

20. Examination of Groom's and Lonah slips, near Penguin.

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GROOM'S SLIP

Movement on this slip [DQ253470] has resulted in repairs being required to the Old Bass Highway and the railway line both of which run along the toe of the slip. The Public Works Department requested a preliminary geological inspection of the area as part of an investigation of methods of dealing with the problem. The slip zone is situated about 3 km east of Penguin and covers an area of about 25 ha.

Relief and Geology

The area involved has a roughly amphitheatre-like shape, the previously unstable material being lower and forming a very hummocky surface pattern. There are numerous small areas of internal drainage, some holding water. Ridges extend up from sea level on the east and west sides to an undulating plateau which extends around the southern side of the unstable area. The plateau rises to about 90 m above sea level and there are steep slopes from the main body of the slipped material up to the plateau top. The land surface within the slip rises sharply for about 15-20 m directly behind the shoreline where it is crossed by the road and railway line, and then undulates with local steep areas to the rear of the slip. A stream which starts towards the back of the slip enters the sea on the eastern side of the slip area.

The geology of the Penguin area was mapped by K.L. Burns in 1963 and reported on by him in 1965. Other workers have examined the slip and have reported on the geology (e.g. Nye, 1931a, b) and Balsille gave information on the materials encountered in three tunnels.

An outline of the geology is given on Figure 46. A Cambrian basaltic rock (spilite) occurs on the two points, up the ridge on both sides of the disturbed area, along the foreshore in front of the slip (where it is very weathered and is best exposed at low tide) and at isolated places between the ridges. Overlying the spilite are a series of basalt flows and interbedded sediments. It is not known how many of these units there are, but it has been suggested by Matthews (1965) that there could be up to 4 or 5 sedimentary horizons in the Penguin area. Greybilly, a silicified sand, occurs on the eastern ridge, east of the highest mapped spilite. Rounded siliceous gravel boulders occur at various places, mainly on the slopes to the plateau (fig.46). There are areas within the slipped material where such gravel fragments occur but where they are clearly not *in situ* whereas the locations marked in Figure 46 may be near the beds from which they are derived. Areas of sand in similar locations are also marked. Nye's sections drawn after the drilling show sequences of basalt, gravelly clay and sand. Towards the base of the slip in the tunnels, rounded gravel including basalt boulders are recorded by Balsille and on the shoreline above the spilite, sand beds are shown in Nye's section. It appears possible that the slip has ridden over shingle of ancient beaches and sand deposits (old dunes?, as most sand occurrences are fine even-grained deposits).

The Tertiary basalt weathers much more deeply than the Cambrian volcanic rocks and slips rarely occur in the latter rock type.

Discussion

Soon after the railway line was built, unstable conditions were

experienced and piles were driven to contain the slip. The piles were tarred in an effort to prevent rot but many of them were set alight by fires and burnt for several weeks (according to the property owner). In any event they failed to stop the slipping and many were overturned.

Serious movement took place in 1931 and it was decided to dig three tunnels to drain the slide mass. A previous attempt by the Railways Department failed to get any further than about 12 m because of bad ground. Bailsille describes these tunnels fully. Up to 60 l/min of water drained from these tunnels. Large amounts of slushy sand were encountered at various stages during the digging of the tunnels. This sand could well have been lenses of saturated sand chopped off and isolated by the slide action. During the digging and for some years afterwards surface collapses occurred and these were no doubt due to the removal of this slushy material and resulted in at least some of the present areas of internal drainage. The adits were backfilled with rock. Since the digging there has been no movement of the slip as a whole (property owner, pers. comm.). An inspection around the slip suggests no recent movement of the whole slip.

The slip that is of concern to both the P.W.D. and the Railways Department is a small slip (in comparison to the whole of Groom's slip) in the steep toe zone of the main slip. According to the property owner this slip commenced movement two years ago, but this year it has caused considerable disruption to both the railway line and road and extensive repairs were required to keep both services open. The slip appears to extend to a considerable depth and is probably of the rotational type. According to Nye's A section line which is near this slip, there is probably about 10 m of sand above bedrock (spilite) on the shore overlain by 3.5 m of basalt which is overlain by about 6 m of gravelly clay. Gravelly clay can be seen in the heel of the slip.

