REPORT

on

650A-C

GROOM'S SLIP NEAR PENGUIN.

INTRODUCTION.

This slip is situated about two miles east of Penguin and is the most serious one in the district. At this place the coast is in the form of a small bay with small rocky headlands at each side. The railway is adjacent to, and parallel with, the shore while the road is parallel to the railway and on the landward side of it. The railway is some 10 to 15 feet above high water level and the embankment has been close-piled in the past for the purpose, it is stated, of preventing a landslide some 28 years ago. One or more tunnels were also driven into the embankment apparently to check theslide by (possibly) draining water away from it. It is stated that the tunnel or tunnels encountered "slurry" which entered the tunnel and prevented further driving.

The road is 5 to 12 feet above the railway and inland from it the surface rises gradually for some 15 chains after which it rises steeply to the summit of the basalt hills. The contours of the ground bear testimony to the occurrence of former landslips.

GENERAL DESCRIPTION.

The area affected by the present land slips is roughly pear shaped. It is narrowest along the road where the width is 12 chains. It extends inland for a distance of 25 chains from the road and is approximately 15 chains wide at the southern end. The boundary of the area is marked by a continuous line of faults or fractures. The vertical displacement is greatest at the head or southern end of the slip where a maximum of 7 feet is attained. The downthrow is generally towards the block involved in the land slip, but at many places the margin of the block is upthrown with regard to the surface on the opposite side of the fault. Thus on the road at the western side the block is downthrown 12 to 18 inches while on the eastern side it is upthrown 10 to 12 inches. In many places the upthrow is due to the block meeting with local resistance in its movement as a result of which relief has been sought by an upward movement with consequent elevation and bulging at the surface.

The greatest movement of the block is a horizontal one in a northerly direction towards the sea. It is stated that since the slip started some two months ago, the railway and road have been pushed seawards a distance of 14 feet. In order to keep the necessary alignment, the railway (and also the road) have had to be moved this distance inland. At the eastern side, the road and drain show a displacement seawards of 9 feet. From measurements taken by the Public Works Department, the daily rate of movement has been two to three inches, with an increase in rate towards the latter half of the period of observation. The measurements also prove that the movement is regular throughout the block from north to south, there being just as much movement at the south end as at the north.

Within the block there are numerous small faults which are generally parallel to the head of the slip or the coast. There ar e usually small vertical and horizontal displacements along these faults. The downthrow is generally on the seaward side. In cases when there is an apparent upthrow to the seaward side, it would appear that the block on the landward side has tilted seaward and come below the level of the seaward block.

The depth of the movement can only be determined along the shore. The movement does not extend to the rocks outcropping on the shore. The tops of the piles in the railway embankment have been pushed seawards and are now lying almost horizontal. The stone wall of the embankment where visible has been broken some two to three feet above the bottom. It is apparent, therefore, that the movement is taking place on a horizontal plane at or a few feet above the level of the shore.

GEOLOGY.

The two sides of the bay are occupied by a dense and fine grained dolerite of Lower Palaeozoic age. In some places the shore and floor of the bay are occupied by the same rock, but for the most part they are occupied by a completely decomposed representative of this rock which is almost indistinguishable from decomposed basalt. The decomposed rock is not visible above high water mark due to the shingle and the embankment of the railway.

At numerous places along the railway cutting and in the drain at the western end a layer of fine sand occurs. Its upper surface is irregular as in places it rises to a height of six feet above rail level and within a short distance dips below rail level. The bottom of the sand is not visible but in view of lack of evidence to the contrary it is assumed that it rests on the decomposed dolerite. The maximum thickness would then be 25 feet, but the average thickness would be 15 feet. The sand is a typical sea sand. Little or no water is seeping from it, but the sand is some places quivers and shakes when trodden on and water can be brought to the surface by this means.

In the railway cuttings, it would appear that the sand is overlain by more or less completely decomposed basalt, which also appears at a higher level on the road, These observations were made at the western side, the relations to the east being obscured by filling, soil detritus and possibly recent gravels.

From the road inland, there are practically no exposures of rock. The soil is for the most part a basaltic one but much of this has been shed from the basalt hills. Water worn pebbles occur in the soil and on the surface at numerous places thus indicating the presence of gravel beds. It is impossible, however, to definitely determine the structure, particularly as old land-slips have occurred and further increase the difficulty of deciphering the geology. The general sequence is somewhat as follows :-

Clays with pebbles in them overlie the basalt exposed on the road and railway especially on the western side. Further south and about 70 - 90 feet above the road, sea-sand is exposed in a creek bed, being apparently derived from a layer about this height above the road. In the drains put into a swamp at a somewhat higher level on the western side basalt was met with. At a still higher level and at one about that of the drain out of the highest lagoon that has been drained, numerous waterworn pebbles occur. These may correspond generally to the gravels which appear in the toe of the slip on the eastern side below the seven foot face, at a height of approximately 150 feet above the road. In this slip the gravels are overlain by solid basalt. Still further south and higher up the hills, there are no exposures owing to the surface being well soiled, but the rock here is probably basalt. There are three depressions here two of which contained water and

have been drained, while the third is dry. The latter one represents an old land slip and with its catchment should contain water. The water must either drain out of it along the old slip-plane or more likely throughout any gravel beds (for which however there is little or no evidence) at this height.

