a well in the lowest lying part as near the corner as possible. A shallow well might yield a supply, particularly if the sands extend onto this portion.

L.S. Horton, 94 ac., Lessee. This property occurs about a mile north of Marrawah and east of the Smithton road. The western half of the property is

occupied by basalt and the eastern half by sand. A water supply is desired about the centre of the western 60 acres of the property. This portion is basalt and so the chances of obtaining underground water are small and it would be necessary to sink through 200 to 250 feet of basalt to pass through this rock. It would be preferable to sink a well in the nearest part to the east where the sand occupies the surface and to pump the water through a pipe line to where required.

H.W. Wainright, 100ac. Lessee. This property is north and adjoining that of L.S. Horton. The geological conditions are generally similar, the western part being occupied by basalt and the eastern by sands. The northern boundary generally represents the top of the face of the plateau and only sand occurs to the north.

The house is situated near the road in the south-western part of the farm. One well was sunk to a depth of 70 feet in partly weathered basalt, from a point immediately north of the house. The possibilities of obtaining water from the basalt are small, as already indicated above. It would be advisable to obtain a supply from a well sunk in the nearest sand and pump and pipe it to where required.

G. Loverock, 146 ac., Lessee. This property is situated one mile west of Marrawah. The northern end embraces the face of the plateau, but the greater part forms a portion of the surface of the plateau. Basalt occupies the plateau country and one small area of limestone occurs on it. The lower part of the face of the plateau and the low-lying ground near the road consists of sand. It is also possible that a small area near the south-western corner may be occupied by an extension of the sand from the south. Water is desired on the surface of the plateau as close to the house as possible. The surface supply consists of a dam in the valley of the small creek flowing south-westerly through the farm. A well was sunk near the centre of the farm, but yields only a small quantity of water. The well is 65 feet deep and from statements made it appears that it passed through 40' of basalt (weathered), 5 feet of clay, and 20 feet into the bedrock of white quartzites. A small amount of water was obtained from the top of the pipe clay, but it is escaping through the joints in the quartzites. The obvious course is to fill the well up to a level just above the quartzites and seal the filling with clay in order to prevent the water escaping. The bedrock is about 190 feet above the sea and forms a part of a buried ridge.

The best place to obtain a supply would be from the sand near the road. While this would involve pumping a height of 150 to 200 feet to make it available on the plateau, it would be the surest way. As regards sinking on the plateau, it is difficult to see how better results could be obtained than in the present well unless sinking was carried out as far to the east as possible where the bedrock might be deeper. Rather than sink near the eastern boundary, it would probably be preferable in the first place to sink a shallow well near the south western corner to determine where the sands exist there. If they do, a fair supply might be obtained, but this would of course involve piping to make it available near the centre of the farm.

The limestone is rather small in extent and while a supply might be obtained, it would depend upon the cutting of any solution channels which would exist.

S.G. Saward, 100 ac. This property is situated some two miles west of Marrawah. It consists mainly of basalt forming the western end of the plateau. Sand occurs along the face of the plateau along the north boundary and a small area of limestone occurs on and to the north of the property.

The house is situated near the northern boundary and a water supply is desired near there, preferably about the plateau level. Several wells have been sunk in a limestone to the east of the house but without any success. This may be considered unusual in view of the good well on Nicholl's property to the north, but the latter derives its supply from a solution channel possibly representing an enlarged bedding plane. It is a matter of luck striking the solution channels but it would be advisable to sink the last well a few feet deeper to make sure that the level of the water in Nicholl's well has been reached.

Apart from this, it would be better to sink in the sand to the west of the house and pipe it to where it is required.

If a supply was needed near the south-eastern corner, it could probably be obtained from a shallow well sunk in the floor of the valley of the small creek flowing southwards out of the property.

MacDonald. This property is situated south of Marrawah. It is occupied mainly by basalt with sand along the valley of the creek flowing south-westerly through it. The house is situated on the high basalt country near the road and a supply is desired nearby. One well has been sunk to 60 feet through weathered basalt and was unsuccessful. It is also understood that shallow wells in the valley have been unsuccessful. The prospects are therefore not hopeful. In any further attempts to sink through the basalt it would be advisable to commence from a lower part, as any water obtained has to be pumped and it could be pumped onto the high ground. In spite of the fact that previous attempts in the valley have failed, this offers the better prospects.

