

## KILLIECRANKIE AND THE OLD GLACIER OF GLEN GARRY.

BY T. F. JAMIESON, LL.D., F.G.S.

ONE of the most beautiful scenes in Scotland is to be found at Killiecrankie in the Perthshire Highlands, where the mountain stream of the Garry, after rushing through the narrow pass, is joined by that of the Tummel coming down from the wilds of Rannoch. Apart from the picturesqueness of its scenery and its historical associations with the battle in which Graham of Claverhouse lost his life, the locality is full of interest in other ways. On the east side of the river, near Fascally, the ground rises in a succession of heights to the noble mountain of Ben Vrackie, "the monarch of the Glen". The name is Gaelic, and means "the speckled hill", while the lower ridge between it and the river is called Meall Uaine, or the green hill. The Gaels have a great variety of names for a hill. Meall is generally applied to a bare round-topped one, while Ben appears to be reserved for the larger and loftier mountains; Craig is a craggy or precipitous one; Cairn a heap shaped like a pile of stones; Dun a fortified hill, and so on. The flank of Meall Uaine next the river, and not far from Fascally House, affords some very curious and interesting evidence of the former passage of a large glacier or stream of ice down the valley here. This hill has two ridges or buttresses of rock projecting from its side towards the river, and in the hollow embosomed between these two ridges there lies a great thick bank of earthy stuff, stretching up the side of the hill for many hundred feet above its base. This bank of earth has a very curious history which I may have some difficulty in getting my readers to believe.

In those valleys of Switzerland which are filled with streams of ice to a depth of many hundred feet, it occasionally happens that the glacier passes across the mouth of a small side gully or ravine, down which comes a

streamlet of water in summer. This water, being dammed up by the flank of the glacier, forms a deep pool, in which there accumulates a thick stratified bed of mud, sand, and stones. The glacier, as everyone knows, carries along with it large quantities of rocky debris, derived from the cliffs that lie along it up the valley. Stones of all sizes roll down upon its surface from these cliffs, and are borne slowly onwards like the leaves and branches that fall into a river. Now, when these stones lying on the top and side of the glacier arrive opposite a pool of the kind I have mentioned, many of them tumble off the ice and drop into the pool, as also does much of the sand and mud which the glacier carries with it. All this mingles with the stuff washed in by the rivulet descending from the top of the side ravine, so that in course of time there is formed a thick stratified bed of mud and stones, in which are found specimens of all the rocks that occur up that side of the valley on which the pool is situated. Many of these will have their surface scored and scratched in the manner known to all students of the ice-world, for the glacier carries with it sand and stones embedded in the ice, and these are held so firmly and pressed so strongly on anything they come against that they act like the tool of an engraver upon the surface over which they slide, forming grooves, furrows, and long fluted scoops, while the finer sand acts like a polisher, glazing the rocks and marking them with fine needle-like scratches. As this action is characteristic, it affords, when observed in places where no glaciers now exist, a good proof of their former presence.

Now, in this little ravine on the flank of Meall Uaine, there are to be found all the indications I have been describing of the former existence of a great glacier descending the valley towards Pitlochry. The surface of the rock underneath the bank of earth shows by every score and line that it has been rubbed strongly by the ice all up the side of the hill. The strata consist of gneiss and mica schist, with some masses of quartz rock. The latter, owing to their hard siliceous nature, have retained the finer needle-like scratches, and are here and there even

polished till they glance again. On the other kinds the scores are ruder, but all run in the same direction, namely, in the line of the main valley of the Garry.

The structure of the great bank of earth is clearly and extensively displayed by the action of two small streams which have cut their way past it. The northern one gives much the better section, as it cuts the bank from top to bottom down to the subjacent rock, showing the mass to be well stratified and to have been deposited in a pool of water, many of the beds being composed of the finest laminated silt. These alternate with others of a coarser description, studded with some big stones. In the channel of the rivulet there are blocks of all sizes up to 8 and 14 feet in length, which have dropped out of the bank, many of them well marked with scores and furrows by the ice. These afford samples of all the varieties of rock which occur along the Garry—gneiss, mica schist, quartz rock, hornblende schist, porphyry, primary limestone, and granite of different kinds—a perfect mineralogical museum, all tumbled down here off the old glacier ready for the geologist's inspection. The bottom of the valley at Fascally is about 400 feet above the sea, and for an altitude of 300 feet higher there is little to be seen on the top of the rock but a few patches of water-rolled gravel, so that we do not reach the foot of the bank of earth in the ravine until we are at an altitude of probably 700 feet above the sea-level and 300 above the river. From this point it stretches up the hill to an altitude of 1200 or 1300 feet, but does not thin out altogether until we get about 200 feet higher. It is remarkable how soon and how completely the action of the weather effaces the scores, scratches, and polish made by the ice, unless the rock is of a peculiarly resisting nature—except where the surface has been protected by a covering of clay, it is rare to find them. This, however, is just what we might expect. We see in any old churchyard how the letters and carving on tombstones gradually wear out. In some railway cuttings near Ellon the rocks, when newly exposed forty years ago, were clearly marked by the ice, but already I observe these

