EXPLANATION

TO ACCOMPANY

SHEET 155 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

ILLUSTRATING PART OF

THE COUNTY OF TIPPERARY.

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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, or 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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EXPLANATION

OF SHEET 155 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

General Description.

The district comprised in this sheet of the map is part of the southern end of the county Tipperary. The principal places in it are the ancient city of Cashel, the western end of the town of Fethard, and the villages of Golden, Bansha, and Ballyclerahan.

1. *Form of the Ground.*

The district is drained entirely by the River Suir and its tributaries, of which the principal are the Multeen brooks, coming from the N.W., the Aherlow, with its tributary the Ara, from the S.W., and the Clashawly and Moyle on the east, which run beyond the limits of this sheet before falling into the Suir. The Suir enters the district about three miles north by west of Cashel, at a level of 220 feet above the sea, and flows generally due south, but with several bold curves, both to the east and the west, till it leaves the area included in the map just under the eastern termination of the Galtee mountains, at a level of about 135 feet above the sea.

The principal features of the ground are the north-eastern extremity of the Galtee mountains, the eastern termination of the Slievenamuck range, the western extremity of the Slieveardagh hills, together with the Cashel hills, and those south of Fethard; the remainder of the district being a large undulating plain, varying from 250 to 400 feet above the sea.

None of the loftiest summits of the Galtee mountains lie within this district, those contained in it varying from 1,356 to 1,649 feet. The highest ground is part of a ridge S.W. of Sturrakeen, running up to Laghtshannaguilla, a peak out of the limits of the map. This ridge rises to about 1,900 feet above the sea. The northern slopes of the Galtees are often very abrupt, while the eastern slope towards the Suir is much more gradual.

The eastern termination of the Slievenamuck range occupies but a small space on this map. North of Bansha it forms low undulations,

gradually extending into the plain, but rises into a regular ridge towards the westward, attaining an altitude of 668 feet above the sea, and rising still higher in the district included in the adjoining sheet (No. 154). In the N.E. corner of the map is the western extremity of the Slieveardagh hills, which run for several miles further to the N.E. The greatest altitude they attain on this sheet is 794 feet above the sea. They slope rather steeply on their western side, but more gradually towards the south. To the north of Knockanglass, they are cut through by a deep north and south valley through which the river Clashawly flows, draining part of the country included in the sheet north of this.

The Cashel hills, separated from the termination of the Slieveardagh by a north and south valley about a mile and a half wide, form a small cluster, the highest point of which is 699 feet above the sea.

A short distance south of the town of Fethard is a low east and west ridge about two miles long and three quarters of a mile wide, of which the western termination is included in this sheet. Its highest point is 470 feet. It is separated by a valley a quarter of a mile wide, from a little undulating table-land of similar elevation, on which Garraun House stands.

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

Aqueous Rocks.

	Name.	Colour on Map.
	Alluvium, Shell Marl, Peat, Bog, or other Superficial covering.	*Pale sepia.*
	Drift (Limestone Gravel.)	*Engraved dots.*
	X Pipe Clay and Lignite.	*Purplish gray.*
Carboniferous.	d^5 Coal Measures.	*Indian ink.*
	d^4 Upper Limestone.	*Prussian blue (dark.)*
	d^2 Lower Limestone.	*Prussian blue (light.)*
	d^1 Lower Limestone Shale	*Prussian blue and Indian ink.*
Old Red Sandstone.	c^3 Upper Old Red or Yellow Sandstone.	*Indian red (dark.)*
	c^2 Old Red Sandstone.	*Indian red (light.)*

Igneous Rocks.

	Ds. Greenstone Ash.	*Pale purplish red, with dark dots.*

c. The Old Red sandstone, as in the adjoining district to the south, consists of a series of red and purple rocks, occasionally interstratified with conglomerates and red indurated shales. In the upper part of the series the sandstones are usually of a yellowish tinge, with thin bedded white conglomeritic sandstones interstratified with beds of red and green shale; this latter part of the series is called the upper Old Red or Yellow sandstone (c^3); the boundary between it and the Old Red sandstone (proper), being quite arbitrary.

The Carboniferous Rocks.—This series only admits of being divided into two well-defined groups in this district, namely, the Coal Measures and Carboniferous limestone. In the adjoining districts to the south and east, the Carboniferous limestone has, itself, a four-fold subdivision, but it has been found impossible to carry this out here on account of the difficulty of separating the calp or middle limestone from the beds above and below it. The space occupied by that which is undoubtedly Upper Limestone has been coloured of a darker blue than the rest, without any engraved boundary. The Lower Limestone shale is only seen in one or two spots, but, as it is necessarily a very narrow band, a boundary has been drawn for it along the base of the formation.

d^1. The Lower Limestone shale does not exceed fifty or sixty feet in thickness, and consists of hard, dark gray shales, and flaggy calcareous grits, with thin beds of limestone.

d^2. The Lower Limestone is gray, or bluish gray, sometimes very massive looking, with very obscure stratification; but there are occasional beds of dark gray compact regularly bedded limestone, sometimes containing black chert, and beds of earthy shale. Fossils are very abundant in it.

d^4. The Upper Limestone is usually of a light gray, or pale bluish gray, generally crystalline and thick bedded. The top beds of the Upper Limestone are flaggy, and contain layers, and large irregular nodules of chert.

d^5. The Coal Measures attain only a trifling thickness in the district included on this map, probably never exceeding 400 or 500 feet. They consist of black carbonaceous shales, and splintery dark gray arenaceous gritty shales, and occasional olive gray grit bands.

The drift and superficial deposits, the pipe-clay lignite and the Greenstone ash, will be noticed hereafter.

J. O'K.

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

The termination of the Galtee and Slievenamuck ranges are formed of the Old Red sandstone rising up from underneath the Carboniferous limestone. The Slieveardagh and Cashel hills, and those near Fethard are formed of the Coal Measures, which rest upon the limestone. Along the northern slope of the Galtee mountains, the beds may be seen dipping to the north underneath the limestone of the vale of Aherlow. From beneath this the Old Red sandstone again rises on to the southern slope of Slievenamuck, where it may be seen dipping to the south; on the northern slope of Slievenamuck, however, there is no corresponding dip of the Old Red sandstone to the south, but neath the limestone of the plain, but the beds, both of the [illegible] sandstone in the hill, and of the limestone in the adjacent [illegible] dip all to the south. If the beds were to be continued [illegible] clination, the limestone would here pass underneath the [illegible] but as this is known not to be the case, it proves the [illegible] great fracture or fault, running along the north foot of [illegible] muck range, as shown in section, fig. 1.

