Memoirs of the Geological Survey.

EXPLANATION

TO ACCOMPANY

SHEETS 117 AND 118 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING A PORTION OF THE

KING'S AND QUEEN'S COUNTIES, AND THE COUNTIES OF GALWAY AND TIPPERARY.

By J. O'Kelly, M.A., M.R.I.A.

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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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This district was surveyed partly by Mr. A. B. Wynne, now of the Indian Geological Survey, and partly by Mr. J. O'Kelly, who has drawn up the following description of it.

J. Beete Jukes.

LIST OF THE ILLUSTRATIONS.

EXPLANATION

TO

ACCOMPANY SHEETS 117 AND 118 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

General Description.

The principal portion of the area included in these two sheets of the Map belongs to the King's county, containing the towns of Birr, or Parsonstown, and Banagher, with the villages of Shannon Harbour, Cloghan, Killyon, Kinnitty, Frankford, Ballyboy, Mountbolus, Killeigh, Geashill, and Clonygowan. The Queen's county occupies a considerable area of the southern half of Sheet 118, the chief places in it being the town of Mountmellick and the villages of Rosenallis and Clonaslee. A part of the county of Galway is included in the N.W. corner of Sheet 117, while a portion of the county of Tipperary, with the village of Lorrha, occupies the S.W. corner of the same sheet.

1. *Form of the Ground.*

The northern part of the Slievebloom Mountains, extending from Rosenallis to Kinnitty, forms the highest ground included in this district. There are several summits, the principal of which are Baunreaghcong, 1,677 feet above the sea; Barna, 1,661; Wolftrap, 1,584, and one, half a mile south of it, 1,602; and the ridge of Capard, 1,590. No features of note occur between these elevations, the top of the range, as in the adjoining district to the south, forming a broad undulating tract, from which the ground slopes to the north towards Clonaslee, to the west towards Kinnitty, to the east towards Mountmellick, and between Wolftrap and Baunreaghcong towards the south. The northern and western slopes are indented by many long and deep glens, the principal of which are Glenbarrow, whence the River Barrow draws its head water, two glens which run up from Clonaslee, and two remarkable glens to the west of Wolftrap Mountain, one of which opens into Cadamstown, and the other into Kinnitty. There are two passes across the range, traversed by a main road, one called "the Cut," south of Clonaslee, the summit of which is about 1,350 feet, and another two miles to the west, which has a height of 1,500 feet. The remainder of the district being a portion

of the great central plain of Ireland, has no features of any importance. It has an average height of about 250 feet above the sea, having occasional elevations of over 400 feet.

The main water-shed of Ireland crosses the eastern side of the district. It enters Sheet 118 at the county boundary, south of Wolftrap mountain, thence running N.N.E., curving to the east a little north of the height 1,602, as far as the Cut, whence it again curves to the north, running between two nearly parallel and closely adjacent glens down to a point half a mile east of the village of Clonaslee. It runs thence across Monettia Bog, which is not much more than 300 feet above the sea, then curves to the east, south of Killeigh, passes south of Geashill Railway Station, and thence curving to the north-east, passes into the adjoining district, north-east of the village of Geashill.

To the west of this line the country is drained by the Shannon and its tributaries, while that to the east is drained by the Barrow and its tributaries. A small portion of the district south of the Cut gives off the head waters of the Delour River, a tributary of the Nore. The Shannon enters the district north of Banagher, at a height of 115 feet, and leaves it S.W. of the same place, at a height of 108 feet, having a fall of only 7 feet in 12 miles. The principal tributaries to the Shannon are the Rivers Brosna and Little Brosna, the former having for tributaries (which, however, do not join it within the limits of this district) the Clodiagh and Silver Rivers, and the latter the Camcor River. The Brosna enters the district N.E. of Shannon Harbour, at a height of 140, and joins the Shannon west of the same place, at a height of 114 feet, having a fall of 26 feet in about four miles. The Little Brosna enters the district S.W. of Birr, at a height of 148 feet, flowing into the Shannon four miles S.W. of Banagher, at a height of 109 feet, having a fall of 39 feet in a course of ten miles. The Clodiagh is formed by the union of several small streams, which rise S.W. of Clonaslee, at a height of over 1,200 feet. It is joined a little north of the same village by a small tributary called the Gorragh River, which rises near the Cut. The height of the Clodiagh at Clonaslee is 370 feet; thence it runs in a northerly direction, leaving the district N.W. of Clonad Wood, at a height of 210 feet, having a fall of 160 feet in its course of about nine miles from Clonaslee. The Silver River is formed by two brooks which rise west and north-west of Wolftrap Mountain. One of these passes through Cadamstown, and the other, farther to the east, forms the boundary between the King's and Queen's counties. The Silver River is also joined by the Ballynacarrig River, which runs out of Annaghmore Lough. The height of the Silver River east of Ballynacarrig Mills is about 255 feet, and its height where it leaves the district N.W. of Frankford 155 feet, having a fall of 100 feet in thirteen miles. The Camcor River rises east of the village of Kinnitty, and flowing thence in an easterly direction, joins the Little Brosna at Birr.

A small brook, fed by some springs north of Barna, at a height of 1,500 feet above the sea, may be considered as the head water of the River Barrow, which gradually increases in size, from being joined by several small streams, which fall into Glenbarrow. At Rathcoffey Bridge, at the foot of the hills, a similar stream, called the Glenlahan

River, falls into it, and thence runs in a northerly direction to the eastern side of Monettia Bog, where it curves round to the south-east, leaving the district north-east of Mountmellick. The height of the Barrow at Rathcoffey Bridge is 319 feet, and where it leaves the district 226 feet, having a fall of 93 feet in thirteen miles.

The principal tributary to the Barrow in this district is the Owenass River, which rises east of Baunreaghcong, at a height of 1,450 feet, and running down the east side of the Slievebloom, flows into the Barrow north of Mountmellick, at a height of 235 feet. Another tributary is the Tfiogue River, which rises in the adjoining district to the south, and drains the south-east corner of the district; it flows into the Barrow less than a mile east of the junction with the Owenass.

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

Aqueous Rocks.

Name.	Colour on Map.
Bog, Alluvium, &c.,	*Pale Sepia.*
Drift,	*Engraved Dots.*
d^3. Middle Limestone, or Calp,	*Indigo.*
d^2. Lower Limestone,	*Prussian Blue (pale).*
d^1. Lower Limestone Shale,	*Prussian Blue and Indian Ink.*
c. Old Red Sandstone,	*Indian Red.*
b. Lower Silurian,	*Purple.*

b. *Lower Silurian.*—Partial sections of this group are all that can be seen in this district, showing strong gray and greenish gray grits, interstratified with dark gray slates, flags, and fine olive grits. Strong greenish and bluish calcareous grits, with bands of dark gray slate, also occur in it.

c. *Old Red Sandstone.*—This consists, as in the adjoining district to the south, of coarse yellow, gray, and purplish sandstones, often more or less conglomeritic, occasionally interstratified with beds of red shale, and thin red sandstone. The basal bed of the Old Red is usually red shale, which varies in thickness from two to six feet. Above it are strong coarse gray sandstones, occasionally changing to a coarse conglomerate, the paste of the latter sometimes becoming highly calcareous. Some of the yellow sandstones are very flaggy, and split readily into flags of excellent quality, which are much used for economic purposes. The total thickness of the group in this district is about 450 feet.

d^1. *Lower Limestone Shale.*—This group consists of alternations of black earthy shales with blue calcareous sandstones and impure earthy limestones, occasionally, however, containing a band of pure limestone. All these beds contain fossils in abundance.

d^2. *Lower Limestone.*—The lower part of this group consists of dark bluish gray crystalline limestones, the beds being often divided by thin partings of black shale. Cherty bands are also met with in this portion of the Lower Limestone. The upper part consists of massive gray crystalline limestone, in which the bedding is frequently

very obscure. It is an excellent building stone, and also well adapted for burning into lime. It is impossible to say what the thickness of the Lower Limestone may be in this district.

d³. *Middle Limestone, or Calp.*—This group consists of black earthy, impure limestones, interstratified with bands of black shale and layers and nodules of chert. The beds are generally thin and regular, and sometimes assume a flaggy character. Fossils are very scarce in most of the beds, and rarely occur in any such abundance as they do in the Lower Limestone. Good stone for some kinds of building may be obtained from portions of this group, but it is not generally well adapted for building purposes. It is also usually quite unsuited for burning into lime. Owing to the imperfect sections exposed, it is impossible to determine the thickness of the Calp Limestone in this district.

