Memoirs of the Geological Survey.

EXPLANATIONS

TO ACCOMPANY

SHEET 126

(AND THE PORTION OF 125 LYING TO THE EAST OF THE SHANNON),

OF

THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF

TIPPERARY AND THE KING'S AND QUEEN'S COUNTIES.

Published by Order of the Lords Commissioners of Her Majesty's Treasury.

DUBLIN:

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE:

PUBLISHED BY

ALEXANDER THOM, 87 & 88, ABBEY-STREET;

HODGES, SMITH, & CO., 104, GRAFTON-STREET.

LONDON:

LONGMAN, GREEN, LONGMAN, AND ROBERTS.

1862.

THE

GEOLOGICAL SURVEY OF THE UNITED KINGDOM

IS CONDUCTED UNDER THE POWERS OF THE

8TH & 9TH VICT., CHAP. 63.—31ST JULY, 1845.

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The observations made in the course of the Geological Survey, are entered, in the first instance, on the Maps of the Ordnance Townland Survey, which are on the scale of six inches to the mile. By means of marks, writing, and colours, the nature, extent, direction, and geological formation of all portions of rock visible at the surface are laid down on these maps, which are preserved as data maps and geological records in the office in Dublin.

The results of the Survey are published by means of coloured copies of the one-inch map of the Ordnance Survey, accompanied by printed explanations.

Longitudinal sections, on the scale of six inches to the mile, and vertical sections of coal-pits, &c., on the scale of forty feet to the inch, are also published, and in preparation.

Condensed memoirs on particular districts will also eventually appear.

The heights mentioned in these explanations are all taken from the Ordnance Maps,

In referring to the six-inch maps, they are generally supposed to be divided into four quarters, the N.W. quarter being numbered 1, and the N.E. numbered 2, the S.W. 3, and the S.E. 4; so that of any County, Sheet 25/3, means the S.W. quarter of Sheet 25.

AGENTS FOR THE SALE OF THE MAPS AND PUBLICATIONS:

MESSRS. LONGMAN, GREEN, & CO., London;
MESSRS. HODGES, SMITH, & CO., Grafton-street, Dublin;
ALEXANDER THOM, Printer and Publisher, Abbey-street, Dublin.

EXPLANATION

OF

SHEET 126, &c., OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

[The whole of this district, except a very small portion entering it from the east, was examined by Mr. A. B. Wynne, by whom the following descriptions have been compiled.—J. B. J.]

General Description.

The district included within Sheet 126 and that part of 125 which lies east of Lough Derg, belongs to three counties. A part of the ground lying in Sheet 126, and crossing it from the N.E. corner to the S. side, belongs to the King's County, while a small portion coming into the eastern side of that Sheet, belongs to the Queen's County. The remainder of the district is in the County of Tipperary.

The principal town in the district is Roscrea, which, with the smaller ones of Cloghjordan and Borrisokane, and the villages of Ballingarry, Carrig, Carrigahorig, Terryglass, Newchapel, and Puckaun, belongs to Tipperary; the little town of Shinrone, and the villages of Dunkerrin and Brosna, lie in the King's County.

1. *Form of the Ground.*

That part of the great central plain of Ireland which is embayed between the Slieve Aughta and Slieve Bloom Mountains forms the largest portion of the ground; the eastern side, and part of the south-east corner of the district being occupied by portions of the Slieve Bloom and the northern extension of the Devil's Bit range. On the west, it is bounded by the expansion of the River Shannon, which is called Lough Derg.

The plain, however, can only be relatively so called, for it contains numerous eminences, some of the highest of which form two broken ranges of hills, one extending along the shore of Lough Derg in a north and south direction, and the other stretching from the S.W. corner of Sheet 126, for eleven miles in a N.N.E. direction, as if to cross the centre of our district, but terminating where the conspicuous ridge called Knockshigowna* sinks into the boggy flats of the Little Brosna

* Generally translated "Fairy hill," but said to mean literally "*the hill of the Calf's Ghost.*" [Information supplied by Mr. Garvey.]

river. Besides these, some more or less detached hills, of smaller, but still considerable height, rise from the low country near the base of the Slieve Bloom Mountains, the most conspicuous of which are the Knock and the wooded hill at Golden Grove. Several other eminences, such as those in the neighbourhoods of Templeharry and Black Bull, have elevations nearly the same as the lowest of these. They occur in various parts of the district, but principally to the eastward of the central chain of hills.

The average elevation of the country is greatest at the south and east sides of the district, for the rivers by which the chief part of its drainage is conveyed to the Shannon, namely, the Ballyfinboy stream and the Little Brosna* river, flow from the high ground S. of Moneygall (in Sheet 135), through the undulatory and boggy country near Dunkerrin, in northerly and westerly directions. The Little Brosna, however, is deflected to the S. of E. for five miles, by some slightly elevated ground near Shinrone, but afterwards leaves the district at the north side of Sheet 126. The Nenagh River, too, flows from the southward into Lough Derg, near the S.W. limit of this district.

The main watershed of Ireland, indeed, between the rivers above named and the Nore, crosses the S.E. corner of the district running from the Devil's Bit to the Slieve Bloom mountains a little east of Roscrea. In crossing the Roscrea gap, it cannot, in some parts, have a much greater elevation above the sea than that marked 361, near Forked Lough.

The greatest elevation in the district is one of the summits of the Slieve Bloom Mountains, called Farbreague, or the Hardy Man, 1,411 feet above the sea. About a mile to the southward, there is another over 1,300 feet; and two more, each exceeding 1,000 feet, occur upon these mountains also, near the north and east sides of the space included in Sheet 126. From such summits as these, the ground falls by long, gentle, heathery or grassy slopes, towards the low country, and with somewhat more rapid inclinations, into the three or four principal valleys which radiate from the western side of this elliptical group of mountains.†

A wide valley, almost entirely occupied by bog, intervenes between the Slieve Bloom and the northern part of the Devil's Bit ranges, and also stretches to the S.W. up the valley of the Noré, between two parallel ridge-shaped spurs, in which the latter mountains terminate. Of the two spurs, that to the W. is the widest and most elevated, having heights of 735 feet; it slopes abruptly to the N.W., but more gently into the valley of the Nore, while the other spur on the opposite side of this valley, although rising somewhat suddenly from low boggy lands, does so more equally upon both sides, and has lower summit elevations of 563 and 594 feet.

The chain of hills running from Knockshigowna southward, is most elevated at the summit of that name, having there a height of 701 feet above the sea; between this and Modreeny, the greatest

* Always pronounced Bresna. This is the same river which, in the map to the N., Sheet 117, is called the Little Bresna, apparently to distinguish it from another Brosna river further north, entering the same map.

† These mountains are chiefly situated in the district represented on Sheet 127.

heights are from about three to over five hundred feet, and the range is crossed by four valleys, two of which are boggy, and another is that of the Ballyfinboy stream, close to Modreeny, beyond which the elevations begin to increase again, from over four hundred feet up to six hundred and two at Screggaun, in the S.W. corner of Sheet 126.*

The still more broken range which runs along the shore of Lough Derg, from the neighbourhood of Puckaun to that of Terryglass, has summit elevations varying from 270 to over 480 feet, the latter height occurring not far from Ballinagross Lough, a boggy pool near the locality called Nanny Moran's rock.

The Knock hill in the north-eastern part of the district rises to 640 feet above the sea, and is separated by a steep valley, from some nearly as high ground between it and Leap Castle; two hills to the N., near Ardeeving and Oakley Park, have heights of 502 and 435 feet, and the hill at Golden Grove is marked 528 feet above the sea.

Regarding the rest of the low country, it may be said that its highest points will be found in the area N. and E. of the Parsonstown Branch Railway; the next, both in number and altitude, in the country to the S.W. of this; and the lowest, in the plains of Ormond, between the Ballygibbon and Knockshigowna range, and the hilly ground overlooking Lough Derg, the shore of which is obviously the lowest ground in the district, its waters having in summer an altitude of not more than 108 feet above the sea.

Very much of the country is covered by connected groups of bogs and alluvial flats, which, although very irregular in their outlines, have a singular arrangement approaching to parallelism; their longest lines, with few exceptions, running in a N.W. or W. N.W. direction.

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2. *Geological Formations, or Groups of Rocks entering into the Structure of the District.*

AQUEOUS ROCKS.

	Name of Rock Formations.	Colour on Map.
	Bog, Alluvium, &c.,	*Pale burnt sienna.*
Carboniferous.	d¹ Carboniferous Limestone,	*Prussian blue*
	$\mu\delta$ Dolomite, Metamorphic,	*Olive green with dots.*
	d¹. Lower Limestone shale,	*Prussian blue and Indian ink.*
Old Red Sandstone.	c. Old Red Sandstone,	*Indian red.*
Silurian.	b. Lower Silurian,	*Pale purple.*

b. *Lower Silurian.*—These rocks consist of a variety of blue and gray grits, shales, and slates, with some coarse grayish conglomerates, containing various pebbles, among which rounded fragments of quartz and hard grit are the most numerous. Some fine gravelly conglomerates, formed of coarse grains of quartz in a greenish matrix, are also, but rarely, met with, and the more shaly and muddy beds are often cleaved into slates, even when they are sufficiently thinly laminated to have formed flagstones had they not been cleaved.

* This range is prolonged but a little way into the district to the south.

These Silurian rocks have generally a more or less sombre hue, and when weathered they take different brownish, olive, and rusty tints; they are in many places flaggy, and in such localities have been found (though not always) to contain graptolites. Hard siliceous or jaspery looking beds occur in one or two places, and some bright red calcareous rocks occurring in one locality, would seem to be a larger development than is usual of the peculiar altered looking, red or purple, beds so frequently found in these rocks, close to the basal edge of the Old Red sandstone. The bedding of the rocks is frequently obscure; but, as might be expected, becomes evident when alternations of the hard blue or gray grits with the softer shales take place. The difficulty of recognising it in other places is caused by numerous small joints which frequently traverse the softer beds, and by the massive character of some of the grits, the indistinctness of their lamination, and their being frequently more apt to give way along the lines of jointing than those of stratification.

This group must be of great, but quite unknown thickness, for neither the top nor the bottom of it is to be seen.

Fossils have only been found in the Silurian rocks of this district which form the crest of Knockshigowna Hill; they will be more particularly noticed further on.*

c. *Old Red Sandstone.*—The Old Red sandstone consists chiefly of coarse, white, dull red, and purplish, or speckled, ferruginous looking sandstones, flagstones, and conglomerates, with some beds of greenish silty shale, and more rarely some of those red shales which are elsewhere so common in this formation. They are frequently calcareous, and sometimes so highly charged with carbonate of lime as to become cornstones. No regularity of alternation or grouping is to be observed in the vertical arrangement of these different beds, but the flaggy beds seem to preponderate in the S.E. part of the district, at a certain depth below the whiter sandstones, which are usually found to form its upper portion. These whitish sandstones form very good building stones, and are quarried for that purpose near Roscrea.

In some instances, where junctions with the underlying Silurians are seen, the basal bed of the sandstone is very highly calcareous, and the Silurian in one place, beneath such a calcareous bed, was composed of a brecciated slate, the interstices of which were filled with carbonate of lime†.

In the upper part of the formation, but still considerably below its upper boundary, some dusky gray, blackish or olive coloured shales are occasionally met, associated with calcareous beds; in these shales very many fragments of linear plants have been observed, amongst which, at one place, branching stems like mid ribs of the fronds of ferns, and one fern-like leaflet were obtained. The thickness of the whole group is estimated at probably 800 or 900 feet.

d^1. *Lower Limestone Shale.*—This group is not apparently largely developed in the district, being only well seen in one place, where

* See Explanation of Sheet 133 for Palæontological notes on the Lower Silurian fossils of the district to the S.