Fig. 1.

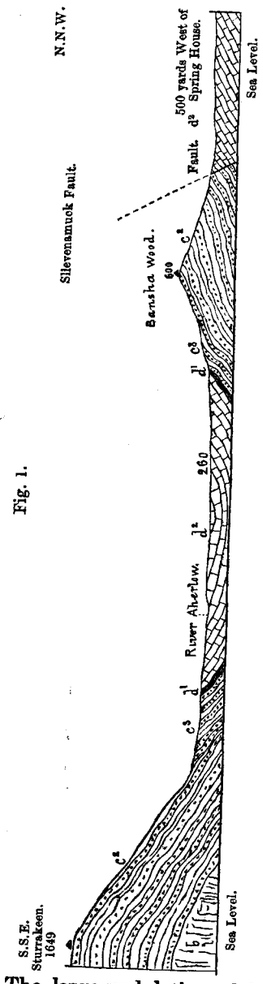
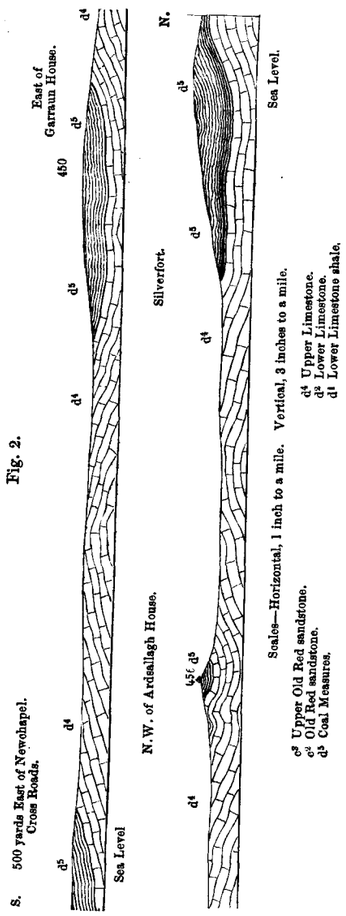


Fig. 2.



The large undulating plain which occupies the greater portion of the district comprised in this map, consists of the Carboniferous limestone, which is generally covered with limestone gravel and clay. There are, however, many places of small extent, where the drift is wanting, and the limestone appears at the surface.

As we approach the hills of Slieveardagh, &c., the upper beds of limestone are seen to dip at them on both sides, and evidently pass down underneath them, as shown in section, fig. 2. J. B. J.

4.—Detailed Descriptions.

[The northern, central, and south-western portion of this map was surveyed by Mr. J. O'Kelly, and the south-eastern by Mr. Du Noyer and Mr. A. B. Wynne.—J. B. J.]

Position and Lie of the Rocks.

Old Red Sandstone.—The best sections of the Old Red sandstone within the limits of this map may be observed at the S.W. corner, on the northern slopes of that portion of the Galtee mountains which extends into this map. Commencing at the extreme S.W. corner of map, and following the stream, which runs north, on the west side of a mountain by-road, a good section of a portion of the Old Red sandstone may be observed dipping to the north, at angles of from 20° to 30°; occasionally at steeper angles, and again flattening to 10° or 15°. The lowest beds in this section are coarse purple sandstones, often conglomeritic, interstratified with reddish purple grits and shaly grits, and hard thick purplish sandstones. The upper portion of the rocks in this section consists of alternations of thin bedded soft red sandstones, with occasional conglomeritic beds. Only a few of the lower beds of the Upper Old Red or Yellow sandstone are seen in this section, and consist of gray, ferruginous, and yellowish and dull purple sandstones, and reddish purple shale. In the stream which flows into the River Aherlow, opposite Castle Mary, a short section of the Upper Old Red sandstone is exposed, but it may be better observed in a stream on the east side of a small plantation west of Ballydavid Wood. The highest beds we observe in this section consist of purplish gray coarse speckled grits, and whitish grits and sandstones, and thin bands of nodular red shale and thin purplish grits, dipping north at from 20° to 40°.

In the vicinity of Bansha Wood, detached quarries of the Old Red sandstone may be seen, but no continuous section is exposed. In the by-road, half a mile west of Aherlow Castle, purple conglomerates, red sandstones and shales dip south, at 30°; 200 yards west of the Police station, south of Kilshane, dipping S.E. at 50°, gray mottled sandstones and dull earthy purplish shaly grits may be observed; about half a mile east of same Police station, on the north side of road, gray, mottled, purplish grits and red splintery shale, appears in a few quarries which have been opened at the S.E. corner of Bansha Wood, on the west side of road, running between Bansha Wood and Bansha Castle; and 200 yards from the road, white coarse grits and sandstones, and pale, greenish shale and speckled grits, all dip south at 60°. At Mount Kennedy, reddish purple sandstones crop out in a few places, also in the Railway cutting, half a mile east by north of Mount Kennedy, red shales, coarse grey conglomerates, and thin sandstones, dip S.E. at 50°; gray ferruginous and white coarse siliceous grits may be seen in a quarry, at the height marked on the map 271, north of the graveyard; these beds dip south by east at 35°.

J. O'K.

The bold anticlinal curve in the Old Red sandstone beds which forms the eastern termination of the Galtee mountains, is represented upon this map near its southern margin, and the rocks are sufficiently well exposed to admit of their strike being traced with some accuracy. In a westerly direction from this place, the same rocks also appear in several natural exposures, projecting from the surface, and along the courses of the mountain streams which flow down the northern slopes of this part of the Galtee range. Two streams in the townland of Cappauniac, between the large woods of Ballydavid and Toureen, exhibit a succession of red, purple, and salmon-coloured sandstones, the lowest beds of which will be found in the upper parts of the stream courses, undulating and dipping to the northward at angles varying from nearly horizontal up to 20°. Descending the streams, angles of 30°, 35°,

40°, and even 45° occur in the inclinations of the beds, which will all be found to dip to the north; and among those last seen before the streams leave the mountain, yellow, gray, and pale purple sandstones, with soft green and purple sandy shales, are frequently to be met with. These latter beds are supposed to be the Upper Old Red sandstone group. The thickness of the part of the rocks exposed in these sections, after making deductions and allowances for the irregularity of their angles, &c., seems to amount to at least about a thousand feet.*

A nearly vertical cleavage bearing about 10° S. of E. was observed in some of the lowest of these beds at the upper parts of the streams where a decrease in the amounts of the angles of dip seems to suggest an approach to the summit of the anticlinal. The top of the ridge near this is covered with bare purple shingle, but no rock is seen near the place; and surrounding the shingle are large tracts of bog, which entirely conceal the rock, except along the courses of the streams.