3. *Relations between the Form of the Ground and its Geological structure, and general account of the latter.*

The Slievebloom Mountains are formed of Old Red sandstone and Silurian rocks, while the plain which occupies the principal portion of the district has for its underlying rock the Carboniferous limestone. The Old Red sandstone, although occupying the highest ground in the district, dips underneath the surrounding limestone, both being deposited in conformable succession. The Old Red sandstone, however, rests quite unconformably on the Lower Silurian rocks. It is obvious that the Lower Silurian beds had been tilted into a highly inclined position, and greatly denuded before the deposition of the Old Red sandstone, and that both had been subsequently upheaved. The form of these mountains as they now appear is not, however, due to that upheaval, as at the time it occurred the Old Red sandstone was covered by the Carboniferous limestone. This has been subsequently removed by denudation from the high ground, while it still remains concealing the Old Red sandstone, which extends beneath the plain (see fig. 1). The Old Red sandstone itself also suffered from this wasting action, which occasionally was sufficient to remove it completely from the underlying Silurian, leaving portions of that rock exposed in several places (see fig. 2). To this denudation is due the present configuration of the Slievebloom Mountains.

rook again turns to the north-west, are thick gray and yellow sandstones, bove which is a bed of greenish clay rock with calcareous nodules. his latter bed may be taken as the top bed of the Old Red sandstone, s immediately above it are yellow thin grits, with Carboniferous fossils which may be considered as the base of the Lower Limestone shale, nd the boundary has been drawn on the map accordingly. Above hese yellow grits are alternations of black earthy shales, with hard blue alcareous grits and impure limestones, with an occasional thin band of urer limestone, all weathering rusty and containing fossils. These beds lip to the N.W. at 10°. This is the only locality along the northern base of the Slievebloom Mountains, where the junction between the Old Red sandstone and Lower Limestone shale is exposed.

Another good section in the Old Red sandstone is visible in the brook which forms the boundary between the King's and Queen's counties, but being similar to the above its description need not be repeated.

Strong, coarse, gray, and yellowish sandstones, with occasional conglomerates, appear in several places about Spink mountain and in the by-road which leads north-west from it. The junction between the Old Red and Silurian is exposed south-east of Spink, at intervals in the brook for a third of a mile. The basal bed of the Old Red, as before, consists of red shale, which, however, is irregularly deposited, at times being very thin, and again thickening to five or six feet; above this are thick, coarse, irregularly bedded ferruginous sandstones. Farther east these sandstones are replaced by a very hard compact blue conglomerate, the paste of which is highly calcareous; the conglomerate rests on about two feet of red shale and thin grits which rest directly on the Silurian, which here is composed of hard gray grits and slaty grits, with some hard green grits and flaggy bands, all undulating at high angles dipping north and south. The calcareous conglomerate observed here appears to be quite local, as it cannot be traced for any distance, nor is it again met with at other localities where the basal beds of the Old Red are exposed. Coarse gray and whitish sandstones are visible in the brook farther to the east, the beds being nearly horizontal.

The underlying Old Red sandstone is almost completely concealed by a thick covering of bog in the vicinity of Wolftrap mountain, and along the county boundary south of it as far as the margin of the map, but its boundary can generally be determined with tolerable accuracy by the contour of the ground, and its debris, together with an occasional exposure at the heads of some of the brooks. Coarse gray conglomeritic sandstones are visible on the south side of the road near the boundary, south of Hugh O'Neill's well, and at the head of the brook farther south are some gray and purplish sandstones with a bed of red shale, the beds having a slight inclination to the east. A little to the west of this in the same brook are hard greenish gray Silurian grits and slates, with some thin gray and greenish flags that dip S.S.E., at from 40° to 60°, and the unconformability between the two formations may be clearly inferred, although they are not visible in immediate contact. Another junction is exposed a little more than a mile to the W.S.W. of the last where the basal bed of red shale is visible.

The Silurian may be observed in most of the brooks near the Old Red boundary, but one of the best sections is visible west of Hugh O'Neill's well. Commencing at the east, we first have dark gray slates and flags, that dip N.W. at 80°, above these are hard blue grits, dark gray slates, and flags; then come some thick greenish gray grits, that dip N.W. at 45°, above which are alternations of strong, gray, and greenish grits, with occasional slate bands that dip in the same direction at from 45° to 80°. Lower down in the valley the Silurian is entirely concealed by the drift, but it may be observed in occasional spots round the spur of Old Red on

which the heights 1184 and 1293 are marked on the map, and the junction between the two rocks is exposed in the stream about three quarters of a mile W.N.W. of the trig. point 1293. Here the basal bed of red shale is only about one foot thick. It is horizontal, resting on gray grits and slates that dip N.W. at 50°; above the red shale are coarse, gray, and purplish sandstones with two bands of red shale, this section of the Old Red is visible for a very short distance, being concealed by the bog a little south of the road.

Coarse purplish conglomeritic sandstones, and flaggy sandstones are visible in a quarry four hundred yards west of the height 1293, and similar beds are exposed north of the same height. The Silurian is probably covered by a very small thickness of Old Red on this spur as it appears itself in a little isolated exposure north of the height 1184, while the Old Red is seen at the castle to the south, and in an occasional exposure, farther to the west, and the junction between it and the Silurian is tolerably well seen to the east, a little less than a mile north of the above-mentioned height, and is similar to those already described.

The Old Red is exposed in the brooks N.W. of the little Silurian exposure consisting of white and reddish sandstones, with an occasional conglomeritic band, and sometimes a bed of red shale, these beds all dip to the N.W. at from 10° to 15°. At Castle Bernard are whitish obliquely laminated conglomeritic sandstones, that undulate to the N.W. at 3°.

To the north-east and south-west of this, towards Cadamstown in one direction, and as far as the margin of the map in the other, south-west of Kinnitty, the underlying rocks are (with one exception, where yellow sandstones are exposed in a quarry two-thirds of a mile east of Lettybrook House) entirely concealed by large accumulations of drift, and the boundary between the Old Red sandstone and Lower Limestone shale is quite provisional. There are also very scanty data for the boundary between the Silurian and Old Red south and south-east of Kinnitty, the drift often extending far over the high ground in that direction. The Old Red, however, is visible in a few places on Knocknaman Hill, and red shales, calcareous conglomeritic sandstones, and gray speckled sandstones, are visible one mile to the east of it, near the margin of the map, and the junction between it and the Silurian is imperfectly exposed half a mile north of the same place.

