A GEOLOGIST ON THE CAIRNGORMS.

By T. F. Jamieson, LL.D., F.G.S.

The Cairngorm mountains are the outward manifestation of a great mass of granite lying on the north side of the valley of the Dee, and extending from Ben Avon on the east to near Glen Feshie on the west. Its northern border runs along from Loch-an-Eilein to Inchrory. All round it is encompassed by the gneiss, quartz-rock and other varieties of schist which form so much of the Scottish Highlands. These mountains as a group being the highest in Scotland, naturally were a stronghold of the ice during the Glacial period, and a centre from which it spread in all directions; but owing to meteorological influences the ice lay in far greater volume over the West Highlands than it did on the east side of the country. The fall of rain on the West Coast is two or three times what it is on the east, and as the fall of snow appears to have been in similar proportions during the age of ice, we find in that circumstance an explanation of the immense development to which the western glaciers attained in former times. Snow and ice differ from rain. Rain runs off as it falls, but snow accumulates; and when the climate is such that it does not melt away in summer, it passes into the state of ice which grows rapidly from year to year, owing to the continual storage that takes place, so that the ice of heavily snowed regions constantly invades adjacent districts where the fall of snow is in smaller proportions. During the Glacial period this circumstance gave rise both in Europe and America to very strange results, which for a long time proved very difficult to understand. As regards the Cairngorm mountains we are still ignorant how far the ice from them extended in a westerly direction, but this might be ascertained by finding out to what distance the granite blocks from these hills were carried, and also the direction which they chiefly followed. As a contribution to this subject I may here give

an account of some facts which I observed many years ago. In the first place, I ascertained that the glaciers coming down from Glen Eunach and the neighbouring parts of the Cairngorms had crossed the valley of the Spey at Aviemore, and left their moraines full of granitic debris well up the flanks of the gneiss hills on the west side of the Spey in that neighbourhood. As the granite rock does not extend down to the Spey, and does not form any part of the hills on the west side of that river, the abundance of granitic debris in these moraines affords an excellent proof that the Cairngorm ice had advanced across the valley of the Spey at this point, and in so doing it seems to have dammed the water coming down and formed a lake extending from near Craigellachie up along the wide hollow past Kingussie. The fine sand and silt which formed the bottom of this old lake was well exposed in the cuttings of the Highland Railway in 1863 when I was there, a depth of 30 feet being seen in some places; and Mr. Gowans, the contractor, told me that this fine sand and silt extended up nearly to Glen Truim, where it stopped, the cuttings then being all in rough gravel. It would be very desirable to explore Glen Feshie and the ground to the west of that valley with the view of ascertaining whether the boulders of Cairngorm granite have gone any distance in that direction, or whether the great flow of ice which proceeded from the West Highlands had been able to repel them. This is a point which I hope some of the Cairngorm Club may be induced to take in hand and settle. Fifty years ago when I began studying these questions, the transport of erratic blocks found over much of Britain was generally ascribed to the action of floating ice, coming chiefly from the north, during a time when the land was supposed to have been deeply submerged beneath the sea, such being at that time the opinion of most of our leading geologists, Lyell, Murchison, Darwin, Hugh Miller and others. It was therefore with this notion in my head that I set out, but it was not very long before I began to be staggered by the facts which everywhere presented themselves, and some of these facts were connected with the Cairngorm mountains. The great granite mass of which they are composed lies, as I have said, on the north side of the