The general structure, therefore, is one of interbedded layers of basalt, gravels and sand but it is impossible to state the number and thickness of same.

DRAINAGE.

The block involved in the slip forms the greater portion of a rough amphitheatre shaped depression in the hills. It is drained for the most part by one small creek with a few branches. A few small swampy places and lagoons occurred but otherwise the drainage was quite free and unhindered. Some of the swamps and lagoons were formed in the depressions caused by old landslips or small subsidences while others are in places characteristic of the north west coastal districts viz. at the level of beds of gravel and sand interbedded with basalt, where the denudation of the former gives a flat surface and springs from them seeping into the flat produces the swamps.

Since the slip started practically all the swampy places have been drained by the Public Works Department, while the flow of the creek has also been improved by ditching. A commencement was made with a pipeline to conduct the creek away from the slipping block and through solid ground on the east side but while movement is taking place it is not advisable to continue this line into the sliding block.

It is usual in landslips to find a seepage of water which has played a part in saturating a clayey bedrock or layer and allowed the overlying material to slip over it. In Groom's slip however, there is no seepage associated with any of the small dislocations, nor does there appear to be any water seeping from the front of the slipping block along the shore.

GENERAL CONCLUSIONS.

It will be noted from the above descriptions that a roughly pear shaped block of land is moving slowly seawards at a rate of two to three inches per day, and that at the shore it is moving on a plane at or slightly above high-water mark.

This block corresponds generally to an amphitheatre-shaped depression in the hills formed mainly by the denudation of a small creek. The denudation has been influenced by the geological structure which is that of a filled-in bay of pre-basaltic times. The basalt, gravels, sands &c. are more easily removed than the hard, resistant dolerite which forms the horns of the present bay and also extends inland as ridges bounding the lower part of the amphitheatre. The bay is being re-exposed by the denudation.

The shape of the block is, therefore, largely determined by the geological structure viz. a filled-in bay now in the process of being re exposed. This structure is largely instrumental in the cause of the land-slip. The floor of the old bay no doubt extends inland some distance with probably a gradual rise to the south. The lowest layer of sea-sand probably also extends inland to the head of the old bay. The floor of decomposed

(now represented by clay) dolerite represents a plane which is extremely slippery and wet. The sand layer though incompressible probably offers little or no resistance to horizontal movement on or even in it. The movement is taking place on the plane of the dolerite floor or in the sand a short distance above it. Whichever it is the block is moving on it slowly but surely without any great amcunt of resistance.

As in most land slips, the movement co-incides with a period of heavy rainfall and yet from visible evidence it is difficult to determine the actual part played by water in this slip. It is considered, therefore, that during the wet winter a larger quantity of water than usual has entered the sand or moved along the decomposed dolerite floor of the old bay. This produced conditions more suitable for slipping than formerly and hence the block began to move. The movement is slow because of the size of the block and because the slope of the dolerite floor is only slight.

The fact that water seepages do not appear at the seaward edge of the slip is surprising and may be due to one of two reasons.

(1). The quantity of water may not be greater than that necessary to saturate the sand and the dolerite floor; or

(2). The surplus water, if any, may be dammed within the slipping block.

RECOMMENDATIONS.

In view of the size and weight of the block of land involved it is obvious that little or nothing can be done to stop the actual movement. The movement will undoubtedly cease of its own accord eventually and then steps can be taken to minimise the possibility of further movement.

In the first place it would be advisable to put down two or three boreholes inland from the road starting near the road and progressing to the south to prove if the sand layer does extend inland and is the probable cause of the movement when it becomes saturated.

If the sand does extend inland then in order to minimise its saturation it would be advisable (and no doubt also even if the sand does not extend far inland) to drive one or more tunnels into it to permit of free access of water from it. If running ground is met as previously, then close timbering would be necessary and driving would have to be carried out with methods used in deep lead mining. If the movement does not stop shortly, it would be advisable to carry out such driving in an attempt to stop the movement.

In order to prevent as little surface water as possible percolating underground the work of draining the swampy places and leading the creek water off the affected block and adjacent solid country as quickly as possible should be completed. Some attention should also be given to the draining of the dolerite ridges each side of the affected block so that there is a minimum of percolation down the sides of the old filled-in-bay. If necessary these could be marked out by one of the staff of the Geological Survey. However, there seems little advantage in so doing until movement has ceased so that the drains, pipe lines &c.

will not be destroyed, thus avoiding repair and replacement, as can easily happen while the movement and subsidiary slips and faults are occurring.

The question of piling or other methods of attempting to prevent further movement after the present one stops, or even of attempting to stop the present movement, is a matter for the Public Works Department to decide. Any piling should be driven, or foundation work carried out, in the decomposed dolerite.

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GOVERNMENT GEOLOGIST.

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