† Since this Explanation was in the press, I have learned from Mr. Kinahan that calcareous beds are often found at the base of the Old Red sandstone, filling up hollows in the Silurian, in the country to the west of Lough Derg.—A. B. W.

it seems to be not more than 100 feet thick; it is composed of dark gray and bluish black shales, fine hard grit, and dark coloured impure lumps of limestone; the latter are full of Carboniferous limestone fossils, and in one of the underlying shale beds a number of rare shells, determined by Mr. Baily to belong to the genus Leda, and other bivalves, were found. Another more isolated exposure of calcareous, nodular, cleaved, and much weathered shales, near the centre of the district, has been referred to this group, and although of slightly different aspect from those above described, it also was found to contain numerous fossils of species such as are usually found in the lower beds of the Carboniferous limestone.

d. *Carboniferous Limestone.*—The limestone of this district occupies a large space, and is frequently seen at the surface of the ground. Those beds which, from their contiguity to the Old Red, seem to occupy the lowest place are dark coloured and frequently crinoidal, while in some central positions in the district shaly and earthy beds are met with, which may either belong to a higher place in the series, or represent the very lowest beds brought to the surface by contortions; but, from the scanty amount of evidence, it would be unsafe to assert that the latter is the case. A group of dark cherty beds occurs to the west, at what would seem to be a considerable height in the formation; and in this direction, although pale compact and splintery limestone, traversed by numerous N. and S. joints, may frequently be met with, more of the dark blue and blackish kinds are seen than in other places. This, however, may be in consequence of the rocks being here more largely exposed.

Some black compact and earthy even bedded limestone, of very Calp-like appearance, occurs to the eastward of Parsonstown Barracks, just within the northern limits of the district.

The Carboniferous limestone here, as usual, is frequently highly fossiliferous, many of the beds seem to be almost entirely composed of crinoid fragments, and others of Fenestellæ, while some of the very pale limestone, like that at Carrigahorig, contains a quantity of shells.

Magnesian limestone of apparently metamorphic origin, is occasionally met with at different positions in this group of rocks.

The Drift of this country is widely and unequally distributed; it consists most largely of limestone debris, and appears under the different forms of "corn" or "bound" gravel, a mingled argillaceous and arenaceous deposit, with various sized boulders of limestone, sandstone, Galway granite, and other rocks; or "clean gravel," composed of limestone pebbles, frequently cemented, so as to form beds of conglomerate; or sometimes it is found to consist of fine sand only. It conceals the rock for large spaces along the flanks of the Slieve Bloom Mountains, as well as at the southern side of the district, and traces of it may frequently be found even where it is not present in large accumulations. It is in many places thin, and in others absent, allowing patches of the underlying rocks to appear. These places are more frequently found upon the higher parts of the low country, but many spaces which are clear of Drift occur also in low, open, or undulating ground. It is not found upon the mountain tops, although it does extend for considerable distances upwards upon their external slopes, and occupies many of their valleys.

3. *Relations between the Form of the Ground and its Geological Structure.*

The high ground at the east side and south-east corner of the district is composed of the Old Red sandstone and Silurian formations; all the low ground, the hills along the shore of Lough Derg, and those south of Knockshigowna, and also, it is believed, the most part of the valley of the Nore (within this district), are formed of the Carboniferous Limestone, while Knockshigowna hill itself, rising conspicuously in the middle of a limestone country, is formed, like the mountains, of the Silurian and Old Red sandstone rocks.

By referring to the annexed sketch section, fig. 1, taken in an E. and W. direction from Lough Derg to the Slieve Bloom Mountains, the arrangement of the rocks, and their intimate connexion with the form of the ground, will be easily perceived. It will be seen that the core or interior of the mountains, and likewise of Knockshigowna, is formed of the Silurian rocks, thickly overspread by their unconformable covering of Old Red sandstone, except where it has been displaced by faults or removed by denudation; this being again conformably covered by the Carboniferous Limestone, and certain portions of all of these being unconformably overlaid and concealed by the Drift and other superficial accumulations.

As the Silurian underlies all the other formations, it is obviously the oldest of them, and the parallel stratification of its beds, even when bent and contorted, points at once to their former extension horizontally, and shows us plainly that at some remote period they did not end abruptly as they do now, being broken off at the surface of the ground. This observation applies with equal force to the Old Red sandstone beds themselves, and also to the overlying beds of the Limestone, which latter may perhaps be most plainly and frequently seen to end thus suddenly. From this we are led to infer that when each of these stony accumulations of sand, gravel, mud, and calcareous matter was deposited, it formed a widely spreading horizontal series; but the strata are now seldom found in their original positions, and from those which they now occupy we learn some further facts.

When the junction between the Silurian and Old Red sandstone beds is observable, the former are found to end against the under surfaces of the sandstones, much in the same way as they do at the surface of the ground where they are not covered by the Old Red. The basal beds of the latter, too, are sometimes composed in part of fragments derived from the Silurian; which leads to the conclusion that a wide interval is marked by the unconformity between these two formations, during which the Silurians, after being horizontally deposited, were contorted, and extensively denuded before they were overlaid by the Old Red sandstone. These Old Red sandstones, conglomerates, shales and cornstones, were successively laid down upon each other in nearly horizontal layers, until they had acquired a considerable thickness, estimated at least at from 700 to 800 feet in this district; and then their upper beds began to be succeeded by more silty deposits, which now form the "Lower Limestone Shale," which in this district at all events, never attains to any very considerable

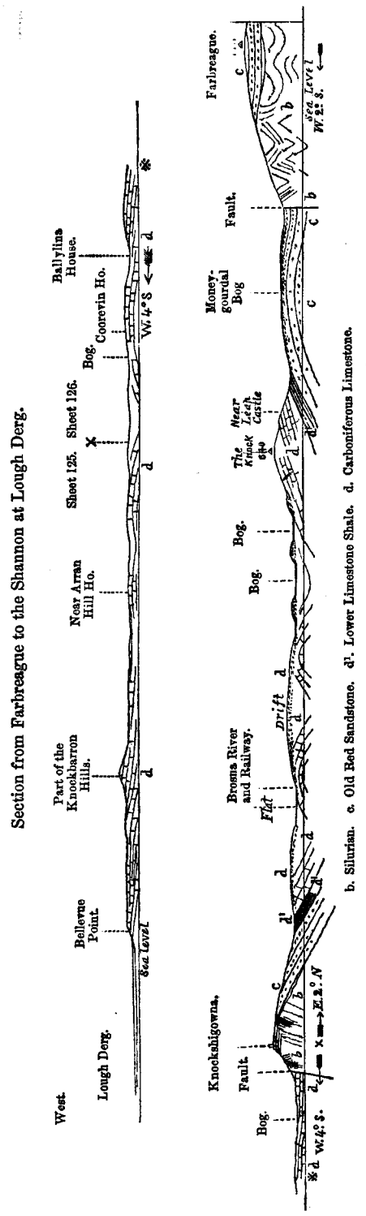

FIG. 1.

thickness. Among the latter, calcareous beds, which were but rare in the preceding period, began to be more frequently formed, and afterwards became so abundantly developed, that the overlying great conformable deposition consisted of little or nothing else. The united thickness of these, now forming the Carboniferous Limestone group, certainly exceeds that of the Old Red sandstone here; but, as its upper beds are not now present in this district, we cannot determine what that thickness was.

After all these Carboniferous Limestone and Old Red rocks were accumulated and consolidated, like the Silurians, and together with them, they were subjected to forces which a second time produced contortions, and also probably caused the deep fractures affecting all the formations within our district.

The flexures which the beds assumed under these influences were in some instances very wide, their larger anticlinal curves arching over the places now occupied by the most elevated ground and the synclinals corresponding to the existing great valleys and to the low country generally, where many minor undulations in the beds were formed. Subsequently to this, another action of denudation, like the former one, set in, and acting unequally upon the different beds,

as they were gradually elevated within its reach, removed the limestone from off the Old Red sandstone, and uncovered the Silurian rocks again in places, and ultimately carved out the various glens, and moulded the principal features of the country as they now exist; these, however, being somewhat changed and softened by the still more recent action of the glacial drift and the subaërial agencies which continue in operation at the present time.

In considering the relations between the form of the ground and its internal structure, we observe the results of the great geological phenomena of conformable and unconformable deposition, of elevation, compression and depression, with the enormous actions of two or more denudations, and the occurrence of faults breaking through and displacing the strata; and lastly, the presence of the drift and other superficial deposits.

Under the influence of the first action of denudation, which left its well-marked traces in this district,* the surface of the old Silurian must have been moulded into undulations, for what were eminences projecting above other parts of these rocks during the Old Red period, were covered over, and are sometimes found surrounded by its beds, the subsequent denudation having worn downwards to them through the overlying strata, but ceased, with regard to these spots, before it obliterated all traces of their isolated character.

This later exertion of denuding agency, having stripped the Silurian of the overlying and newer rocks, beneath which they were buried, and also removed the Limestone off the Old Red sandstone of the mountains, and of every place where the latter is seen; in other localities wore away surrounding parts of the Limestone, so as to make it assume in places the form of considerable hills, like those at Knockbarron, &c., to the west, and along the Ballygibbon and Knocknacree chain, being probably aided, however, in producing this effect in the latter instance, in consequence of the resistance offered by an extensive anticline coinciding in direction with the axis of the Knockshigowna ridge. The shapes of the numerous minor contortions in the limestone country, too, or the occurrence of spaces where they are absent, had, doubtless, an influence upon the present form of the ground, the denudation acting with different degrees of force upon such portions of the beds as were presented to it by these contortions in different positions.

The flat valley through which the railway passes between the Devil's Bit and Slieve Bloom Mountains, seems to owe its origin to the circumstance of two synclinal curves in the strata being crossed obliquely by a third at this place, these curves placing a mass of the more perishable Carboniferous Limestone between the two stronger rock masses of the mountains upon each side, naturally protected by their covering of Old Red Sandstone, and the denudation having removed the limestone from the open strait which existed here as the adjacent mountains were partially elevated above the sea, the valley was thus produced, the tendency to form such a strait being sufficiently caused by the shape of the great curves into which the strata were thrown.

Faults.—Two faults, running in different directions, are indicated by white lines upon map 126. The most considerable of these is

* Another yet earlier action of denudation must have occurred somewhere, by which the pebbles of the Silurian conglomerates were separated from rock masses, and rounded as we now find them in the Silurian conglomerates.—A. B. W.

that passing along the foot of Knockshigowna, at its western flank: it brings the Carboniferous Limestone into juxtaposition with the Silurian rocks, to the exclusion of the Old Red Sandstone, and thus, for want of the protection which the steep "*glacis*" (to borrow a figure from fortification), formed by the sloping beds of the Old Red, would have afforded, the abrupt front presented by the Silurian rocks was opposed to the later action of denudation, the abrasion of which has, no doubt, somewhat altered its slope, but left it sufficiently steep to form a marked feature in the landscape, particularly when contrasted with the gentle inclinations on the opposite side of the hill, which take their angles more or less from those of the sandstone beds, of which they are composed.

The Drift.—The relation which the Drift has to the form of the ground varies in different places. In some it only fills up the pre-existing hollows in the surface of the ground, being apparently drifted into them, and afterwards removed from the surrounding higher spots, or perhaps only retained in the hollows; in others it has long gentle undulations, with an even surface, but the relation is perhaps most conspicuous where it appears forming long narrow ridges, several feet in height, or great accumulations of sharply undulating but still rounded masses, divided by curiously modelled little valleys, and sometimes by remarkably regular elliptical hollows. It runs upwards into many of the mountain glens, opening to the W. of N., filling up the bottoms of some to a depth, in places, of perhaps more than 100 feet, and forming mounds or high river cliffs in most of them. It is found in these situations at elevations of from 600 to 900 feet above the sea, and more than 500 feet above places which are bare of it in the undulating plains below.

In any or all of these positions, the different varieties of its internal structure, mentioned at page 9, may be seen, but the long esker ridges seem never to be composed of sand alone, while this predominates to a great extent in the country occupied by the undulating accumulations of it between Roscrea, Dunkerron, and Shinrone.

