

A GEOLOGIST ON CAIRNGORM.

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The name Cairngorm is a compound of the two Gaelic words *carn*, mountain, and *gorm*, green or blue. Whether *gorm* means green or blue in any particular name must be determined by the distance at which it is viewed. In Tullochgorum it must mean green, because the place is of low elevation and is not visible from a distance; but in Cairngorm it must mean blue, for near at hand it is bare and grey with stones, whereas seen from Carr Bridge, Nethy Bridge, or Tomintoul from a distance of ten or twelve miles over the heads of lower hills it is conspicuously blue.

Cairngorm is not a separate mountain by itself, but one of several summits in a large mountainous mass of granite extending eighteen miles in length from Loch Builg almost to the Spey, and twelve miles in breadth at the west end, but tapering towards the east end. About the middle it does not go so far north as Loch Morlich, and it stops short of Glen Derry on the south.

The granitic area is surrounded on all sides except the east by quartzite and schists, very old stratified rocks which have been changed by heat and pressure. Looking at the west side of Creag Pityoulish from Aviemore we see that its strata once horizontal are now bent and in some places highly inclined to the horizon, and hard strata rise up like dykes above the level of the softer beds. At the east end of the granitic area limestone comes in, and at Inchrory the Avon has eroded a deep gorge in the soft limestone, by which its upper reach has been diverted to the Spey instead of pursuing its original course eastward to the Don.

Though not the highest summit in the granite area, Cairngorm has given its name to the whole group, which is now generally collectively called the Cairngorm

Mountains or the Cairngorms. The group is divided into two parts by a deep ravine extending from north-west to south-east. To it the name Larig Ghru, the gloomy pass, has been given. It originated in a crack in the mountain mass, into which water charged with carbonic acid gas from the atmosphere descended. In long lapse of time the sides of the crack have been decomposed, and in the glacial epoch, when the land was deeply covered with snow, the loose parts were swept away by a snow-flow passing over the mountain mass. As the fall of snow is greater the farther north we go, the movement of snow was from north to south. In the course of several long glacial periods a wide gap was excavated to the depth of two thousand feet below the summits of the main mass. The highest level in the Larig Ghru is 2770 feet above sea, and when it is passed going south there are seen many blocks of granite which had got their corners rounded off when turning over and over under the ice sheet. Snow compressed by its own weight becomes solid transparent ice.

Another great crack began at the east end of the granite mountainous area and travelled westward but had stopped without reaching to the Larig Ghru. This, under the long continued action of rain, carbonic acid gas and moving snow, has given us Glen Avon and Loch Avon. The excavated material was at first carried by moving snow and ice straight out to the east. The upper part of the Don valley is not a granite area, but blocks of granite from Glen Avon may be seen on both sides of the hollow. Latterly the excavation of the soft limestone from Inchrory towards the north diverted the ice flow to the Spey, which is proved by the presence of blocks of granite in the bed of the Avon as far down as Ballindalloch. The sweeping action of snow and ice in Glen Avon has been most thorough. Not an ounce of loose matter was left in the whole Glen. The Shelter Stone and other blocks of rock at the head of Loch Avon have all fallen from the cliffs around it after the ice period had passed away.

Equally severe atmospheric and glacial action is seen on the north side of the mountain mass. West of the Larig Ghru we see, far up Braeriach, corries excavated by snow and running water, where carbonic acid has decomposed the hard granite and converted it into soft impalpable china clay. And at the base we see Loch an Eilein and Loch Eunach, the work of glaciers descending the steep mountain sides. The quantity of matter removed by snow and running water has been enormous. Besides the fine sand which is clothed by the firs of the Glenmore and Rothiemurchus Forests—all of which came from the mountains—there are blocks of granite in the bed of the Spey as far down as Boat of Garten, and an enormous quantity of fine clay had been carried to the sea by the Spey.

East of the gap we have Loch Morlich, formed by the digging of the ends of long glaciers sliding down the mountain sides. Farther east there is a ravine issuing from near the north side of Loch Avon which becomes the bed of the Nethy. This was excavated by ice in Glen Avon finding a weak place which had originated in a deep crack.

As the water of the Spey runs to the north-east we are apt to suppose that the flow of snow and ice was always in the same direction; but in some great glacial epoch ice from the lofty mountains of Norway filled the bed of the North Sea to overflowing. The lowest part of the neck between the Spey and the Spean valleys is only 848 feet above sea level, and the Norway ice entered the Moray Firth and pressing against the glacier of the Spey forced it back over the *col*, when it descended to the Atlantic and speedily melted. On the other hand it appears that at some time ice from the west side crossed the *col* and descended to the Moray Firth. These extraordinary movements might have happened with the land at its present level, but it is quite certainly proved by raised sea beaches that the land was at least 400 feet deeper into the sea at some time than it is now, which would have facilitated the flow of ice up the Spey valley.

