SOME OBSERVATIONS AT THE TOTTANFJELLA, DRONNING MAUD LAND

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SOME geomorphological and biological observations made at the Tottanfjella on 14–17 November 1961, while on a sledge journey from the British Antarctic Survey station at Halley Bay, are described in this report. The distributions of snow petrels (*Pagodroma nivea*) and various lichens in this area are discussed, and there is a brief account of the occurrence of an unidentified substance in one locality.

POSITION AND GENERAL CLIMATIC CONDITIONS

The Tottanfjella are situated in approximately lat. 75°15′S., long. 11°30′W., forming a north-east-trending mountain range which holds back the inland ice to the south-east (Fig. 1). The general snow level north-west of the mountains is approximately 5,000 ft. (1,525 m.) above sea-level, but to the south-east the inland ice rises steadily from about 6,000 ft. (1,830 m.) to the polar plateau. The mountain peaks of this range often exceed a height of 6,500 ft. (1,980 m.) and project at least 1,500 ft. (455 m.) above the general snow level (Fig. 2).

This area is climatically a cold desert which is subjected to prevailing winds from the north-east; the rate of snow accumulation is about 75 cm./yr. in areas not affected by severe drifting or wind-scouring. The predominance of wind along the length of the mountain range has resulted in the formation of snow drifts on the leeward sides of all the rock outcrops and peaks. In the Tottanfjella temperatures remain well below freezing point throughout the year and running water is never seen.

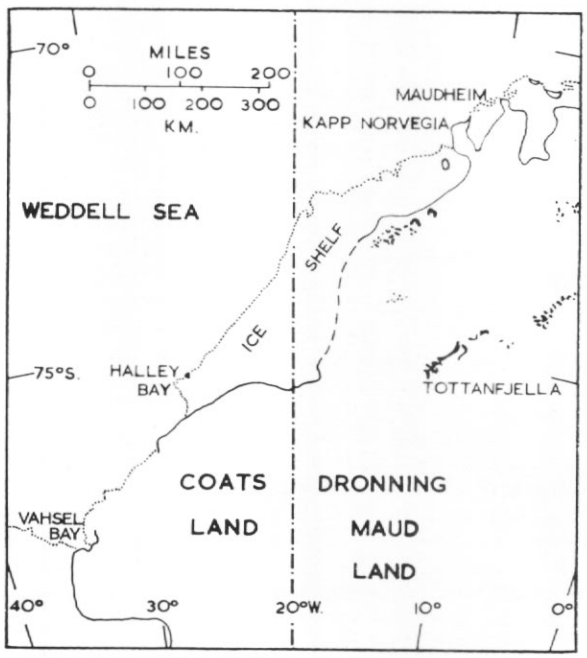

Fig. 1. Sketch map showing the position of the Tottanfjella and their relationship to Halley Bay.

Fig. 2. Some of the mountains at the extreme south-western end of the Tottanfjella, viewed from the north at a distance of 3 miles (4·8 km.). The snow surface in the foreground is approximately 5,000 ft. (1,525 m.) above sea-level, and the peaks on the left of the photograph are 2,050 ft. (625 m.) and 1,450 ft. (440 m.) above the snow surface. The unidentified substance described in the text was found on the rock surface of the ridge immediately to the right of the figure in the photograph.

Geomorphological Observations

The Tottanfjella form the south-western extremity of the Heimfrontfjella, and together these mountains constitute a north-east-trending range which continues farther northward into the Kirwanveggen. This alignment is evidently due to some major structural control and has probably resulted from block-faulting.

Geologically, the Tottanfjella are composed of metamorphic rocks, mainly augen-gneisses and schists, similar in character to the basement complexes which form the cores of most continental masses, and are therefore probably part of the Basement Complex of Antarctica.

The present topography may be the result of glacierization and frost action, such as is at present in progress, operating on a plateau truncated on the north-west by a more or less straight escarpment, or it may be based on the dissection of the landscape during a former time of greater ice cover.

Discrete channels drain the ice from the inland plateau and these have formed at points of structural weakness in the mountain range or where the original escarpment was at a slightly lower elevation. This has resulted in a certain alignment of promontories and nunataks perpendicular to the length of the range and parallel to the flow of ice. These are separated by the embayments resulting from the cutting back of the individual channels.

In certain instances the ice falls and ice streams occupying these drainage channels are separated by residual promontories covered by thin ice caps. Because of their exposed positions these ice caps have little accumulation and are therefore almost stagnant. They then serve as a protective covering and frost-shattering of the bare cliffs is the major erosion agent. Scarp recession resulting directly from frost-shattering is of major importance, because of the almost total absence of scree development. The derived material is removed by the ice

as morainic detritus which is rapidly buried by accumulation, and this process therefore results in the cliffs remaining relatively steep and bare of protective screes.

