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BY

G. P. LEEDAL AND G. P. L. WALKER

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ABSTRACT

Tear faults cutting the Barnesmore Granite in County Donegal are described. The Lough Belshade fault trends N.E.–S.W., and there has been a lateral movement along it in a left-handed or sinistral sense of 2·2 miles; it is believed to be of the same age as the Great Glen Fault. The Barnes Lough Fault crosses and displaces the Lough Belshade fracture, and may be, in part at least, Tertiary. Although the movement along it is much smaller, it has taken place in the opposite sense.

THE Caledonian granite intrusion of Barnesmore forms 20 square miles of rugged and uninhabited country in County Donegal in the north-west of Ireland. A number of faults traverse the granite and shift the outcrop of its margin, and it is the purpose of this paper to describe the faulting, which is interesting in that it appears to include tear faulting of two different ages.

The district in which the Barnesmore Granite Complex lies was mapped in 1881–5 by E. W. Egan, J. R. Kilroe, and W. F. Mitchell of the Geological Survey of Ireland, and a map (sheet 24) on the scale of 1 in. to the mile was published in 1888, accompanied by an explanatory Memoir. The faults were mapped, and the Lough Belshade Fault was described as having "a downthrow to the south . . . accompanied by a very extensive horizontal displacement". We remapped the area in the summers of 1949 and 1950, and obtained new data on the nature and age of the numerous faults cutting the granite mass.

The most noteworthy fracture is the Lough Belshade fault, astride which is the beautiful but little-known corrie-lake from which the fault is named. The fault trends N.E.–S.W. and cuts transversely across the granite mass. Its course is marked by a prominent erosional feature; the Owendoo River is guided for several miles by it, the Lough Belshade corrie has developed on it, and a prominent fault-line scarp has been formed where the granite margin has been shifted and high granite ground now overlooks the lower schist country on the other side of the fault.

The fault plane is vertical, and can be seen in the cols N.E. and S.W. of Lough Belshade, where it is exposed over a vertical distance of several hundred feet. It is accompanied by a belt of intense crushing up to a hundred yards wide which is veined by quartz, calcite, haematite, and pyrite. Slickenside striations have been observed at several points; just over a mile S.W. of Lough Belshade they are inclined 10° S.W., while in the col on the other side of the Lough they are inclined rather more steeply in the opposite direction.

The Lough Belshade fault has displaced the outcrops of both margins of the granite a distance of about 2·2 miles in a left-handed or sinistral sense. The granite margin is everywhere inclined outwards at a moderate or large angle, and there is no doubt that the fracture is a tear fault along which there has been lateral movement of about 2·2 miles. Certain features of the internal structure of the granite point to a vertical displacement of the order of 2,000 feet with downthrow on the S.E. side, in addition to the lateral displacement; and where the fault enters the Carboniferous area on Banagher Hill limestone on the S.E. is downfaulted against the thick basal conglomerates of the Carboniferous on the N.W.

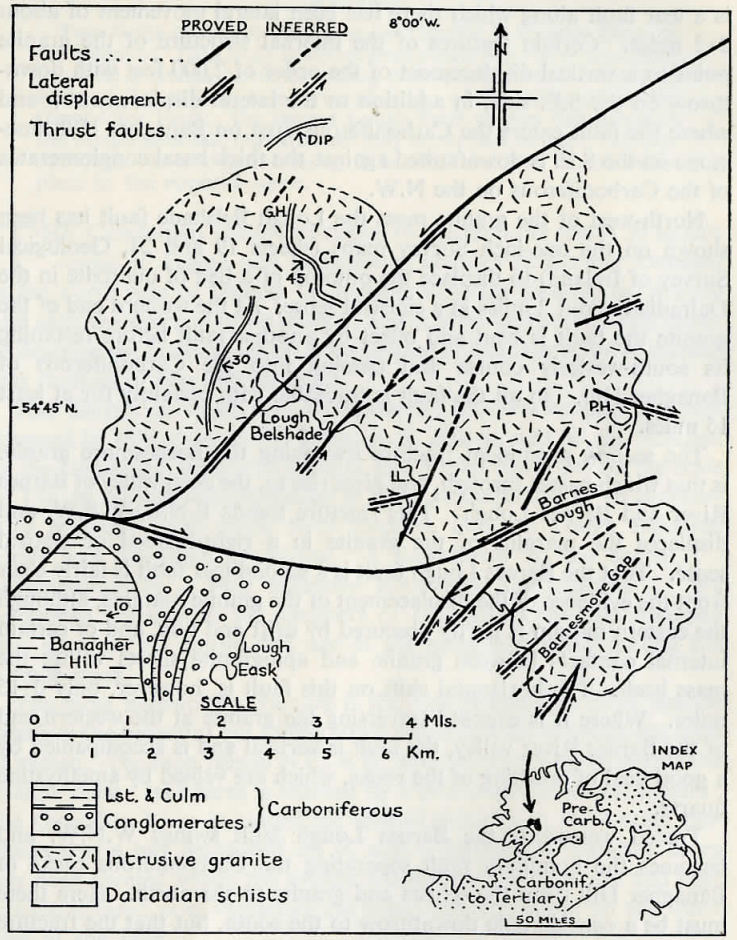
North-west of the granite mass the Lough Belshade fault has been shown on the one-inch Survey maps (sheets 19 and 24, Geological Survey of Ireland) to displace the outcrop of a bed of quartzite in the Dalradian about 2 miles in a sinistral sense. At the western end of the granite the fault is bent and offset by another fault before resuming its south-westerly course and passing into the Carboniferous of Banagher Hill. In all the fault is traceable with certainty for at least 15 miles.