A long narrow valley, called Cappa Glen, runs east and west below Toureen Wood, and on the low ridge to the north of it, associated with the red shales and gray or whitish sandstones, some dark gray gritty shales were observed. The rocks on both sides of this valley dip to the north, and range nearly east and west. At the eastern end of Toureen Wood, near Maguire's Castle, and in that neighbourhood, the Upper Old red rocks again appear. They will be found to consist of coarse purple and gray ferruginous and conglomeritic sandstones, passing upward in the direction of the fall of the stream, into yellowish ferruginous sandstone, associated with which are some olive or dark gray shales. The dips observed in these beds all incline to the north, at angles varying from 20° to 35°. Eastward of the last-mentioned locality, where the road to Caher makes a sudden bend like an inverted letter S, some nearly horizontal massive beds of fine liver-coloured and coarse ferruginous and conglomeritic grit project from the surface of the hill on the west side of the road, and smaller exposures of slightly micaceous grits and red shales occur at a short distance to the northward. Between this road and the Waterford and Limerick Railway, near this place, rises a large hill, which is covered with limestone gravel, and does not expose the underlying rock; but this is, nevertheless, believed to be Old Red sandstone, for on both sides of a valley at its eastern end, through which the railway runs, yellow, gray, and purple sandstones and shales are seen. At the north end of the valley they dip N. at 25°; but at a short distance eastward, as well as where they are next seen to the south, they dip in an easterly direction, at low angles, varying from nearly horizontal to 30°; and beside the railway, where the road above alluded to crosses it, near the entrance to cottage, dark liver-coloured grits, gray flags, and a quantity of soft shales, dip due south at angles varying from 30° to 45°—thus completing the anticlinal curve alluded to above. These are the last seen of the Old Red rocks within this part of the district represented in the map, and their various dips—first north, then eastward, and, lastly, south—together with the form of the ground composed of them, and their general similarity of appearance at different parts of the curve, added to the fact of limestone being seen at no great distance on the other side of the river, prove that this is the place where the Old Red sandstone exposure of the Galtee mountains terminates towards the E.† The Lower Limestone shale does not appear at this end of the Galtee mountains.

There is reason to believe that the Old Red sandstone occupies a small portion of the N.W. corner of this map; but it is not visible at the surface, being concealed by "drift."

* The Yellow sandstone is included in this thickness.

† The continuation of these rocks westward, along the southern part of the curve, may be seen on the sheet of the map to the south, No. 166.—A. B. W.

The nearest limestone to the Old Red sandstone at the eastern end of the Galtees, and, therefore, supposed to be the lowest seen in this neighbourhood, occurs in two places in the townland of Cloghabreedy—on the north side of the River Suir, where it sweeps round the termination of the mountains, and again, near the Suir flour mill, on the opposite side of the river from Caher-abbey demesne. In the latter place it consists of gray compact and crinoidal limestone, which undulates, dipping on one side of the high road eastwards at 5°, but on the opposite side, between the road and the river, in a contrary direction, or towards the mountains, at an angle of 20°; while in the former situations, and nearly in the same line of strike, just north of Kedrah Fort, dark, pale, and bluish gray compact, and crystalline limestone, containing some chert, as well as some reddish earthy and crinoidal beds, occur, which seem to dip E. of N., at angles varying from 40° to 60° and upwards.

Northward of the Galtee range, in the country lying between the Rivers Aherlow and Suir, the limestone is not very frequently seen, owing to the occurrence of drift; but it appears within the distance of a mile, north and north-west, of Kilmoyler House, and in a small quarry to the north-east, just outside the demesne. It consists of massive gray and black limestone, with beds of black shale, containing numerous fossils; and it dips in the quarry nearest to the house southward at 20°; but in that to the N., and where it is seen in the road-cutting to the N.W., the dip is N. at 20°. North and north-east of Grallagh cottage some gray compact and very cherty limestone occurs; it seems to form an anticlinal curve, for in one place, near the road, it dips to the S. at 35°, while, at a little distance to the north, the dip is in an opposite direction at angles of from 10° to 30°.

Directly in a line between Grallagh Cottage and Ballycarrow House, and just inside the demesne within which the latter is situated, some black and dark gray thin rough-bedded limestone, with beds of dark gray shale, dip E. of S. at 20°, and in another place, nearly due south of the house, but outside of the demesne, some fine dark gray compact limestone, having a nearly vertical cleavage, was observed. It appears to dip to the west.

At Bellvue Park, lying near the narrow upper part of a tract of shell marl, which is represented upon the map, some dark gray and compact limestone occurs in two places, dipping southward at angles of 10° and 20°; and at the N.E. extremity of the same tract some gray compact limestone dips south at 10°.

Where the roads from this place to Newinn and Caher separate, dark gray compact and cherty limestone, with shale partings, dips to the north at 40°, and continuing along the road leading to Caher a large rounded hill appears in the townland of Knockgraffon, just north of a place where three other roads meet this one. Upon and about this hill the limestone may be seen in many places. It all appears to be more or less cherty, is generally gray, or dark gray, and frequently contains shaly beds, with some which are, probably, magnesian. Its bedding is contorted, for several dips were observed which inclined in opposite directions at various angles. The axis of one contortion seems to cross the top of the hill in a direction bearing about 30° N. of E., the beds on the north side dipping in that direction at 20° and 30°, while those to the south dip S. and S.E. at angles of 20°, 25°, and 30°. An E. and W. cleavage vertical, or dipping S. at 80°, was observed in one or two places upon the hill.

Bearing about 10° N. of W. from the top of this hill, and at a distance of about a mile from it, along the road leading from Hymenstown House to the moat of Knockgraffon, exposures of the limestone occur on both sides of a stream which crosses the road. In each of these places it forms an anticlinal curve—that to the south being apparently the widest—the dips being to the N. at 35°, and to the S. at 20°, and the rock a dull gray com-

pact and cherty limestone. On the other side of the stream the smaller contortion occurs in beds of black, or dark gray compact limestone, with thin beds of olive shale and bands of white carbonate of lime. A thin bed of a substance something like greenstone ash was here observed, which conformed to the other beds, and like them, dipped to the N. at 35°, and on the opposite side of the contortion, to the S., at 45°. Cleavage was also observed here, striking nearly E. and W., and dipping N. at 80°.

