



Campbell 2 of 9  
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Read. as I think R. 1873

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There are no lakes in Daghestan &  
no ice marks seen at one place  
where both are together. ~~1873~~ Dec 24

## THE WATER BASIN OF LOUGH DERG, IRELAND.

By G. HENRY KINAHAN, M.R.I.A., etc.

(PLATE XVII.)

SOME time since, I read before the Geological Society of Glasgow a paper on "The Valley of Loch Lomond," and pointed out that the deeps and shallows corresponded with the faults and breaks in the adjoining country. This paper was quoted by His Grace the Duke of Argyll, President of the London Geological Society, in opposition to the view (so ably advocated by Professor Ramsay) that ice has been the principal, if not the only, agent engaged in the formation of such hollows.

It was suggested that my observations in this case may have been hastily made; but the valley of Loch Lomond is not the only water basin that I have examined with the help of the Admiralty Charts. I have carefully contoured the chart of Loch Fyne, also in Scotland; while in Ireland I have contoured those of Loughs Mask, Corrib and Derg; also the chart of the fjord called Killery Harbour, Cos. Galway and Mayo, with those of Cork Harbour, and of the archipelago between Crookhaven and Roaring-water Bay, Co. Cork. In all of these I find a remarkable coincidence between the lines of faults or breaks and the deep soundings; while my colleague, E. T. Hardman, F.R.G.S.I., finds a similar connexion between the faults and deeps in the basin of Lough Neagh, and Mr. John Ball, F.R.S., has shown (GEOL. MAG., 1871, Vol. VIII. p. 359, Pl. X.) that neither water nor ice alone could have formed the bed of the Lake of Como. In this paper I propose to describe the form of the water basin of Lough Derg, with the features of the principal portions of the adjoining country, and to put forward suggestions as to how the lake basin could have been formed.

### COUNTRY ABOUT LOUGH DERG.

Lough Derg is one of the large sheets of water through which the River Shannon flows. Formerly its dimensions must have been considerably larger; now, however, they are curtailed in places by accumulations of alluvium and bog, especially towards the north-east. The larger division of the lake basin, extending from its northern extremity at Portumna to the long east and west reach between Youghal and Scarriff bays, is in Carboniferous Limestone; while a smaller division, forming the south-west arm of the lake near Killaloe, is in slates and grits of Silurian age. The country on the east of the larger division cannot be satisfactorily investigated, as the rocks are all so similar, and in places so obscured by drift or bog, that it is nearly impossible to prove faults; however, it

1573

is evident that every bay or creek at the eastern side of the lake lies on a line of break. Youghal Bay, farther south, is known to occupy a line of fault, while in the country on the west of the lake various large faults were proved while working the geology. On this side of the Shannon are two groups of hills, called respectively Slieve Bernagh and Slieve Aughta. The northern portion of the first lies west of the smaller division, on the south-west arm of Lough Derg, and the latter lies west of the larger division, the two groups being separated from one another by the Scarriff Valley.

In the northern portion of Slieve Bernagh no great faults can be positively proved, although it is probable there are at least two; but in connexion with Slieve Aughta six nearly east and west faults have been proved by the Government Survey, each associated with a valley or marked feature. They may be called, beginning towards the south, 1st. The *Scarriff valley north fault*, 2nd. The *Cloonagro and Corra valley fault*, 3rd. The *Lough Atorick valley fault*, 4th. The *Derrybrian valley fault*, 5th. The *Owennaglanna and Boleymeendorrish valley fault*, and 6th. The *Dalystown river valley fault*. These faults, from 1 to 4 inclusive, are downthrows to the southward, while numbers 5 and 6 have downthrows to the northward. All of them are of Post-Carboniferous age, and they, as well as others farther south, probably belong to one system, and were formed simultaneously. The relations between them and the features of the ground were carefully studied during the progress of the Geological Survey, as will appear from the following epitome of the description in the Survey Memoirs.