The drift is shown to have come from a northerly or north-westerly direction by the numerous fragments of granite, gneiss, &c., which it contains, such as exist *in situ* in distant localities situated in that general direction; by quantities of it having been carried far into those mountain glens which open towards the north-west, and by the fact that many boulders of the peculiar Silurian conglomerate found *in situ* in Knockshigowna, are scattered over the country to the S.E. of that hill, while they have not been observed in the parts of the district on other sides of the place from which they were derived. The glacial striæ on the underlying rocks, too, have nearly always a marked north to north-westerly direction, and in the parts of the country where the drift most widely predominates, its elevations and depressions, as shown by the shapes of the intervening bogs, have a similar tendency to run towards the north-west, as may be seen over the whole of the district, except its north-eastern portion and S.E. corner, and the inclination to run in this N.W. direction does not seem to be interrupted by the occurrence of the central chain of hills, the bogs taking advantage of any breaks or depressions which occur to extend themselves through it, even across its very axis.

Some pipe-clay, which was once worked, occurs on a hill-top near the hamlet of Black Bull (north of centre, Sheet 126). It is stated to have been twenty feet deep, and like that at Caher, county Tipperary (Sheet 166), would seem to lie upon the rock, near the edge of, and perhaps below the drift.*

Bogs.—The bogs so numerous in this district seem to be associated in many instances with the alluvial flats.† They contain the usual abundance of the fallen trunks, branches, and roots of large trees; some of them have been artificially drained, thus reducing their natural level so as to permit the underlying gravel to appear in many places.

The alluvial flats are usually composed of river loam and stratified clay, sometimes containing black peaty layers.

At the Commons of Carney, the flat bottom of what appears to have been once a lake is said to be drained by natural subterranean passages, conveying the water, so as to form some fine springs at the edge of a marshy callow about a mile to the S.W. Beneath this flat there is a deposit of white marl, containing numerous marsh and fresh water shells belonging to recent species. Somewhat similar marl, but of a bluish colour, is raised in many places from the bed of the Shannon, or Lough Derg, and the whiter kind appears underneath most of the bogs and in many of the alluvial flats.

Along the edges of such flats as that at Carney, and also along some of those containing bog, &c., the drift appears to have been worn through in spots where it was locally thin, exposing the underlying rock, as if the water which they once contained had produced this result when in a state of agitation, any small drift cliffs, however, which may have been formed at the same time being now obliterated or rendered inconspicuous.

The mountains are covered with upland peat in many places to a depth sufficient to be cut for fuel. This seems to be more common upon the Old Red than the Silurian, the slopes of the latter frequently presenting the smooth green grassy and cultivated appearance so common in this formation in neighbouring districts.

Detailed Description.

For convenience of reference to the map, these detailed descriptions will be commenced at the east and carried to the west side of the district, which will be subdivided into the following parts:—1. *Neighbourhood of the Slieve Bloom Mountains, and country lying N. and E. of the Parsonstown Railway.* 2. *The termination of the Devil's Bit Range, and country near Roscrea.* 3. *Country about Shinrone and Knockshigowna.* 4. *Western side of Sheet* 126. 5. *East side of Sheet* 125, *between the Sheet line and Lough Derg.*

Neighbourhood of the Slieve Bloom Mountains, &c.—The Old Red sandstone of this part of the district forms the S.W. portion of the irregular ellipse occupied by the Slieve Bloom Mountains, and from the width of its surface

* See page 21.

† A connexion seems to exist between the bogs and the drift of this country, the former having apparently grown in the shallow basins of the drift, which caught the rain water, and allowed it to percolate so slowly through it that fresh supplies were added before the last had disappeared, thus keeping these basins always occupied by shallow stagnant pools or lakes, until the water was replaced by the accumulating peat.—A. B. W.

exposure its slight angles of dip may be inferred. It is indented along both its lower and upper margins, the sinuosities of the former being as usual much the most marked; and within these and the adjacent boundary lines of the district are included the largest exposure of the Silurian rocks. Two small isolated patches of the latter within the Old Red are exposed in the valleys of the Bunnow and Aghagurty Rivers, and a third is intersected by the eastern Sheet line of Map 126.

Near where the letter I of the name Ballybeit appears, in the N.E. corner of Sheet 126, an almost straight road runs through a steep natural defile excavated in the Silurian rocks. Its sides are smooth and its bottom nearly level; yet where the stream courses along the upper fences have cut their way through masses of local debris, the tops of some gray slates and grits are occasionally exposed; but more of these will be found in the stream courses and ravines of the picturesque glen, called Glenafilly, immediately to the north. This glen has been excavated in the Silurian rocks to a depth not much exceeding 600 feet; and although extensively occupied by limestone drift occasionally cemented into conglomerate, and sometimes containing granite fragments, the hard gray grits, and splintery or flaggy shales, will be found in the steeper parts of the little streams which feed the main brook. Where two of these separate to join again, enclosing a narrow piece of ground, some of the thin flaggy shales contain orthoceratites in small nodular concretions; and near the place where these little streams unite and enter the main brook, some more gray flags and slaty grits occur in the latter.

On the rising ground to the north of this a slate quarry was opened in the Silurian rocks, but it has not been very extensively worked. The beds dip to the S.S.E. at 55°, and the cleavage runs a little N. of E., dipping to the S. at 35°.

From the heathery and massive aspect of the high ground between Glenafilly and Grouse Lodge, together with its flattish top and gentle slope towards the low country to the W., it might easily be conjectured to be formed of the Old Red sandstone, as is found to be the fact; the coarse white and red sandstones, with some red and variegated shales, being seen in the stream which runs from it past Clonlee House (in ruins), and calcareous flaggy sandstones occurring in a quarry above Grouse Lodge, and also on the brow overlooking the steep defile before mentioned, which leads from Glenafilly into the Tulla and Crumlin part of Glendine.

Taking the several glens, the waters from which pass beneath Aghagurty Bridge, to form Glendine (although this name is only applied to that in the townland so called, which runs to the westward from the singular notch in the mountains, called the Gap of Glendine in Sheet 127, above the latter part of the word Roscomroe), we have a large valley containing several spurs from the adjacent hills, becoming contracted within narrower limits near Tulla Castle, and extending thus past Grouse Lodge, to below Aghagurty Bridge. Ascending the valley from the latter place (below which the stream winds through a narrow flat between high banks or cliffs of drift), the first rocks met with are some hard brownish gray grits and red shales of the Old Red sandstone dipping near the bridge with the stream at angles of from 5° to 15°. Apparently below these are some brecciated or conglomeritic cornstones with highly calcareous patches, belonging to the same formation, but in juxtaposition with hard gray sandstones associated with brownish weathered grit and gray flaggy shale, forming the most northerly of the isolated patches of the Silurian already alluded to. These Silurian beds appear to be contorted and are sometimes vertical, but seem to have a general dip of 45° and 50° to the westward. It is not easy to fix upon a boundary for this small exposure of these rocks, as the sides of the valley here are composed of a thick accumulation of limestone drift, the water oozing from which is

constantly forming layers and stalactitic incrustations of calcareous tufa or travertine.

A little further E. this section ends, nothing but drift being seen, and somewhat further on there is a large development of the calcareous tufa formed by springs on both sides of the river. It is very tough, weathers of a gray colour, and contains fine specimens of encrusted moss, rushes, sticks, &c., with an occasional small marsh shell (Lymnea or Helix). Further on some red shales and sandstones occur in the river dipping to the N.N.W. at 10°, and just beyond them the flaggy and slaty Silurian beds with some gray grits reappear. A few hundred yards to the S.E. the river exposes some strong red sandstones and shales S. of the site of Tulla old castle, apparently resting unconformably upon the same sort of Silurian beds as were last noticed.

Having thus arrived twice at the apparent base of the Old Red, we should naturally expect, instead of finding it again here, that the bottom of the valley would be formed as usual of the Silurian rocks. The streams do not expose any good sections, running as they do through a large deposit of limestone drift; but from the occurrence of more reddish sandstones further on in the bed of the main stream, little doubt is left that nearly all the interior of the valley about this place is occupied by the Old Red sandstone.

Following the northern boundary of the Old Red now, along the road from Tulla Castle to the E., we pass over a quantity of drift, and at length arrive at a place where the rocks are seen beneath it in the streams near the S. end of the transverse glen leading from this valley into Glenafilly.

Here we find the Silurian flags, grits, and shales, dipping at a high but steady angle towards the S.W.; and at one place near some houses a small exposure of the strong red sandstone and shales of the Old Red lying nearly horizontally upon these Silurians, having a slight inclination, however, towards the E. and S. Another stream running through the name Letterluna occurs not far to the S. of that exposing these sandstones; but although many of the gray Silurian beds are seen in it, dipping to the W. at 35° and 60°, and crossed by cleavage striking E. 10° N., the sandstones are not again exposed. Crossing the spur between this stream and that in Glendine, a quantity of Silurian shingle and debris will be found, and one large block of granite was observed resting upon this at a height of nearly 900 feet.

In the Glendine stream itself, near this, there is nothing to be seen, but on the sides of the glen the small runnels from the mountains sometimes cut through the thick covering of local debris, and show the Silurian rocks below. The south side of Glendine, at the E. edge of the map, slopes steeply from the high flattish moorlands of Farbreague, but at a little distance to the west, between this and the Lyre, the slope, at first steep, becomes longer, as the streams on the map will show; and in these, at some height upon this more gently sloping ground, sections in the Old Red sandstone are seen again. The rocks consist of coarse whitish and red sandstone and conglomerate, with some red shales, and having slight inclinations to the southward an ascending series is observable in walking up one of these streams; but after crossing the white line marked upon the map, they are no longer seen, and the steeper slope here having been worn into a small open coomb near the last letter of the name Roscomroe, the Silurian grits and shales are exposed, where a probable dip is marked by an arrow pointing to the south. At other places along this steeper slope, and where it turns round into the valley to the S., either the gray Silurian beds or their debris are found; and as there is reason to believe from the flat-topped shape of Farbreague, and the occurrence of some nearly horizontal beds of the Old Red to the southward and west of its summit, that it is capped by these rocks beneath its deep covering of peat, we can most simply account for the manner of the occurrence of the Old Red sandstone close by in the valley of Glendine, by supposing a fault to

exist, with a downthrow to the N., along where the white line runs upon the map,* and this supposition is greatly strengthened, if not absolutely proved, by the appearance of such a fracture lying continuously in the same direction, at the Gap of Glendine,† to the E. (in Sheet 127).

The valley of Glendine is closed in on the W. by the high ground at the Lyre, extending from the S. of that elevation by the height marked 803, to Drummin Hill, marked 603 feet. This ground falls to the W. at first somewhat more rapidly than the Old Red slopes usually do, but on the west side of the road from Roscrea, passes into an undulating country sufficiently flat to form the basin in which Moneygourdal Bog has been accumulated. Its eastern slopes are rather more steep, but do not expose the sandstone rocks, which are however visible in many places on the higher ground and in the little rocky glen which is generally known by the name of the Lyre. Here the nearly horizontal beds of whitish conglomerate and yellowish sandstone are well exposed, and they may also be observed both to the north and south; but between this high ground and the above-named bog the rocks are concealed by a portion of the drift which so largely overspreads the neighbouring country to the north and west.

In the neighbourhood of Moneygourdal Bog the drift becomes thin in some spots, for the same kinds of sandstone as were last described are to be seen in the spaces upon which it has not been represented, the largest exposure occurring near to and in the deer park of Leap Castle, where some calcareous sandstones dip to the W. at low angles towards the castle, which is built upon a crag of limestone, the dip of which is in the same general direction. Between this crag and the sloping grounds of the park there is a small alluvial and boggy flat, upon both sides of which are some strikingly marked accumulations of limestone drift. In one place it takes the form of a little esker ridge running out northwards into the flat, and in others presents escarpments and the usual curiously moulded mounds, two of which on each side of where the stream has cut through the deposit near the church, and a deep nearly circular hollow (perhaps caused by an eddy), on its west side, are particularly remarkable. In a gravel and sand pit which has been opened in the side of the eastern mound, the deposit is seen to be stratified, and is crossed by thin vertical dykes or veins of carbonate of lime, which appear to have followed lines of separation in the mass.