In the neighbourhood of Newinn the limestone is seen in several quarries scattered over the country. It consists, with few exceptions, of the dark gray, or black varieties; but is sometimes variegated, and pale gray beds are occasionally met with. N.W. of Marlhill House dark gray compact limestone dips to the N. at 60°, and similar beds, having shale partings, occur in two places near the village of Newinn. In one quarry to the north of the village they dip N. at 40°, and near the R. C. Chapel they have an undulating dip eastward at 10°. Near the roads leading northwards, north-east, and eastwards from Lough Kent House, dark gray, rough-bedded, and compact limestone is seen in many places. In the vicinity of that which runs northwards, and in the townlands of Farrankindry and Rahinah, more of the dark-coloured limestones dip towards the north at angles of about 20°, and are, in places, decomposed, forming a dark gray, soft, and dry sand, containing white layers. Southward of this, pale gray limestone occurs on the road between the townlands of Knockannavagh and Ballygerald East; but its dip is not discernible. Where five roads meet, near Lough Kent House, the limestone is seen in six or seven quarries. It appears to undulate, and in the townland of Ballygerald dips to the north at 45°, and to the south at from 30° to 60°; but this high angle to the south does not continue long, for near the road from Lough Kent eastwards to Tooloone, and on both sides of it, the dips are chiefly to the north at angles varying from 10° to 40°.

Along the road from Newinn to Caher the limestone is seen in many places. It may be observed where a by-road leaves the main one, near the stream which crosses the road after passing to the north of Outeragh House. Here two dips occur—one to the north at 70°, and the other to the west at 20°. The beds are dull dark gray compact, earthy, and cherty limestone. Further south, between the stream and a small plantation lying to the north of the cross-roads, near to the Glebe House, a very different kind of limestone has been quarried; on the west side of the road it is of a pale gray, or dove colour, and is very fossiliferous; but the bedding lines are not visible.

About 330 yards south of the Glebe House some pale gray magnesian, variegated, and brecciated looking beds occur, having a dip of 30° to the west, and at about the same distance southward similar beds appear. At both places they were observed to contain a great number and variety of fossils, among which many corals, as well as casts of Isocardiæ, Euomphali, Nautili, Orthoceratites, and crinoidal fragments were recognised.

Half a mile south by east of the last-mentioned locality a winding stream crosses the same road, and the limestone appears in several places along its banks. In some places it is pale gray siliceous-looking; in others darker, more earthy, and perhaps magnesian, and bluish gray limestone is also seen. Midway between the ruins of Short Castle and the road, a dip to the south at 35° occurs in the gray limestone; but just near the castle it is almost horizontal, or inclines at a low angle to the eastward, and has a granular appearance. Nearly in a line between the Glebe House above mentioned and Springfield House, are some exposures of the limestone, which is dark or pale gray, and variegated, containing fossils. It is generally compact, and where of a dark colour it is frequently cherty. Some of it in the demesne of Woodmatown, near the south end of a long narrow plantation, dips to the N.E. at about 5°, and contains fossils, some of which are distorted, though

there is no cleavage very apparent in the limestone. The bedding of the rest could not be determined. A good deal of pale bluish, and dark gray compact, earthy, and crystalline limestone occurs upon and in the neighbourhood of Knockfeagh Hill, particularly north and westward of it. The dips, where seen, are either to the south, or south by east, at angles varying from 20° to 45°. Some pale yellow sandy-looking magnesian limestone also was observed in this neighbourhood at the north side of the townland of Suttonrath.

South and east of the country containing the beds last described, a tract which is coloured of a darker shade will be found upon the map. The limestone here is of a black or dark gray colour, and is often thin bedded. It undulates a good deal, and dips at angles below and up to 35° in various directions, but, upon the whole, seems to form part of a basin consisting of dark coloured beds, within which lies the paler gray limestone that supports the outlier of the Coal Measures occurring at the S.E. corner of the map.

An extension of this dark coloured limestone runs by Donegal and Shanballyard to Maginstown House. In the vicinity of the latter place, thin black shale partings occur between the beds, and some of the limestones weather red upon the bedding surfaces, or are separated by thin red shaly partings. Surrounding this extension of the dark or black limestone, pale and dark gray beds, which appear to be magnesian in places, may be seen at rather wide intervals. Near a cross road N.W. of Ballyclerahan village they dip to the east at 35°, and half-a-mile further to the N.W. some of the pale gray beds undulate at low angles towards that direction, or are nearly horizontal. By the road which runs westward from the abovenamed village, and near the ruins of Ballyclerahan church, there is a dip of 35° to the south in gray compact limestone, which is the last rock seen in this direction until the road runs into the dark coloured tract at Westgrove House.

It ought to be observed here, that all the dark gray limestones which have been stated to occur outside the boundary of the dark coloured space are extremely like many of those which will be found within it; and that, as any boundary or line of separation between them is excessively obscure, the one which has been engraved here was drawn to agree with other places where the order of succession was much more clearly seen.

A. B. W.

The Carboniferous Limestone which bounds the Clonmel Coal Measures on their eastern extremity was originally grouped into three subdivisions, of which the Middle was considered to belong to the Calp. These beds may be well seen in many quarries for a distance of about a mile, from the neighbourhood of Caherclogh House on the east to the townland of Orchardstown on the west. The rocks consist of evenly bedded dark gray and black finely crystalline limestone, with numerous nodular layers of black chert; and in the quarry directly to the east of Caherclogh House, one of the upper beds is coarsely oolitic: the dip of all is S. at 60°. Judging from the regularity of the exposed dips, the thickness of this band cannot be less than 1,000 feet.

Upper Limestone, d⁴.—Directly above these black beds there occurs a great thickness of light gray compact limestone, frequently containing white as well as black chert; they dip very regularly to the S. at 60° for a considerable distance, and eventually get mixed with earthy shales at Rathronan Flour Mill. The beds are here inverted, and dip to the N. at 70° for some distance, regaining, however, their southern dip at Rathronan church hill. The thickness of these Upper Limestones cannot be well estimated at this locality; we must, therefore, trace them to the west in the northern part of Rathronan demesne and on the Clonmel and Fethard road before we can ascertain this with any degree of certainty. At the latter locality, there is

a nearly continuous section exposed in them, and the absolute thickness of the beds is, at least, 860 feet, though it is highly probable that they attain to 1,000 feet. The beds here consist of thick and thin bedded gray compact limestone, passing up into crystalline beds of the same colour, containing gray chert, these are followed by thick and thin evenly bedded hard and compact limestone with black chert; and, lastly, there is a considerable thickness of black earthy compact beds, which terminate in black flaggy limestones and black chert layers, which are the nearest observed beds to the Coal Measures.