A disrupted agricultural pipe drains into the heel of the slip. It appears to drain a depression behind the slip. According to the property owner, a shaft connects this depression to the western tunnel but during wet periods it apparently did not drain quickly enough and the shallow north sloping drain must have been installed. The first day the slip was visited this near surface drain was pouring a considerable amount of water into the slip. The next day, when the rain had finished it was carrying only a little water. The correction of this drain should be included in the repair work.

Several slips, some quite large scale, have taken place around the steep parts of the amphitheatre in the last two years and have caused some concern to the property owner. The movements are isolated from the material that moved in the original Groom's slip. It is possible however that if such slips continue, enough material might come down on the heel of the old slip to promote movement again. Even-grained fine sand occurs in several of these slips, particularly the ones in the east. The property owner plans to plant radiata pines in the slip-prone areas at a rate of 1000 per year.

Conclusions and recommendations

The slip affecting the road and railway line is probably a deep rotational slip. The steepness and height of slope, the high rainfall and disrupted drainage have influenced the movement.

The recent slip is almost certainly not a sign that the whole of Groom's slip is moving, but is a local movement in the toe. The tunnels appear to have been successful in stopping the movement of the main slip.

The slips occurring on the steep slopes around Groom's slip could load

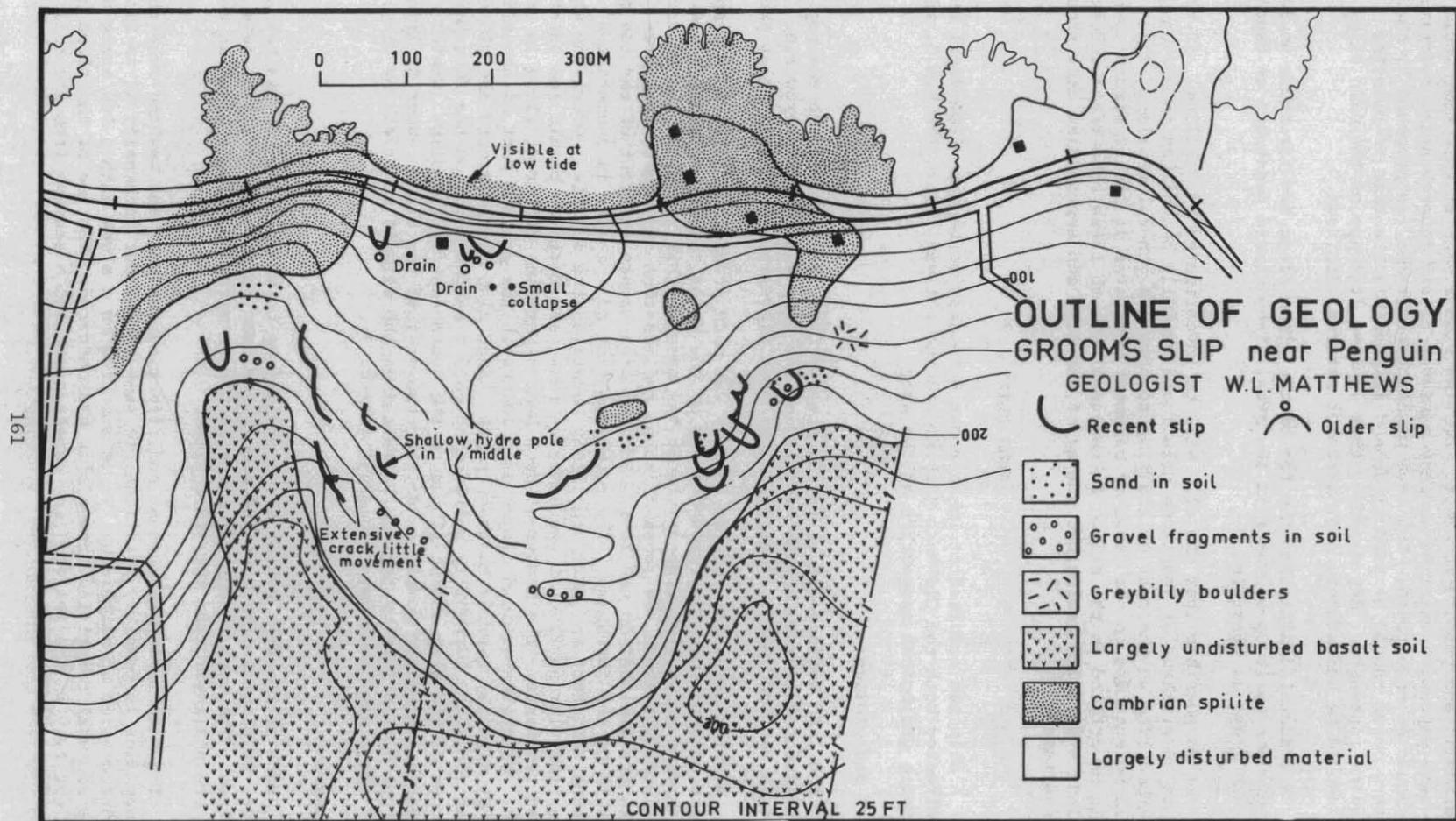


Figure 46.

