Section 3—Engineering

13 GEOLOGY OF THE PENGUIN AREA

by W. L. Matthews

ABSTRACT

The Penguin district has been investigated with the object of indicating areas subject to landsliding. The utilization of these areas should be approached cautiously and with awareness of the problems involved.

INTRODUCTION

Certain areas of the Penguin district have been subject to landslides in the past. A geological survey of the town and surrounding country has been made and zones which have shown instability have been indicated on Figure 26.

The geology has been plotted on a 10 chains to 1 inch base map, most of which is taken from a Town and Country Planning publication. The eastern portion, however, is enlarged from the Lands and Surveys map of the Devonport Quadrangle.

The area has been mapped previously by T. D. Hughes (1953) and K. L. Burns (1964) as part of larger projects. These were the mapping of the Dial Range mineral field and the Devonport Quadrangle respectively. For more details of the geology, reference should be made to the explanatory notes associated with these surveys.

PHYSIOGRAPHY

The Penguin district is still in the youthful stage of its erosional cycle. Streams, although not common in the area mapped, are deeply entrenched, having cut through the basalt plateau into the underlying basement rocks. They are steep sided with no flood plain development except for a small area at the mouth of Penguin Creek. A marine terrace from about 10-30 feet a.s.l. occurs in places along the coast and is developed best underlying central Penguin. In other places it is either absent or has been obliterated by landslide material from the scarp behind. This scarp rises sharply to the areas underlain by Tertiary basalt and sediments and extends to 200-400 feet a.s.l. No general level for the basalt plateau can be given because of the ragged dissection that has taken place. Wave-cut platforms at present sea level are a feature in Tertiary basalt and Cambrian rocks.

GEOLOGY

Folded Precambrian, Cambrian and Ordovician rocks with a regional strike in a N to NE direction, form the basement in the Penguin area. Overlying these are interbedded Tertiary lavas and sediments and some recent material on the low lying areas.

PRECAMBRIAN

Precambrian quartzite, siltstone and slate outcrop for a short distance on the foreshore between Dial Point and the railway bridge and again in a small exposure to the east of Cann Street. Outcrops are common in the vicinity of Penguin and Deviation Creeks. The quartzite is light coloured with very obscure bedding while the argillite is purple, red, brown, light brown and green with very contorted bedding. These sediments probably belong to the Rocky Cape Group.

CAMBRIAN

The Cambrian period is represented by basic lavas, breccia and chert and outcrop is mainly confined to the foreshore, east of Penguin, although a small area of chert outcrops on South Road and some lava along Myrtle Creek. The angular unconformity with the underlying Precambrian can be seen on the beach between Cann Street and Seaside Crescent. At Dial Point, and apparently up Penguin Creek, the Ordovician sediments overlie Precambrian rocks directly, indicating a rapid thinning of the Cambrian westwards, or complete removal by erosion before deposition of the Ordovician at these localities. Some of the lavas exposed on the Bass Highway contain quartz veins which have been mineralized with small quantities of galena and chalcopyrite.

ORDOVICIAN

Red-brown conglomerate is the dominant Ordovician rock although a light coloured quartzite occurs at Dial Point. Outcrop is confined to isolated areas around central Penguin, up Penguin Creek and at Dial Point where the unconformity between Precambrian siltstone and fine grained Ordovician conglomerate can be seen on the foreshore. From dip measurements taken, an anticlinal structure is suggested running approximately along Deviation Creek.

TERTIARY

No rocks between the Ordovician and Tertiary are exposed at Penguin and although sediments may have been deposited and subsequently removed it seems probable that erosion occupied most of this time, leading to an irregular surface below the basalt extrusions.

Thus, at the beginning of Tertiary vulcanism and sedimentation, the depressions in this surface were filled first. A high zone in this surface occurs near the town cemetery where resistant Precambrian quartzite outcrops and although exposure is poor it appears that the pre-Tertiary surface rises to the east of central Penguin and also to the south. It seems probable that the Tertiary rocks were deposited on a surface which sloped down towards the north.

Tertiary sediments separate basalt flows. Possibly four or five different levels occur, although there may be less if some were deposited on sloping surfaces.

The thickest and most persistent band outcrops at 100-250 feet a.s.l. throughout the area mapped. The thickness is variable with at least 100 feet in the scarp at the eastern end of Preservation Bay,

while to the south of Teatree Point it is only about 20 feet thick. Large areas are exposed on either side of Deviation Creek and South Road where it overlies basalt or Precambrian rocks. Where Precambrian underlies it, high zones in the pre-Tertiary surface are represented.