The Silurian is exposed in a few places south and east of Caneyburrow Bridge, and fossils of the genus *Orthoceratites* were observed by Mr. Wynne in some nodules, found in weathered flaggy and shaly beds, one mile S.S.E. of the same place. The direction of the cleavage here is E. 10° N., W. 10° S.

We shall now proceed to describe the localities where the rocks are best seen in the vicinity of Clonaslee, and south of it. The Old Red sandstone is exposed at the Cut, consisting of coarse gray and purplish obliquely laminated sandstones, with thin layers of sandy shale between the beds, and sometimes coarse conglomeritic layers. They are nearly horizontal. Coarse speckled conglomeritic sandstones and flaggy sandstones are visible in the stream to the south, the beds dipping N.W. at 15°. Similar rocks are exposed north and south of the height 1523, and coarse gray sandstones, that dip north at 3°, are seen very close to olive, gray, and greenish Silurian rocks, half a mile south-west of the above-mentioned height. Purplish flaggy micaceous sandstones and gray conglomeritic sandstones may be also observed in the stream farther west, and the Silurian rocks are well seen in the brook to the south, consisting of thick, hard, coarse, greenish, and bluish calcareous grits, with a very tough, fine-grained, blue calcareous grit; above these are hard blue grits, with thin bands of

dark gray slate. These beds dip to the N.W. at from 45° to 60°, when there is a sharp synclinal, the same beds coming up again farther to the N.W. dipping S.E. at 60°, but quickly reversed again and dipping to the N.W. at 60°. Thin blue grits and flags, with slate bands, come in higher up in the section. The Silurian is also exposed in the road south of the Cut, where hard greenish gray grits may be observed dipping south-east at 40°, and again in the brook one mile to the east, where it dips N.W. at 80°,

The Old Red sandstone is entirely concealed by the bog (which spreads over most of the summits of the Slievebloom mountains) in the vicinity of Barna, Baunreaghcong, Knockachorra, and Knockanastumba. It is however well exposed near the source of the Glenlahan River, in which it continues to be well seen at intervals to within three-quarters of a mile south-west of Clarahill Bridge; the beds are nearly horizontal till we come near the northern end of the section, when they commence to dip north at from 10° to 15°.*

The outlying exposure of Silurian marked on the map north of the Cut is well exposed in the Gorragh River, consisting of hard bluish, and olive grits, with bands of dark gray and ribboned slate. At the northern end of the section the dip is N.N.W. at from 40° to 65°, while the beds undulate at the southern end, dipping N.N.W. and S.S.E. The boundary of this exposure of Silurian is quite provisional on the western side, as the rocks are there quite concealed by a large deposit of drift. It is, however, tolerably well seen on the eastern side, as flaggy coarse sandstones of the Old Red, nearly horizontal, are exposed close to the Silurian.

The Old Red sandstone is visible at intervals in the lower part of the Gorragh River to within three-quarters of a mile south of Clonaslee. Fossils, consisting of stems of plants, were observed in some coarse conglomeritic sandstones near its base, close to the northern extremity of the Silurian exposure mentioned above. Some very coarse quartzose conglomerates occur about one mile and a half south of Clonaslee, and again in the space of about half a mile further north. Good flags are obtained to the east of the last locality, in the townland of Srahcullen. These flags, which are in considerable demand, are known as Clonaslee flags.†

A good section of part of the Old Red is seen in the brook which rises north of Wolftrap mountain. The beds consist of coarse gray and purplish sandstones, sometimes conglomeritic, and often obliquely laminated, and occasionally interstratified with a band of red shale. Near where the brook turns to the north-east are some white sandstones and flags, the latter being of very good quality; all these beds are very flat, being either nearly horizontal, or with a slight inclination to the north. After the brook turns to the north-east, the drift setting in conceals the Old Red, with one or two exceptions, in the direction of Clonaslee. Coarse sandstones are occasionally exposed north of the trigonometrical point 1202, and to the west of it about the trigonometrical point 1054. A short continuous section is also seen to the N.W. in the brook which passes beneath Lahoole Bridge and Clonaslee, the Old Red sandstone is exposed in occasional spots, but no good section of it is visible.

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* Flags of excellent quality are obtained from some white flaggy sandstones that occur in the neighbourhood of Trooper's Quarry, and half a mile south of it. These sandstones split readily into slabs of from one to four inches in thickness, and are said to be sometimes obtained ten feet square. They are sold at from two to four shillings per superficial yard, according to quality and time spent in dressing them.

† Mr. Michael Troy, of Clonaslee, who quarries these flags rather extensively, delivers them in Tullamore at four shillings per square yard. Steps are sold at two shillings and sixpence per superficial foot of surface chiselled, and gate posts from twenty-five to thirty shillings a pair.

The position assigned to the Lower Limestone shale between Cadamstown and Clonaslee, and east of it, is quite provisional, as both the Lower Limestone and Lower Limestone shale are concealed along the base of the mountains by the large accumulation of drift which occurs in this portion of the district.

The Old Red sandstone may be well observed in the river Barrow, and in a small tributary which joins it at Mill Quarter. The Silurian appears at the surface about two miles from the source of the Barrow, forming a small outlying exposure, the western boundary of which is provisional, being quite concealed by drift. The eastern boundary is, however, well marked, and the Silurian and Old Red are seen almost in contact in some of the small streams which flow into the Barrow. The ancient floor of Silurian on which the Old Red was deposited appears to have been very uneven in places, as if the beds of the latter were sometimes deposited against a small cliff of the former, which, when now exposed to view, gives the appearance of a fault, although one does not really exist. This appearance is well seen in the Barrow, at the northern end of this exposure, where very hard coarse gray sandstones, with a few beds of cornstone,* and a band of greenish sandy shale that dip to the south at a low angle, while, a little farther south, the Silurian is exposed at a higher level, consisting of dark gray grits and slate, with some greenish flags, which dip to the N.W. at 70°, a sharp anticlinal occurring further south, these beds dipping S.E. at 85°. Now the ends of the above-mentioned beds of Old Red apparently abut against the Silurian, having at first all the appearance of a fault, which, on further examination, is apparently due to the irregularities of the ancient floor on which the Old Red was deposited. To the west of this the Old Red is exposed in several places in the bed of the Barrow, for the space of a mile, the beds being nearly horizontal, with slight undulations. Some coarse quartzose conglomerates occur where the course of the river turns to the south-west, and a small, nearly east and west, fault may be observed a little farther in the same direction.