5 cm

the old slip and promote movement. Dealing with a slip of this size would be a very expensive exercise and any measures to aid in preventing reactivation should be encouraged. The tree planting programme, as proposed by the property owner should be supported, and if possible the rate of planting should be increased. Any measures that improve drainage of the main slip mass should be undertaken, e.g. areas of internal drainage.

Horizontal drains into the toe of the slope along the foreshore would help prevent built up of water in the area. They should penetrate as deeply into the slope as possible.

It is possible that the slip will be investigated by drilling. If this work is undertaken, at least one hole could usefully be drilled in the undisturbed land at the rear of the slip to obtain a general section. This should be extended to sea level or basement whichever is struck first. Others should be drilled in the slip. In conjunction with these subsurface investigations a detailed geological survey of the slip and surrounding area should be undertaken.

LONAH SLIP

A slip has occurred at Lonah about 4 km east of Penguin [DQ264468] and has affected both the Old Bass Highway and the railway line. The P.W.D. requested a geological inspection of the area.

Relief and geology

The land surface slopes fairly steeply from the shoreline to the top of a dissected plateau in the vicinity of the slip with small narrow flat areas at various points. The slip has taken place in one of these flat areas.

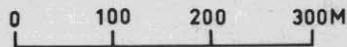
A brief inspection of the geology was made around the slip. Cambrian spilite occurs along the foreshore and at one point extends up to the road. The exposed rocks are apparently near the base of this formation, as at various intervals there are zones of baked red mudstone and chert, and large blocks are included in the lava. Such an area occurs in front of the toe of the slip on the foreshore. The rock type east of the slip is a contorted mudstone and chert and this apparently underlies the spilite. Overlying what is an irregular surface of the Cambrian rocks are Tertiary basalt and interbedded sediments. The number of such beds separating different flows is unknown. Fine even-grained clayey sand occurs in the eastern part of the slip and may directly overlie basement rocks. Sand also occurs around the slopes behind the slip. Greybilly boulders up to 3 m across occur on the foreshore in front of the slip and on slopes to the south-east of the slip. Gravel fragments are fairly common in soil to the west of the slip. Auger drilling to about 8 m in 1964 by the P.W.D. indicates the slip is underlain by clay, sandy clay, sand and clayey (quartz) gravel.

Discussion

Much of the area behind the shoreline up to the plateau top has been subject to slips in the past and some large deep rotational movements have occurred. The more recent movements have been marked on Figure 47 and in general are shallower than the older slips.