Clay, sand, grit, fine and coarse pebble beds outcrop with the last three predominating except in the eastern section where sand and grit alone occur in the exposures. The best exposure is in a road metal quarry up Mission Road where gravel, grit and sand with angular to rounded fragments outcrop. Large structures like cross bedding are present with a variable current direction.

Induration by basalt has altered these sediments to quartzite and conglomerate in some localities. In small outcrops it is sometimes difficult to differentiate these from Ordovician and Precambrian quartzite and conglomerate although the older rocks in most places contain quartz veins.

At sea level on the west side of Preservation Bay is a bed of blue-grey to brown clay containing angular to rounded fragments of quartz up to ½ inch in diameter. Limonite nodules in the clay are common and thin bands of quartz pebble beds are interbedded with the clay.

Around central Penguin, there are several localities where boulder beds containing Ordovician and Cambrian fragments underlie the basalt, e.g. Ironcliff Road, King Edward, Frith and Cann Streets. The boulders are up to about 6 feet in diameter and because of their size it is assumed they have not travelled far. They outcrop mainly at about 50 feet a.s.l., but in some areas they occur up to about 100 feet.

In the eastern part of the area mapped, rounded quartz and quartzite boulder beds with fragments up to about 2 inches in diameter outcrop in several places at about 280 feet a.s.l. The best exposure is in a track cutting on the eastern margin where about 8 feet of gravel is overlain by a similar thickness of clay. Basalt overlies and underlies these beds. At about 400 feet a.s.l. another band of rounded gravel about 15 feet thick is exposed in the same track.

A number of basalt extrusions took place during the Tertiary era. Some are separated by sediments but on Dial Point just below the railway line two flows can be seen in contact. The basalt, in many of its exposures, has calcite-filled vesicles. Jointing is well developed and between Dial Point and Preservation Bay irregular-shaped columns with a large cross-sectional area have formed. On the west side of Preservation Bay, the basalt has been partly bauxitized. Weathering of the basalt results in a deep red-brown soil.

RECENT

Recent sand and gravel underlie the marine terraces while river gravel extends up Penguin Creek.

LANDSLIDES

Landslides in the Penguin district are an exclusive feature of Tertiary rocks. Other rock types do not weather as readily, or form large thicknesses of soil and unconsolidated material. Many landslips have occurred and several have required corrective measures. About a quarter of a mile to the east of the area mapped, a large area of low sloping country slipped towards the railway line in 1931 after a period of heavy rain. Three drainage tunnels driven in from the toe area stabilized the moving mass. In June, 1956, also after heavy rain, a slip developed near Cemetery Hill above the Bass Highway. This again was a low angle slip and was stabilized by a system of drains.

There are three main areas subject to slip in the area mapped. These are:— (1) a large area bordering Preservation Bay and extending to Dial Point; (2) a small area between Mission Road and Penguin Creek; (3) a large area fronting on the Bass Highway from east Penguin and extending towards Ulverstone. This latter area is divided into two parts by a stable ridge of Cambrian lava.

The slides have been grouped into three types.

(1) *Active slides*:—These have shown activity recently.

(2) *Old slides*:—There is no sign of recent activity but they could be reactivated by loading of the heel or undercutting the toe area.

(3) *Old Scars*:—These are old stable slides. Some breaks in topography have been mapped and may represent old slides or just normal erosional features.

Sizes of the slides were not measured in the field and although care was taken to plot the approximate extents, they are not accurate.

Three types of movement have been noted. Earth flows are very common and occur on the face of the scarp. These may originate as rotational slides in some cases but the end product is a flow with a long narrow path of movement. Most of this type are comparatively small in extent. Large rotational sliding has taken place and although it covers an area comparable with the flows there are only a few individual slides. Soil creep is also a feature on steep slopes but is not regarded as dangerous.

The landslides appear to be due to a number of factors. Some of these are:—(1) the youthful stage of erosion and the presence of the scarp in many places back from the shoreline; (2) the unconsolidated nature of the Tertiary sediments which allows ease of undercutting and subsequent collapse; (3) the deep weathering of the Tertiary basalt to a clay soil; (4) the presence of clay beds in the Tertiary sediments; (5) the possible liquefaction of Tertiary sediments which produces flows; (6) the jointing developed in the basalt which allows zones of weathering to form, thus producing the requirements for a rotational slip with a scarp near by; (7) the probable control of drainage to some extent by the pre-Tertiary surface; (8) the development of talus slopes.