At the distance of two miles and three-quarters west of the last locality, a short section in these rocks is obtained; it exposes a few beds of light gray thick irregularly bedded limestone, the dip being to the S.S.E. and S. at from 40° to 60°. Though these beds occupy the same geological horizon as those last described, they differ very much in their lithological character from them, and hence we have an argument against any arbitrary subdivision of such a deposit as this limestone when we find that it can change its aspect in the short distance just stated.

At the distance of one mile further to the west, in the demesne of Barona, and on the same horizon as the last beds, we again find two quarries which expose limestones differing in aspect and structure from the last; here they are dark gray, compact, thin-bedded with black chert, and they pass up into compact and light gray beds, one of which weathers to a soft white sand, possibly from the presence of magnesia, the dip of all being to the S. at 60° in the lower beds, and S.E. at 35° in the upper.

G. V. D.

If we now proceed to the N.W. corner of the district included in this sheet, the limestone may be observed at the following places:—South of the height marked 381, bluish gray, coarsely crystalline, thick-bedded limestone, containing fossils abundantly, dips S. at 5°; at the church, south of the flour mill, dark bluish gray, crystalline, regularly bedded limestone, with thin bands of black shale between the beds, dips S.E. at a low angle; north of Dundrum House thick-bedded, crystalline, bluish gray, and pale gray limestone, dipping in the same direction, may be observed in a large quarry, some of its beds being almost entirely made up of encrinites; compact, dark gray, cherty, semi-crystalline limestone, with black shaly bands, dipping south-east at from 5° to 10°, may be seen at the National School between Knockavilla Police Barrack and Dundrum. Limestone similar in character occurs in Killenure Demesne, N. by W. of the castle, north of Faheen cross-roads, and, also, west of Knockavilla Cottage, along the western boundary of the greenstone ash, dipping from west to west by south, at angles varying from 5° to 10°. South-east of Lacken House, on the north side of the Multeen river, opposite Toberlaghteen, compact, bluish gray, semi-crystalline limestone may be observed. Following the river to the east, and about one mile from the last-mentioned locality, black, earthy, compact limestone, thin-bedded, and nearly horizontal, with a slight inclination to the south, is exposed in a quarry on the south side of the river. North of Kilfeakle House, at Kilfeakle Castle, and a little north of it, there is bluish gray, rather thick-bedded, jointed, massive-looking limestone, with some thin rusty gray sandy beds, "probably magnesian," interstratified with occasional beds of shale. The beds are nearly horizontal at the castle, but undulating 300 yards north of it, the dip being S.E. at 15°. Half a-mile west by north of Kilfeakle House, bluish gray, thick-bedded, and dark bluish gray, thin-bedded limestone is seen in a couple of quarries, the general dip being southerly at from 5° to 20°. About 200 yards south-west of the National School at Kilfeakle, on the south side of the Tipperary road, thick-bedded bluish gray limestone dips south at 50°. Proceeding along the road to the west, and about half a-mile from the last-mentioned locality, thick-bedded bluish gray limestone, alternating with some dark gray earthy impure beds, may be observed on the north side of the road dipping north at 45°; but again dipping south on the south side of the road. North-east and north-west of the schoolhouse marked on the map, near where the Tipperary road passes off this sheet, dark bluish gray compact limestone dips south at 15°. Limestone similar in character may be seen in a quarry about half a-mile west by south of the same schoolhouse, which dips southerly at 25°. Hard bluish gray limestone and pale gray coarsely crystalline limestone is seen at the height marked on the map 420, dipping south at 20°. On the by-road, south by west of the last-mentioned locality, dipping in the same direction at 40°, compact dark gray limestone, alternating with thick-bedded crystalline limestone, is seen in a quarry. On the road leading from Kilfeakle to Bansha, and near the fault marked on the map, there are large quarries of gray and pale bluish gray limestone, some of the beds containing layers and irregular pieces of chert, and dipping south at from 20° to 40°.* Half a-mile east of Kilfeakle R.C. Chapel limestone is exposed in several quarries, and in the sides of a ravine, and is generally of a pale gray colour and thick-bedded. Some of the beds at the southern end of the ravine contain chert, and have a flaggy appearance; they dip S.E. at 35°. West of the village of Thomastown thin-bedded compact dark gray limestone, containing nodules of chert, and the beds much cut up with joints, dips south by west at 20°. On the north-east of Thomastown Castle, and between it and Athassal, limestone is seen in several quarries, and is of the same character in each, being thick-bedded, bluish gray, semi-crystalline, in places slightly magnesian, and dipping in a southerly direction at from 15° to 20°. In one of these quarries the beds dip to the south at 50°. At Grantstown Castle thick-bedded blue limestone, with a few thin beds, dips south at 15°. A little south of the castle, at farm houses, there is a bed of blue sandy magnesian limestone, and here the beds incline at 45° in the same direction. At the by-road S.W. of Grantstown Castle, a little to the east of the height marked 367, blue and pale olive gray limestone, finely crystalline, may be seen in a quarry in which, however, the bedding is not perceptible. Near the grave-yard, south of Ballinaclogh House, compact, thick-bedded and thin-bedded gray and dark bluish gray limestone dips S.E. at from 10° to 15°. At Cloghportagh Fort, dipping N. by W. at 55°, blue, compact, slightly crystalline, and pale gray crystalline limestone, with some flaggy impure earthy beds, may be seen in a quarry. The same beds may be observed on the road, nearly half a-mile to the E.N.E., having the same dip. In Golden Hills Demesne bluish gray, finely crystalline, jointed limestone, having a slightly oolitic structure in places, dips S. at 5°. West of Springmount House bluish gray semi-crystalline, rather compact limestone, containing some flaggy beds, with chert, dips south at from 45° to 50°. At Ballygriffin old castle and church, thick-bedded, bluish gray limestone may be observed. Limestone similar in character is seen at Ballynahinch Castle, where it appears to be nearly horizontal. Between Lisheen and Camus Bridge many quarries are open, the general dip of the beds being southerly at from 5° to 10°. In a quarry south of the schoolhouse there is a bed of brownish magnesian limestone, and in this quarry the beds incline to the south at 45°; in all the other quarries the limestone is usually bluish gray in colour, semi-crystalline, and rather regularly bedded, sometimes containing thin earthy impure beds. On the road north of Camus Bridge, running along the west bank of the River Suir, many quarries may be observed in which the beds

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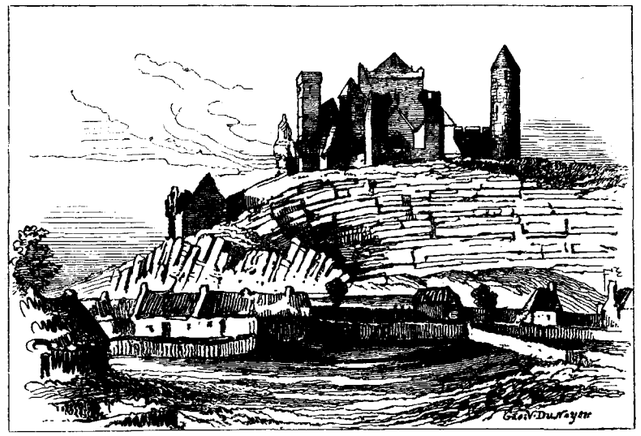
* These beds are very like the uppermost beds of the limestone.

dip to the east at 10°. Between the brook named Black Stream on the map and the height 329, in the townland of Brittas, massive bluish gray limestone is exposed in a large quarry in which the stratification is not apparent. In the vicinity of Cashel, and N.E. and S.W. of it, the rocks are very much contorted, forming a series of sharp anticlinal and synclinal curves, the axes of which run about E. by N.

