Memoirs of the Geological Survey.

EXPLANATION

TO ACCOMPANY

SHEET 124 AND THAT PART OF SHEET 125 THAT LIES ON THE WEST OF LOUGH DERG,

OF THE MAPS OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF THE

COUNTIES OF GALWAY AND CLARE,

By G. H. KINAHAN.

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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.

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The district included in Sheet 124 and the western part of Sheet 125 was surveyed entirely by Mr. G. H. Kinahan, by whom also the following description of it has been drawn up.

A sheet of longitudinal sections is also being prepared by Mr. Kinahan, which will show sections of the rocks along the following lines :—

No. 1. From Scarriff to Turkenagh.
No. 2. From the Scarriff Valley to Derrybrien.
No. 3. From Ayle to Killanena.
No. 4. From Lough Inchaquin to Slieve Aughta.

J. Beete Jukes.

List of Woodcuts in this Explanation.

EXPLANATION

TO ACCOMPANY

SHEET 124 AND THAT PART OF SHEET 125 THAT LIES ON THE WEST OF LOUGH DERG,

OF THE MAPS OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PARTS OF THE

COUNTIES OF GALWAY AND CLARE.

General Description.

The district to be described comprises the north-east corner of the county Clare and the most southern part of the county Galway. In the former lie the villages of Scariff, Feakle, and Crusheen, while in the latter are the small town of Gort, and the villages of Woodford, Mount Shannon, and Whitegate.

On the S.E. the district is bounded by the River Shannon, which here expands to form Lough Derg.

"The spacious *Shenan* spreading like a sea."—Spencer.

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1. *Form of the Ground.*

There are three well marked features in this district :—First, the high mountainous ground towards its centre, that includes all but the northern extremity of that group of hills called *Slieve Aughta ;** second, the low ground that bounds Slieve Aughta on the east, south, and west; and third, the high ground at the N.W. of the district, which is part of the eastern margin of the rugged table-land in the barony of Burren, in the north of Clare.

Slieve Aughta rises on all sides from the plain, with long gradual undulating slopes, to peaks of 900 or 1,000 feet, a few being higher; those of Liss on the west of Lough Graney, Ardeven on the north of

* Also called Slieve Boughta by some of the people in its neigbourhood and on old maps.

Mount Shannon, and Cappaghbaun on the north of Scariff, reaching the respective heights of 1,312, 1,243, and 1,126 feet.*

Nearly in the centre of Slieve Aughta is a large north and south valley, that is partly occupied by Lough Graney. This valley on the south of the lough, changes its direction towards the S.E., and runs into the Scariff Valley. There are three other valleys, lying east and west, two of which cross the Lough Graney Valley, and there are also a few small lateral valleys extending northward from the Scariff Valley, the most marked being that which is occupied by the Bow River. All these usually have steep sides, compared with the outside slopes of the mountain group.†

On the east of Slieve Aughta there is a narrow tract of low country between it and Lough Derg; on the south is the Scariff Valley, opening into Lough Derg between Slieve Aughta and Slieve Bernagh, and on the west is a large tract of low ground between Slieve Aughta and the Burren district. This low country rarely exceeds 200 feet in altitude, its average height being probably less then 100 feet, and it is largely occupied by lakes and bogs. The Burren Mountains rise suddenly from this low country, ascending from a height of 100 to 750 feet in about a mile, and attaining in some points an altitude of 1,000 feet and upwards still farther west. (*See fig.* 2.)

The water-shed between the basin of the Shannon and the small streams that run into Galway Bay, enters the district near the N.W. corner of Sheet 125, at the trigonometrical point 506, from which it goes south to that of 663, and then nearly due west along the boundary between Galway and Clare to the point 589, where it turns northwards to a morass or *mire*, after which it runs to the S.W., leaving Lough Acres on the N.W. and Lannaght on the south, through the trigonometrical point of 448 to that of 408. From here it goes towards the south till it has passed Lough Namugga, when it takes a westing to the point 228, from whence it runs north for over two miles and turns round Lanty Shaughnessy Lough to the point 181. From thence towards the west its exact position is undeterminable, as the N.W. portion of the district is burrowed by subterranean rivers, which may run either north or south.

The largest tributary from this district to the Shannon is the Graney, which joins the Scariff River, and flows into Lough Derg at the west end of Scariff Bay.

Towards the S.W. run the head waters of the Owenagarney and the Moyree River, the latter being, though partly subterranean, a tributary of the Fergus. These empty themselves into the estuary of the Shannon.

Lough Cooter receives the drainage of the north-western shoulder

* From Ardeven on a clear day parts of the following counties can be recognised viz., Roscommon, Westmeath, King's, Queen's, Wicklow, Kilkenny, Tipperary, Limerick, Waterford, Cork, Kerry, Clare, Galway, and Mayo.

† In several of these Explanations I have observed that different officers of the survey have noted that the steepness of the slopes of the valleys within the hills is greater than that of the outside slopes of the hills themselves. I did not at first attach much importance to these observations, but since I have been led to speculate on the origin of the valleys of Ireland, I believe that the reason of this difference is due to the fact that the main outline of the external slopes of the mountain groups is the result of marine denudation, while the interior valleys have been excavated by river action only.—J. B. J.

of the part of the Slieve Aughta within the district, and has itself no open outlet to the sea.* The Beagh River leaves the south end of Lough Cooter, and flows for about two miles towards the west, when it disappears in a cavern. From this its course can be traced for about six furlongs by *swallow holes*, called the *Devil's Punch Bowl*, the *Blackweir*, the *Ladle*, and the *Churn* † to *Pollduagh*, a cave out of which it rushes again to daylight. From this, under the names of

Fig. No. 1.

Pollduagh.

the Cunnahowna and Gort River, it runs by Gort in a northerly direction, into the district on the north for about three miles, when it sinks a second time. It again appears for a short distance in Coole demesne, to the west of Kiltartan, and eventually flows into Coole Lough.

In many places in the low country between Slieve Aughta and the Burren, a stream rises out of the ground or flows from a cave, and in a short space disappears again. These generally, during the rainy season, cause floods or small lakes, which are locally called *Turloughs*. Some of the Turloughs are affected by the rise and fall of the tide, as will be hereafter explained.

* At the village of Kinvarra, on Galway Bay (*Sheet* 115), there is a jet of fresh water rising out of the joints of the rock immediately west of the old castle, which is probably the principal subterranean outlet. It will be described more fully in the explanation of Sheet 115.

† Called the Churn, from the noise like a person churning which is heard in it during floods.

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

Aqueous Rocks.

	Name.	Colour on Map.
	Alluvium and Bog.	*Pale Sepia.*
	Drift.	*Engraved dots.*
Carboniferous.	d^4. Upper Limestone.	*Prussian blue (dark).*
	d^3. Lower Limestone.	*Prussian blue (light).*
	d^1. Lower Limestone Shale.	*Prussian blue and Indian ink.*
	md. When any of the above Limestone are magnesian from original deposition.	*Olive green.*
	$\mu\delta$. When magnesian from subsequent dolomitization.	*Olive green with blue dots.*
Old Red Sandstone.	c^3. Upper Old Red Sandstone.	*Indian red (dark.)*
	When Cornstones, Siliceous Limestone, or Calcareous Sandstone, occurs they are coloured	*Blue.*
Lower Silurian.	b. Grits, Shales, and Slates.	*Pale purple.*

Igneous Rocks.

F.	Felstone.	*Scarlet.*
FP.	Felstone Porphyry.	
FAm.	Amygdaloid.	
Fs.	Felstone Ash.	*Light scarlet with dots.*
D.	Greenstone (Diorite).	*Dark crimson.*
Ds.	Greenstone Ash.	*Light crimson with dots.*

b. The *Silurian Rocks* chiefly consist of green, gray, and blue gritstones, shales, and a few sandstones and slates, with some purple and red beds. Most of the grits and sandstones are calcareous in a greater or less degree, especially the latter. In some places there are massive coarse green sandstones. Although an imperfect cleavage pervades all the rocks, it is seldom well developed, and therefore slates are rare.

Among the Silurians lie the igneous rocks above mentioned; their description will be found in detail in the fourth part.

c^3. *Upper Old Red Sandstone.*—Here, as in the adjoining country, the Old Red sandstone seems to belong to the upper part of the formation only. The bottom bed in this district is usually either a soft coarse red sandstone or a breccia, that is always very ferruginous, sometimes calcareous, and often a *cornstone* or siliceous limestone. In some places over the basal bed there are red flaggy rocks, on which

rests a quartzose conglomerate; in these cases the conglomerate is from fifteen to fifty feet above the base of the formation, but often, especially towards the north of the district, these below it are wanting; and the conglomerate rests on, or is itself, the basal bed.

The rest of the formation consists of yellow and reddish sandstone, gritstones, clayrocks, shales, flagstones, conglomerates, and a few *cornstones*. The sandstones usually predominate, but in some places there is a preponderance of clayrocks and shales, especially near the top of the group. Peculiar red, purple, and green beds were remarked in places, but they are not general. Conglomerates occur more in the north than in the rest of the district.

The basal *cornstone* (siliceous limestone) is very peculiar. It looks as if the calcareous matter had been precipitated on the uneven Old Red sea bottom, levelling it, cementing together the Silurian debris, and filling up the cracks and fissures in the Silurian rocks. The top of the bed is always parallel with the overlying Old Red beds, while the bottom is nearly imperceptible, on account of the nature of the deposit, as the Silurian and cornstone blend into one another. It resembles concrete or cement poured on an uneven surface to form a level floor for a foundation. From this circumstance it must necessarily be of unequal thickness, ranging from a few inches to six or seven feet; it is also variable in its composition, sometimes being a good siliceous limestone, at others a calcareous sandstone, but generally a breccia; large and small angular fragments of the underlying Silurian rocks being cemented together by a gray, blue, or purple limestone. One peculiar form it takes is when it fills the open edges of the Silurian, and lavers of the debris of that rock have the appearance of alternating with the limestone; in this case, when the fissures are far apart, on first sight, the limestone would seem to be of Silurian age, but on examination it is evident that it is part of the basal cornstone. This will be mentioned more fully in the *Detailed Description*. The cornstones, in other parts of this formation, are generally of a purple or gray colour, small particles of sand being cemented together by a calcareous paste, others of them have nodules of limestone in an arenaceous or argillaceous rock, while others contain angular fragments of slate, similar to the general cornstones of the west of Kerry. (*See Explanation of Sheets* 182, *&c.*)

Between the beds of sandstone are green shale partings, that are generally micaceous, often to such an extent that a hand specimen has all the appearance of mica chist. They range from a mere parting to eight or nine inches in thickness, but generally do not exceed three. Some of the sandstones are calcareous to a slight extent, and weather into a dark rusty brown friable stone; this always occurs in patches and lenticular masses.

This group is calculated to be from 800 to 1,100 feet thick at the south of this district, but towards the north it would seem to be variable, as the underlying Silurians are known to protrude into it in hills and peaks farther north, in that part of Slieve Aughta that lies within the limits of Sheet 115. It would also appear probable from so many conglomerate beds occurring in it, some high up near the base of the Lower Limestone shale, and all these are likely to have been formed in the vicinity of some coast line or islands.

In the Old Red rocks fossils have been found in a few localities:—

Coos, North (Galway, $\frac{131}{4}$). Plant stems and branches, with oblique and longitudinal striæ, mostly carbonized.

Derrygoolin, and *Derroran South* (Galway, $\frac{132}{4}$). Obscure carbonized plant stems.

Derroran, East (Galway, $\frac{134}{2}$). Small Lepidodendron, Sagenaria or Sigillaria (?). Sphenopteris,* and stems and branches longitudinally striated.

Kildavin (Clare, $\frac{20}{2}$). Plants.—These are in beds only a few feet above the Silurian.

Derrybrien, South (Galway, $\frac{130}{1}$). Fragments of plants.

d. *Carboniferous Limestone.*—It is possible to subdivide this group in this district into three sub-groups:—The *Lower Limestone shale*, the *Lower Limestone*, and the *Upper Limestone*.

The *Middle Limestone* or *Calp* is either entirely absent or cannot be separated from the others.

d^1. *Lower Limestone Shale.*—This sub-group consists of the transition beds between the sandstones of the *Old Red* and the limestones of the *Lower Limestone;* the lowest gray shales and flags being considered its base, and the first good thick bed of limestone its uppermost limit. The gradation through it is as follows:—First, yellow, gray, and blue sandstones, clayrocks, flagstones, and shales; next, gray and dark blue, sometimes black, shales and flagstones, with one or two yellow grits and a few thin beds of limestone, and above these dark blue shales and shaly limestones. It is about 150 feet thick.

d^2. *Lower Limestone.*—This group consists of a stratified and a seemingly unstratified portion, which are divided from each other by a cherty zone, similar to the Lower Limestone of the districts on the south. The lower or regularly stratified part is a dark blue or gray† fetid argillaceous exfoliating limestone, in beds from a few inches to three or four feet in thickness, having shale and clay partings between them; chert layers and nodules also occur. It is often very crinoidal, and sometimes magnesian, when it is of a dull dark gray colour and sandy aspect. In a few places thick beds of dark blue and black shales were observed very like those of the Lower Limestone shale. Between these stratified limestones and the Lower Limestone shale, as before remarked, there is no defined boundary.

Over the stratified portion lies the cherty zone. This consists of thin bedded limestone and shales full of layers and nodules of chert, sometimes the shales predominate, at other times the limestones, but there are always more or less shales in it, and the limestones generally are of a shaly nature. Chert, as before remarked, may occur here and there below these beds, but then it is not constant, while in these beds it is always found abundant.

* These were identified by Mr. Baily.

† The statement in this and former explanations, that the limestones are of a dark blue or gray colour, is not strictly correct, as the colour seen is due to weathering, as in any new deep cuts I have seen, they gradually, as they recede from the surface and atmospheric influence, change to a green. This remark also refers to the blue shales and limestone in the Lower Limestone shale. The present description has been allowed to stand, as it is only on rare occasions that an observer will be able to see them unweathered.

Lying on the cherty zone are gray and blue massive limestones, that are usually more or less magnesian, but seldom a true dolomite. They are very much cut up by joints and a peculiar structure that weathers out in lines like oblique lamination, which may be mistaken for bedding, but the real bedding is rarely distinguishable.

In the neighbourhood of Gort, above the cherty zone, the gray and blue massive unstratified limestones have thinned considerably, being not more than 100 feet thick. In the rest of the district it is about 400 or 450, the whole group being about 1,200 or 1,300 feet.

d^4. *Upper Limestone.*—Chert may occur anywhere in this sub-group, but immediately above the Lower Limestone is a thick well marked constant set of cherty beds, very similar to those that divide the stratified and unstratified portion of the Lower Limestone, except that in these there are only limestone and chert, while in those of the Lower Limestone there are also many beds of shale. These cherty beds have been taken as the base of the Upper Limestone. They range from twenty to sixty feet in thickness.

The limestones are of a dull gray or dark blue, and rarely a black colour, and occur in beds varying from a few inches in thickness to about eight feet, but generally are two or three feet. When black, it has shale or clay partings. It is much jointed; the bearing of the principal joints varying from N. 10° W. to N. 20° E.*

This limestone is often more or less magnesian, and sometimes a dolomite. When a dolomite it is of a dark brown or blackish colour, and sandy aspect. The more magnesian it is the more easily it may be recognised, as it weathers much more freely than a true limestone; and when a dolomite, the weathering is most peculiar, as it is generally in pointed blocks, that have the appearance, when looked at from a distance, of a *kill* or grave-yard. No dykes were remarked.

The chert in the Upper Limestone occurs either as layers or nodules, it generally forms partings between the beds, but is often found in lines in the centre of a bed or in detatched nodules. The layers are from one inch to nine in thickness.

This group, on the west of Slieve Aughta, is calculated to be about 1,900 feet in thickness, including that which lies to the west, outside the limits of this district.†

* My colleague, Mr. Foot, who has examined the Burren Mountains adjoining this on the west, has paid particular attention to the joints, and as they are similar to those now mentioned, I shall refer readers who are interested in them to his description. (*See Explanation of Sheet* 114, *&c.*)

† There are three well marked divisions in the limestone of this district, viz.:—First: Dark blue bedded limestone, with shale and clay partings, and layers and nodules of chert. Second: Gray and blue amorphous limestone, in which bedding is very rare, and which never contains any chert. Third: Dark blue dull gray or black bedded limestone, with frequent layers and nodules of chert, and shale beds and partings locally occurring. In the first division usually the chert only occurs in the uppermost beds, but in the third it may set in anywhere. The two first divisions form the Lower Limestone of the Government maps, and the third is the Upper Limestone. These divisions are well marked, and constant in all Clare, Limerick, and Tipperary; and my colleague, Mr. Foot, informs me that in the limestone country he has examined that they also occur.—G. H. K.