In the grounds of Lissanieran the sandstone beds appear again, and they are also seen to the southward of the name of Ballybrit Castle, in the hollows between some very conspicuous accumulations of the drift. Near Boheraphuca, and over a large space to the south of it, the Old Red rocks are frequently seen; but they do not exhibit any thing peculiar, except in the stream immediately to the E. of the name Aghacon, where some earthy or silty greenish olive nodular shales, and blue and reddish highly calcareous grit, were observed to resemble the Upper Old Red beds of the Bilboa river, near Cappamore, county Limerick.

A short but deep glen, which runs from near Boheraphuca into the moun-

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* The amount of this downthrow cannot be well ascertained, but it may be considerable.

† It should be stated, that very nearly the same appearance would arise if what is here supposed to be a fault had been a Silurian cliff line in the Old Red period; but its great regularity and straightness argues against this, as does also the slight inclination of the Old Red beds towards it on the north.

It is said to have been humorously observed by an eminent living geologist, that a fault is like a lie—assert one, and another has to be produced to back it up. So in this instance, although our fault may be considered proved, a necessity would seem to arise for a second fault, to account for the eastern termination of the Sandstones in the valley of Glendine; but as no sufficient evidence exists to prove its occurrence, it has been thought better to avoid introducing what might possibly be an error.

tains to the E., contains, perhaps, the finest example of the transported character of the Limestone Drift in the whole district. No obstacle at its entrance seems to have occurred to prevent the introduction of the great masses of the drift, which here form large mounds and dimpled undulations, visible from considerable distances to the N.W., and through which the brook that flows down the valley has excavated a deep channel, between steep cliffs of stratified "corn gravel," &c., most steep within the glen, but becoming gradually lower towards its mouth, until they sink into low banks near Roscomroe cottage.*

Close to the most conspicuous drift mounds in this glen the stream has cut down to the rock below, exposing blue, cleaved, and flaggy Silurian shales; and a little above these yellowish, calcareous, brecciated sandstones of the Old Red are seen on the S. side of the river. A short way to the E. there occurs in the stream a large quarrylike exposure of red, banded sandstone, red shale and pale gray, yellowish and purple sandstone, with one or two cornstone bands; and further up in the same stream, beyond the large mounds of drift, more of these Old Red beds occur.

From the unusual positions which all these occupy, and the course which their boundary takes, descending suddenly from the high-ground obliquely across the glen, instead of conforming to it in shape, it is supposed either that a N.E. and S.W. fault occurs between the two formations, or that an undulation in the surface of the Silurian must have existed here when the Old Red was deposited. From the absence of positive evidence of a fault's existence, it has been thought better to presume that the latter is the case.

Crossing now to the Queen's County, at the headwaters of some rivulets which run to the eastward, close to the margin of the district, and south of Farbreague, some of the basal beds of the Old Red, consisting of the usual kinds of sandstone rocks, project shelf-like, and nearly horizontally, from the brow of the hill, and the gray Silurian grits and shales occur in the streams a little below them, both being well seen near the ruins of a cabin, which was sometimes used as a shooting-box. The flat or slightly sloping ridge above this place, along which the boundary between the two counties runs, is covered by mountain peat, heather, and grass, quite concealing the rocks. Returning to the glen just now described as containing the large mounds of drift, some high ground at its south side exposes the light-coloured flaggy and other sandstones belonging to the Old Red sandstone group; they are nearly horizontal, and the lines of their stratification may be traced from a distance to the W. cropping from the hill-side, and inclining slightly to the S. Near Boheraphuca, more of these gray and purple flaggy sandstones may be seen in many places where the arrows are marked, and between the two last-mentioned localities a depression in the ground, crossing the low ridge between the upper part of Tinwee Glen and the valley to the north, suggests the connexion of the Silurian rocks, which are seen in each of those places by a narrow strip, as shown upon the map.

The southern termination of the Silurian rocks near Tinwee Glen has well marked boundaries, being edged by yellowish, and whitish flaggy, and conglomerite sandstones, on all sides, except where they are supposed to form a small bay in the flat moorland to the W., and these sandstones are also seen along and above the road from this to Nealstown. In Tinwee Glen itself they are found to extend a considerable distance down the stream, upon both sides of, and in which, the Old Red sandstones, with some very calcareous basal beds, may be seen.† The Silurian consists, as usual, of gray slaty

* The "set" of the currents which probably passed through the gap between the mountains near Roscrea, during the drift period, coinciding somewhat with the direction of this open glen, may, perhaps, account for the quantity of drift which has here been arrested and retained.

† See foot-note at p. 8.

(slig) shales and grits; but to the N. of the road to Nealstown some peculiar very hard gray shales and quartzose, flinty gritstone in places of a greenish or variegated colour, will be found; these greatly resemble certain of the Silurian rocks at Gallowshill, N. of Limerick, which have much the appearance of being altered.*

Close to this place a sharp little bend in the boundary of the Old Red occurs at a laneway close to a farm-house. The Old Red beds are seen here to form a small anticlinal, and immediately beneath them are some hard brecciated calcareous slaty shales, the interstices of which are filled with carbonate of lime, apparently derived from the lowest of the Old Red sandstone beds.† Upon the high heathery ground to the S.W. of Tinwee Glen small exposures of the Old Red sandstones occur at intervals; and further on in this direction the ground sinks considerably, and is covered by drift and bog; but on top of the hill, near Dungar Park and Fancroft, the upper beds of the formation may be seen in several places. At the quarries of Fancroft there are white and gray sandstones, mottled with small black specks, and containing some gray and blackish hard gritty shales, full of the fragmentary remains of plants, stems of which sometimes occur also in the sandstone. As these quarries afford a good example of the character of the upper beds of the sandstone, the following note, made at the place, is given.

"The general colour of the rock in these quarries is of a pale gray tint, the beds are thick, but sometimes flaggy, and frequently obliquely laminated; thin partings of green shale occur between the beds, which are generally coarse-grained, easily acted on, and stained of a rusty colour by the weather; softer cream-coloured felspathic (?) portions lie between the little grains of quartz, and the lamination is often marked by black grains, and sometimes by yellowish streaks. Small blackish shale patches occur within the sandstone, sometimes scattered, and sometimes numerous and close to each other. The dark gray and blackish flaggy and gritty shales, which contain the plant fragments, are sometimes spangled by little flakes of mica."

In the valley of the Bunnow river, near its source, and not far from Nealstown, pale purple, gray or white sandstones occur in that stream, and close to where the Nealstown and Roscrea road crosses the county boundary. At this place, too, some of the olive and blue grits, and slig or splintery shales of the Silurian, seem to have projected in the form of a small peak, surrounded by the sandstones, which have been removed by the denudation.* The Old Red beds appear again in one or two places further down the stream; and where this falls over some of its sloping purple on grayish and white sandstones, with red calcareous beds, near the point where the stream from Tinwee Glen joins it, there occurs an unusually dark gray band of shale, containing many fragments of the ribbed and branching stems of plants, and from which one fern-like leaflet was obtained.‡

It will be observed that from the angle at which these beds dip, if this be continuous for any distance, they are situated at a considerable depth in the Old Red formation, and they appear to lie below some other of the sandstone beds, which occur further down in the course of the stream.

Following its course, we next meet with some of the uppermost beds of the group, or the lowest of the Lower Limestone shales, consisting of hard greenish gray and blue shales, immediately over which are some beds of dark gray, shaly, nodular limestone. These beds appear to occupy a synclinal curve a little way from the corn-mill marked upon the map. They dip

* See Explanation to Sheet 143, p. 15, line 25, &c.

† There is a possibility that these Silurian beds may be brought in by a fault extending down the valley and passing near the corn-mill to the S.W., as mentioned in a following note.

‡ Lest this place should be searched for fossils, it may be well to mention that this, the only band which appears to contain them, is situated where the stream washes the base of a little rocky cliff on the S. side of the river, below the sloping fall.

towards the S.W., but would seem to be much contorted in some places, the shales below containing Leda and other fossils, and the calcareous bands being full of Producta, Spirifera, and other Carboniferous organic remains. From the character of these fossils, and the appearance of the rocks, the latter have been included in the Carboniferous or Lower Limestone shale; they seem to be much squeezed or even faulted near the south bank of the stream at this place, for a deep gully forming the channel of a smaller streamlet, which crosses the road near Mr. Fairbrother's farm-house, exposes some of the Old Red sandstone beds, the dip of which is apparently to the south-westward at a low angle, while the calcareous beds of the Lower Limestone shale are seen in junction with these, a thin, vertical, black shaly parting occurring between the two, but there is no appearance of the underlying blue Leda shales being present, although these are seen to have a thickness of at least fifty feet in the neighbouring stream.*

The thickness of the Lower Limestone shales exposed here may exceed 100 feet, a steady section of this amount being obtained.

The Old Red sandstone beds occur abundantly upon the high-ground to the S. of this valley, but they are not so frequently seen on its southern slopes in the Queen's County. They consist of the usual varieties, the flaggy beds being, however, most numerous; and from these fine gray and pale purple flagstones are raised from quarries above *St. Kieran's Well*, on the summit of the ridge at the county boundary, and elsewhere.

The country N. of the railway near Roscrea, is covered by extensive undulating deposits of the drift and bogs, or boggy flats occupying hollows and depressions between the mounds of drift. The most clearly defined range of the drift hills trends to the southward from the high-ground, near Sharavogue, extending with a steep western escarpment overlooking the flats of the Little Brosna, to beyond Roscrea. As is frequently the case, this ridge of drift does not consist of one mass, but is broken up by numerous hollows and undulations, which have sometimes the deep ladle-like form so often seen, and for the formation of which it is difficult to account, except by supposing the existence of swallow-holes in the rock beneath.†

* The existence of a fault at this place might be questioned, supposing the sandstones in the gully to the S. to have a nearly vertical dip passing below that side of the synclinal. On clearing away some ferns and brambles here, however, lines believed to be those of stratification were seen to dip to the south-westward; and the rest of the sandstones higher up in the main stream, as well as on the mountains at both sides, appear to have a general conformity of inclination to the southward, instead of showing a continuation of the synclinal curve, which lets in the Lower Limestone shales in the bottom of the valley. The absence of the fifty feet of underlying shales at the junction, too, where the calcareous beds are brought against the sandstone, although they dip away from it at a very high angle, and the crushed and irregular appearance of the black shaly "leader," which occurs between them, would seem to favour the supposition of, if not to establish, the existence of a fault of some amount, at all events, which may be more extensive than it appears, and may have had something to do with the appearance of the Silurian rocks in its strike near Nealstown.

If there was sufficient evidence upon which to draw this fault for any distance, it would be found to take a course nearly parallel to those of the two other faults, which will be found marked upon the map, the Glendine one to the N., and a longer one, a little portion of which crosses the S.E. corner of the district.—A. B. W.

† One of these peculiar hollows northward of Monte Video House, having smooth steep sides, was seen to be used as a miniature cricket-court by some peasants, the wickets being pitched at the bottom, and the sides acting as the outward fielders, returning the ball when struck to the players below; this occurred every time the ball was driven away by the bat, there being no gap through which it could escape, and the sides being apparently sufficiently high to prevent its flying over, even when struck upwards with considerable force.—A. B. W.

Punch bowl hollows in the drift mounds or small flats, completely surrounded by the Esker ridges, are rather frequent features in these accumulations. They appear to me to prove that the ridges and mounds were heaped up from opposite sides, and are not the result of the denudation of a wide thick deposit.—J. B. J.

Where this drift ridge is crossed by the deep valley of the stream which forms the county boundary near Golden Grove, there occurs a quantity of white shell marl occupying the narrow flat at the bottom of the valley; and further to the N., near where the ridge is crossed by the channel of another stream from the bog at Ettagh, a patch of marly tufa lies upon the sloping surface of the drift beside the road to Parsonstown, at some fifteen feet above the level of the neighbouring flat.