In several cases recession of the scarps bounding the promontories has resulted in the formation of ridges or even nunataks, the latter developing when scarp recession has proceeded more actively at the inland end of a promontory. Each nunatak is therefore bounded on each side by cliffs, and scarp erosion continues until the summit plateau is destroyed, sometimes resulting in a nunatak of pyramidal form. With the destruction of the summit plateau the rate of scarp recession may diminish because of the reduction in amount of abrasion following a decrease in the amount of material involved in rock falls. As erosion continues, increasing isolation and decreasing size result in a reduction of frost action through reduced insolation effects. Insolation is less able to warm the surface of a *small* rock outcrop sufficiently to melt surrounding snow and, since water is a necessary adjunct to frost action, this latter process tends to cease. This increasing isolation also results in a decrease in abrasion by wind-borne sand derived from adjacent outcrops. It is therefore possible for smaller isolated nunataks to survive, whereas the main escarpment of the plateau has retreated leaving them as residuals.

A detailed map was compiled during the preliminary survey and at the same time a related series of photographic panorama was taken; these clearly illustrate the major aspects of the landscape development.

Biological Observations

Snow petrels

During the journey from Halley Bay to the Tottanfjella snow petrels (*Pagodroma nivea*) were seen, both singly and in groups, flying in directions which suggested that they were commuting between the mountains and the open water of the Weddell Sea; the minimum distance for such a journey is at least 200 miles (320 km.). At the mountains numerous snow petrels were observed, mainly in pairs, flying around the main peaks.

A large colony of snow petrels was found nesting on a scree facing north-east at the easternmost arête of the mountain 15 miles (24 km.) north-east of the westernmost extremity of the range. No eggs had been laid at the time of observation but pairs of birds were seen both on the scree and in the air; because many of the birds attempted to hide in the scree when approached, it was possible to lift them from their nests without difficulty. From the general appearance of the snow petrel rookery it appeared to be used annually by the same birds, and debris dating back to earlier breeding seasons was abundant. The body of one bird which had probably died during the previous year was collected for examination by the Survey zoologist. A daily record of birds observed throughout the journey from Halley Bay to the Tottanfjella was kept.

Lichens

The occurrence of lichens on the rocks was rare and mainly limited to small cracks, fissures and scree material in reasonably well-protected north-east-facing situations. The lichens occurred right down to snow level, indicating that ice retreat is not in progress at present.

Unidentified substance

In addition to lichens, a peculiar off-white deposit (Fig. 3) was found as small protuberances on the rocks at the westernmost part of the Tottanfjella (Fig. 2). These were firmly attached to the rock wherever they were found, irrespective of surface slope or aspect, and the normal size of each deposit was between 0·5 and 5·0 cm. in diameter. Each individual was extremely hard at the prevailing low temperatures and it was necessary to use a hammer to break them from the rock surface. At the junction with the rock an almost soil-like interface was present, while the upper surface of each individual was marked by characteristic hexagonal or polygonal cracks (Fig. 3a).

On returning to Halley Bay both specimens of this substance became somewhat waxy in the warmer temperature of the living hut and exuded a faintly resinous odour.

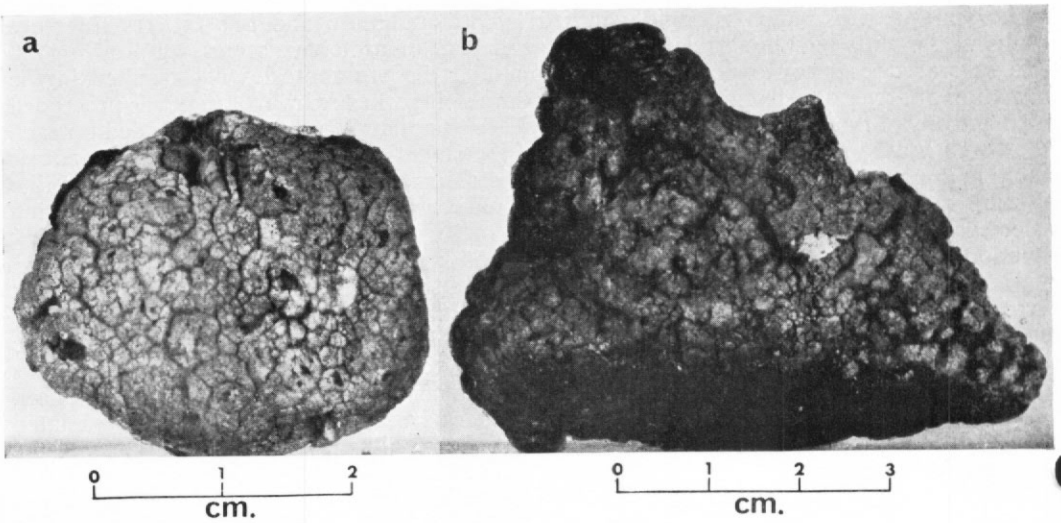

Fig. 3. Two specimens of the unidentified substance from the westernmost rock outcrops of the Tottanfjella (Fig. 2).

At the time of its collection in the field this substance was considered to be of *organic* rather than inorganic origin, but it was not clear whether it was animal or plant material. However, its close field association with the snow petrel rookeries indicated the possibility of it being a modification of the excreta of these birds.

Specimens were examined cursorily in the laboratory but no trace of cellular or plant structure could be determined. They were therefore submitted to chemical analysis, the results of which are reported elsewhere (Jones and Walker, 1964).

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REFERENCE

JONES, A. S. *and* R. T. WALKER. 1964. An Organic Deposit from the Tottanfjella, Dronning Maud Land. *British Antarctic Survey Bulletin*, No. 3, 21–22.