It should be remembered that the subdivisions, noted above by Mr. Kinahan, although good for the district he names, are not applicable to the Carboniferous limestone generally, nor even to many parts of the South of Ireland. Any subdivisions of that formation indeed are too arbitrary to be of more than local value.—J. B. J.

In the *Lower Limestone* fossils are more or less abundant wherever the rocks are exposed. In the unstratified portion they are most plentiful.

The *Upper Limestone* abounds in corals—some thick beds being one mass of them, as also some of the chert layers. The following corals are those that are most numerous:—

* *Lithostrotion affine.*
„ *junceum.*
„ *basaltiforme or striatum.*
Alveolites depressa.

Of the shells *Producta gigantea* and *Producta striata* are most plentiful.

Besides the above *Phanerotinus cristatus* may be mentioned, as it occurs abundantly on the west of Lough Cooter demesne.

The *Drift* of this district is very peculiar, as in all the hill country towards the east of the district the geology is obscured by a stony "Old Red" drift that sometimes is only a few feet in thickness, and seems to be caused by atmospheric agency, but often is of a considerable depth, being hundreds of feet in some of the mountain valleys. In this are found large and small angular fragments of Old Red rocks, but that it is of a similar age to the limestone drift of the counties of Clare and Limerick is proved by patches of that kind of drift occurring in some of the valleys blending into the other. In these places the limestone fragments are sufficiently numerous to be collected for burning by the farmers; pebbles and blocks of Galway granite are also common.

Towards the south and west of the district the drift occurs in esker-like ridges; those on the south bearing N. 20° E., and those towards the west N. 40° E.

Glacial striæ and rounding were remarked in the neighbourhood of Lough Graney, and were noted in the following places:—In the Pass to the S.E. of the *Knockbeha Old Red outlier*, on the east of the lough, where they bear north and south, and on the N.E. of the lough, immediately north of Cahermurphy House, where they are well marked, and run N. 29° W. To the west of Lough Graney they occur on the escarpments of the Old Red at the north of Glendree (which lies on the south of the Loughrea River), and have a bearing N. 10° E. Four miles farther north, at Drumandoora, they were observed, but there the direction of their strike is quite different as they run N. 10° E.; they also occur near Lannaght.

On the south of Skehanagh Lough, which lies about six miles S.S.W. of Gort, they were remarked on the limestone that had been uncovered in a new road cutting; their strike was N. 45° E.

In the Derrybrien Valley, which lies to the east of Gort, they were also noted in two places: a mile N.E. of Bellanamallaght, where they bear N. 80° E., and on the south of Ballinlough, where they run nearly E. and W.

The *Alluvial flats* do not require a general description, but the *bogs* in the lowlands are remarkable, as they occur in irregular lines,

* These fossils were identified by Mr. Baily.

occupying the hollows between some of the previously mentioned drift ridges. On most of the mountains there is a coating of peat which ranges from a few inches to six or seven feet thick. These often occur as shaking bogs and morasses, locally called *mires*. In some of these mountain bogs are large trees, while in others that are at a lower altitude there will be scarcely a vestige, but only a few small twigs and branches. Long wooden vessels full of lard, locally called *bog butter*, have been found on some of the hills, and oak sticks, from a foot and a-half to three feet long, stuck upright in the ground under five or six *spits* of turf.*

In the *Bogs* and *Alluvium* fossils were found as follows:—The horns of the Megaceros, in a small boggy flat a quarter of a mile west of Mount Shannon (Galway, $\frac{138}{2}$);† a skull, in a small boggy flat among the drift, half a mile north of Moneenroe House (Galway, $\frac{134}{5}$); another in the hollow south of Feakle Church (Clare, $\frac{58}{1}$), and horns in a small bog a little S.E. of the village of Glenbonniv (Clare, $\frac{19}{3}$).

The trees commonly in the bogs and flats are white and black oak, yew, sallow, and red and white deal. Cones are also found, and nuts like hazel nuts. Below the bog there is generally a thin stratum of ashes like fine charcoal, as if the woods were destroyed with fire before the bogs began to form. A large tree will be found lying close to its stump, but not joined to it, and both will be charred, seemingly as if the long grass or brushwood that grow around, when on fire, had burned the butt partially through, but had not strength to ignite the trunk, which afterwards toppled over and fell.

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3. *Relations between the Form of the Ground and its Internal Structure, with some account of the latter.*

The hills called Slieve Aughta are principally composed of Old Red sandstone and Silurian rocks, with some traps and ashes associated with the latter.

* A spit of turf in these mountains equals about ten inches. It is the depth of the slane, or tool, with which the turf is cut.

The traditions about these are, that hunters, in a successful year, used to hide the surplus of lard in these wooden bottles to supply themselves with food the next season before the deer came on the ground, and that they sometimes forgot the place or never returned. The sticks are supposed to have been used for spiking the deer, but as none of them seem to have been placed in pits I do not understand how that could have been. The Rev. John Kinahan, of Glenbonniv, showed me one of these oak sticks which was found in the Glenbonniv mountain, while cutting his turf, in the spring of 1860. It was about a foot and a-half long, and two inches and a-half in diameter, with a chisel point on the thick end. At the same time he mentioned that he had one three feet long, which was found the previous year on the same hill, but was now lost. On these hills are ancient stone huts, now nearly overgrown with bog, which may have been used by the natives while waiting for the deer to pass in the migratory seasons.

† There is a tradition in the country, that in the seventeenth century the country hereabouts was covered with wood, and that the natives drove the deer to the shore of the lough, and along it, until they were pounded in a morass here situated, when they slaughtered them. The horns found may have been of some of those thus killed, but I am inclined to think, from the description I received, that they were Megaceros' horns,

The low country and the Burren Mountains have for their subjacent rock the Carboniferous limestone and its accompanying shales.

In Slieve Aughta there is only one large north and south valley, that of Lough Graney; but the east and west valleys are very remarkable, as lines of fault have been proved to occur in each of them. (*See fig.* 3.) The valleys can be traced from the limestone country on the west across into the Graney Valley, and from that to the limestone country at Lough Derg, while the faults could only be observed to have shifted the beds in parts of them.

The series of faults seen in this district are made much clearer by the presence of such different kinds of rocks now in juxtaposition, although they were originally several hundred feet asunder. The dark blue limestone and the yellow and red Old Red rocks occurring on one side of the fault, while the gray and green Silurian rocks are found on the other. They are also remarkable for being all downthrows to the south, while all the large east and west faults in the S.W. of Ireland, south of the parallel of Killaloe,* are downthrows to the north, which would seem to point to a large system of faults all related to one another. An observer traversing these mountains would be struck by the tabular summits of all the principal hills, and also by most of the east and west valleys having gradual slopes on their south sides, while on the north they are steep and rugged. The first is caused by the hills being capped by nearly horizontal rocks of the Old Red sandstone age, and the appearance of the valleys is due to the south sides being usually Old Red rocks, and the north Silurian or traps, on account of the downthrows of the faults being to the south.

The basal beds of the Old Red, especially where they are massive conglomerates, often form well marked cliffs and terraces on the hill sides, which sometimes are continuous for miles.†

This can be well observed looking north from Scariff, where a terrace or escarpment will be seen in various places on the side of the hills and following the contour of the valleys. From the escarpment to the summit the slopes are gradual, while below they are abrupt, and would be much more so were it not for the accumulation of drift that has been piled against it.

They can also be remarked on the north side of the Corra River Valley, but where they are most conspicuous are to the S.W., W., and N.W. of Lough Graney; there they are continuous for miles, in cliffs that range from five to fifty feet in height. The bottom of the cliff is often cavernous, the basal cornstone having been worn by water and the atmosphere. In some places, after the cornstone was denuded, the overlying rocks have given way and fallen, and now lie in confusion, forming steep rocky escarpments. On the north side of the Derrybrien Valley cliffs also occur to a slight extent.

The Lough Graney Valley, except on the N. and N.W., is bounded by Silurian rocks, and, therefore, has steep sides. On its south all

* Gallowshill fault, Slievenamuck fault, &c., &c. (*See Explanations of* 133, 134, 153, 154, *&c., &c.*)

† Wherever a rill of water flows over these cliffs, those beautiful little ferns, the Hymenophyllum Tunbridgeense and unilaterale, are nearly sure to grow in great abundance.

the hills are rugged except one called Monounta, on which there is an outlier of Old Red. On the S.W. there are numerous small Old Red

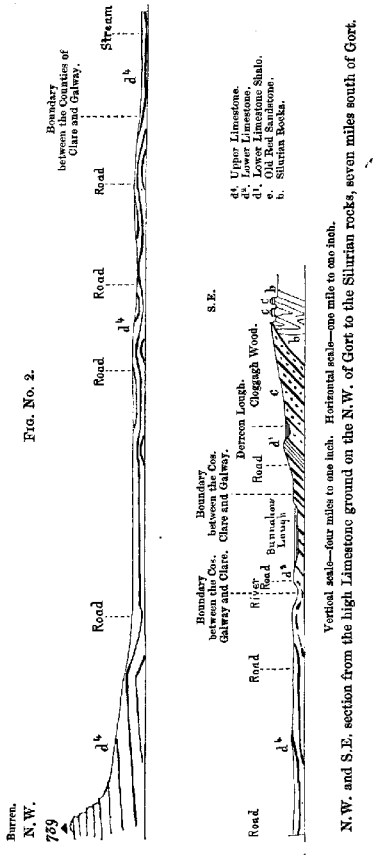


FIG. No. 2.

Vertical scale—four miles to one inch. Horizontal scale—one mile to one inch.

N.W. and S.E. section from the high Limestone ground on the N.W. of Gort to the Silurian rocks, seven miles south of Gort.

outliers lying on the Silurians, which have a marked appearance, looking up the Cahir River Valley. On the E. and W. are the table-

topped hills of Beha and Liss, while on the N. and N.W. is a wild heathery country, covered with drift and bog.

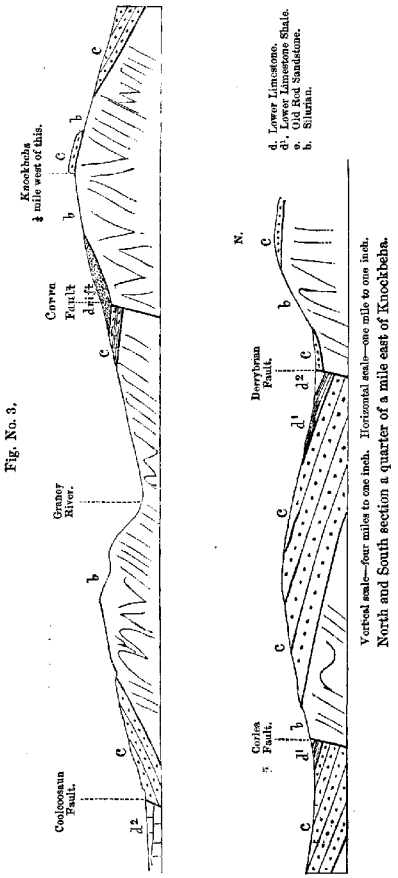


Fig. No. 3.

The Silurian country is generally easily recognised, as, usually, it is either in a state of cultivation, or has a number of little rocky knolls

scattered over the surface, while the Old Red country has a barren and poverty-stricken look, and stretches away in large undulating moors.

The limestone country bounding Lough Derg is remarkable for the quantity of bog and drift which covers its surface, while that on the west of the district is often for miles a bare *crag*, especially towards the N.W.; but here there are long patches of drift scattered over it, and many long narrow lakes and bogs. It is very cavernous, which fully accounts for its numerous subterranean rivers and *turloughs*.

These subterranean rivers occur principally in the *Crusheen and Gort limestone districts*, more especially in the latter. The turloughs form regular features, as, during the wet season, they swell into lake-like sheets of water, while in dry weather no vestige of them remains but the spaces they occupied are green flats. The one in this district that is effected by the rise and fall of the tide can only be observed during the dry season, as in the time of floods, from the large area it covers, the rise and fall, if any, is imperceptible. That the waters of the subterranean rivers find their way into the sea through the joints in the rocks and other small orifices appears probable, as in none of them are sea trout ever caught.

Detailed Description.

To facilitate the description, the area now under consideration has been divided into the following subdistricts, which will be spoken of in the order mentioned:—

I.—*The Mountain District*, including all the mountainous country east, west, north, and south of Lough Graney and Lough Atorick.

II.—*The Northern Limestone District* about Ballinlough.

III.—*The Eastern Limestone District*, which bounds Lough Derg on the west.

IV.—*The South Limestone or Scariff District*, extending from Lough Derg at Illaunmore, by Scariff to Derrynaskeagh, being the strip of limestone country on the south of Slieve Aughta.

V.—*The South-west or Crusheen Limestone District;* and

VI.—*The North-west or Gort Limestone District.*

I. The Mountain District.

Valleys and Faults.—The east and west valleys, with their accompanying faults, may be first described, as they are so well marked, the faults, as before noted, being downthrows to the south, or upthrows to the north. (*See fig.* 3.)

The *first* or most northern of these valleys runs from Lough Cooter, along the Owendalulleegh River, towards Marble Hill, in the district on the N. (*Sheet* 116). In this a fault has been traced from Lough Cooter to near Marble Hill. We have called this *The Derrybrien fault*, as it seems to have its greatest throw in Derrybrien valley, immediately S. of the hamlet called Derrylaur on the map, eight miles east of Gort, where it brings down the Limestone against the Silurians. In the same valley, at Chevy Chase, five miles S.E. of Gort, its throw is also considerable, as there the limestone is now in juxtaposition either with the Silurian or the basal beds of the Old Red sandstone.

The *second* valley runs from the road from Gort to Tulla, along the Hollymount River to Nagilkagh Lough, on the east of which it crosses

the watershed into the catchment basin of Lough Graney, and proceeds down the Drumandoora River to the Lough Graney valley, and from thence along the Bleach and Woodford Rivers to Woodford, crossing out of the Lough Graney basin a mile and a-half N.E. of Lough Atorick. Its accompanying fault lies a little to the north, and has been proved from near Carheeny Lough, by Lannaght, to Corlea Bridge, and from where the valley ends at Woodford to Lough Derg; but between Corlea and Woodford it was not remarked, as the country is covered with either bog or drift. This may be called *The Corlea fault*, as there also the limestone must be lying against the Silurians. Near Woodford the limestone and sandstone are thrown against one another. On the shores of Lough Derg, near the house called *The Lodge*, four miles east of Woodford, this fault brings down the unstratified against the stratified portion of the lower limestone. From Corlea to Carheeny the fault is well marked, dividing into two branches on the west of the village of Lannaght.

The *third* valley can be traced from Lough Blarnagh to Lough Ea, where it crosses into the Lough Graney basin, and down the Lough Ea or Cahir River to Lough Graney, from whence it runs along the Corra and Derrygoolin Rivers, coming out of the Lough Graney basin on the north of Ardeven. Its fault has been traced from near Maghera Lough to Ardeven, and we have called it *The Cloonnagro and Corra fault*. From the Maghera River towards the east this fault can be seen in various places, especially at the village of Cloonnagro. It could not be traced across the Lough Graney valley, but it occurs again in the Corra River valley.

Along the south of the district is the *fourth* or Scariff valley, which bounds Slieve Aughta on the south, and separates it from the mountain group called Slieve Bernagh, which lies in the district to the south (*see Explanations of Sheet* 133 *and* 134). This valley has also an accompanying fault which bounds it on the north, and seems to run from Feakle, Lower, to Mount Shannon. This may be called the *Coolcoosaun fault*, the limestone and Silurians being now together a little east of a hamlet that goes by that name. A mile and a-half S.E. of Feakle the most westerly traces of this fault were remarked.* From this it can be traced to Coolcoosaun. On the east it seems to extend as far as marked, but no positive proofs were seen farther than the Bow River.†

In places, some of what are here considered faults, might only be Silurian cliffs, at the base of which the Old Red sandstone and limestones were deposited, as the rocks strike with the line of fault. This is more especially the case with the *Cloonnagro and Corra fault*, but that they are really lines of dislocation seems probable, as there are so many of them in nearly parallel lines; and also the basal beds of the Old Red on the upthrow and downthrow sides are similar, which would scarcely be the case if they were lines of cliffs.

