BLOCK TERRACES IN THE NENY FJORD AREA, MARGUERITE BAY, GRAHAM LAND

By A. K. HOSKINS

THE coast of Neny Fjord in Marguerite Bay is remarkable because it is free from fringing ice cliffs to a degree not found elsewhere in Graham Land, except in Tabarin Peninsula 300 miles (480 km.) to the north. This appears to be due to a combination of two factors existing in Neny Fjord: extensive north-facing, sea-bounded mountains, and the "continental" aspect of the weather which permits long periods of intense radiation from the sun. The result is that the lower slopes of these mountains, which are relatively free from ice cliffs, are covered by screes, beaches and block terraces. "Block terrace" is the name used by Nichols (1953, p. 74; 1960, p. 1438) to describe certain terrace-like features which are physiographically distinctive in this area; the distribution of some of the better-developed examples in Neny Fjord is shown in Fig. 1, where it can be seen that they occur on Millerand and Neny Islands, Roman Four Promontory and Red Rock Ridge.

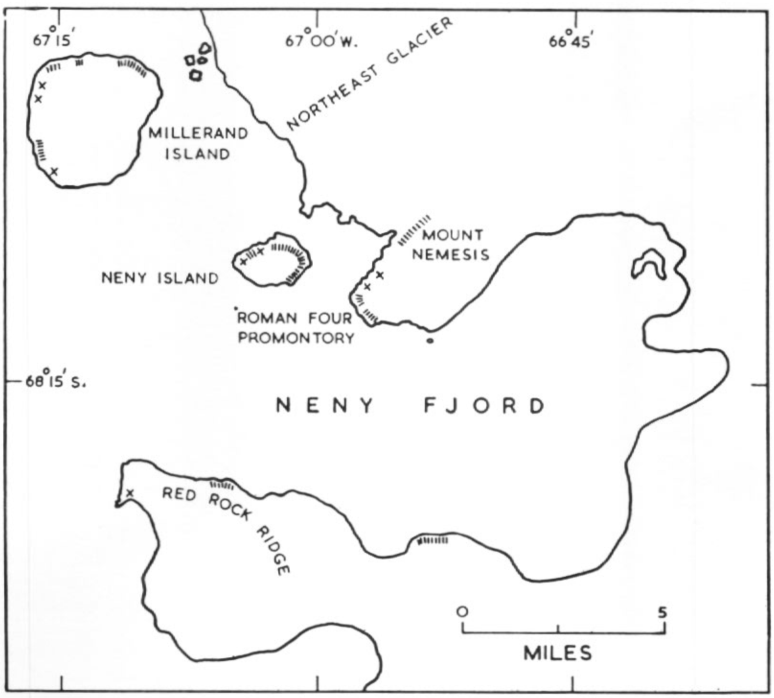

Fig. 1. The Neny Fjord area of Marguerite Bay showing the distribution of block terraces (×) and main areas with normal screes (hatched).

FORM

These terrace-like features can be imagined as truncated scree cones with a small cone of rock debris or avalanche snow on top (Fig. 2). The forward slope rises at an angle of 30–40° to the horizontal and in those cases with the higher angle it has been found that the material constituting the slope is held together with ice. This is a common feature of all talus slopes in Antarctica and is not a feature peculiar to block terraces. In Fig. 3 the surface of the block terrace appears deceptively smooth, whereas in reality it may have boulders up to 3 ft. (0·9 m.) in diameter resting on it; the central parts of the terraces may, as in the one at the western

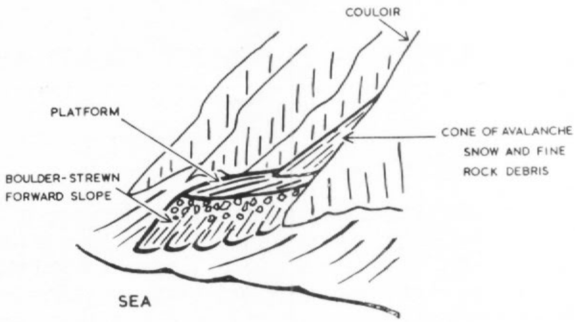

Fig. 2. Sketch diagram of a block terrace showing the main morphological features.

