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# Lochnagar

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## Highlights

Lochnagar is important for its glacial and periglacial landforms, including corrie moraines and geliflucted boulder lobes. These features formed during the Loch Lomond Stadial and provide a record of glacier dynamics and geomorphological processes active at that time.

## Introduction

Lochnagar [NO 250 860], a mountain massif rising to 1150 m OD and located c. 10 km southeast of Braemar, is important for its assemblage of glacial and periglacial landforms. It is noted for one of the best examples in Scotland of a suite of boulder lobes and terraces dating from the Loch Lomond Stadial. It also includes a fine example of a corrie and an excellent sequence of moraines formed during the Loch Lomond Readvance. The periglacial landforms have been investigated by Galloway (1958) and Shaw (1977), and the glacial landforms by Sissons and Grant (1972), Rapson (1985) and Clapperton (1986).

## Description

In broad outline Lochnagar has the form of a residual granite massif rising above the plateau of the 'Grampian Main Surface' (Fleet, 1938). Landforms of glacial erosion are impressive and stand in sharp contrast to adjacent plateau surfaces and slopes that are essentially pre-glacial in their broad outlines, although modified in detail by periglacial processes. The glacial troughs of Glen Callater [NO 190 835] to the south-west and Loch Muick [NO 290 830] to the south-east are fine examples of selective linear erosion by ice-sheets and valley glaciers; on the northern slopes of the massif, corrie development has been predominant. These erosional landforms reflect the effects not only of Late Devensian glaciation, but also of earlier glaciation. Depositional landforms associated with both the Late Devensian ice-sheet and Loch Lomond Readvance glaciers are extensively developed and include hummocky moraines, fluted moraines and corrie-glacier moraines, together with eskers and other meltwater deposits (Sissons and Grant, 1972; Clapperton, 1986). However, it is the north-east corrie of Lochnagar and the higher southern slopes of the mountain that are of special interest for particular glacial and periglacial landforms, formed mainly during the Loch Lomond Stadial.

### The north-east Corrie

The north-east corrie of Lochnagar is a striking example of a corrie with a steep headwall, an enclosed loch basin and a sequence of end- and lateral-moraine ridges (Figure 9.8). A total of nine moraine ridges is present, each less than 3 m high and comprising arcuate lines of boulders resting on a bouldery till substrate (Clapperton, 1986). The boulder moraines represent progressive recession of an active glacier into the corrie, but there are different interpretations of its former extent (Sissons and Grant, 1972; Clapperton, 1986).

The landforms and deposits in this area have a significant bearing on the interpretation of the Late Devensian history of the Cairngorms and adjacent parts of the eastern Grampian Highlands. Sissons and Grant (1972) mapped the geomorphological evidence for the last glaciers in the Lochnagar area and defined the limits of a series of corrie and valley glaciers associated with the Loch Lomond Readvance. This work and its subsequent extension in adjacent areas stimulated keen debate on the wider regional implications of the status of the Loch Lomond Readvance in the Cairngorms and vicinity (Sissons, 1972a, 1973a, 1973b, 1975b, 1979f; Sugden, 1973a, 1973b, 1980; Clapperton *et al.*, 1975; Sugden and Clapperton, 1975). In the absence of a locally established dating framework, interest centred on the extent of the Loch Lomond Readvance and indeed whether some of the small boulder moraines, including those on Lochnagar, could have formed during the Little Ice Age (Sugden, 1977). However, pollen analysis of cores taken from

sites within the glacial limits defined by the corrie moraines on Lochnagar demonstrate that sedimentation has continued undisturbed from about 9700 BP (Rapson, 1985). A peat sample and pine stump located within these moraines have yielded radiocarbon dates of  $7170 \pm 80$  BP (SRR-2272) and  $6080 \pm 50$  BP (SRR-1808), respectively (Rapson, 1985). Together with similar evidence from the Cairngorms, these results preclude any significant Little Ice Age or earlier Holocene glacier development in the Lochnagar corrie and imply that the boulder moraines are most probably of Loch Lomond Readvance age.

Using reconstructed glaciers as palaeoclimatic indicators, Sissons and Sutherland (1976) derived equilibrium line altitudes for the eastern Grampian Highlands during the Loch Lomond Stadial and inferred that precipitation and snow accumulation in this area were principally associated with winds from a southerly or south-easterly direction. Clapperton (1986), however, questioned this interpretation. His reconstruction of the glacier that formerly occupied the north-east corrie of Lochnagar not only identified a slightly lower snowline, but also suggested that the dominant ice source was the south-west basin of the corrie. He therefore concluded that southwesterly winds were dominant at the time of glacier growth and that it was unnecessary to invoke unusual climatic conditions and southeasterly air flows.

## Periglacial landforms

On the granite massif of Lochnagar there is a striking contrast between well-developed corries to the north and smooth slopes to the south. The latter are covered by frost-weathered debris on which have developed massive boulder lobes and terraces, considered by Galloway (1958) to be the finest in Scotland.