In Slieve Aughta there is only one large north and south valley, that of Lough Graney; but the east and west valleys are numerous, and lines of faults have been proved in each. These latter valleys can be traced across the mountains from the limestone country on the west, eastward into the limestone country bordering Lough Derg, but the associated faults could only be proved to have shifted the beds in parts of them. The series of faults seen in this district are made much clearer by the presence of such different kinds of rocks now in juxtaposition, although they were originally several hundred feet asunder; the dark blue limestones and the yellow and red "Old Red" rocks occurring on one side of the fault, while the grey and green Silurian rocks are found on the other. In places, some of what are here considered faults might possibly be only Silurian cliffs, at the base of which the Old Red Sandstones and Limestones were deposited, as the rocks seem to strike with the line of fault; this is more especially the case with the Cloonagro and Corra fault. But that they are really lines of dislocation seems most probable, as there are so many of them in nearly parallel lines; also the basal beds of the "Old Red" on the upthrow and downthrow sides are similar, which would scarcely be the case if they were lines of cliffs.

Bounding the south of Slieve Aughta is the Scarriff valley, which has its accompanying fault on the north of the valley, running from Feakle Lower to Mount Shannon, the Carboniferous Limestone and

the Silurian rocks being brought together a little east of the hamlet called Coolcoosaun. This fault was observed a mile and a half S.E. of Feakle, and from that it was traced by Coolcoosaun toward the east; it appears to extend into Lough Derg, but no positive proofs of its existence were found farther than the Bow River.

A second valley runs from Lough Blarnagh into the catchment basin of Lough Graney at Lough Ea, and from Lough Ea down the Cahir River to Lough Graney; while from Lough Graney it extends eastward along the Corra and Derrygoolin rivers to the flat country near Lough Derg; leaving the Lough Graney catchment basin on the north of Ardeven. The accompanying fault can be traced from near Maghera Lough to Ardeven, being very conspicuous in the Corra River, and near the village of Cloonnagro.

A third valley extends along the Hollymount River to Lough Nagilkagh, on the east of which it crosses the watershed of the catchment basin of Lough Graney, and proceeds down the Drumandoorra River to Lough Graney. East of the last-mentioned lake, it is occupied by the Bleach and Woodford Rivers. The accompanying fault lies a little to the north, and has been proved from Carheeney Lough to Corlea Bridge, and from Woodford to Lough Derg; but between Corlea and Woodford it was not ascertained, as the country is covered with deep drift and bog. At Corlea the Carboniferous Limestone is brought down against the Silurian rocks; near Woodford, the limestones and sandstones are thrown against one another; while on the shore of Lough Derg the unstratified portion of the Lower Limestone is brought down against the stratified part. From Corlea to Carheeney the fault is well marked, and divided into two branches on the west of the village of Lannaght. A branch also appears to run eastward from Lough Atorick; this, however, could not be proved.

A fourth valley extends from Lough Cooter along the Owendalullegh to Marble Hill, a well-marked fault having been traced nearly the entire distance. The fault has its greatest throw in the Derrybrian valley, immediately south of the hamlet called Derry-laur, eight miles east of Gort; but at Chevy-chase the throw is also considerable, as there the limestone is now in juxtaposition with the Silurians or the basal conglomerate of the Old Red Sandstone.

A fifth valley extends across Slieve Aughta, a little north of the summit of Cashlaundrumlahan, in connexion with which there is also a fault, as we find in the Owennaglanna valley Lower Limestone shales, whose south outcrop could not anywhere be found. These rocks are probably bounded on the south by a fault, as farther west in the Boleyneendorrhish river-valley there is another outlier of Lower Limestone shale, which has been proved to be bounded on the south by a fault; but as the country on the south of the Owennaglanna is so covered by deep drift and bog, no positive proofs of a fault can there be obtained.

Another fault in connexion with a valley in Slieve Aughta was proved across the low country N.E. of Dalystown, and in the eastern part of the Dalystown river-valley. A little on the north of the

village of Tynagh, this fault brings up a small tract of Old Red Sandstone. It has been proved towards the north-east as far as Hearnbrook, and S.W. into the Dalystown river valley.<sup>1</sup>

#### LOUGH DERG.

Lakes in a Carboniferous Limestone country are usually very irregular in outline, and, at first sight, it might be supposed that there was no connexion between their shapes and the structure of the subjacent rocks. On examination, however, it is generally apparent that the bays and all wide stretches across the basins conform with the strike of lines of breaks or displacements in the adjoining country, while the minor features of the coast lines are due to the weathering along minor breaks, joint systems, or lines of bedding, more generally one or other of the first two; the basin of Lough Derg prominently illustrates these facts.