Dee, extending west almost to Glen Feshie, while opposite to them on the south side of the valley there is a chain of quartz mountains of considerable size without any granite. Now upon the supposition of a transport by floating ice urged by a current from the north, one would expect to find blocks of Cairngorm granite carried across the valley on to the hills on the south side. I therefore devoted some time to an exploration of these hills on the south side of the Dee lying immediately opposite the Cairngorms, including Carn Bhac, Cairn Tuirc, Cairn-na-Glasha, Ben Uarn More, the Glas Maol and others; I also traversed Glen Connie, Glen Christie, Glen Ey and Glen Clunie, keeping a constant lookout for granite boulders, and was rather surprised to find none until I came near the mouth of Glen Ey and Glen Clunie. I met indeed with several large stones which at first looked like granite, and had a similar reddish appearance, but on breaking them up found them all to be of felspar porphyry, quite distinct from the red stone of the Cairngorms. Dykes of this porphyry occur in many places, and I found several boulders of it on the Glas Maol and also some on Ben Uarn and other hills. On mentioning the result of my exploration to the late Principal J. D. Forbes, the well-known authority on Alpine glaciers, he thought it a fact of some importance, for it is quite in accordance with glacier action, but not with a transport by floating ice.

Ben Uarn, 3424 feet, is a very out-of-the-way hill, and one rarely visited by tourists, who are indeed not particularly welcome in these parts, for all Glen Ey and the adjoining ground has been converted into an extensive deer forest, and the only human habitations now to be seen there are the shooting lodge and a stalker's house. To one looking from the top of Ben Uarn towards Braemar the intervening hills present a curious white appearance, owing to the colour of the quartz rock of which most of them are composed. Ben Uarn itself is of the same nature, for I observed no other rock as I climbed up the steep northern face of it. A single Alpine hare was the only living creature I saw on this lone monntain. From the top a fine sight is got of the Cairngorms, which lie right opposite away to the north. The

view ranges up Glen Dee, showing the deep gap between Ben Muich Dhui and Braeriach. These great hills had a very bare, sterile, reddish aspect when the sun shone on them, and the difference in altitude between Cairn Toul, Braeriach and Ben Muich Dhui as seen from here was scarcely appreciable to the naked eye.

On the south side the granite mass of the Cairngorms does not extend quite down to the Dee, there being some strata of gneiss and quartz rock between it and the river. Near Braemar there is a hill called Cairn-na-Drochaid, 2681 feet, lying on the north side of the Dee, between it and Beinn a' Bhuird. This Cairn-na-Drochaid is largely composed of quartz schist with some granite invading it. I passed over the western shoulder of the hill, which I found to be of quartz with a large dyke of felspar porphyry running through it, and here I observed a great many blocks of red granite, some of them of large size, lying on the quartz rock of the hill-top. These must have been transported some distance, and have probably come from the neighbouring mountain of Beinn a' Bhuird. Along the Sluggan Glen there is also a profusion of granite stones, often very big ones, lying on the quartz strata of the hill-sides. This is in the hollow along the north-east side of Cairn-na-Drochaid.

I have now to mention some facts regarding Morven. Morven is a well-known hill, 2862 feet high, lying 12 miles east of the Cairngorm granite. It is composed of hornblende rock or schist, and no granite is known to form any part of the hill, not at least until you come well down near the bottom, but the lower hill of Culblean, between it and the Dee, is of granite. Now it is a curious fact, which I observed very many years ago, that fragments of reddish granite are scattered over the top of Morven, although not in great numbers nor of great size. How did they get there? Morven is quite an isolated hill, higher than any within ten miles of it, while it greatly surpasses in altitude anything between it and the sea. How then did these granite stones get to the top of this hill? Judging from their mineral character they might be derived from the Cairngorm mountains to the west. In addition to the granite there are also

some of quartz schist, which are also foreign to the hill. Morven has for the most part a smooth, rounded aspect. Some of the slopes indeed are steep, but there are no precipices or crags. The southern side is green and grassy, forming good sheep pasture, and towards the base there is a good deal of juniper.