To the north the Old Red is exposed, with few exceptions, in the bed of Barrow to Mill Quarter. Due north of the Silurian exposure, the river has worn through beds of strong gray sandstones with a bed of red shale, which are seen in the cliffs on either side, these sandstones are irregularly bedded, and apparently faulted at times, as the band of red shale occasionally ends abruptly, and cannot be traced with any certainty; possibly the shale may have been undermined by the river, and the sandstones fallen in at times, or there may be a series of small faults here, but if they do occur it is impossible to follow them out. Sandstones, with an occasional bed of red shale appearing in places, which are probably the same beds as those just mentioned, continue to be visible for half a mile to the north, when the Silurian again appears in the bed of the river, consisting of hard, thin, greenish gray grits, and ribboned purplish slate with calcareous strings; these beds dip N.W. at 60°, and are only visible at one point in the bed of the river, the Old Red sandstones being exposed all round it, the beds being nearly flat, and the basal bed as usual a band of red shale. One of those unaccountable irregularities which sometimes occur in the sandstones of the Old Red is exposed here, which at first sight has all the appearance of a fault, although on further examination the continuity of the beds does not appear to be broken in the line of the supposed fracture, the faulted appearance of the rocks being probably due to the irregular bedding of the

* These cornstones appear occasionally to die out and pass into an ordinary sandstone.

sandstones and shales. To the north of this are stoney, thick, whitish and yellowish sandstones, the beds being nearly horizontal.*

A small fault, the direction of which is E. 20° S., N. 20° W., with a downthrow to the south, occurs here. Farther north are thick, coarse, gray conglomeritic sandstones, and whitish sandstones with a bed of clay rock, with calcareous nodules. Lower down in the river are alternations of whitish and purplish sandstones, with an occasional bed of red shale. Some of the white sandstones are very flaggy, and readily split into good flags, which are quarried to some extent. The Old Red still continues to be exposed, being however concealed at short intervals, till we arrive at Mill Quarter, beyond which it is not again visible in the bed of the river. It is all much of the same character, being composed of sandstones of different shades of gray, and different degrees of coarseness, occasionally more or less conglomeritic and interstratified with some purplish bands, and sometimes a band of red shale. Although the rocks are well exposed in this section, it is by no means easy to form any accurate idea of their thickness, as, owing to the similarity of the beds, and slight undulations which occur, together with the oblique lamination, it is often impossible to tell how the beds lie with regard to each other.

To the east of Mill Quarter, as far as Rosenallis, and south-east of it in the vicinity of Crabtree Farm, also in the brook south of it, the Old Red sandstone is often exposed, being frequently visible in some brook or quarry, or seen at the surface, over a considerable area, between Mill Quarter and Rosenallis. Numerous flag quarries are opened in it, and the flags which are similar to those already described as occurring farther to the west, are of excellent quality.

The Lower Limestone is exposed half a mile north of Rathcoffey Bridge, consisting of thick, regularly bedded, bluish gray limestone, with some dark gray shaly and impure bands, and thin partings of black shale, the bluish gray beds are highly fossiliferous, abounding particularly in crinoids; these beds dip north at 10°. A little further north are thick bedded, dark bluish gray, crystalline, crinoidal limestones, with occasional shaly bands, dipping in the same direction as the last, at from 5° to 10°. Similar beds that dip north and N.N.E. at from 5° to 10°, are exposed in several quarries, in a small hill, a mile and a half to the east of the last locality, west of Ballygillaheen, some of the beds here are slightly oolitic, and are well adapted for building purposes.

These are the only localities where the Lower Limestone is exposed near the Old Red sandstone in this part of the district.

The Silurian which forms a large exposure at Capard, on the eastern slope of the Slievebloom mountains, is well seen in several small brooks near Capard House, one of the best sections of it, which also shows the junction with the Old Red, is in the brook which passes immediately south of the house. Commencing at the western end, at the Old Red sandstone boundary, we first have very hard blue calcareous grits, deeply weathered, that dip S.E. at 80°; on the edges of these beds the Old Red sandstones rest horizontally, the basal beds consisting of a shaly conglomerate. To the east are gray and fine-grained olive grits, interstratified with dark gray slate and slaty grits; these beds come up again south of Capard House, the dip changing to the N.W. at from 70° to 80°, a synclinal, the axis of which is nearly N.E. and S.W., extending through the centre of this expo-

* These sandstones are well adapted for building purposes, being of very even texture, and the beds being thick, very large blocks can be obtained. Some of the fine cut stone used in the erection of Ballyfinn House, the seat of Sir Charles Coote, Bart., was obtained here.

sure of Silurian. At the eastern end of the above section, the Old Red is again seen dipping to the S.E. at 15°, and resting on the edges of blue calcareous grits and slates that dip N.W. at 70°. A similar junction is exposed in the brook 300 yards to the north-east, and the Silurian and Old Red are seen in close proximity in the wood, farther north, while the latter rock may be observed in several places along the road leading to Rosenallis. It is also well exposed all along the western boundary of the Silurian to Clarnahinch mountain, the beds being generally very flat, with occasional slight undulations, and being similar to those already described. The Silurian is also visible in several places near the western boundary, which is very well marked at several points, as both rocks are occasionally seen in contact. The appearance of the ground is also very striking, as the ends of the horizontal beds of Old Red sandstone often crop out, forming rugged barren ground, while the Silurian forms a much more gentle slope. The eastern boundary, which is quite provisional, being completely concealed by a large deposit of drift, is drawn from the appearance of the ground, to where the junction is seen near Capard House. A short section of Old Red is seen in the Owenass River at Cathole Bridge, consisting of thick, coarse, gray, and yellowish white irregularly bedded sandstones, occasionally conglomeritic. One-third of a mile east of the bridge is a bed of red shale. The beds are nearly flat at the bridge, and for two hundred yards to the east of it, when they begin to dip east at from 10° to 20°. Two hundred yards farther east in the river, are thin red sandstones and shale, above which are gray and white sandstones, and shaly sandstones dipping east at from 10° to 15°.

Whitish speckled sandstones are exposed, near the margin of the map, a quarter of a mile S.E. of Cathole Bridge, the beds inclining to the east at a low angle. The Lower Limestone shale is seen a little to the E.S.E. of this in the adjoining district to the south (see explanation 127), where the boundary between it and the Old Red is tolerably well marked. To the north, in the direction of Rosenallis and Mountmellick, the rocks are entirely concealed by a thick deposit of drift, and the boundary between the Old Red and Lower Limestone shale is drawn entirely from the form and general appearance of the ground, as no rock is seen in situ over a considerable area. Black, and dark gray earthy, and impure limestone with bands of black shale, and containing fossils in abundance, is visible on the west side of the road, half a mile south-east of the town of Mountmellick; the dip of the beds here is to the S.E. at 20°. These beds have been included in the Lower Limestone shale, as they are very similar to those in the district to the south, and the large spread of Lower Limestone shale marked on the map here is on the supposition of the rocks being very flat, causing a very small thickness to spread over a large area.

The Lower Limestone is well seen, more than a mile farther to the east, in a crag of rock, on the south side of the canal, near where the National School is marked on the map. It here consists of thick irregularly bedded, pale gray crystalline, and bluish gray limestones, abounding in fossils, the beds dipping to the N.E. Similar limestones are exposed half a mile to the south, the beds dipping S.E. at 20°; and less than half a mile to the E.S.E. of the same locality, are dark gray and bluish gray limestones, with some cherty beds and thin bands of brown shale, that dip W.N.W. at 25°. Beds similar in character are exposed in a quarry two miles to the S.S.W. of Killeen House; they incline slightly to the S.W.

II. *The Country about Mountbolus, Killeigh, Geashill, and Clonygowan.*—The Lower Limestone appears at the surface, over a small area about the village of Mountbolus, where it is composed of amorphous gray crystalline limestone, in which fossils are very abundant. Light, gray, fossiliferous limestone is again visible in a quarry a mile and a half to W.S.W., where

the beds dip south-west at 45°, and similar limestone is well exposed in some crags at Ballynacarrig Bridge. At the latter locality, the beds appear to be nearly horizontal. One mile and a quarter farther to the south-west, at Knock Hill, where the trigonometrical point 499 is marked on the map, the limestone is again exposed in some crags and old quarries, and according to Mr. Wynne, it here consists of pale gray limestone, flaggy and crinoidal in places, with some chert bands, weathering white, north of the trigonometrical point the beds dip east at 40°. These are the only localities where the Lower Limestone is exposed south, and south-west of Mountbolus in Sheet 118. To the north it is visible in several places in the hill on which the trigonometrical point 406 is marked on the map, where it consists of thick bedded gray crystalline limestone, the beds dipping S.E. at 15°. Similar limestone is exposed in a quarry, and on the road west of Mountpleasant House. To the north, about Derrymore House, Pallas House, and Ross House, and thence to the margin of the map, the underlying limestone is quite concealed by large accumulations of drift.

