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ROCK FALLS AT CASCADE JETTY, NORFOLK ISLAND.

by

L.C.NOAKES.

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SUMMARY

At the request of the Department of Territories, I inspected a cliff overlooking the jetty and access road at Cascade Bay, Norfolk Island, on the 23rd November, 1957, in company with an engineer from the Department of Works, Canberra.

The cliff is composed of interbedded basaltic flows and tuffs and shows evidence of numbers of slab-slides and rock falls in the past. A recent rock fall came from an undercut section of a 30' basalt flow and was apparently triggered by water penetration during heavy rain.

Remedial measures to remove obvious danger are discussed; it is emphasised that under existing conditions some hazard from rock fall is inevitable.

INTRODUCTION

In mid-November, 1957, a fall of rock of the order of 400 tons occurred from the cliff overlooking the access road and jetty at Cascade Bay, Commonwealth Territory of Norfolk Island; a dinghy was destroyed but no casualties resulted.

The Administrator of Norfolk Island, Brigadier C.H.B. Norman, asked the Department of Territories to arrange inspection of the cliff by appropriate officers as sections of the cliff face adjoining the slip appeared to be dangerous. It was arranged therefore, that the Department of Works, Canberra, should send an eingineer, Mr. A. Slater, accompanied by a geologist from the Bureau of Mineral Resources, to carry out an inspection. Since the island has only a fortnightly 'plane service, the inspection had to be carried out in less than one day; the officers arrived on the island on Saturday morning, 23rd November and left on the return journey late that afternoon. It will be understood therefore that this report is a quick appraisal of the position, not a detailed survey.

It might be noted, by way of explanation, that access to one of the two jetties on Norfolk Island is a matter of vital importance to the island community. There are no wharfage facilities at the island, which is girt by cliffs, except near Kingston on the south coast. Loading and unloading is carried out by lighter at one of the two jetties which are used as weather dictates (see Plate 1).

The main jetty is situated at Kingston; the other is built on a reef of rock at the base of a 300' cliff in Cascade Bay, on the north coast, about 150 yards east of a narrow valley which provides one of the very few localities where road access to sea level is practicable. The road from the end of the valley to the jetty has been cut into the bottom of the cliff and this section, and the jetty itself, are vulnerable to land slips or rock falls. The whaling station and factory, built at the lower end of the valley, do not face the same hazard.

Geology at Cascade Jetty.

Norfolk and neighbouring Phillip Islands consist mainly of Cainozoic basaltic flows and tuffs; remnants of volcanic cones exist but no volcanic activity in any form has been reported. There are no details of the geology of the islands, but some useful geological information has been provided by Carne (1885) and Stephens and Hutton (1954).

The cliff at Cascade Jetty consists of basalt flows with some interbedded tuffs. The attitude of the beds is close to horizontal along the face of the cliff, which trends W.20°S; there is some evidence of low local dips in a south-easterly direction - into the cliff rather than toward the sea. The boundaries between succeeding beds are commonly irregular, particularly between tuff beds and overlying flows, consequent on intervals of erosion or on subsequent compaction.

Sketch sections of the cliff and of the volcanic succession are shown in Plate 2; more accurate illustrations will be available when coloured photographs have been developed. The cliff is divided into two sections. The lower part, extending for some 110' above the road, is near-vertical and consists of a succession of weathered tuffs and comparatively unweathered basalt flows; the top of the vertical section consists of a 30' flow, which for convenience will be termed the main flow; it overlies a tuff bed and, in places, is undercut to an average of 2 - 3 feet.

The upper section of the cliff, some 140' in height was not accessible; it has an average slope of 45° and consists of weathered and leached rock which may include tuff as well as basalt. Dark-coloured, less weathered outcrops are probably basalt.

The basalt flows have been cut into irregular blocks by a dense pattern of joints and, in places, by a tendency to yield along flow bedding.

Recent rock-fall.

The recent slide was a simple rock-fall immediately following heavy rain, it came from a portion of the undercut section of the main flow. The real cause was the fracturing and undercutting of the basalt; the immediate cause, or trigger, was probably the lubrication of cracks by heavy rain. Two small water channels concentrated water in the area of the slip and explain its location within the undercut portion of the main flow. The removal of part of the flow has probably weakened the adjoining undercut sections and at least one block in an underlying flow has been disturbed by the fall.

Immediate Remedial Measures.

Two points should be borne in mind in deciding what might be done immediately to decrease the hazard of rock-falls.

Firstly, vibration set up by blasting, particularly where heavy charges are used, is likely to decrease stability elsewhere in the face, although there may be no immediate signs of the damage done.