On examining the chart of Lough Derg,<sup>2</sup> it is evident that by a few displacements the lake basin might again be made to occupy a nearly N.N.E. and S.S.W. valley; also that each displacement that has shifted the primary valley out of this bearing coincides more or less closely with the strike of the valleys and faults in Slieve Bernagh and Slieve Aughta. (*See Sketch Map, Pl. XVII., compiled from the Ordnance and Admiralty Maps.*) This will be apparent from the following general description. Beginning at the south, the bearing of the lake from Killaloe to Rinnaman Point is nearly N. and S.; here a change occurs, but no fault has been proved in connexion with it. North of Rinnaman Point, the deeps for four miles extend S.S.W. and N.N.E., where they are probably crossed by a fault which changes their bearing. This fault is not marked on the Government Map, because, as previously stated, it could not be positively proved; but that it does exist seems probable, on account of the position of the Old Red Sandstone in the hill N.E. of the Corragoe Valley. North of this supposed fault the deeps run nearly N. and S., till they unite with the deeps of the previously-mentioned east and west reach that forms part of the lake between Scarriff and Youghal Bays. This long reach lies in the eastern continuation of the Carboniferous Limestone valley that separates Slieve Bernagh from Slieve Aughta, and the limestone seems to be brought into its present position not only by a synclinal curve, but also by faults. On the north of the valley, a large fault with a downthrow to the southward (the Scarriff valley north fault), is quite apparent; while on the south of the valley one or two lines of breaks or faults appear to exist. Within the valley itself they could not be positively proved, on account of the great accumulation of drift and bog at the base of the north slopes of Slieve Bernagh, but farther east in the low country, one of these, with a downthrow to the north, is conspicuous, and in its strike are found the principal deeps in the long east and west reach of Lough Derg. At this reach the lake

<sup>1</sup> Memoirs and Maps, Geological Survey, Sheets 115, 116, 124, and 125.

<sup>2</sup> Admiralty Chart, No. 1552, Lough Derg, Ireland.

basin extends eastward over three miles,<sup>1</sup> but north of the entrance into Youghal Bay, the deeps extend N.N.E. to a little south of Illaunmore, where they are crossed by the strike of the Scarriff valley north fault. Immediately north of this strike the deeps bear N. and S., but farther north, east of Coose Bay, the great deeps (over 70 feet) terminate at the place where the lake basin is crossed by a line in the strike of the Cloonnagro and Corra valley fault. To the north-eastward of Coose Bay, the trough of the lake basin runs nearly N.E. and S.W. to off Drominagh Point, where the strike of the fault, supposed to run nearly E. and W. from near Lough Atorick, crosses it. This fault also is not marked on the Government Maps, as it was not positively proved; but that it does exist seems suggested by the sudden jump in the direction of the associated rocks and the large springs along its line. Still farther northward, an east and west reach extends between Cloondavaun and Terryglass Bays in the line of the strike of the fault proved at Woodford (Lough Atorick valley fault). North of Terryglass Bay the lake basin originally extended much further in a general N.N.E. direction, and its relations to the other faults mentioned in connexion with Slieve Aughta could be pointed out; as, however, this part is now silted up, it may be passed over. We have now mentioned the principal breaks that have apparently shifted and changed the primary valley, all of which are *Post-Carboniferous* and probably *Pre-Glacial*; there are, however, others of a minor rank, many of which seem to be *Post-Glacial*, which have more or less affected the outline of the lake. They must, however, be passed over; for as yet the *Post-Glacial* faults have had very little attention paid to them.