There is Old Red Sandstone Conglomerate rock in the

lower part of the valley of the Spey, but it does not extend farther southward than Mulben, where the railway crosses the river. Old Red Sandstone pebbles are easily distinguished from seaside or river pebbles of similar size. They have been immersed in water coloured red by volcanic ashes and tinged by them externally; but the colour has not penetrated to the heart, and if they are broken by a hammer it is seen that the redness gradually diminishes from the surface to the centre. Dunnottar pebbles are cracked from pressing against one another in the conglomerate bed. Though this is not seen in the Spey valley pebbles, they have the characteristic colour-mark. Old Red Sandstone pebbles are found at Aviemore, and this is conclusive evidence that ice from the Moray Firth has at one time passed up the Spey valley as far at least as Aviemore. For several miles above and below Aviemore Bridge there is no fall on the Spey, and this may be attributed to the contraction of the valley above Aviemore, which led to greater friction of the ice-flow on its bed. The effect of this would have been to deepen the valley till it again opened out, and after the ice age passed away there would have been a lake in the Spey valley above and below Aviemore.

It is no doubt due to the passage of ice along the Spey valley that the surface of the ground is so uneven and hummocky; and to the same cause must be attributed the numerous lochs, large and small, seen in the valley and on its margins. Where the valley became contracted, or where additions to the valley ice were made from side ravines and burn courses, an increased pressure on the ground below the ice resulted, and this caused excavation in one place and heaping up in another.

The beds of stratified sand seen in the valley of the Spey, above and below Aviemore, are of various ages. The level of the river there is now about 700 feet. Some of the sand layers go up to 800 feet, and as they had been laid down in floods of the river, they show that the Spey valley has been excavated to the depth of 100 feet.

The flat area at the base of the Cairngorms, covered

by Glenmore and Rothiemurchus Forests, was excavated by coalescing glaciers from the Cairngorm Mountains on the south and Meall Bhuachaille and Creagan Gorm on the north. The outflow was by Loch Pityoulish, which discharges into the Spey near Kincardine church. The flat area slopes from 1100 feet near Glenmore Lodge to 700 feet at the Spey; but the ice found a lower route by Pityoulish which is only 674 feet above sea. The fine sand that covers the forest area was laid down in floods of the Allt Mor, Allt Ban, and Allt na Feithe Duibhe. The Geological Survey Memoir of the Abernethy district says that the great deposit of sand in the valley of the Dorback burn was made when its water was dammed back by the upper end of a retreating glacier in the route of the Nethy burn. If this were so, then the outflow of the lake thus produced must have been by the Allt na Feithe Duibhe to Glen More. This would have augmented this burn and helped to inundate the forest area and increase the surface deposit of sand.

AN ASCENT OF CAIRNGORM.

Glenmore Lodge was named as the rendezvous in July of 1908 for members of the Cairngorm Club who were to come on from Nethy Bridge, and the writer and his wife who were at Aviemore. In 1855 there were fewer mountaineers than there are now, and the writer was then unable to find a companion in a walk which he proposed to take from Aviemore to Braemar. Rather than abandon the design of seeing Loch Avon, he made the journey all alone *via* Cairngorm, Loch Avon and Ben Muich Dhui.

From Glenmore Lodge to the summit of Cairngorm is four miles in a direct line. At first the road goes downhill to a bridge over the Allt Mor, which is 1060 feet above sea, and the summit of Cairngorm is fully 3000 feet higher. Crossing the burn the road passes

through a wood for more than a mile. Some very large ant-hills were seen, each under the shelter of a fir. Ants were hurrying about in all directions, most of them empty-handed, but some carried needles of Scots fir either to serve as food or to add to the heap. Whatever may be the daily bread of ants, they enjoy a meal of flesh when it can be got. The dead body of a wood-pigeon lying in the path was swarming with ants.

It was rather a surprise to see that the stones in the bed of the Allt Mor were not granite but fragments of stratified rock. At a mile and a half from Glenmore Lodge the wood ends and the path begins to climb the hill. The route lies straight to the top, and there remain two and a half miles to go, with a rise of 3000 feet. On the whole, though the way is steep, it is best to make straight for the top of the mountain and not to diverge far to the right or the left. By keeping to the right, however, and following the course of the burn upward, some interesting rock faces may be seen. The granite lies in layers sloping downwards as if they had oozed at intervals in a semi-fluid state from some vent farther up the hill.

On leaving the wood and making some progress uphill, a change is seen in the stones at the surface. Quartzites and schists give place to fragments of granite, and some very large granite boulders are passed, lying where they were dropped by a glacier. Rows of very fresh-looking granite stones are seen which slope downwards. These mark the east margin of a glacier which came down the bed of the Allt Mor, and they indicate that the most recent glaciation was not on so great a scale as some of the previous had been.