We will now proceed to the rocks of the Mountain District, beginning first with those of Silurian age towards the north and then going south :—

Derrybrien Silurian.—This occupies a long narrow strip of ground, and is cut off on the S.E. by the Derrybrien fault. The boundary between it and the Old Red country on the north is well marked, but not so on

* A fault, a downthrow to the south, was remarked in the Glendree River, which possibly might be the continuation of this.

† This fault may extend to Lough Derg, opposite Illaunmore, somewhere about the line that is supposed to be the boundary between the limestone and the Old Red sandstone, but as there is no proof of its continuation in that direction, it has been considered advisable to stop it off near Mount Shannon.

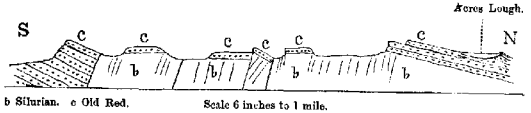
the south, as the country is covered with a deep stony drift that necessitates a provisional boundary being drawn part of the way.

The rocks in this patch are green, gray, and blue grits, and shales, dipping both north and south at high angles, rarely lower than 70°, except in one place, immediately N. of Tooraglassa, where it is as low as 15°. Some of the grits are extensively used for whetstones for scythes. Numerous small faults were observed, and a N. and S. fault, a downthrow to the W., seems to cut off the Silurians on the east. A small outlying patch of Old Red sandstone filling up a hollow in the Silurians was remarked in a stream half a mile due south of the summit of Knocknarebana.

Small Silurian outlying Exposures.—One of these occurs immediately west of those just described, and seems to have been a peak in the bottom of the Old Red sea, as the conglomerate on the south side nearly rests on the Silurian rocks, while to the north various red sandstones and shales intervene. Two small outlying exposures were remarked in the stream that divides the parishes of Kilthomas and Killeenadeema, on the south of the new road from Gort to Marble Hill.

The Lannaght Silurian.—This lies to the S.W. of Derrybrien, and occupies a strip on the N. of the Corlea fault eight miles long, by irregular widths, extending from Corlea Bridge to within a mile of Ballynakill Lough. The west part of this tract is covered with deep drift and bog, obscuring the rocks; but the basal bed of the Old Red was observed on the south of Lough Lackagh, which lies about three miles N.E. of Lough Graney. A mile and a-half west of Lough Lackagh there is an anticlinal curve, the rocks in which, green and purple grits and shales, dip N.N.W. at 40°, and south at 50°. Silurian rocks also appear in the vicinity of the Holy Well, which lies about a mile N.W. of the last mentioned place. Strong green sandstones were observed a mile south of the Holy Well, and half a mile on the S.W., where there is a small fault, as marked on the map. In these last three places the rock dips southward at angles varying from 45° to 80°. From Corlea Bridge to Lahardaun Lough, the boundary between the Silurian and Old Red rocks is partly obscured by the drift and bog, but from the Lough towards the west it is well marked. In the neighbourhood of the village of Lannaght this fault is divided into three or four branches. (*See fig.* 4.)

FIG. No. 4.



Section running S. from Acres Lough.

From the most northern of these faults there is a branch. The second fault seems to end a little to the east of Lannaght; it can be well seen in the small stream five furlongs on the east of the village where the two kinds of rocks are in juxtaposition. The third fault is best seen on the south of the village. As it goes west it divides into two. A north and south branch seems to run south from this fault, about half a mile east of Lannaght. The numerous small outliers of Old Red sandstone show that the present surface of the Silurian must have been the original Old Red sea bottom, and that none of the faults, except that on the south, have a large throw. The most southern must have a cast of about 850 feet, as that is the calculated thickness of the Old Red to the south. All

the Silurians here are nearly vertical or dip at a high angle to the south. To the west of the county boundary, near the road, there are two faults which gradually separate, and are eventually lost in the limestone country to the west. The Silurian rocks here are found to dip at high angles both north and south. In the townland of Inchaboy a trace of copper was remarked, with some quartz strings, in green grits, that were quarried by the road side, one mile N.W. of Connaught Bridge. That the southern boundary of these Silurians is a fault and not a cliff seems evident, as it can be traced into the limestone to the west. It is also parallel with the other lines of faults, and the basal beds of the Old Red sandstone, both on the N. and S. of it, are similar.

Inchaboy Silurian.—The Inchaboy Silurian occurs immediatcly S.E. of Lough Cooter. It is bounded on all sides, except at the S.W., by the outcrop of the Old Red sandstone. At the S.W. there is a fault, which runs N. 4° W., and is a downthrow to the S.W. At the N., a fault, the supposed continuation of the *Derrytrien fault*, crosses the Silurian, and is very remarkable, as where it enters it from the N.E., it is a downthrow to the southward, while where it leaves it on the W., it is a downthrow to the northward.

The Silurian rocks all dip S. at high angles (70° to 85°), and strike nearly east and west. To the N. and S. of this patch the principal rocks are strong massive coarse green sandstones, while in the centre there is a band of green, gray, and blue grits and shales. Some of these beds, adjoining the Old Red sandstone, have a red or purple colour; pink calc-spar strings also occur in some of them.

It seems probable that the Old Red sandstone is only just denuded off this place, as numerous small patches of it are found, eight of which were remarked, four being formed of the basal cornstone, one of the cornstone and the overlying conglomerate; another, a very remarkable one, is situated two furlongs N.W. of the trigonometrical point 407, but is too small to be inserted on the inch map. It is a red breccia, filling up a wide open fissure in the underlying Silurian rocks. Two are of considerable size and thickness, one being near the centre of the Silurian patch, and the other near the fault at the S.W.

Lough Nahaglish Valley.—This lies about five miles south-west of the Inchaboy Silurians. It is a valley of denudation, surrounded by a nearly continuous escarpment, and is principally occupied by local drift (Silurian and Old Red detritus); the underlying rocks, green and purple Silurian grits and shales, being only exposed in a few knobs and in some of the streams. On the N.E. and S.E. the basal beds of the Old Red form low cliffs in places, at the base of which good junctions with the underlying Silurians occur.

As here the uneven bottom of the Old Red sea is well exemplified, we shall examine it in detail, beginning at the N. In the cliff, on the E. of Cloggah Wood, under where the first *g* in *Cloggah* is engraved on the one-inch map, there is from ten to fifteen feet of red soft sandstone and cornstones, between the quartzose conglomerate and the Silurian rocks, lenticular cornstones also occurring in the conglomerate, while at the three outliers of Old Red, which lie a little to the S.E., there is only a cornstone intervening, or it rests on the Silurian. The conglomerate rests on the Silurian at the west side of the western outlier, while on the E. and S. of the same there is a cornstone of an average thickness of five feet.* In

* In this cornstone there are a few strings of quartz and specks of galena. Along the strings the limestone seems to be slightly magnesian.

the centre outlier the cornstone is very thin on the west side; it is also apparently interstratified with the underlying Silurians, as it fills up the fissures and joints in them. At the S. end of the eastern outlier a thin red sandstone intervenes between the cornstone and conglomerate. The conglomerate here is more than fifteen feet thick, and to the S.E., immediately N. of where the boundary between the Silurian and Old Red crosses the road in a detached cliff, it is found to be thirty-five feet thick. In the last-named places it rests on a cornstone two feet thick, under which are red sandstones.

On the east of the road the continuity of the beds is broken by three faults, the principal of which is a downthrow to the S.E., and a wide open fissure has been formed along it, which now goes by the name of Scalpnagown. The other two run at nearly right angles from this towards the N.W., and seem to be branches from it; they are both small downthrows to the S.W. On the N.E. of the northern branch fault, there are about thirty feet of red sandstone and cornstone between the conglomerate and Silurians, the lowest bed being a blue or red cornstone. Between the branch faults the beds under the conglomerate only appear. On the west of these faults, in the stream, there is only four feet of red sandstone; while a little farther west, at the small outlier, the conglomerate rests on the Silurian; and farther S.W., nearly due south of Lough Nahaglish, there are about forty feet of red sandstone intervening, the lowest two feet of which is a brecciated conglomerate. The outlier that is marked on the S.E. of the lough is formed of the beds under the conglomerate.

On the N.W. of the valley the escarpment is formed of large blocks of conglomerate, some of which seem to be *in situ*. Blocks of conglomerate are also scattered very thickly on the south of the escarpment, under which is Silurian debris. It is considered that this was once a cliff similar to those on the north and east of the valley, but that it has been ruptured by some cause or other, perhaps by the softer underlying beds having been denuded away, after which the conglomerate, by its own weight, was broken up.

On the west of the valley, from Meelick Roman Catholic Chapel to Derryboy, there are hillocks of drift, full of large blocks (some of them tons in weight) of conglomerate and sandstone, which quite obscures the boundary between the Silurian and Old Red, but that the former does not go farther west than the hamlet called Caher, is proved by horizontal red sandy shales of the Old Red period being found in the stream that forms the parish boundary immediately south of that place.

To the south of Thimbletown there is a rocky escarpment which runs to the S.W., past the village of Derryroagh. This is covered with large blocks of sandstone and grits. Silurian shales are seen in the stream immediately east of Thimbletown, and the basal bed of the Old Red sandstone at the road on the south of them.

Gortnameara.—This lies to the S.E. of Lough Nahaglish, and the Silurian rocks there situated, occupy an irregular **V** shaped tract. Along the Gort and Tulla road no Silurian rocks were observed *in situ*; but their debris was found in various places, and the basal bed of the Old Red sandstone was also remarked.

On the west of Lough Blarnagh the Silurian can be seen forming cliffs and bosses. The beds dip both north and south, but the strike is always east and west, or nearly so. A trappean-looking bed occurs at the western end.

On the south there is a thick bed of cornstone. Immediately over it are red sandstone underlying the conglomerate.

These intervening beds thin out at the S.W., as there the conglomerate

is the lowest bed, but the cornstone seems to set in again at the east, and to continue for a short way; the conglomerate changes also in places into a coarse yellow sandstone.

Scalpnagown outlying Exposure.—This lies in the valley immediately west of Lough Ea; and the Silurian rocks are either brought up by the continuation of the Cloonnagro fault, or they must have been a peak in the bottom of the Old Red sea, as all the Old Red rocks in the hill on the south dip towards them; but as the country hereabouts is covered with bog, all exact relations are unknown, and the boundaries marked are therefore provisional. The Silurian rocks are only seen in the stream that forms the boundary between the parishes of Tulla and Inchicronan, but trappean rocks of Silurian age appear in places in the rising ground on the north of the stream. The Silurian rocks observed were green and gray grits and shale, that are much contorted and cut up with traps.

Scalpnagown Traps.—These, as just remarked, are much obscured on account of the nature of the country, but they may occur as a bed that strikes nearly east and west, as they seem to dip south at a high angle (75°), and to underlie a green ash. A dyke that runs toward the S.W. cuts across the Silurians that are exposed in the stream where marked on the map. These traps are very similar to those called felstones, and described farther on in this paper, as occurring in the townlands of Liss and Caher, from which they are distant about three miles. They all lie in a line, which strikes about E. 15° N.

Silurian Ground on the West of Lough Graney.—Bounding these rocks on the south is the *Cloonnagro fault*, which was traced from the village of Cloonnagro to near Maghera Lough. East and west of the village the Old Red and Silurian rocks are in juxtaposition, the former dipping to the N.W., at angles varying from 30° to 45°, while the latter occupies the high ground on the north, and dips south at angles varying from 60° to 85°. A quarter of a mile farther west they can also be observed, but here the Old Red dips south at 3°. Farther west in the stream, immediately west of the Maghera River, the Old Red rocks dip south at 5°, except adjoining the fault where they have an inclination of 10° to the N. A north and south fault branches from the Cloonnagro fault, immediately east of that village.

Intrusive Trap rocks are associated with the Silurians on the south slopes of Caher and Liss. On the north of the traps the Silurians are twisted and broken, but with a general strike at the traps. On these Silurians and traps are five small outliers of Old Red sandstone. The most western of these is situated at the village of Liss, crossing the road that runs south from Doorus, and consists of a thick quartzose conglomerate, that rests on red calcareous sandstone or cornstone, towards the west, while in the east part it is a breccia, made up principally of trap debris. The other four are to the S.W. of Caher Wood, one of them being a bluish gray cornstone, the others breccia, made up of trap debris, with sandstones and conglomerates. The rocks in the last four outliers are horizontal, or nearly so, but in the other, at the west of the road, it dips east at from 15° to 30°, and on the east at from 5° to 10° towards the west, forming a synclinal trough. The boundary of the part on the west of the road is easily traced, but the eastern portion is obscured by local drift.

Immediately west of Killanena Roman Catholic Chapel there is a remarkable stream that flows down from Liss to a small alluvial flat on one of the minor water-sheds, where it bifurcates and forms two streams, one that flows to the S.E. and the other towards the north.

Caher, Liss, and Maghera Igneous Rocks.—These lie to the S.W. of Lough Graney, and occupy a narrow tract of country which extends in a nearly

east and west line from the bifurcation of the roads on the south of Caher House for about three miles towards the west. They seem to be intrusive, as the Silurian rocks in which they occur strike towards them, but no junction between them is exposed. That they were intruded and denuded along with the surrounding Silurian rock before the beginning of the Old Red period is proved by the basal bed of that formation being found deposited on them, and in places being made up of their broken fragments.

A focus of eruption seems to have been situated in the townland of Liss, a little on the west of the road, that runs south from Doorus House, where the traps form an irregular boss, out of which dykes seem to have run towards the east into the townland of Caher, and S.W. into the townland of Maghera.

These dykes can be traced in the townland of Caher. The most southern of them is only seen in places where it is deeply weathered, forming a mottled rusty rotten stone, that effervesces freely with acid; and without opening a regular quarry it is hard to procure an unweathered specimen. When unweathered it is a mottled green rock, full of small white veins, that effervesce slightly. In places are dull light gray blotches on which the acid has no effect. Before the blow-pipe it fuses slightly on the edges.

The centre dyke is generally of a bluish gray or white colour, having sometimes a cherty appearance. It is often amygdaloidal, especially on its south side, and contains a few felspar crystals; in places it is a porphyry, containing numerous small black crystals. It does not effervesce with acid, except on the weathered portions, where there is a very slight action. Before the blow-pipe it fuses slightly on the edges. Between it and the northern dyke Silurian shales were found in places, but near the road that runs south from Doorus House they seem to join into one another, and then they sometimes have a gneiss-like appearance, being streaked with black and white, through which are black crystals. Before the blow-pipe the black portions fuse on the edges into a white bead, the white much easier into a beautiful white glass, while the black crystals are refractory. The mass effervesces with acid slightly on the weathered edges.

The northern dyke is a purple or red glistening trap, that in places has a rude columnar structure, and is traversed by joints that cut it up into rude rhombohedrons. It is sometimes a beautiful amygdaloid: the almond-shaped minerals, at its eastern end, being pinkish calcspar, while in some places they are a green glistening mineral. Pink and white crystals of felspar are disseminated through the mass; also green and black crystals. Acid has a nearly imperceptible action on it, and before the blow-pipe it seems to run a little on the edges, but some atoms are quite refractory.

To the north of this dyke in places are scattered blocks very similar to the south dyke, which sometimes appear to be nearly *in situ*. These may point to another dyke that at present is covered up.

The boss of trap on the west of the road, in the townland of Liss, in places is a good porphyry, in others a blue or speckled green trap, while towards its northern limits it has an ashy appearance.

The most northern of the dykes, which run towards the S.W., is similar to the most southern of the Caher dykes, while to the south of it is a whitish light green glistening trap, in places like a serpentine, in others like a compact felstone.

Immediately south of this is a mottled green trap that seems to join into it towards the S.W. This is somewhat similar to the most southern of the Caher dykes.

Half a mile W. of the last-mentioned trap, at the stream immediately west of the Maghera River, there are also trappean rocks. The mass is a green ashy-looking trap, with dyke-like portions of a pinkish white compact trap running through it. The green trap effervesces freely with acid on the weathered edges, and also in places in the mass. There are scattered through it flakes of a dull dark green mineral, which gives it a mottled appearance, and small crystals of hornblende also occur. Before the blow-pipe it fuses readily into a transparent glass bead. The dyke-like portions look very like a felstone, but it fuses readily before the blow-pipe, though not quite as easily as the associated green trap. It has minute veins full of a fibrous mineral like asbestos, along which it breaks. There are also numerous minute crystals of dark green hornblende, and a few of pink felspar: with acid, there is a nearly imperceptible effervescence in places.

