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GEOLOGICAL REPORT ON PORTIONS OF THE RIVER DERWENT AND THE NIVE RIVER HYDRO-ELECTRIC SCHEMES.

INTRODUCTION

The River Derwent scheme includes a dam at Butler's Gorge and a canal to Tarraleah. Tarraleah is 55miles by air-line north-west of Hobart, and Butler's Gorge is 10 miles to the west-north-west of Tarraleah. The proposed Nive River scheme would include a canal or flume from the Nive River immediately below the Tarraleah power station and a power station at some point lower down the River Derwent.

RIVER DERWENT SCHEME

GEOLOGY - From the Butler's Gorge dam, the River Derwent flows in a general east-south-easterly direction for 4,000 feet through a gorge in diabase (or dolerite). The hills occupied by the diabase forming the gorge, trend in a general northerly direction from the river.

To the east of these hills an extensive plain-like tract of country occurs. Along the road and the canal, this plain extends from No. 7 Camp to within a few hundred feet of Drain No. 85. The surface of this plain is occupied, for the most part, by boulder beds of glacial or fluvio-glacial origin. These beds are extensive, but of small thickness. In a few places, sandstones, shales, etc. outcrop in this plain. The sand pit represents one of the most westerly of these outcrops. Other outcrops are present in the two creeks which cross the road and canal between No. 7 Camp and Drain 85. Sandstones etc. are also exposed below the boulder beds in at least one quarry alongside the road. The nature of the excavated material along the canal between No. 7 Camp and Drain 85 indicates that sandstones occur at no great depth along the greater portion of this length. The sandstones, shales etc., probably belong to the Permo-Carbonfierous system of rocks. As Drain 85 is approached from the west, a range of low hills bounds the Plain on its eastern side and extends to within a few yards of the road in that vicinity. These hills are composed of diabase.

The boulder beds have already been referred to above as forming a thin sheet over part of the extensive plain. They are almost certainly of Pleistocene age and have been formed in the valleys of the two main (but unnamed) creeks flowing southerly into the Derwent.

The occurrence of an extensive plain of sandstones etc., between hills of diabase, is common topographical feature in eastern Tasmania. The sandstones, shales, etc., are much more easily eroded than the diabase and thus form the plain, whereas the more resistant diabase forms the hills.

The diabase is intrusive into the sandstones and younger than them. The actual form and nature of the intrusion may be one of several types and is of much interest

in this particular case. One of the most common forms of intrusion in eastern Tasmania is that of large dyke-like bodies transgressive to the intruded sandstone, etc. Another common form is that of a thick sheet of diabase which was originally intruded as a sill along the bedding planes of the sandstones, and from which the overlying sandstones have been removed by erosion. From the brief reconnaissance trip made of the locality it is believed that, in this case, the diabase intrusions are transgressive to the sandstones. A more detailed survey would probably definitely prove the form of the intrusion.

GENERAL CONSIDERATION OF BUTLER'S GORGE DAM SITE -

If, as believed, the diabase of Butler's Gorge is transgressive to the sandstones occurring to the east, the diabase will extend to considerable depths and form, in general, a very satisfactory base for the dam. If, however, the diabase should occur as a thick sill it should be realised that the sandstones, shales, etc. will exist beneath the diabase of the gorge and pass under the dam site. The dip of the sandstones, and, therefore, of the bottom of any postulated diabase sill in the vicinity of No. 7 Camp is not known, and the postulated depth of diabase cannot be determined. If there was a thickness of only say 100 feet of diabase beneath the dam site, the desirability of using such a site would have to be seriously considered because of two factors. One factor would be as to whether the shales and similar rocks interbedded with the sandstones would be compressible to any extent by the weight of the dam and the water in the storage basin. The other factor would be possible leakage of water through the sandstones etc. at depth. If the postulated thickness of diabase is greater than 100 feet, it is possible that such factors would have little effect. A sufficient thickness of diabase would be strong enough and would distribute the stresses and prevent any compression of the underlying sandstones, shales etc. Moreover, there would be little or no possibility of a leakage of water through the sandstones etc. under the diabase. The question as to the thickness of diabase which would be considered neceassary to overcome the possible effect of the above two factors is mainly an engineering matter.