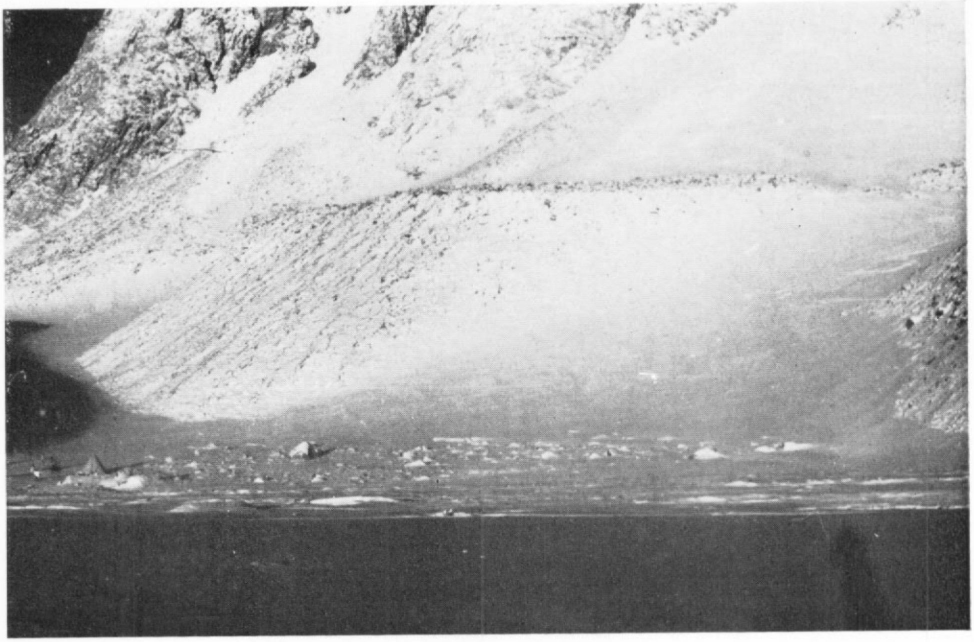

Fig. 3. A block terrace on the north-western side of Roman Four Promontory showing the pronounced platform and avalanche snow on the upper slopes.

end of Neny Island, be slightly lower than their margins. Important features that appear to be common to all block terraces are:

i. A basement platform, either of bedrock or of beach material, and the lower margin of the terrace does not generally reach the sea (Fig. 4).

ii. The block terraces have a layered structure which is approximately parallel to the surface of the terrace, and the whole is visibly held together by ice. This latter point is emphasized by melt streams flowing over the surface of the terrace in the summer and not percolating down through the terrace as they would if it were not frozen.

iii. The perfect form of many isolated examples suggests that each block terrace is an individual product of its immediate environment, although there are cases where coalescence does occur: Roman Four Promontory, where one example has two flat parts, one at approximately 50 ft. (15 m.) and another at approximately 125 ft. (38 m.) (Fig. 5).

iv. Each example is backed by a couloir.