The occurrence of these granite stones on the top of Morven seemed to me so singular a fact that I mentioned it to the Rev. Mr. Michie of Dinnet, and suggested that he should take an opportunity of exploring the hill. This he accordingly afterwards did in company with a geological friend, the Rev. Mr. Davidson of Logie Coldstone, and I had an interesting letter from him giving an account of what they observed. They approached the hill from the north side, and in a narrow glen, about two miles north-east from the top of Morven and at an elevation of about 1600 feet, they found some very large blocks of granite. Crossing the upper part of the valley of the Deskry they observed some others, but fragments of schistose rock were more plentiful there. They now began the ascent of Morven proper, which on this side is steep and covered with heather. Here Mr. Michie says, "We examined every place where the rock cropped out, and every cairn of loose stones, and they were many. The rock was everywhere the same hornblende schist, and for some distance up the hill we did not discover a particle of granite, not till we were at an elevation of at least 2000 feet did we see any. Then we began to meet with them, at first in small specimens of a pound or two in weight, and seldom more than one or two in a large cairn; but as we ascended they became larger in size and more abundant in number, though we discovered none so large that a man might not very easily raise them from the ground by the strength of his arms, and these not very numerous—some seven or eight in a very large cairn. The cairn on the top has about a dozen on its surface. We now descended by the eastern slope, passing what is called the *little cairn*, or what appears from the valley below to be the summit. Between these two cairns we found the granite blocks in about the same number and size as those on the northern slope. At

the little cairn, however, we found them rather more numerous and larger in size. The hornblende rock crops out here. Descending from this point they became scarcer and smaller, till about half-way down the hill they disappeared entirely, and, notwithstanding a careful search, we found no more till we got to within about 200 yards of the base of the hill, where they appeared again in large boulders fit for building purposes. Thus you see the granite appears in large but not numerous boulders around the base of the hill, then there is a zone in which granite is scarcely to be found at all, but towards the summit it again appears, but sparingly and in small boulders, and nowhere on Morven proper, so far as I am aware, is granite to be found *in situ*." Thus far Mr. Michie—He makes no mention of the fragments of quartz schist which I noticed on the top. Their presence however is about as remarkable a fact as that of the granite, for they seem also to be foreign to Morven, the rock of which appears to be all of hornblende, at any rate at the top of the hill. The ridge of Culblean lying between it and the Dee is well worth studying, there, being fine examples of large perched boulders on it, and ice-worn shoulders of bare granite down nearly to the river.

On the top of the higher members of the Cairngorm group, such as Ben Muich Dhui and Beinn a' Bhuird, I saw no foreign boulders, nothing but granite in large weathered masses and heavy blocks, with plenty of granite sand arising from the decay of the stone. Pieces of milk quartz are also to be seen, veins of which occur in the granite, and likewise some crystals of pure quartz or Cairngorm. Granite is a stone that yields more readily to the weather than many other kinds, especially when it is of the large coarse-grained variety like most of the Cairngorm rock. This quality, together with the great length of time that has elapsed since the glaciers vanished from Britain, seems to be the reason why the marks left by the ice have disappeared so completely over the Deeside Highlands and the east side of Scotland generally, unless where the surface of the stone has been protected from the weather by a bed of clay. On the west coast, where the glaciation was far more intense and long

continued, these marks are much more common, and are often finely displayed even on the bare surface of the rock where of suitable quality. To a practised eye, however, the action of the ice may still be detected even on the Deeside granite, in the smoothly rounded shoulders of rock and the perched boulders, such as may be seen on the flank of Culblean and the Pannanich Hill opposite. Many thousand years have passed away since the glaciers finally disappeared from this country, so that it is no wonder the finer ice marks have vanished.

NOTE.—The Club is much indebted to Dr. Jamieson for the various geological papers which he has so kindly contributed to its Journal. We observe from the Abstract of the Proceedings of the Geological Society of London, that a communication of his was read on 8th November last, on "The Glacial Period in Aberdeenshire and the Southern Border of the Moray Firth." The President remarked, that it would be strange indeed if a cordial welcome had not been accorded to a paper, by one who had been a Fellow of the Society for nearly half a century, whose papers on Glacial Geology had been frequently published by this Society—papers which, though theoretical questions were by no means avoided in them, were specially characterised by the great number and importance of carefully-recorded facts. Professor P. F. Kendall observed that Dr. Jamieson, whose name was one of the most revered in Glacial Geology, had added a new division to the Glacial Series of the district with which he dealt, in the shape of the dark clay with the deep-water Arctic fauna.—Ed., C. C. J.