marks are beginning to fade. Now, when we consider the vast period of time that has elapsed since the glaciers disappeared from this country, we cannot wonder at the marks left by them being no longer visible. The late Principal Forbes, of St Andrews, spent the summer at Pitlochry when I was there. He was the man who first made out the true nature of glacier motion, and his classical works on the Alps and Norway did much to clear up our ideas on the subject. I had the privilege of conversing with him on several occasions when I was rambling about near Killiecrankie. "I am surprised", said he, "that I have never observed any marks of glaciers on the rocks in this neighbourhood, for it is just the place where one might expect to find them. Here we have a convergence of Highland glens where there must have been a great congestion of ice, and yet the surface shows no sign of it". I had an ice scratched stone in my pocket, and pulled it out. "Oh, we have plenty of these. It is the rocks in place I allude to". Forbes, however, was then in bad health, and unable to ramble about or climb hills. He was sinking, indeed, under the malady which carried him off, alas, too soon. He was greatly interested in my observations on Meall Uaine, and in my notion as to how the great bank of stuff had been accumulated in a side pool hemmed in by the glacier. At first he was disposed to object. "It is too stratified to be a moraine". He then mentioned how Charpentier, in his "Essai sur les glaciers", describes similar occurrences in the Alps. "I have his work", said he, "in the house. Let us see what he says". The book was accordingly produced, and I turned up the passage, which is illustrated by a small wood-cut. Forbes was immediately struck by the great similarity of the case. "Ah", said he, "Charpentier was an excellent observer. His book has been far too little studied in this country".

The top of Meall Uaine is about 2000 feet above the sea by an aneroid measurement of my own, and it is ice-worn even on the very highest point. The rock here is a hard siliceous gneiss, and the flutings or long shallow scoopings run in the same direction as those on the flank

of the hill lower down, viz., from north-west to south-east. On the west shoulder I found hard quartzose strata worn by the ice into smooth bosses, with some far-transported boulders of granite and porphyry here and there on the surface. It thus appears that the whole hill from top to bottom was grazed by the ice. I found very clear marks about 60 feet from the top, all running north-west, and, as it would have required some considerable weight of ice to wear down the rocks on the top of the hill, the surface level of the sheet of ice must have considerably exceeded 2000 feet. In order to obtain further evidence on this point, I ascended Ben Vrackie, which by aneroid I made 2800 feet high. The Ordnance Survey, however, makes it 2757. This mountain is well worth a visit. Immense blocks of black hornblende are strewn over the lower slopes on the south side of the hill, which was the one I went up. Here the heather reached to about 2600 feet. On the north-west slope it stops at about 2200. Higher up, the slopes are green and grassy, with plenty of the Alpine Lady's Mantle (*Alchemilla alpina*). The crest of the mountain is composed of black hornblende rock, some of which is massive and crystalline, some of a more schistose structure, containing seams of a black, fine-grained, curiously-wrinkled slate, which occurs in various other mountains in this neighbourhood. The rock on the top of Ben Vrackie is in tors or craggy piles, disintegrating into numerous blocks; but on descending the north-west shoulder to a level of about 2200 feet, I came upon strata of a more micaceous nature lying in rounded iceworn bosses, which implied that the ice-sheet had reached up to them, leaving perhaps the part above sticking out as what the Greenlanders would call a Nunatak. Twelve miles to the west of this, on the great mica-slate ridge which divides the Tummel from the Tay, I found a shoulder of the hill iceworn and marked at a level by aneroid of 2220 feet, and far-transported boulders even higher. From these observations it would appear that the surface of the old ice-sheet in this quarter must have attained a level of probably 2500 feet. This would entirely

submerge most of the hills, leaving the tops of those like Ben Vrackie sticking out as Nunataks, and the appearance of the landscape would have been like the interior of Greenland at the present day. All over Scotland we find evidence in harmony with this. No doubt people unacquainted with the progress of geological investigation during the last fifty years will have difficulty in believing that such a state of matters could have existed in this country. Nevertheless the proof is now so complete that there can be no doubt about it, and the geological proof is, moreover, fortified by a mass of other evidence drawn from the former range of the Arctic fauna and flora, which then extended far to the south of Scotland and the whole British Islands.

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#### BEN MUICH DHUI.

O'ER broad Muich Dhui sweeps the keen, cold blast,  
 Far whirrs the snow-bred, white-winged ptarmigan;  
 Sheer sink the cliffs to dark Loch Etagan,  
 And all the mount with shattered rock lies waste.  
 Here brew ship-foundering storms their force divine,  
 Here gush the fountains of wild-flooding rivers;  
 Here the strong thunder frames the bolt that shivers  
 The giant strength of the old twisted pine.  
 Yet, even here, on the bare, waterless brow  
 Of granite ruin, I plucked a purple flower,  
 A delicate flower, as fair as aught, I trow,  
 That toys with zephyrs in my lady's bower.  
 So Nature blends her powers; and he is wise  
 Who to his strength no gentlest grace denies.

JOHN STUART BLACKIE.

—(From "Lays of the Highlands and Islands").