Two miles east of Mountbolus, thin, regularly bedded, impure dark gray, and blackish limestone, with nodules and layers of chert, is exposed in a quarry in the townland of Killananny, the beds dipping east at 15°;* and light gray fossiliferous limestone, the beds dipping north at 45°, may be observed in two quarries a little east of Annaghmore House. Gray limestone is exposed in Mullagh Hill, east of Mullagh House. On the east side of the hill the beds dip east at 10°, and some thin dark earthy beds, with thin bands of shale, and layers and nodules of chert, come in, resting on the gray crinoidal limestone.

The rocks are now quite concealed by bog and drift over many square miles of country to the north-east, east, and south-east, and no rock is visible *in situ* till we approach near the village of Killeigh. The Lower Limestone is visible in a quarry on the side of the road, nearly one mile S.W. of the village, where thick bedded dark gray semicrystalline limestone, with some impure and cherty bands, may be observed dipping to the N.E. at 10°. On the northern side of the village, on the road side, near the R.C. chapel, are some contorted beds of bluish gray semicrystalline limestone, with some impure shaly bands, with nodules of black chert. These beds are considered to be about the top of the Lower Limestone, and the boundary between it and the Middle Limestone, or Calp, has been drawn a little farther north. This boundary is of course sometimes very arbitrary, as in a district where the rocks are so scantily exposed it is often difficult to say whether some of the beds seen in scattered quarries ought to be included in the Lower or Middle Limestone; but the rule that has been adopted as far as possible in this district is to colour on the map, as belonging to the latter series, all black earthy impure limestones, which are often so argillaceous as not to be called a limestone by the people in the country, and which occur clearly above the Lower Limestone.

Black shaly impure limestone, the beds dipping north at a low angle, is exposed in the road three-quarters of a mile west of Killeigh, and similar limestone is seen about two miles to the north-east, at Killeenmore Woods, and again, near where the school is marked on the map, a mile and a half to the E.S.E. At the latter locality the beds are thin and regular, with shale partings and flags; they undulate, dipping south at from 10° to 15°.

To the south-west of the last locality, east of Pigeon Loughs, about the trigonometrical point 488, is a piece of country on which the drift is thinly deposited, and both the lower gray and overlying black limestone are almost

* The beds seen in this quarry are very like the Middle Limestone, and may possibly belong to it, as they occur in the line of the synclinal in which the Middle Limestone comes in to the N.E.

seen in contact. The gray is well seen, forming bare crags of rock, on the sloping ground which descends into the bog south-east of Pigeon Loughs. It is thick bedded, the stratification being often obscure. *Fenestella* and *crinoids* are very abundant in it, and although no quarry has been opened in it here, it appears to be well adapted for building purposes, or burning into lime. The beds dip N.N.E. at 30°.

Farther north, to the north-west of the trigonometrical point 488, are several quarries of black earthy and flaggy limestone, with shaly bands and beds of black shale. The beds here undulate, those seen in the most southern quarries dipping north at from 5° to 10°, while the beds seen in quarries on the old road farther north dip S.S.E. at 15°. Fossils are not generally very abundant in these beds, but *plant stems*, and shells of the genera *Goniatites* and *Orthoceratites*, &c., were observed in a quarry on the old road near the cross-roads.

The lower gray limestone is again visible in a quarry north of Castle Brack, where it dips north at 5°, and is similar to that occurring to the west. To the east the rocks are, with very few exceptions, concealed by large deposits of drift, and the boundary between the Lower and Middle Limestone is entirely provisional. The latter is only exposed at one place —at the extremity of a by-road one mile and a half W.S.W. of Geashill, close to the bog, where a quarry has been opened in compact, regularly bedded, black flaggy impure limestone, the beds undulating, and dipping south at 5°.

The Lower Limestone is exposed in some quarries about Cloneygowan, on the northern side of the railway, north of the church, where it consists of pale gray crystalline amorphous limestone. Similar limestone is visible in several places to the south of Cloneygowan, at some of which the bedding was visible, the beds dipping east at 15°. Fossils are abundant in this limestone. To the west of Killeen, and south of the old castle, are some bluish gray fossiliferous limestones that dip east at 40°; and to the south-east of the same place are gray limestones, with some dark gray, finely crystalline beds.

III. *The country about Shannon Harbour, Banagher, and the northern portion of Sheet* 117.

Large tracts of bog occur along the Shannon, in the neighbourhood of Shannon Harbour, sometimes spreading out for more than three miles on either side of the river, and the higher land is generally thickly covered with drift, so that the underlying rock is rarely visible. Rock is exposed at the village of Clonony, which, according to Mr. Wynne, is pale gray, with beds of bluish, buff, red, and gray compact variegated limestone, which polish well, making a good marble, for which purpose they have been worked; the beds apparently dip to the N.N.W. at 65°.

To the east of Clonony is a piece of country, about Strawberryhill House and Ballyloughan Lough, which is often covered with numerous scattered blocks of calcareous sandstones and impure limestones, which belong to the Lower Limestone shale. From the quantity in which these blocks occur here, Lower Limestone shale is most likely the underlying rock, and the map has been coloured accordingly, although it is not anywhere visible *in situ*.

A little north of the village of Cloghan, blackish-blue oolitic limestone is exposed in a quarry, and black, hard limestone that dips east at 10° is seen on the road one mile and a quarter east of the village. Black shaly fossiliferous limestone is exposed on the east side of Cloghan Hill, the beds dipping S.E. at from 3° to 5°. Similar limestone was met with in sinking

some wells in the vicinity of Stonestown, with a heading of twenty-feet of drift over it. Farther to the S.W., two-thirds of a mile south of Gaybrook, is a quarry of pale gray compact limestone, the beds dipping north-east at 40°. To the east the rocks are quite concealed by large tracts of bog about the north-east corner of Sheet 117.

About the town of Banagher, and south-west of it, the drift is not so thickly deposited, and the underlying limestone may be observed in a good many exposures. Dark gray and black limestone, the beds being nearly horizontal, is visible in a quarry at the southern end of the town, near Hill House, and thick bedded black limestone that dips S.E. at 5° is exposed to the south-west, on the east side of Lismagh Bridge. Similar limestone, with nodules of chert, is shown in two quarries N.N.E. of Claremount House, and black and dark gray compact and crinoidal limestone may be observed on the road one mile N.E. of Banagher. Gray limestone is exposed in a field east of Timolin, which, according to Mr. Wynne, dips to the west at a low angle.

South of Banagher, black limestone, the beds being horizontal, may be observed on the road one-third of a mile south of Claremount House. Limestone similar in character, the beds being also horizontal, is exposed two-thirds of a mile to the south-west, at the margin of the bog, and again at the holy wells south-west of Milltown House, where the dip is to the west at 25°. The rock is, according to Mr. Wynne, probably near the surface for some distance to the south.