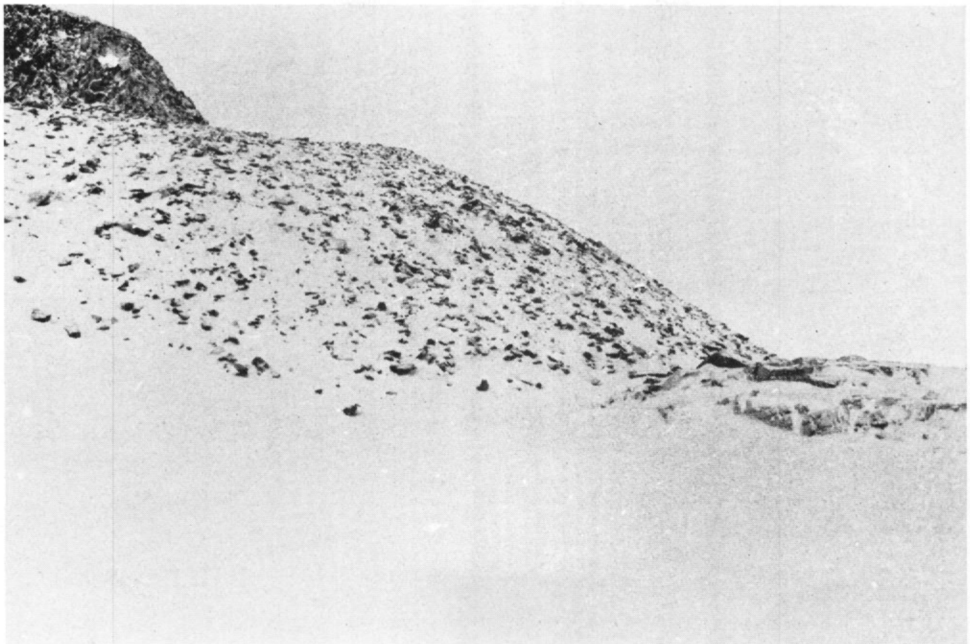

Fig. 4. A block terrace on south-western Millerand Island showing the foot of the forward slope resting on a basal rock platform.

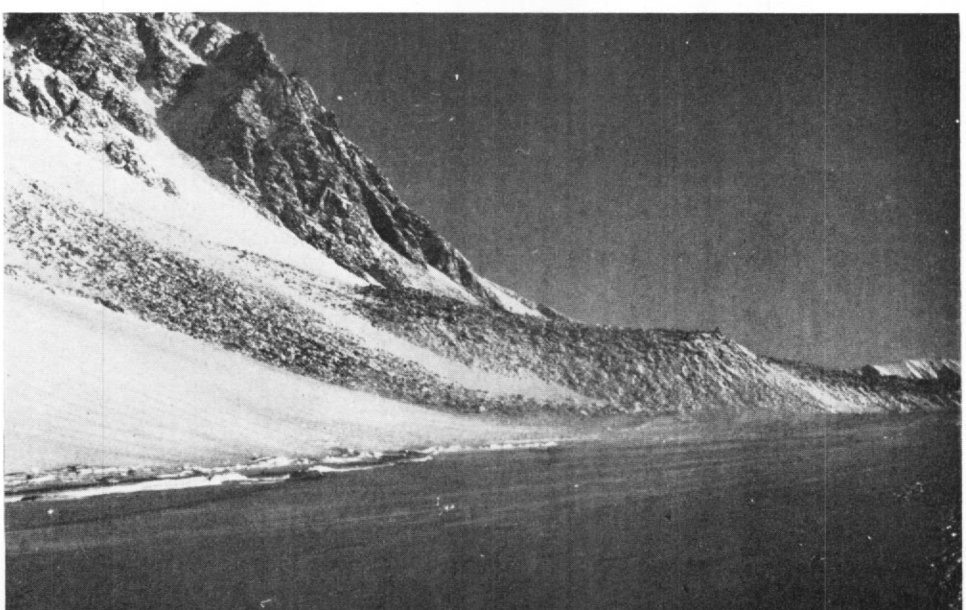

Fig. 5. Composite block terrace on the north-western face of Roman Four Promontory. Note the linear structure of deposition.

Origin

Block terraces occur below couloirs which are relatively sheltered from the wind, which is predominantly easterly in the Marguerite Bay area, and in these couloirs large quantities of unstable snow accumulate. During periods of thaw the snow avalanches, bringing down with it fragments of rock loosened by nivation and the passage of the avalanche itself. The cone of snow at the foot of the couloir serves as a deflector to project the avalanche debris forward. The rocks which have a greater momentum than the snow and the finer debris come to rest on the flattened part of the terrace or fall on to the outer slope. Melting of the snow left on top of the terraces allows the terrace to sink to an approximately level position, resulting in the suggested internal structure of a block terrace shown in Fig. 6.