The wooded hill at Golden Grove rises conspicuously above the undulations of the drift, exposing a quantity of nearly horizontal dark gray or blackish limestone beds, sometimes having a flaggy and earthy or shaly aspect at the top of the hill, and forming a steep cliff-like escarpment round its summit to the S. and E. Many of these beds are fossiliferous, some containing a number of specimens of the Carboniferous trilobite (Phillipsia), and spines of the Palæchinus, as well as many other fossils.

North of this hill the country is occupied by bogs and drift, until the neighbourhood of the Knock and Leap Castle is reached. Although the Knock is a higher hill than that at Golden Grove, it does not expose the rocks to the same extent, but some dark gray cherty and thick flaggy beds appear to have fallen slightly from their true position, and to dip down the N.W. slope of the hill. Upon the high ground, between The Knock and Leap Castle, forming a separate portion of the hill, divided from the other by a steep glen, the same kind of rocks appear in a few places; but they are best seen close to Leap Castle, and beneath it, where they dip to the N.W. at 10°.

Boggy flats and drift occur again in the neighbourhood of Grange, but on the hill S. of Oakley House a quantity of horizontal pale gray limestone appears. It contains fossils, as usual; and a small portion of the cheek of a trilobite, with its spine and rim, was obtained here.

To the westward of this, at the cross-roads near Castletown, some black smooth bedded, flaggy, earthy, and calpy looking limestone occurs; and also to the northwards, near the road leading to Parsonstown. Southward from this, near Killanabreaghan House and Insula Vitæ Abbey, the northern slope and west side of a hill exposes a quantity of pale gray crinoidal limestone, in many places magnesian, and dipping to the N. at a low angle. A curious deep cut or glen, runs N. and S. through the rocks here, being excavated apparently along some of the numerous joints which occur in a N. and S. direction so frequently in the paler kind of compact limestone.

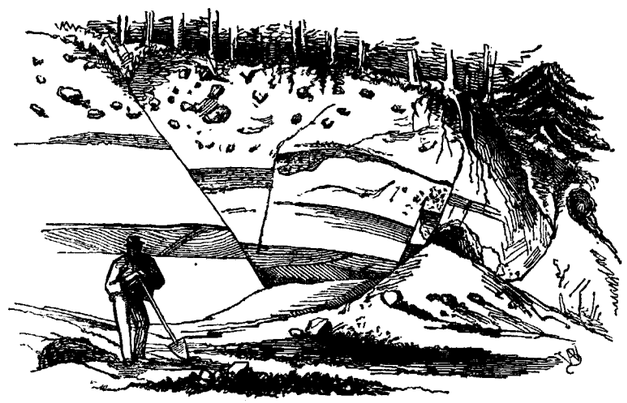
Limestones of the same sort, and also of a paler and more splintery kind, full of the remains of Fenestella, appear in very many places on the high-ground from Clonkelly southwards, by Ballyeagan and Blackbull; and it is also seen in many places along the northern part of the railway; but close to the barracks, a quarry in the drill-field exposes black earthy limestone (with some red shaly partings), of much the same character as that to the E. near Castletown.

The gray limestone in the old road upon the hill above Blackbull, and N. of Rathmore, is crossed in two directions by glacial striæ, one set running about west-north-west and the other to the N.W. Nearly half a mile to the N.E. of this there occur some old pipe-clay pits, near the top of the hill. About these little could be learned, except that the clay was white and gray, about twenty-five feet deep, that the bottom of it was not reached, and that it made good tobacco-pipes. (A specimen of this clay was kindly presented by the Earl of Rosse, who used it for lining the interior of his furnaces.)

The termination of the Devil's Bit Range and Ground near Roscrea.—In the neighbourhood of the town of Roscrea there is a good deal of hilly and undulating drift-covered country, the town itself being built upon the place where the Bunnow River cuts across the chain of drift hills coming from Gloster, and which is continued by Corbally Abbey into the large bog of the Nore valley, where numerous isolated mounds of drift project above the surface of the bog.

More of this drift occurs on each side of the road from Roscrea to Shinrone, and in the country about Inane and Ballystanley, as well as from thence towards Rutland. It undulates considerably, is composed almost entirely of fine sand, and forms the basis of very many small bogs between the esker-like mounds. Sometimes a few gravel layers are present, and the interstratification of these with the sands frequently serves to mark the occurrence of slips or faults shifting the beds from one to two and a-half feet, like those shown in the accompanying figure (2), which is taken from a sketch of a gravel and sand-pit in the demesne of Inane, to the N.W. of the house. The regularity of the sharp straight lines along which the sands are faulted is peculiar; they are sometimes plainly marked by the occurrence in them of calcareous veins, the result of infiltration along these divisional planes, and wedge faults are sometimes found.*

Fig. 2.



Faults in drift at Inane, near Roscrea.

The upper part of the sand-pit contains corn-gravel and boulders, below which occur layers of gravel and beds of fine sand, the oblique lamination of which latter sometimes brings them out in appearance from the mass; and then tracing them they are found to be interrupted by faults which shift them from 8 inches to over 18, and in these lines of fault, thin chalky calcareous infiltrations are sometimes found.

The anticlinal curve of the Devil's Bit range is divided into two, as it approaches the district included in this map, by an intermediate synclinal hollow. The axes of all three flexures are inclined to the N.E., so that the

* There does not seem to be any reason to suppose that these faults extend into the underlying rock, and the displacement may be accounted for by supposing two or more divisional planes inclined towards each other, and making considerable angles with the horizon, to have obliquely intersected, or, at all events, met one another, and then the included wedge-shaped mass having been deprived of support at its wider end by the wearing or wasting away of adjacent portions of the drift, and loosened by the percolation of rain-water, it might slide bodily along the inclined junctions of such divisional planes, the hollow caused in the surface by the shift being but small, and likely to be obliterated either by more recent depositions of the same kind, or by the action of subaerial agencies upon so incoherent a material as that of which the drift is composed.

The occurrence of these faults might also be accounted for by supposing a settlement to have taken place in the mass along a certain line or plane of dislocation; but in this case there is nothing to warrant the supposition that one part of the drift was more compressible than the other, unless subterranean streams may have washed out a sandy portion from below, and thus allowed the overlying mass to sink.

two anticlinal spurs of Old Red sink in that direction, and limestone comes into the intermediate hollow, the whole ridge sinking into the Gap of Roscrea, on the N.E. side of which it rises again as the Slieve Bloom Mountains. The largest of these spurs is the ridge extending to Roscrea, and known in the neighbourhood of that place by the name of Carrig Hill; and the other, after sinking nearly to the level of the low country, where it is crossed by the road from Roscrea to Templemore (in Sheet 134), rises again so as to form the wooded hills at Rockforest and Timoney Park, in the S.E. corner of this district. The white, yellowish, and gray sandstones of the Old Red are seen abundantly upon the ridge near Roscrea; some brownish speckled and calcareous beds also occur, and here and there a bed of red shale, but red or purple sandstones are rarely met with. A quarry in Corville demesne exposes some horizontal, white, brownish, and yellow sandstones, with some layers of red and greenish sandy shale; and very similar beds occur again on the other side of the road, near the height marked 446. Close to this place, too, where a dip of 10° to the S. occurs, there is a quarry in white or yellowish obliquely laminated sandstone in places calcareous, and overlying some deep red shales, which have a thickness of more than five feet. Mr. Smallman, of Roscrea, to whom this quarry belongs, states, that in some shaly and flaggy beds, at the lower part of the sandstone, a thin layer of coal was found some twenty years ago; and that in an adjoining quarry to the S., which has been more than twenty years closed up, an old quarryman who worked there, and who is now dead (1861), told him that he had got "black stones, with which he made a fire and boiled his pot." Mr. Smallman also says that he was told of the occurrence of coal in a similar manner, near Spafield (see S.W. corner of Sheet 127.) A little to the W. of this place are two large quarries, situated on each side of the road from Roscrea to Prospect. In that to the E. coarse pale whitish gray and yellow conglomeritic sandstones, olive and purplish sandy flags and red shales occur; but the other, which is extensively worked for building and ornamental cut-stone, contains from twenty to twenty-five feet of nearly horizontal obliquely laminated, bluish gray and white conglomeritic sandstone, which weathers of a yellowish colour, and contains flakes of greenish indurated clay. A band of pale purple, brecciated, calcareous sandstone, occurs here also; and more of the white or bluish gray kind is said to occur below what was exposed when the quarry was visited in the summer of 1861.

Some of the stone here is very solid, and has to be split by means of wedges, when fine blocks, twelve feet long, can be obtained. The master-joints run at right angles to each other, about 10° W. of N., and 10° N. of E.; they are nearly vertical, their surfaces undulating slightly, or, as it is sometimes expressed, being "*in winding*." The calcareous portion of the stone does not differ much in appearance from the rest, except when exposed to the atmosphere; and the other kind is preferred for ornamental purposes.

The stone from these quarries has been used in the construction of the Parsonstown Railway bridges, and for public buildings in Roscrea, Templemore, Nenagh, &c., &c.*

The steep northern slope of the ridge from where these quarries occur, towards the S.W. as far as Newgrove (now called after the townland Rath-

* This sandstone, like that taken from these upper Old Red beds generally, when newly quarried, is of a beautiful pale bluish white colour; under the action of the atmosphere rusty streaks are developed, and after some time it frequently assumes an even, warm, yellowish tint.

The pale varieties amongst the upper beds of this formation are often spoken of as yellow, and this term has been applied to the whole group; but in most cases, their having this tinge is owing to the partial action of the atmosphere, and whenever they are deeply broken into, and fresh fractures exposed (in the S. of Ireland, at least), they have a predominant whitish gray colour.—A. B. W.

naveogue), frequently exposes the sandstones, and sometimes cornstone bands; they do not present any thing peculiar, except in one place, on the crest of the ridge over Inane House, near an angle in the parish boundary, where a vertical vein of carbonate of lime, in some places more than an inch in thickness, occurs in an old gravel pit, the bottom of which exposes some of the calcareous beds. The longer slope into the valley of the Nore shows the rocks more rarely, as they are covered extensively by the drift, small excavations in which frequently occur near the very top of the ridge, although little or none occurs upon its northern slopes. A considerable deposit of calcareous or tufaceous marl occurs on the S. side of the ridge, along a stream which passes by an old castle.

The Lower Limestone shale does not appear in this neighbourhood.*

The limestone in the country immediately to the N.W. of the Carrig Hill ridge is only seen in open quarries at three places—in the demesne of Inane, where it is dark gray and blue, thick bedded, highly fossiliferous, and easily burned into good lime;† at the Cottage, where it is gray, granular, finely crystalline, and oolitic looking; and in the demesne of Franckfort Castle, where dark blackish crinoidal beds occur. All the rest of the country in this neighbourhood is occupied by bogs and drift, and the underlying rock was not found to appear at the surface of the ground.

The limestone which occupies the Nore valley, between the two spurs of Carrig Hill and Timoney, is only seen at one place, in the townland of Aghsmear, where a quarry, to the W. of the road from Roscrea to Templemore, contains dark gray, compact, and crinoidal limestone, lying nearly horizontal, but having apparently a slight local dip to the W.

Upon the rising ground near Timoney and Rockforrest, the white or pale gray, red, and purplish, coarse conglomeritic beds of the Old Red are frequently seen. They are sometimes calcareous; and the following section was observed in a cutting on the road from Knock cross-roads to Roscrea, the beds being arranged in their natural descending order :—

Dip of beds about 10° to 15° to the E., and the thicknesses given are only approximate.