To the west the limestone is exposed in numerous crags and quarries, in the country north of Newtown, about Corgarve, south and west of where the police barrack is marked on the map, north and south of the R.C. chapel, and farther north, about Inchanaclea, and east of it. It is all of the same character, being pale gray in colour, sometimes very hard and compact, and often highly fossiliferous, the bedding being generally very obscure, which, whenever it can be determined, appears to be nearly horizontal, except south of the R.C. chapel, where some beds apparently dip S.E. at 40°, and in the by-road one mile east of Inchanaclea, where the dip is to the south at 50°.

To the north-west the overlying Calp Limestone comes in, occupying the north-west corner of the map. It is only exposed in a few quarries, being generally much concealed by bog and drift. Black compact limestone is visible two-thirds of a mile west of St. Brendan's, where the beds dip S.S.E. at 3°; the rock appears to be near the surface for some distance about here. Similar limestone is exposed in two quarries near the road farther to the south-west, where the beds are nearly flat. Black flaggy limestone may be observed in three quarries along the same road farther west; at the nearest of these the beds dip south at 10°, and at the cross-roads the dip is to the east at 10°, while, farther west, the beds are nearly flat. Black limestone is also exposed in a quarry two-thirds of a mile N.N.W. of the cross-roads, and again close to the margin of the map, at some houses on the by-road, more than a mile north-east of the same cross-roads. Horizontal slabs of black limestone, which appear to be *in situ*, may be observed close to the margin of the bog about two miles south-east of St. Brendan's, and north of Hemming's-ville; and similar limestone is said to occur in the river at Meelick.

IV. *The country included in the Southern portion of Sheet* 117, *about the Town of Birr, and thence to Frankfort.*

The Calp Limestone is well exposed at the south-west corner of sheet 117, north and north-east of the village of Lorrha. It may be observed in numerous quarries in a radius of more than a mile east and south-east of

Ballyea Lodge, where the rock is, according to Mr. Wynne, very near the surface, and the limestone is all of the same character, being black in colour, compact, and earthy, with flaggy beds and bands of shale and cherty beds; the bedding is usually very flat, the beds sometimes undulating at from 2° to 5°. Similar limestones are exposed east of Moatfield House, and again, farther south, in several quarries north of Grange House, where the beds have a general dip to the south-east at 10°. Dark gray limestone is exposed in the village of Lorrha, and black cherty limestone at the corn-mill, one mile east of it, where the beds dip N.E. at from 5° to 10°. Calp Limestone is also visible in several places about Curraghglass House, and in the road half a mile south-east of it; at the latter locality the beds dip N.W. at from 20° to 40°. Glacial striæ were observed here on the rocks; the direction of the striæ, as observed by Mr. Wynne, being W. 32° N. and E., 32° S. Dark gray subcrystalline limestone that dips N.E. at from 10° to 15° is visible in a quarry south of Hazel Hall, and dark gray and cherty limestone is seen in some quarries west and south of St. Kieran's Well, and also farther to the north-east at Rathcabban.

The Lower gray Limestone is visible in numerous exposures to the south and east-south-east of Lorrha, about Shesheraghmore House, Abbeville, and Somerset. It is all of the same character, being gray, or pale gray, in colour—crystalline, with some more compact beds. The bedding is generally very nearly horizontal. Along the boundary of the Calp Limestone some dark gray cherty beds are occasionally visible, dipping north at from 20° to 35°. Similar horizontal limestone is visible about Walshpark and Rockview, and the country to the east as far as the Little Brosna is often thickly strewn over with numerous blocks of gray limestone, so that although the rock is not often actually seen *in situ*, it is in all probability very near the surface. It is exposed *in situ* at Killeen Wood, where the beds dip S.E. at 2°, and again a mile farther north where the beds dip east at 5°.

Dark gray compact limestone, with some of the beds containing magnesian veins, is visible on the east side of the town of Birr, close to Moor Park; the beds undulate, with a general dip to the south-east at 10°. In the River at the Bridge, farther north, near Elm Grove, is horizontal bluish gray limestone, with a bed of dolomite three feet thick. About one mile to the south-east of the town, a little east of William Brook, near a gravel pit, is black limestone that dips south-east at 10°. Similar limestone, with some cherty bands, may be observed close to the margin of the map south of Fortel Cottage, where the bedding is horizontal. To the north and east of Birr the underlying limestone is rarely exposed, being hidden by large accumulations of drift and bog, which continue to spread over large areas of country here, as in other portions of the district already described. It may, however, be observed at a few exposures—as at the Rape Mills, three miles north of the town, where pale gray crinoidal limestone is visible on the road, and again farther west at the margin of the bog, where the beds dip N.W. at 50°. Crags of gray limestone which, according to Mr. Wynne, are probably *in situ*, may be observed in the island in the bog, three miles to the north-east, where Derrinlough House is marked on the map. Gray crinoidal limestone is exposed in a quarry farther to the east, close to the edge of the bog, one-third of a mile south of Ballynacard House, where the beds dip south at 10°, and similar limestones dipping in the same direction at 15° are also visible two miles to the north-east, north of Broughal Castle, also in some crags one mile to the west of the latter locality, north of Ballyshire, and again two-thirds of a mile farther north, where the dip is to north at 10°.

At the village of Frankford, gray compact and pale gray subcrystalline fossiliferous limestone is exposed in two places near the river; the beds are

nearly horizontal. Dark gray compact limestone, with some violet gray beds, and one or two black earthy bands, which, according to Mr. Wynne, contain indistinct plant remains, may be observed about a mile to the north-east, north of Ballywilliam House, where the beds dip S.E. at 20°. The rock is near the surface on Knock Hill, which lies S.E. of Frankford; and pale gray compact limestone may be observed in several places, and limestone similar in character is visible in a quarry farther south, two-thirds of a mile east of Derrinboy House, where the beds incline slightly to the south-east. Proceeding to the south in the direction of Kinnitty, rock is not again visible *in situ* till we approach the wood where St. John's Well is marked on the map, a little north of which, dark gray compact limestone may be observed dipping east by south at 15°. Pale gray compact limestone is visible in some quarries about a mile and a half west of the village of Kinnitty, north of Osierbrook House, and again about a mile to the south-west of it. To the north of this, north of Birch Lodge, pale gray limestone appears to be near the surface over a considerable area; it is visible on the road immediately north of Birch Lodge, and at the plantations, north, and north-west of it. Glacial striæ were observed on it a little north of the trigonometrical point 426, the direction of the lines of striæ being east and west; the beds here dip west and south-west, at from 10° to 25°; at the other exposures they are nearly flat. Half a mile north-east of Thomastown House are some crags of dark gray compact, thick bedded fetid limestone, and solid gray compact; thick bedded limestone with fossils, is visible in a quarry two-thirds of a mile W.S.W. of the same locality, and again more than a mile in the same direction north of Clonbeale House.

5. *Drift and Superficial Deposits.*

Drift of the Slievebloom Mountains.—Large accumulations of drift extend far into these long deep glens which indent the northern and western slopes of the Slievebloom Mountains. One of the best of these for observing it is Glenbarrow, where sections of it are exposed in cliffs along the River Barrow, occasionally from 100 to 150 feet in height. It spreads over the broad glen which forms the head of Glenbarrow, occupying ground of from 1,200 to 1,300 feet above the sea, and extending thence along the western side of the river in a band of from a quarter to more than half a mile in width, till it joins the drift of the plain. The eastern side of Glenbarrow is free from drift, which has been probably removed by the river, whose course was most likely at one period much farther east, for it is at present gradually undermining the cliffs to the westward, portions of them frequently falling down, the debris being carried away by the river. The drift seen in these cliffs consists principally of brownish clay and clayey sand, with large angular and subangular scratched blocks of sandstone and limestone, the latter varying in quantity, being at one time much more numerous than at another, while sometimes it is altogether absent at the base of the drift,* which then appears to be entirely composed of the debris of the subjacent rock. Small granite boulders, which can be identified as Galway granite, have been occasionally observed on the surface of the ground, or in the beds of some of the brooks here, as well as in other portions of this district. They are not, however, so abundant, or of such large size, on the northern as on the southern slopes of the Slievebloom Mountains (see Explanation, 127).

