TR8_107-112

16. LANDSLIDES IN THE BURNIE DISTRICT

by I. Jennings

The geological map (Figure 38) and report (p. 103) describe the geology of the landslides in the Burnie district. In addition to the rock types present, all the observed landslides, springs and water seepages have also been indicated on the map. Some of the landslides are relatively ancient and have been modified by subsequent erosion. The older the slide the more difficult it becomes to identify it positively and some caution is necessary. The landslips have therefore been divided into several groups for the purpose of mapping as indicated below:—

Active slides: These are slides in which it is possible to recognize signs of movement during the last few years.

Old slides: Slides which can be easily recognized on the ground but which appear to be reasonably stable at present. They could be reactivated by disrupted or improper drainage and excessive loading. They indicate areas of doubtful stability.

Old scars: This group of features includes the older slides which appear to have become stabilized. Many of them have been modified by subsequent erosion. Whilst not active at present they indicate areas of instability which could be reactivated by developmental works.

Others: In addition to the identifiable slides, both ancient and modern, there are areas where unusual topographic features have been noted. On the geological map they are indicated as breaks in topography. They may simply be due to the effects of differential erosion on basalt flows of varying competence or they could represent the heels of ancient landslides. Not all such features in the area have been mapped. However, those which occur close to scarps or in such a position as to endanger the stability of the lower slopes, if over-steepened by any means, are shown.

CLASSIFICATION OF LANDSLIDES

Generally the landslides in this district are of two types or are hybrid slides having features in common with both of the main types. In addition to these there are no doubt numerous small embankment failures in the built up area which have not been recorded in this survey. The general characters of the main types are given below.

Flows

These have features in common with mudflows and debris avalanches. They may move relatively rapidly under appropriate conditions and although quite destructive they are not deeply seated. Generally they involve only surface material probably to a depth of 20 feet or so depending upon the angle of slope, amount of water present and the thickness of superficial material. Flows tend to originate on steep slopes but once movement commences they may encroach onto flatter ground at the foot of the slopes if the flow mass is kept sufficiently fluid by ground and surface waters. The flows are made up of blocks of basalt and older rocks in a matrix of wet plastic clay generally derived from the weathering of basalt. The scars of individual flows are narrow and highly elongated downslope but in places where several flows have coalesced a wide area of instability has resulted.

These movements commence with a small slump along the heel of the flow accompanied by a corresponding bulge at the toe. Further movement results in the formation of a narrow tongue of material flowing down the slope. Numerous landslides of this kind may be seen along the steep slopes between Messengers Creek and West Park.

Rotational failures

This is the classical form of movement which has been widely described in the literature dealing with landslides. It consists of shear failure along an arcuate slip " plane " causing rotation of the landslide block. The top or heel of the slip is characteristically depressed and the bottom or toe of the slip heaves upwards. Tension cracks appear around the heel of the slip and the slip plane usually intersects the ground surface in an arcuate fashion.

In this form of landslide the slip plane may be located at considerable depths, depending upon the size of the slip block. If the movement is purely rotational all movement takes place along the slip plane and there is no disruption of the internal structure of the landslip mass. However, this ideal condition is probably seldom achieved. In such slides it is therefore possible to find apparently solid outcrops of rock within the landslide mass.

Landslides which are probably essentially of this kind have been noted in the suburb of Brooklyn, behind Studholme Street, north of the Mormon Church and behind Cam Creek.

Hybrid slides

The development of the rotational slides leads to further instability in the zone of heave surrounding the toe. Frequently this area becomes oversteepened and earth flows develop in the vicinity leading to yet more unstable conditions which modify the form of the original slide. By mechanisms of this kind hybrid slides having features common to both earth flows and rotational failures are developed.

ORIGIN OF THE SLIDES

Many agencies contribute to the formation of these slides, some geological and others human. Generally speaking it may be said that the fundamental causes of the instability are natural phenomena related to the geological history of the area. However, the localization of the individual slides may often be attributed to human activities. The two agencies are discussed separately below.

Natural influences

The geological study of this area indicates that in the past the sea has encroached over all the flat area bordering the coastline around Burnie. During this period the sea cut back into the basalt plateau forming a series of steep unstable cliffs along the shoreline of that time. Similar conditions prevail at the present time in the vicinity of Cape Grim where nearly vertical basalt cliffs have been produced by marine erosion. When the sea retreated to its present position this row of cliffs became subject to normal sub-aerial erosional agencies. The effect of sub-aerial erosion is ultimately to reduce all topographic features to a plane surface. At first this is accomplished by rock falls and spalling from the bare rock faces and later as the profile of the escarpment becomes more mature, mass transport of sediment by means of landslides and earthflows takes over. This appears to be the state in the Burnie district at present.

This mass transportation has probably been in operation for thousands of years and it will continue until a mature profile is reached unless halted by artificial means.

A feature of basalt country is that the bedrock is thoroughly shattered by a series of closely spaced joints. This allows ready access for water to percolate through the rocks thus leading to the formation of springs and seepages in favourable localities. The soils which result from the weathering of basalt are also comparatively permeable so that in an area of reasonable rainfall abundant quantities of underground water are usually present in basalt

country. Where this water emerges at the surface along the side of steep hillsides conditions are favourable for the formation of landslides.