The drilling already carried out in the diabase forming the foundations of the dam proves that in No. 34 hole there is a thickness of at least 150 feet of diabase and in No. 40 hole a thickness of at least 170 feet of diabase. It is possible that, from the engineering viewpoint, a thickness of at least 170 feet would be considered sufficient. If it is desired to ensure that a greater thickness of diabase exists beneath the dam foundations, at least one of the existing drill holes should be drilled in order to prove if diabase exists to the required depth. Such a procedure would ensure that the requisite thickness of diabase is present whether the diabase is in the form of a sill or, as is believed, in the form of a transgressive body.

SOME DETAILED CONSIDERATIONS OF THE BUTLER'S GORGE DAM SITE -

A proposed dam site was visited by the writer in 1934 and described in a report dated 22/1/34. It would appear that the present site is somewhat different from that visited in 1934. However, a site which is

apparently substantially the same as the present site was reported on by Dr. W.G. Woolnough and Mr. F. Blake on 23/12/38 after Mr. F. Blake had reported on the Drilling policy on 10/10/38.

The report of 23/12/38 dealt in detail with the dam site and a detailed examination of the site was not, therefore, included in the present investigation. A brief visit was, however, made to the site and it is considered advisable to make the following brief comments.

(1) Except for any reservations indicated below, the writer is in agreement with the report of 23/12/38 as far as the dam site is concerned.

(2) It is not known whether the dam site was altered in accordance with section (8) of the report of 23/12/38. The matter of such alteration was not raised nor was any cause necessitating such alteration discussed.

(3) The diabase contains numerous joints. One of the most important systems is one with vertical dips. Another system has dips 45° or thereabouts, while a third has low angles of dip or is almost horizontal.

(4) The jointing will not affect the suitability of the diabase for foundation purposes, but care should be taken that diabase with low angle joints is not relied upon for foundation purposes at the toe of the dam.

(5) The jointing may permit very slight leakage through the foundations, particularly when the water is stored behind the dam. It is not anticipated that the leakage would enlarge the joints beyond possibly removing any loose material in them and perhpas very slowly dissolving some of the calcite from the narrow veins in some of the joints. The diabase on the walls of the joints would resist abrasion and be only extremely slowly altered by the percolating water.

(6) At one of the benches on the north-eastern abutment some of the diabase is partly weathered. The weathered diabase is bounded on its southern side by a major joint dipping at approximately 45°to the north. The weathering is associated with vertical joints which, at shallow depth, will intersect the north-dipping one. It is the combination of joints which has permitted a quantity of water to circulate and thus cause the weathering. It is expected that the vertical joints will terminate at depth against the north-dipping one and that little or no weathering will be found beneath the latter.

DIABASE QUARRIES -

Two quarry sites have been selected for the production of diabase for concrete work at the dam and elsewhere and have been used to a small extent. The lower quarry is close to the western edge of No. 7 Camp. The upper quarry is situated about 4,000 feet to the west and at an elevation of approximately 300 feet above the lower quarry.

It is claimed that the diabase from the lower quarry is softer and easier to drill than is the rock in the upper quarry. The only differences observable in hand speciemens of the two rocks are that the rock from the lower quarry is finer in grain and appears to contain less augite than the rock from the upper quarry. If the diabase is a transgressive one, the finer-grained rock of the lower quarry forms the eastern edge of the intrusion and probably extends in a general north and south direction adjacent to the sandstones of the plain. There would be no possiblity of finding this finer and softer rock nearer the site of the dam. The only possiblity of obtaining the softer rock at a higher level would be to follow the eastern margin of the diabase to the north and to examine the rock at suitable quarry sites.

The diabase and its contained seams of calcite, chloritic material, etc. have been reported upon by a consulting chemist and will not be discussed in this report. The results of any petrological examination made of the two types of diabase, will, however, be communicated at a later date.

LANDSLIDES ALONG CANAL -

Two landslides have occurred in the vicinity of Drain 85 situated some 14,000 feet due east of Camp No. 7. The first slide occurred some time ago, and damaged both banks of the canal to the north of Drain 85, and necessitated a deviation of the road and the canal. A second slide occurred recently in the vicinity of Drain 85, but, beyond causing a crack to open in the spoil bank of the canal and in the surface soil to the east, it has not cuased any other damage.

As this portion of the canal is approached from the west, the plain gives place to a low line of hills which extend to within a few feet of the road and canal. These hills are composed of diabase and form, as it were, a promontory around which the road and canal have to pass. The boulder beds of the plain terminate a few yards to the north-west of the first slide. The diabase hills form low cliffs situated about 100 feet to the north of the road. The material through which this portion of the canal is cut consists of diabase soil and detritus, and weathered diabase bedrock.