The green rock seems to be a trap, not an ash, as it appears to be intrusive, the Silurian rocks being found on its east margin striking up against it, and entangled with it.

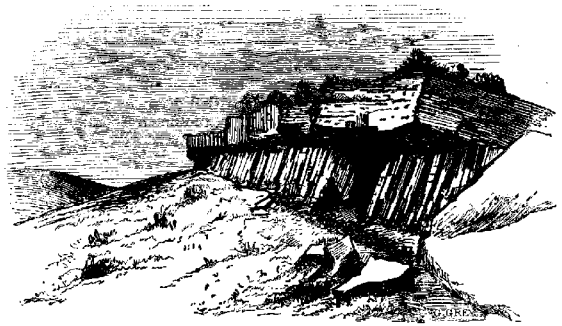
A quarter of a mile N.W. of the Maghera River traps, there is a very peculiar rock that has all the appearance of being trappean, except that it contains, in places, pebble-like particles of a pinkish gray felstone, some of which are as large as marbles, which weather out and give the rock a conglomeratic appearance. In the parts free from these pebble-like particles, the rock is like a dull green friable greenstone. It has been considered most expedient to mark this on the map as an ash.

The green trap near the Maghera River is very like the greenstone dykes in Bear Island, county Cork, while some of the traps in Liss and Caher are similar to what was there called felstone—(*see Map and Explanation of Sheet* 198).

Silurian Country on the S. of Lough Graney and the Cloonnagro Fault.—In Glendree, which lies to the south of Loughea River, the Silurian rocks are exposed in numerous crags and stream sections, and consist of green, gray, and blue grits and shales, that near the Old Red sandstone are generally of a red or purple colour. They all appear to dip towards the south, some of them at angles as low as 45°. On the southern slopes of the Caher River valley the rocks are impregnated with iron ore, principally the micaceous variety of hematite, which gives the surface soil a red colour. This ore may have been worked in ancient times, as there is an old adit still open. Open casts have been made lately hereabouts, as I am informed, in search of copper ore.

On the hill, immediately S. of the Caher River valley, there are nine outliers of Old Red sandstone, a few of which are very small. The most western of these lies immediately east of the road from Glendree to Caher, on the ridge of the hill that divides the valley. Here there are two, one on each side of the old road. That on the east is very small, and is formed of the basal cornstone, while the other has a massive quartzose conglomerate over the cornstone, and occupies an area of about five acres. The other seven occur in a group about half a mile south of the hamlet called Cloonnagro. Two of them are formed of the basal cornstone, while the others are principally conglomerate, no cornstones seeming to intervene between it and the Silurian; in fact, in one place it is proved not to occur (350 yards N.W. of Altoir Ultach), as a beautiful junction is exposed (*see Fig.* 5) of the Old Red lying on the up-turned edges of the Silurians. But here we find the old fissures and joints in the Silurian rocks filled with a siliceous limestone, part of the basal Old Red cornstone. This cornstone was formerly burnt for economic use at these various localities, but rarely of late years.

Fig. No. 5.



Old Red sandstone resting unconformably on the Silurian slates and grits, N.W. of Altoir Ultach.

Along the road from Feakle to Lough Graney partial sections of the Silurian rocks are exposed; and two faults were observed, one on the N.W. of Glenbonniv House, and the other due north of Gortalassa House; both of these bear nearly N. and S., the last-named seeming to be a down-throw to the W. About 600 yards on the N. of Gortalassa House, in the townland of Leaghort, open casts in search of copper ore were made, of which there seems to be a mere trace in a quartz string. The Silurian rocks on the west of the road just mentioned are similar, and similarly circumstanced to those in Glendree. Here, in places, it is evident that the basal bed of the Old Red sandstone has only just been denuded off. This is well seen in the old road from Feakle to Glenbonniv, where we find, on purple shale, small patches of purple limestone or cornstone only a few inches thick, the remains of the basal bed of the Old Red sandstone, and similar to the basal rock seen in the road cutting a little N.E. of Feakle.

In the hills between the River Graney and Glenbonniv, the rocks, which are similar to those just mentioned, generally dip southward at angles varying from 50° to 85°. At the few places in which northern dips were observed they seem to form small local curves. Towards the Old Red boundary on the south the dips are both southward and northward, showing that here there are various sharp anticlinal and synclinal curves, the axes of which strike nearly east and west. Minute veins of blood red calcspar were remarked in some of these rocks, especially towards the south boundary.

Capping one of these hills, called *Monounta*, there is an outlier of Old Red sandstone. This lies nearly horizontal, but has an inclination from its north-west corner of 15°, and from its south margin of 30°. It consists principally of a thick quartzose conglomerate, which seems to rest on a cornstone, as at its S.E. extremity a cornstone, formed of fragments of Silurian grits and shales, cemented together by a gray compact siliceous limestone, was observed. Fossil plants were found a little N. of the cornstone, in beds only a few feet above the Silurian rocks.

A deep drift is found on the south slopes of these hills, especially in some of the valleys. It is formed principally of Old Red and Silurian debris, but there are often sufficient Carboniferous limestone fragments to be collected by the occupiers for lime burning. Granite blocks and pebbles also occur.

Silurian Ground on the East of Lough Graney, including Corra River Valley.—A tract bordering Lough Graney, from the R. C. Chapel of Lakefield to the Corra fault, at Bunshoon, is covered with a deep local drift. This, also, is found in the Corra River valley, on the north side of the river, and extends nearly to the Old Red out-crop on the north, obscuring the rocks. But on the west, south, and east slopes of Knockbeha, surrounding the *Old Red outlier*, the Silurians are seen in numerous crags, bosses, and quarries, a very good section being opened by the road at the east. They are similar to the Silurian rocks previously described, being grits and shales of a gray, green, yellow, and red colour, that strike nearly east and west, and dip at high angles N. and S.; undulating in sharp flexures and curves. In the gap at the S.E. of the outlier there are well marked glacial striæ and roundings, that bear N. and S., and at the eastern Old Red out-crop, a quarter of a mile N.N.E. of the same place, there are calcareous patches in a green shale, which seems to be infiltrations from the basal bed of the Old Red. To the N. and N.W. of the outlier the rocks appear in numerous crags and bosses, forming a broken country, and on some of the highest of them are small patches of the basal bed of the Old Red, which show that very little has been denuded off the Silurians in this place.* In this place the cleavage is better developed than in any other part of Slieve Aughta, and its strike is nearly E. and W., dipping S. at 70°; but though many of the shales are well cleaved, no good roofing slates were observed. Some of the grits are very calcareous, and strings of pink and red calcspar are frequently found. Green sandstones occur at the road, 700 yards E.N.E. of Lakefield Lodge.

In the Corra River valley the Silurian rocks are similar. They occupy a long narrow strip that, at the boundary between the parishes of Tomgraney and Feakle, is nearly a mile wide, but gradually narrows towards the east, where it is only a quarter of a mile across. To the east of this they occur on both sides of the river, on the south stretching up and over the Cappaghbaun ridge, and joining this Silurian country with those of the Bow and Graney Rivers valley. The rocks on the S. of the rivers can be observed in a few crags and stream courses; also on the ridge of the hill, and are similar to those on the north. They strike E. and W., and dip S. at angles varying from 70° to 80°. Seven hundred and fifty yards due west of where the Old Red boundary on the N. crosses the parish boundary between Moynoe and Tomgraney, there are the remains of a trial in search of ore. In the neighbourhood it is called the *Silver Mine*, but Sir R. Griffith, in his published list, mentions copper ore as having been found in it. The associated measures, however, are reddish and dark coloured *Killas* (shales), which are usually considered most uncongenial for all kinds of copper ore. A little more than a mile west of this, on the road from Lough Graney to Woodford, there is a bed of shale with limestone patches.† Close to this is a vein of quartz, with specks of a reddish ore of iron, that when

* Some of these outliers are marked on the map; the rest are too small for insertion.

† These are likely to be part of the Old Red basal cornstone infiltrated into this shale.

weathered effervesces freely with acid. This or a similar vein was also remarked on the hill side a little farther west. In the stream that forms the boundary between the parishes of Tomgraney and Feakle there is a short section exposed, where the rocks dip S. at angles varying from 70° to 80°; to the west of this stream, near the outcrop of the Old Red sandstone, there are also two very small outlying patches, which the scale of the published map does not admit of insertion. To the south of these outliers, near a farmhouse, is a vein of quartz, containing micaceous iron ore.

Silurian Country about Cloonusker.—Along the Graney River there is an *alluvial flat*, that is about three miles long, and of irregular widths; its widest range being three quarters of a mile. It consists of fine sand, gravel, silt, and layers of peat. To the south it joins into the Coolreagh bog and the flats about Lough O'Grady.

To the east of the Graney River, and the flats just mentioned, there is a large irregular tract of Silurian country, that is joined to the main mass at the N.W., and to the Silurians in the Corra and Bow River valleys, by narrow strips that run to the N. 10° E. and S.E. Immediately east of Cooleen Bridge there is a rugged rocky hill consisting of Silurian rocks similar to those previously mentioned. Near the Old Red sandstone the rocks strike S. 15° W., and dip southward at angles varying from 65° to 87°; the rest strike E. and W., and are either vertical or dip N. at a high angle (80° to 89°).

Among these beds, where marked on the map, about half a mile eastward of Cooleen bridge, is a greenish gray *Felstone Porphyry*, containing crystals of sea-green feldspar, small flakes of mica, minute crystals of a black hornblendic-looking mineral, and in places flakes of micaceous iron ore. It can be traced for about a quarter of a mile, and seems to run along the strike of the associated rocks, but in no place was there a junction between them observed. Towards the west it is lost under a small patch of drift, and at the east it seems to be cut off by a fault, a downthrow to the W., which is well seen in a quarry, where marked on the map.

Sections in the Silurian rocks are exposed in the stream about a mile east of Cloonusker, in the north part of another stream two miles north of the same place, and on the hill between these streams. In all these places they strike nearly east and west; and dip at high angles both N. and S. The strip of Silurian country that joins this with Corra River valley is either covered with bog or with stony "Old Red" drift, but in some of the bog holes, streams, and on the ridge of the hill, Silurian debris can be observed. To the N.W. of Cloonusker the ground is principally covered with a stony "Old Red" drift, rocks *in situ* being only seen in a few places, generally in detached quarries or near the outcrop of the Old Red sandstone. In the latter case they are usually of a red or purple colour.

Silurians of the Bow River Valley and Derrygoolin.—A strip of Silurian country, immediately north of the hamlet called Coolcoosaun, joins this with those last described. Here, in the stream that flows nearly north and south, the Lower Limestone is brought down against the Silurians by the Coolcoosaun fault. In the Bow River valley the Silurians are similar, both in lithological character and in lie and position, to those just described. A picturesque waterfall and natural bridge is formed by a hard thick green sandstone, immediately below the junction of the Sheeaun and Bow Rivers.

On the east of the Bow River there are two Old Red outliers, one forming the hill of Kilrateera, a mile N.E. of Bow Bridge, and the other, a mile further north, at the hamlet called Bohateh. The boundary of the *Kilrateera outlier* can be easily traced on the W., N., and E., but on the south

it is only provisional, as stony Old Red drift stretches from Lough Derg as far north as this.*

At Bohateh the Old Red seems to have been deposited in a hollow in the Silurian, as rocks of that age occupy higher ground on the north and south. The Old Red rocks are only exposed at its S.E. end, where they consist of quartzose conglomerate on reddish and yellow flags.

On the N.E. of Bohateh, between it and Derrygoolin, there is a large mountainous tract of country in which no rocks are visible. This, at first, was considered to belong to the *Old Red*, but now it is marked as *Silurian*, as towards its eastern limits in the Mount Shannon River, a mile south of the south-west end of the Derrygoolin valley, there are greenish and reddish sandy shales that dip south at 60°, and are undoubtedly of *Silurian* age. But its south and east boundaries are only provisional, being drawn between that which is undoubtedly *Old Red* and that which looks like a *Silurian* country. The northern boundary is marked along an irregular escarpment that runs for more than half a mile westward, it then turns to the S.W., and leads to a crag on the ridge of the hill (nearly a mile south of the summit of Ardeven), where *Old Red* and *Silurian* are found nearly in juxtaposition, proving that this escarpment must be very nearly, if not quite on the boundary. Chalybeate springs were remarked in this tract, especially towards the north, where they are very numerous.

In the Derrygoolin valley Silurian rocks were observed at its westward end. It is bounded on the N.W. by a steep rugged escarpment, covered with large blocks of yellow sandstone and conglomerate that seems to form the out-crop of the Old Red; on the N.E., by a sloping bog and alluvial flat; on the E. and S.E. by hills of stony Old Red drift, on the northwest slope of which is a small escarpment that is supposed to be the boundary; and on the S. and S.W. by low cliffs of sandstone and conglomerate, at the base of which Silurian rocks were observed. At the S.W. there is a gap, from which the Old Red seems to have been denuded, and forms a junction between the Silurians of Derrygoolin with those of the main mass of the district.†

Scalp Silurian outlying Exposure.—This occurs in the valley immediately north of Ardeven. Only a few of the Silurian rocks are seen, as the hill on the north is covered with bog, while that on the south is so with drift. It may be brought up by the continuation of the *Corra fault*, which, in that case, would bound it on the south; but as there is no conclusive evidence, a provisional boundary has been marked on the north and south.

Old Red Sandstone Country in the neighbourhood of Mount Shannon and Woodford.—This country, for the most part, is covered with hillocks of stony Old Red drift, on which there is generally a thin coating of peat and heather, and in places loose blocks of stones. In the hollows bogs occur. Exposures of rocks are rare, and the following are those most worthy of notice:—

On the west of the Mount Shannon River there are two streams that join in one in Woodpark Demesne; in both of these rocks are seen. In the eastern branch, near the new road, are red and yellow flags, sandstones, and clayrocks, that dip north at about 3°; while in the western, a mile N.W. of Woodpark Lodge, are red and yellow flags, sandstones, and

* Immediately north of *Kilrateera outlier* there is a small tract covered with Old Red debris which may mark another outlier.

† At this south-west end of the valley large blocks of cornstone occur in the drift, and are excavated out and burnt for lime by the occupiers. Nowhere in the neighbourhood could I find it *in situ*, but it is very similar to some of the basal cornstones of the Old Red previously mentioned. It is a breccia of Silurian fragments cemented together by a siliceous limestone.

shales, all of which dip south, generally at an angle of 5°, although in one place it suddenly rises to 20°. These are supposed to be near the base of the *Old Red*, as 700 yards on the west of this section, at the road, are *Silurian* grits and shales; a little north of which, on the same road, are yellow and flaggy standstones of the "*Old Red*" age that seem to be *in situ*, and to have a slight dip to the southward. Though these *Old Red* rocks are supposed to be near the base of that formation, they appear very like the highest beds in other places in these hills; and at an angle in the stream, 400 yards N.W. of the *trigonometrical point* 366, are gray and yellow flaggy shales, very like part of the basal beds of the *Lower Limestone shale*, but if this was the case it would necessitate a north and south fault between these two places, as otherwise the *Old Red* would have thinned to little more than 100 feet in thickness, and the yellow flaggy sandstone seen in the road could not then be *in situ*.

In the Mount Shannon River, from the limestone, northward, to where the first A in INISHCALTRA is engraved on the one-inch map, rocks are exposed, dipping south at angles varying from 2° to 15°, and exhibiting a section at least 350 feet in thickness. Immediately north of the first A in Inishcaltra there is a thick conglomerate, which dips north at 3°, but from that, round the bend in the stream, to the new road from Mount Shannon to Derrygoolin, the rocks, which are red and yellow flags, shales, and sandstones, dip south at from 2° to 5°. A little north of the conglomerate is a strong chalybeate spa. On the west and north of the bridge, under the new road, are red and yellow flags, shales, and sandstones, that are supposed to be near the base of the Old Red sandstone; they dip north at 3°.