Human influences

The first action taken by settlers in the Burnie district was to clear the forests so that farms could be established. Loveday and Farquhar (1958) have shown that the annual surplus of rainfall available for run off in the Burnie district is 5 inches under forest conditions and 13 inches under pastural conditions. Thus the original act of clearing the Burnie forests increased the amount of water available for soil erosion or to be added to the groundwater by 160%. With further development, a huge volume of additional water has been added to this annually from garden hoses, septic tanks, household drainage and leaking pipes. In an area left unstable by natural processes this increment to the surface and sub-surface water must surely have further lowered the stability of the slopes affected.

In many instances it has been necessary to cut into hillsides to provide areas for building or for access roads. The effect of this has been to oversteepen slopes which, in some cases, were already delicately balanced. The construction of houses and roads, &c., on the hillsides, has added more load to the unstable superficial deposits, thus further endangering the stability.

GENERAL CONSIDERATIONS

Geological study has indicated two further features which could have a real significance in this area. However, the exposures of bedrock in the area are not good enough to allow firm interpretations in either case.

The basement rocks had suffered considerable erosion before the extrusion of the Tertiary basalt and the earliest basalt flows filled up any pre-existing valleys. Since the basalts are quite permeable these low areas in the basement tend to act as channels for the underground water. It is to be expected that the more unstable areas should be related to such features. However, the continuity of outcrop is not sufficient to demonstrate this conclusively although the mechanism is regarded as important. This mechanism was first suggested by Hughes (1959) in relation to a small slip in the Parklands district.

A number of beds of sand, gravel and clay have been mapped interbedded between basalt flows. Some of these units are highly permeable and may act as aquifers which locally control the groundwater flow. The effect of this could vary locally. Where such a bed intersects the side of a steep hillside covered with talus it tends to promote landslides. If such a bed outcrops freely it may act as a drainage channel and promote stability. The latter case appears to have occured above West Park where no active slips have been noted although the hillside is probably steeper than any other built up area in Burnie. In other areas around Burnie similar beds have been observed in the scarps left by landslides and they appear to have contributed to their formation.

REMEDIAL MEASURES

The general remedial measures required have been outlined in an earlier report (Jennings, 1963). They consist of careful attention to drainage, even outside of the affected areas, and extreme care in construction so as not to oversteepen existing slopes, &c. Since a number of mechanisms could be operating to localize slides and different types of slides are present it seems that each slide should be treated individually. However, a widespread awareness of the problem and careful attention to the remedial measures recommended should help to minimize the number of slides which may occur in the built up area.

PREVENTATIVE MEASURES

Whilst it may be theoretically possible to completely stabilize all the land in the Burnie District, this would require major engineering works quite out of proportion to the value of the property involved. The simplest course is to avoid building on the unstable land. It was with this course in view that the geological survey was carried out. A map (Figure 39) has been prepared indicating the areas which are considered to be most unstable and likely to result in damage to property if built upon. The boundaries indicated have been drawn after very careful consideration of all the information available but it should be clear that absolute precision in such matters is unattainable. A great number of factors are involved and complete information is not available. The zoned areas are presented as a basis of guidance for the Council in future planning, but no guarantee can be given that landslips will not occur in the areas considered to be stable and that landslips will necessarily occur in the areas considered to be unstable. The following two zones have been outlined:—

Zone 1.—Areas of active land movements and/or slopes which are considered to be unstable or likely to become unstable with increased development. It is recommended that building and development should be restricted in these areas.

Zone 2.—Areas of doubtful stability which may become unstable if proper precautions are not taken before development is approved. Special drainage precautions are necessary and care should be taken so as not to oversteepen existing slopes.

The recommendations made in the previous report to the Council are considered to be still valid. It should be noted that any drainage waters which pass underground on the plateau south of Burnie will ultimately emerge along the hillside around the town.

Thus, septic tank effluents from houses sited on stable areas in South Burnie could ultimately affect the stability of houses in other suburbs. It will be necessary for the Council and for householders to adopt a very wide view of the problems involved.

It is desirable that the Council keep records of all land movements which are noted in the area. Such records could be invaluable in making decisions as to the probable rate of movements of slopes and perhaps enable predictions to be made as to the stability of slides in areas already built on. Records of the kind of materials encountered in excavations would also be a very useful source of information. The present survey was severely limited in some areas

by the lack of outcrop. Specialized knowledge for such a recording programme is not absolutely essential. Such terms as sand, gravel, bluestone and slate would be reasonably satisfactory and doubtful specimens could be retained or sent to this Department for proper examination.

Drainage and water reticulation in landslip areas always presents a difficult problem. The slightest movement usually disrupts the existing pipelines and the resulting leakage magnifies the problems. Wherever possible pipelines should be placed above ground level so that any leakage is immediately obvious and routine inspections can be easily carried out.

Considering the number of potential slides in this area the damage caused up to date has not been great. With careful planning for the future there is no reason why these problems should be aggravated. This study indicates the lines along which it is considered that future planning should proceed.

REFERENCES

HUGHES, T. D., 1959.—Landslides at Burnie. *Tech. Rep. Dep. Min. Tas.* 3, 135-136.

JENNINGS, I., 1963.—Landslips at Parklands, Burnie. *Tech. Rep. Dep. Min. Tas.*, 7, 93-98.

LOVEDAY J. AND FARQUHAR, R. N., 1958.—Soils of the Burnie-Table Cape District, Tasmania. *C.S.I.R.O. Soils and Land Use Ser.*, 26, 19.