An adit was driven in a general easterly direction to drain the ground beneath the portion of the canal near the first slide. The approach to the adit is in completely weathered diabase and solid diabase is encountered towards the face of the adit.

The appearance of the crack over Drain 85 lead to the drilling of two drill holes, the sinking of a shaft and the driving of an adit. No. 1 drill hole and the shaft are on the north or up-hill side of the canal, and exposed weathered diabase, giving place, at shallow depths to unweathered diabase. The No. 2 drill hole and the adit were put in on the south or downhill side of the canal. They also exposed decomposed diabase giving place to unweathered diabase at depth.

From the results of the work carried out in the vicinity of the two slides, it is evident that weathered diabase occurs at the surface and that it gives place at shallow depth to unweathered diabase. The only material above the weathered diabase consists of diabase soil and detritus with, in the vicinity of the canal, the excavated material from the canal.

It is considered that both slides were restricted largely, if not wholly, to the excavated material and to the diabase soil and detritus. The cause of the slides was due to the water-logging of portion of these materials and perhaps a very thin layer of the underlying weathered diabase. The remedy is, of course, to satisfactorily drain the spoil banks and the diabase detritus in the vicinity of the canal near the slides. If this work has not already been done, it should be carried out immediately. The drainage water should be conducted sufficiently far from the canal to prevent any possible slide from affecting the canal.

The deviation near the first slide does not appear to be experiencing any trouble. The adit has drained the upper portion of the diabase and providing the existing drains adequately drain the excavated rock and the diabase detritus, no further trouble should occur at this place. At the second slide, the adit has satisfactorily drained the diabase but, as already stated above, adequate arrangements should be made to drain the excavated material and diabase detritus. Similar arrangements should be made wherever excavated material and diabase detritus overlies weathered diabase along the canal.

THE NIVE RIVER SCHEME

It is proposed to divert the water from the Nive River immediately below the Tarraleah power station and to conduct it by canal or flume along the north-eastern bank of the River Derwent until, at a suitable site, it can be conducted by pipe-line to a power station near the River Derwent. The approximate course of the proposed canal or flume along the Nive River was followed for a distance of 8 miles.

On the western side of the river and to the south of the Tarraleah chalet, as viewed from the power station at river level, it is seen that horizontal - bedded sedimentary rocks (probably sandstones) outcrop a short distance to the south of the chalet and pipe-line. At the power station, solid diabase outcrops in the river bed. The proposed intake of the canal will also be in diabase, providing it is close to the present power station.

A short distance along the proposed course, sandstones outcrop in a few places. The exact length, along the course, of these sandstones cannot be accurately determined, but probably is no more than a few hundred yards. It seems that the sandstones on the western side of the river extend for a short distance across the river towards the east.

The remainder of the course along the eastern bank of the river consists of either diabase or diabase detritus and soil, with the exception of a few narrow alluvial flats along the river and tributary creeks.

For the first 5 to 6 miles from the intake, the slope of the country to the Nive River is very steep. Over much of the country the slope exceeds 25° and must in places exceed 30°. In the last 2 miles of the course, the side slopes are much less.

Diabase does not outcrop to any large extent along the steep slopes, but the large amount of diabase detritus and the outcrops of solid diabase in the river bed and on the opposite side of the river indicate that diabase comprises the bed rock throughout the greater portion of the 8 miles. It is not anticipated that the thickness of diabase detritus will be very great. On general grounds, it is to be expected that the thickness of the detritus might range up to 20 feet but would, in general, probably average no more than 5 to 10 feet. It must be understood, however, that these estimates of thickness are purely general ones and that trenching or shaft-sinking would be necessary to determine the accurate thickness at any point. Owing to the existence of the diabase detritus on very steep slopes, it is considered advisable that the ground should be excavated as little as possible in order to avoid landslides. The excavating of the canal cannot, therefore, be recommended. The water should be preferably conducted in a flume situated above ground level and supported by piles which should penetrate the diabase detritus and enter the underlying diabase. Even with the use of a flume on piles the surface of the ground should be disturbed as little as possible. Drainage arrangements should be made where there is any possibility of the accumulation of water.

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26th September, 1941.