Secondly, the removal of rock can also affect the stability of the face by withdrawing some of the support for adjoining blocks.

It is evident therefore that either the whole cliff should be blasted back to a safe batter - a major undertaking - or the minimum of rock brought down by experts to remove what appear to be definite and immediate hazards. Less discriminating action is likely to increase the future hazard.

The immediate hazards are considered to be:

1. The section of undercut main flow immediately west of the recent slip (A on Plate 1).

2. The partly displaced block in the flow beneath the main flow (B).

Area A shows virtually the same characteristics as those of the section of the flow which recently slipped. It is undercut; cracks, making a small angle with the face and providing potential slip surfaces, can be seen and two small channels in the upper portion of the cliff would concentrate water on this section (see Plate 1). The rock involved, of the order of 800-1000 tons, is directly above the road.

The ledge at the top of the main flow will provide access but ropes would be necessary. Drilling and blasting will need to be done in such a way as to cause minimum disturbance to the toe of the ridge of partially weathered basalt immediately above the ledge.

The section of the main flow immediately east of the recent slip, although undercut, appears much more stable and there are no channels to concentrate storm water on it. Furthermore, removal of this section would withdraw support from the toe of potential slip material farther up the cliff.

The partly displaced block (B) can readily be removed and in fact may fall with the rock debris from A.

In addition, the stability of a triangular block of basalt at the toe of the small ridge above A ("C" on Plate 1) should be inspected when work is proceeding on the ledge; it should not be disturbed unless it is loose.

The feasibility of providing extra strength to portions of the face by use of rock bolts will be discussed with the Department of Works. They could be effective in strengthening isolated blocks such as that at C, or in strengthening the toe of the ridge above A, depending on the degree of weathering of the rock. The density of fracturing in the main flow suggests that the pattern of rock bolts would have to be dense to be effective and installation would be difficult.

There seems no practical way of minimising or diverting the water running from the weathered material in the top section of the cliff except perhaps by increasing the vegetation cover. At least existing vegetation on this section of the cliff should not be allowed to deteriorate as this would further concentrate water in the weathered rock and on the underlying beds.

Stability of the Cliff.

It must be emphasised that the immediate action suggested will not make the area of the road and jetty safe from rock-falls; only removal of much of the cliff could accomplish that. In the existing situation, some hazard of rock-falls must remain, particularly during and after heavy or consistent rain, earthquakes or blasting.

Inspection on the ground and of air photographs shows clear evidence, near the jetty and elsewhere in Cascade Bay, of numbers of slides of two general types, slab-slides in the weathered material in the upper portion of the cliff and rock-falls from the stronger flows lower down. Slab-slides toward the top of the cliff near the jetty are apparently ancient ones which, in places, are covered by vegetation. However this upper portion of the cliff also needs watching. Deterioration of cover from any cause, should be countered by its re-introduction by one or more of the methods used by the Snowy Mountains Hydro Electric Authority and Soil Conservation Authorities to stabilise steep slopes.

CONCLUSIONS

Under existing conditions at Cascade Bay some hazard of rock falls is inevitable but expert blasting of one potential rock fall will remove the obvious immediate danger. Rock bolts might be considered as a means of strengthening overhanging or isolated blocks.

The cliff should be kept under close survey by local officers; this includes the upper portion where deterioration of existing cover should be countered by slope stabilisation work.

REFERENCES

CARNE, J.E., 1885 - Appendix H, Annual Report Department of Mines, N.S.W. for 1885, p.145-8.

STEPHENS, C.J. and HUTTON, J.T., 1954 - Soils and Land Use Study of the Australian Territory of Norfolk Island, South Pacific Ocean. Soils and Land Use Series No. 12, C.S.I.R.O.

PLATE 1.