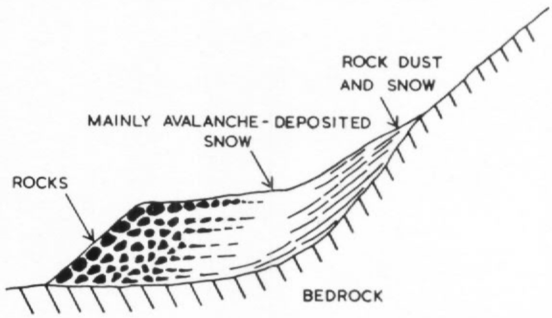

Fig. 6. Sketch section of a block terrace showing its possible internal structure.

Discussion

Although Cotton's (1942, p. 211–12; 1958, p. 328) descriptions are brief, it would seem that block terraces can be regarded as a special case of avalanche ramparts which develop when falling debris is canalized in a couloir.

Under the name of "talus delta", Taylor (1922, p. 36, fig. 35) has figured a remarkably fine example of a block terrace from the Kukri Hills, in McMurdo Sound. He emphasizes its relationship to a couloir which he considers to be mainly the result of frost action assisted by water. He regards talus deltas as evidence of intermittent but abundant supplies of water. Without further precise evidence as to the size of material composing these deltas and the nature of deposition, it is not possible to evaluate this mode of origin in these circumstances. The dimensions of the examples cited from the Kukri Hills (30 ft. (9 m.) high and 30 yd. (27 m.) long) are considerably smaller in proportion to the surrounding mountains than those in Marguerite Bay. Although the couloirs in Marguerite Bay contain small streams, none of the material in the block terraces except possibly some of that of finest grain-size shows evidence of water deposition. Furthermore, the Marguerite Bay block terraces are not backed by catchment areas of sufficient size to provide the requisite amount of water to move rocks 2–3 ft. (0·6–0·9 m.) in diameter.

Nichols (1953, p. 79; 1960, p. 1440) maintains that the boulders comprising the block terraces in Marguerite Bay did not reach their positions in present-day conditions, because they are too far from the cliffs. In this, it would seem that he has underestimated present-day conditions; a moderate-sized avalanche which was observed on Neny Island in 1959 was seen to deposit material on the sea ice below. Boulders up to 3–4 ft. (0·9–1·2 m.) in diameter skimmed down the screes, hardly touching the surface, in the same way as a stone can be bounced on water. The presence of broken avalanche snow on their surfaces suggests that these block terraces are still in the process of formation. Fringing glaciers are essentially continuous features and therefore they cannot be invoked in the formation of these localized terraces, because on the northern coast of Neny Island a normal conical scree occurs between two block terraces within a distance of 0·25 miles (0·4 km.). This conical scree is backed by a rocky gully, so that at this point it is possible to see clearly the respective relationships between block terraces and normal scree slopes, and snow-filled and rocky gullies. A study of the snout of Northeast Glacier near Mount Nemesis suggests that no fringing ice cliff ever occurred along the north-western coast of Roman Four Promontory. Northeast Glacier is separated from Mount Nemesis by an inlet and there is no fringing glacier; in fact, the situation is quite the reverse; for about 0·5 miles (0·8 km.) inland Northeast Glacier is terminated by an ice cliff *facing* Mount Nemesis. Similar features occur to a greater or lesser degree on the south sides of Neny Glacier and Romulus Glacier, indicating that remanent fringing ice cliffs never occur on the north-facing coasts of this area.

The only other block terrace so far described from British Antarctic Territory occurs on Livingston Island (Fig. 7) and has been referred to by Hobbs (1963, p. 24, fig. 18). This is 100 yd. (91 m.) long and 40 yd. (37 m.) wide, and the occurrence of glacial pebbles on the terrace platform led Hobbs to support the mode of origin suggested by Nichols. However, Hobbs also found rounded pebbles on the terrace, which leaves open the possibility of a marine origin for this terrace.

Fig. 7. A block terrace on Livingston Island, South Shetland Islands. Photograph by G. J. Hobbs.

In the Neny Fjord area, Nichols (1960, p. 1434) has postulated a rise in sea-level of 100 ft. (30 m.) to account for the raised beaches at Red Rock Ridge. No rounded pebbles were found to be associated with the block terraces of Neny Island, and if they were formed without the protection of a fringing ice cliff, they must be a very recent formation; otherwise, the terrace material would have been reworked by the sea.

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