Lough Derg is one of the natural reservoirs on the Shannon, and during floods its waters are muddy, while at other times there is a great evaporation from its large expanse of surface; consequently large depositions of mud and marl are continually taking place: therefore the nature of the original bottom of the lake-basin cannot be learned from the soundings; but we do learn that all the deeps are in the lines of the different longitudinal or transverse breaks, or at the junction or crossing of two or more; while most, if not all, of the islands, rocks, shoals, or shallows, are on the upthrow sides of the different faults. The latter fact is very apparent, except in the long reach between Scarriff and Youghal Bays, as the existence of the faults to the south of the Scarriff valley have not as yet been proved. If, however, as is highly probable, the previously-mentioned fault in the plain on the west of that valley extends through it and into the long reach, all the deeps in that part of the lake-basin are on the downthrow side of this fault. In concluding this portion of the paper it may be observed, that if faults or breaks have no connexion with the formation of lake-basins, it appears remarkable that in this basin all the changes in the bearings of

<sup>1</sup> This east and west valley might possibly shift the N.E. and S.W. valley about three miles towards the eastward; but it is more probable that this second nearly north and south portion of the lake basin was excavated along a nearly parallel fault line to that along which the first portion was formed.

the different lines of deeps should be connected with the strikes of the different faults in Slieve Bernagh and Slieve Aughta, and that the islands, rocks, and shallows should be on the upthrow sides of these lines of faults.

#### SUPPOSED FORMATION OF THE LAKE-BASIN.

We have now only to offer suggestions as to how the "rock basin" of Lough Derg was excavated; for although its water is now in most places margined with drift or alluvium, yet the probability is that it was originally almost, if not entirely, surrounded by rocks.

The faults and breaks were probably developed at such times as the land was rising from under water, in which case the sea must have been the first excavator, marking out along those faults and breaks valleys and ravines, which were afterwards occupied by rivers and ice; for when the sea retired, these other denudants must have accomplished more or less work. It has been pointed out by Prof. J. S. Newberry, M.D.,<sup>1</sup> in relation to some of the large North American lakes, that the original surface outlets from them have been apparently obliterated by large accumulations of drift, and thereby the waters have been forced to find other outlets; and this probably may also have been the case in regard to the basin of Lough Derg, as the valley extending from Youghal Bay round the hills called Slieve Arra, and down the Kilmastulla River to the Shannon, a few miles south of Killaloe, is now occupied by a deep accumulation of drift. This drift, which is principally gravel and sand, apparently of the "Esker sea period" may be of sufficient depth to fill a valley whose original trough corresponded with the height of the rocky barrier that forms the rapids and falls of Doonass, in the neighbourhood of Castleconnel; and if such a valley ever existed, either marine action or meteoric abrasion would have been capable of excavating the basin of Lough Derg to a depth of about sixty feet below the present surface of the water. Such a passage would be able to drain all the upper part of the lake basin, except four small deeps: one northward of Illaunmore, one immediately west of that island, and two to the S.S.W. of it; but it would be incapable of draining a portion of the long east and west reach and a long narrow tract in the south-west arm of the lake, they being over sixty feet in depth, while in places they are over 100 feet; one spot which is situated in the former, a little on the north-east of Parker's Point, being 119 feet deep.

In the paper on "Soundings in the Lake of Como," referred to in the introduction, Mr. Ball has pointed out as to a lake basin, "supposing the rocks on either side to be of equal hardness, and similarly stratified, it is safe to affirm that if they had been hollowed out by glacial action, or by aqueous erosion, the slope would be steepest on the concave side of the bend in those parts of the lake where the

<sup>1</sup> "On the Surface-Geology of the Basin of the Great Lakes, and the Valley of the Mississippi," by Prof. Newberry, M.D., U.S. Geologist. *Ann. Lyceum Nat. Hist.*, New York, 1869, vol. ix. See *GEOL. MAG.*, 1870, Vol. VII. p. 227.

glacier stream was turned aside from its previous direction." Mr. Ball has shown that this is not the case in the basin of the Lake of Como; neither is it the case in the Lough Derg basin; as at all such bends the slopes are steepest at the convex side of the bends, while the deepest part of each cross-section is nearest to the same side. If, however, the rocks were broken up in lines by breaks and faults, ice would act along such lines and lift up and carry away rocks, excavating some places, where the rocks were broken, much more deeply than either marine action or ordinary meteoric abrasion could do.<sup>1</sup> Such deeps would be nearest to the convex sides of the bends, as the natural action of the ice would excavate away the higher rocks in the section more toward the concave than toward the convex side.