In the stream that flows east into Lough Alewnaghta, some very peculiar beds were observed. Half a mile west of Ballyhinch Bridge are green spheroidal clayrocks; farther west, from where the parish boundary crosses the stream, to where the nearly north and south fault is marked, are yellow and greenish sandstones and flags, which undulate, but seem to have a slight general dip towards the east. Immediately west of the fault, which hades towards, and, therefore, is supposed to be a downthrow to the east, are greenish clayrocks and flaggy sandstones. Some of the former are fossiliferous, and one bed is full of minute calcareous nodules, that weather into a brown ochre. These beds occupy from this fault to Derroran Bridge, as the strata are rolling in gentle undulations.* A little west of the bridge are yellow sandstones and grits, that lie nearly horizontal, and half a mile S.W. of it is a purple *cornstone*, or siliceous limestone, which seems to come in as a lenticular mass.†

Over the limestone are purplish and yellow sandstone and flags, that form a very broken country, a little S.E. of where the limestone is exposed. Here the rocks are broken up in a remarkable manner, but the beds seem to be either horizontal or to have a slight dip towards the north. A little north of the cornstone are yellow sandstones.

In the Derrygoolin River rocks appear, but not in a continuous section. Above and below the mill are yellow gritstones, sandstones, and clayrocks, with one remarkable bed of bright yellow laminated soft sandstone, and a twelve-inch bed of dark gray shale, that contains fossil plants; a bed like the latter is very unusual in the *Old Red* of this country. All these dip east

* A few yards to the eastward of the bridge the fossil collector, C. Galvan, found fossil plants.

† Similar cornstones are very common towards the west of the Aughta Mountains in the Old Red, but this was the only bed remarked in the eastern portion.

at from 2° to 5°. Higher up the stream, or to the westward, where the branches from Scalp and Derrygoolin join, Old Red rocks occur in both streams, having a general dip E. or E.N.E., at angles varying from 3° to 10°, except in one place, where, in a bed of conglomerate, it rises suddenly to 45°. Fragments of plants were also found in a bed in the south stream, where the fossil sign is marked on the map.

On Derryknav, which lies west of Derrygoolin, Old Red rocks also appear in crags and small cliffs, more especially on its N.E. slope, where they form rude terraces. The top of the hill is covered with a deep coating of peat, which is cut for turf by the inhabitants of the Derrygoolin valley.

On the S.E. slopes of Ardeven the Old Red rocks, which are nearly horizontal, but have a slight dip to the N., form rude terraces, that are greatly modified by the mountain bog which occurs on most of them. The northern slope is nearly covered with bog, the rocks only appearing in crags and bosses, while the west slope is entirely covered, obscuring the boundary between the Old Red and Silurians, except near the source of the Bow river. To the north of this, on the slopes of Scalp, are yellow and purplish sandstones and conglomerates, that lie nearly horizontal, and appear through the mountain bog in crags and bosses. The basal bed of the Old Red standstone, as seen on the west of the outlying Silurian exposure, is a soft sandstone, and must be very ferruginous, as the water from it precipitates a quantity of peroxide of iron.

On these hills are large shaking bogs and morasses, locally called *mountain mires;* they are very common on all the hills in the Slieve Aughta.*

On the south of Woodford the rocks crop to the surface in the brows of some of the hills, others of them are covered with loose blocks. In the stream, north of Featherstone Lodge, horizontal red flags and shales, under yellow clayrock, are exposed. Some of the peat hereabouts is impregnated with peroxide of iron, and was used for purifying gas, as will be seen in the following extract from a letter communicated by Mr. John Hill, County Surveyor, Tullamore:—"For some time this stuff" (peat impregnated with peroxide of iron) "was raised in a bog about a mile and a-half S.W. of Woodford for the purification of gas in London. It was tried as a substitute for *Breese's purifier*, mixed with oxide of iron, for which there is a patent, but was given up, as they found it cheaper to get similar stuff from the Island of Islay, in Scotland, and from near Tarbert, in Kerry, on account of the facility for shipment.'

In the Woodford river a few yellow and red sandstones are seen, that all dip north at about 5° or 10°.

Bounding the northern limestone district on the south is an escarpment, covered with large blocks of sandstone, conglomerate, and grits, many being of a considerable size, often tons in weight. From Reyndrumadda, that lies about a mile S.E. of Ballinlough, by Cappagh, to Shannonhill, the yellow sandstones, some of which are flaggy, crop out on the ridge of the hill. They generally dip southward, at angles varying from 2° to 10°,

* On the south slope of Scalp, near the detached tract of Silurian country, there is a cave in yellow and reddish sandstones, geologically remarkable, as it does not appear to lie on a line of joint, and how it was formed is hard to conjecture. It is locally called *Poula broderick*, and is supposed to be the residence of a fairy in charge of a treasure concealed under the water of a lake in the interior. This *good person* has taken the form of a turkey cock, who floats at the surface of the lake, and if adventurers seek to deprive it of its charge it immediately rises above the water, and with its wings raises a mighty rushing wind, so powerful that it will extinguish the strongest flame that can be lighted. When I visited it I had not the pleasure of meeting with the guardian spirit.

although in one place the angle is as high as 25°. Only in two places were northward dips observed, one being on the old road from Woodford to Lough Rea, a mile and a-half N.N.W. of Woodford, where the dip is 35° to the N.W., and the other about 300 yards to the west of this, in a bohereen, where red sandstones dip north at 5°;* besides these there are conglomeritic sandstones half a-mile south of Ballinlough, which may be *in situ*, and, if they are, they also dip south at 25°. A little south of Cappagh thick flags are raised and sold at a price of two pence per square foot, with a good demand for them at that rate.

From the line of outcrop just mentioned to the Woodford river the country is covered with small hillocks of stony Old Red drift, on which there is generally a thin coating of peat and heather, and in places loose blocks of stones. Rocks *in situ* were not observed. In the hollows bogs occur.

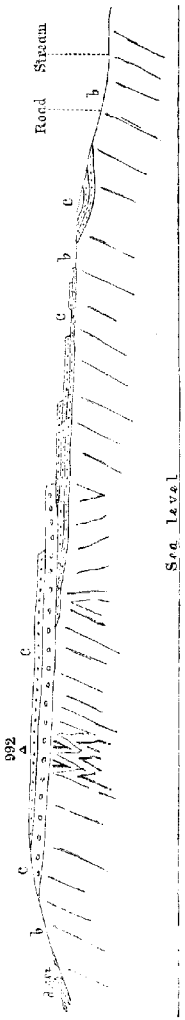
Slieveanore and Lough Atorick.—Slieveanore, which signifies *the mountains of gold*, is the name given to the barren heath-clad hills N.W. and N. of Lough Atorick. Very few rocks appear at the surface, except to the south of Lough Lackagh, and on the north of Lough Atorick. In the former place the basal conglomerate, along with the associated Old Red beds, crop out, which are similar to the beds immediately above the Silurian rocks in the Corlea valley, on the south of the fault; and also to beds that appear at a hamlet more than a mile west of Lough Lackagh, where they dip N. at 3°, and rest on purple and green Silurian rocks that dip S. at 70°.

To the north of Lough Atorick, nearly horizontal yellow and red sandstone form rude terraces both north and south of Shanemore's Lough.

Corlea and Pollagoona Mountains.—Pollagoona is covered with bog and drift, but a short section in the Old Red is exposed in the centre of it, showing yellow and purplish sandstones, flags, and shales, with a few beds of clayrock, all of which dip south at angles varying from 2° to 20°. A partial section is also seen at the parish boundary on the west, and a few crags protrude through the bog and drift in other places. On the south, overlooking the Corra valley, the basal beds are well exposed, the lowest being a red soft breccia, which is generally calcareous, and sometimes a very siliceous limestone or cornstone. In Corlea and thereabouts the rocks more frequently appear at the surface, broken sections having been observed in the Corlea river, along the road from Lough Graney to Lough Atorick, and in other places. In the Corlea river, about six furlongs south of the bridge, there is a very peculiar rock, as two irregular masses of yellow sandstone are enclosed in red sandy clayrock. About a mile and a-half south of Corlea Bridge, and a little S.E. of the trigonometrical point (724 feet), there is a thick bed of spotted gray cornstone that was formerly burnt for lime, but now, since the country was opened up with roads, it is found cheaper to bring the stone from the limestone country, as the Carboniferous limestone gives a larger return of lime and takes less fuel to burn it.

Towards the south, along the boundary of the Silurian of the Corra valley, the Old Red rocks form small escarpments and cliffs where they can be well examined. The basal bed is generally a soft red breccia, that sometimes changes into a cornstone. In the Bleach River Valley a large

* If a fault bounds the northern limestone district on the south, as will be hereafter suggested, it would run south of these places; that no fault lies to the north of them seems certain, as black shales were found over them, a short distance to the north of the rocks that dip N.W. at 35°. I may here mention that borings were made in these shales in search of coal, and coal is still supposed to occur there, which would be very unlikely, as coal was never found anywhere in shales of that group.



Section across Knockbeha, bearing N. 20° W., and S. 20° E. (*See next page.*)

FIG. No. 6.

b. Lower Silurian rocks.
Scale—Six inches to one mile.
c. Old Red sandstone.

lenticular mass of gray cornstone appears, near Lough Graney, immediately north of Cahermurphy House; this is not now used for lime-burning for the reasons just stated; over the cornstone is a thick quartzose conglomerate. That the cornstone is a lenticular mass is proved on the east of the wood, as there the conglomerate rests on red clayrock, which lies on the edges of green Silurian grits and shales. As the conglomerate is traced towards the S.E., from fifteen to twenty feet of flags and shaly beds come in under it; these can be well examined both north and south of where the boundary between the Silurian and Old Red crosses the road from Lough Graney to Corlea Bridge. From the sections exposed in this neighbourhood it is also seen that the Old Red sandstone was deposited on an uneven sea bottom, as, on the north of Cahermurphy House, there are twenty feet of limestone between the conglomerate and the Silurian, while on the east of the wood there are only three feet of clayrock. At the bridge last mentioned, and in the north part of the Knockbeha outlier, there are from fifteen to twenty feet of flags, &c., while at the south of the outlier it rests on the Silurians. Good sections of the basal beds were seen in numerous places along the boundary overlooking the Corra River, especially along the road from Bunshoon to Lough Atorick.

Carboniferous Rocks of the Bleach River Valley.—In this valley are very fossiliferous blue and black shales, and shaly limestones belonging to the Lower Limestone shale. These are bounded on the north by the fault that we have called from this place the *Corlea fault*. It is a downthrow to the south, and here seems to bring the Silurian rocks and those just mentioned into juxtaposition, in which case the throw must be at least 1,000 feet, or a little more than the whole thickness of the Old Red sandstone.

All these rocks in Pollagoona and Corlea, including the Carboniferous rocks, are either nearly horizontal, or incline to the south, at angles varying from 1° to 10°, except in a few places, where they rise to 20° or even 25°, but these cases are very rare, and seem only to be local twists, as they never last for any distance. In the northern part of the Corlea river the beds lie nearly horizontally, and as they consist of alternations of sandstones and clayrocks, form numerous cascades. Many of the sandstones in this tract are obliquely laminated, and split easily into coarse flags.

Knockbeha Old Red Sandstone Outlier.—This occupies the crest of the hill immediately east of Lough Graney, being divided from the main mass of the Old Red at the S.E. by a narrow pass. It is a narrow tract, a little more than a mile long, and about one-quarter of a mile wide, that lies N.W. and S.E. To the south a strong quartzose conglomerate rests on the Silurians, while at the north red flags, sandstones, and breccia intervene between them, as shown in the accompanying section (*see Fig.* 6, p. 32), the conglomerate being about twenty feet above the base of the formation at this place. The basal bed here is a red soft coarse sandstone or breccia, that is highly calcareous, over which are flags, with one or two beds of sandstones. All the rocks in this outlier dip north at angles varying from 5° to 10°, except in one place, where they rise to 30°.

The Old Red Outlier at Gortaderry.—The Gortaderry outlier is situated on the south of the *Corra Valley fault*, and occupying the high ground between it and the Graney River valley. It occupies an east and west strip of ground four miles long by about six furlongs wide, except at its eastern end, where a spur extends from it, for about a mile, towards Cloonusker, along one of the secondary ridges. On the east, looking towards the Sheeaun outlier (from which it is separated by a shallow boggy valley), the Old Red boundary is marked by a well-defined escarpment. On the south the boundary is only provisional, on account of the mass of stony "Old Red" drift which here is found, not only in the valleys, but also stretching up for a considerable distance on the south slopes of the hills, over the Old Red sandstone, concealing its basal bed, except in one locality. In this place, which is situated exactly one mile due west of the summit of Gortaderry, it can be seen for about three hundred yards, being either a very calcareous breccia or a siliceous limestone.*

On the north it is bounded by the *Corra and Cloonagro fault*. That this is a fault is shown by the following considerations. All the Old Red sandstone rocks seen in the *Gortaderry outlier* have a northern dip, at angles varying from 2° to 10°, giving a vertical thickness of at least 200 feet of Old Red rocks in the section at the bounds between the parishes of Feakle and Tomgraney, and near the middle of the outlier, where a good section is also exposed, the Old Red must be at least 400 feet thick;† but 300 yards on the north of the first mentioned section, on ground 100 feet higher, are Silurian grits and shales. From this it would appear that there must be a fault in this place, as represented in *fig.* 3.

The only way a fault could be dispensed with here would be by supposing that the Gortaderry outlier occurred in a synclinal basin, the northern side of which dipped with a high angle towards the south, or that in the

* A limekiln was built here and some of this *cornstone* was broken and burned, but was abandoned, as very little of it burned into lime. The stone used was extremely bad; a much better quality occurs in the yard of a farmstead a short distance west of the kiln. The last stone mentioned is very like that which is found in boulders at the S.W. of Derrygoolin.

† Calculating this section at a uniform dip of 6°, which is below the average, gives a thickness of 499 feet.

Old Red sea there was a hill of Silurian rocks on the north of this place, at the base of which the Old Red was deposited. But, in the first case nowhere is there a northern dip found, nor are high angles of dip to be seen in the Old Red anywhere in the neighbourhood; and if they did occur they would be nearly sure to bring up the rock somewhere to the surface. The second case of the rocks being deposited at the base of a Silurian cliff, is more likely than the first, as the Old Red rocks strike parallel to the line of the supposed fault. But as this is nearly parallel to the Coolcoosaun and Corlea faults, it appears more probable it is also a fault. Besides the basal beds on the south side of the outlier are similar to those on the north side of the Corra River valley, which would scarcely be the case if one set was deposited on the top and the other at the base of a cliff.

The rocks in this outlier can be easily examined in two good sections; one in the Corra River, and the other in a new road that has been made across the centre of it. From these it would appear that it consists of yellow, red, and greenish sandstones, clayrock, shales, and flags. Towards the west, as seen in the Corra River and the parish boundary, red seems to be the prevailing colour, while towards the east yellow; but perhaps this may be due to weathering in the latter place. In the Corra River the thickness of the beds of clayrocks and shales range from five to fifteen feet, and as the beds are flat (3° to 5° to north), they form a succession of picturesque waterfalls,—the water having worn away the clayrocks much quicker than the sandstones. No good conglomerate was observed, but on the horizon of the quartzose conglomerate, *i.e.*, from fifteen to thirty feet above the base of the group, patches and lenticular masses of that kind of rock occur. In places some of the sandstones are very calcareous. Flags are found near the base of this group, and besides the regular flagstones some of the sandstones are obliquely laminated, and make flags. On most of this outlier there is peat from one to five feet in depth, under which, at its highest part (1,070 feet), there are parts of thick red deal trees, some of them ten feet long, and over eighteen inches in diameter. Similar timber is found in the Corra River valley and on Turkenagh to the north. It is remarkable that although those trees abound on the hills on the east side of Lough Graney, yet on the S.W. there are none, although the hills are much lower.*

Old Red Sandstone outlier at Sheeaun.—Bounding the Bow River valley on the west is the *Sheeaun outlier*, which is nearly the shape of a fore-quarter of lamb, the shank end pointing towards the north. It is two miles long, and a mile and a quarter wide in its widest place. Its eastern boundary can be easily traced, as it forms a well marked escarpment on the west of the Bow River valley, along which the rock can be seen at intervals, and the Silurians below it appear. At the north it turns round the summit of Cappaghbaun, where the *trigonometrical point* 1,126 is printed on the map, and from thence southward on the east side of the parish boundary, but when the Sheeaun River is nearly reached it turns towards the east for about 400 yards, when it crosses the Sheeaun. At this place the *Old Red* rocks are well exposed, forming rude terraces, and consist of yellow and red sandstones and conglomerates, which are nearly horizontal, but have a slight inclination to the south (3°). When the Sheeaun is passed, the boundary

* In this neighbourhood split deal is used instead of candles, therefore these logs are greatly prized, and as no bogs are cut on the hill tops the inhabitants search in the peat with a long iron rod, which they thrust down until they find a log or stump. There is a tradition in the country that all these hills, 200 or 300 years ago, were covered with timber. That oak abounded seems evident from many of the names in the Aughta Mountains being a compound of *Derry*, which signifies an oak wood.

is supposed to run for half a mile towards the west, when it turns with a bold sweep to the south, at which place it forms a low cliff, from whence it runs in an irregular line till it joins the eastern boundary.