	Thickness.
White flaggy sandstone,	about 5 feet
Red shales,	,, 11 ,,
Calcareous whitish sandstone,	,, 8 ,,
Blank space,	room for about 14 ,,
Olive and red muddy shales,	about 9 ,,
Whitish sandstones, obliquely laminated and calcareous,	,, 9 ,,
Olive and red shales,	,, 9 ,,
Red thin platy flags and shales passing into each other, Ferruginous pale obliquely laminated sandstone, with a lenticular band of red shale, thrown down by a small fault, two feet, Calcareous shales,	,, 20 ,,
Layer of variegated calcareous brecciated cornstone, six inches, [*At this place a nearly vertical dyke or vein of hard dark gray limestone, nine inches thick, crosses the shales.*] Dull weathered shales or mudstones in places calcareous,	,, 53 ,,
Blank space,	room for about 25 ,,
Hard olive quartzose sandstone,	about 20 ,,
Red sandy shale.	

The lowest of these beds are at the cross-roads close to the height marked 563. An anticlinal occurs here, the beds beginning to dip to the

* As this shale may possibly be a variable deposit, not always present, and as no evidence of its existence occurs to the S. in the districts included within Sheets 135 or 144, while it does occur to the E., the fact of its thinning out is suggested at the S. side of this map.

† A cave occurs in the quarry at this place.

W., and ferruginous sandstones and red shales predominate. The sandstone about these hills seem to undulate at low angles, and not to be very far from the surface of the ground in most places.

Some black and dark gray, lumpy, and crinoidal limestone, occurs at the foot of these hills on their S.E. side, and from the position of the apparent dip in one of the exposures of it, close to the E. margin of the district, it is believed that the fault, which extends to the W.S.W. in the adjoining part of the district to the south, is continued here.

The great bog which occupies so much of the Nore valley within this district, has been so much reduced by drainage, that what were once boggy lakes or pools are dry, and the higher parts of the underlying gravel approach the surface in many spots; while in some places near Monaincha House and Racket Hall, the character of the ground is so much changed by its being reclaimed, that without a means of penetrating the artificial surface it is quite impossible to tell when one stands on peat bog or upon ground devoid of peat. The bog, too, extends into every little hollow of the undulating drift, so that its boundary becomes intricate, and it often surrounds the higher eminences of the drift, like those near Shehill's House, and at Monaincha or Inchanameo Abbey.*

The country about Shinrone and Knockshigowna.—In the neighbourhood of Shinrone, and thence southwards to the limits of the district, the country is covered with drift, and no rock is seen except at the place already mentioned near Franckfort Castle, and in a few spots nearer to Shinrone. As usual, where the drift occurs in quantity, it forms undulating hills, separated by boggy flats, and it sometimes appears in the shape of escarpments, thickly clustered gravel mounds, or esker ridges. Some of the latter occur to the southward of Shinrone, near Glass House, and the town itself is built upon another; but the most conspicuous is one which rises near the town, at first gradually, but soon attains a height of about twenty feet, and extends along the N. side of the Little Brosna River by Mount Lucas, near which place it is crossed by a gap, where two alluvial flats are united; and shortly beyond this, near Mount Heaton, it has a summit sixty-nine feet above the flat to the N.W. It continues high, with many smaller mounds, from this to where the Bunnow River enters the Little Brosna, and it seems to have been joined to the larger bank on the other side of the river which runs from Gloster to Roscrea. The drift which forms this and the other esker ridges, consists of sand, gravel, pebbles, and boulders, the latter being sometimes large, but more frequently of the size used for paving-stones. The gravel of this esker N. of the bridge over the Little Brosna, on the road from Shinrone to Roscrea, is cemented by carbonate of lime, so as to form a recent conglomerate.

At this bridge, in sinking for its foundations, dark earthy limestone was found beneath the alluvium, and crystallized carbonate of lime and iron pyrites intermixed were found associated with it. Specimens, both of the stone and these minerals, occur in a pile of debris on the N. bank of the river below the bridge. The river below and above this place has been much altered, deepened, and made straighter by the Arterial Drainage Department of the Board of Works, and in doing this, nearly horizontal beds of black limestone were exposed a little way above the bridge, about half a mile to the W.N.W., and in the course of the river through Mount Heaton demesne. A quarry in black limestone occurs also in this demesne, at the western end of a wood near the Roscrea road.

Some rocky patches occur in the alluvial flats of the Brosna, to the southward of Shinrone, and near one of the above mentioned exposures of the dark

* It is stated, that within the memories of the fathers of the people now alive, Inchanameo Abbey could only be reached from the neighbouring Abbey of Corbally by using boats.

limestone in the stream; but it is doubtful if the pale gray limestone which occurs here is absolutely *in situ*.

Dark gray cherty and flaggy limestone appears in front of a cabin a little way off the road, to the S.W. of Shinrone, near where the letter R in the parish name appears; and in the moory or boggy ground to the W. of this, pieces of the same kind of limestone are seen apparently not far out of place; while just to the W., in Cangort demesne, hard and pale gray limestone appears nearly horizontal; and dark cherty beds occur between this place and where the C of Clonlisk* is engraved.

There is a great deal of drift to the S.W. and northward of Shinrone; but, at Carrigatane, on the road between this place and Brosna village, a crag of pale gray limestone appears, and similar limestone occurs in a quarry to the N.N.W., near Corrolanty House, and also near Ballincor, being, in the latter place, magnesian; while darker beds occur on the road above the railway to the W. of Brosna Flour Mills.

Knockshigowna Hill lies to the N.W. of Shinrone, its position being well marked upon the map by the different colours representing the Silurian and Old Red sandstone. It forms a ridge running N.N.E and W.S.W., with a high western slope, and more gentle inclinations in the opposite direction. One of its undulations to the N., is called Lacka Hill, and on the S. it sends off a spur to the E.S.E., which is partly separated from the rest of the hill by the valley between Cangort and Clifton House (along which the boundary between the King's county and Tipperary runs), and the eastern part of the bog surrounding Lough Nahinch, while its steep summit, marked 701 feet, rises conspicuously above the other parts of the hill.

Upon the part of the southern spur over which the road from Shinrone to Sopwell Hall runs, dark gray and cherty limestone is exposed at the different places where the symbols marking the "lie" of its stratification occur upon the map; and in a new road, near the summit marked 154, some cleaved and weathered shaly and calcareous fossiliferous beds, which have been taken to represent the Lower Limestone shale, are seen. The cleavage in these beds runs about N.E., and dips S.E. at 40°, in the same direction as the beds do, but at a higher angle. The E. flanks of the hill to the northward of this place, are covered with drift, but to the N.W., near the Pike, the whitish and red conglomeritic sandstones and shales of the Old Red curve round the south end of the Silurian exposure; and at the Pike cross roads, pale gray compact and magnesian limestone comes to the surface, the magnesian portion appearing to occur as an E. and W. dyke-like mass. Within the curve formed here by the basal boundary of the Old Red, the hard bluish gray coarsely grained sandstones, gray grits, and shales of the Silurian, are seen along an old road, and the distance from them to the limestone at the Pike seems too small to include the thickness of the Old Red sandstone as seen in this neighbourhood. For if we supposed it to be present and dipping at an angle of 45°, there would only be room for a thickness of 350 feet of it between the points where the Lower Silurian and the Carboniferous limestone rocks are seen; and even if vertical there is only room for 650 feet, while the probable thickness immediately to the S.E., upon the opposite side of the anticlinal, is at least 800 feet, when calculated at so low an angle as 10°. The limestone at the Pike, too, being magnesian, like that close to the fault, which is proved to exist at the wood near Loughkeen Glebe, to the northward, and the high northern slope of the hill there being continued on close to the Pike, it becomes most likely that the fault is also continued to this place as shown upon the map; and the more so from the fact, that the

* From the frequent occurrences, in this neighbourhood, of slabs of dark cherty limestone lying scattered about in the flats or moory places, this variety is known by the name of "moor stone," the word "moor" being always used for peaty ground.

dark limestones in the country to the westward, dip towards the hill instead of away from it, as they might be expected to do if there were no fault.

In the fox-cover, above the Pike, the conglomeritic, shaly, and gritty beds of the Silurian appear at the surface of the ground, the conglomeritic beds containing a few fragments of fossils. Further northwards, below and around the summit of the hill, conglomeritic, flaggy, and shaly beds again occur, and the summit itself is capped by full fifty feet of massive, slightly inclined beds of coarse greenish gray conglomerate, containing pebbles of gray quartzite, flinty hornstone, white quartz, red jasper, green flinty rock, and pieces of various sorts of trap and altered rock, as well as many pieces of hard purplish grit. A nodule of limestone was also observed* in the conglomerate here, containing Murchisonia and other fossils, and in the spaces between the pebbles, corals, shells, and crinoidal fragments have been found.

These strong conglomerate beds extend from the summit of the hill northwards, along a road which runs in that direction a little to the eastward of its crest. Upon each side of the conglomerate, both in the demesne of Fairymount House and below the summit (701), between it and the cross road to the N., leading to Fairymount gate, graptolites were found in the flaggy shales occurring at these places.

Where the three roads meet at the gate lodge of Fairymount, the conglomerate is seen to be interstratified with thin shaly beds, and it appears to have been shifted by one or more small cross faults. From one of these dark greenish gray shaly layers, close to the conglomerate, in the roadway here, a fine set of Lower Silurian fossils was collected. This set included thirty-six species, of which the following list has been drawn up by Mr. W. H. Baily :—

	Number of Specimens Collected.
CŒLENTERATA.	
ACTINOZOA.	
Petraia elongata (subduplicata, *M'Coy*),	4
Stenopora fibrosa,	2
MOLLUSCA.	
POLYZOA.	
Graptolithus priodon,	20
,, Nilssoni,	6
Ptilodictya lanceolata,	3
BRACHIOPODA.	
Orthis elegantula,	8
,, testudinaria,	4
,, calligramma,	2
Leptæna sericea,	5
Strophomena depressa,	3
,, alternata,	3
Spirifera trapezoidalis,	2
Atrypa crassa?	1
Discina ? sp.,	2
CONCHIFERA.	
Ctenodonta obliqua,	3
Pterinæa tenuistriata,	1
Ambonychia Triton?	1
Modiolopsis modiolaris,	1
,, nerei,	1
,, expansa,	1
Orthonota nasuta,	1

* By Mr. Crawford, County Surveyor, North Riding, Tipperary, and myself, in 1859.—A.B.W.

GASTEROPODA.

	Number of Specimens Collected.
Cyclonema sp.	2
Holopella sp.	3
Trochonema sp.	2
Bellerophon bilobatus,	3

PTEROPODA.

Ecculiomphalus (?),	1
Theca,	1

CEPHALOPODA.

Orthoceras filosum,	1
,, angulatum,	1
,, sp.,	1

ANNULOSA.

ECHINODERMATA.

Crinoid stems and joints,	10

CRUSTACEA.

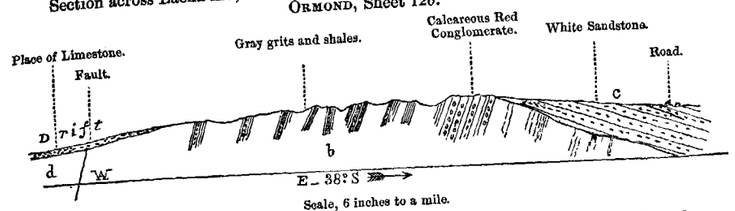
Calymene Blumenbachii,	16
Phacops caudatus,	1
Encrinurus punctatus,	9
Acidaspis? sp.,	1
Proetus latifrons,	3
Trinucleus concentricus,	2

A few yards to the N.E. of where these fossils were found, some more graptolites occur in flaggy beds, in a quarry on the E. side of the road; and further to the N., where the same road turns down to Wingfield, the conglomerates and shaly beds are crossed by a small fault at the gate of an old by-road leading towards Loughkeen Glebe. Along this road, and to the northwards, the same sort of conglomerates, shales, and grits, belonging to the Silurian, are very frequently seen, dipping at high angles to the N.W. and S.E.; the prevailing dips being, however, in the former of these directions. From some houses near the place where the lane or by-road above mentioned turns sharply towards the S. of E., nearly vertical red calcareous and conglomeritic Silurian rocks extend along the boundary of the Old Red sandstone, to the place where it is crossed by a road running obliquely over the hill towards Wingfield House; these red beds are very remarkable, they strike towards the boundary of the sandstone close by, making a very acute angle with it, and they seem to consist of the same group of conglomerates continuing from the southward; being here, however, fully 250 feet in thickness, and also much more calcareous and altered in colour by the same agency which, in such a number of instances in the mountains to the E. and S., has apparently changed the gray Silurians to a red colour where they are found in contact with the Old Red sandstone. This sandstone crops to the surface in many places both to the N. and S. of this locality, it is composed chiefly of white sandstone, and in one spot, to the N.E., where a dip arrow occurs near the end of the word Ashgrove, some of the overlying basal beds of the Lower Limestone shale, consisting of dark fossiliferous limestones, appear in the brook which forms the county boundary. Further north, some more calcareous beds occur; close to the same boundary, and the Old Red sandstone appears to the W. in a boggy flat, and in the woods near Ashgrove; while the gray Silurian beds forming Lacka Hill are seen along its crest and beside the road from the Glebe House to Ballincor. In the wood S.S.W. of the Glebe House, gray and magnesian limestones are seen abundantly; and close to these, at a few yards distance to the E., the Silurian grits and shales project at the

surface of some broken ground near a spring, a small depression occurring between the two formations, through which the fault, which must exist here, is supposed to run.