A large deposit of drift, similar to that in Glenbarrow, spreads over the eastern slope of the Slievebloom Mountains, south of Rosenallis, but it does not occur at so great an altitude as in Glenbarrow, seldom occupying ground

* These limestone blocks are much collected for burning into lime for agricultural purposes; they are collected at a height of 1,200 feet above the sea.

above 800 feet, at which height, however, limestone boulders and pebbles are sometimes very numerous and much water-worn. At one locality, about one mile south-east of Clarnahinch Mountain, close to the margin of the map, the limestone drift is well exposed in a large gravel pit. It is here occasionally cemented together by a calcareous paste into irregular layers of conglomerate of a great degree of hardness; thin layers of sand, cemented into a calcareous sandstone, also occur. The drift on the north side of the pit is not consolidated.

The country is thickly covered with drift in the neighbourhood of Clonaslee, forming picturesque, undulating ground in Brittas demesne, and good sections of it are seen in cliffs along the river, south of Brittas House, which are sometimes nearly 100 feet high. It may also be traced for two miles and a half from Brittas House, in the glen which extends to the S.W. towards Barradoos Mountain, limestone being common in it at over 700 feet. It also extends into the glen running south from Clonaslee for more than three and a half miles, to within less than half a mile of "the Cut," occupying ground over 1,000 feet in height.

As in the above-mentioned glens, the drift spreads far into and along the slopes of those running up from Kinnitty, Cadamstown, and that through which the brook forming the county boundary flows, occasionally making fine grassy land, which forms a strong contrast to the barren appearance of the mountain, where the rock is near the surface. Numerous large angular blocks of dark gray fossiliferous limestone, sometimes many feet in diameter, occur at an altitude of nearly 1,000 feet, on the west flank of Spink Mountain, and in the brooks south and south-west of it some of these blocks, roughly measured, would weigh at least ten tons.

About two-thirds of a mile east of Cloneybarrow Bridge is a small deposit of plastic, finely laminated calcareous clay. It is seen for a distance of about 50 yards on either side of the brook, and appears to be from two to three feet in thickness. The layers of lamination, which are horizontal, are beautifully seen in it. On exposure to the atmosphere it becomes indurated, forming a kind of polishing stone.

Calcareous tufa is common in many of the brooks, and it occasionally occurs at a considerable altitude, as in the brook about one mile south of Wolftrap Mountain, where it occurs on the Old Red sandstone, at a height of nearly 1,500 feet.

The plain which forms the principal portion of this district is, with few exceptions, thickly covered with drift, in the hollows of which large tracts of bog occur. The drift of the plain differs from that occurring on the slopes of the Slievebloom Mountains, in being less of a clayey character, it is often composed of sand or coarse gravel, which is principally made up of the debris of the subjacent limestone; but also contains Silurian, Old Red sandstone, and Coal Measure pebbles.

The Eskers.

As in the adjoining districts, some very remarkable eskers occur in the area included in these two sheets of the Map. It will perhaps be most convenient in describing them in detail, to commence with the

Esker between Eyre Court and Banagher.—This esker, according to Mr. Wynne, is not well marked, generally forming a low wide drift ridge, which, however, occasionally becomes indistinct. It appears to commence on the Eyre Court and Banagher road south-east of Abbeyland House, whence it runs in a sinuous line, having a general direction a little south of east, to the Shannon at Banagher, a distance of over four miles, the road being carried on the summit of the ridge. From Esker Bridge to Banagher the ridge is

Fig. 4. View of esker at Coneycarn, looking west, showing remarkable hollows near top of esker, one of which is filled with bog.

Fig. 5.

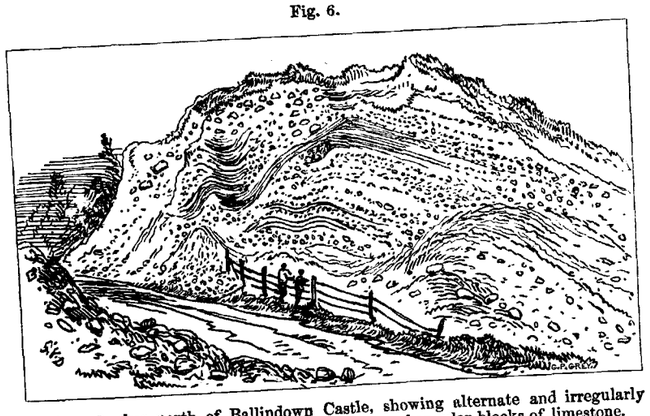
View of esker looking S.E. from Coneycarn.

more striking, forming a comparatively narrow strip of drift bounded on the north by callow, and on the south by the river and callow. This ridge apparently does not extend across the Shannon as the drift appears to be scantily deposited in the town of Banagher, and for some distance south-east of it.

Newtown and Frankford Esker.—This drift ridge, which can be traced for about twenty-five miles, commences rather abruptly in hillocks at Cloghan Castle, three miles S.W. of Banagher, a little north of which the underlying limestone is bare of drift. These mounds and hillocks unite near Newtown, where the esker forms a well defined narrow ridge, which continues for about three quarters of a mile farther to the S.E., when it spreads out into a curiously shaped gravel hill known in the country as Coneycarn. The highest point of this hill is 208 feet above the sea, and about 80 feet above the surrounding bog. Some very remarkable and deep hollows occur in it, one of which is filled with bog (see fig. 4). The esker which continues in a south-easterly direction forms a very striking feature when viewed from a point a little south of the summit of Coneycarn, making a narrow well-defined ridge bounded on either side by the bog for more than half a mile to the S.E. (see fig. 5), when it spreads out into a less distinct ridge for about a quarter of a mile, but rises quickly again into a broad and undulating ridge with some very curiously shaped hollows. Still farther to the east the ridge becomes narrow and strongly marked, having slopes of from 30° to 35°, and from 35 to 50 feet high, and in places only wide enough on the top to admit of a roadway. After crossing the Banagher road, south of Rape Mills, it curves sharply to the south-east for about a mile, turning again east for nearly another mile, when it curves to the N.E., the ridge still continuing to be well defined, although the country south of it in the wood, west of Ballindown Castle, and thence for more than a mile in the direction of Birr, is made up of abruptly undulating ground, with gravel hills and small eskers running in various directions. To the north of the main chain also numerous undulations and variously-shaped gravel hills and eskers occur, which extend to the N.W. as far as Rape Mills. A good section of the main chain is exposed in the cutting made for the by-road through the ridge north of Ballindown Castle, and the alternate and irregularly deposited layers of gravel and sand, with large blocks of limestone, may be well observed (see fig. 6).

The sketches given in figures 4, 5, and 6 were made by Mr. Du Noyer, who visited the district with me for that purpose.

Fig. 6.