No actual junction between the *Old Red* and *Silurian* was observed, although the two kinds of rocks are nearly in juxtaposition at the low cliff to the extreme south of this outlier. The *Old Red* rocks that were noted are principally yellow and reddish sandstones, which are often flaggy, but in a few places are beds of clayrock, and in two places, one being where the Sheeaun River crosses the eastern boundary, and the other half a mile farther west, are red and yellow thin flags, covered with ripple marks, which are not usual in this country. These beds can be well seen in the last-named place.

Strip of Old Red Sandstone Ground on the East of Cooleen Bridge and North of the continuation of the Coolcoosaun Fault.—If the *Coolcoosaun fault* is followed towards the S.W., to the north of it, and on the east of the Graney River, there is a small strip of *Old Red sandstone*, which is supposed to be bounded on the south by the fault. This tract, as previously mentioned, is covered with ridges of stony "Old Red" drift, no rock being seen except the outcrop of its lowest beds and a small portion towards its eastern end. The outcrop is well exposed, and can be easily traced as marked on the map, the basal bed being a soft red breccia or coarse sandstone, over which there is usually a reddish compact very hard grit, more like a *Silurian* than an *Old Red* rock, that underlies yellow sandstones and grits, some of which contain large rounded pebbles of white quartz.

Old Red Country between Graney and Glendree Rivers.—Between the Graney and the Ayle Rivers no good section is visible, as the country is covered with mounds of stony "Old Red" drift, the rocks only appearing in a few places. On the west of the alluvial flat the basal bed is a cornstone (gray siliceous limestone). From this to the church a calcareous red sandstone was remarked here and there, over which is a strong quartzose conglomerate; on the west of the church, in the road cutting, it is a purple brecciated cornstone, while on the west of Feakle it seems to be red sandstone, over which there are yellow sandstones. All these dip south, at angles varying from 2° to 35°.

In the Ayle River an excellent section was observed, of which the following is an account, with the calculated thickness of each set of beds:—

Section No. 1.

			Feet.
17. Black shales,	dipping south at 10°,	*over*	30
16. Vacant space,		*about*	181
15. Yellow sandstone,	,, ,,	15 ,,	45
14. Red sandstone and clayrock,	,, ,,	20 ,,	68
13. Red and yellow sandstone,	,, ,,	45 ,,	141
12. Yellow flaggy sandstone,	,, ,,	40 ,,	164
11. Conglomeritic sandstone,	,, ,,	3 ,,	3
10. Red sandstone,	,, ,,	10 ,,	9
9. Red shales and clayrock,	,, ,,	35 ,,	34
8. Coarse yellow sandstone,	,, ,,	3 ,,	3
7. Yellow and purple sandstone,	,, ,,	10 ,,	26
6. Yellow sandstone,	,, ,,	30 ,,	38
5. ,, ,,	,, ,,	20 ,,	43
4. Red and yellow flags, sandstones, and shales,	,, ,,	10 ,,	48
3. Red sandstones and shales,	,, ,,	5 ,,	22
2. Yellow and red sandstones,	,, ,,	5 ,,	46
1. Cornstone (bluish gray siliceous limestone),	,, ,,	3 ,,	14
		Feet.	915

Bed No. 17, and half of 16, is supposed to belong to the Lower Limestone shale, which would leave a thickness of about 800 feet for the Old Red sandstone.*

No. 1, the cornstone, forms a picturesque waterfall, called Poulawillin, where its peculiar junction with the underlying Silurians can be examined. It also encloses a small tract of Silurian country, as the water has cut through it below the fall, and exposed the rocks for a space of about 150 yards. The cornstone can be traced from this towards the west for about half a mile to the north and south road there situated. Two small outliers of it occur at this road. It is also exposed a little east of the Glendree River, near Tobercleneen, in three places, two of which are outlying patches.

Between the Ayle and Glendree Rivers few rocks are seen, but the outcrop can be easily traced, as the basal beds appear at intervals along it. The basal bed, as just remarked, is often a cornstone, but in other places it is flaggy sandstones or clayrock; over these is a yellow quartzose conglomerate, which is succeeded by red and yellow sandstones, on which is a deep red fine conglomerate. A section is also exposed in the Glendree River, but not so complete as that just described, all the rocks in which dip south, at angles varying from 3° to 20°.

Some of the yellow sandstones are made into whet-stones for scythes by the inhabitants. They can make two dozen and a-half in a day, which are worth 1s. per dozen in Limerick, or any of the neighbouring towns. To make them they roughly square them with a hammer, and afterwards grind them on one of the rocks in the bed of the river. They work at them for a month in the year. The trade is now only carried on by one family, but formerly numbers were employed.

An east and west fault, a downthrow to the south, occurs about 300 yards south of the bridge over the Glendree River.

The Mountain Tract between Glendree and the Crusheen Limestone District.—This is over six miles long, by about three wide, the whole of it being covered with hillocks of stony Old Red drift, bogs, and marshes. Large blocks of Old Red sandstone are in places scattered over it, or piled in heaps. Sandstones were only observed in a few of the streams, where they always dip south, at angles varying from 3° to 10°.

Country on the West of the Lough Nahaglish Valley.—In, and to the east of, the north part of Cloggagh wood sandstone and shales occur, that dip N.W. at angles varying from 5° to 30°, but from the wood south to Derryboy no rocks were observed, they being covered with a very stony Old Red drift, most of which is full of, or covered with, large blocks, some of them tons in weight, of Old Red sandstones and conglomerates. In places numerous blocks of cornstone also occur.

Gortnameara Old Red Outlier.—This is situated on the S.E. of the Silurians of the Nahaglish valley, being a narrow strip about a mile long, and of various widths. At the south side and west end, the conglomerate seems to rest on the Silurians, while on the north side various beds intervene, in one place being as much as forty-two feet in thickness; on the east it is cut off by one of the previously mentioned branch faults. To the north of it are two small outliers, one near Lough Nahaglish, which consists of red soft sandstone or breccia, and the other of the conglomerate. This latter is

* This may be less than the real thickness, as the above is calculated at the lowest possible angle; besides, a fault, a downthrow to the south, may intervene between Nos. 11 and 12, which is not unlikely, as one is well proved farther west in the Glendree River; and here, in No. 12, there is a sudden high dip as if the rocks rose to a fault.

situated immediately south of where the second h in Nahaglish is engraved on the one-inch map, and a good junction with the Silurians is seen on its east side.

The Old Red Country between Nagilkagh Lough and Lough Ea.—This is a wild mountainous tract, usually covered with a coating of peat that varies from a few inches to six feet in thickness.* On the east of Lough Nagilkagh, at and near the road, the basal conglomerate may be observed dipping north at 35°, and between it and the lough, where marked on the map, is a pale greenish yellow cornstone. To the east of the lough yellow and red sandstones appear, that dip N.W. from 15° to 30°, while on the south there is nothing but stony drift and bog, in places covered with huge blocks of conglomerates and sandstones; but a partial section can be examined in the stream that forms the boundary between the counties of Clare and Galway on the west of Fahy Lough, the rocks seen in which all dip N.W. at angles varying from 5° to 20°, and consist of red and yellow sandstone shales and clayrocks, the upper beds being principally red. On the south of where the county boundary crosses the road from Gort to Tulla the basal conglomerate is over thirty feet in thickness, and as it is lying nearly horizontal, it occupies a considerable quantity of ground, standing out in large bosses with nearly perpendicular sides. To the south of this deep fissures cut across these beds, two occurring to the west of the trignometrical point 776, and one on the east. All these seem to occupy lines of dislocation or faults, but that fact could only be proved in one of them. From this, as marked on the map, there are the two branch faults previously described.

On the northern slope of Liss the rocks form rude terraces, among which are a few purple and gray cornstones, as marked on the map. They dip north at about 3°. In the neighbourhood of Lough Ea the rocks are much exposed, forming cliffs and crags; they dip north at about 10°. One bed on the S.E. of the lake, a fine calcareous conglomerate, is full of small caves. The same, or a similar conglomerate, appears on the west of Lough Nacally, and half a mile to the north of this a thick purple cornstone was observed.

In the Lough Ea River rocks are seen, but as it runs nearly along their strike, not much can be learned. On the south of the river, near the road, is a cliff from thirty to fifty feet high, in the face of which two beds of cornstone were observed, one being a purple bed full of gray limestone nodules about the size of a man's fist. These beds are cut off to the east by a nearly north and south fault, an upthrow to the east, which brings up the Silurians hereabouts. To the S.E. of Lough Nacally there is another cliff, in which there are also cornstones, varying from one foot to five in thickness. Blocks of cornstone are found in various places, numerous large blocks of a purple colour, which seem to be *in situ*, occurring between Loughea River and Lough Nacally.

Liss Old Red Outliers.—About a quarter of a mile east of the summit of Liss there are two outliers that consist of a blue *cornstone*, about five feet thick, under a massive conglomerate. The largest is about half a mile long by a quarter wide, and the smaller, one furlong in length by about three-quarters of a furlong wide. Good junctions between the cornstone and the Silurian rocks may be observed in various places, especially on the east side of the large outlier. The rocks in them lie nearly horizontal, a slight hollow occurring in the middle of the large one, which causes its drainage to flow to its centre, from whence it finds

* If these bogs were properly drained and intersected with roads they would be valuable, as in the country to the north-west, in the vicinity of Gort, fuel is very scarce.

its way through a subterranean passage in the cornstone, coming out at the east side in a small cave, in which that beautiful fern, the *Cystopteris fragilis*, grows most luxuriantly.

Corbehagh Outlier.—This lies about half a mile west of Killanena R. C. Chapel. It is nearly surrounded by a low cliff, formed by the basset of a massive conglomerate, of which it consists. This conglomerate is locally called *kidney stone*, from the form and size of the contained quartz pebbles. It rests on the Silurian rocks, and is from ten to fifteen feet thick. The dip is to the north at 15°.

Old Red Ground on the North and North-west of Lough Graney.—This, on the north, is bounded by the Corlea fault, and on the south by the basal bed of the Old Red, which is similar to that in the *Corbehagh outlier*, a massive quartzose conglomerate, except towards Lough Graney, where a soft red breccia and sandstone set in between it and the Silurians. Over the conglomerate are red, yellow, and gray sandstones, flags, clayrocks, and shales. All the observed dips are towards the north, generally at angles varying from 10° to 15°, but in one place it was observed to be as high as 45°, and in another as low as 2°. A good section across it can be examined in the before mentioned stream that flows north from the R. C. Chapel at Killanena to the Drumandoora River. Here the thickness is calculated to be about 840 feet; and as the basal conglomerate occurs immediately north of the fault, it would give a downthrow to the south of about 850 feet to the fault at this place. (*See ante*, p. 19.)

On the north of Lough Graney the country is covered with bog, alluvium, and mounds of stony Old Red drift, which conceal all the rocks.

Old Red Country about the Inchaboy Silurians.—These lie immediately S.E. of Lough Cooter. On the south and east of the Silurians there are from ten to thirty feet of red sandstone between the conglomerate and the Silurians, the lower bed being a soft breccia that is sometimes calcareous, but seldom a good cornstone. On the N. and N.W. the lowest bed is nearly always a green, red, or gray cornstone, a good section being exposed of the basal bed in a cutting for a new road at the extreme north, of which the following is an account:—

Section No. 2.

		Ft.
* 8.	Conglomerate,	over 6
7.	Calcareous sandstone,	2
6.	Hard red sandstone,	3
5.	Soft red sandstone,	4
4.	Red sandstone,	5
3.	Cellular red sandstone, calcareous,	5
2.	Sandy red clayrock,	10
1.	Blue silecious limestone (*cornstone*),	15
		50

All these rocks on the south and east are nearly horizontal, generally dipping north at about 5°, while on the N.W. the dip is usually about 40° to the N.W. To the S.W., on the east of Ballynakill lough, between the bog and the Silurians, there is a section of the Old Red rocks exposed in the stream that divides the parishes of Beagh and Kilbeacanty. This shows a thickness of about 180 feet; one bed is a purple brecciated cornstone. On the N.W. of the Silurians, between the fault and the river, there is a whitish gray cornstone, immediately north of which in the river

* The conglomerate (bed No. 8) is not well marked in this place, being more a conglomeritic sandstone than a regular conglomerate, but this bed can be traced into a good conglomerate a little way both to the south and west.

the beds are found to be rolling in gentle curves, dipping N.W. at 25°, S.E. at 10°, and N.W. at 20°. To the south of the fault, on the west of the wood, the beds similarly undulate, a thick massive purple cornstone cropping out near the S.W. corner of the wood.

A mile on the east of this purple cornstone, and immediately north of Lannaght lough there is a brown cornstone. The beds here all dip north at angles varying from 5° to 10°, the basal conglomerate being very massive, and forming a low cliff along the northern boundary of the Lannaght Silurian country; it is often the lowest bed, but in some places, especially at and to the west of the village of Lannaght, a calcareous breccia or a cornstone sets in under it.

Country south of the Derrybrien Fault.—Near the boundary of the counties of Clare and Galway, this tract is similar to that on the east, being wild, heath-clad, stony drift hillocks, with bog and *mires* in the hollows, and rocks only showing here and there on a few of the hillsides or in some of the streams. But near the fault the ground is generally good, as its subjacent rock is limestone, or its accompanying shale, while the hills to the south are on sandstone and shales of the Old Red age.

A few of the Old Red rocks require special notice. A little north of the Holy Well, situated on the road that runs from Chevychase to the Bleach River, the basal conglomerate rests on gray and green Silurian grits and shales, and can be traced about half a mile towards the east. A bed of purple cornstone appears three-quarters of a mile S.W. of Chevychase Cottage, forming a boss in the bog; and in a crag a little to the S.W. of this limestone, a trace of copper is said to have been observed,* but there is no appearance of any lode or vein. All the Old Red rocks observed dip northwards at about 10° or 15°.

In the Owendallulleegh River valley Lower Limestone shale and limestone occur. The most western of these was remarked at the river on the north of the cornstone last mentioned, in which place there are blue and gray shales and shaly limestone, that dip N.W. at 10°, and N.E. at 5°. On the west of these, at the bend of the river, are yellow and green grits, with a few blue shales. In the wood around Chevychase Cottage, Mr. Burke, of Derrykeel, pointed out four places where these shaly limestones and shales appear. Under the little grove, north of the west end of the wood, he informed me, that there were good dark blue limestones; and on the parish boundary, to the east of the cottage, he showed dark blue shales and thin limestones, that dip N.N.E. at 3°; the other two places are cuts in which similar rocks were found. Where the road crosses the river, on the east of Chevychase, are yellow sandstones, belonging to the top of the Old Red sandstone, that dip N.N.W. at 5°.

Two miles E.N.E. of the cottage, in the river, similar rocks are exposed, that dip N.N.E. at 5°, and north at 20°. Farther east, the stream that flows down the north slope of Kinnageeragh, exposes the basal beds of the Lower Limestone shale with the underlying Old Red rocks. They dip N.N.W. at 10°, and fragments of fossil plants were observed in one of the beds in the Old Red.

In the Owendallulleegh, immediately south of Derrylaur, are good dark blue limestones, with shales, that dip N.W. at 20°. A quarter of a mile east of these limestones are yellow sandstones, and about half a mile east of them are the basal beds of the Lower Limestone shale, that dip N.E. at 15°, showing that on the south of the village of Tooraglassa there is an anticlinal

* Communicated by Mr. Burke, of Derrykeel.

curve which throws out the shales. Half a mile east of Tooraglassa are shaly limestones, that dip north at 15°.

From this for more than two miles towards the east no rocks were observed, but in the stream half a mile east of the Barony boundary, are the debris of shaly limestones, that seem to be nearly *in situ*, and immediately north of them are Old Red rocks, that dip south at from 5° to 15°. The Old Red rocks are supposed to be on the north or upthrow side of the fault, which here must be gradually diminishing, as no traces of it were remarked in the *Ballinlough Limestone district*, which lies immediately east of this place.