W.W.W. Ford. This property is situated west and adjoining the 100 acre block owned by L.T. Gale. Basalt occupies the northern part and sandy beds the southern part. In the first place it would be advisable to sink into the sandy beds somewhere near the road, in any attempt to obtain underground water. Failing this, sinking through the basalt would have to be tried with all the uncertainty attendant on obtaining supplies in this rock in the Marrawah district.

L.T. Gale, 100 ac. This property is situated about one mile south-east of Marrawah. It is occupied almost entirely by basalt except possibly near the north-eastern corner. If a supply is desired at any particular place, the basalt would have to be sunk through and the chances of obtaining a supply would be small. The best place to attempt to obtain a supply would be as close to Grey's well (which is north of the northern boundary) as possible in the hope of intersecting the same water-bearing layer. Failing this, shallow wells could be tried in any sandy beds near the north-

eastern corner. The latter two positions might involve piping the supply to where it is required for use.

A. Wells, 100 ac. This property is situated two miles south of Marrawah and on the south side of Williams Creek. The northern portion is occupied by white quartzites and the remainder consists of a thin layer of basalt overlying the quartzites. An attempt was made to obtain a supply near the centre of the property by sinking a well into the basalt. The well is 12 feet deep and five inches of water makes in the bottom. This supply might be improved by sinking to the bedrock of white quartzites. Care would then have to be taken to line the bottom with clay to prevent any leakage into the quartzites.

King Bros., Redpa. The properties of King Bros. are situated some two miles to the south of Redpa station.

The 99 acre block east and adjoining the road is occupied wholly by basalt. One well has been sunk from a point south of the house to a depth of 36 feet and a good supply is stated to have been obtained. A further supply is required north of the house and it is proposed to sink a well in this locality. While this might be successful, it would be advisable to sink as close to the existing well as possible. The greater chance of obtaining a supply would tend to make up for the piping required.

A supply is also desired on the 100 acre block situated some three quarters of a mile to the east. A well has already been sunk to a depth of 24 feet through the basalt which forms the western portion of the block. The eastern portion is occupied by Pleistocene limestone, while to the east and south this limestone overlies the Cambro-Ordovician limestone and dolomite.

The well bottomed on limestone, but it cannot be ascertained as to which of the limestones it was. The deepening of this well or sinking anywhere in the limestone is attendant with the risks outlined above, viz. that the obtaining of a supply depends upon the intersecting of bedding or joint planes, or solution channels. A supply would probably be obtained but it might necessitate the sinking of several wells before intersecting the necessary planes or channels.

The chances of obtaining a supply in the basalt is also somewhat doubtful, but not hopeless. It would probably be better to sink in the low-lying ground near the south-western corner of the block.

CONCLUSIONS.

The above descriptions show that in general, the sand deposits are the rocks in which there exists the best chance of obtaining a water supply. The basalt is too weathered to carry water in general and it is a matter of luck whether a supply can be obtained from this rock or not. The past experience has proved that there are more failures than successes in sinking in the basalt. The limestones are likely to yield supplies but it is a matter of chance as to whether solution channels are encountered in the wells.

The Marrawah district is, therefore, unfortunate in that it is largely a matter of luck as to whether water supplies can be obtained from some of the rocks and there are no reasons to indicate whether any

particular spot on basalt or limestone country will give a supply or not.

With regard to the question of sinking wells or putting down bofeholes, the matter depends upon the depths to be sunk and the rocks to be passed through. In shallow wells and soft rocks e.g. sand and decomposed basalt, it would be much cheaper to sink wells rather than bore. In deep wells and hard rocks, e.g. certain limestones and fresh basalt, the boring would probably be cheaper.

The total cost of boring depends largely in the first place upon the cost of transport of the boring plant to and from Marrawah. If a large number of people use the plant the proportionate share of the transport cost becomes much less. The cost of the actual boring can be done by contract, or at cost price plus 10% for wear and tear &c. Other details are obtainable from the Secretary for Mines and have already been obtained by some residents interested in the question of boring.

P.B. Nye (sgd.)

GOVERNMENT GEOLOGIST.

Mines Department,
Hobart,
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