Preservation Bay Area

A new subdivision is being planned at Preservation Bay. Numerous small to moderately large movements have taken place here and many have been active recently. This is particularly so on the west

side of the bay where seeps are also common. The subdivision is sited mainly on old slide material which covers an old marine terrace but this should be stable provided it is well drained and excavations are kept to a minimum. Excavation slopes should be cut at a low angle as this material is not stable in high angle cuts. An area in front of the scarp should be left vacant as most of these slides are of the flow type and extend for a distance on to the gently sloping ground. Development of the scarp itself should be avoided.

The scarp flattens out at about 200 feet a.s.l. and extends back to the heel of a large rotational slide which appears to be stabilized. It could possibly be reactivated by excessive removal of material from the toe area approximately at the base of the scarp and loading of the extensive areas of internal drainage on the flat between the heel and the scarp top.

On the eastern side of the bay, the slides are older and seepages are rare but development on the scarp should be limited. From Preservation Bay to Dial Point numerous active slides occur with some seepage. Caution is advised in development of this area.

Area Between Mission Road and Penguin Creek

Several old slides are present and active slides have formed in the slide material with toes in Penguin Creek. Houses placed closer to the creek on the upstream side than at present could possibly be flooded by damming of the creek if a major slip takes place. There appears to be no danger to houses in their present positions. The creek will eventually remove all the material in the present active slips leaving a scarp where new slips are likely to develop. The area around these active slips is regarded as potentially dangerous.

East Penguin Area

The situation here is very similar to that in the Preservation Bay area as there is a large rotational slip or series of slips which is at present stabilized. Seeps in the toe area are common but small slides down the scarp are rarer than in Preservation Bay. Similarly, loading of the flat combined with excessive removal of material from the toe and disruption of drainage could possibly reactivate this slip.

The sub-zone to the east is an area of several large slips which could easily be made active by the above methods.

Zones of Unstable Ground

The areas which are considered to be potentially dangerous have been divided into three types as indicated in the accompanying map (Figure 26).

(1) Those areas where no development is recommended.

(2) Areas where particular attention should be paid to drainage of the land and where excavations should be limited and only low angle cuts be made.

(3) Zones which underlie the flats in front of the two large rotational slips. They should be stable unless large quantities of material are removed from the toe area combined with poor drainage practices around the heel.

Certain areas have been selected for particular attention but there are other locations where slides could develop if the right conditions were present. These are the moderately steep to steep areas underlain by unconsolidated material such as basalt soil. If cuttings are steep and drainage is disrupted and more water is introduced to soil, formation of slides could be promoted.

REFERENCES

BURNS, K. L., 1964.—Devonport. *Explan. Rep. Geol. Surv. Tas.*, 1-mile Geol. Map Ser. K/55-6-29.

HUGHES, T. D., 1953.—The Dial Range Mineral Field. *Rep. Dep. Min. Tas.* (*Unpublished*).

————, 1956.—Landslip near Cemetery Hill. *Rep. Dep. Min. Tas.* (*Unpublished*).

NYE, P. B., 1931.—Report on Groom's Slip near Penguin. *Rep. Dep. Min. Tas.* (*Unpublished*).

GEOLOGY – PENNGUIN AREA

B A S S

S T R A I T

Preservation Bay

Dial Pt.

Beecraft Pt.

PENGUIN

Tea Tree Pt.

0 10 20 30 40 CHS.
0 1000 2000 2500 FT.

5 cm

LEGEND

- QUATERNARY SAND & GRAVEL.
- TALUS, SLIP MATERIAL, DRIFT.
- TERTIARY BASALT.
- TERTIARY SAND, GRAVEL, QUARTZITE, CLAY.
- ORDOVICIAN CONGLOMERATE & QUARTZITE.
- CAMBRIAN LAVA, BRECCIA & CHERT.
- PRECAMBRIAN MUDSTONE, SLATE, QUARTZITE.

- OUTCROP
- ACTIVE SLIDE
- OLD SLIDE
- OLD SCAR
- BREAK IN TOPOGRAPHY.
- INTERNAL DRAINAGE.
- SEEP.
- STRIKE & DIP.
- UNCONFORMITY.

GEOLOGY BY
W. L. MATTHEWS.
1963

TR9_96_101

MERCURY

FIGURE 26