Fig. 3.

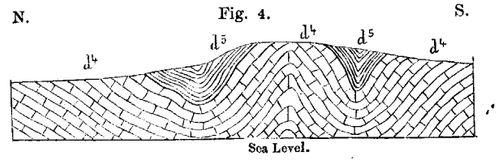


The Rock of Cashel as viewed from the east, showing the central horizontal beds and their high inclination at the southern extremity.

The small abrupt hill, known as the Rock of Cashel, on which are the celebrated ruins, forms a striking feature in the landscape as seen from several directions. The beds in the central portion of the hill are nearly horizontal for 200 feet, dipping at each end at a high angle from the hill. On the east the rocks are well exposed, forming a bold escarpment, and the curve of the beds is clearly seen at each end (see fig. 3). Close under this escarpment there is a small N. and S. fault, a down-throw to the east, which lets down the lower shales of the Coal Measures on the east side of the Rock, for the Coal Measure shales are visible 100 yards east of the limestone at a considerable lower elevation than the top of the hill. On the north side of the Rock of Cashel the rocks, from being horizontal, suddenly incline to the north at from 75° to 85°; and on the south side, incline to the south at 80°. The limestone is crystalline, thick-bedded, and varies from a pale bluish gray to dark blue, often having veins of carbonate of lime between the beds and thin veins running across the beds. Some of the beds contain nodules and large irregular pieces of black and white chert, and this character of the top beds of the limestone is constant all along the Coal Measure boundary. Five hundred yards N.W. of the Rock of Cashel, on the road side, the beds which form the Rock of Cashel come to the surface again, dipping S.E. at 35°. The limestone is here cut up by a series of joints running N. 10° W., and inclining to the east at from 85° to vertical. A very large quarry has been opened here, and very fine building stone is obtained. On the Holycross road, about one mile north of Cashel, bluish gray, coarsely crystalline limestone, with some cherty beds, dips S.E. at 30°. A short distance south of this the same beds appear, traversed by a small anticlinal curve, dipping N.

and S. West of the height marked 650, on the parish boundary, the junction of the limestone and Coal Measures is well exposed, and the limestone is seen dipping beneath the black shale north, east, and south, at from 15° to 20°. The beds immediately beneath the shales are very full of chert. Two hundred yards east of this quarry the limestone again comes to the surface, forming a small island in the Coal Measures, from which the shales have been denuded, while those resting in the hollows of the limestone on each side of it have escaped.—See section (fig. 4).

N. Fig. 4. S.



Scales, { Horizontal, 3 inches to a mile. Vertical, 6 inches to a mile.

The limestone again comes to the surface six hundred yards north of the last-mentioned locality, and may be seen on the east side of a by-road, and on the same road east of the old castle, also on the coach-road west of the same castle, and in the townland of Ganyard. On the east side of the Cashel Coal Measures, limestone may be observed south of Newpark House dipping beneath the shales at from 5° to 10°, also south of Dually House in Meldrum Demesne.

In the vicinity of Coleraine House and north of it along the Coal Measure boundary, many quarries are visible, the general dip of the beds being to the E. at from 5° to 10°, and being similar in character to those already described in the neighbourhood of Cashel.

At Mocklershill, and between it and Cashel, several quarries may be observed on the south side of the road; the dip is southerly for some distance, and on the north side northerly, the road running along an anticlinal ridge south of Mocklershill. The same beds come to the surface north of Ballyduagh House, and dip north at from 10° to 45°, traversed by a synclinal curve between the by-road north of Ballyduagh House and Mocklershill and Cashel road. These undulations are of frequent occurrence on the eastern end of the district, the same beds constantly appearing, so that it will suffice to mention the localities where the limestone may be best seen. Along the southern boundary of the Coal Measures at the N.E. corner of the map, the limestone may be observed three-quarters of a mile N.W. of Mobarnan House, dipping N.W. at 80°; north-east of Beechmount House, dipping N.N.W. at 30°; and extensive quarries are open at Knockanglass, dipping northerly at 15°. In all these quarries the cherty beds immediately below the Coal Measures are well seen, and fossils may be seen in each of them, but occur very plentifully in a quarry east of Drummin bridge.

In the vicinity of Coolmoyne House and Coolmoyne Hill, the Upper Limestone often appears, and is much contorted, the beds being often bent from horizontal to vertical in very short distances. A small outlying patch of Coal Measure occurs on the hill north of Ardsallagh House west and south of Tullamaine Castle. The cherty beds of the Upper Limestone again appear, and the junction of the Coal Measures and limestone is seen on the road side south of Tullamaine Castle. Two hundred yards west of Tullamaine Church a few of the Coal Measure shales occur, but occupy too small a space to be marked on the map; they may be seen in a quarry on the slope of the hill, and the cherty limestone is seen north and south of them.

Within a mile and a-half south-west of Fethard many limestone quarries may be observed along the Coal Measure boundary, striking E. and W., and dipping S. at 45°; the same beds come to the surface again on the south side of the Coal Measures, and may be well observed east and west of Killerk Castle and south of Rathdrum Castle, dipping north at 35°.