Whether this is a line of ancient cliff, or a fault, as before mentioned, is not positively proved; but that it is a line of fault seems probable, as in the strike of it near Lough Cooter a fault is proved, and it is nearly parallel to the lines of faults on the south (the Corlea, Corra, and Coolcnosaun faults). Also at Derrylaur and Chevychase the limestones, and their accompanying shales, dip north, and there does not seem to be room in either place for them to come up again towards the north to form small basins. In other places they might lie in basins, as the ground to the north of where they were observed is covered with deep drift for a considerable distance. But then again the nearest rocks seen on the north of them are the basal beds of the Old Red, which would make the Old Red very thin in these places. That the Old Red is of different thicknesses hereabouts is extremely likely, as immediately north of this, within the area contained in Sheet 115, the Silurian rocks are found to rise in peaks and hills through part of the Old Red sandstone, but for the reasons mentioned, and wanting positive evidence to the contrary, we have supposed a fault to exist here.

Old Red Ground about Loughaunlea.—This is nearly covered with stony Old Red drift and bog, in which are a few rock exposures. In the stream on the north of the shaly limestone debris last mentioned, is a partial section, consisting of yellow and red sandstones and conglomerates, all of which dip southwards, at angles varying from 5° to 15°. In the stream, on the east of Bellanamallaght, there is also a partial section of the basal beds of the Old Red and a junction between them and the underlying Silurian. The lowest bed is a red breccia, over which are red shales and sandstones, that are succeeded by yellow sandstones and conglomerates; the rest of the rocks are red and yellow sandstones, conglomerates, and shales, all of which dip south, or S.E., at angles varying from 1° to 15°.

Knocknarebana, Pollduff, and Knocknamona.—The tops of these hills are flat and covered with mountain bog over a stony drift. On the south slopes the lower beds of the Old Red sandstone form rude terraces, and near the road from Gort to Marble Hill are Silurian rocks. Good sections of the basal beds of the Old Red can be examined in a few of the mountain torrents, an excellent section being exposed in the barony boundary on the S.W. of Knocknarebana, where the beds are in the following order:—

12. Massive conglomerate.
11. Red sandstone and shales.
10. Red and yellow sandstones.
9. Conglomerate—two feet thick.
8. Red shales and sandstones.
7. Red cornstone—seven inches.
6. Red shales and sandstones.
5. Gray cornstone—two feet.
4. Red shales and sandstones.
3. Red cornstone—fifteen inches.
2. Red shales, with a few thin sandstones and conglomerates.
1. Red shales under a thin brecciated conglomerate.

The beds from 1 to 11 inclusive, are usually from fifty to seventy feet thick, but in some of the sections they seem to be considerably thinner. The cornstones are not found in all the sections. Above the conglomerate, on Knocknamona, are thick yellow and purple sandstones and conglomerates.

Tract between the Derrybrien Silurians and the Fault.—This is nearly covered with stony Old Red drift and bog, rocks being only exposed in a few streams and crags, a partial section of Old Red rock occurring in the parish boundary, when the rocks belong to the lower part of that group, and roll in gentle undulations, leaving the two small exposures of Silurians in the stream uncovered. Although all that tract has been coloured on the map as an Old Red country, other small spots of Silurian rocks are likely to occur, but cannot be observed on account of the deep drift and bog.

Old Red Ground between the Derrybrien Silurians and the Gort Limestone District.—This tract is also nearly covered with drift and bog, the former taking the form of mounds and ridges as the limestone country is approached. Over a great part of it the lower beds of the Old Red seem to be rolling in undulations, but in no place were Silurian rocks observed. Immediately north of Chevychase Cottage it is probable they occur, although none of them appear through the drift.

Old Red rocks can be examined to the N.E. of Lissbrien House, about Shaughnessy's Bridge, W. and S.W. of the Derrybrien Silurians, and between the woods and the large bog that lies on the east of Lough Cooter, there are numerous crags and cliffs of red, yellow, and purple sandstones and conglomerates, which have a dip to the N.W., varying from 1° to 15°. To the S.W., near the Police Barracks, the angle of dip suddenly rises to 40° or 45°, on which account the Old Red country narrows to a belt.

II. The Northern or Ballinlough Limestone District.

That part of this limestone ground, which is included within this map, occupies a triangular tract east and west of Ballinlough, four miles long by about three-quarters of a mile wide, measured at the centre of the triangle near the N.W. corner of Sheet 125, but the limestone extending into the district on the north. Towards the west the limestone runs under an alluvial flat and bog, beyond which the country is covered with deep, stony Old Red drift hillocks, and on the south it is supposed to be bounded by the outcrop of the Old Red sandstone. This southern boundary is only provisional, as it is, perhaps, more likely that a fault or downthrow to the north cuts it off here, as all the Old Red rocks seen on the south, except in two places, as previously mentioned, are horizontal or dip southward; besides the Old Red rocks seen nearest to the limestone seem to be beds which are low down in that group. But if there is a fault it must strike into the Old Red country towards the east and west, as the debris of the Lower Limestone shale was noted half a mile west of Attipierce, and black shales of the same age occur at the north margin of the district, about three miles E.N.E. of Attipierce. Farther west, in the continuation to the W.S.W. of this valley, there is the previously mentioned *Derrybrien fault*, that brings down the limestone against the Silurians, but it is a downthrow to the south, and the strike of it seems to run north of this. The limestones here lie in the fold of a synclinal curve. Immediately east of the alluvial flats, at the margin of the map, there is a steep escarpment of dark blue limestones, with shales and clay partings, that dip south at 3°. On the south of this there is an east and west ridge of stony Old Red drift, and more south still, half a mile west of Attipierce, are gray unbedded lime-

stones,* that lie on the *cherty zone*, under which are dark blue and gray-bedded limestones, and a little farther south, in a cutting for the new road, are blue shale debris. These all dip north, the cherty beds at 30°, and the most southern limestones at 55°. The cherty zone is the division between the stratified and unstratified portions of the Lower Limestone.† The debris of the shale beds are supposed to be part of the Lower Limestone shale. At Attipierce there are dark blue limestones, that dip south at 3°. On the east of Ballinlough there is a rise of ground where dark blue shaly limestones come to the surface, that are either horizontal or dip north at angles varying from 3° to 10°.

III. The Eastern Limestone District.

Most of this subdistrict is covered with drift, bog, or alluvial flats. The drift generally occurs in mounds, being principally Old Red debris. The bogs and alluvium are very extensive, especially towards the north, one large tract on the east of Woodford being about three miles long by two and a-half wide.‡ From Woodford, running nearly east and west to Lough Derg, the eastern continuation of the *Corlea fault* was observed. This, as before mentioned, at the Bleach River (ten miles to the S.W.), brings down the Lower Limestone shale against the Silurians, but here the throw is not so considerable. Near Woodford it brings down the limestone against the Old Red, but as it is followed east it still more diminishes, as near the lough it only throws the unstratified and stratified portions of the Lower Limestone against one another. This is seen on the east of the large bog near the farmstead that lies about half a mile S.W. of The Lodge, where dark blue, nearly black, calcareous shales and chert (part of the cherty zone), and dark blue shaly limestones, that dip S.E. at 15°, strike above all the gray and blue unbedded limestones in the vicinity of The Lodge. Some of the unstratified limestone is very fossiliferous, more especially that on the south of the fault, near the margin of the bog, which abound in large and various Cephalopoda, one large Nautilus dorsalis that was measured being nine inches in diameter. A mile N.W. of The Lodge, where the road crosses a stream, there are dark blue shaly limestones, that dip south at 5°. From this last named place to near Shannon Hill no rocks were observed *in situ*, but where the Old Red sandstone boundary is marked on the map the ground suddenly rises, and appears as if there was a change in the underlying rocks.

On the west of the large bog, in the vicinity of Clonco, there are dark blue limestones that are nearly horizontal, but have a slight dip towards the east. Similar rocks are found on the S.E. of it, in the neighbourhood of Boleymore, while farther east, north and south of the bog bounding Lough Derg, are gray and blue unbedded limestones, that are often slightly magnesian. The latter rocks are of the upper or unstratified part of the Lower Limestone, and the debris of the cherty beds that form the division between the stratified and unstratified portions is found N. and E. of the Police Barracks that is situated near Pollagh Wood.

Between the Woodford and Derrygoolin Rivers shales and shaly limestones, belonging to the Lower Limestone shales, were observed, but in no place were the grits of this group exposed. The following are the places in which they were noted:—Near Looscaun, which lies a little more than two miles S.E. of Woodford; in two streams half a mile N.W. of the Upper Village; a little west of the Upper Village, and in the stream half a mile north of the Derrygoolin River. Half a mile N.W. of the Upper Village, in the townland of Gorteeny, there is a remarkable large spring well, the waters from which have deposited round it a quantity of earthy calcareous tufa, forming a large conspicuous mound; a similar well is said to be situated in the vicinity of Woodford.

The hill immediately west of Lough Alewnaghta, on which 171 is engraved, is formed of drift, principally composed of angular shale debris, and a little south of Kilcooney is the debris of gray and blue flags and shales, part of the Lower Limestone shale. From these rocks occurring in these places the Old Red sandstone is supposed to occupy the space from Cregg Lough to Tintrim House. Due north of Tintrim, near Rinbarra point, dark blue limestones occur.

IV. The South or Scariff Limestone District.

This strip of ground, under which Lower Limestone shale or limestone is supposed to exist, has the usual character of the country, being covered with deep drift, bog, and alluvium, that obscures the geology, as the rocks only come to the surface in a few places. Towards the east it has a coating of stony drift, consisting of angular fragments of sandstones, limestones, and shales, which gradually changes its character towards the west, in the neighbourhood of Woodpark, forming dome-shaped hills, while on the west of Scariff they are more like eskers. From the Grancy River to Derrynaskeagh Bridge the drift is in low rounded hills, and is full of Old Red sandstone boulders, in some places of considerable size; fragments of limestone and granite also occur; the limestone sometimes is in sufficient quantities to be collected for burning. Over this drift, often for more than thirty feet in depth, is aerial drift, which was evidently formed by atmospheric agency on the hills, and carried down the slopes during the rainy seasons.

On the north of Scariff *the South Limestone district* is bounded on the north by the *Coolcoosaun fault*. This fault is well proved in a stream near the village of Coolcoosaun, where the Silurian rocks are found in juxtaposition with dark blue shales and limestones, the latter dipping nearly south at 35°, the rocks rising to the upthrow. Here the fault ought to be an upthrow to the north of more than 1,000 feet, as the Old Red sandstone and the Lower Limestone shale which are cut out, are supposed to be of at least, that thickness.

From this the fault runs E. 20° N. to the Bow River, along a well-marked fissure; and at the latter place the throw is probably less than at Coolcoosaun, as Old Red rocks occur on the south of the fault. A thickness of at least 350 feet of the upper beds of the Old Red is here exposed, the principal rocks seen being yellow flaggy sandstones. Below Bow Bridge blue and gray flags and grits, the lowest members of the Lower Limestone shale, were also observed. All the rocks in this part of the Bow River dip south, at angles varying from 3° to 25°. Between Moynoe House and Woodpark Lodge the limestones are exposed in a few places, and are found to be rolling in gentle undulations. Nearly a mile east of Bow Bridge, in a stream, are shales and shaly limestones, that dip southward at 5°. Limestones are also seen along the shores of the lough, near the north point of Inishcaltra, and in a few places on the west of Mount Shannon.

* Between these gray limestone and the dark blue just mentioned, under the ridge of stony Old Red drift, there may be Old Red sandstone rocks, brought up by the continuation of the *Derrybrien fault*, but, as none were found, it has been considered advisable to end the fault at the alluvial flat.

† One of the beds below the cherty zone in this place is very remarkable and uncommon, as it is a gray limestone, a hand specimen being exactly the same as the beds above the cherty zone, but it is in a well-defined bed, and only a few feet in thickness.

‡ All these bogs are extensively cut, and sent down the Shannon to the counties of Clare and Tipperary and the city of Limerick.

The nearest places to the supposed boundary between the limestone and Old Red, in which the limestone was actually seen, are in Mount Shannon River, immediately N.E. of that place, where they dip north at 5°; S.W. of Cregg Lough, where the stream runs under the road, their dip being southward at 5°; and immediately south of Kilcooney, two miles N.E. of Cregg Lough, where they dip N.E. at 15°.* Opposite to the last named place is Illaunmore, round the coast of which dark blue shaly limestones, with shale and clay partings, appear. These undulate, but have a general dip to the S.E.

Returning again to Coolcoosaun, we can trace the fault towards the S.W. to the vicinity of Ross Lough.

Limestones were observed at, and in the vicinity of, the race-course which lies about half a mile north of Scariff, and a little west of Moynoe House, where they form crags of broken ground, the dip being S. 30° E., at from 5° to 15°; between Scariff and Drewsborough it is also seen, and has a general dip to the west. Half a mile N.N.W. of Scariff there is a large limestone quarry, a little west of which a stream cuts a large bed of nearly black shales, very like the Lower Limestone shale; but these seem to be on a higher geological horizon; and in the road from Scariff to Feakle the limestones appear at the surface of the ground, undulating slightly, but at so low an angle as to be nearly horizontal.

Between the Cloghaun River and Kilbarron, limestones are rolling in gentle undulations, and are well exposed in the vicinity of the road that runs northward and southward. Here, as marked on the map, the fault is supposed to occur, and to cut out the outcrop of the Lower Limestone shale, and bring the Lower Limestone and Old Red sandstone into juxtaposition. In this place it is not so well proved as at Coolcoosaun, but that it occurs is likely, as we find the limestone immediately N.E. of Ross Lough dips north at from 20° to 35°, while a furlong farther north, on higher ground, are horizontal yellow sandstones, leaving no room between for the Lower Limestone shales to occupy.

Half a mile due north of Kilbarron, sandy clayrocks and bluish shales, the lowest beds of the Lower Limestone shale, were observed in a gravel-pit by the wayside. Some of the beds contain fragments of plants.

Near Kilbarron House are dark blue limestones and shales, that dip south, on the north of the house, at 10°, while near Carter's Lough at 30°. Immediately S.W. of Carter's Lough are gray and blue unbedded limestones, that are part of the upper or unstratified portion of the Lower Limestone, while all the other limestones in the *South Limestone* district belong to the lower or stratified portion.

In the Ayle River, a little south of Ayle Bridge, are black and blue shales, part of the Lower Limestone shale.

A little S.W. of the ruins of Ayle House, are dark blue limestones and shales, that dip S.W. at 5°.

From Ayle to Derrynaskeagh rocks are not seen, except in the Glendree River, as none of the other mountain torrents have cut deep enough into the drift. In the Glendree River the very basal beds of the Lower Limestone shales were observed. They consist of yellow and greenish shales and flaggy grits, that dip south at 5°.

On the east of the Glendree River, immediately above *Cappanknockaun fort*, we were informed by Sir Robert Kane, that galena was found in limestone rock.

* These last named strike for the previously mentioned flags and shales on the east of Tintrim House, and may point to a fault (the continuation of the *Coolcoosaun fault*), lying between these two places.

V. South-west or Crusheen Limestone District.

Lower Limestone Shale.—The boundary marked on the map for this group must necessarily be provisional, as the country in which it occurs is covered with deep drift or bog or both, and rocks belonging to it are only visible in two places.

One of these lies on the east of Crusheen, about midway between the hamlets called Derryboy and Derrycalliff Lower, where green, gray, and blue horizontal shales and flags were observed; and the other locality is a stream a mile N.E. of Doon Lough, in which a good section of its upper beds were noted. They consist of black, blue, and gray shales, limestones, and flags, that dip N.W. at 5°.

Lower Limestone.—At, and to the south of, Inchicronan Lough, a mile from Crusheen, the cherty beds that divide the stratified and unstratified portions of the Lower Limestone must be very thick, as acres are covered with their debris, some of them being tons in weight, and piled in most fantastic heaps. They can be seen *in situ* in the islands in the lough, and by the road immediately N.E. of Crusheen, also a quarter of a mile northward of Glenwilliam, and two miles N.E. of that near Derroogh Lough. The stratified dark blue exfoliating limestones that underlie them are well exposed on the east of Derroogh Lough, to the north of Doon, and on the east of Inchicronan. All these rocks, though disturbed, have a N.W. dip, varying from 5° to 30°.