The boulder lobes and boulder sheets of Lochnagar are best developed on Broad Cairn around [NO 240 818], Cac Carn Beag [NO 244 861] and on the south-east slope of Cuidhe Cròm [NO 262 848] (Figure 9.9). Galloway (1958) described those of Cuidhe Cròm in detail, and concluded that the lobes were stone-banked solifluction lobes of Lateglacial age, immobilized by eluviation of fine material, but that nearby boulder sheets and blockfields are still undergoing mass movement. Shaw (1977) carried out a very detailed study of the boulder lobes. He found that they occupy slopes of  $10^\circ$ – $34^\circ$  at altitudes of 640 m to 1110 m OD, and are most frequently developed on west-facing slopes. They range in thickness from 0.3 m to 5.9 m, in width (across slope) from 3.9 m to 33.3 m, and in length (downslope) from 2.1 m to 76.3 m. They are composed of openwork boulders with an average length of more than 0.7 m, with little interstitial finer material and a cover of peat up to 1.2 m thick over the 'treads'. Boulder terraces generally occupy gentler slopes ( $14^\circ$ – $22^\circ$ ) and are similar in composition and thickness. Shaw considered all of these features to be inactive, and concluded that they had crept downslope as a result of the deformation of interstitial ice. Strong evidence of a Lateglacial age for these features has been provided by Sissons and Grant (1972), who observed that they are entirely absent from the areas that were occupied by Loch Lomond Readvance glaciers, and indeed that near Loch Buidhe [NO 252 827] the boulder features are apparently truncated by a lateral moraine deposited by the Glen Muick glacier.

Shaw (1977) also made observations on present mass-movement activity in this area. Ploughing blocks are common on slopes of  $9^\circ$ – $38^\circ$ ; these range from 0.39 m to 2.4 m in length, and movement is marked by furrows 0.13 m to 3.07 m long and turf banks that have been pushed downslope by as much as 0.83 m above the adjacent ground. Current rates of movement do not exceed a few millimetres per year. Shaw also documented several rockfalls from the Lochnagar corries, and described avalanche tracks 100 m and 180 m wide cutting through woods on the slopes north-west of Loch Muick. These terminate in fan-like avalanche tongues under the surface of the loch. The effects of recent snow avalanche activity in the north-east corrie of Lochnagar are relatively minor and restricted to occasional perched boulders, pits in the surface of talus and scratch marks (Ward, 1985b). Similar findings have been reported by Davison and Davison (1987) for an avalanche site in Glen Shee. Elsewhere, however, the geomorphological role of such avalanches is locally more important, for instance, in parts of the Cairngorms and on Ben Nevis (Ballantyne, 1989b; Luckman, 1992).

## Interpretation

Lochnagar is important both for a range of individual glacial and periglacial landforms and also for the complete assemblage of features present. The north-east corrie of Lochnagar is a particularly fine example of this landform type,

with steep, enclosed rock walls, a loch basin and suite of Loch Lomond Readvance moraines. The latter have had an important bearing on the debate concerning the extent of the Loch Lomond Readvance both locally and regionally. The moraines also demonstrate clearly the progressive active retreat of the glacier back into the corrie and offer scope for correlations with similar features in the Cairngorms and for interpreting the relationships between glacier fluctuations and climate during the readvance. Dating of organic deposits inside the moraines demonstrates conclusively that there was no recrudescence of glacier ice on the corrie floor during the Little Ice Age.

