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WATERSHEDS.

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THE yearly excursions of the Cairngorm Club should not be looked upon by those taking part in them merely as holidays, or occasions for the exercise of their physical energies, or even for the gratification of their appreciation of the grand and sublime in nature. These and other such objects are useful and beneficial in their way and are not to be despised, but there might be combined with them an investigation into many features of the localities visited which would throw no little light on obscure points in physical science and natural history. The habitats of plants, for instance, their seasons of growth, flowering, and seeding at different elevations, is a subject yet requiring much investigation. To the botanist, zoologist, and, indeed, naturalist generally, no excursion of the kind the Cairngorm Club provides need be without interest, and it may be made to contribute to the advancement or the elucidation of some branch of natural science. No one who knew him could, for example, conceive of the late Dr. John Roy (an honoured member of the Club) in the days of his health and strength accompanying his fellow excursionists to the top of Ben Muich Dhui, or even to the Brimmond Hill, without adding something to his stores of botanical knowledge; and there must be in the Club several members (to whom these excursions are rare opportunities) capable of doing good work in the same field. It is to the geological

members of the Club—and everyone is, or may become, a geologist to some extent—that the following observations on the phenomena of watersheds are more particularly addressed.

I remember—it is a long time ago—accompanying an eminent mineralogist in an excursion to Ben Cruachan. It was a fine clear day, and the view was glorious. I was in raptures with it, while he was intent on his scientific pursuits and heeded it not. "How can you, Professor", I exclaimed, "withdraw your attention from this grand scene to fix it on the minute chips you are hammering away at"? "Well, my young friend", he calmly replied, "I have seen all that before with as much admiration as you can feel, who now see it for the first time. A glance at it is now quite enough for me; my present business is to discover whether the rare mineral *spodumene* is to be found among these mouldering blocks of granite. You may come to this by and by, who knows"!

After having surmounted all the high peaks of the Grampians and other lofty Scottish ranges the Cairngorm Club may come to investigate more humble tracts, who knows? As a step in this downward course, I would invite their attention to *Watersheds.*

No doubt, the top of every mountain is a watershed of some sort, but often it is the least interesting to be met with. The summit of Cairn Toul, one of the highest and most imposing of the Cairngorm group, is a watershed, but one of no civil or geographical importance. It is wholly within Aberdeenshire, and drains on all sides into the Dee, presenting only weather-beaten fragments of decaying granite. As a watershed it is unimportant, though in many other respects we have not a mountain better worth making the acquaintance of. The same may be said of Lochnagar and several others. Very different are the characteristics of humbler *divides*—to use an Americanism. Most of them are full of interest to the geologist, and even to the common visitor. Might not the Cairngorm Club devote an occasional excursion to some portion of these interesting localities? The field within their reach is an

extensive one. The boundary of the Dee basin, setting out from the heights at Nigg and following the windings to the return at the head of the Spital, cannot be much under 240 miles, and not a mile of it is without some interest. Geikie, in his fascinating work on earth sculpture, has directed attention to many of the bolder features presented by the more elevated ridges, but there is scarcely any portion that is not suggestive of thought on the wonderful operation of nature continued throughout the long geological ages. Take a broad survey of that great cluster of mountains "that guard the infant rills of highland Dee", and imagine the time when the whole was one huge mass of molten granite. Then watch it during the process of cooling, how it shrank and cracked, forming gullies, corries, and gaping clefts, afterwards to become the sources and channels of mountain torrents, and broader valleys for greater rivers. You will see evidence of all this along the watershed between the Dee and the Spey. The rents that lie on either side of Cairn Toul, through which the Geusachan and the Garchary tumble are such; the wider opening that forms the Learg Ghruamach, giving passage to the infant Dee, the shattered rift at the head of the Derry, and the sneck between Beinn a' Bhuird and Ben Avon are all examples of the behaviour of this mighty mass in the course of its cooling into solid rock. It is wonderful, also, with what regularity these cracks and rents occur. This, too, no doubt, is in accordance with a law of nature whereby a cooling mass of mineral in the process of shrinkage splits up into separate blocks. The gaps thus left between our mountains have, since their first formation, been much modified by the abrading action of many agents; and nowhere can that action be better studied than on the high watersheds—the higher the better—because there we can the more plainly see the work going on before our eyes.

It is to be remarked that a watershed may, under certain topographical conditions, continue for miles without much variety of character. This usually happens where the dividing ridge is broad and but little indented, and this again is the case where the courses of the main draining

streams on both sides are parallel or nearly so. A good example of this is to be seen in the broad ridge extending westward from Mount Keen to the Capel Mounth, drained by the Mark and the Lee on the south and the Tanar and the Muick on the north, all having an easterly trend. On the other hand, where the main draining streams trend in an opposite direction, the ridge between them is usually narrow, sometimes cut through altogether, forming a larig, or pass. Originally, of course, the rock fissures determined the openings for the streams; but in after ages these have eaten into the mountain mass on either side till they have met, or nearly met, on a narrow ridge. If we examine the ten or eleven passes that formerly were frequented as traffic routes between the Dee valley and the southern counties, and still are recognised as public highways, we shall find that in most cases they have been selected on account of these natural openings in the mountain chain produced by the above-mentioned agency, namely, by streams cutting into the dividing ridge in opposite directions at, or nearly at, the same point. And, on the other hand, the fact that we have culminating points in the range, which we distinguish as separate mountains, is mainly due, after the original splitting up of the cooling granitic mass, to the absence of such agency. No doubt these original fissures to a large extent determined the course of the streams, but not always. The water supply is dependent on the internal configuration of the bounding rocks. The internal drainage may be away from the rift, and where this is the case the original rift, instead of being excavated, will be filled up with the *debris* of abraded rock material lodged there by the action of glaciers and other agents, and remain so to the present day.