FIG. 3.

Section across Lacka hill, N. end of Knockshigowna, through last letter of the name ORMOND, Sheet 126.

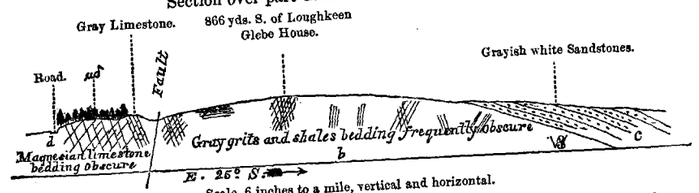


Scale, 6 inches to a mile.

Besides the crags of pale gray and magnesian limestone in the wood and in the road near it, some more limestone of a more solid kind occurs in quarries nearer to the Glebe; and in these, as well as in one place outside the wood, on its east margin, the beds were observed to dip towards the Silurian at different angles, as marked upon the map; and this circumstance, together with the narrowness of the space left for the Old Red to occupy—there being little more than room for 100 feet of it, while it is fully six or seven times this thickness immediately to the S.E.—the fault here may be considered proved, and the arrangement of the rocks is seen to be like that in the annexed section.

FIG. 4.

Section over part of Lacka Hill, to show fault.



Scale, 6 inches to a mile, vertical and horizontal.

Having thus seen reason to believe in the existence of this fault from what has been just now stated, and the foregoing remarks, page 27, it becomes necessary to say something further about it.

Supposing no fault to exist, we can infer from an inspection of the map that a more or less regular anticline would have existed here, in the Upper Palæozoic rocks, its axis being bulged upwards at this place, so as to bring their lowest beds into the form of an arch along any vertical section; such an arch being very much longer in the direction of the length of the hill than across its axis. If the fracture occurred either at or after the elevation of the anticline, its course lying obliquely along the major axis of the contortion, and the beds to the W. being depressed, or those to the E. elevated, we should find—when the denudation had worn the rocks so as to bring their central portion into view, with the overlying beds wrapping round outside each other in regular courses—precisely the same state of things as occurs at Knockshigowna, the regularity of these courses being interrupted by the fault against which they terminate.

The amount of the shift caused by this fault is not exactly determinable, but still we can form some ideas about it, one of which is probably nearly true.

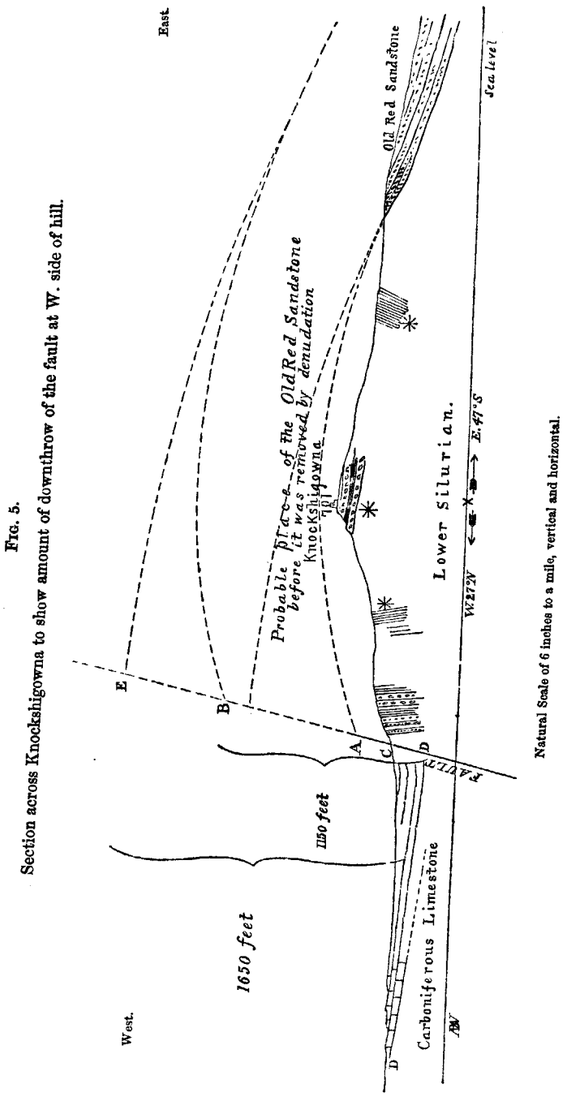


FIG. 5.
Section across Knockshigowna to show amount of downthrow of the fault at W. side of hill.

It is plain that the amount of the displacement must be equal to the distance from the first bed of the Old Red, at an unknown depth below the limestone on the W. side of the fault, to the place at which it parted from the sandstone on the E. of the side fracture. The latter place has been completely removed by the denudation; but, by restoring the anticlinal, as shown in fig. 5, and assuming that it inclined equally on both sides of its axis, we get the point A, where the fault intersected the base of the Old Red. Adding over this, say 700 feet of Old Red sandstone, we get the point B; to this, add the height of the Silurian from the present level of the ground C to A, say 200 feet, and the thickness of limestone from C to D. We thus have the amount of the throw equal to the thickness from B to D + the unknown depth below D at which the first bed of Old Red sandstone occurs.

The vertical height from B to D is equal to 1,150 feet, so that the fault is of that amount at all events; and if the sandstone on the E. ran on straight upwards, from where it now lies, to the point of intersection with the fault, as it might perhaps do if this side were elevated *en masse* from the level of the beds to the west, the throw would be as much greater as the difference between B and E, making the whole, perhaps, equal to 1,650 feet.

The thickness between B and D is measured vertically, and of course would depend in some degree upon the angle at which the fault sloped to the W. As no natural or artificial section, however, occurs on the ground, the hade of the fault cannot be determined.

Where a dip of 3° to the N. of W. is marked in the Silurian above the wood containing the limestone, at so short a distance from these rocks, glacial striæ were observed upon the surface of a bed of gray grit, bearing in the direction of about 5° or 8° N. of E.

The country in the neighbourhood of the N. end of the Knockshigowna ridge is occupied by the boggy flats of the Little Brosna in which occur isolated rocky patches. Of these it is very difficult sometimes to say with certainty whether the rugged pieces of gray limestone which protrude, are certainly *in situ* or not, but from their quantity and similarity of kind they often appear to be so. Beyond these flats the ground rises to the N. and is covered by a quantity of drift, crossed by an esker ridge (which will be found marked upon the map), and its depressions are occupied by bogs; while, on the summits, the drift seems to have no great depth, and the gray limestone comes to the surface at Carrig and Rockville, as well as in a lane which passes between the two last letters of the parish name LOUGHKEEN, and some more gray limestone, occurring on the upland N. of the first part of this name, may possibly be *in situ*.

To the W. of Knockshigowna hill, near Ballymona, and N. of this place, as well as further N., between Oak Park and Ivy Hall, gray and dark gray limestone comes to the surface of the ground, or is exposed by quarries, its dip, wherever seen, being towards the hill at low angles. In the neighbourhood of Ballingarry, along the road to the N., near a small square plantation at the race-course of Lismacrory, as well as on the high ground near Lisbryan, on the W., and at a point marked 317, to the E., more gray and dark gray limestone occurs in places where the drift is thin or locally absent. Between Ballingarry and Sopwell Hall a considerable space is left without the stippling to represent the drift; for within this the gray limestone frequently appears, and strong dark coloured beds of the same rock occur in the demesne of the latter place.

The limestones which form the hills of Knocknacree, at the S.E. side of Scohaboy Bog, are of different kinds. On the road to the E. of Laghile Wood, fossiliferous gray limestones occur, while further E. a band of dark cherty and very shaly limestone—not at all unlike some Lower Limestone shales—crosses a by-road from the above-named wood to Behamore, with a general dip towards the S. of W. Higher up on the hills to the S., and in as well

as beyond Knocknacree Wood, the paler limestone predominates, and similar kinds occur in isolated localities at Behamore Bridge, and upon both sides of the chain of bogs which extends to the southward along the boundary between the two counties. These localities will be distinguished by the small patches left without the stippling to represent the drift.

The town of Cloghjordan is built upon gray limestone, which is also seen in several places between this and Modreeny, on the hill above Deerpark House, and in the wood near Knockanacree-Wood House, as well as close by the latter, and on the S. side of the road near it.

To the S.E. of the Glebe House, near Willow Lodge, the drift and large bogs occupy a great extent of country in the parish of Templeharry.

Country on the W. side of Sheet 126.—The Ballygibbon hills, in the S.W. corner of Sheet 126, are covered by fields, woods, gorse, and scrub; and the drift, although perhaps but thin, extends a considerable distance up their flanks. Scrub and naked rock only are seen at the summits, but the low country, from Coolnamunna S. to Glenahilty, is covered by undulating drift, with some esker ridges and mounds of gravel; the latter occurring in greatest quantity, and with small boggy patches interspersed, between Bantis House and the large bog W .of Emmel Castle. The limestone is generally of the pale and compact kind, but some dark cherty and shaly beds contrast strongly with the more splintery gray limestone at one place on the west side of Scraggaun.

A narrow deep ravine, over a quarter of a mile in length, has been excavated along the N. and S. joints of the limestone, midway between Tenessee House and Corrowle cross-roads (in character much resembling that to the E. of Insula Vitæ, at the N. side of this map, S. of the first letter in the name Ballybrit), and much of the limestone in this neighbourhood is magnesian.

To the westward of these hills the country is covered to some extent by drift and bogs, the gray limestone being seen, however, here and there, and appearing most frequently in the space between Hilton, Modreeny, and Fortwilliam Houses. In the neighbourhood of Merton Hall and Kylebeg House, the drift again occupies a considerable space; but at Ballynavin Castle, pale gray limestone comes to the surface, and further to the N., in the space between Scohaboy Bog and the margin of the map, dark gray and black limestone is frequently seen, most of the places where it occurs being indicated by the symbols upon the map. Black and dark gray limestone occurs also along the road from Borrisokane to Ballingarry, where the dips in it are marked, and near the bog E. of Castle Sheppard some paler beds occur. All these rocks seem to undulate a great deal, but have apparently a slight general dip towards the S.E.

North of the beginning of the name Ormond, and about High street, a large space of ground is occupied by little else than bare gray limestone rocks, the inclinations of which will be found marked on the map. The ground exposing these rocks has no greater elevations than 240 feet to the northwards, and 254 feet to the southwards of High-street, both elevations being far less high than many of those occupied by the drift in other parts of the district, many of these being much over 350 feet, and thus showing the irregularity of its deposition or arrangement with regard to altitude.

A large bog occupies much of the N.W. corner of Sheet 126, and the promontories which stretch into it, as well as the hills around, are much covered by drift; but the limestone is seen close to the edge of the bog, S. of Firville, and W. of Kilcarren House. Some gray and black limestone occurs also at the W. margin of the district, along the road from Firville to Borrisokane, between the points of latitude marked 53° 1′ and 53° 2′.