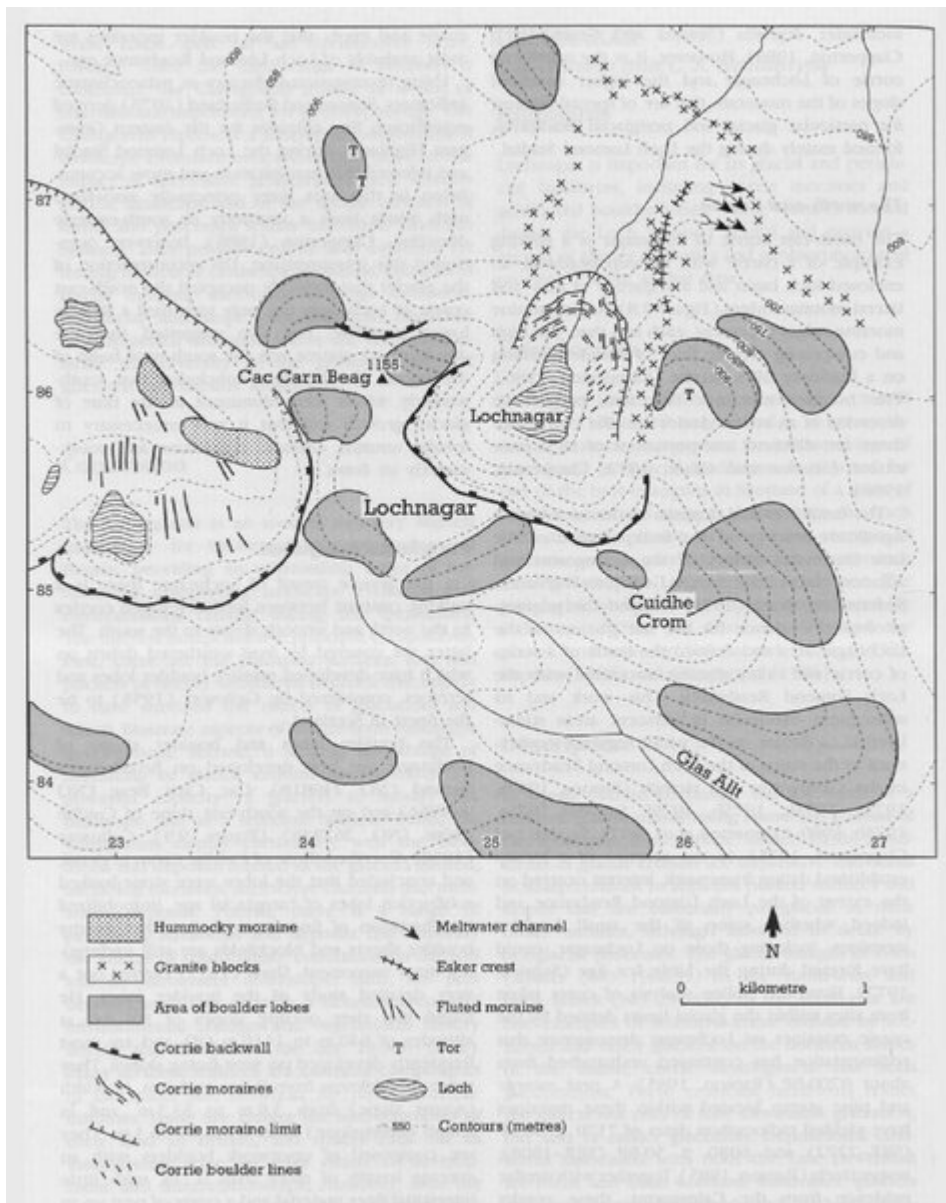
Lochnagar also provides particularly fine examples of periglacial features, notably relict boulder lobes that are among the finest in Scotland.

In many respects the geomorphology of Loch-nagar is similar to that of the Cairngorms. Although the assemblage of features on Loch-nagar is less complete, it is developed in a much more compact area. Lochnagar therefore provides an outstanding demonstration of key features of the geomorphology of the Loch Lomond Stadial and their spatial relationships, notably boulder lobes and end moraines.

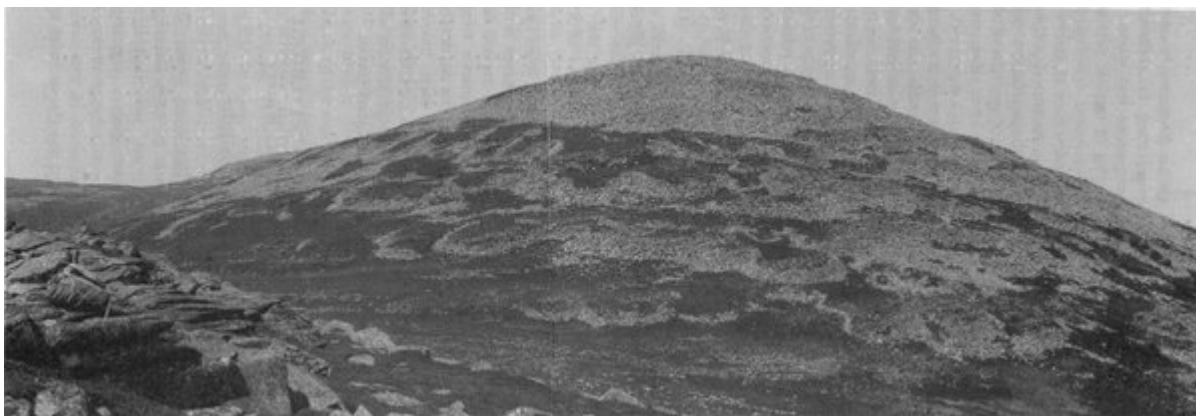
## **Conclusion**

Lochnagar is important for glacial and periglacial geomorphology. It provides a particularly good example of an assemblage of landforms that developed during the intensely cold climatic phase at the end of the Devensian stage and known as the Loch Lomond Stadial (approximately 11,000–10,000 years ago). These include periglacial boulder lobes formed by the slow mass movement of the soil downslope and a series of bouldery moraines formed by a corrie glacier. The landforms are developed in a relatively small area and their interrelationships are clearly demonstrated. Lochnagar forms part of a network of sites representing the geomorphology of the Loch Lomond Stadial.

## **[References](#)**



(Figure 9.8) Geomorphology of the Lochnagar area (from Shaw, 1977; Clapperton, 1986).



(Figure 9.9) Summit blockfield, blockslopes and boulder lobes on the south-east flank of Cuidhe Cròm, Lochnagar. (Photo: J E. Gordon.)