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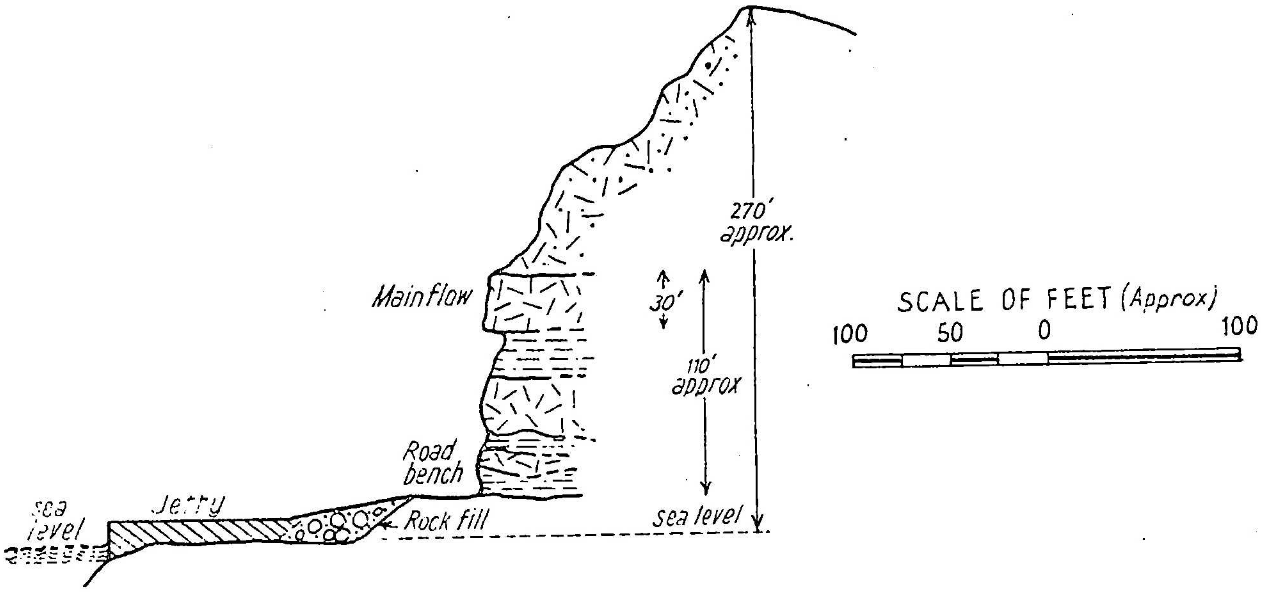
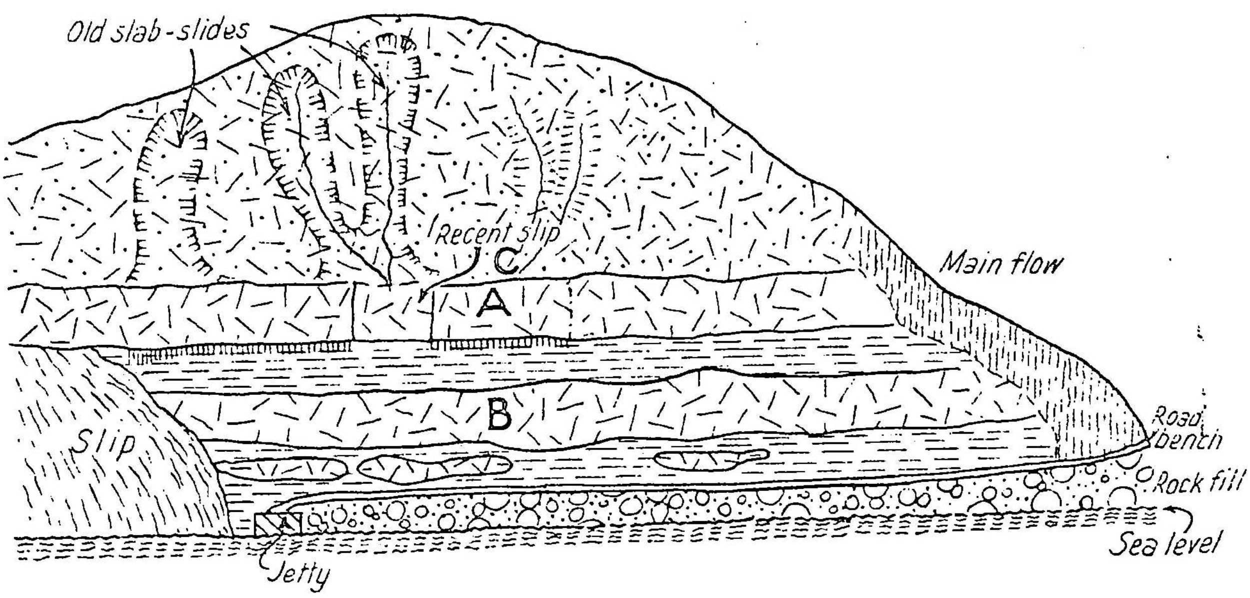
NG.2-2

SKETCH SECTIONS
CLIFF AT CASCADE JETTY
NORFOLK ISLAND



SECTION LOOKING EAST



SECTION LOOKING SOUTH

Reference

- *Deeply weathered rock, mainly basalt.*
- *Massive jointed basalt.*
- *Tuff*
- *Overhang*

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