There are many other interesting phenomena connected with watersheds that cannot fail to engage the attention of the intelligent observer. On the broad flat to the west of Mount Keen already referred to, the explorer will meet with many moss-hags and pools, great and small, the direction of the outflow of which he can with difficulty determine. In fact, in many cases the drainage is some-

times in one direction and sometimes in the opposite. When a pool so situated has its outflow obstructed by the growth or accumulation of moss or other matter and a heavy fall of rain occurs it discharges itself through the bank of least resistance, which may happen to be on the very opposite side from that through which it formerly found vent for its surplus waters. Thus, much of the rainfall which in one season swells the waters of the Muick may in another feed the Mark or the Lee.

But there is yet another and still more interesting feature of undetermined outflow of even large lakes situated on a watershed. There has been much contention among geologists whether lakes so placed might not have two outflows in opposite directions. There can be no doubt the thing is possible. A traveller some years ago asserted that he had discovered on the Dovre Fjeld, in Norway, such a lake, with two distinct outfalls, one westward into the Sogne Fiord, and the other eastward into the valley of the Glomen. But it is very doubtful whether this double discharge could be long maintained, there are so many causes to disturb it—the nature of the channels of the different outfalls, more or less liable to yield to the wear and tear of the current, and even the general direction of the winds and storms forcing a larger body of water in one direction, thus tending to deepen one outlet more and faster than the other.

However this may be, there is at least one lake on the watershed between the basins of the Dee and Spey which is in reality drained into both these rivers, though in a manner not affected by these disturbing elements. This is Loch Builg, situated at the eastern base of Ben Avon, and in the glack, or bealach, between that mountain and the Brown Cow Hill, which forms the pass called the Bealach Dearg, and exactly on the watershed in the heart of the pass. The only visible outlet from it is by a small rivulet issuing from the north end. At first it flows over the bare rock into which it has not worn a channel of more than a few inches in depth. At the other, or south, end there is no band of rock near the surface, but the shore consists of a

great accumulation of loose gravel. In this deposit, at a short distance from the lake, there are several blind hollows filled with water. The gravel deposit extends for more than a quarter of a mile towards the Gairn.

Many years ago Professor Heddle and the writer paid a visit to Loch Builg for the purpose of examining the geological structure of the rocks in the vicinity. What first struck us as remarkable about the lake was the small discharge of water issuing from the north end compared with the quantity poured into it by the streamlets on both sides. It seemed to us that evaporation from the surface in this cold region would in no way account for the difference. But on examination of the southern shore we were at no loss to see how it arose. We made a minute inspection of the material of which it is composed, and found that it was morainic in character, very loose and porous, and that the blind hollows, a common feature of such deposits, were all filled with water, the surface of those nearest the lake being very little below its own surface. We found also that from the lower base of the morainic deposit there issued a considerable stream almost, if not altogether, equal in volume to that which escaped from the north end of the lake.

Whence came the supply of water to these hollows? They are so situated that they can receive no surface supply, and yet they are always full. Manifestly the source is in the lake. One can easily see that a ditch of moderate depth would drain the whole lake into the Gairn and leave the northern exit quite dry.

Did the lake at any time wholly empty itself into the Gairn? If so, whence descended the glacier that deposited these moraines, blocking up the natural exit? Why is there such a large accumulation of these at the south end and none at all at the north? Where is the real watershed? If it cannot be ascertained on the bosom of the lake, where can it be found on either side? As the watershed is understood to mark the boundary of the contiguous counties and properties, is this march recognised in the boundary actually and legally agreed upon? From the fact that the legal boundary on one side at least is more than half way up the

lake, and the further fact that the proprietor on the south side has a legal right to fish on the lake, are we to conclude that there was even then, at the time when the estate boundary was fixed, a recognition of the underground drainage to which we have referred?* These and many other interesting questions might abundantly engage the attention of the Cairngorm Club during a long summer holiday; and if the weather were favourable few excursions could be more instructive or more enjoyable.

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*We understand that by a recent arrangement between the proprietors a fence has been erected touching the loch at its southern extremity and marking the boundary of the respective properties; but of old it was not so. The tenant of the Invercauld grazings on the south had the right of pasturage over the whole eastern shore of the lake. —J. G. M.

[*Vide C.C.J.*, Vol. I., pp. 239-40.—*Ed.*].