Part of Sheet 125, *E. of the Shannon.*—The north-eastern part of Sheet 125 consists of low undulating rocky country, with but little drift, and of several bogs. It would be next to impossible to enumerate all the places

where the rocks are seen, or even those consisting of different shades of black and gray limestone, so frequently do these occur.

At Ballyquirk Castle some blackish limestone was worked for marble, but gray beds appear not far away to the N.E.; and in the opposite direction at Carrigahorig some pale gray limestone is full of fossils; a ridge consisting chiefly of this limestone, with some magnesian portions, runs from Carrigahorig nearly to Terryglass, having for a considerable distance a low cliff escarpment along the bog to the W. of Firmount, as if this had once been the shore of the Shannon; but if so, the ground must have changed its level twice since, at all events, for the bog to the N.W. runs down to the very shore of Lough Derg, without any ridge occurring to form its basin on that side, and the mosses of which it is composed could not have grown beneath the waters which wore the rocks so as to form this cliff. The probability, therefore, is, that at one time water occupying the basin of Lough Derg came up to this cliff, that subsequently, owing to changes in the level of the land, it receded, and the bog was formed in a shallow pool, and afterwards, that by another change of level, the bog was partly submerged. Between this and Borrisokane dark and pale gray limestones are seen in so many places that it would be, generally speaking, difficult to walk for a mile in any direction through the country without coming upon rock *in situ*. The beds are sometimes magnesian, as at Springpark, or dark and cherty as at Milford and near it; but they are much more generally of the paler gray kinds, seen to the W. and S. of Milford, to the east of Monavoggaun Bog, and in the neighbourhood of Kylepark and Arranhill Houses, and that of Borriswood.

Along the shore of the Shannon and Lough Derg, from Derrymackeagan at the N. side of 125, by Bawnacullagh Point, Slevoir* Port, Gortmore Point, and thence southward past Bellvue and Blackquarry Points to Goose Island, there seems to extend a belt of black or dark gray limestone, sometimes, as at Bawnacullagh Point, being cherty, and containing large branch corals. At the shores of the bays between these points paler gray limestone, which apparently overlies them, is sometimes seen; and these paler kinds, with some interstratified bands of mottled red marble and dark cherty limestone, appear to form the whole of the Knockbarron hills, and their extension northwards by Drominagh Wood and Terryglass. On the shore of Cornalack, N.W. of Drominagh Wood, a closely-grained bluish gray limestone occurs in one or two spots at the edge of the water. It is very solid, rings when struck with a hammer, and from this is called Bell stone. It is said to be valuable for cut stone work, and is reported to occur again at the Galway side of the lake, near Church Island.

The dark-coloured limestones of Gortmore Point, near this, which are, perhaps, brought against the paler limestone of Gortnalack by a fault, have been extensively used in building the locks on the Grand Canal, and the Martello Towers along the Shannon.

The stratification of the pale gray limestone, which forms the Kilbarron rocky hills, is frequently obscure, but it is also often marked by the cherty bands which are seen in several places, showing that, although the rocks are all much contorted, they have a slight general inclination to the eastward. As usual, where the limestone is pale gray and compact, it is traversed by N. and S. joint planes, and has generally a rough and broken appearance in consequence of the numerous intersections of these and other joints. The difference between such limestones, and the stronger cherty bands is strongly marked when they occur near each other.

These Kilbarron hills are very irregular both as to height and position, some of their highest summits of 470 feet and upwards, being but little more elevated than the undulating country about Barna, in Sheet 126. They fre-

* Said to be misspelled for "Slievyre," which it is always called.

quently present an approximation to the typical form of limestone hills, having cliffs or steep declivities upon one side, and long even slopes upon the other; and the steeper declivities are not constant upon one side of the irregular chain, which they form, but are frequently presented to the eastward and north-west. Near Ballinagross Lough and Nanny Moran's Rock, and to the southward of this place, there are steep cliffs, and generally greatly broken ground, while to the northward the ground rises towards the N. and W., presenting steep declivities in those directions. The cliff close to the S. of Scarragh marshy pool, rises probably 80 or 100 feet above it, presenting a fine example of the strong contrast between the cherty and pale jointed kinds of limestone, and the beds seem to be slightly shifted by small faults. At Nanny Moran's Rock, a small promontory, which juts out into the marshy flat here, the same nearly horizontal cherty limestones which form the base of the cliff to the S.W. are seen to support a small patch of the paler gray kind; and just beneath it, the cherty beds contain a layer of greenish and red variegated marble. To the eastward of this the pale gray limestone, with some cherty bands, occurs again; and to the S.W., the hill upon which Clashlanateigeboght old castle stands exposes the same cherty and pale gray beds in many places, and in some the latter are magnesian. Near Coolbaun cross roads, to the S.W. of this place, the same rocks are frequently seen; and just at the Police Barrack, near this, some beds of red marble dip to the N. at 52°. In the strike of these to the N. of the cross-roads a few feet of similar variegated red beds occur; and a little way to the N. of Mungopark House they seem to come out from the other side of the hill. To the N.E. of this they occur again on both sides of the road, which runs from Scarragh Lough up the hill to the W. As their connexion cannot be traced from each of these places to the other, it cannot be said that they are all continuations of the same few beds, some five or ten feet thick at the most, but they are in all these localities very similar; and it is not improbable that they are all upon the same horizon.

The country to the N. and S. of this neighbourhood, and indeed also to the E. and W., is very rocky, and the limestone is seen in a great number and variety of places. Pale gray compact limestone, with cherty beds, occurs in the vicinity of Newchapel, and to the E.; while a cherty band seems to stretch from Oldcourt House southwards by Castlecarrig and Springmount, becoming wider as it approaches Prior Park and Prospect. All the country round the Commons of Carney is rocky, the usual varieties of dark gray limestone occurring in a number of places; and it is stated that the beds between these Commons and Garrynacurry House afford a subterranean passage to the water which falls upon the Commons, or flows into them, thus forming the fine springs at the edge of the marsh near Springmount. Wherever the water comes from the springs are there, and the Commons of Carney are drained; but they seem once to have formed the basin of a lake or marshy flat, for their level surface is composed to a considerable depth of white shell marl, which is carted off to be used as manure. A small bog called the Mung, is situated at less than a mile to the N.E. of the Commons of Carney, in the neighbourhood of Finnoe and Rodeen Houses. Some of the peat in this little bog is peculiar, having, when wet, a dark chocolate colour, and soft spongy or gelatinous* appearance, but drying into flakes or chips, which have greatly the look of lignite, not entirely transformed into coal.†

On the uplands all round this bog the dark gray limestones are seen; and the same variety of this rock occurs along the roads from this place to Bell-

* The occurrence of "jelly peat," which, when wet, seems to have a similarity to this, is mentioned by Mr. E. W. Binney, F.G.S., in the Transactions of the Manchester Geological Society, No. 3, pages 19, 20, and 21, Session 1860-61.

† I am informed by Mr. Waller, of Prior Park, that numbers of large oak trees were taken out of this bog.—A. B. W.

grove and to the town of Borrisokane. That place built upon such limestone, which is also seen in many neighbouring localities; and is in the road or street leading to the rectory, it bears evidence of glacial smoothing and striation, the striæ running in a direction N. of W. and S. of E. From Borrisokane southwards towards Bellpark, Bellgrove, and Mount Falcon, the drift appears to be thin, and the dark gray limestones frequently appear; being seen near Bushypark; and also not far from any of the above-mentioned places; but at Ballinderry (Park) House the drift seems to attain a considerable depth upon the hill there, while in the low-ground to the S.S.W., called the Forty Acres, and also near Congor Church, the black or dark gray limestone may be seen, containing in the former place the same kind of corals as were noticed at Bawncullagh Point, W. of Carrigahorig.

Black and gray limestone occurs also about Willsborough and Whitestone House, but the country lying immediately to the S.E. of this, and about Ardcrony, is covered by drift, and crossed by three "esker" or gravel ridges of twenty-five feet or more in height, the longest reaching from near Ardcrony old Church north-westwards by Mackey's hill, turning at the flat beyond that to the S. of W., and extending to beyond Prior Park. Large boulders of cherty limestone are scattered over the country to the S. and S.W. of this long esker; and a remarkable one, of a quadrangular shape, nearly eight yards long, five to six wide, and six feet high, lies flat on the surface of the ground, close to the stream which crosses the road between Ardcrony and Ashley Park. Doonhill, further up the course of this stream, is a great mound of drift, and a smaller one occurs in the flat to the S.E.

Gray limestones are seen near Beechwood, and on some high-ground to the W.S.W., and also further on in this direction, across the Nenagh road. Near Lough Ourna pale gray limestones are again seen in the road, and on the N. side of the lake, near Ashleypark House; and in the Foxcover, near this, some pieces of limestone occur which cannot be stated to be *in situ*, but may probably be similar to many large blocks in the neighbourhood of Prior Park to the N.W., which, although large and in great numbers, and often apparently *in situ*, it was found possible to bury and cover up, turning them into a hole dug beside them. Some of the cherty and dark gray beds are seen in quarries in the neighbourhood of Prospect, and near the cross-roads N. of the name Ballythomas.

Frequent exposures of dark cherty limestone are seen N. and N.E. of Claree Lough, and the white marl which occurs in the flat S. of this lake is sometimes interstratified with peat.

Not far from the N. end of this lake some pale gray limestone occurs where the word Castle is marked S.W. of Ballycolliton House; and here, too, a portion of it, worn somewhat like a saddle by the action of the weather, is called Colliton's stone.*

The hills to the N. and N.W. of this, near Annagh Castle and Annagh Lodge, and to the W. of that place, expose cherty and pale limestone. The latter elevation, N. of Cameron Island, commands a fine view of the lake to the S., and the mountains beyond.

Upon Urragh hill to the S., and towards Clonnanoul, N. of St. David's, a good deal of gray limestone is seen; and more of this occurs near Urragh Castle, and on the opposite side of a steep valley there, as well as in many places in the neighbourhood of Peterfield or Johnstown, and thence towards Claree Lough and Ballycolliton. In the wood at the N.E. side of Poulawee

* The legend referring to this stone states that a man named Colliton, when riding along an old road which once passed by that place, was overtaken by the night here; he died, and his saddle was afterwards found petrified, and is now called Colliton's stone.

Lough some mottled red marble, the same as that in the Kilbarron hills, to the N., has been quarried.

South and E. of this, in the vicinity of Puckaun, the rocks frequently appear at the surface of the ground, consisting generally of pale or gray limestone; and in the demesne of Lodge some decomposed limestone, containing a mass of crystalline carbonate of lime, occurs.

The hill upon which a turret is built in the demesne of Blackfort or Lissduff exposes the rocks along a steep breast to the W., and also on its north side; they consist of gray limestone, and the same will be found upon Knigh hill, over Knighwood, and at Caherbewly, as well as at Knigh cross-roads.

Pale gray limestone is seen at Dromineer Castle, and on the hill to the southward, W. of Annaghbeg House; and at intervals all round the shore of the Monsea promontory, black flaggy and fossiliferous limestones, very similar to those at Blackquarry Point and to the northward, may be seen.

A. B. W.

Note.—The fossils mentioned at pp. 9 and 20, as occurring in the Lower Limestone Shale, to the north of Roscrea, will be described by Mr. Baily in the explanation of Sheet 127.

In the Palæontological notes in the explanation to Sheet 133, the heading "Sheet 143," at the top of p. 18, ought to be "Sheet 135, continued," including all the localities 24 to 51.

The only localities on Sheet 143 from which fossils were examined are 52 to 55 inclusive.

In the same notes, for "*Graptolithus?* hamatus" read "*Didymograpsus* hamatus," at p. 14, line 16, and p. 19, line 26.

J. B. J.

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DUBLIN: Printed by ALEXANDER THOM, 87 & 88, Abbey-street,
For Her Majesty's Stationery Office.