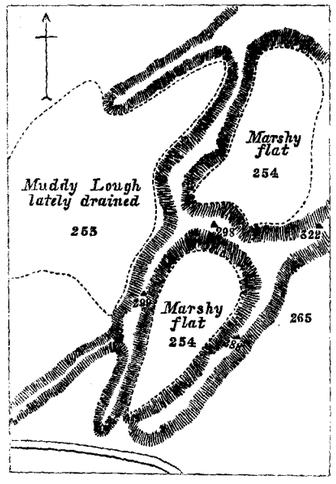
Section of esker north of Ballindown Castle, showing alternate and irregularly deposited layers of gravel and sand with large subangular blocks of limestone.

Proceeding to the N.E. the esker continues unbroken, being occasionally about 50 feet in height, to "The seven wells," where it is divided by a remarkable cut, beyond which it again forms a narrow ridge flanked by numerous mounds, which character it maintains for the space of about three quarters of a mile, when, according to Mr. Wynne, the ridge is divided into a remarkable system of eskers; in shape they resemble a little mountain chain, and the highest peak, particularly from some points of view, is very sharp and steep, as much so, indeed, as many mountain ones on a far larger scale; the hollows are deep and often separated by lesser ridges.

Between the village of Fiveally and Frankford, a distance of about five miles, the main chain, according to Mr. Wynne, is not so symmetrical, being divided into numerous ridges and gravel hills, which, however, are sufficiently well developed to leave no doubt as to the continuation of the esker. To the north of Frankford, the ridge, although of small dimensions, is well defined, forming a well marked feature passing by Ridgemount and Ballywilliam into the adjoining Sheet 118. At Ballywilliam House a section of the esker is exposed, which, according to Mr. Wynne, consists of gravel confusedly heaped up, but apparently at one place rudely conformable to the slope of the esker.

On Sheet 118 the esker still continues to form a well marked small ridge running parallel to the road, having, however, occasional short breaks, as far as Killooly Hall, when it again spreads out into undulations and gravel hills for the distance of about one mile and a half. Still farther to the N.E. the esker forms a very prominent feature, making a ridge of from 40 to 70 feet in height, sometimes nearly 100 yards wide on the top, while again it contracts, forming peaks and narrow ridges. It maintains this character for more than three miles, running in a slightly sinuous line to the N.E., when this great chain terminates, in the undulating ground, N.E. of Pallas House, which also extends into the adjoining sheet to the north. There are numerous large subangular blocks of limestone on the esker north of Pallas House. The ground to the N.W. of this latter portion of the esker is thickly covered with drift which occurs in mounds and hillocks forming abruptly undulating ground.

Fig. 7.



Plan of eskers at Muddy Lough.

Eskers at Muddy Lough one and a half miles N.W. of Kinnitty.—These eskers, although of no great extent, are very curious, and afford good examples of the various shapes and strangely irregular courses which these drift ridges sometimes assume. Muddy Lough, and two small loughs to the east of it, which have been lately drained, now form marshy flats, which are divided, and sometimes partly (or as in the case of one of the loughs wholly) surrounded by a narrow, well-defined embankment-like ridge, of from about 20 to 46 feet in height (see plan, fig. 7). The slopes of these ridges are occasionally very steep and persistent from the base to the top of the ridge at an angle of about 30°. At other times the slope is very irregular, and the height of the esker and its width on top also vary considerably, the latter being sometimes only a few feet. These eskers continue for more than half a mile to the N.E. of Muddy Lough, spreading out, however, through Glen Wood, into a variety of curiously-shaped ridges and drift-mounds, which, according to Mr. Wynne, are occasionally 50 feet in height, and frequently separated by deep hollows. They extend but a short distance south of Muddy Lough, terminating east of Droughtville.

The arrangement of the gravel and sand is seen in a gravel pit which has been opened in the side of one of these eskers, on the north side of the road, and south of Muddy Lough. It consists of a confused mass of gravel and sand, with rounded boulders of limestone, varying from three feet in diameter to the size of a walnut. Sandstone blocks also occur in it, but not in any abundance.

Eskers west of Clonaslee.—A very remarkable system of eskers sets in at the foot of the Slievebloom Mountains, west of Clonaslee. They commence in some hillocks and undulating ground north-east of Edge Hill, and extend for about three miles and a half to the west. They are very irregular in form for the first mile and a half, consisting of curiously-shaped ridges and mounds of drift which are sometimes connected one with another, while again they are separated by hollows of various shapes, which are occasionally broad and deep. The ridges vary considerably in width, being sometimes over a hundred yards wide on the top, with steep slopes on either side, while again they contract and are only a few yards wide. This character is well seen near Ballinfulla, and a very curious cup-shaped hollow may be observed half a mile to the west of it.

Proceeding to the west the eskers become more regular in form, and one very well-defined ridge may be traced for more than a mile and a half in that direction. This ridge begins to be well marked near the road, running north towards Clonad Wood. It runs nearly due west for about three-quarters of a mile, when it curves sharply to the W.S.W., ending rather abruptly three-quarters of a mile N.E. of the County bridge. This esker forms a narrow ridge for its entire length, being in some parts only wide enough on the top to admit of a fence. It varies in height from about 30 to 50 feet above the surrounding ground; but at one place, where it is bounded by the bog on the north, rises to at least 80 or 100 feet above it. The slopes are steep and occasionally strewn over with angular blocks of sandstone and limestone. The ground between this esker and the bog is very irregular, and contains numerous small hillocks and eskers; one of the latter is nearly half a mile long, running parallel to the main chain. Farther north are some curious drift mounds, forming isolated patches in the bog, one of these, north of Derries Hill, although only a little more than 100 yards in diameter at the base, rises to a height of 55 feet above the bog.

To the south of the esker the ground undulates a good deal, but has a general slope to the north, towards the base of the esker.

Eskers near Mountmellick.—The continuation of an esker ridge which commences in the adjoining district, south of the town of Maryborough (see explanation 127), enters this map at its south-east corner. The ridge is very narrow where it joins this district, being sometimes not a hundred yards wide at its base, and only sufficiently broad on the top to admit of a roadway. It forms an embankment-like ridge for the first mile, being bounded on either side by an alluvial flat. These flats are connected by a small brook, which makes a curious gap in the esker, about half a mile north of the margin of the map. Proceeding northward, the esker runs in a slightly sinuous line nearly due north, making a distinct, but narrow ridge of from 10 to 20 feet in height, ending in the alluvial flat east of Mountmellick.

An esker which is probably the continuation of the last, although a gap of more than a mile intervenes, commences north of Mountmellick. It is first seen on the south side of the river Barrow, in a north-west and south-east ridge, about 300 yards long and thirty feet high. This ridge is separated from one about 300 yards farther to the north-west by the alluvial flats of the River Barrow. The esker now forms a very regular ridge along the north-east bank of the Barrow, of from fifteen to twenty-five feet above the flat. It is about one mile and a half long, terminating rather abruptly west of White Hill, where a section of the esker is exposed in a gravel pit. It consists of a confused mass of gravel and sand, principally composed of the debris of limestone.

To the west of where the last esker terminates, and north of the village of Rosenallis, about Nut Grove and the Glebe House, are some curious drift mounds and short eskers.

Eskers near Geashill.—A small chain of eskers which commence in the adjoining Sheet 109 (see explanation 98, &c.), enters this district north of Geashill. They run about south-east, and are occasionally separated by gaps. North of Geashill Castle they are very curious, being divided by deep and remarkable hollows, which are generally in the direction of the main chain. The ridges are sometimes very sharp on the top, and occasionally attain a height of sixty feet, with very steep slopes. The eskers may be traced for about a mile and a half to the south-east of Geashill, although not always forming a connected ridge.

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