Within a mile of the summit, where the surface is bare and stony and no trace of a path can be seen, "stone-men" have been placed at intervals to show the way to the top, which is not always in sight. Large quantities of pure white stones are seen lying on the surface, arranged in lines. When the granite mass of the Cairngorm Mountains was first formed it was much loftier than it is now. In cooling, it became fissured by long and deep cracks such

as have been already mentioned, but in movements of the crust of the earth some parts of the rocks were compressed and crushed, while in other parts, probably during elevation, there had been tension or stretching of the rocks. By this means deep-seated fissures were made which did not reach the surface. Tension fissures are not long, but they are numerous and run parallel to one another. These fissures, if at a great depth from the surface, would in the wet season of the year become full of hot water containing quartz in solution. In the dry season the water would pass away leaving quartz on the walls of the cracks. In the course of time the fissures became completely filled up with quartz. If there remained cavities not fully charged with quartz they would be lined with crystals, but not with those called Cairngorm crystals. These were formed in small pockets or cavities interspersed through the body of the rock. In granite quarried on Bennachie and used as a building stone at Oyne, there may be seen numerous very small cavities containing crystals adherent to the wall at one side and free at the other. These serve to show the mode of the formation of the large valuable Cairngorm crystals.

When glacial epochs came, and coats of snow hundreds of feet thick covered the mountain mass and crept slowly towards the sea, so much of the upper part was removed that the quartz in the fissures and the crystals in the cavities came to be at the surface, though originally deep in the heart of the granite mass.

When nearing the summit, a slight diversion to the east would bring the thirsty traveller to a spring of pure water issuing from the ground. This is now called "The Marquis's Well"; but five and fifty years ago it was a treacherous bog in which the unwary traveller, anxious to get a drink, ran some risk of wetting his feet. Since then the bog has been cleared out, and the "well eye" may be approached in comfort. Seeing that this well is within 100 feet of the summit level it is surprising to find it flowing at all times of the year. Probably there are in the cone on the mountain top some cracks made too recently

to become filled up with quartz, and the eye of the well may be so small that it does not allow the reservoirs in the cone to empty themselves during the intervals between rains.

On reaching the summit a good view all around was obtained; but it was felt that a useful thing would have been a small chart with Cairngorm in the centre and lines radiating from it and pointing to the principal mountains and places within the range of vision. Some far-off hills to the south-west were identified, and most of the Cairngorm summits were in sight. By turning westward and going along the crest of the ridge, Ben Muich Dhui could have been reached and Loch Avon would have been seen by the way. Most tourists, however, prefer to take Loch Avon in the way to Ben Muich Dhui, and go down into the glen at the head of the loch. The descent is easy at first, but steep near the bottom.

Loch Avon is about 2400 feet above the sea, and cannot be seen from the top of Cairngorm, which rises to 4084 feet. It may, however, be seen by going south-east from the summit to a group of rocks, the position of which is not indicated on the Ordnance Survey maps, nor has it been provided with a name. For the sake of identification it might be called Creag nan Cuach, rock of the cups, because on the top of one block there are several deep round cups about three inches wide. They are smooth inside, and evidently the work of natural agencies. In the glacial epochs Cairngorm was clothed with a mantle of ice, hundreds of feet thick, produced by the melting of snowfalls by day and refreezing at night. So long as the ice had a uniform slope in its progress down the sides of the mountain its surface remained unbroken; but, in passing over a steep place, cracks widening into crevasses were formed. Alternating snowfalls and heavy rains produce innumerable streams on ice-clad mountains, and a stream coming to a crevasse and plunging into it would have gained great force in its fall. Water swirling in the crevasse and carrying round grains of quartz could in long lapse of time have eroded the holes in the rock. The cup

nearest the edge was formed first, and slight changes in the place of the crevasse altered the position of the others. Similar cups are seen in rocks in other places among the Cairngorms. The seams in the cup-crag look as if at it molten granite in a semi-fluid state had welled up from the interior and slowly oozed out. This would account for the resistance it has made to abrasion by the ice sheet.

Though the day was fine there was a slight wind, and it was too cold to make a long stay at the cairn on the summit. A violent gale must have passed over it from the south-west, and other signs indicated that this had been a recent occurrence. The upper part of the cairn has been moved bodily towards the north-east several inches without displacing individual stones. Further evidence of the force of the wind was seen in descending. Numerous small hollows were observed, the bottoms of which were covered with angular grains of quartz. A shower of these had been swept along by the wind and driven with great force against the north-east sides of the hollows. There they had worn away the fog or heather growing on the surface, and the look of the vegetation indicated that the gale had been raging not very long before.

The surface of Cairngorm is very bare, and rare plants need not be looked for. A species of willow grows in the wet places at springs, even within 100 feet of the summit of the hill. The recumbent stems creep on the surface and send up shoots which must die down in winter. It is probably *Salix herbacea*, Least Willow. Dr Macmillan states that *Drosera rotundifolia* grows very abundantly on the north shore of Loch Morlich. From what he says it might be looked for towards the west end. On the north shore also may be seen a large stone which gives the loch its name. Morlich is a corruption of the Gaelic words, *mor leac*, meaning big stone.