Ice, however, could scarcely excavate or gouge out the sudden deep holes that occur in so many lake-basins; to which I would add, that after carefully contouring and examining the Charts of the lakes and bays mentioned in the introduction, I am convinced that the sudden deep holes could not have been excavated by the sea, ice, or ordinary meteoric abrasion; but as all of them seem to occur on breaks, or at the junction of two or more dislocations, it appears inevitable that they are due, at least in part, to fissures formed by the contraction and displacement of the rocks; while subsequently most, if not all of them, may have been connected with subterranean streams, which at different times drained, or helped to drain, the lake-basins. Ice, when it first forms on a country, will be more or less full of foreign matter, viz. the broken rocks and other detritus that occur at the surface; after a time, however, all these will be carried away; so that if the Lough Derg basin had been for ages occupied by ice, most, if not all, of the loose portions would have been removed out of it, leaving the ice, prior to its final disappearance, comparatively speaking, pure, and without any rock detritus in it, to incumber the lake basin; therefore, none of the deeps in it could have been filled with drift. At the present time, the deepest spot in Lough Derg is only eleven feet below the low-water of ordinary spring-tides at Limerick; but as the level of the lake is 108 feet higher, there would even now be an underground drainage if any of these holes are connected with subterranean passages. During the Glacial Period, if the land was higher than at present, the water would find vents through such passages, denuding away their walls and enlarging the deeps from which it flowed. After the Glacial Period water would still flow through them, until eventually the land sank so low that they were incapable of acting; or even previous to this, they might be choked by successive depositions of mud and marl. Even now there are reasons for supposing that some such passages may exist out of Lough Derg, as in the summer less water leaves the lake at Killaloe than flows into it by the main river at Portumna and from the numerous other smaller feeders; part of this deficit is certainly

<sup>1</sup> The Rev. M. H. Close is of opinion that "there never was 'a glacier' in the basin of Lough Derg. That basin, however, was no doubt swept by a flow of the general ice-covering of the country."

due to evaporation, but the whole of it could scarcely be thus accounted for.

Many of the Irish lake basins, especially those in the Carboniferous Limestone, which now have a surface drainage, may once have had subterranean vents. This appears probable from the various systems of lakes connected with subterranean rivers that still exist in different places in the island, and we would call especial attention to those connected with the River Fergus, Co. Clare, since a system of lakes somewhat similar to this may have formerly existed in the basin of Lough Derg. These lakes are of considerable size and are irregularly situated, and the river is thus described by the late Mr. F. J. Foot, "The River Fergus rises in Lough Fergus, between Corrofin and Ennistimon, at an elevation of about 350 feet above the sea, flows eastward and northward for two miles and a half, when it receives the Clooneen river; thence it takes an easterly course for a mile and a half, when, on entering the limestone ground, it suddenly disappears in a swallow-hole or vertical cavity in the rock. Half a mile to the east, it again emerges to the light, from a cavern called Poul naboe, from which it flows down into Inchiquin Lough and thence into Lough Atedaun. No visible river flows out of this Lough, but the Fergus is supposed to have a subterranean course in a direction of about E.S.E. to Dromore Lough, whence it flows southward, now above and now below ground, to Ennis, and thence to the Shannon." In the basin of Lough Derg, if the deeps below the 50-foot line of soundings were mapped, they would make a system very similar to those connected with the River Fergus, and the similarity would be more complete, if each deep was connected with its fellows by subterranean passages; while the great deep (119 feet) in the long east and west reach had a passage from it to the sea somewhere in the neighbourhood of Limerick.

I have now offered suggestions as to the mode of formation of the basin of Lough Derg; they are antagonistic to the views entertained by many persons; still they appear to me more reasonable than any others; and the physical agencies appealed to are all either such as have been by common consent admitted to have been at work in former times, or such as can be seen in operation at the present day.

EXPLANATION OF SKETCH MAP (PLATE XVII.) OF LOUGH DERG.

A	Portumna.	K	Deepest sounding (119 feet).
B	Terryglass Bay.	L	Mountshannon.
C	Cloondavaun Bay.	M	Coolcoosaun.
D	Woodford.	N	Scarriff.
E	Slieve Aughta.	O	Scarriff Bay.
F	Drominagh Point.	P	Cornagnoe Valley.
G	Coose Bay.	Q	Slieve Bernagh.
H	Illaun More.	R	Rinnaman Point.
I	Youghal Bay.	S	Slieve Arra.
J	Parker Point.	T	Killaloe.