The second prominent fracture traversing the Barnesmore granite is that which passes through, and gives rise to, the deep valley of Barnes River and Barnes Lough. This fracture trends E.N.E.–W.S.W. and displaces the margins of the granite in a right-handed or dextral sense. That the Barnes Lough fault is a second tear fault is fairly clear from the evidence of the displacement of the granite margins, although the eastern margin is partly obscured by drift and bog, and of certain internal contacts between granite and aplogranite sheets within the mass itself. The horizontal shift on this fault is, however, only 0·15 miles. Where it is exposed traversing the granite at the western end of the Barnes River valley, the fault is vertical and is accompanied by a good deal of crushing of the rocks, which are veined by amethystine quartz.

Traced westwards the Barnes Lough fault swings W.N.W. and becomes the boundary fault separating the Carboniferous rocks of Banagher Hill from the schists and granite to the north. Here there must be a considerable downthrow to the south, but that the fracture is still a tear fault is indicated by the bending and off-setting of the Lough Belshade fault.

The Barnesmore granite mass is traversed by a large number of "lanes", or shallow, steep-sided, rectilinear valleys. Most of these represent lines of crush, but in twelve only has faulting been proved. It is rather surprising that the Barnesmore Gap, which is so prominent a topographic feature, is not a large fault. Fracturing of the granite there certainly is, but no displacement of the granite margins can be

demonstrated, although the exposures are not sufficiently good to preclude the possibility that some movement has taken place. A belt of very intense crushing, almost comparable to that found along the Lough Belshade fault occurs in a small stream which descends to the



Geological sketch-map showing the faults cutting the Barnesmore Granite Complex. (G.H. = Glascarns Hill ; Cr = Cronloughan ; P.H. = Pollakeeran Hill ; I.L. = Illanmore Lough.)

Owengarve River north of Glascarns Hill. Unfortunately exposures of the granite contact are here masked by a considerable thickness of drift and bog, and faulting cannot be demonstrated.

Most of the proved faults trend approximately N.E.–S.W., and shift the outcrops of the granite margin left-handedly; on one dislocation

an internal contact between granite and aplogranite has been shifted in the same sense. Though it is not possible to state definitely that any of these are tear faults, the manner in which they displace the granite margins suggests that they are left-handed tear faults of the same set as the Lough Belshade fault. Two faults, one north of Pollakeeran Hill and the other south of Illanmore Lough, trend N. 75° W. and N. 75° E. respectively, and displace the granite margin in a dextral sense. Again definite proof of the movement is lacking, but they are probably right-handed tear faults similar to the Barnes Lough fault.

A fault of a different kind is exposed in the vicinity of Cronloughan; it is not vertical like the others but dips at about 50° towards the north-east. This is beautifully illustrated by the manner in which its outcrop crosses the two ridges walling the Cronloughan corrie. The fault is very well exposed in gullies descending from both sides of the northern ridge, and also south of Cronloughan. Locally it is followed by dykes of the Caledonian and Tertiary swarms. It is believed that this fracture is a reversed fault displacing aplogranite sheets several hundred feet. A second, similar, fracture west of Lough Belshade is also followed in part by a Caledonian dyke and it, too, may be a reversed fault, although no conclusive evidence of movement has been found.

The Barnesmore granite was intruded into Dalradian schists after their folding and regional metamorphism, and it is cut by a swarm of dykes of Caledonian type, fragments of which are found in the basal conglomerates of the Carboniferous on Banagher Hill. The granite is thus of Caledonian age, one of the Newer granites of the British Caledonides. The faults which cut the Barnesmore granite are later than local deuteric alteration of the granite, but many of them had been initiated before the injection of the Caledonian dyke swarm, although some of these dykes were later sheared.

It is known that movement along the Lough Belshade fault continued after Lower Carboniferous times, although at present we have no way of deducing what proportion of the movement was post-Lower Carboniferous. Several Tertiary dolerite dykes enter the fault zone without themselves being crushed, which places an upper limit to the age of the fault, and in the col N.E. of Lough Belshade a 3-ft. Tertiary dyke crosses the fault without being offset or broken. It seems probable that the fault is of the same age as the well-marked set of left-handed tear faults with N.E. trend in the Scottish Highlands, of which the Great Glen fault is the best example. W. Q. Kennedy (1946) regards the greater part of the movement along that fault as having been accomplished in pre-Upper Carboniferous times.

The Barnes Lough fault cuts the Lower Carboniferous on Banagher Hill and is at least in part post-Lower Carboniferous. Near the

western end of the Barnes Lough valley several N.W.-trending Tertiary dolerite dykes, on approaching the fault, change direction and follow it for a short distance, before resuming their N.W. course on the other side. Two of these dykes are seen crossing crushed granite in the fault zone but are not themselves crushed. However, one mile west of the western extremity of the granite and a short distance north of the fault are two dykes of quartz-dolerite that are crushed and heavily altered. Though it cannot be certain that these dykes are Tertiary, they are nevertheless of Tertiary type, and are quite unlike the Caledonian dykes in the area. Although they might possibly be Carboniferous or Permo-Carboniferous, they are much more likely to be Tertiary and indicate that some movement along the Barnes Lough fault took place after the intrusion of the Tertiary dyke swarm. The fact that the Lough Belshade fault is itself displaced proves that most of the movement along that fault was accomplished before the initiation of the Barnes Lough fault. According to current conceptions of the dynamics of faulting (Anderson, 1942), the Lough Belshade and Barnes Lough faults could not have been produced by the same stress conditions, and it is suggested that the latter fracture is very much later than the Lough Belshade fault, and is of late- or post-Carboniferous or possibly Tertiary age.

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