To the north of Ballyclerahan, thick-bedded bluish gray limestone, dipping south at 45°, is seen at the church north of Moyle bridge. South of St. Nicholas's well, near the Coal Measure boundary, light bluish gray crystalline limestone may be observed; it is divided by a set of regular joints running a little west of north and vertical. The limestone is here slightly magnesian in places. Limestone is well seen in the vicinity of Black Castle, Castle Blake, and north of Ballinattin House; it is very similar in character, generally light gray in colour, crystalline however, occasionally containing dark gray earthy beds with thin layers and nodules of chert. The limestone is often here slightly magnesian in character. At Rosegreen, coarsely crystalline bluish gray limestone occurs in which the stratification is not perceptible. About half a mile south-west of the last-mentioned locality the dip is well seen, and the beds incline to the N.W. at 15°; in these beds nodules of white chert occur. Gray and light bluish gray crystalline limestone is well exposed in a large quarry on the west side of the road west of Johnstown Castle; regular north and south joints occur here in the limestone. South of Racecourse Hall a line of quarries may be observed, the beds striking steadily a little to the north of east, and dipping northerly at from 55° to 65°; these beds are very like those occurring in the Rock of Cashel. At the N.E. corner of Racecourse Hall Demesne, on the road side, and five hundred yards to the east, the same beds again appear dipping S. at 65°; and about half a mile to the north the dip is again reversed, the beds inclining N. at 45°.

South-west of the city of Cashel, south of the Golden and Cashel road, and between Suir Castle and Racecourse Hall, the rocks undulate very much, the direction of the dip of the beds frequently changing from north to south, and *vice versâ*, so that the same beds are constantly appearing. The direction of the ridges formed by these contortions is very steady, running about E. by N.; and the same beds may be traced for several miles along the flanks of these ridges, dipping usually at high angles to the north on the north side of the ridge, and to the south on the south side. The northern dips are much better exposed than those to the south. A short continuous section is exposed on the west side of the Suir near Suir Castle: first, we have bluish splintery limestone, in which the stratification is not perceptible, then gray and bluish gray crystalline limestone, interstratified with some earthy impure looking beds; over these are thick bedded bluish gray crystalline beds, with occasional dark gray and blackish impure beds; the dip is here N. by W. at 45° to 50°. Light bluish gray coarsely crystalline limestone is seen in the railway cutting south of the village of Bansha, and also in a quarry on the road side south of the Glebe House; at neither of last-mentioned localities is the bedding visible.

Coal Measures.—The lower shales of the Slieveardagh coal field extend into this district, occupying a portion of the N.E. corner of the map; their southern boundary, between Silverfort House and Coleraine House, and in the vicinity of Arbourhill House, is very arbitrary, and sometimes drawn merely from the form of the ground, the rocks being generally concealed over a considerable area by thick deposits of drift; nor is there any good section of the Coal Measures anywhere exposed within the limits of this map, so that it is impossible to give their exact thickness, but they probably do not exceed six hundred feet, if they even attain to that thickness.

The first or lowest bed of workable coal in the Slieveardagh coal field is

about fifteen hundred feet above the limestone, so that if the highest bed in this district is not more than six hundred feet above the limestone, it is very improbable that any coal worth looking after will be found here. I was informed that some trial pits in search of coal had been sunk north of Coleraine House and south of Fethard, but without success. If we proceed along the Coal Measure boundary from Coleraine House, passing near the Garrison and old church, the lower black shales of the Coal Measures often crop out, and may be observed in many places along the boundary. In a stream about six hundred yards N.W. of the height marked 787, some hard gray and olive grits may be observed dipping E. at 5°; these beds lie above the black shales. Where the "Coal pit" is marked on the map a few dark olive grits occur, dipping N.E. at 20°; south of this, in the stream and to the west in a cutting of the road, nodular gray splintery and dark gray gritty shales appear in a few places. On the road cutting the dip of the beds is well defined, and is to the N.E. at 10°. Half a mile west of Silverfort House, olive gray coarse grits dip northerly at 30°. On the road side east of the height marked 633, thin olive grits and flaggy shales and black shales dip N. at from 10° to 15°. On the same road, and about one mile north of the last locality, similar beds, only much better exposed in a road cutting, may be seen dipping S.S.E. at 15°. Dark olive grits and flaggy gray grits and shales may be seen in several places east and west of the height marked 755. The beds are rolling, dipping in various directions at low angles. Shales are exposed in the road north of Knockanglass and north and south of the height marked 665, also in the road west of Clonbrogan House.

Black shales may be observed at the east end of the city of Cashel and in the road leading to Palmer's Hill House; the edges of the beds only appear, and the stratification is very obscure. About one mile N.W. of Cashel, where the Coal Measure boundary turns back to the west, the junction between the limestone and Coal Measures is visible. The first bed resting on the limestone is a soft black shale from twenty-five to thirty feet thick.* Over this bed of black shale we have brownish olive grits and nodular gray shales. On the side of the road, twenty-five yards N.W. of the last-mentioned locality, shales are again to be seen; and for a mile to the east along the side of the hill, olive gray grits and shales are visible in several places near the limestone boundary dipping S. and S.S.E. at from 20° to 25°. I was only able to get one satisfactory dip to the north, on the north side of the dome-shaped island of limestone, before described (page 17); it is at the north-east corner on the south side of the road, and the beds dip N. at 35°. Two dips are also well seen in the narrow band of Coal Measures on the south side of this patch of limestone, one to the S. at 50° on the side of the road very near the limestone, and the other still further south near the main mass of the limestone, dipping N. at 50°.

In the hill west of Meldrum House, and for more than a mile to the north of it, shales are seen at the surface in many places; but as limestone can be had at short distances from any portion of this outlier of Coal Measures, few quarries have been opened on it, nor are there any good sections exposed in the streams.

The outlier of Coal Measures north of Ardsallagh House occupies but a very trifling extent on the map. Some of the lower shales having here escaped denudation, they may be observed on the top of the hill near the height marked 456, but are only imperfectly seen, as no quarry or cutting is here exposed, and the ends of the beds are only visible.

Rusty olive gray and flaggy grits, dipping W. at 10°, may be seen in a

* Bricks are made from this shale; it is dug up and exposed to the air, when it rapidly decomposes into a kind of tenacious yellow clay.

quarry west of Garraun House. Similar beds may be observed half a mile south of the same locality; at the latter place the beds are rolling, and dip west and north at low angles. Gray and olive gray grits and rusty gray shales may be seen in a quarry near Rathacokera; these beds dip to the N. at 45°; the same beds may be seen a little farther north on the by-road, dipping S.E. at 45°. The lower shales next the limestone are exposed in the road south-east of Tullamaine Castle; they dip S.S.E. at 10°. Similar beds to those already described are exposed in several places in the Coal Measure outlier south of Fethard. The basal shales are well seen near Killerk Castle and on the road north-west of Rathdrum Castle. Grey and olive grits are seen on the by-road east of the height 470.