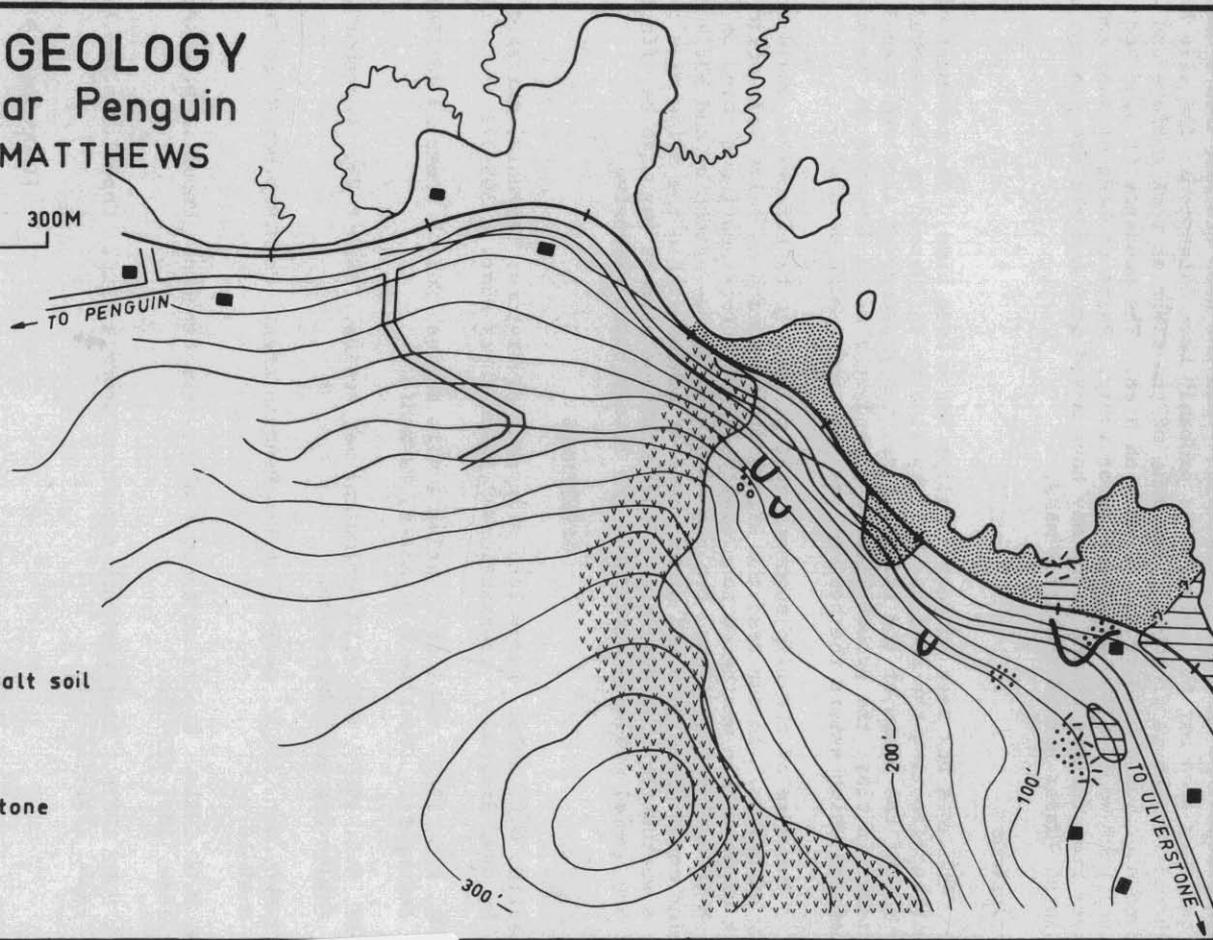
The slip moving at present and affecting the road and pushing over the railway line is possibly rotational to some extent but internally it is fairly disturbed as in an earthflow. It is situated on a slope with a low angle and it is somewhat surprising that a slip has occurred. The toe of the slope has been cut away in the railway line construction and a seepage from the hill

OUTLINE OF GEOLOGY
LONAH SLIP near Penguin
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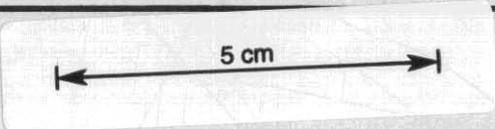
CONTOUR INTERVAL 25 FT

-  Sand in soil
-  Gravel in soil
-  Greybilly boulders
-  Largely undisturbed basalt soil
-  Cambrian spilite
-  Contorted chert and mudstone
-  Landslip



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Figure 47.



behind seeps into the heel of the slip. This has been drained into a culvert in the slip area but the culvert has probably been disrupted. The slip has occurred in what is probably a low zone of the Cambrian rock surface and groundwater would be directed to such an area. The presence of sand and gravel beds would allow ease of flow of water. Parts of beds of sand and gravel from further up the slope may have moved down and are now present in isolated lenses within the slide mass.

Conclusions

The area has been subject to slips for a long time. The movement of the slip affecting the road and railway line is influenced by the removal of the toe of the slope at the railway line, the presence of sand and gravel horizons in clay, the probability of groundwater being directed to the area, a seepage which enters the heel of the slip and a high rainfall.

The size of the slip suggests that piling, to be effective, would be very expensive. In any case the slip could be moving on relatively solid rock or on a thin weathered zone overlying solid rock leaving nothing in which to anchor the piles. Drainage measures may be effective and horizontal drains could drain sand and gravel beds or lenses within the slide mass and are a worthwhile consideration. Other drainage methods may also be effective but any useful drainage procedures are likely to be expensive.

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