Above the cherty bed just mentioned, the unstratified gray and blue limestones occur. These, though seldom a good dolomite, are often magnesian, especially near the Upper Limestone. A large surface of it is exposed on the S.W. of Inchicronan Lough, where it is supposed to be undulating at a low angle. At Crusheen it is also seen, where it is magnesian, sometimes a yellow dolomite. In the neighbourhood of Canthill and Skehanagh Lough it is also well exposed.

Upper Limestone.—The cherty zone, which has been taken as the base of this group, enters this district on the south with the mail coach road from Ennis to Gort, it then turns to the west round Curraderra Lough; from this towards the N.W. as far as Cant Hill, a mile north of Crusheen, it is covered with the drift, except in the river at Ballyline House.

From Canthill to Carheeny Lough it runs very irregularly, as marked on the map, among low hills of the Lower Limestone, an outlier occurring immediately west of Skehanagh Lough. It is well exposed along most of this boundary, and dips westerly at a low angle (3° to 15°) away from the Lower Limestone, except in the vicinity of Lughid House, where the angle rises to 50° or 60°. Immediately south of Lughid House a *quaquaversal* dome occurs in these beds, and Canthill is also formed by one.

From the cherty zone to the west margin of Sheet 124, the other beds of the Upper Limestone are found to be rolling in gentle undulations, but seem to have a general dip to the W. and N.W. In places it forms extensive rocky crags, the largest of these lie N. and S. of the Moyree River, and N.W. of Muckanagh Lough. To the W.S.W. of Muckanagh Lough are thick beds of blackish brown dolomite, where marked on the map.

A small vein of calcspar was remarked half a mile S.W. of Lughid House, and fragments of galena and fluor spar were found in a small garden immediately adjoining. Flying veins of sulphate of baryta were noted in one or two places, but none worthy of special record.

Drift, Bog, and Alluvium.—The drift is generally, when it occurs, deep, and usually forms long esker-like ridges, that have a general bearing of N. 40° E. They are sometimes a mile or more in length, except on the

S. and W. of Inchicronan, where they lose the character of ridges, and become short, some being nearly domes. The drift consists of Old Red sandstone and limestone detritus, the former usually being the principal ingredient especially in the neighbourhood of the hill country. That much of this drift is due to icebergs seems probable, as when it has been recently removed from the underlying limestone glacial striæ and roundings will be observed. These are well marked to the south of Skehanagh Lough, where the drift has been taken away to fill in a new road, leaving the face of the limestone bare. The bogs and alluvial flats take the same general bearing as the drift hills, especially those near the high land on the east, which are quite narrow, but miles in length.*

Shell Marl and Sand.—Freshwater shell marl occurs under many of the bogs, and in the lakes. A large deposit of shell sand and marl was remarked at Muckanagh Lough, about three miles S.W. of Toberreendoney. This ought to be excellent manure for the Old Red country to the east, but at present none of it is used for any purpose.

VI. The North-west or Gort Limestone District.

Lower Limestone Shale.—As is generally the case in this district, this group is covered with deep drift or bog. A section, however, was observed in the Hollymount River, five miles south of Gort, where the gradation from the shales into limestone can be well observed, and the basal flags and shales were remarked farther east, three furlongs due north of the Red Lough. In the latter place the dip is to the N.W., at 3°, while in the river it varies from 5° to 15° to the W.N.W.

Lower Limestone.—The stratified or cherty portion of this group occupies a band on the west of the Lower Limestone shale as far north as Lough Cooter, but to the N.W. of Lough Cooter, on the north of the Beagh River, it rolls in gentle undulations and occupies a large tract of land. On the road to the east of Lough Beg, two miles east of Gort, they dip S.E. at 2°, to the north of the Lough they are horizontal, on the east of the Roman Catholic Chapel they dip N.W. at 10°, while half way between the chapel and Fort Hill Cottage there is a *quaquaversal* elongated dome that has a general dip every way from its centre of about 10°. About a quarter of a mile west of the chapel they become magnesian and oolitic, being of a dull brownish gray colour and sandy aspect. On the west and south of the magnesian limestone the country is covered with the debris of the cherty zone, which in a few places seems to be *in situ*. The cherty portion of the Lower Limestone also appears farther west in a small outlying exposure between where Gort and *Drummin Cottage* are engraved on the one-inch map, being brought in by an anticlinal curve, which at the margin of the district brings up the Lower Limestone shale, and farther north, in Sheet 115, the Old Red sandstone.

On the east and south of Lough Cooter these dark blue limestones are also exposed, and immediately N.E. of the castle, on the shore of the lough, an excellent section of the cherty beds was observed, which gives a thickness to them of at least sixty-five feet.

On the S.W. of Ballinakil Lough, which lies south of Lough Cooter, all this part of the Lower Limestone becomes extremely cherty, a bed free from layers or nodules of chert being rare. Here they are shifted three times towards the west, as marked on the map, by the western continuation of the *Derrybrien* and *Corlea faults*, the latter, as before remarked, having split into two branches hereabouts.

* Most of these are too small for insertion on the one-inch map.

The faults are well proved here, as the stratified limestone with chert is found striking against the unstratified limestone without chert. At the S.W. corner of the Lough Cooter demesne, immediately north of the continuation of the *Derrybrien fault*, the cherty zone, which is here very shaly, is rolling over a few acres; in one place forming a small basin, the north side of which appears as a small cliff on the side of the mail coach road. From this to the south branch of the *Corlea fault* the rocks dip either to the N.W., or W., at angles varying from 10° to 30°.

The unstratified limestones without chert bounds the last mentioned on the west. It is well exposed from Bunahown, four miles north of Crusheen, to the north of the district, being shifted by the faults where they cross it. It is generally more or less magnesian, sometimes a good yellow dolomite, which seems to occur in patches and blend imperceptibly into the other kinds. On the north of the Derrybrien fault, at the S.W. corner of Lough Cooter demesne, the angles rise to 50°, and at Lough Cooter, N.E. of the castle; a good section is exposed in both these places. This part of the Lower Limestone is between 400 and 450 feet thick. On the north of Lough Cooter it takes a westerly direction round Gort, and from thence towards the north, leaving the district with the road to Loughrea. To the west of Gort the gray limestone without chert seems to become very thin, not more than fifty or sixty feet thick; but it thickens again as we proceed towards the N.E.

Outlying Exposures.—One of these occurs N.W. of Shanaglish, two miles west of Lough Cooter, consisting of the gray limestone without chert. Its south and west boundary are well marked, but the others are obscured by drift or bog. Another of them was noted about two miles S.W. of Gort, but its boundary is very uncertain.

The Upper Limestone.—This is *par excellence* the limestone of this country, as it rolls in gentle undulations covering an area of about sixty-four square miles. It can be examined in numerous places, as much of the country is a bare rocky crag.

A thick bed of yellow dolomite was observed where the river sinks at the road, a mile south of Gort, and a small calcspar vein half a mile S.W. of Shanaglish.

To the N.W. of Derryowen Cottage, six miles S.W. of Gort, there are three beds of blackish gray dolomite, one of which lies round a small *quaquaversal* dome. In various other places the limestone is more or less magnesian.

The colour of the Upper Limestone here is generally dark gray or blue, and without shale partings, but in one place, near Lough Aslaun, about five miles S.W. of Gort, it was of a black colour and had shale partings.

Drift.—This occurs in low ridges that usually run about N. 20° E. to N. 35° E. It principally consists of limestone debris, with numerous blocks of granite, similar to that on the north of Galway Bay.

Bog and Alluvium.—These lie in irregular lines with a similar bearing to the drift. The bogs are usually shallow, and so hard to be drained that they are often unprofitable; but good bogs occur in the neighbourhood of the lakes nine miles S.W. of Gort. The alluvium is principally shell marl mixed with peat.

6. *Mines and Minerals.*

In this district iron ore was formerly extensively raised and smelted. The remains of three furnaces are still to be seen.* One at Furnace, a

* There is another which is not included, as it was only partially built, and never used for smelting purposes. It is situated about three miles S.W. of Woodford.

little east of Feakle Church, another at Furnace, two miles and a quarter eastward of Mount Shannon, and the third at Woodford. Besides these there are old iron mills at Coolcoosaun, one mile north of Scariff, at Meelick two and a half miles east of Mount Shannon, and at Woodford.

Mr. Hely Dutton, in his *Statistical and Agricultural Survey of Galway*, 1824, *section V., p.* 33, says:—"Iron ore was formerly raised in the neighbourhood of Woodford, and after being mixed with that brought up the Shannon from Killaloe, by a Mr. Croasdale, was smelted near that village, part of the estate of Sir John Burke. The works were carried on so extensively that they devoured all the great oak wood with which that country abounded, and was then abandoned. Mr. Berry, I understand, at present raises ore on part of Lord Clanrickard's estate."

From inquiries made in the country it appears that the last furnace put out, was that of Woodford, about 110 years ago, and the furnace near Whitegate, about forty or fifty years before.*

The ore principally used was the *bog ore*, which occurs in numerous places in the hills and valleys. This was mixed with "red mine"† and ore that was brought up the Shannon from below Limerick,‡ as the mountain mine used by itself made iron that was too hard.

In the furnace near Feakle bog ore and "red mine" were smelted; the bog ore was raised in the bogs and flats south of Lough Graney and in other places; the red mine in the hill, one mile N.E. of Feakle Church, where some of the old burrows are still visible. Red mine is also said to have been raised near the north of Glendree, where the old adit, previously mentioned, now exists.

The bog iron ore occurs nearly everywhere in the mountain bogs and hollows. Sections exposing beds of it having been remarked in most of the rivers and streams, and Mr. Mathews, of Shannon Hill, pointed out to us a large bed of it on the hill to the west of his residence.

An earthy ore of manganese§ is very common in the drift of the mountain district; it is often associated with the bog ores of iron.

The other minerals remarked are principally traces of lead and copper, none of which seemed to be of any promise. They have been mentioned previously in the places where they occur. G. H. K.

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* Sir T. Burke, Bart., M.P., kindly accompanied me to Woodford, and pointed out the sites of the old mills and furnaces, also the anvil, hammer, and one of the bars of the furnace; on the latter is the date 1681, which is supposed to point to the year they were first erected, and from calculations Sir T. Burke made, he considers that they were put out in the year 1750. An old intelligent man, near Woodford, also informed me that he was eighty years of age, and that his father told him "That when he" (the father) "was quite a small boy, the furnaces were put out;" which, our informant says, must be about 110 years ago. Sir T. Burke could not point out the exact place where the ore was raised, but as it abounds everywhere there may have been no regular workings. At Woodford there was a furnace, casting house, and rolling mills.

† Perhaps some of the ore from the neighbourhood of Tomgraney.—(*Clare, Sheet* 28).

‡ Perhaps from the coal measures in Limerick and Clare.

§ This has been called Diallogite, *see Bristow's Glossary of Mineralogy*; but Sir R. Kane, who found it occurring as a buff coloured marl in Glendree, would confine that name to the crystalline variety.

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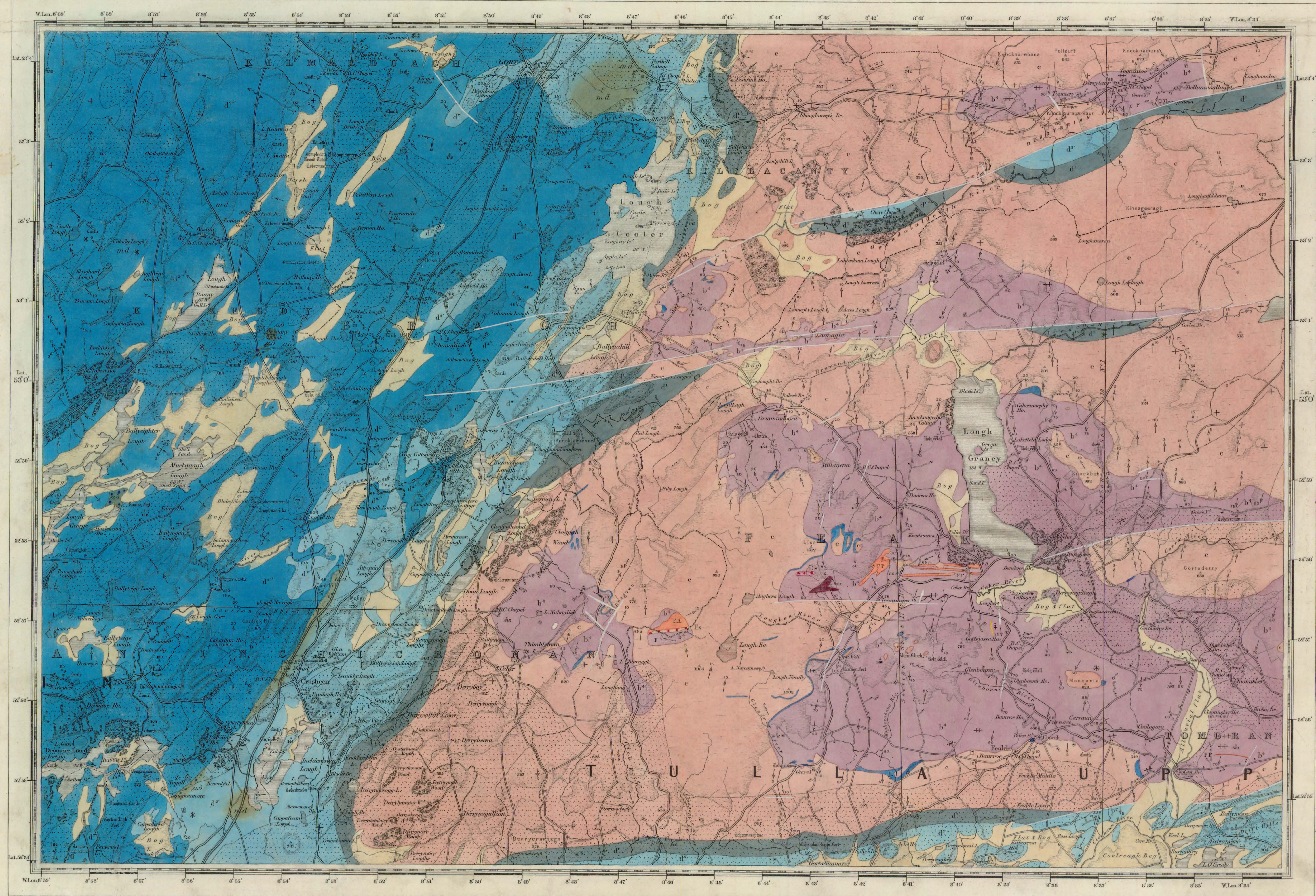
ORDNANCE SURVEY OF IRELAND.

GEOLOGICAL SURVEY OF IRELAND

(Gort) SHEET 124



Bog Alluvium &c.

Drift

Carboniferous Rocks

- $d^{2'''}$ & $d^{2''}$ Upper & Middle Limestone (not separable in this district)
- $d^{2'}$ Lower Limestone
- d^{1} Lower Limestone (Shale)
- Dolomite Metamorphic
- md Magnesian Limestone

c Old Red Sandstone. Blue lines are Cornstones or Siliceous Limestone

b^{4} Upper Silurian Llandovery

F Felstone
FP „ Porphyry
FA „ Amygdaloid

D Greenstone Diorite
DP „ Porphyry
DA „ Amygdaloid

Fs Ds Trappean Ash

Dips. Inclination of the beds the figures expressing the angle below the horizon

Contorted beds

+ Horizontal beds

++ Vertical beds

Quaquaversal domes

Anticlinal curves

Synclinal curves

White lines are faults. Gold lines are lodes or mineral veins

♀ Copper

♂ Iron

Lead

Zinc

Bisulphide of Iron. Iron pyrites

✱ Fossil localities

The Geology of this Map published May 1863.
Sir R.I. Murchison D.C.L. F.R.S. *Director General.*
J. Beete Jukes A.M. F.R.S. *Local Director.*
Surveyed by G.H. Kinahan.
Silurian Rocks revised by J.R. Kilroe (Published 1901).
Sir Archibald Geikie D.C.L. L.L.D. F.R.S. *Director General.*

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25	26	27	28

Galway (top), Clare (bottom)

Scale of One Inch to a Statute Mile $\frac{1}{63360}$

8 7 6 5 4 3 2 1 0 — 1 — 2 — 3 — 4 Miles

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123	124	125
132	133	134

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