J. O'K.

The Coal Measures which appear on the south margin of the map, near its south-east corner, occur in the form of a long narrow basin, forming a low ridge, the whole of which very nearly comes into the limits of the sheet; it measures about five miles and a half from east to west, with a maximum width of one mile and one-sixth; its average width, however, is not more than three-quarters of a mile. The beds forming this basin are best seen at the cross-roads of Rathronan, and from thence westerly at either side of the by-road which stretches along the summit of the hill, which is 393 feet in elevation, and also in the ditches, farm roads, and other cuttings which traverse the southern side of the ridge. The evidence is unfortunately confined to shallow superficial cuttings in which the true dip of the beds may be often concealed. The data, such as they are, enable me to say that the Coal Measures consist, first, or in their lowest part, of hard black shales containing one or two beds of grit, and layers of black flint or chert at their base of the deposit; these may amount to about four hundred feet in thickness; above them appear hard greenish gray micaceous grits, containing plant impressions, and plentifully interstratified with black splintery shales, and their thickness may be about one hundred feet, thus giving a total of five hundred feet for the Coal Measures forming the eastern part of the basin. On its northern side, at Rathronan cross roads, there is a short but interesting section exposed in these beds; it consists of, first, thin soft light gray grit with black earthy shale, with black flint layers in the upper portion; over this are some thin light brown and gray finely laminated micaceous grit, with friable shale partings, the uppermost layers decomposing to a red ochreous sand. There are many fossils throughout the grit layers. Some of the black shales in the upper portion of these Coal Measures weather *white*. These may be observed on the side of the road bounding the townlands of Rathnasliggen (the latter part of which name is suggestive of the subsoil rock) and Lawlerstown; as we proceed westerly from this locality we find but little superficial evidence for the Coal Measures over the low ridge which we are describing till we pass the cottages of Jamestown, and here the data are confined to ditch and road cuttings; and there is no change observable in the mineral character or general aspect of the coal rocks from where they were first noticed.

In the demesne of Woodroff, there is a quarry, which exposes thin bedded, hard, dark greenish gray, or olive grits, the dip of which is S. at 5°, their beds and their associated shales are cleaved in the direction E. 20° N. vertical.

G. V. D.

Greenstone Ash.—This rock only occurs at one locality in this district, forming a small hill at Knockavilla, S.E. of Dundrum House. The eastern and northern boundary of the greenstone ash is drawn entirely from the form of the ground, as the rocks are here concealed by a large deposit of drift. The junction of the ash and limestone is well seen in a quarry on the western side immediately south of the parish boundary. The first beds of ash rest on thin bedded compact dark gray cherty limestone. These beds dip to the east at from 5° to 15°. The ash is a fine-grained nearly compact mass of trappean debris or powder of a greenish gray colour, is irregularly bedded, and often obliquely laminated, and some of the beds have a spheroidal concretionary structure. It is very deeply weathered, having a rusty brown colour, but when broken with the hammer, it is of a light bluish gray; it is very compact and tough, and contains angular pieces of gray and black limestone and nodules of chert; it is slightly calcareous, particularly along the weathered edge, and fuses very readily with the blow-pipe.

Very coarse brecciated ash, with angular fragments of dark trap, is seen in a few places on the top of the hill; but as it is only seen at the surface, and is deeply weathered, it is difficult to obtain good specimens, nor is the stratification visible.

J. O'K.

Drift.—The large undulating plain occupying the principal portion of the district comprised in this map, is generally covered with drift. The drift varies from a clayey gravel, to a very coarse gravel, principally made up of limestone boulders, often, however, having a large proportion of sandstone pebbles, and occasionally granite and syenite boulders. Patches of fine sand often occur in this coarse gravel. A small esker commences on the west side of the road, about one mile S.W. of Kilfeakle. It runs in a north-easterly direction curving round to the north, and may be traced for nearly a mile. At times it runs very regularly, like an embankment, but again is lost in the undulations which occur here in the drift.

Large piles of irregularly deposited drift extend over wide areas at the N.W. corner of the district. In the vicinity of Morpeth Bridge, and west of Mount William, small eskers and hillocks of drift often form abrupt elevations. Owing to the irregular way in which the eskers occur, it is generally impossible to trace their direction for any considerable distance.

One of these, eskers commencing about half a mile S.E. of Morpeth Bridge, runs due south, and forms a very regular ridge where the height 369 is marked on the map, that being the summit of the ridge. At this place it rises from fifty to sixty feet above the surrounding low ground, having very abrupt slopes, particularly on the east side. It can only be traced a few hundred yards south of the height 369, when it is lost in the irregular masses of drift, which occur to the S.W.

J. O'K.

The drift which covers most of the country north and east of the Galtee mountains consists, as usual, chiefly of limestone gravel and debris, either transported or composed of fragments of the local rocks. It is of variable thickness, but is very frequently met with. Eskers are not numerous; but a gravel hill occurs north of the cross-roads near the ruins of Outeragh Castle, and others of larger dimensions may be observed near Kilmoyler cross-roads underneath Kedrah Fort, and in the demesne of Caherabbey. Limestone gravel occurs in many places near the termination of the Galtee range heaped up in banks along their northern foot, as at the place where the railway crosses

the road from Tipperary to Caher, or covering the lowest elevations of the range, as may be seen on the hill south of Ballydrehid House, and on that near Cottage. The greater part of the drift, however, consists of gravel and boulders mixed with clay instead of sand.

Syenite boulders are frequently met with scattered all over this country, as well as other large erratic fragments.

Near the top of the hill stated to occur in the townland of Knockgraffon a place was pointed out where pipe-clay of superior quality was said to have been raised. So far as could be ascertained no lignite was found associated with it. Pipe-clay has also been stated to have been found on the townland of Mooretown near Woodroof House. (*See Paper by Sir Richard Griffith, read before the Royal Dublin Society, May*, 1821.*) Two tracts of white shell marl occur, one near Hymenstown and Garranlea, and the other south of Newinn; they will both be found delineated and coloured on the map.

The marl, which consists entirely of decaying and decayed fresh-water shells, is principally used as manure. In the locality south of Newinn, near Oughteragh House, it is seen to be from ten to twelve feet, and stated to be as much as twenty feet deep. Several Lymnea, Planorbis and Helix shells were found in it here, and some calcareous stalactitic pipe veins which were the results of infiltration, or were, perhaps, formed round the roots or stems of aquatic plants, and left hollow by their decomposition, were observed running through it in different but nearly upright directions.

There are no large lowland bogs in this neighbourhood.

A. B. W.

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* There seems to have been some change in the levels of the country since this space was occupied by a lake, as the marl is several feet above the level of the brook which runs through it to the Suir, and no artificial cutting is apparent along the course of the brook sufficient to account for the difference.—J. B. J.

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